NATURAL FLOOD MANAGEMENT

A practical guide for landowners in the Derbyshire Derwent catchment

ACKNOWLEDGEMENTS

This guide provides information on Natural Flood Management (NFM) measures for landowners and land managers in the River Derwent catchment, Derbyshire.

The document is based on the publication 'Natural Flood Management Measures – a practical guide for farmers (2017)'.

All information contained in this publication – including links to websites and further reading – is believed to be correct at the time of going to press.

Natural flood management measures form part of the Derwent Living Forest vision, where 30,000 hectares of wetland and wooded habitats will be created by 2050. This will provide connectivity for the movement of species between the National Forest and planned Northern Forest. This connectivity will provide resilience against climate change and extreme weather events.

If you own or manage land in Derbyshire and would like to work with us on woodland creation or natural flood management measures, please get in touch at: **enquiries@derbyshirewt.co.uk**

Tell us:

- Your name
- Contact details (an email address or phone number)
- Location of your land (please provide a grid reference, postcode or What3Words)
- Current land use
- Size of your land (less than 1 ha, 1–5 ha, 5–10 ha, over 10 ha)
- Do you own the land? (If you help manage the land do you have contact details for the owner?)

A staff member will be in contact with you to arrange a site visit and discuss funding for your project.

WORKING TOGETHER IN PARTNERSHIP

nature returns

HM Government · Natural England · Environment Agency · Forestry Commission · Kew · Derbyshire Wildlife Trust · Freshwater Habitats Trust · Gloucestershire Wildlife Trust · Groundwork · National Trust · Plymouth · Derbyshire Derwent Catchment Partnership

Working together to build the evidence for nature-based solutions to climate change and biodiversity loss

INTRODUCTION

Derwent at Cromford Mill © Wesley Mallin

Floods are nothing new. Humans have lived with extreme weather for thousands of years. However, climate change is causing an increase in occurrence and severity of extreme weather events. Subsequent increases in both flooding and drought will occur.

Within the UK, our flood defence system includes large-scale, hard engineered solutions in and around major cities, and flood banks; small-scale engineered solutions for rural communities and farmland; and coastal engineering. There is increasing political and public interest in how the management of the wider countryside can contribute to the UK's flood defence system, particularly through NFM.

Ladybower Reservoir © Kayleigh Wright

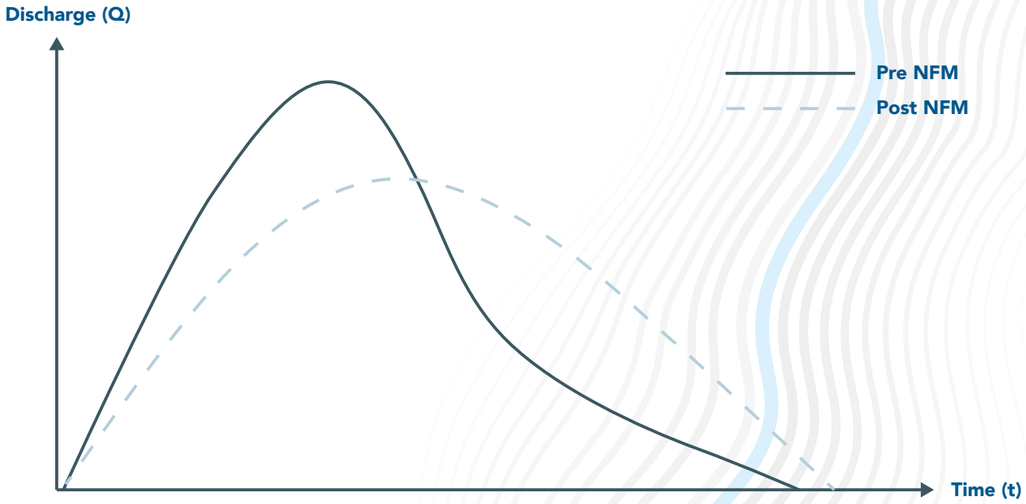
Low water levels Derwent Reservoir

Flooding in Derby City Centre 2023 © Dan Blake

WHAT IS NATURAL FLOOD MANAGEMENT?

Natural flood management aims to **reduce the downstream flood peak**, the maximum water height of a flood, or to **delay** the arrival of the flood peak downstream, increasing the time available to prepare for floods.

This is achieved by restricting the progress of water through a catchment, using a range of physical interventions. These interventions work with the natural features of the catchment to slow down or store flood waters.



NFM relies on one, or a combination, of the following underlying mechanisms:

- **Increasing soil infiltration:** free-draining soil will make prolonged saturation less likely and reduce surface runoff
- **Evaporation** from increased vegetation can make space for more water. Vegetation also provides beneficial shading
- **Slowing water** by increasing resistance to its flow – for example, by planting floodplain or riverside woods, or blocking grips on moorland
- **Storing water** by using, and maintaining the capacity of, ponds, scrapes or previous river channels
- **Reducing surface water runoff** by interrupting surface flow pathways – for example, by planting buffer strips of hedges or trees.

Natural flood management structures can be designed so that they **do not** significantly impact on existing land use. They can be **small in size** and considered an extension to the existing land drainage system.

Each structure or technique provides runoff storage or attenuation, gradually releasing flood water over 12 to 24 hours. It is the collective network, rather than individual features, that aims to provide flood mitigation in the immediate vicinity and further downstream.

