Sample rainwater harvesting case study
Costco store in northern Virginia

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Rainwater harvesting can be a sound environmental and economic investment when the effects on water conservation and stormwater management are considered. To illustrate the potential benefits of rainwater harvesting, we examined the estimated return on investment if a rainwater harvesting system was installed on a new Costco in the northern Virginia or Washington D.C. area. We assumed that the new store was 150,000 ft^2 and would provide irrigation for ½ acre. Based on templates for Core and Shell projects in the LEED Reference Guide for Green Building Design and Construction, we estimated water use for water closets (1.6 gpf) and urinals (0.8 gpf) as 1,936 gpd. We used the Rainwater Harvesting Spreadsheet from the Virginia Stormwater BMP Clearinghouse to determine the best tank size and the stormwater credit for the rainwater harvesting system (Figures 1 and 2). The volume of rainwater collected from the whole roof would be far more than is used for irrigation and water closets/urinals, so the system is designed to collect from 99,000 ft^2 of roof area. A 60,000 gallon rainwater harvesting system would supply 90% of the water demand for water closets/urinals and irrigation, supplying about 907,000 gallons of harvested rainwater per year. This harvested rainwater would also be removed from other site stormwater management practices. Based on the sizing template, the rainwater harvesting system would satisfy the water quality treatment requirements for 44,550 ft^2 of impervious area.

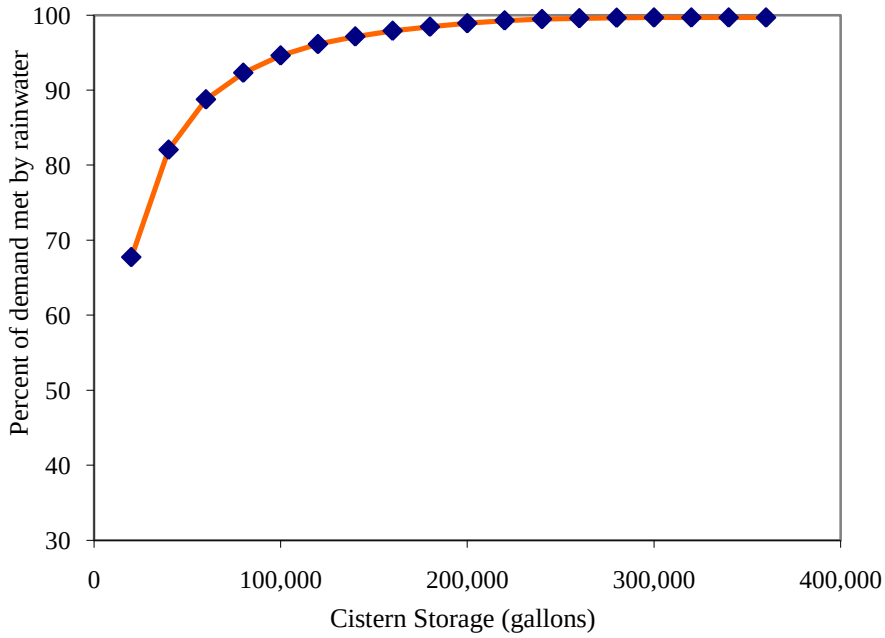

Figure 1. The Rainwater Harvesting Spreadsheet uses daily rainfall data to model the rainwater harvesting system. Larger storage tanks are able to meet a higher percentage of demand because they can hold more water from large storms and have more storage capacity for droughts. However, there is a point of diminishing returns beyond which increasing the tank size has only minimal effect on the supply of harvested rainwater.

Return on investment:

The return on investment for the rainwater harvesting system is based on the cost of the rainwater harvesting system, decreased cost of other stormwater management features, and decreased expenditure for water. An order of magnitude budget estimate for the rainwater harvesting system is $115,000 based on time and material estimates and similar projects.

