Advisory Visit

River Devon

01/10/2019

Undertaken by Gareth Pedley (WTT)

Key findings

- General habitat quality on the river is good and a natural array of bankside cover is present in many areas, particularly where livestock are excluded. Correspondingly, excluding livestock from the watercourse where they do currently have access would be beneficial.
- The habitat observed during the visit appears more than capable of supporting healthy wild salmonid populations and stocking with hatchery reared fish should not be necessary.
- It would be beneficial to leave more of the naturally occurring woody material within the channel, to provide cover, shelter and protection from predators for the river's fish populations.
- Fish passage could be greatly improved on the Dollar Burn, where a previously installed Larinier pass is well outside the optimal design specifications for that (or any) type of pass.

1.0 Introduction

This report is the output of a visit to the River Devon in Clackmannanshire at the request of Devon Angling Association (DAA), undertaken on 1st October 2019. The visit was conducted as a series of spot-checks (working in a general upstream direction) to provide an overview of the habitat quality for wild salmonids and identify potential areas where improvements could be made. Normal convention is applied throughout this report with respect to bank identification, i.e. the banks are designated left bank (LB) or right bank (RB) whilst looking downstream. The Ordnance Survey National Grid Reference system is used to identify specific locations.

2.0 Background

Table 1. Details for the two Water Framework Directive (WFD) waterbodies covering the sections of River Devon visited

	Waterbody details	
River	Devon	
Waterbody Name(s)	**River Devon (Source to Gairney Burn confluence); River Devon (Gairney Burn confluence to Estuary);** & **Dollar Burn**	
River Basin District	Scotland	
Current Ecological Quality 2017	**River Devon** ID: 4501	**Poor ecological potential**: **poor** for **fish ecology** and **bad** for **hydrology** (medium/high flows).
	River Devon ID: 4500	**Moderate ecological potential**: **poor** for **fish ecology** & **hydrology** (medium/high flows); **moderate** for **reactive phosphorus**
	Dollar Burn ID: 4503	**Poor: poor** for **fish** (fish barrier)
U/S Grid Ref of reach inspected	NO 00825 02165	
D/S Grid Ref of reach inspected	NS 93890 97237	
Length of river inspected (km)	c. 2km (over 14km)	

(www.sepa.org.uk/data-visualisation/water-classification-hub/)

The major impacts upon the WFD status for the upstream waterbody section visited (ID: **4501**) appear to be the poor performance of fish populations and hydrology at medium/high flows, likely as a result of the reservoirs in the upper reaches. The major impacts upon the WFD status for the downstream waterbody section visited (ID: **4500**) appear to be the poor performance of fish populations and impact upon the hydrology at medium/high flows, likely an impact of Castlehill Reservoir upstream. Dollar Burn is also Poor for fish, stated to relate to a fish barrier.

The River Devon originates on Blairdenenon Hill in the Ochills, before flowing in a general easterly direction, through two reservoirs (Upper and Lower Glendevon) towards Glendevon, then Castlehill Reservoir downstream. These upper reaches lie within an area of tough igneous bedrock, with superficial deposits of peat and till in the surrounding catchment and clay, silt and sand within the narrow valley bottom. Two other reservoirs (Glensherup and Glenquey), located on tributaries also contribute to an altered hydrology in this area of the catchment.

Downstream of Castlehill Reservoir, the river wends its way around the Crook of Devon, flowing in a naturally steep and relatively straight channel, over a more varied geology, also including sandstone, siltstone and mudstone, that imparts greater productivity to the water. Couldron Linn (NT 00400 98800), a large bedrock outcrop within the middle reaches of the catchment, creates an impassable barrier for fish and forms the upstream limit of salmon on the river. Further downstream, in the middle to lower reaches, the river valley gradient reduces naturally creating a more meandering watercourse, particularly so downstream of Dollar.

DAA control c.24km of the river which they now operate as a wild salmonid fishery, having taken the decision to stop stocking in recent seasons and promote the river's wild fish populations. The Association also has stillwater fishing on Glenquey Reservoir.

3.0 Habitat Assessment

At the downstream limit inspected (around Tait's Tomb), cattle have access to the watercourse and there is an impact from grazing upon the abundance and diversity of bankside vegetation. Although the stock density did not appear to be excessive, it was limiting natural tree and shrub regeneration, with only mature trees and heavily browsed saplings present. This reduces the riparian habitat quality for invertebrates and other wildlife but allows increased erosion by reducing the extent of root structure within the riverbank; something that was particularly evident on the sharper bends (Fig. 1). Erosion is not necessarily bad, but when occurring at accelerated rates it oversupplies soil and fine sediment to a river. This can block the spaces between coarser bed material and limits the habitat quality and availability for invertebrates. The restriction of water flow through the bed, also reduces its value for salmonid spawning as incubating eggs laid within the gravels/cobbles require a supply of oxygenated water.

