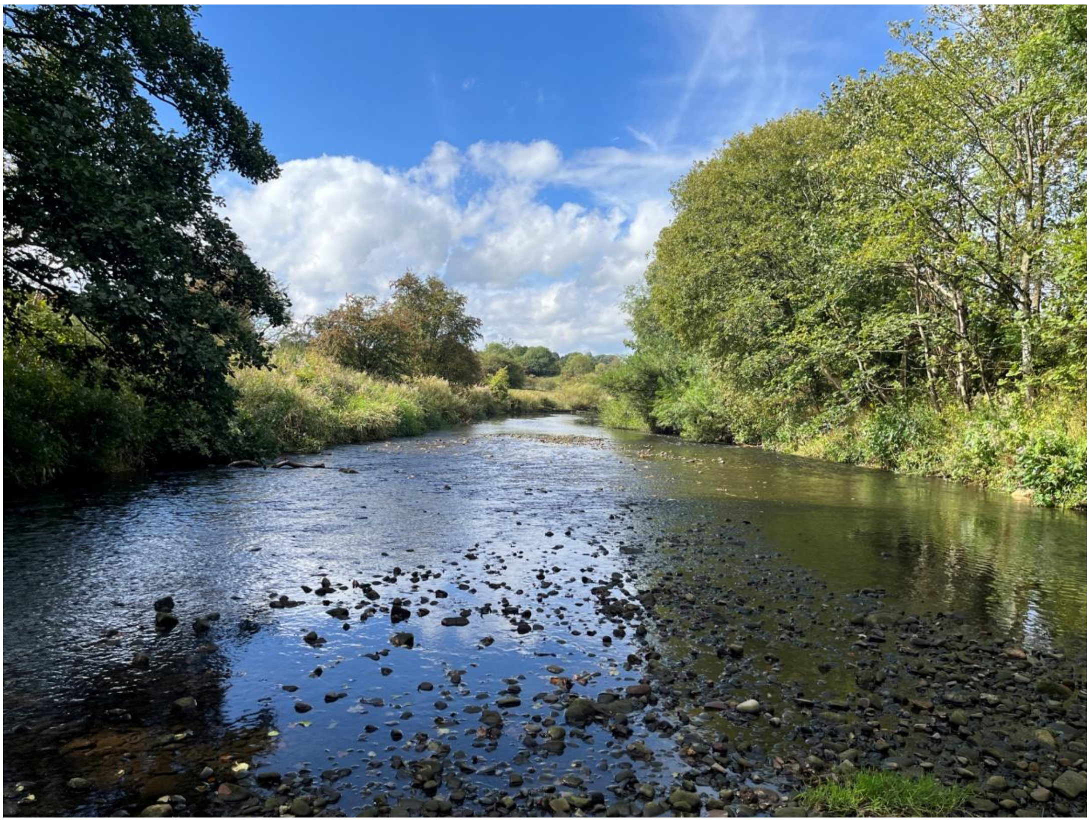
Advisory Visit
Pendle Water
Reedley, Lancashire



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10/09/2025

River	Pendle Water
Waterbody Name	Calder - Pendle Water to conf Ribble
Waterbody ID	**GB112071065490**
Management Catchment	Ribble
River Basin District	North West
Current Ecological Status	Moderate
U/S Grid Ref inspected	SD8345834841 (53.809620, -2.252538)
D/S Grid Ref inspected	SD8273634897 (53.810038, -2.263624)
Length of river inspected	1.1 km

1 Summary

- *Over-supply of sediment from extensive bank erosion appears to be the most significant impact on the visited reach*
- *Shallow root systems created by grazing up to the bank-top create extensive sections of riverbank with very little resistance to erosion*
- *Exclusion of grazing to establish a much wider vegetated buffer strip would create multiple ecological benefits within and around the river channel*
- *Control or eradication of the invasive plant species Himalayan balsam and Japanese knotweed would create complementary biodiversity benefits*
- *Other invasive species included submerged pondweed and American signal crayfish, for which there are no reliable, current control or eradication options*
- *Examples of structurally and biologically diverse habitat were found to be particularly associated with areas more extensively vegetated riverside land*
- *Good adult and juvenile trout habitat in particular was found within the visited reach*
- *Conversely, high quality spawning habitat was in short supply*
- *Reduction in sand and silt supply to the reach, combined with more frequent examples of large woody material creating localised bed-scour would improve spawning conditions*
- *Riverfly monitoring upstream and downstream of outfall sites would provide valuable characterisation of baseline invertebrate populations as well as highlighting potential pollution impacts*
- *In the event that creating more densely-vegetated riparian buffer strips resulted in loss of all eroded cliff habitat, artificial sand martin nesting structures could be considered*

2 Introduction

The Wild Trout Trust (WTT) was invited to assess habitat quality on a length of Pendle Water in Lancashire by the Balderstone Syndicate. Throughout the report, banks are designated as right (RB) and left (LB) while facing downstream. The summary table at the start of this report contains both Decimal Degrees and National Grid Reference formats for mapping locations to enable cross-referencing between reporting systems. Decimal Degrees are cited in the main body text for ease of use with online mapping.

3 Habitat Assessment

The surveyed reach was walked in a downstream direction. Observations were recorded and are reported following that same downstream, sequential progression. At the upstream limit the M65 bridge crosses the river at 53.809620, -2.252538 and, upon entering the water, an abundance of cobble and gravel substrate is apparent (Fig.1).

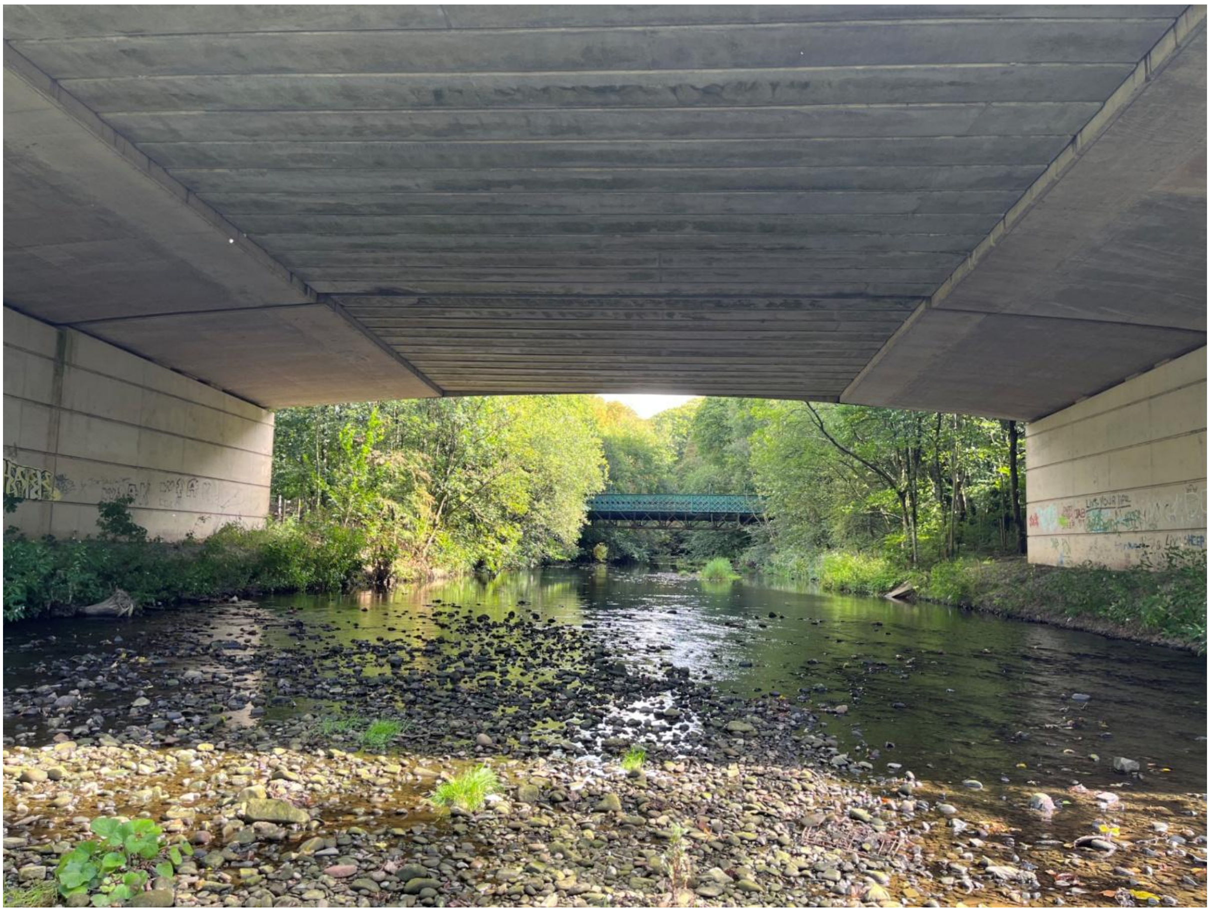

Figure 1: Partiallyvegetated cobble and gravel bar indicating an abundant supply of relatively mobile substrate.

In this reach some shaggy, trailing marginal vegetation provides valuable cover for fish of all sizes while the presence of Himalayan balsam (*Impatiens glandulifera*) is also notable (Fig.2). Invasive, annual plants such as balsam tend to dominate native vegetation and, upon dying back in winter, leave banks susceptible to widespread elevated rates of erosion.

Competitively dominant, invasive plant species also tend to reduce the diversity and abundance of native vegetation. In turn, that tends to result in a lower diversity and abundance of invertebrate species associated with native flora. The combined suppression of native flora and fauna, along with increased topsoil erosion during winter storms, has a significant negative impact on river corridor ecology.

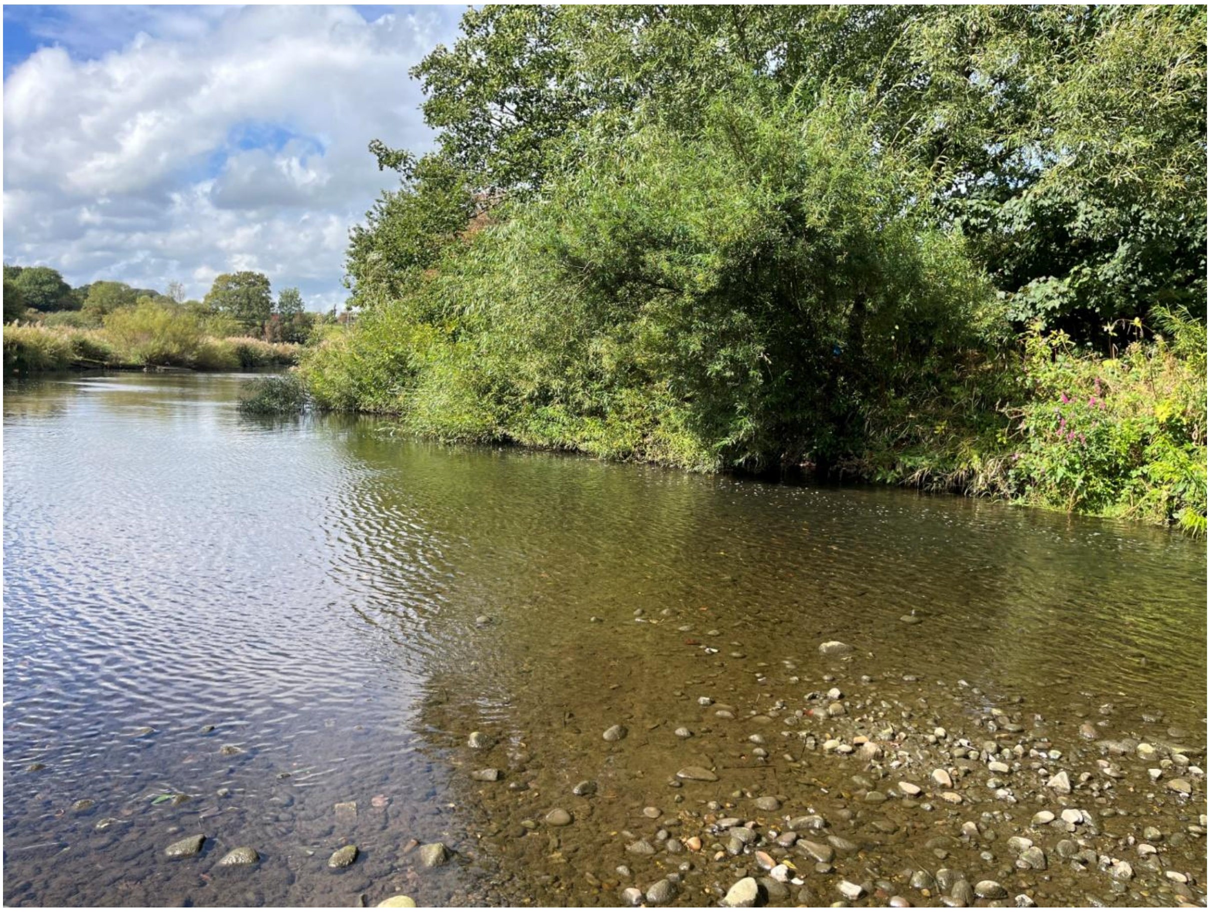

Figure 2: Himalayan balsam (right of frame) competes with the surrounding native vegetation. Note the low-hanging vegetation cover on the RB (centre frame) and overhanging tree canopy. This type of cover is essential in balancing predator/prey interactions.

Over time, if stands of invasive plants become sufficiently dense, then tree seedling growth can also be suppressed. Reduced riparian (riverside) tree canopy cover leads to a loss of shade, cover from predation and reduced terrestrial invertebrate inputs to aquatic foodwebs. The low, trailing marginal branch and tree-root cover that persists throughout winter is particularly valuable to juvenile fish as well as to overwintering adult fish. When structural complexity in the habitat is reduced, it creates an imbalance by raising the foraging efficiency of predators. That imbalance exposes prey populations to the risk of severe depletion. In river corridors, predation pressure on fish includes highly mobile predators in the form of piscivorous birds. This means that, in the event of prey fish populations becoming depleted, flying predators can move to new feeding grounds with relative ease. By contrast, the recovery of prey populations is likely to be slower and more fragile in habitat that lacks sufficient cover from predation and relies on in-river recruitment. Any factors in the river that impact or control reproductive, survival and growth rates in fish populations place limits on how quickly those populations may bounce back. Avian predation on river systems is likely to be greatest during cold winters when alternative, stillwater feeding grounds are frozen solid. Consequently, submerged and trailing structural cover that remains year-round is important in balancing predator/prey dynamics. Contrast the mixed-species native tree cover (Fig. 3) with invasive Japanese knotweed (*Fallopia japonica*; Fig.4) where knotweed will die back during the winter.