Natural flood management is not the complete solution to flooding, but is one of many tools needed to manage flood events. These tools are more effective at reducing the frequency of flooding for high probability fluvial events (for example, less than a 1 in 20-year return period) compared to extreme events (for example, a 1 in 200-year return period). Used in conjunction with other flood management solutions, like hard engineering, natural flood management will have a beneficial impact on reducing and slowing the flow of flood water downstream. Research at a number of catchments has shown this to be the case.

NFM IN THE DERWENT CATCHMENT

The frequency and intensity of flood events is increasing in the Derwent catchment due to climate change and other factors. Recently, there have been severe and record breaking floods in November 2019, February 2020, February 2022 and October 2023.

NFM can play its part by introducing practical measures which work with natural processes to slow down water flow and retain water in the landscape. This is important within the Derwent catchment as it has the potential to provide a range of benefits to land managers/owners, the landscape and the wider community.

Flooding in Matlock © DCC

BENEFITS FOR LAND OWNERS:

- ✔ Reduction in soil loss
- ✔ Increased stability of the soil, and river banks
- ✔ Increased soil fertility, and reduced runoff, reducing costs
- ✔ Additional benefits, including drought resilience, carbon storage, biodiversity gain and amenity value
- ✔ Improved water quality for stock and wildlife

BENEFITS FOR LANDSCAPE AND SOCIETY:

- ✔ Improvement of water quality
- ✔ Reduction in sediment and pollution downstream
- ✔ Economic benefits from higher landscape quality, such as tourism, business investment and diversification
- ✔ Better opportunities for outdoor recreation, and the associated health and wellbeing benefits
- ✔ Creation of environments more resilient to climate change and extreme weather events

Tree planting in the Derwent catchment © Ady Cox

Leaky dam in the Derwent catchment © Dan Blake

OPPORTUNITIES WITHIN THE DERWENT CATCHMENT

1. Headwater/Moorland Blocks & Dams
2. Sustainable Woodland
3. Cover Crop
4. Leaky Wooden Dam
5. Orchard
6. Flow Pathway Bund
7. Scrub
8. Hedgerows & Dry Stone Walls
9. Soil Management
10. Mixed Species Herbal Ley
11. Storage Ponds (Online & Offline)
12. Wetland & Wet Woodland
13. Wood Pasture
14. Swales & Cross Drains
15. Floodplain Restoration & Riparian Planting

USING THIS GUIDE

This guide has been developed to provide the advice and key information needed to aid decision-making, should you wish to install flood management features on your land. We have included further resources to support the work you may want to undertake.

The various measures have been ordered to broadly align with the opportunities diagram.

Approximate installation costs, maintenance costs and maintenance levels are also shown as follows:

INSTALLATION COSTS

LOW

Land manager can implement system with minimal advice, equipment, and specialist material.

MEDIUM

Requires some raw materials, specialist equipment, and/or expert involvement.

HIGH

Requires significant raw materials, specialist equipment, and/or expert involvement.

MAINTENANCE COSTS

LOW

Mostly involves routine inspections and low-grade management, which can be undertaken by the land manager.

MEDIUM

Expert advice or equipment required occasionally (e.g. < 10 yrs).

HIGH

Expert advice or equipment required frequently (e.g. < 5 yrs).

LEVELS OF MAINTENANCE

LOW

Intervention requires minimal maintenance. Natural processes should dominate over time.

MEDIUM

Some maintenance likely for a number of years including ocassional practical activities or inspections.

HIGH

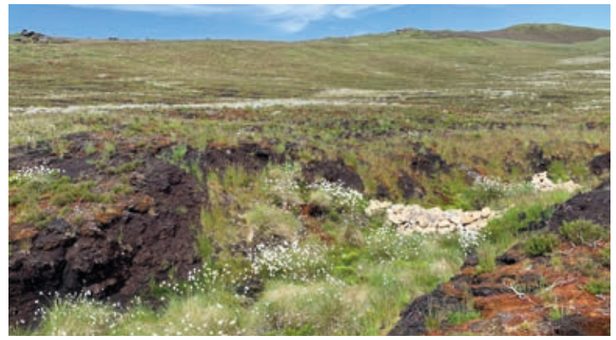
Regular maintenance is likely for a number of years.

NFM pond in Leicestershire © Environment Agency

HEADWATER/MOORLAND BLOCKS AND DAMS

A series of dams can be used to block grips (man-made drainage channels) and gully systems (naturally occurring drainage channels) in moorland areas. This raises the water table, creating a habitat for plant species, especially Sphagnum mosses, which help the bog act as a water storage facility. This work is often undertaken in conjunction with work to restabilise blanket bog which may require revegetation and inoculation with moorland species. Gully blocking is particularly applicable on drained moorland and in grips or gullies that are actively eroding.

Blocking of grips and gullies aims to convert traditionally drained moorland back to active blanket bog. This reduces runoff and slows water and stores during flood events.



Gully with stone dams on the roaches © Environment Agency

HOW

Different types of dams can be used. These include heather bales, machine-built peat dams, plastic dams, stone dams and timber dams. Moorland species including sphagnum mosses may be planted afterwards.

CONSTRUCTION CONSIDERATIONS

- Can alter access to moorland
- Blocks and dams will require land drainage consent from the Lead Local Flood Authority

BENEFITS

- Slows the flow of water, raising the water table
- Re-wetting reduces severity of wildfire
- Reduced soil erosion and reduced transfer of sediment into rivers
- Can reduce the need for hard-engineered flood risk measures lower down in the catchment.

