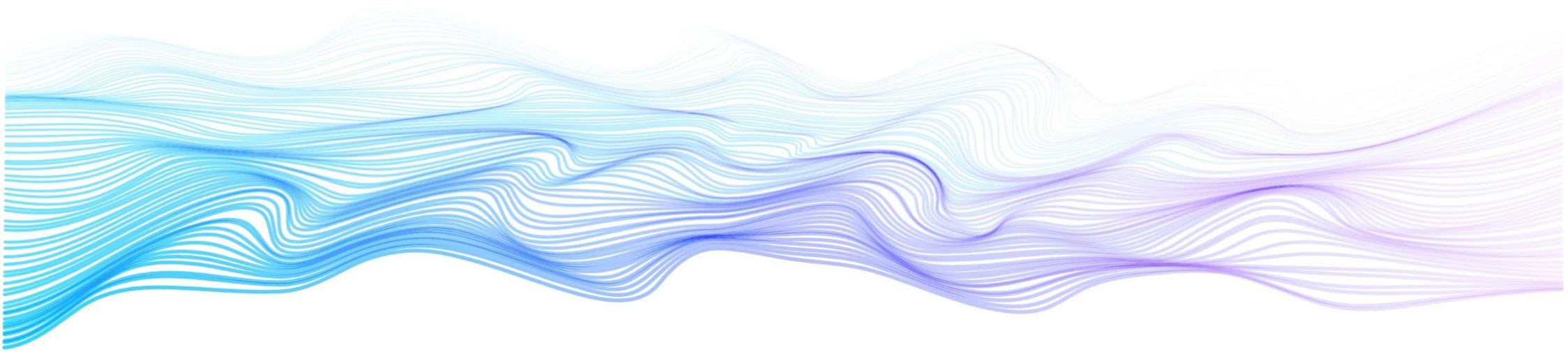
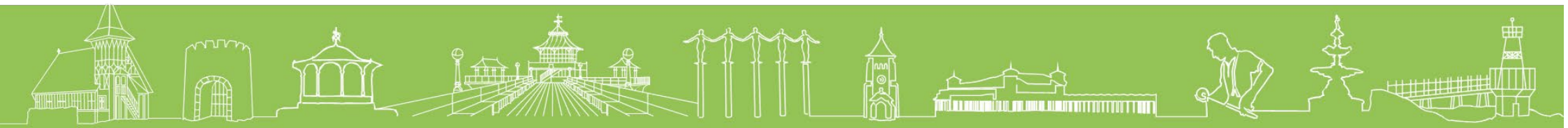
North Somerset Council

Open, Fairer, Greener

Local Flood Risk Management Strategy for North Somerset

Part D – North Somerset Natural Flood Management - A practical guide for landowners and farmers of North Somerset





Contents

This guide has been developed to provide simple, straightforward information on natural flood management measures for landowners and farmers in North Somerset.

This document is based on three publications:

- 'Natural Flood Management Measures – a practical guide for farmers (2017),' which was specifically requested by the farmers and land managers of the Yorkshire Dales National Park, and compiled by the Yorkshire Dales National Park Authority, Yorkshire Dales Rivers Trust and North Yorkshire County Council, with support from Natural England and the Environment Agency.
- Natural Flood Management Measures - A Practical Guide for Farmers and Landowners of The Solent and South Downs, which was put together has been put together by the South Downs National Park Authority (SDNPA) and Sussex Flow Initiative (SFI), with support from the Environment Agency (EA).
- The Natural Flood Management Guide (2022) has been written by CIRIA to guide NFM best practices.

The information in this guide is not definitive. Details relating to localised circumstances may not be included. Readers should seek full advice from Lead Local Flood Authorities and other NFM experts before acting on any of the recommendations in this guide. North Somerset Council does not accept any liability for those implementing the recommendations outlined in this report.

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

1.0 Introduction

North Somerset has been shaped by centuries of human impact and is less able to cope with high rainfall than it once was. Fewer trees, compacted soils and drained wetlands result in more water travelling more quickly to the levels and moors as the features that used to slow the flow of water have been removed. Climate change will increase the frequency and amount of heavy rainfall.

In the UK, flood defences include large-scale, hard engineering in and around towns, flood banks and small-scale engineering for rural communities and farmland, and coastal engineering. There is an increasing awareness of how broader landscape management can reduce the risk of flooding in towns and villages by slowing the speed of water coming off the hills and temporarily storing water in areas where it will not cause damage. This is known as Natural Flood Management (NFM) and Working with Natural Processes (WwNP).

2.0 What is Natural Flood Management?

NFM involves implementing measures that work with nature and emulate natural processes to store water in the landscape and slow the rate at which water runs off the landscape into streams, rhynes and rivers. It is a potential approach to help reduce the risk of flooding from rivers and surface water. It should be considered alongside other options to reduce the likelihood of flooding, such as embankments, flood walls and storage reservoirs.

NFM relies on one or a combination of the following techniques:

Slowing water: by increasing resistance to its flow - for example, planting hedgerows and trees, installing woody debris dams or creating buffer strips.

Storing water: creating and maintaining capacity in bunds, ponds, ditches, swales or floodplains so they fill during rainfall and empty slowly.

Directing water: water flow paths can be intercepted and redirected to where it causes fewer problems.

Soaking water into the soil: Improving soil structure can increase the depth of water absorbed, significantly increasing the volume of water stored in the soil and reducing surface runoff.

NFM features are typically small, so they do not significantly impact farming. Many of these measures will likely provide additional benefits to farm businesses and the general public.

Benefits for land managers

- Reduced flood risk to productive farmland and farm buildings;
- Improved soil fertility and reductions in soil loss, pesticide and fertiliser runoff;
- Reduced effects of drought as healthy soils retain water for longer in dry periods;
- Improved drainage of waterlogged areas preventing prolonged inundation of farmland;
- Hedges and tree planting can provide shelter and shade for stock;
- Reduced erosion of tracks and river banks;

The cumulative impact of implementing a range of NFM measures provides multiple benefits for the broader landscape and community:

- Reduced flood risk to rural communities;
- Improved water quality and pollution removal;
- Improved habitat for wildlife;
- Economic benefits from higher landscape quality, including tourism and recreation;
- Some of these measures, such as woodland creation and restoration of peat bog habitat, absorb carbon from the atmosphere and store it in the landscape.

