Lowland Natural Flood Management Measures
– a practical guide for farmers

Dales to Vale
Rivers Network
Natural Flood Management Measures – a practical guide for farmers

This guide has been produced to provide simple, clear advice on the provision of natural flood management measures for lowland areas.

This document is based on the publication ‘Natural Flood Management Measures – a practical guide for farmers (2017), produced by the Yorkshire Dales National Park. It has been compiled by the Yorkshire Dales Rivers Trust, Hull & East Riding Catchment Partnership, Dale & Vales River Network and North Yorkshire County Council, with support from Natural England and the Environment Agency.

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.

Introduction

Floods are nothing new. Humans have lived with extreme weather for thousands of years. However, climate change science predicts an increase in occurrence and severity of high rainfall events. Subsequent increases in extreme flooding will follow suit.

Within the UK, our flood defence system includes large-scale, hard engineered solutions in and around major cities, flood banks and 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 country’s flood defence system, with reference made to natural flood management (NFM) sometimes called Working with Natural Processes (WwNP).

The conundrum faced by landowners and managers is associated with pressure to increase crop yield related to market forces, to achieve the same level of farm income. This guide aims to provide information to landowners to allow them to decide on which NFM measures will match their farm business.

If you have any comments or need further information about this publication please contact us at dvrn@ydrt.co.uk

Image © Paul Skirrow
Image © Yorkshire Dales River Trust
What is natural flood management?

Natural flood management aims to reduce the downstream maximum water height of a flood (the flood peak) 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 techniques. These techniques work with the natural features of the catchment to slow down or store flood waters. They rely on one, or a combination, of the following underlying mechanisms:

1. **Increasing soil infiltration**: an open soil structure that will make saturation less likely, potentially reducing surface runoff.
2. **Evaporation** from vegetation and soil can also make space for water.
3. **Slowing water**: by increasing resistance to its flow – for example, by planting floodplain or riverside woods, or blocking grips on moorland.
4. **Storing water** by using, and maintaining the capacity of, ponds, ditches, embanked reservoirs, channels or land.
5. **Reducing water flow connectivity** by interrupting surface flows of water – for example, by having buffer strips of grass, hedges or trees.

Natural flood management measures have been designed so that they do not significantly impact on farming. They are typically small in size and can be considered an extension to the farm’s land drainage or as part of an Internal Drainage Board’s maintained network.

Each structure or technique performs a small amount of 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.

In lowland Yorkshire, good management of soil is critical to productivity and natural flood management. This includes practices which are beneficial for soil and water health, including increasing organic matter, contour ploughing and appropriate drainage as well as sensitive ditch management, employing buffer strips and rainwater harvesting.

This publication covers lowland areas in Yorkshire. It is one of two publications, the other one being specifically for upland areas and is available from the Yorkshire Dales National Park.

Natural flood management is not the complete solution to flooding but is one of many tools needed to manage flood events and water levels by taking a total catchment management approach. These tools are known to be effective at reducing the frequency of flooding for high probability fluvial events (for example, less than a one in twenty-year return period) rather than extreme events (for example, a one 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 slowing the flow of flood water downstream. Research at several small-scale catchments has shown this to be the case.

Why land management in Lowland Yorkshire can play its part

Most of the main rivers which flow through the Yorkshire lowlands arise in the hills of the Pennines and North York Moors. They can cause problems by directly flooding farmland and settlements, but it can be the smaller tributaries which affect homes, businesses and infrastructure in their catchments. Natural flood management techniques often work well on a smaller scale, and while your focus is, as a farmer, land-water level manager such as an Internal Drainage Board (IDB), you may be in a position to help contribute to the reduction of flooding locally or regionally.

Research carried out by Leeds University in the Yorkshire Dales indicates that a combination of simple flood management measures over 10% of the catchment area can help slow down the flow of water during high rainfall events by up to 12%. This is a significant and something that can be achieved from a farming, land and drainage management perspective without sacrificing production levels or greatly altering land or water level management practices.

Help us keep track

Please keep us updated! If you choose to implement a natural flood management technique on your land, let us know:

- the date of construction
- which technique was used
- the size and number of treatments used

This will help us monitor the use of natural flood management in our area and enable us to evaluate the success.

Contact details: dvrn@ydrt.co.uk
Using the 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 farm. We have included funding sources to support the work you may want to undertake.

