Advisory Visit

Brailsford Brook, Derbyshire

July 2015

1.0 Introduction

This report is the output of a site visit undertaken by Tim Jacklin of the Wild Trout Trust to the Brailsford Brook, Ednaston, Derbyshire on 21st July, 2015. Comments in this report are based on observations on the day of the site visit and discussions with Sir David Samworth and Robert Hiddersley.

Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left hand bank (LHB) or right hand bank (RHB) whilst looking downstream. Specific locations are identified using the Ordnance Survey National Grid Reference (NGR) system, for example Dam Farm, NGR SK2425642735.

2.0 Catchment / Fishery Overview

The Brailsford Brook rises to the south east of Ashbourne and flows south, joining the Shirley Brook to form the Sutton (or Hilton) Brook, which joins the lower Dove near Egginton.

The Brailsford Brook spans the northern boundary of the Needwood and South Derbyshire Claylands Natural Area (www.naturalareas.naturalengland.org.uk/Science/natural/NA_search.asp). The brook flows over a geology of Mercia mudstone with superficial deposits of alluvium and river terrace material; this is reflected in the bed substrate which is predominantly gravel. Land use in the catchment is predominantly agriculture with a mix of arable and livestock farming. The surrounding land falls within the East Midlands Theme for Higher Level Stewardship, although current agri—environment agreements in the immediate vicinity are all of the basic Entry Level Stewardship type (www.magic.gov.uk). There are no statutory conservation designations such as Sites of Special Scientific Interest (SSSI) in the vicinity.

Under the Water Framework Directive, the Environment Agency assess rivers and streams against targets for water quality, ecology and physical condition of the channel. This section of the brook falls within waterbody ID GB104028052870 which encompasses the whole Hilton Brook catchment to its confluence with the Dove. It was classified as being in good status in 2009 and moderate status in 2014. The reason for the recent reduced status appears to be detection of an elevated level of zinc in a water sample (failure of a single parameter affects the overall classification). Measures for invertebrates, plants and algae, and other water quality parameters remain good or high.

The section of the Brailsford Brook inspected has in the past been engineered and adapted for fishing, with the creation of numerous weirs and lakes and ponds fed by the brook. This is referred to in the book *By Dancing Streams* by Douglas McCraith, published in 1929:

The Bradley Brook in its natural state is a tiny burn only a few feet wide, but money skilfully expended has converted it into a trout stream with pools and weirs. Mr. W.H. Radford, the well-known civil engineer and water authority, who owned the property at that time, was responsible for having effected the improvements, and only an expert could have done it as he did. In addition to the improvements to the brook, Mr. Radford has taken advantage of a natural depression in the land to form a small lake of about one and a half acres, into which he introduced water plants and larvae of various forms of water insects. Trout in this lake grew up to two pounds without any artificial feeding.*

[* The Bradley Brook (with Bradley Lake) and Spinneyford Brook (with Secret Lake) join to form the Brailsford Brook, but the latter name is used throughout this report to refer to the fishery].

The section of brook inspected is over 2km in length and includes two lakes (Secret Lake and Sandy's) and several ponds which are fed from the brook. The latter (Top, New, Long, Middle, Round and Rainbow Ponds) are known collectively as the hatchery ponds because of their former use as such. In addition, two lakes (Bradley Pond and Monk's Pond) are present on dammed side streams to the west of the brook; these were not inspected on the visit.

A fishing syndicate with four members fishes the brook, along with the owner and family. Six hundred trout have been stocked into the fishery this year, spread between the brook and the lakes/ponds. Some supplementary feeding with trout pellets takes place in the vicinity of the hatchery ponds. The non-native, invasive signal crayfish (*Pacifastacus leniusculus*) is present throughout the fishery and upwards of 4000 have been removed and destroyed by trapping.

3.0 Habitat Assessment

The brook was walked in an upstream direction from Dam Farm to the upstream limit at Secret Lake; the downstream section was then inspected between the outflow from Monk's Pond upstream to Top Pond.