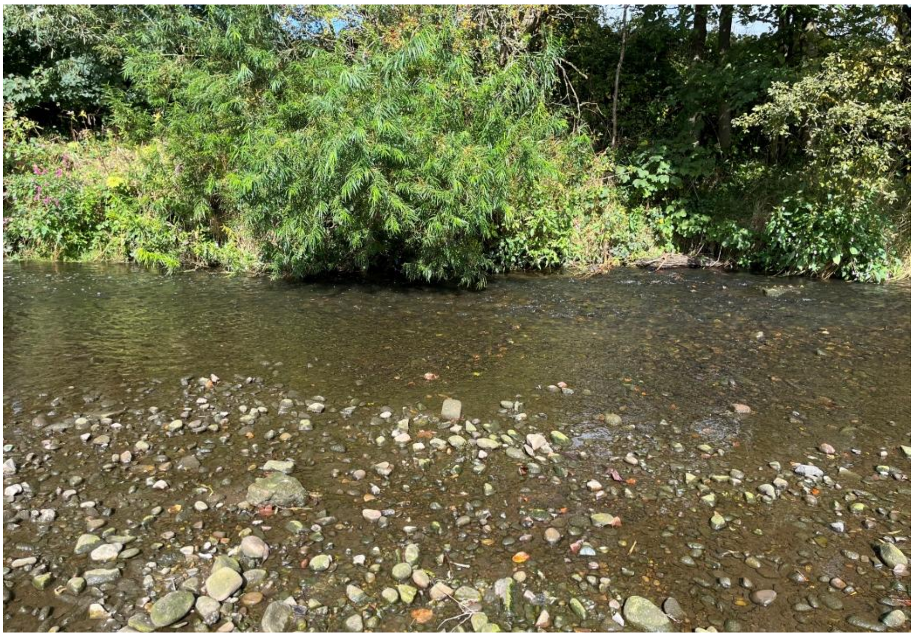

Figure 3: Low, trailing branch cover on this riffle will provide some year-round cover from predation. During hot weather, vital cooling is also created by the shade it provides.

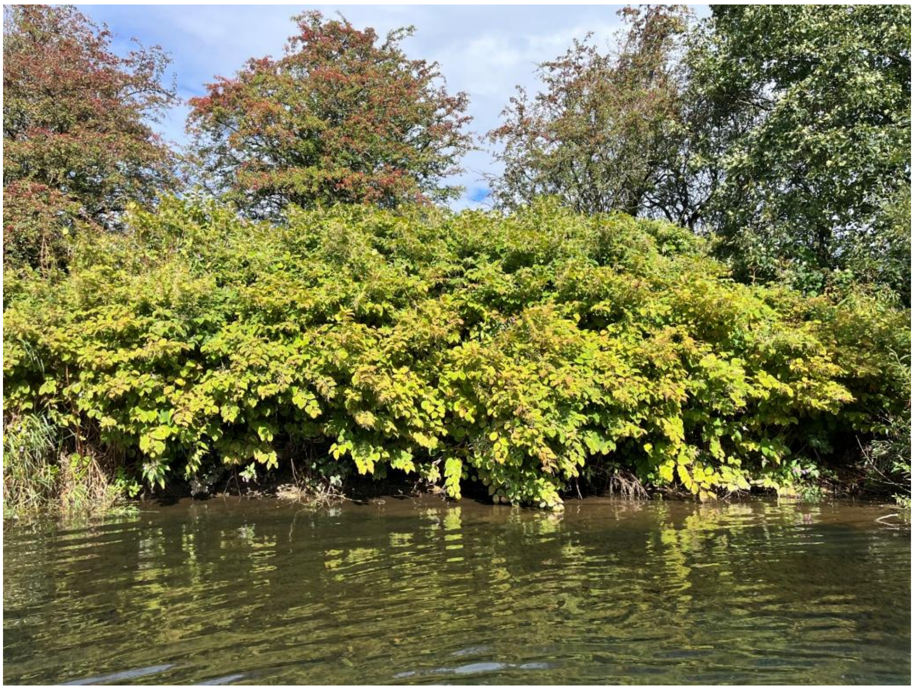

Figure 4: This Japanese knotweed stand at 53.809469, -2.253403 will die back to leave bare earth in winter.

When wading the channel, the high bed-loading of fine silt and sand is very apparent (Fig. 5). Consequently, even though gravel and cobble substrate is in plentiful supply, much of it is either choked or entirely buried by fine sediment.

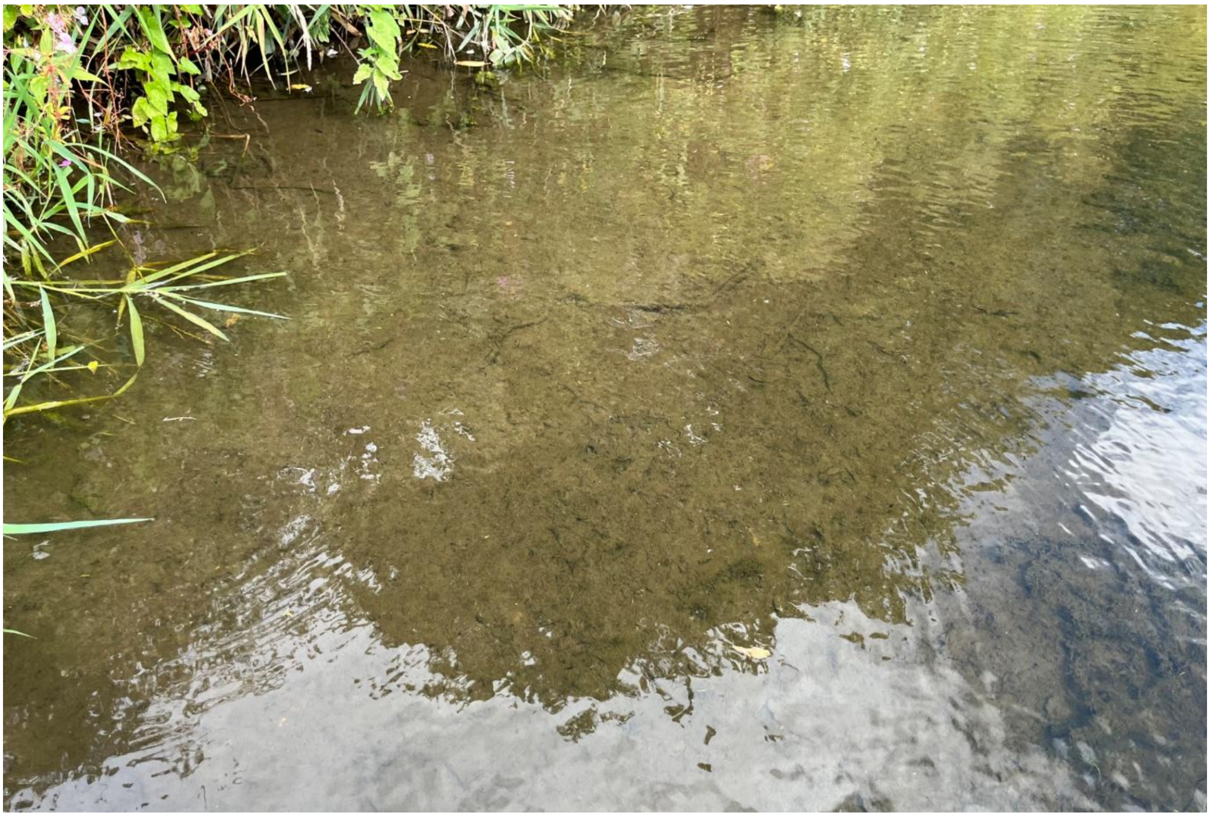

Figure 5: Thick deposits of silt and sand completely burying the abundant cobble and gravel substrate below.

Complete burying, or simply the choking of gaps between larger substrate particles with fine sediment, both create simpler habitat with less structural variation. This effect is comparable to the loss of trailing and submerged complex cover provided by vegetation. Essentially, the fewer complex nooks and crannies present within a river reach, the fewer different species can find their ideal microhabitats in which to thrive. To compound habitat homogenisation impacts, fine sediment often also carries elevated nutrient levels from surrounding land into the watercourse. Associated algal blooms and increases in microbial respiration will suck dissolved oxygen out of the water – particularly during warm weather. Nutrients and fine silt may also favour in-channel weed growth of submerged macrophytes that favour organic enrichment and/or soft riverbed substrate. For instance, in glide reaches of Pendle Water, large stands of invasive, submerged macrophytes were noted. These were thought, on preliminary observation, to be either *Elodea* or *Lagarosiphon* species (e.g. Fig.6).

The sources of elevated bed load of sand and silt are likely to include high levels of suspended particles from upstream surface water runoff and bank erosion. Sediment-rich runoff and bank erosion are commonly associated with agricultural land use.

Figure 6: Sample of submerged macrophyte (probably *Elodea nutallii* or *Lagarosiphon sp*.) present as substantial stands in steadily flowing areas of the surveyed reach.

Significant supplies of sand and topsoil were evident within the surveyed reach. Before highlighting the conditions where supply of topsoil becomes a problem, it is important to understand that bank erosion as a process is also essential. As with much in ecology, it is a question of balance between competing processes that determine whether something is healthy or problematic. Erosion, deposition and remobilisation of substrate are excellent examples of the need for this type of balance. Therefore, the first thing to consider here is that bank erosion is a fundamental component of healthy river habitat. The ability of river channels to shift back and forth over time is vital for maintaining structural and biological diversity. Bank erosion is also a major source of cobble and gravel substrate needed by gravel-spawning species. However, significant expanses of agricultural land surrounding a river can unbalance the rate and type of substrate supply.

Where cultivation or grazing practices restrict the root structure to the surface few inches of soil, very little resistance to bank erosion is provided. If long tracts of riparian bank consist of soil with a very shallow root horizon, the rate of input of sand and silt is greatly increased. Similarly, if crops are planted such that large expanses of loose topsoil are susceptible to being washed away during heavy rainfall, this will also result in significantly elevated inputs of fine sediment. That latter issue is exacerbated when ploughed furrows run parallel down a slope towards a watercourse. A better option is to plough perpendicular to the slope to aid topsoil retention along with use of appropriate ground-cover crops, retention of stubble and instigation of effective riparian buffer zones. As with any implementation of riparian buffers, it is important to avoid their interception function being bypassed by piped discharges of runoff.

Within the surveyed reach, there are long sections of shallow root-horizon banking with little to no resistance to erosion. Looking at the exposed cross sections of eroded cliff features is a perfect illustration of the mechanisms at play. The shallow root horizon associated with grazed land is clearly visible (e.g. Fig. 7).

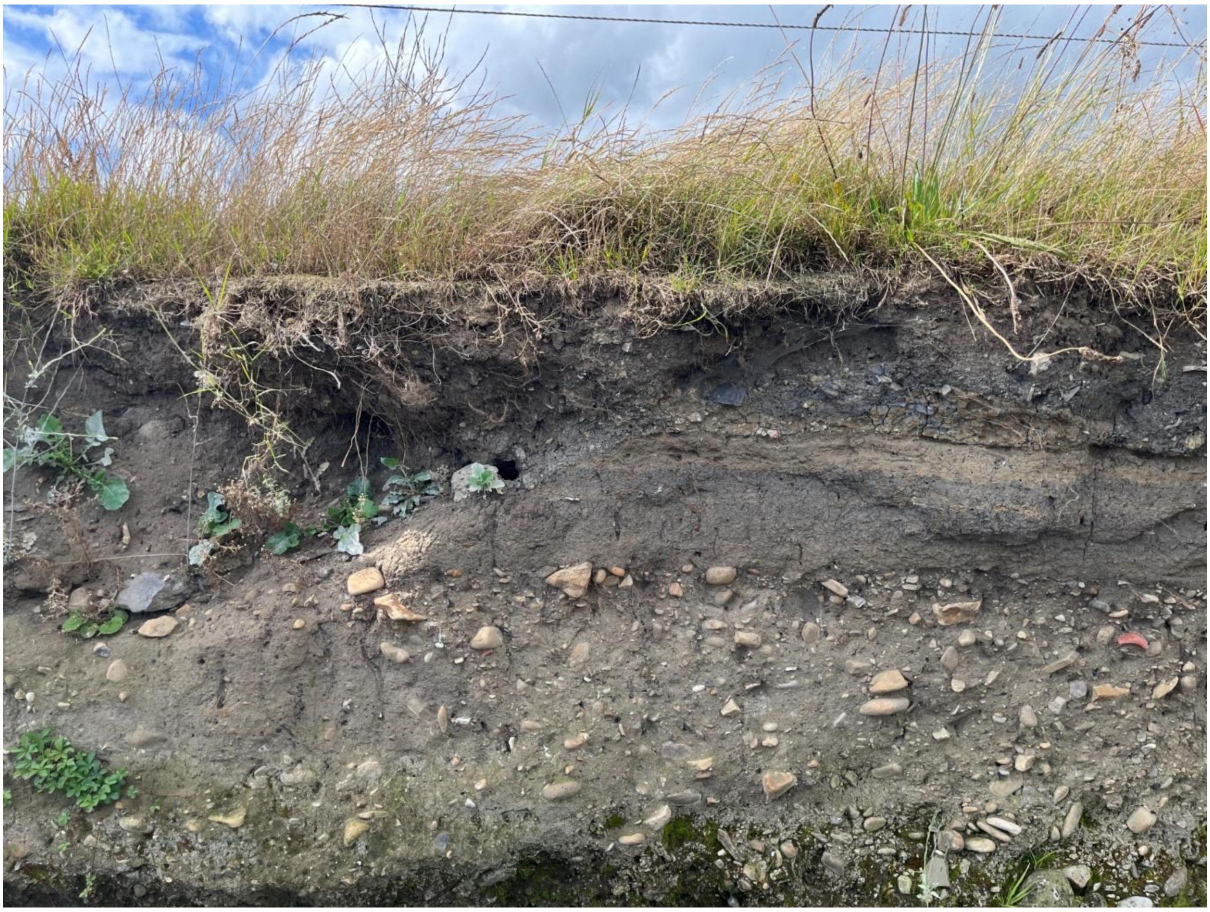

Figure 7: Shallow root horizon associated with grazed grassland. Little resistance to erosion and a source of large tonnage sand/silt inputs along with gravels.

The rate of erosion appears to be causing problematic land loss to the landowner due to the river's movement under and through the fence-line bordering the surrounding fields (e.g Fig. 8). However, what is also easy to see is how the lateral migration of the channel creates valuable erosion as it meanders, and provides an important source of cobble and gravel. Eroded cliffs clearly show the layers of alluvial deposits of cobble and gravel at the bank-toe throughout the reach (e.g. Fig.9). Consequently, it is the rate and extent of erosion that is currently causing a relative oversupply of fine sediment and loss of surrounding land on the LB for a significant proportion of the surveyed reach.

