European Commission

NWRM

Natural Water Retention Measures

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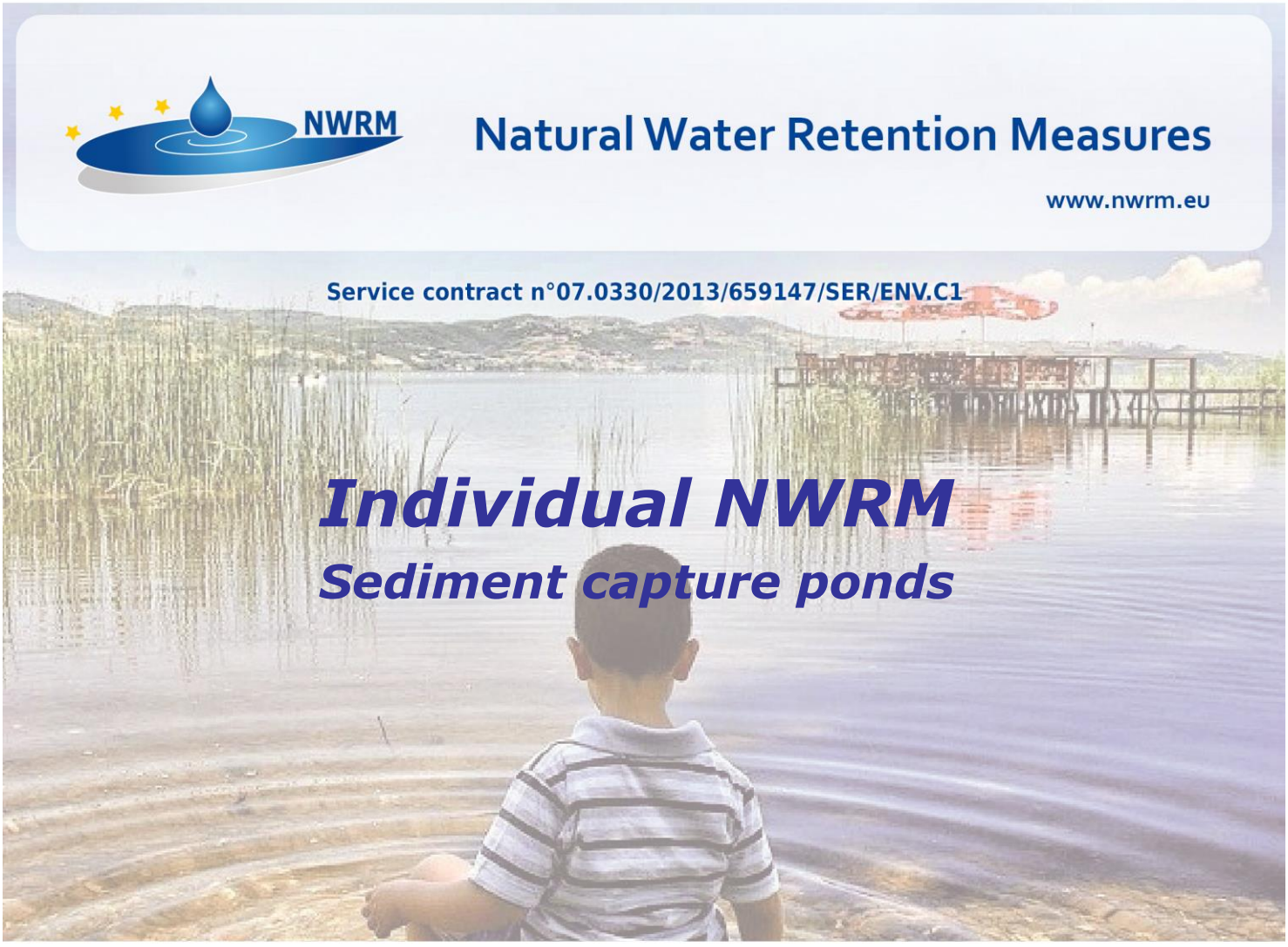

Individual NWRM

Sediment capture ponds

ACTeon environment research & consultancy

Office International de l'Eau

amec foster wheeler

BEF LATVIA

enveco Environmental Economics Consultancy

I.A.CO Ltd Environmental & Water Consultants

institute IMDEA water

REGIONAL ENVIRONMENTAL CENTER

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Environment

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I. NWRM Description

Sediment capture ponds are engineered ponds placed in networks of forest ditches to slow the velocity of water and cause the deposition of suspended materials. Sediment capture ponds are most useful for managing the effects of ditch construction and maintenance, road work and final feeling. While used primarily in forests, sediment capture ponds may be a useful temporary measure for preserving water quality in and around construction sites or mines. They may also be useful for capturing sediment in agricultural runoff. Sediment capture ponds have a limited lifespan, depending on how much suspended material is in the inflowing water. However, ponds can be maintained by removal of accumulated sediment. As most water protection methods, sediment capture ponds function well during base and moderate flow events. Catchment area, hydraulic properties of ditches, discharge rate and soil characteristics are among factors influencing functioning of sedimentation capture ponds. Effective functioning largely depends also on expertise and skill of professionals designing and implementing this and also many other measures.

