SEPA
Scottish Environment Protection Agency

Engineering in the Water Environment
Good Practice Guide

Riparian Vegetation Management

Second edition, June 2009

Your comments

SEPA is committed to ensuring its Good Practice Guides are useful and relevant to those carrying out activities in Scotland's water environment.

We welcome your comments on this Good Practice Guide so that we can improve future editions.

A feedback form and details on how to send your comments to us can be found at the back of this guide in Appendix 1.

Acknowledgements

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Engineering in the Water Environment Good Practice Guide:
Riparian Vegetation Management
Second edition, June 2009
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Contents

1 Introduction

This document is one of a series of good practice guides produced by SEPA to help people involved in the selection of sustainable engineering solutions that minimise harm to the water environment. This Guide provides guidance on the establishment and sustainable management of vegetation in the riparian zone of rivers, lochs and wetlands for the benefit of the environment and people.

Vegetation management in and around rivers, lochs and wetlands will not require authorisation from SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2005 – also known as the Controlled Activity Regulations or CAR. However sustainable riparian vegetation management may be a suitable alternative to an engineering solution (eg bank reinforcement). Alternatively SEPA may require it to be implemented in order to mitigate the impacts of a range of engineering works in the water environment that do require authorisation (eg bank reinforcement and river realignments). For more information on the Controlled Activity Regulations and activities that do require authorisation, see the CAR Practical Guide available from the SEPA website (www.sepa.org.uk/water/water_regulation/regimes.aspx).

General Binding Rules (GBRs), a requirement under the Controlled Activities Regulations, provide a statutory baseline of good practice; Using this Good Practice Guide will also help to achieve compliance with the requirements of GBR19 Keeping of Livestock and GBR20 Cultivation of Land. GBR19 requires that there shall be no significant erosion or poaching of any land including river banks by livestock. GBR20 requires the leaving of a buffer strip at least two metres wide between surface waters and wetland and cultivated land. More information on GBRs can be found in the CAR Practical Guide (see above).

1.1 What's included in this Guide?

There are many types of riparian vegetation and a great number of ways it can be managed. This guidance aims to give an overview of the major issues and techniques involved in the management of riparian vegetation. Links and references to guidance on specific topics are provided as appropriate.

Much of the riparian zone in Scotland is a managed environment to a greater or lesser degree. Vegetation on river banks is managed, for example, for agricultural, fishing, recreational and flooding purposes. Riparian vegetation is often affected as a result of engineering works that take place in and around rivers. Section 2 describes the importance of riparian vegetation.

It is important to recognise that much of the riparian environment in Scotland has been modified and that riparian management practices have existed for centuries. With this in mind, this guidance aims to achieve a cover of vegetation on a river bank which:

- is appropriate to the site;
- includes species native to the area;
- has a multifunctional purpose in stabilising the bank, creating good wildlife habitat and in being aesthetically pleasing;

- assists in reducing fragmentation of existing valuable riparian habitat.

For the purposes of this guidance, activities have been split into two broad categories.

- **Establishment/creation of riparian vegetation**. Section 3 covers this and includes:
  - soft or green engineering techniques;
  - seeding and planting of bare soil;
  - creating of buffer strips;
  - planting trees and shrubs;
  - marginal vegetation;
  - urban watercourses.

- **Management of existing vegetation**. Section 4 covers this and includes:
  - management of grasses and herbs;
  - management of heath and bog;
  - management of adjacent wetlands;
  - management of non-native plant species;
  - management of scrub and hedgerows;
  - management of individual trees;
  - management of trees – riparian woodland;
  - management of trees – conifer plantations;
  - large woody debris;
  - marginal vegetation;
  - urban watercourses;
  - use of herbicides;
  - environmental management of vegetation;
  - Vegetation Management Plans.

Section 5 contains a list of further sources of information.

Colour coded boxes in this Guide highlight key information.

Green boxes provide summaries of important points.

Blue boxes provide details of other useful sources of information.

Orange boxes provide summaries of regulatory information.

Vegetation management in or near rivers, lochs and wetlands will not require authorisation from SEPA under the Controlled Activities Regulations. However SEPA may require sustainable riparian vegetation management to be implemented in order to mitigate the impacts of a range of engineering works in the water environment.

General Binding Rules (GBRs) under the Controlled Activities Regulations provide a statutory baseline of good practice. Using this Guide will help comply with the requirements of GBR19 Keeping of Livestock and GBR20 Cultivation of Land.

More information on the Controlled Activity Regulations and General Binding Rules is available in the CAR Practical Guide (www.sepa.org.uk/water/water_regulation/regimes.aspx).

Where herbicides are the only option for weed control in or near rivers, lochs or wetlands, the local SEPA office must be notified at least 21 days before the spraying operation commences. Contact details for local SEPA offices can be found at www.sepa.org.uk/about_us/contacting_sepa/regional_offices.aspx

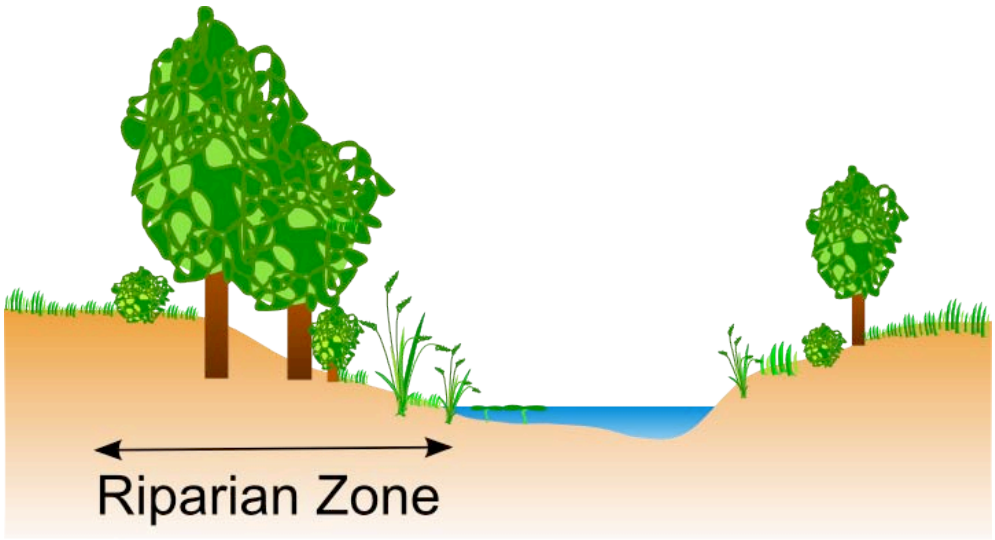
When undertaking riparian vegetation management, it is essential to avoid harm to species or habitats protected under the Wildlife and Countryside Act 1981, the Nature Conservation (Scotland) Act 2004, European directives or identified as priorities in the UK Biodiversity Action Plan (BAP).

Contact Scottish Natural Heritage (SNH) for more information (www.snh.org.uk).

2 Importance of riparian vegetation

The riparian zone forms the link between the environments of water and land (Figure 1). The word ‘riparian’ is derived from the Latin *ripa*, meaning river bank. In this guidance, the term ‘riparian zone’ does not include the wider floodplain.

Figure 1 Riparian zone



The structure, species composition and extent of riparian vegetation all play an important part in the quality of the water environment. The riparian zone has many important benefits including:

- **Habitat and habitat connectivity**. Many species of plants and animals utilise riparian vegetation; for example, otters use tree roots as places for rest and protection, and bats use trees as roosts. Species in the water environment can be highly dependant on riparian vegetation; for example, insects falling off plant foliage can form a significant component of the food for salmon and trout. Indeed, leaves and other plant materials falling into watercourses from riparian vegetation can form the basis for the entire food chain in the water environment. Woody debris, often sourced from the riparian zone, plays an important role in storing/recycling organic material in rivers, which in turn feeds invertebrates. It also provides refuge for fish. The shade and cover which riparian vegetation creates can also be important for aquatic organisms. In addition, the strips of riparian habitat along watercourses are often the only semi-natural habitat present in an area. The ‘corridor’ of habitat that a river bank can provide links areas together allowing species to move between them.

- **Strengthens rivers banks**. The roots of plants can bind river banks together, preventing erosion and protecting important farmland or housing for example. Without vegetation, river banks are a lot weaker and there is a far greater chance that the bank will be excessively eroded by the river; it can also be susceptible to erosion by rain. Materials washed into the river as a result of the bank erosion can introduce excessive nutrients and also smother habitats in rivers that plants and animals depend on. Channel form and habitat is controlled by many factors, one of which is

bank strength. Riparian vegetation is a key factor in determining bank strength and therefore has a major role in determining channel form and habitats; for example weaker banks can lead to wider shallower channels with steeper bed slopes, which can affect the quality of in-stream habitats.

- **Diffuse pollution mitigation**. A buffer strip of riparian vegetation can protect water quality by reducing the impacts of diffuse pollution.

General Binding Rule 20 requires a buffer strip at least two metres wide to be left between surface waters and wetlands and cultivated land.

General Binding Rule 19 requires the prevention of significant erosion or poaching of land within five metres of any surface water or wetland.

More information on General Binding Rules is available in the CAR Practical Guide (www.sepa.org.uk/water/water_regulation/regimes.aspx).

- **Reduces the risk of flooding**. Rivers in high flow can be slowed down by riparian vegetation alleviating flood problems. Riparian vegetation can slow down surface run-off during heavy rain, further reducing flooding problems.

