



Cisterns

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The Pennsylvania Stormwater Manual encourages the capture and reuse of stormwater runoff. The goal is to capture runoff from impervious areas, most often roofs, in appropriate containers. During the time before the next runoff event, this water should be used for some appropriate purpose. The purpose of this fact sheet is to provide guidance on how to develop effective runoff capture and reuse systems as part of a stormwater management plan.

A cistern is a storage tank located to collect runoff water from an impervious area, most likely a roof. Cisterns can be used to capture runoff from other impervious areas as well. Cisterns come in many shapes and sizes, see Fig. 1, from rain barrels to larger plastic, steel or concrete tanks that can be located above or below the soil surface.

potable, the uses for this water are limited. The most common use is for irrigating lawns, gardens, or flower beds. Many avid gardeners place rain barrels under downspouts and capture roof runoff so they can water their vegetables and flowers. These seasonal uses may make sense during the growing season, but obviously are not available during the dormant season.

Using captured runoff water to flush toilets can require re-plumbing of your home and can be very expensive. In Pennsylvania, where winters are cold, a cistern to supply a gray water system will need to be buried so the stored water does not freeze. Captured runoff water has been proposed as a source of fire protection water. This is rarely practical.

Advantages

Capturing runoff water from your property reduces the quantity of stormwater discharged from your property. This captured water can be a source of much needed water for irrigation of vegetables and flowers, watering animals, flushing toilets, washing vehicles, driveways and walks, and in some cases washing cloths (some people like the softness of this captured runoff). Especially in times of drought, or as a substitute for water purchased from a Water Authority, captured runoff can be a beneficial source of water.



Fig. 1. Examples of a cistern.

Disadvantages

You need to be aware that runoff water captured and stored in a cistern, MUST be used before the next runoff event or the system becomes ineffective and will not accomplish its stormwater management purpose. So before we discuss issues of sizing and design, consider how the runoff water captured in your cistern will be used. Remember, in Pennsylvania, it rains more than 0.25 inches on average every 7 days, see Fig 2. Since runoff water is rarely

Making the Cistern Work

Two basic pieces of information will be needed before we can discuss the system. First, how large is the area from which you wish to collect runoff into your cistern system? Second, how much water do you need for your intended use? The design process must create a balance between these two requirements.

Runoff volume

Every 100 square feet of impermeable surface will yield about 12 gallons of runoff water from each 0.20-inch rain. Table 1 shows how much runoff water to expect from impermeable areas and shows how much runoff water can be captured. Fig. 2 shows the average number of non-rain days between rain events of varying sizes (e.g. on average a 0.20-inch rain can be expected every 7 days). Something that must be considered is “what will be done with the runoff water in excess of that you plan to capture?” In other words, when the cistern is full, where does the runoff water go? Be sure you plan an appropriate disposal path for this excess water.

Now that you have considered the runoff volume that might be captured, also consider how much water you will need. Estimating these volumes can be very difficult.

I wash my car with about 3 gallons of water. Most people use more than that. Sprinkler irrigation of a 1000-ft² vegetable garden on a weekly basis could require as much as 600 gallons of water. Drip irrigation could require much less. These irrigation systems will most certainly require a pump. Hand watering the same garden could require as little as 50 to 100 gallons. Since these estimates are difficult to make, it is sometimes better to start small with one or two rain barrels and see how it works. History has shown that most folks do not effectively use the runoff water they capture, since it is easier not to do the extra work required to make these systems effective stormwater measures. There is also the earlier-mentioned concern about what to do with the runoff water during the cold winters.

Table 1. Volume of run off (in gallons) produced from rain on varying impermeable areas.

Imp. Area (ft ²)	0.10-in Rain	0.20-in Rain	0.30-in Rain	0.40-in Rain	0.50-in Rain	0.75-in Rain	1.00-in Rain
100	6	12	19	25	310	47	62
250	16	31	47	62	78	120	160
500	31	62	94	120	160	3230	310
750	47	94	140	190	230	350	470
1000	62	120	190	250	310	470	620
1500	94	190	280	370	470	700	930
2000	120	250	370	500	620	930	1200
2500	160	310	470	620	780	1200	1600
3000	190	370	560	750	930	1400	1900
3500	220	440	660	870	1100	1600	2200
4000	250	500	750	1000	1200	1900	2500
4500	280	560	840	1100	1400	2100	2800
5000	310	620	940	1200	1600	2300	3100

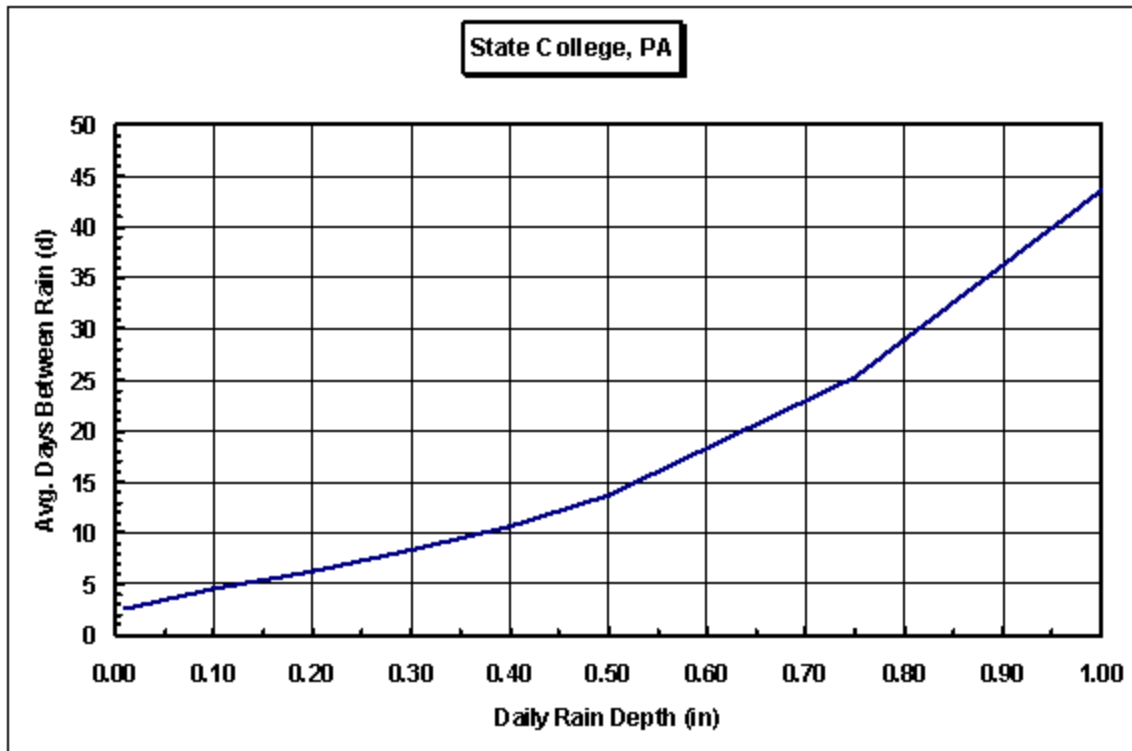


Fig. 2. Average number of dry days between rains of varying depth.

Summary

Capturing and reusing stormwater runoff from a roof or other impermeable surface is a concept that has promise, especially in cases where the reuse system can be automated and able to effectively utilize the captured water. If you are planning a capture/reuse system, but cannot see your way to some automatic reliable system, it may be best to not invest in this technology.

For additional assistance, contact your county extension agent.

For further information on this or other agricultural engineering topics check our website: www.abe.psu.edu

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