North Lake, West Compton, Dorset

An Advisory Visit by the Wild Trout Trust, March 2016

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Introduction

This report is the output of a visit undertaken by Mike Blackmore of the Wild Trout Trust to a small lake situated on a small tributary of the River Hooke at West Compton, Dorset (national grid reference (NGR) SY 5647 9462). A walk-over of the site was requested by Mr. Nick Mirchandani and Mrs. Sophia Mirchandani who are the land owners. The visit was primarily focussed on assessing habitat for wild fish, including brown trout (*Salmo trutta*) and biodiversity in general.

Comments in this report are based on observations on the day of the site visit. Throughout the report, normal convention is followed with respect to bank identification i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.

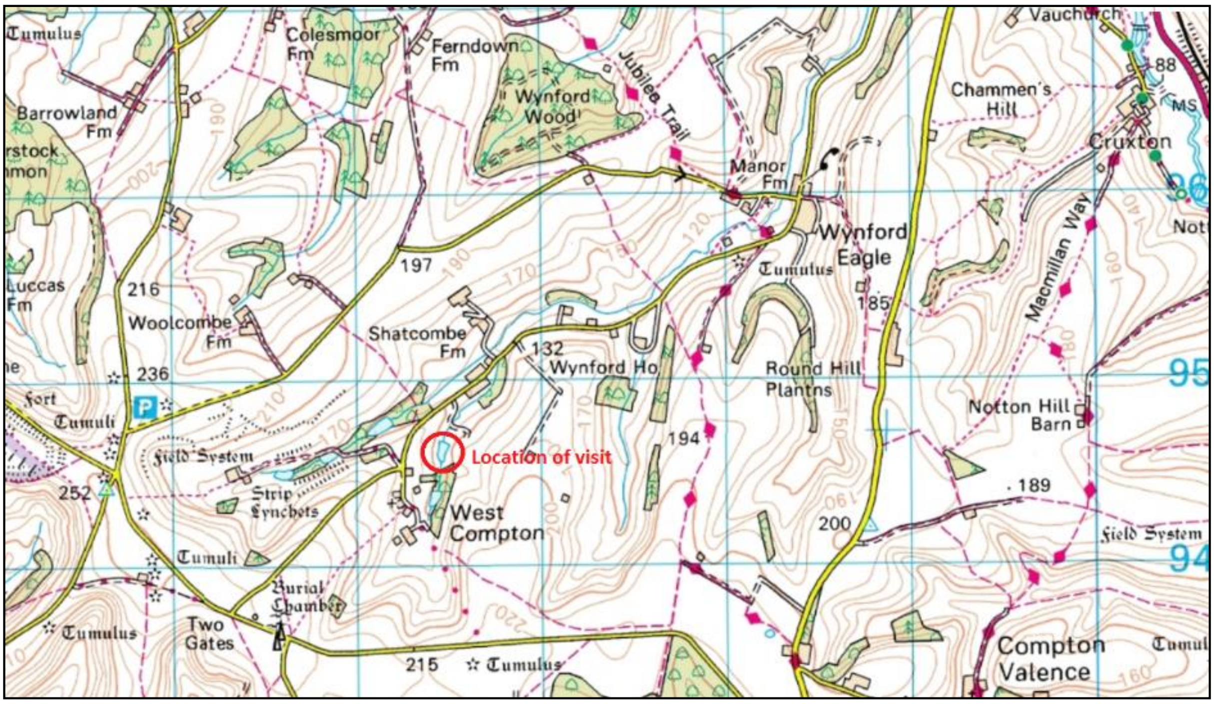

Figure 1: Map showing the location of the water visited

Catchment and Fishery Overview

The stream on which the lake is situated drains a catchment of mixed geology. West Compton is situated on the western edge of the southern chalk measures and the geology is predominantly white chalk with occasional deposits of of gault (stiff blue clay), oolitic limestone, sandstone and greensand. The main land use of the catchment is arable agriculture with a high proportion of cereal crops. The naturally undulating topography of the landscape combined with the land management practices associated with intensive cereal crop agriculture (ploughing and leaving exposed soil during winter months), burden the stream with surface water run-off heavily laden with fine sediment.