The overriding influence on the in-stream habitat of the brook is the presence of numerous weirs. Approximately 50 weirs were counted along the course of the brook, equating to about one every 40 metres.

As described in the book extract above, the weirs were installed to create a fishery which would be more easily accessible to anglers than the small brook in its natural state. Whilst this aim has been successful, there are several negative impacts upon the production of wild brown trout which result.

The transport of coarse sediment (gravel) is disrupted by the weirs. The beds of natural rivers and streams are dynamic and such sediments are moved downstream during periods of high water, forming features such as riffles, shoals and side bars (beaches). These features are vital habitats for trout spawning, flow-loving invertebrates (such as brook duns, March browns, olives, blue-winged olives) and plants (such as water crowfoot).

Figure 1 and Photo 1 show how gravels which would normally be transported, graded and deposited by the brook are trapped behind the weir structure. The slower, stilled water immediately upstream of weirs also promotes the settling out of finer sediments (sand and silt), uniformly across the full width of the channel, filling the spaces between the gravels, making them unsuitable for trout spawning and flow-loving invertebrates.

Linked to the disruption of sediment transport and impoundment of flows, weirs also change the natural shape (morphology) of the river channel, reducing bed scouring and preventing the formation of the natural pool-riffle sequence. This reduces the availability of trout spawning and juvenile habitat (Figure 2). Increased rates of bank erosion can also take place downstream of weirs where back eddies occur, leading eventually to the river bypassing the weir structure (Photo 2).

A further downside to weirs is the impediment to the free movement of fish. In rivers and streams, adult trout tend to run upstream in autumn and breed in headwaters and side-streams. Their offspring then disperse in a <u>generally</u>

downstream direction as they grow and mature, occupying available habitat niches. Note the emphasis on "generally", as all sizes of fish will move both upstream and downstream to fulfil their requirements for spawning, feeding and shelter from predators/floods, over varying timescales from hours to months/years. The ability to move between habitats is compromised by weirs and even small structures can prevent or significantly delay progress, especially given the cumulative effect of multiple weirs. For example, disruption to the downstream progress of smolts has been shown to greatly increase losses to predation at weirs on the River Tweed (Gauld *et al*., 2013).

The overall effect of the weirs throughout the Brailsford fishery is to create adult trout habitat (weir pools and glides) at the expense of spawning and juvenile habitat, leaving the fishery reliant on stocking or immigration of wild trout from adjacent reaches (the latter being compromised by the weirs themselves as noted above). Removal of weirs would restore a more natural channel form and sediment transport regime, which would improve in-stream habitat and natural productivity of trout within the fishery.

There are however a number of caveats:

- Secret Lake, Sandy's Lake and the hatchery ponds are fed from the brook and each abstraction point relies on the water level being maintained by the weir immediately downstream (Photos 3 - 6). Removal of these weirs would lower upstream water levels and prevent abstraction of water into the lakes.

- The large weir at NGR SK2436142611 (Photo 7), downstream of the footbridge below Dam Farm, appears to maintain water levels supplying the mill leat leading to Brailsford Mill (Slack Lane, NGR SK2433542040). This was not inspected during the visit and further investigation is required.

- Removal of weirs would alter the nature and appearance of the brook considerably, reducing its width, creating long sections of shallow, faster-flowing water and re-distributing river bed material. This would in turn affect ease of access for angling, making it more challenging and possibly requiring wading rather than fishing from the bank. An approximation of what the brook would look like in the absence of weirs is visible in the short section adjacent to the inflow from Monk's Pond (Photos 8 - 9) at NGR SK2424742427.

