River Trent, Trentham Gardens: Advisory Visit

Paul Gaskell, Wild Trout Trust 23/08/2016

	Groundwork West Midlands/Trentham Estate: River Trent
River	River Trent
Waterbody Name	Trent, Fowlea Brook to Tittensor
Waterbody ID	GB104028053271
Management Catchment	Trent Valley Staffordshire
River Basin District	Humber
Current Ecological Quality	Moderate
U/S Grid Ref inspected	SJ8668640812
D/S Grid Ref inspected	SJ8677140473
Length of river inspected	~500m in total

1 Introduction

A site visit and habitat appraisal was carried out by Paul Gaskell at the request of Richard Schneider (Groundwork West Midlands) and Matt Lawrence (Environment Agency) to explore the potential for habitat improvement on the River Trent at Trentham Gardens. The Water Framework Directive (WFD) captures this section of the Trent under the Waterbody ID code GB104028053271.

The 2015 classification for the full waterbody cites "high" status for fish ("moderate" in 2009 assessment) and "moderate" status for invertebrates ("moderate" in 2009). The other notable result from the 2015 surveys is the "poor" rating for phosphate. Overall the 2015 published classification data show that the Ecological potential of this waterbody is "moderate". However, while the WFD classification provides impetus to investigate the cause(s) of phosphate pollution, there are additional relevant considerations. In particular, the implications posed by a pollution incident that occurred after the site inspection (and prior to the drafting of this report). Although, at the time of writing, still subject to investigation; this event had a significant impact with >15,000 fish mortalities recorded.

Consequently any recommended actions for improvement or protection of physical habitat must also be viewed in the context of a need to tackle any chronic or episodic impacts on water quality. This pollution incident also highlights the importance of maximising the connectivity (ease of passage) of the wider catchment for aquatic fauna – including fish. As well as providing "escape routes" from pollution, the potential for immigration of fish from un-affected, self-sustaining populations elsewhere in the catchment is maximised. This negates the need for artificial re-stocking of fish and provides greater natural resilience for fish populations.

Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.

2 Habitat Assessment notes

The upstream and downstream limits of the surveyed reach were SJ8668640812 and SJ8677140473 respectively. Consequently, the full reach is sited within the formal gardens on the Trentham Estate. However, depending on the specific location – and proximity to footpaths or other formally-landscaped features – the river corridor management varies between minimal intervention (woodland) to more formal landscaping and mowing (rows of deliberately spaced trees, lawns and formal planting).

A typical impression of the more formally-gardened sections can be seen from the footbridge at SJ8674140598 (Fig. 1). This is a good indication of the historic channel realignment to make a generally straighter and more uniform channel. Consequently, the riverbed substrate and cross-sectional depth profile are generally less-varied than in channels predominantly formed by natural geomorphological processes.

However, the presence of beds of water crowfoot (*Ranunculus* spp.) not only adds some diversity to the flow but is also indicative of higher water quality compared to watercourses in which comparable plants like *Potamogeton spp*. flourish.

Figure 1: Photograph facing upstream off the footbridge at SJ8674140598.

A narrow, un-mown strip is maintained along the river in these, formally-managed sections (which is a boon to the ecology of the river). However, the seemingly ubiquitous Himalayan balsam (*Impatiens glandulifera*) often dominates this riparian strip of vegetation. As an invasive non-native species, the competitive dominance of this annual plant negatively impacts the integrity of the riverbank. By dying back in winter, this shallow-rooted species leaves the banks bare and hence vulnerable to accelerated rates of erosion (with the associated inputs of fine sediment that can smother spawning gravels). Additionally, Himalayan balsam is also observed to negatively impact the riverbank fauna – as highlighted in the infographic and text on this link: https://himalayanbalsam.cabi.org/latest-news/himalayan-balsam-impact-on-invertebrates/ .

