Practical Guidance

Natural flood management guidance:

Woody dams, deflectors and diverters

July 2016

WOODLAND TRUST

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Sussex Flow Initiative
River Ouse

1 Introduction

Large and small pieces of wood in our rivers and streams are a vital component of a healthy functioning system. Rivers without wood often lack a diversity of features such as pools and gravel beds favoured by fish, whilst in-channel wood can also help to store sediments, reducing the amount travelling downstream.

Many of our rivers and streams have been deepened, becoming disconnected from their natural floodplain. This means floodplains only provide their natural flood storage in extreme conditions. Carefully placed and individually designed wood dams and deflectors can be used to direct water into preferential areas, increasing temporary water storage and slowing water passage. They are low cost, and utilise natural materials and processes.

These woody dams, deflectors and diverters can be designed to suit the location, and use local and natural materials. They can be easily and cheaply installed, and designed to offer multiple benefits for flooding and wildlife.

This document offers guidance in the use of natural dams, deflectors and diverters to improve river health and increase water storage during flooding events.

Best places for large woody debris:

- Disconnected floodplains.
- Headwater streams.
- Streams lined with woodland.
- Drainage ditches.
- Degraded uniform channels.
- Areas adjacent to flood storage areas.

Photo by Sandra Manning-Jones

Woodland Trust volunteers building a dam in Views Wood

Photo by Sandra Manning-Jones

Woody dams slow the passage of water downstream, increasing sediment retention.

2 Woody dams

Dams span the whole river channel or ditch, and are pinned in place behind trees or using cables or large stakes. In strategic low risk locations dams can be used to increase out-of-bank water movement, helping to reconnect the floodplain to the river. They are also useful in locations requiring rapid restoration of degraded and homogeneous channels, or where disused woodland drainage ditches exist.

Dams accrete sediment leading to an increase in upstream bed levels, creating a step-change. They help form deep pools and increase and grade large gravels — creating important habitat and spawning ground for fish, see image 1. Woody dams also trap other debris as it floats downstream reducing blockage of culverts. Channels that are very deep or wide (i.e. >5m), or those that receive high volumes of water will carry higher risk of movement and should be avoided. Where possible 'out-of-bank' flow should be channelled into woodland, scrub or rough grassland.

The effectiveness of dams are greatly influenced by spacing. Where dams are too close together the impounded water from a lower dam may 'wash out' the upper dam rendering it ineffective. Spacing should therefore account for the upstream area of impoundment, positioning the next dam out of this area, see image 2.

Opportunities:

- Homogenous channels in need of rapid restoration.
- Headwater streams.
- Disconnected floodplains.

