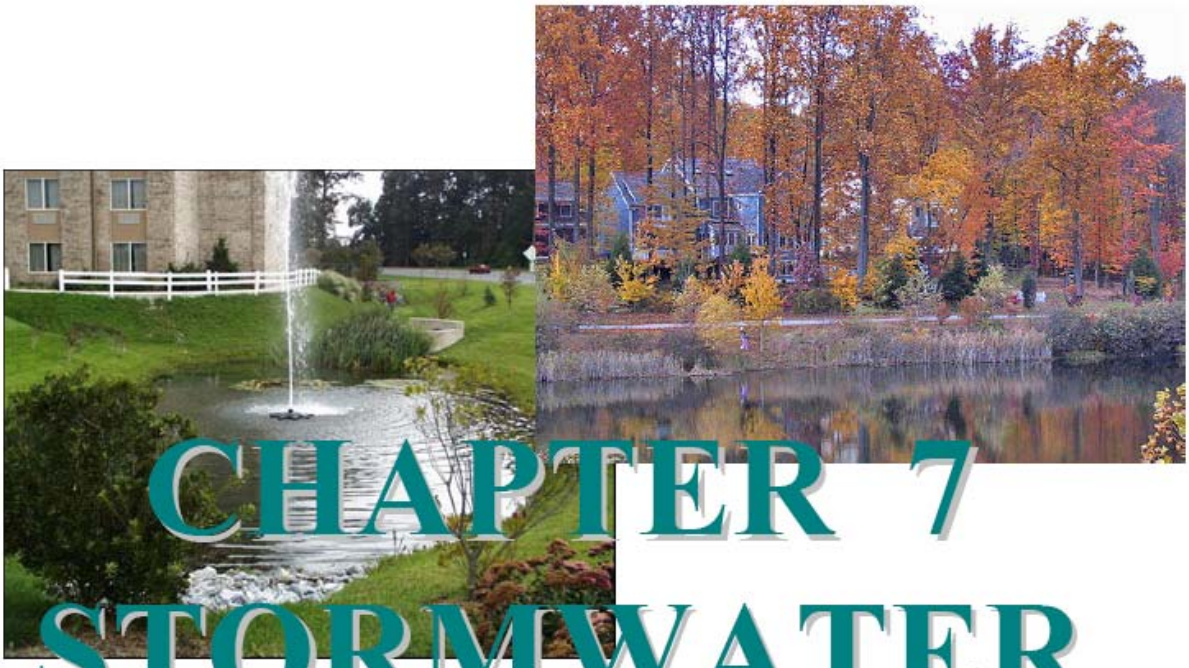


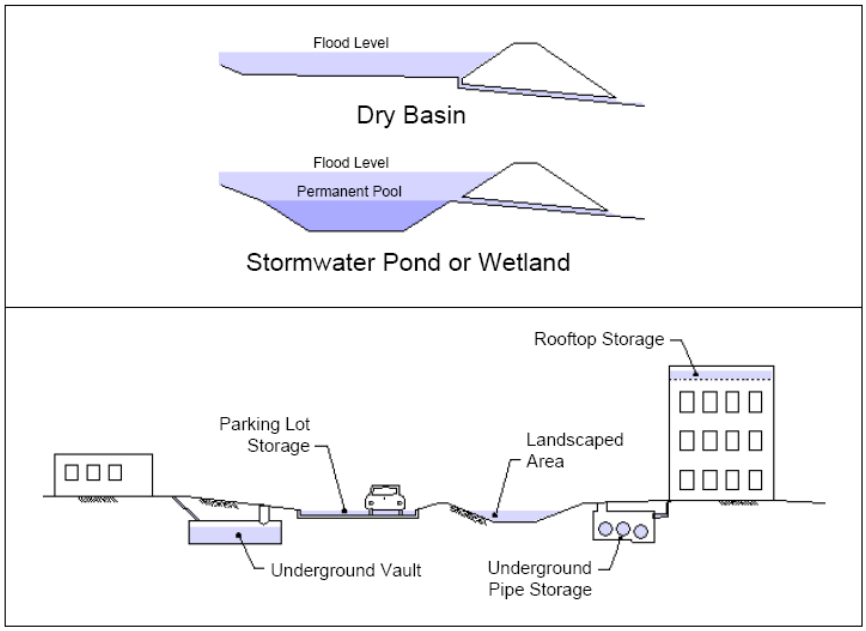
CHAPTER 7
STORMWATER STRUCTURAL CONTROLS