- **Amenity and recreation**. Riparian vegetation can have significant benefits for people too. It can add significant aesthetic value – increasing people's enjoyment of the environment – and provide green recreation space.

Environmental benefits of the riparian zone

- Provides habitat for many species (eg water vole) and increases biodiversity.
- Provides habitat corridor linking fragmented and isolated habitats through which species can move (essential to maintain and increase biodiversity).
- Provides habitat and food for aquatic species such as fish and invertebrates.
- Strengthens river banks and reduces the risk of bank erosion.
- Can reduce the impact of diffuse pollution on the water environment by providing a barrier to, and breaking down, pollutants before they reach the watercourse.
- Can reduce the risk of flooding by increasing the channel 'roughness', slowing flows and stopping flows increasing downstream.
- Amenity and recreation.

3 Establishing/creating vegetation

Bare soil on a river bank can result from:

- construction of new banks or other engineering works in and around rivers (Figure 2);
- stock grazing or poaching;
- landslides;
- natural erosion of riverbanks by the river.

Figure 2 ✗ Poor practice: bare soil as a result of flood prevention works (photo courtesy of Kathy Dale, NES)

In all these cases, there may be the temptation to use 'hard' engineering options such as gabions, boulders or concrete to stabilise the banks. Using these materials often excludes much of the riparian habitat that is so important for plants and animals, while also creating erosion problems elsewhere on the river. The most sustainable approach may be to establish vegetation to do the job of stabilising the bank.

3.1 Soft or green engineering techniques

Sometimes vegetation needs a helping hand to establish on a river bank. The use of soft or green engineering techniques such as biodegradable geotextiles and coir planting rolls may be appropriate, Some example are given below:

- **Geotextile** is a mesh that stabilises the river bank by allowing vegetation to grow through it. It can be used in conjunction with revegetation schemes to aid rapid re-establishment to stabilise an eroding bank. It can be either biodegradable or non-biodegradable. The geotextile used under water may need to be different from that above because it is likely to be the primary medium for some time before being supplemented by vegetation growth.
- **Coir rolls** can be placed at the toe of the river bank to prevent erosion. If they have

been pre-planted with vegetation such as reeds, this kick-starts the development of a protective, energy-absorbing marginal fringe along the bank.

- **Reeds can be established** above normal water level, the reed rhizomes then spread down the bank into the water to provide strong underwater growth.
- **Live willow hurdles** can be used at the toe of the bank which will grow rapidly, although they may give too much shade on very narrow watercourses (less than 1 metre). On watercourses less than 3 metres wide, willow should be used only on one bank.

Green bank reinforcement requires an authorisation from SEPA under the Controlled Activities Regulations (CAR). More information on the Controlled Activity Regulations is available in the CAR Practical Guide (www.sepa.org.uk/water/water_regulation/regimes.aspx).

Soft engineering techniques such as these are usually most effective in the more lowland reaches of slower flowing rivers where erosion from flood events is not excessive. They are less effective in upland, dynamic rivers with large-sized sediment.

Objectives of soft engineering:

- Retain steep earth banks (up to 45°) without slippage.
- Prevent erosion.
- Provide a substrate for vegetation establishment.
- Provide wildlife habitat.

Where used:

- Where erosion from flood events is not excessive.
- Use of live willow is not suitable on very narrow watercourses.

How to use:

- Install during low flow periods and from the bank.
- Secure with stakes.
- Further management may be required such as cutting vegetation.

Sources of further information on soft engineering techniques

- *Bank Protection: Rivers and Lochs,* SEPA Engineering in the Water Environment Good Practice Guide WAT-SG-23, 2008. www.sepa.org.uk/water/water_regulation/guidance/engineering.aspx
- *The New Rivers and Wildlife Handbook,* RSPB/RSNC/NRA, 1995. ISBN 0903138700
- *Manual of River Restoration Techniques,* 2002 version, River Restoration Centre. www.therrc.co.uk/rrc_manual.php

3.2 Seeding and planting of bare soil

It is recommended to establish a cover of vegetation as soon as possible after the creation of areas of bare soil on a riverbank. Works that result in the creation of bare soil near watercourses are often best carried out in spring/early summer so that planted/seeded vegetation has a significant part of the growing season to establish.

When planning works, the amount of maintenance required should be considered. For example, managing grasslands for wildlife may mean only cutting once a year resulting in a cost saving in comparison to higher maintenance options.

The following should be considered when planning to seed and plant bare soil.

- **Soil preparation.** A friable subsoil with small amounts of top soil is better for establishing low maintenance seed mixes (topsoil is often high in plant nutrients and can contain weed seeds).
- **Sowing times.** It is preferable to sow seed in the spring (April to May) as this means that there is a summer growing season to allow seedlings to become established.
- **Soil seed banks.** Most soils contain a reservoir of buried viable seed. This can be a valuable source of native plant material but can result in a competitive sward where slower growing species succumb.
- **Erosion resistance.** If enhanced erosion resistance is required, a biodegradable geotextile can be used onto which the seed is sown.
- **Seed selection.** The selection of seed mixes depends on local conditions and needs. Mixtures of suitable grass seeds and wildflowers can be used. Native species of local provenance should be used wherever possible.
- **Nurse species.** In some situations where quick greening is required, a nurse species can be planted to stabilise the soil and provide niches for more desirable species to establish.
- **Turf transplants.** At developments, turves may be saved and reused along the river bank and in the riparian zone. These will need to be pinned in place if the bank is steep. Turves can be used in combination with geotextiles and coir rolls.
- **Bare root transplants.** Tussocks of species such as mat-grass, tufted hair-grass and soft rush, or creeping species such as bent grasses, can be dug up and pulled apart to form a large number of rooted fragments for transplanting. Transplants have high survival rates provided they are not allowed to dry out. An example of transplanted soft rush along a diverted watercourse in Aberdeenshire is shown in Figure 3.
- **Potted plants.** Where particular species of an area are unlikely to colonise naturally and turves or transplants are unavailable, the introduction of potted plants can be appropriate. Using pot-grown plants is not cheap, but the cost of raising them has to be compared with the cost of labour and machines for collecting and planting turves or transplants.
- **Aftercare and maintenance.** The sward should be checked periodically and invasive weed or alien species removed. Mowing or grazing regimes will need to be determined.

Figure 3 ✓ *Good practice: transplanting of soft rush during construction and two years later (photos courtesy of Kathy Dale, NES)*

Sources of further information on seeding and planting of bare soil

- *The New Rivers and Wildlife Handbook,* RSPB/NRA/RSNC, 1995. ISBN 0903138700
- *Habitat Creation and Repair,* O. Gilbert and P. Anderson, OUP. ISBN 0198549660
- The Flora Locale website (www.floralocale.org) has information and a directory of stockists of native plants.

3.3 Creating buffer strips

'Buffer strip' is a term usually used to describe the vegetated area of land in the riparian zone between the watercourse and agricultural land or other land use. Buffer strips have the potential to conserve, enhance and protect the water environment. The use of natural buffer strips to protect freshwater from diffuse agricultural pollution has been carried out in Europe for a number of years. Buffer strips can also slow down flood flows as well as providing bank stabilisation and habitat. A buffer strip can consist of grassland, wetland, scrub or trees (for management of these habitats see the following sections).

General Binding Rule 20 requires a buffer strip at least two metres wide to be left between surface waters and wetlands and cultivated land.

General Binding Rule 19 requires the prevention of significant erosion or poaching of land within five metres of any surface water or wetland.

More information on General Binding Rules is available in the CAR Practical Guide (www.sepa.org.uk/water/water_regulation/regimes.aspx).

Fencing may be required to exclude livestock where they are causing excessive erosion of rivers banks (poaching) or where they are preventing riparian vegetation from establishing. Where fencing is required it should ideally be located as far back from the river as possible (Figure 4).

Figure 4 ✓ *Good practice: fenced off section of watercourse*

The type of fencing depends on the situation. Line wire fencing is often best next to a river as it resists trapping too much debris during flood events; locating the fencing parallel to the water flow will further reduce the obstruction to flood water and debris during times of high flow. Include some gates in buffer strip fencing for easy release of stock inadvertently trapped beyond the fence line.

To allow stock access to water consider the use of 'off-stream' watering troughs or pumps (which allow stock to pump up water from the burn without needing to access the burn directly), or alternatively create one or two stock access points using best practice techniques (Figure 5). Further information on providing alternative stock watering points can be found in the River Restoration Centre's *Manual of River Restoration Techniques* (see sources of further information at end of this section).

Figure 5 ✔ *Good practice: pasture pump in Aberdeenshire (photo courtesy of Kathy Dale, NES)*

Buffer strips on agricultural land

- Where livestock has ready access to a watercourse, water can become polluted with animal waste. The banks of the watercourse can also become eroded or 'poached', leaving them open to further erosion by the river. Fencing a watercourse off from livestock access and allowing vegetated buffer strips to establish will protect the watercourse and its banks.
- Buffer strips can filter diffuse pollutants running off fields. Cutting field drains and routing them through a buffer strip can further protect a watercourse.
- In an intensively managed landscape, a buffer strip along a watercourse will act as a place of refuge for wildlife and provide connections to other habitats.

The Scottish Rural Development Programme (SRDP) provides funding for a variety of measures to help improve the environment including the creation of buffer strips, fencing and water troughs.