II. Illustration

Example of sediment capture pond, Slovakia

III. Geographic Applicability

Land Use	Applicability	Evidence
Artificial Surfaces	Yes	Sediment capture ponds can play an important role in protecting water quality at mines or construction sites or in forest areas damaged by fires. This functionality may also be addressed with measures "U10 Detention Ponds" and "U11 Retention Ponds"

F9: Sediment capture ponds

Land Use	Applicability	Evidence
Agricultural Areas	Yes	Sediment capture ponds can play an important soil conservation role where arable agriculture is practiced. They are also relevant in areas with permanent agriculture with bare soil (i.e. orchards) where measure "A13 Mulching" is not practiced.
Forests and Semi-Natural Areas	Yes	Sediment capture ponds are a forestry measure to reduce the negative effects of forest management (harvesting and ditching) on surface water quality. The measure may also be applicable in other semi-natural areas where extensive land management leads to sediment mobilisation.
Wetlands	Possible	Sediment capture can be used for water quality improvement downstream of managed wetlands.

Region	Applicability	Evidence
Western Europe	Yes	This measure is relevant anywhere in Europe where land management activities may produce sediment which can later be mobilized and transported to surface waters. However, the usefulness of sediment capture ponds may be limited by long periods of below freezing temperatures.
Mediterranean	Yes	
Baltic Sea	Yes	
Eastern Europe and Danube	Yes	

IV. Scale

	0-0.1km^2	0.1-1.0km^2	1-10km^2	10-100km^2	100-1000km^2	>1000km^2
Upstream Drainage Area/Catchment Area	Yes	Yes	Possible	No	No	No
Evidence	While sediment capture ponds are only effective when they have a small upstream drainage area, their beneficial effects for the aquatic environment can be seen in much larger catchments. The dense network of forest ditches in which sediment capture ponds are typically placed means that each pond drains a relatively small area, but that there is close correlation between the number of ponds and the strength of floods in bigger catchment systems downstream.					

V. Biophysical Impacts

Biophysical Impacts		Rating	Evidence
Slowing & Storing Runoff	Store Runoff	Medium	Because of their small size, sediment capture ponds have a limited ability to store runoff. However, a network of sediment capture ponds distributed across the landscape may have a significant ability to store runoff, especially during dry conditions when the ponds are empty and have an ability to retain added precipitation. As is the case with any pond, the ability to store additional runoff is limited by size and antecedent wetness.
	Slow Runoff	Medium	The sediment capturing ability of ponds is based on a slowing of water velocity. Thus, this measure will have a localized ability to slow runoff. Multiple ponds distributed across the forest landscape might have a significant ability to slow runoff during drier periods but will probably have limited effectiveness during spring snowmelt.
	Store River Water	Low	It is questionable whether or not it is appropriate to state that sediment capture ponds store or slow river water as their use is limited to ditch networks and potentially headwater streams. However, within these smaller watercourses, sediment capture ponds will both store and slow water.
	Slow River Water	Low	
Reducing Runoff	Increase Evapotranspiration	None	
	Increase Infiltration and/or groundwater recharge	Low	Because sediment capture ponds will store and slow water, they have some limited potential to increase infiltration and groundwater recharge. Increased infiltration because of slower water flows can also have some benefits for soil water retention.
	Increase soil water retention	Low	
Reducing Pollution	Reduce pollutant sources	High	Much of the water pollution in managed forests is associated with particulate matter. Suspended sediment can be a major water pollutant, as can phosphorus and heavy metals transported with suspended material. By slowing water velocity in forest ditches, sediment capture ponds can help to reduce pollutant sources in the managed forest landscape.
	Intercept pollution pathways	High	The key design focus of sediment capture ponds is to intercept pollution associated with particulate matter mobilization during forest management activities and to prevent it reaching receiving waters.
Soil Conservation	Reduce erosion and/or sediment delivery	High	The key purpose of sediment capture ponds is to reduce the delivery of sediment from managed forests to receiving waterbodies. Sediment capture ponds may have a limited ability to reduce bank erosion by slowing flow velocities but their primary focus is to limit sediment delivery.

