Advisory Visit

River Granta, Cambridgeshire

August 2019

Key issues

- The river is disconnected from its floodplain and flows within an incised channel. Under-utilised floodplain capacity is known to be present at Leadwell Meadows and an idea for its better use is presented.

- The many weirs and sluices present barriers to the movement of fish, interrupt sediment transfer and impound flow, increasing flood risk to Linton. The weirs should be removed, or partially cut through (notching) to reinstate natural flows and sediment transport.

- Much of the river is over-wide and has poor habitat. Habitat enhancement measures could be deployed to enhance the river's low-flow channel whilst still enabling flood flows to be conveyed. A simple habitat enhancement scheme could be worked-up between Linton Parish Council and the Wild Trout Trust to address the pressures highlighted.

- A lack of marginal vegetation was observed in the lower river. Marginal vegetation aids fine sediment retention, gives bank protection against scour and provides valuable habitat.

- Much of the river was over-shaded, but tree cover is important for keeping water temperature cool (especially in low-flow rivers). A management plan should be agreed so that important trees are retained, and allowing light to the river where it is beneficial.

- Large woody material and fallen/cut trees could be used to provide habitat features, initiate natural geomorphic processes and to slow flood flows.

- Woody material is a natural component of rivers and it should be retained where it does not pose a flood risk.

- The incised channel makes many parts of the river hard to access, especially alongside the recreation ground. Children and dogs have created bank-slides down to the river; those slides create unwanted sources of fine sediment. Re-grading the banks could reduce fine sediment input while providing improved access and greater flood storage capacity.

1.0 Introduction

This report is the output of a site visit undertaken by Rob Mungovan of the Wild Trout Trust to the River Granta at Linton, at the request of Linton Parish Council (PC). A PC representative was present for the duration of the visit which was undertaken on the 22nd August 2019. Comments in this report are based on observations on the day of the visit and its known history.

The purpose of the visit was to advise on the suitability of the river for wild brown trout, to consider measures that could be implemented to improve habitat for trout and other biodiversity, and to identify how the PC could manage, enhance and restore the river.

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.

2.0 Catchment Overview

Table 1 summarises the Water Framework Directive (WFD) data for the River Granta. The overall classification for the Granta is 'moderate' ecological status. Parameters that make up the classification include 'moderate' for fish and 'high' for invertebrates (the lowest scoring attribute usually driving the classification).

The Granta is a medium sized (29km long) chalk stream with a wild brown trout population present throughout its length.

The catchment falls mainly within the East Anglian Chalk National Character Area. It has a chalk geology overlain with deposits of clay, sand and flint gravel. The main land use is one of intensive arable cultivation, yet a few river valley meadows remain together with wet woodland alder carr. The land use changes subtlety in the lower reaches, with the intensity of development increasing as the outskirts of Cambridge are approached. The steep nature of the hills forming the upper parts of the catchment can make the river prone to run-off which has caused flooding to properties in Linton on a number of occasions.

The Granta has been modified by humans for centuries, with a large mill still present in Linton village and further downstream, in the parish of Babraham, was the only documented floated water meadow system in Cambridgeshire. This would suggest that the catchment was historically much wetter than it is today. As with many chalk streams in the region, over-abstraction for public water supply has had a significant impact on flow. At the time of the visit, the river was experiencing prolonged drought conditions with extreme high temperatures that are a major stressor of the river's fauna and flora, despite the Environment Agency's compensatory borehole maintaining flow to the upper river. Without this compensation flow, it is doubtful that the river would have been flowing at all; the river was dry at Bartlow, but sadly that tends to be the case in most years now.

	Waterbody details
River	River Granta
WFD Waterbody Name	Granta
Waterbody ID	GB105033037810
Management Catchment	Cam and Ely Ouse
River Basin District	Anglian
Current Ecological Quality	Overall classification of Moderate for 2016
U/S Grid Ref inspected	TL 57154 46341
D/S Grid Ref inspected	TL 55760 47123
Length of river inspected	1.75

Table 1 Data from https://environment.data.gov.uk/catchment-planning/WaterBody/GB105033037810

