Advisory Visit

Harper's Brook, Sudborough, Northamptonshire

September 2018

1.0 Key issues

- The shallow nature of the brook and its relatively small size means that simple habitat enhancement techniques, such as flow deflectors and brushwood ledges, would present a cost-effective means of bringing about habitat gains to the brook.
- The brook is surprisingly clear of Large Woody Material (LWM). LWM material should be retained in-channel (securely) whenever and wherever it does not pose a flood risk (such as at and below water level).
- The brook is receiving a high sediment load which is smothering the gravel bed and is believed to be contributing to an impoverished invertebrate community.
- Much of the brook lacks flow diversity with an even depth across the channel contributing to poor habitat diversity.
- There is a particular deficit of marginal habitat such as emergent vegetation or deposits of LWM.
- A low stone weir is present which does not appear to serve a purpose. It should be removed.
- Himalayan balsam, an invasive non-native plant, is present and should be eradicated.
- Much of the brook is over-shaded. Tree thinning to open up selected parts of the brook would aid marginal vegetation growth.

2.0 Introduction

This report is the output of a site visit undertaken by Rob Mungovan of the Wild Trout Trust to the Harper's Brook, Sudborough, Northamptonshire, on 5th September 2018. Comments in this report are based on observations on the day of the site visit and discussions with the owner and a representative from the River Nene Regional Park.

The purpose of the visit was to advise on the suitability of the Harper's Brook for wild brown trout and measures that could be implemented to improve habitat for brown trout. The visit took place after a period of extended hot weather with little rainfall.

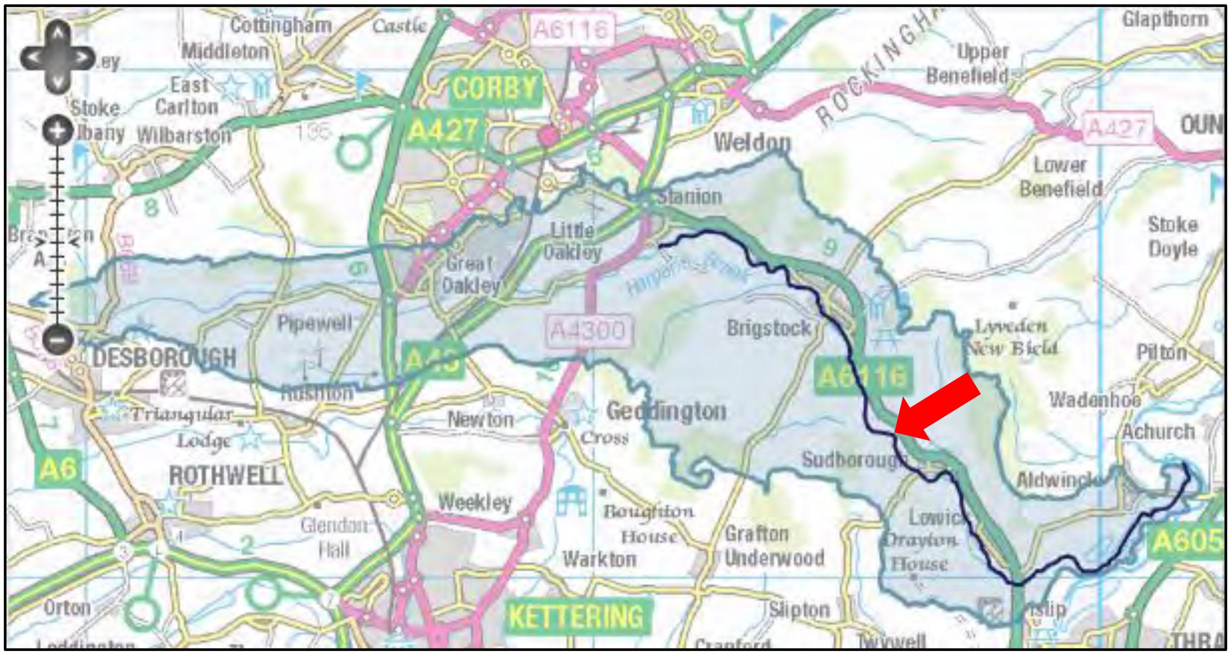
Normal convention is applied throughout the report with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) whilst looking downstream.

3.0 Catchment Overview

Table 1 summarises the environmental data collected for the Water Framework Directive (WFD) for the Harper's Brook. In the 2016 assessment cycle, it was classified 'moderate' ecological status (i.e. it is failing to meet some of its targets). Parameters that make up this overall classification include 'good' for fish (2009 data only), 'high' for invertebrates (2009 data only), and 'high' for dissolved oxygen. There are no specific water quality problems known to be associated with the reach visited. Encouragingly, the 2016 assessment cycle did not require investigation of 'other pollutants', it had ammonia classed 'high' (being good) and phosphate as 'moderate'. The biological quality elements were listed as 'high' in the 2009 cycle but had fallen to 'moderate' by 2016. The overall health of the brook appears good which is encouraging given the industrial legacy of mining within the immediate catchment and the industrial town of Corby (a former major steel producer) in its upper reaches. There are no conservation designations relating to the site.