The spacing and the structure of the tree canopy along this section of river does provide a variety in light and shade conditions as is also evident in Fig. 1 as well as in Fig.2. Consequently this is likely to promote natural variation in the distribution and density of water crowfoot patches; with crowfoot flourishing in full sunshine and being inhibited in shady areas. Such variation is a good thing since structural/flow variation tends to provide a greater range of habitat-niche conditions for a wider variety of species.

From the perspective of wild trout, there appear to be two main habitat limitations on robust, self-sustaining populations. First of all, a poor "sorting" of spawning gravels (different particle sizes from fine clays, sands, gravel and cobbles are all aggregated together – somewhat like a "cake mix"). This is compounded by the relatively sandy catchment and associated inputs of finer materials; leading to an increased potential for smothering of trout eggs and difficulty in female trout cutting "redds" (nests) into the gravel bed.

Secondly, the opportunity for scour-pool creation has been reduced by the historic realignment of the channel and is, in turn, compounded by the relatively low resistance of the banks to erosion. Scour pools typically form on the outside of bends, with deposition of material on the inside of each bend forming a gentle gradation in depth from shallow to deep over the full cross-section. The easily-eroded banks mean that the river cuts away at those banks much more readily than it can scour down into the riverbed; making the channel generally wider, shallower and more uniform.

Figure 2: Closer look at the balsam, tree-shading, water crowfoot and bed substrate.

However, there are some examples of excellent habitat features within the formal garden sections of the visited reach. During the visit these features were being used by several adult wild trout (though these fish are almost certain to have been killed during the pollution incident).

Figure 3: Some excellent marginal and over-hanging cover is provided by willow and alder at SJ8672340748. While it is not advisable to make an entire reach resemble this section, some additional patches that incorporate the low-growing and easily-managed elements would be extremely valuable at selected points along the river.

The tremendous value of low, overhanging and submerged cover (e.g. Fig. 3) in terms of cooling, shelter from predation and refuge during spate flows is important to highlight. It is counter-productive to exchange one type of

homogeneity for another (i.e. by lining all "open" banks with a uniform corridor of the vegetation shown in Fig. 3). By the same token, it would add significant ecological value to produce scattered stands of small-scale, low-level woody vegetation at the foot of the banks (for example, trained and hinged or "laid" sapling growth coupled with light coppicing).
By interspersing such patches with more open, herbaceous margins, a good balance of structural diversity would be maintained – along with an aesthetic that is in-keeping with the rest of the grounds. The use of hinging and rotational coppicing, in combination with relatively low-growing/manageable species of trees, can provide this value whilst avoiding excessive additional maintenance.

Again, the historic straightening of the channel is evident when looking upstream off the bridge at SJ8672340748 (Fig. 4).

Figure 4: Straightened channel, balsam infestation and also "block failure" bank erosion.

The lack of resistance to erosion due to the exclusion of deeper-rooted plants is evident in Figs. 4 and 5. In some cases this will be due to, or exacerbated by balsam infestation - as on the RB (left of frame in Fig. 4). In others it may be due to mowing of vegetation – possibly as on the LB in the reach pictured in Figs. 4 and 5.

The mechanism by which banks typically erode involves the "toe" (i.e. the joint between river bed and river bank) being scoured out by powerful flows. Beyond a certain point during this process, the weight of the blocks of bank that are being under-cut can no longer be supported by the adjoining land. Those blocks then break off and slump into the river – with much of the soil washing downstream. Often the shallow-root horizon and turf from the upper surface of those blocks is knitted together strongly enough to resist being completely dispersed by the current. These form clumps of vegetated turf that can often be seen in the margins of the river.

Figure 5: Block-failure visible on the opposite bank. This is due to the shallow root horizon of turf associated with mowing (possibly motivated by previous balsam infestation). However, note also the beneficial, low, overhanging cover from trees. The problem with dense balsam stands is that they prevent succession of trees by out-competing seedlings prior to them becoming tall enough to outstrip the understory.