Cycle 2 classifications

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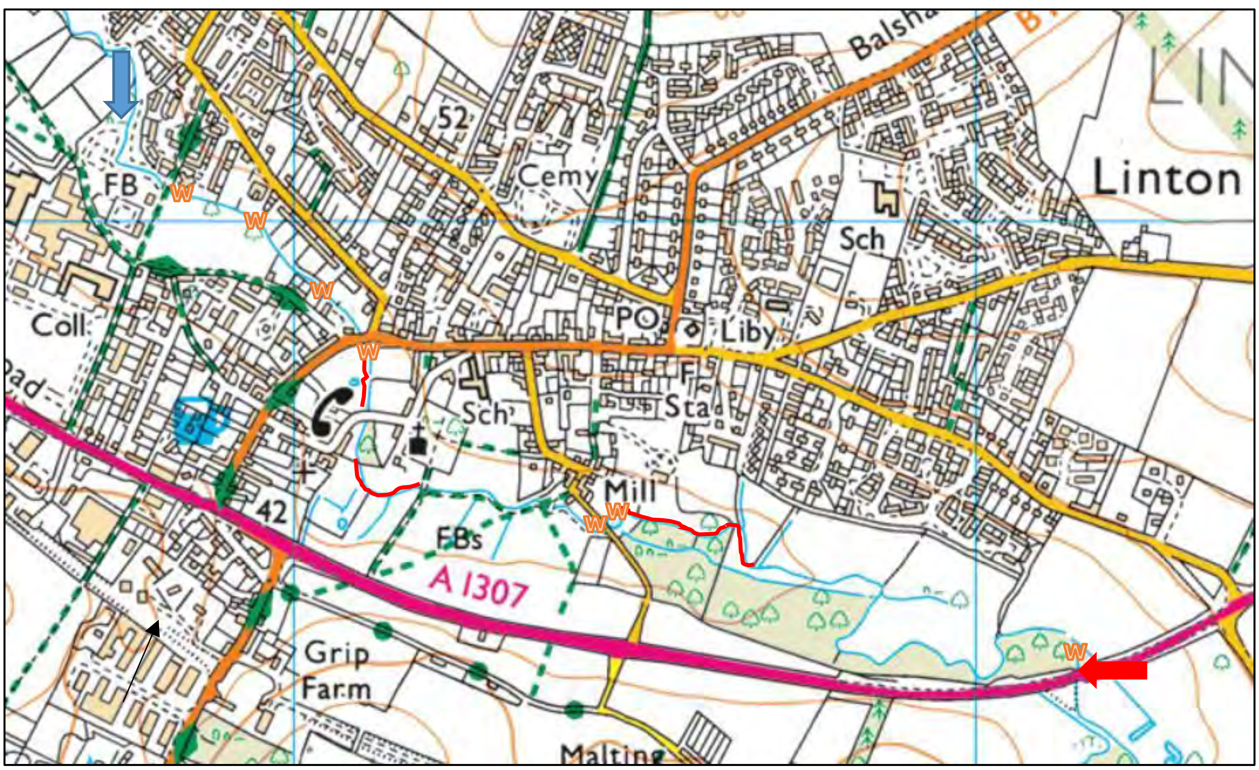
Classification Item	2013	2014	2015	2016
Overall Water Body	Good	Moderate	Moderate	Moderate
Ecological	Good	Moderate	Moderate	Moderate
Biological quality elements	Good	Moderate	Moderate	Moderate
Macrophytes and Phytobenthos Combined	-	Moderate	Moderate	Moderate
Fish	Good	High	Good	Good
Invertebrates	Good	Good	Good	High
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good
Hydrological Regime	Does Not Support Good	Does Not Support Good	Does Not Support Good	Does Not Support Good
Morphology	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	High	High	Moderate	Moderate
Ammonia (Phys-Chem)	High	High	High	High
Biochemical Oxygen Demand (BOD)	High	High	High	High
Dissolved oxygen	High	High	High	Good
pH	High	High	High	High
Phosphate	-	-	Poor	Poor
Temperature	High	High	High	High
Specific pollutants	High	High	-	-
Chemical	Good	Good	Good	Good

Table 2 Data from https://environment.data.gov.uk/catchment-planning/WaterBody/GB105033037810

Map 1 – The River Granta at Linton. Red arrow is upper limit, blue arrow is downstream limit of visit © Ordnance Survey.



Map 2 – The length of River Granta visited at Linton. W = weir or significant barrier, Red arrow is upper limit, blue arrow is downstream limit of visit, red lengths = not seen. © Ordnance Survey.

Linton PC controls over 1.75km of the River Granta through the village. Historically, the Environment Agency (EA) has undertaken maintenance of the river under its permissive powers. Management has focussed on the removal of fallen debris and vegetation control (with herbicide in recent years).

The river is not controlled by any angling club and no formal angling takes place. The river forms the backdrop to the village as it runs through recreation grounds, alongside gardens and through PC-owned meadows.

Water voles used to be present but no signs of voles were observed during the visit. Numerous otter spraints were found, all containing the remains of signal crayfish. Otters and their habitat receive full legal protection under the Wildlife and Countryside Act, 1981.

The signal crayfish is an invasive non-native species which poses a threat to native biodiversity. They must not be moved to other watercourses nor to new sites along the Granta.

3.0 Habitat Assessment

The visit started at the lowest end of the village recreation ground where the river flows within a ~3m deep by ~3.5m wide channel. Water depth during the visit was seriously affected by the low-flow and ranged from ~0.03m over gravel riffles (pic 1) to ~0.5m in natural pool habitats. A pool and riffle sequence is important in a river 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 found in the pools.

Pic 1 – The Granta at the lowest end of the visit had a distinct pool and riffle sequence but flow was significantly depleted.

Where the river was accessible it was accessed by children and numerous dog slides were present. Whilst it is desirable to have children exploring their local rivers, the slides that they have created, in combination with bank erosion, have led to elevated volumes of fine sediment input. Fine sediment can smother the gravel, reducing the number and diversity of niches for aquatic invertebrates within the bed. Importantly, brown trout need clean and stable gravel (particularly in the size range 15-40mm) to spawn upon. With their eggs remaining in the gravel for up to 100 days before the fry emerge, trout eggs are very susceptible to mortality from siltation or physical disturbance. Illustration 1 shows the life cycle of the brown trout.

