5.3.9 Runoff Capture and Reuse

Description

Rainwater can be used as a resource when it is captured from rooftops and other impervious surfaces, stored in rain barrels or cisterns, and reused as non-potable water (see Figure 5.3.9-1). Captured rainwater can be used for landscape irrigation, fire needs, toilet flushing, or other greywater uses. Roof runoff is generally cleaner and more suitable than runoff from parking lots and roads, which require additional treatment and maintenance to address sediment. Air conditioning condensate (although not part of runoff) can also be captured for reuse instead of being discharged to the storm sewer. Runoff capture and reuse reduces the volume and peak flows associated with stormwater runoff.

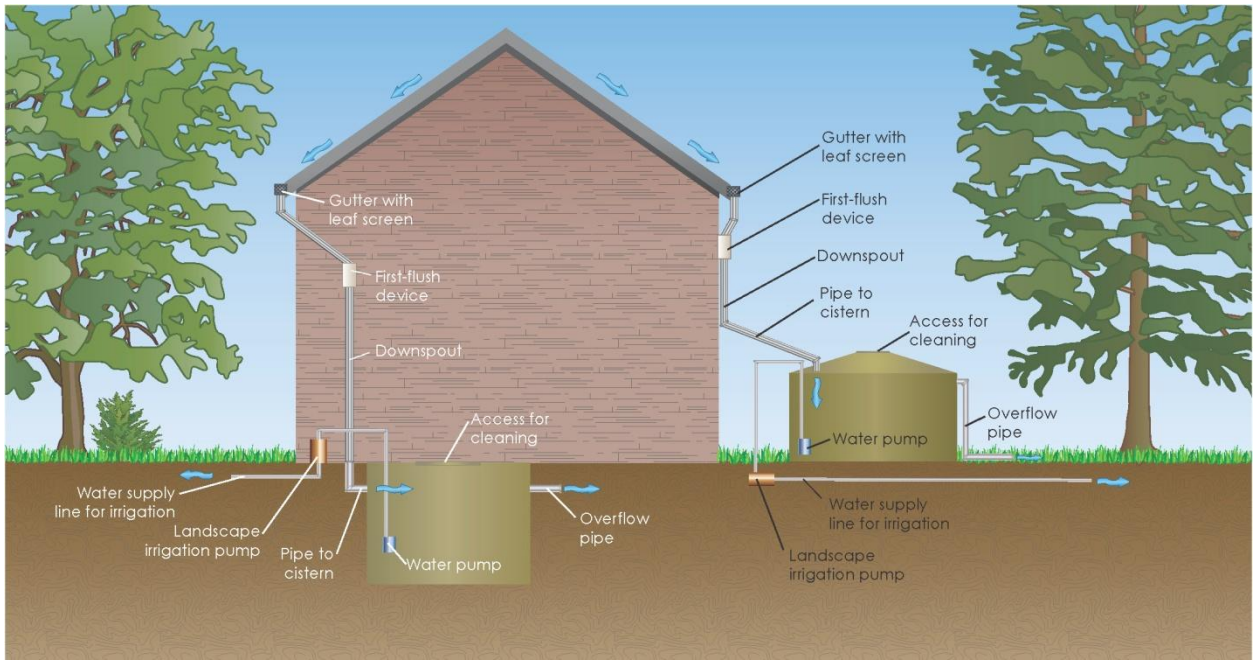

Figure 5.3.9-1. Roof runoff can be captured in cisterns above or below grade and used for irrigation or non-potable water needs.

BMP Functions Table

BMP	Applicability*	Volume Reduction	Water Quality	Peak Rate Reduction	Recharge	Runoff Temperature Mitigation	Heat Island	Habitat Creation	Maintenance Burden*	Cost*
Runoff Capture and Reuse	U/S/R	H	H	H	L	H	L	L	M/H	M/H

KEY: U = Urban; S = Suburban; R = Rural; H = High; M = Medium; L = Low

*Rating varies based on design considerations.

