

M-1. Rainwater Harvesting (Cisterns and Rain Barrels)

Rainwater harvesting practices intercept and store rainfall for future use. Stored water may be used for outdoor landscaping irrigation, car washing, or non-potable water supply. The capture and re-use of rainwater promotes conservation, as well as reduces runoff volumes and the discharge of pollutants downstream.

Applications:

Rainwater harvesting can be applied on residential, commercial, municipal, or industrial sites. For small-scale residential applications, rain barrels are typically used to provide storage of rooftop runoff. These systems are generally designed for outdoor use. However, because water demand varies seasonally, other treatment practices may be needed for dewatering during winter months.

Larger storage tanks or cisterns are used in commercial or industrial applications. These systems use the captured rainwater for non-potable water supply, providing a year-round source. The complexity of the sizing, installation, and accessories of this type of application make it more realistic for commercial operations. Separate plumbing, pressure tanks, pumps, and backflow preventers are necessary for indoor applications.

Performance:

The pollutant removal capability of rainwater harvesting systems is directly proportional to the amount of runoff captured, stored, and re-used. Therefore, P_E for the contributing drainage area is based on the volume captured in the rainwater harvesting design. In addition, Re_v requirements may be met only when stored water is used on landscaped areas.

Constraints:

The following constraints are critical when considering the use of rainwater harvesting techniques to capture and re-use stormwater runoff:

- **Space:** Lack of space and the presence of surrounding trees can limit the opportunities for rain barrels and cisterns. Leaves and woody debris from overhead trees can clog the storage tanks or attract birds whose droppings may contaminate the tank. Space limitations can be overcome if storage is provided on the roof or underground. The proximity to building foundations also needs to be considered for dewatering and overflow conditions.
- **Topography:** Locating storage tanks in low areas may increase the volume of rainwater stored but will require pumping for distribution. To prevent erosion on steeply sloped surfaces, a bermed or concave holding area down gradient can store water for landscape irrigation.

- **Drainage Area:** The drainage area to each storage tank needs to consider year-round water demands. The drainage area to each rain barrel needs to be small enough to prevent concentrated flow during dewatering operations.
- **Operation:** Rain barrels and other storage tanks must be operated and maintained throughout the year. This includes any necessary dewatering in between rain events so that the required storage volume is available. Where freezing and ice formation are concerns, rainwater harvesting systems should be located underground or indoors.

Rain barrels are subject to elimination and/or neglect by homeowners. Education is needed to ensure that captured runoff will flow to pervious surfaces and overall system function is sustained.

Design Guidance:

The following conditions should be considered when designing rainwater harvesting systems:

- **Conveyance:** *A stable discharge shall be provided to pervious areas for any necessary dewatering between storm events. An overflow shall be provided to pass larger storm events.* Conveyance to rainwater harvesting storage tanks consists of gutters, downspouts, and pipes. The overflow should be near the top of the storage unit and may consist of plastic hoses or similar materials to direct runoff safely to a stable outfall to down gradient properties.
- **Treatment:** Rainwater harvesting systems shall meet the following conditions:
 - *Screens and filters shall be used to remove sediment, leaves, and other debris from runoff for pretreatment and can be installed in the gutter or downspout prior to storage.*
 - *Rain barrels and cisterns shall be designed to capture at least 0.2 inches of rainfall from the contributing rooftop area. A P_E value based on the ESD_v captured and treated shall be applied to the contributing rooftop area.*
 - *Where rainwater harvesting systems are connected to indoor plumbing, the Re_v requirement shall be addressed separately.*
 - *The design shall plan for dewatering to vegetated areas.*
 - *The design of large commercial and industrial storage systems shall be based on water supply and demand calculations. Stormwater management calculations shall include the discharge rate for distribution and demonstrate that captured rainwater will be used prior to the next storm event.*
 - *Large capacity systems shall provide dead storage below the outlet and an air gap at the top of the tank. Gravity-fed systems should provide a minimum of six inches of dead storage. For systems using a pump, the dead storage depth will be based on the pump specifications.*
- **Distribution System:** Most outdoor distribution is gravity fed or can be operated with a pump. For underground tanks or cisterns, a pump, pressure tank, and backflow preventer will be needed.

- **Dewatering:** During the non-growing season, irrigation systems are typically turned off and may need to be dewatered.
- **Observation Wells:** *An observation well consisting of an anchored, perforated pipe (4" min.) shall be provided on all below-ground installations. The top of the observation well shall be at least six inches above grade.*
- **Safety:** *Above ground home storage tanks shall have secured openings small enough to prevent child entry. For underground systems, manholes shall be secured to prevent unauthorized access.*
- **Operation:** Rainwater storage designs need to consider the potential for freezing. These systems may need to be located indoors or underground below the frost line if freezing conditions are expected.
- **Mosquitoes:** Screens should be provided to prevent mosquitoes and other insects from entering the tanks.
- **Setbacks:** *Overflow devices shall be designed to avoid ponding or soil saturation within 10 ft. of building foundations.*

Construction Criteria:

