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Best Management Practice Fact Sheet 14: Wet Ponds

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This fact sheet is one of a 15-part series on urban *stormwater management* practices.

Please refer to definitions in the glossary at the end of this fact sheet.
Glossary terms are *italicized* on first mention in the text. For a comprehensive list, see Virginia Cooperative Extension (VCE) publication 426-119, "Urban Stormwater: Terms and Definitions."

What Is a Wet Pond?

Wet ponds (WP) are ponds or lakes which provide treatment and storage of *stormwater*. The water depth is set by a structure known as an *outlet structure*. Wet ponds are probably the most well-known *best management practice* for treatment of stormwater. Because of their size, they are usually designed to include storage above the normal pool elevation. This added storage can provide reductions in downstream flooding and assist in protecting stream channels. They tend to be large and in some cases, they can become a passive community amenity (See Figure 1).

Figure 1. Typical wet pond (VA-DCR 2011).

Where Can Wet Ponds Be Used?

An adequate, consistent water supply is necessary to maintain *baseflow* for a functioning WP. This usually requires a contributing *watershed* area of at least 10 acres for the pond to have a *sustainable* water level. Sandy soils should be avoided or an *impermeable liner* should be installed in order to assist in holding water and minimize *seepage* losses. Due to their placement at the exit point of the watershed, WPs are often the last opportunity to treat stormwater before it is discharged to a stream. Because they only provide modest pollutant removal benefits, other opportunities for runoff reduction and/or water quality treatment should be explored prior to resorting to this BMP.

How Do Wet Ponds Work?

Management of stormwater in a WP is provided in two ways: water quantity control and water quality treatment. A typical wet pond profile is shown in Figure 2.

Water quantity control is provided by WPs in the form of storage. Inflow enters the pond and partially displaces water collected during previous storms. The displaced water is slowly discharged to an adjacent stream system, and the new inflow remains in the pond to be treated. WPs therefore effectively reduce *peak runoff* flows.

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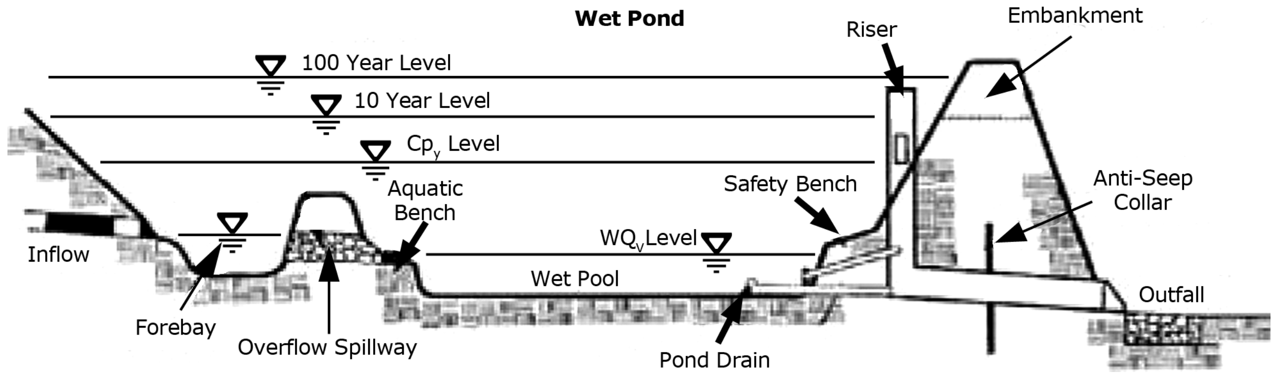

Figure 2. Typical wet pond profile. *Source: Fairfax County Department of Public Works and Environmental Services, 2011.*

Water quality improvement in WPs is provided by natural processes, including *biological uptake*, *microbial decomposition*, and *settling*. WPs are most effective at removing excess *sediment* and those *nutrients* that attach to sediment.