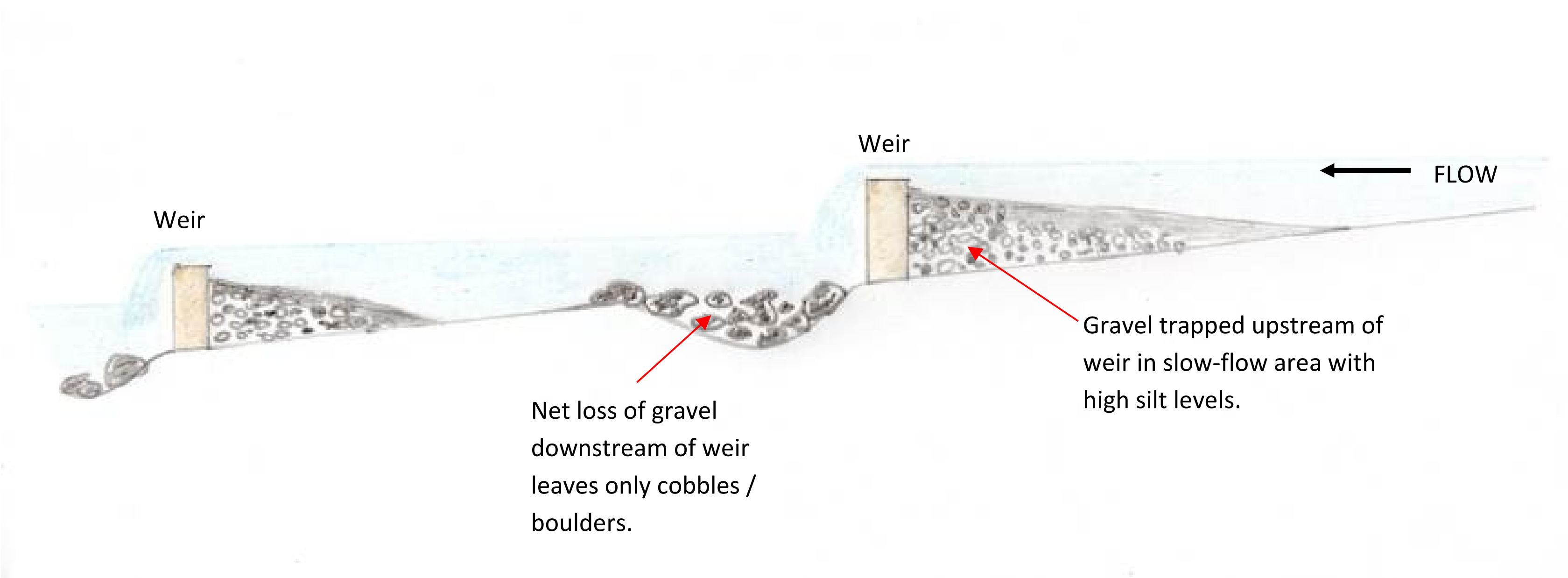

Figure 1 Longitudinal section of brook showing the effect of weirs on sediment transport. Coarse sediment (gravel) of the correct size for trout spawning is trapped in areas upstream of weirs where the flow is too slow and fine sediment (sand/silt) accumulation too great for successful spawning. Downstream of the weir where flow is faster and oxygenation greater, no suitably-sized spawning gravels remain (just large cobbles and boulders).

Photo 1 Accumulation of gravel upstream of a weir, trapping suitably-sized trout spawning medium in an unsuitable area for spawning. Also note the accumulation of silt amongst the gravel.

Photo 2 Bank erosion and channel widening caused by flow patterns generated by the weir in high flow events.