Image 1

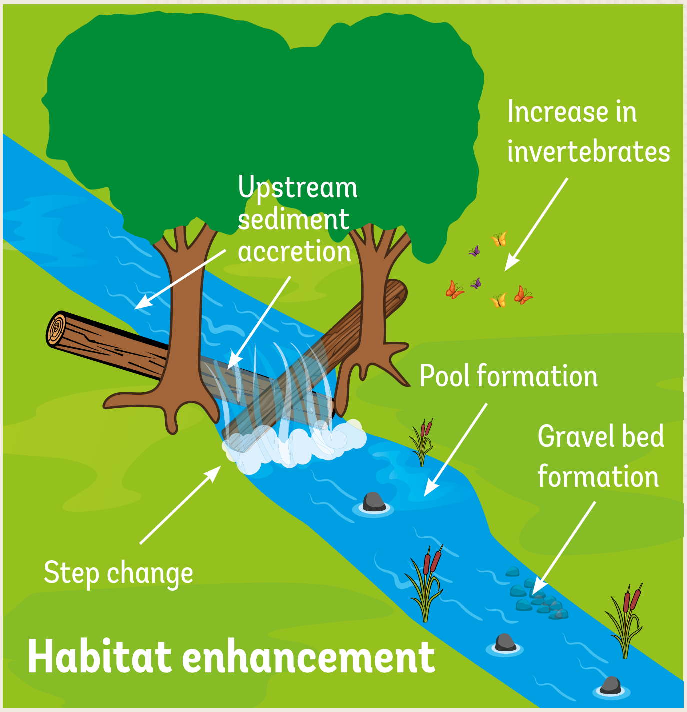


Image 2

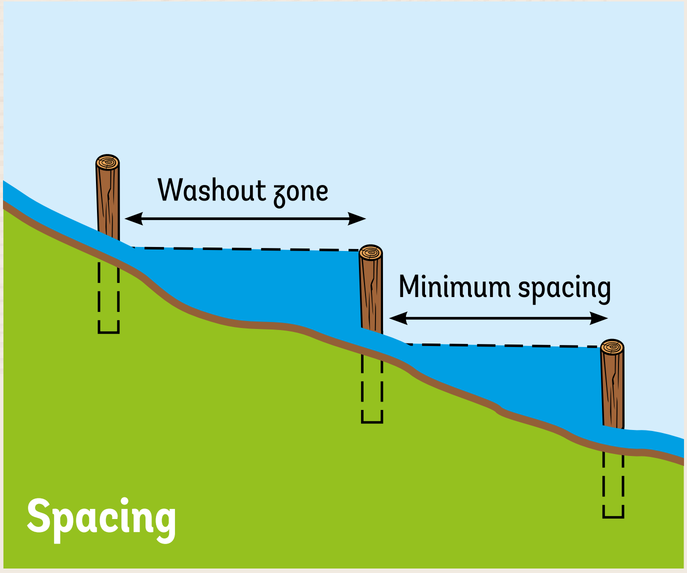
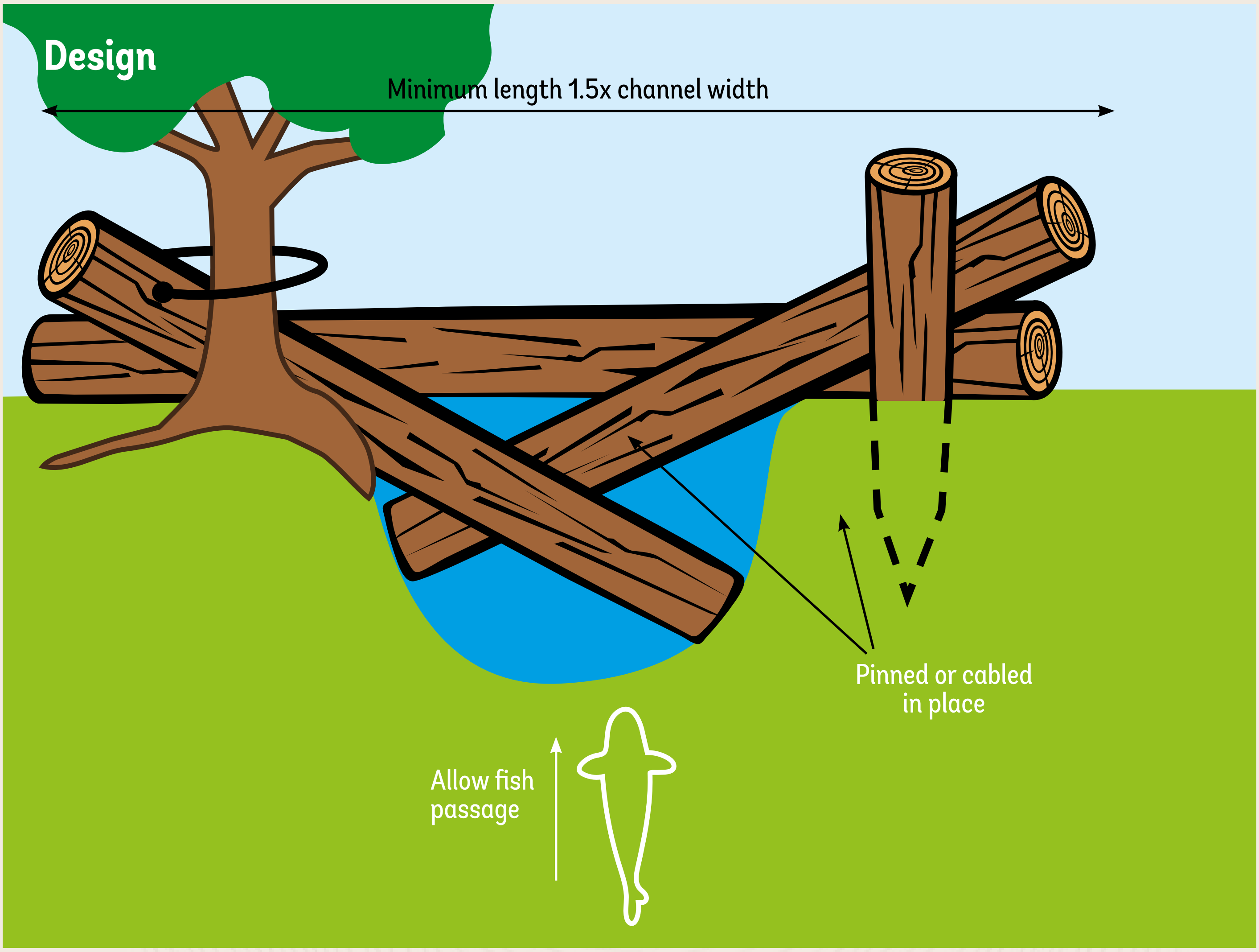


