Stormwater Best Management Practice

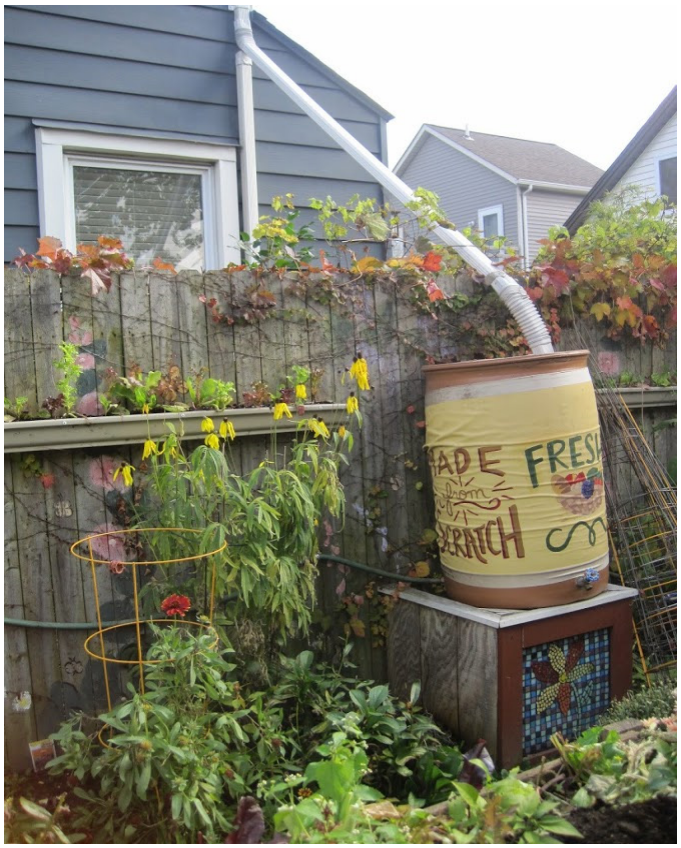
On-Lot Treatment

Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment
Subcategory: Retention/Detention

Description

The term "on-lot treatment" refers to a range of stormwater controls that treat discharges from individual residential lots. The primary purpose of most stormwater controls for on-lot treatment is to manage discharges from rooftops and, to a lesser extent, driveways and sidewalks. On-lot treatment reduces surface discharge, either by enhancing infiltration or by temporarily storing the water for irrigation or infiltration during dry times. Although the volume of stormwater that individual lots generate is small and its quality is generally good compared to other urban stormwater (NAS, 2016), the cumulative effect of untreated stormwater from thousands of households can be a major contributor to problems like water quality pollution and erosive flows in urban streams (Walsh et al., 2005). Treating residential discharges at the source is therefore one of the best and easiest ways to restore a community's natural hydrology.

There are many options for on-lot treatment stormwater controls. The best option depends on a community's goals, local laws, the feasibility at a specific site and the property owner's preferences. Table 1 summarizes common practices. Additional information can be found in the individual links.



A rain barrel decorated by a homeowner and used for watering a garden.
Credit: Alisha Goldstein, USEPA

Table 1. Common stormwater controls for on-lot treatment for residential homes

Stormwater Control	Description and Siting Considerations
Bioretention (rain gardens)	▪ Consists of a shallow depression with multiple layers, including soil mix media, a mulch layer and native vegetation. ▪ Provides landscaping and aesthetic benefits. ▪ Requires regular maintenance.
Cisterns and rain barrels	▪ Cisterns and rain barrels are the simplest on-lot treatment method. ▪ Property owners can retrofit existing roof drains to lead into rain barrels. ▪ Sites can use harvested rainwater to water plants during dry weather. ▪ Their effectiveness depends on storage volume and seasonal rainfall rates.
Dry wells	▪ Subsurface storage facilities can receive and temporarily store stormwater from roof structures.

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Stormwater Control	Description and Siting Considerations
	▪ Property owners can retrofit existing roof drains to connect to dry wells. ▪ Wells help store stormwater with high flow and encourage groundwater recharge. ▪ They are only practical in areas with high soil infiltration rates.
Grassed swales or filter strips	▪ Strips of grass or vegetation can transport stormwater to a larger pervious area for infiltration. ▪ They are most effective in conjunction with other stormwater controls.
Infiltration trenches	▪ Property owners fill trenches with various-sized rocks to reduce the stormwater flow rate and encourage infiltration. ▪ They are most effective in areas with highly permeable soils. ▪ They require regular maintenance.

Application and Design Considerations

With very few exceptions (e.g., very small lots or lots with no landscaping), some sort of on-lot treatment applies to most sites. Traditionally, municipalities have encouraged but not widely adopted on-lot treatment of residential stormwater discharge, as the property owner is responsible for initial and maintenance costs. However, more local governments are offering financial incentives for on-lot treatment, such as reducing fees and supporting public outreach (see "Cost Considerations" below).

Although simpler than other types of stormwater controls, on-lot treatment still has certain design elements common to all practices. Pretreatment is important to ensure the controls do not clog with leaf litter or debris. For rainwater collection systems, a settling tank, first flush diverter, or debris-trapping grate or filter in the downspout is recommended.

Common Terms

Pretreatment plays an important role in stormwater treatment. Pretreatment structures, installed immediately upgradient to a stormwater control, reduce flow rates and remove sediment and debris before stormwater enters the stormwater control. This helps to improve the stormwater control's pollutant removal efficiency and reduces maintenance requirements.