7.01 Types of Stormwater Structural Controls

When land is altered to build homes and other developments, the natural system of trees and plants over relatively spongy soil is replaced with harder surfaces like sidewalks, streets, decks, roofs, driveways, and even lawns over compacted soils. As a result, less water is soaked up and more stormwater flows off the land at a faster rate. This can lead to streambank erosion within the local streams and possible downstream flooding.

In addition, there are increased concentrations of pollutants in storm water/drain water (called non-point source pollution). These pollutants include sediment, phosphorus and nitrogen from fertilizers, salts, and oil/grease from roads and parking surfaces, and bacteria from pet waste. These pollutants, which are a direct result of a variety of common outdoor human and animal activities in the neighborhood, degrade water quality and limit the habitat for wildlife in the stream. An effective stormwater management program must include stormwater structural controls to prevent this increase in pollutant concentration as. These controls will also limit streambank erosion and flooding.

There are many types of stormwater structural controls. Structural controls are physical or chemical processes by which stormwater is managed and sediment removed; these controls include infiltration-filtration (physical separation), biofiltration-bioretention (biological mechanisms), or detention-retention (physical settling). The types that are commonly used in Collierville are stormwater retention ponds, dry detention basins, and underground detention. These are shown in the graphic below. The remainder of this section will give a brief overview of the many structural controls that are available.



Stormwater retention ponds are constructed stormwater retention basins that have a permanent pool (or micropool) of water. Runoff from each rain event is detained and treated in the pool. This type of stormwater control is very common in Collierville and will be discussed in detail later.

Stormwater wetlands are constructed wetland systems used for stormwater management. Stormwater wetlands consist of a combination of shallow marsh areas, open water and semi-wet areas above the permanent water surface. Collierville does not currently have many of these systems, but they could be considered for increased usage in the near future.

Bioretention areas are shallow stormwater basins or landscaped areas which utilize engineered soils and vegetation to capture and treat stormwater runoff. Runoff may be returned to the conveyance system, or allowed to partially exfiltrate into the soil. These are also used infrequently in Collierville but could provide another option in the future.

Sand filters are multi-chamber structures designed to treat stormwater runoff through filtration, using a sand bed as its primary filter media. Filtered runoff may be returned to the conveyance system, or allowed to partially exfiltrate into the soil.

An **infiltration trench** is an excavated trench filled with stone aggregate used to capture and allow infiltration of stormwater runoff into the surrounding soils from the bottom and sides of the trench.

Enhanced swales are vegetated open channels that are explicitly designed and constructed to capture and treat stormwater runoff within dry or wet cells formed by check dams or other means.

Both **filter strips** and **grass channels** provide "biofiltering" of stormwater runoff as it flows across the grass surface. However, by themselves these controls cannot meet treatment requirements. Consequently, both filter strips and grass channels should only be used as pretreatment measure or in conjunction with other treatment approaches.

Organic filters are surface sand filters where organic materials such as a leaf compost or peat/sand mixture as the filter media. These media may be able to provide enhanced removal of some contaminants, such as heavy metals. Given their potentially high maintenance requirements, they should only be used in environments that warrant their use.

Underground sand filters are sand filter systems located in an underground vault. These systems should only be considered for extremely high density or space-limited sites.