The springs that feed the stream rise from chalk aquifers, providing naturally clear, mineral-rich water. However, diffuse sources of fine sediment, such as drainage from arable fields, roads and farm tracks are probably elevating levels of fine sandy sediment in the stream. In addition, two fishing lakes upstream of North Lake have been recently de-silted (Pers. Comm. Nick Mirchandani). No matter how carefully an online (directly connected to a watercourse both upstream and downstream) lake is de-silted, a proportion of fine sediment is likely to be washed downstream. There are de-silting techniques available which can limit the volume of fine sediment released and these are explored in the *Recommendations* section. The combination of diffuse fine sediment from the catchment and from the desilting of the lakes upstream appear to have significantly increased the volume of fine sediment in the stream. As North Lake is also an online lake (formed by damming and significantly widening and deepening a stream), it will inexorably act as a sediment trap as flow slows upon entering the lake and fine sediment drops out of suspension.

The lake is populated with an unknown community of fish but Mr Mirchandani reports that a pike (*Esox lucius*) is present. If the pike is feeding on other fish and it is likely its prey are probably coarse species that were stocked by previous owners or may have dropped down from the lakes upstream. It is also possible that a small population of wild trout is present. If this is the case, then the population will be using the stream above the lake as a spawning habitat. Some juvenile trout may drop downstream from North Lake but at present it is not possible for any wild trout to pass over the weir into the lake from the stream below. It is not known if trout from the River Hooke migrate up as far as the lake. However, the stream is similar in characteristics to some tributaries used by wild trout as spawning and nursery habitat.

Habitat Assessment

The stream above the lake flows through a densely-wooded valley. The bed mostly consists of small flint gravels and could potentially provide spawning habitat for wild trout. However, only a short section of the stream was inspected as this is the upstream boundary of the Mirchandani's land.

Figure 2: The stream above the lake

The wooded valley casts dappled shade over most of the stream which is important as shade plays an important role in regulating temperature in rivers. In small headwater streams, where trout prefer to spawn, this function is especially important as low flows during periods of prolonged dry weather can leave many temperature-sensitive species of fish and invertebrates vulnerable; not only does warmer water contain lower concentrations of dissolved oxygen, but it can also increase the effect of pollutants and the susceptibility of trout and other species to a range of pathogens. Although salmonids are able to acclimate somewhat to different average temperatures, one week at 25^{O}C, or only 16 minutes at 27^{O}C will be lethal to brown trout. Any temperature above 19.5^{O}C will severely stress trout, potentially threatening long-term survival. Temperature also regulates the incubation period for trout eggs (~100 days at 5^{O}C or ~50 days at 10^{O}C) and the period in which alevins consume their yolk sack (~38 days at 7.5^{O}C). Further details summarised by the Environment Agency can be found here:https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291742/scho1008boue-e-e.pdf

Tree cover provides another vital function in headwater streams; fallen leaves provide the primary energy input for the stream ecology. Lower in the catchment, where flows are more stable and the canopy more open, fragmented or removed, primary production is predominantly undertaken by algae and submerged and marginal plants. However, headwaters and steep-gradient rivers often cannot support large aquatic plant communities. Here, bacteria and invertebrates breaking down trapped leaf litter provide the base of the ecosystem's food chain.

Although essential to the ecosystem, leaf litter contributes to sedimentation in lakes. An overabundance of trees, particularly on western banks (the direction of prevailing winds) can limit the natural mixing effect of wind on the surface of lakes. Wind acting on the surface can also help to concentrate leaf litter at one end of the lake, potentially making sediment management easier to tackle.

