water sensitive urban design

8 Vegetated swales and buffers

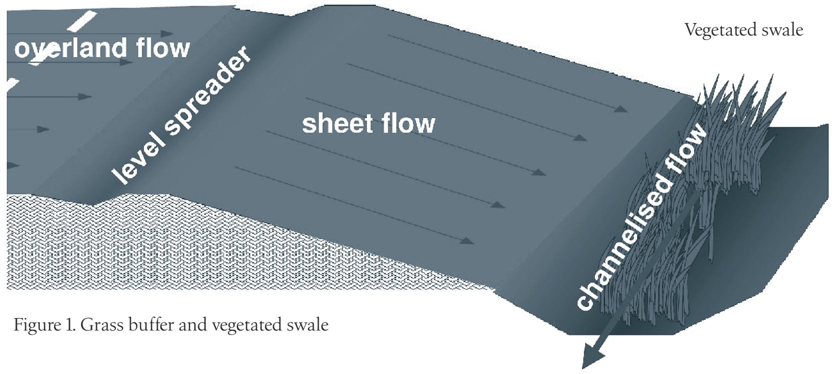

Figure 1. Grass buffer and vegetated swale

This Water Sensitive Practice Note explains how vegetated swales and buffers contribute to water sensitive urban design.

1.1 Introduction

Vegetated swales and buffers perform both a stormwater treatment and stormwater conveyance function. A vegetated buffer is a swathe of level vegetated ground surface over which 'sheet flows' of stormwater are directed. Sheet flow is achieved through the use of a level spreader at the top of the slope. A swale is a vegetated trapezoidal channel used to convey stormwater. Swales can be used in combination with conventional piped drainage systems or can replace them altogether.

Both systems treat stormwater via filtration through the vegetation. Additional pollutant removal is achieved through stormwater infiltration to groundwater and vegetative uptake.

Buffers and swales are often used in conjunction (see Figure 1) so that the buffer strip's level spreader collects overland flow and distributes the flow evenly over the buffer, which provides some pre-treatment for the water prior to entering the swale for conveyance downstream.

Buffers and swales can also be incorporated into a treatment train including bioretention, e.g. where swales meet overflow points or entrances to the sub-surface drainage network, bioretention swale cells can be used (see Figure 2).

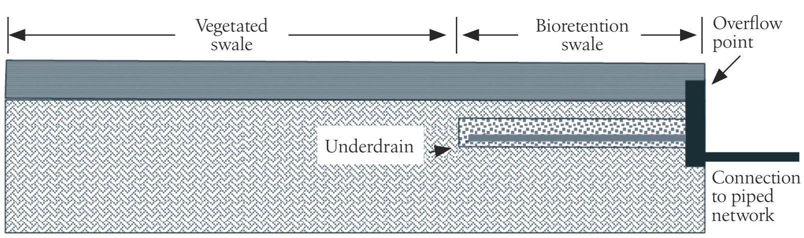

Figure 2. Swale and vegetated swale system

1.2 Treatment processes

Both swales and buffers provide water quality treatment through physical filtration of water through the vegetation with some additional pollutant take-up provided by the vegetation. It is important that vegetation height is greater than flow depth at the treatable flow rate to achieve effective filtration through the vegetation. To maintain effective treatment performance, vegetation must be well-maintained for pollutant take-up and to ensure that bare patches do not create preferential flow paths and associated erosion.

1.3 Site Considerations

Site gradients – Vegetated swales are usually only suitable for slopes of 1-4% as steep slopes often lead to high

Grass swale in Lynbrook Estate, Melbourne. Curb 'funnels' direct road runoff into the swale system.

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velocity flows that may scour the channel and damage vegetation. Swales less than 1% commonly have problems with water pooling and becoming stagnant. However, there is some adaptability in design characteristics to overcome such issues. Swales constructed on slopes of approximately 3% or higher can be designed with periodic check dams along the length of the swale. Check dams are simply small barriers constructed across the channel that cause water to back up slightly before overtopping and continuing down the swale. They have the benefit of reducing flow velocity, redistributing flow evenly across the bed of the channel and providing a small detention area behind the dam which may allow coarse sediments to fall from suspension. Ponding and stagnant water problems in swales on flat land may be overcome by the use of collector under-drains that allow water to infiltrate through the swale bed and be carried away to a drainage network by perforated pipes.

Driveway crossings – Where swales are constructed as an urban drainage system, there is often the need for driveway crossings between the street and a property. There are two main ways of providing crossings, culverts and at-grade crossings. Culverts prevent vehicular movements across the swale surface. This avoids compaction of the vegetation but causes a concentration of flow and increased velocity creating a risk of channel bed scour at the outlet. At-grade crossings reduce construction costs, however will only be effective in very wide swales (batter grades of approximately 1:6) so that standard vehicles may traverse them. They also require some form of management to prevent tyre ruts establishing, for example grass paver or permeable pavers along tyre paths. In both cases, driveway crossings make ideal locations for check dams if they are required.

Traffic control – All swale systems require some management technique to prevent vehicular access to the swale. It is crucial that this be considered in the design phase of the project. Traffic movements across a swale will damage vegetation and cause soil compaction, which will also inhibit revegetation and create erosion points. Similarly, the motorist can also see swales as convenient places to park, which should be avoided at all costs for the reasons discussed above. Traffic can be kept from swales through the use of bollards, fences or strategic plantings. It is also important to implement traffic control during construction and establishment by either establishing the permanent control methods initially or by temporary fencing.

References

Deeks, B. & Milne, T., 2005, 'WSUD Engineering Procedures for Stormwater Management in Southern Tasmania 2005', Derwent Estuary Program, Department of Primary Industries Water and Environment, Hobart.