WILD TROUT TRUST
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River Mells and tributaries, near Frome, Somerset

Wild Trout Trust report following an Advisory Visit on 28-29 June 2022

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Contents

1. Introduction

This report is the output of a visit undertaken by Theo Pike of the Wild Trout Trust on approximately 2.5 miles (4 km) of the River Mells and its tributaries, the Whatley Brook (also known as Fordbury Water) and the Nunney Brook (also known as the Egford Brook) in Somerset.

A walkover of this area, which corresponds to land owned by Hanson UK, was requested by the Frome & District Angling Association (FADAA). The visit was particularly focused on assessing habitat for wild brown trout *(Salmo trutta),* minor fish species, and biodiversity in general.

For ease of use, this report is arranged by water body, and also by landowner where relevant. Over time, it is hoped that assessments of additional reaches of the river will be added, building progressively into a useful catchment plan for the Mells catchment.

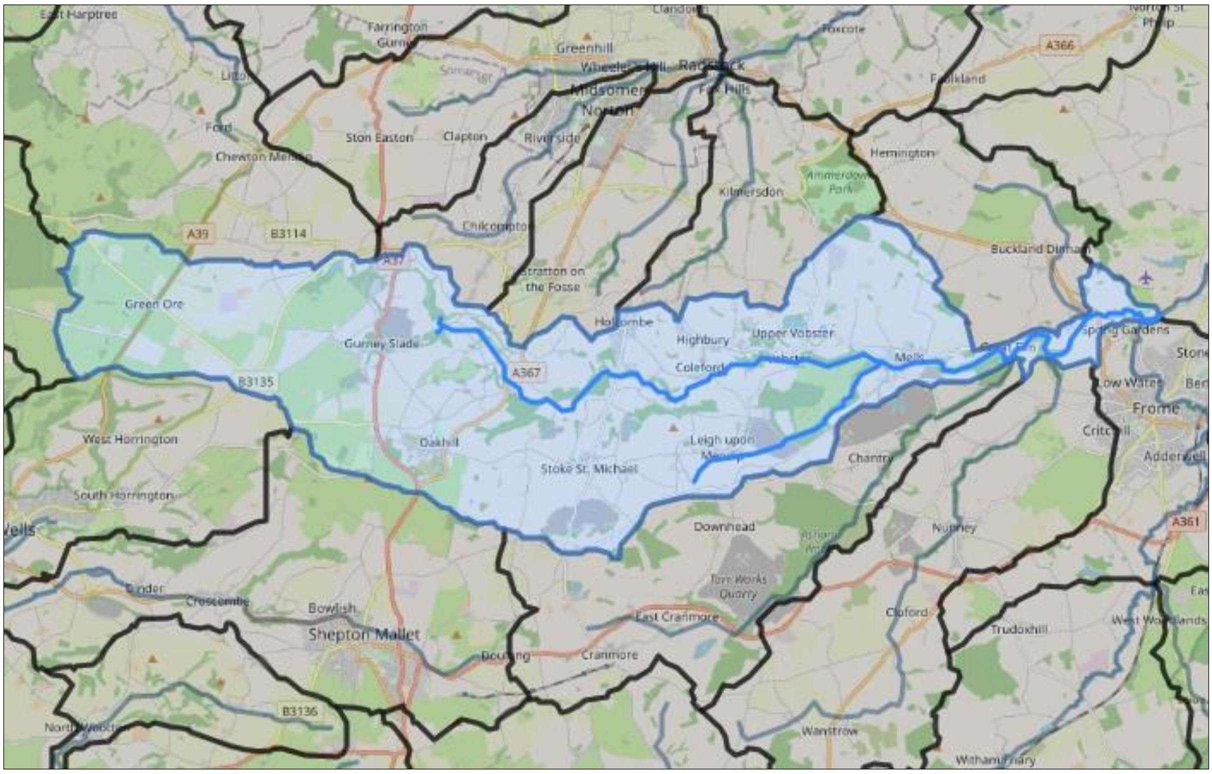

Figure 1: A map of the River Mells catchment. Source: https://environment.data.gov.uk/catchment-planning/WaterBody/GB109053022020

2. Catchment overview

The River Mells (also known as the Mells Stream) is a tributary of the Somerset River Frome, rising at Emborough Pond, and flowing east, through the villages of Nettlebridge, Holcombe, Coleford, Vobster, Mells and Great Elm.

The river picks up small tributaries at Gurney Slade, Ashwick, Whitehole, Coleford, Great Elm, Vallis Vale and Hapsford, before meeting the Frome at Spring Gardens, and flowing on to meet the Bristol Avon at Freshford, and finally into the Bristol Channel.

The upper course of the River Mells roughly delineates much of the southern boundary of the Somerset coal field, with predominantly Carboniferous Coal Measures of mudstone, siltstone and sandstone to the north, and Carboniferous and Jurassic limestone to the south. Between Mells and Hapsford, where the river breaks out of the eastern Mendips into the valley of the Frome, it flows through a deep limestone gorge. Karst-type features of the catchment include numerous swallow holes (locally known as 'slockers') and associated cave systems in the Stoke St Michael area, a tufa spring and cascade at Whitehole, and a stream sink/spring in the gorge just downstream of the village of Mells. Surface soils tend to reflect underlying geology, with relatively impermeable gleys over the Coal Measures, and calcareous brown earths over the limestone.

The limestone massif of the eastern Mendips may have been quarried since Roman times, and the Mells catchment includes numerous active and dormant quarry sites. Apart from the quarrying industry, land use in the Mells catchment is mainly agricultural, with dairy, beef and sheep farming on permanent pasture. Recent years have seen increasing cultivation of cereal crops, particularly maize, which may contribute to surface runoff laden with sediment and nutrients.

Much of the river's riparian corridor is well wooded, and thus shaded, with very real benefits for keeping the river cool and protecting river ecology in the face of climate change: summer water temperatures in shaded channels can be 9 degrees C lower than in unshaded areas. Beyond the immediate river corridor, there are also extensive woodland areas in the catchment, including Harridge, Edford, Whitehole and Asham Woods.

Despite major historic exploitation by industries including mining and ironworks, the River Mells and its tributaries can now be seen as a successfully recovering post-industrial catchment – but one that is still in need of significant help to reach its full ecological potential.

2.1. Water Framework Directive assessment

For the purposes of the Water Framework Directive (WFD: the scheme currently used to assess the Ecological Status or Ecological Potential of our surface waterbodies in Britain), the Mells catchment has been assessed as per the table below (NB the Whatley Brook and Nunney Brook are separately assessed):

River	Mells
Waterbody Name	Mells source to conf with Somerset Frome Water Body
Waterbody ID	GB109053022020
Management Catchment	Avon Bristol and Somerset North Streams
River Basin District	Severn
Current Ecological Quality	Moderate (as at 2019)
U/S Grid Ref inspected	ST 74608 49043 (Great Elm)
D/S Grid Ref inspected	ST 75782 49146 (Hapsford industrial estate)
Length of river inspected	1.25 miles / 2 km approx

Water Framework Directive (WFD) information for the River Mells

Under WFD, the Mells is classified as 'not designated artificial or heavily modified'. Such a classification understates the actual levels of historic modification in many areas. Particularly from Coleford downstream to Spring Gardens, significant channel alterations are very evident, including straightening, bank revetment and impoundments for industrial purposes.

However, having avoided classification as a 'Heavily Modified Water Body' (HMWB) under WFD, the River Mells is subject to the target of 'Good Ecological Status' (GES) in spite of clear post-industrial pressures upon it: a more ambitious target than 'Good Ecological Potential' (GEP) which is usual for urban and post-industrial HMWBs.

In the 2019 round of WFD assessment, the Mells was assessed as 'Moderate': latest data are available from the Environment Agency's Catchment Data Explorer site:

https://environment.data.gov.uk/catchment-planning/WaterBody/GB109053022020

This 'Moderate' status appears to be driven primarily by failing for phosphate pollution since 2010 (status was 'Good' in 2009). Reasons for Not Achieving Good status (RNAGs) are listed as point source phosphate pollution from sewage treatment works (STWs), and diffuse phosphate pollution linked to poor livestock management.

Returning to the EA's WFD data, the River Mells's biological elements (invertebrates plus macrophytes and phytobenthos) both declined from 'High' to 'Good' status between 2013 and 2014: as discussed above, this may also be linked to phosphate pollution. However, other physico-chemical quality elements, apart from phosphate, have been consistently assessed as 'High' since 2013. Hydromorphological supporting elements (hydrological regime and morphology) have been assessed as 'Supporting Good'.

Fish do not appear among the biological quality classifications. The wild trout population of the Mells currently appears to be relatively healthy (pers. obs. and pers. comm.) but it is likely to be progressively threatened by many stressors including obstructions to fish passage, nutrient enrichment, excessive sedimentation, invasive non-native species (INNS) and the impacts of climate change.

2.2. Local designations

Under the Habitats Directive, several areas of the Mells catchment are designated SAC and SSSI. These include:

SAC: Mells Valley, for its exceptional breeding population of greater horseshoe bats, as per https://sac.jncc.gov.uk/site/UK0012658

SSSI: Edford Wood and Meadows, St Dunstan's Well sub-catchment, Cooks Wood Quarry, Moons Hill Quarry, Asham Wood, Mells Old Ironstone Works, Vallis Vale, as per https://en.wikipedia.org/wiki/List_of_Sites_of_Special_Scientific_Interest_in_Somerset

3. Wider catchment pressures

3.1. Quarrying: hydrological impacts

The natural hydrology of the Mells catchment was progressively impacted by historic quarrying activities, as easily-exploited streamside rock faces were 'worked back', and the watercourses themselves were modified for ironworks and other industries. These impacts have continued to proliferate up to the present day: for instance, in the early 1960s, c.1km of the Whatley Brook was culverted to facilitate the expansion of Torr Works.

Because of the complex and unpredictable structures of shallow limestone aquifers, with groundwater mainly moving through fissures which may be enlarged by karst dissolution processes, it is notoriously difficult to predict what may be found in the course of quarry operations, or to model the effects of dewatering as work descends below the water table and produces a local 'cone of depression'. However, it is clear that sub water table quarrying activities, and dewatering to facilitate these, have had a significant impact on the Mells catchment.

In 1977 and 1987, work was suspended at Fairy Cave and Cookswood quarries respectively, when they threatened to intercept subterranean karst channels linked to springs at Ashwick and St Dunstan's Well. Wider impacts were also noted as larger 'super-quarries' like Whatley and Torr began working deeper below the water table. In 1980, the deepening of Whatley quarry's pumping sump from 81m to 75m AOD caused permanent failure of the Mells sink/spring; in 1990, further deepening to 58m AOD caused major derogation at Bristol Water's Oldford borehole and the early failure of Hapsford spring. In 1984, it was noted that pumpage from Whatley quarry exceeded the Mells's baseflow at Vallis Vale.

Various research has been undertaken on the subject of spring flows within the Mendips. According to a report produced in 2005 by Hafren consultants ('Effect of Quarry Water Discharges on Stream Flows in the Mendip Hills') the quarries in the Mells catchment discharge water into the river and its tributaries at various point sources, as follows:

- Moons Hill quarry:
    - Dewatering discharge to Long Cross Bottom Stream at ST 66313 46490 approx.

- Halecombe quarry:
    - Dewatering discharge to Finger Valley Stream at ST 70264 47422 approx.

- Whatley quarry:
    - Dewatering discharge to Whatley Brook at ST 732 478 (1 ML/day, with suspended solids not exceeding 30mg/l). It has been suggested that Whatley Brook was historically ephemeral before quarry dewatering commenced.
    - Augmentation to Mells River at ST 73627 48774 (approx.) (suspended solids not exceeding 60mg/l) since 2003. At a fairly constant 100-140 l/s, this augmentation is believed to constitute approximately 10-30% of river flow in winter, and 50-90% of flow in summer.

