



Grass channel for road drainage

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Background

- Need to ensure safe (fast and effective) drainage of road runoff
- Preferred method: Surface water channels with triangular cross-section built along the edge of the road (or carriageway) receiving flow along their length



Background (cont.)

There is recognition that changing from concrete to grass-lined earth channels could provide:

- **Environmental benefits**
 - Natural material
 - Greener, more attractive appearance
 - Some pollution control (retention of fine solids and pollutants)
- **Hydraulic benefits**
 - Grass is a very effective soil protection material against water induced erosion (almost 4m/s for 1hour, 3m/s for 2 hours)
 - Capacity to slow down the flow, thus reducing the quantitative and qualitative impacts on the receiving water

Grassed channels for road drainage

Research has been carried out on the following:

Review study

- Selection of appropriate grass types, construction constraints

Laboratory study and safety trials

- Experimental determination of the channels' hydraulic resistance and safety aspects
- Adaptation of the existing design method for concrete channels to grassed channels
- Guidance on construction and maintenance

Site trials

- Selection of trial sites
- Development and installation of monitoring instrumentation
- Analysis of results

Development of advice note

Selection of appropriate grass types – Criteria

- Slow growing grass (to reduce maintenance requirements)
- Fast establishment rates, native seeds and suitability for many locations
- Tolerance of wet conditions (wetter conditions may affect balance and density of the grass types)
- Quick recovery from damage (by vehicles parking or accidentally running off the road)

Grasses chosen were:

- Perennial Ryegrass Mixture
(speed of establishment, high recovery rate from damage, tolerance to wet conditions)
- Red Fescue Mixture
(good salt tolerance, slower growth rate)

Laboratory study - hydraulic capacity

- Experimental study to determine resistance of grassed channels
- Limitations on capacity imposed by:
 - safety considerations: depth < 150 to 200mm
 - verge width.



Testing in PRG channel; $Q = 50.8$ l/s; grass height = 100mm

Test facility

14m long, 3.6m wide

Two half triangular channels were reproduced with two types of turf (Perennial Ryegrass and Fescues)

Design formulae

Based on Manning's equation - relationship between n and VR, dependent on grass height

$$n = 0.05 + 0.0048 (1 + \alpha) \frac{H}{VR}$$

with $\alpha = 0$ for Perennial Ryegrass
 $\alpha = 1$ for Fescues

where n is Manning's coefficient, H is the height of grass, V is the mean cross-sectional velocity and R is the hydraulic radius

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Safety and resilience tests at Transport Research Laboratory (TRL)

- Full-scale grass channel, approx. 50m in length, 2m in width, max. depth 150mm
- Vehicles used: small car, van, rigid flat bed lorry and a loaded 38T HGV
- Conditions: driven through at increasing speeds, braking and acceleration from rest.
- Safety risk was not significant
- Braking of heaviest vehicles caused deep ruts



TRL channel

Grassed channels for road drainage



Vehicle trials

Site trials

Sites

- Three sites on a motorway in UK - a total of 500m of grassed channel were built
- Monitoring period: from early 2003 to mid 2004
- Triangular cross-section; turf (60% Fescue; 40% Bent)
- Impermeable liner

Site	Length	Width	Depth	Slope
1	44m	2m	150mm	1/75
2	97.5m	3m	150mm	1/66
3	147m	2m	150mm	1/35

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Site 1

A2-M2

Junction 1



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Site 2

A2-M2

Junction 1



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Site 3

A2-M2

Nashenden
Valley



Construction

- Need to consult the environmental regulatory authority regarding location of aquifers
- If aquifers are present an impermeable liner may need to be provided
- Need to consider hard areas around outlets and for emergency stoppage on verge (but maintain greenness)
- Avoid positioning safety fences in the channels; signage and ducts away from the channels, etc



Initial recommendations on establishment and maintenance of grassed channels

- For channels built in summer months, water for establishment of grass during first two weeks for one hour every day. Water in dry periods.
- Grass height to be kept at **50mm** (max 70mm)
- Grass cuttings do not need to be collected
- Weed killer can be applied but no fertiliser is needed.

Monitoring

- Continuous monitoring of rainfall and water depths in the channels
 - Raingauges and dataloggers
 - Ultrasonic probes for water depth reading (triggered by rain gauge)
- Back-up system using water sensitive tape to measure maximum water levels
- Permeability tests
 - Monitoring of grass condition



Installing instrumentation

Grassed channels for road drainage



A120 Reinforced grassed channel

Conclusions:

- Grassed channels are an environmentally improved means of safely disposing of runoff
 - Sustainable drainage system  but requires maintenance
 - Minimal use of non-sustainable materials
 - Provide “greening” of the road (reduced impermeable area) but this also attracts litter!
 - Flow attenuation: flow vel. in grassed channels are 25% of velocity concrete channels

Conclusion (cont):

- Safety aspects have been addressed – grassed channels do not impose greater risks to drivers but prompt remedial action is needed if damage is caused to the channel
- Quantification of pollution control properties of grassed channels requires research.

Grassed channels – a good idea for road drainage





Any questions?

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