

# RAINWATER SYSTEMS

## Overview

---

Rainwater Systems collect water run-off rainwater for environmental management, domestic, and agricultural use.<sup>[1]</sup> Rainwater systems can be traced back to ancient civilizations who would collect water falling on their roofs in a process called rainwater harvesting (RWH). Recently, rainwater harvesting has increased in popularity as people begin searching for more sustainable buildings. However, a majority of water systems today are still not concerned about harvesting rainwater; instead, most water systems transport the rainwater to bodies of water through gutters, inlets, and storm sewers.

## Conventional Rainwater Systems

---

Conventional rainwater systems divert rainwater into bodies of water in order to prevent flooding. Gutters, ditches, and other small scale water relocation devices are often called minor rainwater systems.<sup>[2]</sup> The main purpose of these minor systems is to collect rainwater from the roofs of buildings and transport it to larger systems that can handle larger volumes of water.



Figure 1: Gutters and downspouts are one example of minor rainwater systems

Larger rainwater systems are typically called major rainwater systems. Major rainwater systems typically are used to both transport and filter large amounts of rainwater. Examples of major rainwater systems include storm sewers, water retention ponds, and water treatment plants. [Figure 2](#) illustrates how the rainwater flows through major rainwater systems before it is released into a lake or river.<sup>[3]</sup>

Occasionally, rainwater is treated before it is discharged. One of the simplest ways to treat rainwater is by using a water retention pond. Water retention ponds are like water detention ponds however the water is released from the top of the pond so that some water is in the pond at all times.<sup>[4]</sup> The primary goal of a water retention pond is to reduce the peak rate of surface runoff like a water detention pond. The second goal of a water retention pond is to remove some of the pollution in the water.<sup>[5]</sup> Pollutants are removed from the water because they settle to the bottom of the pond before the water is discharged.<sup>[6]</sup> In addition to using retention ponds, rainwater could also be treated by diverting the water to a wastewater treatment plant where the rainwater would be combined with sanitary waste. Treating rainwater is a good way to promote sustainability because untreated water can contain hazardous chemicals like motor oil and pesticides that may harm the environment.<sup>[7]</sup>

## Rainwater Harvesting (RWH)

---

Rainwater harvesting is the collection and storage of rainwater for later use.<sup>[9]</sup> Rainwater harvesting has become extremely popular recently because of recent shortages of safe drinking water across the world. According to the World Health Organization, about 6000 children die every day due to not having safe drinking water.<sup>[9]</sup> However, the lack of safe drinking water is not just limited to third world countries. According to the EPA, 36 states anticipate water shortages during the next two decades of this century.<sup>[10]</sup> Rainwater harvesting can help prevent water shortages and allow for buildings to be more sustainable by capturing rainwater before it is contaminated as it washes away.

### History of RWH

Ancient civilizations have been using rainwater harvesting systems for thousands of years. There is evidence of rainwater harvesting in 2600 B.C in the ancient Harappan civilization in modern day Pakistan.<sup>[11]</sup> The Harappans used tanks to store rainwater; this water was then used for agricultural purposes.<sup>[12]</sup> Rainwater harvesting continued to be an important part of ancient society until wells and pipes allowed for water to be transported more effectively. Recently, rainwater harvesting has become more popular due to greater demand for clean water especially in India and other parts of southeast Asia where clean water is not easily accessible.