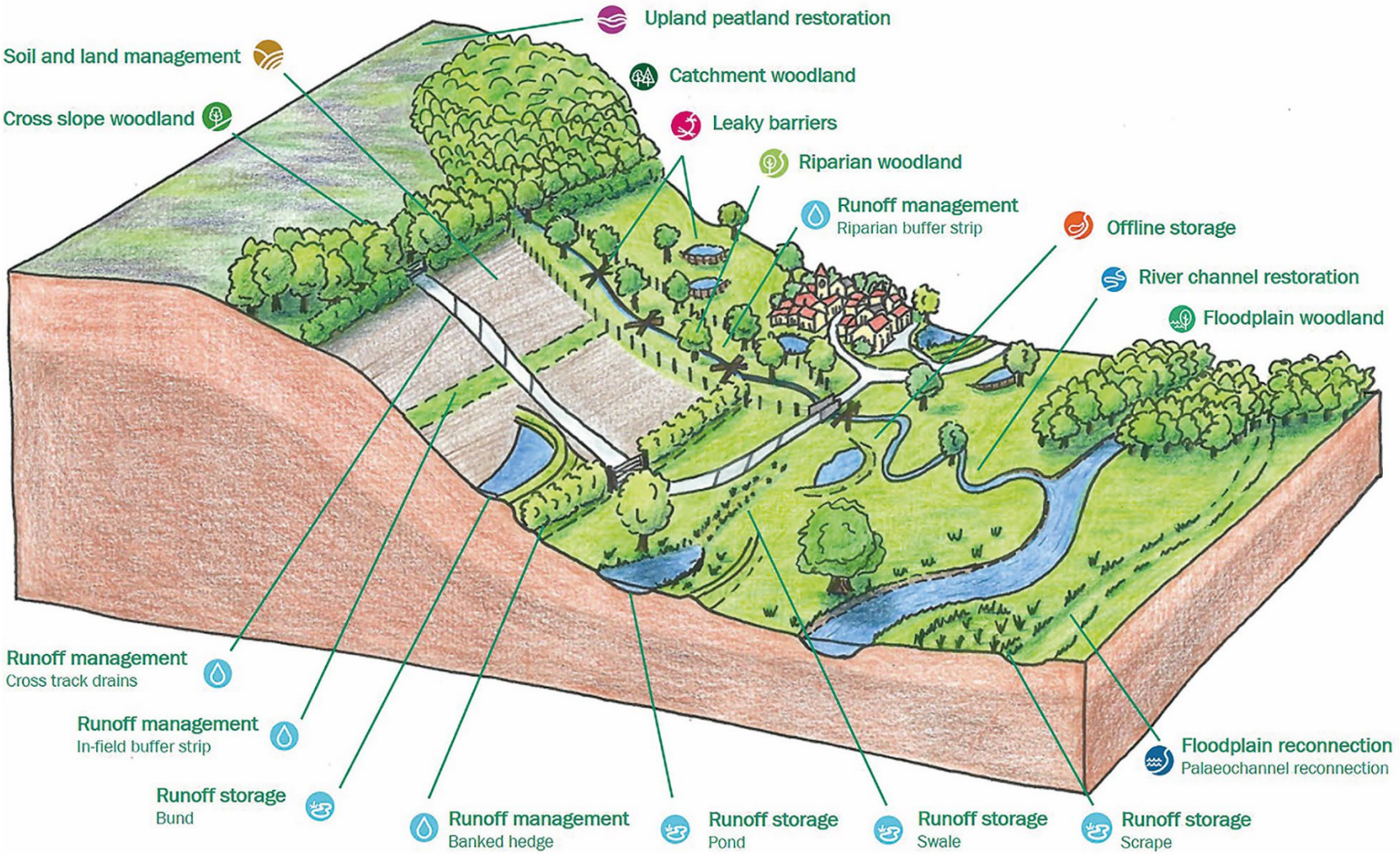


Figure 1. NFM across a river catchment. Wren, E, Barnes, M, Janes, M, Kitchen, A, Nutt, N, Patterson, C, Piggott, M, Robbins, J, Ross, M, Simons, C, Taylor, M, Timbrell, S, Turner, D, Down, P *The Natural Flood Management Manual*, CIRIA, C802, London (ISBN: 978-0-86017-945-0). Go to https://www.ciria.org

3.0 Natural Flood Management in North Somerset

North Somerset is mainly a rural county with a diverse landscape, including the levels and moors as well as steep valleys, known as Combes, on the Mendips. The Mendips and the Combes are a source of fast-flowing flood water that can impact isolated individual properties, small communities, and the rural highway network. In these areas, NFM offers the most cost-effective way of reducing flood risk and provides many other benefits. More information is provided below.

4.0 Using the guide

The implementation of NFM measures can vary in terms of complexity, cost, and benefits provided. This guide provides advice on the range of NFM measures available and critical information for landowners and farmers considering which measures might be appropriate for their land. Information is also provided on the potential sources of grant funding available to help support the work.

The various measures have been grouped into three different levels:

LEVEL 1 - Measures requiring minimum or no consultation with authorities such as North Somerset Council, Internal Drainage Board or Environment Agency. These measures are usually low-cost and straightforward to instal but highly effective.

LEVEL 2 - Measures requiring a certain level of consultation and possibly consent of authorities. These measures are a mix of low to medium cost and may need contractors' help to install them.

LEVEL 3 - Measures targeted to specific locations within the catchment may require design, planning permission, and authorities' consent. In most cases, advice from professional water management consultants will be required. These measures are usually high cost and need contractors to install them.

Each measure is described in terms of its flood management effectiveness, benefit to agricultural businesses, required considerations, and overall cost. Set-up and maintenance

costs have been colour-coded, with the definition provided below.

SET-UP COSTS

LOW – The land manager can implement a system with minimal advice, equipment or specialist material.

MEDIUM - Requires some raw materials, specialist equipment, and expert involvement

HIGH - Requires significant raw materials, specialist equipment, or expert involvement

MAINTENANCE COSTS

LOW - Mostly involves routine inspections and low-grade management, which the land manager can undertake.

MEDIUM - Expert advice or equipment required to be brought in occasionally (e.g. around ten years)

HIGH - Expert advice or equipment required to be brought in frequently (e.g. less than five years)

HELP US KEEP TRACK

Please keep us updated. Please let us know if you implement a Natural Flood Management technique on your land.

5.0 Natural Flood Management Measures

5.1 Soil management – Level 1

Soil compaction is when soil is squashed into an impermeable layer. This can occur due to high livestock densities and the movement of farm machinery, with specific soil types being more susceptible to compaction. Soil compaction often occurs around gateways and water troughs due to frequent use.

Image 1. The soil in this sloping field has been compacted by agricultural machinery, contributing a significant volume of water to the watercourse, along with sediment and nutrients that have been applied to the field — image credit Bristol Avon Rivers Trust.

Soil compaction reduces the amount of water that can soak into the soil, increasing the rate and volume of water flowing across the surface. Runoff from compacted soils can be 50-60% higher than on healthy aerated healthy soils.

Soil compaction can be detrimental to grass and root growth, reducing the ability of grass to pick up nutrients and water from the soil. It creates conditions for waterlogging and poaching and increases the risk of soil and nutrient loss through runoff.

Reducing the compaction of soils by aerating, subsoiling, or sward lifting can help alleviate flooding and improve land drainage. Changes to farm management practices also encourage more natural habitats.

Natural flood management purpose

- Reduces overland flows
- Increases the amount of water held in the soil
- Improves connectivity with groundwater by promoting strong root growth.

Agricultural benefits

- Improved movement of air and nutrients through the soil profile.
- Promotes strong root growth and more efficient crop growth. Improved fertiliser uptake, so less fertiliser input is needed.
- Reduced soil loss and poaching.
- Increased available grazing days (waterlogged soils stay colder for longer).
- Enhanced heat and drought stress tolerance.
- Easier access through reduction of waterlogged, muddy areas.
- Improved water quality by reducing runoff and soil loss into streams.

Methods

- Look for signs of waterlogging, including water pooling on the surface, slimy topsoil and algae growth, boggy soils, and yellowing crops and pasture.
- Dig a hole up to 40 cm deep to look at soil condition and depth of compaction in topsoil and subsoil.
- Undertake soil tests to identify pH – add lime if pH is below 6. This encourages the separation of soil particles from one another, creating air pockets.
- Mechanically aerate soils using spiked aerators, subsoilers or sward lifters, depending on the depth of compaction.
- Managing crop and livestock rotation can reduce compaction while improving soil fertility and yield.
- Avoid using heavy machinery on wet soils to further protect from compaction.
- Consider re-seeding or overseeding using deep rooting plant species – for example, festulolium and clovers for grassland.

Considerations

- Sub-surface and surface historic features can be damaged by mechanical treatment – mainly where these operations have not been carried out before

Level of maintenance

- Low

Key locations

- Any field below the moorland line, mainly where water is seen to flow across the surface in high rainfall events
- Fields used for winter grazing

Costs

- Set Up - Low
- Maintenance – Low

Funding

- Contact your local Rivers Trust, who may be able to offer advice.
- Countryside Stewardship contains a range of options to reduce soil compaction. Contact Natural England for advice.
- The Environmental Land Management (ELM) scheme will be based on ‘public money for public goods’. Therefore it is likely there will be funding through the new scheme.

Consents and permissions

- Consent will generally not be required for work to reduce soil compaction. Using sward lifters and subsoilers requires consultation with the North Somerset historic environment team.

Additional information

- The Agriculture and Horticulture Development Board (AHDB): www.ahdb.org.uk/greatsoils
- UK Government: https://www.gov.uk/guidance/remove-soil-compaction

- National Farmers Union: https://www.nfuonline.com/updates-and-information/soil-is-a-farmer-s-greatest-asset/
- Southwest Farmers Knowledge Hub:
- https://www.swarmhub.co.uk/soil-management/soil-structure/

5.2 Winter cover crops – Level 1

Winter cover crops are non-cash crops grown on land that would otherwise be left bare over the winter.

Cover crops protect and improve the soil between regular crop production periods. Cover crops reduce winter runoff and soil loss whilst improving soil quality.

Natural flood management purpose

- Winter cover crops help to reduce overland flow by increasing infiltration.
- They slow runoff by increasing land roughness.
- Reduced runoff results in less soil and sediment entering watercourses.

Agricultural benefits

- Prevents soil erosion and reduces nutrient losses via runoff and leaching.
- Careful choice of cover crops can help fix nitrogen in the soil and reduce fertiliser costs.
- Using deep-rooting plants consistently over the years will improve the soil structure and nutrient content, enhancing soil health and improving crop yields.
- Reduces the need for herbicides and other pesticides.
- Conserves soil moisture reducing the effects of drought.

Methods

- Sow any plant that can grow throughout the winter. You can use phacelia, vetch, ryegrass, grazing rye, barley and mustard, or a mix of these depending on local conditions and needs.

- Leaving crop residues throughout winter can also protect the soil surface and increase infiltration.
- Do not destroy until immediately before establishing the following spring crop.
- Ploughing should be along the contours of any slope and not up and down.