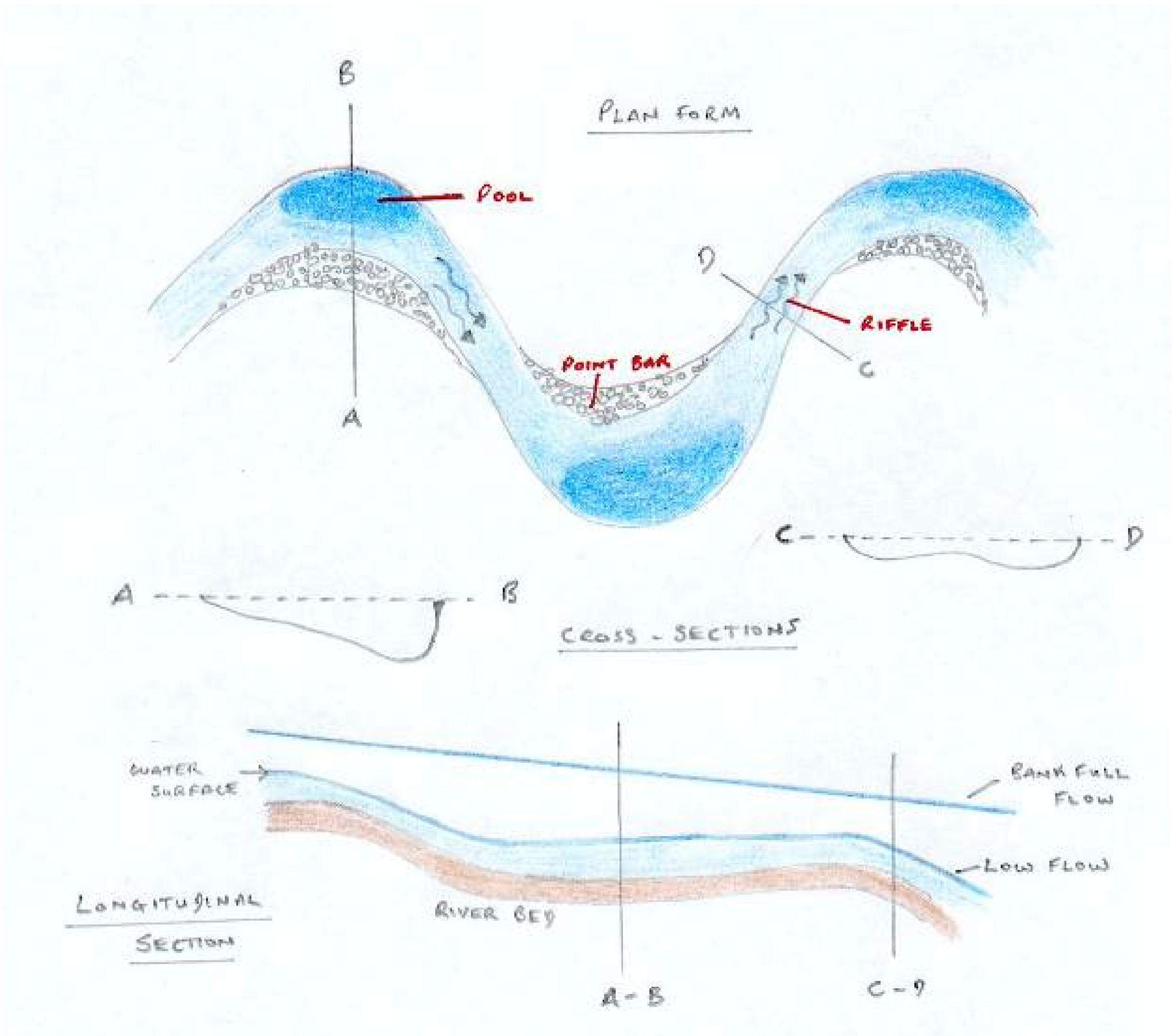

Figure 2 Natural channel morphology of lowland alluvial streams. Note the meandering plan-form, with deeper pools on the outside of bends and gravel point bars (or side bars) on the inside. Shallower, faster-flowing, gravel riffle areas are formed between bends/pools. The gradient of the river bed is unevenly distributed, with relatively flat-bottomed pools and steep riffles. The gradient break-points across the riffles promote flow of water <u>through,</u> as well as over, the gravels, providing areas where trout eggs buried in the gravel can survive. Deeper pools provide adult trout habitat and the shallower riffles provide spawning and juvenile habitat.

