Use of Large Woody Debris

Issues

Large Woody Debris (or LWD, generally defined as timber greater than 0.1m in diameter and 1.0m in length) is a vital natural component of all chalkstreams. However, due to human intervention over the millennia, it is now largely absent from many river systems. Traditional chalkstream management has included a presumption for the removal of LWD, on the grounds that it restricts angling access, collects debris around it and could pose a risk of flooding. Many fishery interests have also had concerns that LWD can adversely restrict the upstream migration of pre-spawning salmonids.

However, more recently, research has shown that LWD is fundamental to many river processes, which are of direct and indirect importance to trout, with its influence particularly strong in headwaters. LWD causes localised changes in water velocity, with consequent downstream scouring of gravel substrate, improving its quality for spawning salmonids and some fast water loving coarse fish species. The lower water velocity occasioned upstream and within LWD bundles results in the detention of fine sediment in marginal zones where it can become colonised by emergent vegetation. The increased variability of water velocity also results in significant changes to the river's water depth and width.

Similarly, leaf litter tends to accumulate in and around LWD, providing an important food reserve for 'shredding' macroinvertebrates. LWD also provides shelter for a range of invertebrate and fish species, and reduces water temperature by shading.

Accumulations of LWD can cause the formation of so-called 'woody debris dams'. These can become remarkably stable, with some examples lasting for years. These can have particular value in riverine systems, becoming important structural features in their own right. However, careful monitoring of extensive woody debris dams is important. Although concerns regarding their impact on migrating fish are generally not well founded, in extreme circumstances, they can totally occlude channels, preventing access to spawning areas for brown trout and salmon. In these unusual circumstances, it is usually possible to carefully remove a small section of the dam, re-establishing a passage for fish.


LWD ESTABLISHED IN RIVER.


RECENTLY POLLARDED TREES.

Potential restoration options

RETAINED LWD-NOTE SCOUR PRODUCED DOWNSTREAM.

Retention of LWD

The simplest and cheapest method of increasing the abundance of LWD in a stream is to retain as much of the naturally occurring timber as possible. The maxim for all fishery managers with respect to LWD should be 'don't remove it, leave it'. There will inevitably be some situations where it proves impossible to abide by this maxim; for instance it would be foolhardy to leave a large tree immediately above a hatch or bridge arch, which it could potentially block.

The West Country Rivers Trust has published a simple guidance note relating to the retention of LWD in river channels. Whilst no simple prescription can be universal, this guidance is robust and provides an excellent basis for decision making.

Guidance on the retention of LWD in river channels:

