European Commission

Natural Water Retention Measures

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# Individual NWRM

## Buffer strips and hedges

Environment

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# I. NWRM Description

Buffer strips are areas of natural vegetation cover (grass, bushes or trees) at the margin of fields, arable land, transport infrastructures and water courses. They can have several different configurations of vegetation found on them varying from simply grass to combinations of grass, trees, and shrubs. Due to their permanent vegetation, buffer strips offer good conditions for effective water infiltration and slowing surface flow; they therefore promote the natural retention of water. They can also significantly reduce the amount of suspended solids, nitrates and phosphates originating from agricultural run-off. Buffer strips can be sited in riparian zones, or away from water bodies as field margins, headlands or within fields (e.g. beetle banks). Hedges across long, steep slopes may reduce soil erosion as they intercept and slow surface run-off water before it builds into damaging flow, particularly where there is a margin or buffer strip alongside.

# II. Illustration


**Illustration 1: Hedgerow (UK)**

*Source*: http://www.bbc.co.uk/nature/habitats/hedge

**Illustration 2: Example of beetle bank (UK)**

*Source:* http://commons.wikimedia.org/wiki/File:On_Fox_Hill_-_geograph.org.uk_-_816223.jpg?

# III.Geographic Applicability

| Land Use | Applicability | Evidence |
|---|---|---|
| Artificial Surfaces | No | Not applicable |
| Agricultural Areas | Yes | Applicable to all agricultural land uses: arable land; permanent crops; pastures; heterogeneous agricultural areas. |
| Forests and Semi-Natural Areas | No | Not applicable |
| Wetlands | No | Not applicable |

| Region | Applicability | Evidence |
|---|---|---|
| Western Europe | Yes | Data on the uptake of buffer strip measures (e.g. under the RDP) is not available, but they are applicable across a range of land use types. The measure includes riparian buffer strips, field margins and headlands, beetle banks and hedgerows. |
| 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 | This measure operates and field/farm scale. | | | | | |

# V. Biophysical Impacts

| Biophysical Impacts | | Rating | Evidence |
|---|---|---|---|
| Slowing & Storing Runoff | Store Runoff | None | |
| | Slow Runoff | High | Borin et al (2010) report on a study in Padova, Italy, in which a 6m wider buffer strip of trees and shrubs reduced runoff by 78% compared to no buffer strip, this was equivalent to a runoff depth of 231mm over 5 years.<br><br>CORPEN (2007) report that a 10m buffer strip can reduce runoff by at least 50%.<br><br>The Heilbronn field margins case study (Stuttgart, Germany) reports that runoff was reduced by 20% |
| | Store River Water | None | |
| | Slow River Water | None | |
| Reducing Runoff | Increase Evapotranspiration | Medium | The greater density of leaf area in buffer strip vegetation (whether grass or woody plants) should result in greater evapotranspiration compared to similar areas of pasture or arable crops. Total potential will reflect the relative size of the buffer strips. |
| | Increase Infiltration and/or groundwater recharge | Low | Interception of runoff will result in higher infiltration, aided by the root structure and improved structure of buffer strip soils. However, this will reflect the relative size of the buffer strip. |
| | Increase soil water retention | Medium | Soil water retention will be increased due to the root structure and improved structure of buffer strip soils. However, this will reflect the relative size of the buffer strip. |
| Reducin | Reduce pollutant sources | None | |

## A2: Buffer strips and hedges

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|---|---|---|---|
| | Intercept pollution pathways | Medium | JRC (2013) report the following impacts on runoff of 5m buffer strips:<br>• 15-20% P reduction (10% for pastures)<br>In hilly areas these impacts are:<br>• 42-96% P reduction<br>• 27-81% N reduction<br>• 83-90% organic matter<br><br>Borin et al (2010) report on a study in Padova, Italy, in which a 6m wider buffer strip of trees and shrubs reduced pollutant loads:<br>• 74% total N reduction<br>• 80% total P reduction (soluble P concentrations were unmodified) |
| Soil Conservation | Reduce erosion and/or sediment delivery | High | Buffer strips provide both covering vegetation and can trap/filter sediments from surface flow.<br><br>JRC (2013) report that a 5m buffer strip in a 'hilly area' reduced sediment by 55-97%<br><br>Borin et al (2010) report that a 6m buffer strip reduced total suspended solids by 94%. |
| | Improve soils | Low | Buffer strips can reduce risks to soil such as compaction and poaching by livestock. The extent of these benefits is reduced by the relatively small area covered and its removal from production. |
| Creating Habitat | Create aquatic habitat | None | |
| | Create riparian habitat | None | |
| | Create terrestrial habitat | Medium | Buffer strips can be managed (cutting regimes etc.) to directly provide habitats for a range of plant and animal species. They also have a role in providing habitat connectivity. |
| Climate Alteration | Enhance precipitation | None | |
| | Reduce peak temperature | None | |
| | Absorb and/or retain $CO_2$ | Medium | Buffer strips can increase $CO_2$ absorption through both increased biomass and reducing losses from soils. |