Photo 3 Water off-take feeding into the hatchery ponds, which relies on the water level maintained by the weir downstream of this picture (NGR SK2433143031).

Photo 4 Weir at NGR SK2443643403 which maintains upstream water levels to feed the off-take into Sandy's Lake (Photo 5).

Photo 5 Off-take from the brook feeding into Sandy's Lake

Photo 6 Weir at NGR SK2457044159 with off-take into Secret Lake in the background (arrow).

Photo 7 Weir downstream of the footbridge below Dam Farm (NGR SK2436142611) which maintains water levels for the mill leat to Brailsford Mill (requires further investigation).

Photo 8 Un-impounded (no weirs) section of brook near Monk's Pond outflow (NGR SK2424742427). Note the gravel side bars, riffles and shallow water.

Photo 9 As above, showing a gravel riffle and a deeper pool on the meander bend (lateral scour pool).

Inspection of old maps back to 1880 (www.old-maps.co.uk) show the brook follows approximately the same course now that it did 135 years ago. There was a bifurcation of the channel (and by inference a weir) at the same point where the hatchery pond off-take is now (NGR SK2433143031); the hatchery ponds themselves first appear on a 1922 map (absent in 1901). Monk's Pond also appears between 1901 and 1922, supporting the reference in McCraith (1929) to the works carried out by Mr. Radford. A fish pond just upstream of Blue Bridge is also marked on the 1922 map but is absent by 1978 (NGR SK2453443694).

Sandy's Lake and Bradley Lake do not appear on maps until 1978 (absent in 1955) indicating relatively recent construction. The smaller pond (right bank) between the two aforementioned lakes also appears at this time. It was not clear during the visit where the outflow from Sandy's Lake re-entered the brook. Some drainage pipes were discharging to the river on the left bank (NGR SK2437343031, Photo 10) but this requires clarification. In addition, there appeared to be an interruption to the flow of the brook in the vicinity of the smaller pond, where no water was passing over a weir despite good flows over the ones immediately upstream and downstream; this requires further investigation to clarify the flow pathway (Photo 11).

Despite the river following the same course as in 1880, it is highly likely that the course adjacent to the current hatchery ponds was moved to the west from its original course. This section of the brook appears to be in a perched channel (higher than the adjacent land) and it was common practice to move river courses to higher levels on valley sides to provide a head of water for milling (the diversion of the brook into the mill leat is a short distance downstream, at the weir in Photo 7). The original course probably flowed through the field in Photo 12, which still shows a linear wet area marked by rushes.

Some of the hatchery ponds appeared to have become silted and shallow. This requires further investigation to determine the depth of silt over the original bed level, but it is likely that fine sediment washed in from the brook and organic silt from the breakdown of leaf litter and weed have accumulated over the years. Siltation and shallowing of ponds leads to elevated water temperatures and generally poorer conditions for fish, particularly cool-water species such as trout.

De-silting can be carried out by draining the pond/lake, allowing the sediment to dry and then excavating it, or by suction dredging where the sediment is "Hoovered" up by pumps. In both cases, the main practical constraint is disposal of the spoil. With the former method, spoil can be spread to land for agricultural benefit (with appropriate waste exemption licence). The latter method is less invasive in terms of heavy plant access, but a lagoon needs to be constructed to allow settlement and drying of the sludge, which can then be spread to land (as above). The need to haul spoil for disposal and the distances involved greatly influence the cost of these operations.

Where ponds and lakes are fed by streams, the rates of siltation are greatly increased because the stillwaters act as settling ponds for sediment washed in by the stream (especially during high water events). Ideally ponds and lakes should be "offline" (have no inflow), but this depends on whether pond water levels can be sustained without an inflow. The hatchery ponds were built for fish farming hence have been designed to allow draining and re-filling. Now they are no longer used for this purpose, the amount of flow entering the ponds could be varied to see what effect it has on water levels. Installing penstock sluices at the inflows would allow a much greater degree of control over the feed of water from the brook and facilitate experimentation (Photo 13). In addition, the flow could be shut off completely in times of flood, reducing the input of silt from the brook.

