The Cam Brook, Midford

An Advisory Visit by the Wild trout Trust, March 2013

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Introduction

This report is the output of a Wild Trout Trust visit undertaken on the Cam Brook at Midford near Bath. The visit was requested by Mr Fred Scourse, who is a serving Committee member of the Avon and Tributaries Angling Association (ATAA) and the Five Valleys Trust, a volunteer conservation organisation working closely with the ATAA. The visit was primarily focussed on options to improve the river habitat for wild brown trout *(Salmo trutta)* and sympathetically manage the river and banks.

Comments in this report are based on observations on the day of the site visit, and discussions with ATAA members and Jody Armitage of the Environment Agency.

Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank or Right Bank whilst looking downstream.

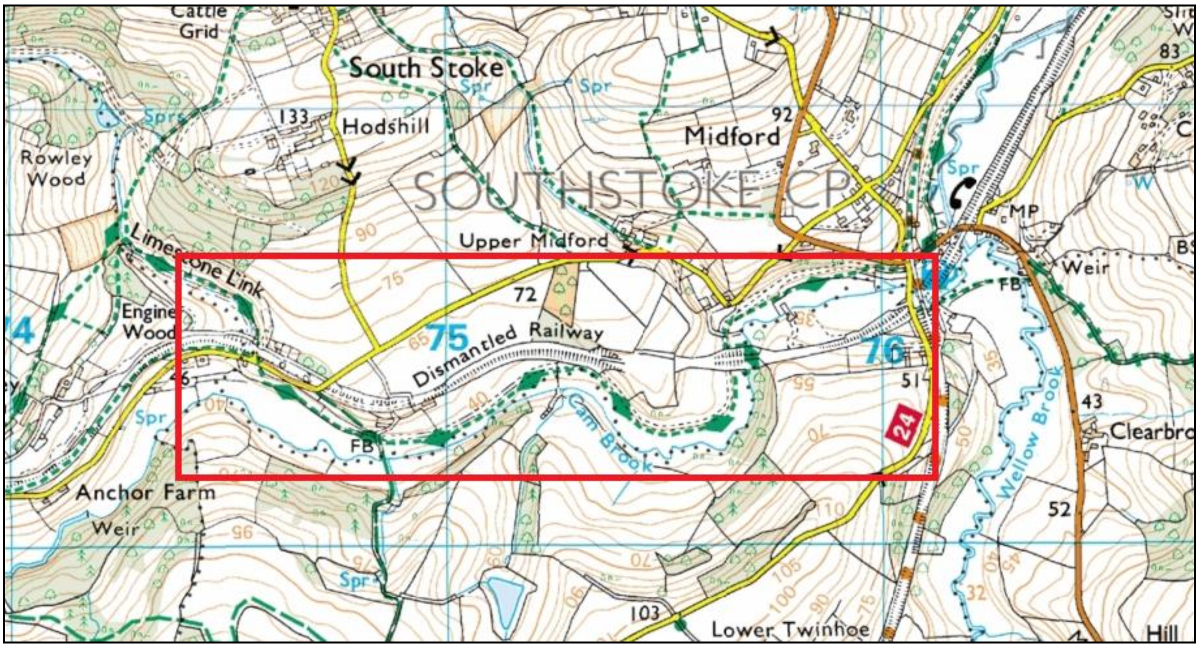

Figure 1: A map showing the section of the Cam Brook visited

Catchment and Fishery Overview

The Cam Brook rises from springs in the Mendip Hills at Hinton Blewett, draining in an easterly direction through Cameley, Temple Cloud, Camerton, Dunkerton, Combe Hay, joining the Wellow Brook at Midford, and becoming the Midford Brook, before joining the Bristol Avon. The Brook confluences with small tributaries that flow from near the villages of Farrington Gurney and High Littleton.

The brook rises from sedimentary bedrock geology of Blue Lias formation (undifferentiated mudstone and limestone) and flows over areas of sandstone and mudstone overlaid by superficial alluvial deposits of clay, silt, sand, limestone oolite and gravel. The permeability of the ground varies through the catchment, with the higher land dominated by limestone, and mudstones more prevalent lower in the valleys. In general a combination of clay soils and steep periglacial valleys cause the brook to be a relatively reactive spate river.

Environment Agency fish surveys have been undertaken along the Cam Brook at Cameley (2000), Temple Cloud (2000, 2004, 2011), Hallatrow (2000), Radford (2000), Camerton (2000), Dunkerton (2000, 2004, 2011), Combe Hay (2000) and on the ATAA's waters near Midford (2000, (Appendix I)). Every survey has recorded wild brown trout. European eel *(AnguillaAngulla anguilla)*, bullhead *(Cottus gobio)*, 3-spined stickleback *(Gasterosteus aculeatus)*, and brook lamprey *(Lampetra planeri)* have also been recorded.