The following should be addressed during construction of projects with rainwater harvesting systems:

- **Site Disturbance:** Underground storage tanks shall be placed on or in native soils. If placement on fill material is necessary, a geotechnical analysis may be required by the approving authority.
- **Storage Tanks:**
 - *Storage tanks shall be designed to be watertight and all materials should be sealed with a water safe, non-toxic substance.*
 - *Storage tanks shall be protected from direct sunlight and shall be opaque to prevent the growth of algae.*
 - *The top of underground tanks shall be beneath the frost line.*
 - Cisterns may be ordered from a manufacturer or constructed on-site. Typical materials used to construct cisterns are fiberglass, wood, metal, or reinforced concrete.
 - Rain barrels can be purchased or custom made from large, plastic (e.g., 55-gallon) drums.

Figure 5.8 Rain Barrels

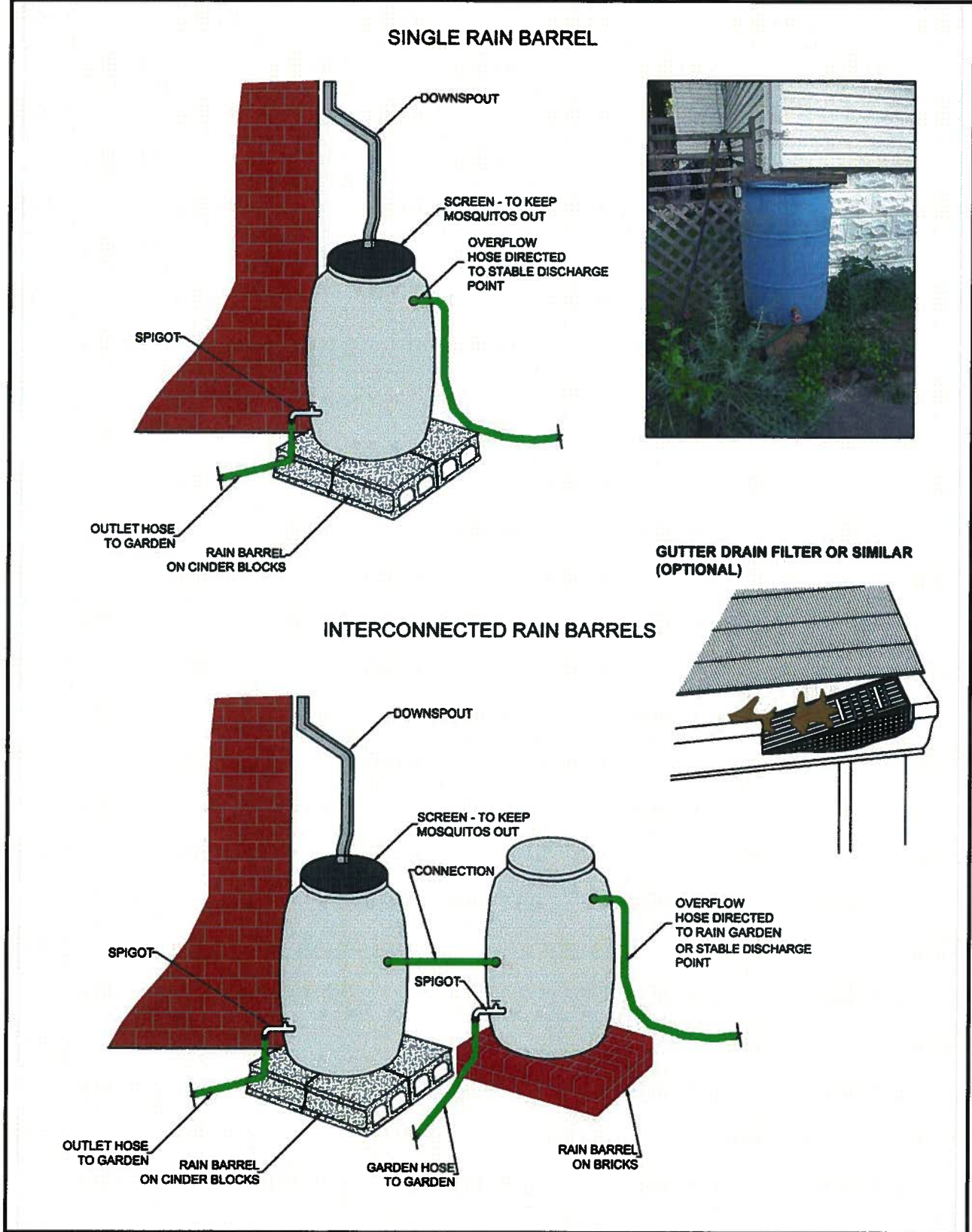
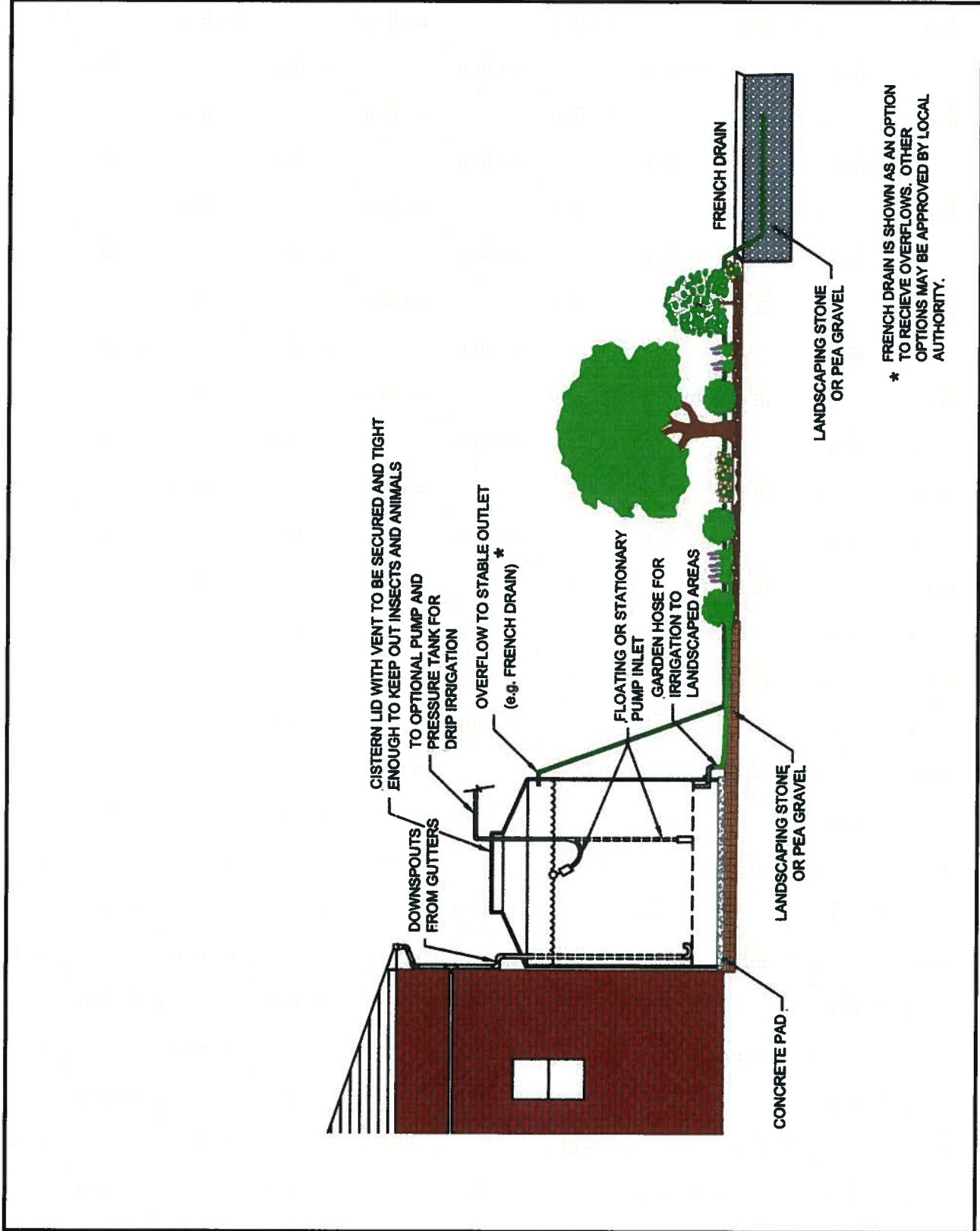


