



Advisory Visit
River Itchen, Chilland
7th July, 2008



1. Introduction

This report is the output of a site visit undertaken by Tim Jacklin and Denise Ashton of the Wild Trout Trust on the Chilland section of the River Itchen, located upstream of Winchester, between the road bridge at Itchen Abbas (National Grid Reference SU535327) and Chilland (SU526325).

Comments in this report are based on observations on the day of the site visit and discussions with Mr Andrew Impey.

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

2. Fishery Overview

The fishery is approximately 970 metres long comprising both banks, and is owned by the Impey family who lease the fishing to a small syndicate of anglers who can fish on allocated days. There are good stocks of wild brown trout and grayling; no fish stocking is carried out. The fishery is split into two beats upstream and downstream of a concrete bridge at the access point (SU531325), and each beat has a wooden footbridge at the approximate halfway point.

The River Itchen is a Special Area of Conservation (SAC) and a Site of Special Scientific Interest (SSSI) (Appendix 1).

Maintenance of the fishery is carried out by the Impey family and includes weed cutting (during designated periods agreed by the Test & Itchen Association), maintenance of paths and bridges and bankside vegetation management.

3. Habitat Assessment

Upper beat (concrete bridge to footbridge)

This section of river is generally wide (15 – 17 metres) and shallow with a river bed of fine substrate (fine gravel, sand and silt). The submerged aquatic vegetation is dominated by starwort *Callitriche* sp. and water parsnip

Berula sp., with occasional areas of mare's-tail *Hippurus vulgaris*. This gives way to increasing amounts of coarser gravel and water crowfoot *Ranunculus* sp. in the faster water of a riffle at the upstream end of the section, and in the deeper faster-flowing area where the channel narrowed under the footbridge. There is also abundant growth of mats of algae on the river bed, particularly upon the finer sediment in the wider, slower-flowing section (Photo 1).



Photo 1 Wider section of upstream beat (above concrete bridge)

The left (south) bank has a fringe of marginal vegetation comprising lesser pond sedge *Carex acutiformis*, reed canary-grass *Phalaris arundinacea* and reed sweet-grass *Glyceria maxima*, species typical of chalkstream margins. There are also wetland species such as common reed *Phragmites australis* and bulrush *Typha latifolia*, and also tall perennials such as meadowsweet *Filipendula ulmaria*. Land on the left bank is used for grazing and is fenced, and alongside the riffle is a stand of white willow *Salix alba* trees.

The right bank has a lesser fringe of marginal vegetation and a path for angler access. There are more trees (willow, ash) on this bank, particularly further upstream towards the footbridge. This bank falls within unit 42 of



Photo 2 View upstream from concrete bridge



Photo 3 Large Woody Debris pinned to river bed - note downstream pointing angle deflects water towards the bank (view is downstream)



Photo 4 Tall marginal vegetation fringe, left bank, upstream of concrete bridge



Invertebrates from kick sample of upper beat riffle. Baetis nymphs (left) and caseless caddis *Rhyacophila* sp. (right)



Photo 5 Upper beat, upstream of footbridge. A good mixture of instream vegetation



Photo 6 Upper beat – downstream of road bridge. Spawning gravels, a good mix of instream vegetation and bankside cover, plus some large woody debris

the River Itchen SSSI and the main habitat is classed as fen, marsh and swamp – lowland and is in unfavourable, recovering condition according to assessments by Natural England (Appendix 1).

Some large woody debris (LWD) has been fixed in place in two locations just downstream of the footbridge. This is an exception and there is generally a lack of LWD in the river channel throughout the fishery.

A brief kick sample for invertebrates was carried out on the riffle section of this beat. Amongst the water crowfoot, there were good numbers of Baetidae (olive nymphs), Simulium (black fly larvae), *Serratella ignita* (blue-winged olive nymph), *Gammarus pulex* (freshwater shrimp) and *Aselleus aquaticus* (hog louse). Amongst the gravel there was *Rhyacophila* sp. (caseless caddis), Baetidae (olive nymphs), annelid worms and freshwater shrimp.

Upper beat (Footbridge to road bridge)

Above the footbridge the river channel is generally narrower and faster flowing than the downstream section. Where the channel is wider there is a mid-stream island (previously enhanced by the Environment Agency to create a lie for otters). The submerged aquatic vegetation reflects the narrower channel width and faster current speed, with more water crowfoot *Ranunculus* sp. present along with starwort and water-parsnip.

A good marginal fringe of vegetation is present on both banks, being denser on the right bank where there is less shading from trees. Both banks fall into units of the River Itchen SSSI, the right being similar habitat to the lower section described above, and the left being *broadleaved, mixed and yew woodland - lowland* (Appendix 1).

At the upstream end of this section the river bifurcates and flows in two channels under the road. Above the road is a hatch diverting flow down a mill channel.

Lower beat (Concrete bridge to footbridge)

This section is similar to the section upstream of the concrete bridge. Apart from a short section below the concrete bridge, the channel is relatively wide

and shallow and this is reflected in the submerged aquatic vegetation which is similar to above the concrete bridge.

Land use on the left bank is a continuation of the grazing field and the marginal fringe is protected from livestock by a fence. The right bank is grazed by cattle and a three-strand barbed wire fence is present. This bank falls within unit 43 of the SSSI and is *neutral grassland – lowland* in *unfavourable recovering* condition (Appendix 1).

There are some riparian trees present on this section, mainly willow and some alder. These overhang the river giving some good shade and overhead cover for fish.