The section of river visited is close to the confluence with the Wellow Brook at Midford. ATAA manage the reach as a catch and release wild brown trout fishery, but the lowest reach of the Cam is stocked by the club.

The Cam valley was once an important link between the Northeast Somerset Coal Fields and markets in Bath and Wiltshire. In the 18th and 19th century, various attempts were made to utilise the valley as a transport link. This included the construction of the Somerset Coal Canal, as well as tramway and railway lines. Modifications to the valley for the construction of such infrastructure, and for land drainage and river management since their decommission have likely influenced the course and physical shape of the river.

Habitat Assessment

For the purposes of this report, the section of the river visited is described from the upstream boundary of the ATAA's water, downstream to the confluence with the Wellow Brook.

The most upstream section of the ATAA's water on the Cam Brook (National Grid Reference: ST 7453 6028) is heavily incised with steep, densely wooded banks. This section of the brook is relatively inaccessible to anglers and is rarely fished. The course of the river is naturally sinuous, providing a good diversity of flow conditions, which are further enhanced by an abundance of woody debris from fallen trees and branches.

Flow diversity is important for a healthy river ecosystem, as the greater the range of flow patterns, the more diverse the scouring effect of the flow will be. This results in a greater diversity of physical habitat niches and greater opportunities for a variety of aquatic life to flourish. For wild trout, a diverse river will provide better habitat and refuge for the various trout life-stages, and a higher chance of fish surviving to breed. In addition, adult trout, being relatively territorial, can more densely populate a section of river where the topography of the bed and the range of submerged features such as large woody debris (LWD) create a mosaic of different micro-territories.

Figure 2: LWD providing habitat and helping to diversify local flow patterns

For millions of years trees have fallen into rivers forcing the flow around them and re-shaping the channel, with freshwater river species evolving to utilise these features. Woody debris is important for invertebrates with shredding mouthparts which utilise woody material as a food source. Other invertebrate communities will graze on algae growing on the wood. Emergent woody material can also be an important interface between the aquatic and terrestrial habitats for fly life with life-stages in both.

In places, woody debris has become lodged in the Cam Brook and created 'debris dams'. Debris dams across the river force flows underneath causing lateral scour to shape deep pools in the bed. A deep scour pool with overhead cover is prime territory for adult trout. The bed material thrown up by the scour will also be cleaned and sorted by the flows before being deposited a short distance downstream to create a glide or riffle, and potentially provide good spawning habitat.

Although providing important habitat, debris dams should be regularly assessed and monitored to ensure that they do not create issues for flood risk and fish passage. If a debris dam is considered to pose a flood risk, it may be prudent to dislodge the woody debris and reposition it so that it does not impound flows. Similarly, if the debris is impassable for fish it may be worthwhile adjusting the dam to ensure that a solid plume of water is flowing through the obstruction allowing fish to easily pass upstream. This could range from an occasional sympathetic relocation of the material to cutting and removing a section of the blockage.

Fish have evolved to overcome natural barriers by following the fastest-flowing water. This will normally allow them to discover a path around, under, over or through a diffuse blockage. This flume of fast flow is known as the 'attracton flow' as fish are attracted towards it.

Figure 3: A debris dam should be passable so long as a solid flume of water is flowing through, over or under the blockage

In many spate rivers, the flashy nature of the water level, combined with a naturally meandering course and steep banks, has led to problems with erosion. Fortunately for this section of the Cam Brook, the density of bankside trees provides a matrix of tree roots that help to reinforce the banks. In places this dense matrix of roots is clearly visible (Fig 4).

Along with helping to protect the steep banks from erosion, bankside trees provide vital habitat through shade and cover over the river. Concerns over the possible effects of hot and dry periods, possibly exacerbated by the impact of climate change, have led to the development of the Environment Agency's *Keeping Rivers Cool* guide.

http://www.wildtrout.org/sites/default/files/news/Keeping%20Rivers%20Cool_Guidance%20Manual_v1%20%2023%2008%2012.pdf

This advocates the use of shade from riparian trees for helping to regulate water temperature for freshwater species such as trout.

Figure 4: A dense matrix of roots in the steep banks helps to control bank erosion

As important as shade is for keeping the river cool, direct sunlight is also equally as important for in-stream productivity. Through the most heavily shaded sections of the river, selective rotational tree works to open up occasional 'skylights' in the canopy and allow more sunlight into the channel would be beneficial.

Tree works should have an emphasis on trees located on the south side of the river with the goal of allowing more sunlight onto shallow, fast-flowing riffles, where important plant species such as water crowfoot *(Ranunculus spp.)* will have the best chance of flourishing. Tree works should be undertaken in a 5 or 10 year rotation so that a diverse range of crown heights and densities are established that roughly create a 50:50 mosaic of direct sunlight and dappled shade on the river.