Pervious pavement or **porous concrete** are the terms for a mixture of coarse aggregate, portland cement and water that allows for rapid infiltration of water and overlays a stone aggregate reservoir. This reservoir provides temporary

storage as runoff infiltrates into underlying permeable soils and/or out through an underdrain system. The Town might consider encouraging use of this system on future projects.

Alum treatment provides for the removal of suspended solids from stormwater runoff entering a wet pond by injecting liquid alum into storm sewer lines on a flow-weighted basis during rain events. Alum treatment should only be considered for large-scale projects where high water quality is desired.

Dry detention basins and **dry extended detention basins** are surface facilities intended to provide for the temporary storage of stormwater runoff to reduce downstream water quantity impacts.

Underground detention tanks and **vaults** are an alternative to surface dry detention for space-limited areas where there is not adequate land for a dry detention basin or multi-purpose detention area.

Of these many different structural controls available for stormwater management, the following sections (7.02, 7.03, 7.04) discuss the most common types of stormwater structural controls used in Collierville.

7.02 Stormwater Retention Ponds

Stormwater retention ponds (also referred to as **wet ponds** or **wet extended detention ponds**) are constructed stormwater retention basins that have a permanent (dead storage) pool of water throughout the year. They can be created by excavating an already existing natural depression or through the construction of embankments.

In a stormwater pond, runoff from each rain event is detained and treated in the pool through gravitational settling and biological uptake until it is displaced by runoff from the next storm.The permanent pool also serves to protect deposited sediments from resuspension. Above the permanent pool level, additional temporary storage (live storage) is provided for runoff quantity control. The upper stages of a stormwater pond are designed to provide extended detention of the 1-year storm for downstream channel protection, as well as normal detention of larger storm events (25-year and, optionally, the 100-year storm event). Stormwater ponds are among the most cost-effective and widely used stormwater practices. A well-designed and landscaped pond can be an aesthetic feature on a development site when planned and located properly.

There are several different variants of stormwater pond design, the most common of which include the **wet pond**, the **wet extended detention pond**, and the **micropool extended detention pond**. In addition, multiple stormwater ponds can be placed in series or parallel to increase performance or meet site design constraints. Below are descriptions of each design variant:

- **Wet Pond** – Wet ponds are stormwater basins constructed with a permanent (dead storage) pool of water equal to the water quality volume. Stormwater runoff displaces the water already present in the pool. Temporary storage (live storage) can be provided above the permanent pool elevation for larger flows.

- **Micropool Extended Detention Pond** – The micropool extended detention pond is a variation of the wet extended detention pond where only a small "micropool" is maintained at the outlet to the pond. The outlet structure is sized to detain the water quality volume for 24 hours. The micropool prevents resuspension of previously settled sediments and also prevents clogging of the low flow orifice.

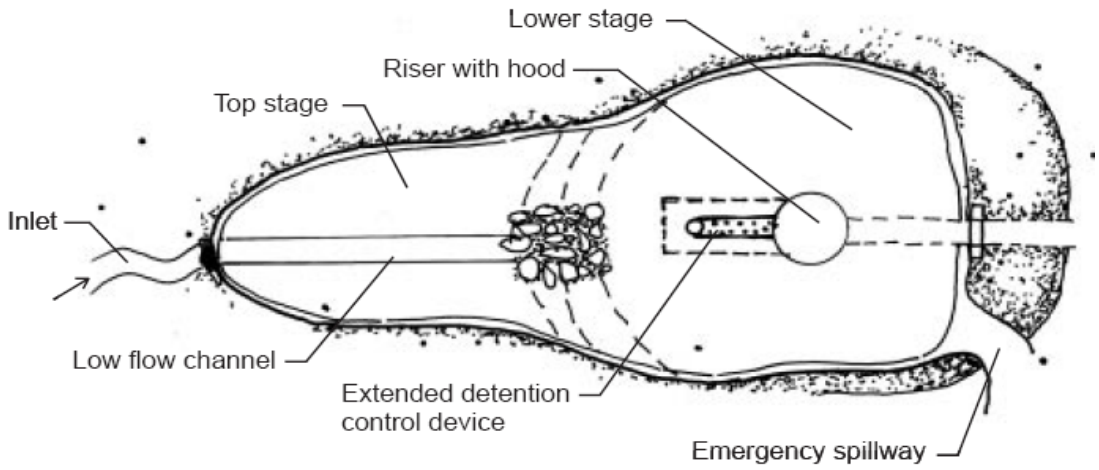
Multiple Pond Systems – Multiple pond systems consist of constructed facilities that provide water quality and quantity volume storage in two or more cells. The additional cells can create longer pollutant removal pathways and improved downstream protection.