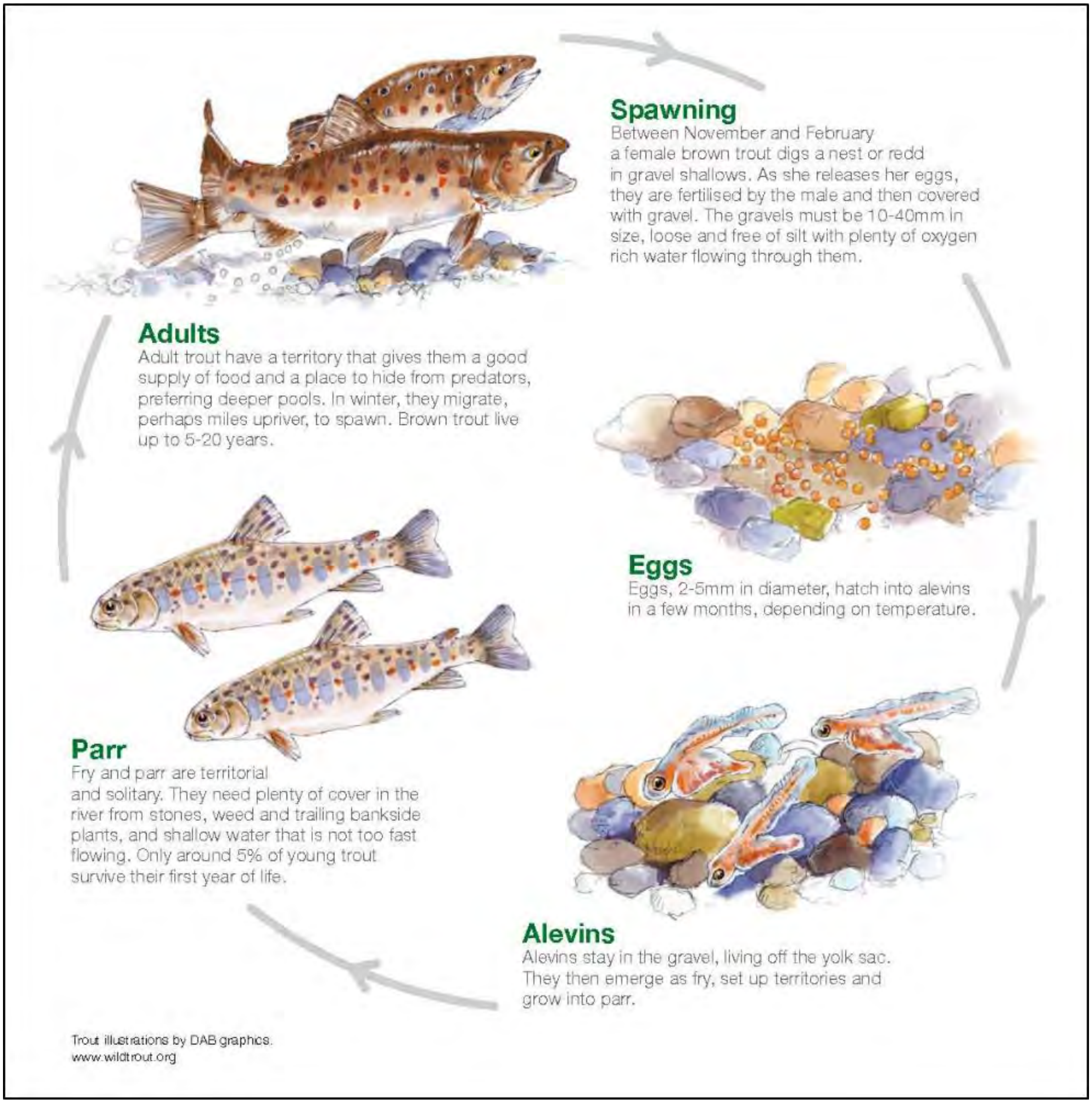


Illustration 1 – The life cycle of the brown trout.

A healthy mix of open areas and tree-lined lengths provide valuable habitat diversity. Trees are hugely important for rivers, with their canopies providing shade in summer and regulating water temperatures (thus providing a degree of climate change resilience). A high number of terrestrial invertebrates inhabit tree canopies and some of those will fall on to the water to become food for fish. Trees also drop organic matter into rivers (whether it be leaves, twigs or larger limbs) which provide valuable structure, cover and food for aquatic invertebrates, initiating nutrient cycling and increasing the diversity of food webs. Tree roots are also crucial in maintaining bank cohesion and stability.

Branches and trees should only be removed from a river where they pose a flood risk. Wherever possible, fallen trees should be secured in the river margins to provide habitat cover. There was certainly scope for this along the lower reaches of the Granta.

At one sharp meander, a prominent pool had developed. That pool provided depth, with cooler water almost certainly present given the shade of riparian trees. In 2013, the author (whilst in a different role) had been consulted regarding the stability of the bank. So, to monitor the rate of erosion, a stake was driven into the bank. That stake has remained relatively flush with the bankface, suggesting only limited erosion since. The meander had previously been reinforced with semi-rigid posts and wire netting. That revetment has entirely failed (pic 2). A scheme had previously been discussed to deliver sensitive bank protection and habitat creation over the length of the meander (that original concept is presented in the appendix) and it is still considered to be a worthy project which could be delivered under the EA's Exempt Flood Risk Activities FRA 15: https://www.gov.uk/government/publications/environmental-permitting-regulations-exempt-flood-risk-activities/exempt-flood-risk-activities-environmental-permits#installing-channel-habitat-structures-made-of-natural-materials-excluding-weirs-and-berms-fra15.

Pic 2 – This meander could be enhanced to provide greater habitat cover and scour control to protect the nearby footpath.

The river ran relatively shallow for ~50m over a gravel bed. The gravel was very silted due to the low-flow conditions. Encouragingly, the gravel was not compacted, and it is likely that it will become cleansed once normal flow returns. The particle sizes ranged from grit to cobbles and showed a good degree of sorting by the river. The gravel, once clean, should provide good spawning opportunities for brown trout (refer to Illustration 1 above).

Of note in the shallows was the general lack of marginal plants such as reed canary grass, pendulous sedge or great willowherb (pic 3). It is possible that the shade of the tree canopy was limiting their growth. Where the river was more open great willowherb lined the channel and provided important marginal cover, interspersed with pendulous sedge.

Pic 3 – Shade from the tree canopy appeared to be suppressing marginal growth on shallow riffles.

A small branch was observed in the river (pic 4). Whilst the branch may look unsightly to some, the presence of such material is of great importance within rivers and is often referred to as large woody material (LWM). The structure creates an increase in the surface area on to which a biofilm (algae, bacteria and other microbes) can grow, thus initiating nutrient cycling. In turn, the biofilm may become a source of food for invertebrates, increasing the total biomass that a river can support. LWM also provides underwater cover, offering protection for fish against otters or fish-eating birds. Importantly in this instance, the branch was providing a small degree of flow deflection which accelerated the river's flow over the riffle, assisting cleansing of the gravel bed. Where LWM presents no flood risk it should be retained.

Pic 4 – Fallen LWM should be retained within the river where it poses no flood risk.

