Advisory Visit

R. Wharfe, Kilnsey Angling Club

19/02/2018

Key Findings:

- The Wharfe and the Skirfare both have a naturally flashy flow regime because of the underlying geology, and this has been exacerbated by historic and ongoing land management and engineering of the channel. However, ecological status remains good and there is great potential to improve both instream and bankside habitat to support and promote the existing wild trout population(s).

- Good quality riparian habitat comprising fringing trees and a diverse herb layer is found in patches on many of the Kilnsey beats, and hence provides an indication of what is possible elsewhere. Tree planting is being undertaken in some areas, and it could be extended considerably to maximise ecosystem benefits.

- Livestock grazing and trampling is degrading the condition of the banks wherever there is free access. Installation of fencing is a key consideration, as well as monitoring and maintenance of that already *in situ*.

- There is currently good access to several potential spawning tributaries, but these should be explored further upstream to better assess their contribution to wild fish population sustainability. White Beck and Black Keld are of particular interest but suffer from very different pressures. Cray Gill has already received considerable habitat improvement work.

- The Yorkshire Dales Rivers Trust (YDRT) will be a good ally in habitat improvement work as the Upper Wharfe is a focal project area for them, working with the National Trust and Natural England on the SSSI and environs. WTT already work closely with YDRT on the river above Buckden.

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1.0 Introduction

This report is the output of a site visit undertaken by Jon Grey of the Wild Trout Trust to the River Wharfe at the request of Kilnsey Angling Club. The Club Bailiff, Steve Haithwaite, accompanied the walk on the lower waters and provided much useful information. The rationale was to assess in-river and riparian habitat quality, and identify any remedial actions that might be implemented. Jack Hirst & Dan Turner (Yorkshire Dales Rivers Trust) commented on the document.

Normal convention is applied with respect to bank identification, i.e. left bank (LB) or right bank (RB) whilst looking downstream. Upstream and downstream references are often abbreviated to u/s and d/s, respectively, for convenience. The Ordnance Survey National Grid Reference system and Kilnsey AC beat names are used for identifying locations.

	Kilnsey Angling Club		
River	River Wharfe		R Skirfare
Waterbody Name	Wharfe from Oughtershaw Beck to Park Gill Beck	Wharfe from Park Gill Bk to Barben Beck/River Dibb	Skirfare from Cowside Beck to River Wharfe
Waterbody ID	GB104027069290	GB104027064253	GB104027064180
Management Catchment	Wharfe and Lower Ouse	Wharfe and Lower Ouse	Wharfe and Lower Ouse
River Basin District	Humber	Humber	Humber
Current Ecological Quality	**Good** ecological status	**Good** ecological status	**Good** ecological status
U/S Grid Ref inspected	SD 93366 78425 on Cray Ghyll (road bridge)	SD 96808 72328 (Kettlewell)	SD 94699 70987 (Top of beat)
D/S Grid Ref inspected	SD 95305 74071	SD 97963 66373 (End of beat)	SD 97737 69269 (Watersmeet)
Length of river inspected	~5500m in total	~6500m	Spot checks (~500m)

Table 1. Overview of the waterbody. Information sourced from: http://environment.data.gov.uk/catchment-planning/WaterBody/GB104027069290

2.0 Catchment / Fishery Overview

The River Wharfe is a gravel bed river in a glacial valley, rising on the Carboniferous limestone of Cam Fell in the Yorkshire Dales National Park and flowing for ~130km to join the Yorkshire Ouse near Cawood. Kilnsey Angling Club control ~14km of fishing on the Upper Wharfe & Skirfare (Fig 1). Most Yorkshire Dales' rivers have been affected by drainage and intensive stock grazing in both the catchments and floodplains, resulting in rapid transit of water and flashy hydrographs with narrow, high peaks and troughs of flow, excessive erosion, and a scarcity of wetland features.

These anthropogenic effects overlay a naturally 'flashy' spate regime caused by the steep sides of the u-shaped valley (with thin soils and scree) and the underlying semi-permeable limestone geology. There is typically over-supply of cobble and gravel resulting in pools filling in to become uniformly shallow, especially where natural geomorphology is interrupted or altered through straightening / realignment of the channel. Hence, the wetted channel appears over-capacity in many sections during low summer flow. The substrate is also highly dynamic as it is reworked / redistributed by subsequent floods.

Under the Water Framework Directive classification scheme, the Environment Agency consider each of the two components of the R Wharfe, and the R Skirfare, as achieving good ecological status.

Brown trout dominate throughout the waters. Kilnsey AC stock (currently) with two-year-old fish, bought in and raised in their own hatchery facility. Fish are not introduced higher than the Kettlewell stepping stones. Although there are grayling u/s of Grassington and into the very lowest Kilnsey beat, and historical reports of them being caught on The Falcon waters on the Skirfare, natural and augmented falls at Linton and at Mill Scar Lash appear to limit their ability to sustain a population here. The Environment Agency has stocked between the two barriers mentioned above, but these grayling do not appear to be making their way upstream past the Mill Scar Lash falls.