While on-line lakes are simply a slowing of the flow of a stream, the change in physical parameters can have a significant impact on the chemistry and biology, ultimately the ecology of the river. The larger surface area of slow-flowing water is more-easily warmed by the sun, particularly over the shallows if the bed is covered in a layer of dark-coloured sediment. This warming can reduce the concentration of dissolved oxygen and increase the frequency of algal blooms. As for the stream then, shade from bankside tree cover remains important as it can help to regulate water temperature. It is essential to achieve the right balance of tree cover around stillwater habitats to ensure that shade and cover is provided but that leaf litter and wind screening are as limited as possible.

A further useful function of bankside trees is to provide overhead cover. Brown trout and many other fish instinctively favour overhead cover as it offers a certain degree of protection from predators such as piscivorous birds. In many cases, pollarding or coppicing tall, over-stood trees, and retaining lower, younger trees is a good way of maintaining good cover and shade whilst allowing the lake surface to be wind-blown. This will, however, depend on the slope of the landscape, the direction of sunlight and prevailing winds. For example, at this latitude, it is sometimes worthwhile retaining tall trees on the southern bank to provide shade but reducing tree cover on the western bank or taller, steeply sloping banks.

Sedimentation near the inflow of the lake (Figure 3) is a classic sign of stream-fed siltation. The sudden drop in flow speed at the mouth of the stream allows sediment to drop out of suspension and accumulate on the bed. This process causes the lake to shallow around the mouth.

The dense willow thicket at this end of the lake may be preventing marginal plants from colonising and consolidating the sediment deposits. Cutting this back and allowing more direct sunlight onto this end of the lake may promote the development of a bed of marginal plants which will improve biodiversity and also provide cover for adult trout running up to spawn in the stream and a vital refuge for any juvenile trout dropping back down. In lakes with wild trout populations, young parr dropping into the lake will rely heavily on the 'shaggy' marginal habitat provided by emergent plants, roots and fallen trees. This not only protects them from predation, but also allows a greater number of juvenile trout to occupy a certain area without feeling threatened by each-others presence. From the moment they emerge from the gravel, trout are territorial and do not remain within sight of each other if they can avoid it. Brown trout are also naturally photophobic, favouring overhead cover and shade. Dense, complex habitat in the form of shaggy marginal vegetation, roots and fallen branches provide refuge from predators, an abundance of cover and plenty of visual barriers blocking the line of sight between individual fish.

Creating marginal reed beds could help to filter water from the stream and could help to trap sediment at the upstream end of the lake, potentially making it easier to manage. This option will however require some initial works followed by occasional maintenance to prevent bankside vegetation from encroaching into the lake or blocking upstream migration. Marginal encroachment could reduce the size of the lake over time and potentially impeding upstream access for trout. However, if undertaken as part of a broader suite of actions as outlined in the *Recommendations* section, annual maintenance can be kept to a minimum. Re-profiling the lake around the mouth of the stream to create a gentle slope down from the vegetated bank will create a marginal zone where a succession of different plant species, favouring different levels of saturation, will continue to flourish. A relatively abrupt increase in water depth from the marginal zone down to the benthic zone (lake bottom) will prevent marginal plants from encroaching further into the lake.

Figure 3: The inflow of the steam into the lake is heavily silted

A short distance downstream of the inflow are some relatively small and low-growing bankside trees with low, trailing branches (Figure 4). These should be retained as the marginal cover habitat they provide is extremely valuable. Other taller trees further back from the bank edge should be prioritised for tree works.

The day of the visit was particularly stormy and followed a night of heavy gales and a morning of torrential rain. The lake was resultantly coloured, impeding an assessment of the aquatic plant community, and a large white poplar had been blown over on the eastern side of the lake (Figure 5).

Figure 4: Bankside trees providing some good low cover habitat

Figure 5: The root ball of the fallen poplar (background).

White poplars are notorious for having shallow roots and are particularly vulnerable to high winds once they have grown to a certain height. Cutting the fallen tree near the stump may allow it to right itself and the tree may yet survive. However, it would probably be better for the lake to remove the tree completely and instead provide habitat for marginal and emergent wetland plants.

