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Facts About Stormwater Management Programs in the State of Florida

The Stormwater Problem

Stormwater is that surface and ground water resulting from precipitation. In developed areas, surface water runoff is the major component of sewer and stream flows. The percentage of impervious areas that are directly connected to a sewer or other water conveyance system determine the major portion of the volume and rate of discharge.

As an area becomes more urbanized, the peak rate of discharge, volume of discharge, and pollutant mass discharge increases. These effects are caused in part by modifications to surface drainage patterns, increased impervious areas (less infiltration and depression storage), and increased human and vehicle traffic. Human activities add pesticides, fertilizers, animal wastes, oil, grease, solids, heavy metals, and other potential pollutants to the stormwaters.

The increased urbanization and many existing drainage practices in rural lands have caused flooding, erosion, and water quality degradation. In Florida, stormwater is the largest source of pollutants to lakes, rivers, and estuaries. In many lakes, it is the only major source of pollutants. On a statewide basis, stormwater as compared to regulated discharges (sewage and industrial treatment facilities) is the source of: (1) 80 to 95 percent of heavy metals; (2) 99 percent of all sediment; (3) 90 percent of oxygen demanding substances; and (4) 50 percent of the nutrients. Thus, severe environmental and economic impacts result when stormwaters are not managed.

Stormwater Management Defined

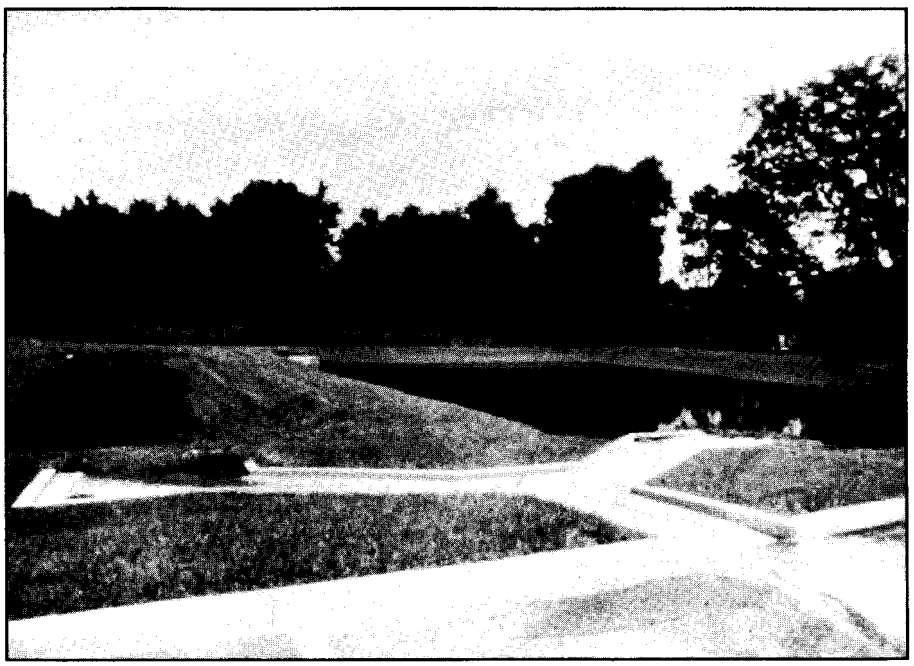
Stormwater management is a comprehensive, interdisciplinary body of knowledge required to design and operate stormwater programs to prevent flooding, reduce land loss due to erosion, maintain water quality, increase water availability, and provide funding sources. A stormwater program must have goals and objectives that are implemented using a stormwater rule that specifies levels of performance. The minimum levels of performance in Florida are based on pre- versus post-peak discharge and 80 percent removal of pollutants. Stormwater management practices have been developed to meet these performance standards.

Stormwater Management Practices

For a stormwater management practice to be successful, it must satisfy water quality and quantity considerations and have the necessary funding to be constructed and operated. There are at least five stormwater management practices that are now used in the State of Florida, namely (1) off-line retention by infiltration ponds and exfiltration trenches; (2) wet-detention ponds; (3) swales that both infiltrate and transport; (4) porous parking areas; and (5) alum injection.