# VI. Ecosystem Services Benefits

| Ecosystem Services | | Rating | Evidence |
|---|---|---|---|
| Provisioning | Food provision | Low | Buffer strips take land out of production but can provide a number of benefits to adjacent crops, e.g. habitats for pollinators and pest predators; slowing runoff;' reducing wind and water erosion. |
| | Water Storage | None | |
| | Fish stocks and recruiting | None | |
| | Natural biomass production | Low | Buffer strips, particular when consisting of woody plants (e.g hedgerows), can increase natural biomass production. |
| Regulatory and Maintenance | Biodiversity preservation | Low | Buffer strips can be managed (cutting regimes etc.) to directly provide habitats for a range of plant and animal species. They also have a role in providing habitat connectivity.<br>The Heilbronn field margins case study found that the density of earthworms in the field margins was double that in neighbouring fields. |
| | Climate change adaptation and mitigation | Medium | Buffer strips can increase CO2 absorption through both increased biomass and reducing losses from soils. |
| | Groundwater / aquifer recharge | Medium | Interception of runoff will result in higher infiltration, aided by the root structure and improved structure of buffer strip soils. However, this will reflect the relative size of the buffer strip. |
| | Flood risk reduction | High | Flood risk can be reduced through interception and reduction of runoff. |
| | Erosion / sediment control | High | Erosion and sediments are controlled both through reduction of runoff and filtration by buffer strip vegetation:<br>• JRC (2013) report that a 5m buffer strip in a 'hilly area' reduced sediment by 55-97%<br>• Borin et al (2010) report that a 6m buffer strip reduced total suspended solids by 94% |
| | Filtration of pollutants | High | Buffer strips can be very effective in filtering pollutants:<br>JRC (2013) report the following impacts on runoff of 5m buffer strips:<br>• 15-20% P reduction (10% for pastures)<br>In hilly areas these impacts are: |

| | | | |
|---|---|---|---|
| | | | • 42-96% P reduction<br>• 27-81% N reduction<br>Borin et al (2010) report an 80% reduction in total P by a 6m wide buffer strip, however soluble P was unmodified. |
| 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 | Buffer strips can contribute towards reducing nutrient inputs into water bodies. Shruby riparian buffer strips can provide shading of water during summer months. |
| | Improving status of physico-chemical quality elements | Low | Buffer strips contribute to this objective by filtering nutrient and particulate inputs from agricultural land. |
| | Improving status of hydromorphological quality elements | Medium | Buffer strips contribute towards this objective by intercepting and slowing runoff. |
| | Improving chemical status and priority substances | Low | By slowing and filtering runoff, buffer strips may reduce the levels of priority substances (e.g. plant protection products) entering water bodies. |
| Achieve Good GW Status | Improved quantitative status | Low | By slowing surface flow combined with soil and root structures, buffer strips may improve infiltration and ground water recharge. |
| | Improved chemical status | Low | Buffer strips may increase the filtration of pollutants. |

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|---|---|---|---|
| Prevent Deterioration | Prevent surface water status deterioration | High | Buffer strips can contribute towards this objective by slowing and reducing runoff and increasing the filtration of pollutants. |
| | Prevent groundwater status deterioration | Medium | Buffer strips can contribute towards this objective by increasing infiltration of water and filtering pollutants. |
| **Floods Directive** | | | |
| Take adequate and co-ordinated measures to reduce flood risks | | High | Buffer strips can contribute towards reducing flood risk by slowing runoff, thus attenuating peak flows. |
| **Habitats and Birds Directives** | | | |
| Protection of Important Habitats | | Low | Buffer strips can offer habitats to a range of plant, animal and bird species and associated ecosystems, but this requires appropriate management, e.g. cutting times and frequencies. |
| **2020 Biodiversity Strategy** | | | |
| Better protection for ecosystems and more use of Green Infrastructure | | High | Buffer strips contribute directly to habitat provision, and indirectly by providing connectivity between habitats. |
| More sustainable agriculture and forestry | | High | Buffer strips can contribute towards sustainable agriculture both by reducing the negative impacts of agricultural activity, and by providing habitats of pollinators and bio-control species. They can also reduce risks and impacts of water and wind erosion. |
| Better management of fish stocks | | Low | Buffer strips can contribute to this objective by mitigating the potential for eutrophication of fresh and marine waters. |
| Prevention of biodiversity loss | | High | Buffer strips contribute towards this objective by providing habitats and habitat connectivity. |