Considerations

- Using cover crops may require altering the arable rotation away from winter drilling towards spring.
- Cover crops can be used repeatedly as part of an arable rotation's long-term strategy.

Level of maintenance

- Low

Key locations

- Works well on arable or temporary grassland adjacent to watercourses, particularly on sloping fields.
- Where water is seen to flow across the surface in high rainfall events.
- Land vulnerable to nitrate leaching.

Costs

- Set Up - Low
- Maintenance - Low

Funding

- Certain cover crop types can be funded through the Countryside Stewardship scheme for mid and higher tier providing the land is eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- The Environmental Land Management (ELM) scheme will be based on 'public money for public goods'. Therefore, it is likely that there will be funding through the new scheme.

Consents and permissions

- Consents are unlikely to be required for work to establish cover crops.

Additional information

- Championing the Farmed Environment (CFE): https://www.cfeonline.org.uk/advice-training/winter-cover-crops/
- The Agriculture and Horticulture Development Board (AHDB): https://ahdb.org.uk/cover-crops

5.3 Cross drains in farm tracks – Level 1

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 in watercourses. Tracks are costly to repair but are essential to the farm.

Image 2. An example is a block stone track drain designed to divert surface water from the track into the adjacent vegetation —image credit Bristol Avon Rivers Trust.

A cross drain is a system to collect runoff and divert water off a track or path. If the water carries much sediment, it should be diverted into a sediment trap for the sediment to settle out. Otherwise, water can be diverted into areas of vegetation which will slow down the flow and allow infiltration.

Natural flood management purpose

- Cross drains to divert the main pathway of water, reducing the volume and velocity of runoff and encouraging infiltration.
- Reduced soil and sediment entering watercourses, particularly when used with a sediment trap.
- These measures slow flow pathways.

Agricultural benefits

- Farm tracks suffer from less erosion.
- Sediment caught in traps can be re-used on the track, saving time and money.
- Cross drains potentially reduce water issues at the end of the track and can prevent sediment from being washed onto grassland.

Methods

- The size of the cross drain will depend on local conditions. Small drains are typically d0.1 x w0.1 m constructed of concrete, wood, metal or clay pipe. For heavy rainfall, d0.2 x w0.2m drains will be more effective.
- Depending on the substrate of the track, a block stone cross drain may be more effective and require less maintenance.

Considerations

- Works on steep slopes or where runoff volume is high; several cross drains will be required, located at specific intervals along the track.
- They can be linked with swales and sediment traps alongside the track to encourage sediment to drop out of the water. This also prevents sediment from being washed onto grassland.

Level of maintenance

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

Key locations

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

Costs

- Set Up - Low
- Maintenance - Low

Funding

- Cross drains can be funded through the Countryside Stewardship scheme for mid and higher tier providing the land is eligible.
- The Environmental Land Management (ELM) scheme will be based on ‘public money for public goods’. Therefore, it is likely that there will be funding through the new scheme.
- Local Rivers Trusts in their project areas may be able to help support this**.**

Consents and permissions

- If work to a track is within 8 m of main river or on the floodplain of a main river, the work must be registered with the Environment Agency as an exemption. This is free of charge. Consents are not required for works close to an ordinary watercourse (see Consents and Permissions section to check whether this applies).
- A utility check will need to be carried out before work. These can be above or below ground or overhead (e.g. gas, electricity, water). They can restrict location for proposed measures as well as the methods used.

Additional information

- Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- https://www.gov.uk/guidance/catchment-sensitive-farming-reduce-agricultural-water-pollution

5.4 Creating buffer strips and riparian tree planting – Level 1

Creating strips of vegetation within a field can provide a physical barrier that slows the flow of overland runoff, increases infiltration, and prevents soil, sediment and nutrient loss from fields.

Image 3. Fencing & planting of native trees to create a vegetated riparian buffer strip along an exposed riverbank. Image credit Bristol Avon Rivers Trust.

Riparian buffer strips are next to watercourses, whereas in-field buffer strips are found adjacent to field boundaries and across fields.
Buffer strips can contain long grasses, trees, and shrubs. This vegetation increases the surface 'roughness' and slows down runoff.
Buffer strips often require fencing to prevent livestock from accessing the buffer strip and the watercourse. Alternative drinking sources, such as gravity-fed troughs, solar pumps or pasture pumps, can be used with buffer strips to provide livestock with access to water.

Natural flood management purpose

- Vegetation in the buffer strip increases the roughness of the land surface, which slows runoff.
- Vegetation increases and rainfall interception.
- Reduce loss of soil and sediment into watercourses.
- Bankside trees stabilise the banks of watercourses, helping prevent erosion and siltation from bank material.
- Bankside trees shade rivers, keeping them cool for aquatic wildlife and more resilient to climate change.

Agricultural benefits

- Stabilise the banks of watercourses, reducing erosion.
- Reduce the frequency of ditch management through decreased rates of siltation and weed development.
- Enhance crop management operations by straightening irregular field edges.
- Provide habitat for beneficial insects, including pollinators and predators of pests.
- Reduce the effects of spray drift.
- Provide shelter and shade for livestock.
- Reduce the risk of livestock acquiring waterborne diseases.
- Buffer strips trap and filter runoff, preventing loss of fertilisers, sediment and pesticides to watercourses, helping to meet cross-compliance rules.
- Evidence suggests that the increase in soil moisture and climatic control provided by buffer strips aids field grass growth.

Methods

- Riparian buffer strips should be a minimum of 6 m wide for maximum effect and may require fencing to exclude livestock from the river banks.
- The in-field buffer strips should be at least 2m wide. A beetle bank can be created by building a small mound along the in-field buffer strip, further benefiting the wildlife and encouraging natural predators of crop-eating insects.
- Planting native tree species within the buffer strip increases benefits for NFM and wildlife. Avoid planting tall growing species; shrubs such as hawthorn and hazel interspersed with alder, willow and birch would be more beneficial for slowing runoff and stabilising riverbanks. Planting should take place during the winter months to avoid periods of dry weather, providing trees with the best chance of survival.
- Maintenance of field buffer strips will depend on the land use, but fertilisers and manures should not be used.

Considerations

- If the strip is to be fenced from grazing, with the fence line more than 3 m from the middle of the river, there may be reductions in eligible land area under the Basic Rural Payments Scheme and implications for field boundary changes.
- Existing habitats and species may be protected or require particular specialist surveys and consent before work. Potential opportunity to enhance/connect existing habitat for these species.
- Fencing of watercourses may require installing alternative water access for livestock (such as gravity-fed drinking troughs, solar pumps or pasture pumps) and can impact livestock movements through fields.
- A utility check will need to be carried out before tree planting. These can be above or below ground or overhead (e.g. gas, electricity, water). They can restrict location for proposed measures as well as the methods used.

Level of maintenance

- Medium
- Dependent on the need for replacement/repair of fencing after flood events. To minimise this, fences in flood-prone areas should be in 50 m sections and line wire where possible.
- Trees will require future maintenance, including removal of guards and replacement if individuals do not survive. Once mature, trees will need to be maintained to prevent limbs from falling, damaging the fence line, and blocking the watercourse.

Key locations

- Throughout the catchment, adjacent to rivers, and especially on grazed land next to streams and ditches that suffer from high sediment loads.
- In-field strips on arable land at risk from soil erosion. This option works well alongside other run-off incepting options, such as contour bunds and hedgerows.

Costs

- Set Up - Medium
- Maintenance - Low

Funding

- Countryside Stewardship scheme contains a range of buffer strip, grass margin, and riparian management strip options for a mid and higher tier, providing the land is eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- The Environmental Land Management (ELM) scheme will be based on 'public money for public goods'. Therefore, it is likely that there will be funding through the new scheme.
- Local Rivers Trusts may assist with riparian fencing costs in their project areas.
- Forest of Avon Trust may support landowners with the development of tree planting plans.

Consents and permissions

- Consents are unlikely to be required for work to establish buffer strips.
- Fencing can be erected alongside a river without an environmental permit, providing the fencing is post and rail or post and wire. If wire is used, it must be strands or at least 100 mm spaced mesh.

Additional information

- Championing the Farmed Environment (CFE):
- https://www.cfeonline.org.uk/advice-training/grass-buffer-strips-next-to-a-watercourse-or-pond/

- https://www.cfeonline.org.uk/advice-training/in-field-grass-strips-to-avoid-erosion/

- Royal Society for the Protection of Birds
- https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/barn-owl/habitat/

5.5 Cross slope tree planting – Level 1

Planting trees within farmland can be beneficial for reducing flood risk, for wildlife, and farm business. Tree planting doesn't have to mean taking land out of production; even small-scale tree planting can be beneficial when well-sited. Cross-slope planting and riparian planting are particularly beneficial.