- Colemans quarry
    - Dewatering discharge to Nunney Brook at ST 3728 1448 (40-100% of flow).

- Torr quarry
    - Dewatering discharge to Whatley Brook (between 0 and 300 l/s, contributing up to 100% of flow during both wet and dry periods).
    - Augmentation to Nunney Brook and River Alham (a tributary of the River Brue).

The combined effects of dewatering, reduced surface runoff and intercepted groundwater flow, along with reduced spring flow, require the implementation of carefully controlled water management systems as a key part of environmentally sensitive quarry operations. As such, all of the discharges in this complex water management system are understood to be governed by Section 106 agreements with Somerset County Council.

In addition to abstraction licences associated with quarry dewatering activities, a number of other surface water abstraction licences are also understood to have been granted within the catchment. These cover activities including public water supply, agriculture, fish farming, golf course irrigation and a mineral water bottling plant.

3.2. Industry and quarrying: channel modifications including weirs

As a result of its past industrial history, including harnessing energy for hydropower as well as 'locking' the channel in place in order to maximise usable bankside land, the River Mells is fragmented by significant numbers of weirs.

In all sizes, weirs are often significant barriers – or even complete obstacles – to fish passage, preventing many species from moving up and down rivers freely to fulfil the different stages of their life cycles. Weirs also interrupt the natural process of river sediments being transported downstream. When this process is 'strangled' by a weir, it can cause the channel downstream of the weir to become depleted of coarse sediment – with the result that rates of bed and bank erosion are dramatically increased because of the interrupted supply of suitable gravel and cobbles from upstream.

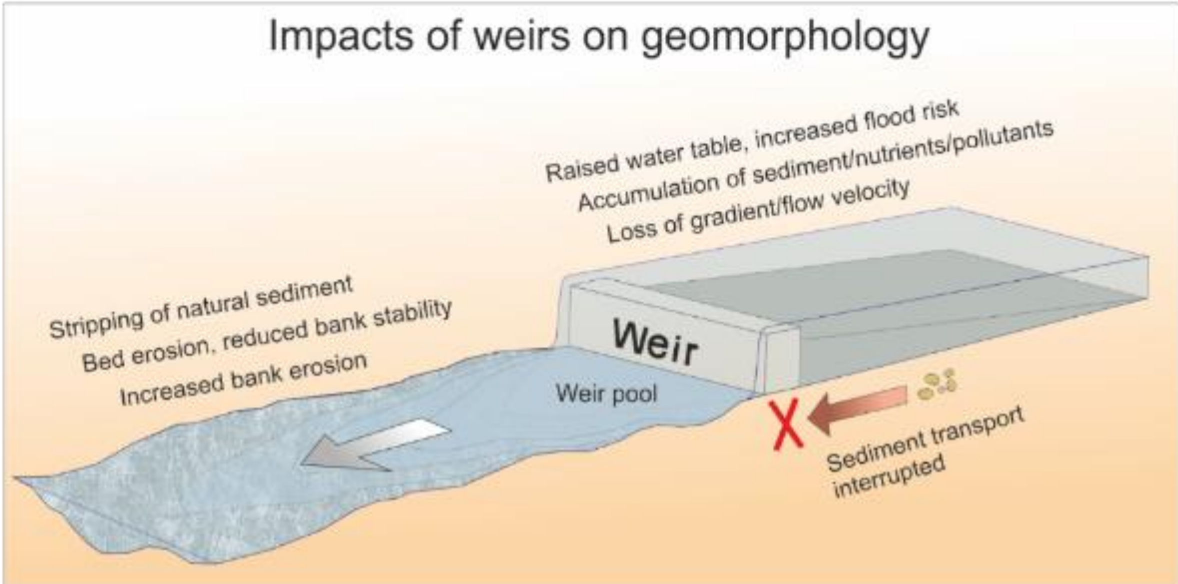

Figure 2: An illustration showing the impacts of weirs on river geomorphology.

At the same time, in the slow-moving water above a weir, any sediment carried in suspension drops out of the water column uniformly across the river bed, and habitat quality and diversity are severely degraded. Such conditions can sometimes temporarily provide sufficient deep water habitat for small numbers of adult trout and other species (until the deep water inevitably fills with sediment) but are generally unsuitable for many beneficial invertebrates, and gravel spawning fish, fry and juveniles. Fish populations can also become fatally isolated, and are very vulnerable to predation.

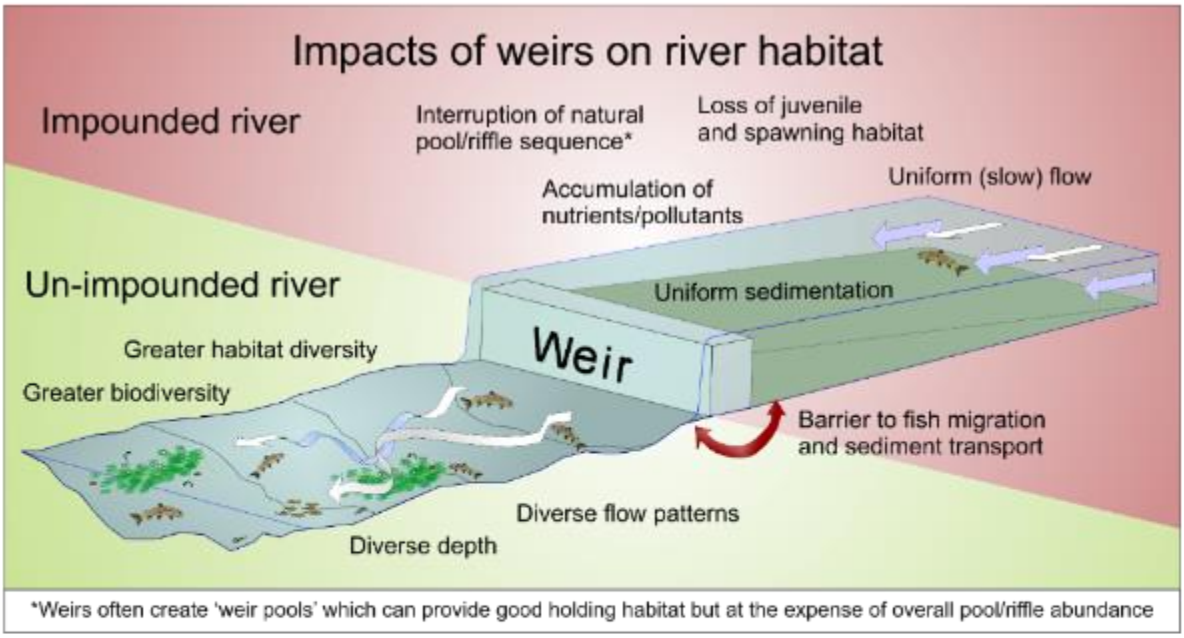

Figure 3: An illustration showing the impacts of weirs on habitat quality.

Weirs and other modifications also produce cumulative effects in terms of their impact. More information about weirs, and the benefits of removing them, can be found on the following links:

https://www.wildtrout.org/content/weirs-culverts-and-barriers

http://urbantrout.blogspot.com/2018/02/why-presume-to-remove-weirs-with-river.html

https://www.americanrivers.org/threats-solutions/restoring-damaged-rivers/how-dams-damage-rivers

Other channel modifications on the Mells include long stretches of bank 'armouring' in the form of rough stone walls, with the result that the river is frequently pinched and dropped into an artificially narrow and high-velocity channel below the level of the surrounding landscape. The net result can often be a hostile environment for fish, especially following any significant rainfall event.

Fortunately, the beds of these channels are often rough and bouldery, offering mitigation in the form of refuge for fish in high and low flows alike. It is recognised that bed-raising and re-establishing lateral connectivity between the river and its floodplain may not always be possible. In such areas, adding more in-channel structure (in the form of well-secured woody material) is likely to be beneficial because it will help to re-start processes of scour and deposition, creating sequences of deeper pools and shallower riffles where these do not currently exist. In areas where sediment transport has been interrupted by weirs, for decades or even centuries, gravel augmentation may also be helpful.

3.3. Industry and quarrying: chemical pollution

Post-industrial rivers like the Mells are notorious for their long histories of serious pollution. Coal mines and coking works at Vobster, and ironworks at Mells, are likely to have caused significant environmental damage, including by returning water to the river after heating it with industrial processes and contaminating it with various chemicals. Fine bedload sediments in the river have frequently been observed to be magnetic – perhaps a legacy of slag being dumped in the channel for cooling and / or disposal.

Following the collapse of the coal and iron industries in the catchment, a significant level of pollution continued as a result of quarrying. According to a study in 1991 ('Water Resource Problems Related to Mineral Working in Wessex Region') by WI Stanton, the years from c.1960 to c.1975 saw "a period of intense pollution of surface watercourses by uncontrolled quarry floor runoff (including) mud, silt, oil, creosote, and chemicals".

Affected parts of the catchment included Asham Stream and Chantry Lake (Torr, Asham and West Down quarries), Whatley Brook (Whatley quarry), Stoke St Michael Stream (Moons Hill and Stoke quarries), and Gurney Slade Stream (Gurney Slade quarry).

Thanks to the steepness of the catchment, many of these pollutants may have been swept out by high flows, but legacy contamination may still be present, for instance in sediment deposits behind weirs and other impounding structures.

3.4. Nutrient enrichment

As noted above, the River Mells has failed to reach WFD 'Good' status since 2010 as a result of point source phosphate pollution from sewage treatment works (STWs), and diffuse phosphate pollution linked to poor livestock management.

Elemental phosphorus is extremely toxic to aquatic life, but phosphate (the most commonly appearing form) is generally damaging only at concentrations of parts per million or higher, for instance as a result of STW discharges. Phosphate exerts a primarily indirect effect, such as causing eutrophication with features including algal blooms. When nutrients reach eutrophic levels in rivers, algae proliferates, blocking essential light from macrophytes like water crowfoot. Algae also increase dissolved oxygen (DO) levels by photosynthesising during daylight, while reversing this process at night, potentially reducing DO below fatal levels for fish. Toxins produced by specific algae are some of the most toxic known.

In order for the River Mells to achieve Good Ecological Status, progress will need to be made in controlling sources of phosphate pollution. Some of the most significant STW sources may be suggested by the map below, but other sources of phosphate pollution are likely to include misconnections and spills from septic tanks – a persistent problem in many rural areas. Diffuse pollution (ie lots of small point sources of pollution) from agriculture will also require investigation and amelioration.