Downstream of the footbridge at ST 74851 60185, as the brook approaches the remains of the Somerset Coal Canal, the river becomes noticeably more straightened and flows roughly parallel to the derelict canal. The habitat through the straightened reach is more uniform than the river upstream and is heavily shaded, which is partly due to the steeply elevated and wooded land on the Right Bank (southern bank). As both banks are densely wooded, rotational tree works to allow more light into the channel would be beneficial.

Figure 5: The steeply rising ground on the right bank (left of image) and the dense tree cover will heavily shade the river in mid-summer.

Tree works will also help with angler access; however, it is important to note that low-lying and trailing branches provide important cover for trout, and that excessive clearing of the channel for improved casting could remove existing trout lies and may actually diminish angling opportunities.

Woody material arising from tree works could be used to mitigate the straightness of the channel and introduce a greater abundance of habitat features. Woody debris features and simple flow deflectors could be fixed to the bed to introduce lies for trout and help create more sinuous flow patterns through the reach.

A variety of woody debris features are described in the *Recommendations* section.

About half way through the straightened reach, the brook bends to the right and becomes slightly impounded by the remains of a weir. As the weir is dismantled, the effect of impoundment does not extend far upstream and the structure is passable to fish, so should not be considered a problem. The remnants of the structure pinch the channel and accelerate flows over rubble that is strewn across the bed downstream and probably originates from the weir. The remnants of the structures wing-walls have helped protect the banks and maintain the fast flow. The accelerated flow has helped to initiate a series of pools and riffles through the reach downstream.

Figure 6: The remains of a weir or sluice structure slightly impound the river upstream but pinch the channel and accelerate flow velocity downstream

It appears this section of the brook was managed in the past by a series of small weirs or sluices, which are located through the reach downstream. It may be that pool depths were artificially elevated during dry periods, probably as part of the management regime when the river was a more intensively managed fishery; however, this is unlikely to have provided any real benefits and probably further degraded habitat within the reach by increasing the effect of their impoundment.

At ST 75304 60343 (Fig 7), a pinch point in the channel caused by one such structure appears to be exacerbating erosion. It is likely that under high-flow conditions, a back-eddy is formed against the Right Bank. The bank is below grazing land and is susceptible to erosion having very few trees or marginal plants to naturally reinforce the bank.

Bank erosion is not necessarily a problem and is part of the natural morphology of the river. However, excessive, accelerated erosion may be undesirable to the land owner or tenant farmer, and to the river. There are often a number of contributing factors to consider, and controlling erosion may require the adoption of a number of measures.

Fencing the upper bank from grazing livestock and allowing a wide buffer of rough vegetation can help protect the banks from erosion. Rough grassland at the top of bank is valuable for fly life such as caddis (Trichoptera), and for mayflies (Ephemeroptera) as a habitat to hatch from sub-imago to adult form. A buffer of un-grazed grassland is also important for limiting soil compaction and creating a natural filter for surface water run-off. Ideally the river should be fully fenced wherever the adjacent land is grazed, but with occasional gates included to allow livestock into the buffer strip once or twice a year (if required) to help control invasive species such as Himalayan balsam *(Impatiens glandulifera)*. It may also be worth considering planting occasional trees or driving in occasional whips of live willow to help protect the banks from erosion.
These options are explored in the *Recommendations* section.

Figure 7: Bank erosion at this location may be the result of eddying flows and heavy grazing

A short distance downstream, bank erosion at the toe of the bank has caused a rotational slump. The slumped bank has since stabilised and this has helped to reduce the gradient of the bank. Planting live willow into the slumped bank could help to ensure the bank remains stable. A low-growing species such as Goat Willow *(Salix caprea)* could introduce additional cover habitat for trout.

Figure 8: A rotational slump has stabilised and reduced the bank gradient

Downstream of the straightened reach the brook once again follows a more naturally meandering course and exhibits many classic spate river characteristics. The inside banks of meanders retain a generally shallower gradient whilst the outside banks have formed steep eroding cliffs that provide valuable habitat for sand martins *(Riparia riparia)*.

Figure 9: A steep, cliffing bank provides habitat for sand martins

The erosion of the banks also introduces new sediment into the brook. Where the brook flows through seams of flint or oolitic limestone, a steady flow of coarse bed material (gravel) is introduced into the river.

Figure 10: A steady supply of oolite gravels are washed into the brook by bank erosion.

Trout require clean and well oxygenated 10-50mm diameter gravel to successfully spawn. Gravels need to be 'sorted' in order to remain free from fine sediment and tufa (calcium carbonate precipitant), which can compact the gravel and inhibit redd-building and egg survival. Gravels scoured and lifted from the bed are naturally 'sorted' as the largest gravels drop back to settle first, smaller gravels are carried slightly further, and fine sediment is washed downstream (Fig 11). This sorting helps to prevent gravels becoming compacted and makes it easier for spawning trout to cut their redds (egg nests created within the gravel). Well-sorted gravels in the fast flows at the tail of a pool provide the ideal location for spawning and minimise the chances of fertilised eggs becoming smothered.