KEY LOCATIONS

Upper catchment, in areas of drained and eroded moorland.

COSTS

Set-up: MEDIUM

Maintenance: LOW

Cost is dependent on scale and complexity. Will require specialist help for a technical assessment before installation. Regional peatland restoration partnerships can advise on funding for these interventions.

LEVEL OF MAINTENANCE

LOW

Well-implemented grip and gully blocking work requires minimal maintenance. Periodic inspection of some dam types may be beneficial. In bare peat areas on blanket bogs, revegetation of gullies and grips, in addition to blocking, is encouraged.

SUSTAINABLE WOODLAND

Well-sited and well-managed upland, floodplain and riparian woodland can provide a wealth of benefits. They offer important wildlife habitat, and increased canopy shade and shelter for water-based flora and fauna. They can also provide shade and shelter for livestock, and prevent damage to crops and soil erosion.

There is growing interest in the potential to use woodland measures to help reduce flood risk. The Forestry Commission has been directly involved in a number of trials and demonstration projects. These projects have shown that looking after existing native woodlands and plantations, and targeting certain areas for tree planting, will significantly slow overland flow of water and reduce riverbank erosion within that area.

The roots of trees and associated vegetation help to bind and strengthen stream banks, reducing the risk of bank collapse, erosion and siltation.

Tree Planting © PP

HOW

Planting of trees increases the roughness of the vegetation, slowing the flow of water during a flood event.

It reduces the volume of runoff by promoting rainfall infiltration into the soil and reducing the rate of runoff.

Well-managed woodland cover can increase the capture and evaporation of rainfall.

Interception can reduce the amount of rainfall reaching the ground by as much as 45%, or more for some types of woodland. A reduction of even half of this amount could therefore make a major contribution to flood control.

CONSTRUCTION CONSIDERATIONS

- Planting new trees within 8m of a main river or within the flood plain may require a Flood Risk Activity Permit – please check with the Environment Agency
- Existing woodlands should ideally be fenced from livestock to encourage tree regeneration and increase vegetation under the canopy
- New planting will need protecting from livestock grazing
- Under-planting of shrubs and young tree saplings improves the infiltration rates of existing woodland
- For new areas, link up with existing woodland or hedgerows to create a wildlife corridor effect
- Works well alongside the leaky woody dam technique.

BENEFITS

- Creates areas of shelter and shade for livestock
- Reduces floodwater damage on productive farmland and can trap and filter runoff, preventing loss of fertilisers, sediment and pesticides.

KEY LOCATIONS

Throughout the catchment particularly upper catchment areas.

Across slopes following a contour.

Existing woodlands, plantations and shelter belts.

Alongside watercourses.

COSTS

Set-up: MEDIUM

Maintenance: LOW

LEVEL OF MAINTENANCE

MEDIUM

Initial maintenance tasks would include weeding, checking or straightening guards, and replacing failed trees as the woodland becomes established. Any plastic guards will need to be removed when the trees have established.

COVER CROPS

Winter cover crops are non-cash crops that can be grown on land that would otherwise be left bare over the winter months after harvest. They help to reduce nitrate leaching and may also reduce the risk of potential pollutants, such as sediment and nutrients being carried into neighboring watercourses.

Winter cover crops help to reduce overland flow, prevent soil erosion and increase the health and permeability of soil.

Winter crop cover © Paul Harris 2020VISION

HOW

Sow any plant that can grow throughout the winter. Do not destroy until immediately before establishment of following spring crop. You can use phacelia, vetch, ryegrass, grazing rye, barley and mustard, or a mix of these depending on local conditions and needs.

CONSTRUCTION CONSIDERATIONS

- Sow plants that have the ability to grow throughout the winter. Leaving crop residues throughout winter can also act to protect the soil surface and increase infiltration
- Deep-rooting plants will provide additional benefits by loosening compacted soils. Using cover crops may require altering the arable rotation away from winter drilling towards spring.

BENEFITS

- Slows runoff by increasing land roughness
- Conserves soil moisture
- Prevents soil erosion
- Returns nitrogen to the soil, reducing fertiliser costs
- Deep rooting plants will improve the soil quality over the years by loosening compacted soils, improving the nutrient content and increasing soil biological activity.

KEY LOCATIONS

Works well on arable or temporary grassland adjacent to watercourses, particularly on sloping fields. As well as areas where water is seen to flow across the surface in high rainfall events in lower parts of a catchment.

COSTS

Set-up: LOW

Maintenance: LOW

LEVEL OF MAINTENANCE

LOW

LEAKY WOODEN DAMS

Leaky wooden dams or leaky barriers can be constructed in a variety of locations across the catchment. These structures are often built from logs and woody materials and are placed in streams or ditches to hold back water. Where possible, these structures are designed to mimic the natural complexity of rivers and create a variety of habitats and flow conditions.

Leaky wooden dams slow and divert flood flows and allow increased infiltration of water into the soil. They are designed to slowly drain trapped water once the flood flow has passed. Leaky wooden dams are set above normal stream level so only flood flows are blocked. A network of leaky barriers work well on a local scale to control channel flows.

Leaky barrier at New Mills © Environment Agency

HOW

Large logs can be laid across small streams in a cross formation and staked or wedged into position. Smaller woody material can be wedged in between the large logs. To maximise impact, it is recommended to place more than one leaky barrier at different locations across the land holding.