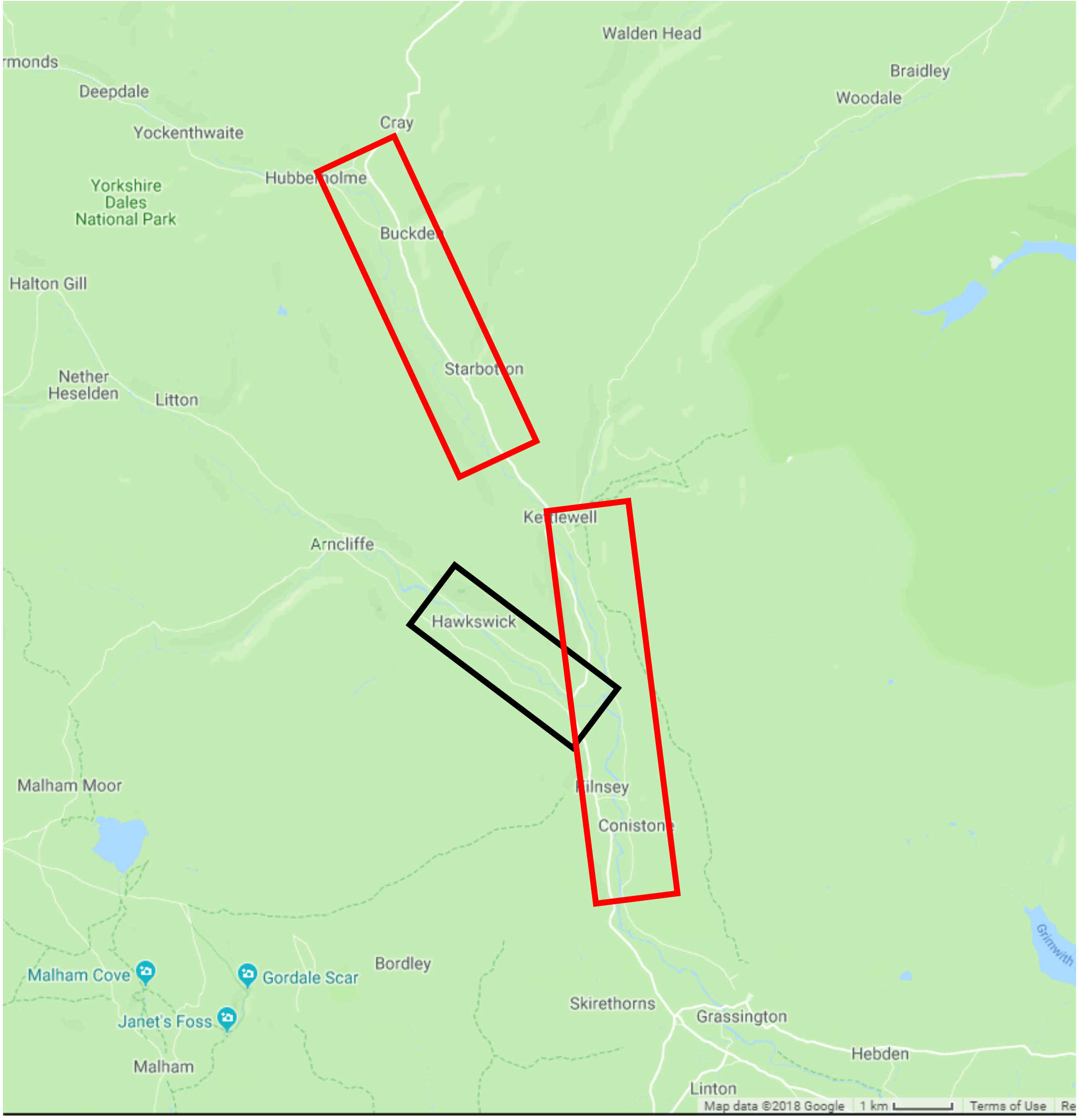

Fig 1. Extent of Kilnsey AC waters walked during the visit on the R Wharfe (bounded by red) & the Skirfare (bounded by black).

3.0 Habitat Assessment

3.1 Lower River Wharfe (White Beck Down to Kettlewell beats)

The walkover commenced on the lowest beat at Mill Scar Lash falls (Fig 2), a natural bed-rock feature which is almost certainly a barrier to grayling but less of an issue to the more powerful swimming trout. A brief discussion was had about historic records of grayling being caught on the Arncliffe beats of the Skirfare; these are almost certainly fish that were translocated above these falls and those at Linton.

Fig 2. Mill Scar Lash falls on the White Beck Down beat are likely to be a barrier to grayling but less of a challenge to wild brown trout.

The field on the RB, immediately u/s of the falls is large and almost entirely devoid of diverse vegetation and tree cover at the bank edge because of livestock access. The posts and bottom wire of an incomplete fence were evident for much of the field length, and these were in good condition (Fig 3). If extended and completed, the fence would provide a considerable buffer zone which would regenerate quickly and could be augmented with some judicious planting of native tree species to complement those found locally. A more diverse riparian vegetation promotes faunal diversity. It also provides protection / cover where the ‘shaggy’ fringe trails from the bank into the water, which is used by fry and smaller individuals, as well as increasing resilience to spate erosion. The wooded sections on the LB (fenced) appeared to be in good condition, containing a variety of native tree species of mixed ages.

Introduction of tree leaf litter is an important food source for 'shredding' invertebrate species such as gammarid shrimps which in turn process the material, making it available for some of the net spinning caddis flies. Alder (*Alnus glutinosa*) is particularly beneficial as it has nodules on its roots containing nitrogen fixing bacteria which impart greater nutritional quality and palatability to the senescent leaves. Trees and trailing vegetation are also important for emerging fly life as structure to help them exit the water, as shelter from wind, rain and predation during the short winged-phase of the life-cycle, as focal points for mating swarms, and as egg laying structures for some species returning to the river. The more fly life can be encouraged, the more food there is for trout.

Fig 3. The first long field on the RB above Mill Scar Lash was devoid of tree cover and diverse bankside vegetation. Finishing the incomplete fence-line should be explored.

In terms of providing beneficial cover directly to fish, there were relatively few truly low hanging branches (<30cm from the water, to trailing on the surface) and fewer still examples of submerged wood; important refugia from spate flows and predators such as saw-bills. Some anglers may view such structure as untidy or a casting hazard. However, the benefits in terms of securing greater numbers of fish within a given stretch far outweigh the perceived negatives.

Introducing such cover is achievable, even on a spate river such as the Wharfe, provided that appropriate sites and techniques are selected. Relatively pliant species such as hazel (*Corylus avellana*), elm (*Ulmus* spp.), willow (*Salix* spp.) and smaller alder can be 'hinged', essentially hedge-laying to maintain a healthy attachment. These species should be considered for planting on the RB, in small clumps, offset to that on the LB – see *Recommendations*.