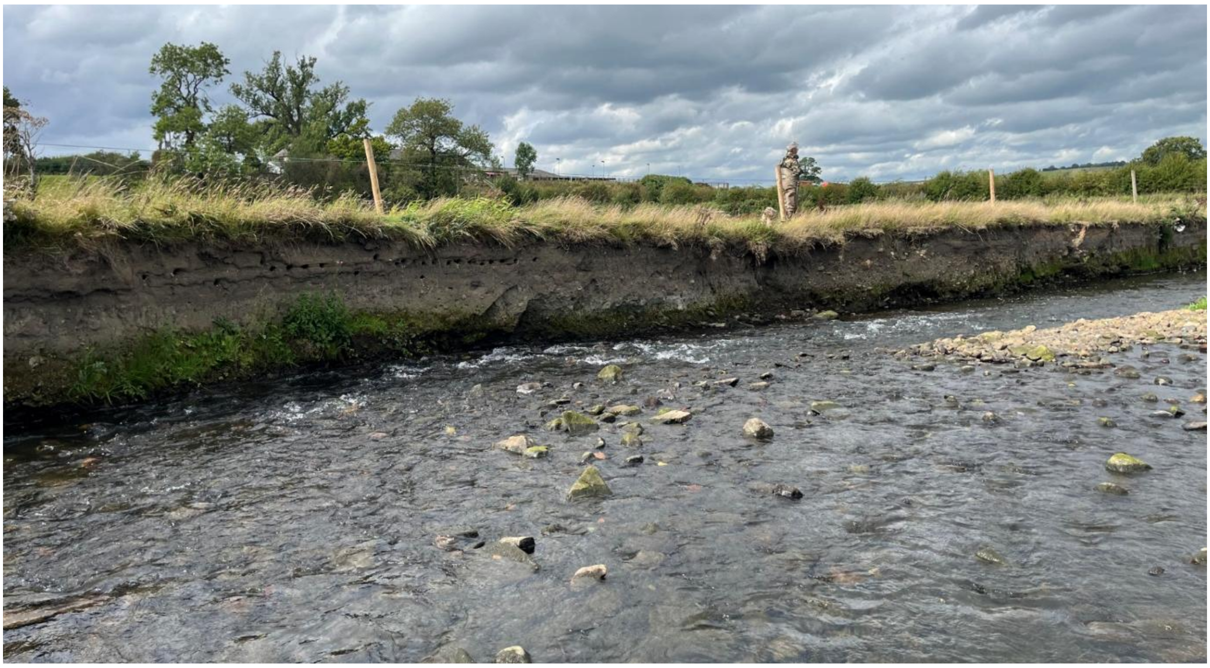

Figure 8: Some posts in this fence-line were suspended over a clear drop by a thin surface crust of topsoil. Note also the lines of oval burrows well above the winter high water mark which may be sand martin nest sites. Other, scattered burrows close to the summer water level may belong to signal crayfish.

Figure 9: Gravel and cobble at the bank-toe (where the vertical bank joins the riverbed). This is a major source of spawning gravels via erosion during spate events.

Along with multiple flat, oval-shaped burrows at or below the winter high-water level in the bank (Fig.10), a discarded claw (Fig.11) suggests that the river has a high population density of invasive crayfish species. As well as displacing native crayfish, the invasive species tend to achieve such high population densities that their omnivorous feeding will substantially impact invertebrate communities. No reliable means of control have yet been identified with variable results reported from “sterilised male” release trials.

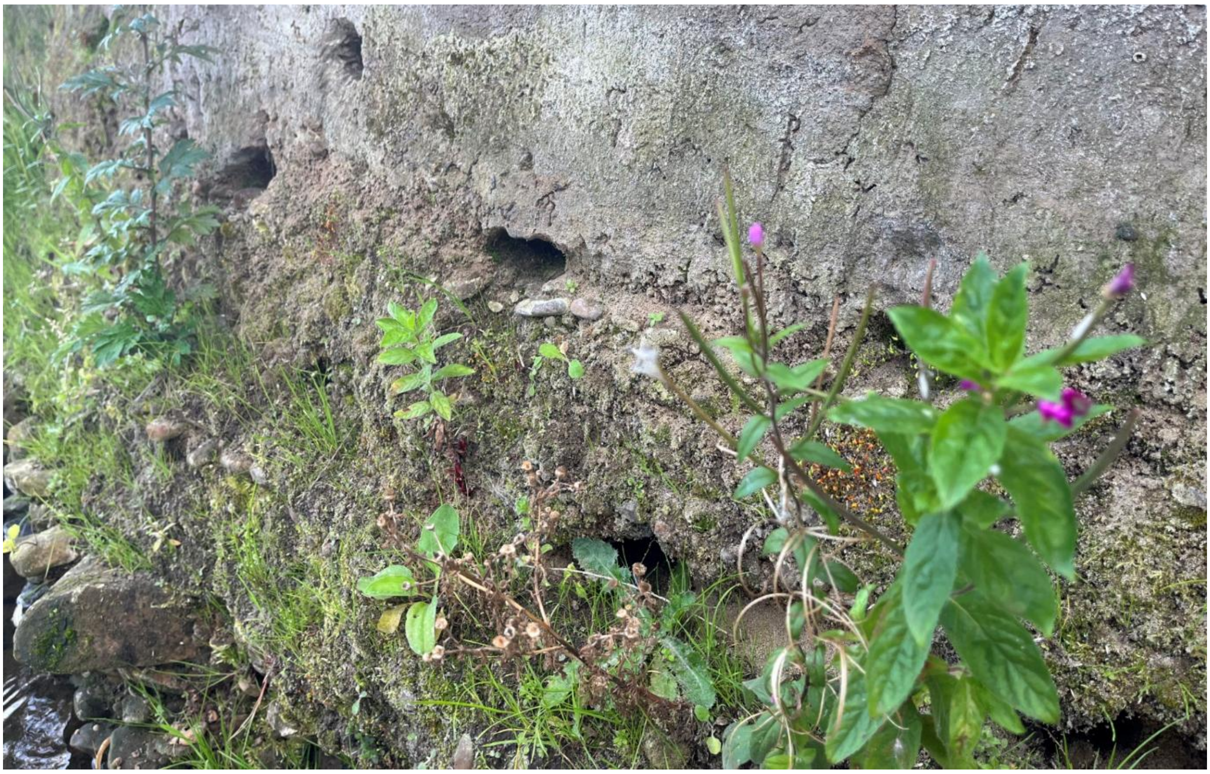

Figure 10: Probable invasive crayfish burrows.

Figure 11: Discarded claw from invasive signal crayfish.

What appears to be the remains of previous attempts to reduce the rate of bank erosion were noted on the LB around 53.809246, -2.254396 (Fig.12). While it isn't possible to be certain of the intended aim of the wooden stakes driven into the riverbed, that approach is consistent with reinforcement of the bank toe.

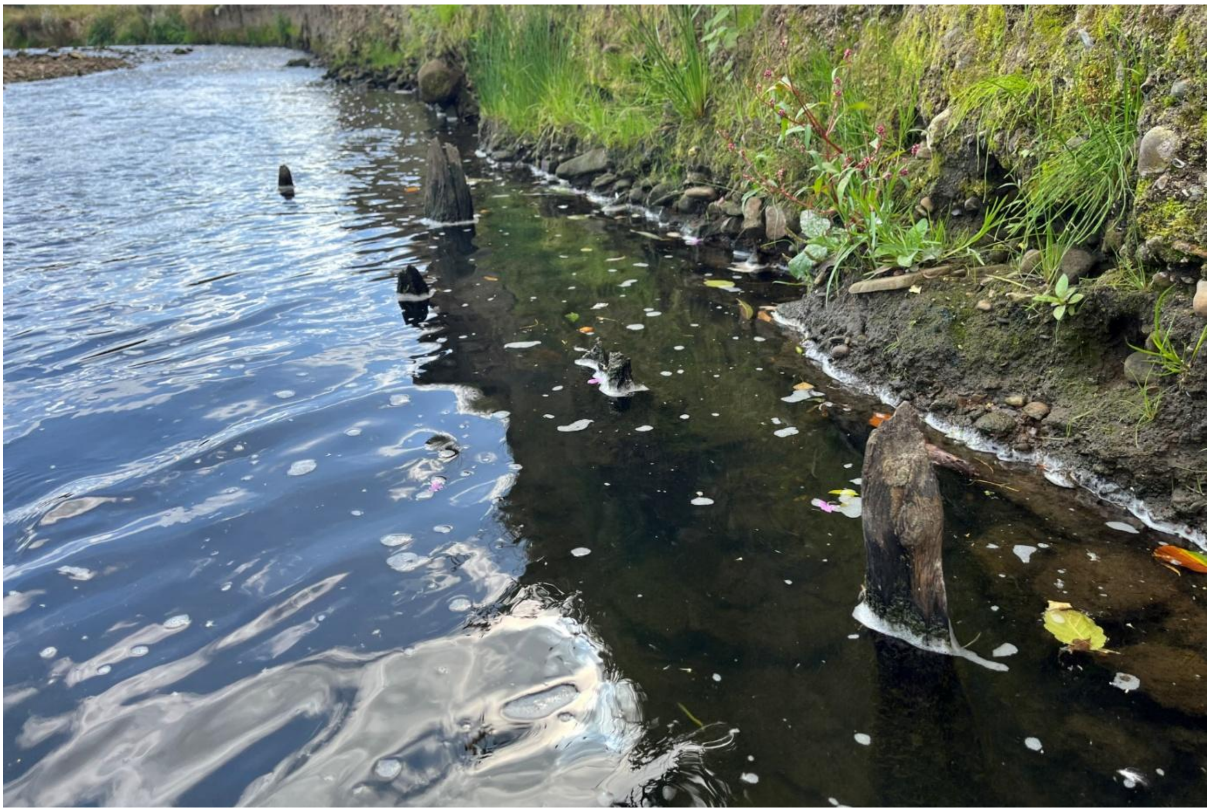

Figure 12: Remains of old wooden stakes driven into the riverbed, presumably as part of an effort to stabilise the bank toe.

Contrasting the extensive eroded cliff-face of the LB with deposition of substrate towards the RB (Fig.13) gives an important perspective on dynamic river processes. Both the volume of deposited material (cobble, gravel and sand) and the presence of early successional plant colonisation give clues to the power and dynamism of this system. Most obviously, there are large quantities of substrate being supplied to and moved through the system. This is easy to see from the extent of depositional features such as point bars (deposition on the inside of bends) and also mid-channel island formation. However, relatively high frequency significant disturbances due to supply and redistribution of substrate is evident in the pattern of plant colonisation. Figures 13 and 14 show large expanses of exposed substrate along with young, early colonist plant specimens. Longer-standing areas of substrate have been consolidated by greater establishment of vegetation in terms of ground coverage and age of plants. The stage of plant colonisation provides an estimate of the frequency with which that habitat is disturbed and substrate is turned over in response to spate flows.

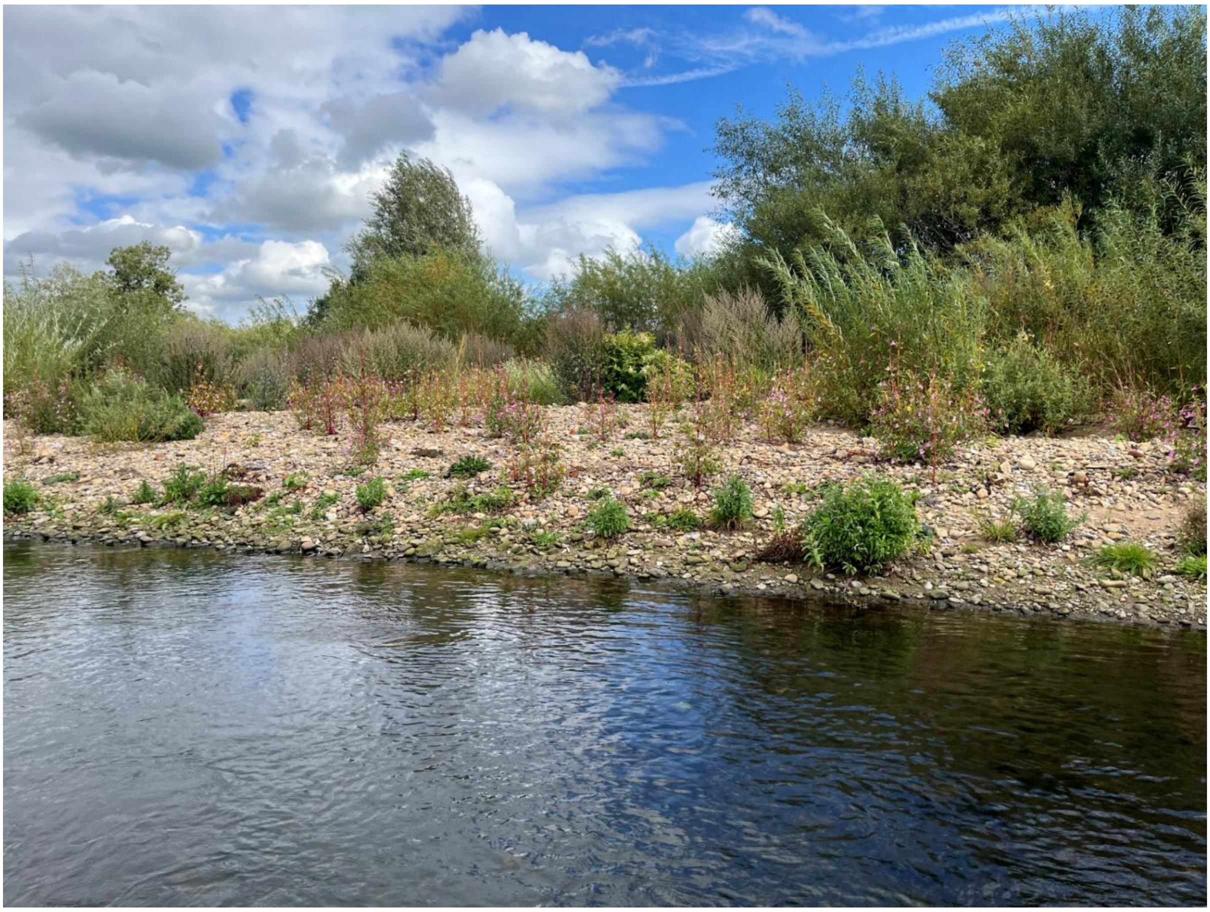

Figure 13: Point bar/mid-channel island on the RB that appears to have an ephemerally wetted channel adjacent to the junction with the surrounding floodplain land. Note the spectrum of vegetation coverage and age spanning from newest in the foreground (most frequently disturbed) to most established in the background (less frequently disturbed).

