Clifton Beck: Advisory Visit for Calder & Colne Rivers Trust

Report by the Wild Trout Trust – 26/02/2016

1 Introduction

A site visit and habitat appraisal was carried out by Dr. Paul Gaskell and Prof. Jon Grey of the Wild Trout Trust (WTT) at the request of Judith Milner of Calder and Colne Rivers Trust and alongside Ailsa Henderson of Yorkshire Wildlife Trust to explore the potential for habitat improvement on the Clifton Beck in Wellholme Park, Brighouse. The Water Framework Directive (WFD) identifies the Clifton Beck as an individual waterbody via the code **GB104027062700**.

The most recent (2014, Cycle 2) WFD assessments conducted to assess the ecological status of this waterbody include many "good" and "high" classifications. However, the current overall rating is "moderate". There are a small number of measured factors that appear to be responsible for this. Both phytobenthos (single-celled algae and diatoms living on the riverbed) and phosphate classifications are often reported as either "poor" or "moderate" across the different cycles of assessment over time. Additionally, the hydromorphological supporting elements are listed as "not high".

Superficial geology around the river corridor consists of alluvium, silts, sand and gravel with bedrock that is an approximately even split for the whole surrounding area of sandstones (including but not limited to; Elland Flags, Birstall rock, Clifton rock) and Pennine Lower Coal Measures Formation. It was interesting to note that, at the time of the visit, there was no discernible peat stain to the water – and the upstream surface geology does not indicate significant peat deposits in the Clifton Beck's catchment.

Throughout this Advisory Visit (AV) 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. The features noted during the visit are reported here in the sequence in which they were observed. The survey was conducted in an upstream direction beginning at National Grid Reference **SE 14913 23119** and ending at a concrete ford at **SE 14715 23643**. Whilst the straight-line distance between the upstream and downstream limits is around 500 m, the meandering course of the river probably means that around 750 m of river habitat was assessed.

2 Habitat Assessment notes

The variety of different characteristic structural features in the channel at this point indicates the potential for geomorphology (the formation of topographic features via erosion and sedimentation driven by air, water or ice) to produce valuable habitat on the Clifton Beck. The different depths, flow-velocities and particle-sizes of bed material that were observed provide many niche opportunities for a variety of flora and fauna (Figs. 1 and 2).

Figure 1: Glide and riffle feature at SE 14913 23119. Varied habitat supporting diverse invertebrate communities

Figure 2: Even though constrained by a wall on the RB, processes of erosion and deposition have created cross-sectional (and longitudinal) variety in depth, velocity and particle size. It is possible that there is an elevated supply of fine (sand/silt) to the channel. If this is derived from improved farmland, this could be a source of the high phosphate concentrations reported in its WFD classification.

Although the channel appears to be capable of re-mobilising and redistributing fine sediment, there appears to be a somewhat elevated supply of sand and silt fractions. This is often associated with surface water runoff washing loose soil into the river (or sometimes runoff from road drainage systems). Land-use in the upstream catchment is reported by AV recipients to include dairy farming and possibly sheep farming. It is possible that, depending on the presence/absence of grazing exclusion to produce vegetated buffer strips, a greater input of fine sediment is derived from agriculture in the upstream catchment.

In addition, the mowing regime within Wellholme Park, dog access/bank erosion and infestation of Himalayan balsam (*Impatiens glandulifera*) are also likely to raise local inputs of fine sediments. Mowing vegetation prevents establishment of deep root structure that would, otherwise, reinforce the banks. Similarly, the existence of (and mechanism for) elevated soil erosion due to balsam infestations has been published in primary scientific research literature recently (http://rd.springer.com/article/10.1007%2Fs11368-013-0825-9) and is also illustrated in a simple WTT video (https://youtu.be/VijmRm-qd4Y). While fine sediment is not in and of itself a bad thing – the overall amount and its capacity to act as a vector for nutrients and pollutants into watercourses can lead to negative impacts on biodiversity.