If possible, use locally sourced wood from the catchment. Debris bundles can also be constructed in wooded areas to further roughen the surface of the floodplain and trap overland flows.

CONSTRUCTION CONSIDERATIONS

- Risk of woody material moving further downstream
- It is recommended to consider the potential impacts downstream and to follow design standards (such as those available from the Forestry Commission)
- Surrounding land may need to be capable of withstanding periodic flooding due to spillover when there is a high rainfall event
- Requires consent of Lead Local Flood Authority (LLFA) or the Environment Agency.

BENEFITS

- Delays flood peaks further downstream
- Traps sediment and water
- Can provide additional habitat for fish and invertebrates
- Low cost and effective
- Can be designed to incorporate a silt trap, improving water quality
- Reduces runoff.

KEY LOCATIONS

Throughout catchment, often alongside wooded areas in smaller watercourses. Leaky wooden dams work well alongside other woodland measures, such as understorey planting.

Leaky wooden dams can also be constructed in ditches in open farmland, as well as in small upland ditches in open land, away from woodland and flowing channels. Due to possible effects on fish passage, in-ditch barriers are more suited to small watercourses and ditches where fish passage is less important, or where the watercourse runs dry during the summer months.

COSTS

Set-up: MEDIUM

Maintenance: LOW

LEVEL OF MAINTENANCE

MEDIUM

May require periodic checking to ensure the integrity of the leaky dams and to remove any sediment or blockages where necessary. High longevity if well maintained and designed to encourage natural processes.

FLOW PATHWAY BUNDS

Flow pathway or contour bunds are low earth mounds that are built to follow the contour of the slope. These work most effectively when constructed across known runoff pathways which appear after heavy rainfall. Through creating the contour bund, a detention area is made, where water can be retained and allowed to disperse through a combination of infiltration into the soil, evaporation and slow release.

Detention basins can be designed so that the area is normally dry and can remain productive, as well as providing an opportunity for reclaiming soil and nutrients. Alternatively, they can be designed to encourage the development of wetland habitat by permanently retaining some water.

Creation of bunds across known runoff pathways can intercept water flowing over the ground, slow the flow and redirect runoff. Bunds can also be used to direct or control movement of animals and machinery away from compaction sensitive areas. Detention basins slow, store and filter water.

Contour Bund © PP

Sediment traps can also be integrated with flow pathway bunds. These are containment areas that purposely allow silt and sediment to settle. A sediment trap can be a single excavation with an inlet and an outlet, or a more complex series of chambers. Sediment traps are unlikely to provide significant flood prevention on their own, but provide very useful function when used in conjunction with other measures.

HOW

Design of bunds should take into account the natural contours of the surrounding land, the positioning in the landscape, and the soil type. Detention areas should be sized for the area draining into it. Specialist advice may be required.

CONSTRUCTION CONSIDERATIONS

- Design of the bunds or detention basin should be site-specific and carried out by a land drainage specialist
- The location of these solutions may well be suggested by the reaction of the landscape to heavy rainfall
- Consideration should be given to where the water would go if the storage area becomes full and the bund overtopped. These exceedance flowpaths should not create a new flood risk area
- Can impact livestock movements through fields
- Can make cutting and mowing practices more complex.

BENEFITS

- Directly intercepts and redirects runoff
- Reduces soil erosion and diffuse pollution
- If bunds are grassed and permanent, they can provide additional wildlife habitat
- Bunds can be engineered in such a way as to provide access to fields in times of flood which would otherwise be inaccessible
- Detention basins and sediment traps provide opportunity for nutrient and soil reclamation.

KEY LOCATIONS

Slopes prone to runoff during flood events. Areas where runoff with a heavy sediment load is known to compromise local drainage.

COSTS

Set-up: MEDIUM

Maintenance: MEDIUM

LEVEL OF MAINTENANCE

MEDIUM

Require regular inspection to ensure that they are intact and the area behind the bund is not filled with silt.

Dependent on the scale and design.

Arrangements for ongoing maintenance may need to be submitted as part of any planning application.

Sediment traps will require emptying and a waste exemption licence if re-spread onto land.

HEDGEROWS AND DRY STONE WALLS

Hedgerows are an intrinsic part of the landscape within many parts of the Derbyshire countryside and, along with dry-stone walls, act as field boundaries. Historically, many have been removed to allow larger parcels of land to be farmed. They act as a valuable shelter belt for both crops and livestock, and help reduce wind erosion of soils.

Hedgerows and dry stone walls provide habitat for many farmland birds and wildlife species, but also perform a natural flood management function by trapping sediment and slowing water flow between fields, similar to buffer strips.

Hedgerow © Chris Gomersall 2020VISION

HOW

Hedgerows reduce the volume of runoff by promoting rainfall infiltration into the soil and reducing the rate of runoff.

They remove water faster from the soil than crops during periods of excessive rainfall through increased evapotranspiration.

They trap sediment and reduce sediment flow into watercourse.

CONSTRUCTION CONSIDERATIONS

- New planting: plant a double staggered row hedge using 4–6 plants per metre, with a distance between the rows of 1–1.5m. Plant a varied row of trees between these hedging plants
- Tree guards may be required to protect young plants from rabbit damage. Protect both sides of a new hedge with a stock proof fence, erected at least 1m from the centre of the hedge
- Planting should be carried out between November and March. Up to 75% of the species can be thorns – for example, hawthorn and blackthorn. Consider a mix of shrub species, including hazel, guelder rose, rowan and holly, to enhance hedgerow for wildlife
- Planting should not be undertaken in freezing weather or waterlogged soils.

