Appendix 10: Alternative Pre-treatment Options for Dry Extended Detention Ponds - Rationale and Expectations

Research has shown that of the various mainstream stormwater BMPs (wet ponds, dry ponds, media filters, bioretention, wetlands), the suspended solids removal efficiency of dry ponds is the lowest or worst. The National Pollutant Removal Performance Database for Stormwater Treatment Practice, 2nd Edition (Center for Watershed Protection, 2000) reports the median TSS removal efficiencies for end-of-pipe controls as shown in the table below. Because of their poor water quality performance, several states no longer allow the use of dry ponds.

BMP	Median TSS Removal (%)
Dry Pond	47
Wet Pond	80
Stormwater Wetland	76
Filtering Practices	86
Infiltration Practices	95

Table 1. Median total suspended solids removal efficiences (CWP, 2000).

Ohio EPA has been interested in providing the most flexibility/options to the site designer but, with a 80% TSS removal target, the traditional dry pond designs fall short. Forebays have been shown to be effective pretreatment for all types of end-of-the-pipe stormwater BMPs, improving performance numbers significantly. A WinSLAMM (Source Loading And Management Model) analysis using solely the required 0.1*WQv volume would allow a wet pool forebay to remove upwards of 50% of the annual TSS load from most development types. Needless to say, such a forebay would significantly improve the water quality performance of dry basins.

Ohio EPA and ODNR-DSWR recognize there may be sites where, because of concerns about standing water (e.g. for safety reasons), the designer needs alternatives to a dry basin having wet pool forebays and micropools.

Figure 1. "Dry" extended detention pond with a forebay and a micropool (near the dam and the outlet).

First, the designer should consider whether the WQv requirement can be met through the use of other structural BMPs such as bioretention, enhanced swales, and/ or pervious pavement. Bioretention and enhanced swales pond water only briefly and shallowly, and would not create the same perceived threat as wet forebays and micropools. Pervious pavement does not pond water. If these BMP alternatives can be used to meet the WQv requirement, a dry basin without permanent pools can still be used to meet local peak discharge requirements.

A site can usually be divided into smaller drainage areas for WQv requirements. Bioretention works extremely well for small drainage areas, and often parking lot islands or landscape requirements may offer the needed locations/ area. If these BMP alternatives are deemed unsuitable for the site, the alternative dry basin design used to meet the WQv requirement must show performance and maintainability equivalent to a dry basin with forebay and micropool. The key considerations to address would be:

- pretreatment of runoff such that 50% of the annual TSS load is removed before discharge enters the dry basin;
- the outlet design allows for long-term function of the extended detention volume with minimal maintenance and oversight.

Pretreatment Options

> **Both filter strips and grass channels provide "biofiltering" of stormwater runoff as it flows across the grass surface. However, by themselves these controls cannot the 80% TSS removal performance goal. Consequently, both filter strips and grass channels should only be used as pretreatment measure or as part of a treatment train approach.**
>
> **(*Georgia Stormwater Management Manual*, Page 3.1-3)**

Water quality pre-treatment is provided through practices that slow, spread, filter and/or infiltrate water along its flow path. The needed level of pretreatment can be attained by using a "treatment train" approach, i.e., combining practices such as impervious area disconnection, grass filter strips, and grass swales. Another strategy is to focus these practices on treating runoff from pollutant hot spots such as parking areas driveways and roads. Our observations suggest these opportunities exist on almost every site, in-spite of the engineer's or developer's initial concerns about space limitations.

Preliminary parking lot runoff modeling results using WinSLAMM show that disconnecting the parking lot from the storm sewer system (i.e., placing all storm drain inlets in vegetated/ grassed collection areas with a minimum 15 ft travel distance from the parking lot) reduce both the annual runoff volume and load of total particulate solids by about 25%[1].

Grass swales can be designed to remove upwards of 50% of total solids. To provide the desired water qua[illegible] depths and residence times for the water quality event, and maintaining flow velocities that prevent erosion and resuspension.

Figure 2. Disconnecting parking and storm sewers in order to reduce pollutant loads.

Figure 3. Disconnecting parking and storm sewers in order to reduce pollutant loads.

Guidance for these practices is available in the Rainwater and Land Development Manual. In addition, the Iowa Stormwater Manual provides more detailed calculations for sizing/ designing filter strips (Section 21-4) and grass swales (Section 21-2) to meet water quality targets. The Georgia Stormwater Manual and Lake County, Ohio, Swale Guidance are other useful design references.

One alternative is to incorporate the pretreatment options noted above into the design of the basin itself. The resulting basin will look more like a low, wide swale than the traditional deep-sided detention basin, and can often times be incorporated into the lawn and landscaping of the site (see photo).