During the visit, it was noted that the interstitial spaces (pores) between gravel particles were generally filled with fine sand and silt. This lack of "sorting" of deposited material tends to lead to reduced niche opportunities for invertebrates and also reduced egg survival for gravel-spawning species like trout. The blockage of pores within gravel beds prevents the through-flow of oxygenated water that eggs require to survive and thrive. Localised sorting of gravels (and associated wash-out of fine sediment) is produced when stable woody material is present in the channel. The action of the current finding a path over and around woody material produces localised scouring of the riverbed (Fig. 3). The aggregated fine and coarse sediment that is washed from the riverbed by the action of this localised scouring flow leaves a hollow in the riverbed (a scour-pool). As the scouring flow dissipates downstream of the woody material, material is deposited according to flow velocity: larger particles fall out of suspension in faster water – fine particles settle in slower currents. This ensures separate zones of deposition for fine and coarse particles. The existence of localised bed-scour and grading of particle sizes is, as a result, a huge benefit to egg survival in gravel-spawning species.

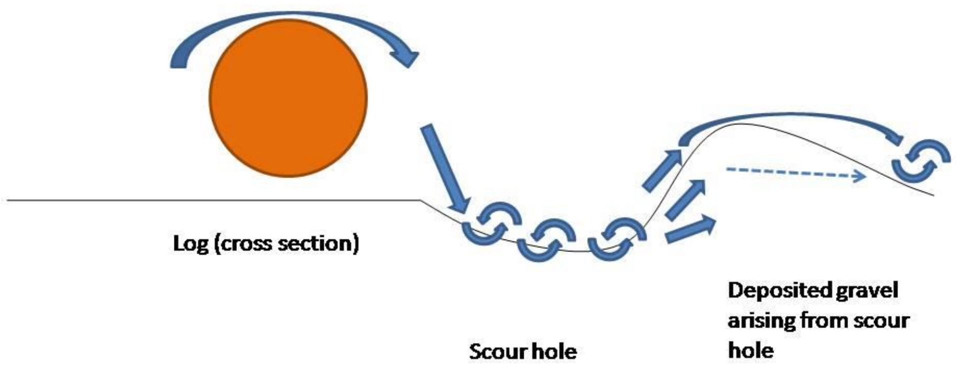

Figure 3: Woody material in the channel is not only responsible for scour-pool creation, but also "sorting" of deposited gravels with an associated through-flow of oxygenated water that is essential for good egg survival.

Consequently, exploring opportunities to control riparian invasive plant species and establish a more varied bank-side flora are likely to be a positive development in Wellholme Park (Section 3: Recommendations). Special areas where walkers and dogs cannot access can be produced to meet this aim. When coupled with interpretative signage, those high-biodiversity “wildlife plots” can provide social as well as ecological benefits. As a more ambitious aspiration, extending the existing work on the Upper Aire catchment (i.e. the Large Project award winners at the 2015 WTT/Thames Water Conservation Awards: http://www.wildtrout.org/news/winners-2015-conservation-awards) – potentially by working collaboratively with the Aire and Calder Catchment Partnership (http://www.aireandcalderpartnership.org/) – would bring significant benefits.

Localised scour and the valuable habitat that results is exemplified by the riverbed morphology caused by the “undershot scour” (i.e. scour resulting from water being squeezed underneath) associated with the curved tree trunk growing outwards and upwards at SE 14920 23120 (Fig. 4). During the visit a significant amount of ad-hoc pruning and lopping of tree limbs with hand saws was observed. The arising branches were discarded haphazardly, suggesting that it was carried out via unofficial channels. This activity should be discouraged where possible due to the potential for unintended consequences for tree health and damage to habitat creation processes (such as those described with reference to Fig. 4).

Figure 4: Scour pool habitat created beneath and downstream of the tree growing out of the wall. During spate conditions the flow diverted underneath and around the trunk has created valuable habitat. Note the speed of the water on the outside of the bend and the slowing of that by the increased depth of the pool habitat (darker water). The slower flow on the inside of the bend (lower right of frame) is associated with deposition of bed material to form a sloping “point bar” – additional structural variety that supports greater biodiversity.