Source: West Country Rivers Trust

1 Is the debris fixed, if yes then continue to **2**, if not continue to **5**.

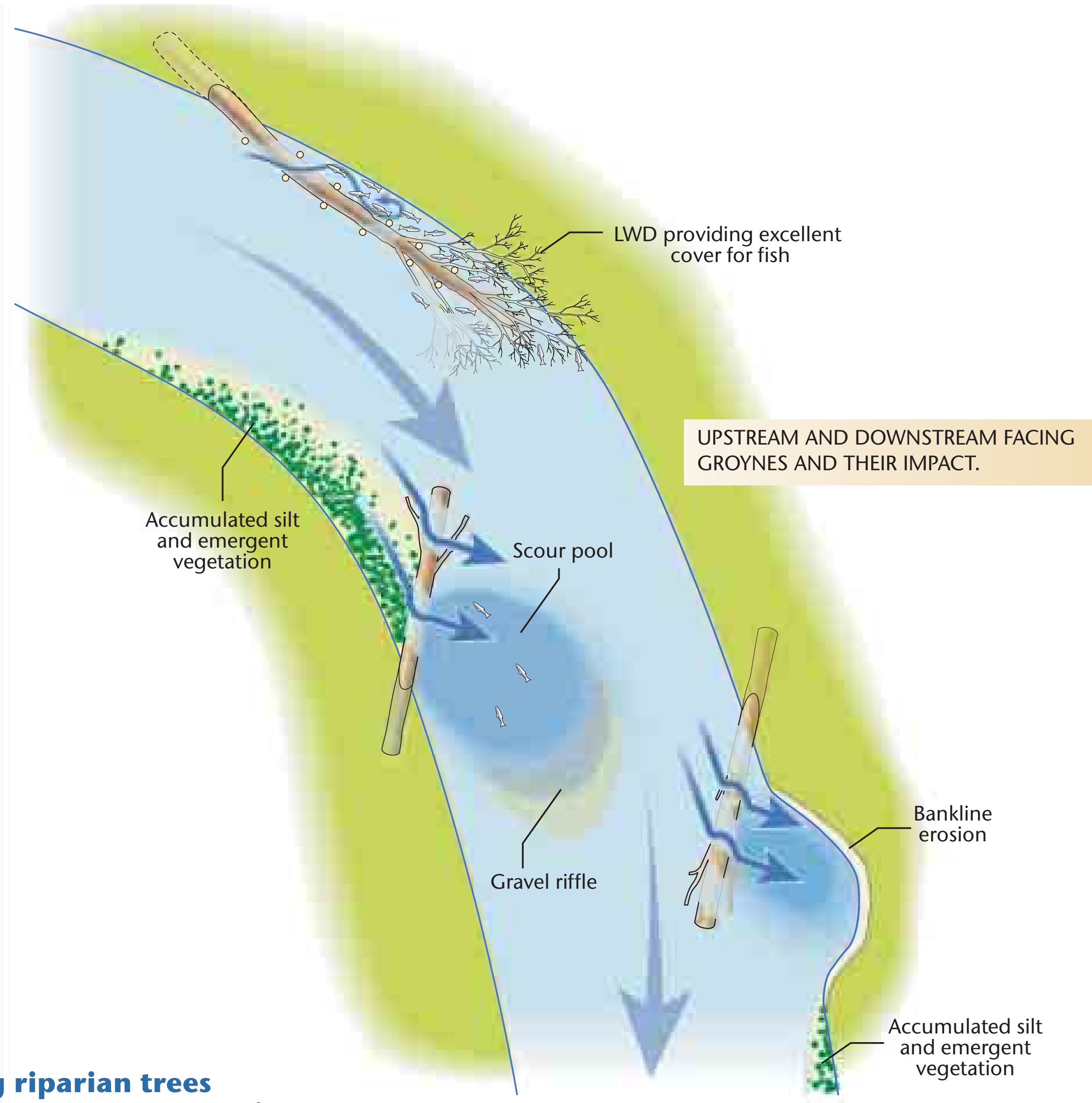
2 Is the debris causing excess erosion by redirecting the current into a vulnerable bank? If yes then go to **5**, if not then go to **3**.

3 Would fish be able to migrate past it (take into account high river flows). If yes go to **4**, if no go to **5**.

4 **Retain the woody debris in the river**.

5 **Extract the debris**.

Provided that it is considered safe to retain the LWD in the channel, careful consideration must be given to how and at what angle to the bank it is to be stabilised. The angle at which the LWD should be stabilised depends fundamentally on the desired outcome. For example, some limited bank protection and provision of cover for juvenile fish can be provided by fixing LWD parallel and close to the existing bank. Alternatively, setting the LWD facing upstream at an angle of some 30°- 45° to the bankline, in effect creating a LWD groyne, will tend to create an area of mid-stream scour, eventually forming a small holding pool. It will also tend to promote the deposition of fine sediment in marginal areas, and hence encourage narrowing of the channel.



UPSTREAM AND DOWNSTREAM FACING GROYNES AND THEIR IMPACT.

Cutting riparian trees

(*see* **Tree management section**)

Unless there are specific reasons to do so (for instance, disease, control of alien tree species or Health and Safety concerns) there is generally no reason to cut down or remove trees. The control of overshading by trees is best effected by a combination of coppicing, pollarding or singling.

Coppicing and pollarding

These are techniques traditionally used to manage trees on a regular cycle. In coppicing, which should undertaken during the winter, the young shoot stems are cut off cleanly immediately above ground level, promoting the development of several new stems. These are allowed to grow from the base (or 'stool') until they are re-cut, normally on a 5-30 year rotation. Coppice regrowth is very palatable to livestock, deer, hare and rabbits. It therefore needs careful protection during the early stages of regrowth. Species that are regularly coppiced include ash, hazel *Corylus avellana*, and alder. Coppice products historically included hazel sticks for hurdle making, ash poles for tool handles and alder trunks for clog making

Pollarding is basically a similar process adapted for areas of 'wood pasture' where livestock were present. Trees were cut above the height that grazing cattle could reach. Some riverside trees particularly crack willow *Salix fragilis* have historically been managed by pollarding, with trees cut on 15-30 year cycle in order to promote longevity of individual trees.