A road drainage outfall was observed on the RB. The outfall was partially hidden by brambles. It is advisable to keep outfalls clear, making it easy for them to be found in the case of a pollution event. A similar outfall on the LB (believed to take water from the bowls green) was suffering from erosion where dogs and children have scrambled around the pre-cast concrete structure to access the river. The resulting erosion poses another source of fine sediment input to the river and should be stopped to prevent the headwall from standing proud of the bank. Alternative arrangements to allow children and dogs access to the river should be considered such as re-grading of the riverbank to provide a defined access point to the river (see recommendations).

A white metal footbridge crosses the river almost half-way along the recreation ground, a short distance above the bridge was a sparsely vegetated berm (pic 5). That berm was subject to herbicide application in 2011 (reported to be the EA). In the subsequent eight years, the berm has only just become re-vegetated but not to the extent that it previously was. Vegetated berms provide important storage points for fine sediment. Without vegetation fixing sediment, it may be deposited on the riverbed where it can degrade invertebrate and fish spawning habitat, or in pools, causing them to shallow. Vegetated berms also provide natural channel narrowing that is in balance with the flow of the river (as it has been created through the river's processes of erosion and deposition) and enable a low-flow channel to evolve. This improves a river's resilience to climate change, especially prolonged periods of drought, as vegetation grows inwards leading to a reduced wetted channel width, which in turn causes water velocity to increase, aiding sediment transfer and bed cleansing. High flows will then scour away excess vegetation and fine sediment to maintain an appropriate width.

The use of herbicide by the EA on the Granta at Linton (acknowledged in correspondence with EA's FCRM function) is not considered to provide any significant level of flood protection, yet the removal of marginal plants is likely to negatively impact upon bank stability, fine sediment input and biodiversity. Herbicide acts by causing the breakdown of a plant in situ, and as the plants rots it will take oxygen from the water column. In combination with the hot weather and low-flow, the wide use of herbicide places an unnecessary stress upon the river's diminished form. A return visit to the river in early September confirmed that watercress immediately downstream of the recreation ground had been killed-off by herbicide. Its use was also observed at a number of locations further downstream. The repeated use of herbicide is thought to be a reason for the diminishing occurrence of marginal plants downstream of Linton.

Pic 5 – The red oval is the remains of a previouly established vegetated berm which was lost through the application of herbicide.

Pic 6 – Top picture shows the same location as pic 5 after herbicide application to the reed canary grass (red oval) in 2011. The bottom picture was taken in July 2013, the emergent vegetation had not recovered, fine sediment and gravel was exposed. Removal of the berm will not occur as the river's natural processes dictate that sediment deposition must occur on the inside of a meander.

A short length of dilapidated hard bank revetment was observed (pic 7). Hard revetments are not appropriate in a natural river setting as they provide minimal habitat gain, can be costly to replace and simply move erosive forces downstream. Where bank erosion is leading to bank collapse the underlying cause of the instability should be investigated. In this instance it will be a combination of factors, but the most pressing one is the occurrence of a weir ~20m upstream (pic 8).

Pic 7 – Concrete slabs had been used to support the bank and were starting to collapse.

Pic 8 – A low-weir within the recreation ground, degrading the river habitat.

Weirs disrupt the natural process of sediment transfer along a river, acting as traps for coarse sediment (refer to illustrations 2 & 3). With a paucity of coarse gravel supply, the riverbed is prone to down-cutting (or incision) as bed material is washed downstream without a regular supply from upstream. Down-cutting can lead to an incised channel with a consequential loss of bank stability and floodplain connectivity. This problem is likely to have been magnified by historic river dredging. Eventually, the pool habitat originally present upstream of a weir is also lost as it fills with sediment. That was the case at all 3 of the weirs observed downstream of the Dog and Duck pub.

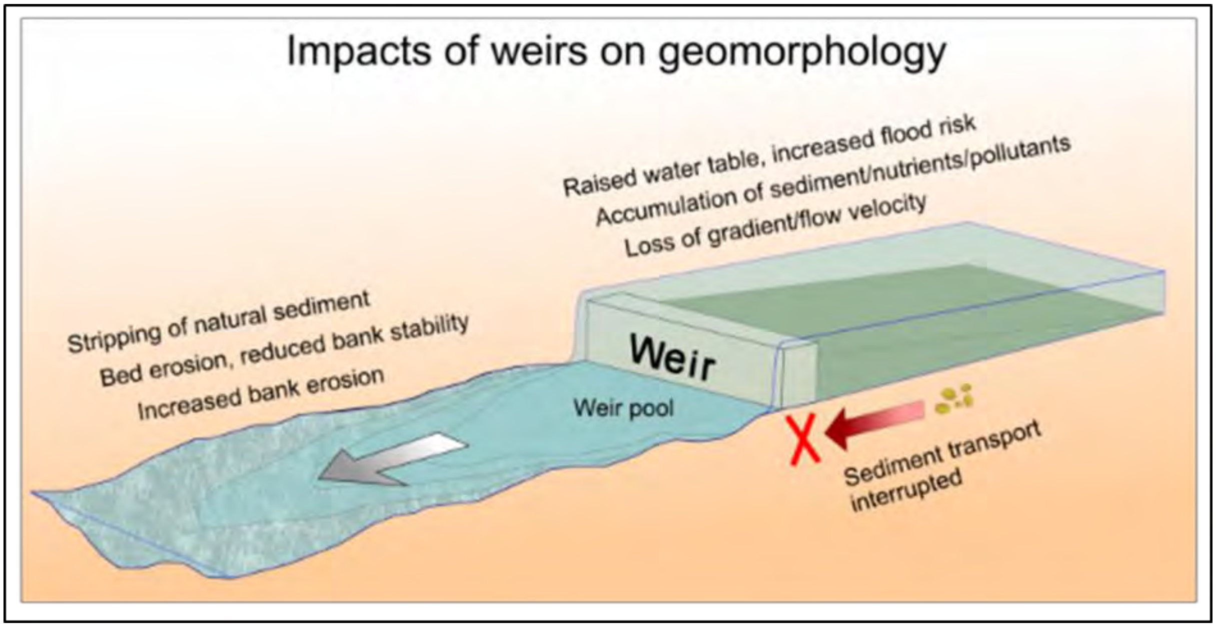


Illustration 2: The impact of a weir on river morphology.