BENEFITS

- Creates areas of shelter and shade for livestock
- Trap and filter runoff, preventing loss of fertilisers, sediment and pesticides
- Animal health may also be improved through reductions in standing water from increased infiltration rates
- Limits spread of disease by reducing animal-to-animal contact
- Provides habitat for farmland birds and beneficial insects.

KEY LOCATIONS

Consider installing a new hedge and dry stone walls across slopes where runoff occurs or perpendicular to the river in a floodplain.

Where hedgerows or dry stone walls have been lost from an area or the network is very fragmented.

Restoration and management in areas where there are good networks of hedgerows and dry stone walls.

COSTS

Set-up: MEDIUM

Maintenance: MEDIUM

LEVEL OF MAINTENANCE

HIGH

Newly planted hedges will require annual maintenance until at least 1.5m tall, particularly with regard to weed control, cutting every two years from then on to ensure life of hedgerow. Cutting to a box shape will increase benefits for wildlife, as well as shelter for stock. The laying of hedge every 12–15 years will increase wildlife benefits and the overall health of the hedge. Potentially damaging vegetation should be removed as early as possible from dry stone walls. Stones which have been removed or dislodged should be replaced.

SOIL MANAGEMENT – REDUCING SOIL COMPACTION

Soil compaction occurs when soil is squashed into an impermeable layer. This can be caused by high livestock densities and the movement of farm machinery. Gateways, farm tracks, tramlines and water/food troughs are areas most at risk from compaction.

The effects of soil compaction can be detrimental to grass and root growth, reducing the ability of grass to pick up nutrients, particularly nitrogen and water, from the soil. It creates conditions for waterlogging and poaching and increases the risk of runoff, leading to soil and nutrient loss. Runoff can be around 60% higher than on healthy aerated soils. Wet soils stay colder for longer, reducing the number of available grazing days. They can also make harvesting difficult, which is likely to reduce the quality of the resulting silage.

Surface water flooding

HOW

Managing soil compaction is one of the most effective treatments farmers can undertake to reduce overland flow and lower flood risk. It can help to increase the amount of water held in the soil over a wide area.

CONSTRUCTION CONSIDERATIONS

Techniques include:

- Mechanically aerating soils using spiked aerators. Undertake minimal tillage for arable crops or when considering re-seeding
- Managing crop rotation and reducing livestock density through livestock rotation
- Avoiding use of heavy machinery on wet soils to further protect from compaction
- Creation of hardstanding areas or regular moving of feed and water troughs to help reduce localised soil compaction

BENEFITS

- Reduces runoff and soil compaction over a wide area
- Improved fertiliser uptake and reduced fertiliser input needed
- Promotes strong root growth
- More efficient crop growth
- Increased grass cover due to longer water availability
- Reduction of muddy areas in key locations
- Improves water quality by reducing runoff and soil loss into streams.

KEY LOCATIONS

Any field below the moorland line, particularly where water is seen to flow across the surface in high rainfall events. Also fields used for winter grazing.

COSTS

Set-up: LOW

Maintenance: LOW

LEVEL OF MAINTENANCE

LOW

SOIL MANAGEMENT – EROSION CONTROL

Different materials, such as fascines (bundles of sticks) and geotextiles, can be installed on slopes to stabilise areas at risk of erosion, and assist the establishment of vegetation. Additionally, in-field buffer strips can be grown along the boundary or across the middle of fields.

These features can strengthen slopes and riverbanks, trap sediment, reduce soil loss and provide a structure to allow additional vegetation to establish. They subsequently provide habitat for wildlife and form links between other habitats.

In Field Buffer © PP

HOW

Fascine structures can be made according to the scale of the slope or riverbank under management. They can be constructed in a series of rows on a slope, within an erosion scar or landslide, or as a bank running alongside a river or stream. Local woodland managers can provide fascines made from thinning.

Strips of dense and permeant vegetation along boundaries or across sloping fields can be created through seeding or allowing existing vegetation to grow. These can be mown to prevent scrub from forming.

CONSTRUCTION CONSIDERATIONS

- Can impact livestock movements through fields
- Features may need protecting from livestock
- For new areas, consider linking up with adjacent habitats to create wildlife corridor effect

BENEFITS

- Prevents agricultural chemicals, sediment and nutrients reaching the watercourse, reducing waste
- Can be designed to straighten irregular field edges, enhancing crop operations
- Can reduce effects of spray drift
- Reduces risk of erosion and loss of valuable topsoil
- Can reduce overland flow impacting roads and neighbouring propertiesf
- Allows establishment of vegetation for long-term stabilisation.

KEY LOCATIONS

Throughout catchment. Steep slopes, riverbanks, anywhere prone to erosion.

COSTS

Set-up: LOW

Maintenance: LOW

LEVEL OF MAINTENANCE

LOW

Inspection may be needed to ensure that the installation remains in place and that vegetation is re-establishing on the slope.

STORAGE PONDS (ONLINE AND OFFLINE)

Storage ponds are depressions that hold water with additional capacity for storm events. Online (in-stream) ponds are a depressions through which a water channel flows. They provide water storage capacity during storm events. The water slowly drains from the pond once the flood period has passed.