The installation of LWD features or simple flow deflectors can help to promote natural sediment sorting and retain viable spawning gravels.

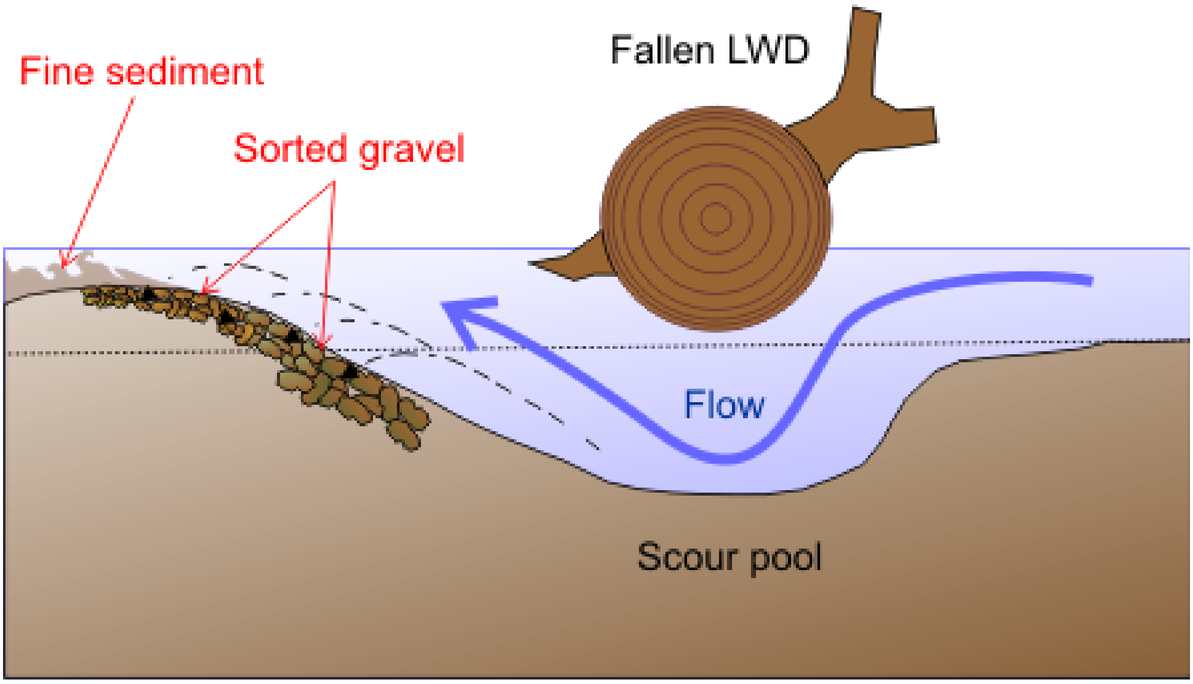

Figure 11: An illustration of how woody debris can scour gravel from the bed and naturally 'sort' it.

At ST 75520 60210 (Fig 12), groyne-like structures in the river appear to be the remains of small, semi-dismantled weirs, probably installed to impound flows for fishery management. The practice of impounding the river with a series of small weirs has historically been employed as a means of increasing holding capacity for large fish at the expense of spawning and juvenile habitat. This practice of artificially ‘ponding’ the river has particularly been used in heavily stocked fisheries where holding large fish for angling has been considered more important than retaining a sustainable wild population. The deterioration/demolition of these structures has helped the river to recover a more natural geomorphology that allows a natural pool-riffle sequence to establish. This has subsequently allowed better quality spawning and juvenile habitat to develop.

Where the remains of the weirs protrude into the channel, they act as flow deflectors, accelerating flows and increasing scour. The impact of the deflection may require further assessment to determine whether or not the structure should be left *in situ*, or whether it should be removed or repositioned. If concerns over bank erosion caused by the deflected flows outweigh the benefits of increased flow diversity and bed scour, it may be wise to adjust the structure or perhaps replace it with a more natural woody debris feature. Options to use woody debris for flow deflectors are explored in the *Recommendations* section.

Figure 12: The remains of a small weir structure now acts as a flow deflector which increases habitat diversity but may be contributing to excessive bank erosion

Where the brook is less incised, the shallow gradient of the banks on the inside of some meanders has allowed shoals of gravel to accumulate.

