Extended Detention Basin

Description

Extended detention basins are designed to receive and detain stormwater runoff for a prolonged period of time, typically up to 48 hours. Extended detention is achieved by use of an outlet device regulating the flow from the basin at a rate which minimizes downstream erosion, reduces flooding, and provides for enhanced pollutant removal.

Extended detention basins may be designed as either single-stage or two-stage. Single-stage basins are normally used strictly for flood control and are not usually recommended where water quality benefits are needed. A two-stage basin contains water from small, frequent storms and the first flush of large storms in a lower second stage, with a normally dry upper stage for detention of larger storms for flood control. Managing a second stage as a shallow marsh increases the effectiveness of the basin to remove pollutants. All designs should be developed with multiple uses in mind.

Other Terms Used to Describe

Single-Stage Detention Basin
Two-Stage Detention Basin
Dual Purpose Basins

Pollutants Controlled and Impacts

A single-stage detention basin can be effective at removing sediment, nonsoluble metals, organic matter and nutrients through settling. Up to 90% of particulates may be removed if the stormwater is held for 24 hours or more.

A two-stage detention basin is also effective at settling out nonsoluble pollutants and sediment. Additional pollutant removal is gained when the second stage is managed as a shallow marsh. The marsh area helps prevent resuspension of sediment and provides some removal of soluble pollutants through plant uptake and bacterial activity. Still greater pollutant removal would be expected from a single-stage basin, followed by a Wet Detention Basin.

Extended detention basins also reduce peak discharges of storm runoff, thereby reducing flooding and stream bank erosion. They may actually help increase low flows, and reduce the peak discharge rate from urbanized areas.

Since extended detention basins can significantly warm the water in the marsh area over a short period of time, if the receiving stream is sensitive to increases in temperature, such as a trout stream, this BMP may not be appropriate.

Application

Land Use
Urbanized, urbanizing and agricultural areas

Soil/Topography/Climate
Soils with low infiltration rates may cause standing water problems. Extremely permeable soils may prohibit the establishment of a marsh area.

When to Apply
Extended detention basins may be applied to new or existing developments, and are usually considered permanent, year-round control measures. If used as a sediment basin during construction, the accumulated sediment must be removed at the end of the project and the banks stabilized.

Where to Apply
Basins should be sited as a result of a hydrologic analysis of the watershed. Too small a drainage area (less than 10 acres) may not provide sufficient volume to support wetlands, or may require a release orifice smaller than is practical.

A single-stage basin uses approximately 5% of a site, as opposed to 10% for a two-stage basin. This may be important where land prices are high or where little land is available.

Relationship With Other BMPs

Riprap is used to protect side slopes and inlet and outlet areas. Grassed Waterways are used to direct water from the inlet or to the outlet. Sediment Basins can be used upstream of the extended detention basin to remove large sediment particles. This technique will increase the pollutant removal efficiency and reduce the maintenance of the extended detention basin.

Specifications

Planning Considerations:
The **location** of basins must be determined through a hydrologic analysis of the watershed. If the peak discharge from a particular basin is delayed to coincide with the peak discharge from an upstream tributary or release from an upstream basin, the actual stream discharge peak can increase.

The location of any Sediment Basin should logically correspond with the location of any stormwater basins, including extended detention basins.

Adequate **access** right-of-way must be assured. The access should be a minimum of ten feet wide and stabilized to provide for passage of heavy equipment.

A **spill response plan** must be developed which clearly defines the emergency steps to be taken in the event of an accidental release of large quantities of harmful substances to the basin at any time. As a result of this plan, design changes such as shut-off valves or gates may be needed.

Design Considerations:

NOTE: All structural best management practices should be designed by a registered professional engineer.

The design of extended detention basins can be quite different depending on whether the primary function of the basin is flooding/erosion control or water quality enhancement. Each issue should be evaluated and a design developed which meets both requirements (as closely as possible).