Key Design Features

(see Figure 5.3.9-2)

- Cisterns may be above- or below-ground tanks made from a variety of materials including wood, concrete, plastic, stone, or modular storage units.
- The volume of runoff generated from the contributing area must be considered.
- Contributing areas must be evaluated for potential pollutants including metals, fungicides, and herbicides. Roofs should not include copper or be treated with fungicides or herbicides.
- Storage devices should be sized to store the appropriate runoff volume from the contributing capture area and reuse needs should be adequate to drain the cistern within 96 hours to ensure that sufficient storage is available for subsequent rainfall events.
- When used for greywater reuse (such as toilet flushing), a backup water supply is required to supplement the system during dry periods.
- Collection and reuse systems must include an emergency overflow for large storm events.
- Cisterns must be watertight, vented, completely covered or screened, composed of non-reactive materials, and be approved for potable water storage, although runoff cannot be used for potable needs without treatment. This includes irrigation water that has any human contact (i.e., sprinklers).
- Distribution lines and other system appurtenances must be clearly labeled as non-potable water.
- If the storage device is open to the air, a screen or other cover is necessary to prevent mosquito breeding.
- Spigots or hose bibs at above-grade cisterns should be labeled “NON-POTABLE” and be equipped with an atmospheric vacuum breaker.
- Safety labels should be placed on cisterns stating “NON-POTABLE” and “DROWNING HAZARD.”
- Backflow preventers must be installed on water service lines from cisterns.

- Storage tanks should be placed in cool, shaded areas to help prevent the growth of algae.
- All collection and redistribution of stormwater runoff have the potential to cause human pathogenic issues. All capture and reuse BMPs that involve human contact must include disinfection components to prevent human health and safety issues arising from any potential contact with the collected water. Both ultraviolet (UV) and ozone disinfection systems are available for this purpose.

Applications

- Residential
- Commercial
- Institutional: schools, universities, libraries, etc.
- Brownfields
- Uses: irrigation, toilet flushing, fire storage
- Toilet flushing in high-use buildings (i.e., schools, visitor centers) is one of the most effective reuse methods.

Advantages

- Provides volume reduction.
- Contributes to peak rate reduction.
- Reduces potable water needed for irrigation, toilet flushing, or other applications.
- Visible cisterns increase public awareness.

Disadvantages

- Water held within a cistern must be emptied between storms to provide volume reduction for the next storm.
- Treatment of water for reuse may be necessary depending on the contaminants in the contributing drainage area. Reusing runoff for potable uses is not recommended in the U.S., unless water is treated to all required water quality standards.
- Pumps may be required. Note: there are proprietary systems that automate the emptying before the next storm event.