The various measures have been grouped into three different levels of intervention:

**Level 1**
Measures requiring minimum or no consultation with authorities such as the Local Authority or local Internal Drainage Board consent or Environment Agency (EA), or local Internal Drainage Board consent. These measures are usually low cost and simple to install, but extremely effective.

**Level 2**
Measures requiring a certain level of consultation and possibly consent of authorities (see summary of consents section). These measures are a mix of low to medium cost and may need contractors’ help to install them.

**Level 3**
Measures involving a level of design that is targeted to certain locations within the catchment, requiring planning permission and consents from authorities, and, in most cases, involving professional water management consultant advice. These measures are usually high cost and need contractors to install them.

Each measure is described in terms of its flood management effectiveness, its benefit to agricultural production, and its overall cost. Set up and maintenance costs have been colour-coded, with the definitions provided here:

**Set up costs**
- **HIGH** Requires significant raw materials, specialist equipment, or expert involvement
- **MEDIUM** Requires some raw materials, specialist equipment, and/or expert involvement
- **LOW** Land manager can implement system with minimal advice, equipment, and specialist material.

**Maintenance costs**
- **HIGH** Expert advice or equipment required to be brought in frequently (e.g. < 5 yrs)
- **MEDIUM** Expert advice or equipment required to be brought in occasionally (e.g. < 10 yrs)
- **LOW** Mostly involves routine inspections and low-grade management, which can be undertaken by the land manager.

Possible locations of natural flood management measures within the Yorkshire lowland landscape:

- Leaky woody dams
- Targeted new native woodland planting and hedgerows
- Watercourse buffer strips
- Interception of run-off pathways – for example, rough grass strips, natural scrub areas and bunds
- Flood water storage e.g. swales and offline ponds
- Wetland
- Contour ploughing
- Good soil health is a fundamental to the whole landscape
- Riversides woodland planting
Intervention treatments: Level 1

Increasing Soil Health – reducing soil compaction

Compaction is where soil particles are pressed together reducing pore space between them, turning the soil into a solid, impermeable layer either at the surface or within the topsoil. This reduces the ability of air and water to move through the profile, reducing pore space between them, turning the soil into a solid, impermeable layer either at the surface or within the topsoil. This reduces the ability of air and water to move through the profile, reducing the movement of air, water and nutrients down through the soil profile.

Hence heavily compacted soils contain few large pores and solid, impermeable layer either at the surface or within the topsoil. This restricts the movement of air, water and nutrients down through the soil profile.

- Look out for signs of waterlogging and look for evidence of soil biota, particularly earthworms.
- Assess current soil structure by digging a hole, up to 40cm deep, to look at condition of soil and depth of compaction in topsoil and subsoil.
- Undertake soil test to identify pH – add lime if below 6. This encourages increased water filtration. Improved soil structure with reduced cultivation costs.
- Consider introducing solid manure to increase soil water retention – see section on cover crops
- Consider the use of cover crops, re-seeding or over-seeding using deep minimum tillage techniques, where appropriate, to increase soil water retention – see section on cover crops
- Contour ploughing prevents the development of compacted tracks and swarms which channel water and soil
- Any field where an impact on crop development is seen – see section on cover crops
- Any field where water is seen to flow across the surface in high rainfall events.
- Local Rivers Trusts (RT) may assist with riparian fencing cost in their area.
- Consider all archaeological features before starting and mechanical operations have not been carried out before.
- Any field where water is seen to flow across the surface in high rainfall events.
- Contour ploughing prevents the development of compacted tracks and swarms which channel water and soil
- Any field where an impact on crop development is seen – see section on cover crops
- Contour ploughing prevents the development of compacted tracks and swarms which channel water and soil
- Any field where water is seen to flow across the surface in high rainfall events.
- Consider your use of contractors and the timing of the work
- Use of contractors – timing, passes, equipment and expertise
- Appropriate timing for working the land
- Yield mapping – IT precision farming
- CTF and Precision farming e.g. yield mapping

Increasing Soil Health – managing soils in an arable rotation

Soil health is a measure of how able a soil is in sustaining maximum plant growth and biodiversity, whilst offering additional benefits for sustainability such as flood mitigation and drought resistance.

Soil health is essential for efficient crop production, water and nutrient movement, drought and flood resilience.