For more information on SRDP funding and eligibility, see the Scottish Government website (www.scotland.gov.uk/Topics/Rural/SRDP). The Scottish Agricultural College (SAC) website (www.sac.ac.uk/consultancy/services/s-z/srdp/) also has information on SRDP funding.

One of the most important factors to consider in the design of a buffer strip is how wide it should be. The width is mainly dependant on the objective (erosion control, diffuse pollution mitigation, habitat restoration) and the conditions at the site where it is to be used

Buffer strip for bank stabilisation

It is better to create as wide a corridor as possible for the purpose of bank stabilisation. This will allow vegetation to re-establish on parts of the floodplain as well as the banks of rivers and lochs. The appropriate width will depend on factors including the rate of bank erosion at the site and the local flood level. If fencing is required, it should be erected set back from the top of the bank this helps to avoid the fence being submerged during high flows and minimises the risk of trapping woody debris.

Figure 6 ✓ Good practice: unfenced buffer strip in arable land (photo courtesy of Kathy Dale, NES)

Buffer strip for pollution control

For pollution prevention, the width of the buffer strip will depend on site conditions and the pollutants present. It is a requirement of General Binding Rule 20 (GBR20) made under the Controlled Activities Regulations that a buffer strip at least two metres wide should be left between surface waters and wetland and cultivated land. More information on the General Binding Rules is available in the CAR Practical Guide (www.sepa.org.uk/water/water_regulation/regimes.aspx).

Further information on buffer strips to prevent pollution is given in SEPA's Best Management Practices, PEPFAA Code and the Four-Point Plan (see sources of further information at end of this section).

Buffer strip for wildlife benefit

A strip of at least 10m is recommended; generally speaking, the wider the buffer strip the more beneficial it is for wildlife. As above, the exact size will depend on:

- site situation;
- what wildlife already exists at that location;
- how land and existing vegetation is currently managed;
- any links to the wider countryside or other buffer zones.

Sources of further information on buffer strips

- *Buffer Zones: Their Processes and Potential in Water Protection*, Quest Environmental, 1997. ISBN 0953005100.
- Section 8.1 'Fords and stock watering point', *Manual of River Restoration Techniques,* 2002 version, River Restoration Centre. www.therrc.co.uk/rrc_manual.php
- *Farming and Watercourse Management: A Good Practice Handbook*, WWF Scotland www.sepa.org.uk/water/habitat_enhancement/best_practice_guidance.aspx
- *Forests and Water Guidelines Fourth Edition*, Forestry Commission, 2003. www.forestry.gov.uk/PDF/fcgl002.pdf/$FILE/fcgl002.pdf
- SEPA Agricultural Best Management Practices (BMPs): http://apps.sepa.org.uk/bmp/
- Scottish Rural Development Programme: www.scotland.gov.uk/Topics/Rural/SRDP
- PEPFAA Code: www.scotland.gov.uk/Publications/2005/03/20879/54890
- Four-Point Plan: www.sac.ac.uk/4pp

3.4 Planting trees and shrubs

Riparian woodlands play a crucial role in helping maintain the health and productivity of rivers and burns; they protect river banks, control erosion, capture and recycle mineral nutrients, increase biodiversity and filter pollutants.

Where it is mainly composed of native species, riparian woodland is an important and valuable habitat both for the terrestrial organisms that depend directly on it and for the many aquatic organisms that derive indirect benefits from its presence. For example these organisms can benefit fish and fisheries by reducing siltation of spawning grounds, supplying invertebrates and leaf litter for food, and providing shade and cover. Riparian woodland also increases the general amenity value of watercourses for people.

On many rivers, riparian woodland cover has been greatly reduced or completely eradicated. Where small pockets remain, they have no connection to other woodland habitats, greatly reducing their wildlife value.

Establishing new riparian woodland and connecting existing areas of riparian woodland provides a huge benefit to biodiversity and the environment.

In general, when planting trees and shrubs on a river bank, the aim should be to re-create semi-natural riparian woodland using native species appropriate to the local area. Expert guidance can be sought on what is 'appropriate'.

Shade influences the growth of aquatic plants, freshwater algae and ground plants. In turn, this can affect assemblages of invertebrates and fish. Consequently, selection of the appropriate species and the determination of the location and density of planting require careful consideration. If planned correctly, habitat enhancement from tree planting may, through shading, reduce the need for weed and algae management in lowland rivers and lochs. Figures 7 and 8 illustrate good practice in planting.

Figure 7 ✓ Good practice: suitable planting sites

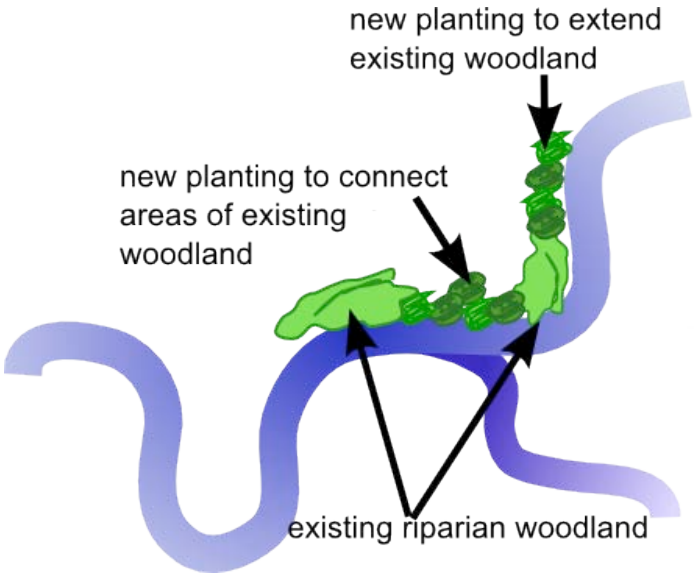
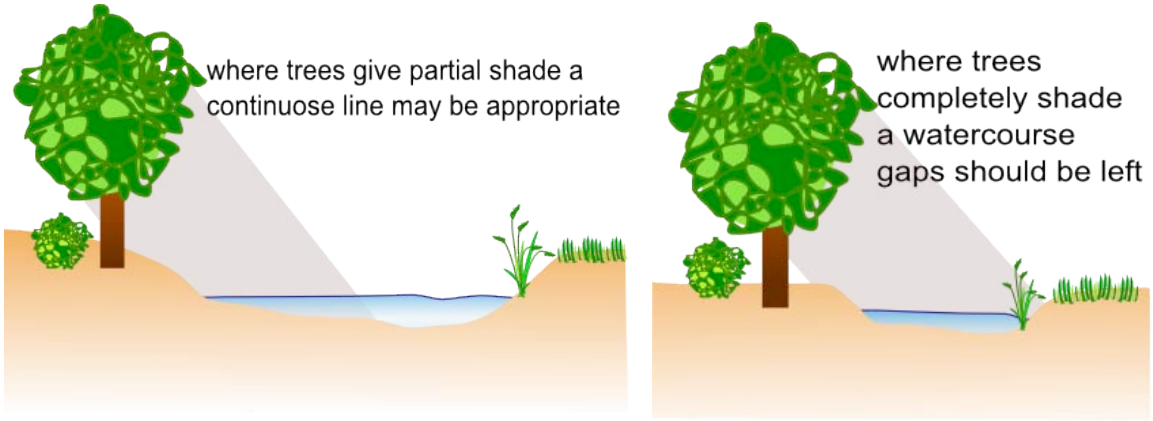


Figure 8 ✓ Good practice: appropriate shading in river channels



Manipulation of shade involves the use of shaded and unshaded sections of bank to:

- depress or eliminate aquatic plant growth in the shaded sections;
- encourage plant growth in the unshaded section.

General tree and shrub planting issues to consider while planning works

- Do not plant in areas that are already important from a wildlife or landscape perspective (eg wetland, species-rich grassland, reedbed, tall herb communities).
- Consider whether there are other options for vegetation establishment that might result in more valuable habitats (eg tall herbs).
- Link planting to existing features to optimise their value for wildlife in the river corridor (eg consider extending existing areas of scrub or trees).
- Plant species that are native to the locality and are appropriate to the site.
- Plant on, rather than away from, the bank in treeless rivers so that eventually the tree roots will create physical structures which may be used by wildlife such as otters.
- Make new planting flexible to allow for planting around existing vegetation features and to leave open areas to create glades.
- Carry out planting from October to the end of March (like tree management) when the ground is free from frost and waterlogging.

Ideally, allowing **natural regeneration** of riparian woodland will be the cheapest and potentially most successful method of establishing tree cover on a river bank. If there is a nearby source of seeds a riparian woodland can develop if the river bank is protected from grazing by fencing it off.

If natural regeneration fails after some time, ground preparation may be necessary. Low levels of grazing by domestic stock can be beneficial in assisting natural regeneration as it can reduce competition from grasses and other vegetation.

In cases where natural regeneration is not possible or fails, obtain planting stock from a reputable nursery. Where possible, obtain plants of local genetic origin. Provenance certificates can be asked for. As zones can be large, it may be possible to ask where seed was collected from within the appropriate seed zone. Ideally seed should be sourced from the local vicinity and should at least be of British origin and ideally from similar site types within the native range of the species. Use small trees rather than larger ones, as they tend to establish better.