The confluence of White Beck was clear, providing good depth of water for fish to move in or out for spawning, feeding, or refuge (Fig 4). This limestone-spring fed stream is valuable for all three aspects – see Becks section. A triangle of land immediately u/s of the confluence which is already fenced should be considered for tree planting to promote low cover and extra security for fish moving through the confluence.

Fig 4. Upper: the confluence of White Beck and the Wharfe (RB) – access is good and the water quality appears reasonable from this limestone spring, but sediment quality could be improved; see Becks section. Lower: the LB of White Beck immediately u/s of the confluence is fenced off and could be planted up with native trees.

The Wharfe has been subject to considerable historical realignment and straightening, primarily to create coherent plots of land along the valley for fields. Reinforcement of bank lines with stone and walling is more evident in some places than others, and clearly there are some natural pinch points in the valley or encounters with natural bed-rock, such as Mill Scar Lash, which reinstate some natural geomorphology. One feature that results from the straightening or refining of bends to long, sweeping curves, is the development of overly long riffles or glides instead of a repeating pool-riffle-glide sequence; this is a function of the straightening also artificially increasing the gradient.

Fig 5. A small parcel of land, apparently occupied by a single horse, that was severely poached. An attempt had been made at electric fencing to protect the river bank but was not maintained. The bank was degraded as a consequence, contributing fine sediment pollution to the river.

Bank degradation from livestock poaching, trampling and grazing can be quite severe even at very low stock density, as exemplified by the small field containing a single horse (Fig 5). Denudation of the bank at the very water's edge will exacerbate erosion and promote fine sediment ingress which can degrade gravel habitat elsewhere.

The impact of livestock grazing and poaching was also clear u/s of Consitone Bridge; compare the vegetative structure of the two banks in Fig 6, and note the erosion 'scallops' developing on the RB despite it being on the inside of the bend and hence, theoretically, a deposition zone. Regular intensive grazing reduces plant diversity to short-sward grasses that are capable of withstanding such disturbance. However, those grasses invest the majority of their growth in replacing shoot material and little into root depth. Hence, banks that are heavily grazed to the very water's edge are susceptible to 'block failure'. Lateral erosion at the toe of the bank undermines the soil above, and without any root material to bind it together, blocks collapse into the river leaving further exposed material behind, introducing fine sediment, and causing over-widening of the river.

The creation of a shallow levee or bund was also evident here to prevent the river flooding onto the fields. Such structures disconnect the river from its floodplain and keep the power of the river under spate flow constrained within the channel, thereby increasing erosive force instead of allowing that force to dissipate. Increasing conveyance along the Wharfe here essentially transmits and increases the flood risk (and associated habitat degradation) further down the system.

The first of several areas of buffer-fencing and tree planting was encountered at the u/s end of the same field. The difference in vegetation structure was apparent, even in mid winter (Fig 6).

Fig 6. Upper: unfettered livestock access on the RB immediately u/s of Conistone Bridge leaves only short sward grass at the bank edge with little root matrix to resist erosion (note erosion scallops forming). The white arrow demotes position of the shallow flood bund / levee. Lower: further u/s on the same field, a buffer strip has been fenced off and planted with small copses of trees. Compare the vegetation in the two panels.

The consequences of hard-engineering to protect a bank and ‘steer’ the river are evident in Fig 7. Substantial rock armouring has been used to stop the river meandering toward the right-hand side of the valley floor, and instead, it is swept in a smooth curve toward the left. Prevented from lateral movement, the river is scouring downward and creating a deep channel on the outside of the bend. Material arising or transported rapidly through that bend is then deposited immediately downstream as flow energy dissipates and has created a wide, braided (multichannel) section. Such deposition bars, which are regularly shifting in position and inundated by even relatively small increases in flow, are very important ephemeral habitats for invertebrates such as detritivorous beetles and predatory spiders and beetles living at the cusp of land and water; many of these will contribute to trout diet.

A mink was spotted on the LB where pheasant pens are located in the adjacent field (Fig 8). Such honey-pots tend to attract predators, and invasive species like mink can have detrimental impacts upon a fish population, so this area should be monitored and perhaps a trapping regime set up in collaboration with the gamekeeper.

Fig 7. Upper: a dynamic zone of gravel, cobble and boulder deposition which has braided the channel. This zone has undoubtedly developed in response to the rock armouring of the RB on the bend immediately u/s (mid panel). Lower: from Google Earth, it is clear to see how the river is scouring deeply around the outside of the armoured bend and then depositing its load in a wider cross-section d/s. White squares mark sites of upper and mid panel images.

Fig 8. A long glide towards the u/s end of Conistone / Byrom, typical when a river is straightened and constrained by bank reinforcement. Reasonable tree cover was evident, more consistent on the LB, but almost all trees were mature i.e there was a lack of diversity in age / canopy structure. Note the pheasant pens: a mink was spotted on this bank, probably drawn to the game rearing but no doubt taking fish too.

Long sections of the Wharfe are currently protected by buffer fencing, but small chinks in that armour, particularly at the head and tail of lengths, are readily exploited by livestock if the opportunity arises and degradation can be swift (Fig 9 & 11). It is advisable for the condition of fencing to be monitored and maintained on a regular basis.

Fig 9. Although this bank had a sturdy livestock exclusion fence affording some development of buffer strip vegetation, the post & rail at the head of it, i.e. perpendicular to the river and down to the water, had been damaged in a spate. Sheep had gained access and degraded the quality of the riparian zone.

There has been extensive tree planting around Throstle Nest on the LB and the habitat quality will only improve further because of it (Fig 10; see also Fig 14). Around the Tufa Rock, the Wharfe is pressed hard against a natural outcrop of rock and the channel is more physically diverse as a consequence. The ideal would be natural woodland (of diverse age / canopy height) on both banks, but for the majority of the Kilnsey lower beats, at least one bank is almost always wooded to offset a grazed bank opposite. Ash (*Fraxinus excelsior*) becomes more prevalent further u/s and especially on the valley sides; the threat of ash dieback caused by an Ascomycete fungus is a considerable worry for the future of this landscape. Hence, any tree planting should consider future proofing for the potential loss of ash.