- Enhanced soil water uptake.
- Improved drainage
- Stronger roots.
- Reduced water runoff and soil loss
- Enhanced heat and drought stress tolerance.
- Improved soil structure with reduced cultivation costs
- Increased water filtration
- Increased windows for cultivation, drilling and harvesting

Natural flood management purpose

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Creating and managing buffer strips

Management of vegetated/grass strips next to watercourses

IDBs will need access for maintenance of the ditch sides and/or water. This option works well alongside other run-off incepting measures and is used near road and highway barriers and wind-breaks. A mix of grasses is planted to create a sward that is suitable for ground nesting birds, and the presence of low growing vegetation provides cover from predators. In addition, the wildflower mixture planted provides a habitat for bees and butterflies. These management regimes can be retained for a minimum of 10 years, with the exception of where IDBs have access. For the wider strip, a barrier to the spread of disease, reducing animal and plant disease and allowing for additional management activities. It is therefore important to ensure that the strip is fenced to prevent livestock access. This is particularly important when the river is high or the presence of standing water from increased infiltration rates.

Hedgerows can be cut every two years once established. Newly planted hedges will require annual maintenance until at least 1.5m tall, particularly regarding weed control and watering. Where hedgerows have been lost from an area or the network is significantly reduced, the boundaries of farms and parishes. The older a hedge is standing water from increased infiltration rates. Planting and managing hedgerows

Hedgerows provide excellent natural weather barriers, protecting crops, soils and livestock, provide ideal habitat for farmland birds and wildlife species, but also perform a natural flood management function by trapping and slowing water flow. They are important habitat to trap and filter runoff, by catching soil sediment protecting watercourses from bank erosion.

Hedgerows reduce the risk of flooding and pollution, and can be effective in reducing sediment loads. These measures can be applied to any small watercourses without restrictions. They control or prevent erosion of valuable topsoil from field edges. They reduce frequency of ditch maintenance through decreased rates of erosion and reduced stormwater loading. They help reduce erosion by vegetation growing on the buffer strip absorbs nitrogen.

They help reduce erosion by vegetation growing on the buffer strip, a beetle bank can be created, further down the in-field buffer strip, which slows the flow of runoff and increases infiltration.

Agricultural benefits

Buffer strips trap and filter runoff, by catching soil sediment and nutrients, and prevents them from being washed into water. This can be achieved in both arable and grassland fields and give the same result. They also protect the water courses from bank erosion, increases bio-diversity and prevent poaching.

In buffer strips, as their name implies, are found adjacent to field boundaries, by their ditches, watercourses, ditches etc. and across fields. They can reduce overall flow reducing soil loss and flood risk and improving the health of adjacent water bodies. They provide surface to volume ratios that will limit run-off and flood water levels.

Natural flood management purpose

Methods

The core of the Countryside (CS) scheme is to restore and enhance hedgerows and to support management of hedgerows to reduce water and sediment losses from agricultural land. This option works well alongside other run-off incepting measures and is used near road and highway barriers and wind-breaks. A mix of grasses is planted to create a sward that is suitable for ground nesting birds, and the presence of low growing vegetation provides cover from predators. These management regimes can be retained for a minimum of 10 years, with the exception of where IDBs have access. For the wider strip, a barrier to the spread of disease, reducing animal and plant disease and allowing for additional management activities. It is therefore important to ensure that the strip is fenced to prevent livestock access. This is particularly important when the river is high or the presence of standing water from increased infiltration rates.

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Drainage ditches play an important role in the lowlands, especially in drier summers. On large ditches creating a staged or stepped berm will help to mitigate against drought. Lagoons, providing corridors for wildlife to pass along, can be connected to small ponds and water storage ponds to create multiple benefits whilst also fulfilling your duties as a natural flood management options in your ditch network can create semi-permeable in channel barriers to hold back high flows while allowing water to infiltrate and sediment drop out, as well as offering storage and sediment capture. Ditch Management

Methods

- Ditch bank stability and channel widening
- Control excess water from productive fields
- Setup drainage systems with open and closed channels
- Control excessive water from lowlands
- Remove culverts, where suitable, reconnects the watercourse to its floodplain
- Reduce the conveyance capacity
- Leave headwaters uncut
- Create alternating sections of cut and uncut vegetation in low flood risk areas
- Use trees
- Key locations
- Ditches are more important in lowland areas, mainly found on low-gradient agricultural land.
- Well managed ditches help to remove excess water from productive fields. They can also provide shade and shelter for livestock and prevent damage to crops and soil erosion.
- Tree planting can vary from planting in hedges, buffer strips, cross compliance areas. New planting will need protecting from livestock grazing.
- Key locations
- Buffers in riparian habitats
- Woodland Trust (WT).
- Countryside Stewardship (CS) scheme – higher and mid-tier.
- Existing woodlands, plantations and shelter belts.
- Throughout the catchment – particularly in upper parts of the catchment.
- Alongside watercourses.
- Cost and Maintenance
- Countryside Stewardship (CS) Scheme – Mid-tier
- Additional information