Limitations

- WPs are large — about 1 percent to 3 percent of the contributing drainage area. If land is expensive, this may result in higher costs.
- Steep WP bank slopes can erode and are therefore dangerous. These should be avoided in the design of WPs.
- WPs export nutrients during the nongrowing season when vegetation is not actively growing or is dying back.
- WPs raise water temperatures because they provide a larger surface for solar heating and a longer standing time for heating to take place.
- WPs may provide habitat for mosquitoes unless biological or physical controls are developed.
- WPs may cause community safety issues which should be addressed or mitigated.

Maintenance

Routine Maintenance (annual)

- Inspect the inlet and outlets regularly for functionality. Clear debris and repair as needed.
- Remove floating trash and debris.

Nonroutine Maintenance (as needed)

- Remove excess sediment. It reduces treatment and peak flow capacity. It can also cause sediment to *resuspend* and degrade water quality.
- Mow vegetation to a manageable height outside of a buffer, depending on the use and needs of the surrounding area. Leave an undisturbed buffer of at least 25 to 50 feet, if possible. However, trees should be prevented from growing on the dam or filled areas.
- Monitor and replace slope and shoreline stabilizing plants in the buffer area as needed.
- Control *invasive species* and thin woody growth to keep vegetation manageable.
- Control pests such as geese, muskrats, and beavers.
- Address algae blooms with skimmers or carp (if permitted); avoid chemical treatment unless absolutely necessary.

Performance

Wet ponds provide a modest amount of pollutant removal. A typical WP is expected to reduce total phosphorus (TP) by 50 percent and total nitrogen (TN) by 30 percent. In a more advanced design, the WP is much larger and has multiple cells. These measures can increase treatment and provide a longer *residence time*. Multiple cells improve settling and remove large particles before water is treated in the primary pond. Advanced WP designs can improve the expected reduction of TP to 75 percent and TN to 40 percent. However, this increases the already large space requirements for this BMP (VA-DCR 2011).

Expected Cost

WPs are a relatively expensive *stormwater treatment practice* when compared to other alternatives and can vary greatly. An average construction cost of wet ponds is approximately $9/ft^3; operation and maintenance costs can be estimated to be 3% of these costs, annually (Washington State Department of Ecology, & Herrera Environmental Consultants, 2012). This is for routine maintenance costs and does not include dredging.

Additional Information

The Virginia departments of Conservation and Recreation (VA-DCR) and Environmental Quality (VA-DEQ) are the two state agencies that address nonpoint source pollution. The VA-DCR oversees agricultural conservation; VA-DEQ regulates stormwater through the Virginia Stormwater Management Program.

Additional information on best management practices can be found at the Virginia Stormwater BMP Clearinghouse website at https://www.swbmp.vwrrc.vt.edu/ (Permanent link: https://perma.cc/WC5L-KCZ8). The BMP Clearinghouse is jointly administered by the VA-DEQ and the Virginia Water Resources Research Center.

Online Resources

Charles River Watershed Association – https://www.crwa.org/hs-fs/hub/311892/file-634371474-pdf/Our_Work_/Blue_Cities_Initiative/Resources/Stormwater_BMPs/CRWA_Wet_Pond.pdf

Clermont County, Ohio – https://clermontswcd.org/wp-content/uploads/sites/23/2016/08/clermontswcd-basinmanual.pdf

Metropolitan Council, St. Paul, Minnesota – www.metrocouncil.org/environment/Water/bmp/CH3_STRetenWetPond.pdf

New Jersey Department of Environmental Protection – https://www.state.nj.us/dep/stormwater/pdf/tech_man_6_12_wet_ponds.pdf

North Carolina State University – https://content.ces.ncsu.edu/maintenance-of-stormwater-wetlands-and-wet-ponds (Permanent link: https://perma.cc/S5VE-4NXE)

Pennsylvania Department of Environmental Protection – www.dep.state.pa.us/dep/subject/advcoun/stormwater/manual_draftjan05/section06-structuralbmps-part3.pdf

Virginia Stormwater BMP Clearinghouse – https://www.swbmp.vwrrc.vt.edu/ (Permanent link: https://perma.cc/WC5L-KCZ8)

Companion Virginia Cooperative Extension Publications

Daniels, W., G. Evanylo, L. Fox, K. Haering, S. Hodges, R. Maguire, D. Sample, et al. 2011. *Urban Nutrient Management Handbook*. Edited by M. Goatley. VCE Publication 430-350.