Image 4. Cross-slope tree planting to intercept significant flow pathways on a steep slope. Image credit Bristol Avon Rivers Trust

Trees reduce flood risk by intercepting rainfall (catching rainwater on their leaves from which it then evaporates), increasing surface roughness which slows overland runoff, and increasing infiltration rates via their roots. Trees planted along contours across a slope intercept the flow of water as it runs downhill and increases infiltration, storing water and nutrients in the soil.
They have many other benefits, including stabilising riverbanks, providing shelter for livestock, reducing soil loss, increasing wildlife habitat and helping address the climate emergency.

Natural flood management purpose

- Trees increase surface roughness, slowing overland flows.
- Reduce the volume of runoff by promoting rainfall infiltration into the soil. Woodland soils typically have a relatively open, organic-rich upper layer, facilitating the rapid entry and storage of rainwater – a 'sponge' effect.
- Interception can reduce the amount of rainfall reaching the ground by as much as 45%.
- The roots of bankside trees and associated vegetation help to bind and strengthen stream banks, reducing the risk of bank collapse, erosion and siltation of watercourses.

Agricultural benefits

- Trees create areas of shelter and shade for livestock.
- Trees trap and filter runoff, preventing loss of fertilisers, sediment and pesticides to watercourses, helping to meet cross-compliance rules.
- Evidence suggests that the increase in soil moisture and climatic control provided by buffer strips aids field grass growth and prolongs the growing season.
- Reducing soil erosion by protecting soil and crops from the full impacts of strong winds and rain.
- Planting trees can increase the potential for game shooting on farmland.

Methods

- Cross-slope planting should be along contours in areas with high overland runoff.
- Mixed woodland with a range of species, including a significant conifer component, offer the greatest natural flood management benefits.

Considerations

- Woodlands should be fenced from livestock to encourage the growth of trees and vegetation under the canopy.
- Potential change in eligibility for Basic Payment Scheme.
- Trees need maintenance in at least the first three years to ensure establishment, including removal and recycling of guards and replacement if individuals do not survive.
- A utility check will need to be carried out before tree planting. These can be above or below ground or overhead (e.g. gas, electricity, water). They can restrict location for proposed measures as well as the methods used.

Level of maintenance

- Medium
- For new native woodland, this will involve weeding, checking or straightening guards, and replacing failed trees as the plantation becomes established. Guards will need to be removed when the trees are grown.
- Forest of Avon Trust may support landowners with the development of tree planting and maintenance plans.

Key locations

- Tracks Across a slope following a contour.
- Increasing existing gill woodlands, plantations and shelter belts.
- Alongside watercourses

Costs

- Set Up - Medium
- Maintenance - Low

Funding

- Woodland Trust can help with on-the-ground advice, tree procurement and some small-scale provision of grant-funded materials.
- Local Rivers Trusts in specific project areas

Consents and permissions

- Consents are unlikely to be required for small-scale tree planting unless they are adjacent to a watercourse in the Internal Drainage Board District.

Additional information

- Woodland locations and forestry standards www.gov.uk/government/publications/the-uk-forestry-standard

- Woodland Trust – Woodland Creation Guide
- https://www.woodlandtrust.org.uk/publications/2022/02/woodland-creation-guide/

- Forest of Avon
- https://forestofavontrust.org/

5.6 Management of existing woodlands and understory planting – Level 1

Appropriate management of existing woodlands can enhance their benefits for flood management and biodiversity.

Image 5. Thinning the thick tree canopy along the watercourse. Image credit Bristol Avon Rivers Trust

Woodlands managed for various ages, sizes and types of trees, with a dense understory of both ground cover and shrubs below the tree canopy, will have the most significant potential for slowing overland runoff and increasing infiltration and interception.

Thinning thick tree canopies along the watercourse can provide multiple benefits, such as improving instream river habitat and encouraging shrubs and understory vegetation to grow. In turn, this can benefit biodiversity and help slow the flow of surface water running into the watercourse because of increased surface roughness. A ratio of 60:40 shade to light is recommended.

Natural flood management purpose

- Understory of small trees and shrubs in existing woodland increases the surface roughness and slows overland runoff.
- Reduces the runoff volume by intercepting rainfall and promoting infiltration into the soil.
- The roots of vegetation help to bind and strengthen stream banks, reducing the risk of bank collapse, erosion and siltation.

Agricultural benefits

- Understory planting increases the flood mitigation potential of woodland without extending the area of the woodland.
- Roots stabilise and strengthen the soil.
- Reduces runoff preventing loss of fertilisers, sediment and pesticides.
- Provides habitat for terrestrial wildlife.
- In poor weather, stock can use the woodland margin for shelter.
- Coppicing can provide firewood.

Methods

- The Coppicing stimulates the growth of the trees and allows more light, enhancing understory growth.
- Fencing off woodlands to exclude livestock access can allow the natural regeneration of understory plants.
- Plant native species such as holly, blackthorn, hazel, hawthorn or woodrush.

Considerations

- Loss of open space in the woodland.
- Potential loss of grazing land if livestock is excluded.
- This technique is particularly beneficial where plantations will likely need clear felling at some point in their management cycle. Establishing continuous cover means forest soils are less likely to be exposed after forestry operations and reduces soil erosion.
- Riparian canopies are to be thinned when the watercourse's shade-to-light ratio is greater than 60:40.

Level of maintenance

- Medium
- Trees need maintenance for at least the first three years after planting to ensure establishment.

Key locations

- Throughout catchment in existing woodland, especially along known overland flow pathways.

Costs

- Set Up - Low
- Maintenance - Low

Funding

- Woodland Trust can help with on-the-ground advice, tree procurement and some small-scale provision of grant-funded materials.
- Local Rivers Trusts in specific project areas

Consents and permissions

- Consents are unlikely to be required to manage existing woodlands, but large-scale felling requires a licence from the Forestry Commission.

Additional information

- Contact Managing woodlands & forestry standards
- www.gov.uk/government/publications/the-uk-forestry-standard

- Woodland Trust – Managing Woodland
- https://www.woodlandtrust.org.uk/plant-trees/managing-trees-and-woods/managing-your-woodland/

- Forest of Avon
- https://forestofavontrust.org/

5.7 Planting and managing hedgerows – Level 1

Image 6. Hedgerow planting to reduce the impact of livestock, including soil compaction and trampling of the riverbank. The hedgerow will also provide a valuable habitat corridor for wildlife and slow surface water flow — image credit Bristol Avon Rivers Trust.

Hedgerows are an intrinsic part of the landscape and, in many places, owe their existence to the need to divide grassland into conveniently-sized grazing pastures for livestock.

Hedgerows provide excellent natural weather barriers and habitat for wildlife but also perform a natural flood management function by intercepting rainfall, slowing overland runoff and increasing infiltration. Planting hedgerows on small embankments, known as bunded hedgerows, can improve the growth of the hedge and enhance the NFM and water quality benefit by intercepting and temporarily storing overland flow.

These benefits can be achieved by planting new hedgerows across slopes or restoring old hedgerow boundaries still evident in the landscape.

Image 7. Hedgerow combined with a wildflower buffer

Natural flood management purpose

- Hedgerows reduce runoff volume by intercepting rainfall and promoting infiltration into the soil. They also slow flow pathways are designed to intercept.
- Bunded hedgerows can intercept surface runoff, temporarily storing flood water and increasing infiltration.
- Hedgerows trap sediment, reducing the amount of sediment and diffuse pollution reaching watercourses.

Agricultural benefits

- Hedgerows create areas of shelter and shade for livestock.
- Hedges trap and filter runoff, preventing loss of fertilisers, sediment and pesticides to watercourses, helping to meet cross-compliance rules.
- Reducing soil erosion by protecting soil and crops from the full impacts of strong winds and rain.
- Increased leaf litter improves soil quality.
- Can prevent animal-to-animal contact, reducing the spread of disease.
- Provide habitat for farmland birds and beneficial insects.

Methods

- Prepare the ground along a 1.5m wide strip to provide good soil conditions and as little competition from other vegetation as possible.
- Plant a double staggered row hedge using six plants per metre.
- Up to 75% of the species can be thorns – for example, hawthorn and blackthorn.
- Consider a mix of shrub species, including hazel, geulder rose, rowan and holly, to enhance the hedgerow for wildlife.
- Add in an oak, lime, aspen or alder every 10 m to grow into a single landscape tree for additional shade and shelter. Use a 1.2 m guard to protect the standard tree as it grows.
- Fence off the plants, keeping fences far enough away so the hedgerow can grow at least 2 m in width. Rabbit netting may be needed, either on its own or with stock fencing, if there is a known problem with rabbits or hares.
- Remove individual guards and tree shelters once the plants are established.

Considerations

- Planting can be undertaken throughout the winter but not in freezing weather or waterlogged ground. If planting into clay soils, wait until March.
- If new hedgerows are planted, consider linking existing hedgerows and habitats.