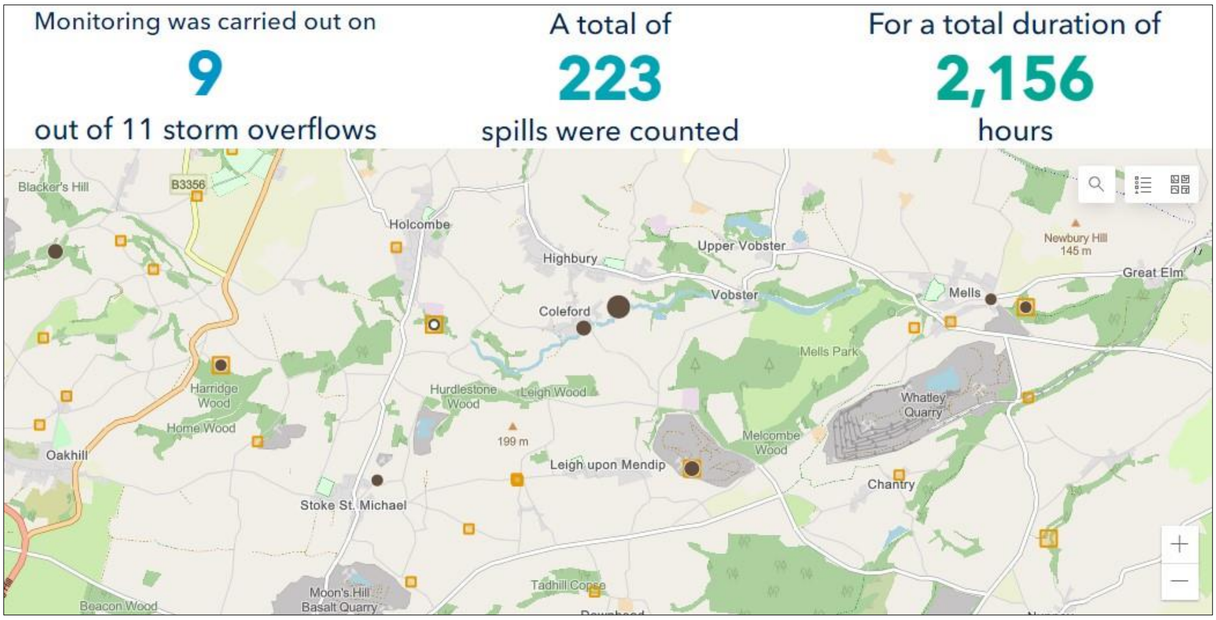

Figure 4: CSOs on the River Mells: the relative sizes of the black circles indicate numbers of sewage spills discharged into the river from storm overflows during 2021 (Source: Wessex Water data, published by the Rivers Trust in 2022).

STW discharges are also known to contain pharmaceuticals, whose impact is still poorly understood:

https://environmentjournal.online/articles/dangerous-levels-of-medical-drugs-polluting-uk-rivers-poses-a-risk-to-wildlife/

3.5. INNS

Like many water bodies in the UK, the River Mells suffers damage from a range of invasive non-native species (INNS).

Invasive plants which have been noted in the catchment include:

- Himalayan balsam: impacts include shading out other plant species before dying back in winter, leaving river banks vulnerable to erosion without the reinforcing root matrix provided by native plants.
- Giant hogweed: impacts include making river banks inaccessible to local people for health and safety reasons: contact with the plant's phyto-phototoxic sap can inflict recurring, sunlight-activated third-degree burns

Invasive animals which have been noted in the catchment include:

- American signal crayfish: impacts include burrowing up to 2 metres into banks, causing instability and eventual over-widening of the channel, as well as mobilisation of fine sediment which covers gravels, smothering invertebrate habitat and suffocating fish eggs. Excessive fine sediment in the water column may reduce photosynthesis and survival of valuable plants such as water crowfoot. Signal crayfish also predate on aquatic invertebrates, as well as fish eggs and fry.
- American mink: impacts include voracious predation on water birds, fish and other animals, including water voles, which have been forced into local extinction in many catchments, possibly including the Somerset Frome.

Invasive pathogens which have been noted in the catchment include:

- Ash dieback: a fungal disease which causes leaf loss and dieback before killing ash trees completely, or making them more vulnerable to other pathogens: https://www.forestresearch.gov.uk/tools-and-resources/fthr/pest-and-disease-resources/ash-dieback-hymenoscyphus-fraxineus/
- Phytopthora: a water mould disease affecting alder trees, which can sometimes be regenerated by coppicing: https://www.forestresearch.gov.uk/tools-and-resources/fthr/pest-and-disease-resources/phytophthora-disease-of-alder-phytophthora-alni/

Strategies for addressing the impacts of each of these INNS are discussed as relevant recommendations in various areas.

4. River Mells: Hanson estate

The Hanson estate includes 1.25 miles (2 km) approx. of the lower River Mells, from Great Elm downstream to Hapsford.

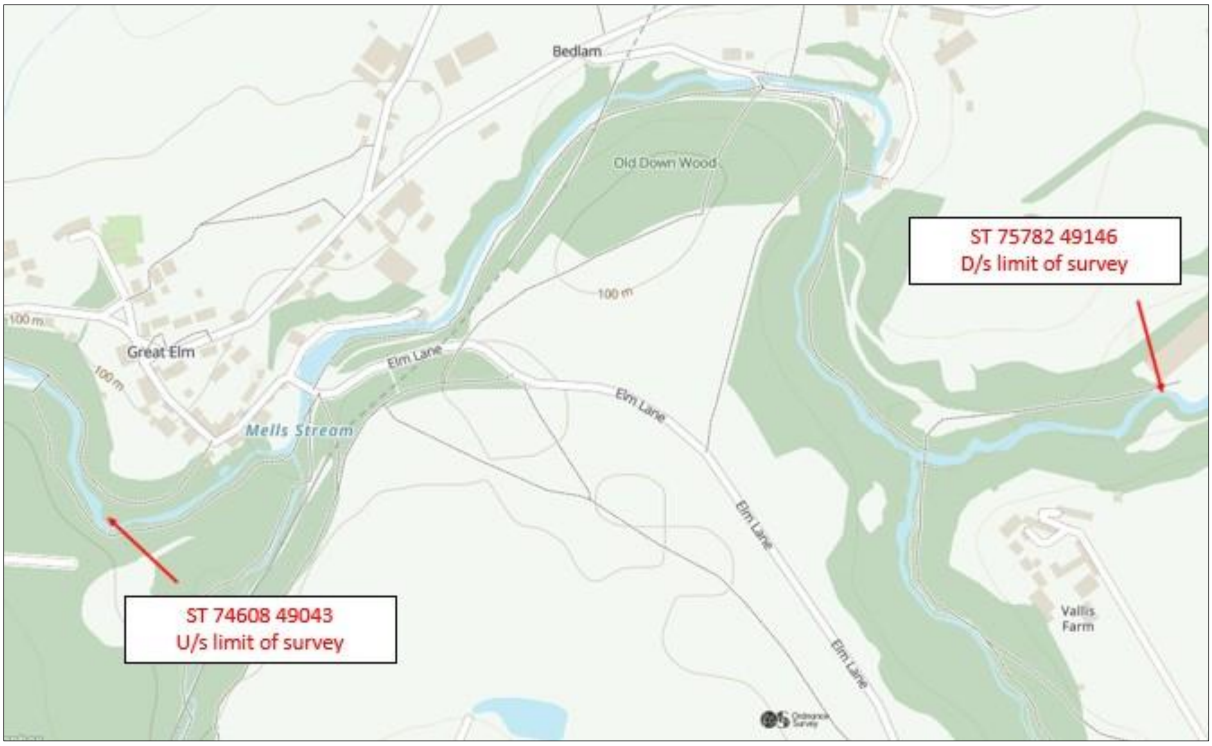

Figure 5: A map showing the stretch of the River Mells assessed in this report.

Comments in this report are based on observations on the day of the site visit and discussions with local members of FADAA. Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.

4.1. River Mells: Hanson estate habitat assessment

At the time of this walkover survey on 28 June 2022, flow was judged to be at a low summer level.

Figure 6: Naturally-occurring Large Woody Material (LWM) is a huge asset to habitat diversity on the River Mells.

As the River Mells enters the upstream extent of the Hanson estate, at ST 74608 49043 approx., the channel appears generally overwide, with unsorted cobbly and bouldery substrate. However, this is mitigated in some areas by ongoing hydromorphological processes, including the presence of naturally fallen trees which 'force' very much greater habitat complexity by concentrating flows in particular areas of the channel - which in turn triggers localised scour and deposition of scoured-out materials.

An exceptionally good example of such beneficial Large Woody Material (LWM) in action is shown in Figure 6 above: a tree has fallen across the full width of the channel, focusing flows towards the LB. Here, a deeper scour has formed under the trunk, with a plume of gravel ejected downstream: the scour has created a refuge for adult fish, even in lower flows, while the gravel plume provides a spawning area. There is also a plethora of low, trailing cover along the LB.

Naturally fallen LWM like this should be welcomed as a 'gift from nature' and left in place whenever possible. Simply due to its size and weight, LWM of this size is likely to remain stable for many years or even decades: it also offers a template for creating similar structures by careful selective felling of other trees, so that they fall into and across the channel, lodging securely against the opposite bank.

For more information, see Appendix B: Tree hinging and similar works: A Wild Trout Trust summary.

Figure 7: The simplified channel at Great Elm could be improved by introducing boulders and LWM in order to restore the river's natural 'roughness'.

At the village of Great Elm, the river flows alongside formal gardens, with a vertical stone and concrete retaining wall on the LB. In its natural state, this stretch of the Mells would have been a very bouldery river in a narrow limestone gorge. Today, this length of channel is simplified, straightened and generally uniform, with unsorted substrate: it is possible that many larger boulders and cobbles have been historically 'robbed' from the channel for building works.

Measures to restore the health and hydromorphological complexity of this stretch of the river could include felling suitable trees into the channel (perhaps as 'tree kickers' parallel and secured to the RB) as well as reintroducing clusters of boulders in the form of rough berms and 'boulder gardens'. The aim should be not so much to dictate the exact 'shape' of the river through this area, as to provide the channel with enough 'roughness' to re-start its own natural processes of scour and deposition, thus evolving to become progressively more varied, complex and sinuous alongside the hard LB wall – similar to this boulder reinstatement project in Yorkshire:

https://twitter.com/ProfJGrey/status/1557284778361102337

A short stretch of the RB of the river in this area is also heavily shaded by mature cherry laurel, a non-native species which can become invasive, and tends to suppress native plant species by overshading them. Removal is recommended for this reason, followed by replacement with native species such as goat willow. NB cutting laurel branches and leaves can release cyanide into nearby air and water: any tree works involving laurel should prevent arisings from falling into the river or watercourse, and people should avoid being in a confined space with cut leaves and laurel branches:

https://www.express.co.uk/life-style/garden/1129540/laurel-laurel-hedging-cyanide-poisonous-plants-alnwick-poison-garden-video


Figure 8: Left, the heavily-silted mill pond at Great Elm; Right, the narrowing impoundment just upstream of the weir.

A short distance downstream, the flow of the river is augmented by its confluence with the Whatley Brook, and the combined flows quickly become impounded by the mill pond at Great Elm.

Originally associated with a corn mill, the pond provided power for one of the Fussell's ironworks until the early 1890s. Online impoundments such as the Great Elm mill pond are notorious for acting as sediment traps - offering habitat for a small number of adult trout, but very few possibilities for juveniles - and this one appears to have become progressively more filled with nutrient-rich fine sediment in the course of the last 10 years (pers. obs). Shallow water with a dark silt bed can also act as a heat sink in summer – raising the temperature of the water and reducing its ability to carry dissolved oxygen. Any dredging operation to remove the silt is likely to be costly, including the possibility of needing to dispose safely of contaminated sediments from the river's past industrial history, and will need to be regularly repeated.

A more sustainable long-term solution would be to remove or lower the weir at the downstream end, and then recreate a more natural, sinuous channel through the area of the present impoundment (which narrows almost to natural channel width as it approaches the weir, and is believed to host an anomalous population of roach). An inspiring example of this kind of solution can be found on the River Wandle in south London, where a similar silt-trap impoundment was successfully restored as a free-flowing, self-scouring channel:

https://www.wandletrust.org/hackbridge-river-restoration-project-underway/

https://www.wandletrust.org/hackbridge-river-restoration-the-work-progresses/

https://www.wandletrust.org/hackbridge-restoration-update/

Figure 9: Left, the impassable weir at Great Elm; Right, the collapsing LB wall just downstream of the weir.

Viewed from downstream, the weir at Great Elm is clearly a barrier to fish passage, and is likely to be impassable to all fish in all flow conditions. As discussed above, the most sustainable option would be removing the weir completely. If this is not possible, a compromise solution could involve some reduction in height, plus installation of a rock ramp downstream to improve fish passage through this area, whilst helpfully eliminating the requirement for ongoing maintenance of a technical fish pass.

