European Commission

NWRM

Natural Water Retention Measures

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Individual NWRM

Channels and rills

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I. NWRM Description

Channels and rills are shallow open surface water channels incorporated in to the start of a SuDS train. They collect water, slow it down and provide storage for silt deposited from runoff. They can have a variety of cross sections to suit the urban landscape, and can include the use of planting to provide both enhanced visual appeal and water treatment.

The main role of channels and rills are to capture runoff at the start of a SuDS train, allow deposition of sediment and convey the runoff to downstream SuDS features. They can also be used in between SuDS features as connectors. They collect water, slow it down and provide storage for silt and oil that is captured. The outlets are designed to act as a mini oil separator, making them effective at treating pollution and reducing treatment requirements downstream. Clearly channels can be included in many situations and settings, but would not always considered to be NWRMs unless specifically designed to perform these functions and used in conjunction with other measures.

Planting in channels and rills can visually enhance the urban landscape and offer biodiversity and amenity value. These features can be applied to all new developments and can be retrofitted to existing developments.

II. Illustration

Example of a vegetated channel in Stamford, UK (photo courtesy of Susdrain)

III. Geographic Applicability

Land Use	Applicability	Evidence
Artificial Surfaces	Yes	Channels and rills can be relevant anywhere that other SuDS features are being applied, normally in urban areas, to connect features and convey runoff in to a SuDS system.
Agricultural Areas	No	
Forests and Semi-Natural Areas	No	
Wetlands	No	

Region	Applicability	Evidence
Western Europe	Yes	Channels and rills can be relevant anywhere that other SuDS features are being applied, to connect features and convey runoff in to a SuDS system.
Mediterranean	Yes	
Baltic Sea	Yes	
Eastern Europe and Danube	Yes	

IV. Scale

	0-0.1km²	0.1-1.0km²	1-10km²	10-100km²	100-1000km²	>1000km²
Upstream Drainage Area/Catchment Area	✓					
Evidence	Channels and rills should only be used to collect runoff from a small area: they are small channels that should have shallow flow and allow suspended solids to settle out.					

V. Biophysical Impacts

Biophysical Impacts		Rating	Evidence
Slowing & Storing Runoff	Store Runoff	Low	Channels and rills provide a small amount of storage, and help to control the rate of runoff. They can be flexibly designed to accommodate and control flow as necessary, according to the local requirements. Planting in channels and rills can help to slow the rate of runoff.
	Slow Runoff	Low to Medium	
	Store River Water	None	
	Slow River Water	None	
Reducing Runoff	Increase Evapotranspiration	None to medium	The rate of evapotranspiration will depend on dimensions, residence time and type of vegetation. With dense vegetation and relatively low velocities, evapotranspiration can substantially increase. However if channels and rills are designed only to convey water, with a very low residence time, evapotranspiration will not be significant. Evapotranspiration in planted channels can be far more efficient than predicted by agricultural engineering. Hess (2014) carried out experiments that showed vegetation can evapotranspire more than needed if there is an excess of water, by up to 30mm per day.
	Increase Infiltration and/or groundwater recharge	None to low	Channels and rills can have permeable beds, although due to the low residence time there is likely to be relatively little infiltration.
	Increase soil water retention	None	
Reducing Pollution	Reduce pollutant sources	None	
	Intercept pollution pathways	Medium	Channels and rills are designed to control the rate of flow and provide sediment deposition, thereby providing water quality improvements and reducing the treatment requirements of downstream SuDS. A wide variety of devices could be incorporated with channels and rills (such as planted sand filters), that significantly improve the water quality of runoff. For example, some substrates can capture almost 99% of heavy metals (le Moniteur, 2013).

Soil Conservation	Reduce erosion and/or sediment delivery	Low	As channels and rills collect runoff they have little influence on erosion itself, but they encourage the deposition of sediments, thereby reducing the transport of sediment further downstream.
	Improve soils	None	
Creating Habitat	Create aquatic habitat	Low	In some cases, channels and rills may include planting, particularly when incorporated in to a wider design scheme. This has the potential, therefore to create a limited amount of new aquatic habitat (e.g. Graham et al, 2012).
	Create riparian habitat	None	
	Create terrestrial habitat	None to medium	Channels and rills may be planted, providing a 'green' alternative to conventional drains. They should be planted with native vegetation to be most effective in enhancing biodiversity. They can be incorporated as an element in a network of green areas, thereby creating a green corridor, which is a key issue for the provision of terrestrial habitat.
Climate Alteration	Enhance precipitation		
	Reduce peak temperature	None to low	Channels and rills may be planted. Depending on vegetation density and how widespread they are, they can contribute to creating cool islands in urban landscapes (as a result of evapotranspiration, water supply, shadow).
	Absorb and/or retain CO_2	None to low	If a vegetated channel is added where no vegetation would otherwise be present, this will result in a small localised increase in uptake of CO_2.