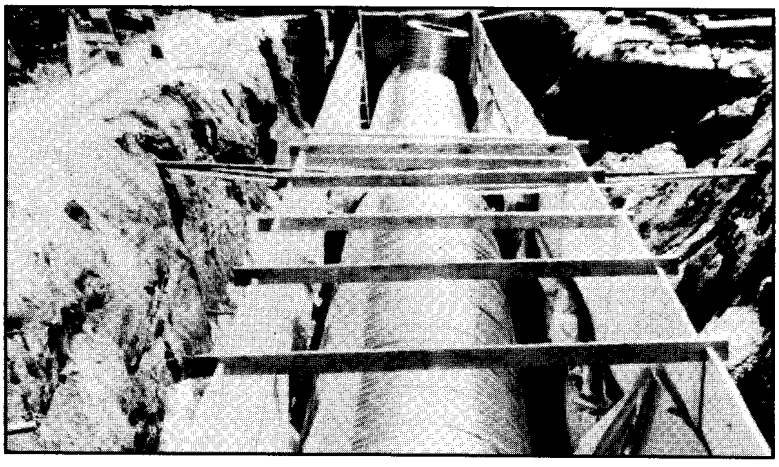
Retention Using Infiltration Ponds

An infiltration pond is one that retains stormwater on-site in a surface pond. The soils beneath the pond must be capable of percolating the infiltrated water, and as such, the water table is usually below the bottom of the pond. The pond is designed to store a specific runoff volume. This volume is determined from an analysis of storm events with their rainfall volume (Wanielista, 1990). In the State of Florida, these rainfall analyses have defined the design criteria for pond volume as the runoff from the first inch of rainfall with a minimum of 1/2 inch over the watershed. The objective for sizing is to remove 80 percent of the runoff mass. The practice incorporates both pollution control and ground water recharge; however, the impact of soluble pollutants on ground water must be carefully considered. The practice is used throughout the State where soils permit infiltration rates of at least 3-5 inches an hour. The infiltration pond is sized for the runoff from the first inch of rainfall; thus, additional runoff is diverted to direct surface water discharge or into a detention pond for peak discharge control.



Retention Using Exfiltration Trenches

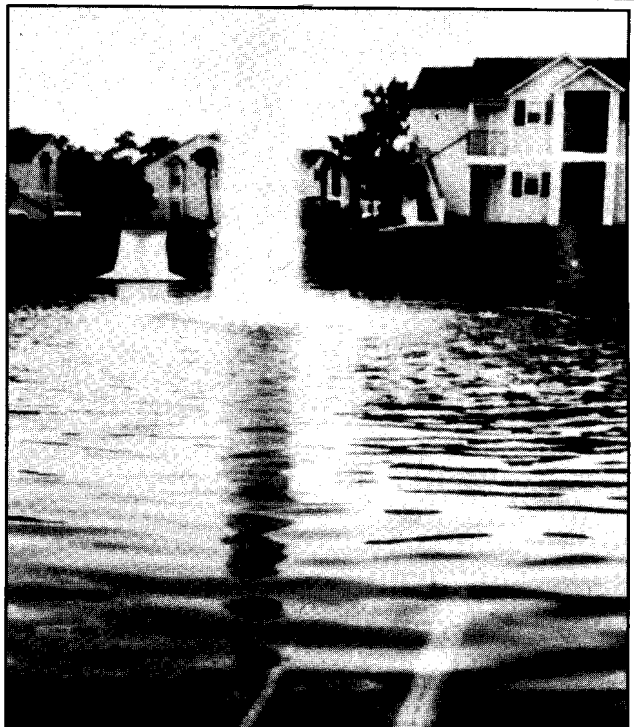
While infiltration ponds are constructed on the surface, exfiltration trenches are subsurface holding areas. They are also referred to as exfiltration pipes or pits. Highly permeable rock (i.e., limestone) or soils (sandy) must be present. The most common construction practice is an excavation trench backfilled with coarse graded rock. Runoff is diverted to the exfiltration system. The system often includes perforated pipe surrounded by aggregate and a filter cloth. The pipe will increase the storage volume, since the rock aggregate has a porosity of about one-half or less that of the pipe. The design volume is calculated as the runoff from the first inch of rainfall, and a diversion structure or inlet control can be used to regulate runoff volumes greater than the design volume.