Produce a suitable **planting scheme** with the objective of creating a woodland in which the composition and structure of the tree, shrub and field layers will eventually approach those of a semi-natural wood. Keep planting distances and configurations simple, with a mixture of trees and shrubs to give maximum structural diversity; two or three tree species and four or five shrub species is an ideal mix. Grouping single species prevents fast-growing species from dominating others. Space trees and shrubs in plots no further than 1.5m apart. This helps to suppress weed growth and create early shrubby cover.

Again any planting plan will depend on land use; for example, if planting for game birds the planting scheme will be different from planting purely for wildlife.

Young plants will need to be protected from grazing animals. There are a range of tree shelters and mesh guards available. Fencing off the entire planting area is recommended.

Adequate maintenance in the first two, or preferably three, years is essential. Impede the vegetation around the base of each shrub or tree to a radius of 0.5m to give the growing shoot a chance and to prevent smothering by tall weeds. Preferred methods of weed control are mulch mats or strimming, rather than the use of herbicides.

Sources of further information on planting

- *The New Rivers and Wildlife Handbook*, RSPB/NRA/RSNC, 1995. ISBN 0903138700
- *Creating New Native Woodlands*, Forestry Commission Bulletin 112, 1994. ISBN 0117103209
- *Restoring and Managing Riparian Woodlands*, Scottish Native Woods, 2000. www.scottishnativewoods.org.uk/index.asp?tm=23
- *The Management of Semi-natural Woodlands: 8. Wet Woodlands*, Forestry Commission, 2003. www.forestry.gov.uk/PDF/fcpg008.pdf/$FILE/fcpg008.pdf
- *Native Woodlands of Scotland*, Forestry Commission, 1998. www.forestry.gov.uk/PDF/nws.pdf/$FILE/nws.pdf
- *The Selection of Tree Species*, M.L. Anderson, 2002. ISBN 1897604262
- *The Silviculture of Trees Used in British Forestry*, P.S. Savill, 1991. ISBN 0851987397
- *An Ecological Site Classification for Forestry in Great Britain*, 2001. Forestry Commission Bulletin 124. ISBN 0855384182
- *Ecological Site Classification. A PC-based Decision Support System for British Forests,* Forestry Commission, 2001. www.forestresearch.gov.uk/esc

Details of how to order Forestry Commission publications can be found at www.forestry.gov.uk/publications

If herbicides are to be used in or near watercourses, the local SEPA office must be notified at least 21 days before the spraying operation commences. Contact details for local SEPA office can be found on the SEPA website (www.sepa.org.uk/about_us/contacting_sepa/regional_offices.aspx).

3.5 Marginal vegetation

Marginal vegetation refers to plants growing along the **base of the bank** 'with their feet in the water'. Marginal vegetation can provide valuable habitat for wildlife and erosion protection for the bank.

When considering whether planting of marginal vegetation is appropriate, ask the following questions:

- Are the species to be planted appropriate to the area and likely to benefit the desired species of wildlife in terms of cover, food or breeding sites?
- Is the water quality good enough to sustain the species to be planted?
- Is the channel of a sufficient capacity to accommodate the growth and spread of the vegetation without requiring intensive maintenance?
- Is the planting area free from disturbance that is likely to cause irreparable damage, eg excessive erosion, intensive grazing, trampling, vehicle damage, herbicide drift?
- Are geotextiles or coir rolls necessary to help the vegetation become established (see Section 3.1)?

The easiest way to decide what species to plant is to carry out a quick **survey** of the aquatic vegetation already present in the watercourse. Alternatively, a number of books provide useful checklists (see sources of further information below). Figure 9 shows an example of good practice in planting marginal vegetation.

Figure 9 ✓ *Good practice: marginal vegetation established naturally in a channel after two years (photo courtesy of Kathy Dale, NES)*

Type and sources of aquatic plants

Aquatic plants are divided into the following categories:

- **Emergent plants.** These include reed, rush, grass and sedge species that can provide erosion protection for the base of the bank and will often spread up the bank. Large areas of reeds are valuable wildlife habitat. Different species prefer different types of watercourse, ie fast or slow flowing water, coarse or fine substrate.
- **Submerged plants.** These are usually found in deeper water, rooted on the bottom and entirely below the surface, but some such as pondweeds have floating leaves as well. Submerged plants provide food for invertebrates and cover for fish. Again, different species prefer different types of watercourse.
- **Floating plants.** These can be rooted on the bottom such as water lilies or free-floating such as duckweed. Floating plants can be visually attractive but can also be a nuisance in slow flowing water if their growth is unchecked, as they can shade out

other species, impede water flow and clog structures.

Aquatic plants can be established from the following sources:

- individual plants taken from the wild where the species is abundant and permission has been obtained;
- plants supplied by an approved nursery;
- seeds collected from the wild where the species is abundant and permission has been obtained;
- seeds supplied by an approved wildflower seed mix supplier.

Taking individual plants from the wild where the species is abundant and permission has been obtained is often the most effective way of obtaining plants. Plants must be taken from a suitable site and not damage an existing habitat. The site must also be free of alien and invasive species seeds, rhizomes or fragments. Individual plants may be transplanted.

Nursery-grown common reed can be a valuable source of plant material as pot-grown plants establish well if planted just above the water level in early summer. Seeds – either from a supplier or collected from the wild – are rarely used for established aquatic plants along rivers and virtually no information is available on their success.

Planting

Vegetation may be planted by hand or machine. Plants dug out by spade in spring and planted immediately into shallow water or moist ground often thrive best. It is vital to ensure they are planted firmly into the river bed.

The use of faggots may be necessary to protect the plants from wave action in larger rivers. In deeper water submerged and floating plants can be tied to stones, released and allowed to sink to the bottom to root.

In addition to rhizome clumps and cuttings, an already established reedbed can be encouraged to expand by pegging to the ground the tips of mature non-flowering shoots.

Before uprooting wild plants, permission must be sought from landowners or occupiers under Section 13 of the Wildlife and Countryside Act 1981. Specially protected plants must not be removed without permission from Scottish Natural Heritage.

Sources of further information on marginal vegetation

- *The New Rivers and Wildlife Handbook*, RSPB/NRA/RSNC, 1995. ISBN 0903138700

Checklists of river plants can be found in:

- *Vegetation Communities of British Rivers: A Revised Classification*, JNCC, 1999. ISBN 1861074581. Available to order from www.nhbs.com

3.6 Urban watercourses

In urban areas river corridors are valuable for **amenity, recreation and nature conservation** and have a major role in enhancing the quality of urban living.

With the ever-increasing threat of flooding in towns and cities, the river management approach is now to hold back flood waters, restore floodplains and create suitably designed flood and balancing areas with an interlinked network of river corridors. This is sustainable river management.

In the urban environment watercourses may be culverted, flow through concrete channels, be squeezed by infrastructure or industry, or flow through parks or residential areas with gardens. Areas of habitat can be fragmented and isolated. Vegetation in the channel and on the banks can not only provide visual amenity but can also provide valuable habitat and wildlife corridors linking other habitat areas. It can also minimise bed and bank erosion.

Artificially straightened and widened rivers in the lowlands can be enhanced by installing **aquatic ledges**. These ledges help control undercutting of the bank toe as well as introducing desirable habitat and improving visual amenity. They also narrow the normal flow channel, encouraging velocity variations in what may be an otherwise sluggish river.

Ledges can be created with wood and coir matting and backfilled with sediment or soil and either planted with pre-grown materials or left to colonise naturally. Over time the ledges will accrete silt and develop into thicker vegetation with new spring growth every year.

Creation of aquatic ledges may require authorisation under the Controlled Activities Regulations. More information is available in the CAR Practical Guide (www.sepa.org.uk/water/water_regulation/regimes.aspx).

Overwidened rivers may benefit from the creation of a low flow channel. Narrow, more natural channels generally create greater water velocity, which reduces sedimentation and weed growth. Artificial, vegetated **'berms'** can be constructed within the channel to recreate meanders. If the berms are created at a variety of levels, a range of riparian communities – from swamp to dry grassland and even woodland – can be established.

Figures 10 and 11 show good practice in ledge design and channel creation respectively.

Figure 10 ✓ Good practice: schematic design of a created berm

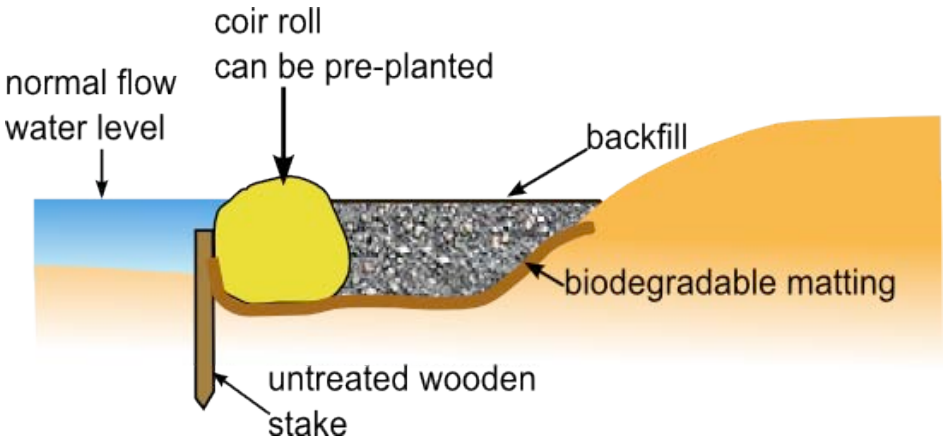


Figure 11 ✓ Good practice: berm creation on the right of the channel and the berm two years later

When constructing engineering structures such as bank reinforcement it is often possible to incorporate measures that not only screen the visual impacts but also provide habitat. British Waterways has experimented with vegetation suspended in fabric pockets hung over sheet piling and establishing reeds in front of vertical banks with a good degree of success. Considerable aesthetic and wildlife value can be derived from the incorporation of vegetation planting in front of hard-engineered banks.