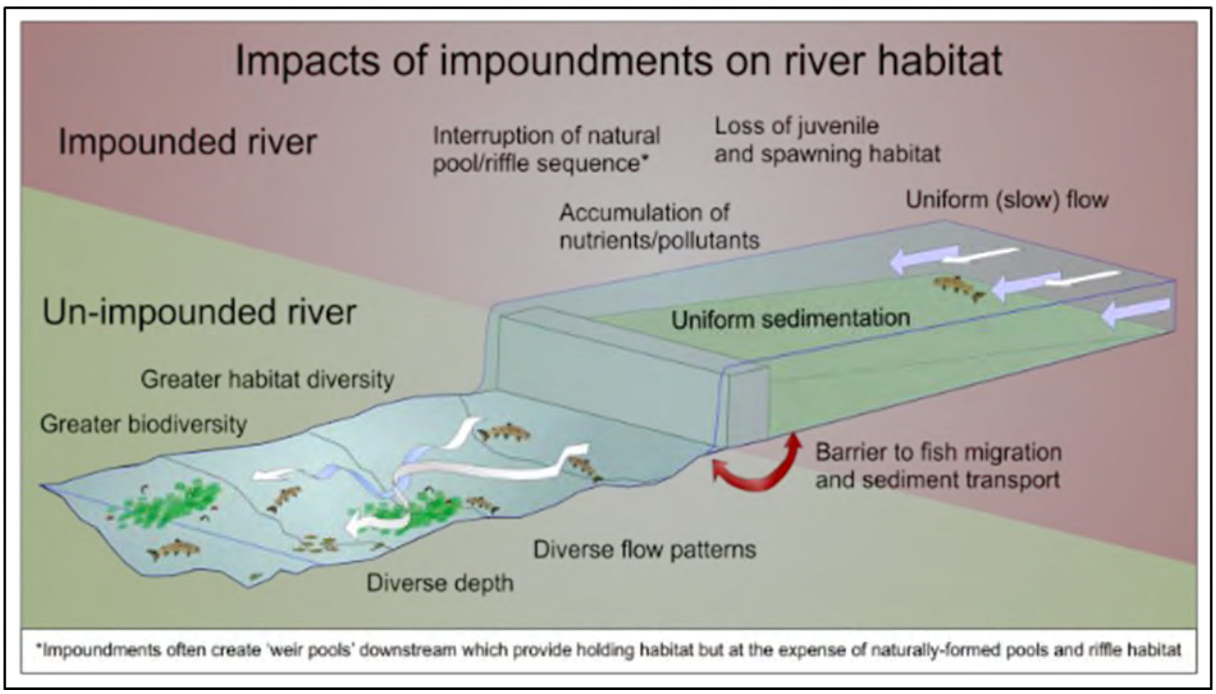


Illustration 3: The impact of a weir on river habitats.

Shallowing of water behind weirs presents further problems in low-flow situations, causing water to be ponded and with less flow diversity, the water becomes stratified. This results in a warming of the surface layer; effectively the weirs have caused the river to become ponded between them. Ponded habitats are not what one would expect to find on the Granta.

The purpose of the lowest 3 weirs is unknown. If they were not installed to reduce the river’s energy, they may have been for amenity purposes. It was estimated that the 3 weirs cumulatively hold back a head of water of ~0.9m.

It was concerning that no brown trout were observed in the recreation ground reach, their distribution probably being controlled by water temperature and dissolved oxygen content. It was noticeable that above the weir, the water was affected by filamentous algae which filled the water column as it grew in response to the bright sunlight (pic 9) and warming water temperature. Casual investigation of the river for aquatic invertebrates revealed the species expected for the downstream riffle habitat (freshwater sponge, cased and caseless caddis larvae, mayfly larvae and freshwater shrimp). However, upstream of the weir the invertebrate community was severely impoverished, with only occasional flat worms and pond snails (both species that can tolerate low oxygen levels).

Pic 9 – The river above the weir presented a degraded habitat of silt and algae.

Gardens led down to the river on the RB, with many being supported by revetments to prevent their collapse into the river. The recreation ground was then dominated by the cricket ground on the LB. At this point the river has been embanked (pic 10). The embankment may increase flood risk to upstream properties by preventing water from spilling on to its floodplain.


Pic 10 – The embanked river adjacent to the cricket ground.

The river ran parallel to the recreation ground in an incised channel which was impounded by two further weirs (Pic 11). In this section, there is little flow variation even though some gravel bars had become exposed due to the low water levels. The river was suffering from siltation, excessive algal growth and excessive shade (pic 12).

The management of shade requires careful consideration. In hot periods, as previously mentioned, the shade can bring benefit, but when excessive, it limits the growth of marginal plants which are important for retaining bank strength and controlling fine sediment input. The trees present interesting opportunities for habitat management to address the lack of flow diversity and the balance of shade versus open habitat. Open reaches tended to be dominated by pendulous sedge growth (pic 13); no aquatic plants were observed and the channel was dominated by algae. A technique favoured by the Wild Trout Trust for delivering instant woody cover at water level is tree-hinging. Trees (large or small) are cut to produce an effect similar to hedge laying. Species such as willow and hazel respond particularly well. Laying retains a living hinge that secures the cut stem to the tree stump so structural strength is retained. With the tree-top laid at water level, it provides excellent over-head cover, flow deflection and, if beneath the surface, increased habitat for aquatic invertebrates and cover for fish against predators.