Figure 5.9 Cistern – Plan View



* FRENCH DRAIN IS SHOWN AS AN OPTION TO RECEIVE OVERFLOWS. OTHER OPTIONS MAY BE APPROVED BY LOCAL AUTHORITY.

- **Pressurization:** Depending on the use of stored water, pressurization may be required. To add pressure, a pump or pressure tank can be used.

Inspection:

Prior to operation, certification shall be required that the constructed system meets the conditions specified on the approved plans. Additionally, certification regarding the water tightness of the underground storage tank shall be required after its installation.

Maintenance Criteria:

The following items should be addressed to ensure proper maintenance and long-term performance of rainwater harvesting systems:

- *Privately owned practices shall have a maintenance plan and shall be protected by easement, deed restriction, ordinance, or other legal measures preventing its neglect, adverse alteration, and removal.*
- *Access shall be provided for cleaning, inspection, and maintenance in all cisterns. A drain plug shall also be provided to allow the system to be completely emptied if needed.*
- Leaf screens, gutters, and downspouts should be cleaned to prevent clogging. Built-up debris can also foster bacterial growth in gutters and downspouts.
- Storage tank lids and mosquito screens should be inspected and cleaned.
- Damaged components should be replaced as needed.
- To avoid freezing of components, above ground systems should be disconnected, drained, and cleaned at the start of the Winter season.
- Underground system connections should be checked for frozen lines and ice blockages during Winter.
- Indoor systems may require more specific maintenance.