Lower beat (downstream of the footbridge)

The river channel is pinched to a width of approximately 7 metres at the footbridge and the increased current speed has scoured a pool downstream; *Ranunculus* sp. is present here. Downstream of this point the river widens and is shaded quite heavily by trees on the left (south) bank. The banks are reveted in this section, mainly on the left bank with metal sheet piles, giving way to wattle hurdles further downstream. In some areas logs have been used to protect the banks.

Aquatic vegetation in this section is mainly starwort *Callitriche* sp. and water parsnip *Berula* sp. and is noticeably sparser than elsewhere, probably because of the shading on the south bank. Mare's-tail *Hippuris vulgaris* and common club-rush *Schoenoplectus lacustris* are also present in some areas.

Land use on the right bank is a continuation of the grazing from the previous section; the fence is quite close to the river and in places cattle can just reach the edge of the marginal fringe of vegetation and have grazed it.

On the left bank is woodland which is described in Natural England's assessment of July 2002 as 'populus plantation with *Phragmites* ground layer. Recommendation is to restore the unit to fen.' This area falls into unit 44 of the SSSI, with a main habitat of *fen, marsh and swamp – lowland* in a condition described as *unfavourable, no change* (Appendix 1).

At the downstream limit of the fishery a carrier leaves the main channel on the left bank. There is a section on the right bank where livestock have access for drinking; the bank has a shallow angle and the marginal fringe of



Photo 7 Lower beat, between concrete bridge and wooden footbridge



Photo 8 Lower beat - view downstream from wooden footbridge. Note increased diversity of flows and vegetation in immediate vicinity of bridge (narrow channel), and heavy shade on left bank further downstream.



Photo 9 Lower beat downstream section. Note wattle revetment, heavy shading on left bank and sparser instream vegetation



Photo 10 Lower beat downstream section. Right bank marginal vegetation fringe nibbled by livestock leaning over the fence.



Photo 11 Lower beat. Metal sheet piling on the right bank.



Photo 12 Lower beat. Area of common club-rush *Schoenoplectus lacustris* and Mare's-tail *Hippuris vulgaris*

vegetation is absent. The relatively long section of bank with livestock access and low stock density means there is currently no issue with bank poaching or sediment ingress.

A brief kick sample for invertebrates was carried out on the lower beat, opposite the wattle hurdle revetment. Amongst the starwort and water parsnip were freshwater shrimp (*Gammarus pulex*), hog louse (*Asellus aquaticus*), olive nymphs (Baetidae), blue-winged olive nymphs (*Serratella ignita*) and caseless caddis; amongst the river bed sediments there were freshwater shrimp, hog louse, cased caddis, annelid worms, blue-winged olive nymphs and olive nymphs.

Other observations

- Concern had been expressed by anglers that some of the fish being caught were thin for their length, and that this may be due to some underlying problem with water or habitat quality impacting upon food supply. During the visit a number of brown trout caught by angling were measured and weighed, and compared with an average length-weight index for brown trout. All the fish caught appeared to be in excellent condition, and were heavier for their length than the average. There was a single exception which was almost certainly a fish of farmed origin judging from the condition of its fins and different markings from the rest of the fish.

- In addition to the riparian habitat units identified by Natural England, the river itself is identified as being in habitat unit 106 *Rivers and streams* and was described as being in *unfavourable condition (no change)* in January 2003. The reasons given for this are:

inappropriate water levels, inappropriate weirs dams and other structures, siltation, water abstraction, water pollution (agriculture/run off; and discharge). River management practices are also contributing to the condition - probably greater than 50% of channel plants are removed by weed cutting. (Appendix 1).

It must be remembered that these factors describe a much longer length of river and all may not be relevant to this reach.

4. Conclusions

Overall the habitat quality in this reach is good and this is reflected in it supporting a high quality wild trout and grayling fishery. In common with many managed chalkstreams the river has a relatively uniform bank profile and channel width, particularly in the lower sections of the fishery.

Improvements to habitat quality could be made in the following areas:

- Increasing diversity of flows within the channel and promoting the sorting of river bed sediments. This is particularly relevant on the lower half of the top beat, and on the lower beat.
- A reduction in shading on lower beat
- 'Softening' the margins alongside the artificial revetments on the lower beat.

5. Recommendations

5.1. Increasing flow and sediment diversity

There are a range of options available for increasing the diversity of flow. It is recommended that contact is made with the local offices of the Environment Agency and Natural England to discuss these options and how they might fit within a catchment context, and the aspirations of these organisations.

5.1.1. Channel narrowing

Channel narrowing could be carried out in appropriate areas such as upstream of the concrete bridge. The aim of this should be to use natural physical processes to encourage the deposition of fine sediment ('silt') in marginal, low velocity areas, where it will consolidate, vegetate and help narrow the channel. This can be achieved by a variety of techniques using brushwood bundles (faggots) and untreated stakes to create new banklines, and then backfilling with brushwood. Islands and causeways can also be constructed in a similar manner to promote a flow and sediment diversity. These options are detailed in the forthcoming WTT chalkstream management guidelines, and illustrated in Figure 1 below. A good example of where some

of these techniques have been carried out is at Woodford on the River Avon (see <http://www.streamlife.org.uk/>).