Pic 11 – Two further weirs were observed, one alongside the recreation ground and another immediately downstream of the Dog and Duck pub.

Pic 12 – Tall riparian trees cast excessive shade preventing marginal growth.

Pic 13 – Marginal vegetation growth was limited in terms of its true emergent species. Most plants trailed down into the water. This may be indicative of previous herbicide control which had removed the few emergent plants present.

One garden property was using a more sensitive bank revetment approach: a brushwood retaining wall. That type of feature is beneficial for the river in that it provides invertebrate habitat, looks natural to the setting and creates channel roughness, acting to slow the river's flow through the reach (adopting the philosophy of *Slowing the Flow* see http://slowtheflow.net/the-science/). If this approach was promoted more widely along the river, it could bring flood management benefit (pic 14).

Pic 14 – A brushwood retaining wall provided a complementary habitat to the river.

The bank angle was near vertical at one location (at the rear of Meadow Lane). The exposed bare earth bank could potentially provide a kingfisher nest site and it should be left undisturbed if future tree works take place.

Alongside and upstream of the Dog and Duck pub, the riverbed was ~5m and concrete-lined (pic 15), offering minimal habitat other than very shallow deposits of gravel in a few places. The concrete was covered by ~30cm of water and was densely covered in algae. The river had no flow diversity and did not provide an attractive frontage to the pub's garden. The water level was governed by the weir immediately downstream.

It was possible to walk along the edge of the concrete-lined channel. Passing beneath the village High Street bridge, the channel capacity became restricted to ~4m. Numerous otter spraints were observed beneath the bridge, most showing evidence of feeding upon signal crayfish.

Pic 15 – The concrete-lined River Granta in the centre of Linton.

A short distance upstream of the High Street bridge was another, ~10m wide weir (pic 16) that retained a ~0.9m head of water and had a very smooth concrete spillway. There was no scour pool downstream and the weir significantly degraded the river, presenting a barrier to fish movement over a wide range of flow conditions.

Upstream of the weir, the adjacent land was private gardens, edged with stone and hard wooden panelling which provided little habitat or graduation from land to water. Habitat upstream of the weir was considered poor but was not seen at close range.

The river was next viewed at the historic ford site in Horn Lane, a favoured location for duck feeding. The downstream weir retained a head of water that encouraged ducks to stay (in combination with them being fed). Habitat enhancement measures have been undertaken at the ford site in recent years to soften the appearance of the adjacent footbridge footings. Coir rolls combined with marginal planting and earth backfill had taken place. The PC representative reported that the first phase failed due to the impact of ducks upon the feature. The work was adjusted and planting was undertaken using pendulous sedge. The sedge has been strong enough the withstand the activity of the ducks and it now screens the bridge footings.

Pic 16 – The weir in the centre of the Linton increases flood risk, prevents sediment transfer and degrades the river habitat.

Above the main duck activity area, it was apparent that the river's water quality appeared to improve, likely a combination of:

1) The lack of ducks defecating in the water.
2) Being nearer to the source of the EA's compensatory water inflow.
3) The lack of a concrete-lined channel.
4) The lack of weirs impounding the flow.

However, the channel was still over-wide with little flow diversity and suffered from excessive shade (pic 17). The river then flowed through private gardens again and was not inspected. It was re-joined south of the parish church where a public footpath crossed.

The river upstream of the village was a contrast to its downstream reach, appearing more natural with a varied bank profile providing a range of niches for marginal plants to take hold. The river was lined with tall stands of great willowherb which had fallen in the margins (pic 18), as well as reed canary grass which bound the banks firm. In addition to shading the river, the willowherb provided important marginal cover to the shallow river. There were occasional trees, dominated by common alders; these did not cast excessive shade and their roots provided bank stability enabling a greater variety of bed and bank form to be present, with a few tight meanders having evolved deep scour holes (up to ~1m in depth).

The riverbed comprised undulating gravel with pools, short riffles and glides. The gravel was well-sorted (with good potential for trout spawning) and was generally clean of algae and excessive sediment. As the channel was entered to aid assessment, a large brown trout (~30cm) was disturbed which moved upstream to shelter beneath the marginal vegetation. Four other trout were seen in the deeper pools. This upstream reach was clearly providing an important habitat reserve for the trout, with none seen downstream within the village.

The habitat value of this reach for trout was much greater than that downstream of it, demonstrating that even a small river can support trout. Trout require habitat diversity for feeding, spawning and nursery areas, in addition to good water quality. The reach was generally unshaded which allowed the sedge beds to naturally narrow the river. The presence of good stands of marginal habitat in this upper reach contrasted with their absence downstream, and where the habitat was suitable, brown trout were present.

Pic 17 – Upstream of Horn Lane the river was shaded and over-wide with little flow diversity.

Pic 18 – Upstream of the village the river was lined with lush emergent vegetation.

At the rear of Camping Close (open meadows) there was a limited area of bank erosion associated with a rope swing (Pic 19). The trade-off between young people enjoying the river and an area of slight bank erosion is considered acceptable. However, it might be prudent to monitor the eroding bank and undertake strengthening work if, and when, considered necessary.

Pic 19 – Bank erosion associated with a rope swing.

The river finally had the appearance of a healthy chalk stream with clear water, a gravel bed and healthy marginal plants (pic 20), albeit suffering from very low flow. A good balance of tree cover was also present. It is important to note how the more natural channel form had far greater resilience to the negative impact of low flow.

A short distance upstream the river became degraded. The owner of one garden on the RB had used concrete sandbags to create a revetment wall and another property had used wooden boards. Both of these methods of bank stabilisation isolate the river, interrupting the natural graduation from land to water and removing opportunities for plants to grow.

Pic 20 – The river had an attractive appearance of a chalk stream as is expected for the River Granta.

The ford/bridge at Mill Lane consisted of 12 pipes (~20cm diameter) which ran beneath the road (pic 21). In high flow periods, the river would overflow the road.