Several instances of the ecologically valuable processes of scour and deposition were noted in the lower reaches assessed during the survey (e.g. Figs. 5 and 6). In many “post-industrial” rivers, weirs and other channel modifications are common and have a very large combined impact on habitat quality – particularly when they result in impounded reaches of river. Such impacts are at least equal to (and may even be more damaging than) the barrier to migration that such structures represent. This highlights the contribution to biodiversity at the landscape and local scales associated with a lack of impounding structures.

Figure 5: As well as scour-pool creation, the roots of this tree have stabilised and controlled rates of bank erosion after the failure of the stone wall.

Figure 6: A scour pool of impressive depth formed by a sharp bend on the river. Both the depth and the tight angle of the bend are enabled by the resistance of the banks resulting – not only from the old stonework – but also from the deep root-structure of woody vegetation. Over the longer-term, the self-regenerating living reinforcements (tree roots) will be more reliable than temporary built stonework for ensuring the resistance of banks to lateral erosion.

The structurally-diverse habitat is evident up to SE14873 23185. At that point, a weir impounds the upstream watercourse and significantly reduces the variety of available niches. Compare the reach below the weir (Fig. 7) with that directly upstream of the structure (Fig.8).

Figure 7: Despite bank erosion caused by foot-fall and dog-access (right of frame), the deposited gravel and cross-sectional variation in depth and current-speed provides a variety of habitat features.

Figure 8: Slow, canal-like flow that extends across the full width of the channel. The substrate is dominated by fine sediment - providing much more homogenous habitat with fewer available ecological niches.

The weir is also likely to be a completely impassable structure to trout (at least in an upstream direction; Fig. 9).

Figure 9: The sloping face of the weir with its shallow, fast flow of water is a complete barrier to upstream migration of trout and other fish. White water indicates the air entrained within the flow that removes the ability of fish to swim.

There are multiple beneficial effects of removing weirs such as the one pictured in Figure 9. However, in this case, there are particular considerations that must be accounted for. Firstly, a general lack of deep root structure has resulted in the river already beginning to cut off the sharp meander upstream of the weir (Fig. 10). Deep roots act a bit like reinforcing bars in concrete and significantly increase the resistance of riverbanks to the process of erosion.

Figure 10: Looking downstream from above the weir, the hand-rail can be seen on the footbridge over the weir top left of frame (also visible in Fig. 9). The shallow root system caused and maintained by mowing of vegetation means that the river is cutting its way around the weir.

Removal of the weir would probably accelerate this process. An alternative view would be that, left to its own devices, the river will eventually bypass the obstruction on its own. Whether this latter approach is an acceptable one will depend largely on the potential for the river to impact on the adjacent playground amenity area. The use of tree planting and vegetated buffer-strip establishment to protect existing amenities is discussed in section 3 "Recommendations".

The importance of free passage upstream and downstream (with the avoidance of bottlenecks that significantly increase mortality due to predation) is generally under-appreciated for many fish species. Most attention is paid to marine-migratory (anadromous) species such as salmon and, perhaps, sea trout. However, a number of fish species that complete their lifecycles within freshwater also need to migrate in order to spawn.

Brown trout are one such species. In addition to a simple requirement to move from habitat that is suitable for adult trout to habitat that is suitable for spawning during the breeding season, there are other more subtle phenomena. As a very simple example – the natural redistribution/recolonisation of fish following spate flows can be impeded by barriers constructed in watercourses. As a more complex example, barriers can sometimes cause the artificial segregation of what would, otherwise, be a single breeding population. This reduction in the total effective breeding population size in the two separated groups can have negative implications for the ability of those populations to survive.

The smaller the number of individuals that are able to mate with each other – the greater the role of pure chance in the allocation of genes to offspring. This can lead to shifts in the genetic makeup of populations that are **not** driven by adaptation to local conditions. Such stochastic, non-adaptive shifts are found to be associated with increased risk of population extinction. This effect is greatly under-appreciated and not well-accommodated within typical cost/benefit discussions relating to removal of weirs.