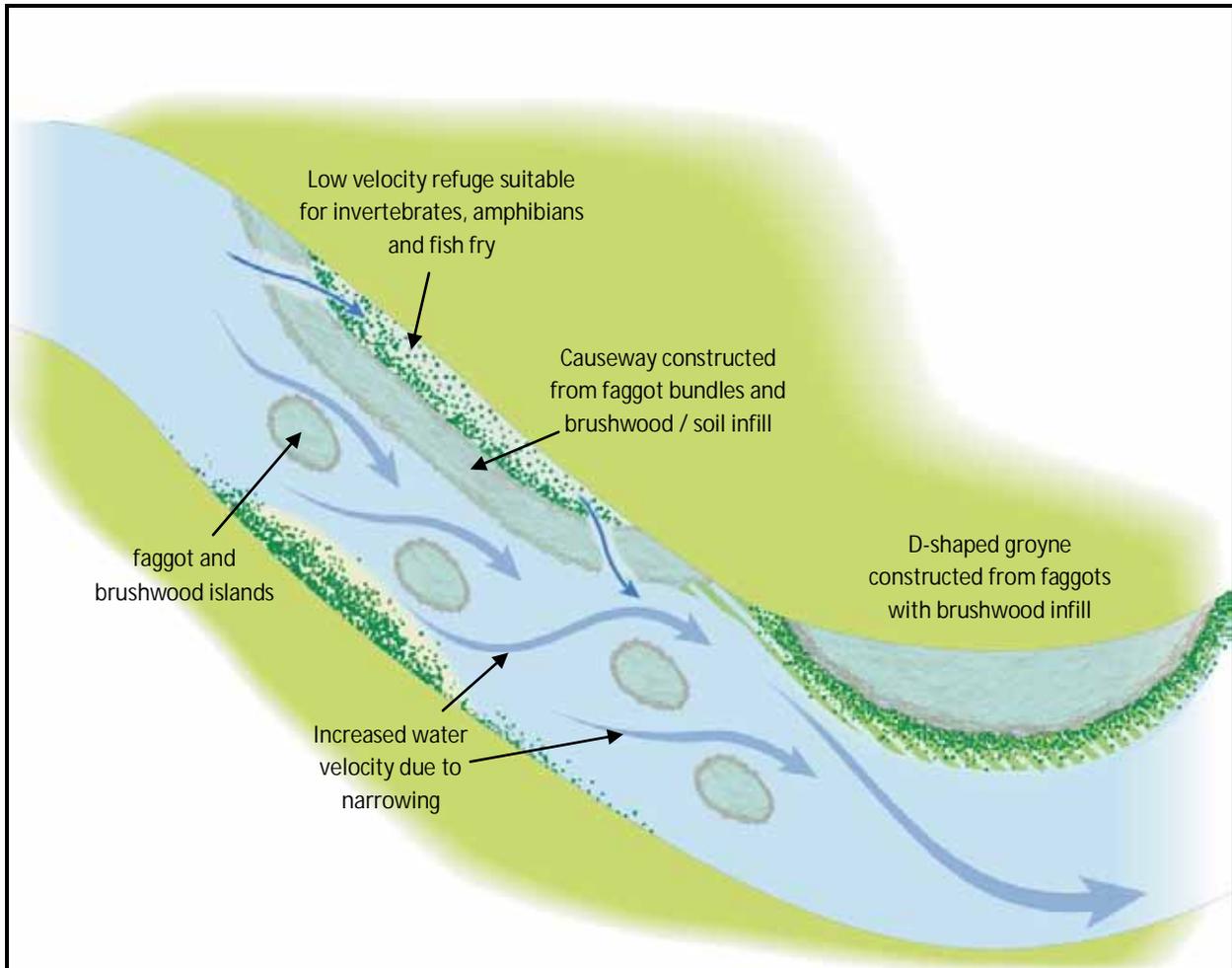


Figure 1 Channel narrowing techniques

5.1.2. Instream structures and Large Woody Debris (LWD)

Channel narrowing could also be achieved using woody debris. Figure 2 illustrates how upstream pointing flow deflectors with brushwood infill between them can be used to encourage silt deposition in the margins, and subsequent colonisation with vegetation.

Trees laid parallel to the bank (Figure 3) would also assist in narrowing the channel and provide valuable cover for fish and invertebrates. This

technique would be particularly appropriate on the downstream part of the lower beat alongside the artificial revetments in this area.

In addition to using LWD to effect narrowing of sections of overwide channel, it can be used elsewhere to create flow and depth diversity, gravel sorting, fish cover and invertebrate habitat. LWD can be deliberately introduced, and also retained when it falls into the channel naturally. It is recommended that a policy of retention of LWD is adopted unless it is causing significant problems. The West Country Rivers Trust provides a useful guide to the management of natural LWD:

1. Is the debris fixed, if yes then continue to 2, if not continue to 5.
2. Is the debris causing excess erosion by redirecting the current into a vulnerable bank? If yes then go to 5 if not then go to 3.
3. Would fish be able to migrate past it (take into account high river flows). If yes go to 4, if no go to 5.

4. Retain the woody debris in the river.

5. Extract the debris.

Note: If the debris dam needs to be removed but there is still a significant amount of the root system attached to the bank then it is recommended that the stump be retained for its wildlife habitat value and its stabilising effect on the bank.