At Throstle Nest Dub, there is another very short section of dilapidated fence which has allowed livestock to access an otherwise well-protected bank (Fig 11).

Fig 10. The wooded LB below Throstle Nest and the Tufa Rock. This is one of the few areas in the lower beats where the river butts up to the steeper side of the valley. Arguably, it has been pushed there by channel realignment and stone bank revetment to maximise farming land on the floodplain to the west (RB). However, it should be noted that the natural vegetation here is apparently resilient to spate flow despite it being on the outside of the bend. Gaps in the wood have been recently planted.

Fig 11. Another small chink in the armour. This one very short section of dilapidated fence (RB; Throstle Nest Dub) has allowed sheep access into the otherwise well-protected riparian zone beyond.

Downstream of Watersmeet, the confluence of the Wharfe and the Skirfare, there is a large deposition bar of cobbles and gravel which has braided the channel (Fig 12). This is an entirely natural and ephemeral feature which will wax and wane in response to spate flows removing and replacing that material from either or both of the rivers. Braiding diversifies the channel(s) habitats and provides a mosaic of depths and flow speeds which will suit different life-stages of trout. Amerdale Dub itself will provide excellent, deep holding habitat for trout when moving in and out of the Skirfare. The Skirfare is discussed in Section 3.3.

Fig 12. The deposition bar formed below the Amerdale Dub and Watersmeet (confluence of the Skirfare and the Wharfe) creating a fantastic braiding and diversification of flows / habitat.

Fig 13. Views at Watersmeet. Upper: looking u/s on the Skirfare demonstrating a lack of cover on both banks, despite the LB being buffer-fenced. Mid: the confluence of the Skirfare (from left of image) and the Wharfe, with a deep holding pool immediately into the Skirfare (underneath the foam). Lower: looking d/s at the deposition bar below Amerdale Dub (see Fig 12).

Upstream from Watersmeet, there was increasing presence of willow species (primarily goat willow, *S. caprea,* which is small and shrubby and provides good low cover over the water; Fig 14). These could provide a local supply of whips to be used elsewhere on the river. Mile House Dub is a pool formed in a natural pinch point and bedrock outcrop of the valley (Fig 16). Upstream, even within the confines of such a narrow part of the valley, the river has been pushed to the left side to accommodate a field on the right, which has a degrading fence-line that should be repaired asap (Fig 17).

Fig 14. More evidence of recent tree planting on the LB behind some goat willow, presumably as part of the Throstle Nest holdings.

Fig 15. Poor maintenance of fencing on the RB, d/s from Mile House Dub. Again, a relatively short section has fallen into disrepair but the damage to the bankside from livestock entering through this gap is disproportionately extensive.

Fig 16. Mile House Dub is formed from a natural pinch in the valley (note the slope on each side of the river) which has constrained the channel width at this point.

Fig 17. The fence-line on the RB immediately above Mile House Dub could also do with some TLC to retain its efficiency. The river is pinned against the left-hand side of the valley (right of image) by stone embankment to maximise use of the narrow floodplain for farming. The result is a straighter channel of steeper gradient and almost continuous riffle.

The confluence of Black Keld with the Wharfe was clear and appeared to offer easy access to fish (Fig 18); see Section 3.4.

Fig 18. The confluence of Black Keld, entering the Wharfe from the LB. Access appears good, as does riparian buffer fencing along this potentially important spawning tributary. See Becks section.

The Wharfe is tightly pinched into a relatively narrow section of the valley around Kettlewell, but even so the banks have been armoured to keep the river straight along the very bottom and stop any meandering into adjacent fields on either side (Fig 19). Bed-rock outcrops break up the almost continuous riffle, and some of these are sufficiently large to have formed deposition bars d/s (Fig 20). Those bars that have been consolidated by encroaching vegetation quite often have associated slack water refugia which are good habitat for fry. Newly formed bars can be encouraged to consolidate by pushing in some willow whips – see Recommendations.

Fig 19. From Black Keld towards the stepping stones and Kettlewell Bridge, there is more evidence of stone revetment or walling of the banks, although the valley is narrower here too so it would not be expected to meander as such. Bedrock outcrops diversify channel form (lower panel). A public footpath and farm access track is a focal point for trampling and erosion (mid panel) although, it appears that little, if any fine sediment can enter the river here except under high flow.

Fig 20. Natural bedrock outcrops have allowed this deposition bar to form d/s, which has been stabilised by colonising plants. Such overgrown pockets of water are useful nursery holding areas for weaker swimming fry.

3.2 Upper river (Starbotton Down to Buckden Up)

The Wharfe between Kettlewell and Starbotton exhibits two magnificent meanders which demonstrate what the river should be doing within its floodplain (Fig 21). In stark contrast to this sinuosity, examination of the area using Google Earth or maps highlights the straightened sections and the 90-degree bends that are forced upon the channel elsewhere. Consider how many kilometres of channel length have been shaved off the river by all the engineering, and how much longer it would take a flood peak to reach Otley, Wetherby or Tadcaster if the natural sinuosity was to be reinstated.

Fig 21. Looking down from Moor End Fell at what the Wharfe should be doing in its floodplain. Imagine how many more miles of fishing Kilnsey Angling Club might control, and how diverse the habitat would be if there were more meanders like this.

The walkover of the upper beats commenced at approximately halfway along Starbotton Down at one of the large meanders (Fig 22). The channel cross-section is incredibly diverse due to scour and deposition, and the substrate often well-sorted as a consequence. There is a rich mosaic of shallow (and some braided) riffles and deep pools, with swift and slack water. The difference between bank top height and water surface is relatively small, indicating good connectivity with the floodplain. Unfortunately, sheep have access to both banks in many areas so the tree cover is sparse and aging with little opportunity for replacement.