Fencing off the watercourse would allow a vegetated buffer strip to establish and would improve riparian habitat quality. This would require the farmers relinquishing a strip of land from grazing, but it would help to stabilise the channel, ultimately to their benefit, especially if tree planting is undertaken within the strip to help bind the bank together. Confining the livestock to one or other side of the river may provide additional benefits for the farmer. The Woodland Trust can often supply trees free of charge if suitable locations can be found in which to plant them (see Recommendations).

In areas where bankside trees are present they create high quality habitat, particularly where low branches trail into the river, providing cover and structure that will protect the fish from predators and offer respite from high flows. These features are particularly valuable where they encourage wood-jams that diversify flow and create scour to develop deeper pools. The greater variety of habitat niches created increase the number and size of fish that an area can hold. While some may see in-channel structure as an obstruction to angling, the habitat benefits and increased angling opportunities they provide far outweigh any inconvenience.

Figure 1. Livestock grazing is reducing species diversity on the banks and facilitating areas of accelerated erosion (red ellipse).

Figure 2. High quality habitat created by trailing branches, with the area further enhanced by an accumulation of woody material. The urge to remove or alter this type of habitat should be resisted. Note the small alder sapling that has managed to establish (red circle) just out of livestock reach, but little more than short grasses in the accessible area to the left.

A small burn enters the river at NS 94015 97360, offering potential salmonid spawning and juvenile habitat, although it appeared to carry a high load of sand and fine sediment, as evident by the change in water and bed colour (Fig. 3). It would be worthwhile identifying the fine sediment source as addressing the issue could improve its potential for juvenile production. It was not possible to ascertain whether the grass in this area has just been grazed or possibly also strimmed. either way, the lack of vegetation degrades the bankside habitat. Again, excluding livestock would be beneficial. If vegetation maintenance is undertaken to improve access, it is best to create a main access track well-back from the bank top, with occasional routes leading to the watercourse, thereby maintaining the valuable riparian fringe for invertebrates and other wildlife. An old alder tree leaning over the river here could be coppiced to encourage valuable low-level regrowth and reduce the risk of it toppling (Fig. 3).

Figure 3. It is unclear whether the short grass here is due to strimming or livestock access, but it would be beneficial to maintain more of the valuable riparian fringe, further back from the river. Coppicing the tree in the background (red circle) could prolong the tree's life by preventing it from toppling into the river (taking a chunk of bank with it), while also reinvigorating the tree with low-level regrowth.

Figure 4. The small tributary at NS 94015 97360 appears to offer good potential as a spawning/juvenile area, providing fine sediment inputs can be prevented. Maintaining a well-vegetated riparian zone in all areas (resembling that shown here) would ensure high quality habitat.

The next area inspected was at the metal bridge (NS 94975 97580), a short distance downstream of the Dollar sewage treatment works. Downstream of the bridge, habitat quality is good, with a healthy diversity of bankside trees and vegetation providing low/trailing cover and shade. The in-channel habitat is a little open and would benefit from more structure like low-hanging/trailing branches or large woody material. Again, the urge to tidy the river should be avoided and any such material that occurs should be left in place.

Figure 5. Good riparian habitat, although the in-channel habitat would be improved by additional structure, as observed upstream of the bridge.

Upstream of the bridge, the bankside habitat is similar, but with more woody material in the channel, increasing flow diversity and providing additional fish-holding features (Fig. 6). Some of the original material has clearly been removed, as evident by the angular saw marks on the branches, but the remaining branches diversify what would otherwise be relatively featureless, open water. There is always a trade-off between providing fishing access and maintaining high quality fish habitat, but it is invariably better to retain the maximum amount of habitat possible and work out how to fish around it, rather than removing the features that hold the fish in the first place. Retaining these features (and even encouraging them to develop) will increase the number of fish a river can hold (be they resident or migratory) but also, equally importantly, the range of areas fish will hold, thereby spreading the angling opportunities and pressure throughout the fishery.

Figure 6. The pool habitat upstream of the bridge is greatly improved by the structure the fallen tree/branches (red circle) and low, trailing branches (blue circle) provide.