Works to install a rock ramp could also include repair of the deteriorating garden wall on the RB, just downstream of the weir: this deterioration of the retaining wall is a demonstration of the river's erosive power when deprived of its upstream sediment supply as a result of a weir (as discussed in *Channel modifications including weirs*, above).

Figure 10: Tree works related to ash dieback have skylighted the river in several areas.

Proceeding downstream towards the railway bridge at ST 75184 49481, it was noted that recent tree works (presumably to remove trees affected by ash dieback, in dangerous proximity to a public footpath) had reduced overshading of the channel from the southerly RB. Despite the tragedy of ash dieback, this could be a beneficial first step towards re-establishing a healthier age structure of trees along this stretch of the river.

On many post-industrial rivers like the Mells, regular coppicing of bankside trees (often originally planted to further stabilise rock-armoured river banks) has lapsed, resulting in a very uniform age and species profile of trees, which may now be extra vulnerable to diseases like phytopthora (and indeed ash dieback). Taking this opportunity to diversify the age and species of bankside trees, by introducing a programme of tree planting and rotational coppicing alongside any ongoing ash dieback clearance work, could create a much healthier woodland mosaic and provide a patchwork of light and shade over the river – ideally, neither heavily tunnelled and overshaded, nor completely open to direct sunlight.

In general, lack of sunlight penetration to a river can lead to loss of riparian and aquatic vegetation and their associated habitats, while lack of shade can result in excessive growth which clogs the channel. Shade can also help to protect river ecology from overheating: summer water temperatures in unshaded channels can be 9 degrees C higher than in shaded areas. In general, most of the shade should be over deeper pools, and most of the light should be over shallow riffles, where the food web's primary production takes place.

At the time of the walkover, it was also noted that large piles of brash (and in some cases, lengths of tree trunk) remained on the bank. While these could be helpfully formalised as habitat log piles or lengths of dead hedging, they were already offering a useful addition to terrestrial ecosystems, as well as potential future resource for 'feeding' LWM into the river to increase habitat and hydromorphological complexity. Conversely, allowing this woody material to be indiscriminately chipped would be a sad waste of environmental resources: it could also be ecologically damaging if wood chippings were mistakenly directed into the river.

Figure 11: A stable piece of LWM in a classical 'angle of repose' with root ball upstream and crown downstream.

Just upstream of the railway bridge, it was also observed that an alder tree, which had fallen into the river several years ago (pers. obs.), had remained in position since that time without showing any signs of moving further downstream.

Some smaller branches had broken off, but the main trunk was still lying in a typical, hydrologically stable 'angle of repose' with the root ball upstream, and the crown downstream. At least one trout was seen moving in and out of its shelter.

This provides another excellent example of naturally-contributed LWM continuing to offer stable, habitat complexity for many years after its arrival in the river.

For more details of opportunities for LWM management on the Mells, please see Appendix B: Tree hinging and similar works: A Wild Trout Trust summary

Figure 12: Left, RB weir structures at Bedlam; Right, LB weir structures at Bedlam.

Arriving in the former milling area known as Bedlam, the remains of industrial infrastructure can still be seen at ST 75323 49494, including two small weirs adjacent to the RB and LB respectively.

At the time of this walkover, most of the flow was directed down the LB weir. Due to downstream movement of coarse sediment, which appeared to have created a virtual rock ramp over the sill, this weir did not appear to be a significant obstacle to fish passage. However, any such structure can still impede passage of juvenile trout, or weaker-swimming fish species, so notching or lowering the structure would be advisable for this reason. In higher flows, an additional passable channel may also be activated on the RB.

Figure 13: Left, a severely-eroded area of bank at a popular access point; Right, signal crayfish burrows at Bedlam. Such burrows can be up to 2 metres deep, undermining river banks, and making them more vulnerable to erosion.

A short distance downstream from the ruined mill buildings, a stretch of the RB at ST 75375 49502 has been significantly trampled and eroded by dogs and walkers accessing the water.

Erosion can be a valuable natural process when it creates channel diversity and resupplies the river with gravel from its previous course across a floodplain - but artificially accelerating excessive bank erosion (as in this case) can cause damaging quantities of silt to be 'dumped' into a river, smothering fish eggs and habitats for many species.

Here, erosion will also have been exacerbated by the tunnelling activities of American signal crayfish, whose burrows were noted in an area of soft bankside among the mill buildings just upstream. (Ironically, the combination of hard bedrock and rock armour walls along many stretches of the Mells may actually be protecting the river from even more widespread impacts caused by this damaging INNS).

It is recognised that the Mells is highly valued by local people as a recreational and dog walking venue. As such, it would be beneficial to improve the amenity of well-used areas such this one – by formalising the relatively shallow banks as an erosion-resistant dog-dipping area – while fencing off or otherwise discouraging river access via steeper banks where erosion is likely to be more severe (see below).

A simple approach would be to restore the original bank line with local limestone boulders c 50-60cm in diameter, back-filled with similarly-sourced limestone cobbles and gravel (which will concurrently help to 'design out' signal crayfish activity). As can already been seen at the dog dip on the Nunney Brook, gravel could also be introduced to the channel to reduce mobilisation of fine sediment by people and dogs. In conjunction with these works, selected areas of bankside could be fenced off from trampling, and planted with a range of visually-appealing native plants.

At popular and/or formalised dog dipping locations like this one, and others along the River Mells, it would also be beneficial to install signage to educate dog owners about the dangers of pet flea treatment to aquatic life:

https://www.wildtrout.org/news/pet-flea-treatments-in-our-rivers

Figure 14: Further excellent examples of dynamic LWM in action.

Moving a short distance downstream from the dog dipping bank, more examples of the very positive influence of LWM on river processes were noted. Possibly as a result of historic interruption of sediment transport in this area, significant deposits of gravel were evident, with comparatively deep, narrow, sinuous channels and scour holes created by dynamic accumulations of LWM.

Such shifting, high-energy interactions between water, geology and wood are a demonstration of the vital contribution of wood to river processes. In general, it is not well recognised that most rivers are functionally starved of LWM due to long-term management conventions. This stretch of the Mells offers a textbook glimpse of how generous, natural inputs of wood can directly ‘force’ elements of healthy river processes which are likely to be more resilient to varying flows and other future impacts of climate change. This could also provide inspiration for future habitat works elsewhere on the river – including adapting learnings from American

‘Low Tech Process-Based River Restoration’ professionals to ‘feed’ the river with regular ‘meals’ of wood in order to kick-start natural processes throughout the catchment:

https://www.anabranchsolutions.com/low-tech-pbr.html

Figure 15: Severely-eroded banks, including a ‘dog slide’, in Vallis Vale.

Proceeding downstream into Vallis Vale, the public footpath crosses from the RB to the LB of the river, bypassing a short stretch of river which is privately owned and could not readily be observed – apart from noting c 30 m of new stone gabion basket revetment on the outside of the bend upstream of the footbridge at ST 75441 49372. From this point, the average depth of the channel appears to increase, and the river adheres tightly to the high south face of the gorge, while much of the LB has steep earth banks without the rock armouring which is so prominent further upstream.

Today, these earth banks are suffering from extensive erosion by people and dogs. As seen at the dog dip in Bedlam, Vallis Vale is clearly an important local amenity, attracting many visitors year-round. Some stretches of the footpath through the valley are set back from the river and well made up with limestone chippings, perhaps due to past history as railway trackbeds, but easily accessible stretches of riverbank are suffering from general trampling and erosion, with localised 'dog slides' into the river as seen in Figure 15 above. The depth of the wooded valley also means that many of the river banks are heavily shaded, limiting vegetation growth and contributing to the rate of erosion.

As a result of tree works associated with ash dieback, there may now be an ideal opportunity to reset the woodland and bankside management of the whole valley, including rotational coppicing, and allowing better understorey growth now that overshading from the canopy has been reduced. Where certain stretches of river bank are particularly vulnerable to erosion, it would be beneficial to fence them off, with a buffer strip of up to 20m, in order to allow for natural regeneration (perhaps with some supplementary planting). Shorter areas of bank could also be protected by recycling brash from tree works as dead hedging.

At the same time, some areas of seriously eroding river bank (such as that shown in Figure 15 above) may require more immediate intervention: for instance, by packing them with brash to encourage silt deposition and reconsolidation. Planting live goat willow whips within the brashy matrix may also help to reinforce these areas for the longer term, as the whips become established and develop root systems which will help to bind the bank together. Further temporary protection could be provided by constructing dead hedges on the bank top. Stabilised banks with healthy native vegetation, instead of bare earth, will also be more capable of resisting invasion by INNS like Himalayan balsam and giant hogweed.

Figure 16: Another popular dog-dipping area: the regression of the bank from the lowest step indicates how much bank has been lost, and dumped into the river as silt.

Approaching the footbridge which crosses the river from Egford at ST 75534 49086, a significant area of the LB has suffered from serious erosion – again, probably due to heavy footfall, plus destabilisation by invasive signal crayfish, and possibly also an eroding back eddy created by the steps during higher flows. Projecting into the channel, the position of the lowest access step in the photographs above is probably an indication of the previous bank line, as is perhaps the line of isolated alder stumps in the middle of the channel a little further upstream.

As discussed with reference to the dog dip in Bedlam, it would be beneficial to prevent further erosion, and formalise this area as a dog dip, by restoring the bank toe with local limestone boulders, back filled with locally-derived cobbles and gravel.

Figure 17: Left, bank erosion around the junction of the Nunney Brook with the main River Mells; Right, looking downstream from the confluence of the Mells and Nunney Brook.

In the immediate vicinity of the footbridge and the confluence of the Nunney Brook with the Mells at ST 75534 49086, erosion should also be reduced by fencing off the bank top, including as wide a buffer strip as possible, with signage directions to the formalised dog dipping area a few metres upstream.

Downstream of the footbridge, the river is wide, straight and relatively shallow, with a bed of gravel, cobbles and small boulders, and overhanging trees on both banks. Such low, trailing overhead cover is very valuable for trout, and should be retained and encouraged wherever possible – as is the complex root structure of alders and other bankside trees, which provide excellent refugia for fish of all ages.

This area has been suggested as a potential location for felling selected trees into the river as additional woody structure. One or two trees from each bank could easily be felled into the margins as tree kickers, with crowns downstream, and secured back to their stumps with steel cable. (In view of the very rocky substrate in this area, securing with chestnut stakes may not be feasible).

It is interesting to note, from historical photographs, that this stretch of river was once very much more open, with fewer trees overhanging the river, and possibly abundant growths of water crowfoot. Appropriate skylighting or tree thinning, could allow more sunlight into the river (especially from the southern RB), and help this valuable aquatic plant to recolonise from the Nunney Brook.

 

Figure 18: Left and right: the EA gauging weir at Vallis Vale could be replaced with a non-impounding ultrasonic device.

A short distance downstream of the straightened section shown above, the river becomes impounded for c 200m by an EA gauging weir at ST 75723 49112. While the structure of this weir is not as extreme as some of the other 'flume-type' gauging stations seen further downstream on the Frome and on other Somerset rivers, the shallow laminar flow over the smooth concrete face of the weir is still likely to present a barrier to most fish species under most flow conditions.

In the short term, options for installing an eel pass should be investigated with the EA – perhaps including low-cost baffles on the downstream face of the weir, to ease passage for as many species as possible, including trout moving upstream to spawn in the Nunney Brook. In the longer term, full replacement of this whole structure with an ultrasonic gauge could also be investigated:

https://twitter.com/EnvAgencyMids/status/1281240869023121408

In previous years, INNS including Himalayan balsam and giant hogweed have been noted in this area, and cleared by informal community action. In view of the reappearance of giant hogweed, a short distance upstream on the Nunney Brook, it would be prudent to maintain vigilance and eradicate these harmful plants wherever they appear.

Figure 19: Left, heavy post-industrial rubbish in the river downstream of the gauging weir; Right, the upstream end of the Hapsford mill impoundment drowns a potential spawning riffle: flows in this area are unlikely to have enough energy to keep gravels scoured free of silt.

