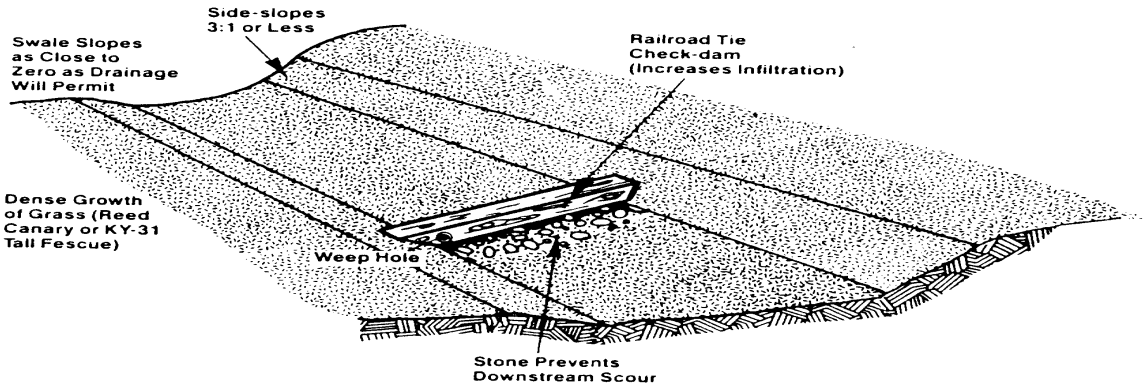
Schematic Design of an Enhanced Grass Swale



Reference: Schueler et. Al., 1993.

Description

Conventional grassed swales are gently sloped, vegetated conveyance ditches in which pollutants are removed from stormwater by filtration through grass and infiltration into the soil. Enhanced grass swales (see figure above), or biofilters, use check dams and wide depressions to increase runoff storage and promote greater settling of pollutants.

Effectiveness

Swales have achieved mixed success in removing particulate pollutants, such as suspended solids and trace metals, and are generally unable to remove soluble metals and nutrients except through infiltration. As noted in Design of Stormwater Filtering Systems (Claytor Dec. 1996) removal rates are dependent on factors including the residence time of water in the swale.

Opportunities for Use

Swales are best used in combination with other treatment BMPs. Their attractiveness is that they can be easily integrated into landscaping plans and can even replace curb and gutter in single-family residential subdivisions and highway medians (they are less expensive to install than curb and gutter or underground piping). The suitability of a grassed swale at a site will depend on the area, slope, and imperviousness of the contributing watershed as well as the dimensions and slope of the swale system.

Costs

Swales can substitute for underground piped stormwater drainage systems at a lower cost, as shown below. Where appropriate, swales can also eliminate the need for curbs and gutters along streets when runoff is allowed to drain directly into a swale along a street's length. However, there is no data presented in the table below to indicate if the operating and maintenance costs would be greater than for curbs and gutters.

	Swale	Underground Pipe	Curb & Gutter
Construction cost (per linear foot)	$4.50 - 8.50 (from seed) $15 - 20 (from sod)	$2 per foot per inch of diameter (e.g., a 12" pipe would cost $24 per linear foot)	$13 - 15
Annual O&M cost (per linear foot)	$0.75	no data	no data
Total annual cost (per linear foot)	$1 (from seed) $2 (from sod)	no data	no data
Lifetime (years)	50		20

Source: BASMAA fact sheet (June 1997)

Design Considerations

A single swale can drain up to approximately four acres of land. Maximum flow rates to the swale should not exceed 1.5 feet per second (fps) to prevent erosion. Swales should be designed to be as flat and as wide as possible in order to decrease velocities. It is difficult to prevent erosion in swales located in highly urbanized areas. In addition, swales should not receive construction site runoff or post-construction runoff with high sediment loads.

Swales should be designed for a maximum residence time of 24 hours. This will eliminate mosquito problems since mosquitoes generally require 48 hours to breed and hatch. If a site has clay soil with low permeability, the swale may require an underdrain or other design adjustment to keep the maximum residence time below 24 hours. Soils with high clay content, and sandy soils, may also require soil amendments to develop a dense turf. Vegetation that can survive periodic inundation should be used in the swale bed. If the groundwater table is located close to the swale bed or long periods of standing water are expected, wetland vegetation should be planted in the swale, which will function as a pocket wetland. In these cases, swales may be seeded with Bti bacteria or other methods may be used to reduce the number of mosquito larvae (Lichten, 1997). **See Appendix B for additional design guidance**.

Regulatory Issues

According to RWQCB staff (Lichten, June 1997) grassy swales are not classified as jurisdictional wetlands and are not subject to mitigation if their use is later changed, as long as:

The swales are clearly identified on the project plans and accompanying documentation as a stormwater treatment Best Management Practice.
The swales are not used as mitigation for impacts to other wetlands.

The use of grassy swales to remove stormwater pollutants is supported by the Regional Water Quality Control Board.

Operation and Maintenance Requirements

Swales require routine maintenance, including mowing, watering, fertilizing, and removal of sediment (especially behind check dams), which can be performed by a landscape maintenance contractor or groundskeeper. In California, they must usually be watered during the summer months to keep the vegetation (preferably turf grasses) healthy and dense, so that it will be effective during the first autumn rains. (There are no data available on the effectiveness of native grasses in removing pollutants.) For this reason, they are most successful in a landscaped area that will be irrigated.

Sediments removed during maintenance should be tested at least once for classification as hazardous waste. In general, sediment accumulation rates in swales are low, and it is unlikely that sediment will need to be disposed of as hazardous waste.

Case Studies

In the City of Livermore, California, grassed swales and a detention pond are being constructed in a residential subdivision. The swales are approximately 7 feet wide located between the curb and sidewalk. The first 50 units of the subdivision will be completed by the end of 1997. The homeowners association will be responsible for maintenance, which includes mowing four times a year.

ADVO, Inc., uses grassy swales to filter runoff from the site's surface parking and warehouse roof. The 8-acre site is located at Mowry Avenue and the Southern Pacific railroad tracks in Newark. The site's swales were the subject of a 1996 case study by Woodward-Clyde Consultants summarized in the report "Draft Monitoring Report - Grassed Swales at the ADVO Facility."

The BT Office Supply Warehouse, Newark has implemented swales. Like the ADVO site, the 10.9 acre Office Supply Warehouse drains much of its parking lot and roof runoff into long, linear swales. This site is notable for the length of its swales and for the way they have been fit into the small landscaped edge between the warehouse and the property line. The site also uses Fossil Filters in its storm drain inlets to treat runoff from a portion of the parking lot.

Across the Bay, a new office building at 3300 Hillview Avenue, Palo Alto provides an excellent example of the artful use of swales as a form of stormwater drainage. The 2.5 acre site drains parking lot runoff into two swales. One is located in the center of the parking lot, where a raised landscape bed would ordinarily be found. Instead, the lot is sloped to drain into the swale.

Another swale forms the border for an attractive garden adjacent to the office building. The site also uses Fossil Filters to clean runoff from another portion of the parking lot.

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