	Waterbody details
River	Harper’s Brook (Nene Middle Operational area)
Waterbody Name	Harper’s Brook
Waterbody ID	GB105032045230
Management Catchment	Nene
River Basin District	Anglian
Current Ecological Quality	Overall status of Moderate ecological status sustained through two assessment cycles from 2009 - 2016
U/S Grid Ref inspected	SP 96715 81890
D/S Grid Ref inspected	SP 96912 82067
Length of river inspected	~300m in total

Table 1 Data from www.environment.data.gov.uk/catchment-planning/WaterBody/GB105032045230



Map 1 - Location of the Harper's Brook catchment, Northants. Red arrow marks Sudborough
Scale 1:200,000, one grid square = 10 km^2, © Ordnance Survey

Map 2 – Close-up view of the Harper's Brook at The Old Rectory, Sudborough. Red arrow is upstream limit and blue arrow is downstream limit. © Ordnance Survey.

The Harper's Brook rises within the Rockingham Forest National Character Area which is typified by a broad, low, undulating ridge underlain by Jurassic limestone. The distinct scarp and ridge of the area comprises mainly Jurassic limestones, with shallow or exposed Lincolnshire Limestone Formation and

Northampton Sand Formation rocks along the river valleys. Boulder clay caps the plateau, giving rise to heavy soils. Historically, the heavy clay soils within Rockingham Forest deterred widespread clearance for cultivation, so many of the woodlands present today are ancient.

Land use in the vicinity of the brook is mainly domestic gardens and permanent pasture with small copses and tree belts, with some arable cultivation. No cultivation extends directly to the brook; it is buffered by tree belts. The land falls within Countryside Stewardship target areas for farmland birds, particularly tree sparrow, turtle dove and yellow wagtail.

The Old Rectory garden, Sudborough is ~7.5km from the brook's confluence with the River Nene, north of Islip. Flowing in a south easterly direction, the Harper's Brook is joined by one main tributary from the Geddington Chase. It was not possible to assess whether the brook has free passage for fish to its confluence with the Nene but from inspecting online Ordnance Survey maps it would appear that there are at least three structures that may prevent the free movement of fish, with one structure above the A6116 possibly being an Environment Agency (EA) flow gauging station.

There are no angling clubs on the Harper's Brook. Anecdotal evidence from downstream at Lowick suggests that occasional angling takes place for coarse fish species, with brown trout reported to be present. There are no known records of the river having been stocked with trout at the site in question.

It is doubtful that water voles are present due to the heavily tree-lined and shady nature of the brook at Sudborough suppressing the lush marginal vegetation required by voles for feeding and cover. No specific field signs of water vole were observed during the visit. Water voles and their habitat receive full protection under the Wildlife and Countryside Act 1981 (WCA 1981). Otters are known to be widespread in the region, and it was not surprising to find spraint deposited on riverside stones (pic 1). Otters and their habitat also receive full legal protection under the WCA 1981.

Pic 1 – An otter spraint found alongside the brook.

4.0 Habitat Assessment

Within the reach visited, the land use adjacent to the brook is cattle grazed pasture on the RB and formal gardens of the Old Rectory on the LB, with parts of the gardens becoming small copses. The brook is largely tree-lined.

The general form of the channel is ~3.5m wide with depths ranging from ~0.02m over gravel riffles to ~1m in pool habitats. The bed consists of firm gravel, but in places a claybed was visible. Whether the outcropping is natural, or has been exposed from dredging, was not possible to determine at the time of visit. The gravel substrate is clearly mobile and it is possible that the high flows of early 2018 have mobilised gravel within the reach; as a result of poor gravel supply from upstream, gravel may have become depleted locally, thus leading to an exposure of the underlying claybed.

Pic 2 – The bed of the brook is dominated by coarse to very coarse substrates (16mm to 64mm) which can be utilised by gravel spawning fish such as brown trout, dace and minnow.