Downstream of the gauging weir, the river's course turns sharply right, through a deep pool with concrete revetment on the RB, before descending a short pool and riffle sequence, and dropping into a very long impoundment created by the weir at Hapsford Mill.

This impoundment extends all the way through the Hapsford industrial estate, and was extended further upstream by the commissioning of the Hapsford Mill hydropower scheme. Like the impoundment at Great Elm, this modern mill pond provides habitat for a few adult trout, but very few possibilities for trout to complete their full life cycle. Spawning opportunities are likely to be limited to small accumulations of gravel in depositional areas downstream of the gauging weir, but riffles have been drowned, and there is little juvenile habitat. There are also doubts as to the efficacy of the fish pass at Hapsford Mill, so trout populations in this area are likely to consist very largely of fish which may be washed downstream over the gauging weir, and are unable to re-ascend.

Additional habitat diversity could be created by hinging small bankside trees into the margins as trailing cover wherever possible. Removing heavy litter which seems to have accumulated in this stretch would also help to dispel erroneous impressions that the river is not being cared for.

4.2. River Mells: Hanson estate: summary table of recommendations

Location	Issue	Proposed action	Urgency /Priority
Bedlam, Vallis Vale	Sediment control	Formalise dog dip areas with erosion resistant limestone boulder bank toe, back filled with cobbles and gravel	1
Vallis Vale generally	Sediment control	Repair 'dog slides' with brushwood; protect bank tops with dead hedges	1
Vallis Vale generally	Sediment control	Fence off more extensive areas of vulnerable banks, with buffer strips to allow vegetation to regenerate	1
Great Elm, Bedlam, Vallis Vale generally	LWM augmentation	Introduce LWM to river: prioritise selective felling of large trees, plus tree kickers, to improve habitat and flow diversity	1
Vallis Vale generally	Tree management	Re-set woodland management with rotational coppicing, creating mosaic of light and shade over river	2
Bedlam	Fish passage	Notch or lower LB weir for easier fish passage	3
Great Elm	Fish passage	Investigate lowering or removing Great Elm weir, with re-meandering of channel in impoundment upstream	3
Vallis Vale gauging weir	Fish passage	Investigate eel and other fish passage, plus eventual replacement with ultrasonic gauge	3
Great Elm, Bedlam, Vallis Vale generally	INNS	Maintain vigilance for invasive non-native plant species including Himalayan balsam and giant hogweed	1 (easy)
Great Elm	INNS	Remove cherry laurel, replant bank with native species	2
River Mells (linked to Whatley and	INNS	Initiate mink trapping project	2

Nunney Brooks)			
Great Elm, Bedlam, Vallis Vale generally	Rubbish removal	Remove rubbish to improve public perceptions of river	1 (easy)
Vallis Vale generally	Water crowfoot propagation	Plant water crowfoot in suitably ‘skylighted’ areas of channel to improve habitat and flow diversity	2

5. Whatley Brook

The Whatley Brook is formed by 3 small streams which converge near Cranmore STW (ST 69327 43482) before flowing under the A361 and part of the Torr Works limestone quarry.

At ST 69988 44320, the brook emerges from this c 1 km culvert (which was constructed during expansion of the quarry in the early 1960s) and flows in a north-easterly direction along the gorge-like valley of Leighton Hanging, and through the currently-inactive Asham quarry. It then flows under the Bulls Green Link Road at Dead Woman's Bottom, towards the old milling impoundment of Chantry Pond, and finally through Railford Bottom (adjacent to Whatley quarry) and Murder Combe to meet the main River Mells at Great Elm.

River	Whatley Brook
Waterbody Name	Whatley Brook - source to conf Mells River
Waterbody ID	GB109053021990
Management Catchment	Avon Bristol and Somerset North Streams
River Basin District	Severn
Current Ecological Quality	Good (as at 2019)
U/S Grid Ref inspected	ST 74331 48482 (Murder Combe)
D/S Grid Ref inspected	ST 74832 49091 (Great Elm – Mells confluence)
Length of river inspected	0.75 miles / 1.2 km approx

Water Framework Directive (WFD) information for the Whatley Brook

In the 2019 round of WFD assessment, the Whatley Brook was assessed as 'Good': latest data are available from the Environment Agency's Catchment Data Explorer site:

https://environment.data.gov.uk/catchment-planning/WaterBody/GB109053021990

According to EA sources, the Whatley Brook holds trout but no minor fish species, whereas the parallel Nunney Brook holds minor fish species but no trout. In the case of the Whatley Brook, this may indicate periodic water quality issues which extirpate all fish species, before highly migratory trout are able to recolonise, but less strongly migratory species fail to do so. Recolonisation by bullheads and weaker-swimming species may also be hindered by modest bed impoundments.

As a result of active quarrying operations at Torr and Whatley, the Whatley Brook carries a great deal of fine suspended sediment, which is frequently visible as a 'plume' where the Brook joins the mainstem of the Mells. Some of this may derive from roads around the Whatley quarry entrance and exit at Fordbury Bottom, where the road surfaces and roadside vegetation are often heavily dusted with limestone dust (pers. obs). Significant deposits of similar dust have been noted in the Whatley Brook, especially in a deep, straight stretch of channel which acts as a silt trap just upstream of the Mells-Frome road bridge.

As well as damaging trout spawning efforts by clogging gravels and suffocating eggs by depriving them of oxygen, this fine sediment may also be preventing recolonisation by weaker-swimming species such as bullhead, which spend more time deeper in the water column than trout, and in areas with slower, more depositional flows.

All sources of fine sediment should be investigated on a catchment scale, and remediated as quickly as possible.

5.1. Whatley Brook: Hanson estate

The Hanson estate includes 0.75 miles (1.2 km) approx. of the Whatley Brook, from Murder Combe downstream to Great Elm.

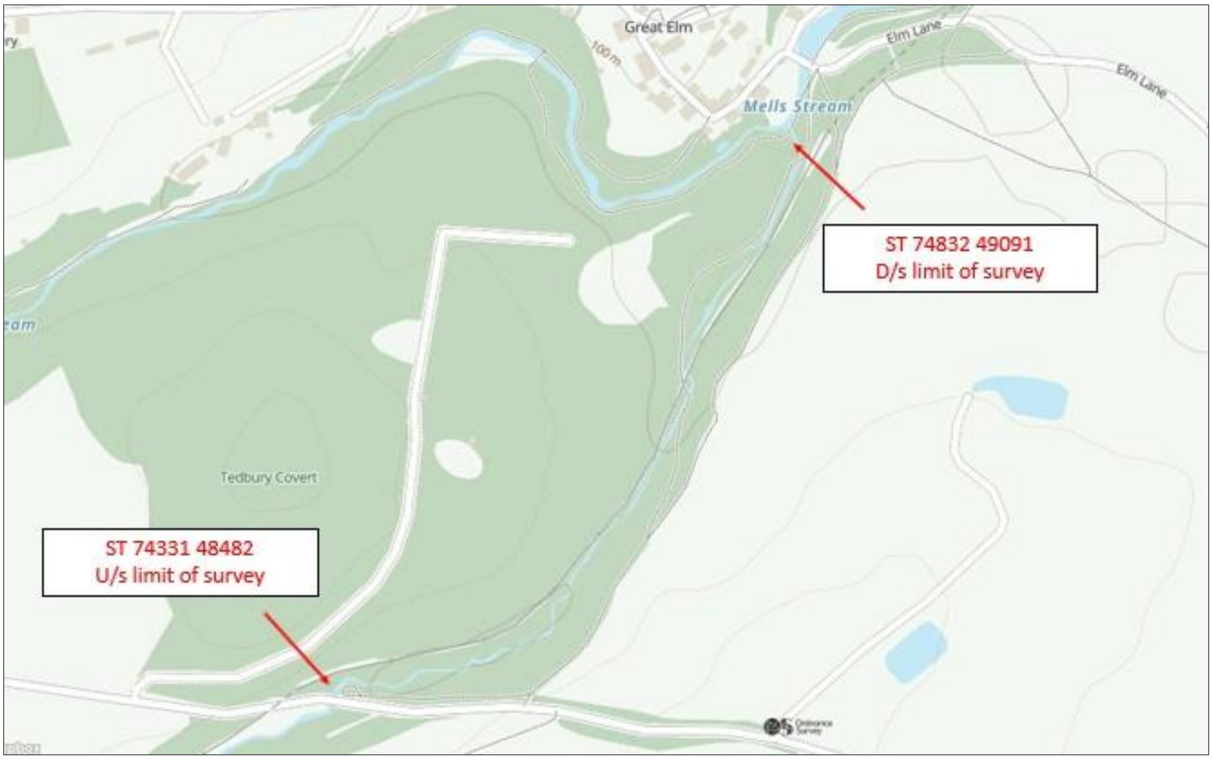

Figure 20: A map showing the stretch of the Whatley Brook assessed in this report.

Comments in this report are based on observations on the day(s) of the site visit(s) and discussions with local members of FADAA. Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.

5.2. Whatley Brook: Hanson estate habitat assessment

At the time of this walkover survey, flow was judged to be at a low, clear summer level.

Figure 21: Left, the Whatley Brook's sinuous channel at the upstream extent of this survey; Right, an accumulation of woody material and silt which could be formalised with stakes and additional brash.

As the Whatley Brook flows under the Mells-Frome road bridge, its course is briefly quite natural and sinuous before it appears to have been straightened alongside the Whatley quarry rail yard.

Even in this straightened channel, as shown above, accumulations of LWM along the margins have started to trap silt and pinch the channel width. Naturally-occurring structures suggest that introducing further material in the channel might accumulate silt quite quickly, and become stable permanent features, adding beneficial diversity to the channel. Selective skylighting of trees in this area – perhaps felling them directly onto such depositional areas - would provide woody material, while also allowing more sunlight into the channel, and helping habitat structures to become vegetated.

Figure 22: A highly beneficial accumulation of LWM in the Whatley Brook.

Further downstream, as the gorge pinches the river more tightly, a much larger and more complex natural accumulation of woody material has formed – offering a wonderful diversity of habitat niches for many different species including birds, insects and fish. It is a feature of LWM behaviour in river channels that the more wood is present, the less likely it is that any single piece will move very far. Impressive accumulations of wood, like this one, are rare in highly-managed UK rivers, and should be cherished for the value that they bring to aquatic ecosystems.

Figure 23: Left, an informal rock cascade which may present fish passage issues in this small stream; Right, bankside hazels which could be hinged into the margins to promote mid-channel scour(and thus more ecologically useful areas of deeper water, as well as habitat for invertebrates and cover for small fish).

As it flows alongside the railway line, the straightened channel gradually becomes more torrential, and some informal attempts seem to have been made to create boulder cascades (as shown above), possibly to hold back a slightly greater depth of water for fishing purposes.

Because these may act as obstructions to fish passage, especially (and ironically) in low flow conditions, it would be better to focus on increasing mid-channel scour and encouraging natural pools and pockets to develop, with sinuosity and variable depths within the stream's current planform. The presence of numerous bankside hazel coppices suggests an easy solution: hinging stems down into the margins to add immediate habitat and hydrological diversity, including refugia for juvenile trout seeking shelter from higher flows, as well as capturing silt and perhaps becoming vegetated (as discussed in relation to Figure 21 above). Increasing mid-channel scour may also assist any spawning efforts by trout – by keeping high levels of suspended sediment moving past deposits of suitable spawning gravel.

For more information on tree hinging, please see Appendix B: Tree hinging and similar works: A Wild Trout Trust summary.

 

Figure 24: Left, the box culvert under the railway line; Right, downstream of the culvert, the channel appears relatively naturalistic, with plenty of arisings from recent tree works which could be used to improve in-channel habitat.