Singling

Singling offers an alternative to coppicing, in that rather than cutting all stems of the tree, the most upright stem is retained and allowed to grow into a semi-mature tree. It is a less risky option than coppicing in circumstances where there is significant grazing pressure. It also maintains a large, structural element to the landscape that may important at sensitive sites.

Whichever technique is chosen, the aim should be to create a mosaic of trees, with individuals at differing stages of succession. This approach avoids abrupt change to overall habitat and helps to maintain refuges and corridors of stable habitat for a range of woodland species.

Tree management is best undertaken during the dormant winter period, when the trees are not Reversing the direction of the LWD (i.e. arranging it pointing downstream), will tend to cause scour of the bank immediately downstream, resulting in over-widening of the channel (often not a desirable outcome).

A number of techniques can be used to retain LWD safely in the channel. These include:

- **Wooden stakes**. Untreated wooden stakes, either cut from material on site or provided by others, can be driven firmly into the river bed at 0.6m-1.0m centres along either side of the LWD. Steel wire can then be attached to the post and pulled tight over the top of the LWD, holding it firmly in place

- **Reinforcing bar** ('Rebar'). Heavy duty can be used to fix LWD in place. The diameter of the rebar should match the size of the LWD but in any case should not be less that 15mm. The LWD should have suitably sized holes drilled through it. One end of the rebar is then burred over sufficiently to retain a large washer, slipped up the bar. The rebar is then driven through the LWD and into the substrate beneath to a depth ensuring a firm fixing. The washer stops the rebar slipping through the LWD.

UNTREATED WOODEN STAKES AND STEEL WIRE HOLDING LWD IN POSITION.

- **High tensile steel wire** is very effective when used both to fix the LWD in position and provide an 'anchor' should any other fixing method fail. The wire can either be wrapped around the base of the LWD and fixed in place with galvanised staples, or can be inserted into a pre-drilled hole through the LWD, and fixed to itself using proprietary crimps. The other end of the wire should be affixed either to ground anchors (see below) or to a mature tree or stump on the bank.

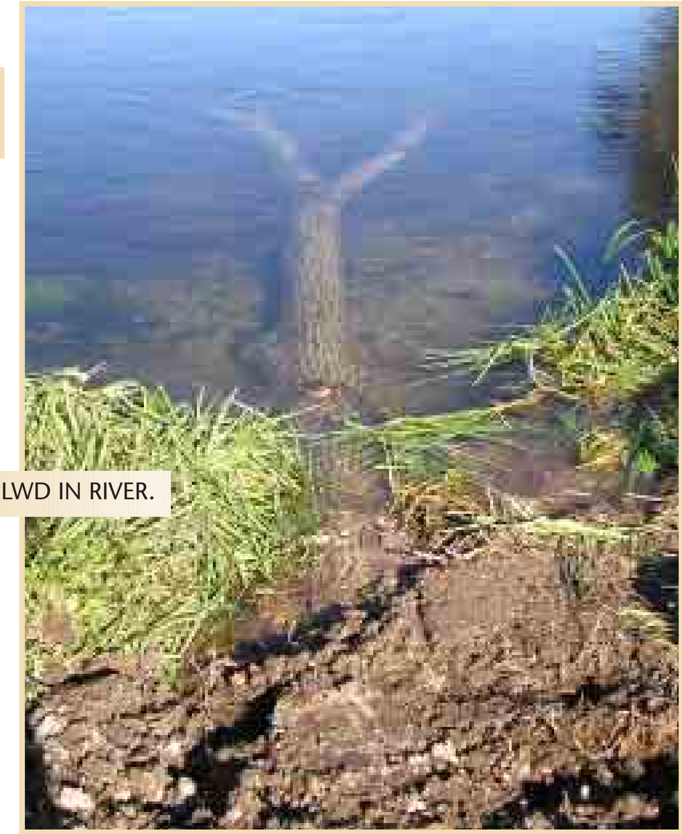
- It is good practice where possible to bury the butt end of LWD into the existing bankline in order to reduce the risk of erosion at this vulnerable interface. For smaller sections of LWD, a trench can be cut into the bank using hand tools and the LWD placed in this and firmly backfilled. More substantial pieces of LWD will require a trench to be dug using an hydraulic excavator.

REBAR DRIVEN THROUGH PRE-DRILLED LWD TO PROVIDE FIRM FIXING.