The bed level undulated as a result of a pool and riffle sequence interspersed with deeper (~0.6m) glides. A few large stones within the upper most riffle were turned to investigate the occurrence of aquatic invertebrates. Stone turning revealed an impoverished invertebrate community. For example, one would expect to find a high number of freshwater shrimp (*Gammarus* spp.) feeding on the leaf litter falling from riparian trees, but they were largely absent. No larvae of upwing mayflies (*Baetis* spp.) were observed. However, it was encouraging to observe some caseless caddis (*Hydropsyche* spp.) and cased caddis (*Agapetus* spp.; pic 3). Hoglouse (*Asellus aquaticus*) was observed, a species that is indicative of poorer water quality. Interestingly, the stone turning released a high volume of fine silt which was trapped in voids beneath stones. It is these voids that are usually occupied by a range aquatic invertebrates. It is also of concern that no bullhead or stone loach fish were found. The silt is degrading to the river environment (pic 4).

Pic 3 – Stone turning revealed a low number of both caseless (red arrow) and cased caddis (blue arrow).

Pic 4 - Fine silt was found beneath all stones turned. Silt has to ability to smother and infiltrate the river bed reducing the available niches for invertebrates and small fish.

The river banks were assessed to see if they contained friable material that might be washing into the brook and contributing to the high sediment load. However, the banks were sound and the clay material is able to hold a steep angle (pics 5 and 7), particularly where tree roots aid bank stability.

Pic 5 – Note how the clay banks are able to sustain a steep angle without slumping. The majority of the river bank within the reach is stable and not inputting fine sediment through collapse.

Pic 6 – Tree roots (even when fine and fibrous) increase bank stability and provide cover at water level.

Interestingly, at one location, a number of holes were observed in the bank at water level. First thoughts turned to the invasive non-native American signal crayfish but none were found during the stone turning investigation. The holes are thought to be from bank voles (not being big enough for water voles).

Pic 7 – A number of small burrows were observed, in this case they are suspected to be bank voles. Note the accumulation of fine sediment amongst the marginal stones (red arrows).

The brook is has an extensive gravel bed exhibiting bed form diversity, which when considered with its trailing branches and exposed tree roots represent ecologically valuable features. The gravel bed appears quite deep in places, but when it is disturbed a large volume of fine sediment is released. The gravel also appears to be poorly sorted with a mix of all particle sizes occurring fairly evenly across the channel indicating poor sediment transfer and sorting. In a stable river environment one expects to find gravel sorted according to river velocity and particle size.

Trailing branches are particularly important as overhead cover for a wide range of fish, especially wild brown trout, creating small areas of shelter and increasing the available number of lies within a river. The branches also present opportunities for invertebrates to fall into the channel where they become food for fish (this being particularly important when aquatic invertebrate production is limited within a reach). Branches that extend into the water may provide a means for some aquatic invertebrates to emerge from the brook and to return beneath the water in order to lay their eggs.

Pic 8 – Trailing branches provide the only cover at water level through much of the reach and should be retained. The new sapling growth (red arrows) is coming from alder suckers and should be encouraged.

There was a lack of in-channel large woody material (LWM) and lush marginal cover at water level. These two elements are important constituents of a diverse and healthy river. The presence of LWM is extremely important within a river. It increases the available surface area on to which a biofilm (algae, bacteria and other microbes) can grow, thus starting off nutrient cycling. In turn, the biofilm may become a source of food for invertebrates, thus increasing the total biomass that a river can support. LWM also provides underwater cover, offering protection for fish against otters or fish-eating birds.

Pic 9 – Note the lack of in-channel LWM and a resulting uniform profile to the river bed. Marginal vegetation is very sparse, with its growth limited by shade and a lack of rooting substrates (such as accumulated LWM).

LWM is also a key element in kick-starting riverine processes. LWM, such fallen trees, may locally increase scour resulting in pools. As sediments are transported downstream, they will be deposited according to flow, lightest first. This may enable the development of riffles (shallow, gravel-rich runs with broken surface water) which are extremely important as spawning areas. Furthermore, the sorting of bed load material will encourage the marginal deposition of fine sediment or may enable it to be deposited upon the floodplain when out-of-channel flow is experienced.

The lack of vegetated marginal cover will negatively impact upon fish holding capacity as fish, particularly trout, will lie-up even in shallow water when cover is present. Invertebrate production will be reduced if key niches, such as trailing or emergent vegetation, are missing. For example, the larvae of the banded demoiselle damselfly can often be found amongst trailing marginal vegetation but not within gravel substrates. No banded demoiselle damsel flies were seen during the visit even though they were on the wing at many other rivers across the region.

Moving downstream, a discrete area of the LB (not in control of the Old Rectory) has been protected using stone rip-rap (pic 10). This type of bank armouring may initially prevent erosion at the site of its use, but the force of water is simply moved elsewhere rather than dissipated, often resulting in downstream erosion, or the voids between the stones erode-out, leading to instability and ultimately their collapse into the brook. Furthermore, the occurrence of a significant stone outcrop is not in keeping with the landscape character of the brook. A much better approach to controlling bank erosion would be to use a brushwood ledge combined with tree-thinning to let light to the toe of bank. The brushwood ledge would act to provide erosion control whist the fine lattice work of the fixed brushwood would encourage silt entrainment and consolidation, leading to a rooting substrate for marginal vegetation to establish, providing further bank protection. Another approach would be to use tree-hinging to provide instant bank protection and flow deflection. Examples of these techniques are provided at the end of this report, in the recommendations.