Offline flood water storage areas are depressions adjacent to water courses that are adapted to capture and store flood waters during periods of high flow. These are often situated within a flood plain, and can be designed to hold some water permanently, which may add to the wildlife value of the land.

Flood water is directed out of the watercourse and into a pre-constructed storage area. The flood water is then stored temporarily and is released back into the watercourse in a controlled manner. This provides extra storage capacity for water during flood events.

NFM storage pond in Leicestershire © Environment Agency

HOW

A suitable site needs to be selected. It is recommended to create an irregular shape for water storage, and inlets, outlets and spillways may need to be constructed. A liner may be required.

CONSTRUCTION CONSIDERATIONS

- Any works taking place within 8m of a main river or in the flood plain may require a Flood Risk Activity Permit from the Environment Agency. This distance increases to 16m if the activity involves excavation
- Online flood storage areas elsewhere will need land drainage consent from the Lead Local Flood Authority.

BENEFITS

- Removes sediment which can be reused on the farmland
- The depth and speed of drainage can be manipulated according to the needs of the farmer
- Can be a valuable community asset if well designed
- Provides rich wildlife habitat
- Retention of water is also beneficial in times of drought
- Reduces runoff
- Can be designed to incorporate a silt trap, improving water quality.

KEY LOCATIONS

Throughout the catchment near to watercourses. At the bottom of the slopes, particularly in fields draining to a single corner.

COSTS

Set-up: HIGH

Maintenance: LOW

LEVEL OF MAINTENANCE

MEDIUM

Requires maintenance for removal of sediment and debris, which can vary from monthly to yearly according to need and whether the pond has a sediment trap. Management of vegetation may also be required.

WETLAND

Wetlands are normally shallow ponds and marshy areas covered almost entirely in vegetation. They are designed to accept runoff water that otherwise may discharge into a watercourse and to hold it for long enough to allow sediments to settle and for pollutants to be removed through plant uptake and breakdown in the soil. Wetlands provide significant biodiversity benefits. Designs for wetlands vary widely and can range from single-celled wetlands to systems with multiple stages.

Wetlands can also act as a water storage area during times of flood, and can reduce the flood peak downstream.

Wetlands © Jenny Morley

HOW

Wetlands should be designed with a significant storage capacity. Seasonality should be considered when selecting plant species.

Wetlands should not be created in areas where they may pose a flood risk to nearby property .

CONSTRUCTION CONSIDERATIONS

- Any works taking place within 8m of a main river or in the flood plain may require a Flood Risk Activity Permit from the Environment Agency. This distance increases to 16m if the activity involves excavation
- Wetlands elsewhere which intercept watercourses will need land drainage consent from the Lead Local Flood Authority.

BENEFITS

- Effective removal of water contaminants, including suspended solids and pathogens
- Retention of water year-round
- Can be a valuable community asset if well designed
- Possible creation of nature reserve and educational visits
- Provides rich wildlife habitat.

KEY LOCATIONS

Throughout catchment. Simple wetlands are more suited to a small-scale intervention plan on a single farm whereas more complex multi-staged wetlands can be designed in larger areas of the catchment.

COSTS

Set-up: HIGH

Maintenance: MEDIUM

Set-up cost is dependent on site, and specialist advice on funding may be needed.

LEVEL OF MAINTENANCE

MEDIUM

Requires regular checking and removal of sediment as required.

SWALES

Swales are linear, shallow, vegetated drainage features that convey and store surface water and provide the opportunity for infiltration and water treatment by encouraging settlement.

They can be built in combination with bund detention areas alongside roads and tracks, or on their own to contain and redirect water flow after heavy rain.

They are easily incorporated into the landscape, and the roughness of the vegetated channel helps to slow the flow of water. This can be reduced further by the introduction of check dams and berms within the swale.

Swale

HOW

Swales reduce runoff rates by slowing overland flow. They reduce volume of runoff by increasing the opportunity for infiltration and evaporation. Swales trap sediment and pollutants.

CONSTRUCTION CONSIDERATIONS

- Design of the swales should be site-specific and take into account the contours of the surrounding land, positioning in the landscape, and the soil type
- The location of these solutions may well be suggested by the reaction of the landscape to heavy rainfall.

BENEFITS

- Reduces soil loss and surface scour
- Intercepts, diverts and contains surface run-off
- Enables pollutant removal through sedimentation and vegetation uptake.

KEY LOCATIONS

Shallow slopes prone to runoff during flood events.

Areas where runoff with a heavy sediment load is known to compromise local drainage, including beside roads and tracks.

COSTS

Set-up: MEDIUM

Maintenance: LOW

LEVEL OF MAINTENANCE

LOW

Low, though some vegetation control may be required. Maintenance is increased by the addition of structures within the swale.

Removal of sediment and re-spreading onto land will require a waste exemption licence from the Environment Agency (EA).

CROSS DRAINS

Roads and tracks provide a significant transport pathway for water and sediment. This creates problems with erosion of the track and deposition of sediment on farmland, roads or watercourses. A cross drain is a system to move water across a path or route and can be used to collect runoff from a vulnerable area. Water can be diverted to places of vegetation to slow down the flow.

Cross drain © West Wolds Slow the Flow

HOW

Cross drains divert the main pathway of water, reducing flow volume, velocity and sediment load. When used with a sediment trap, they can slow the flow of storm water significantly.