LWD SHOWING 'T' BAR CONSTRUCTION..

- More advanced techniques include the use of 'T' anchors, and so-called 'duck bill'anchors. 'T' anchors can be constructed by first excavating a deep (<1m) shaped trench. The main stem of the trench should be at least 2m long, aligned at the correct angle to the river, with the top of the 'T' excavated at right angles to the first trench, and to a length of at least 1m. The piece of LWD to be placed in the stream is attached to another shorter section of timber using high tensile wire, so as to form as 'T' shape. The completed structure is then placed in the excavated trench and backfilled. This is an excellent technique for anchoring very large sections of LWD.

LWD BEING PUT INTO POSITION.



LWD IN RIVER.

'Duck bill' anchors are convenient methods for anchoring smaller sections of LWD. These consist of a short (15cm-30cm) section of tubing cut at an angle on one end. The tube is drilled through and has a length of high tensile wire attached. The duck bill is pushed into a pre-formed hole in the bank and then turned through right angles, thus forming a firm anchor point.

All of these techniques can be used in combination to ensure firm fixing for LWD in a range of situations. Once the LWD has been safely stabilised in the channel, its smaller limbs can be trimmed to permit access for angling.

Cutting and hinging of timber

In many rivers, the supply of naturally occurring LWD is inadequate. As a consequence, it may be necessary to deliberately introduce additional material into the channel. If there are suitable deciduous trees alongside the river, it may be possible to partially cut through the trunks of individual trees, and 'hinge' them into the channel. Ideally, on smaller streams, the hinged timber should span the width of the channel, with its extremities braced behind a far bank tree. This not only provides great stability, but also reduces significantly the risk of wash out during high flows. As with rotational coppicing, only a percentage, perhaps 25-30% of tree present should be cut in a single season.

This technique allows the felled tree to continue growing, at least in the short term, whilst also providing a firm fixing. An additional benefit is that the resulting reduction in shading will also encourage the development of instream and marginal vegetation. Species that can be treated in this way include willow *Salix Spp*, hazel *Corylus avellana*, ash *Fraxinus excelsior*, oak *Quercus robur*, alder *Alnus glutinosa* and field maple *Acer campestre*.

If there are no trees adjacent to the river, LWD can be imported from sustainably managed woodland nearby. Large sections of LWD can be introduced in the form of groynes, aligned and retained in position as described above.

A more specialist use of LWD is so-called 'tree-kickers'. This technique is used to protect vulnerable eroding banks, particularly on the outside of high bends (>1.5m), where significant undercutting is taking place. Effective operation of tree-kickers relies on the LWD being securely


'Tree-kicker' LWD.

attached to the bank, generally using high tensile wire, but being free to rise and fall with changing river levels. As a consequence, erosion is controlled over a range or river levels and discharges. Bundles of brushwood can be attached to the kicker to further reduce the impact of erosion.

The introduction and placement of tree-kickers in deep water areas is generally a tricky operation, requiring significant planning, particularly with respect to safe working practices. It may require the use of powered plant to place the kicker in position.

Always look for the cause of erosion when considering how to solve it. If the bank is eroded from flow coming over the bank from adjacent land, kickers are not applicable. If the stream is just naturally meandering, protection measures should not be installed unless really necessary. Tree kickers will not correct erosion due to lack of root structure. In that case, new vegetation should be planted. However, banks that lack vegetation and root structure are vulnerable to undercutting, so a kicker might be needed in addition to the new vegetation.