Pic 10 – Stone rip-rap used to protect the bank is not in keeping with the landscape of the brook and offers minimal habitat.

The presence of veteran coppice field maples, is interesting as it is indicative of a tree canopy that has not been broken for many years. This suggests that mechanical maintenance, such as dredging, has not taken place for many decades (if at all). The lack of dredging has allowed coarse sediment (gravel) to accumulate at certain points leading to ecologically important habitats (riffles, glides and exposed gravel bars; pic 12).

Pic 11 – At least four veteran coppice field maples were observed growing from the bank. Their age suggests a lack of mechanical maintenance (at least from the RB).

Where light reaches the channel, tall and vigorous plant species such as nettles, hops, bindweed and Himalayan balsam grew. The dominance of these plants is preventing the establishment of true marginal plants (if they were able to find wet margins to colonise). The only marginal plant present was pendulous sedge (being shade tolerant). As an invasive non-native plant, the occurrence of Himalayan balsam is not desirable (pic 13). It has the ability to colonise extensive tracts of marginal habitat through the production of high numbers of seeds which are dispersed through 'explosive' seed capsules. Once balsam is present, it tends to grow tall and outcompete native marginal plants. This then leads to a monoculture of balsam which creates two main problems. Firstly, native invertebrates are not well suited to exploiting non-native plants for food or shelter. Secondly, the roots of balsam are shallow and don't provide bank stability particularly given that balsam is an annual and dies-back entirely in winter, leaving banks exposed to erosion.

Pic 12 – Exposed gravel bars are an important habitat for specialist invertebrates.

Pic 13 – Himalayan balsam is an invasive non-native species and should be eradicated from the site.

A low stone weir (pic 14) was encountered and its purpose is not known. It is believed to have been constructed by the opposing landowner. The current arrangement of the weir is likely to increase scour of the banks.

Pic 14 – A low stone weir has been created across the brook. Even small weirs interrupt sediment transfer and can prevent the movement of fish.

Weirs, even small ones, provide a number of problems to rivers namely:

- Habitat fragmentation and isolation of fish populations.
- Increasing vulnerability to pollution and predation (as fish cannot overcome a weir to escape or recolonise).
- Increased water temperature to the ponded water behind a weir.
- Interruption of sediment transfer resulting in sediment depletion downstream, which can lead to increased rates of erosion.
- Accumulation of sediment above a weir as material is deposited in the depth void above a weir (which once filled inevitably leads to a shallowing of that habitat).
- Weirs can often increase local flood risk as they impound flow.

Wherever possible, the first approach should be to remove a weir in order to reinstate natural river processes, which in turn will govern the development of riverine habitats.