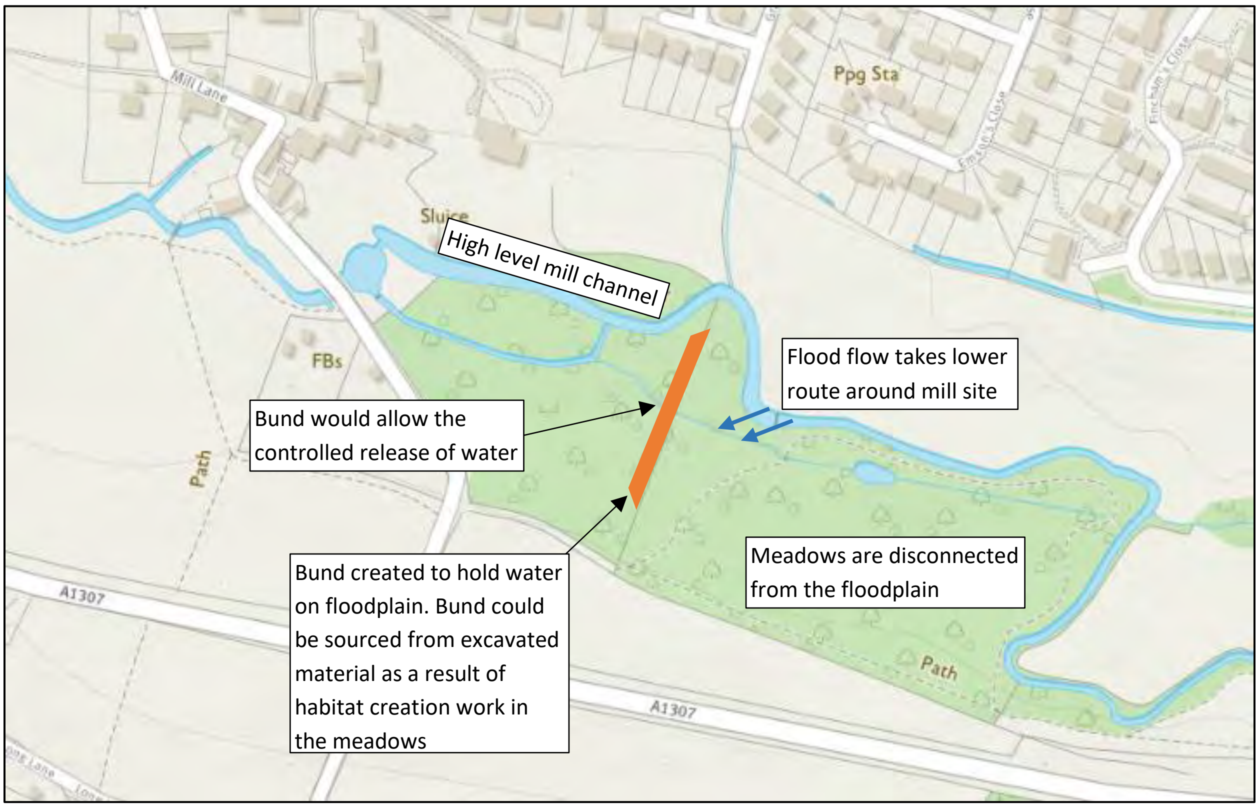
Immediately upstream of the pipes was a smooth concrete weir which retained a head of water for the mill pool (pic 22). The retention of the weir is strange given that it creates an unnecessary head of water that would accelerate flow over the ford and put road users at risk.

The mill pool was observed from the road. It was providing a deeper water reserve for a range of aquatic species in the low-flow period. However, the very presence of the mill and its associated water control structures has resulted in an artificial regulation of the river levels, and a barrier to the movement of a range of fish species.

Pic 21 – The Mill Lane bridge/ford combination – a barrier to fish movement.

Pic 22 – The river emerges from beneath the fence to flow through pipes which ran beneath the road. The pipes must be prone to blockages given their narrow size.

Through previous involvement on environmental matters locally, the author is aware that during significant flood, flows can by-pass the mill. The flood water then moves on to inundate land including some properties. However, the riverside meadows upstream of Leadwell Meadows do not receive full inundation as the river is disconnected from its floodplain. Previous investigations have looked at means of increasing floodplain storage. It is still considered appropriate to investigate the potential for creating a bund at the lowest part of the meadows in order to retain floodwater and to prevent it by-passing the mill. The suggested location for a bund is illustrated on map 3.



Map 3 – The possible location of a flood relief bund to hold water on Leadwell Meadows.

Once in Leadwell Meadows, the impounding effect of the mill became apparent with depths in excess of 1.2m and the slow-flowing water covered with algae (pic 23). Whilst the algae can look unsightly it does keep the water beneath cool from the sun and it should be tolerated. The algae is growing due to the impoundment, bright sunlight and high nutrient content of the groundwater.

Pic 23 – The effect of the mill impoundment was noticeable.

The river was little more than ~3m wide as it crossed the meadows. In many places, it was entirely over-grown by tall emergent vegetation (often branched bur reed; pic 24). Whilst this may look to be a problem it is quite the opposite; again the vegetation was providing shade to the river, in-channel habitat and if the river's flow is restricted then it can only increase the frequency at which the river would connect with its floodplain utilising underused floodplain capacity.

The dense vegetation offered excellent water vole habitat, and two brown trout (up to 20cm) were seen in clearer areas. Evidence of signal crayfish burrows was apparent amongst the alluvium-rich banks, and in places the banks were collapsing leaving fence posts hanging. Bank failures as a result of crayfish burrowing can be a significant problem and an input of fine sediment to a river.

Pic 24 – The river was over-grown with emergent vegetation, but it still conveyed its flow through the vegetation.