Level of maintenance

- High
- Newly planted hedges will require annual maintenance until they are at least 1.5m tall. Competitive weeds should be controlled (including brambles, nettles and grasses) during the first growing season.
- The laying of a hedge every 8-15 years will increase wildlife benefits and create a denser stock-proof barrier.

Key locations

- Consider planting a new hedge across a slope where runoff occurs or perpendicular to the river in a floodplain.
- Where hedgerows have been lost from an area or the network is fragmented.
- Restoration of historic hedgerows

Costs

- Set Up - Medium
- Maintenance - Low

Funding

- Woodland Trust can help with on-the-ground advice, tree procurement and some small-scale provision of grant-funded materials.
- Countryside Stewardship scheme capital hedgerows and boundaries grant can fund hedgerow laying and maintenance, providing the land is eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- Local Rivers Trusts in specific project areas

Consents and permissions

- Consents are unlikely required for work to establish hedgerows unless they are adjacent to a watercourse in an IDB District.

Additional information

- Government Advice - Plant and manage hedgerows
- https://www.gov.uk/guidance/plant-and-manage-hedgerows

- Hedgelink – Managing Hedgerows
- http://hedgelink.org.uk/index.php?page=23

5.8 Watercourse (ditch/rhyne) naturalisation – Level 1

With weather patterns predicted to be more erratic with climate change, holding water back in watercourses and encouraging infiltration could also help to mitigate against drought. Some watercourses are essential for flood drainage, but others can be naturalised to create a fully functioning floodplain through collapsing incised banks.

Naturalised watercourse networks can create multiple benefits for people and wildlife while fulfilling your duties as a riparian owner.

Watercourses can be used as a pond, which helps slow water flow into main rivers and streams by holding water during rainfall.

Natural flood management purpose

- Store excess water during heavy rainfall events, encouraging water infiltration into soil and storage in times of drought.
- Instream and bankside vegetation can help to slow the flow.
- Reduced velocity and erosion of sediment.
- Backwaters, junction ponds, and 2 stage channels (particularly where soil is moved out of the floodplain) provide extra flood storage capacity.

Agricultural benefits

- Conserving water into and through drought conditions.
- Vegetation can trap pollution and sediment leaving farm systems.
- Increase in biodiversity.
- Increased groundwater recharge.

Methods

- Collapsing incised banks.
- Creating junction ponds, meandering edges, and creating a two-stage ditch channel.
- Adding backwaters and leaky dams.

Considerations

- Works well with soil and land management to avoid erosion, sediment traps and riparian buffer strips.
- The Lead Local Flood Authority can give specific advice, as can the Internal Drainage Board or Environment Agency.
- Consult the Lead Local Flood Authority where obstructions are placed in the channel.
- Precautions will need to be made if protected species are present, such as nesting birds, great-crested newts and water voles.

Level of maintenance

- Low

Key locations

- Ditches and artificial drainage channels throughout the catchment, mainly found on low-gradient agricultural land.

Costs

- Set Up - low
- Maintenance - low

Funding

- Countryside Stewardship (CS) Scheme – mid-tier.
- The ELM scheme will be based on 'public money for public goods. Therefore it is likely there will be funding through the new scheme

Consents and permissions

- Lead local flood authority.
- Internal Drainage Board.
- Environment Agency if main river.

Additional information

- Association of Drainage Authorities (ADA) - The Drainage Channel Biodiversity Manual
- https://www.ada.org.uk/knowledge/environment/
- The River Trusts – Managing Ditches https://theriverstrust.org/media/2017/04/Pinpoint-21.0-Soil-Management-Managing-ditches.pdf

5.9 Bunds and detention basins – Level 2

Bunds are low earth mounds built following the slope's contour. Water is held by the bund and allowed to disperse through a combination of infiltration into the soil, evaporation and slow release (for example, through a small pipe or filter material).

Image 8. A series of bunded scrapes created within a newly created grass buffer between the watercourse (beside established hedgerow) and agricultural practice. Once established, the surface roughness will increase the effectiveness of slowing the flow and capturing soil — image credit Bristol Avon Rivers Trust.

Bunds work most effectively when constructed across known runoff pathways that appear after heavy rainfall. Bunds can be designed to keep the area dry and productive or encourage wetland habitat development. This can be carried out on a small to large scale, depending on the size of the catchment area and the local soil conditions.

Natural flood management purpose

- Creation of bunds across known run-off pathways can intercept water flowing over the ground, slow the flow and redirect runoff.
- They reduce the runoff volume by increasing the opportunity for infiltration and evaporation.
- They trap sediment and nutrients, which can reduce the function of neighbouring watercourses and drainage systems.

Agricultural benefits

- Bunds reduce soil loss and surface scour.
- They filter diffuse pollutants and provide an opportunity for nutrient reclamation.
- They provide pollutant treatment by allowing settlement.
- Bunds can be engineered in such a way as to provide access to fields in times of flood which would otherwise be inaccessible.

Methods

- The Design of more extensive bunds or detention basins should be site-specific and carried out by a land drainage specialist. Local Rivers Trusts may be able to help with this.
- Detention areas should be sized for the area draining into them.
- The slope of the sides should be less than 1 in 4 and vegetated.
- Construction materials will depend on the size of the detention basin, the method of flow control used, and the consideration of future maintenance.

Considerations

- Consideration should be given to where the water would go if the storage area became full and the bund is overtopped. These exceedance flow paths should not create a new flood risk area.
- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Deliberate and planned flooding of agricultural land to create new watercourses and permanent wetlands is not considered a temporary flooding event as the land is not being maintained in a state suitable for grazing or cultivation, which is the primary eligibility factor for BPS.
- Can make cutting and mowing practices more complex.

Level of maintenance

- Medium
- Dependent on the scale and design. Require regular inspection to ensure that the bund is intact, the outlet is not blocked, and the area behind the bund is not filled with silt.

Key locations

- Small vales and 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

Funding

- Bunds can be funded through the Countryside Stewardship scheme for mid and higher tier providing the land is eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- Countryside stewardship payments may be available for flood mitigation on permeant grassland for higher tier agreements only, providing the land is eligible.
- Local Rivers Trust in specific project areas

Consents and permissions

- Large structures may need planning permission.
- Activities carried out on the floodplain of a main river need a flood risk activity environmental permit if you do not have planning permission.

Additional information

- Government Advice – Rural Sustainable Drainage Systems
- https://www.gov.uk/government/publications/rural-sustainable-drainage-systems
- Construction Industry Research and Information Association
- www.susdrain.org/resources/ciria-guidance.html

5.10 Swales – Level 2

Swales are shallow, linear, vegetated drainage features that store and redirect surface water flows that appear after heavy rain.

The vegetation in the swale increases roughness, slowing the flow of water. The water can be slowed further by introducing check dams and berms across the swale.

Swales also increase the opportunity for infiltration and reduce downstream pollution by encouraging sediment settlement. Swales can be built across contours to intercept and store runoff and work well alongside bunded hedgerows. Swales can also be built in combination with bunded detention areas and act to direct runoff into the storage area.

Image 9. A swale leading to a basin that stores water in heavy rainfall

Natural flood management purpose

- Swales reduce runoff rates by slowing the flow of water.
- They reduce the runoff volume by increasing the opportunity for infiltration and evaporation.
- They trap sediment, which can reduce the function of neighbouring watercourses and drainage systems.

Agricultural benefits

- Swales reduce soil loss and surface scour.
- They provide pollutant treatment by allowing settlement.

Methods

- Design of the swales should be site-specific and consider the contour of the surrounding land, the position in the landscape, and the soil type.
- Swales can be dug along boundaries, with the spoil used to create a hedge on a small embankment, known as a kested hedge.

Considerations

- The location of the swale will be suggested by the reaction of the landscape to heavy rainfall. Their design should be tailored to each location.
- Consult with the Rural Payments Agency (RPA) about eligibility for the Basic Payment Scheme (BPS) as a swale may be considered a ‘new watercourse’, which would render that area an ineligible feature.

Level of maintenance

- Low
- Some vegetation control may be required. Sediment build-up will need to be removed periodically. The addition of structures within the swale increases maintenance.

Key locations

- Shallow 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 - Low

Funding

- Swales can be funded through the Countryside Stewardship scheme for mid and higher tier providing the land is eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- Local Rivers Trusts in specific project areas

Consents and permissions

- If the swale is on the floodplain of a main river, the work must be registered with the Environment Agency (see Consents section to check whether this applies).
- If the total area is less than 0.1 Ha, the swale will be registered as an exemption. This is free of charge.
- If the swale area is over 0.1 Ha, the work will require a flood risk activity environmental permit.
- Consent may be required from the Environment Agency.