- Costs
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- Countryside Stewardship (CS) scheme – higher and mid-tier – Woodlands (FT).
Winter cover crops

A cover crop is a non-cash crop grown primarily for protecting or improving the soil in between periods of regular crop production. Cover crops can be used repeatedly as part of an arable rotation away from winter drilling towards spring.

- Cover crops can be used as part of Ecological Focus Area (EFA) for the Basic Payment Scheme (BPS).
- They can be used as part of Natural Flood Management (NFM) measures, as part of the Countryside Stewardship (CS) scheme.
- Cover crops can provide a significant transport pathway for water and sediment.

### Agricultural benefits

- Protects water quality.
- Conserves soil moisture.
- Prevents soil erosion and reduces nutrient losses via runoff.
- Reduces the need for herbicides and other pesticides.
- Improves soil structure, porosity, and biological activity and improving crop yields.
- Increases soil organic matter, organic carbon, and nutrient content, thereby enhancing soil health, increasing soil fertility, and productivity.
- Deep-rooting plants will provide additional benefits by loosening compacted soils.
- Each cover crop has a different ability such as fixing nitrogen to soil or providing other benefits.

### Considerations

- Deep-rooted crops may not provide additional benefits by increasing infiltration if rain falls predominantly during the winter months rather than the summer.
- Winter cover crops can be used during mid-tier (including water-quality capital items) maintenance. Countryside Stewardship (CS) grants can be used to set up and maintain cross drains to help reduce pollution incidents.

### Costs

- Land vulnerable to nitrate leaching.
- Where water is seen to flow across the surface in high rainfall events this creates a problem with erosion of the track and water gathering at the end of the track.
- Cross drains potentially reduce flooding of the track and water gathering at the end of the track.
- Cross drains divert the main pathway of water, reducing flow volume, and they last longer.
- Stone caught in traps can be re-used on the track, saving time and money.

### Funding

- Tropical Rivers Trusts (RT) in their project areas.
- Hardstanding areas, to segregate dirty (slurry) and clean water.

### Additional information

- Cross drains divert the main pathway of water, reducing flow volume, and they last longer.
- Stone caught in traps can be re-used on the track, saving time and money.

### Key locations

- Tracks on steep slopes, adjacent to yards or roads, or within close proximity of watercourses.
- Cross drains potentially reduce flooding of the track and water gathering at the end of the track.
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### Level of maintenance

- Cross drains divert the main pathway of water, reducing flow volume, and they last longer.
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Intervention treatments: Level 2

**Bunds and detention basins**

A bund is a stone or earth formed into an embankment to hold back water, and often involves the creation of a corresponding detention area. This work can be carried out on a wide range of scales depending on the local opportunity, size of the catchment area and the local soil conditions.

Earth bunds work most efficiently when they are located across known surface runoff pathways which appear following heavy rainfall or when the soil is saturated. The detention area holds water until it disperses through a combination of infiltration, evaporation and controlled slow release such as a small pipe, outfall pipe or filter material.

Intervention methods:

- **Considations**
  - The location of those solutions may be influenced by the reaction of the catchment and drainage system to both design standards and events.
  - Design options should be selected within the water quality and drainage system that could be loss to the paper when developing by permitting surface spills. Bunds can be constructed to double up as an access track for hydro vehicles and machinery over the waterlogged fields (flooding) during peat periods (e.g. Belford), or as bunds to filter through larger agricultural fields.

- **Design of the bund or detention basin should be site specific and tailored to each distinct location.**

- **Additional information**
  - Design guidance:www.susdrain.org/resources/ciria-guidance.html
  - Basic Payment Scheme (BPS) criteria:www.gov.uk/government/collections/basic-payment-scheme

- **Swales**

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

- **Key locations**
  - Next to farm tracks
  - Areas where runoff with a heavy sediment load is known to compromise local drainage.
  - Shallow slopes prone to runoff during flood events.