The Longton Beck enters the Trent via the LB, opposite the point at which the photograph in Fig. 5 was taken. This tributary stream was not inspected during the site visit, but from inspection of maps it appears to be impacted by the development of surrounding land and transport infrastructure. As such, there may be a risk of point-source pollution inputs as well as the potential for significant channel modifications to degrade habitat-structure. In addition, extensive channel modification (possibly including culverting) often reduces connectivity for pelagic (swimming) fauna between high-quality habitats. Reduced connectivity also constrains opportunities for fish to escape pollution and/or subsequently re-populate impacted reaches.

This confluence (at SJ8668640812) was the upstream limit of observations during this visit, however a section of contrasting character was visited at a point downstream at SJ8677140473. Although still within the formal gardens, this section of the river is further from the nearest footpath and sits within a more densely-wooded river corridor. There is currently little management undertaken in this section.

This scenario presents additional opportunities from several standpoints. Firstly, there is a less stringent requirement to aesthetically match the formal planting in the surrounding grounds. Secondly, the light-touch management has allowed some good features to develop - including natural woody material inputs to the channel. However, that same low intervention also results in quite uniform, dense shading and an associated lack of understory vegetation. This is most apparent in the bare muddy banks of the river (Fig. 6). Just a very low-level of rotational coppicing to introduce a slightly more staggered canopy height and density structure would be very beneficial here. Some of the woody material arising from that activity could provide some valuable in-stream structure (and geomorphological function) as long as suitably robust anchor-points could be identified.

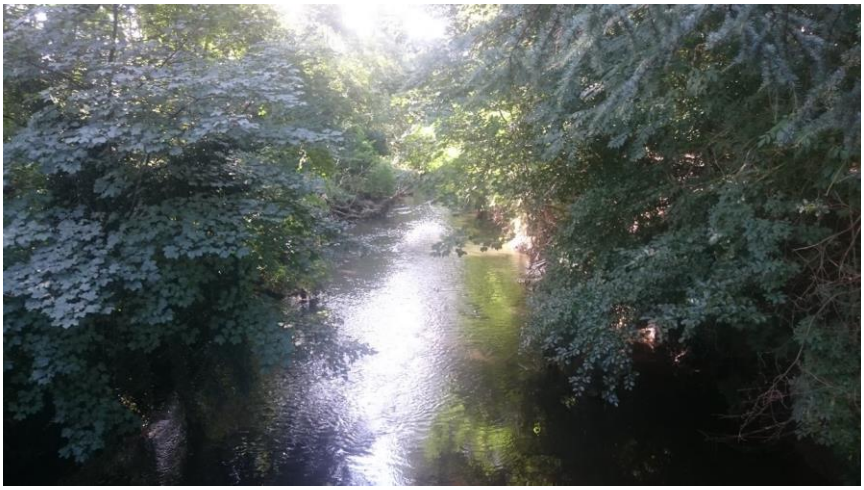

Figure 6: Some excellent features, which could generate additional ecological value with the introduction of a little more variation in canopy structure and in-channel woody material.

To put the findings of the habitat assessment into context, it is helpful to refer to the requirements of three key lifecycle stages of wild trout. These three key stages are spawning, juvenile and adult phases. Each phase has specific habitat features that are necessary for successful completion. If those features are not all present within a single habitat "patch", there is a requirement for good "connectivity" such that the fish can migrate between the habitat features throughout the full lifecycle. Clearly, this makes connectivity incredibly important – even for those river species who do NOT make marine migrations.