Image 3



Cross pieces should be pinned behind trees or using stakes and cables to prevent downstream movement. Wood should be at least 1.5x the channel width. The dam should be designed to allow fish passage under the structure, see image 4.

Photo by Sandra Manning-Jones

Woody Dam, View Wood.

3 Woody diverters

Logs or boards (untreated) can be used across ditches and small streams to help slow and disconnect the drainage network, channeling water into preferential storage areas. Depending on site requirements they can be designed to interact with high flows only (ditch top diverters) or inserted into the ditch or stream to restrict flow. They should be pinned in place to prevent movement.

Design: Positioned across a ditch or stream bank tops and pinned behind trees or using large stakes. Suggested minimum length of wood is 1.5x the channel width, see image 4.

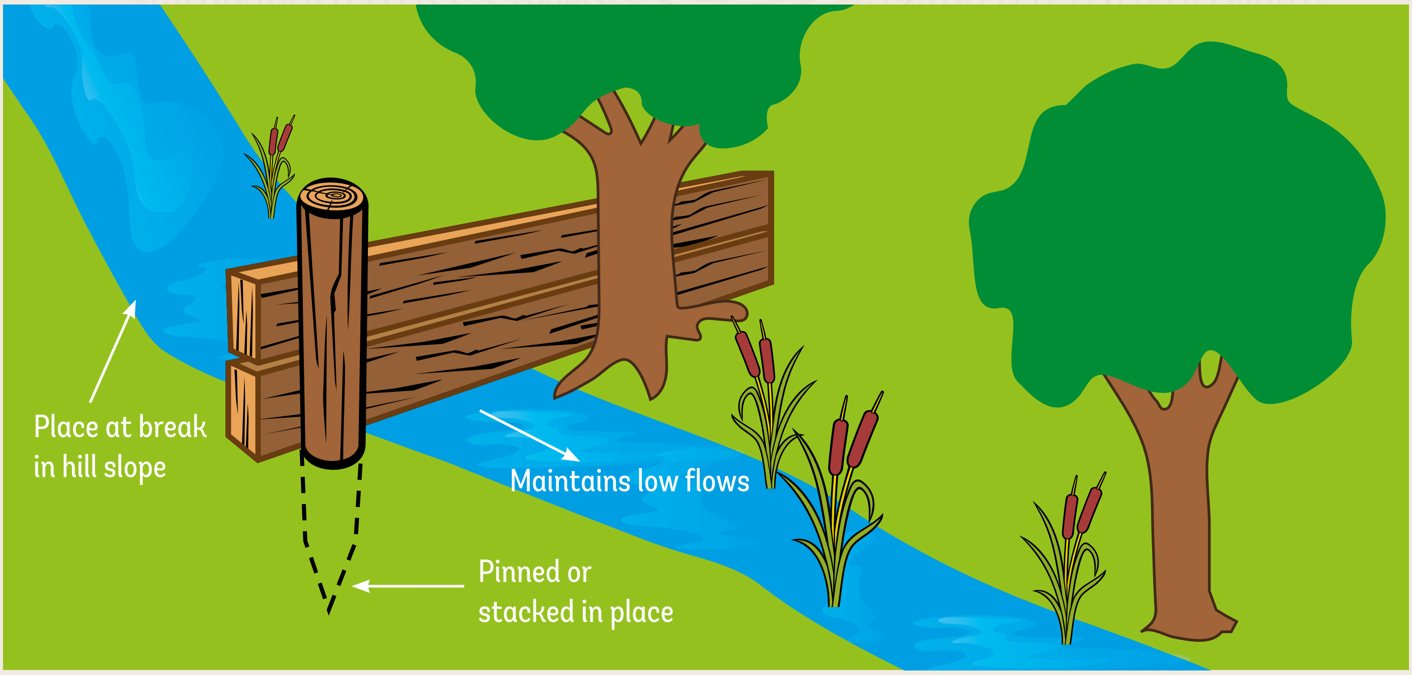
Opportunities:

- Where low flows need to be maintained.
- Changes to channel geomorphology are undesirable.
- Where land use constraints mean that interaction with the drainage network is only possible in extreme circumstances.
- Ditches and streams adjacent to woodland.
- At the break in hillside as it meets the floodplain or flatter area.

Photo by Sandra Manning-Jones

Stream top wood, Sussex

Image 4



4 Woody deflectors

Deflectors do not span the whole channel, large trunks can be positioned in-channel and pinned, cabled or buried into bankside to prevent movement. Alternatively living bankside trees, such as willow, can be laid into the channel where they will continue to grow. They can be designed to channel water into preferential flood storage areas, float under high water conditions, reduce bank erosion, or encourage restoration of meanders. They provide rapid fish habitat and refuge, and also help trap coarse woody debris travelling downstream, help to create sediment bars and diversify in channel flow types.

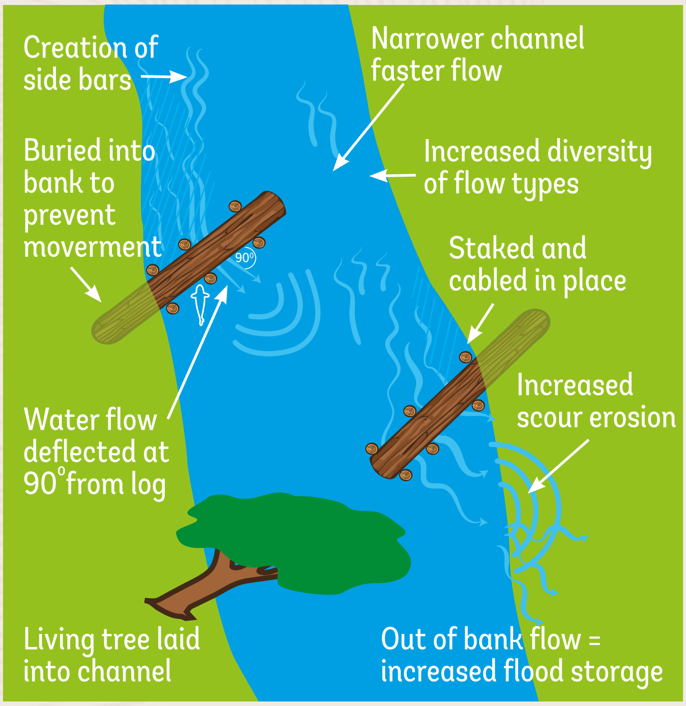
Design: Use bankside trees or large stakes to cable or pin trunk to bank. Flow is deflected at 90° angle from deflector. Back stakes to help maintain angle.
Large trunks can be buried in bank to increase stability. Use large, heavy and immobile pieces or lay living tree into channel, see image 5.