Fig 22. Images from around the meander bend highlighted in Fig 21, and which sits approximately halfway along Starbotton Down beat. This a highly active zone of erosion but also of deposition. As a consequence, there is great diversity in channel cross-section depth (and even some braiding caused by deposition bars instream), as well as longitudinally which has allowed the natural development of pool-riffle-glide sequences. Note at this point how well-connected the river is with its floodplain; i.e. little difference between bank top height and water surface.

Palaeo-channels are evident across the floodplain (Fig 23), indicating how dynamic the river has been when unconstrained (and hence why farmers have tried to shackle it). This entirely natural movement by lateral erosion supplies the river with a lifeblood of substrate which should be transported and deposited downstream. Straightened channels are starved of supply, but will transport lighter substrate more effectively, leaving an unsorted (more uniform) bed of larger boulder and cobble.

Fig 23. Palaeo-channels are evident within the floodplain. Where they retain water, they provide important habitat for flora and fauna better suited to slower flows or still waters. They will also act as temporary refugia for fish during spate flows.

Below Starbotton footbridge, the river is once again constrained between straightening walls, and while an avenue of mature trees (mostly alder) lines the river bank, unfettered access by sheep in some reaches is causing erosion around their roots (Fig 24). Without exclusion fencing, there will be no self-set regeneration of trees to replace the mature specimens as they inevitably start to die off or are lost to spates. One land owner has placed piles of cobbles (probably sequestered from the river without consent) in several developing erosion scallops. The unconsolidated material is more likely to exacerbate the problem during the next spate as the cobbles are moved against the softer bank soils.

Artificial widening of the channel to form an historic ford (now the Starbotton footbridge) has reduced flow energy and caused deposition bars to form u/s and d/s of the bridge infrastructure (Fig 25). The localised diversification of flow paths has afforded sediment sorting and potentially created some spawning habitat.

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Fig 24. Upstream towards Starbotton, the river is once again entrained within stone banking. Where erosion scallops have formed by livestock accessing the water from the LB, small piles of cobbles have been dumped which are only likely to exacerbate the situation.

Fig 25. Looking u/s (upper) and d/s (lower) from Starbotton footbridge exemplifying: a) how the river has been straightened; and b) how the infrastructure associated with the bridge and formerly the ford has caused erosion and over-widening of the channel at this point.

Upstream of the footbridge (Fig 26), it is clear that sheep have been grazing the riparian vegetation, so the dilapidated single or double-strand fencing should be replaced by 'flood-resistant' 7-strand with tensioners if possible.

Fig 26. Upstream from Starbotton footbridge, fencing on the LB is only single or double strand and in a sorry state of repair in places, allowing sheep to degrade the bankside vegetation and prevent the establishment of self-set trees. Foss Gill enters on the RB but is unlikely to be of much use as a spawning tributary because of the gradient.

Within a small copse at Starbotton, Cam Gill Beck joins the Wharfe on the LB (Fig 27). Access was good and the gravel bar at the mouth comprised appropriately sized gravels for trout spawning (15-40mm).

Fig 27. Access to Cam Gill Beck is good and the tributary has an abundant supply of gravel of appropriate sizes for trout spawning (inset). See Becks section.

Starbotton Up beat signifies a marked change in the character of the river, entirely because of engineering for land management. The river is once again bunded (especially on the LB), straightened, and may have been dredged as well in the process of realignment as it is rather deep (and consistently so; Fig 28). The depth also could have been caused by the river scouring vertically rather than laterally because it cannot dissipate so easily over its floodplain during spates since being bunded; indeed, the two mechanisms are not mutually exclusive. Block failure of the banks was once again evident, exacerbated by livestock access to the bank top (as seen in the grazed and bunded field at Conistone; Fig 6).

The RB is better protected from livestock and the diversification of herbage is immediately apparent. Some tree planting has been carried out by YDRT to help stabilise the RB; adequate livestock fencing is *in situ* on the LB on some reaches but lacks supplementary planting (Fig 29). At the very top end of Starbotton Up, the river has breached the tail end of a stone embankment which forces it around a U-bend and is badly eroding the RB and destroying an area of tree planting (Fig 30). This is at the downstream end of a series of inappropriate historic engineering feats to steer the river (a long straight, a 90-degree right-hand bend – see Fig 31, immediately followed by the relatively tight U-bend, and formerly there would have been another 90-degree right-hander). The saplings are not sufficiently established to withstand the force of the Wharfe now that it has begun to cut a new path behind the stone revetment. YDRT and the Environment Agency have drawn up plans to address the erosion.

Fig 28. Above Starbotton stepping stones, the Wharfe is once more tightly constrained by stone revetment along a straightened channel and disconnected from its floodplain by bunds / levees. There is no protection from livestock on the LB (compare vegetation in lower panel). Block failure and slumping of the bank is occurring in many places as a consequence (particularly evident in mid panel).

Fig 29. Planting is evident on the RB along many stretches but despite adequate livestock fencing and space, there was none on the LB.

Fig 30. The white dotted line indicates the curve of the stone revetment which used to force the river through a U-bend and push it back to the left (eastern) side of the valley. This has been breached and the river is now evidently trying to cut a new course under spate flow through a stand of recent planting which has little chance of resisting the power of the Wharfe.

Fig 31. At the juncture between Buckden and Starbotton beats, the Wharfe has been perched to the east side of the valley for ~250m and maintained in a relatively narrow and very straight channel (evident in upper panel, top right), before being forced abruptly right (white arrow) and then into the U-bend described in Fig 30. The stone banking is evident along the LB (lower panel) to withstand the force of water under spate flow. Note the deposition bar (lower panel).