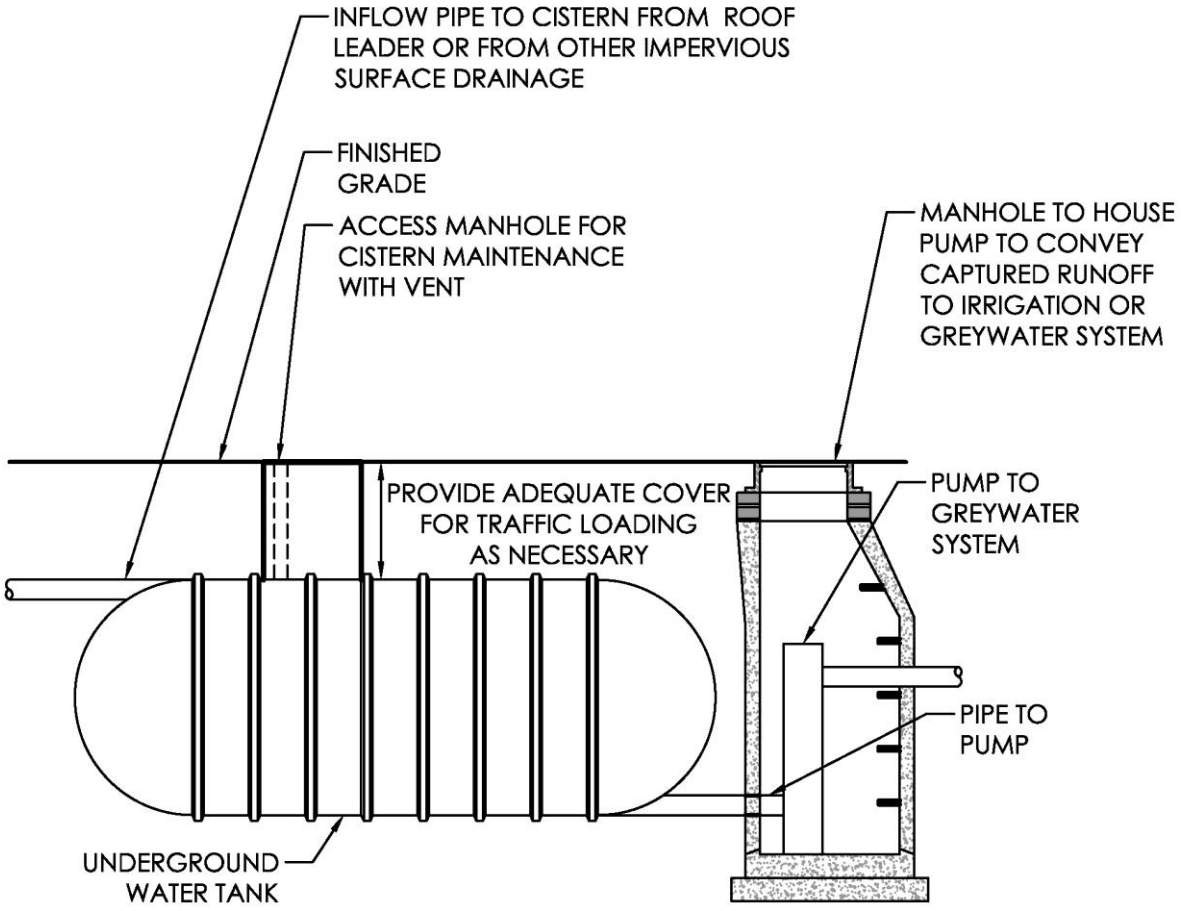

Figure 5.3.9-2. Cross-section of an underground cistern.

Applications

Runoff capture and reuse may be implemented on a variety of sites in urban and suburban environments, on residential, institutional, and commercial properties. Potential applications include office buildings, schools, libraries, multi-family residential buildings, and mixed-use areas for irrigation, fire suppression systems, toilet flushing, or other greywater uses.

Residential Rain Barrel

Figure 5.3.9-3. Rain barrels generally do not capture very large amounts of runoff, but are useful for increasing public awareness of stormwater issues.

Decorative Cistern Capture and Reuse

Figure 5.3.9-4. Cisterns can be decorative as well as functional, as is this cistern capturing runoff from a library roof. The cistern, located outside the children's library, is essentially a rain barrel with a slow-release discharge to the landscape.

Capture and Reuse for Toilet Flushing

Figure 5.3.9-5. This wooden cistern captures roof runoff at a research facility. The water is used for both toilet flushing and research needs. The captured runoff was more suitable and required less treatment for research use than the available potable water supply.

Indoor Cistern Capture and Reuse

Figure 5.3.9-6. This cistern is located indoors. Roof runoff is captured for toilet flushing within the building.

Applicable Protocols and Specifications

The following Specifications (see Appendix F) are applicable to runoff capture and reuse and must be addressed:

- Stormwater System Specifications
  - Aggregates and Drainage Layers
  - Pipes
  - Control Structures
  - Geotextiles
  - Impervious Liners and Waterproofing

Design Considerations for Runoff Capture and Reuse

The key design components for runoff capture and reuse are discussed below.