CONSTRUCTION AND CONSIDERATIONS

- On steep slopes or where runoff volume is high, a number of cross drains will be required, located at specific intervals along the track
- Can be linked with swales and sediment traps alongside the track to encourage sediment to drop out of the water
- Also prevents sediment being washed onto grassland and into waterways. The size of the cross drain will depend on local conditions.

BENEFITS

- Roads and tracks suffer from less erosion and last longer
- Stone and sediment caught in traps can be re-used on the track, saving time and money
- Potentially reduces pooling of water at the end of the track.

KEY LOCATIONS

Tracks on steep hillsides, adjacent to yards or roads, or within close proximity of a watercourse.

COSTS

Set-up: LOW

Maintenance: LOW

LEVEL OF MAINTENANCE

MEDIUM

Cross drains should be inspected, cleaned out, or reshaped to original capacity after each major storm.

FLOODPLAIN RECONNECTION AND RESTORATION

Reconnecting and restoring rivers and floodplains to more natural states may involve reversing or removing previous hard-engineering structures. Works can also include the restoration of meanders, removal of embankments, restoration of original river shape and revegetation with native species.

Restored floodplains enhance the natural water retention capacity and function of the river and surrounding land. The aims are to connect the river with its floodplain, to slow the flow, retain water for longer, and reduce erosion caused by unnatural river behaviour.

Floodplain restoration in Lincolnshire © Dan Blake

HOW

River and floodplain restoration generally requires collaboration with other stakeholders and experienced contractors.

Previous meanders and curves in the water course can be identified by historical aerial photographs and maps. The greatest benefit is achieved by targeting installation to wide, flat areas where there is little risk to property or infrastructure.

CONSTRUCTION AND CONSIDERATIONS

- Any works taking place within 8m of a main river or in the flood plain may require a Flood Risk Activity Permit from the Environment Agency. This distance increases to 16m if it involves excavation.
- Particular caution is required around any diversion of river flow and controlled release into the water course.

BENEFITS

- Allowing more natural lower energy flooding reduces risk of bank failure and soil loss
- Removes need for maintenance of alternative artificial engineering works
- Reduces the peak flow at sensitive locations, such as road bridges or residential areas
- Can be achieved naturally in some cases, with minimal interventions to kick-start the process
- Provides rich wildlife habitat
- Wider community value.

KEY LOCATIONS

Lower catchment, in rivers and floodplains, where channel alteration and/or engineering has taken place.

COSTS

Set-up: HIGH

Maintenance: MEDIUM

Set-up cost is dependent on site, and specialist advice on funding may be needed.

LEVEL OF MAINTENANCE

HIGH

The process of restoration can take many years.

Once restored, the level of maintenance should generally be low, as the river can function naturally.

RIPARIAN PLANTING

Creating wide strips of vegetation alongside streams, ditches and rivers helps slow the surface water runoff from the surrounding landscape. These strips act not only as a barrier to hold back water, but also increase infiltration and act as a filter, capturing sediments, nutrients and any pesticides and fertilisers present in the runoff. This would otherwise enter the river and reduce water quality. Increased vegetation provides shading, preventing large fluctuations in water temperature. Riparian planting stabilises the banks of watercourses, reducing erosion. This in turn will improve water quality in streams and reduce the build-up of sediment in watercourses throughout the catchment.

Buffer © Guy Edwardes 2020VISION

HOW

Careful management and planting of land adjacent to streams and rivers, maintaining native vegetation and excluding livestock.

CONSTRUCTION CONSIDERATIONS

- Any works taking place within 8m of a main river may require a Flood Risk Activity Permit from the Environment Agency
- Potential installation of pasture pumps to allow livestock access to water away from riverbanks.

BENEFITS

- Prevents agricultural chemicals, sediment and nutrients reaching the watercourse, reducing waste
- Can reduce effects of spray drift
- Reduces risk of erosion and loss of valuable topsoil
- Reduces risk of livestock acquiring waterborne diseases
- Can reduce overland flow impacting roads and neighbouring properties
- Strengthens riverbanks
- Wildlife habitat creation
- Can also be planted with trees to increase benefits for NFM and increase carbon sequestration.

KEY LOCATIONS

Throughout the catchment, adjacent to rivers, and especially on grazed land next to streams and ditches that suffer from high sediment loads. Primarily land with sandy and light silty soils, medium and chalk and limestone soils.

In-field strips on arable land at risk from soil erosion. This option works well alongside other runoff interception options, such as contour bunds and hedgerows.

COSTS

Set-up: LOW

Maintenance: LOW

LEVEL OF MAINTENANCE

LOW

INVASIVE SPECIES CONTROL

Himalayan balsam © Gillian Day

Removal or control of certain invasive, non-native species plant will help to ensure healthy, diverse vegetation throughout the catchment.

Invasive species, such as Himalayan balsam, can establish on riverbanks and will outcompete the native plant species and destroy understory vegetation. Himalayan balsam then dies down in winter, leaving riverbanks free of vegetation and therefore susceptible to runoff and erosion. Japanese knotweed and rhododendron can have a similar effect.

Controlling invasive species and allowing native species to re-establish will ensure maximum absorption capacity of soil and reduce runoff and erosion, thus reducing flood risk.

HOW

Physical control, such as removing plants and safe disposal using biosecure practices.

Seeds are often carried down the river, so it is best practice to start at the head of the catchment and work downstream. This will help control invasive species on a catchment scale.

