6.10 Rainwater Harvesting and Use

Figure 6-43: Rainwater is collected and used for flushing toilets at Mills College, Oakland.

Best Uses

- High density residential or office towers with high toilet flushing demand.
- Park or low density development with high irrigation demand.
- Industrial use with high non-potable water demand.

Advantages

- Helps obtain LEED or other credits for green building.

Limitations

- High installation and maintenance costs.
- Low return on investment.
- Municipal permitting requirements not standardized.

Rainwater harvesting systems area engineered to store a specified volume of water with no discharge until this volume is exceeded. Storage facilities that can be used to harvest rainwater include above-ground or below-ground cisterns, open storage reservoirs (e.g., ponds and lakes), and various underground storage devices (tanks, vaults, pipes, arch spans, and proprietary storage systems). Rooftop runoff is the stormwater most often collected in harvesting/use system, because it often contains lower pollutant loads than surface runoff, and it provides accessible locations for collection. Rainwater can also be stored under hardscape elements, such as paths and walkways, by using structural plastic storage units, such as RainTank, or other proprietary storage products. Water stored in this way can be used to supplement onsite irrigation needs, typically requiring pumps to connect to the irrigation system. Rain barrels are often used in residential installations, but typically collect only 55 to 120 gallons per barrel; whereas systems that are sized to meet Provision C.3 stormwater treatment requirements typically require thousands of gallons of storage.

Uses of Harvested Water

Uses of captured water may potentially include irrigation, indoor non-potable use such as toilet flushing, industrial processing, or other uses. As indicated in Appendix I, the Harvest and Use, Infiltration and Evapotranspiration Feasibility/Infeasibility Criteria Report (Feasibility Report) identified toilet flushing as the use that is most likely to generate sufficient demand to use the C.3.d amount of runoff. The demand for indoor toilet flushing is most likely to equal to the C.3.d

amount of stormwater in high rise residential or office projects, and in schools. Irrigation demand may equal the C.3.d amount of runoff in projects with a very high percentage of landscaping.

System Components

Rainwater harvesting systems typically include several components: (1) methods to divert stormwater runoff to the storage device, (2) an overflow for when the storage device is full, and (3) a distribution system to get the water to where it is intended to be used. Filtration and treatment systems are typically required for indoor uses of harvested rainwater (see Table 6-2).

LEAF SCREENS, FIRST-FLUSH DIVERTERS, AND ROOF WASHERS

These features may be installed to remove debris and dust from the captured rainwater before it goes to the tank. The initial rainfall of any storm often picks up the most pollutants from dust, bird droppings and other particles that accumulate on the roof surface between rain events. Leaf screens remove larger debris, such as leaves, twigs, and blooms that fall on the roof. A first-flush diverter routes the first flow of water from the catchment surface away from the storage tank to remove accumulated smaller contaminants, such as dust, pollen, and bird and rodent feces. A roof washer may be placed just ahead of the storage tank and filters small debris for systems using drip irrigation. Roof washers consist of a tank, usually between 30- and 50-gallon capacity, with leaf strainers and a filter.

TREATMENT METHODS

The Texas Manual on Rainwater Harvesting (3rd Edition, 2006) identifies two methods of treatment used in rainwater harvesting systems for indoor use: chlorine and UV light. Chlorine has a longer history of use in the US, and is still reported to be used by rainwater harvesters, but it has drawbacks. Chlorine combines with decaying organic matter in water to form trihalomethanes, a by-product that has been found to cause cancer in laboratory rats; some users may find the taste and smell of chlorine objectionable; and chlorine does not kill *Giardia* or *Cryptosporidium*, which are cysts protected by their outer shells. ***UV light has more recently become common practice*** in U.S. utilities. Bacteria, virus, and cysts are killed by exposure to UV light. The water must go through sediment filtration before the ultraviolet light treatment because pathogens can be shadowed from the UV light by suspended particles in the water. In water with very high bacterial counts, some bacteria will be shielded by the bodies of other bacteria cells. UV lights are benign: they disinfect without leaving behind any disinfection by-products, and they use minimal power for operation.

Table 6-2
Typical Water Quality Guidelines from the Texas Rainwater Harvesting Manual

Use	Minimum Water Quality Guidelines	Suggested Treatment Guidance
Non-potable indoor uses	▪ Total coliforms < 500 cfu per 100 mL ▪ Fecal coliforms < 100 cfu per 100 mL	▪ Pre-filtration – first flush diverter ▪ Cartridge filtration – 5 micron sediment filter ▪ Disinfection – chlorination with household bleach or UV disinfection
Outdoor uses	N/A	▪ Pre-filtration – first flush diverter

Source: Low Impact Development Manual for Southern California, Low Impact Development Center, 2010, which, in turn, cites the Texas Rainwater Harvesting Manual for this information.

Design and Sizing Guidelines

HYDRAULIC SIZING

- If a rainwater harvesting system will be designed to meet Provision C.3 stormwater requirements, there must be sufficient demand to use 80 percent of the average annual rainfall runoff, as specified in Provision C.3.d.
- If the project's completed Rainwater Harvesting Worksheet (or other project-specific calculation) indicates that there is sufficient demand, size the cistern (or other storage device) to achieve the maximum drawdown time indicated in Table 9 of the Feasibility Report (included in Appendix I).

DESIGN GUIDELINES FOR ALL SYSTEMS

- Equip water storage facilities covers with tight seals, to reduce mosquito-breeding risk. Follow mosquito control guidance in Appendix F.
- Water storage systems in proximity to the building may be subject to approval by the building official. The use of waterproofing as defined in the building code may be required for some systems, and the municipality may require periodic inspection. Check with municipal staff for the local jurisdiction's requirements.
- Do not install rainwater storage devices in locations where geotechnical/stability concerns, such as a slope above 10%, may prohibit the storage of large quantities of water.
- Provide separate piping without direct connection to potable water piping. Dedicated piping should be color coded and labeled as harvested rainwater, not for consumption. Faucets supplied with non-potable rainwater should include signage identifying the water source as non-potable and not for consumption.\
- The harvesting system must not be connected to the potable water system at any time.
- When make-up water is provided to the harvest/reuse system from the municipal system, prevent cross contamination by providing a backflow prevention assembly on the potable water supply line, an air gap, or both, to prevent harvested water from entering the potable supply. Contact local water system authorities to determine specific requirements.

DESIGN GUIDELINES FOR INDOOR USE

- Avoid harvesting water for indoor use from roofs with architectural copper, which may discolor porcelain.
- Provide filtration of rainwater harvested for indoor non-potable use, as required by the plumbing code and any municipality-specific requirements.

DESIGN GUIDELINES FOR IRRIGATION USE

- Water diverted by a first flush diverter may be routed to a landscaped area large enough to accommodate the volume, or a hydraulically-sized treatment measure.
- First flush diverters shall be installed in such a way that they will be easily accessible for regular maintenance.
- Do not direct to food-producing gardens rainwater harvested from roofs with wood shingles or shakes (due to the leaching of compounds), asphalt shingles, tar, lead, or other materials that may adversely affect food for human consumption.

MAINTENANCE CONSIDERATIONS FOR ALL TREATMENT MEASURES

- A Maintenance Agreement shall be provided and shall state the parties' responsibility for maintenance and upkeep.
- Prepare a maintenance plan and submit with Maintenance Agreement.

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