Figure 13: Gravel shoals collect at the insides of meanders providing potential spawning habitat

Ensuring that gravels are kept well-sorted and free from fine sediment will be vital for wild trout recruitment. In addition, identifying areas where trout spawn and focussing efforts to enhance the surrounding habitat for fry will also help to maximise juvenile survival. When fry first emerge from the gravel they are prey for a wide range of predators, including adult trout. Coarse woody debris (brushwood and trailing branches), dense root systems and beds of emergent vegetation provide vital refuges for trout fry. Even at this early stage, trout fry start to become territorial and will actively distance themselves from other fry. The volume of available refuge habitat is therefore extremely important in ensuring good natural recruitment. Studies suggest that 95% of juvenile trout perish before their first birthday, but accessible, varied habitat can produce profound changes to survival rates that are reflected in more three and four year-old fish that are of interest to anglers.
http://www.flyforums.co.uk/news/index.php?news=6537

At ST 75692 60375 (Fig 14), a small weir is an intact example of the type of holding structures that have been dismantled upstream (Fig 6, Fig 7 & Fig 12). Although this structure may be a favourite spot for some of the club's anglers, the impounding effect on the water upstream is locally degrading the natural habitat. Impoundment structures interrupt the migration of gravels downstream, slow flows and allow fine sediment to accumulate on the bed. This results in a more uniform channel cross section and a reduction in habitat diversity. In addition, such structures can become barriers to fish movements during periods of low-flows and can fragment wild fish populations.

Removing the structure and replacing it with paired deflectors to retain scour through the pool downstream will allow natural morphological processes to resume whilst still retaining good holding habitat for adult trout.

Figure 14: A small weir impounds flows and degrades the habitat upstream

Downstream towards the confluence with the Wellow Brook, the Cam Brook mostly follows a sinuous and meandering course with a good range of habitat features. A mixture of pools and riffles, shaggy margins and occasional woody debris features provide habitat for the various life-stages of wild trout. A relatively short section near the confluence appears to have been artificially straightened and could benefit from the introduction of some woody debris and flow deflectors to increase habitat diversity.

Conclusions

Overall, the ATAA's section of the Cam Brook provides a good habitat for wild trout. In places, however, the river is over-shaded and may benefit from rotational tree works, and where the adjacent land is use for grazing, the installation of stock fencing would be beneficial. The impact of historical straightening works and the vestige of previous stocked fishery practices continue to impact on habitat quality. These issues will need to be addressed if the brook is to achieve its full potential as a wild trout habitat.

Recommendations

In order for the Cam Brook to achieve its full potential as a rich and biodiverse habitat, capable of supporting a maximum sustainable population of wild trout, the following actions are recommended:

- Woody debris in-channel should be left *in situ,* and if deemed to cause an issue, repositioned and fixed in place, rather than removed.
  http://www.wildtrout.org/sites/default/files/library/Woody_Debris_Apr2012_WEB.pdf

- Where the river is heavily shaded and angler access is poor, a programme of tree works should be initiated to introduce a ratio of approximately 50:50 direct sunlight to dappled shade. Works should be staggered over a 5-10 year rotation ensuring a diverse range of crown heights and densities. Pollarding too many neighbouring trees to the same height will result in uniform re-growth that will not provide a good balance of light and shade.
  http://www.wildtrout.org/content/how-videos#tree

- Woody material arising from tree works should be utilised to create woody debris habitat features. LWD can be pinned to the bed with sweet chestnut stakes and fencing wire, or by drilling holes though the LWD with a petrol auger and driving reinforcing steel bars through the holes.

  LWD features can be used to introduce cover for adult fish, to help scour gravel or introduce a greater diversity of flow conditions. Trout like to lie under overhead cover, particularly in pockets of slacker water adjacent to faster-flow. This enables them to conserve energy somewhere safe between darting in and out of the faster flow to snap up passing prey.

  Simple log deflectors can be used in a variety of formations to deflect flows. These simple structures are a good place to start when planning an in-channel habitat enhancement project and a good way of mitigating an artificially straightened channel.
  http://www.wildtrout.org/content/how-videos#log

- Engage with local land owners/tenant farmers to discuss the possibility of establishing a fenced buffer strip wherever the river flows through grazing land. Occasional gates should be included to provide access for periodic grazing or clearance works. Funding for fence building may be available to land owners through Catchment Sensitive Farming or Higher Level Stewardship grants from Natural England. Opening a dialogue with Natural England on the subject of fencing is recommended.

- Where erosion is considered to be a problem, a long piece of LWD can be fixed to the bed at the toe of the bank and the eroded bank protected by packing brushwood against the face sloping down towards the toe. This will slow water velocity across the slip and encourage deposition whilst also providing a habitat for small fish and invertebrates. If possible plant the slip with marginal species such as sedges *(Carex spp.)* to help stabilise the friable soil.