At the western end, the lake discharges back into the stream over a small weir (Figure 6). At present this structure is a complete barrier to upstream fish migration. This isolates fish populations within the lake and makes them particularly vulnerable to pollution, predation, habitat degradation or other scenarios that could lead to fish mortality. Without good access for fish attempting to run upstream, the lake would not be able to naturally repopulate following a fish kill event.

The bed of the stream immediately below the lake is undergoing head-cut erosion, causing the stream to become incised and leading to bank erosion and slumping (Figures 7 and 8). This appears to be largely due to the head drop from the outfall of the lake to the stream below (Figure 6) and the resulting turbulence stripping away coarser sediment and gravel. However, it is also worth noting that the lake is a significant barrier to sediment transport meaning that the gravel transported downstream from below the lake cannot be replaced by gravel from upstream. Once the natural gravel seam of the bed has been removed, the underlying alluvial clay is easily eroded and the rate of channel incision can become accelerated. Left unaddressed, the rate of erosion in the channel could risk the integrity of the lake dam.

Figure 6: The outfall of the lake is impassable for fish and is contributing to erosion

Figure 7: The channel downstream of the lake is incising as the bed erodes

Figure 8: A bank slip as a result of the bed erosion destabilising the banks

The straight drop from the lake outfall to the stream also makes it a barrier to fish passage and prevents any trout that may inhabit the stream from accessing the lake or any habitat above it. Installing a series of pre-barrage structures in the stream below the lake could help to improve fish passage and also reduce the rate of bed and bank erosion. This is explored in greater detail in the *Recommendations* section of the report.

A section of the stream below the lake was also inspected toward the downstream end of the Mirchandani's land. Here the gradient of the land is shallower, the wetted perimeter becomes wider, and the stream flows through a diffuse channel choked by thick deposits of fine, sandy sediment (Figure 10). A certain proportion of this sediment is likely to have originated from the erosion immediately below the lake but it is also likely that a great part of it comes from land use practices within the wider catchment and from the recent de-silting of the ponds further up the valley.

Figure 9: The heavily-silted stream below the lake

A relatively high abundance and diversity of wetland plant species is present and these have encroached across the channel in places, compounding the diffuseness of the stream habitat (Figure 11). Consolidating the fine sediment in the margins of the stream and focussing available flow through a sinuous central channel will help to restore the stream in this location and may improve habitat diversity and fish passage. Techniques for achieving this are outlined in the *Recommedations* section.

A number of large greater tussock-sedges (*Carex paniculata*) were observed next to the stream (Figure 12). These specimens should be conserved as they will be quite old to have reached such a size and will provide valuable habitat for a number of invertebrate species.

Figure 10: Marginal plants encroach across the stream

Figure 11: Tussocks next to the stream provide valuable invertebrate habitat and should be conserved

A cursory examination of the sediment accumulating in the stream and lake suggests that a proportion of the sediment is organic. It is therefore likely that silt treatments based upon stimulating bacterial decomposition, such as treating with porous calcium carbonate (e.g. a product called Siltex), will have an effect in reducing the volume of silt in the lake. This treatment involves adding finely ground chalk to the lake, at around a dose rate of 2 tonnes per hectare, that will sink onto the bed and raise the pH of the mud, stimulating bacterial decomposition of the organic component in that mud. Results are somewhat unpredictable: the reduction in silt depth is small and the treatment quite labour intensive. It is likely that mechanical removal such as via systems that pump silt/sand through large, permeable geotextile bags positioned on the upper bank will probably also be required to fully desilt the lake. These systems allow filtered water to drain back into the lake whilst the fine material trapped in the bags slowly dries. There are a number of specialist companies that provide this service and searching online for nearby contractors and inviting them to provide quotes will probably provide the best value for money. It should, however, be noted that the only sustainable, long-term solution is to reduce the sediment input from upstream.