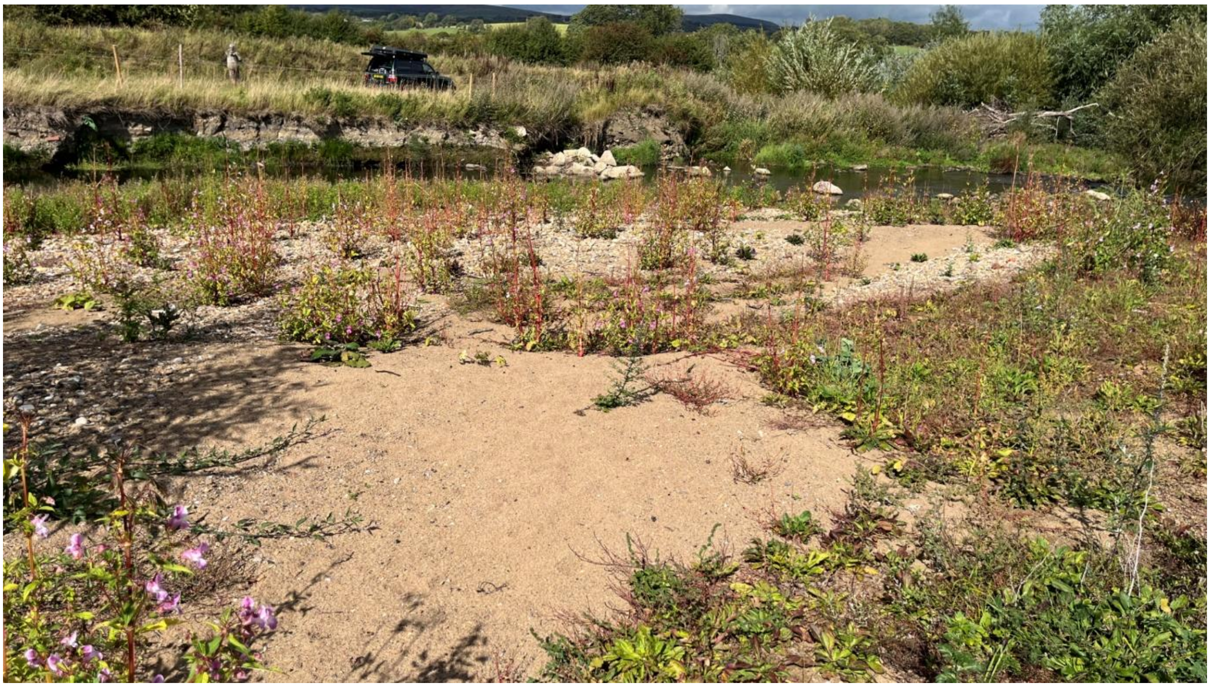

Figure 14: Indication of the proportion of sand deposited as part of substrate matrix in the point bar/ephemeral island. Himalayan balsam and other ruderal/rapid colonising species in evidence.

Japanese knotweed was noted at 53.809574, -2.254185 (Fig.15) and adjacent to the high-flow channel at 53.809656, -2.253790 (Fig. 16).

Figure 15: Recently-established stand of Japanese knotweed at 53.809574, -2.254185

Figure 16: Older knotweed stand in flower (centre frame, background) bordering on the (well vegetated) high flow channel at 53.809656, -2.253790.

Re-crossing the river to return to the LB and progress downstream, what appeared to be a failed rock revetment structure was noted at 53.810139, -2.255786 (Fig. 17).

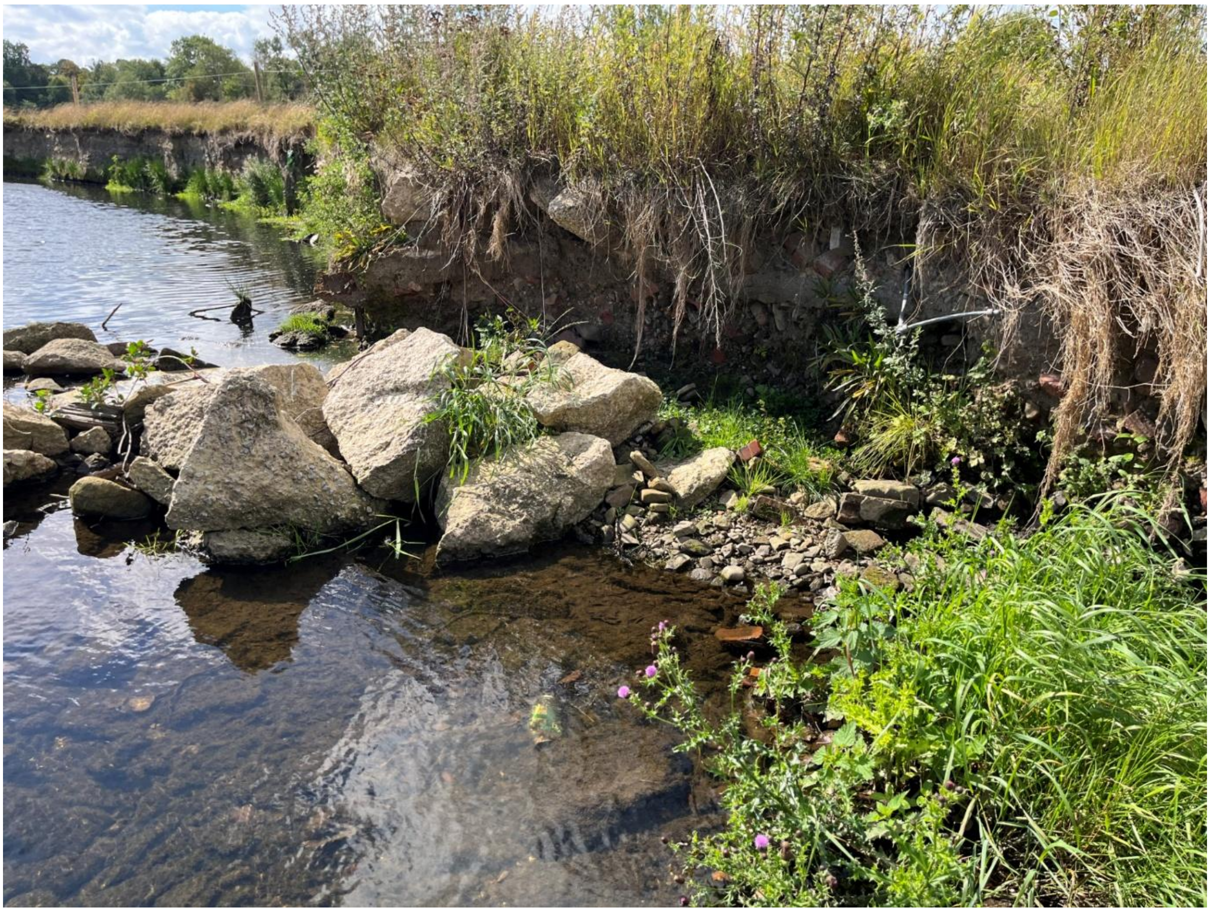

Figure 17: Accelerated erosion behind rocks that appear to originally have been placed with the intention of bank protection.

Although it is not certain that these rock placements were intended to protect against bank-loss, it provides a good example of accelerated bank erosion due to eddy creation by hard, angular surfaces. This process is described more fully, along with the counter example of complex brash and root matrices, in the following video: https://youtu.be/q7zq1yxaPEA. Scanning the following QR code will also take you to the video explanation:

Just downstream from the presumed rock revetment, the river channel enters an area with wider and more extensively vegetated riparian buffer strips. Within this section there is an apparently stabilised island with well-defined channels passing each side of the consolidated substrate. Both the island and surrounding main riverbanks support woodland vegetation. On the outside of the meander within this section (RB) is an excellent illustration of the effects of deeper and more varied root systems on bank erosion (Figs. 18 and 19). Although this is still an eroding bank, the rate at which the river is spreading laterally is significantly slowed. The reduced rate of bank loss results from the reinforcement and flow-dissipation created by deeper and more robust root systems. Instead of being allowed to chew easily into the sandy bank, the exposed roots and trailing stems force the river to dig downwards and create a deeper scour pool.

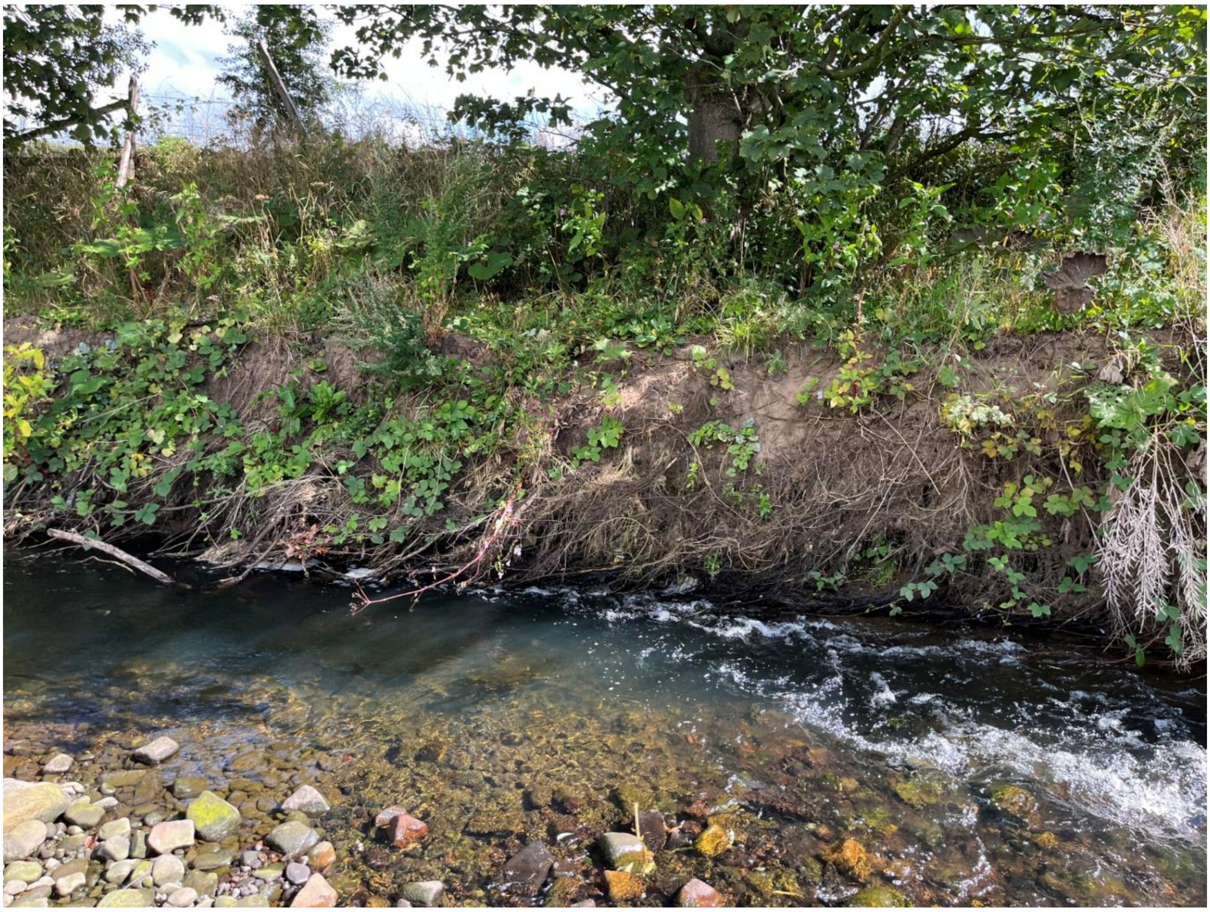

Figure 18: Bankside trees and a more varied understory vegetation has created a much more erosion-resistant bank. Here the river is forced to dig downwards and create a deeper scour pool instead of rapidly eroding sideways and eating away at the RB.

It’s important to note that additional depth is created by an erosive force of moving water, rather than water being held back by a dam. Pools with a good flow of water tend to avoid becoming filled with sediment. Conversely, slow or static water impounded behind a dam (or weir) will promote deposition and become shallower over time. In general, you achieve better results by having a river drive the bed down in localised areas rather than by holding water back. With a localised bed-erosion approach, the river will maintain that variation in depth to create structural diversity. Attempts to artificially create pool habitat for adult trout by installing weirs has multiple negative impacts. Impoundments homogenise habitat, creating a tendency to reduce invertebrate, plant, fungal and microbial biodiversity. Any depth that is temporarily achieved will often need to be artificially maintained by mechanical removal of sediment. Weirs also restrict free upstream and downstream passage for individuals of all species that move between different areas to complete their lifecycles. Perhaps less obviously, weirs also interrupt the processes of substrate transport and redistribution that are essential to create habitat features. The section of Pendle water surveyed in this report significantly benefits from the absence of artificial weirs.

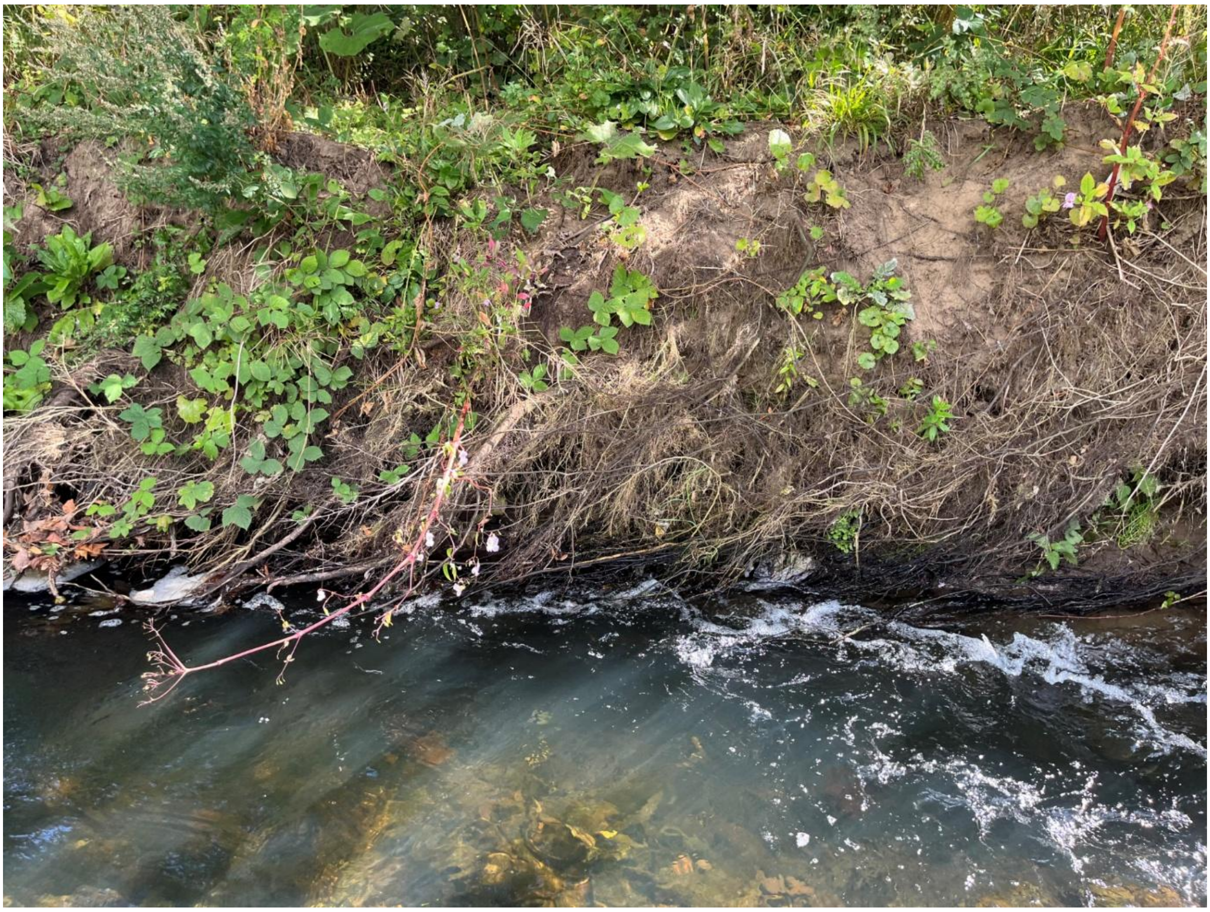

Figure 19: Details of the bank reinforcement as well as cover habitat created by tree and shrub root systems. Contrast this with the shallow root system of grazed land shown in Fig.9. The reinforcement also helps to create stable undercut refuge areas which are important shelters for adult and juvenile trout.