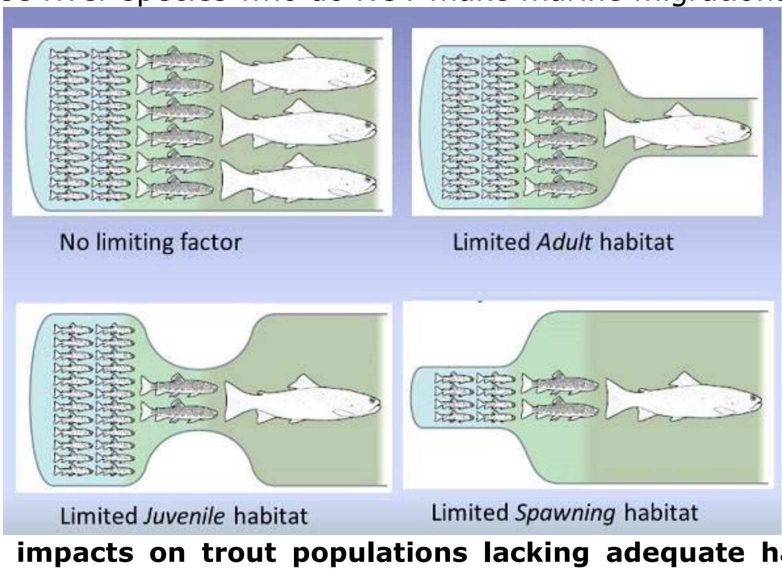

Figure 7: The impacts on trout populations lacking adequate habitat for key lifecycle stages. Spawning trout require loose mounds of gravel with a good flow of oxygenated water between gravel grains. Juvenile trout need shallow water with plenty of dense submerged/tangled structure for protection against predators and wash-out during spates. Adult trout need deeper pools (usually > 30cm depth) with nearby structural cover such as undercut boulders, sunken trees/tree limbs and/or low overhanging cover (ideally within 30cm of the water's surface. <u>N.B.</u> *Excellent quality in one or two out of the three crucial habitats cannot make up for a "weak link" in the remaining critical habitat*.

A basic explanation of the specific features of habitats required at each key lifecycle stage gives a useful guideline to appropriate interventions.

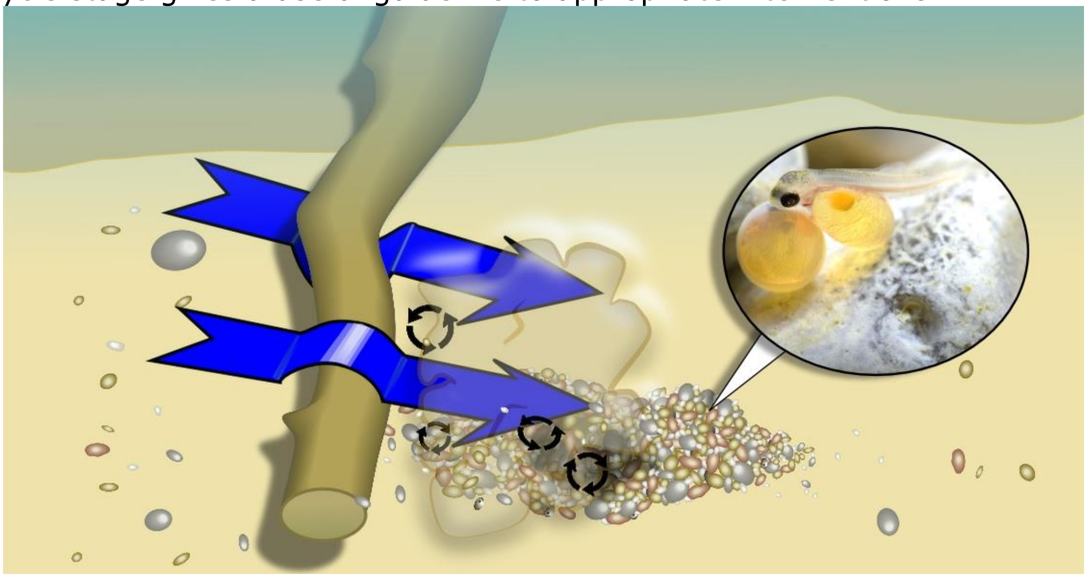

Figure 8: Features associated with successful trout spawning habitat include the presence of silt-free gravels. Here the action of fallen tree limb is focusing the flows (both under and over the limb as indicated by the blue arrows) on a small area of river-bed that results in silt being blown out from between gravel grains. A small mound of gravel is deposited just below the hollow dug by focused flows. In these silt-free gaps between the grains of gravel it is possible for sufficient oxygen-rich water to flow over the developing eggs and newly-hatched "alevins" to keep them alive as they hide within the gravel mound (inset) until emerging in spring.

