# Grass Channels

**Description:** Limited application structural control. Open channels that are vegetated and are designed to filter stormwater runoff, as well as slow water for treatment by another structural control.

## Components:

- Broad bottom channel on gentle slope (4% or less)
- Gentle side slopes (3:1 (H:V) or less)
- Dense vegetation that assists in stormwater filtration
- Check dams can be installed to maximize treatment

## Advantages/Benefits:

- Provides pretreatment if used as part of runoff conveyance system
- Provides partial infiltration of runoff in pervious soils
- Less expensive than curb and gutter
- Good for small drainage areas
- Relatively low maintenance requirements

## Reasons for Limited Use:

- Cannot alone achieve 80% removal of TSS; Fifty foot long channel is assumed to achieve 50% removal of TSS
- Must be carefully designed to achieve low flow rates in the channel (< 1.0 ft/s)
- May re-suspend sediment
- May not be acceptable for some areas because of standing water in channel

## Design considerations:

- Maximum drainage area of 5 acres
- Require slopes of 4% or flatter
- Runoff velocities must be non-erosive
- Appropriate for all but the most impermeable soils
- Requires vegetation that can withstand both relatively high velocity flows and wet and dry periods.

## Selection Criteria:

☐ **Water Quality 80% TSS Removal**

☑ **Pretreatment**

☑ **Residential Subdivision**

☑ **High Density / Ultra Urban Use**

**Other:** Replaces curb and gutter

## Maintenance:

- Mow grass to 3 or 4 inches high
- Clean out sediment accumulation in channel
- Inspect for and correct formation of rills and gullies
- Ensure that vegetation is well-established

L **Maintenance Burden**

L = Low M = Moderate H = High

## General Description

Grass channels, sometimes called biofilters, are conveyance channels that are designed to provide some treatment of runoff, as well as to slow down runoff velocities for treatment in other structural controls. Grass channels are appropriate for a number of applications including treating runoff from paved roads and from pervious areas.

Grass channels do not provide full water quality treatment because they are not designed with engineered filtration areas, as water quality swales (PTP-06) are. Because they are not enhanced for increased filtration and infiltration, they provide a lower TSS removal and are appropriate for limited application in combination with other structural controls.

Grass channels are able to infiltrate some runoff from small storms when situated in pervious soils. They provide other ancillary benefits such as reduction of impervious cover, accenting natural features, and reduced cost when compared with traditional curb and gutter.

The most important considerations when designing a grass channel are the channel capacity and erosion prevention. Runoff velocities must not exceed 1.0 foot per second during the peak discharge associated with the 2-year design storm. In addition, the vegetation height should provide 5 minutes of residence time in the channel.

Figure 8.1 illustrates a grass channel. A grass channel consists of the following elements:

1. A broad bottomed, trapezoidal or parabolic channel on a gentle slope (4% or less);
2. Gently sloping sides (3:1 (H:V) or less);
3. Hardy vegetation that can withstand relatively high velocities as well as a range of moisture conditions from very wet to dry; and
4. Optional check dams to increase residence time.

## Site and Design Considerations

The following design and site considerations must be incorporated into the grass channel design:

**General Considerations**

1. The drainage area (contributing or effective) must be 5 acres or less. Runoff flows and volumes from larger drainage areas prevent proper filtration and infiltration of stormwater.
2. Grass channels should be designed on areas with slope of less than 4%. Slopes of 1% to 2% are recommended.
3. Grass channels can be used on most soils with some restrictions on the most impermeable soils. Grass channels should not be used on soils with infiltration rates less than 0.27 inches per hour if infiltration of small runoff flows is intended.
4. A grass channel should be designed to accommodate the water quality flow. Calculations for the water quality flow are as follows:

$$Qp = C * I * A$$

Where:
Qp = the peak flow through the grass channel in cfs
C = runoff coefficient
I = rainfall intensity, 2.45 in/hr
A = the contributing drainage area for the grass channel in acres

Larger flows should be accommodated by the channel if dictated by the surrounding conditions. For instance, Metro requires site drainage to accommodate the 10-year design storm.