Probably the most structurally diverse and ecologically valuable habitat was encountered within this divided channel section of Pendle Water. Extensive cover from predation is provided by low, overhanging branches and trailing marginal vegetation (e.g. Figs. 20 and 21). Fallen trees augment cover and also create additional complexity by influencing localised bed scour.

Deadfall of large woody material is an extremely valuable component of healthy river systems. With the island apparently being in place for a long time, a dense stand of mature woodland has arisen. This provides a source of woody material as well as a high probability that fallen trees will lodge securely against remaining trees and bends in the channel (e.g. Figs. 22 and 23).

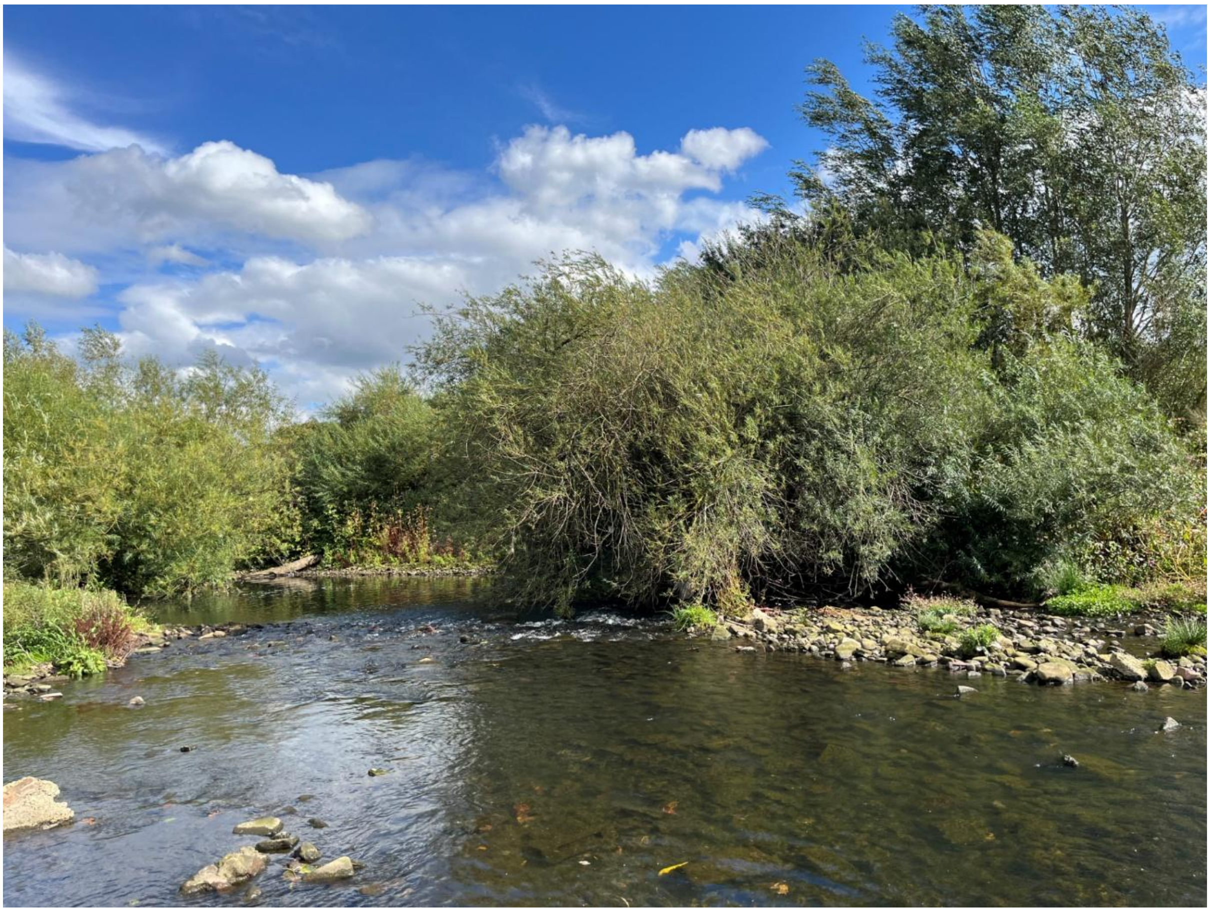

Figure 20: Mid channel island and surrounding banks colonised by mature vegetation.

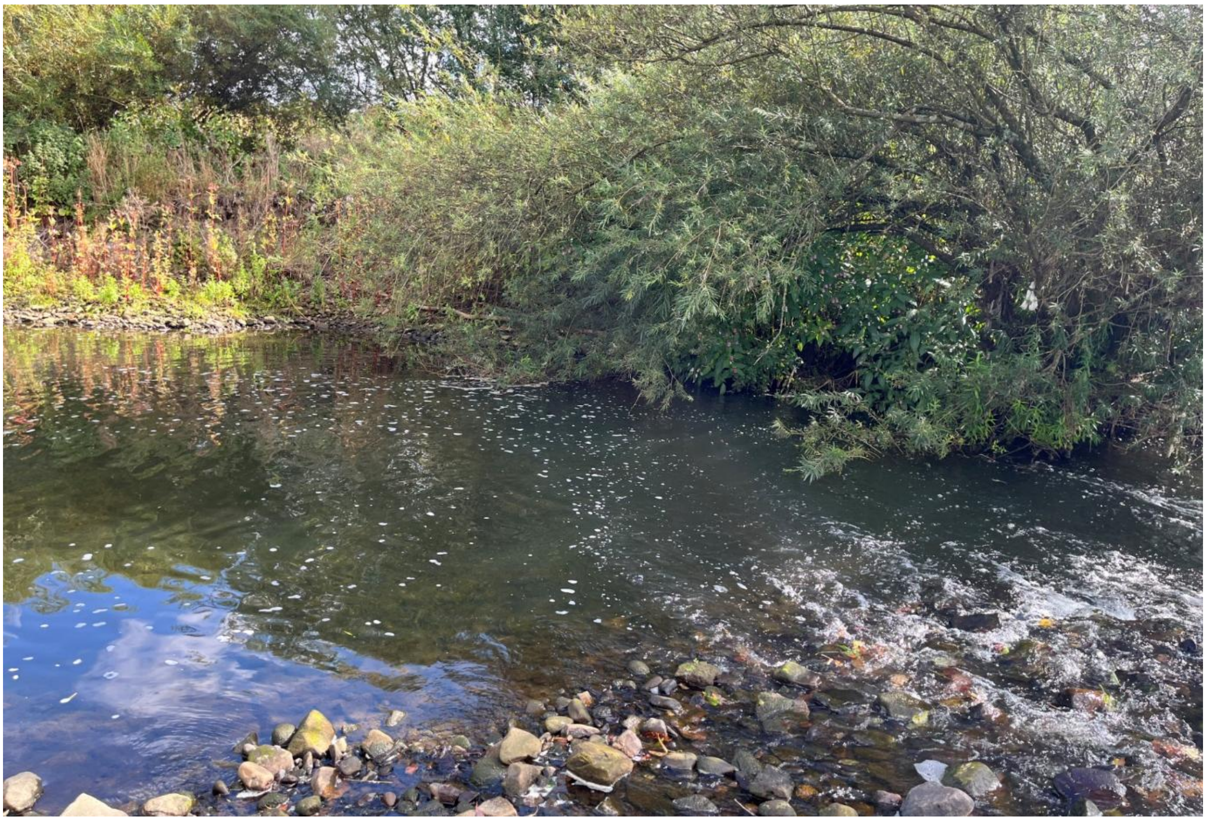

Figure 21: Cobble riffle running into a scoured bend-pool under the protection of low, overhanging willow branches. Excellent trout habitat for a range of life-stage.

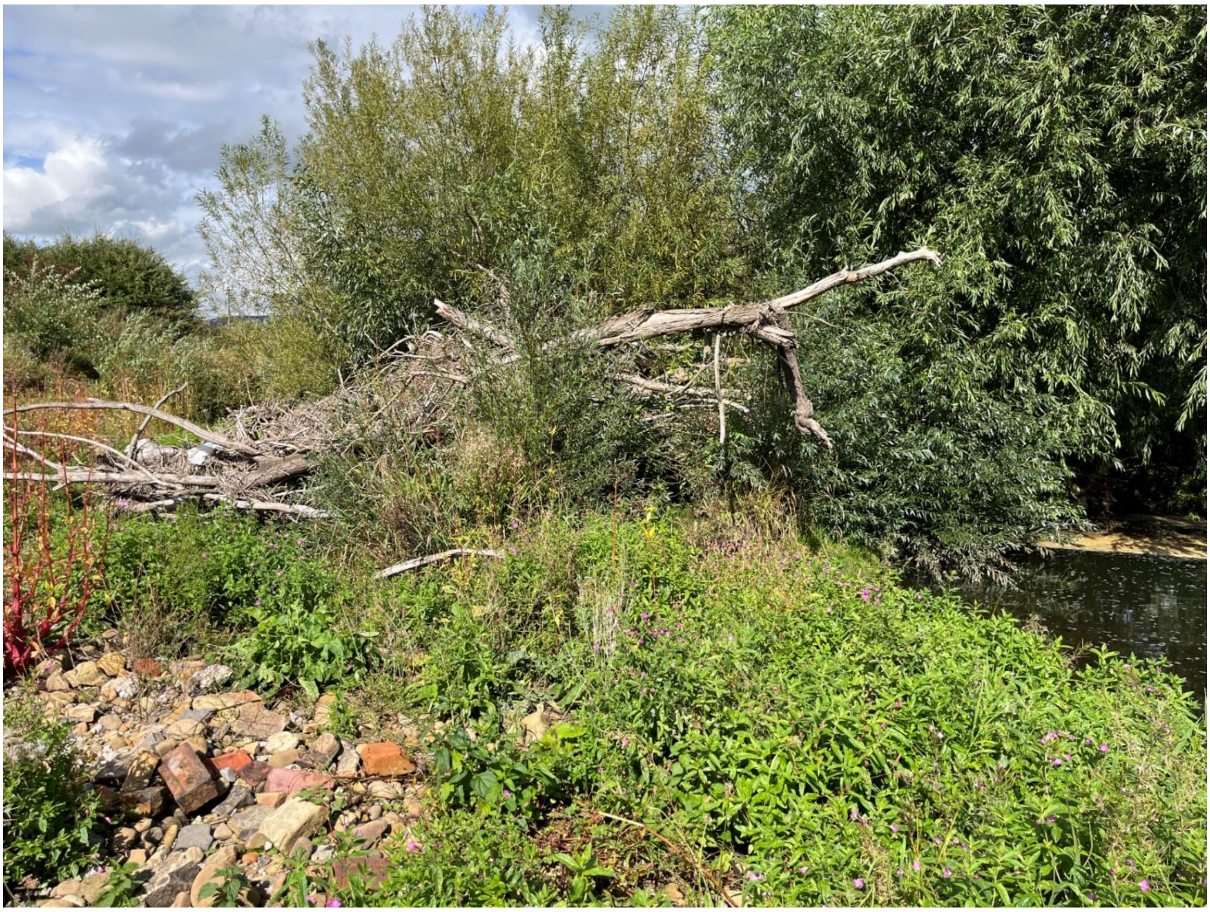

Figure 22: Natural deadfall lodged securely by spateflows between the LB and island.

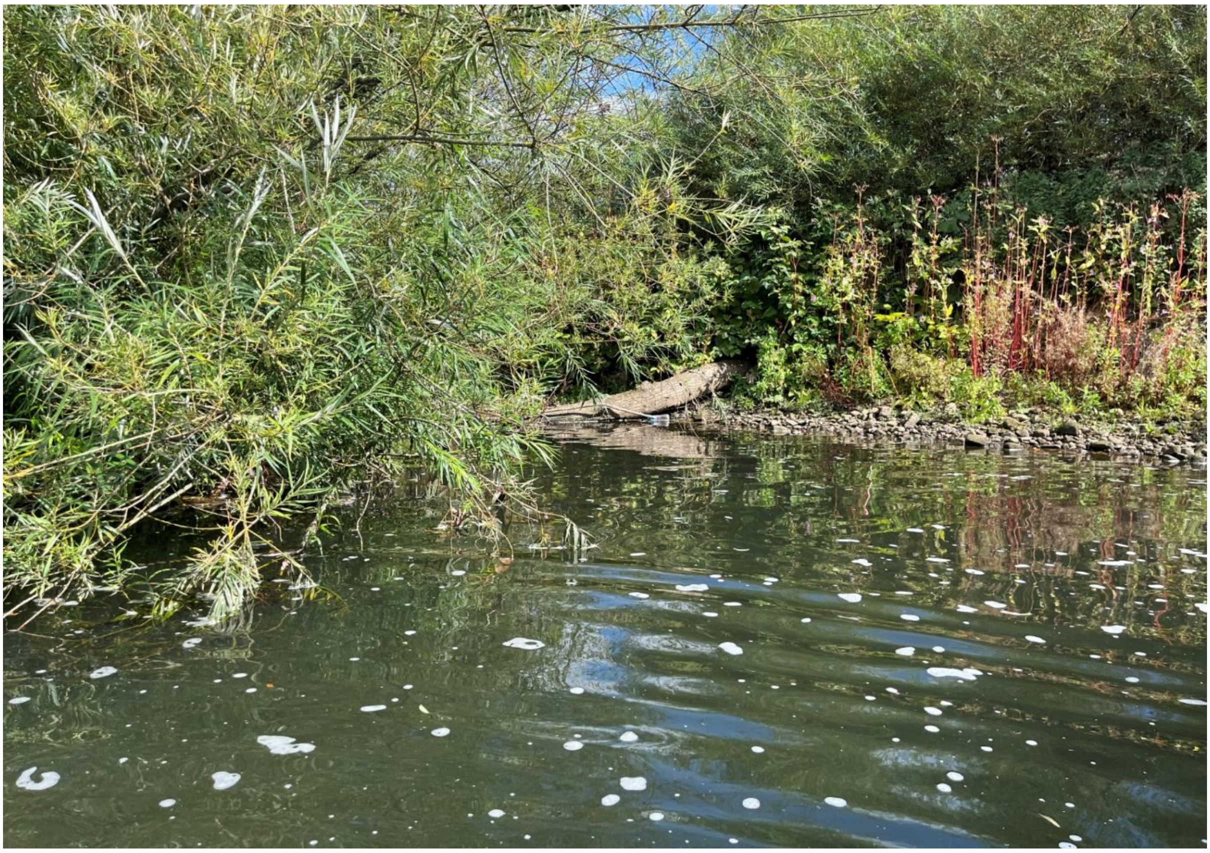

Figure 23: Lodged, fallen tree projecting down into the water in a way that is likely to promote undershot flow (beneath the log) creating beneficial localised bed scour.

With sufficient room for the river to wander within an ungrazed, riparian buffer strip, it has developed into a braided channel with good variation in depth, flow velocity and meandering planform. While the control or removal of invasive plant species would further improve biodiversity, the structural variety of habitat in this section is supporting a range of native plant species. It may be the case that the much higher physical complexity of habitat has afforded a greater opportunity for those native plants to maintain a foothold. The presence on both banks of ungrazed, well-vegetated buffer strips is central to the river's ability to generate this higher quality, more biodiverse habitat that includes backwater areas (e.g. Fig. 24)

Figure 24: Facing upstream into a backwater channel along the LB (right of frame). Note the vegetated bank face bordering the channel and compare to areas with unrestricted grazing along the bank top.