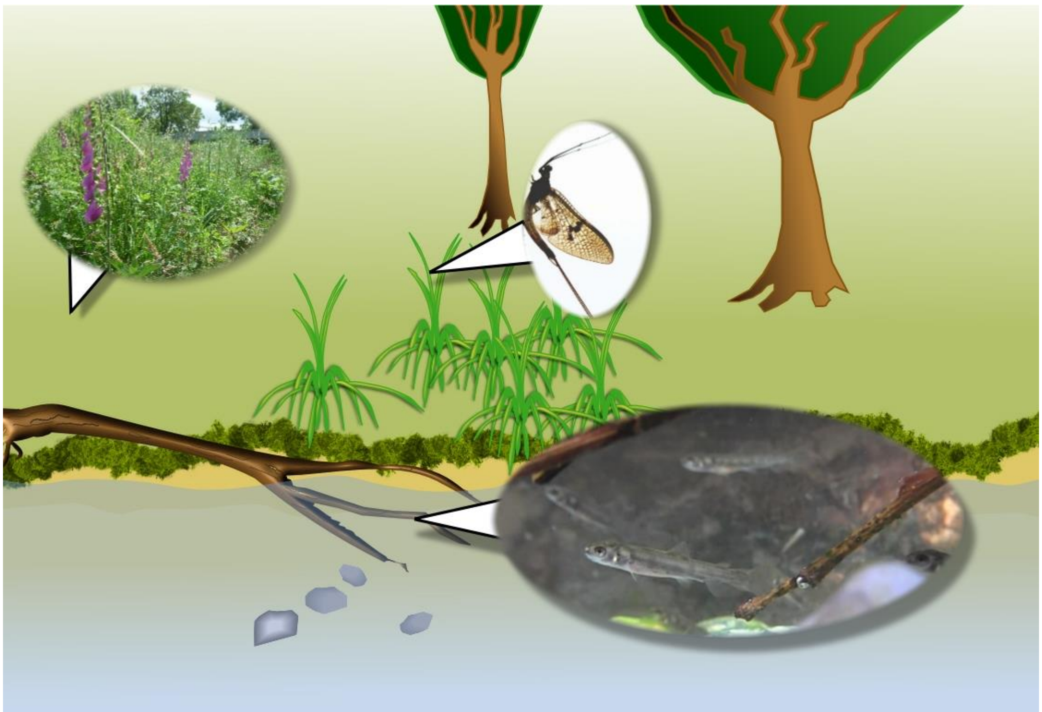

Figure 9: Larger cobbles and submerged "brashy" cover and/or exposed fronds of tree roots provide vital cover from predation and spate flows to tiny juvenile fish in shallower water (<30cm deep). Trailing overhanging vegetation also provides a similar function and diverse bank-side vegetation has many benefits for invertebrate populations (some of which will provide a ready food supply for the juvenile fish).

Figure 10: The availability of deeper water bolt holes (>30cm to several metres), low overhanging cover and larger submerged structures such as boulders, fallen trees, large root-wads etc. close to a good food supply (e.g. below a riffle in this case) are all strong components of adult trout habitat requirements.

With these broad descriptions of the elements of spawning, juvenile (nursery) and adult trout habitat in mind, measures to address the issues identified during the survey can more easily be described.

Firstly, although mindful of the significant labour involved, it would be extremely beneficial to undertake strimming (below first node on stem) or hand-pulling of the Himalayan balsam infestation (both prior to plants setting seed). In order to not unduly burden the staff of the Trentham Estate directly – it may be possible to co-ordinate with organisations like Groundwork, local Wildlife Trusts or "Friends of" groups (or a combination of all) to have them carry out hand-pulling of balsam. At the discretion of the Estate, it may be possible to reward volunteers with entry to the gardens after successful clearance of a previously-agreed area. Note that "control" rather than "eradication" at the local patch scale is both sufficient and extremely valuable at the broader landscape scale i.e. http://urbantrout.blogspot.co.uk/2014/07/volunteer-action-on-urban-river.html. This is true even if an upstream source of recolonization exists (as long as subsequent efforts at control are undertaken at the site of interest within Trentham Gardens).