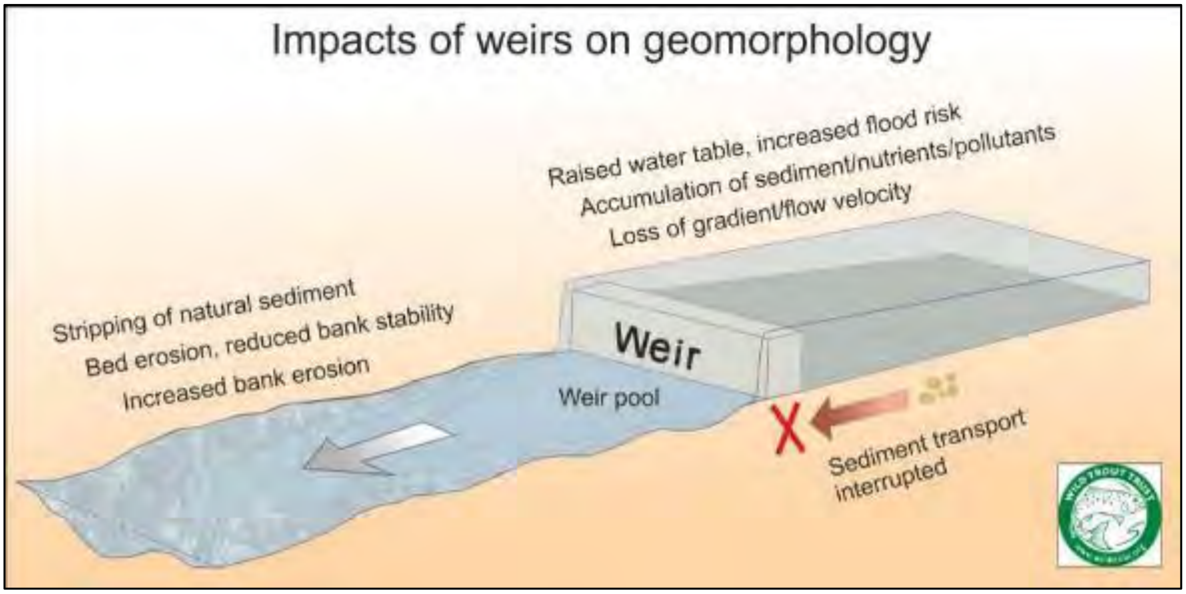


Illustration 1: The impact of a weir on river morphology.

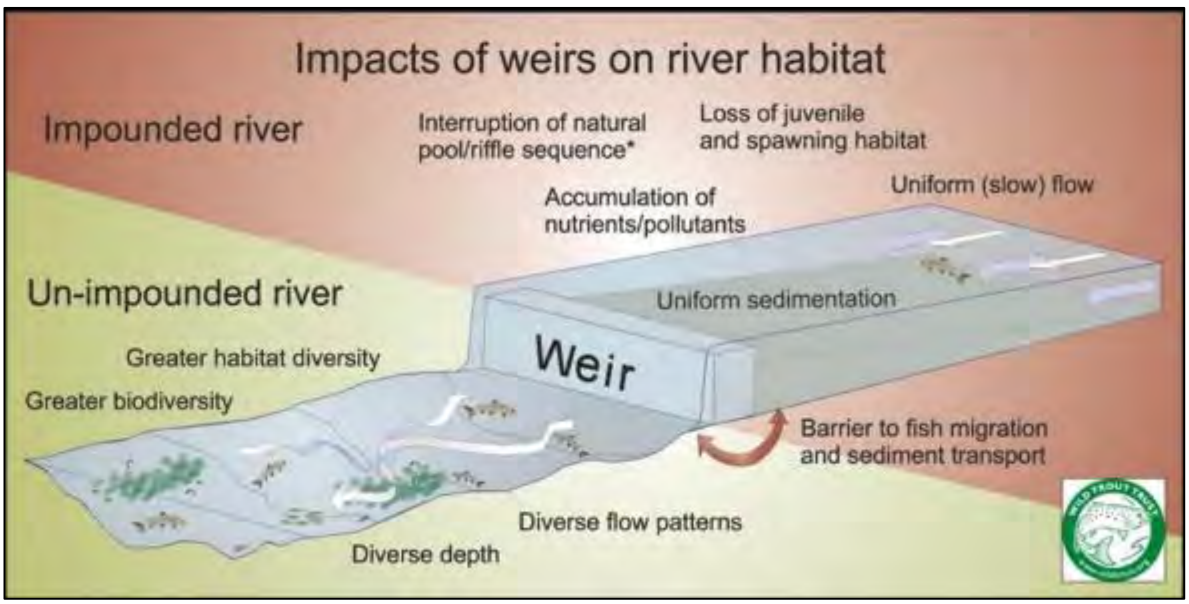


Illustration 2: The impact of a weir on river habitats. Note that impoundments often create weir pools downstream which provide habitat but at the expense of naturally formed pool and riffle habitats.

The weir is also acting as a focal point on the brook. Bank erosion to the true RB is being caused by animals (most probably dogs) repeatedly traversing the bank (pic 15). The owner of the Old Rectory does not have dogs and is not sure of the source of the bank erosion.

Pic 15 – The bank adjacent to the weir is being eroded by animals (most probably dogs). As the banks become degraded they become a source of fine sediment input to the brook.

With much of the channel tree-lined, one would have expected to find a greater amount of LWM within the channel, such as fallen trees, large tree limbs and branches, yet there was no significant accumulation suggesting it has been cleared. This activity may be the result of EA flood risk management. Through dialogue with the EA team, it may be possible to ease-back on some of this clearance work.

Pic 16 – Much of the tree-lined channel is surprisingly devoid of LWM.

One specific pool and riffle sequence is of particular interest. Under the recent low flow conditions, the channel width has reduced down to ~1m but the water velocity has remained fast, keeping the gravel cleansed of fine sediment and partially mobile as can be seen by its golden colour (pic 17 plus inset). As the flow enters the pool, there is an accumulation of woody debris which in turn is acting as a trap for fine sediment (pic 18).

Pic 17 – The water velocity leading into the pool is enough to keep the gravel cleansed of fine sediment.

Pic 18 – The accumulation of woody material is aiding retention of fine sediment. Marginal vegetation would colonise this habitat if stable and unshaded.