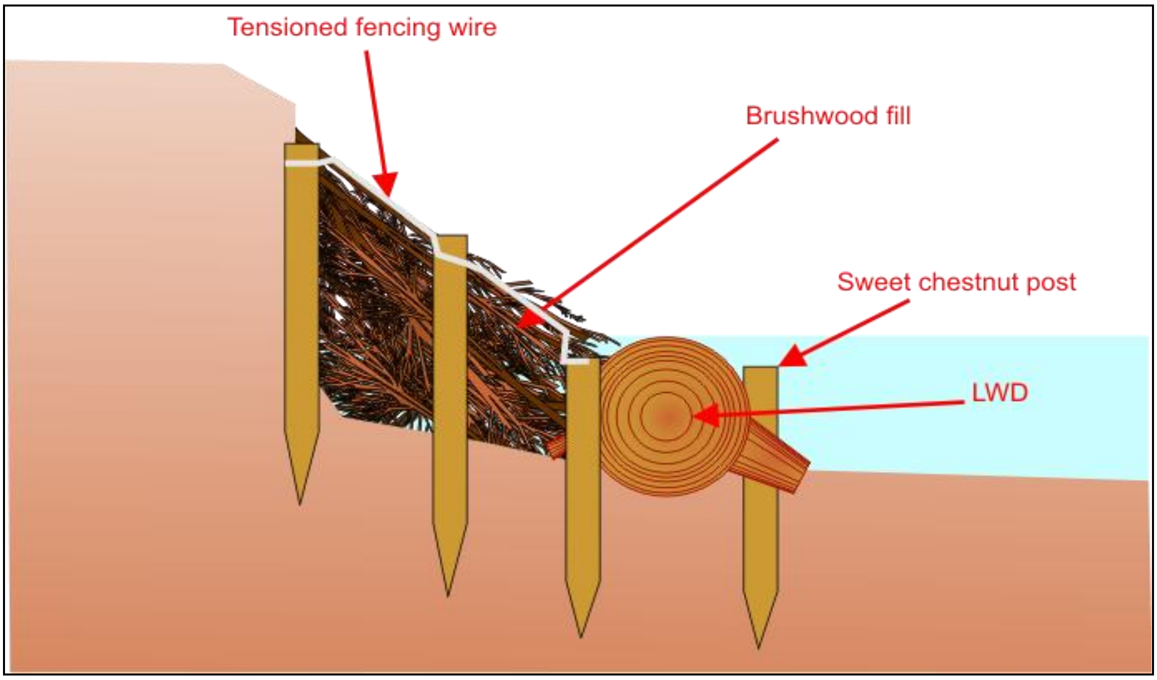

Figure 15: An illustration of an LWD and brushwood sloping revetment

Where banks slump but do not immediately wash away, consider driving whips or stakes of live willow into the slumped area. If they successfully take root, the saplings will quickly help to hold the bank together. This technique is best undertaken during late winter/early spring when the willow is dormant, but can often be successful throughout the year.

It is important to take into account the annual maintenance a live willow bank repair will require before undertaking such works.

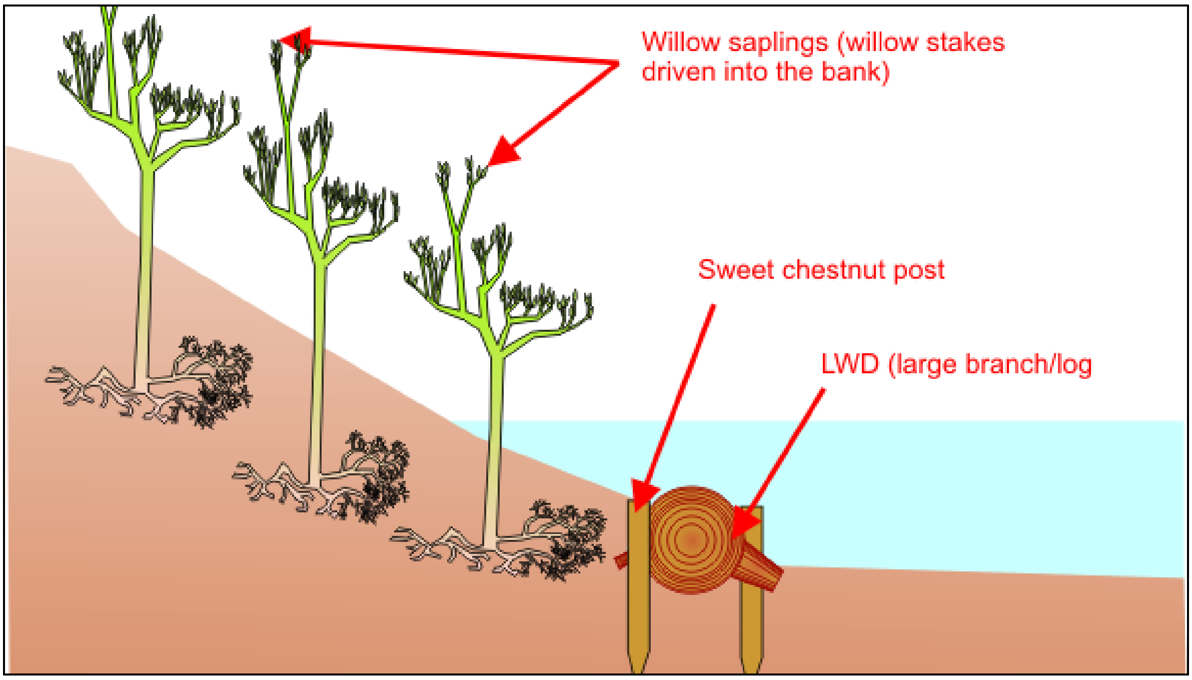

Figure 16: An illustration of a simple live willow bank repair

- Impounding structures should ideally be removed so that natural morphology can resume and habitat remains as well connected as possible. If anglers are concerned about losing holding water at favoured fishing spots, paired log deflectors can be fixed to the bed in an 'upstream V' formation to ensure that the existing weir pool remain scoured clear of sediment continues to hold trout (Fig 17).