In concert with balsam control, some scattered planting of relatively easily-managed species like Goat Willow (*Salix caprea*) and subsequent "laying" into the margins (as in Fig.11) would provide some additional bank stability and promote the creation of additional depth. At the same time this would provide submerged cover for juvenile fish.

Gains from controlling balsam could be further consolidated (in the absence of sufficient regrowth from the seedbank of native species) by supplementary seeding with locally-appropriate riparian herbaceous species.

Figure 11: Hinging or laying of saplings to create marginal cover (in this case using hazel).

The "sorting" of gravel can be achieved by promoting localised bed-scour. A limited amount of such sorting is often associated with marginal tree "kickers" (Fig. 12).

Figure 12: Newly-installed tree "kicker" (attached to a secure anchor point using braided steel cable).

A guide to installation and the typical effects of a tree kicker can be seen in this video: https://vimeo.com/72720550.

More extensive gravel "sorting" to improve spawning success can be achieved by secure installation of features like root wads (Fig. 13) or by pinning the "free" end of a tree kicker so that the trunk becomes an upstream-angled log which promotes scour (Fig. 14).

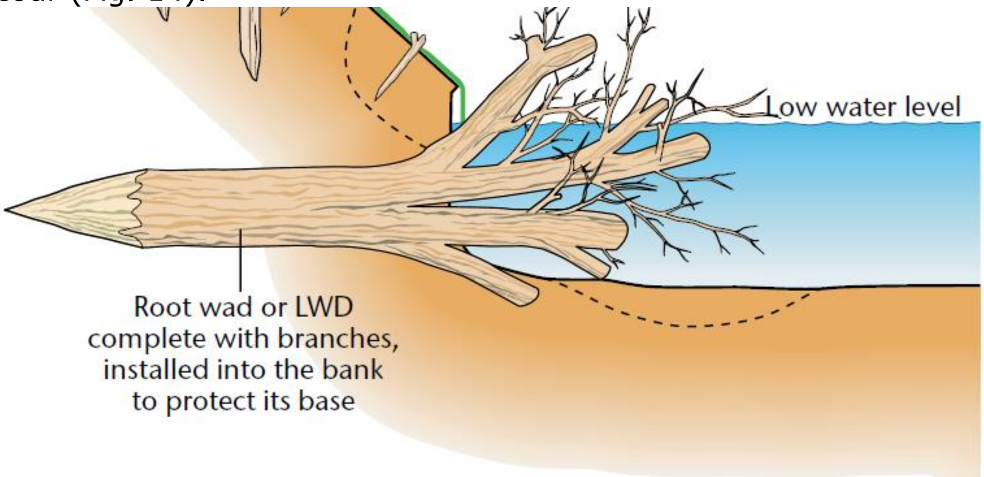

Figure 13: Root wad (arising from forestry work). The upright trunk is cut to an appropriate length - with a sharpened "point" cut into it. When driven into the bank using an excavator bucket, these are very secure (and often used to protect eroding banks).