Additional information

- Contact Government Advice – Rural Sustainable Drainage Systems
- https://www.gov.uk/government/publications/rural-sustainable-drainage-systems
- Construction Industry Research and Information Association
- www.susdrain.org/resources/ciria-guidance.html

5.11 Sediment traps – Level 2

Sediment traps can take many forms but typically involve excavation on a surface runoff pathway. Runoff enters the excavation and is detained there, allowing sediment to settle out before the runoff is discharged via an outlet.

Image 10. A sediment trap designed to take water off a nearby road allows suspended sediment to settle before flowing into the downstream watercourse — image Credit Bristol Avon Rivers Trust.

Reducing sediment inputs to watercourses also benefits aquatic wildlife and reduces water pollution.

Sediment traps do not store large volumes of water to reduce flood risk but reduce sediment inputs to watercourses, thus maintaining their capacity downstream. Sediment traps can also be used as a pre-treatment for water running into a temporary storage area, reducing diffuse pollution downstream.

Natural flood management purpose

- Sediment traps hold some excess floodwater, but many would be needed in a catchment to impact the flood peak significantly.
- They reduce siltation, maintaining the capacity of downstream watercourses.
- They can be used as a pre-treatment for other natural flood management measures, such as retention ponds.

Agricultural benefits

- Retain washed-off topsoil allowing for re-spreading.
- Enhances longevity of other NFM measures such as bunds and ponds.
- Maintains capacity of watercourses and ditches, reducing the need for maintenance.
- Improve water quality.

Methods

- A small excavation is created, usually with a gravel outlet. Rocks and vegetation around the outlet will protect against erosion.
- The slope of the sides should be less than 1 in 4 and vegetated.
- Ensure access is provided for cleaning the sediment trap.
- The size will depend on the site and the runoff volumes to be intercepted; however, the greater the scale, the greater the removal efficiency.

Considerations

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

Level of maintenance

- Medium
- Sediment traps will need to be regularly emptied. The frequency will depend on the area being drained and how much sediment is being intercepted.
- This can be re-spread onto agricultural land (may require an exemption for the use of waste to be registered with the Environment Agency).

Key locations

- Within an area where surface runoff flows downhill.
- In conjunction with cross drains.
- As a pre-treatment for temporary water storage areas.
- Adjacent to, or within, ditches.

Costs

- Set Up - Low
- Maintenance - Low

Funding

- Sediment traps can be funded through the Countryside Stewardship scheme for mid and higher tier providing the land is eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- Local Rivers Trusts (RT) within their project areas.

Consents and permissions

- Constructing a sediment trap on the floodplain of a main river or within 9m of a watercourse in the IDB District may require a flood risk activity environmental permit or Land Drainage Consent. Contact the Environment Agency or IDB for guidance.

Additional information

- Championing the Farmed Environment (CFE)

  https://www.cfeonline.org.uk/cfe/resources/water-quality-protection-for-your-farm-business/

- Government Advice – Rural Sustainable Drainage Systems https://www.gov.uk/government/publications/rural-sustainable-drainage-systems

- Construction Industry Research and Information Association www.susdrain.org/resources/ciria-guidance.html

5.12 Leaky barriers or large woody dams – Level 2

Leaky barriers constructed in streams and ditches are designed to hold back flood water within the channel or encourage water to spill onto the banks, reducing the downstream flood peak by temporarily storing water and slowing the flow.

Image 11. A leaky dam was constructed along an incised tributary to slow the flow by increasing storage capacity upstream of the structure. Image credit Bristol Avon Rivers Trust

Leaky barriers are designed to replicate naturally fallen trees and create a variety of habitats and flow conditions. They are set above average stream levels, so normal flows and fish movement are not impeded. When whole trunks are used and secured, they are referred to as large woody dams.

Image 12. An example of a Large woody dam within the headwaters of a watercourse. Image credit Bristol Avon Rivers Trust

Natural flood management purpose

- Leaky barriers slow high flows, increasing the time it takes for stormwater to pass downstream, thereby reducing the maximum flood peak.
- Leaky barriers can be constructed so that floodwater spills onto the floodplain for additional temporary storage where conditions are suitable.
- They are designed to slowly drain trapped water once the flood flow has passed.

Agricultural benefits

- Leaky barriers can successfully reduce localised flooding within the farm holding.
- Trap sediment, improving water quality.

Methods

- Large woody dams are created by laying large tree trunks in a cross formation across the channel to rest safely on both banks, wedged and secured in position. Smaller timbers can be held in place between the larger ones.
- Leaky barriers are constructed by securing a support across the channel and securing slats to form a barrier that lets some water pass through.
- The height of the lowest timber should allow normal flows to pass underneath. This will also permit fish passage.
- To maximise impact, it is recommended to create a series of at least three leaky barriers.
- If possible, use locally sourced wood.

Considerations

- Many barriers are likely needed in a catchment, and their implementation will need careful planning to ensure they do not cause flood peaks to coincide.

Level of maintenance

- Medium
- Large woody dams will need periodic checking to ensure the logs are still wedged in the correct position. Periodic clearance of debris and sediment from the leaky dams will prevent blockage and overflow of water.

Key locations

- Generally suited to smaller watercourses (< 2 m wide) and ditches throughout the catchment, where holding water back will not create additional problems.

Costs

- Set Up - Low
- Maintenance - Low

Funding

- Leaky barriers can be funded through the Countryside Stewardship scheme for mid and higher tier providing the land is eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- Local Rivers Trusts within project areas.

Consents and permissions

- Constructing in-channel will require consent from the Lead Local Flood Authority, IDB or Environment Agency.

Additional information

5.13 Ponds and scrapes – Level 2

Ponds and shallow scrapes capture and store water during flood events. They should drain down slowly after flood events to maintain capacity but can be designed to hold some water permanently.

Image 13. A series of small ponds created within a wet and unproductive corner of an agricultural field. Image credit Bristol Avon Rivers Trust

Offline ponds and scrapes are situated in the floodplain to capture overland runoff. Online ponds have a stream channel flowing through. The flood water is then stored temporarily and is released back into the watercourse in a controlled manner.

Natural flood management purpose

- Provides water storage capacity during storm events. The water slowly drains from the pond once the flood period has passed via infiltration or an outlet point.
- Ponds can be designed to hold some water all year, adding to the wildlife value of the farm.

Agricultural benefits

- Sediment is removed from the flow, which maintains the capacity of watercourses and ditches and can be returned to the land.
- Can be designed to incorporate a silt trap, improving water quality.
- Retention of water is also beneficial in times of drought.

Methods

- Ponds must be individually designed according to the characteristics of the site.
- Ponds should drain within 10 -24 hours so that storage is available during multi-day extreme events.
- A liner may be required.
- The pond can include an armoured spillway to avoid erosion damage when overtopped.

Considerations

- Test pits will be needed to see how well the pond will hold water if a permanent water source is desired.
- Ponds will be classed as ineligible features under the Basic Payment Scheme (BPS) rules if they are 0.01 hectares or more or add up to 0.01 hectares or more.

Level of maintenance

- Medium
- Check for scouring of inlet and outlet features. Sediment may accumulate to the level of the outlet and may need removal. Management of vegetation may also be required.

Key locations

- Near to watercourses in non-productive areas of land - buffer strips, inside small meanders or field corners, throughout the catchment.
- At the bottom of slopes, particularly in fields draining to a single corner.

Costs

- Set Up - High
- Maintenance - Low

Funding

- Scrape creation and pond management can be funded through the Countryside Stewardship scheme for higher tier only, providing the land are eligible. Contact your local Natural England Catchment Sensitive Farming Officer for advice.
- Local Rivers Trust in project areas

Consents and permissions

- Larger ponds may require planning permission.
- Ponds on the floodplain of a main river will require a flood risk activity environmental permit from the Environment Agency if they do not have planning permission.
- If the pond alters the flow of an ordinary watercourse, land drainage consent will be required from the Lead Local Flood Authority or the IDB

Additional information

- Government Advice – Rural Sustainable Drainage Systems

  https://www.gov.uk/government/publications/rural-sustainable-drainage-systems

- Construction Industry Research and Information Association www.susdrain.org/resources/ciria-guidance.html

5.14 Woodland creation – Level 2

Well-sited and well-managed woodlands significantly benefit natural flood management and sheltering livestock, providing wildlife habitat and stabilising soils.

Image 14. A small woodland was planted to increase surface roughness and slow surface water flows from several prominent flow pathways — image credit Bristol Avon Rivers Trust.

Several different grants are available to establish new woodlands; if managed as a commercial woodland, they can generate income for the landowner.

Woodlands reduce flood risk in several ways. Trees are very good at intercepting rainfall; between 25-45% (conifers) and 10-25% (broadleaves) less water reaches the ground annually by intercepting and evaporating from the leaves1. Woodlands also slow the runoff flow and increase infiltration by up to 60 times compared to grazed pasture.