	Improve soils	None	
Creating Habitat	Create aquatic habitat	Low	While the primary purpose of sediment capture ponds is not the creation of aquatic habitat, some additional habitat will be created but it will be gradually lost as the pond is filled with sediment. Sediment capture ponds have a much stronger effect of preserving downstream aquatic habitat by preventing sediment pollution which can lead to smothering of spawning beds or eutrophication.
	Create riparian habitat	None	
	Create terrestrial habitat	None	
Climate Alteration	Enhance precipitation	None	
	Reduce peak temperature	None	
	Absorb and/or retain CO_2	Negative	There is a possibility for increased greenhouse gas emissions from sediment capture ponds associated with the breakdown of organic sediments. Sediment capture ponds may release CO_2, methane, and potentially N_2O. This phenomenon of pollution swapping where a reduction of surface water pollution contributes to an increase in greenhouse gas emissions is a wide but under-appreciated problem with measures that keep water on the landscape.

VI. Ecosystem Services Benefits

Ecosystem Services		Rating	Evidence
Provisioning	Water Storage	Medium	Because of their small size, sediment capture ponds can only be considered to have low to moderate water storage potential.
	Fish stocks and recruiting	High	If sediment capture ponds function correctly, they will prevent inputs of sediment to water bodies that may have adverse effects on spawning habitat.
	Natural biomass production	None	
Regulatory and Maintenance	Biodiversity preservation	High	If sediment capture ponds function correctly, they will prevent inputs of sediment to water bodies that may have adverse effects on spawning habitat and habitat for species such as freshwater pearl mussel.
	Climate change adaptation and mitigation	Low	Sediment capture ponds may emit excess greenhouse gases under some circumstances depending on oxygen concentration in the water and amount of organic matter. Low ambient oxygen concentrations and high nitrogen concentrations or large amounts of fresh leaf litter and other easily decomposed carbon sources may lead to production of greenhouse gases such as methane and N_2O.

	Groundwater / aquifer recharge	Low	Since sediment capture ponds slow the transit of water through the forest landscape, they may have some ability to improve groundwater or aquifer recharge.
	Flood risk reduction	Medium	Because of their small size, sediment capture ponds can only be considered to have moderate potential for flood risk reduction. However, multiple ponds spread throughout a forest may play an appreciable role in flood risk reduction by providing additional water holding capacity in the landscape.
	Erosion / sediment control	High	The primary purpose of sediment capture ponds is to control sediment transport in the forest landscape. Sediment capture ponds will limit the transport of suspended material in forest ditches, thereby contributing to a reduction in pollution of downstream watercourses.
	Filtration of pollutants	High	Because they slow the velocity of water in forest ditch networks and allow suspended material to sink out of the water column, sediment capture ponds can act to filter pollutants such as phosphorus and heavy metals which are associated with suspended materials.
Cultural	Recreational opportunities	None	
	Aesthetic / cultural value	None	
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 biological quality elements	Low	The primary purpose of sediment capture ponds is to prevent deterioration in water quality associated with forest management. Thus, they have a relatively low ability to improve biological, physic-chemical, hydromorphological or priority substance status of WFD water bodies.
	Improving status of physico-chemical quality elements	Low	
	Improving status of hydromorphological quality elements	Low	

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	Improving chemical status and priority substances	Low	
Achieve Good GW Status	Improved quantitative status	None	
	Improved chemical status	None	
Prevent Deterioration	Prevent surface water status deterioration	High	The primary purpose of sediment capture ponds is to reduce the potential for surface water status deterioration associated with forest management activities. Sediment mobilization associated with final felling, road construction or ditch maintenance can have adverse impacts on downstream water courses. Biological quality may be impaired through loss of habitat, and physico-chemical elements, especially those associated with eutrophication, may also be compromised.
	Prevent groundwater status deterioration	None	
Floods Directive			
Take adequate and co-ordinated measures to reduce flood risks		Low	Flood risk reduction is not the primary purpose of sediment capture ponds. However, networks of ponds in a forest may help to reduce flood risk by acting as a spatially extensive green infrastructure which is capable of retaining additional water on the landscape.
Habitats and Birds Directives			
Protection of Important Habitats		Low	Sediment capture ponds can protect habitat by preventing sediment transport associated with forest management activities. Sediment produced during forest management can negatively affect fish and invertebrate habitat. Excessive inputs of fine sediments to rivers can lead to the smothering of fish spawning habitat and extirpation of species such as freshwater pearl mussel.
2020 Biodiversity Strategy			
Better protection for ecosystems and more use of Green Infrastructure		Medium	Sediment capture ponds will protect surface water ecosystems in managed forests by preventing the deterioration in water quality and physical habitat associated with sediment pollution. Networks of sediment capture ponds in the forest landscape can be a form of extensive green infrastructure contributing to flood risk reduction.
More sustainable agriculture and forestry		High	The direct effect of sediment capture ponds is to reduce the potential for negative effects associated with sediment mobilization due to forest management activities. By reducing one dimension of the environmental footprint of forestry, sediment capture ponds contribute to more sustainable land management.
Better management of fish stocks		Medium	If sediment capture ponds can prevent the transport of particulate material produced during forest management operations, they can help to avoid damage to spawning habitat caused by excessive inputs of fine particulate