7.03 Dry Detention

Dry detention and **dry extended detention basins** are surface facilities intended to provide for the temporary storage of stormwater runoff to reduce downstream water quantity impacts. These facilities temporarily detain stormwater runoff, releasing the flow over a period of time. They are designed to completely drain following a storm event and are normally dry between rain events. Dry detention basins are intended to provide overbank flood protection which is peak flow reduction of the 25-year storm as well as an intermediate storm runoff control. They can also be designed to control the extreme, or 100-year, flood. Design of

dry detention basins includes locating proper sites for construction of the basin, calculating the appropriate detention time, treatment of the expected range in volumes of stormwater from storms, and maintenance procedures and schedules. The stormwater should be held for at least 24 hours for maximum pollutant removal. Soils should be permeable to allow residual water to drain from these basins between storms. Detention-only facilities must be used in a system of with other structural controls that provide treatment.

The **dry extended detention pond** is a shallow intermittent impoundment which utilizes devices normally attached to low flow orifices or risers for purposes of lengthening the period that stormwater runoff is detained. The dry extended detention pond provides a controlled release of stormwater by limiting the volume and rate at which it leaves the pond. This type of detention can also provide control of the 25 and 100-year storm.



Dry Extended Detention Pond
Plan View

These ponds are an effective, low cost means of controlling increases in downstream bank erosion by reducing the frequency of erosive floods. They also effectively remove particulate pollutants. Stormwater detained for 24 hours or more can remove as much as 90% of particulate pollutants. Construction costs seldom are greater than 10% higher than those for conventional dry ponds. Their other advantages include creation of wildlife and wetland habitat, and some protection of aquatic habitat downstream. This type of treatment is applicable to most new development, as well as existing wet and dry ponds that could be retrofitted for extending detention times. Both **dry detention** and **dry extended detention** basins provide limited pollutant removal benefits and are not intended for water quality treatment. Detention-only facilities must be used conjunction with other structural controls to provide treatment of stormwater. The future of upcoming pollutant removal requirements by TDEC is discussed in detail in section 7.06.