Natural flood management purpose

- Interception can reduce the amount of rainfall reaching the ground, conifers being particularly effective.
- Planting trees increases the surface roughness, slowing water flow during a flood event, especially when combined with understory planting.
- Woodlands reduce the runoff volume by promoting rainfall infiltration into the soil and increasing evaporation.
- The roots of bankside trees and associated vegetation help to bind and strengthen stream banks, reducing the risk of bank collapse, erosion and siltation.
- Provides habitat for terrestrial wildlife and improves water quality.
- Stores carbon, helping to regulate climate.

Agricultural benefits

- Timber production creates diversified income generation and tax-efficient opportunities. The forestry sector is resilient, and demand for UK-grown timber is consistently increasing.
- Trees provide essential shelter and shade for livestock, ideally outside rather than inside the wood. Reduced wind speed around the wood can result in higher lamb survival rates and reduced animal hypothermia and energy loss.
- Grazing areas sheltered by trees have shown up to 20 % increase in average annual pasture growth, up to 21 % increase in the live weight of sheep and increases of up to 17 % in dairy milk production.
- Reduced floodwater damage on productive farmland.
- Woodlands trap and filter runoff, preventing loss of fertilisers, sediment and pesticides to watercourses, helping to meet cross-compliance rules.
- Planting trees can increase the potential for game shooting on farmland.

Methods

- The optimum area and species to be planted vary at each potential site.
- Mixed woodland with a range of species, including a significant conifer component, offer the greatest natural flood management benefits.

Considerations

- New planting will need protection from livestock grazing.
- Adding leaky barriers within the woodland will increase the natural flood management benefits.

- If woodland creation is funded through the Countryside Stewardship scheme, the BPS payment on the site is retained.
- Trees need maintenance in at least the first three years to ensure establishment, including removal and recycling of guards and replacement if individuals do not survive.
- A utility check will need to be carried out before tree planting. These can be above or below ground or overhead (e.g. gas, electricity, water). They can restrict location for proposed measures as well as the methods used.

Level of maintenance

- Medium
- For new native woodland, this will involve weeding, checking or straightening guards, and replacing failed trees as the plantation becomes established. Guards will need to be removed when the trees are grown.

Key locations

- Throughout the catchment – in particular, remote upper catchment areas.
- Linking up with existing woodland or hedgerows creates a wildlife corridor effect.

Costs

- Set Up - Medium
- Maintenance - Low

Funding

- Engage the Forestry Commission early for advice and support.
- Forestry Commission Woodland Carbon Fund can fund larger tree planting schemes. A Woodland Creation Planning grant is also available under this scheme to fund the development of woodlands.
- Woodland Trust can help with on-the-ground advice, tree procurement and some small-scale provision of grant-funded materials.
- Local Rivers Trusts in specific project areas.
- Forest of Avon Trust may support landowners with the development of tree planting and maintenance plans.

Consents and permissions

- An Environmental Impact Assessment (EIA) determination may be required. The Forestry Commission is responsible for administering this. Further details can be found at www.gov.uk/guidance/environmental-impact-assessments-for-woodland-overview
- Forestry Commission consent is required to fell a woodland.
- Contact your local FC Woodland Officer for further information.

Additional information

- Woodland locations and forestry standards www.gov.uk/government/publications/the-uk-forestry-standard
- Woodland Trust – Woodland Creation Guide https://www.woodlandtrust.org.uk/publications/2022/02/woodland-creation-guide/
- Forest of Avon https://forestofavontrust.org/

5.15 River and floodplain restoration – Level 3

Many rivers have been straightened, and flood embankments built to increase the land available for agriculture. Even small becks have often been altered. These changes disconnect rivers from their natural floodplain, reducing the area naturally available to store floodwater.

Image 15. The Large Woody Debris deflectors create pinch points improving flow diversity necessary to improve fish and aquatic invertebrate habitats. Image credit Bristol Avon Rivers Trust.

This results in more flood water travelling faster downstream to villages and towns.

River and floodplain restoration encompasses a range of different techniques which are often used in conjunction. They include restoring meanders, removing or setting back flood banks, reconnecting old side channels and connecting the river to floodplains. Restoration will change the form of the river channel, often adding bends into the river, lengthening its course, enabling additional storage and slowing the flow to reduce the downstream flood peak.

Restoring the connection between a river and its floodplain allows floodwater to spill naturally onto land to provide significant flood storage, reducing risk to lives and property further downstream. This also allows the river to drain back into the channel more rapidly after flood events, reducing prolonged inundation of fields and the need for channel maintenance.
Restoration always needs to be carefully planned by 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 modelling and design and require planning and other permissions and consents. It is likely to be high cost and needs specialist contractors. Local Rivers Trusts or Environment Agency staff can give initial advice on a site's suitability, and early contact is highly recommended.

Natural flood management purpose

- Storage of potentially large amounts of floodwater on the floodplain, with a controlled discharge back to the river once the flood event has passed.
- Re-creating meanders will increase the time the floodwater will flow downstream by making it take a longer route. The greater length of a meandered river allows it to carry a greater volume of water before it spills out of its channel.
- Naturally functioning rivers will create features such as bars, riffles and pools, which can help slow the flow.
- River and floodplain restoration can also create habitats such as wetlands and wet woodlands, which benefit a wide range of species, including breeding and wintering wading birds.

Agricultural benefits

- Allowing more natural lower-energy flooding reduces the risk of bank and embankment failure.
- The river can drain back into the channel rapidly as levels fall rather than water trapped behind embankments.
- Removes the need for maintenance of artificial engineering works.
- Provides rich wildlife habitat and better fisheries.

Methods

- Dimensions are entirely site-dependent and will need detailed specialist advice.
- Pre-work assessments and surveys will be required to ensure that works do not increase flood risk (for example, an embankment may be holding water back during a flood event, and removal could increase flood risk).
- Historical aerial photographs and maps can identify previous meanders and curves in the water course.

Considerations

- The Rural Payments Agency (RPA) will need to be informed about any changes to the land parcel areas.
- Flooded agricultural land is still eligible for BPS if the flooding is temporary and the land would otherwise still be available for agricultural activity. Areas where agricultural land is deliberately flooded to create new watercourses or permanent wetlands, are not eligible for BPS.
- Environment Agency or IDB advice and consent will be required as part of the planning process for this kind of project.

Level of maintenance

- Low
- Very little once the initial work is done.

Key locations

- Where there is no risk to property or infrastructure from an altered river course or floodplain inundation.
- Re-meandering needs careful planning and is most likely practical, where the same landowner owns both sides of the channel.
- Small becks in the upper parts of the catchment will be easier to restore than main rivers.

Costs

- Set Up - High
- Maintenance - Low

Funding

- Specialist advice on funding is needed. Contact Local Rivers Trust, Environment Agency, LLFA or IDB staff.
- Countryside Stewardship ‘Making space for water’ grants may be available as part of higher tier agreements. Contact Natural England for advice.

Consents and permissions

- Planning permission and bespoke consent are likely required for a re-meandering project. Your local Rivers Trust will lead in obtaining the necessary consent.