BENEFITS

- Ensures maximum absorption capacity of soil
- Reduces runoff and erosion
- Removes competition for native plants allowing deep-rooted native species to colonise
- Reduces the risk of invasive species colonising areas further down the catchment.

KEY LOCATIONS

Throughout catchment. Riverbanks.

COSTS

Set-up: LOW

Maintenance: MEDIUM

LEVEL OF MAINTENANCE

MEDIUM

Regular maintenance may be needed depending on effectiveness of control methods.

CONSENTS AND PERMITS

Implementing most NFM interventions will require consent. This section gives information on the usual types of permits and consents required but others may be necessary depending on the intervention type, work required for installation and location.

PERMITS FOR WORKS IN OR NEAR RIVERS AND STREAMS

The type of consent or permit required will depend on the type of watercourse. Measures that are going to be implemented in or within 8-16m of a 'Main River', flood defence structure, culvert or on a floodplain may require a flood risk permit from the Environment Agency.

To find out if the watercourse is a designated 'Main River', check the interactive Statutory Main River Map on the Environment Agency website.

If the proposed works are not on a main river (i.e. on 'ordinary watercourses'), contact the Lead Local Flood Authority (LLFA) to check if land drainage consent is required. The LLFA for Derbyshire is Derbyshire County Council's Drainage and Flooding team.

Activities on ordinary watercourses that require consent are those likely to cause an obstruction to flow or affect storage. This is the case, no matter how small the watercourse is, even if there is minor flow for just part of the year.

Planning consent may be required when constructing larger structures. A discussion about proposed work should be held with the local planning authority prior to construction.

Flood risk permits or land drainage consents are still required even if planning permission or other consents have been granted.

Derbyshire Wildlife Trust have experience with successfully obtaining these consents and can provide advice to landowners and managers. There may be opportunities to combine multiple NFM interventions into single permit or consent applications to save time and costs.

OTHER CONSENTS AND CONSIDERATIONS

NFM interventions that are proposed on land with protected status, such as **Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC) and Special Protected Areas (SPA)**, will require habitat regulation assessments and consents from Natural England.

The protected status of some sites can be checked on www.magic.gov.uk/home.htm

Depending on the NFM measure or activities involved, other consents may be required. For example, certain trees or areas of trees may be protected by **Tree Preservation Orders (TPOs)** and a consent for tree work may be required from the local authority.

For interventions that require soil, sediment or spoil extraction, transport or spreading including near watercourses, **a waste exemption licence** may be required from the Environment Agency.

Critical infrastructure is an important consideration. Checks for overhead and buried utility pipelines and cables will be required before most work. Easements set by the utility companies restrict certain activities within set distances from these assets.

Consent will be required for interventions proposed on or near to scheduled monuments and in heritage or archaeological areas. In the River Derwent Catchment, checks should be made with Historic England, Derbyshire County Council's Historic Environment Record and the Derwent Valley Mills World Heritage Site, among others.

CONTACTS

ORGANISATION	DETAILS	CONTACT INFORMATION
Derbyshire Wildlife Trust	Further information on Natural Flood Management across Derbyshire	**Telephone:** 0177 388 1188 **Email:** enquiries@derbyshirewt.co.uk
Environment Agency	Flood risk permits (main rivers) Waste exemption licences	**Telephone:** 0370 850 6506 **Email:** enquiries@environment-agency.gov.uk
Derbyshire County Council	Land drainage consent (ordinary watercourses) Historic Environment Records	**Telephone:** 01629 533190 **Email:** contact.centre@derbyshire.gov.uk
Historic England	Scheduled monuments	**Telephone:** 0370 333 0670 **Email:** midlands@historicengland.org.uk
Natural England	Protected sites	**Telephone:** 0300 060 3900 **Email:** enquiries@naturalengland.org.uk

ADDITIONAL RESOURCES

ORGANISATION	DETAILS	WEBSITE
Derbyshire Wildlife Trust	Further natural flood management information	Derbyshirewildlifetrust.org.uk
The Rivers Trust	River and catchment conservation	Theriverstrust.org
The Woodland Trust	Woodland conservation	Woodlandtrust.org.uk
Forest Research	Forest and tree-related research	Forestresearch.gov.uk
Catchment-Based Approach	Civil society-led initiative to maximise the natural value of the environment	Catchmentbasedapproach.org
Rewilding Britain	Rewilding information across the UK	Rewildingbritain.org.uk
Innovative Farmers	Agroecological farming practices and on-farm research	Innovativefarmers.org
River Restoration Centre	Technical advice on river restoration	Therrc.co.uk
Construction Industry Research and Information Association (CIRIA)	Includes detailed Natural Flood Management manual	Ciria.org
Knepp Wildland Foundation	Nature recovery information including soil restoration	Knepp.co.uk

GRANTS AND FUNDING

ORGANISATION	DETAILS	CONTACT INFORMATION
Sustainable Farming Incentive (SFI)	Rewards for farming practices that help produce food sustainably and protect the environment	Farming.campaign.gov.uk
Forestry Commission Grants and Incentives	Woodland creation, maintenance, management and tree health, including other NFM	Gov.uk/government/publications/woodland-grants-and-incentives-overview-table
Woodland Trust Schemes	Grants for trees and subsidised tree packs	https://www.woodlandtrust.org.uk/plant-trees/trees-for-landowners-and-farmers/