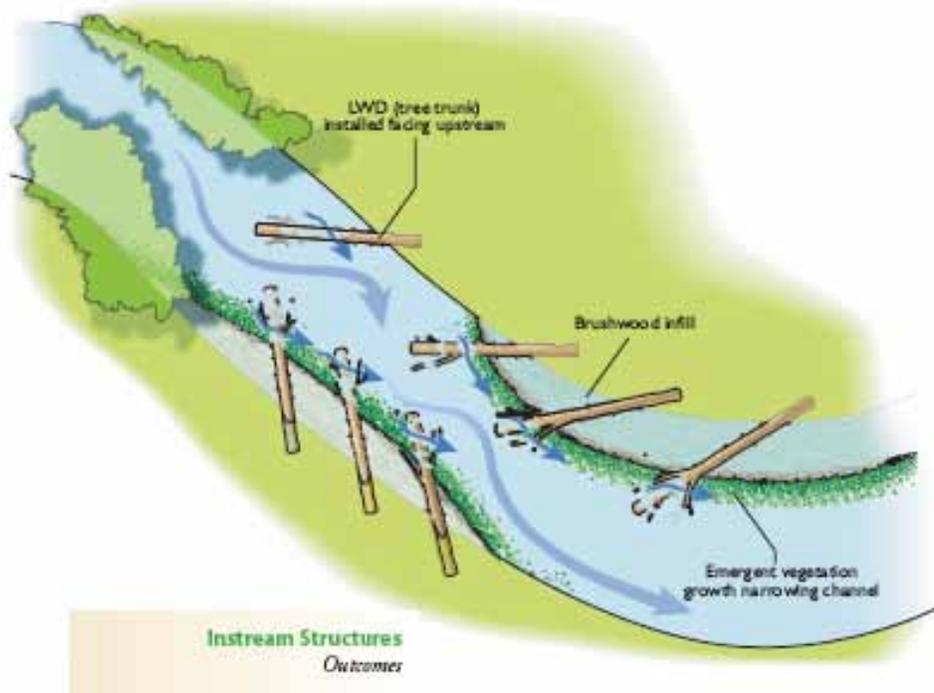


Figure 2 Channel narrowing using LWD and brushwood infill

LWD should be deliberately introduced to the river channel in the form of upstream facing groynes and trees parallel to the bank. Downstream facing groynes are not recommended as these tend to deflect flows towards the bank causing erosion (Figure 3).

It is a legal requirement that all the works to the river require written Environment Agency (EA) consent prior to undertaking any works, either in-channel or within 8 metres of the bank.

The River Itchen is designated under UK legislation as a Site of Special Scientific Interest (SSSI) and under European legislation as a Special Area of Conservation (SAC). These designations recognise its importance as a conservation resource. They also place significant restrictions on operations that can be undertaken without consent from the competent authority, Natural England (www.naturalengland.org.uk). Natural England should be consulted at an early stage of any project undertaken.

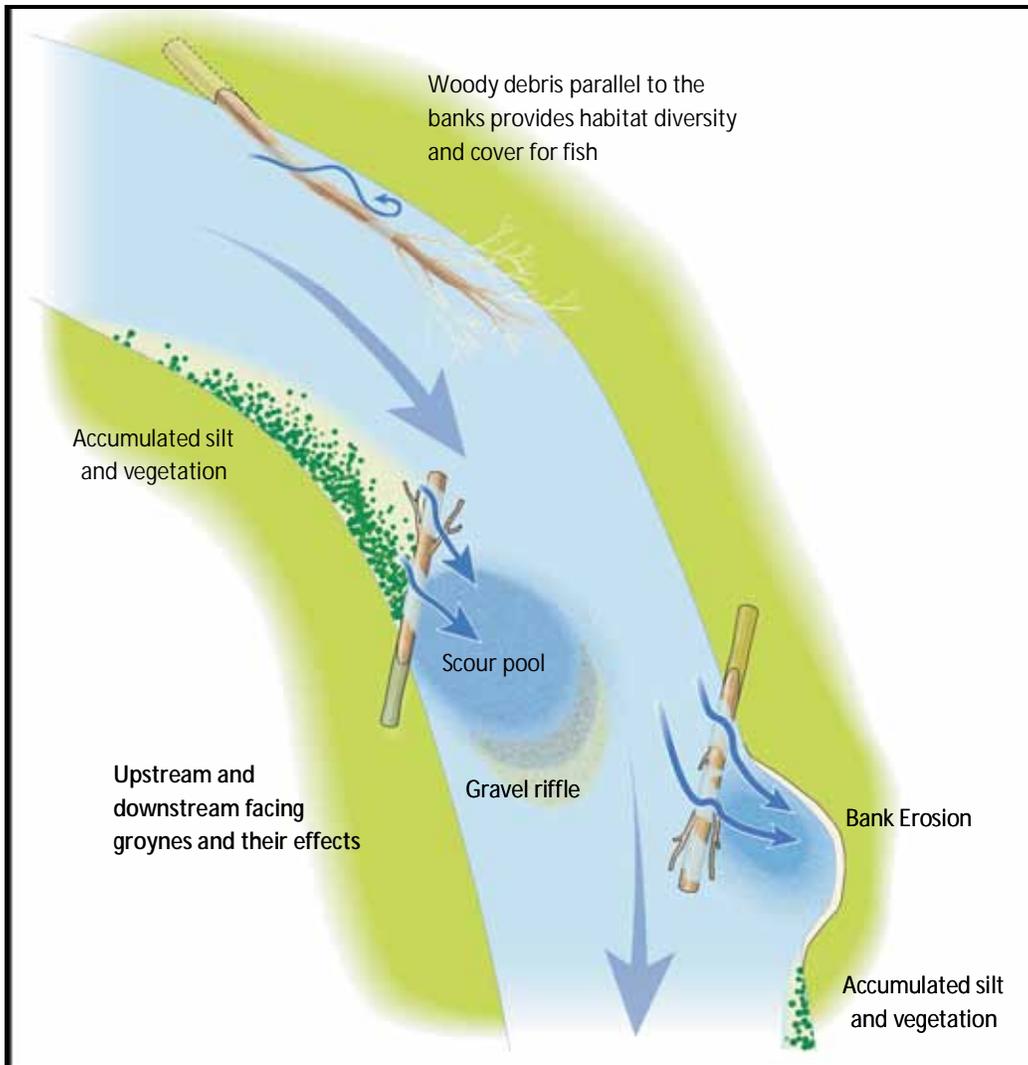


Figure 3 Different effects of upstream and downstream facing flow deflectors

5.1.3. Weed cutting practice

The guidance on instream vegetation management in chalk rivers from the forthcoming WTT Chalkstream Management Guidelines is reproduced in Appendix 2. Although the weed cutting practices carried out on this part of the Itchen were not discussed in detail, the author understands the management is relatively light. The following advice is based upon the guidelines in Appendix 2:

- Cutting should be undertaken by hand in spring and summer, prior to the flowering of water crowfoot. Weed cutting in autumn is not recommended. A maximum of 40% of weed should be removed at any one time.
- The removal of water cress from the river margins, so-called 'edging in', is not recommended.
- Selective cutting to totally remove "undesirable" species such as *Hippuris* (mare's tail) and *Schoenoplectus lacustris* (common club rush) is not recommended. There are extensive invertebrate communities associated with these species. Indeed, some plants have more species of invertebrates living on them than does *Ranunculus*. Consequently, care should be taken to ensure that stands of all species should be allowed to remain; a 'monoculture' of *Ranunculus* is an undesirable outcome to any weed-cutting programme.
- A caveat to the previous point is that a watching brief should be maintained on the stands of *Schoenoplectus lacustris* (common club rush). Although a native species, this can be quite invasive and careful management is required to prevent its spread across large areas of the river channel. Fixed point photography is recommended to monitor the existing stands of club rush. Targeted control is probably most easily achieved with a contact herbicide (glyphosate). Prior written consent of the Environment Agency is required prior to the use of herbicides in or near water – contact the local office for advice. The relevant application form can be found at www.environment-agency.gov.uk/subjects/conservation/840870/840941/.

5.2. Reduction of shading (left bank, lower beat)

Shading of the river channel plays an important role in the well-being of chalkstreams. Too much shading can suppress the growth of instream and marginal vegetation; too little can lead to undesirable increases in water temperature. Good management requires striking a balance between light and shade, and generally a figure of around 60% open water to 40% shade is a reasonable compromise. This can be achieved by management of riparian trees.

On the lower beat on the left bank there is a tree plantation which shades a great deal of the river. It is recommended that, if possible, these trees are thinned to allow more light to reach the river channel. Natural England (NE) assess this area as being fen, marsh and swamp habitat in unfavourable condition (with respect to the objectives of the SSSI): "populus plantation with *Phragmites* ground layer. Recommendation is to restore the unit to fen." It is recommended that the possibility of working with NE is explored to reduce the shading of the river in this area and achieve the conservation objectives of this unit of the SSSI. It may also provide a valuable local source of large woody debris for the recommendations made above.

5.3. Softening the margins (left bank, lower beat)

It would be beneficial to stake some brushwood bundles (faggots) along the front of the metal sheet piling and hurdle revetment to encourage silt deposition and colonisation with marginal vegetation. This would soften the artificial appearance of this section of the bank and create valuable habitat for juvenile trout and grayling amongst the submerged brushwood and overhanging marginal vegetation.

6. Making it Happen

This report makes a series of recommendations that will improve both the biodiversity and status of the wild trout in this reach of the Itchen. At this point it is worth discussing restoration plans with a suitably qualified contractor to get approximate project costs, before working up a project proposal.

Before the detailed proposal is drawn up it is strongly recommended that contact is made with the Fisheries/ Biodiversity and Development Control functions of the local Environment Agency, and with the local contact for Natural England to arrange a 'pre-application meeting'. Pre-application meetings are extremely useful to help scope out design work and to take into consideration any issues that could affect proposed works.

The worked-up proposal should provide all the necessary information for the completion of a land drainage consent application and any Natural England

consent applications. Consents must be obtained in writing before works can commence, and can take several weeks to process.

The WTT can provide further support to help deliver the project including:

- Attending the pre-application meeting
- Providing seed corn funding (normally between £1000 - £2000) for use as matched funding to assist in securing funding towards the project (contact projects@wildtrout.org).
- A practical visit (PV) to demonstrate some of the techniques recommended. Please note that demand for PVs is currently high, and they are intended to assist groups that will be undertaking the work themselves, so a PV may not be appropriate in this case. Further details about PVs are on the WTT website www.wildtrout.org (under the Practical Help link).

Funding could be sought from the Environment Agency Fisheries Project budget, emphasising the concurrence of the project's aims with those of the National Trout and Grayling Strategy of habitat improvement and protection of wild brown trout stocks. This may prove more likely to be successful if matched funding is available.

7. Disclaimer

This report is produced for guidance only and should not be used as a substitute for full professional advice. Accordingly, no liability or responsibility for any loss or damage can be accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon comments made in this report.

Appendix 1 – River Itchen Conservation Designations

The River Itchen is a Special Area of Conservation (SAC) and a Site of Special Scientific Interest (SSSI).

Special Areas of Conservation (SACs) are strictly protected sites designated under the EC Habitats Directive. Article 3 of the Habitats Directive requires the establishment of a European network of important high-quality conservation sites that will make a significant contribution to conserving the 189 habitat types and 788 species identified in Annexes I and II of the Directive (as amended). The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds). Of the Annex I habitat types, 78 are believed to occur in the UK. Of the Annex II species, 43 are native to, and normally resident in, the UK. Details of the process of SAC selection and designation are available on the Joint Nature Conservation Committee's web pages at www.jncc.gov.uk

The habitats and species present on the River Itchen leading to its designation as a SAC are:

1. Annex I habitats that are a primary reason for selection of this site

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation

The Itchen is a classic example of a sub-type 1 chalk river. The river is dominated throughout by aquatic *Ranunculus* spp. The headwaters contain pond water-crowfoot *Ranunculus peltatus*, while two *Ranunculus* species occur further downstream: stream water-crowfoot *R. penicillatus* ssp. *pseudofluitans*, a species especially characteristic of calcium-rich rivers, and river water-crowfoot *R. fluitans*.