Pic 19 – Fish were observed rising in this pool. The species was unknown.

The depth cover offered by the pool will be utilised by adult brown trout. Wild brown trout require habitat diversity, food, spawning and nursery areas and good water quality. Trout (as well as chub, dace and minnows) will spawn on well-sorted gravels (particularly in the range 15mm to 40mm) that are relatively stable within a river. A pool and riffle sequence is important in river systems as it naturally diversifies the flow and provides habitat for juvenile trout (within the shallow riffles) which keeps them from competing with (or from being eaten by) adult trout. Appendix 1 contains a diagram illustrating the brown trout's life cycle.

Pic 20 – Seepages of iron oxide were observed emerging from the bank. This is a natural occurrence and in volumes that don't discolour the water or lead to a lowering of the pH it is not considered a problem. This natural occurrence is not surprising given the geology of the area which in turn lead to its iron and steel industry.

Pic 21 – Only one true marginal plant is present (red arrow), pendulous sedge.

A footbridge was encountered and its banks have been stabilised using a non-degradable plastic mesh (pic 22). Plastic meshes pose a risk to wildlife with birds and small mammals becoming trapped. The banks are quite sound and it is probable that the mesh is serving no purpose. However, if the mesh is removed it could be replaced with a brushwood structure to provide bank protection and flow deflection away from the bridge footings.

Pic 22 – The bank beneath the bridge has been strengthened with a non-degradable plastic mesh. It is a hazard for wildlife and is unsightly.

Animals are able to access the brook through a cattle drinker present on the RB (not in the control of the Old Rectory). The cattle drinker is in a poor state and is a source of sediment and nutrient input to the brook. The best approach would be to exclude cattle from watering in the brook and to use an alternative water supply such as mains water to a trough or a cattle pasture pump. If cattle have to water from the brook, then stone should be added to the drinker to reduce the input of soil resulting from bank erosion but this will do nothing to prevent nutrient pollution from faecal matter.

From April 2018, farmers are subject to new 'Farming Rules for Water' which seek to ensure that they manage land to avoid water pollution and to benefit their business. The rules can be found at www.gov.uk/government/publications/farming-rules-for-water-from-april-2018/farming-rules-for-water-overview .

Pic 23 – the cattle drinker is a source of fine sediment and nutrient input to the brook.

As the brook was followed downstream to the limit of the Old Rectory, it became more open. The number of pendulous sedge plants increased but the diversity of marginal plants remained low. Starwort grew from the river bed and at one location, a number of branched bur reed plants were observed; other than this the aquatic plant diversity was low.

Pic 24 – Where light is able to reach the channel there was a greater number of marginal plants and starwort was present (red arrows).

An old grass cuttings pile was located immediately adjacent to the brook (pic 25). It is unadvisable to add further grass cuttings to the pile as the leachate will add nutrients to the brook.

Pic 25 – An old large grass pile, a good egg incubation site for grass snakes.

At the limit of the Old Rectory's control is a shallow riffle (pic 26). The riffle appears to be formed from well-sorted material but due to the steep banks it was not possible to access it. The riffle is a potential spawning area for brown trout and habitat enhancement work to increase cover for adult fish during spawning and marginal cover for fry emerging from the gravel in early spring would be beneficial.

Pic 26 – At the downstream limit of the Old Rectory a shallow riffle is present. The riffle presents a potential spawning site for brown trout but it lacks habitat cover for both adult fish and emerging fry.

5.0 Recommendations

The brook is surprisingly clear of LWM. LWM material should be retained in-channel where it does not pose a flood risk (such as at and below water level). Where concern exists regarding the stability of LWM, it can be fixed in place through staking and/or using wire rope anchored to the banks and/or existing trees. Dialogue with the EA flood risk management team would be useful to establish the extent of flood risk to Sudborough and what habitat enhancement measures would be acceptable for the brook.

The brook is limited in brown trout habitat mainly through a lack of habitat diversity and particularly a lack of marginal cover. The shallow glides present an opportunity for safe in-channel working. Following dialogue with the EA, it would be possible to conceive a habitat enhancement scheme to increase the trout holding potential of the brook through the application of approaches such as tree-hinging, flow deflectors, brushwood berms and the fixing of LWM to the bed. The WTT would be able to provide further support on this issue.

Tree-hinging: trees (large or small) are cut to produce an effect similar to hedge laying. Some species such as willow and hazel respond particularly well, others can be less pliable and a judgement should be made depending on the main species and the season. The laying retains a living hinge that secures the cut stem to the tree stump. The hinge continues to allow the tree to live so structural strength is retained. With the tree-top laid at water level it provides excellent over-head cover, flow deflection and a potential spawning substrate for coarse fish such as roach and perch.