Additional information

- River Restoration Centre
- https://www.therrc.co.uk/

6.0 Consent and approval

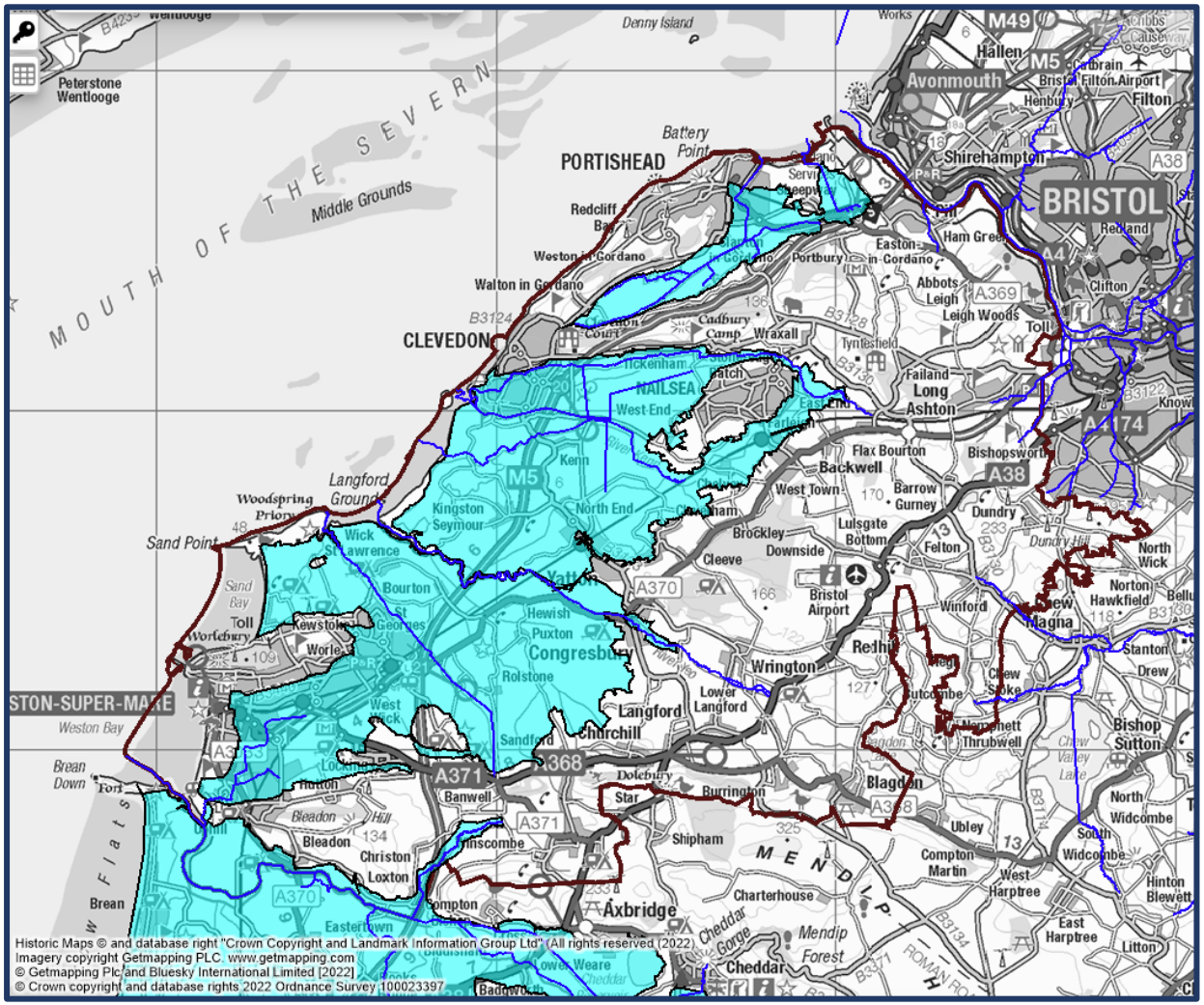


Figure 2 - Plan showing where the IDB District and EA Main River are. The IDB districts are in light blue, and main rivers are in dark blue

Some Natural Flood Management (NFM) measures may require consent before construction.

Land drainage consent on main rivers

A Flood Risk Activity Permit (FRAP) will be required from the Environment Agency (EA) for any works within 8 metres of a main river or 16 metres if tidal.

On ordinary watercourses

Works in or near an ordinary watercourse (non-main river) may require ordinary watercourse land drainage consent from North Somerset Council as the Lead Local Flood Authority or the Internal Drainage Board.

Contacts

Environment Agency
https://www.gov.uk/government/organisations/environment-agency
email: enquiries@environment-agency.gov.uk
Tel: 03708 506 50

North Somerset Council
https://www.n-somerset.gov.uk/
Tel: 01934 888 888

Somerset Drainage Boards Consortium
https://somersetdrainageboards.gov.uk
email: admin@somersetdrainageboards.gov.uk
Tel: 01278 789906

Planning consent

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

New woodlands

An Environmental Impact Assessment (EIA) enquiry should be undertaken if more than 2ha of woodland planting is planned. This will allow the Forestry Commission (FC) to judge whether your project needs to undertake an EIA. This is done for projects outside of the agri-environment schemes by completing an EIA opinion form for afforestation projects. If applying for a woodland creation grant via the agri-environment scheme, the process is undertaken as part of your grant application. For further information, visit www.gov.uk/government/organisations/forestry-commission

Specialised consent

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

Public rights of way

Public footpaths, public bridleways and byways are managed by the North Somerset Council. Consent must be obtained before any work that might affect the physical right of way or those using it. Be aware that the actual ‘used’ route that the public walk or rides across your land could differ from the legal definitive line.

7.0 Case studies

Case study 1 – Large Woody Debris (LWD)
Location: Candlestick Stream, Chelwood, Chew Valley

Issue:

The Candlestick stream has the potential to support a wide variety of aquatic species, including the migratory Atlantic salmon and brown trout that are present on the River Chew. However, several issues prevent the stream from supporting suitable habitats for the benefit of wildlife and local communities. These include:

Lack of flow diversity – the uniform channel lacks features encouraging wildlife diversity, including deep pools and shallow riffles.

Lack of in-stream woody habitat – natural tree fall, hanging branches, and protruding roots are essential for providing refuge and feeding habitat in healthy waterways. Given a large number of bankside trees in the woodland, more of these features should be in the stream.

The stream is disconnected from its floodplain – incised banks mean it does not spill into the floodplain during high flows, limiting the opportunity for flow attenuation and settlement of sediments and the functioning of wet woodland habitat.

Downstream flood risk – the River Chew catchment is 'flashy', meaning that water drains quickly into the Chew and puts communities at risk of flooding. Streams that are disconnected from their floodplains and have uniform channels do little to slow the water flow through the catchment.

Image 16. The stream flows through Lord's Wood, where there is potential for diverse flow conditions and woody instream habitat

Solution: Introduce a variety of woody materials into the stream at strategic locations in the woodland. This was achieved by:

Image 17. The low-lying floodplain 'shelves' provide a good opportunity for surface water to be stored in the floodplain during rainfall events

Strategically and sensitively felling trees into the stream in locations where they will promote connectivity of the stream with the floodplain - target areas where there are low-lying ‘shelves’ where water can be encouraged to spill into and hold during medium to high flows.

Securing trees or large branches in the channel where there is a lack of flow diversity.

Hinging trees and branches where possible so they continue to grow and create new opportunities for promoting geomorphological processes.

Image 18. The woody material will promote diverse flow conditions and provide an instream habitat for a range of wildlife

Benefits:

Enhanced flow diversity – promoting processes such as stream bed (creating deeper pools), sorting bed substrate, and creating a multi-braided channel. These processes and

features benefit aquatic wildlife and have positive knock-on effects up the food chain.

'*Slow the flow' during rainfall events* – more regular spilling of the stream into the flood plain will benefit catchment hydrology by reducing the speed at which rainwater is drained into the River Chew. Spilling water into the surrounding woodland will enable increased water storage capacity and encourage sediment deposition, thus reducing the sediment load downstream.

Enhanced in-stream habitat – woody debris in the stream provides refuge and habitat niches for the stream ecology, which we hope will encourage a diversity of species into the stream.

Image 19. Volunteers helped to secure the woody material in place

Case study 2 – Cross Drains
Location: Chelwood, Chew Valley

Issue: A series of forestry tracks through the woodland, used by the commercial plant, act as flow pathways for surface water. This surface water flows from the steep forest slopes after rainfall and builds momentum, eroding the unnatural track surface and carrying it into the Candlestick Stream. This causes:

Pollution of the stream with imported track sediment reduces water quality

High peak flows following rainfall due to the speed at which rainfall drains from the woodland

Surface water likely has a high acidity due to the coniferous woodland it flows through. Acidity can negatively impact aquatic life at all levels of the food chain.

High maintenance requirements and costs for the landowner to replace the track surface

Image 20. One of the well-used forestry tracks is a flow pathway for surface runoff. The erosion caused by runoff poses issues to the stream and maintenance of the track.

Solution: Install sustainable drainage features that intercept and divert surface water from the track. BART worked with a contractor to install ten linear drainages ‘bumps’ in strategic locations on two of the priority tracks, focusing efforts at the top of the tracks to intercept water before it builds momentum, then spacing features along the tracks to provide momentum-breakers. The features were constructed using locally sourced grey lias stone, cut to even shapes, set in a blast and cement, and pointed with cement to form an impermeable barrier. The features protrude from the track (up to 100 mm above the surface) and divert the water into heavily vegetated areas or shallow depressions where sediments and pollutants can settle. Runoff is slowed and filtered before reaching the stream.

Images 21 and 22. Installation of the stone track drainage features

Benefits:

Improved stream bed habitat – less fine sediment entering the stream means the stream bed is less likely to be smothered, maintaining a clean gravel bed which is valuable habitat for wild fish and invertebrates.

Improved water quality – enabling runoff filtering by low-lying vegetation, helping remove oils or fuels used in forestry.

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Create small wetland habitats and niches for plant and animal life – in the drainage sumps and areas where the drained water will settle.

Safer forestry infrastructure and reduced maintenance – both the hard and soft surface tracks through the woodland will remain drier and more even to allow safe travel through a steep woodland environment. The landowner regularly resurfaces the track to maintain operations, and this need and cost will be reduced as resurfacing will be less regular