At the sewage treatment works outfall, a slight odour and obvious discolouration of the river water, strongly indicative of poor water quality. This was supported by the presence of elevated algal growth and sewage fungus on some of the in-channel woody material. The discharge is very likely to be contributing to the WFD failure for phosphorus.

Figure 7. Water discoloration (foreground) and signs of enrichment at the sewage works outfall.

Upstream of the sewage outfall (around NS 95217 97485), the uniform age class of the trees, coupled with the loss of low branches, has resulted in a relatively high canopy that casts uniform shade (Fig. 8). While the habitat observed is certainly not bad, coppicing the occasional tree (one in every five or so) could let more light to the channel and encourage low-level regrowth from the stool that would develop valuable fish cover. Some of the material generated could be cabled or lodged among the remaining trees or stumps to provide additional woody material, increase flow diversity and provide additional fish lies.

Figure 8. Good general habitat quality, although it could be improved by very selective coppicing to diversify the canopy and encourage an increased density of low-level branches.

The substrate quality in the area around the sewage discharge is generally good, providing habitat for invertebrates and potentially salmonid spawning, particularly for larger migratory fish. River resident trout tend to utilise 10-40mm gravels in which to cut their redds, so generally spawn in smaller, lower energy tributaries but being larger, migratory salmonids tend to use 20-60mm+ gravel and cobbles, and often also use the main river channel for spawning. The value of any spawning areas can be increased by ensuring that there is ample cover and structure within the river margins downstream in which fry can find refuge. Scruffy river margins with trailing branches and vegetation = good salmonid habitat.

Figure 9. Well-sorted substrate, relatively free from fines. Many areas of the main river channel offer potential for migratory salmonid spawning. Even resident trout will use areas of the main channel but often favour the smaller tributaries, so they also require protection.

The next area of the main river visited is downstream of Vicar's Bridge (NS 98575 98010), where the particularly straight (possibly modified) course of the river creates long sections of relatively steep, uniform channel, with little depth variation. This provides some good potential spawning and juvenile salmonid habitat, but lacks the increased depth that pools, associated with more regular bends would create. In such areas, the retention, and even addition of in-channel woody material, becomes even more important to increase flow diversity and drive high flows downwards into the bed and scour deeper adult fish holding water.

For this reason, it is recommended that any trees naturally falling into the channel should be retained (even if they restrict access at that point), allowing high flows to naturally develop and improve the channel morphology. Fallen trees are often removed as being untidy, unwanted debris, or on flood risk grounds, without questioning whether they can or even should be left in place to perform their vital natural function of habitat creation. Providing that a tree is not lodged in place at both sides of the river, it will invariably swing round in high flows before a complete blockage occurs, but not before it has created bed scour that will provide a valuable pool. Moreover, if left to adjust naturally, such structures have a high probability of remaining attached at one end, thereby retaining a valuable in-channel structure that will continue to enhance the habitat of the area long-term. Even seemingly large logjams are usually passable by fish.

Fallen trees at a deeper bend create great cover for fish and contribute to the development and maintenance of high-quality habitat (Fig. 10). The increased flow diversity around the structures provides additional food lanes and lies for fish and will create bed scour at high flows contributing to a more varied pool, both as habitat and for fishing.

Figure 10. A great example of the enhancement that woody material can create to the habitat quality of a pool. More features like this (and even more extensive) throughout the river would increase the number of areas in which larger fish will hold.

To replicate some of the in-channel structure in Figure 10, the willow tree highlighted in Figure 11 could be laid down along the bank, or even into the water. Other willow shrubs and pliable tree species (hazel, thorn and elm) along the river could be treated similarly, although it is only willow that will thrive with its canopy partially submerged. Care should be taken to only lay the occasional tree so as not to create too much of one type of feature and a negative impact upon habitat diversity.

Upstream of Vicar's Bridge, the river flows through a wooded gorge, with a strong bedrock influence upon the character of the channel (Fig. 12). Being more naturally defined, and left alone to develop, habitat there is of a naturally high quality. In most cases where anthropogenic impacts (farming, infrastructure, channel maintenance etc.) are absent, simply leaving an upland river alone and allowing the habitat to develop naturally is all that is required and will deliver the best results. Having more shaded, wooded sections of the river is important in regulating water temperature and provides good fishing opportunities, even on the hotter, brighter days.