  Using pieces of natural LWD with more complex shapes to create such structures could allow for the inclusion of additional overhead cover to make holding pools even more attractive to wild trout.

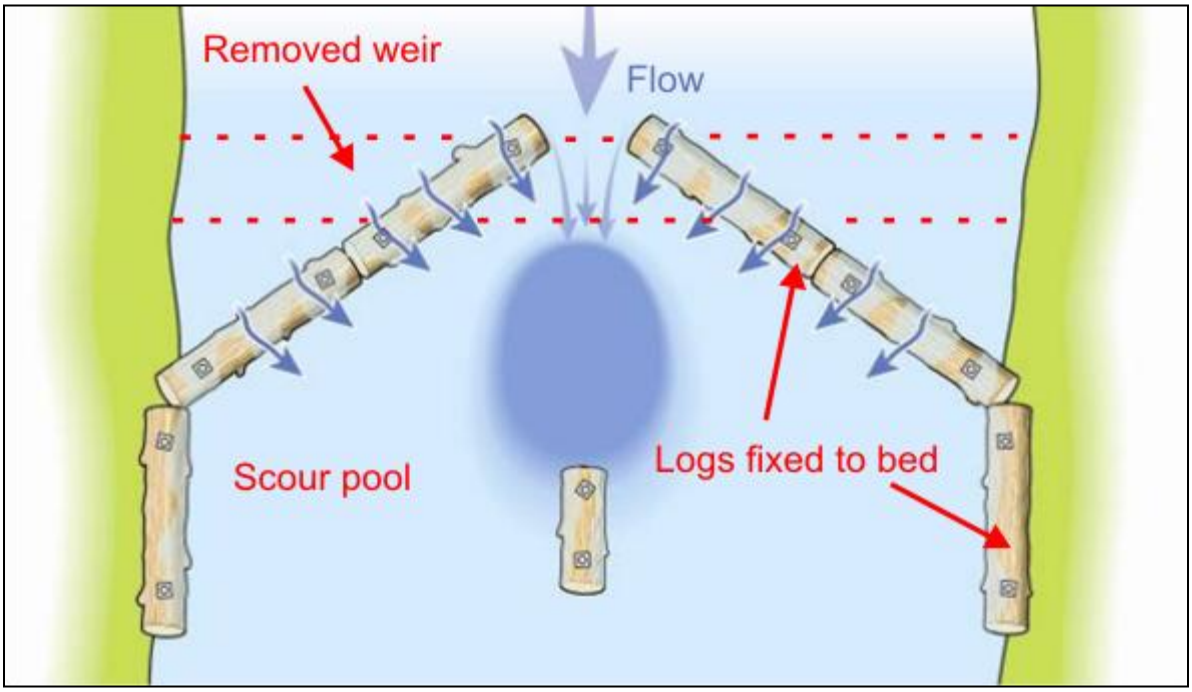

Figure 17: An illustration of a basic 'Upstream V' structure to retain a holding pool without impounding flows

- The practice of impounding rivers is sometimes a response to low levels during periods of low flow. However, it is during low flow conditions that the impacts of slow flow velocity, sedimentation and uniform habitat are greatest. The best means of 'drought-proofing' the river is by safeguarding a natural 2-stage channel formation with plenty of natural pools. A spate river should naturally carve its own low-flow channel or 'thalweg'. A natural 2-stage channel will self-narrow as levels drop and flows are pinched into the thalweg ensuring that flow velocity and connectivity are retained as well as water depth.