Reducing the flow into the lakes and ponds to the minimum required would also benefit the ecology of the brook. It was evident during the visit that the sections of brook between the inlets and outlets for Sandy's Lake and for the hatchery ponds had very little residual flow (for example, Photo 10 showing no flow over the weir).

Photo 10 Plastic drainage pipes discharge water to the brook from the true left bank (right of picture) – the outflow from Sandy's Lake? Note the lack of flow over the weir upstream, resulting from the diversion of flow through the hatchery ponds which lie on the true right bank adjacent to this area.

Photo 11 No flow over the weir near the Bradley Brook confluence – further investigation is required to clarify the flow pathway here.

Photo 12 Field on the true left bank of the brook which is in a perched channel to the right of the picture. The original brook course probably flowed through the lowest part of the field.

Photo 13 Installing a pre-fabricated penstock sluice at a lake inlet from the River Glaven, Norfolk.

Riparian habitat along the brook is generally very good with a mixture of mature trees and herbaceous vegetation which provides shade and cover over the water. Unfortunately the non-native, invasive plant Himalayan balsam (*Impatiens glandulifera*) is rife throughout the fishery. This plant can dominate native vegetation, yet dies back in winter leaving bare banks vulnerable to erosion. Diversity of both vegetation and invertebrates is reduced where balsam is abundant. Control by pulling or repeated strimming (below the first node of the stem) before it flowers is the best approach.

4.0 Recommendations

It is recommended that a number of weirs are removed to restore a degree of natural sediment transport and to improve habitat conditions for trout spawning and juveniles. Preferably blocks of weirs should be removed, rather than, for example, alternate ones; this is to give a reasonable length of river over which natural river processes can re-establish.

Given the restriction on weir removal where water levels need to be maintained to feed lakes and ponds (Section 3), suggested areas where weir removal could take place are:

- Between the weir at Secret Lake off-take and Sandy's Lake off-take. Both the weirs maintaining water levels for these abstractions and the weir below each should be retained.
- Downstream of the large weir at the mill leat off-take (Photo 7). There are four or five weirs here which could easily be removed, plus maybe some more in the wood downstream (not inspected on this visit).

There is also scope for weir removal between Sandy's off-take and the hatchery ponds off-take, but it is recommended that the further investigation is carried out to clarify the exact flow pathway and discharge route from Sandy's lake before considering this. Also, the results of weir removal elsewhere will inform further work.

Please note, it is a legal requirement that all the works to the river require written consent from the lead flood authority (Environment Agency or

County Council depending on watercourse classification) prior to undertaking any works.

In terms of stocking trout, it is recommended that the numbers of fish introduced to the brook is reduced considerably or ceased, particularly in the areas where weir removal takes place. This will improve the prospects of survival for naturally spawned fish through reduced competition and predation. Stocking could be restricted to the lakes, allowing improved wild production to populate the brook.

It is recommended that an assessment of the lakes and ponds on the fishery are assessed to determine the degree of siltation, options for managing the inflows and outflows and options for de-silting (if required).

5.0 Making it Happen

The WTT can provide further assistance to help implement the above recommendations. This includes help in preparing a project proposal with more detailed information on design, costs and information required for obtaining consents to carry out the works. It can extend to selecting suitable contractors and overseeing the project delivery. We do have a high level of demand for our services, but this is an interesting and challenging project and we would be very pleased to work with you if resources allow.

We have 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.

The WTT website library has a wide range of materials in video and PDF format on habitat management and improvement: http://www.wildtrout.org/content/index

6.0 References

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7.0 Acknowledgement

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8.0 Disclaimer