VI. Ecosystem Services Benefits

Ecosystem Services		Rating	Evidence
Provisioning	Water Storage	None	Although channels and rills can form an integral part of a sustainable drainage system, they themselves provide very limited storage, which is routed to downstream features.
	Fish stocks and recruiting	None	
	Natural biomass production	None to low	If planted, channels and rills may contribute to natural biomass production, particularly if the vegetation is dense

Regulatory and Maintenance	Biodiversity preservation	None to low	If planted, channels and rills introduce vegetation where there would otherwise be hard surfaces only. The extent to which biodiversity benefit is provided depends on the soil moisture and choice of vegetation. Even when their individual contributions are minor, their potential for contributing to networks of vegetated areas and green corridors can make them a useful element in biodiversity preservation in urban landscapes.
	Climate change adaptation and mitigation	None to low	Channels and rills can contribute to climate change adaptation. Predominantly this is by improving adaptation to the more intense rainfall events that are expected as a result of climate change. In addition, if new vegetation is introduced, they may also make a minor contribution to increasing carbon sequestration and helping to regulate urban temperatures.
	Groundwater / aquifer recharge	None	
	Flood risk reduction	Low	When used as an integral part of a sustainable drainage system, channels and rills contribute to good management of surface water and hence help to reduce the risk of urban flooding.
	Erosion / sediment control	Low	As part of a sustainable drainage system, channels and rills can promote sediment deposition. However this is likely to be only a minor contribution, particularly when considered at the catchment scale.
	Filtration of pollutants	Low	As part of a sustainable drainage system, channels and rills can contribute to reducing urban diffuse pollution through reducing total runoff and encouraging deposition of sediments and associated pollutants.
Cultural	Recreational opportunities	None	
	Aesthetic / cultural value	Low to medium	In some cases, channels and rills can be attractively designed in to urban landscapes, thereby providing aesthetic value (e.g. Cambridge City Council, 2009) Using such channels and rills is a communication tool for promoting sustainable water management. Keeping water on show (rather than hiding it in traditional drainage systems) helps to raise people's awareness and knowledge. This is particularly the case where the detail and value of SuDS is communicated to the public, for example by installing information panels.
Abiotic	Navigation	None	
	Geological resources	None	

	Energy production	None	

VII. Policy Objectives

Policy Objective		Rating	Evidence
Water Framework Directive			
Achieve Good Surface Water Status	Improving status of biology quality elements	None	
	Improving status of physico-chemical quality elements	None	Although as part of a sustainable drainage system, channels and rills contribute to reduction in diffuse pollution, in isolation their effect on water quality of receiving waters is likely to be negligible.
	Improving status of hydromorphology quality elements	None	
	Improving chemical status and priority substances	None	Although as part of a sustainable drainage system, channels and rills contribute to reduction in diffuse pollution, in isolation their effect on water quality of receiving waters is likely to be negligible.
Achieve Good GW Status	Improved quantitative status	None	
	Improved chemical status	None	
Prevent Deterioration	Prevent surface water status deterioration	None	
	Prevent groundwater status deterioration	None	
Floods Directive			
Take adequate and co-ordinated measures to reduce flood risks		Low	When used as an integral part of a sustainable drainage system in urban areas, channels and rills will make some contribution towards the management of surface water flooding.
Habitats and Birds Directives			
Protection of Important Habitats		None	

2020 Biodiversity Strategy		
Better protection for ecosystems and more use of Green Infrastructure	Low	Where applied as an effective component in sustainable urban water management, channels and rills provide a contribution towards improved green infrastructure and protection of ecosystems. However in isolation the contribution is limited, particularly because this measure itself does not contribute any new habitat.
More sustainable agriculture and forestry	None	
Better management of fish stocks	None	
Prevention of biodiversity loss	None to low	If planted, channels and rills can make a contribution to the prevention of biodiversity loss. The extent of contribution will be more or less effective depending on the type of vegetation used and how widespread they are.