Where a watercourse flows through parks or gardens, visual amenity and safety are more likely to be the paramount issues when establishing vegetation – though this does not mean that planting should not be targeted for wildlife. Where appropriate, grade back steep banks and consider installing two-stage channels with reed ledges. Check people can see the water. If there is no room for reprofiling, a hedge could be put at the top or gorse planted to discourage access. Figure 12 shows an example of good practice from Angus.

Figure 12 ✔ *Good practice: example of a park watercourse in Angus with a gently sloping bank, a semi-natural edge and amenity tree planting. The park is allowed to flood in periods of high flows (photo courtesy of Kathy Dale, NES).*

Parks are ideal places to support a natural watercourse. However, many parks and recreation grounds have over-maintained watercourses, ie straightened, re-profiled, or even constrained by brick or concrete lined channels. Here trees can be planted to provide shading to prevent weed growth and provide visual interest. Natural forms of bank protection using willow spiling can sometimes be used as a more habitat friendly option than harder structures.

Sources of further information on urban watercourses

- *Bank Protection: Rivers and Lochs*, SEPA Engineering in the Water Environment Good Practice Guide WAT-SG-23, 2008. www.sepa.org.uk/water/water_regulation/guidance/engineering.aspx
- *Manual of River Restoration Techniques,* 2002 version, The River Restoration Centre. www.therrc.co.uk/rrc_manual.php
- *The New Rivers and Wildlife Handbook*, RSPB/NRA/RSNC, 1995. ISBN 0903138700
- *Watercourses in the Community*, SEPA, 2000. www.sepa.org.uk/water/habitat_enhancement/best_practice_guidance.aspx

4 Managing vegetation

Some level of vegetation management in the riparian zone is often undertaken in order to:

- maximise biodiversity;
- maintain the habitat type;
- maintain the human uses of a river site.

Beforehand it is important to clearly define the **management goal or goals** (some of which may be conflicting). Once the goals are set the next step is to identify appropriate materials and techniques. The creation of a **vegetation management plan** will aid this process (see Section 4.14).

Vegetation may need to be managed for a number of reasons:

- for flood management;
- for maintaining plant vigour and the structural stability of the bank;
- for conservation and wildlife (to encourage target species);
- for cropping or to control natural succession to scrub and woodland;
- for control of invasive or alien species or to suppress dominant rank species;
- for recreation and access, safety or visual aesthetics.

The existing condition of the vegetation needs to be ascertained, eg invasive and alien species may be a problem. Before the management goals can be set, ecological survey work may be required to:

- list the plant and animal species present;
- map the vegetation communities on the site.

The choice of vegetation management methods is likely to vary with:

- the local conditions;
- the plant and animal species present;
- the relationship of the riparian vegetation to existing adjacent habitats and land use.

Riparian vegetation has an important role in supporting in-stream ecology such as invertebrates and fish communities, and should be managed appropriately. Although both nature conservation and operational requirements are important, in many instances flood management needs can accommodate practices that benefit wildlife.

4.1 Management of grasses and herbs

Management of grasslands is a process that has taken place for thousands of years and a huge range of native British plants and animals has adapted to managed grassland.

Grassland on a river bank is nearly always a managed landscape; if left unmanaged, woody plant species are likely to begin to dominate and eventually woodland will form. If managed sensitively, grasses and herbs on a river bank can provide benefits for wildlife while also maintaining the needs of society.

The objectives of the management must be clear as this will determine the end result; for example, lapwings prefer short vegetation with invertebrates available all year round,

whereas curlew prefer longer vegetation and require invertebrates in the breeding season.

In general a combination of long and short swards on a length of river is likely to be beneficial to more species than a single height.

Short swards provide important feeding habitat for grazing wildfowl in winter and are used by other birds in summer. However, a short sward reduces the supply of food and shelter for other birds, small mammals and invertebrates.

Long, rough swards with tussocky areas provide much greater habitat structure benefiting invertebrates, small mammals and birds, eg bumblebee nests, butterfly colonies, bank and water voles, reed buntings. They are also hunting areas for owls.

In general, a mosaic of short and long swards gives the most habitats and is good cover for otters.

Grassy river banks are generally less able to resist erosion than a wooded bank. But in certain situations (eg on a flood embankment), managed grassland will protect the bank from the effect of high river flows as hydraulic roughness is reduced (water can flow smoothly over the structure without encountering any disrupting features).

Grassland management can take various forms:

- grazing;
- mowing and cutting;
- the use of herbicides.

<u>Grazing</u>

Grazing is a natural way of managing grasses and herbs. Low intensity grazing on grassland with no additional chemical/nutrient inputs can have considerable conservation benefits. Using appropriate grazing animals can be cheaper and more practical in certain situations in comparison to cutting by machinery or by hand – especially on wet sites.

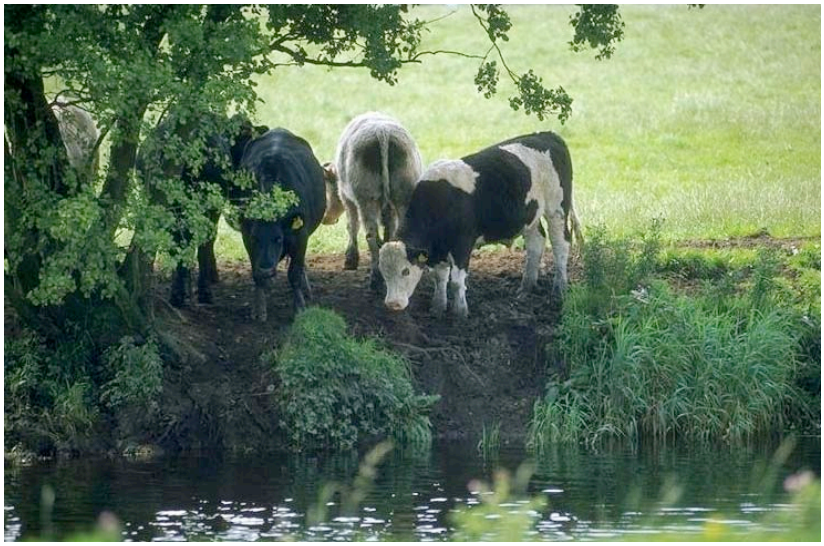
However, using grazing animals can be a fine balance. Sites can be damaged by:

- grazing at the wrong time of year;
- grazing for too long or too short a period of time;
- overstocking the area;
- using the wrong type of animal.

‘**Poaching**’ of a riverbank by grazing animals (Figure 13) can create significant erosion problems, decrease bank stability and allow weeds to colonise a site as well as introducing nutrients into the river.

If the site to be grazed supports ground nesting birds, grazing should be left until after July.

Figure 13 ✗ Poor practice: cattle 'poaching' of a riverbank



Sources of further information on grazing
The range of techniques and the types of livestock that can be used for grazing are extensive. Different grazing timings and different animals/breeds can be used to achieve specific management goals.

See the 'Grazing Animals Project' website (www.grazinganimalsproject.org.uk) for detailed information, relevant publications and further links:

Mowing and cutting

Mechanical cutting of grasses and herbs is often employed where animals are not used to maintain a grassland, or where mechanical cutting is needed before the introduction of animals.

Mowing machinery can be highly sophisticated and effective. If considering undertaking mowing at a site, it is important to first establish the management objectives and then consider if mowing is the right choice for vegetation management. This is because mowing rapidly alters the plant community and therefore has implications for the wildlife using the site.

The timing, frequency and pattern of cutting will need to be carefully planned.

- **Timing.** In general cutting in the autumn is recommended because it has benefits for conservation including:
  - avoiding the bird breeding season;
  - maintaining abundance and diversity of herb species;
  - allowing time for plants to grow and set seed;
  - providing habitats and food for invertebrates.
- **Pattern.** It is important to avoid cutting all the area at once. It is better to cut patches on a rotation basis. This improves plant diversity and habitat structure.

On riverbanks, it is recommended that periodically a strip from the top of the bank down to the edge of the water is left uncut. At the very least a margin should be left uncut at the toe of the bank. This ensures that a good mix of aquatic, semi-aquatic and terrestrial plants are maintained, which is beneficial for wildlife.

Disposal of cuttings
Vegetation cutting should not be disposed of in watercourses or wetlands.

Where cuttings do not contain any invasive species they can be left to compost at a suitable area on-site at least 10m away from any watercourses or surface water drains. Composting may require an exemption under Paragraph 12 of the Waste Management Regulations 1994 (as amended). For more information, see the SEPA website (www.sepa.org.uk/waste/waste_regulation/application_forms/exempt_activities.aspx).

If cuttings are taken off-site they should be disposed of at a suitable licensed facility.

For disposal of invasive species see Section 4.4.

Herbicides
The use of herbicides for riparian vegetation management is only acceptable as part of a management solution for spot treatment of nuisance or invasive plant species such as Giant hogweed.

