Rainwater Harvest Makes Sense and Cents (and Dollars)

David Crawford, President

Rainwater Management Solutions, 1260 West Riverside Drive, Salem, VA 24153

Abstract. *Rooftop rainwater harvesting has moved beyond the leaf-filled rain barrel sitting at the corner of your home's porch to a cost-effective, scalable system. As water scarcity issues and the need for protection of the declining quality of surface and groundwater are becoming more pressing, we are now realizing that rainwater harvesting addresses another important concern, stormwater. Captured rooftop rainwater turns unwanted stormwater runoff, which would otherwise require handling in stormwater treatment facilities or contribute to stream erosion and lake sedimentation, into a valuable resource, useable for both indoor and outdoor purposes. In addition, rainwater harvesting reduces the total volume of potable water demand, thereby cutting water treatment costs and energy use. By using non-potable water for non-potable uses, it provides a viable alternative to traditional centralized water treatment and distribution, which are inefficient in both water and energy.*

In addition to the economic value of reduced water supply costs, making rainwater harvesting part of the entire stormwater management design can result in significant savings on stormwater fees and reduce the cost of other site stormwater practices. The long-term economic feasibility of such projects depends on minimal system servicing and high-quality components to divert, collect, and store water. A consistent design standard, including pre-tank filtration and proper water storage, uptake, and overflow, will preclude many of the common pitfalls in design, leading to more cost-effective, sustainable systems. Systems which provide a reliable, high-quality water source will encourage rainwater harvesting as a lasting environmental solution to save water, energy, and *money.*

Keywords. Rainwater harvesting, stormwater management, tanks, water conservation, groundwater, erosion, sedimentation, runoff, irrigation, LEED certification, water quality, site management, filtration, water storage, sustainability, building machine

Environmental Benefits

Rooftop rainwater harvesting has moved beyond the leaf-filled rain barrel sitting at the corner of your home's porch to a cost-effective system, scalable to any size. As water scarcity issues have increased, the need for water conservation and protection of the declining quality of surface and groundwater initially created interest in rainwater harvesting. These issues are becoming even more pressing, and we are now realizing that rainwater harvesting addresses another important concern, stormwater management. Captured rooftop rainwater turns unwanted stormwater runoff, which would otherwise require handling in stormwater treatment facilities or contribute to stream erosion and lake sedimentation, into a valuable resource, useable for both indoor and outdoor purposes, from flushing toilets to irrigation. In addition, rainwater harvesting reduces the total volume of potable water demand, thereby cutting water treatment costs and energy use. By using non-potable water for non-potable uses, it provides a viable alternative to traditional centralized water treatment and distribution, which are inefficient in terms of both water and energy.

Economic Benefits

In addition to the economic value of reduced water supply costs, making rainwater harvesting part of the entire stormwater management design can result in significant savings on stormwater fees and reduce the size and cost of other site stormwater practices. Rainwater harvesting is also one component that can contribute to LEED (Leadership in Energy and Environmental Design) certification, and a number of LEED credits are available through rainwater harvesting systems. The economic and environmental benefits of rainwater harvesting, reducing the demand on an aging water supply infrastructure, saving energy, decreasing runoff, and preserving water quality, make it an integral part of whole-site water management.

Often, the primary cost savings associated with rainwater harvesting systems is based on the reduction in use of potable water from a municipality. Manassas Park Elementary School, located in northern Virginia, is an excellent example of potential cost savings due to potable water use reduction. Based upon comparison with a similar school located on the same campus, the facilities management team of the City of Manassas Park Public Schools believes that they are recognizing a savings of 1.3 million gallons of municipal water per year by flushing school toilets with harvested rainwater. Using water cost data from a similar municipality in Virginia, this scenario creates a situation where a cost savings of approximately 8,500 dollars per year can be realized (Authority, 2013). Further, because the domestic water that serves as a backup to the harvested rainwater used to flush the toilets is introduced at a "Day Tank", the municipal water service feeding the facility could be reduced in size. This potential reduction in tap and pipe size can have significant financial implications. For example, the reduction of a water line tap from a 3” to a 2” can result in over 30,000 dollars initial savings with additional monthly savings being realized as well (Lawson, 2012). Finally, it should be noted that across America, water rates continue to increase on a yearly basis. A 4% increase per year appears typical. While decreasing the amount of potable water that has to be purchased by a facility for non-potable uses is one way to save money through the use of rainwater harvesting, it is not the only way.