A significant input of sediment was observed draining from a nearby arable field (Figures 12 and 13). Placing brushwood bundles across silt pathways may help to reduce the rate at which sediment enters the lake. However, the best way of reducing the volume of run-off would be for the farmer to retain a buffer margin of un-ploughed grass around the boundary of the field. This will help to naturally filter surface run-off.

Figure 12: A point-source of fine sediment drains from an adjacent field

Figure 13: A sediment pathway winds its way down to the lake

Recommendations:

In order for North Lake and the stream above and below it to achieve their full potential for biodiversity and to function as good quality habitat, capable of supporting healthy, self-sustaining populations of wild brown trout, the following actions are recommended:

1. Address the erosion and improve fish passage at the outfall of the lake by installing a series of pre-barrage structures. This will spread the head drop from the weir over a greater distance, reduce turbulence and help to stabilise the bed and banks. The outline design shown in Figures 14 and 15 consists of site-won logs stacked and secured with steel rebar driven through holes drilled in them. A notch with a curved nape on the downstream side should be cut in the top log to provide a solid flume of water with as little entrained air (white water) as possible. In order to improve fish passage, the head drop over each of the barrages should be no greater than 100-200mm. A non-woven nylon soil retention geotextile is shown affixed to the upstream side of each barrage with a long skirt to prevent the river undercutting the structures.
   This design is an outline design concept and it is recommended that further advice be sought from an experienced consultant/contractor before construction. WTT can recommend contractors in the area that may be able to help.

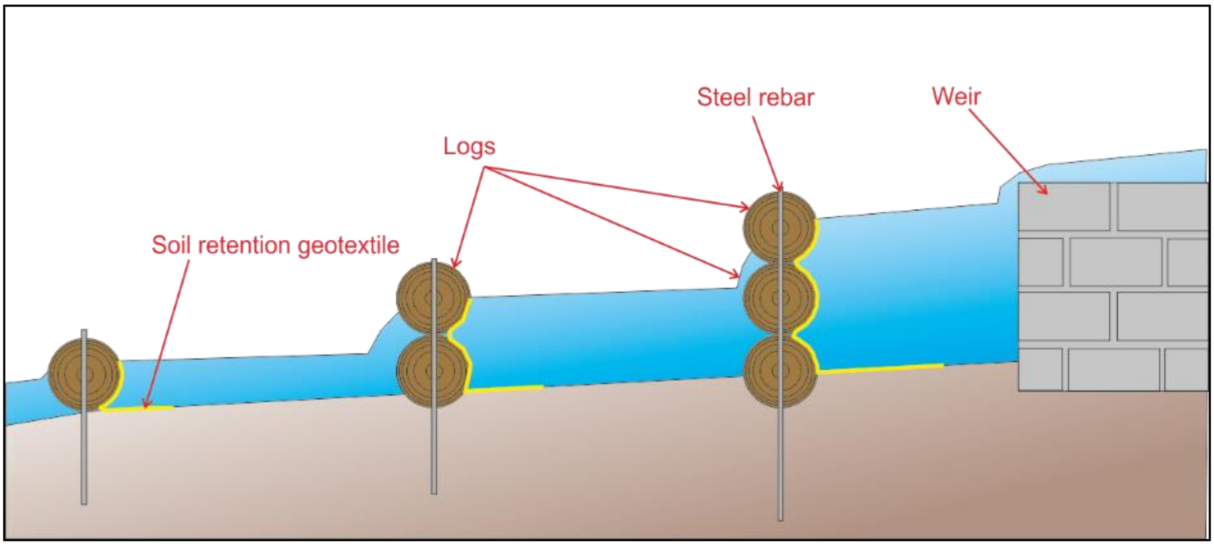

Figure 14: An outline concept design for a low-cost fish passage easement. This will also help stabilise the bed and banks