If herbicides are to be used in or near watercourses, the local SEPA office must be notified at least 21 days before the spraying operation commences. Contact details of local SEPA offices can be found on the SEPA website (www.sepa.org.uk/about_us/contacting_sepa/regional_offices.aspx).

4.2 Management of heath and bog

Heathland occurs on peat and includes vegetation dominated by heather or dwarf gorse species. It can occur in dry or wet situations. Heathland is generally drier than bog and occurs on shallower peat. In the transition to bog the species composition will change and bog moss (*Sphagnum* species) will increase. In the transition to grassland (common in the uplands) the proportion of grasses will increase. Heath vegetation may be found adjacent to watercourses and continue right down the bank. Grazing is the traditional management on heaths but additional scrub management may be needed by hand pulling or cutting.

Bogs are fed by rainwater and have no input of water from the surrounding land. Blanket bogs consist of *Sphagnum*-rich vegetation on deep peat, forming a blanket over both concave and convex surfaces, on level to moderately sloping ground in the uplands. The water table is at or just below the surface and the drainage is often diffuse. Raised bogs are found on river floodplains and other level areas with impeded drainage in the lowlands. In a

classic raised bog, the peat is several metres deep and has accumulated to form a distinct raised dome. Drainage tends to flow around the bog. Bogs have been modified by draining, grazing and burning in the past and so many do not have a high cover of bog moss any more.

Bogs have an important function in that they retain water and release it slowly, as well as being habitats for specialist plants and animals. The aim of management in a bog is to **maintain wetness and plant diversity**. Scrub clearance is a vital element of management to prevent natural succession to woodland and the drying of the bog. Re-establishing light grazing on bogs will reduce shrubs and favour bog moss communities, although very wet bogs are hazardous and only certain breeds of sheep and cattle can cope with the poor grazing provided by bog vegetation. Again, additional scrub management may be needed by hand pulling or cutting.

Sources of further information on heathland and bogs

- *The Biology of Peatlands*, H. Rydin and J. Jeglum, OUP, 2006. ISBN 0198528728 (available from NHBS www.nhbs.com)

4.3 Management of adjacent wetlands

Wetlands adjacent to the watercourse may include marsh/marshy grassland, fens or swamps. There may also be areas of open water created from previous meanders of the river (termed oxbow lakes) or field ponds in the floodplain.

Marsh/marshy grassland can cover grasslands with a high proportion of rushes and sedges, and wet meadows and pastures supporting broad-leaved herbs such as marsh marigold and meadowsweet. This habitat occurs on more or less level areas, rather than the banks of watercourses.

Fens are associated with surface water and have the water table at or just below the surface. They contain different vegetation communities depending on whether they are acid or alkaline, or have water flow or not. Mosses, sedges, reeds and heathers are typical of fens.

Swamps contain tall emergent vegetation typical of the transition between open water and land. Swamps are generally in standing water for most of the year. All are valuable for wildlife and for water retention.

Vegetation management in these habitats will depend on the management objectives for the site and there is a wealth of guidance available. Light grazing is most suitable for marsh/marshy grassland but management may not be necessary at all in fens and swamps. If open water is desirable in oxbows and ponds, cutting of vegetation may be necessary but

otherwise, tall emergent vegetation – especially extensive reed beds made up of common reed – is very valuable for birds such as reed bunting (a UK Biodiversity Action Plan species).

Sources of further information on management of wetlands

- *The Pond Book: A Guide to the Management and Creation of Ponds*, The Ponds Conservation Trust, 1999. ISBN 0953797104
- *Reedbed Management for Commercial and Wildlife Interests*, RSPB, 1996. ISBN 0903138816
- *European Wet Grasslands*, C. Joyce and M. Wade, 1998. ISBN 0471976199
- *Ponds, Pools and Lochans*, SEPA, 2000. www.sepa.org.uk/water/habitat_enhancement/best_practice_guidance.aspx

4.4 Management of non-native plant species

Non-native species, particularly the highly invasive ones, are a major problem on many Scottish watercourses. Giant hogweed (Figure 14), Japanese knotweed (Figure 15), Himalayan balsam (Figure 16) and, in places, rhododendron are the dominant plants on many river banks where they out compete native species and greatly reduce biodiversity. Giant hogweed also poses a public health risk; the clear water sap found in all parts of the plant can cause blistering on contact with skin. This effect can be enhanced by exposure to sunlight.

Figure 14 Giant hogweed

Figure 15 Himalayan balsam

Figure 16 Japanese knotweed

SEPA has no statutory duty to undertake control of invasive species but must be consulted if any control measures are undertaken that involve the application of herbicides near watercourses.

If herbicides are to be used in or near watercourses, the local SEPA office must be notified at least 21 days before the spraying operation commences. Contact details of local SEPA offices can be found at www.sepa.org.uk/about_us/contacting_sepa/regional_offices.aspx

Japanese Knotweed is considered a 'controlled waste' and as such there are various precautions that must be taken during disposal.

Guidance on the disposal of Japanese Knotweed:

- NetRegs: www.netregs.gov.uk/netregs/63095.aspx
- SEPA: www.sepa.org.uk/waste/waste_regulation/guidance__position_statements.aspx

Sources of further information on non-native species

- *Guidance for the Control of Non-native Invasive Weeds In or Near Fresh Water*, Environment Agency, 2007. http://publications.environment-agency.gov.uk/pdf/GEHO0307BLZO-e-e.pdf
- *On-site Management of Japanese Knotweed and Associated Contaminated Soils,* SEPA, 2008. www.sepa.org.uk/waste/waste_regulation/guidance__position_statements.aspx
- *Giant Hogweed Management in the United Kingdom*, O. Booy and M. Wade, 2007. ISBN 9780906269046

4.5 Management of scrub and hedgerows

Scrub is often considered an undesirable land use/habitat and is often controlled or eradicated. However the conservation and biodiversity value of this habitat type is now being recognised.

In general:

- In terms of biodiversity, scrub is an important and valuable habitat in itself.
- Scrub is not a static, unchanging habitat. Management will be required to maintain desirable plant/habitat types and control those considered less desirable.
- Try to maintain or enhance scrubland diversity. Ensure an appropriate and diverse plant community. Include open ground, herbaceous species, 'shrubs' and small trees.
- Livestock and wild animals can have an important role to play in scrub management.
- If the management goal is the eradication or reduction of scrub, tackling the problem early (when plants are young and establishing) will prove far easier and cheaper.
- If eradication or reduction of scrub is planned, root removal or stump treatment may be necessary.
- Immediately after eradication or reduction of scrub, management techniques that slow down its return (grazing, browsing or mowing for example) must be put in place.

Hedgerows are sometimes found in the lowlands along the top of the bank of the watercourse or perpendicular to it.

Sources of further information on the management of scrub and hedgerows

- *The Scrub Management Handbook*, J. Day, N. Symes and P. Robertson, 2003. http://naturalengland.etraderstores.com/NaturalEnglandShop/product.aspx?ProductID=21718cb5-df0b-4861-acc3-b790ca97c84e
- RSPB guide to good hedgerow management:

4.6 Management of individual trees

In general, **maintain existing trees** wherever possible.

Consider **coppicing or pollarding** (ie cutting to encourage regrowth from the stump) suitable tree species such as willow if they cast a lot of shade, rather than removing them. Before coppicing or pollarding, undertake a survey to ensure that no protected species will be affected. Regular pollarding will prevent a tree from collapsing and should be carried out every 10–15 years. However a short coppice cycle of up to six years:

- stops development of mature trees;
- encourages vigorous root growth;
- provides the light and shade required for specialist flora and fauna.

Standing and fallen deadwood should be retained where not posing a risk to the public. Leave trees where they have fallen wherever this can be done without interfering with cropping or fence lines. The upended roots make good nest sites for kingfishers and the

vegetation that grows through the branches forms sheltered sites for a range of wildlife. Branches and timber that accumulate can provide nest sites for moorhens, coots and swans.

Tree work is best conducted in winter – thus avoiding the bird breeding season – although working in the wet should be avoided to minimise the risk of soil erosion leading to silt pollution. Work from the bank wherever possible so as not to disturb in-channel habitats.

With selective limb removal, only those branches that are causing a flood hazard should be removed and, ideally, some overhanging branches should be left.

With pollarding and coppicing, cut material can be used elsewhere or retained away from the watercourse in wood piles (these are beneficial to wildlife). It could also be used for soft engineering materials or cuts used to produce more plants.

Grazing of cut stems often prevents regrowth and therefore after coppicing there may be a need to protect shoots from grazing livestock. Fencing the bank will also encourage trees to grow vertically instead of over the water.

Veteran and/or ancient trees will have value in their own right and should be identified and managed appropriately. More information on the management of ancient/veteran trees can be found from *Veteran Trees – A Guide to Good Management* (see sources of further information at end of this section).

Best practice principles to follow when working around established trees

- The base and area under the canopy should remain as undisturbed as possible.
- Protect this area from damage during river bank works with chestnut paling fence.
- Mark individual trees to be managed. Standard codes are 'C' for coppice, 'P' for pollard and 'SR' for selective removal of limbs.
- Trim or remove vulnerable branches before work starts, in order to avoid more extensive damage.

Standing deadwood and trees with holes may contain bat roosts which are protected by law. It is an offence to disturb breeding birds. It is also an offence to destroy a red squirrel drey.