Although the impounding effect of the weir begins to disappear about 150 metres upstream (shorter as the crow flies, due to meandering planform), this represents a considerable amount of degraded habitat. When coupled with the barrier effect of the weir (and considering the "Not High" WFD status of Hydromorphological supporting elements), there is a strong imperative to remove or bypass this structure.

Further examples of the erosion and associated fine sediment inputs arising from shallow root structure were observed throughout the reach (e.g. Fig. 11).

The progressive collapse of the stonework that is used to control the path of the river is, similarly, noted throughout the visited reaches (e.g. Fig. 12).

Figure 11: Elevated fine sediment inputs due to lack of riparian vegetation caused by mowing and public footfall at SE 14862 23322.

Figure 12: Gradual collapse of stonework (expensive to maintain) may highlight the desirability of establishing woody vegetation that will automatically regulate rates of bank erosion with little requirement for additional intervention or cost.

Much of the river channel within the park sits within quite a steeply "incised" channel. In other words, the banks on either side are steep and the surface of the water at normal flow levels is set well below the level of the bank-top. This may reflect the geomorphological processes of the river that, in response to artificial realignment, act over time to re-establish inherent channel dimensions, profile and planform. Steeply incised channels exacerbate problems of erosion due to footfall (whether by walkers or pets). A rare example of the water's surface being relatively close to the level of adjacent bank and flood-plain features was noted at SE14819 23533 (Fig. 13).

Figure 13: Deposition and vegetation of a point bar on the left of the frame (RB) has produced a bank-top level that is much closer to the normal flow height of the water. Similarly, the opposite bank is also much closer to the level of the water than is typical of the visited reach as a whole.

It is not clear whether this is due to historic widening of the channel – with a subsequent re-balancing of channel dimensions according to the inherent, emergent properties of the channel. It may also be due to the river flowing over a less easily erodible substrate. Whatever the case, there is value in the fact that this variation from the predominant incised character also exists within the visited reach since it provides additional structural diversity.

The footings of what was previously an impounding weir structure were visible at SE14818 23585 (Fig. 14). The resultant increase in upstream flow energy (and also the downstream redistribution of material from the weir) has produced valuable habitat. This is an example of the benefits of removing impounding structures for overall biodiversity. There are particular benefits for rheophilic (flow-loving) species such as trout and also the organic-pollution-sensitive stone-clinging mayfly nymphs observed during the visit.

Whether incised or not, there was a general lack of submerged or low-overhanging "brashy" cover. As well as conferring protection for cold-water specialists via passive cooling during hot weather/low flow conditions, this type of habitat is an essential refuge for young fish. It protects against both excessive predation and also against washout of fry during spate flow conditions. Not only that, but these refuge areas also reduce the disturbance experienced by adult fish caused by high volumes of walkers and other park-users (see section 3 "Recommendations").

Figure 14: Remains of an old weir and associated gravel-bar depositional feature. At the far bank, the weir structure has washed away so that the original bed level is close to being reinstated. This has restored fish passage and has also delivered habitat improvements upstream and downstream.

The upstream boundary of the visited reach was marked by a substantial concrete ford (Fig. 15).

Figure 15: Concrete ford at SE14715 23643 – a serious barrier to fish migration.

Although perhaps appearing to be more innocuous than a high weir, this ford is actually a serious barrier to migrating fish. It is also another interruption to the downstream transit of riverbed material. Such transit is an essential process for creation of in-stream habitat structures. The apparent requirement for access means that potential improvements to this situation are likely to be more challenging than is evident to most observers at first sight.

3 Recommendations

There are a number of opportunities to improve habitat and prospects for biodiversity – including wild trout – in the Clifton Beck within Wellholme Park. Options include simple, low-cost and low-tech activities. There are also potential benefits associated with much more extensive, landscape-scale projects. However, those more ambitious objectives do not devalue the benefits that are possible to achieve through more modest works. There are some excellent opportunities to create pockets of riverbank habitat where public access and formal vegetation management/mowing are prevented. With appropriate signage, these plots could provide extremely valuable engagement tools for the public – while at the same time greatly improving the ecology of the river corridor. Public access should be encouraged to take place in designated areas with the aim of providing access that is much more sensitive to wildlife. Reduction in vegetation trampling (and associated bare earth) as well as lower sediment inputs arising directly from footfall are two important benefits.