Figure 11. The willow in the centre of shot (NS 97937 97841) could be laid down along the bank in a downstream direction to provide cover and structure within the channel. Ideally, the trees used for this technique would already be leaning downstream (the direction they are best felled), but if cut in the right place, it should be possible to lay the tree round to a downstream direction. In the unlikely case that it snapped off, the low regrowth from the stump would still be beneficial and the trunk could be pinned elsewhere.

Figure 12. Looking upstream into the gorge section: naturally unkempt rivers provide great, natural habitat. It is often resisting the urge to try and alter them that is the hard part.

The upper sections visited were downstream, then upstream, of the fish farm at Yetts o' Muckart (NO 00966 01986). Downstream of the fish farm and A91 road bridge, livestock have open access to the RB of the river. Grazing pressure is supressing the diversity of vegetation and preventing tree regeneration. Correspondingly, the reach is relatively open. The buffer fenced LB supports a greater diversity of vegetation and higher quality habitat for a range of invertebrates and other wildlife. The willow shrubs that have established there are almost certainly a result of the long-term livestock exclusion as willows are preferentially browsed by livestock (particularly sheep) wherever access is allowed. Ideally the RB should be buffer fenced here (and anywhere else livestock have access), to allow more of the natural vegetation and trees to establish (and be planted where lacking). Small enclosures along the bank could potentially facilitate areas of planting and/or tree and vegetation regeneration but would be less beneficial than a full buffer strip. Bankside enclosures and fences that meet the river (e.g. drinking bays) are susceptible to flood damage and the perimeters are more easily browsed, so complete livestock exclusion from the watercourse with alternative watering (mains water, or pasture, solar or ram pumps) is always preferable, with maintenance of any invasive species like Himalayan balsam undertaken. The relatively straight, steep channel in this area is predominantly glide and riffle, although the narrower areas and bends do create some deeper water habitat suitable for adult fish and the riffles provide plenty of opportunities for fry and parr (Fig. 13).

Figure 13. The fields downstream of the fish farm have open livestock access which is suppressing tree and vegetation regeneration that could be addressed with buffer fencing.

Moving upstream, it became apparent that there is a significant increase in the abundance of aquatic weed downstream of the fish farm outflow (Fig. 14), with very little observed upstream (Fig. 16). Increased weed growth is not necessarily an issue (providing it doesn't become excessive). It will provide habitat for fish and invertebrates, but the suspected increased nutrient input facilitating the weed growth should be monitored - it is to be hoped that the Scottish Environment Protection Agency (SEPA) are doing so. DAA could also undertake invertebrate monitoring, ideally at representative sites upstream and downstream of the fish farm, along with other sites throughout DAA waters (such as upstream and downstream of the sewage treatment works), to build a baseline of the river's invertebrate populations, what is present, and to identify if and when changes occur, which could potentially highlight an issue. The Anglers' Riverfly Monitoring Initiative (ARMI) by the Riverfly Partnership (www.riverflies.org/rp-riverfly-monitoring-initiative) is a great way of doing this.

Figure 14. Good quality juvenile salmonid habitat in the shallower riffles. Aquatic weed offers additional habitat, but its proliferation should be monitored as a potential indicator of excess nutrients in the river (especially in light of less growth further upstream).

The fish farm outlet appears to be well screened for larger fish (Fig. 15), but as this is believed to be a juvenile rearing unit it will be important that there are also much finer screens within the farm to prevent fry from escaping and potentially polluting the genetic integrity of the River Devon salmon population. Screening systems can always fail, and as the site is upstream of impassable falls, it is worth being vigilant for juvenile salmon escapes (particularly around the outflow) and reporting them if they occur.

Figure 15. The outlet to the salmon rearing unit. The coarse screen should prevent the escape of larger fish, but much finer screening should also be in place within the farm to retain juveniles.

Figure 16. Upstream of the farm there is a distinct reduction in the abundance of aquatic weed, with hardly any observed. This may be indicative of increased levels of nutrient entering the system in the section downstream facilitating the growth.

Water for the fish farm is provided by a large weir (NO 00819 02155) that interrupts sediment transport and impounds the river for some distance upstream. The weir is a major barrier to fish passage, symptomatic of the lack of regard for resident trout migration within river systems. The reservoir a short distance upstream also limits habitat availability and quality. Trout could potentially ascend the c.1.5m boulder weir in certain conditions, but it greatly limits access to the habitat upstream. Fish delayed upstream and downstream of the weir (depending upon which direction they are attempting to move) will also be more susceptible to predation, so it is important to ensure good availability of in-channel structure in these areas.