At ST 74717 48824, the Whatley Brook flows under the Whatley quarry railway line in a box culvert (which does not seem to present any fish passage problems – indeed a small point bar of sediment has formed on the LB, thus increasing the depth of flow against the RB), and then flows down to meet the Mells on the western side of the railway.

Despite likely straightening in the past, this is now a fairly natural-looking stretch of stream, which has recently been extensively de-shaded as a result of tree works related to ash dieback.

At the time of this walkover, quite large quantities of arisings were still present on the banks, including some large sections of trunk, and it would be valuable to reposition some of the larger sections so that they lie partly within the channel, creating hydromorphological benefits, whilst being secured at their bankside end.

 

Figure 25: Two areas of severe erosion on the RB of the Whatley Brook as it approaches the confluence with the main River Mells.

As the Whatley Brook approaches its confluence with the Mells, the pressures of footfall from people and dogs become more evident, and at least two stretches of bankside are showing signs of severe, long-term erosion. As discussed elsewhere in this report, either or both of these areas could be formalised as dog dip areas, by re-establishing the bank line with 50-60cm boulders of local limestone, and back-filling with similar cobbles and gravel.

Alternatively, the heavily eroded areas could be packed with brash from recent tree works, providing a matrix for silt to settle out and eventually revegetate, while being protected with a fence. Fencing off other heavily-trampled areas along the footpaths in this area could also help natural regeneration of vegetation to take place.

5.3. Whatley Brook: Hanson estate: summary table of recommendations

Location	**Issue**	**Proposed action**	**Urgency /Priority**
Whatley Brook catchment	Sediment control	Investigate and address sources of fine sediment ingress into stream	1
Great Elm	Sediment control	Formalise dog dip areas with erosion resistant limestone boulder bank toe, back filled with cobbles and gravel	1
Whatley Brook generally	LWM augmentation / habitat improvement	Introduce LWM to river: formalise marginal accumulations of LWM and silt; also hinge bankside trees into margins to promote mid-channel scour	1

Whatley Brook generally	Tree management	Re-set woodland management with rotational coppicing, creating mosaic of light and shade over river	2
Whatley Brook generally	INNS	Maintain vigilance for invasive non-native plant species including Himalayan balsam and giant hogweed	1 (easy)
Whatley Brook (linked to main River Mells)	INNS	Initiate mink trapping project	2
Whatley Brook generally	Rubbish removal	Remove rubbish to improve public perceptions of river	1 (easy)
Vallis Vale generally	Water crowfoot propagation	Plant water crowfoot in suitably ‘skylighted’ areas of channel to improve habitat and flow diversity	2

6. Nunney Brook

The Nunney Brook rises at Wanstrow and flows in a north-easterly direction past Colemans quarry and under the A361 at Holwell. It continues north-eastwards through the village of Nunney, past the smaller settlement of Egford, and joins the River Mells in Vallis Vale.

River	Nunney Brook
Waterbody Name	Nunney Brook - source to conf Mells River
Waterbody ID	GB109053022000
Management Catchment	Avon Bristol and Somerset North Streams
River Basin District	Severn
Current Ecological Quality	Moderate (as at 2019)
U/S Grid Ref inspected	ST 75684 48524 (Elm Lane, Egford)
D/S Grid Ref inspected	ST 75522 49076 (Vallis Vale, Mells confluence)
Length of river inspected	0.5 miles / 0.8 km approx

Water Framework Directive (WFD) information for the Nunney Brook

In the 2019 round of WFD assessment, the Nunney Brook was assessed as 'Moderate': latest data are available from the Environment Agency's Catchment Data Explorer site:

https://environment.data.gov.uk/catchment-planning/WaterBody/GB109053022000

This 'Moderate' status appears to be driven primarily by long-term failing for phosphate (since first classification in 2009). Reasons for Not Achieving Good status (RNAGs) are listed as poor agricultural and rural nutrient management, point source phosphate pollution from sewage treatment works (STWs). Zinc pollution from active and abandoned quarrying operations is also cited among RNAGs, although this improved from 'Moderate' in 2016 to 'High' in 2019.

According to EA sources, most of the length of the Nunney Brook holds minor fish species but no trout, whereas the parallel Whatley Brook holds trout but no minor fish species. In the case of the Nunney Brook, this suggests improving water quality throughout, coupled with barriers to fish passage towards the lower end of brook, which have prevented trout from recolonising fully. A high, impassable weir is known to exist at Lower Whatley (NGR ST 73877 46969) and there may also be other barriers to fish passage.

6.1. Nunney Brook: Hanson estate

The Hanson estate includes 0.5 miles (0.8 km) approx. of the Nunney Brook, from Egford downstream to Vallis Vale.

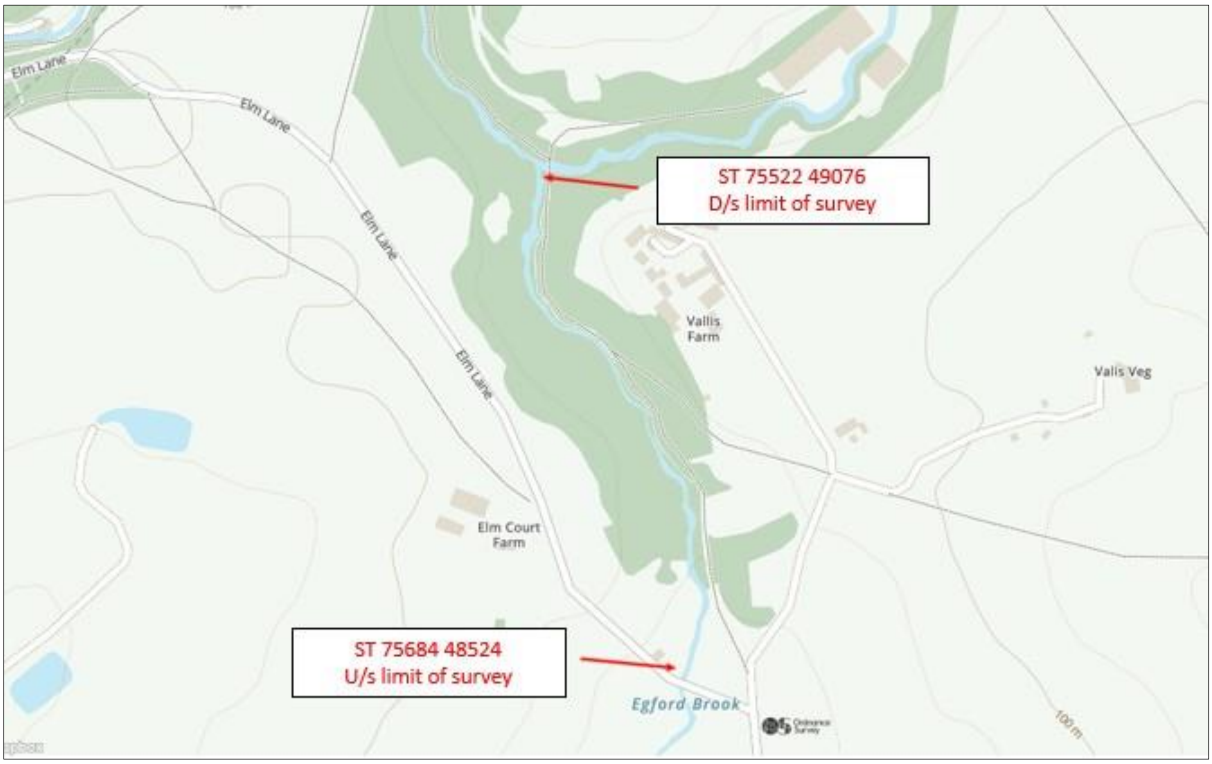

Figure 26: A map showing the stretch of the Nunney Brook assessed in this report

Comments in this report are based on observations on the day(s) of the site visit(s) and discussions with local members of FADAA. Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.

6.2. Nunney Brook: Hanson estate habitat assessment

At the time of this walkover survey on 29 June 2022, flow was judged to be at a low, clear summer level.

Figure 27: Left, good channel diversity in the Nunney Brook; Right, abundant gravels could provide a valuable spawning area for Mells trout

The Nunney Brook enters the Hanson estate at Elm Lane in Egford (ST 75677 48511) and flows down a gradually deepening gorge to meet the River Mells in Vallis Vale.

Although the brook is likely to have been straightened in the past, it now exhibits reasonably dynamic habitat, with notably abundant gravels which suggest high potential value as a spawning area for the Mells trout population.

Figure 28: Left, a typical 'dog slide' causing localised erosion along the Nunney Brook; Right, a previous attempt to repair this erosion with a gabion basket. A more natural approach would be packing the eroding area with brash, protecting the bank top with a dead hedge, and guiding dog walkers towards formalised, erosion-resistant dog dip areas.

In several areas along the Nunney Brook (for instance, where the footpath first meets the stream at ST 75706 48606), localised bankside erosion was noted – most likely 'dog slides' where pets are encouraged to enter and leave the water. The Egford car park is a popular access point to Vallis Vale, and these dog slides are likely to become progressively more heavily eroded, eventually threatening the stability of the footpath, and dumping silt into the stream where it will clog spawning gravels.

Previous attempts to protect the footpath from this kind of persistent erosion seem to have included installing 'gabion baskets' filled with cobbles. A softer 'green engineering' approach could involve repairing affected areas by packing them with brushwood (perhaps arisings from tree works), and protecting them with short dead hedges at the bank top. Longer stretches of the bank could also be protected with fenced-off buffer strips: this may be very effective because the public footpath from the Egford car park is often rather close to the river. Short explanatory notices could be used to inform dog walkers of the reasons for these measures, and guide them towards designated dog dips.

Along the whole of the lower Nunney Brook, consideration could also be given to moving the footpath further back from the stream, with a fenced buffer zone and more space for the brook to 'wiggle' naturally. With the addition of more LWM to the channel, this area has also been suggested as a potential site for 'Stage Zero' type development.

Figure 29: Giant hogweed on the Nunney Brook.

On the RB of the Nunney Brook, around ST 75680 48622, an infestation of giant hogweed was noted, including three tall flowering plants. As described above, giant hogweed is a very dangerous INNS, with phytophototoxic sap which can be transferred to human skin or clothing simply by brushing against the leaves or stems, and can cause recurring third-degree burns when exposed to sunlight.

Due to the proximity of these plants to a public footpath, and the likelihood of seeds being released and carried downstream, swift action is recommended, with follow up spraying carried out in early spring for several years, until the potential seed bank's exhaustion is assured. (It is understood that local dog walkers alerted Hanson to the presence of these plants in summer 2022: however, it is not known if the problem was immediately addressed).

Figure 30: Left, the toe-boarded edge of the dog dipping area on the Nunney Brook; Right, a more naturalistic boulder edge

Moving downstream, the footpath reaches an area of bankside which was previously very heavily poached and eroded, due to intensive use as a dog dipping area (previous pers. obs.). This has now been formalised with a solid toe-board edge, backfilled with gravel, and additional gravel augmentation within the channel of the stream, which is unusually wide at this point.

The measures seem to have been effective in reducing sediment ingress into the stream, although a more naturalistic approach could have been taken: for instance, by creating a bank toe with locally-sourced limestone boulders, as described elsewhere in this report (and indeed as seen adjacent to the toe-boarding – although larger boulders would be more durable than the ones used in this case). Depending on previous treatments, toe-boarding can also risk leaching wood preservative chemicals into adjacent watercourses: if the opportunity arises, consideration could be given to replacing the boards with boulders instead. As above, the path could also be moved away from the river bank.

Figure 31: Water crowfoot growing in skylighted areas of the Nunney Brook.

The lower Nunney Brook is notably rich in water crowfoot – a beneficial aquatic plant which traps sediment, filters nutrients out of water, oxygenates the water, and provides excellent complex habitat for fish and aquatic invertebrates.