2. Annex II species that are a primary reason for selection of this site

- Southern damselfly *Coenagrion mercuriale*

Strong populations of southern damselfly *Coenagrion mercuriale* occur here, estimated to be in the hundreds of individuals. The site in central southern England represents one of the major population centres in the UK. It also represents a population in a managed chalk-river flood plain, an unusual habitat for this species in the UK, rather than on heathland.

- Bullhead *Cottus gobio*

The Itchen is a classic chalk river that supports high densities of bullhead *Cottus gobio* throughout much of its length. The river provides good water quality, extensive beds of submerged plants that act as a refuge for the species, and coarse sediments that are vital for spawning and juvenile development.

3. Annex II species present as a qualifying feature, but not a primary reason for site selection

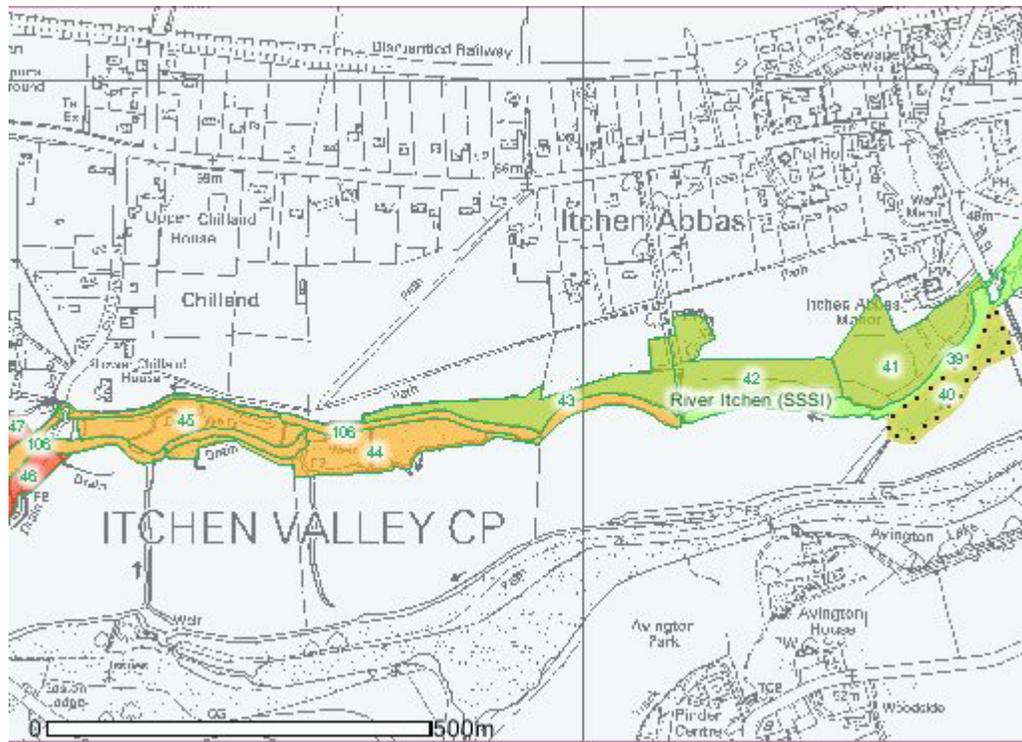
- White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*
- Brook lamprey *Lampetra planeri*
- Atlantic salmon *Salmo salar*
- Otter *Lutra lutra*

Further details on the River Itchen SAC can be found at

www.jncc.gov.uk/protectedsites/sacselection/sac.asp?eucode=uk0012599

Notification as a SSSI gives legal protection to the best sites for wildlife and geology in England. Natural England has responsibility for identifying and protecting the SSSIs in England under the Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way Act 2000). Each SSSI has a citation which details the 'features of interest' for which it has been notified. Each citation shows details of the SSSI location, size and the date of notification. It also describes the general reasons for notification and the habitats, plants and animals that are found at the site. The citation for the River Itchen can be viewed at www.english-nature.org.uk/citation/citation_photo/2000227.pdf

The SSSI is sub-divided into units and these have been the subject of a review by Natural England to assess their status in relation to the original designation. The Government's Public Service Agreement target is for 95% of SSSI land to be in 'favourable' or 'recovering' condition by 2010. The SSSI units pertaining to the section of the river at Chilland are shown on the map below, and their status in the adjoining table.



Main Habitat	Unit number	Unit ID	Unit area (ha)	Latest assessment date	Assessment description	Condition assessment comment	Reason for adverse condition
Broadleaved, mixed and yew woodland - lowland	39	1026878	3.39	15 Jul 2002	Favourable	See 2002 River Itchen wet grassland NVC survey.	
Broadleaved, mixed and yew woodland - lowland	40	1026879	0.63	15 Jul 2002	Unfavourable recovering	See 2002 River Itchen wet grassland NVC survey.	
Fen, marsh and swamp - lowland	41	1026880	1.65	15 Jul 2002	Unfavourable recovering	Expand grazing to include riverbank. return garen to SSSI habitat if damaged. See 2002 River Itchen wet grassland NVC survey.	
Fen, marsh and swamp - lowland	42	1026881	1.36	15 Jul 2002	Unfavourable recovering	Include riverbank in grazing area. See 2002 River Itchen wet grassland NVC survey.	
Neutral grassland - lowland	43	1026882	1.18	15 Jul 2002	Unfavourable recovering	See 2002 River Itchen wet grassland NVC survey.	
Fen, marsh and swamp - lowland	44	1026883	1.35	15 Jul 2002	Unfavourable no change	Populus plantation with Phragmites ground layer. Recommendation is to restore the unit to fen.	Inappropriate water levels, Undergrazing
Rivers and streams	106	1026940	11.90	29 Jan 2003	Unfavourable no change	River management practices are also contributing to the condition - probably greater than 50% of channel plants are removed by weed cutting.	Inappropriate water levels, Inappropriate weirs dams and other structures, Siltation, Water abstraction, Water pollution - agriculture/run off, Water pollution