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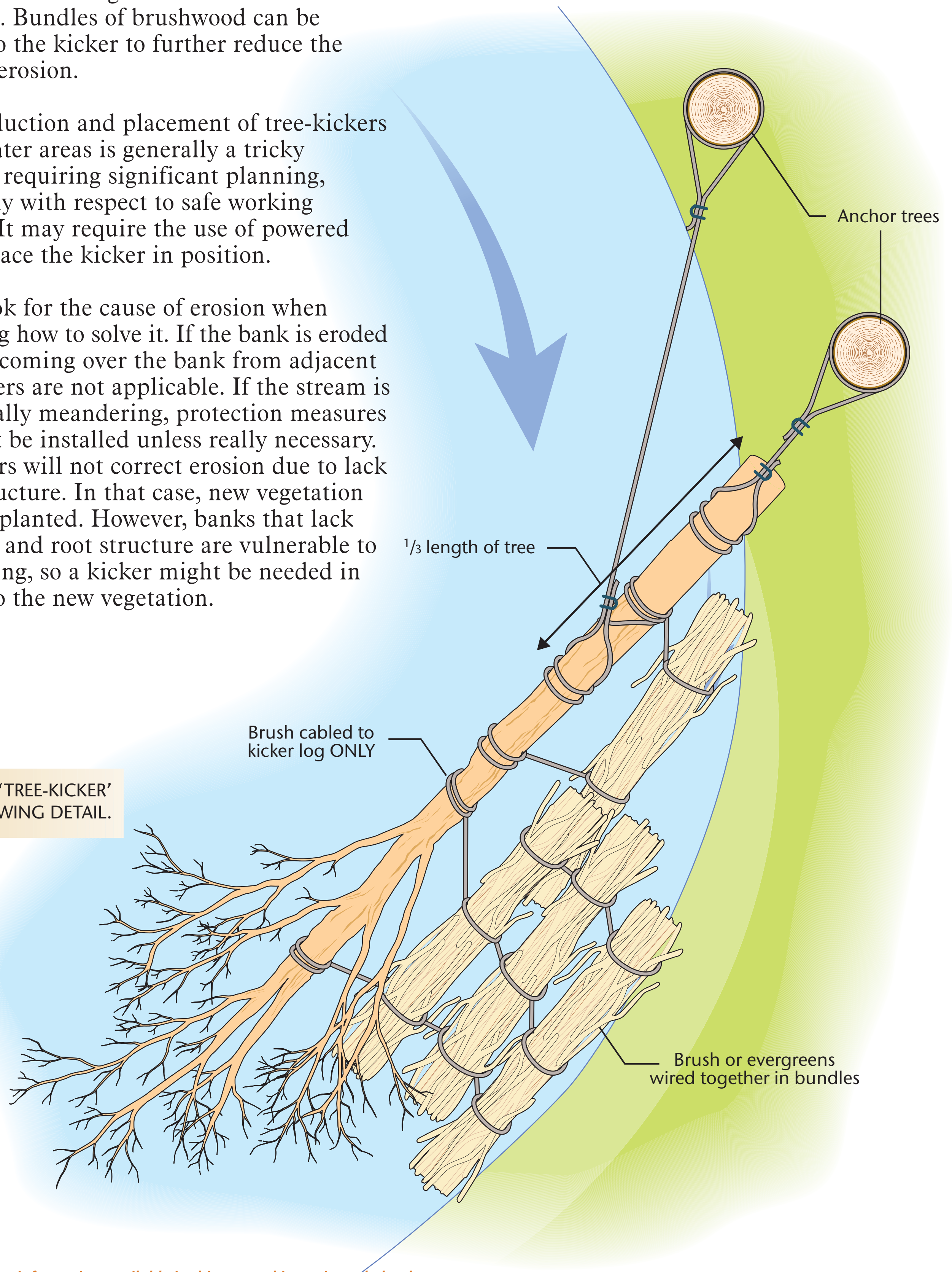
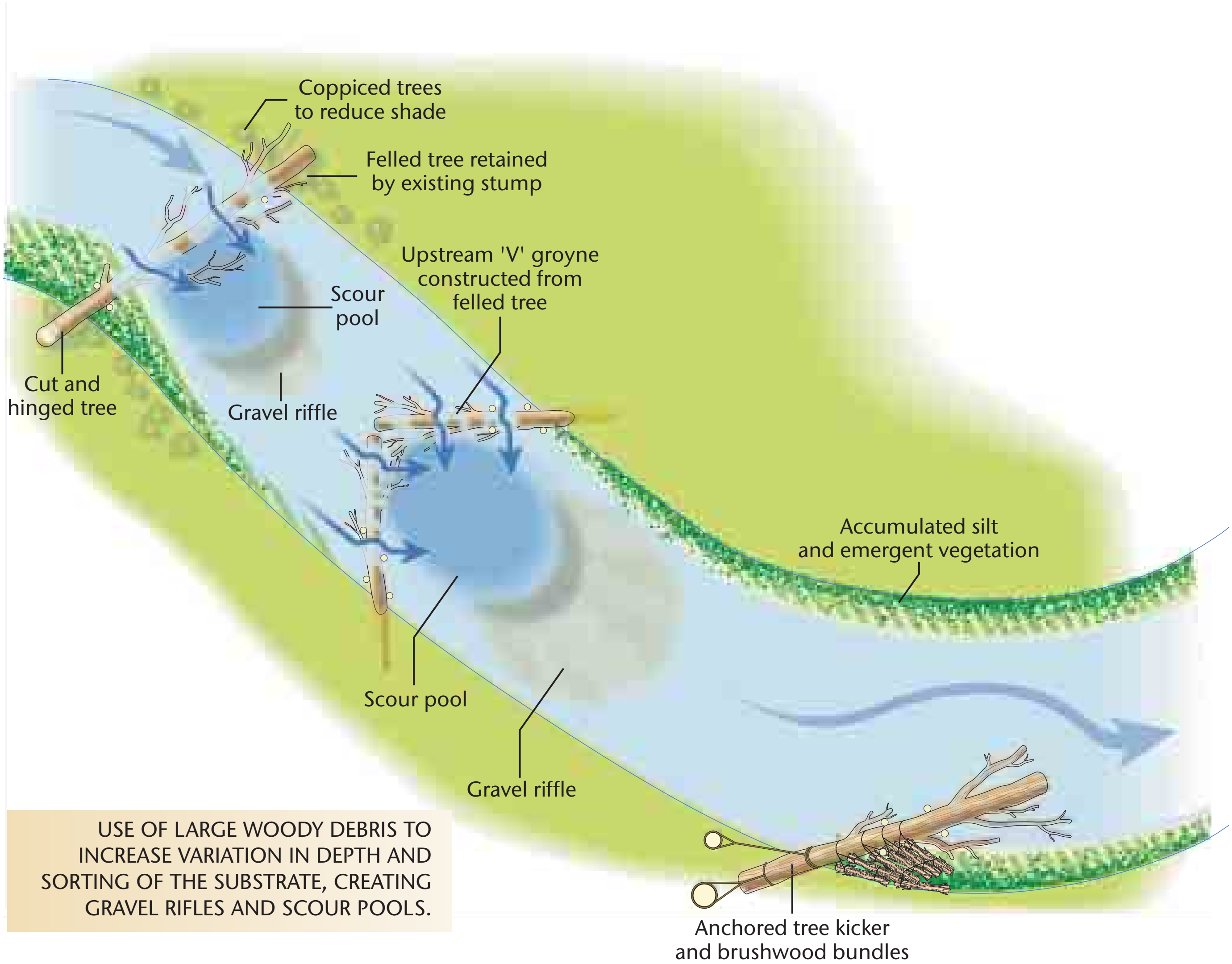