Tree felling may require permission. For further information see the Forestry Commission's publication, *Tree Felling: Getting Permission* (www.forestry.gov.uk/pdf/FCCS100TreeFelling.pdf/$File/FCCS100TreeFelling.pdf).

Sources of further information about management of individual trees

- *The New Rivers and Wildlife Handbook*, RSPB/NRA/RSNC, 1995. ISBN 0903138700
- *Restoring and Managing Riparian Woodlands*, Scottish Native Woods, 2000. www.scottishnativewoods.org.uk/index.asp?tm=23
- *The Management of Semi-natural Woodlands: 8. Wet Woodlands*, Forestry Commission, 2003. www.forestry.gov.uk/PDF/fcpg008.pdf/$FILE/fcpg008.pdf
- *Native Woodlands of Scotland*, Forestry Commission, 1998. www.forestry.gov.uk/PDF/nws.pdf/$FILE/nws.pdf
- *Tree Felling: Getting Permission*, Forestry Commission, 2007. www.forestry.gov.uk/pdf/FCCS100TreeFelling.pdf/$File/FCCS100TreeFelling.pdf
- *Veteran Trees: A Guide to Good Management*, English Nature, 1999. http://naturalengland.communisis.com/NaturalEnglandShop/product.aspx?ProductID=e8771873-af32-4426-b230-0605e123f1d9

4.7 Management of trees – riparian woodland

Riparian woodlands vary greatly in the composition of tree species present and in their ground flora, reflecting the wide range of sites they occupy. Alluvial deposits, springs, exposed crags, waterlogged ground and shifting river channels each support different types of vegetation. The result is a mosaic of different woodland types supporting a diversity of wildlife. Riparian woodlands include some of the most pristine native woodlands in Scotland, as well as some of the most fragmented. In the least wooded parts of the uplands, where there has been a long tradition of grazing by sheep and deer and muirburn, riparian trees are frequently the only woodland remnants in an otherwise treeless landscape. Figure 17 shows an example of well-developed riparian woodland alongside a watercourse.

Figure 17 Well-developed riparian woodland

Native riparian woodland is an important and valuable habitat for the terrestrial organisms that depend directly on it, but also for many aquatic organisms which derive indirect benefits from its presence.

Management on the more pristine and undisturbed riparian woodland sites will, in the main, be undesirable as it is the natural processes that maintain the woodland and support the species associated with the habitat. At the majority of sites, however, riparian woodland has been disturbed, fragmented or indeed planted. Management practices at such sites will benefit not only wildlife but also people, as riparian woodland resists bank erosion, maintains fish populations (and fisheries interests) and provides amenity value.

Woodlands with a wide age-class distribution, where seedlings to mature trees are present, favour high biodiversity. Young trees indicate woodland is regenerating and old trees provide a wide variety of niches for different species. Standing and fallen deadwood will further increase the potential niches in a woodland, eg providing habitat for rare insects and fungi.

Woodland with a **closed canopy** will provide fewer opportunities for trees to regenerate and will favour shade tolerant species. Where woodland is even aged or dominated by one or two species, regeneration can be encouraged by thinning parts of the woodland or creating small coupes by felling.

It is usually possible to secure and expand woodland simply by **reducing grazing levels** and allowing a wood to regenerate naturally. In many woods, following a reduction in grazing, a policy of limited intervention will be appropriate.

The **removal of exotic tree species** from riparian woodland is desirable and often a management goal. Before undertaking such work it is important to consider the value of the timber, the sensitivity of the site and the ease of access. If it is un-economic or damaging to remove the timber, cutting it and leaving it where it falls may be the best option. However, felled timber can complicate further management activities by hindering access. Public perception of the felled trees may also be negative. Killing by ring barking is a method for providing standing and eventually fallen deadwood. Felled exotics often re-grow from their stumps, so some form of herbicide application to the stumps might be considered necessary.

Coppicing and pollarding were frequently used woodland management techniques in the past. There are a number of considerations and options for trees previously coppiced. These options depend on:

- site logistics;
- site objectives;
- age;
- species and growth form of tree;
- the importance of the present tree for biodiversity.

Old coppiced trees, for example, often do not respond well to coppicing. Old pollarded (lapsed) trees may collapse with removal of large limbs, especially lower down, which can result in destabilisation.

Standing deadwood and trees with holes may contain bat roosts which are protected by law. It is an offence to disturb breeding birds. It is also an offence to destroy a red squirrel drey. Scottish Natural Heritage (www.snh.org.uk) should be contacted for further information

Tree felling may require permission. For further information see the Forestry Commission's publication, *Tree Felling: Getting Permission* (www.forestry.gov.uk/pdf/FCCS100TreeFelling.pdf/$File/FCCS100TreeFelling.pdf).

Sources of further information on management of trees in riparian woodland

- Section 3 of *Farming and Watercourse Management: A Good Practice Handbook*, WWF Scotland, 2000. www.sepa.org.uk/water/habitat_enhancement/best_practice_guidance.aspx
- *The New Rivers and Wildlife Handbook*, RSPB/NRA/RSNC, 1995. ISBN 0903138700
- *Creating New Native Woodlands*, Forestry Commission Bulletin 112, 1994. ISBN 0117103209
- *Restoring and Managing Riparian Woodlands*, Scottish Native Woods, 2000. www.scottishnativewoods.org.uk/index.asp?tm=23
- *The Management of Semi-natural Woodlands: 8. Wet Woodlands*, Forestry Commission, 2003. www.forestry.gov.uk/PDF/fcpg008.pdf/$FILE/fcpg008.pdf
- *Native Woodlands of Scotland*, Forestry Commission, 1998. www.forestry.gov.uk/PDF/nws.pdf/$FILE/nws.pdf
- *Tree Felling: Getting Permission,* Forestry Commission, 2007. www.forestry.gov.uk/pdf/FCCS100TreeFelling.pdf/$File/FCCS100TreeFelling.pdf

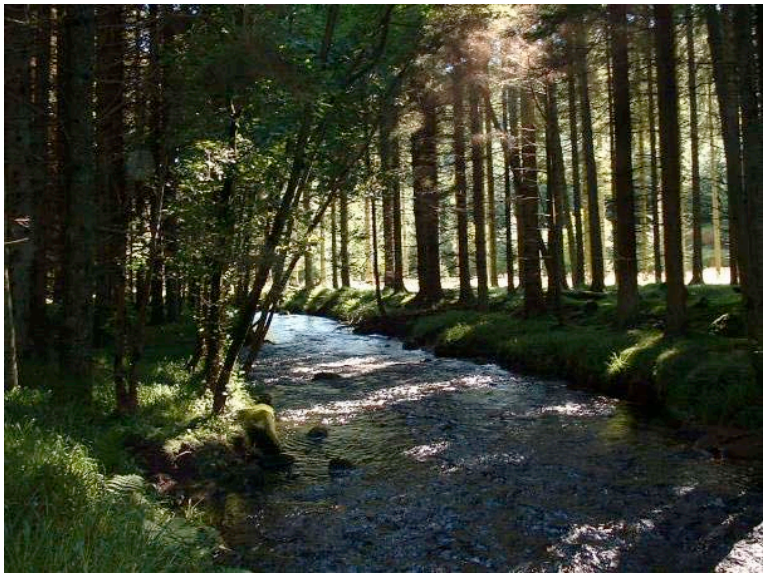
4.8 Management of trees – conifer plantations

Historically, conifer plantations were often planted right up to the banks of watercourses. Although General Binding Rule 20 now applies and requires a buffer strip of at least 2m wide, there is still an extensive legacy of watercourses surrounded by dense conifer stands (as in Figure 18). The resultant heavy shading reduces the biodiversity and productivity of the watercourse. The presence of conifers in a catchment can also result in exacerbate acidification of watercourses.

Source of further information of the management of conifer plantations

- *Forests and Water Guidelines Fourth Edition*, Forestry Commission, 2003. www.forestry.gov.uk/PDF/fcgl002.pdf/$FILE/fcgl002.pdf

Figure 18 ✗ *Poor practice: lack of buffer strip between conifer plantation and watercourse*



In general:

- Removal of conifers from watercourse banks should be the management goal.
- Ideally, clearance of the entire floodplain should be achieved.
- In situations where complete removal is impossible, partial felling and opening up of the channel will still produce benefits.
- Riparian banks and river floodplains can be sensitive habitats. The use of heavy machinery can result in considerable damage and also pollution. All efforts should be made to reduce damage and prevent pollution (including siltation of watercourses).
- Where remnant riparian woodland still exists, it will provide a seed/sucker source for natural regeneration.
- Management is likely to be required to discourage non-desirable species and protect desirable ones.
- Coppicing, pollarding or selective felling will aid the diversity of the woodland.

Commercial conifer plantations must conform with the requirements of General Binding Rule 20 under the Controlled Activities Regulations. GBR20 requires a buffer strip at least two metres wide to be left between surface waters and wetlands and cultivated land. More information on General Binding Rules is available in the CAR Practical Guide (www.sepa.org.uk/water/water_regulation/guidance/engineering.aspx).

Standing deadwood and trees with holes may contain bat roosts which are protected by law. It is an offence to disturb breeding birds. It is also an offence to destroy a red squirrel drey. Contact Scottish Natural Heritage (www.snh.org.uk) for further information

Tree felling may require permission. For further information, see the Forestry Commission's publication, *Tree Felling: Getting Permission* (www.forestry.gov.uk/pdf/FCCS100TreeFelling.pdf/$File/FCCS100TreeFelling.pdf).