Exfiltration trenches with pipes, fabric wrap and rock are being used in central Florida. From these operating systems, it was concluded that the treatment volume should not be placed in the water table. In southern Florida, the pipe is frequently not used; however, the systems must be maintained to remove debris. Maintenance will vary directly with the amount of debris.

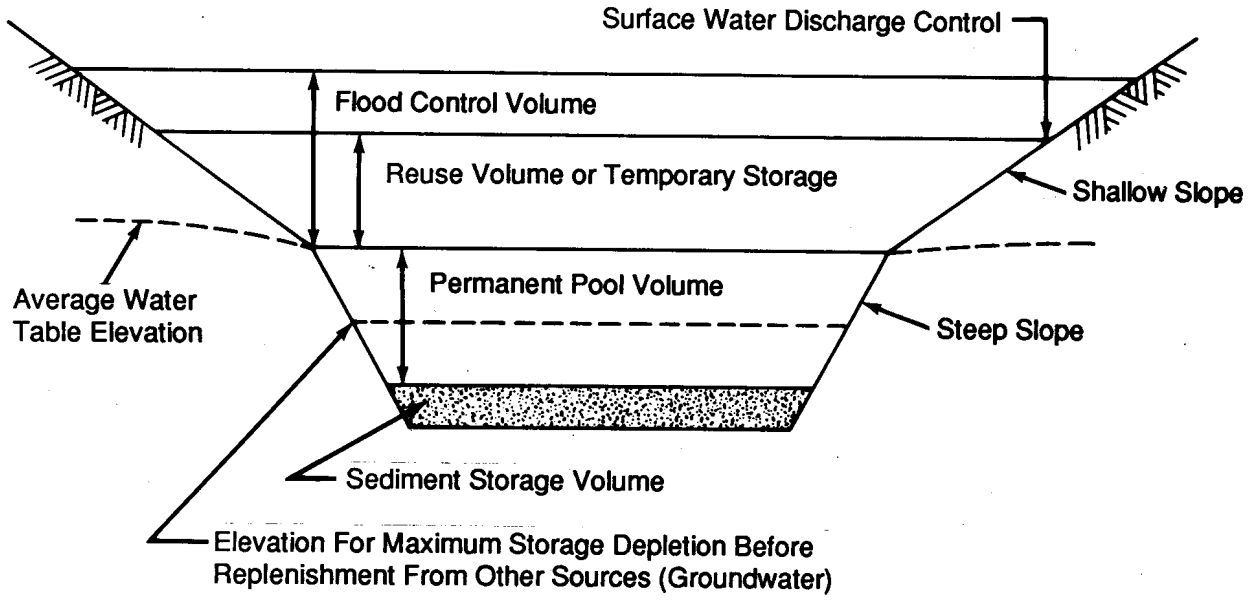
Wet Detention Ponds

Wet detention ponds are excavated areas with a pool of water that exists throughout the year (permanent pool), a debris storage volume, and a temporary storage area. The ponds are used to attenuate (reduce) hydrograph peaks, pollutant loadings and concentrations of pollutants, and to provide water for re-use purposes. Downstream water quality is improved because of sediment removal, plant uptake of nutrients, chemical transformation, and runoff water re-use. Temporary storage volume designs vary depending on the use of storage volume; however, the minimum size is calculated as one inch over the entire watershed. The total pond volume if used for peak attenuation is frequently greater than the temporary storage volume. A maximum depth for the permanent pool has been specified as six feet to minimize recycling of pollutants stored in the bottom muds. A vegetated area that leaves no more than 70 percent of the



permanent pool in open water is recommended. Short-circuiting of flow should be minimized.

These detention systems are found throughout the State in areas where the water table is of sufficient height to maintain the permanent pool. Recycling for irrigation purposes is being used more frequently to minimize the volume of discharge and pollutant loadings. In all cases, the invert elevation for the discharge structure should be above the seasonal high water elevation.