An example of a typical two-stage extended detention basin is shown in Exhibit 1.

Buffer Strip:

A minimum 25-foot buffer from the basin to any adjoining property should be provided. This buffer should be landscaped to improve the appearance for local residents, provide wildlife habitat and meet any other local design considerations.

Volume:

The minimum volume of the basin to address water quality should be equal to 0.5 inches of runoff from the entire contributing watershed. Greater pollutant removal is gained with larger basin volumes. Additional capacity should be considered, especially in two-stage basins, to account for five to ten years of sediment accumulation. Additional volume up to the 100-year storm is recommended for flooding and erosion control.

Holding Time:

For optimum pollutant removal, the basin should be designed to hold the design volume for a minimum of 24 hours. Longer holding times may be necessary in large watersheds to prevent stream bank erosion. Storms smaller than design should be held a minimum of six hours. The hydrologic analysis of the receiving stream should be used to determine the optimum release rate.

Outlets:

The basin outlet will control the release rate from the basin. It must control both the design storm and lesser storms. Multiple outlets may be necessary to control discharge from a range of storms. Example outlets for normally dry basins are shown in Exhibit 2. Example outlets for basins with marsh areas or permanent pools are shown in Exhibit 3. A hydraulic analysis of the outlet structures at the low flow and design storm will be necessary to size the outlets to achieve the desired release rate. All outlets should have an accessible, above-ground cap to allow easy cleaning.

Outlet design can be extremely complex. A detailed design method can be found in the "Stormwater Management Guidebook" by Bruce Menerey and published by the Michigan Department of Natural Resources, Land and Water Management Division.

A stabilized outlet structure must be used to prevent scouring at the discharge point. <u>Stabilized Outlets</u> are normally constructed using <u>Riprap</u>, corrugated pipe or concrete.

Basin Configuration:

The length of the basin should be at least three times the width. Baffles may be used to increase the length of the basin. The basin should be narrow at the inlet and wide at the outlet.

Side Slopes:
Berm side slopes should not be more than 3:1 and not less than 20:1. The basin floor of the dry portion should have a slope of 2% toward the outlet.

Emergency Spillway:
An emergency spillway must be included to handle storms greater than design. The spillway must be designed and installed to protect against erosion problems.

The banks should be constructed such that two feet of freeboard is above the emergency spillway.

Low-flow Channel:
A low flow channel should be provided through the dry portion of the basin. This channel should be lined with riprap to prevent scouring. The remainder of the basin should drain toward this channel. Where recreational uses are desired, the low-flow channel should be placed to one side instead in the middle of the basin.

Anti-seep Collars:
Anti-seep collars should be installed on any piping passing through the sides or bottom of the basin.

Construction Considerations:
At the conclusion of construction, stabilize the surrounding area following the guidance in the Seeding and Mulching, or Sodding BMPs.

Maintenance

Regular maintenance includes mowing the buffer/filter strip and removing debris from the basin. Follow mowing specifications in the Buffer/Filter Strip BMP. If properly designed, sediment removal from an extended detention basin will be necessary every five to ten years.

The basin should be inspected regularly during wet weather. Particular attention should be given to the outlet structure and low-flow channel.

Exhibits

Exhibit 1: Typical 2 Stage Detention Basin. Michigan Department of Natural Resources. Surface Water Quality Division.

Exhibit 2: Examples of Outlets Used in Dry Detention Basins. "Controlling Urban Runoff: a Practical Manual for Planning and Designing Urban BMPs." Metropolitan Washington Council of Governments (Schueler). 1987.

Exhibit 3: Examples of Outlets Used in Wet Detention Basins. "Controlling Urban Runoff: a Practical Manual for Planning and Designing Urban BMPs." Metropolitan Washington Council of Governments (Schueler). 1987.