Rainwater harvesting can be an integral part of an overall treatment train for stormwater. Instead of simply detaining stormwater onsite for a period of time, rainwater harvesting allows water to be retained and reused on site. The Southwest Regional Jail in Roanoke County, Virginia illustrates this type of scenario. Initial cost estimates for a “traditional” stormwater detention system, comprised primarily of detention ponds, was approximately 240,000 dollars. The rainwater harvesting system and the rest of the integrated stormwater system that was installed cost 258,000 dollars. A cost savings of 11,675 dollars was realized in the first year of operation based on the cost of municipal water that did not have to be purchased. This system illustrates a payback scenario requiring less than two years (Sojka, 2009). After this point, the potable water that does not have to be purchased can actually be viewed as income. Using harvested rainwater for non-potable uses can allow for additional cost savings by viewing the rainwater system as an integral component of the building machine.

Harvested rainwater also has advantages over municipally processed water. Rainwater is inherently soft. As a result, the laundry operators at the Southwest Regional Jail report an approximate 70% reduction in the use of detergent and softener when operating with harvested rainwater. Since harvested rainwater is often stored in belowground tanks, it maintains a consistent temperature. At the jail, this fact was capitalized upon by utilizing this water which is consistently 58 degrees to cool the motors that operate the vacuum flush sewage system. Once the harvested rainwater passes through the heat exchanger to cool the motors, the now preheated water is utilized in the initial gross wash in the laundry and requires less heating to bring it to temperature, reducing the amount of natural gas required in the water heating process. When harvested rainwater is viewed as an integral part of the building machine, its advantages can be seen not only in potable water conservation and reduction of stormwater runoff but also in lessening the demands on other building systems. All of these attributes result in financial advantages for the building and its operator.

System Design

Rainwater harvesting is a suitable water source and stormwater solution for residential, commercial, industrial, and agricultural applications, and systems can be retro-fitted to existing buildings or integrated into new building designs. A simple, consistent system design, which preserves the quality of the rainwater, will allow it to be scaled to a project of any size, from a residential home to a commercial factory. The long-term economic feasibility of rainwater harvesting projects depends on minimal system servicing and high-quality components to divert, collect, and store water. A consistent design standard, including pre-tank filtration and proper water storage, uptake, and overflow, will preclude many of the common pitfalls in design, leading to more cost-effective, sustainable systems. A vertical pre-tank filter protects the quality of rainwater stored in the tank by preventing the introduction of debris. Build-up of organic debris in the tank leads to higher decomposition, low oxygen levels, and an increase in nutrient concentrations. This in turn can result in the development of odors as well as the growth of harmful bacteria in the tank (Lawson, LaBranche-Tucker, Otto-Wack, & et al., 2009). In a healthy rainwater system, the tank will never need to be emptied or cleaned as the water stored is of the highest quality and, thus, minimal maintenance is required for downstream filtration, maximizing the use of this natural resource.

Conclusion

As water rates continue to increase, the cumulative savings attributable to rainwater harvesting will increase as well. Thinking beyond the rain barrel to scalable rainwater harvesting system design that is part of the whole-site water management plan will help address ongoing issues of water quality, conservation, and sustainability. Modern rainwater harvesting is based on scientifically sound principles, and further understanding of the components necessary for a safe and sustainable water supply will ensure production of high-quality harvested rainwater. Systems which provide a reliable, high-quality water source will encourage rainwater harvesting as a lasting environmental solution to save water, energy, *and* money.

References

Authority, A. C. (2013, July 1). *Albemarle County Service Authority Water and Sewer Rate Schedule.* Retrieved October 7, 2013, from Albemarle County Service Authority Web site: http://www.acsanet.com/publicnotice/RatesEffective.pdf

Lawson, S. (2012). Making Rainwater Pay. *American Rainwater Catchment Systems Association 2012 Conference proceedings* (p. page 8 of 10). Raleigh, North Carolina: ARCSA.

Lawson, S., LaBranche-Tucker, A., Otto-Wack, H., & et al. (2009). *Virginia Rainwater Harvesting Manual.* Salem: The Cabell Brand Center.

Sojka, B. (2009). Rainwater Harvesting Going Beyond the Rain Barrel. *Architectural Exchange East Conference proceedings* (p. page 39 of 41). Richmond, VA: ARCHEX.