Appendix 2 – Instream Vegetation management

The following advice is extracted from the forthcoming WTT Chalkstream Management guidelines (due for publication late 2008):

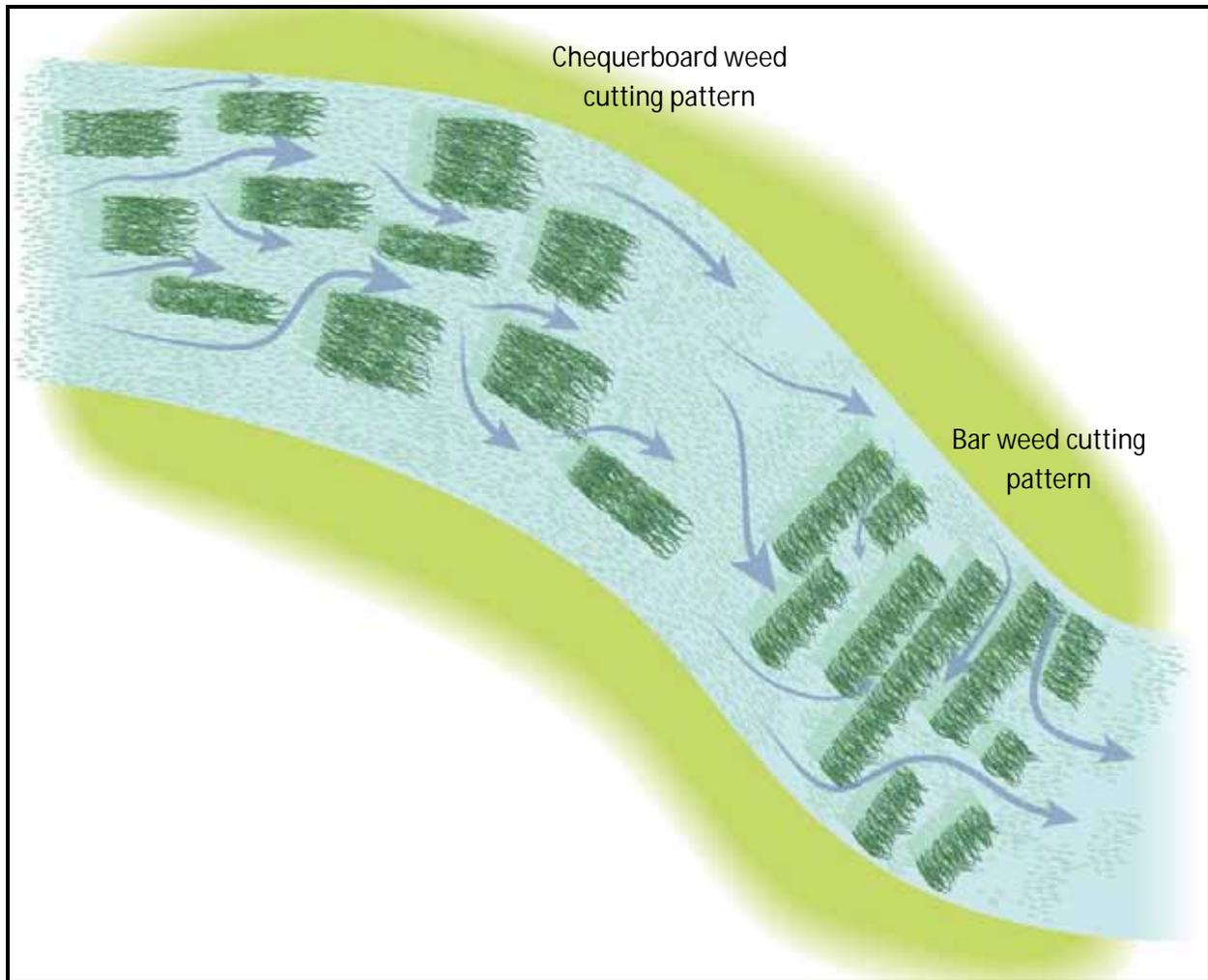
Instream weed is cut in order to maintain a good diversity of habitat and to control water level. The timing, amount, and pattern of weed cutting are vital factors affecting the growth of weed in the river.

Much of the research on weed cutting has focused on southern chalk rivers, where the role of water crowfoot *Ranunculus* in chalkstream ecology has been extensively studied. This genus grows rapidly, reaching maximum biomass by summer. Self-shading and hydraulic drag on weed are thought to be the major factors limiting biomass. Stands of water crowfoot act to develop a range of microhabitats, with summer water depth increased by up to 80 cm. as a result of its growth. Water temperature within the plant stand may rise by 2–4°C, whilst water velocity in the same location may fall to one tenth of the external velocities. Associated silt accumulations may make this increase more pronounced. Fragmentation of water crowfoot begins soon after reaching maximum biomass, with over 75% of plant material fragmented within three months and broken down and utilised in-situ. The presence of submerged macrophytes, particularly water crowfoot retains organic material, preventing it being washed downstream during the higher autumnal/winter flows. This both increases the fragmentation of organic litter near to its site of origin and prevents the accumulation of thick layers of silt on the riverbed.