Figure 17. The weir that feeds the fish farm is likely to be impassable by fish in most flows.

3.1 Dollar Burn

Dollar Burn (in Dollar) was also visited to asses an obstruction and the general habitat quality. Being artificially straightened, the burn is incised, steeper, more uniformly shallow and fast flowing than it should naturally be. It provides some potential salmonid spawning and juvenile habitat but lacks deeper pools and refuge for fish (particularly for juveniles) from high flows (Fig. 18). Deliberate removal of woody material from the channel by locals exacerbates the issue. These issues mean that fish are likely to run the burn immediately prior to spawning and leave immediately after, rather than residing within pools on the burn around spawning time as they might do ordinarily. This increases the importance of free access so that larger adult fish can utilise the artificially restricted spawning window.

Figure 18. Some good fry and smaller parr habitat is provided by Dollar Burn, but habitat for larger parr and adult fish is limited owing to the uniform, steep, shallow water conditions.

Unfortunately, an old weir on the burn creates a notable obstruction (Fig. 19). The steps of the weir are bunded to create pools, but the height of each step and the size of the pools greatly limits their use to upstream migrating fish. In addition to the pools on the weir, a more modern Larinier, bottom baffle pass has been installed to the LB side of the weir in an attempt to aid fish passage. However, there are several flaws in the design and/or installation of the pass that severely limit its efficacy.

The limitations of the site (e.g. height and length of the weir) mean that to achieve an appropriate gradient the pass extends past the downstream extent the weir. This reduces its attraction to fish as there is a good chance that they will follow the majority flow past the entrance of the pass, taking them upstream to the weir. This is an unfortunate site limitation and would have been hard to overcome without instead extending the pass upstream of the weir. More concerning is the fact that the upstream end of the pass does not even extend to the level of the weir crest, failing to effectively pass the obstruction (Fig. 20). The result being a thin film of water over a vertical step onto a baffle, which is well outside the design parameters for this type of pass and creates very poor conditions for upstream fish passage, practically negating the value of the pass at most flows. Several measures could be taken to improve fish passage at this location (see Recommendations).

Figure 19. Looking upstream at the weir, with stepped pools and a poorly installed fish pass to the LB side (right of shot).

Figure 20. The significant step and thin film of water, with air cavity behind, falling onto the top baffle of the Larinier pass (red ellipse) creates a major obstruction to further upstream progress for fish.

4.0 Non-native species

Japanese knotweed was observed at several locations along the river, the furthest upstream being at NO 01280 01817, which should be used as the starting point for investigations into the upstream extent of the plant. Once the upstream extent is identified, the stands should be treated with herbicide, working downstream through the catchment to eradicate the infestations before they spread further. Direct stem injection with a systemic herbicide is the recommended method and should be undertaken by qualified personnel.

Himalayan balsam was also observed throughout the lower sections. The upstream extent is not known, but some plants were observed in the section downstream of Vicar's Bridge, indicating that they are present at least to that point. Again, its upstream limit should be identified, and an eradication programme should be initiated. Unlike knotweed, herbicide is not usually the best method to tackle balsam. Pulling by hand and/or strimming is usually the most effective method. Stem injection with herbicide is too labour intensive and spraying leads to the death of non-target species and the same issues of bare ground and erosion that the balsam creates.

N.B. Wherever fencing is present or installed, it is important to undertake management of invasive non-native species to prevent them taking over.

5.0 Recommendations

It is always tempting to try and improve a river, but it is not always necessary to do so. Allowing habitat to develop naturally is invariably the best course of action where it is capable of doing so and not degraded by other ongoing management. A light touch is usually best, so the measures that would be beneficial are:

- Installing buffer fencing to exclude livestock from the watercourse and riparian zone wherever they have access (including potential spawning tributaries).
- Leaving all naturally occurring woody material in the channel wherever possible. This includes low-hanging branches.
- Where appropriate, undertake light-touch tree work such as laying and installing occasional in-channel structures.
- Undertake judicious tree planting in the more open areas.
- Undertake routine invertebrate monitoring. This will be beneficial in gaining an understanding of the invertebrate communities present and will potentially highlight water quality issues missed by other monitoring.

5.1 Tree work

5.1.1 Tree laying

Laying the occasional suitable tree species down into the channel, as described for the willow in Fig. 11 would be beneficial. This technique can be applied to trees and shrubs elsewhere on the river too.