Both infiltration- and storage-based on-lot treatment stormwater controls typically incorporate some type of bypass to direct heavy stormwater discharges away from buildings. In many cases, this simply entails allowing for an overflow route that will not cause erosion or flooding. For cisterns or rain barrels, emptying the container before large storm events helps prevent the container from overfilling. For example, property owners typically mount a hose at the bottom of the barrel or cistern to irrigate gardens or for landscaping; owners can use the hose to manually empty the tank or connect the hose to a drip tape to allow for slow drawdown after each rain event. In infiltration-based on-lot treatment, an aboveground opening in the downspout can serve as the bypass. Additionally, design engineers can design grassed swales and bioretention cells to absorb all but the largest of stormwater flows. In extreme cases, flows generally pass untreated over these stormwater controls.

When designing infiltration-based on-lot treatment stormwater controls, it is important to locate the infiltration area far enough away from the building's foundation to prevent the undermining of the foundation or basement seepage. The infiltration area should be at least 10 feet away from the house.

Limitations

Limitations to the use of on-lot treatment include the following:

- Property owners should perform some basic maintenance.
- Property owners who do not enjoy landscaping may struggle to find uses for water stored in rain barrels or cisterns, since the water is not potable.
- Some of these stormwater controls may be impractical on very small lots.

- Rainwater harvesting may have restrictions in some arid states, where water rights laws apply. Always consult local limitations.
- Even if every property in a watershed uses on-lot treatment, these stormwater controls would only treat a portion of the watershed imperviousness, because they would not address roads and parking areas (see the Right-Sized Residential Streets and Green Parking fact sheets).

Maintenance Considerations

Bioretention practices, infiltration trenches, filter strips and grassed swales require regular maintenance to ensure that the vegetation remains in good condition and clogging does not occur; see the Bioretention (Rain Gardens), Vegetated Filter Strip and Grassed Swales fact sheets for more detailed information. Infiltration-based stormwater controls require regular removal of sediment and debris that settle in the pretreatment or treatment area (see the Bioretention and Infiltration Trench fact sheets). Property owners might also need to replace the media if they become clogged.

Rain barrels and cisterns require minimal maintenance, but the property owner should maintain the rain barrel and any apparatus to prevent freezing or cracking. In addition, the property owner should clean the tank about once per year and periodically check that rain barrels and cisterns are properly sealed to prevent mosquito breeding.

Effectiveness

On-lot treatment is most effective at reducing the volume of stormwater that individual lots generate. Pollutant removal may not be as high as larger-scale stormwater controls—see the Infiltration Trench, Bioretention (Rain Gardens), Vegetated Filter Strip and Grassed Swales fact sheets—because the pollutant concentrations entering the systems are generally low. Still, benefits can be significant if implemented on many lots throughout a watershed. Even if only 10 to 20 percent of properties adopt on-lot treatment, these controls can measurably reduce peak discharge rates and total discharge volumes (Jarden, Jefferson, & Grieser, 2016).

In an assessment of three watersheds in the Mid-Atlantic region, sub-watersheds with over 10 percent adoption of rain gardens, detention ponds, bioswales and green roofs showed a 26 to 44 percent reduction in peak flow, a reduced frequency of discharge-generating events and up to a 50 percent reduction in stormwater nitrogen export (Pennino et al., 2016).

Many on-lot treatment stormwater controls also promote groundwater recharge, helping address typical urban stream problems such as reduced baseflow and increased frequency of erosive flows (Walsh et al., 2005). Finally, landscaped areas such as rain gardens beautify the landscape and may also provide habitat for pollinators and other native wildlife.

Cost Considerations and Local Incentivization Programs

On-lot treatment can be relatively inexpensive. Typical costs are $100 for a rain barrel and $500 for a dry well. The property owner is usually directly responsible for the cost, which can make adoption rates low. For dry wells, rain barrels and cisterns, property owners can reduce costs by making their own rather than purchasing a commercial product. Incentive and rebate programs are also becoming more popular, which can offset nearly all installation costs. Currently, some municipalities offer credits or other incentives for installing stormwater controls on residential properties. Consult local agencies to determine if these incentives are available.

The city of Seattle, Washington, developed the RainWise program for residents, offering up to $4 per square foot of controlled rooftop discharge, with an average rebate of $4,800 to each qualifying household in the Seattle area (City of Seattle, n.d.).

Montgomery County, Maryland, has a similar program, called RainScapes, which provides a variety of incentives for installing and maintaining on-lot treatment stormwater controls. These incentives include a rebate of $1 per gallon for cisterns and rain barrels, $10 per square foot of rain garden total area, and $3 to $7 per square foot of pavement removal (MCDEP, n.d.).

Additional Resources

- Soak Up the Rain: Rain Barrels
- What is Green Infrastructure?
- What is EPA Doing to Support Green Infrastructure?
- Green Infrastructure Modeling Tools
- Green Infrastructure Design and Implementation
- Green Infrastructure Funding Opportunities
- Tools, Strategies and Lessons Learned from EPA Green Infrastructure Technical Assistance Projects
- Manage Flood Risk
- Build Resiliency to Drought
- Green Infrastructure Webcast Series

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

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Walsh, C. J., Roy, A. H., Feminella, J. W., Cottingham, P. D., Groffman, P. M., & Morgan, R. P. (2005). The urban stream syndrome: Current knowledge and the search for a cure. *Journal of the North American Benthological Society, 24*(3), 706–723.

Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.