In order for most species of fish to complete their lifecycles, there is a requirement for access to a range different habitat types. The complexity of habitat found in this section with greater riparian buffering and more room for the channel provides a full range of habitats required by, for instance, wild trout. As well as deep scour pool habitat with plentiful overhead and submerged cover, some cleaner gravel glides were noted along with suitably-protected shallow nursery habitat (e.g. Fig. 25).

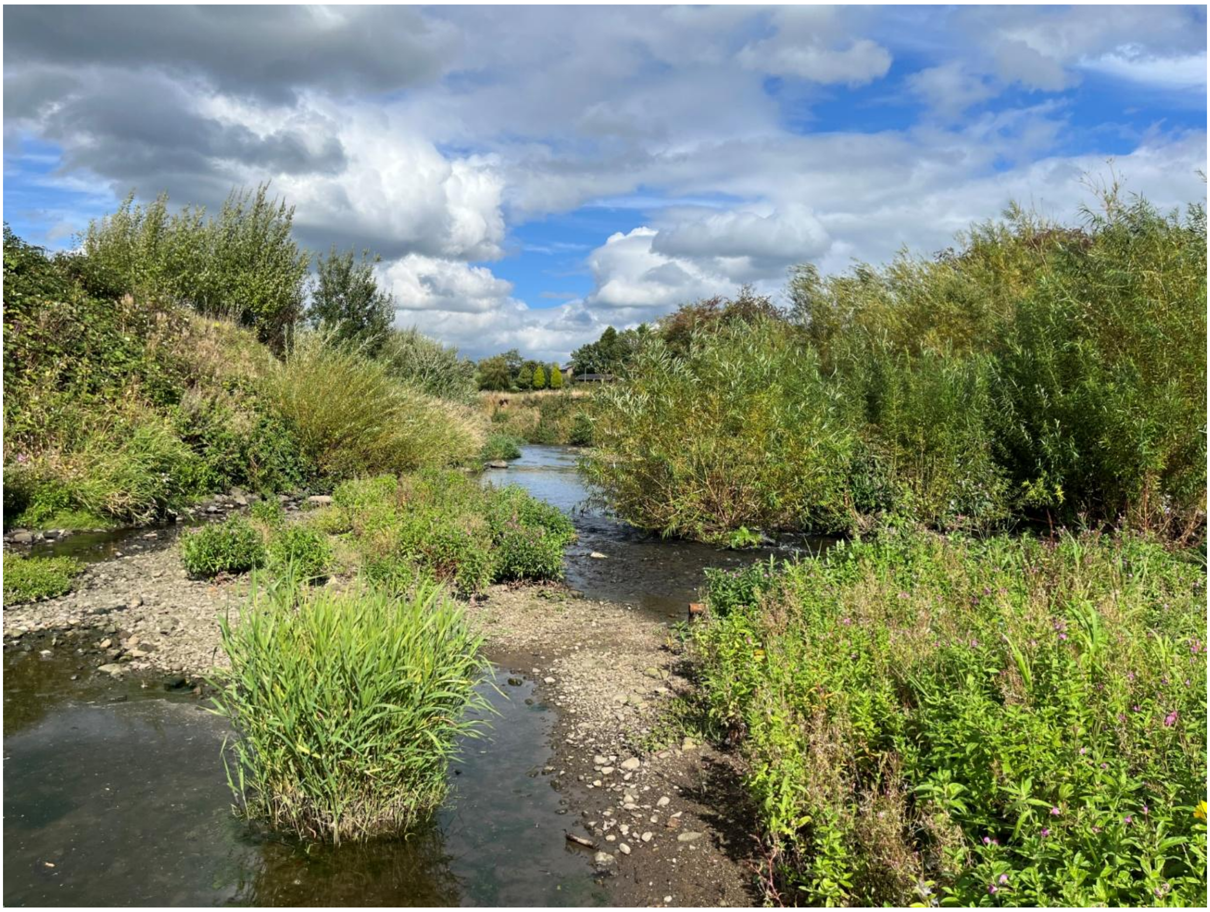

Figure 25: A range of current depths and speeds suitable for juvenile stages of fish development. The flow of water here is allied to increased cover provided by partially submerged and overhanging vegetation. This type of nursery habitat is often an overlooked necessity for resilient wild fisheries and is one of the features arising from channel braiding via the formation of mid-channel islands.

A common and understandable oversight by many angling clubs is the need for an unbroken chain of different habitat types that support a complete lifecycle of their fishery's species. Those habitat types can either exist within the reach of river controlled by a club or be easily accessible via good connectivity to the wider catchment. However, when both connectivity and habitat quality rely on features outside of a club's control, it makes sense to focus on conditions within a fishery reach. Consequently, nursery habitat that can help to maximise the conversion of hatched eggs into young trout that survive beyond their first year is highly valuable. Protecting habitat of the type shown in Fig. 25 is therefore an important priority for wild fisheries. A further important observation on the habitat shown in Figs.24 and 25 is that riparian buffer strip vegetation means that there is no problem with excessive bank erosion.

Several instances of habitat showing the value of bankside trees and trailing understory vegetation were evident within the reach with well-vegetated riparian zones (e.g. Fig.26). Overall, the value of creating sufficient space for the river is well demonstrated within this section. As well as creating a more predictable boundary with surrounding land through a controlled zone of bank erosion, the in-channel habitat diversity is clearly enhanced.

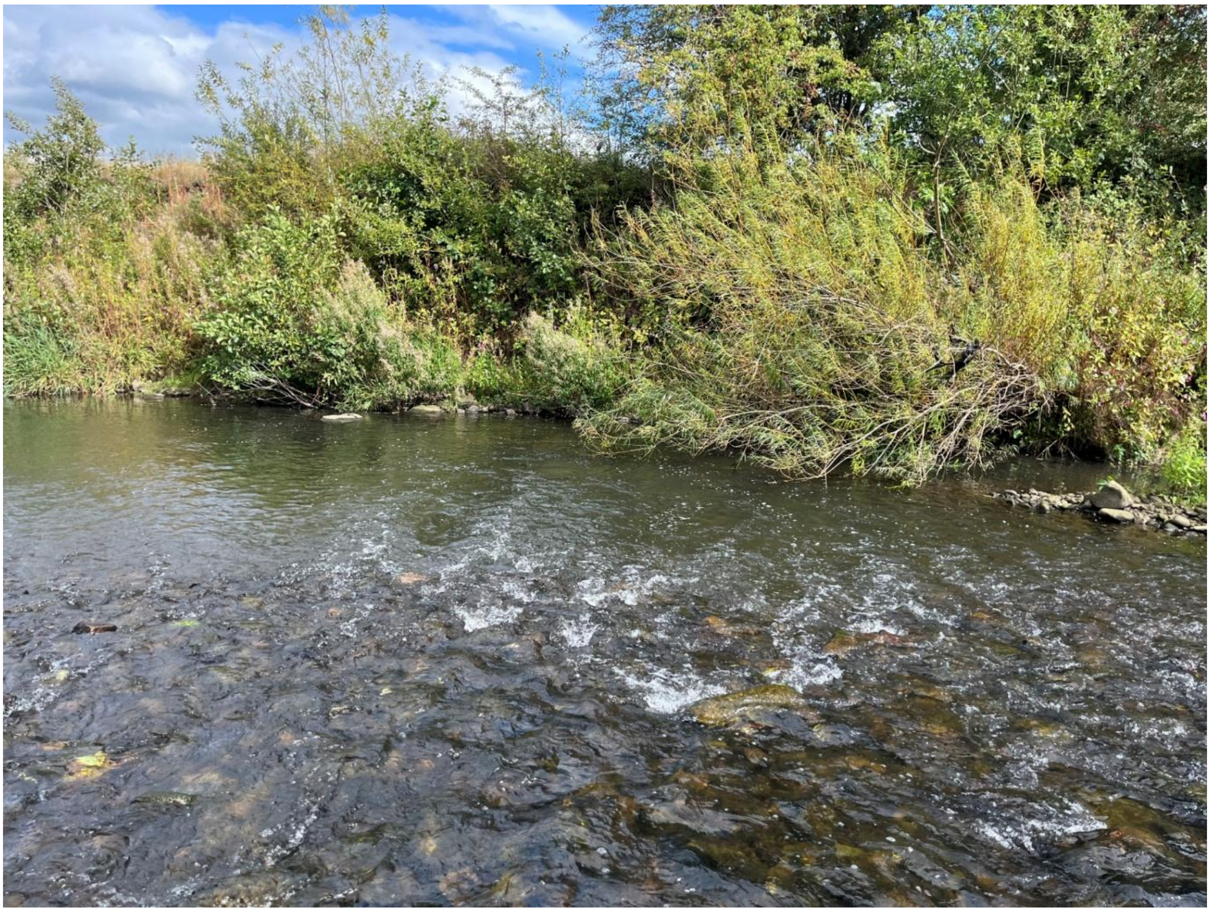

Figure 26: Tail end of a riffle with flow running towards the outside of a bend to meet a bank reinforced by deeper root structure and with overhanging/trailing cover and localised shade.

These beneficial features suggest it would be worthwhile seeking viable opportunities to extend ungrazed buffer zones throughout the areas experiencing excessive bank erosion rates. Funding schemes such as Countryside Stewardship Higher Tier (CSHT; https://www.gov.uk/find-funding-for-land-or-farms/csw25-manage-riparian-and-water-edge-habitats) can help landowners to create ungrazed riparian buffer strips at least 12m wide. Alternative funding schemes for 10-m riparian woodland buffer strips can be sought through the Woodland Creation Planning Grant scheme (WCPG; https://www.gov.uk/government/publications/woodland-grants-and-incentives-overview-table/woodland-grants-and-incentives-overview-table). Stabilising a consistent boundary would also reduce costs of continually shifting fence-lines in a forced retreat from bank erosion. Similarly, costs of retrieval and health issues or injury incurred by animals that breach ineffective fencing are also minimised.

An ochreous discharge was noted at 53.812222, -2.257111 creating a band of orange precipitate that lines the RB margin for several tens of metres downstream (Fig. 27). Typically associated with underlying coal seams and abandoned mine-workings, these iron-rich discharges can well up at unpredictable points due to groundwater inputs following networks of cracks and fissures to the surface. However, they can also be associated with surficial soils and also mining-waste spoil heaps. The orange substance is essentially rust (iron III oxide) which is relatively chemically inert but can create a physical smothering effect from its fine, sludge consistency. However, when present deep below ground in the absence of oxygen it exists as the green iron II oxide and is much more toxic. Contact with atmospheric oxygen is what reduces that reactivity. The scale of the riverbed smothering in this case is relatively limited though it may be worth exploring potential sources of this outfall in case additional treatment and interception could be implemented via reedbed creation.

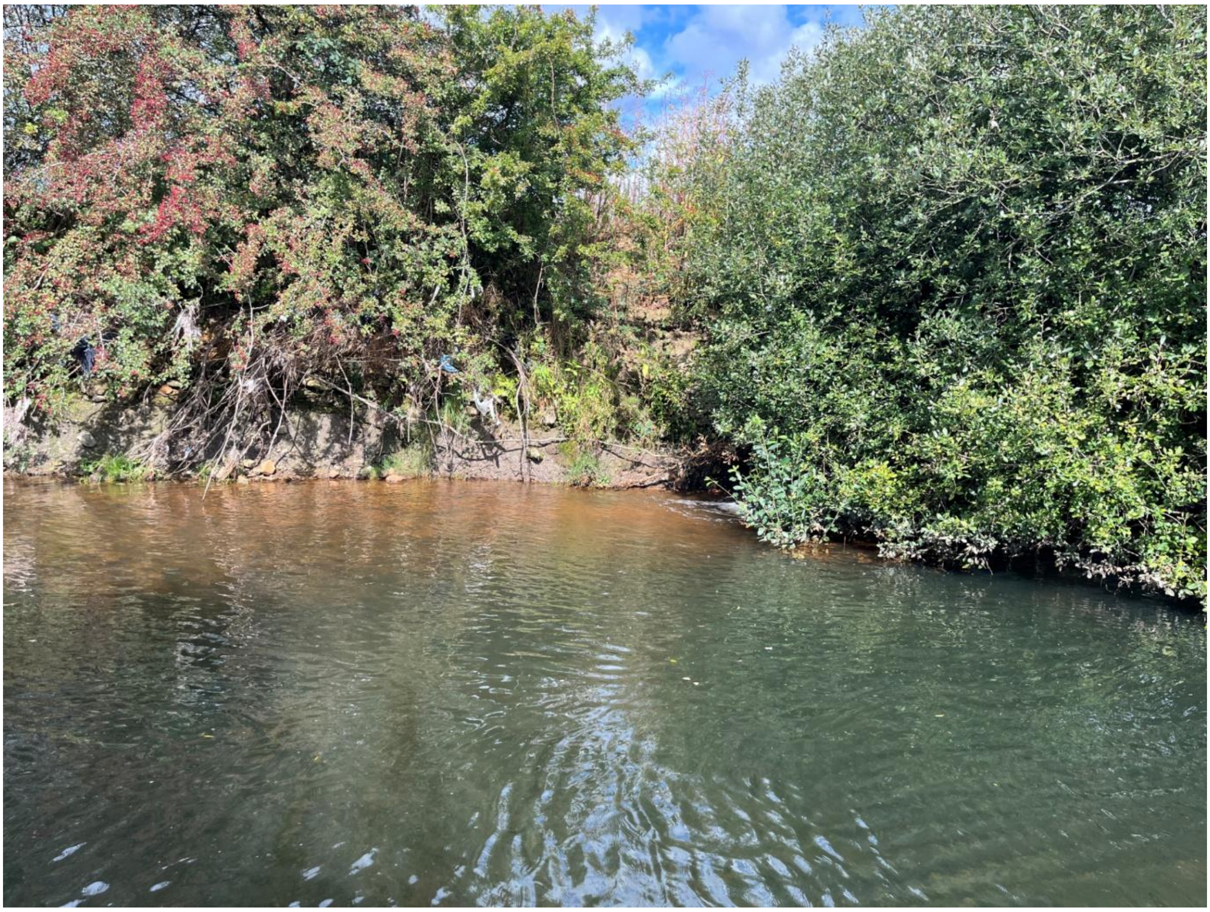

Figure 27: Ochreous discharge point with iron oxide precipitate along the RB margin.

A relatively straight section with a lower gradient (Fig.28) leads downstream from the ochre discharge to a ford and then, after a very gentle right hand curve, into another straight section. The latter reach is dominated by an eroding cliff face running along the LB in response to grazing access being allowed up to the bank top (e.g. Fig. 29). With the same mechanisms of shallow root horizon and low resistance to erosion evident, previous discussion of those principles in this report are equally applicable to this section. At the end of the straight, eroded cliff-face section a ninety-degree left hand bend guides the channel along the perimeter of a wastewater treatment works site. The RB in this section is more extensively revetted using a combination of stone walling and sections of sheet piling (e.g. Figs. 30-32). Apparently, the engineered realignment and dimensions of the channel in this low-gradient section has created generally slower flow.