Buckden Down beat (in part fished by Bradford City AA) is still heavily constrained on both banks but is more sympathetically managed as part of the Upper Wharfedale SSSI; it is well fenced and has been in receipt of planting schemes for a longer period. In addition, the historic engineering to shift (and hold) the river back and forth across the valley is less abrupt than that just described in Figs 30-31. Goat willow is well established in areas and provides valuable habitat features as well as attenuating flood risk by filtering out debris (Fig 32).

Fig 32. Scrubby willows along the LB provide some much-needed low cover and protection during spate flows on the most d/s straightened section of Buckden Down. Upper: the stone bank revetment has been breached here and scour behind the willow has resulted in a useful backwater refuge area for fry. Lower: a fenced section of bank where the few willows to left of image are trapping a considerable amount of flood debris. This area could be further planted with willow whips.

For the majority of the Buckden beats, there are good examples of pool-riffle-glide sequences, despite still being within realigned and rock-armoured banks (Figs 33-36). The planting by YDRT and others will soon begin to demonstrate benefits, but there are still wide buffer strips which would benefit from further planting of groups of 5-10 trees. On Buckden Up, the avenue of trees is almost entirely mature, so it would be prudent to start a programme of augmented planting to compensate for loss of mature trees in the future. Cray Gill is picked up in the Becks section. Hubberholme and above was not viewed but will benefit from the work by YDRT to slow the flow u/s at Oughtershaw. There is a lack of natural cover due to livestock.

Fig 33. The mid-section of Buckden Down where the river crosses the valley floor has some natural pool-riffle-glide sequences. Riparian cover is being augmented by planting from YDRT.

Fig 34. Buffer fencing is present right through Buckden Down and there is typically good quality, 'shaggy' vegetation at the toe of both banks.

Fig 35. Meander d/s of another artificially straightened section parallel to some exotic conifers to the south of Buckden. Judicious planting could be undertaken within the buffer strip.

Fig 36. Marked scouring of the LB in response to the river depositing a substantial amount of bedload at the end of another artificially straightened run (towards the top end of Buckden Down).

3.3 River Skirfare

The Skirfare was observed at Watersmeet, and then at a few strategic points from a drive to Arncliffe and back. The lack of tree cover was noted in the upper panel of Fig 13 (at the confluence) and again exemplified on the lower reaches in Fig 37. An engineered channel cross-section, over-capacity to cope with spate flow and maintained by bank revetment means that the proportions of the river barely change, even around the bends (Fig 37). As a consequence, the flow energy tends to be dispersed over a greater area and the bed substrate and cross-section profile become more uniform; a shallow trapezoid. The presence of large boulders can introduce some habitat heterogeneity (limited 'pocket water') and makes for reasonable juvenile / parr habitat (Fig 38) but offers less holding potential than deeper pools would for larger individual fish.

Fig 37. Views of the lower Skirfare from High Wind Bank: upper – looking d/s; mid – looking u/s. These images exemplify the lack of variability in channel cross-section, and an almost continual riffle habitat typical of a realigned, over-capacity channel. Lower – taken from the opposite side of the valley looking back to the point (white arrow) where the upper & mid images were taken. Note the scarring and slippage caused / exacerbated by sheep grazing on steep banks.

Fig 38. Up & downstream views of the Skirfare just above Hawkswick demonstrating similar proportions and straightened character as in Fig 37 but with better riparian tree coverage and buffer fencing.

It is little wonder that the flow regime of the Skirfare (and Wharfe) is so flashy when one observes that most tributaries have been straightened to varying degrees. An extreme example was found u/s of Hawkswick (Fig 39); water will be conveyed very rapidly along this overly straight and steepened watercourse into the Skirfare, and it will probably flush out small gravels each time, leaving only cobbles (i.e. no use for spawning).

There are a number of reaches where it appears that livestock are effectively excluded by fencing or walling from one bank or the other, but which still lack trees. This may be due to stock crossing the shallow channel during summer flows, or deer browsing. Tree planting should be considered in those reaches. An example of what can be achieved with adequate stock exclusion is shown in Fig 40, on a more natural bend in the river just above the Kilnsey limit.

Fig 39. A typical small tributary which has been degraded to a ditch, 'perched' in a raised embankment and forced down the side of the field.

Fig 40. A small area of good quality, diverse habitat containing palaeo-channels where the Skirfare traverses from one side of the valley to the other. Note the buffer fencing.

3.4 Becks

Gravels of an appropriate size (~15-40mm) for spawning habitat are likely to be at a premium within the mainstem Wharfe; undoubtedly, larger individuals will spawn in the main river but lesser mortals will be reliant upon the tributaries. Even deceptively small becks <1m width will be used by fish provided there is ample water depth, cover and suitable substrate is retained. Hence, it is important to assess the condition and take action to sympathetically manage potential spawning becks for the benefit of wild trout populations, even if those waters are not seen as 'fishable'. The main becks below are listed from d/s to u/s position on the Wharfe

White Beck

White Beck was observed at the confluence with the Wharfe (see Fig 4), from the road bridge to Conistone (Figs 41 & 42) and next to Kilnsey fishing lakes. Water clarity and submerged macrophyte growth was as expected from a limestone spring source, but algal growth on the substrate hinted at excessive nutrient enrichment. That growth would be exacerbated by the light climate; there is almost no tree cover for the majority of its length, and it has been straightened and embanked through the field to the Wharfe (Fig 41). From a cursory stone turn, macroinvertebrate life was diverse. This has great potential as a spawning and juvenile nursery beck if it can be protected. The one fly in the ointment might be escapement of overly large stocked fish from the fishery lakes which will cause detriment to wild fish in many ways.

YDRT are already in discussions about improvements for White Beck.

Fig 41. White Beck, a potentially glorious limestone stream that has been bunded and straightened into a field drain, whereas it should be wending its way to the Wharfe across the floodplain watermeadow. If nothing else, it is crying out for livestock fencing to allow a natural riparian fringe to develop which will provide shade and cover for fish in this shallow, clear watercourse.

Fig 42. Looking upstream on White Beck from the Conistone bridge. The substrate is typical of a limestone river with good potential for macrophyte growth, but the gravels and cobbles are currently unsorted because of straightening of the channel.