Pic 27 - An example of tree hinging, a simple and effective technique for increasing cover in a river.

Brushwood berms: these features can be created following tree works. A brushwood ledge provides a means of creating complex cover at water level. Brushwood from tree thinning is pinned against the bank in alternating direction or increasing stem thickness, and is then securely wired down or held with batons. The brushwood lattice provides niches for invertebrates and small fish, aids silt entrainment and provides a rooting substrate for plants to establish. In time (~3yrs) the brushwood ledge will become a vegetated berm if exposed to full sunlight. The vegetated berm can then have attractive native marginal plants added such as hemp agrimony, marsh marigold, purple loosestrife and yellow flag iris. The colour of these plants would provide an attractive riverside setting to the gardens of the Old Rectory.

Pic 28 – A low level brushwood berm created on the River Misbourne following tree thinning work. Brushwood berms can be used to protect banks from erosion, to create in-channel sinuosity and to entrain silt and sand. They are particularly effective for enhancing low flow rivers with the low profile ledge being drowned out during floods.

Pic 29 – A brushwood ledge on the Welland in the process of becoming vegetated <1 year after construction. The purple loosestrife at the back could be complemented with colourful hemp agrimony and yellow flag iris in the wetter habitat of the foreground.

Flow deflectors: these features can be used to increase flow diversity within a channel. They can be simple log deflectors or tethered tree stems. The complex flow that arises from such features aids scour and sediment transport. The broken water they create can increase the visual attraction of a river whilst increasing cover for fish.

Pic 30 - A flow deflector used to focus flow and scour into the centre of the channel.

Fixing LWM to the river bed: this is a means of increasing flow diversity and in-channel cover. In gravel-rich rivers such as the Harper's Brook, the positioning of LWM mid-channel is likely to increase bedform diversity, through scour and deposition of gravel. This could result in a highly diversified channel with complex flow patterns and a greater level of habitat diversity.

Pic 31 – Examples LWM fixed to the bed on the River Wylye. Large pieces of timber create both underwater scour to sort sediments and a broken water surface providing cover and oxygenation.

The brook is over-shaded for much of its length, restricting the growth of marginal plants. Careful tree-thinning to achieve a shade/light balance along the lines of 60:40 should be considered. Tree management should have regard to the retention of important trees such as the veteran field maples. Trees should also be retained over pools for their shading to aid summer cooling and for controlling vegetation growth. Trailing branches at water level ideally should not be removed.

The low stone weir should be removed. However, as the Old Rectory only owns half of the river bed at that point, it would be best to engage the oppose landowner in dialogue about its removal. That being said, it would be fair to undertake half removal of the weir. Particularly in view of the fact that any person wishing to erect a structure within or across a Main River requires the written permission of the EA prior to undertaking such work. In determining the application (now referred to as an Environmental Permit) the EA would assess the proposal's impact upon flood risk and biodiversity before deciding if it should be allowed.

The Himalayan balsam should be eradicated through pulling or strimming (below the first growth nodule) in order to prevent it from forming further extensive monocultures. The local Wildlife Trust is undertaking control of the plant in the Nene valley, more information can be found at www.wildlifebcn.org/wildlife/wider-countryside/water-wildlife/himalayan-balsam

The gravel was found to contain high amounts of fine sediment. The approach of gravel jetting (where a water pump is used to deliver water into the gravel at high pressure using a metal lance) could be deployed to wash out the fines. However, this only delivers a quick fix and does not address the source of the sediment. It would be better to instigate the approaches detailed above to see if they bring about natural gravel sorting and fine sediment transfer prior to deploying gravel jetting. Following such works, it would be necessary to identify the original cause of the gravel's deterioration so a sustainable solution can be found.

6.0 Making it Happen

It is a legal requirement that (most) works to 'Main River' sites like the Harper's Brook require written EA consent prior to their implementation, either in-channel or within 8 metres of the bank.

The Wild Trout Trust can provide further assistance in the following ways:

- Assisting with the preparation and submission of an Environmental Permit to the EA (formerly referred to as Land Drainage or Flood Defence consents), or by identify appropriate exemptions to take forward small-scale habitat improvement works.

- Running a training /demonstration day to demonstrate the techniques described in this proposal.

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 material, enhancing fish stocks and managing invasive species.

