The Texas Manual on Rainwater Harvesting

Texas Water Development Board

Third Edition

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Chapter 1
Introduction

Rainwater harvesting is an ancient technique enjoying a revival in popularity due to the inherent quality of rainwater and interest in reducing consumption of treated water.

Rainwater is valued for its purity and softness. It has a nearly neutral pH, and is free from disinfection by-products, salts, minerals, and other natural and man-made contaminants. Plants thrive under irrigation with stored rainwater. Appliances last longer when free from the corrosive or scale effects of hard water. Users with potable systems prefer the superior taste and cleansing properties of rainwater.

Archeological evidence attests to the capture of rainwater as far back as 4,000 years ago, and the concept of rainwater harvesting in China may date back 6,000 years. Ruins of cisterns built as early as 2000 B.C. for storing runoff from hillsides for agricultural and domestic purposes are still standing in Israel (Gould and Nissen-Petersen, 1999).

Advantages and benefits of rainwater harvesting are numerous (Krishna, 2003).

- The water is free; the only cost is for collection and use.
- The end use of harvested water is located close to the source, eliminating the need for complex and costly distribution systems.
- Rainwater provides a water source when groundwater is unacceptable or unavailable, or it can augment limited groundwater supplies.
- The zero hardness of rainwater helps prevent scale on appliances, extending their use; rainwater eliminates the need for a water softener and the salts added during the softening process.
- Rainwater is sodium-free, important for persons on low-sodium diets.
- Rainwater is superior for landscape irrigation.
- Rainwater harvesting reduces flow to stormwater drains and also reduces non-point source pollution.
- Rainwater harvesting helps utilities reduce the summer demand peak and delay expansion of existing water treatment plants.
- Rainwater harvesting reduces consumers' utility bills.

Perhaps one of the most interesting aspects of rainwater harvesting is learning about the methods of capture, storage, and use of this natural resource at the place it occurs. This natural synergy excludes at least a portion of water use from the water distribution infrastructure: the centralized treatment facility, storage structures, pumps, mains, and laterals.

Rainwater harvesting also includes land-based systems with man-made landscape features to channel and concentrate rainwater in either storage basins or planted areas.

When assessing the health risks of drinking rainwater, consider the path taken by the raindrop through a watershed into a reservoir, through public drinking water treatment and distribution systems to the end user. Being the universal solvent, water absorbs contaminants and minerals on its travels to the reservoir. While in residence in the reservoir, the water can come in contact with all kinds of foreign materials: oil, animal wastes, chemical and pharmaceutical wastes, organic compounds, industrial outflows, and trash. It is the job of the water treatment plant to remove harmful contaminants and to kill pathogens. Unfortunately, when chlorine is used for disinfection, it also degrades into disinfection by-products, notably trihalomethanes, which may pose health risks. In contrast, the raindrop harvested on site will travel down a roof via a gutter to a storage tank. Before it can be used for drinking, it will be treated by a relatively simple process with equipment that occupies about 9 cubic feet of space.

Rainwater harvesting can reduce the volume of storm water, thereby lessening the impact on erosion and decreasing the load on storm sewers. Decreasing storm water volume also helps keep potential storm water pollutants, such as pesticides, fertilizers, and petroleum products, out of rivers and groundwater.

But along with the independence of rainwater harvesting systems comes the inherent responsibility of operation and maintenance. For all systems, this responsibility includes purging the first-flush system, regularly cleaning roof washers and tanks, maintaining pumps, and filtering water. For potable systems, responsibilities include all of the above, and the owner must replace cartridge filters and maintain disinfection equipment on schedule, arrange to have water tested, and monitor tank levels. Rainwater used for drinking should be tested, at a minimum, for pathogens.