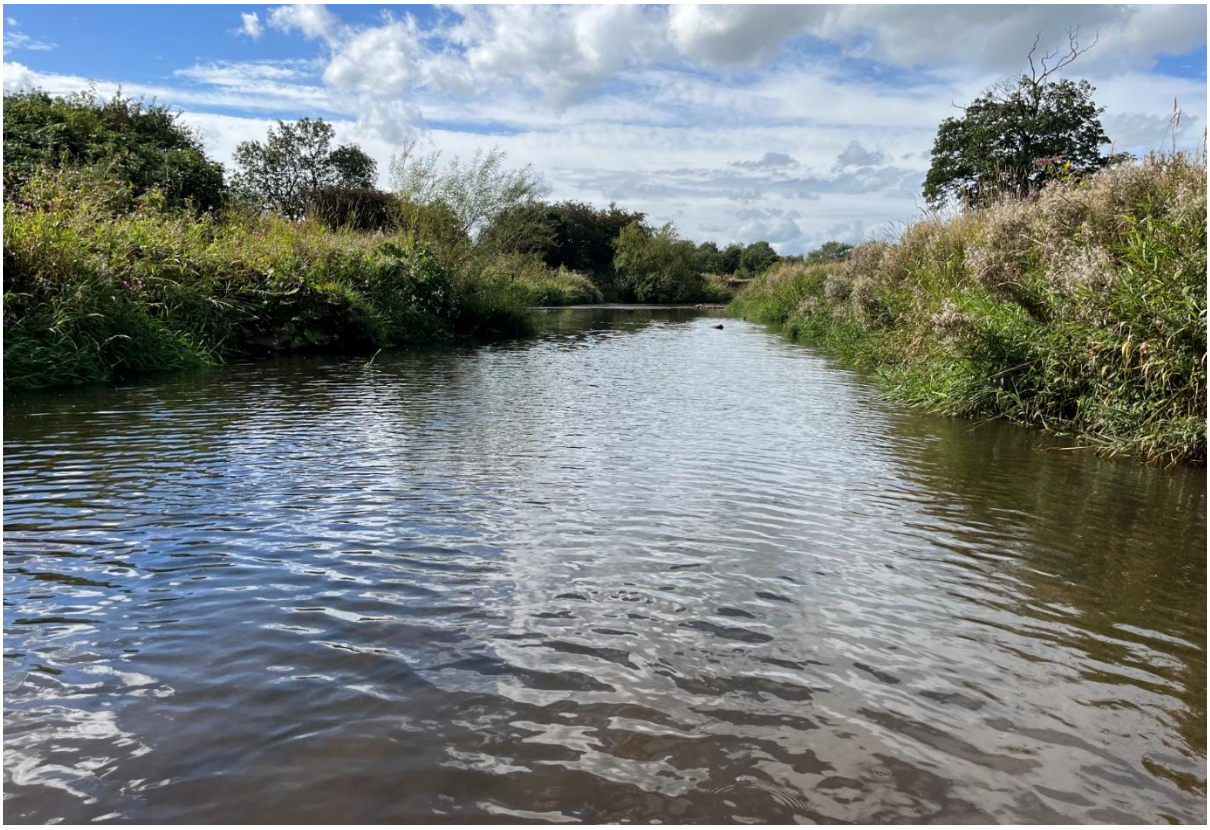

Figure 28: Straight section of slower glide habitat which retains ungrazed riparian zones on both banks. A fording point is just visible in the far background.

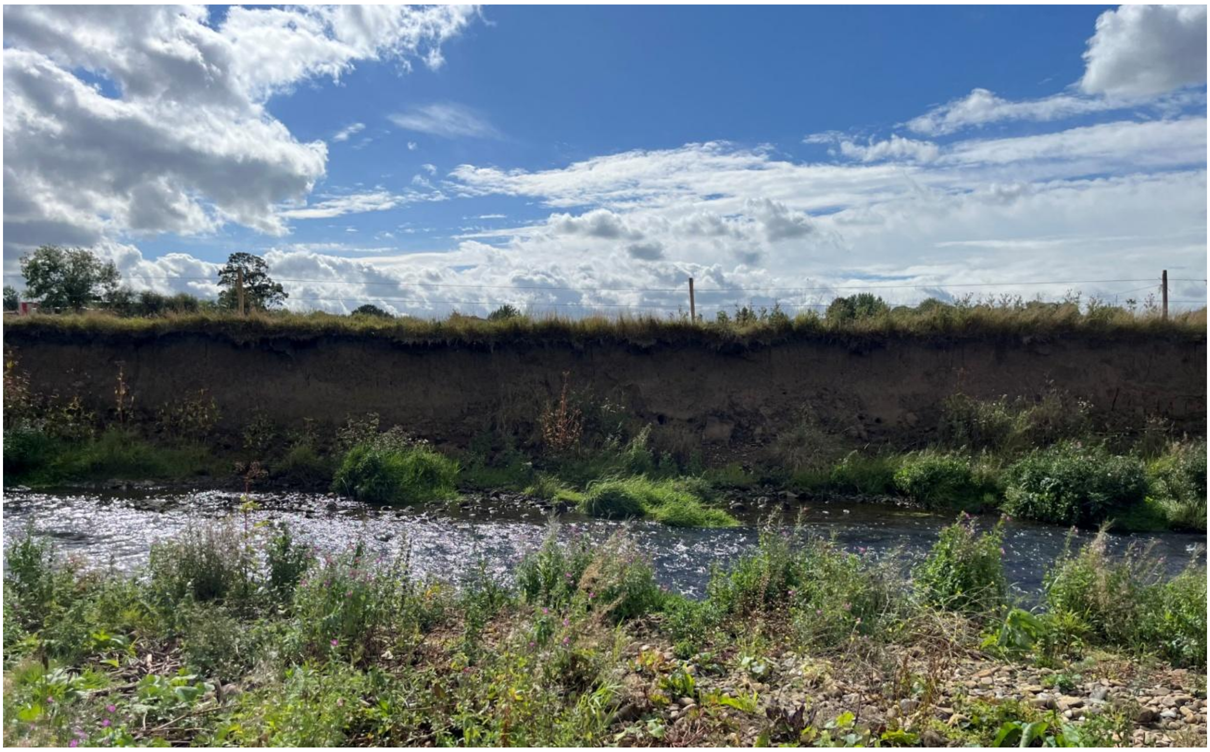

Figure 29: Eroding cliff forming the LB (background) with deposited gravel bar running along the RB (foreground). Note the placement of fence posts allowing grazing access to the bank top and the associated loss of land on the fenced side.

Those slower flows in the modified, widened channel are reflected in the colonisation of emergent macrophyte beds favouring still or slow water (Fig.30).

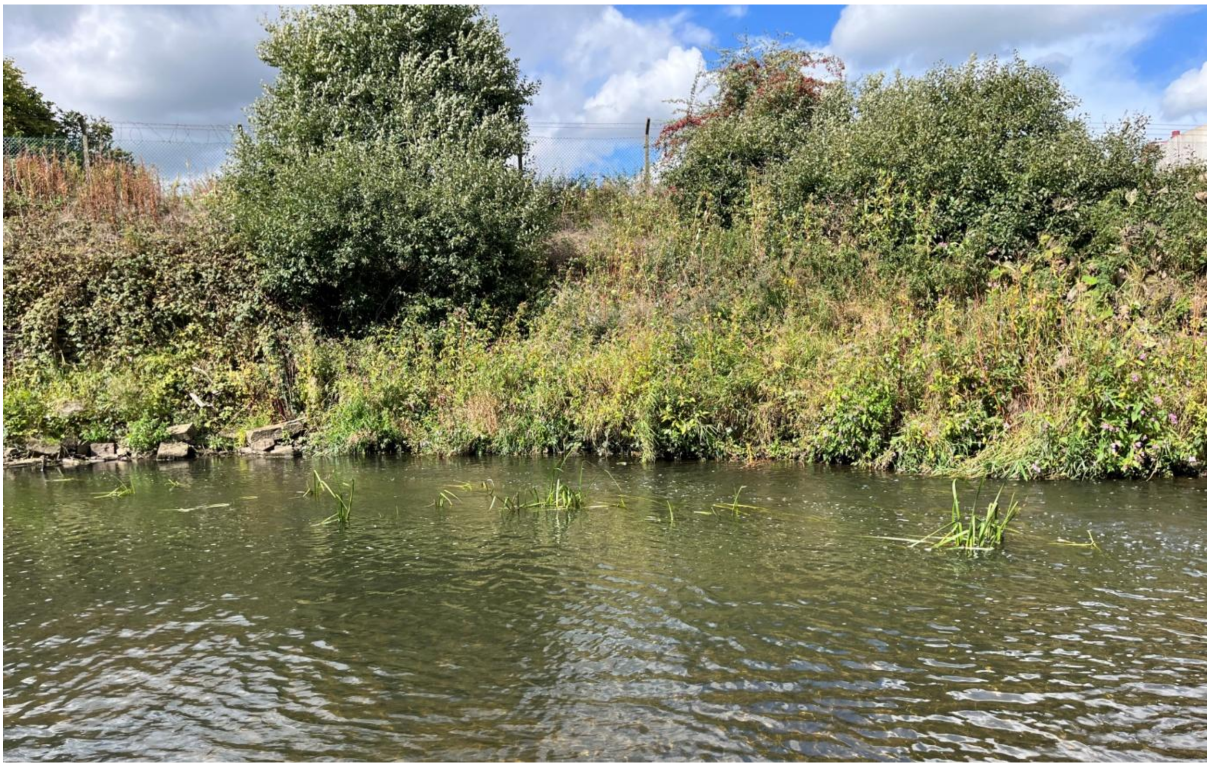

Figure 30: Mid-channel beds of what appears from distance to be branched burr reed (*Sparganium erectum*), typically associated with slow flows. Note stone bank revetment towards the left of frame.

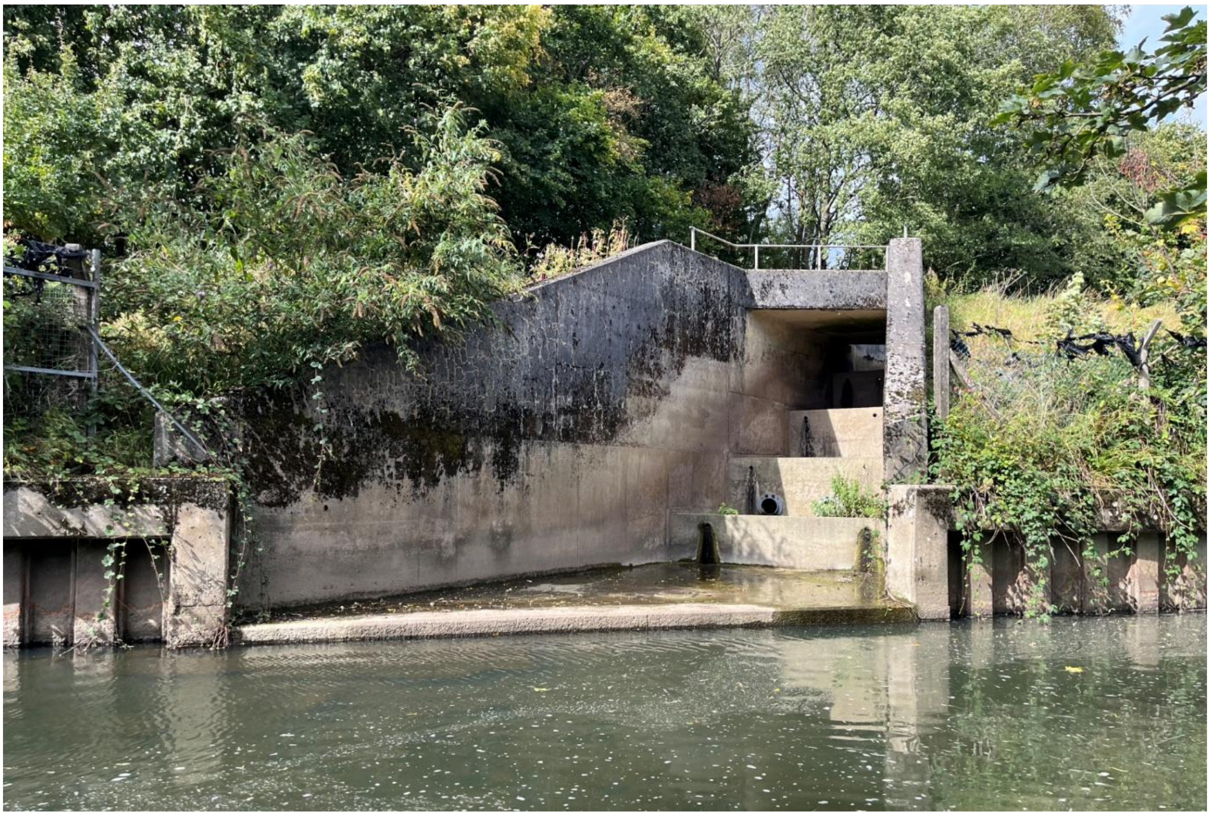

Figure 31: Outfall from wastewater treatment works protected by sheet piling bank revetment.

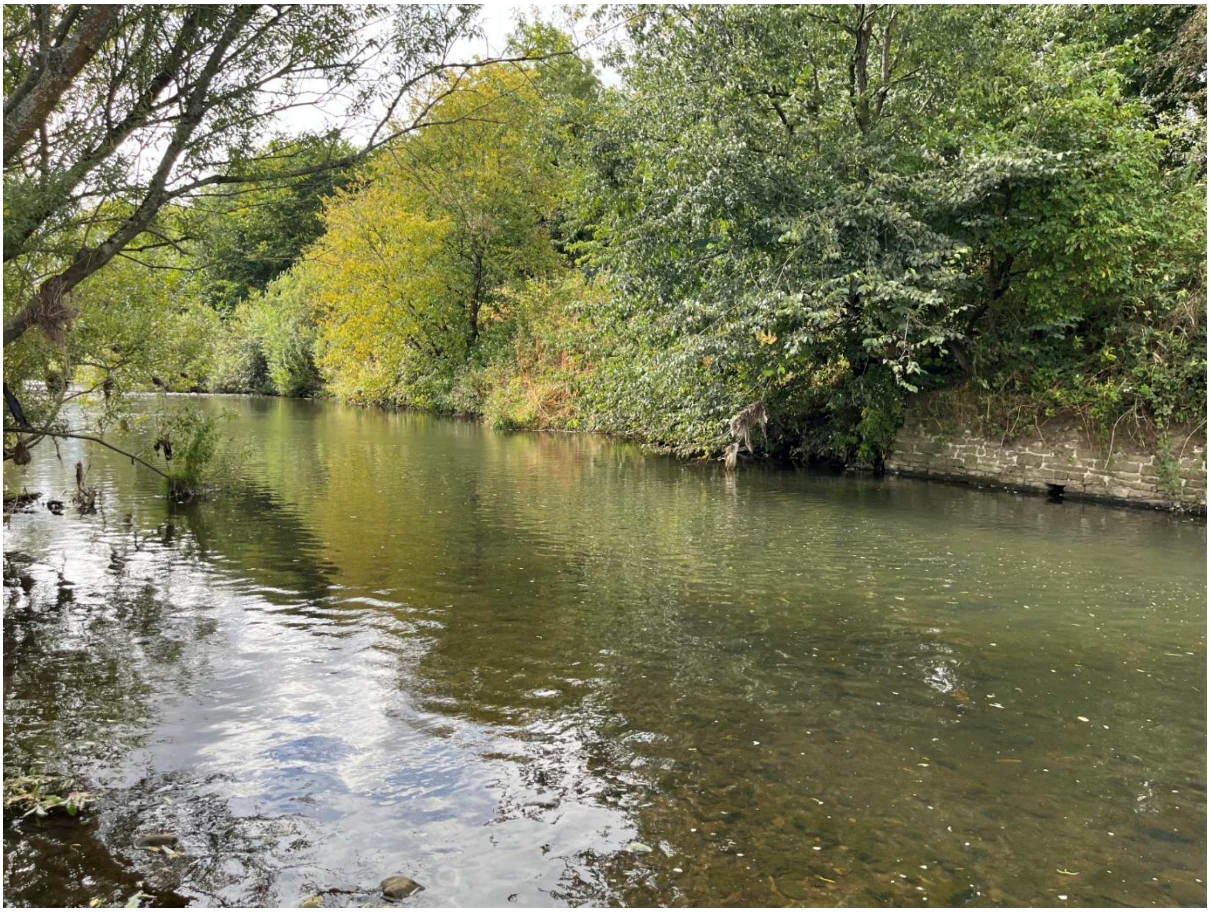

Figure 32: Stonework revetment of the RB downstream of the wastewater treatment works outfall. Note also the mature woodland lining the RB.