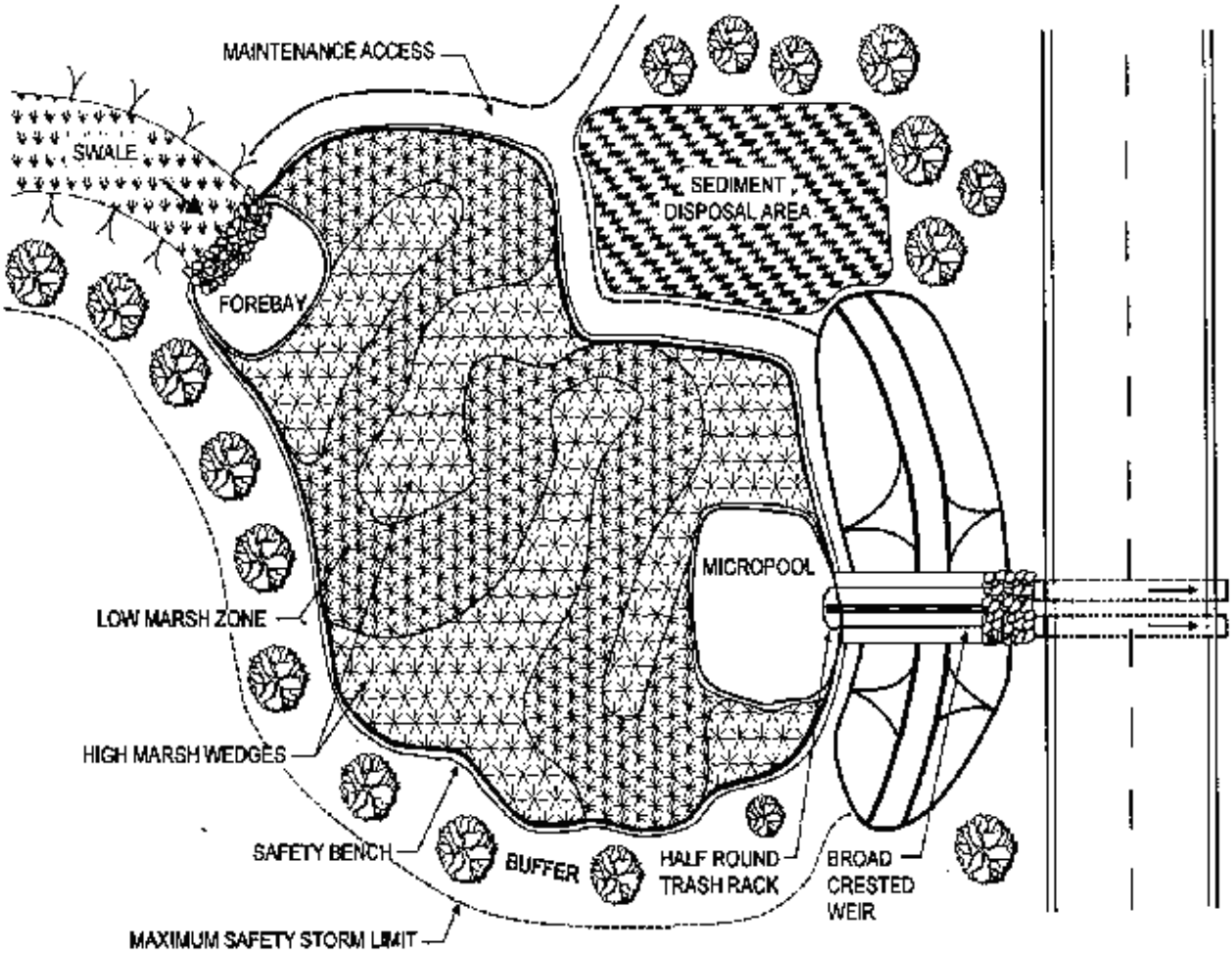
7.04 Underground Detention

Underground detention facilities, such as vaults, pipes and tanks, are designed to provide temporary storage of storm water runoff. Significant water quality improvements should not be expected in underground detention facilities. They should mainly be used for providing storage to limit downstream effects due to high peak flow rates. The Town of Collierville requires that the owner of the property where the facility is located submit a biannual certification from a licensed civil engineer of the underground detention system's functionality and capacity. This also requires that the facility be large enough for an inspector to access and enter the detention area.