The impact of cutting regimes on the growth of *Ranunculus* has been studied in detail. The commonly used pattern of spring and summer hand cutting generally results in only short-term control of growth. After cutting there is a rapid, synchronised growth in water crowfoot, as plants became free from the progressively poorer growth conditions and self-imposed burden of high biomass, which naturally leads to the collapse of undisturbed populations in late summer. Additionally, the roots of cut plants do not die back, but continue to grow in the autumn, thus increasing the probability of high over-wintering biomasses earlier in the subsequent year.

The implications of these facts have a fundamental impact on the standard 'chequerboard' or 'bar' weed cutting patterns most often practised on chalk rivers. In essence, this traditional approach to weed management stimulates

the growth of water crowfoot, maintaining freshly growing stands throughout the fishing season. Care must be taken however to avoid excessive cutting, as this can significantly lower the water level, leading to decreased habitat availability and increased water temperature and risk from avian predation, particularly during low flow periods.



Research has also shown that following a four year cessation of cutting on trial chalkstream reaches, the maximum biomass of *Ranunculus* declined to approximately 50% of that found when water crowfoot was regularly cut. However, following cessation of cutting, a wider, more extreme range of both dissolved oxygen and water temperature was apparent compared to unmanaged streams of a similar size. There is no indication that any of this

increased variation was of a magnitude that could be damaging to stream ecology. A 'no-cut' policy may thus be of benefit in the longer term on rivers with a very heavy growth of water crowfoot.

Flowering signals the start of decline in the rate of growth of *Ranunculus*. Cessation of flowering coincides with maximum biomass. Flowering can thus be regarded as an indicator of the seasonal cycle and adaptation of the plant to average environmental conditions of that reach of river. Flowering generally commences earlier at upstream, spring fed river sites. Difference in timing of flowering has been recorded as between two and three months from source to estuary, on the River Piddle, Dorset.

Heavy weed cuts sometimes take place following the end of the fishing season. The impacts of this type of management have also been extensively researched, with a reduction in the biomass of water crowfoot early in the following season the normal outcome, particularly in water with a depth of less than 0.7m. Very careful consideration should therefore be given as to whether this is a sound management policy, before undertaking a weed cut after the senescent period for crowfoot.

The removal of water cress, *Rorippa nasturtium-aquaticum* is routinely carried out, both to prevent the accumulation of associated marginal silt and as a pre-emptive flood management measure. The importance of cress to the river's ecology should not be underestimated. The invertebrate fauna associated with water cress has been quantified, with a mean of 21 associated taxa found. Water cress and water crowfoot can be seasonally co-dominant and interact so that the biomass of each regulates the success of the other; as crowfoot dies back, cress growth increases and vice versa. This feedback mechanism helps to maintain water velocity in what would otherwise be an often over-wide channel. Timing of the autumnal increase in flow is the natural event regulating this interaction, with the impacts of weed cutting artificially affecting this balance. The removal of water-cress in the autumn/early winter (so-called 'edging-in') is thus not a recommended technique. Not only does it remove valuable invertebrate habitat, but it also threatens to destabilise the relationship between cress and water crowfoot.

The fate of weed following cutting is of great importance. Allowing the passage of weed down the watercourse as in the Test and Itchen, may permit invertebrates to migrate from the weed and hence remain in the river. However, the pre-set calendar of dates on which cutting may take

place does impose an artificially rigid structure on fishery interests, perhaps making them cut weed when it may not need removal.

Removal of cut weed from the river adjacent to the site of cutting reduces opportunities for associated invertebrates to drop off and remain in the watercourse; depositing it close to the water's edge allows mobile invertebrates to regain the river. Risks associated with deoxygenation of the watercourse and the provisions of the Water Resources Act, 1991, mean that cut weed should never be allowed to remain in the watercourse.

Selective cutting to totally remove "undesirable" species such as *Hippuris* (mare's tail) and *Schoenoplectus lacustris* (common club rush) should be undertaken with care. There are extensive invertebrate communities associated with these species. Indeed, some plants have more species of invertebrates living on them than does *Ranunculus*. Consequently, care should be taken to ensure that significant stands of all species should be allowed to remain; a 'monoculture' of *Ranunculus* is an undesirable outcome to any weed-cutting programme.

By altering the timing of cutting to avoid critical periods, impacts on particular species could be reduced. However, it is inevitable that cutting at any time of the year will affect one or more species. The extensive pre-emptive autumn cutting of *Ranunculus* and water cress carried out on some rivers, does produce benefits to flood defence and is financially efficient. However, reduction in over-winter vegetation cover, decrease in biomass of *Ranunculus* in the year following autumn cutting, possible changes to floral composition, impacts on invertebrates and lowering of autumn/winter river levels, all make this practice less desirable from an overall nature conservation viewpoint. Traditional hand cutting to the "side and bar" pattern during spring and summer probably represents the best compromise with respect to both fisheries and conservation interests.

There has been little research comparing the effects of manual and mechanical methods of weed cutting on stream ecology. However, mechanical cutting using either weed cutting boats or a Bradshaw bucket mounted on a hydraulic excavator, has the potential to remove greater amounts of weed in a less selective manner than manual methods. As a consequence, the use of such devices should be avoided, unless absolutely essential. In conclusion, the key factors relating to the impact of weed cutting on nature conservation interests are timing and extent of the cut,

along with species targeted. The long established history of weed cutting in the chalk and limestone streams suggests that much of the floral and faunal communities currently recorded are in part a consequence of this regime. In order to retain this diversity, it is recommended that a maximum of 40% of weed (by area) should be cut at any one time.