4.9 Large woody debris

Large woody debris (LWD) in watercourses is a habitat component largely lost to British rivers. It can be a valuable feature of a river or burn providing various types of organism with food and shelter.

There is often a negative perception of LWD and it is removed from catchments. However, a number of studies have shown its benefit in the riparian environment. The debris dams in watercourses are often passable by fish and the pools that form around these features are often extensively utilised by fish species.

Extensive removal of LWD should be avoided wherever possible. Removal should only be considered where, for example, it poses significant flood or safety risks. Given the value of LWD, its introduction should be considered in systems deficient in LWD.

Sources of further information on large woody debris

- *Restoring and Managing Riparian Woodlands*, Scottish Native Woods, 2000. www.scottishnativewoods.org.uk/index.asp?tm=23
- *Managing Woody Debris in Rivers, Streams and Floodplains*, Staffordshire Wildlife Trust, 2005. www.staffordshirewildlife.org.uk/reports.asp?ses=&pl=false
- *Conceptual Design Guidelines: Application of Engineered Log Jams*, SEPA, WAT-SG-37, 2006. www.sepa.org.uk/water/water_regulation/guidance/engineering.aspx

4.10 Marginal vegetation

Aquatic plants are the **primary food source** in all rivers. The more varied the structure and composition of such plant communities, the greater the diversity of other wildlife they can support. However, in some cases aquatic plants can become so dominant that they choke channels and suppress the growth of other species. Knowing the growth habits of aquatic

plants and being able to recognise potential nuisance species is vital for good river management.

The main drivers for aquatic plant control are:

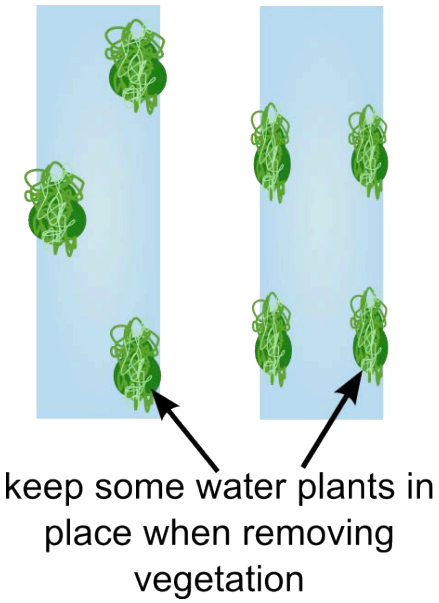
- impeded flow;
- flood management;
- silting;
- danger to humans and livestock;
- blocked pumps and sluices;
- water quality (some algae release toxins into the water);
- public health (various water-borne pests and diseases are dependent on aquatic plants);
- de-oxygenation;
- invasive aliens.

In upland rivers with few nutrients where vegetation growth consists mainly of mosses and liverworts, there is little need for vegetation control. In addition, high velocities and coarse substrates do not favour excessive plant growth.

In contrast, sluggish lowland rivers often have problems because finer substrates and higher nutrient levels encourage plant growth. This problem can be exacerbated by lack of shade from a lack of bankside trees. Annual weed control may be necessary.

Weed control can be undertaken using mechanical or chemical methods. The type of control varies depending on whether it is individual plants, stands, or large areas that require control. Part removal is better for wildlife as some habitats are retained. Figure 19 shows examples of good practice.

Figure 19 ✓ Good practice: examples of selective removal of water plants to permit recolonisation



Most native emergent, rooted, submerged and floating leaved plants are controlled effectively by cutting. This should ideally be done from the bank, either by hand or using a weed-cutting bucket on a digger. Weeds are usually cut in an upstream direction as this makes the operation easier and allows fragments of weed and associated invertebrates to drift downstream and recolonise. This is not desirable for invasive species, so care must be taken when dealing with these (see Section 4.4).

Timing of cutting is important as it stimulates regrowth. As a general rule, submerged plants are cut in summer and emergents in the autumn. Cut material should be removed from the site.

Herbicides are covered in Section 4.12.

Vegetation control should be repeated as needed – annually to every 3–5 years. The same patches can be retained every year (good for establishing a range of plants) or the patches can be rotated on successive visits (more appropriate for vegetation with fewer plant species and prevents consolidation of sediment around plant roots).

Pre-survey information and walk over checks before work begins should be undertaken to identify and preserve important and protected animal and plant species.

Source of further information on marginal vegetation

- *The New Rivers and Wildlife Handbook*, RSPB/NRA/RSNC, 1995. ISBN 0903138700

4.11 Urban watercourses

Walls along the side sides of rivers may become colonised by plants, the roots of which may cause structural instability. Spot treatment by herbicide is probably the best way to deal with weeds on walls (see Section 4.12).
Vegetation ledges are unlikely to require management as they are constrained by the physical conditions on the ledge.

All other vegetation found in watercourses flowing through or next to parks and gardens, town centres, industrial sites, etc may need to be managed according to the techniques already covered for the habitats and species above – though grazing is unlikely to be possible or practical.

Visual amenity and safety are important in urban areas and vegetation should be managed so people can see the water.

4.12 Use of herbicides

Only herbicides cleared for aquatic use may be used in or beside water. They must be used under strict control and in accordance with the instructions printed on the product label.

The main benefits of herbicides are that they can be applied more quickly than mechanical methods and weeds are controlled for longer. They are often cheaper than mechanical control. However, plants may take several weeks to die off so benefits may be slow to come.

The timing of herbicide application is important and it may be necessary to wait for the appropriate stage of growth of the target plants.

Selection of the most appropriate chemical for a management objective requires expert knowledge of:

- the capabilities and environmental impact of the chemical;
- its effectiveness against different plants;
- the conditions under which it is to be applied;
- the nature of the watercourse.

If herbicides are to be used in or near watercourses, the local SEPA office must be notified at least 21 days before the spraying operation commences. Contact details of local SEPA offices can be found on the SEPA website (www.sepa.org.uk/about_us/contacting_sepa/regional_offices.aspx).

Source of further information on the use of herbicides in or near water

- *The New Rivers and Wildlife Handbook*, RSPB/NRA/RSNC, 1995. ISBN 0903138700

4.13 Environmental management of vegetation

Environmental management means altering conditions to make them less suitable for plant growth. Three principal methods are:

- channel manipulation;
- shading;
- reducing nutrients.

Channel manipulation is not recommended without expert guidance from a geomorphologist but nutrient stripping and shading take longer to achieve results.

Shading is best located on the south bank and as close to the water's edge as possible for marginal plants. Alternating shaded and open stretches creates the greatest variety of river habitats for wildlife. Trees are most suitable for larger watercourses and shrubs for smaller ones.

Nutrient stripping from sewage treatment works (STW) removes phosphate and reduces excessive growth of invasive large plants and blanket weed. Buffer strips are effective nutrient strippers for the control of vigorous bankside plants such as nettle and thistle.

4.14 Vegetation management plans

Developing a vegetation management plan has the advantages of:

- ensuring there is continuity and stability of management;
- identifying local goals and constraints.

Preparing a plan requires relevant information to be assembled and appraised. A vegetation management plan should detail all the important features associated with the site and how they are to be protected or enhanced. The management goals should be clearly defined and activities and timescales set out step-by-step. The types of monitoring activities used to judge the successes and failures of the management should also be detailed. In order to allow for the flexibility to react to changes and problems, the plan should be reviewed on a regular basis.

Formal land management schemes may require a management plan and often include for one to be produced in the grant or maintenance payments, especially on designated sites for nature conservation such as Sites of Special Scientific Interest (SSSIs).

5 Sources of further information

5.1 Publications

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5.2 Websites

Environment Agency: www.environment-agency.gov.uk

Flora Locale: www.floralocale.org

Four-Point Plan (4PP): www.sac.ac.uk/4pp

Grazing Animals Project (GAP): www.grazinganimalsproject.org.uk

Scottish Natural Heritage: www.snh.org.uk

Natural England: www.naturalengland.org.uk

Scottish Rural Development Programme: www.scotland.gov.uk/Topics/Rural/SRDP

SEPA Agricultural Best Management Practices (BMPs): http://apps.sepa.org.uk/bmp/

Appendix 1: Feedback form – Good Practice Guide WAT-SG-44

SEPA is committed to ensuring our Good Practice Guides are useful and relevant to those carrying out activities in Scotland's water environment.

We welcome any comments you have on this Good Practice Guide so that we can improve future editions.

After completing the short questionnaire, please detach it and post to the address below or fax it to 01355 574 688.

SEPA
WFD Administration Officer
5 Redwood Crescent
Peel Park
East Kilbride
G74 5PP

The aim of this Good Practice Guide is to provide guidance on the establishment and sustainable management of vegetation in the riparian zone of rivers, lochs and wetlands for the benefit of the environment and people.

1. Which of the following do you think describes how well the Guide meets these aims?

Excellent ☐ Good ☐ Average ☐ Poor ☐

2. How relevant was the content of the Guide to your activity?

3. What elements of the guidance did you find most useful?

4. What elements of the guidance did you find least useful?

5. Did you find the Guide clear and easy to follow?

Yes ☐ Sometimes ☐ No ☐

6. If there were areas that could be clearer, please let us know in the box below

7. Were there issues you felt should have been covered, omitted or dealt with differently in the Guide?

Please use the box below for other comments or suggestions on the Guide (continue on a new sheet if required)