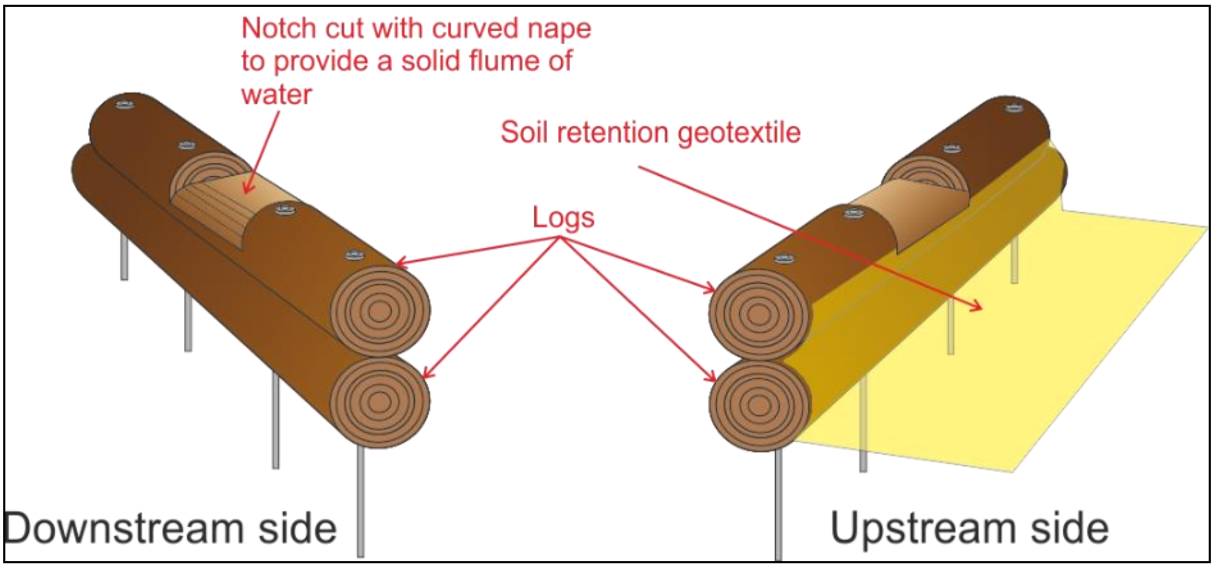

Figure 15: A detail drawing showing the suggested design of a pre-barrage structure

2. Measures should be taken to improve the heavily-silted section of the stream shown in Figures 9 and 10. This can be achieved by making use of the abundance of hazel around the lake to create faggot bundles of hazel brushwood (branches) and densely packing them into the soft margins of the stream. In addition, some of the willows around the stream should be coppiced or pollarded to allow more sunlight onto the bed and banks. This in turn will allow marginal plants to quickly take root and further consolidate the banks, replacing the hazel brushwood at it biodegrades. Some translocating of the existing marginal plants from the centre of the channel to the margins will also be required. This will focus available flow through the central channel and help keep it scoured clean.
   Unfortunately, the willow is not suitable for consolidating the soft sediment. Willow is tenacious and any live wood cut from the trees will sprout and re-grow into new trees provided it remains saturated.

Figure 16: An illustration showing where hazel brushwood can be packed into the soft stream margins to consolidate the fine sediment.

3. Consider managing tree cover around the lake to minimise wind-screening and leaf litter input. However, low, trailing or submerged braches should be retained wherever possible.

4. Consider options for de-silting the lake. The site is relatively inaccessible but there are a number of specialist contractors who may be able to provide a range of novel approaches for undertaking the task. Particular emphasis should be placed on the inflow side of the lake as this is where sediment enters and is also probably where leaf litter accumulates (owing to the direction of prevailing winds).
   Providing a gently sloping shallow margin will provide good habitat for marginal plants. This should continue out to a relatively abrupt drop off into deeper water to plants encroaching further out into the lake.

5. Consider commissioning an ecological/fish survey of the lake to better understand its ecology.

Disclaimer

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