1. Location and Capture Area

- Contributing drainage areas must be considered to determine if sufficient runoff will enter cisterns to provide the necessary water demands.
- Often, contributing drainage areas are rooftops. Consideration of roof pitch, roofing materials, and large overhanging trees must be made when evaluating capture and reuse.
- Roofs made of copper or that are treated with fungicides or herbicides should not be used for rainwater capture and reuse.
- Pavement areas, such as parking lots, sidewalks, or roadways, may also be captured for irrigation reuse but may require more treatment.

2. Entrance/Flow Conditions

- When runoff enters a rain barrel or cistern through roof leaders, it should pass through a first-flush diverter that is self-draining with a cleanout (see Figure 5.3.9-7).
- Runoff captured from paved surfaces may enter a subsurface cistern through stormwater structures and piping, or after first passing through a water quality, pretreatment BMP. A first-flush diverter with a cleanout should be a part of the piping system conveying runoff to the cistern (see Figure 5.3.9-7).

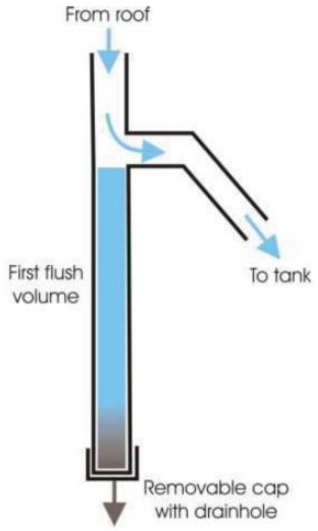

Figure 5.3.9-7. Simple first-flush diverter
(http://cehi.org.lc/Rain/Rainwater%20Harvesting%20Toolbox/Media/Print/RWHCEHI.pdf).

3. Management of Sediment, Trash, and Debris

- Screens should be used on gutters, inlets, and outlets to limit debris entering the system.
- A first-flush diverter may be used to prevent leaf litter and other debris from rooftops from entering cisterns.
- Captured runoff has the potential to collect sediment, metals, dust, bird waste, and other foreign components that may contribute to pathogenic growth, discolor collected water, or add an odor to reused water. These concerns may be minimized by avoiding collection of water from areas with large overhanging trees and installing gutter guards to prevent leaf litter and other large debris from entering the cistern from roofs.
- Regular inspection and cleaning of both the distribution system and the cistern tank itself will prevent contamination of reuse systems from sediment, trash, and debris.

4. Storage and Stay-on-Volume

A rain barrel or cistern provides volume management within the storage device only. The size of the storage device is dependent on the contributing drainage area.

The **SOV** is a function of the storage volume available within the storage device for the 1.0-inch or 1.6-inch storm. The portion of the project roof that is tributary to the storage device would be **considered to meet 100 percent of the SOV only if the collected volume of water is completely used by the intended reuse application within 72 hours of a rainfall event.**

5. Area and Dimensions

- The number of rain barrels or the size of the cistern required will be determined by the drainage area, the intended capture goal, and the usage needs of the reuse application (see Figure 5.3.9-8).
- The designer must select a pump of adequate capacity to meet the flow requirements for the reuse system.

