



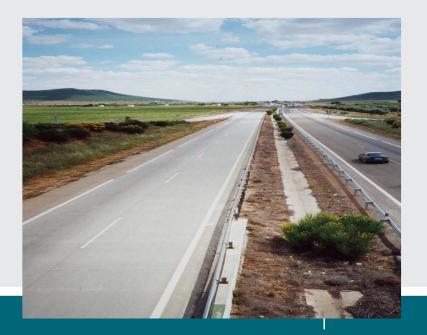
Steven Wade, HR Wallingford



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 grasslined 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



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



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





Vehicle trials



HR Wallingford Grassed channels for road drainage

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



Site 1 A2-M2 Junction 1





Site 2 A2-M2 Junction 1





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 raingauge)

Back-up system using water sensitive tape to measure maximum water levels

- Permeability tests
- Monitoring of grass condition



Installing instrumentation





A120 Reinforced grassed channel



Conclusions:

- Grassed channels are an environmentally improved means of safely disposing of runoff
 - Sustainable drainage systembut 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

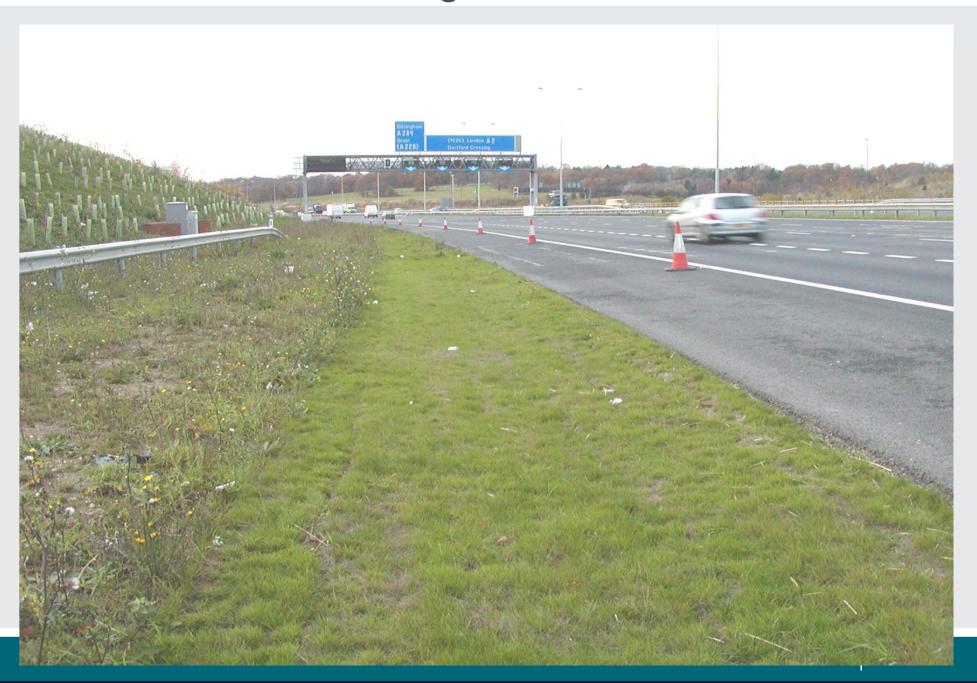


Conclusion (cont):

- Safety aspects have been addressed grassed channels do not impose greater r 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?

HR Wallingford Howbery Park, Wallingford, Oxfordshire OX10 8BA, United Kingdom tel +44 (0)1491 835381 fax +44 (0)1491 832233 email info@hrwallingford.com