- **Swales reduce runoff rates by slowing runoff flow.**

- **Swales may be designed to be either wet or dry, depending on land use.**

Swales can help to mitigate against drought.

- **Level of maintenance**
  - Maintenance should be set up to remove of any sediment.

- **Additional information**
  - Basic Payment Scheme (BPS) criteria:www.gov.uk/government/collections/basic-payment-scheme

- **Key locations**
  - Next to farm tracks

- **Costs**

- **Add to existing drainage systems.**
In-channel barriers

In-channel barriers can be installed in intermittent streams and ditches to hold back floodwaters. These barriers are typically whole tree trunks, secured into place above normal stream level, so that under normal weather conditions water flows naturally through, under storm conditions, flood waters are held back.

A method of holding back floodwaters through in-channel barriers is to lay large woody dams or ‘ferry dams’. As a result, water is stored within the channel bedform constructed dam, reducing the downstream flow by slowing the flow. They can also help to reconstruct the streams with the floodplain for encouraging the river to overtop its banks.

There are a range of different designs of woody dams which are best suited to different types of watercourses.

Sediment traps

Sediment traps are small to medium scale runoff attenuation features that can provide localized drainage of surface flood waters and can be used across a landscape to accommodate a reduction in flood peaks downstream. In addition, these features can benefit water quality by reducing siltation of watercourses, so maintaining capacity.

Payment Scheme (BPS) rules if they are 0.01 hectares, or if together they add up to 0.01 hectares or more. Bigger features will be mapped from their eligible areas.

Sediment traps are not intended to treat wastewater or effluents. Consent from the EA may be required to remove and spread sediment caught in a sediment trap.

Sediment traps will need to be regularly emptied – the frequency will depend on the area being drained and how much sediment is carried by the stream or ditch. Removal of sediment and re-spreading to land will require a waste exemption license from the Environment Agency (EA).

In-channel barriers could reduce the 1 in 100-year flood peak by 20%.

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Large woody dams are created by laying two large tree trunks, in a close formation across the bed to slow down the flow and prevent erosion, with a space left in the centre. Smaller barriers may be required in some cases and removal and re-spreading of the material caught in- channel will require a waste exemption license from the Environment Agency (EA).

Sediment traps © Environment Agency

Funding

Funding

The level of maintenance and costs required for in-channel barriers will depend on the area being drained and how much sediment is carried by the stream or ditch.

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Natural flood management measures

- Offsite flood storage pond/basin (permanent structure): An Offline flood storage pond/basin is constructed adjacent to watercourses and during periods of high flow – some of the river flow is diverted out and into the pond. By storing some of the flow through a storage pond, the route for the river flow is diverted out and into the pond. By forcing some watercourses and drainage systems.

- Field: Floods limited. Channel flooding can be controlled and the extent, and damage, of a dry basin can receive excess water from the coming into use during low frequency events. By constructing Offline ponds can be constructed in combination with other NFM measures such as in-channel barriers giving more flexibility to the location of the features.

- Maintenance: Multiple small ponds can be dug along a water course on less valuable land.

- Level of maintenance: The maintenance of Offline flood storage pond/basin (permanent structure) will be classified as ineligible features under the Basic Payment Scheme (BPS) rules if they are 0.01 hectares, or if together they add up to 0.01 hectares or more. Bigger features will be mapped by the Rural Payments Agency (RPA), and farmers must deduct them from their payments. Availability will be calculated on a per hectare basis with fields up to 0.01 hectares or more designated as ineligible features. If the basin is dry and only inundated occasionally, maintenance will be even less. If the basin is dry and only inundated occasionally, maintenance will be even less.

- Considerations: Ponds will be classed as ineligible features under the Basic Payment Scheme (BPS) rules if they are 0.01 hectares, or if together they add up to 0.01 hectares or more. Bigger features will be mapped by the Rural Payments Agency (RPA), and farmers must deduct them from their payments. Additionally, the structure affects a river, stream or lake. Payments Agency (RPA) may be needed for flood storage, reducing risk to lives and property further downstream. The mid and lower parts of the river system, where the river enters the floodplain, are the most appropriate areas. Floodplain restoration always needs to be carried out with specialist water engineers and ecologists as it will influence the behaviour of the flow of floodwater over a wide area. It will need detailed computer modeling and design and will require planning and other permissions and consents.