1 WinSLAMM, Dayton 1991 rainfall, 1 Ac parking lot, clay soil

For in-basin pre-treatment, the minimum requirements allow waiving of the requirements:

- flow length that would minimum residence time of 5 minutes above the top of the WQv (see the figure below)
- max flow depth of 4” (0.33 ft)
- use manning’s n=0.15
- for HSG C&D soils, an under drain should be used to help maintain appearance and function
- designs should ensure stability (i.e., maintain flows less than max velocity) for soil, grass mix and method of establishment
- storm drain outfalls should be properly designed for stability and energy dissipation.

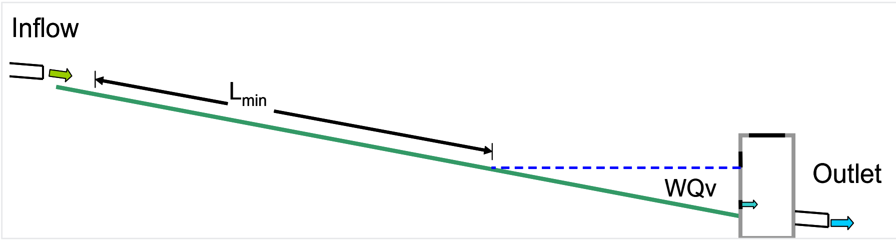

Figure 4. Alternative vegetative pre-treatment requires a flow length that allows a minimum of 5 minutes residence time above the water quality volume.

Outlet Protection

Incorporating a permanent micropool into a dry basin design allows the use of a reverse slope outlet pipe in addition to enhanced water quality treatment,. The advantage of the reverse slope pipe is that it moves the pipe entrance below the water surface protecting it from floatable debris (bottles, bags, styrofoam, leaves, etc.) that commonly blocks small (less than 4”) outlet openings at the water surface (see photos).

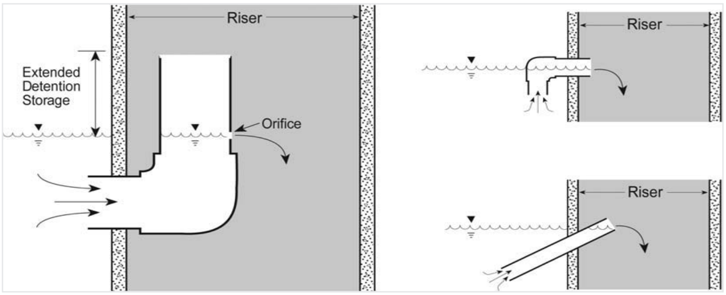

Figure 5. Reverse Slope Outlets

Figure 6. Unprotected Dry Basin Outlets

When eliminating the micropool from a WQv dry basin design, an alternative protected outlet design must be used. The protection comes from removing the controlling orifice inside the catch basin, and using a perforated lateral (or riser) and gravel filter to block any floatable materials (see the figure and photo).

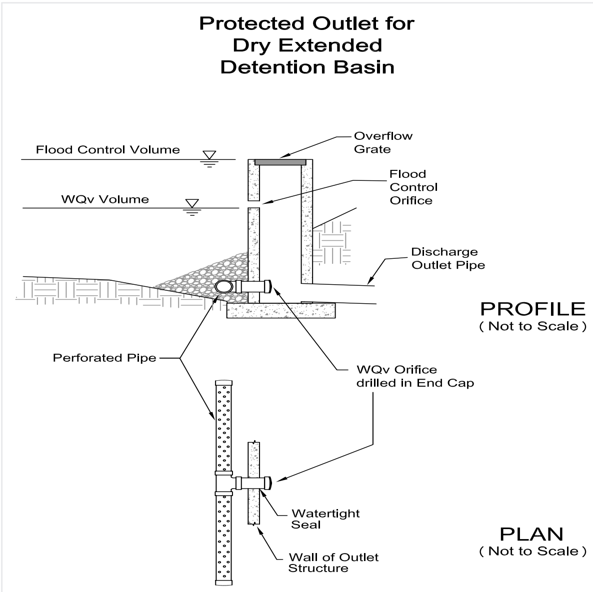

Figure 7. Protected Basin Outlets

Conclusion/Recommendation

There may be situations where a dry basin with: permanent pool forebay and micropool is not an option. In these situations, the designer should first consider alternative BMPs (bioretention, enhanced swales and/ or pervious pavement) for meetjng the WQv requirement.

Pre-treatment and outlet protection options are available that will provide equivalent performance to forebays and micropools. The designer must follow guidance to ensure that performance and maintenance goals are met.

Reference

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CTRE. 2008. Iowa Stormwater Management Manual. Center for Transportation Research and Education, Iowa State University, Ames.

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