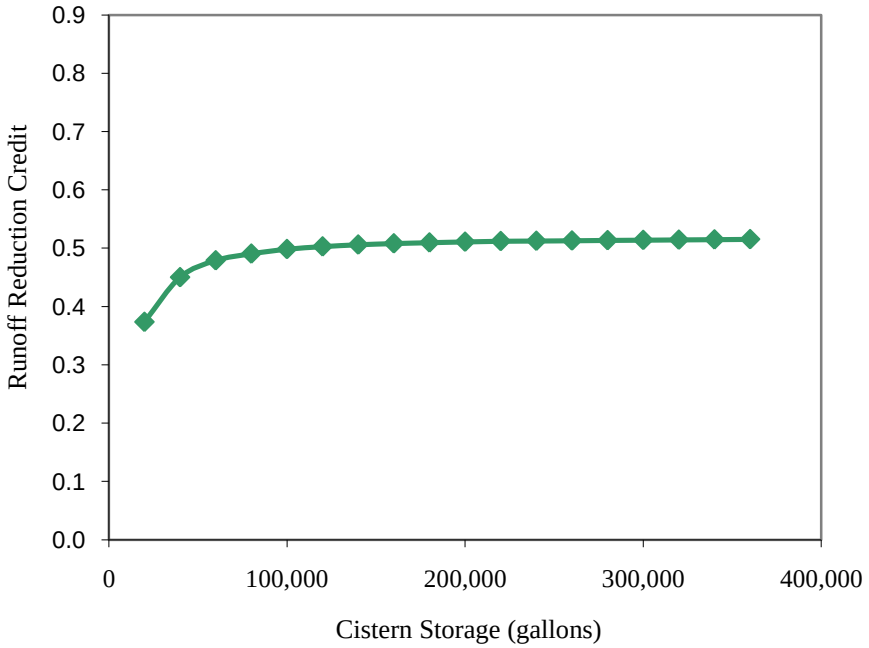

Figure 2. The Rainwater Harvesting Spreadsheet uses daily rainfall data to model the rainwater harvesting system and calculate how frequently a 1" or smaller rainfall event causes and overflow from the system. With pending storm water management regulations in Virginia, all rainfall from events 1" or smaller must be retained on-site. The graph reaches a point of diminishing returns because the water use, and drawdown of the tank, is not high enough to prevent overflow, even with larger tanks. The 60,000 gallon storage tank will provide credit for 45% of our 99,000 ft^2 collection area (44,550 ft^2). This area can then be removed from further calculations for water quality treatment.

Installing the rainwater harvesting system would provide the same stormwater benefits of a bioretention cell with a surface area of 2,970 ft^2 (based on a Level 1 design from the Virginia Stormwater BMP Clearinghouse). The cost of bioretention areas varies widely, but $59,400 is a reasonable estimate ($20 per ft^2) for the cost of this size system (http://www.lid-stormwater.net/bio_costs.htm).

Water rates in the Northern Virginia area vary widely, so an average rate from seven water purveyors was used (Table 1). Based on this average rate of $3.55 per 1,000 gallons, the rainwater harvesting system will save an estimated $3,220 per year. At this water rate, in 18 years, the rainwater harvesting system will save the $57,960, more than the $55,600 spent to build a rainwater harvesting system instead of a bioretention area. However, water rates are increasing across the United States. Of the water purveyors included in the cost estimate, four reported recent rate changes ranging from 1.5% to 24% increase in water rates. If the return on investment is recalculated assuming a 5% increase in water rates, the rainwater harvesting system payback is less than 13 years, and after 30 years, the system has created a net gain of over $150,000.

Water purveyor	Rate per 1,000 gallons	Rate per 1,000 gallons (peak use)
Town of Leesburg (outside town limits)	$5.04	$7.31
Town of Leesburg (inside town limits)	$3.57	$5.18
Town of Vienna (outside town limits)	$4.37	
Town of Vienna (inside town limits)	$3.99	
District of Columbia	$3.35	
City of Falls Church	$3.03	$4.62
Arlington County	$3.50	
Prince William County Service Authority	$3.15	$3.11
Fairfax County	$1.93	$4.63
Average	*$3.55*	*$4.97*

Table 1: Representative sample of water rates in northern Virginia and the District of Columbia. Rates were determined based on internet searches on July 7, 2010.

Some difficult to predict costs and benefits are not included in this case study. The electrical and maintenance requirements are highly design dependent. Maintenance requirements for a properly designed rainwater harvesting system are typically less than for other stormwater management BMP's. The case study also does not include benefits from increased developable land. Rainwater harvesting systems are typically belowground and do not take up space on the site, unlike bioretention areas. This case study also did not adjust the water savings for higher rates during high demand times. In many areas, water rates increase 30 to 50% for increased usage during the summer months. Using a rainwater harvesting system for irrigation can prevent these peak use charges, representing a significant water savings. These savings are based on the overall water usage and therefore are difficult to predict without further information.

We would be happy to revise this return on investment case study to more closely fit your needs and the design of Costco stores.