Black Keld

It was not possible to access Black Keld during the walkover, but the tree cover along the banks appeared good and it was buffer-fenced for as far as it was possible to observe (instigated by YDRT). The lower reach might have been straightened (observation from maps), but as a relatively short and low gradient spring-fed beck, it should be investigated further for spawning potential.

Dowber Gill Beck

The lower reaches of Dowber Gill Beck where it flows through Kettlewell are tightly constrained and straightened with numerous shallow check weirs for service pipes crossing the beck. The substrate is mostly unsorted cobbles and there is a lack of natural cover. The narrow, steep-sided valley is impacted by roads and residential properties to the top of the village where the gradient increases markedly and a series of natural bed-rock falls are probably impassable to trout. As a consequence, spawning habitat potential is low.

Fig 43. Straightened, walled and weir'd. Dowber Gill Beck lower reaches in Kettlewell.

Fig 44. Some of the natural bed-rock falls towards the top end of Kettelwell on Dowber Gill Beck which probably limit the upstream passage of trout.

Cam Gill Beck

The lower reaches of Cam Gill Beck appeared to have been dredged relatively recently, and it is straightened from Starbotton down to its confluence with the Wharfe (Fig 45). Gravel supply appears healthy and the lower reach appears well protected from stock, indeed throughout the village, so if habitat could be improved and gravels retained and sorted, then it offers good potential as a spawning tributary (Fig 46). The steep valley sides above the village are likely to create naturally impassable falls, so it is important to maximise potential on the shallower gradient sections.

Fig 45. Cam Gill Beck below Starbotton village. The channel has been realigned and dredged; spoil is evident on the RB (left of image).

Fig 46. Two views of Cam Gill Beck as it wends its way behind the village of Starbotton. Naturally steep banks are covered by a diverse, natural flora.

Cray Gill

From its confluence with the Wharfe to Haw Ings road crossing, Cray Gill has been historically straightened but has been buffer-fenced on both sides and subject to some habitat improvements by YDRT & WTT (instream deflectors; willow bank protection; planting). Above the road bridge, it is more natural in its course within the steep sided valley but exposed to stock grazing in places. Bed-rock falls limit the extent of trout within the system to probably ~750m from the Wharfe but the habitat has potential and is being improved further.

4.0 Recommendations

As mentioned in the Introduction, the Upper Wharfe is a naturally flashy river but this has been exacerbated by historic and ongoing land management in the wider catchment and channel realignments to augment that land management. High and prolonged spate flows during winter will adversely affect spawning on straightened becks with poor habitat. Low flows during summer physically disconnect the upper beats of Kilnsey AC. That said, water quality is generally good and there is diverse fly life to support wild fish. The maintenance and improvement of existing buffer strips along the river banks will augment trout diet via terrestrial insects. Considerable work is being undertaken at the wider catchment scale by Yorkshire Dales Rivers Trust to help tackle broader issues such as slowing the flow; it is important to support them in such ventures. They are also tackling issues of bank erosion, livestock access and reconnecting the river with the floodplain on several Kilnsey beats and so open dialogue between the Club and YDRT should be encouraged. The following recommendations are all achievable on Kilnsey waters.

4.1 Management of riparian vegetation

Livestock exclusion is key to maintaining a diverse riparian fringe which brings with it a host of ecosystem benefits including increased resilience to erosion. There are benefits to the land-owners for keeping livestock away from the water's edge including less erosion of their valuable soil and less disease / parasite transmission. Several sections of fencing are identified in the report that require repairing and extending, and ultimately maintaining. Some of these may be required as part and parcel of stewardship agreements. None of the fencing *in situ* was of flood resistant type (seven or nine-strand, with tensioners and strainer posts, and sectioned every 50m to be 'sacrificial') which would probably be required by the Environment Agency. Other sections were identified for new fencing.

YDRT has worked extensively with land-owners to install appropriate fencing (e.g. along Black Keld), and may be able to help with funding schemes and / or negotiate with land-owners on behalf of the club if required.

If livestock can be excluded, then natural recolonisation of the shrubby flora will occur rapidly. It may be prudent to augment redevelopment of the riparian zone with some planting of native tree species from local stock, particularly alder. Much quicker, simpler and cheaper, is to use willow whips and stakes, pushed into the toe of the bank at a low angle (to reduce transpirative stress) and also angled downstream (to offer less resistance to higher flows). This can be undertaken at any time of the year, but will have the greatest success if within the dormant season, shortly before spring growth begins (ideally late Jan-March). Willow takes readily and may require some future management to keep in check but it is easy to coppice and lay to create low cover, and also the material removed can be used for remediation work elsewhere. Insert whips in bunches to (hopefully) form clumps of young trees, especially on bare banks immediately adjacent to where there is sufficient water depth to potentially hold fish. Staggering clumps of willows on alternate banks, or to augment established trees on an opposite bank, creates more lies and refugia from predators.

Pruning and removal of trailing branches on the wooded banks should be resisted wherever possible. While slightly more challenging to cast to and between, it should be remembered that the benefits to leaving low cover and thereby providing more lies for fish per unit area, greatly outweighs the cost of the odd fly. More importantly, it provides a greater number of fish to aim at.

Where multi-stemmed trees are evident on the potential spawning becks, it is possible to introduce woody material submerged cover as a 'tree-kicker'. The idea is to emulate natural tree fall, but securely retain the material in position so as to not cause a flood risk. Selectively felling a mid or downstream-side trunk and cabling it to its own stump or around another of the trunks, and laying it parallel to the bank with the crown d/s creates localised flow deflection and scouring, thereby increasing channel heterogeneity, whilst also providing brashy refugia for fish from predators and spate flow. The appropriate legal permissions and consents, as well as any other required site-specific guidance, must be obtained before carrying out such works. WTT can help with this; see

http://www.wildtrout.org/content/how-videos#tree%20kicker

4.2 Spawning tributaries

Access to the most prominent potential spawning tributaries was noted as good during the walkover, but this should be checked periodically, especially in autumn during the most likely migration period. Supply of gravels also appeared to be good. The key issues appear to be retention and sorting of appropriately sized gravels, and the presence of shaggy trailing vegetation or brashy woody material (for fry to move into) adjacent to spawning grounds. The causes are straightening of the channel and grazing or poaching of the banks. The latter can be improved by livestock exclusion and riparian vegetation management. White Beck could be an extremely attractive and highly visible full-channel restoration to overcome the straightening issue but this would obviously require substantial landowner agreement.