The crowfoot's presence may be related to increased light penetration into this part of the brook's valley: certainly it is comparatively rare elsewhere in the Mells, especially where the main river runs through a deep east/west orientated valley, with heavy tree cover, and shade from high slopes to its south.

However, where tree works related to ash dieback have newly skylighted some stretches of river, it may be worth attempting to establish water crowfoot. This can be achieved by harvesting strands of weed from areas where it is well established, and planting 'crowns' in a methodology developed by Action for the River Kennet:

1 – Gently wind harvested water crowfoot into loose spirals in big trugs for transportation

2 – At the planting site, create 'crowns' by folding about a quarter of the plant back onto itself (without crushing the stems) and securing this with an elastic band.

3 – Digging a hole in the river bed, placing the folded-over crown into the hole, and covering most of the plant with gravel and cobbles.

Figure 32: The gauging weir on the Nunney Brook.

At ST 75505 49865, the Nunney Brook flows over a gauging weir which presents an obstruction to fish attempting to move in and out of the main River Mells at different times of their life cycle, as well as interrupting natural processes of sediment transport as discussed above.

Informal communications with the Environment Agency suggest that this weir may have originally been installed to monitor augmentation flows into the Nunney Brook from local quarries (possibly Torr and Coleman's) but may not now be supplying data. Further investigation is recommended, and if this weir does prove to be redundant, complete removal should be considered.

6.3. Nunney Brook: Hanson estate: summary table of recommendations

Location	**Issue**	**Proposed action**	**Urgency /Priority**
Nunney Brook	Sediment control	Improve natural appearance of dog dip area by replacing toe-board with limestone boulders	2
Nunney Brook	Sediment control	Repair 'dog slides' with brushwood; protect bank tops with dead hedges	1
Nunney Brook	Sediment control	Fence off more extensive areas of vulnerable banks, with buffer strips to allow vegetation to regenerate	1
Nunney Brook	LWM augmentation / habitat improvement	Introduce LWM to river: also hinge bankside trees into margins to promote mid-channel scour	1
Nunney Brook	Tree management	Re-set woodland management with rotational coppicing, creating mosaic of light and shade over river	2
Nunney Brook: small gauging weir	Fish passage	Investigate and remove if redundant to improve fish passage	3
Nunney Brook	Fish passage	Investigate eel passage, plus eventual replacement with ultrasonic gauge	3
Nunney Brook	INNS	Remove giant hogweed: URGENT	1
Nunney Brook	INNS	Maintain vigilance for invasive non-native plant species including	1 (easy)

		Himalayan balsam and giant hogweed	
Nunney Brook (linked to main River Mells)	INNS	Initiate mink trapping project	2
Nunney Brook	Water crowfoot propagation	Harvest and propagate water crowfoot in suitably 'skylighted' areas of channel to improve habitat and flow diversity	2

7. Making it happen

The creation of any structures within 'Main Rivers' or within 8m of the channel boundary (which may be the top of the flood-plain in some cases) normally require a formal Environmental Permit from the Environment Agency. This enables the EA to assess possible flood risk, and also any possible ecological impacts. The headwaters of many rivers are not designated as 'Main River', in which case the body responsible for issuing consent will be the Local Authority. In any case, contacting the EA early and informally discussing any proposed works is recommended as a means of efficiently processing an application.

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

A focused Trout in the Town Urban River Toolkit (which also has relevance to post-industrial rivers like the Mells) is available at:

https://www.wildtrout.org/content/trout-town

There is also the possibility that the WTT could help via a Practical Visit (PV). PV's typically comprise a 1-3 day visit where WTT Conservation Officers will complete a demonstration plot on the site to be restored.

This enables recipients 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 attendees.

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.

8. Acknowledgement

The Wild Trout Trust would like to thank the Environment Agency for their continued support of the Advisory Visit service.

9. Disclaimer

10. Appendix A: Trout habitat

Due to their need for clean, well-oxygenated water, structurally-varied habitat, and free movement between different types of habitat at different life stages, the UK's native wild brown trout makes an ideal indicator species for healthy rivers. These characteristics mean that a simple and effective assessment for overall river health can be based around the life cycle requirements of brown trout.

As a result, identifying and noting the presence or absence of habitat features that allow trout to complete their full life cycle is a very practical way to assess overall habitat quality (Figure 33**Error! Reference source not found.**). By identifying the gaps (i.e. where crucial habitat is lacking: Figure 34**Error! Reference source not found.** to Figure 36**Error! Reference source not found.**), it is often possible to design actions to solve those habitat bottlenecks.

To put all this into context, there are three main habitat types required for wild trout to complete each of their three key life cycle stages. This creates a demand for varied habitat, which is vital for supporting a wide diversity of other species too.

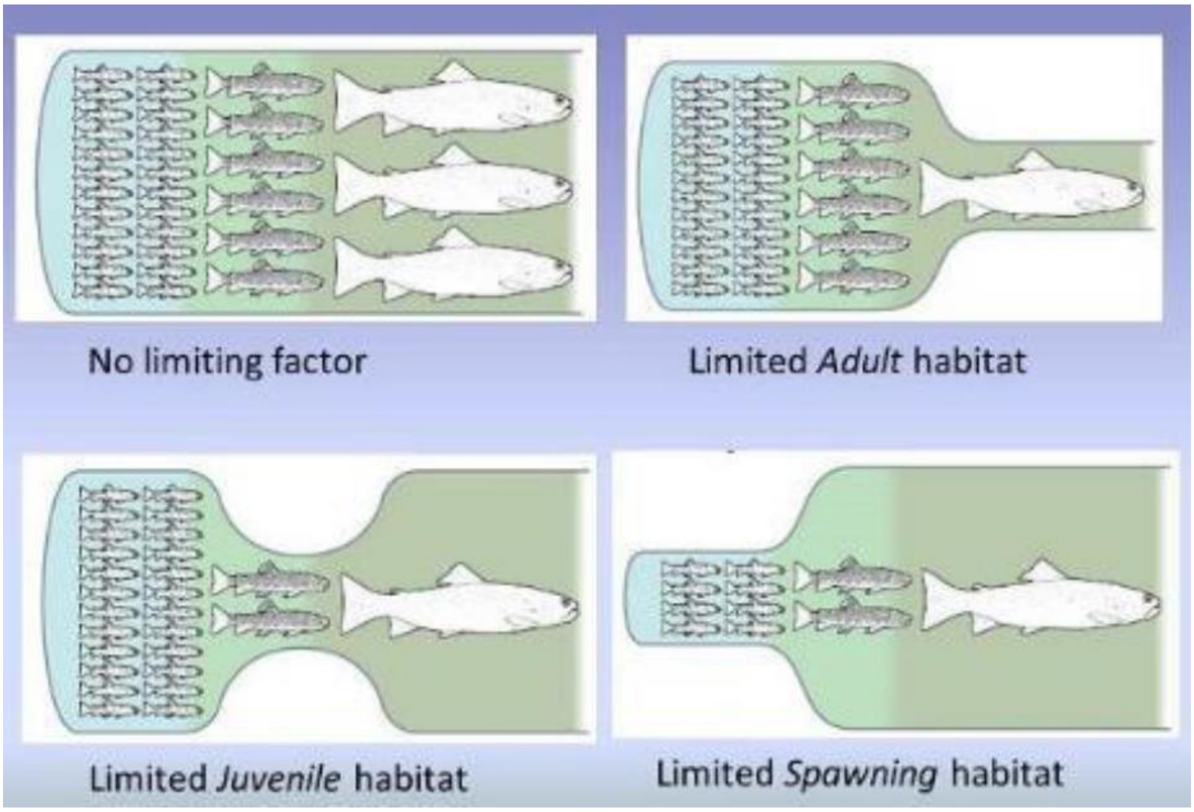

Figure 33: The impacts on trout populations lacking adequate habitat for key life cycle stages. Spawning trout require loose gravel with a good flow-through of oxygenated water. Juvenile trout need shallow water with plenty of diverse structure for protection against predators and wash-out during spates. Adult trout need deeper pools (usually > 30cm depth) with nearby structural cover such as undercut boulders, sunken trees/tree limbs and/or low overhanging cover (ideally trailing on, or at least within 30cm of, the water's surface). Excellent quality in one or two out of the three crucial habitats may not mitigate a 'weak link' in the remaining critical habitat.

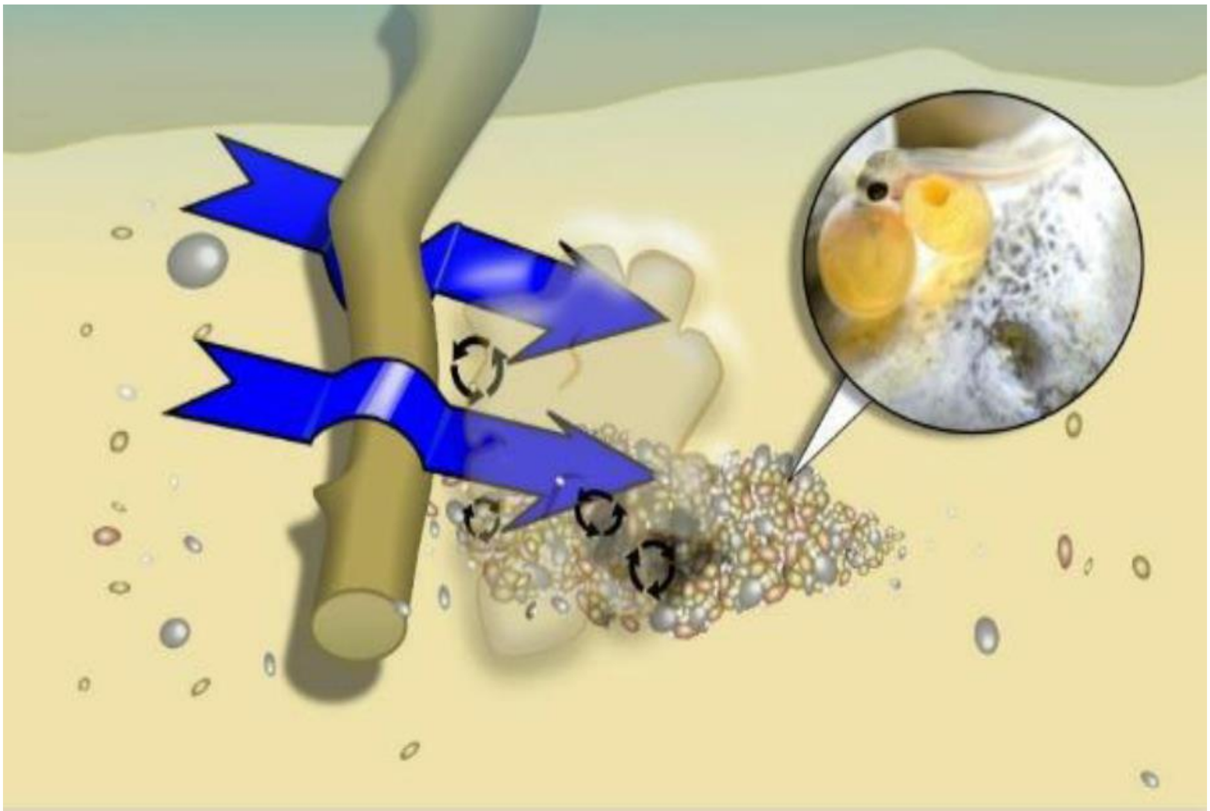

Figure 34: Successful trout spawning habitat requires relatively silt-free gravels. Here, the action of a fallen tree limb is focusing the flows (both under and over the limb as indicated by the blue arrows) on a small area of riverbed that results in silt being washed out from between gravel grains. A small mound of gravel is deposited just below the hollow scoured out by focused flows: this mound will be selected by trout to dig a 'redd' for spawning. In the silt-free gaps between the grains of gravel it is possible for sufficient oxygen-rich water to flow over the developing eggs and newly-hatched 'alevins' to keep them alive as they hide within the gravel mound (inset) until emerging in spring.