'TREE-KICKER' SHOWING DETAIL.

Summary

Technique	Advantages	Disadvantages
Retention of LWD	Optimises the acknowledged ecological advantages of LWD in rivers. Cheap. Reduces resource expenditure on removal of LWD. May not require use of chainsaws, with stabilisation often possible using hand tools.	Can result in obstruction to fish migration, excessive erosion, increased localised flood risk due to blockage of structures. Refer to West Country Rivers Trust (WCRT) guidance for decisions on individual LWD.
Realignment and consolidation of LWD in river channels	Provides opportunities for repositioning LWD in order to create current deflectors.	Can result in obstruction to fish migration, excessive erosion, increased localised flood risk due to blockage of structures. Refer to WCRT guidance for decisions on individual LWD.
Removal of LWD	Loss of valuable physical component of chalkstreams. Loss of habitat for fish and other groups of animals.	Can reduce local flood risk, erosion and obstruction to fish migration. Refer to WCRT guidance for decisions on individual LWD.
'Hinging' of bankside trees	May be cheap, provided that trees are small enough to cut using hand tools. Trees remain attached to roots and are thus easily stabilised. Secondary benefit of increased light onto channel in heavily shaded sections.	May require use of suitably qualified chain saw operators if trees are large.
Introduction of LWD from elsewhere	Can be used in areas with limited local supply of LWD.	Likely to require the services of suitably qualified chainsaw operators to fell trees. Powered plant will be required to transport LWD to site and introduce it to the river. Likely to be more expensive.
Tree kickers	Useful technique for reducing scour in deeper areas of river, particularly on the outside of bends.	May require the use of powered plant and hence can be expensive.



USE OF LARGE WOODY DEBRIS TO INCREASE VARIATION IN DEPTH AND SORTING OF THE SUBSTRATE, CREATING GRAVEL RIFLES AND SCOUR POOLS.