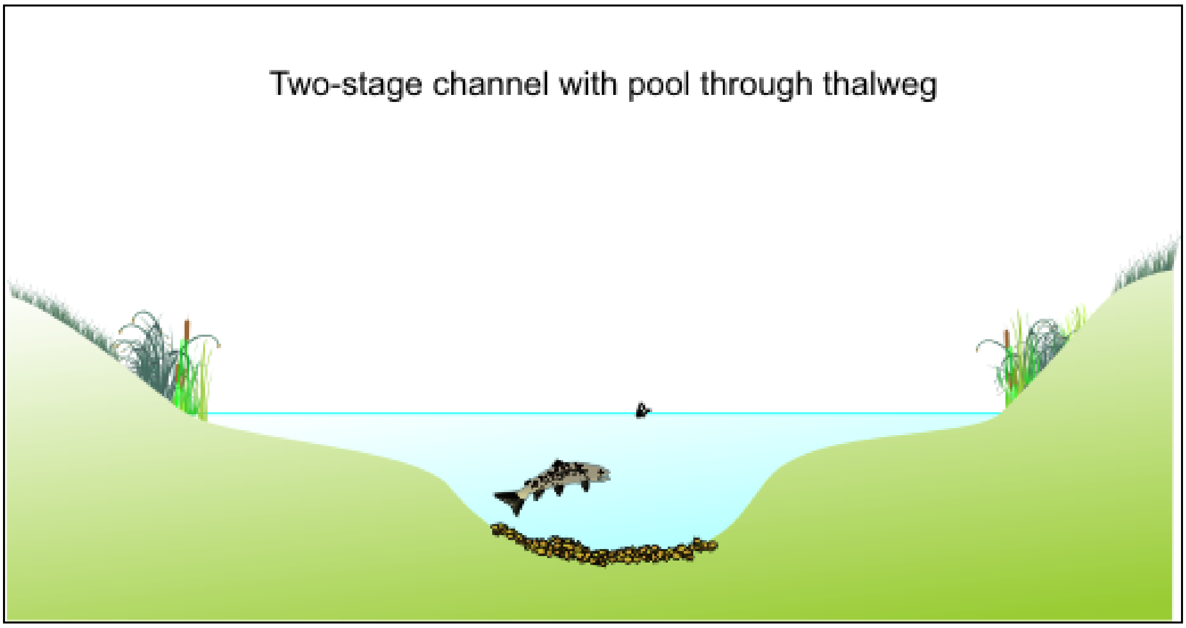

Figure 18: An illustration of a two stage channel cross section with a deeper 'low-flow' channel holding trout during low flows.

- The present stocking regime of the lower section of the Cam Brook may require some consideration. Although it may seem logical that extra fish means extra catches, this is not always the case and it is worth noting that even triploid stocked fish can have a negative effect on resident wild populations. There are methods to ensure that stocked fish have as minimal an impact on the wild population as possible, but it is worth considering that the river will only hold as many trout as there is habitat for. Once the available habitat is occupied, surplus trout will either move downstream or die. The following links to an article in *Trout and Salmon* and a video both by WTT's Dr Paul Gaskell may shed some interesting light on the subject.

  http://www.wildtrout.org/content/how-videos#Trout stock

  http://www.wildtrout.org/sites/default/files/library/to%20stock%20or%20not%20comp.pdf

Making it Happen

The WTT website library has a wide range of free materials in video and PDF format on habitat management and improvement:

http://www.wildtrout.org/content/index

The Wild Trout Trust has also produced a 70 minute DVD called 'Rivers: Working for Wild Trout' which graphically illustrates the challenges of managing river habitat for wild trout, with examples of good and poor habitat and practical demonstrations of habitat improvement. Additional sections of film cover key topics in greater depth, such as woody debris, enhancing fish stocks and managing invasive species.

The DVD is available to buy for £10.00 from our website shop http://www.wildtrout.org/product/rivers-working-wild-trout-dvd-0 or by calling the WTT office on 02392 570985.

There is also the possibility that the WTT could help to start a project via a Project Proposal (PP) or a Practical Visit (PV). PV's typically comprise a 1-3 day visit where approved WTT 'Wet-Work' experts will complete a demonstration plot on the site to be restored.

This will enable project leaders and teams to obtain on the ground training regarding the appropriate use of conservation techniques and materials, including Health & Safety, equipment and requirements. This will then give projects the strongest possible start leading to successful completion of aims and objectives.

Recipients will be expected to cover travel and accommodation (if required) expenses of the WTT PV leader.

There is currently a big demand for practical assistance and the WTT has to prioritise exactly where it can deploy its limited resources. The Trust is always available to provide free advice and help to organisations and landowners through guidance and linking them up with others that have had experience in improving river habitat.

Disclaimer

This report is produced for guidance and not for specific advice; no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon guidance made in this report.

Appendix I – Fish survey data for the ATAA's waters on the Cam Brook

Location:	South West Wessex (North - Bridgwater)
Report Date:	15/10/12
Site Name:	**South Stoke**
Site Reference:	MB75
Survey Date:	26/07/2000
Catchment:	Bristol Avon Catchment
Sub Catchment:	Midford Brook
Fisheries Management Unit:	
Upstream NGR:	
Midstream NGR:	ST7570060300
Downstream NGR:	
Gradient (m/km):	1.7
Distance to Confluence (km):	0.7
Survey Length (m):	112
Survey Width (m):	6.6
Survey Area (m2):	739.2
Mean Survey Depth (m):	

Species	Minimum Length (IF)	Maximum Length (IF)	Mean Length (IF)	Numbers Caught	% of Catch by Number	Weight Caught	% of Catch by Weight
Brown / sea trout [Salmo trutta]	193	332	260	36	87.8	8636	88.89
European eel [Anguilla anguilla]	258	632	457	5	12.2	1079	11.11