5. The channel should accommodate the 2-year, 24-hour storm without eroding.
6. Grass channels should have a trapezoidal or parabolic cross section with relatively flat side slopes (generally 3:1 or flatter).
7. The bottom of the channel should be between 2 and 6 feet wide. The minimum width ensures a minimum filtering surface for water quality treatment, and the maximum width prevents braiding, which is the formation of small channels within the swale bottom. The bottom width is a dependent variable in the calculation of velocity based on Manning's equation. If a larger channel is needed, the use of a compound cross section is recommended.
8. Runoff velocities must be nonerosive. The full-channel design velocity will typically govern.
9. A 5-minute residence time is recommended for the water quality peak flow. Residence time may be increased by check dams, reducing the slope of the channel, increasing the wetted perimeter, or planting a denser grass (raising the Manning's n).
10. The depth from the bottom of the channel to the groundwater should be at least 2 feet to prevent a moist swale bottom, or contamination of the groundwater.

**Site and Design Considerations (Continued)**

11. Incorporation of check dams within the channel will maximize retention time.
12. Designers should choose a grass that can withstand relatively high velocity flows at the entrances, and both wet and dry periods.
13. A forebay is recommended in order to minimize the volume of sediment in the channel. (Refer to PTP-01 for forebay design.)
14. Provide an overflow for larger storm events.
15. Refer to Volume 2, Chapter 3 for design of open channel hydraulics.

**Grass Channel as Pretreatment**

A number of structural controls such as bioretention areas and infiltration trenches may be supplemented by a grass channel that serves as pretreatment for runoff flowing to the device. The lengths of grass channels vary based on the drainage area imperviousness and slope. Channels must be no less than 20 feet long. Table 8.1 below gives the minimum lengths for grass channels based on slope and percent imperviousness:

**Table 8.1 Grass Channel Length Guidance**
(Source: Georgia Stormwater Management Manual)

| Parameter | <= 33% Impervious | | Between 34% and 66% Impervious | | >= 67% Impervious | |
|---|---|---|---|---|---|---|
| Slope (max = 4%) | < 2% | > 2% | < 2% | > 2% | < 2% | > 2% |
| Grass channel minimum length* (feet) *assumes 2-foot wide bottom width | 25 | 40 | 30 | 45 | 35 | 50 |

**As-Built Certification Considerations**

After the grass channel has been constructed, an as-built certification of the grass channel must be prepared by a registered Professional Engineer and submitted to Metro. The as-built certification verifies that the BMP was installed as designed and approved.

The following components must be addressed in the as-built certification:

1. The channel must be adequately vegetated.
2. The channel flow velocities must not exceed 1.0 foot per second.
3. A mechanism for overflow for large storm events must be provided.

## Maintenance

Each BMP must be addressed in the overall Operations and Maintenance (O&M) Agreement (refer to Volume 1, Appendix C) for the development and submitted to Metro for approval with site plans.

Maintenance requirements for grass channels include the following:

1. Maintain grass height of 3 to 4 inches.
2. Remove sediment build up in channel bottom when it accumulates to 25% of original total channel volume.
3. Ensure that rills and gullies have not formed on side slopes. Correct if necessary.
4. Remove trash and debris build up.
5. Replant areas where vegetation has not been successfully established.