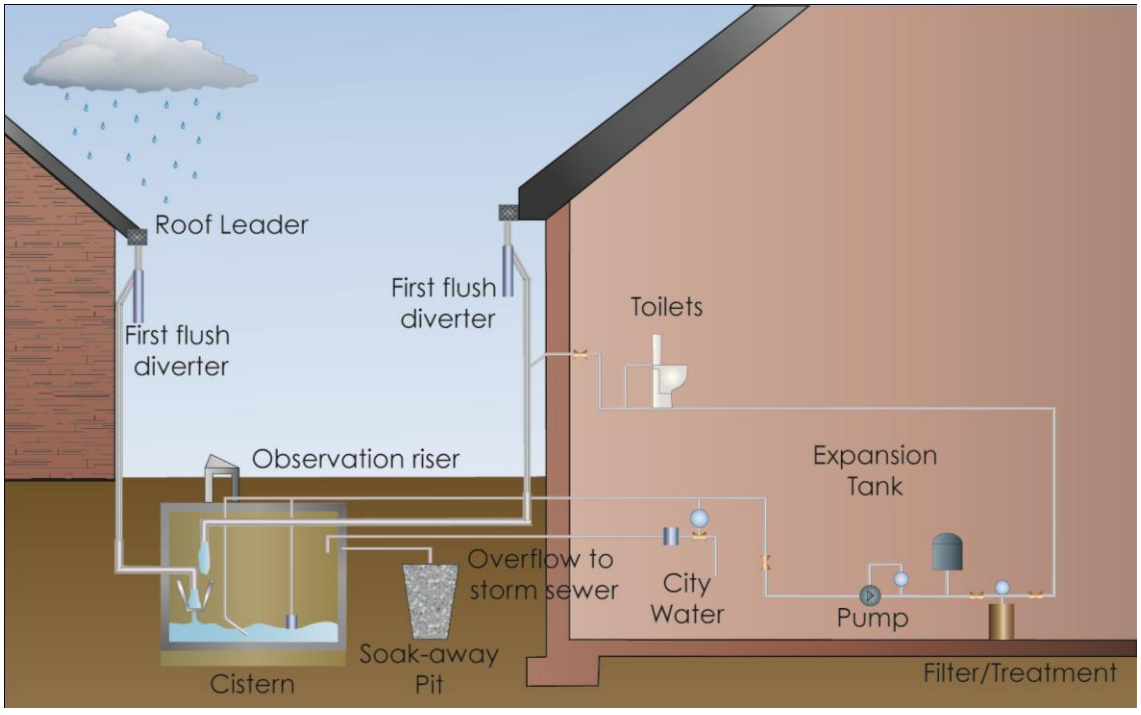

Figure 5.3.9-8. Runoff from residential buildings can be reused for irrigation, toilet flushing, or other greywater uses, such as washing machines.

6. Overflow and Peak Rate

- All rain barrels and cisterns must provide a safe way for water to exit the system when large storms generate more stormwater runoff than the storage device can hold, or bypass the system when it is full. The cistern can be designed to slowly drain to the landscape between storm events to provide capacity if it is not completely used. The overflow should convey runoff to an approved discharge point.
- The size of the overflow device or orifice should be equal in area to the total of all inlet orifices.

Peak Rate Control Credit

- For the purposes of site peak rate control, the designer may adjust the Curve Number value based on the volume managed by the SOV during a portion of a 24-hour storm event. This is described in Chapter 7.

7. Waterproofing

- Cisterns must be watertight and seams should be checked regularly for leaks.

8. Water Quality / Total Suspended Solids

- All capture and reuse BMPs must include disinfection components to prevent human health and safety issues arising from any potential contact with the collected water.
- All cisterns should be shaded to the maximum extent possible to help prevent algal growth.

Sizing Calculations Worksheet for Runoff Capture and Reuse

(Link to worksheet)

Construction Considerations

- Prior to installing a rain barrel or cistern, clean roofs, gutters, and downspouts and install effective leaf screens.
- Install rain barrels and cisterns on level surfaces.
- For elevated cisterns, consider head required to provide necessary pressure for the designed reuse.
- Follow the manufacturer's instructions for rain barrel or cistern installation.

Operations and Maintenance

All runoff capture and reuse systems require regular maintenance to ensure proper functioning.

- All parts of rain barrels and cisterns should be inspected twice annually to make sure they are operable and that there are no leaks.
- Detritus and other debris should be removed regularly from gutters, downspouts, and other screens and filters to prevent system clogging.
- Tanks should be cleaned once per year with a non-toxic cleanser.
- Backflow preventers should be checked annually for proper functioning.
- Complex systems may require pumps, valves, and other appurtenances that may require increased maintenance to ensure functionality.