VIII. Design Guidance

Design Parameters	Evidence
Dimensions	Channels and rills can be designed to any dimensions, which should aim to slow runoff and encourage sediment deposition. They should have a shallow depth, for example Cambridge City Council (2009) allows a maximum depth of 150 mm, while others suggest that depths of up to 300mm can be suitable. They are most effective when draining from a catchment with a small impermeable area.
Space required	Channels and rills are relatively narrow features, so land-take is minimal. They can be incorporated in to landscaping, e.g. in pedestrianised areas, without significant loss of land.
Location	As part of a sustainable drainage system, channels and rills can be located anywhere that such systems are required, predominantly in urban areas. Their design can be very adaptable, allowing them to be well integrated with architectural and landscape choices, and contribute to the aesthetics of the project.
Site and slope stability	There are no specific constraints, but channels and rills should be constructed on stable land, and not with a steep slope (which may encourage rapid runoff), unless check dams are included in the design to assist with slowing the flow.
Soils and groundwater	Channels and rills, as part of a sustainable drainage system, would not generally be expected to provide significant infiltration. As such, they can be located on any soils, with an impermeable base, avoiding interactions with groundwater.

Pre-treatment requirements	Channels and rills may form pre-treatment for downstream measures such as rain gardens or swales, as they can encourage sediment deposition and hence reduce sediment loading on downstream features.
Maintenance requirements	Regular inspection and maintenance is important for channels and rills to ensure effective ongoing operation. Maintenance should include sediment, litter and debris removal. If vegetation is deliberately incorporated then it will need to be maintained, and otherwise any vegetation growth should be regularly removed.
Synergies with Other Measures	Channels and rills provide a conveyancing function within a SuDS 'train'. For example, they may connect a green roof to an infiltration feature. In isolation they would provide relatively little function in the way of 'natural water retention' and should not be considered as an NWRM in such situations.

IX. Cost

Cost Category	Cost Range	Evidence
Land Acquisition		Channels and rills are only relevant as NWRM as a component in a wider SuDS scheme, where they provide a routing function and link between other measures. As a result, it is not appropriate to assign costs to this measure in isolation.
Investigations & Studies		
Capital Costs		
Maintenance Costs		
Additional Costs		

X. Governance and Implementation

Requirement	Evidence
Stakeholder involvement	The effective planning, design, construction and operation of urban NWRM requires the involvement of a wide range of stakeholders. This may include local planning authorities, environmental regulators, sewerage undertakers, highways authorities, private landowners and land managers, and other bodies with responsibilities for drainage and water management (e.g. irrigation bodies, drainage boards, etc). Effective planning is essential to delivering urban NWRM, since they must be delivered within the constraints of the urban environment. This requires alignment between stakeholders from planning authorities through to developers and land owners.

Ensuring clear responsibility for maintenance	The adoption of SuDS has historically been a major issue in ensuring their long-term effectiveness. This is important for linear features such as rills, which may cross different land ownerships and will reduce in effectiveness if only partially maintained.
Ensuring that appropriate design standards and effective designs are implemented appropriately at each location	The preparation of planning guidance and/or SuDS guidance documents that set out planning and design criteria, as well as local technical information (e.g. on soil types and underlying geology) can assist in this.

XI. Incentives supporting the financing of the NWRM

Type	Evidence
National and local legislative and regulatory requirements	Some countries and territories encourage and/or require the use of Sustainable Drainage systems in new development. For example, in England the use of SuDS is required through planning policy for new developments over a certain size. National and local instruments are the most widely effective for SuDS due to their wide-scale application at the household or very local level. The possibility of local incentives should always be explored (since they cannot be covered here comprehensively).

XII. References

Reference	Comments
Graham, A, Day, J, Bray, B and Mackenzie, S (2012) Sustainable drainage systems. Maximising the potential for people and wildlife: a guide for local authorities and developers. RSPB and WWT report.	
Wilson, S, Bray, B, Neesam, S, Bunn, S and Flanagan, E (2009) Sustainable Drainage: Cambridge Design and Adoption Guide	
Le Moniteur (2013) Le caniveau filtrant s'adapte aux fortes charges	Article dealing with filtering channels published in a French magazine specialising in construction and environment.
Hess (2014), Monitoring of evapotranspiration and infiltration in rain gardens designs, Vilanova University	