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Intervention treatments: Level 3

Floodplain restoration

While natural flood management measures associated with land management seek to reduce flood water generation, natural flood management measures in the river channel or on its banks or floodplain seek to improve the ability of rivers to manage those floodwaters. Scottish Environment Protection Agency (SEPA), Natural Flood Management Handbook, 2016

Restoring the connection between a river and its floodplain provides a valuable contribution to natural flood management, allowing floodwater to spill naturally onto land to provide significant flood storage, reducing risk to lives and property further downstream. The mid and lower parts of the river system, where the river enters the floodplain, are the most appropriate areas. Restoration always needs to be carried out with specialist water engineers and ecologists as it will influence the behaviour of the flow of floodwater over a wide area. It will need detailed computer modeling and design and will require planning and other permissions and consents. It is likely to be high cost and need specialist contractors.

Initial advice as to a site’s suitability can be given by local Rivers Trusts (RT) and Environment Agency (EA) staff and early contact is highly recommended. The process of river and floodplain restoration encompasses a range of different techniques which are often used in conjunction. They include restoring meanders and removing or setting back flood banks, often with hedgerow creation such as wetlands, habitat for breeding and wintering waders, and wet woodland.

Scottish Environment Protection Agency (SEPA), Natural Flood Management Handbook, 2016

Additional information: Ponds will be classed as ineligible features under the Basic Payment Scheme (BPS) rules if they are 0.01 hectares, or if together they add up to 0.01 hectares or more. Bigger features will be mapped by the Rural Payments Agency (RPA), and farmers must deduct them from their payments. Payments Agency (RPA) may be needed for flood storage, reducing risk to lives and property further downstream. The mid and lower parts of the river system, where the river enters the floodplain, are the most appropriate areas. Floodplain restoration always needs to be carried out with specialist water engineers and ecologists as it will influence the behaviour of the flow of floodwater over a wide area. It will need detailed computer modeling and design and will require planning and other permissions and consents. It is likely to be high cost and need specialist contractors.

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**Ditch/Dyke Restoration & Management**

The purpose is to alter drainage ditches so that the water holding capacity is increased and the flow of water is slowed down.

Restoring drainage ditches to a more natural state will need detailed specialist advice.

**Natural flood management purpose**

- **Set up**
  - **Design and dimensions** are entirely site dependent and will need detailed specialist advice.

- **Methods**
  - **Soil erosion is reduced significantly.**
  - **Silt and pollutants do not spread over the whole water course.**
  - **Reducing diffuse pollution with silt and pollutant traps, means that pollutants do not spread over the whole water course.**
  - **Reducing diffuse pollution with silt and pollutant traps, means that pollutants do not spread over the whole water course.**

- **Funding**
  - **Wetlands should be designed with a significant storage capacity.**
  - **Wetlands should be designed with a significant storage capacity.**
  - **Wetlands should be designed with a significant storage capacity.**

- **Considerations**
  - **Wetlands are normally shallow ponds and marshy areas covered almost entirely in vegetation.**
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- **Agricultural benefits**
  - **Wetland creation**
    - **Wetlands are normally shallow ponds and marshy areas covered almost entirely in vegetation.**
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- **Biodiversity**
  - **Wetland creation**
    - **Wetlands are normally shallow ponds and marshy areas covered almost entirely in vegetation.**
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- **Level of maintenance**
  - **NATURAL FLOOD MANAGEMENT MEASURES**

- **Costs**
  - **Countryside Stewardship (CS) scheme**
  - **Countryside Stewardship (CS) scheme**
  - **Countryside Stewardship (CS) scheme**

- **Funding**
  - **Countryside Stewardship (CS) scheme**
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- **Additional information**
  - **Wetlands should be designed with a significant storage capacity.**
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Restoring meanders

In the past, rivers have been managed to increase the land available for agriculture by straightening the channel and to protect land from flooding by building embankments. Even small becks have often been altered. These changes combine to disconnect rivers from their natural floodplains, speed up the flow of water and reduce the available area for water storage, increasing the flood risk for those downstream.

Restoring meanders can be by physically digging out the meanders or by encouraging the power of the water to form its own natural course. This can be enhanced with the installation of flow deflectors which can help to focus the flow to speed up the natural process. This can also create areas of still water of flow deflectors which can help to focus the flow to speed up the natural process. This can also create areas of still water of which have benefits for fish and other aquatic species.

For larger water courses and flood plain areas flood modelling is necessary.

### Natural flood management purpose
- Management of small or large areas of floodplains or the floodplain, with a floodplain to the rear cross the floodplain (if possible).