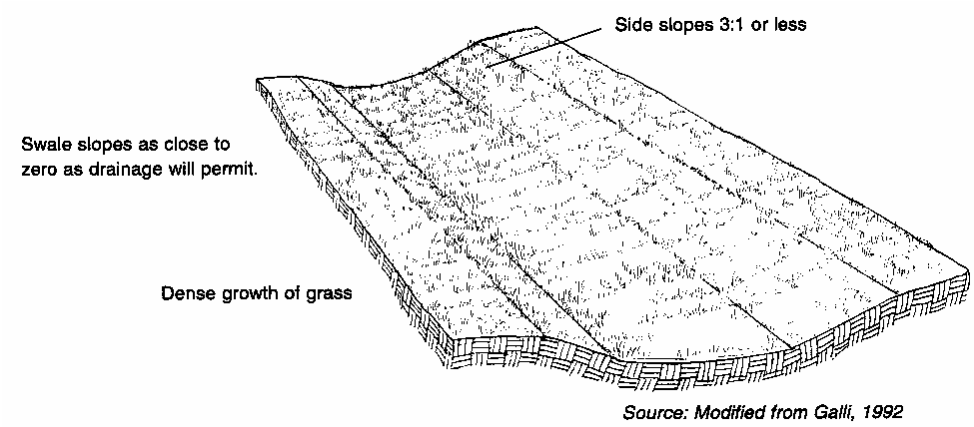
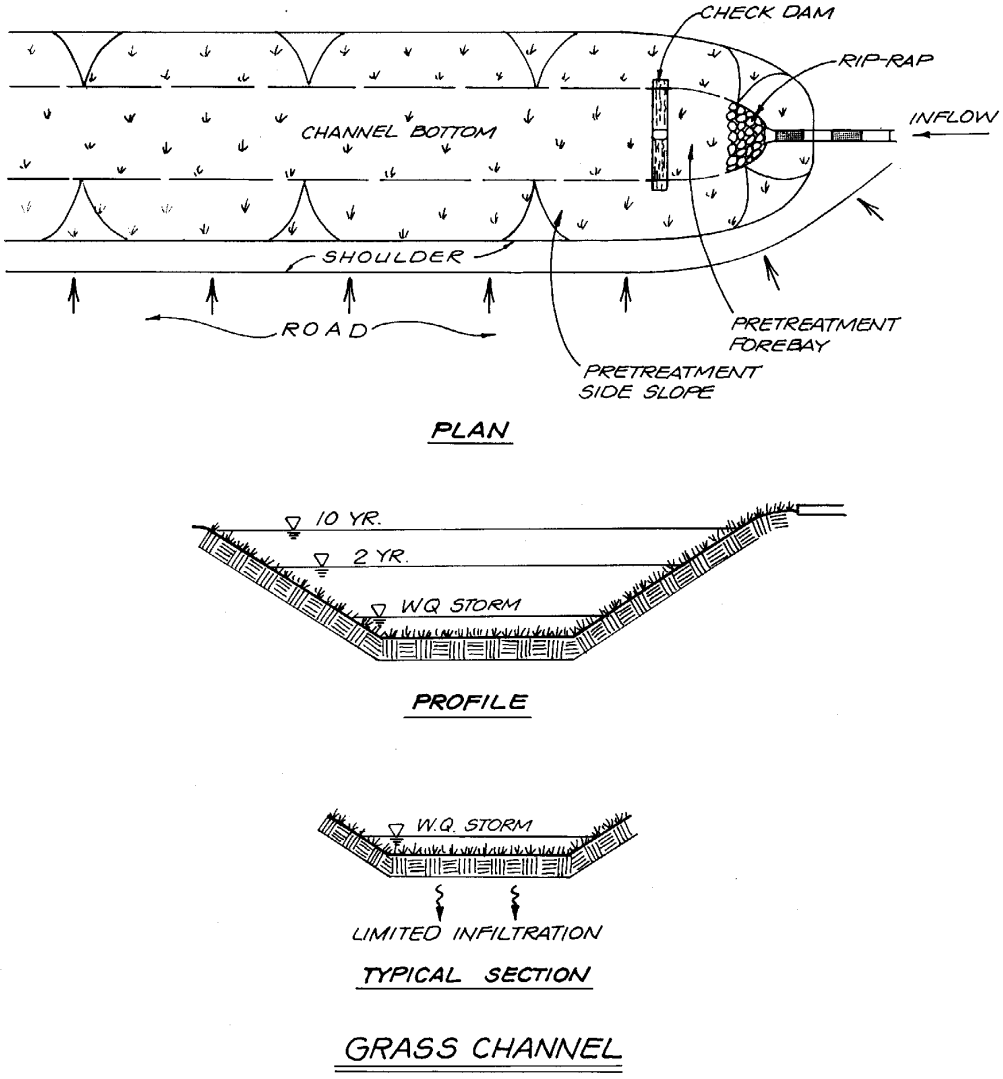



**Figure 8.1 Typical Grass Channel**




*(Source: Center for Watershed Protection)*

**Figure 8.2 Grass Channel Schematic**

## References

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Claytor, R.A., and T.R. Schueler. 1996. Design of Stormwater Filtering Systems. The Center for Watershed Protection, Silver Spring, MD.

## Suggested Reading

California Storm Water Quality Task Force, 1993. California Storm Water Best Management Practice Handbooks.

City of Austin, TX, 1988. Water Quality Management. Environmental Criteria Manual. Environmental and Conservation Services.

City of Sacramento, CA, 2000. Guidance Manual for On-Site Stormwater Quality Control Measures. Department of Utilities

Horner, R.R., 1988, "Biofiltration Systems for Storm Runoff Water Quality Control", Washington State Department of Ecology.

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