Opportunities:

- Wide low velocity channels.
- To aid rapid habitat restoration and cover for fish.
- Channels lacking sinuosity.

Deflector being pinned in place by Sussex Wildlife Trust and Environment Agency staff. Knepp Estate, West Sussex.

Image 5



5 Key considerations

- Prior assessment of geomorphological impacts and environmental flow is advisable.
- Addition of dams can lead to impoundment (also known as the backwater effect) – the extent of such impoundment will be increased in low lying areas.
- Avoid areas in close proximity to bridges and culverts to reduce blockage.
- Avoid areas in close proximity to urban development or protected assets.
- Woody dams, deflectors and diverters can increase scour or erosion. In most cases this will stabilise in time, and further mitigation can be incorporated.
- Wrong placement could mean that flood water 'cuts corners' – increasing speed, and reducing the conveyance length of the channel.
- Speed of surface water passage may be increased if floodplain is reconnected to area of low roughness (e.g. improved grassland as opposed to woodland or species rich grasslands).
- In steep gradient channels step change may increase pooling and eutrophication during times of low flow.
- Consider setting up monitoring before installation.
- Materials must be up to the job. Stakes and cables should be sufficiently robust.
- Local materials should be used where possible.
- All wood used must be untreated.
- Assessment of local Water Control Structures and flood risk must be undertaken prior to planning.
- Relevant licences and permissions should be sought from the Environment Agency or other relevant body.
- Work must be undertaken with full agreement from landowners.
- Ongoing maintenance may be required to ensure that structures allow fish passage.
- Can also be linked to leaky wooden bunds or storage ponds to further delay and store water.

6 Further reading and resources

DEFRA Multi-Objective Flood Management Demonstration Project – The National Trust, Holnicote. From Source to the Sea: Natural Flood Management. The Holnicote Experience. March 2015.

Dixon, S. J. (2016) *A dimensionless statistical analysis of logjam form and process*. Ecohydrol., doi: 10.1002/eco.1710.

Krause, S.; Klarr, M.; Hannah, D. M.; Mant, J.; Bridgeman, J.; Trimmer, M.; Manning-Jones, S. (2014). *The potential for large woody debris to alter biochemical processes and ecosystem services in lowland rivers.* WIREs Water 2014, 1:263-275. doi: 10.1002/wat2.1019

Mott, N. (2010) Fish Live in Trees Too! River Rehabilitation and Large Woody Debris. Staffordshire Wildlife Trust, Stafford.

Nicholson, A.R.; Wilkinson, M. E.; O'Donnell, G. M.; Quinn, P.F. (2012). *Runoff attenuation features: a sustainable flood mitigation strategy in the Belford catchment, UK*. Royal Geographical Society. doi: 10.1111/j.1475-4762.2012.01099.x

River Restoration Centre. Provides a wide range of river restoration resources and case studies – **www.therrc.co.uk**

Slowing the Flow at Pickering (Forest Research) – **www.forestry.gov.uk/fr/slowingtheflow**

Thomas, H. and Nisbet, T.R. (2012). *Modelling the hydraulic impact of reintroducing large woody debris into watercourses.* Journal of Flood Risk Management 5 (2): 164 – 174.

The Woodland Trust. (2014). *Holding back the waters – woodland creation and flood mitigation.* Search Holding back the water at **woodlandtrust.org.uk**

The Woodland Trust. (2014). *Stemming the flow – the role of trees and woodland in flood protection.* Search Stemming the flow at **woodlandtrust.org.uk**

The Woodland Trust. (2016). *Keeping Rivers Cool – creating riparian shade for climate change adaptation.* Search Keeping Rivers Cool at **woodlandtrust.org.uk**

Welton, P and Quinn, P. (2011). Runoff Attenuation Features: *A guide for those working in catchment Management*. Belford Catchment Solutions Project.

Wild Trout Trust – Large Woody Debris and Chalkstreams Manual – helpful guidance on management and creation of woody debris features. **www.wildtrout.org/sites/default/files/library/Large_Woody_Debris.pdf**

For further information, help or advice please contact us at
sussexflowinitiative.org

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