To help retain gravels, existing trees can be laid (as before) or woody or rock deflectors can be created in various ways depending upon the desired outcomes (see rationales in the legend of Fig 47).

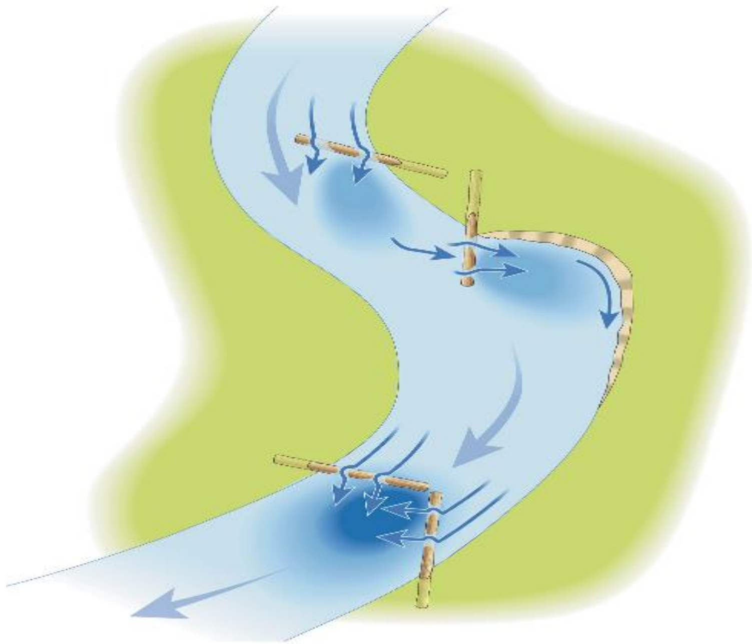

Fig 47. Conceptual diagram of use of woody material (or stone) as deflectors. From the top of the figure:

Upstream angled – diverts flow to the centre of the watercourse and creates localised scour with associated deposition in slack water areas; locating deflectors on opposite banks of a straightened section, but off-set in position, can create sinuosity of flow without eroding the banks.

Downstream angled – diverts flow toward the bank, increasing likelihood of erosion and can be used to increase sinuosity of the entire channel.

Paired upstream angled – focuses more flow to the centre and creates a deeper scour pool with associated ramp of sorted substrate (gravels) further downstream.

Woody material may be won from the bankside or sourced locally and pinned into position either within channel or from the bank itself. Rearrangement of larger boulders (by hand or winch) to create similar structural shapes is also perfectly valid given the rocky nature of the substrate, but they would need to be of a size not to be further reorganised by the next spate. In particularly energetic systems, a combination of large boulders placed against a brace of woody material helps to maintain the structure in place, with the two components supporting each other.

4.3 Pollution

There was little evidence of any excess nutrient point sources. Any discharges of discoloured water, especially under low flows should be reported via the EA hotline (0800 807060). A useful exercise is to partake in the Riverfly Partnership's Anglers' Riverfly Monitoring Initiative (sites are already monitored on the Skirfare and Buckden Bridge), and this could be usefully extended to key spawning becks identified above (http://www.riverflies.org/rp-riverfly-monitoring-initiative).

In April 2018, new Farming Rules For Water come into effect which means that watercourses should be better protected from slurry spreading, manure storage, feeding stations, and poaching / trampling. It is worthwhile getting acquainted with the overview facts and figures so that breaches or likely infringements can be dealt with quickly.

Development and maintenance of effective buffer strips (see Management of riparian vegetation) will help to minimise impacts from diffuse pollution (which includes fine sediments).

4.4 Fish Stocking

It is understood that Kilnsey currently stock their waters below the Kettlewell stepping stones. Evidence from the upper beats and Bradford City AA waters at Hubberholme & Bickden suggests that a wild fishery is sustainable on the Wharfe. Many clubs further downstream have ceased or are winding down their stocking because of the recognised detriment to wild fish populations, and are already enjoying the benefits of a wild fishery. The habitat improvements outlined above will certainly help to promote wild fish populations.

Further information can be found at:

http://www.wildtrout.org/content/trout-stocking

More information on the measures discussed and many other enhancement and restoration techniques can be found in our various publications on the Wild Trout Trust website, under the library tab (www.wildtrout.org/content/library).

5.0 Making it Happen

The WTT may be able to offer further assistance:

- WTT Project Proposal
    - Further to this report, the WTT can devise a more detailed project proposal report. This would usually detail the next steps to take and highlight specific areas for work, with the report forming part of a land drainage consent application.
- WTT Practical Visit
    - Where recipients are in need of assistance to carry out the kind of improvements highlighted in an advisory visit report, there is the possibility of WTT staff conducting a practical visit. This would consist of 1-3 days work, with a WTT Conservation Officer teaming up with interested parties to demonstrate the habitat enhancement methods described above. The recipient would be asked to contribute only to reasonable travel and subsistence costs of the WTT Officer. This service is in high demand and so may not always be possible.
- WTT Fundraising advice
    - Help and advice on how to raise funds for habitat improvement work can be found on the WTT website - www.wildtrout.org/content/project-funding

The WTT officer responsible for fundraising advice is Denise Ashton: dashton@wildtrout.org

In addition, 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

We have 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.

6.0 Acknowledgement

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7.0 Disclaimer

This report is produced for guidance only; 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.