L. Fox and M. Andruczyk. 2018. *Urban Water-Quality Management - What Is a Watershed?* VCE Publication 426-041.

Sample, D., et al. 2011-2012. Best Management Practices Fact Sheet Series 1-15, VCE Publications 426-120 through 426-134.

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Washington State Department of Ecology and Herrera Environmental Consultants. *PugetSound Stormwater BMP Cost Database*. 2012

Glossary of Terms

Baseflow – The portion of flow in a stream that continues even during extended dry periods.

Best management practice (BMP) – Any treatment practice for urban lands that reduces pollution from stormwater. A BMP can be either a physical structure or a management practice. Agricultural lands use a similar, but different, set of BMPs to mitigate agricultural runoff.

Biological uptake – The process by which plants absorb nutrients for nourishment and growth.

Erosion – A process by either physical processes, such as water or wind, or chemical means that moves soil or rock deposits from one source and transports it to another. Excessive erosion is considered an environmental problem that is very difficult to reverse.

Habitat – The environment where organisms, like plants, normally live.

Hydric Soils – Soils that form under saturated conditions. When saturated conditions exist, anaerobic chemical processes dominate, and unique chemical properties develop. A common characteristic of hydric soils is the presence of a rotten egg odor, indicating the presence of hydrogen sulfide (H_2S) gas.

Impermeable liner – A material designed to retard seepage from ponds and wetlands.

Impervious surfaces – Hard surfaces that do not allow *infiltration* of rainfall into it.

Infiltration – The process by which water (surface water, rainfall, or runoff) enters the soil.

Invasive species – Nonnative species that can cause adverse economic or ecological impacts to the environment, usually due to the tendency of these introduced species to dominate local *habitats* and replace native ecological communities.

Microbial decomposition – The breakdown of compounds or organic matters into smaller ones with the aid of microorganisms.

Nutrients – Substances required for growth of all biological organisms. When considering water qualities, nutrients of greatest concern in stormwater are nitrogen and phosphorus. Excessive amounts of these substances are pollution and can cause algal blooms and dead zones to occur in downstream waters.

Outlet structure – A structure that regulates water discharge from best management practices and serves as an exit point from the BMP. Also known as control structure.

Peak runoff – The highest amount of water flowing from a watershed during a storm event.

Residence time – The average time it takes water to travel through a treatment system, such as a wet pond. Residence time can also be called detention time.

Resuspend, resuspension – When sediment that has settled becomes suspended in the water after being disturbed.

Sediment – Soil, rock, or biological material particles formed by weathering, decomposition, and *erosion*. In water environments, sediment is transported across a watershed via streams.

Seepage – Water lost through the bottom of a lake or wetland.

Settling – The process by which particles that are heavier than water fall to the bottom under the influence of gravity.

Stormwater – Water that originates from *impervious surfaces* during rain events; often associated with urban areas. Also called runoff.

Stormwater management – The management of runoff from pre- to post-development, often using stormwater treatment practices and best management practices to manage quality and control release into receiving bodies of water.

Stormwater treatment practice – A type of best management practice that is structural and reduces pollution in the water that runs through it.

Sustainable – The ability of the system to endure and remain productive over a long time duration.

Watershed – A unit of land that drains to a single "pour point." Boundaries are determined by water flowing from higher elevations to the pour point. The pour point is the point of exit from the watershed, or where the water would flow out of the watershed if it were turned on end.

Wetland – Land that has hydric soil and wetland vegetation, and is periodically saturated with water.

Wet ponds – Stormwater impoundments that have a permanent pool of water used to treat water pollution.