		material. When riverine spawning habitats are subject to excessive inputs of fine sediment, the exchange of water between the sediment and the water column is reduced, leading to a reduction of oxygen concentrations in the sediment and smothering of spawning habitat. If too much of the available spawning habitat is smothered, fish may be extirpated from the region.
Prevention of biodiversity loss	Medium	Sediment capture ponds can help to prevent aquatic biodiversity loss associated with the mobilization of fine sediments which later smother fish spawning or invertebrate habitat.

VIII. Design Guidance

Design Parameters	Evidence
Dimensions	Sediment capture ponds are generally small scale (10s of metres) water features in forest ditch networks.
Space required	A relatively small amount of the total landscape is needed for installation of sediment capture ponds in an existing ditch network.
Location	Most often sedimentation ponds are located on the main ditch before its inflow into watercourse. Exact location of the pond depends on specific conditions and gradient of the ditch and river. If the distance between the pond and river is too small, there is a risk of turbulent water movement from the river increasing transport of suspended solids. Ideally, multiple ponds will be located in the forest ditch network. This may help to reduce sediment load on individual pond and increase their efficiency and lifespan.
Site and slope stability	This measure is most suitable for managed forests in northern and central Europe. Such forests are generally not in areas of high relief (not in mountains) and their productivity is improved if water can be removed from the landscape. The primary purpose of ditch networks in such forests is to remove water from the landscape more rapidly than would be accomplished using natural drainage. Sediment capture ponds can help to reduce some of the adverse water quality effects of forest drainage an drainage system maintenance by reducing the mobilization and transport of particulate material which could pollute downstream watercourses.
Soils and groundwater	
Pre-treatment requirements	
Synergies with Other Measures	Sediment capture ponds can be combined with other forest measures including riparian buffers, continuous cover forestry, peak flow control structures and overland flow areas to minimize the negative environmental consequences of forest management activities.

IX. Cost

Cost Category	Cost Range	Evidence
Land Acquisition	None	There is no land acquisition cost associated with this measure
Investigations & Studies	None	No investigations or studies are required before implementation of this measure.
Capital Costs	Low	There will be slightly higher costs associated with creation of ditch networks when sediment capture ponds are present as the volume of material excavated will be slightly larger than it would be if no ponds were created.
Maintenance Costs	Low	There are maintenance costs associated with dredging of sediment capture ponds. The frequency of dredging will depend on the sediment load in the ditches.
Additional Costs	Low	Because sediment capture ponds are an areal feature, they will remove some (very small) fraction of the available forest land from production, having an impact on the total income per unit forest area.

X. Governance and Implementation

Requirement	Evidence
n/a	

XI. Incentives supporting the financing of the NWRM

Type	Evidence
n/a	

XII. References

Reference	Comments
Neary, Daniel G., George G. Ice, and C. Rhett Jackson. "Linkages between forest soils and water quality and quantity." Forest Ecology and Management258.10 (2009): 2269-2281.	Good general reference on forest water issues
Planinšek, Špela, et al. "Adjustment of forest management strategies to changing climate." Forest Management and the Water Cycle. Springer Netherlands, 2011. 313-329.	Good review of Finnish literature on sediment capture ponds

Joensuu, Samuli. 2002. Effects of ditch network maintenance and sedimentation ponds on export loads of suspended solids and nutrients from peatland forests. Finnish Forest Research Institute Research Papers 86, 59 p.	Dissertation on the effects of ditch network maintenance in Finland
Marttila, Hannu. 2010. Managig erosion, sediment transport and water quality in drained peatland catchments. Acta Universitatis Ouluensis C Technica 375, 93 p.	Dissertation on sediment transport processes and possible methods applicable for water quality improvement.
Joensuu, S., Ahti, E. and Vuollekoski, M. 1999. The effects of peatland forest ditch maintenance on suspended solids in runoff. Boreal Environmental Research 4: 343–355	Study on effects of ditch network maintenance and effectiveness of sediment capture ponds