It seems that, in response to historical modifications of the channel, a straight path and relatively uniformly-shallow cross-sectional profile is maintained in this section (e.g. Fig. 32). However, the greater age and size of riparian trees in the woodland lining the RB is a very obvious feature compared to most trees growing in the upstream sections. As well as influencing the supply of leaf litter and foodweb subsidies from invertebrates living in the tree canopy, veteran trees will also tend to supply larger-scale woody material via deadfall. A good example of this was noted just upstream of the confluence with the Calder (Fig.33).

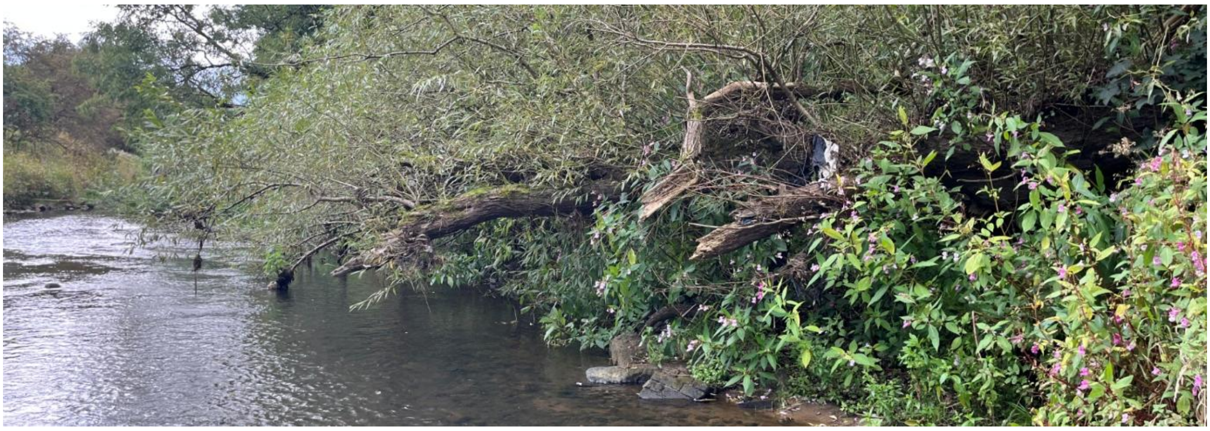

Figure 33: Large fallen willow with just the remnants of the branched crown reaching over the margins. Most of the massive trunk remains on the bank (consequently very stable).

While the multiple stems of the tree crown remained, they would have created structural variation through localised, undershot flow and bed scour. The massive size of the trunk (the main part of which remains on the bank) provided great stability as evidenced by it remaining after the ends of the crown have been torn off.

Despite the large supply of gravel to this section of Pendle Water, there is a general lack of high quality spawning material for trout and other gravel-spawning species. In areas where the channel gradient and dimensions would otherwise be suitable, gravels were mostly smothered by fine sediment. In straightened sections with more gradient, the retention of gravel tends to be poorer and substrate is dominated by coarser cobble and larger rock fragments (e.g. Fig. 34).

Figure 34: Cobble-dominated reach where gradient increases within the straightened section below the wastewater treatment outfall.

Overall, both adult and juvenile stages of flow-loving fish are well catered for in the visited reaches. The main constraint for gravel-spawning species is the lack of well-sorted/silt-free gravel beds that would be well-irrigated by oxygen-rich water. At the downstream limit of the visited reach, the Calder joins Pendle Water (Fig. 35). From a short inspection, it may be that a significant proportion of the trout population present in this section of Pendle Water may rely on spawning opportunities provided by the Calder. There appears to be a much lower fine sediment supply in the tributary compared to Pendle Water. Additional spawning opportunities may, consequently, be provided by migration upstream into those lower tributary reaches.

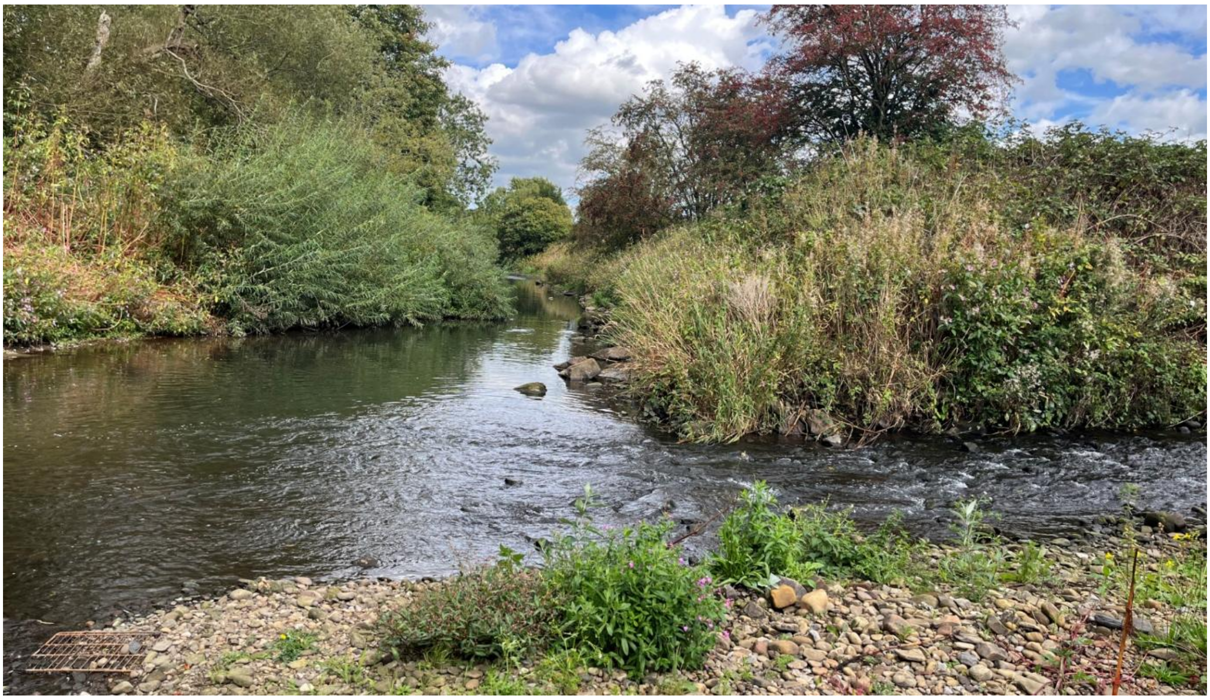

Figure 35: Confluence between the Calder joining on the LB (right of frame) and Pendle Water (centre/left of frame). This was the downstream limit of the visit at 53.810038, -2.263624.

Alternatively, spawning substrate and additional, silt-free water supplied into Pendle Water at the confluence may also locally improve spawning success within the combined Calder/Pendle Water main river (e.g. Fig. 36). The combined watercourse continues downstream and is known as the Calder – despite it being the tributary to Pendle Water where they join.

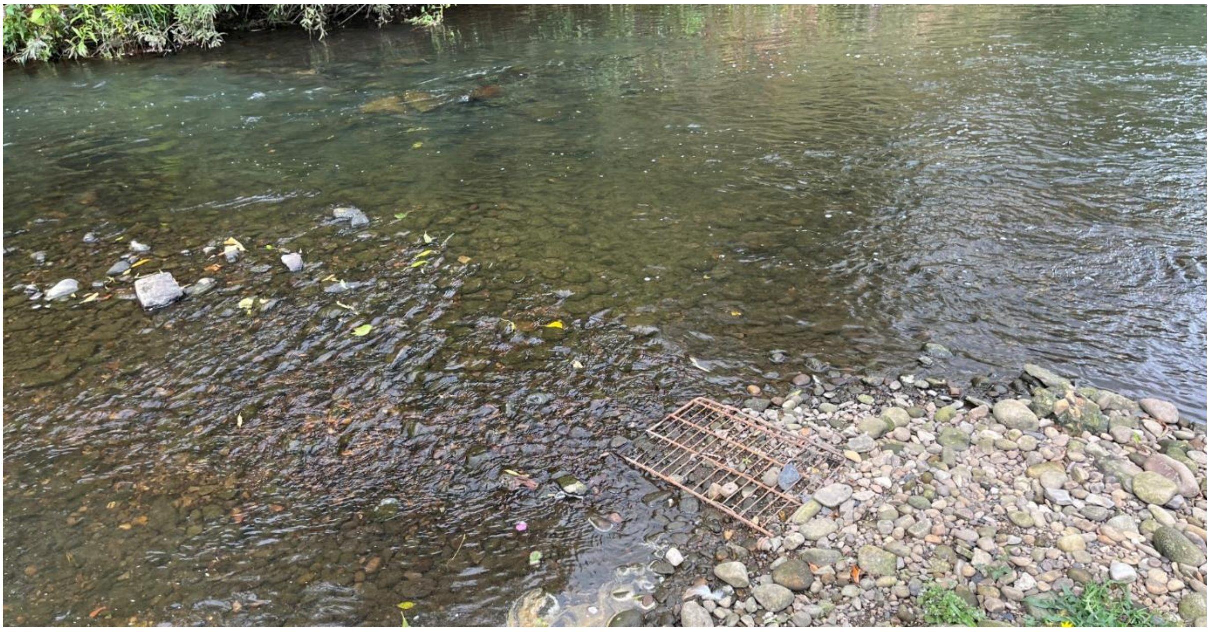

Figure 36: Main river just below the confluence showing some potential spawning gravel. This would be an area to monitor for trout redds during late autumn to mid-winter. However, this is a small and relatively poor quality area of spawning habitat.

In order to properly understand likely access to breeding opportunities for gravel spawning species, it is necessary to gain an understanding of the conditions in connected sections of the local catchment. For instance, below the confluence is there an increase in available good quality spawning habitat in the Calder? Similarly, what is the relative fine sediment supply to Pendle Water upstream of the visited reach? This latter point will also help to calibrate the degree to which local bank erosion is responsible for the high sand and silt loadings within the visited reach. A combination of aerial photography records, walkover investigations and collaboration with local stakeholders such as Ribble Rivers Trust and known landowners will help to inform relevant local catchment conditions. As an initial step, consulting publicly-accessible online mapping services that include satellite photography can provide valuable insights. It is often possible to gain basic insights into riparian land-use, vegetation cover and likely runoff pathways for fine sediment.

4 Recommendations

There are a range of options that would help to protect and improve habitat within the river corridor considered during this Advisory Visit. Options will span a range of difficulty and likely cost to implement. The following summary of recommended actions should help to create a prioritised list of future actions for Pendle Water:

- Creation of an effective riparian buffer strip of ungrazed, woodland vegetation via
    - Exploring options with relevant landowner(s) to set back fence-lines to a functional distance from the bank top (recommended 10-12m)
    - Work with landowners in seeking funding designed to support riparian buffer strip/riparian woodland creation via potential routes such as
        - CSHT; https://www.gov.uk/find-funding-for-land-or-farms/csw25-manage-riparian-and-water-edge-habitats (12-m buffer strip minimum)
        - WCPG; https://www.gov.uk/government/publications/woodland-grants-and-incentives-overview-table/woodland-grants-and-incentives-overview-table (10-m buffer strip minimum)
        - Using fencing grant funding to create grazing exclusions a minimum of 5m (ideally 8m or more) from the bank top; https://www.gov.uk/countryside-stewardship-grants/fencing-fg1
        - Sourcing subsidised tree planting via https://www.woodlandtrust.org.uk/plant-trees/trees-for-landowners-and-farmers/morewoods/ in support of river woodland creation; https://www.woodlandtrust.org.uk/plant-trees/river-woodland/
    - If insufficient soft bank habitat remained to support sand martin nesting, suitable artificial nest boxes could be installed (for example: https://www.greenfuturebuilding.co.uk/products/sand-martin-banks)

- Seek to understand upstream inputs of sand and silt via bank erosion and surface runoff sources using a combination of
    - Online mapping (including satellite photography for land-use, tree cover and topography details to help discover likely runoff pathways)
    - Walkover visits where possible
    - Collaboration with local/regional expert stakeholders and existing knowledge (e.g. Ribble Rivers Trust)

Riparian buffer strip creation, incorporating sufficient space for the river to adjust its course over time, is likely to be the single most impactful intervention for this section of Pendle Water. Securing sufficient space and funding for maximum structural and sediment supply control benefits can often be challenging. In addition to installation of fencing and any supportive planting, there is likely to be a significant challenge in ongoing control of invasive, non-native plant species. Aim to achieve significant reductions in coverage of Himalayan balsam and allow native vegetation to re-establish

    - Hand pulling using volunteer parties (potentially drawing on local wildlife groups and wider volunteering networks)
    - Strimming below the first node while plants are in flower
- Eradicate known stands of Japanese knotweed while still relatively small
    - Stem injection of knotweed stands by appropriately certified personnel
- Establish regular Riverfly monitoring at points upstream and downstream of areas of concern (e.g. outfall from wastewater treatment works, ochre-rich outfall point) to gain an understanding of baseline invertebrate populations and any point-source impacts
- Within existing (and any created) riparian woodland sections, monitor for and retain any large dead-fall trees so as to promote localised bed scour and improve spawning gravel conditions as well as diversifying channel morphology

5 Acknowledgements

Wild Trout Trust would like to thank the Environment Agency for supporting the work in this report. The advice and recommendations in this report are based solely on the expert and impartial view of WTT's conservation team.

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.

Legal permissions must be sought before commencing work on site. These are not limited to landowner permissions but will also involve regulatory authorities such as the local council as well as relevant departments within the Environment Agency – and any other relevant bodies or stakeholders. Alongside permissions, risk assessment and adhering to health and safety legislation and guidance is also an essential component of any interventions or activities in and around rivers.