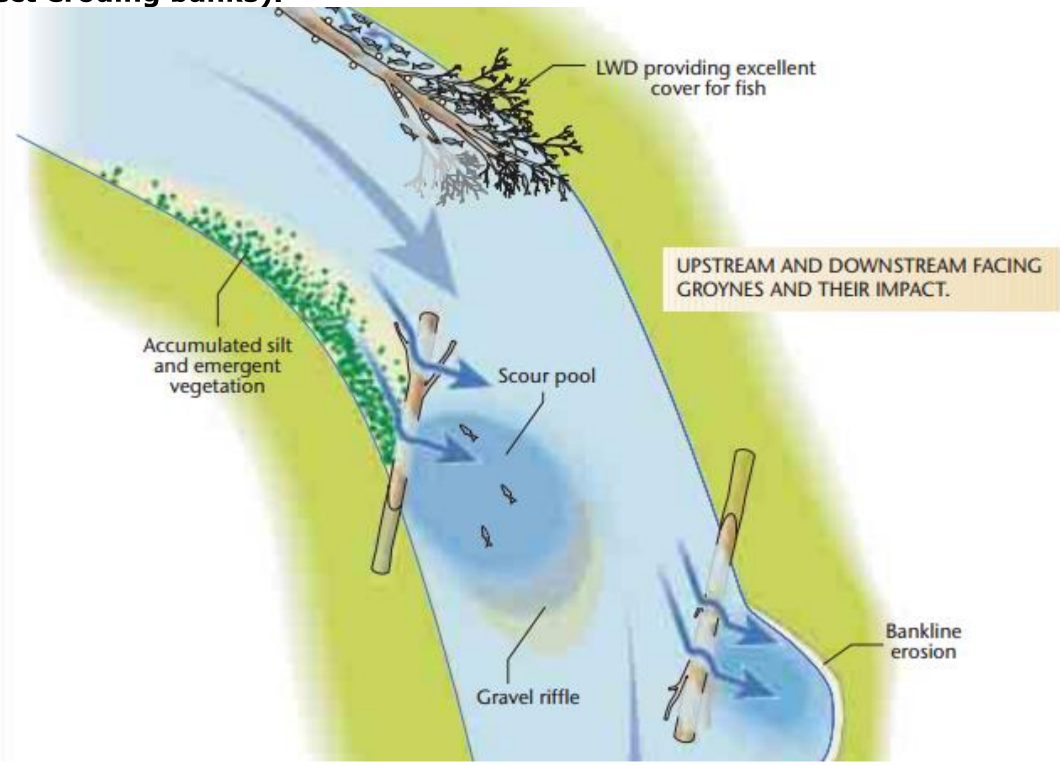

Figure 14: Note the counter-intuitive effect of upstream versus downstream-angled tree trunks. The upstream-angle promotes scour of the riverbed in the channel. Conversely, downstream angled installations create bank erosion. In the case of Trentham Gardens, the upstream-facing installation is recommended. N.B. the necessary anchoring of the bank-side end of this installed material can either be achieved by burying or by cabling (as for the tree kicker).

Finally, it will be important to follow up on the serious pollution incident. Not only is it necessary to establish what measures can/will be put in place to prevent recurrence; there are mechanisms by which the polluter can financially support remedial habitat works. The Environment Agency can advise on these mechanisms (which include an "Enforcement Undertaking"). Any pollution to water or land should be reported to the E.A. incident hotline on 0800 80 70 60.

3 Summary of Recommendations

- Initiate volunteer-led control of Himalayan balsam
- Establish an un-mown vegetated strip along the river consisting of native herbaceous plants and scattered (frequently hinged) easily-managed tree species (Consider supportive seeding/planting using locally-sourced appropriate species to achieve as necessary)
- Seek opportunities to install tree kickers (if necessary, these could be confined to the less visible, less accessible sections of river corridor) – note that this would be subject to relevant E.A. consenting procedures
- Create more staggered canopy within the densely-wooded river corridor areas
- Utilise any root wads and/or trees arising from forestry work to create localised bed scour to create higher quality spawning areas (via gravel "sorting")
- Explore wider connectivity (including Park Brook) and potential for those areas to provide refuge from pollution as well as sources of spawning and recolonization
- Explore available mechanisms to secure funding following the serious pollution incident that affected the surveyed reach

4 Next Steps

Following the circulation of this report to relevant stakeholders (and subsequent arising discussions); it may be appropriate to draw up a more specific project proposal. The WTT is happy to contribute to that process and may also be able to help to deliver the suggested objectives of such a proposal. Similarly, the WTT is happy to participate in discussions and activities required to secure project funding.

5 Acknowledgement

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

6 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.