The DVD is available to buy for £10.00 from our website shop 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: www.wildtrout.org/content/library

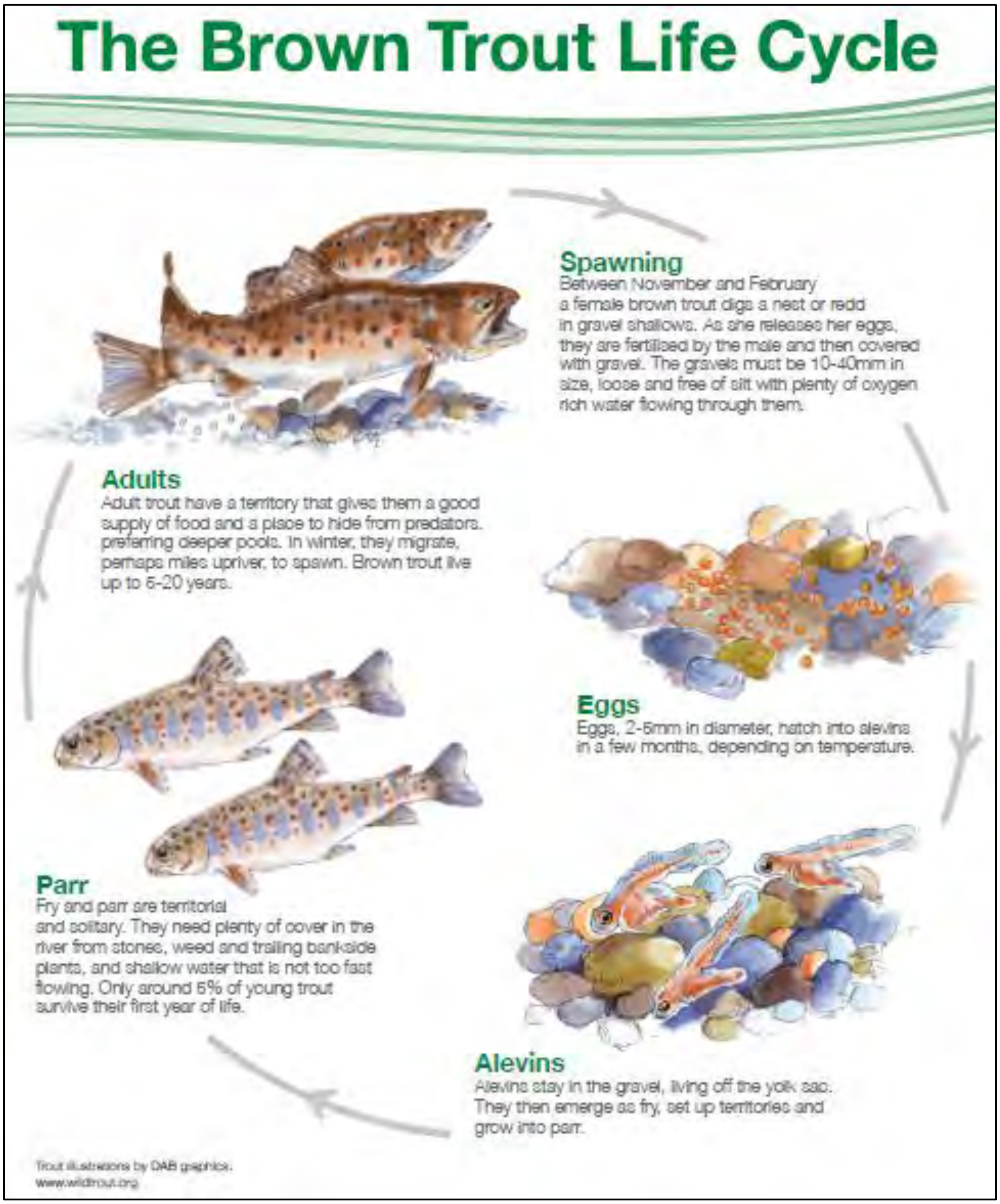
7.0 Acknowledgement

The WTT would like to thank the Environment Agency for supporting the advisory and practical visit programme in England, through a partnership funded using rod licence income.

8.0 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. Accordingly, 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 comments made in this report.

Appendix 1


The Brown Trout Life Cycle
Spawning
Between November and February a female brown trout digs a nest or redd in gravel shallows. As she releases her eggs, they are fertilised by the male and then covered with gravel. The gravels must be 10-40mm in size, loose and free of silt with plenty of oxygen rich water flowing through them.
Adults
Adult trout have a territory that gives them a good supply of food and a place to hide from predators, preferring deeper pools. In winter, they migrate, perhaps miles upriver, to spawn. Brown trout live up to 6-20 years.
Eggs
Eggs, 2-5mm in diameter, hatch into alevins in a few months, depending on temperature.
Parr
Fry and parr are territorial and solitary. They need plenty of cover in the river from stones, weed and trailing bankside plants, and shallow water that is not too fast flowing. Only around 5% of young trout survive their first year of life.
Alevins
Alevins stay in the gravel, living off the yolk sac. They then emerge as fry, set up territories and grow into parr.
Trout illustrations by DAB graphics.
www.wildtrout.org