5.1.2 Low cover

In areas where numerous uniform height/age trees line the bank (as in Fig. 8), coppicing one or two trees could reinvigorate low-level bushy regrowth and increase the availability of fish cover. This should ideally be undertaken within the dormant season to reduce the impact upon the tree and to nesting birds.

5.1.3 In-channel structure

As highlighted in Fig. 21, where multiple trees or stems are present, one can be cut (with no significant detriment to the overall canopy or other habitats) and lodged between two or more others. This would complement the recommended tree work in the area around the sewage treatment works discharge (Fig. 8), utilising the material won from the coppicing.

Figure 21. A lodged flow deflector – the technique can be used with a single trunk or branch (primarily to increase scour) or a multi-branched limb (to create greater flow dissipation and more in-channel structure). The elevated butt end (bank end) reduces the potential for detrimental bank scour (usually associated with d/s deflectors) as a through-flow is maintained along the bank.

An alternative, nature-like, lodged flow deflector method that could be applied is equally simple but involves hooking one branch of a multi-stemmed branch around an upright tree (Fig. 22). The example uses a medium-sized branch, but any size of branch or tree can be employed providing the anchor tree is stable and of sufficient size.

Figure 22. A medium-sized piece of lodged woody material which is securely anchored in place against an upright tree.

5.1.4 Tree planting

Willow whip planting would be beneficial along the bankline in the more open areas, particularly where livestock are excluded and/or after buffer fencing is installed. Shrub species like goat willow would be the best to use in most as, being smaller, it will provide good, low-level cover. However, the larger crack willow can be beneficial in areas where increased woody material input to the river is required as it breaks up as its canopy matures.

The easiest way of establishing willow is by pushing short sections of freshly cut willow whip into areas of wet ground, ideally close to the waterline. Whip planting can be undertaken at any time of the year but will have the greatest success during the dormant season, shortly before spring growth begins (ideally late Jan-March). This kind of planting should be undertaken sparingly to avoid dominance by willows.

Whips should be planted into the ground so that there is a greater length ($^2/_3$) within the ground, to minimise the distance that water has to be transported up the stem. Planting them on a shallow d/s angle will also ease water transport within the developing shrub and reduce the potential for it catching debris and breaking or being ripped out of the ground. Leaving 300-400mm of whip protruding from the ground is sufficient, providing they protrude past the surrounding vegetation (to allow access to light). Whips of 5mm-25mm diameter tend to work well, but even large branches can be used. If undertaken during the growing season, care should be taken not to leave excessive amounts of foliage on the whips as it greatly increases the rate of transpiration and can lead to their dehydration.

5.2 Fish passage

5.2.1 Dollar Burn

Increasing fish passage is undoubtedly one of the best ways to assist fish populations and there is great potential to improve the situation on Dollar Burn. Identification of the exact solution would require more detailed site inspection, but the options are likely to include:

- Creating a notch into the weir crest at the upstream end of the Larinier pass. This notch should extend down to level with the base of the uppermost baffle, so as not to negatively impact upon the hydraulics of the pass.
- To maintain an appropriate flow volume down the pass, lowering the crest of at least part of the remaining weir is likely to be required to maintain the same flow split between the two channels (assuming that the flows were calculated accurately for the original installation).
- Rather than lowering the height of the entire weir crest, it may be more beneficial to create notches into the weir steps. As a minimum, this could be done to the crest but would also be beneficial if undertaken to the other steps, at alternating sides, to deflect the flow pathway from one side of the weir to the other (Fig. 23). This would increase the distance the water has to travel, thereby decreasing the overall gradient of the flow pathway over the weir. This would slow the water along the steps, impounding the water though the notches and slowing the velocity. The slower flow within the pools would also allow fish resting areas between the notches (where increased exertion is required). N.B. undertaking this may be dependent upon the exact structure and integrity of the weir. An alternative could be to notch the uppermost step and raise all but a narrow notch on the lower steps (creating a similar alternating baffle).
- The baffles of the Larinier pass also appear to be trapping bed material supplied from upstream. It would be worth maintaining the baffles free from this debris, to optimise their efficiency.

Figure 23. Possible notching of the weir that could reduce the potential for super-charging the Larinier pass with flow by the required crest lowering at the upstream end. This option would actually improve the passability of the weir via an alternative route, delivering multiple benefits. The blue arrows signify the potential flow pathway though the notches.

6.0 Further information

The WTT website library has a wide range of free materials in video and PDF format on habitat management and improvement:

www.wildtrout.org/content/wtt-publications

We have also 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 debris, enhancing fish populations 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.

7.0 Disclaimer

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