Exhibit 1
Typical 2 Stage Extended Detention Basin

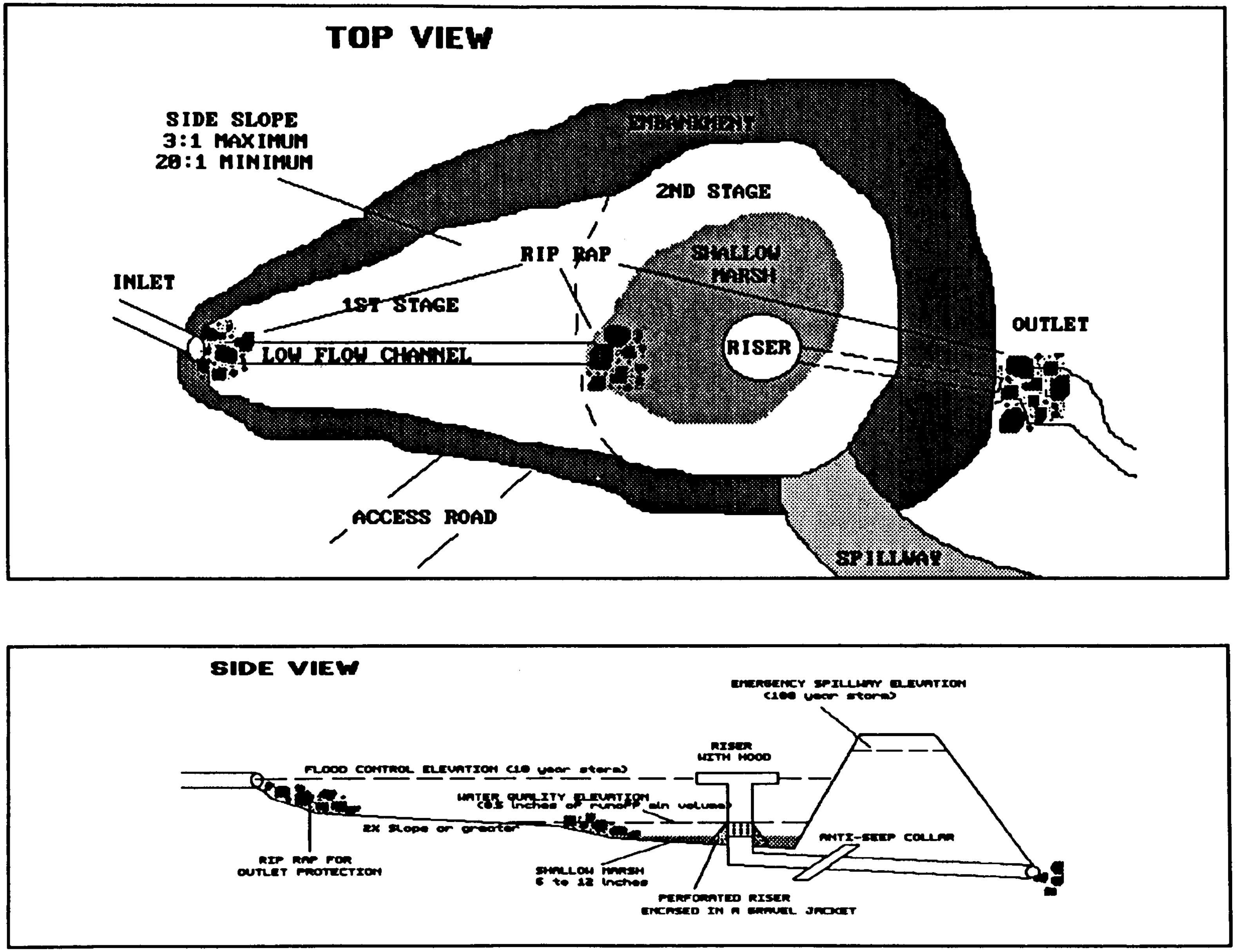
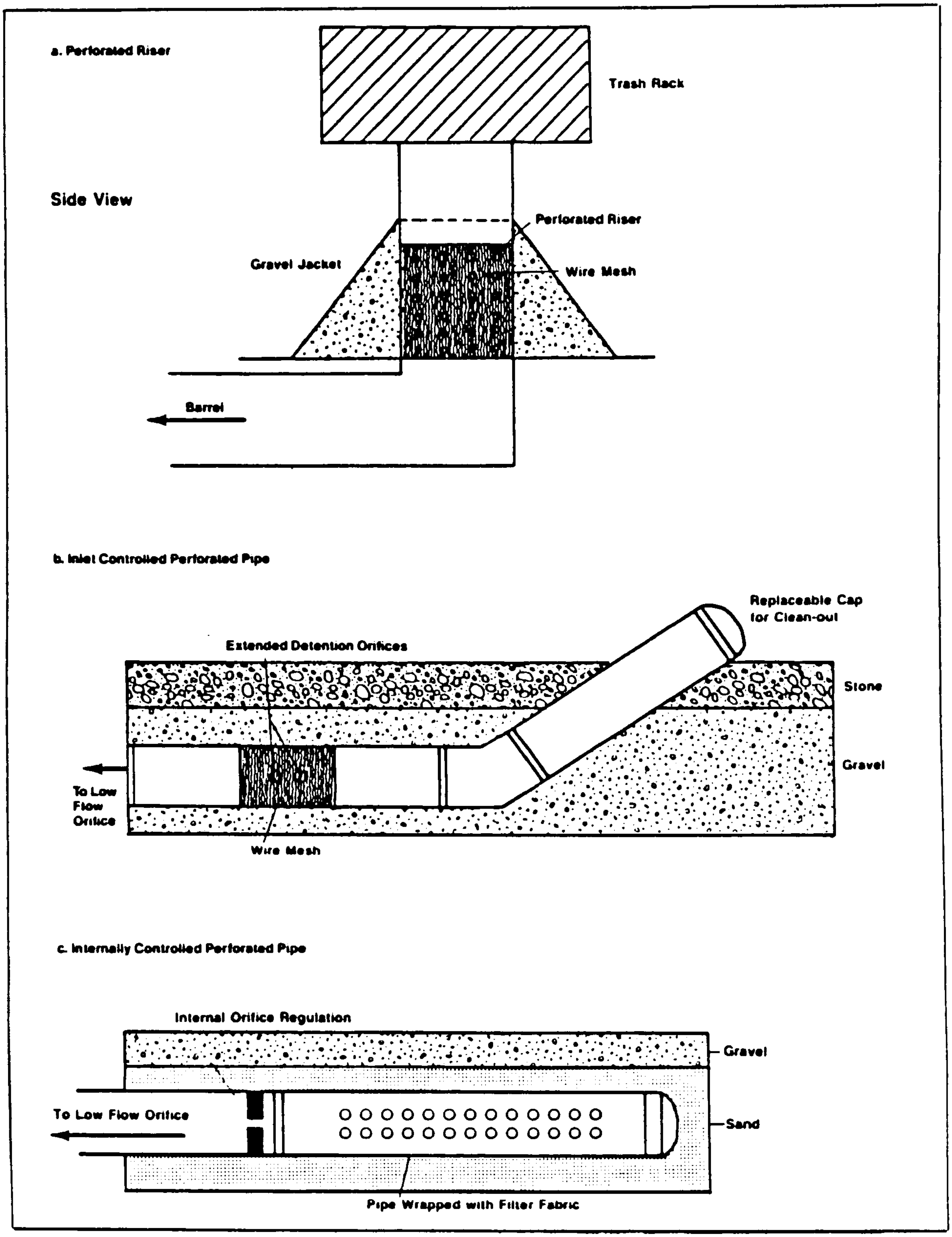