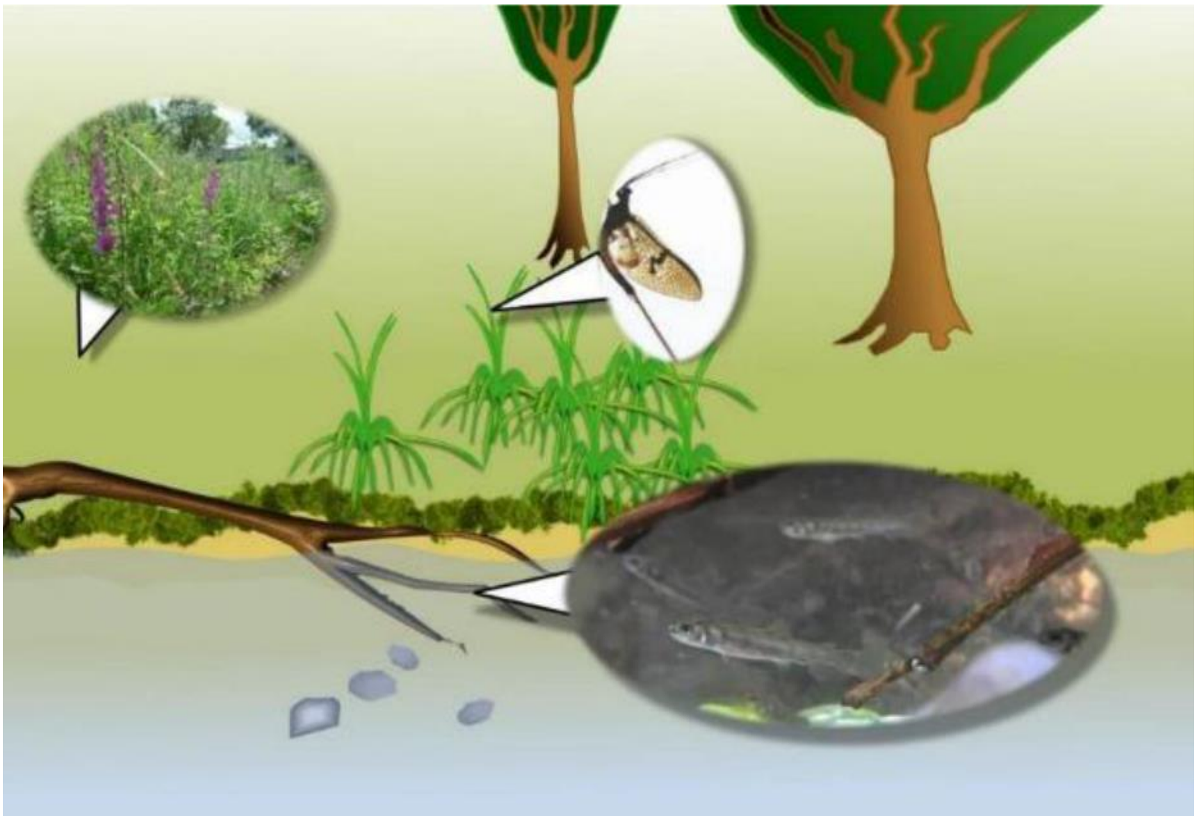

Figure 35: Larger cobbles and submerged 'brashy' cover and/or exposed fronds of tree roots provide vital cover from predation and spate flows for tiny juvenile fish in shallower water (<30cm deep). Trailing, overhanging vegetation also provides a similar function, and has many benefits for invertebrate populations (some of which will provide a ready food supply for the juvenile fish).

Figure 36: The availability of deeper water bolt holes (>30cm), low overhanging cover and/or larger submerged structures such as boulders, fallen trees, large root-wads etc. close to a good food supply (e.g. below a riffle in this case) are all strong components of adult trout habitat requirements.

11. Appendix B: Tree hinging and similar works: A Wild Trout Trust summary

11.1. Introduction

Hinging (also called laying, folding or pleaching) trees, shrubs or saplings into the edge of a watercourse is an excellent way of adding flow diversity and roughness to a channel which may have been simplified or straightened in the past, and now lacks complex habitat for many different species. It can also be used to increase the availability of overhanging cover in areas that have been over-pruned or only have trees set back from the riverbank. Tree branches in and above the water provide great cover for fish and invertebrates, while gravel and silt will settle and be 'sorted' around the branches. In turn, some of this silt may be colonised by aquatic plants.

Hinged and felled trees can also be an excellent way of protecting eroded sections of bank, or for creating bed scour - the end result depending on the location and way the technique is implemented. Willows are the best type of trees for hinging directly into the channel and can still thrive with up to 50% of their canopy submerged. Many other species also hinge well but should be laid into shallower areas or along the river margin, to ensure that the majority of their canopy remains in the dry.

Hinging replicates the natural process of trees falling into the channel, with the added benefit that the hinged section of tree should continue to grow, developing even more habitat complexity over time. It can also be very beneficial on long shaded reaches of river or stream – allowing enhanced light penetration by 'skylighting' as well as providing added habitat value and diversity.

11.2. Small trees

Small, pliable species of trees and shrubs like willow, hazel, elm, hawthorn and even alder (with a bit of practice) can easily be hinged into the margin, using hand tools such as pruning or bow saws to cut trunks or limbs up to 100 – 150mm diameter, in a process much like hedge laying. The more brittle species such as sycamore, ash or elder should be avoided as they tend to break off rather than bend.

In its simplest form, hinging involves a single quick cut through the 'top' half to two-thirds of the trunk/branch, then continuing to cut a little at a time until the trunk/branch collapses down over the river or along the bank (depending upon species). The cut should be made from the exact opposite side of the tree to the direction you want it to fall in, as if the tree were being felled, but without the face (gob) cut, as that is the area that will be retained as the hinge.

Think about the intended hinge and the way it has to bend: e.g. the bark must be retained on the hinge to keep the limb alive, so the cut must be from the opposite side. The depth of the cut should be the minimum required to bend the limb over, as this will maintain maximum size and strength of the hinge and the health of the tree/shrub.

Figure 37:: Trees can be hinged and then staked to reduce movement in high flow and provide greater protection of the hinge. Once completed, these valuable living structures will benefit a range of aquatic and terrestrial wildlife.

11.3. Larger trees

The technique for laying large trees is similar to that of smaller ones but is likely to be slightly higher risk, requiring a chainsaw.

With larger trees, it becomes more important to understand which way the canopy is weighted, the way the tree is leaning and therefore, the direction it will naturally fall, as this will influence exactly where the cut needs to be. It will still be approximately opposite the intended hinge, but may require a little finessing to steer the tree in the right direction.

The angle of the hinge in relation to the flow of the watercourse must also be considered, as it will only usually hinge in the one plane (unless it twists, which is trickier to achieve intentionally and requires experience). A downstream hinge is much more likely to fold than snap in a spate, and will also accumulate less debris than a cross-channel or upstream hinge. By the same token, a hinged tree straight out across the channel has a much higher chance of breaking off in high flows as it cannot bend across its hinge.

For these reasons, trees tend to be hinged in a downstream direction along the bank, to reduce the force from direct flow and so that the canopy is braced against the river margin or other trees. As highlighted previously, where necessary, additional posts can be driven into the bed around the canopy to help brace the limbs and protect the hinge.

Figure 38: The arrow indicates the intended direction for these two limbs to be felled in and the area for the cut. As the trees are crack willow, they are perfectly suited to hinging into the water (other species would be laid onto the bank, so as to create overhanging cover, without being directly in the water).

Figure 39: The end result with the trunks hinged into the river margin, providing beneficial cover and structure.

Figure 40: Another example of a larger willow tree successfully hinged into the river margin to improve habitat diversity. Note how, because the tree was leaning in the right direction, only a single cut into the opposite side of the tree was required to allow it to

fold over into the channel – a few side-branches have also been pruned to allow it to sit down into the water.

11.4. Important notes for professionals and experienced chainsaw operatives

Depending on size, and the angle of lean, larger trees may require a different approach. In most cases, tree hinging is quite safe, but a large or heavily-leaning limb can sometimes 'barber-chair' unexpectedly if it is not cut correctly by an appropriately trained or experienced person. A 'barber chair' is where a tree splits upward from the felling cut before falling and slides backwards under its own weight in an unpredictable direction, which can be very dangerous.

To counter this, where a tree is unbalanced, a horizontal 'plunge cut' (using the tip of the chainsaw to bore through the tree in a plunging motion) can be used as the first cut to remove the resistance in the centre of the trunk while the tree is still being held upright by the remaining trunk on either side. This allows the tree to fall more easily on its hinge when the controlled 'final cut' is made (see Fig. 5). A variation on this technique is to also include an initial vertical plunge-cut, to dictate exactly where the edge of the hinge will be, but this can increase the likelihood of the saw becoming trapped and is usually unnecessary.

Figure 41: A diagram showing the sequence of chainsaw cuts for a dog tooth style of hinge for a larger tree.

N.B. The plunge-cut can cause the saw to kick back if not correctly executed – so this is a more advanced technique that should only be attempted by more experienced chainsaw operators.

When hinging larger trees, please also take the following into account:

- Large crack willows can hinge well, but may be susceptible to barber-chairing
- Alders tend not to produce a strong hinge, so may not be appropriate in high energy or high flood risk areas. They can also crack suddenly, especially if affected by *Phytopthora* disease. However, they can be laid effectively with practice and in appropriate places
- Poplars can be even trickier than alders: the bark tends to crumple and ruck up, and should only be used if nothing else is available
- Ash and sycamore are very brittle, and tend to lay very poorly as a result
- In cold weather, trees can react particularly explosively to being cut – failing more suddenly, and splitting further and in a less controlled way

11.5. Other important points to note

- Use chainsaws with the greatest care – if you're in any doubt at all, employ a specialist contractor
- WTT recommends that all volunteer groups wanting to implement tree hinging should seek demonstration and training from a qualified chainsaw operator
- For added security (where necessary), hinged trees can be secured in the channel with stakes and wire, and/or sisal rope (and possibly even secured back to the stump with 12 mm steel cable and cable clamps) - but these additional measures should not usually be required

11.6. Tree kickers

If the hinge fails in the course of felling (or if hinging requires advanced chainsaw skills that aren't available), it is still possible to construct a useful habitat feature with felled timber by securing it back to the stump, or to another tree. These non-hinged but secured structures are called tree kickers.

Use a chain saw or augur to bore a hole through the felled trunk and its stump, then thread a suitable length of 10 mm (6.5 tonne breaking strain) or 12 mm (9.4 tonne b.s.) steel cable though both holes, and secure the ends with steel cable clamps. The tethering cable length should be relatively short, to stop the kicker floating up and lodging in an awkward spot, or even ending up high and dry on the bank. The length of cable should also be kept to a minimum so that the kicker does not move excessively in high flows. To achieve this, a winch can often come in handy to pull the trunk back towards its stump.

Figure 42: Making a tree kicker: details of steel cabling used to secure the sawn-off trunk back to its stump. The hinge on this structure is minimal, so the decision was made to provide additional security with a steel cable – effectively turning it into a tree kicker.

11.7. Lodged woody material

In most circumstances, it is possible to create very durable structures simply by lodging a large piece of woody material in or around an existing bankside tree. If the pieces of wood are suitable, no wire or stakes will be required to create highly naturalistic habitat features. In many cases, this technique is at least as secure as cabled structures, as the lodged material cannot move downstream before it begins to disintegrate.

Figure 43: Lodged woody material.

11.8. Consent

In England, EA permissions may be required for some of these techniques in certain locations.

11.9. Disclaimer

This document is produced for guidance; 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.