### Agricultural benefits
- Potential benefits will be specific to the location chosen.

### Key locations
- Principally, where floodplains are wide and flat and there is no risk to existing infrastructure. Guidance is given in the Floodplain Management Handbook [Natural Flood Management Handbook, 2016].

### Costs
- Maintenance
- 

### Methods
- Key locations
- Costs
- Funding
- Considerations
- Agricultural benefits
- Considerations
- Costs
- Funding
Consent and approval

Some intervention treatments may require consent prior to construction.

Land drainage consent

On ordinary watercourses

Works in the water course may require land drainage consent from the Lead Local Flood Authority or Internal Drainage Board depending on the area. For guidance and application forms see your local council’s webpages and local internal drainage board webpages.

Planning consent

This may be required for larger structures, and a discussion about proposed works should be held with the local planning authority. Standard construction dimensions are recommended for each intervention treatment to enable quicker approval.

New woodlands

An Environmental Impact Assessment (EIA) may be required if more than 2ha of woodland planting is grant funded from sources other than the national Agri-environment schemes. The Forestry Commission (FC) would need to undertake this assessment. If it is funded by the national Agri-environment schemes, an EA would not be required. Website for further information: www.forestry.gov.uk/forestry/infd-6dfl55

Specialised consent

In some cases, a higher level of consent would be required before any intervention treatment can be put in place – for example, where Scheduled Monuments, Sites of Special Scientific Interest (SSSI) or Public Rights of Way are involved.

Public Rights of Way

Public bridleways and byways are managed by the Local Authority, which acts as the highway authority. Consent must be obtained before any works take place that might affect either the physical right of way or those using it. Be aware that the actual ‘used’ route that the public walk or ride across your land could differ from the legal definitive line.

Open Access land

Some rough pasture land and lowland heath in the lowland areas of Yorkshire are designated as Open Access land. The public have a legal right of access on this land and, before any works take place that might affect this access, consent may be required.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Consent required from</th>
<th>Contact information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduled Monument Historic England</td>
<td>0370 333 0607</td>
<td></td>
</tr>
<tr>
<td>Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) or Special Protection Area (SPA) Natural England</td>
<td>0300 060 3900</td>
<td></td>
</tr>
<tr>
<td>Public Rights of Way and Open Access land Local Authority</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Consent and approval
## Summary of consents

Guideline consent required for each treatment level and type (consent required for treatments along major rivers may vary).

<table>
<thead>
<tr>
<th>Intervention treatments</th>
<th>Pre-application consultation &amp; consents</th>
<th>Recommended consultation</th>
<th>Grant funding</th>
<th>Affect on schemes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planning permission (GPDO)†, full planning permission</td>
<td>Land drainage, main river works</td>
<td>Historic environment (Local authority)</td>
<td>Hydrological specialist support</td>
</tr>
<tr>
<td>Level 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increasing soil permeability – reducing soil compaction</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Creating and managing buffer strips</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Planting and managing hedgerows</td>
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<td>N</td>
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</tr>
<tr>
<td>Using trees</td>
<td>N</td>
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<td>Y</td>
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</tr>
<tr>
<td>Level 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Winter cover crops</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Cross drains in farm tracks</td>
<td>N</td>
<td>N</td>
<td>N</td>
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<tr>
<td>Bunds and detention basins</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
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<tr>
<td>Swales</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Sediment traps</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
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<tr>
<td>In-channel barriers</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
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<tr>
<td>Off-line flood storage pond (permanent structure)</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
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</tr>
<tr>
<td>Level 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ditch restoration</td>
<td>N</td>
<td>Y</td>
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<td>Y</td>
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<tr>
<td>Creating Wetlands</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Restoring meanders</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Reconnecting the river with its flood plain</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

1. Applies if you receive payment from the schemes listed
2. Depends on which machinery is used – yes, for subsoiler and sward lifter
3. If tree planting is within 20m of a main river
4. CS grant funding available if river is designated SSSI
5. Depends on which machinery is used – yes, for subsoiler and sward lifter
6. If changes are made to cropping areas.

**KEY:**

- Basic Payment Scheme (BPS)
- Countryside Stewardship (CS) scheme
- Environment Agency (EA)
- Environmental Stewardship (ES) scheme
- Forestry Commission (FC)
- General Permitted Development Order (GPDO)
- Local Rivers Trust (RT)
- Wildlife Trust (WT)