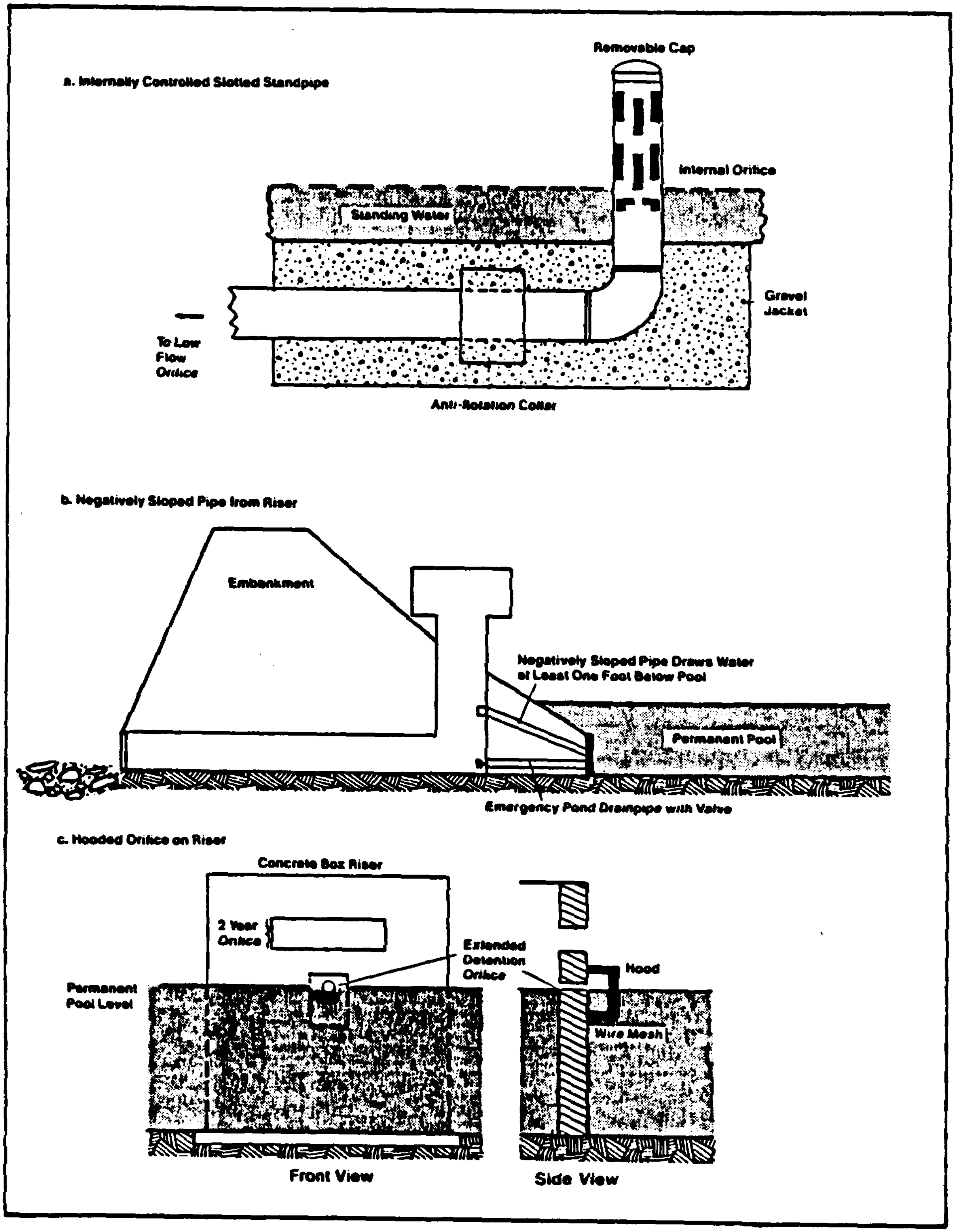


Exhibit 2 – Examples of Outlets Used In Dry Detention Basins



Source: Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Council of Governments (Scheuler). 1987.

Exhibit 3 – Examples of Outlets Used In Wet Detention Basins



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