

## Enhanced Dry Swales

### Description

Enhanced dry swales are conveyance channels engineered to capture, treat, and release the storm water quality runoff volume from a particular drainage area. Enhanced swales are different from normal drainage swales in that they have a designed structure implemented in them to enhance detention and storm water pollutant removal. Enhanced dry swale systems are designed primarily for storm water quality and have only a limited ability to provide storm water runoff volume control and downstream channel protection. Enhanced dry swales are vegetated channels designed to include a filter bed of prepared soil that overlays an underdrain system. Dry swales are sized to allow the entire water quality storage volume to be filtered or infiltrated through the swale bottom. Because these swales are predominantly dry, they are preferred in residential settings.

### When and Where to Use It

Enhanced swales are applicable in moderate to large lot residential developments and industrial areas with low to moderate density where the impervious cover (parking lots and rooftops) of the contributing drainage areas is relatively small. Enhanced swales are also useful along rural roads and highways that have driveway entrances crossing the swale.

### Design Criteria

Design enhanced swales with minimal channel slope, forcing the flow to be slow and shallow. This aspect of the enhanced swale allows particulates to settle out of the runoff and limits the effects of erosion. Place berms, check dams, weirs, and other structures perpendicular to the swale flow path to promote settling and infiltration.

- Enhanced swales are open conveyance channels that have a filter bed of permeable soils overlaying an underdrain system. Runoff is detained in the main swale section where it filters through the filter bed. The runoff is then collected and conveyed to the desired outlet through a perforated pipe and gravel system.
- The maximum designed de-watering time is 48 hours, with the recommended de-watering time being 24-hours.
- Enhanced swales have a contributing drainage area less than five (5) acres.
- Design the swale to capture the required water quality runoff volume, and safely pass larger flows. Flow enters the swale through a pretreatment forebay or along the sides of the swale as sheet flow produced by level spreader trenches along the top of the bank.
- Limit swale slopes between 1 and 2 percent, unless site topography dictates larger slopes. In this instance, place drop structures in the swale to limit the slope of a particular section of the swale. Set the spacing between drop structures a minimum of 50-feet. Add energy dissipation techniques on the downstream side of the drop structures.
- The maximum overall depth of the water quality runoff volume detained in the channel is 1.5-feet.
- The bottom width of the swale ranges between 2- and 8-feet where applicable to ensure an adequate filtration area. Wider channels may be designed to increase the filtration area, but consideration must be given to prevent uncontrolled sub-channel formation.
- The maximum side slopes of the swale are 2H:1V, and 4H:1V is recommended for ease of maintenance and for side inflow to remain as sheet flow.
- Design the peak velocity for the 2-year 24-hour storm event to be non-erosive for the soil and vegetation selected for the swale.

### **Filter Bed**

The filter bed for an enhanced dry swale consists of a permeable soil layer at least 2.5-feet deep. The drainage pipe is a minimum 4-inch diameter perforated PVC pipe (AASHTO M 252) in a 6-inch gravel layer. Select a soil media that has a minimum infiltration rate of 1.0-foot per day, and a maximum infiltration rate of 1.5-feet per day. Place a permeable geotextile filter between the gravel and the overlying permeable soil.

### **Forebay**

Protect flow inlets to an enhanced dry swale forebay to reduce erosive forces of the runoff. The preferable material is a TRM. Riprap may also be used. Provide swale pretreatment with a sediment forebay. The pretreatment volume is equal to 0.1-inches per impervious acre of the drainage area. The forebay is typically provided by designing a check dam at the inlet of the swale.

### **Outlet Structures**

The underdrain system of the enhanced dry swale discharges to the storm drainage system on site, or discharges to a stable protected outlet point.

### **Overflows**

For maximum performance, enhanced dry swales are recommended to be off-line structures. If a swale is designed to be an online structure, it must be able to safely pass the 25-year 24-hour storm event.

### **Landscape Plan**

Design the enhanced dry swale landscape plan to include the type of turf grass species required along with a permanent maintenance guideline. Have the planting plan prepared by a qualified landscape architect, botanist or qualified extension agent.

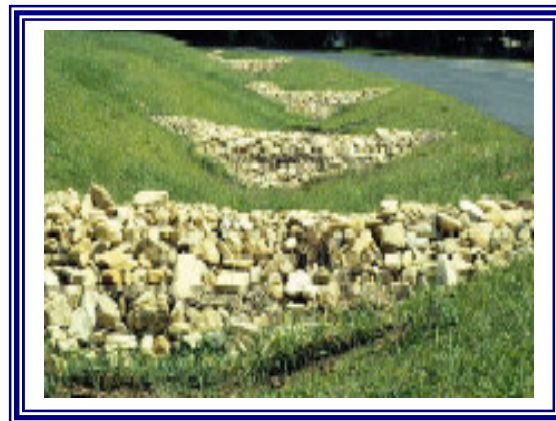
### **Inspection and Maintenance**

Regular inspection and maintenance is critical to the effective operation of enhanced swales. Maintenance responsibility should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

The surface of the filter bed may become clogged with fine sediments over time. Light core aeration is required to ensure adequate filtration. Other required maintenance includes but is not limited to:

- Mowing to maintain storage volume and appearance as needed.
- Remove trash and debris as needed.

<b>Average Pollutant Removal Capability</b>			
<u>Total Suspended Solids:</u>	70%-80%	<u>Hydrocarbons:</u>	65%
<u>Total Phosphorus:</u>	35%-50%	<u>Lead:</u>	60%-70%
<u>Pathogens/Bacteria:</u>	10%-60%	<u>Copper:</u>	15%-45%
<u>Total Nitrogen:</u>	40%-60%	<u>Zinc:</u>	40%-65%



Enhanced Swales

**Summary of Maintenance Requirements**

<b>Required Maintenance</b>	<b>Frequency</b>
Mow grass to maintain design height and remove clippings.	As needed (frequent/seasonally)
Nutrient and pesticide management.	Annual, or as needed
Inspect side slopes for erosion and repair.	Annual, or as needed
Inspect channel bottom for erosion and repair.	Annual, or as needed
Remove trash and debris accumulated in forebay.	Annual
Inspect vegetation. Plant an alternative grass species if original cover is not established.	Annual (semi-annually first year)
Inspect for clogging and correct the problem.	Annual
ROTO-till or cultivate the surface of the bed if swale does not draw down in 48 hours.	As needed
Remove sediment build-up within the bottom of the swale.	As needed, after 25% of the original design volume has filled