## VIII. Design Guidance

This measure covers a number of distinct sub-measures each of which has its own set of design requirements.

| Design Parameters | Evidence |
|---|---|
| Dimensions | There are a variety of buffer strip types, the dimensions of which differ according to location and vegetation type. Requirements for buffer zones also vary across member states, with width ranging from 0.6 to 20m.<br>Riparian Buffer strips and field margins:<br>The effectiveness of any particular buffer strip will depend on its design and context. For example on slopes of less than 7° (medium, chalk and limestone soils) or 11° (sandy and light silty soils) a 6m buffer strip may be sufficient to slow surface flow, on higher slopes a 12m buffer strip might be required (Natural England, 2011).<br>Beetle banks:<br>Natural England (2010a) describe beetle banks as being ridges of between 2m and 4m width and 0.4m high, planted with perennial tussock forming grass. Care is required in positioning beetle banks to avoid channelling of surface water that might exacerbate soil erosion. |
| Space required | |
| Location | |
| Site and slope stability | |
| Soils and groundwater | |
| Pre-treatment requirements | |
| Synergies with Other Measures | The adjacent land-use, i.e. arable or pasture, will impact on the effectiveness of buffer strips. |

## IX. Cost

| Cost Category | Cost Range | Evidence |
|---|---|---|
| Land Acquisition | 0 | No change in land ownership |
| Investigations & Studies | 0 | Measure does not require pre-implementation studies |

| | | |
|---|---|---|
| Capital Costs | 400 to 800 €/ha<br><br>€454<br>(€13 to €865)<br><br><br>€4.73/m<br>€5.08/m<br>€9.45/m<br><br>€140000/yr<br><br><br><br><br><br><br><br><br>€75000 | Establishment of 3m buffer strip (European Commission, 2006)<br><br>Mean and range 2007-13 RDP payment Rates for field margin creation (European Commission, 2011)<br><br>Hedgerow planting and maintenance capital costs (Scottish Government, no date)<br>Planting or replanting a hedge<br>Coppicing a hedge<br>Relaying a hedge<br><br>The Heilbronn field margins case study reports this as the total programme cost including €601/ha compensation payments to 94 farmers to cover loss of gross margin.<br>Field margin establishment costs were:<br>Field margins = €1250/ha + seeds<br>Field margins (fallow land) = €1170/ha<br>Field margin with row of trees = €1740/ha + trees<br>Field margins with a hedge = €2900/ha + plants<br><br>The case study on flood breaking hedgerows in the Lèze River Basin in Southern France reports this as the total costs for 3500m of newly planted hedgerow covering 35000ha. |
| Maintenance Costs | 75 to 150 €/ha<br><br><br>€63.75/100m | Maintaining a 3m buffer strip (European Commission, 2006)<br><br><br>Management of hedgerows (Natural England, 2010) |
| Additional Costs | €140/ha/yr | Loss of revenue from arable (European Commission, 2006) |

## X. Governance and Implementation

| **Requirement** | **Evidence** |
|---|---|
| Support for buffer strips should be better targeted. | JRC (2013) notes a variety of barriers to uptake of buffer strips, which reflect the balance between compulsion and voluntary implementation. In Denmark, buffer strips are unpopular as they are mandatory. This may mean that design and management is suboptimal. In Poland 20m buffers strips are required within NVZs and are considered to have a high opportunity cost. Outside of NVZs in Poland the level of support is not sufficient to encourage uptake. In contrast, uptake in Scotland is high, but support is not targeted at areas where impacts would be highest. |

# XI. Incentives supporting the financing of the NWRM

| Type | Evidence |
|---|---|
| CAP (Pillar I) 'greening' measures with respect to ecological focus areas. | Effective payment rate will depend on MS implementation of Pillar I and choice of greening measures. 'Buffer strips' (including buffer strips, field margins and beetle banks) and hedgerows are considered to be equivalent practices. |
| Rural Development Programme (Pillar II) measures might include payments for converting arable to permanent pasture and reducing the intensity of inputs and stocking levels | Payment rates are based on income forgone/cost incurred and will vary across MS |

# XII. References


| Reference |
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