The river had stands of water starwort (pic 25), a plant typical of chalk rivers and able to sustain its growth in slower conditions than water crowfoot (another typical chalk river plant that was not observed). Where the river ran shallow, habitat was improved where flow was funnelled between dense stands of lesser water-parsnip (another typical chalk river plant, pic 26). It should be noted that the typical chalk river plants are occurring where the river's water temperature is coolest, where they are not smothered by algal growth and not disturbed by ducks dabbling nor dogs entering the river.

At a few locations, the tree cover was dense and reduced the growth of aquatic plants. Sedge species tended to dominate in the semi-shade. The open water habitat of the shaded areas provided a valuable "pool" habitat in contrast to the more choked open reaches (pic 27). The tree coverage could be manipulated to provide more cover at water-level, but it is considered important to also retain overhead cover in an otherwise largely open reach.

Pic 25 – The clear water sustained water starwort growth (red arrows).

Pic 26 –Stands of lesser water-parsnip narrowed the channel maintaining flow velocity and a clean gravel bed. This "micro-channel" could still sustain juvenile brown trout and other fish species.

Pic 27 – The limited amount of shade in the upper reaches provided important open water in an otherwise vegetation choked channel. Adult trout would be able to utilise such areas.

At the upper most reach of Leadwell Meadows, the vegetation had been strimmed (pic 28) in order to prevent the dominance of woody vegetation which could affect the EA's gauging station. Whilst this is not desirable in terms of the river's marginal habitats, its impact is relatively insignificant given the dense marginal vegetation found elsewhere in the reach.

The gauging station itself presents a significant barrier to the movement of fish (pic 29). It was completely impassable at the time of visit, and a large volume of water would be required before it could become passable, even to species as energetic and able as trout. The structure is likely to be a complete barrier to bullhead, stickleback and stone loach. That is an important consideration should the upper reaches of the Granta become dry (or fish be killed due to pollution or low oxygen levels) as natural recolonisation and/or recruitment from elsewhere is prevented.

~20m above the A1307 bridge, the EA's compensatory borehole outflow was located on the LB (pic 30). At the time of the visit, it was considered to be the main source of the river.

Pic 28 – The river downstream of the gauging station is regularly maintained by the EA to keep it clear of woody vegetation which could affect its operation.

Pic 29 – The EA's gauging station presents a barrier to the movement of fish.

Pic 30 – The EA's compensation borehole outflow, the current source of the river.

4.0 Recommendations

The removal, or partial notching, of the weirs (excluding the gauging station weir) should be undertaken to allow free flow, fish passage and sediment transfer. It will also increase flood protection by allowing early flood water to move downstream without water backing-up within the channel behind the weirs. The lowest weir in the recreation ground could be worked upon first due to it being in a state of partial collapse with water leaking around it.

The lower reaches of the river showed little flow diversity, lacked LWM and had limited marginal vegetation. A scheme could be worked-up to provide suitable habitat enhancements. The delivery of such work could be implemented, under guidance from WTT, by the newly formed "Friends of the River Granta, Linton" group. Simple habitat enhancement and restoration techniques could be deployed using:

- Brushwood ledges: these features can be created following tree works. A brushwood ledge provides complex cover at, and below, water level. Brash from tree thinning is pinned against the bank in alternating directions or increasing stem thickness, and is securely wired down or held with battens. 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.

Pic 31 – A low-level brushwood ledge created on the River Misbourne following tree thinning work. Brushwood 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.

- Flow deflectors: these features can be used to increase flow diversity and bed scour. They can be simple log deflectors or tethered tree stems. The complex flow that arises creates increased depth variation, cover and sediment sorting.

Pic 32 - A flow deflector used to focus flow and scour into the centre of the channel.

- Tree-hinging would be a simple first approach to managing the tree stock whilst providing cover at water level (pic 33). The process and benefits of tree-hinging has already been discussed on page 19.

Pic 33 - An example of tree hinging, a simple and effective technique for increasing cover in a river.

The river is disconnected from its floodplain. Leadwell Meadows is known to be an area of floodplain that is underutilised during floods. Action to store a greater volume of water, for a longer period of time, on Leadwell Meadows would give flood protection to the village and provide a reduction in the peak-flow events (see map 3, page 30).

Monitor the bank erosion associated with the Camping Close rope swing.

The outfalls, and the effluent that they convey, present a threat to water quality. Outfalls should be kept clear so that their discharges can be observed. Planting in the vicinity of outfalls may help to buffer any low-level contaminants that arise from them.

The tree stock along parts of the lower river could benefit from a degree of management, but the need to retain cover for shade and water cooling is important. Strategic removal/hinging/crown raising of trees at intervals along more shaded parts of the river channel should be worked up into the plan for future work. Work to trees should only to take place once agreed by PC.

Identify a suitable location at the recreation ground to allow bank re-grading work to specifically enhance public access to the river. This could be through a combination of bank adjustment and/or the placement of gravel shoals to enable ease of access to the river. Provision of new, and better, river access points would allow some of the more damaging dog slides to be blocked off.

Pic 34 – Before and after views of bank re-grading work on the River Shep to enhance public access to the river at a less ecologically sensitive location. The river was previously steep-sided and inaccessible, with a deep muddy bed. It is now a clean stream suitable for children to explore.

The River Granta through Linton is a degraded chalk stream with much potential to be enhanced to bring biodiversity gain and to improve its aesthetics. The fact that it still retains a population of wild brown trout is hugely encouraging and points to its potential. It would not take too much effort to improve the reaches above the village, and to then conceive a more involved scheme to improve the degraded reaches through the village and downstream of it. Removing the barriers which currently fragment and degrade the available habitat should be the top priority.

5.0 Making it Happen

It is a legal requirement that (most) works to 'Main River' sites like the River Granta 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 training days 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/shop/products/rivers-working-for-wild-trout-dvd 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

6.0 Acknowledgement

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7.0 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.

8.0 Appendix

A concept scheme for habitat creation and bank protection which could be revisited along with further ideas.