Rainwater harvesting, in its essence, is the collection, conveyance, and storage of rainwater. The scope, method, technologies, system complexity, purpose, and end uses vary from rain barrels for garden irrigation in urban areas, to large-scale collection of rainwater for all domestic uses. Some examples are summarized below:

- For supplemental irrigation water, the Wells Branch Municipal Utility District in North Austin captures rainwater, along with air conditioning condensate, from a new 10,000-square-foot recreation center into a 37,000-gallon tank to serve as irrigation water for a 12-acre municipal park with soccer fields and offices.
- The Lady Bird Johnson Wildflower Research Center in Austin, Texas, harvests 300,000 gallons of rainwater annually from almost 19,000 square feet of roof collection area for irrigation of its native plant landscapes. A 6,000-gallon stone cistern and its arching stone aqueduct form the distinctive entry to the research center.
- The Advanced Micro Devices semiconductor fabrication plant in Austin, Texas, does not use utility-supplied water for irrigation, saving $1.5 million per year by relying on captured rainwater and collected groundwater.
- Reynolds Metals in Ingleside, Texas, uses stormwater captured in containment basins as process water in its metal-processing plant, greatly offsetting the volume of purchased water.
- The city of Columbia, Nuevo León, Mexico, is in the planning stages of developing rainwater as the basis for the city's water supply for new

growth areas, with large industrial developments being plumbed for storage and catchment.

- On small volcanic or coral islands, rainwater harvesting is often the only option for public water supply, as watersheds are too small to create a major river, and groundwater is either nonexistent or contaminated with salt water. Bermuda, the U.S. Virgin Islands, and other Caribbean islands require cisterns to be included with all new construction.

In Central Texas, more than 400 full-scale rainwater harvesting systems have been installed by professional companies, and more than 6,000 rain barrels have been installed through the City of Austin's incentive program in the past decade. Countless "do-it-yourselfers" have installed systems over the same time period.

An estimated 100,000 residential rainwater harvesting systems are in use in the United States and its territories (Lye, 2002). More are being installed by the urban home gardener seeking healthier plants, the weekend cabin owner, and the homeowner intent upon the "green" building practices – all seeking a sustainable, high-quality water source. Rainwater harvesting is also recognized as an important water-conserving measure, and is best implemented in conjunction with other efficiency measures in and outside of the home.

Harvested rainwater may also help some Texas communities close the gap between supply and demand projected by the Texas Water Development Board (TWDB), as the state's population nearly doubles between 2000 and 2050 (Texas Water Development Board, 2002).

In fact, rainwater harvesting is encouraged by Austin and San Antonio water utilities as a means of conserving water. The State of Texas also offers financial incentives for rainwater harvesting systems. Senate Bill 2 of the 77th Legislature exempts rainwater harvesting equipment from sales tax, and allows local governments to exempt rainwater harvesting systems from ad valorem (property) taxes.

Rainwater harvesting systems can be as simple as a rain barrel for garden irrigation at the end of a downspout, or as complex as a domestic potable system or a multiple end-use system at a large corporate campus.

Rainwater harvesting is practical only when the volume and frequency of rainfall and size of the catchment surface can generate sufficient water for the intended purpose.

From a financial perspective, the installation and maintenance costs of a rainwater harvesting system for potable water cannot compete with water supplied by a central utility, but is often cost-competitive with installation of a well in rural settings.

With a very large catchment surface, such as that of big commercial building, the volume of rainwater, when captured and stored, can cost-effectively serve several end uses, such as landscape irrigation and toilet flushing.

Some commercial and industrial buildings augment rainwater with condensate from air conditioning systems. During hot, humid months, warm, moisture-laden air passing over the cooling coils of a residential air conditioner can produce 10 or more gallons per day of water. Industrial facilities produce thousands of gallons per day of condensate. An advantage of condensate capture is that its maximum production occurs during the hottest month of the year, when irrigation need is greatest. Most systems pipe condensate into the rainwater cistern for storage.

The depletion of groundwater sources, the poor quality of some groundwater, high tap fees for isolated properties, the flexibility of rainwater harvesting systems, and modern methods of treatment provide excellent reasons to harvest rainwater for domestic use.

The scope of this manual is to serve as a primer in the basics of residential and small-scale commercial rainwater harvesting systems design. It is intended to serve as a first step in thinking about options for implementing rainwater harvesting systems, as well as advantages and constraints.

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