3.1 Recommended local Reach-scale activities include:

- Hand-pulling of Himalayan balsam (can be heaped and composted effectively *in-situ* to avoid the need for treatment as biohazardous waste implied by transporting off site).
- Establishment of unmown, vegetated buffer strips in areas that currently lack vegetation (other than shallow-rooted grass turf). This is an excellent opportunity for partnership work between Calder & Colne Rivers Trust and Yorkshire Wildlife Trust to derive and source a locally-appropriate riparian vegetation species mix (see notes above on creating "demonstration" plots with interpretive signage).
- Construction of more managed public access points to control erosion of soft banks by dogs and members of the public (planting schemes can co-ordinate with this aim in order to encourage/discourage access to specific points)
- Supportive planting of trees (see Fig. 16 for information on existing local Forestry Commission-supported works) and locally-appropriate riparian understory species.
- Removal or bypass of the weir at SE 14873 23185 (likely to require expert geomorphological advice in order to manage the response of the channel – again planting schemes could perform a central role in that management as a means of effectively controlling bank erosion rates).
- Engage local highway and council authorities, an EA development control representative and EA fisheries/biodiversity staff to pursue permissions, design and delivery of fish passage easement across the ford at SE14818 23585. Again, Forestry Commission involvement may also be valuable in achieving this aim.
- Some very light, occasional coppicing of existing bank-side trees would promote low, bushy regrowth that would provide valuable additional cover for a variety of species – including juvenile and adult trout. This work should be planned and also carried out by properly certified personnel (i.e. not the ad-hoc lopping activity noted during the visit).
- Planted trees (or whips) of suitable sizes could also be selectively hinged (or "laid") into the margins of the beck to provide shelter from predation

and spate flows for juvenile fish (Fig. 17). Some localised bed-scour can also be encouraged by material laid into the margins in this manner.

All the above works require permissions and cooperation from a variety of sources. Invasive plant removal and changes to the management of riparian vegetation will require liaison with the local council as well as any partnership organisations. In addition, because the Clifton Beck is classified as "Main River" in terms of its flood risk, any planting, hinging or (more obviously) bypass channel/weir removal/fish passage works either in the channel or within 8-m of the channel boundary will be subject to consenting via the EA. The principle departments involved in this process will be Development Control, Flood Risk Management and Fisheries & Biodiversity.

Figure 16: Sign photographed in Wellholme Park during the visit


Figure 17: Hinging or laying of saplings to create marginal cover (in this case using hazel – but many suitable species exist)

3.2 Landscape Scale Improvements:

As indicated in Section 2 "Habitat Assessment", there would be great value in pursuing a large-scale project in the upper Calder catchment that aimed to control both sediment/pollutant inputs as well as surface-runoff. Activities that were central to the excellent works completed in the upper Aire catchment included:

- Grazing exclusion (and associated reduction in bank poaching/faecal matter input)
- Deciduous tree planting to control runoff
- Improvement of in-channel structure
- Improved land-use practices that reduced sediment and nutrient inputs

In addition, there is great value in identifying and tackling Combined Sewer Outfall (CSO) issues (and associated potential mis-connections or blockages) within the upper Calder catchment as this is also implicated by the high phosphate levels detected during WFD waterbody status classification cycles.

Ongoing support in the pursuit of these various aims is available from the Trout in the Town project manager (Paul Gaskell Email: pgaskell@wildtrout.org Tel: 07919 157267) and the rest of the Conservation Team at the WTT.

4 Acknowledgement

The WTT would like to thank the Environment Agency for supporting the advisory and project proposal work associated with this project – including a portion of funds arising from rod licence sales.

5 Disclaimer

This report 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.