### Simple RWH Systems

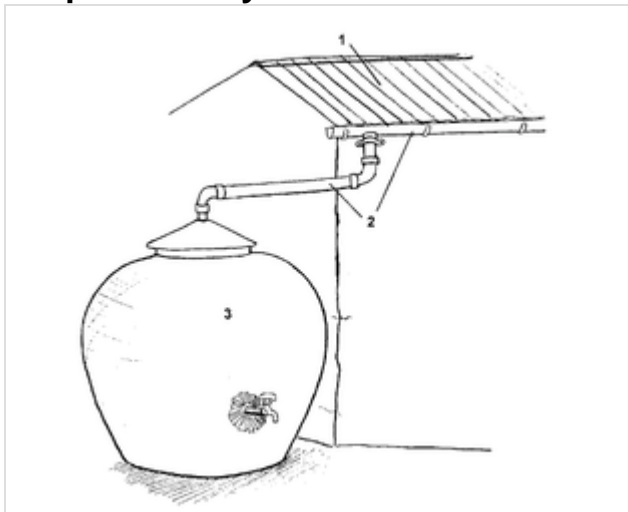


Figure 3: This simple RWH system includes a catchment (1), delivery system (2), and a storage reservoir (3)

The simplest rainwater systems include a catchment, delivery system, and a storage reservoir (see figure 3).<sup>[13]</sup> Simple rainwater harvesting systems can be traced back to 1700 B.C in the island of Crete. Simple rainwater harvesting systems often must have corrugated iron sheets, tiles, or asbestos sheets for roofing in order to divert the rainwater to the gutters and a storage tank.<sup>[14]</sup> Simple rainwater harvesting systems are especially useful for agricultural use in third world countries.

### Filtered RWH Systems

Harvested rainwater that will be used for potable use must include some sort of a filtration system. The main source of rainwater contamination is the organic matter, inter solids, fecal decomposition from birds, and trace amounts of metals.<sup>[15]</sup> One of the best ways to remove a majority of these pollutants from the

harvested rainwater is by using a first flush system. First flush systems remove the rainwater collected at the beginning of a storm because the water collected at the beginning of a storm typically has a much greater amount of pollutants.<sup>[16]</sup> The longer the dry period before the storm the higher the amount of polluted material in the first flush system.<sup>[17]</sup> This polluted rainwater that is discharged from the collection system can still be used for agricultural uses. Rainwater is still not always potable after the first flush; so, rainwater must also be treated before it can be used as drinking water.<sup>[18]</sup> Treating the rainwater often includes filtration and chlorination of the rainwater (see Figure 4).<sup>[19]</sup>

## RWH examples

One example of a large scale filtered rainwater harvesting system is the dormitory at Seoul National University in South Korea. Three of the dormitory buildings combine to have 2098 cubic meters of catchment area which is diverted to a 200 ton storage tank.<sup>[20]</sup> This rainwater is then filtered, mixed with tap water, and pumped into one of the dormitory buildings. This rainwater harvesting system has dramatically reduced the amount of municipal water that the dormitories require.<sup>[21]</sup>

A second example of a building that successfully installed a rainwater system one of the buildings on the University of British Columbia's campus called the CIRS building. This building collected the water that fell from the roof and diverted it to large holding bins in the basement of the structure. The water is then filtered and combined with municipal water as it is pumped into the rest of the building.<sup>[22]</sup>

## Benefits of RWH

Rainwater harvesting has many benefits both environmentally and economically. One of the biggest advantages of rainwater harvesting is that it is an easy way to save money on water bills. Simple rainwater harvesting systems without filtration or pumps have virtually no upkeep expenses and can be easily used for watering lawns or agriculture. Non potable harvested water can also be used for toilet flushing in large buildings, which accounts for 30 percent of indoor water use.<sup>[23]</sup>

Using harvested rainwater improves sustainability because it reduces peoples dependence on water that is removed from aquatic ecosystems like lakes and rivers. Rainwater harvesting systems eliminate the electricity required to pump water from the water treatment. Rainwater harvesting also reduces the amount of water runoff. Reducing the amount of runoff that enters storm sewers can reduce the chances of flooding and erosion after a big storm.



Figure 4: Complex RWH system with filtration

## Problems with RWH

One of the biggest problems with rainwater harvesting is that the water must be filtered in order to be used as drinking water. Many people in third world countries that drink harvested rainwater without filtration can get sick from the bacteria and lead that may be in the water. The energy and upkeep supplies needed to filter the water can also be relatively expensive. These expenses often makes filtered rainwater more expensive than water obtained traditionally.