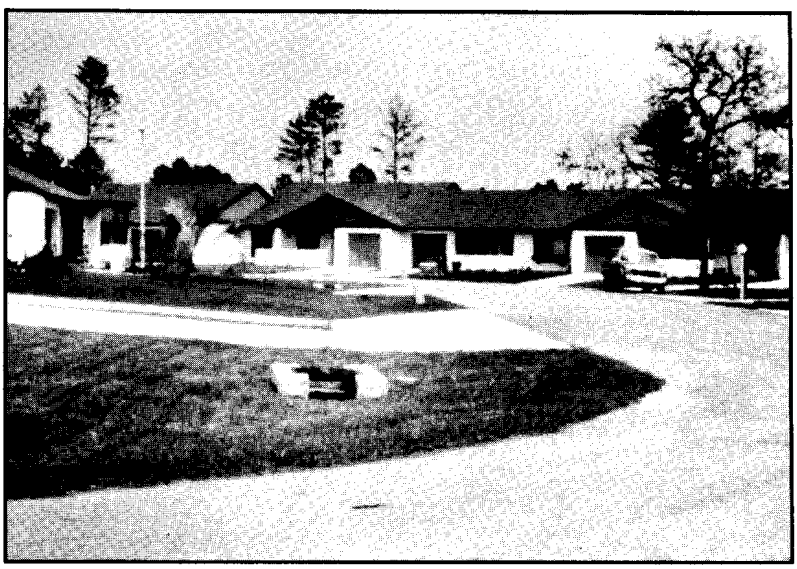


Swales

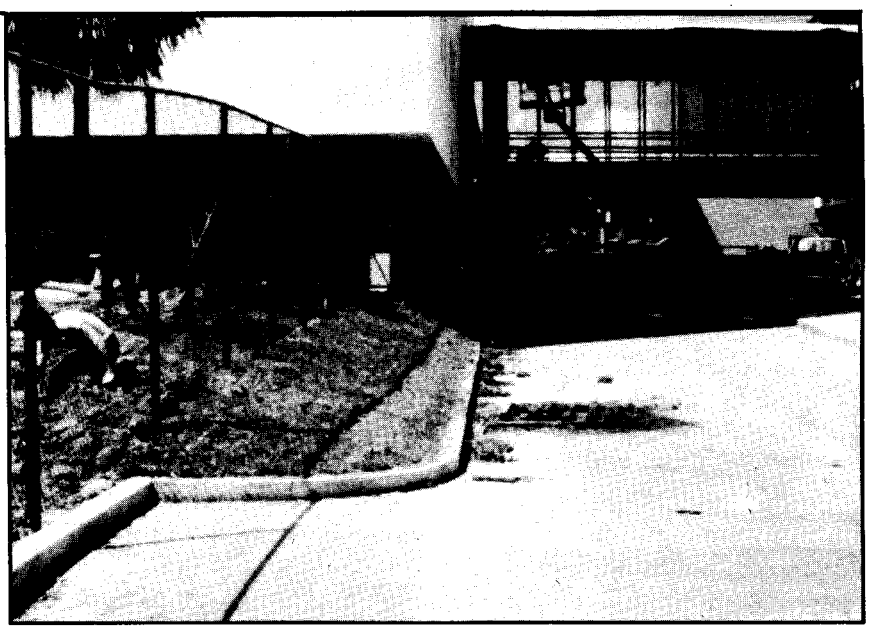
Swales are vegetated ditches that both infiltrate and transport runoff water. The top width to depth ratio must be equal to or exceed 6 to 1. Generally, the longitudinal slope is shallow to prevent erosion of the ditch. The design infiltration volume is based on a State rule that requires 80 percent of runoff from the three-year, one-hour design storm to be infiltrated over the length of the ditch (Livingston et al., 1988). Design equations are available and were developed by the Florida Department of Transportation (Wanielista, 1988).

Since long swale lengths are necessary to infiltrate runoff waters, swale blocks (berms) have been used to hold the runoff water until infiltration has occurred. The infiltration rate is critical, and care in selecting the rate is important.

Swales are used primarily along major highways within the right-of-way areas. However, some residential areas provide raised inlets to act as swale blocks and have been widely used in low ground water table areas.



Porous Parking Area



Applications included both total and partial coverage using pervious concrete surfaces. They are used to reduce peak runoff and infiltrate rainwater. Pervious concrete has a special formulated mixture of uniform open graded aggregate. Air entraining agents may be used. Proper installation is required. Partial coverage with a concrete grid having regularly interspersed void areas that are filled with sand, gravel, or sod is used in a few areas. Applications are found statewide and have been limited to parking and walkway areas.

Alum Injection

Buffered alum, which is a combination of aluminum sulfate and calcium compounds, is very effective for the reduction of phosphorus and some metals. The injection is being used in Tallahassee and Orlando.

References

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