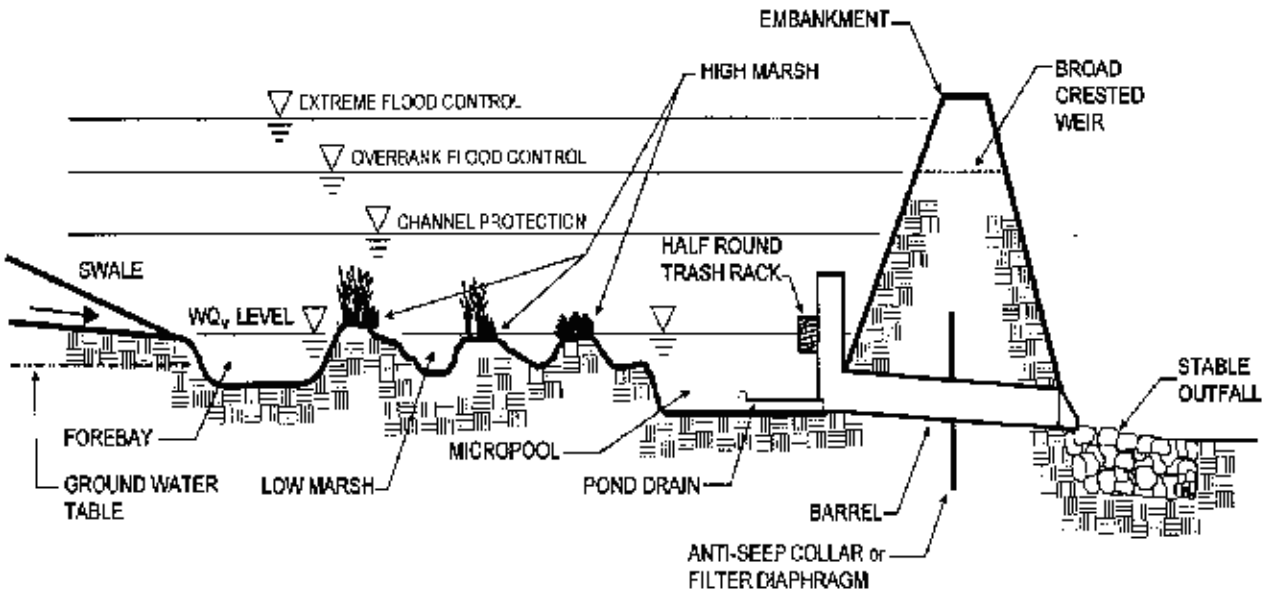
Like detention basins, underground detention systems are designed to empty out between runoff events so that storage capacity is available for subsequent runoff events. The next step in these systems is to determine the usefulness of in-system detention (storing runoff temporarily in the storm drainage system through the use of valves, gates, orifices, etc.), This idea is in the preliminary stages and is only useful in certain cases. This is a potential alternative for retrofitting existing storm drains in the upper portions of the drainage system to delay the peak discharge rate and provide a limited amount of additional temporary storage volume. However, a careful analysis of the storm drainage system is necessary in order to prevent flooding in the upper reaches of the drainage area.

7.05 Future of Stormwater Detention/Retention in Collierville

Currently a shift in TDEC's stormwater management requirements are being made towards water purification in addition to sediment control when putting in stormwater controls. Currently, a development will include a plan for a basic stormwater pond and that has generally been acceptable. Anticipating the future standards has put the Town of Collierville on the cutting edge of these improvements. The following plan and profile view of a retention pond is what we are looking to move to. This type of pond will not only decrease the sediment load in a given stormwater runoff area but will expose the water to multiple biological and mechanical filtering stages. Collierville will continue to be a leader in stormwater management and will endeavor to be ahead of future TDEC requirements with these innovative solutions to stormwater control. This will benefit the Town, the citizens, and the environment as a whole.


MAINTENANCE ACCESS
SWALE
SEDIMENT DISPOSAL AREA
FOREBAY
MICROPOOL
LOW MARSH ZONE
HIGH MARSH WEDGES
SAFETY BENCH
BUFFER
HALF ROUND TRASH RACK
BROAD CRESTED WEIR
MAXIMUM SAFETY STORM LIMIT

PLAN VIEW


EMBANKMENT
HIGH MARSH
BROAD CRESTED WEIR
EXTREME FLOOD CONTROL
OVERBANK FLOOD CONTROL
CHANNEL PROTECTION
HALF ROUND TRASH RACK
SWALE
WQ$_v$ LEVEL
STABLE OUTFALL
FOREBAY
MICROPOOL
GROUND WATER TABLE
LOW MARSH
POND DRAIN
BARREL
ANTI-SEEP COLLAR or FILTER DIAPHRAGM

PROFILE