LOCH DEE SPAWNING BURNS – HABITAT SURVEY

PREPARED FOR NEWTON STEWART AND DISTRICT ANGLING ASSOCIATION

FUNDED BY THE WILD TROUT TRUST SAGE BURSARY

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1. INTRODUCTION

In 2005, Newton Stewart and District Angling Association (NSDAA) were awarded a Wild Trout Trust (WTT) bursary, funded by Sage. The bursary was awarded to provide funds towards a project that aims to restore the wild brown trout fishery of Loch Dee in South West Scotland.

In the 1950s and early 1960s, Loch Dee was considered to be amongst the best wild brown trout fisheries in Scotland. However, towards the end of the 1960s, catches crashed dramatically. It is now recognised that the system was susceptible to the effects of acidification. Acidification of freshwaters can occur in upland areas for a variety of reasons. In the case of Loch Dee, major factors contributing to the loch's acidification were atmospheric pollution (in the form of acid rain) and a geology that had a limited capacity to neutralise this acid rain. Furthermore, the planting of 28.5% of Loch Dee's catchment with Sitka Spruce is thought to have contributed to the acidification effect, through a variety of mechanisms.

The acidification of the loch system has been the subject of intensive chemical and biological study for many years and indications that the system has started to recover have been carefully logged. In recent years catches of wild brown trout have improved considerably, suggesting that the recovery cycle is well underway.
NSDAA have entered into a partnership with the Forestry Commission Scotland (FCS) and the Galloway Fisheries Trust (GFT) to undertake a project that aims to further assist in the recovery of the Loch Dee trout population. The award of the 2005 Sage Bursary to NSDAA has allowed the partnership to continue its work and has also funded some additional study. Part of the award has been used to improve the broodfish holding cages that are an integral part of the loch's stocking programme. In the programme, eggs from broodfish are grown in the GFT hatchery before being stocked back into the upper reaches of the loch's spawning burns as fed fry. The award has supported the planting of native willows at a low density on some spawning burns in order to supplement aquatic foodstuffs with terrestrial invertebrates. Furthermore, a habitat survey of the spawning burns has been undertaken to focus future works. A trial tagging programme also will be continued with part of the funds.

The following report records the information collected during the habitat survey of Loch Dee's feeder burns.

2. AIMS OF THIS REPORT

The aims of the habitat survey were:

- To assess the state of habitat in Loch Dee's feeder burns, with regards to trout spawning.
- To identify areas of the feeder burns where the habitat may be limiting trout production (e.g. through access).
- To identify areas of the feeder burns where the habitat could be enhanced to improve trout populations.

3. METHODS

3.1 SFCC Habitat Survey

The Scottish Fisheries Co ordination Centre (SFCC) developed a habitat survey method that addresses the needs of fisheries managers and researchers. It was specially developed to assess habitat for juvenile salmon and trout and not used to evaluate habitat for other fish species.

The survey methodology takes into account many recording requirements and information gathered about river stretches using SFCC fish habitat survey protocol can be used by trained interpreters and within reason to:

- Evaluate quality of habitat for juvenile salmonids
- Identify the potential location of salmonid spawning gravels
- Identify stream stretches that would be of benefit from habitat improvements
- Target areas for stocking
- Identify and classify point pollution sources
- Identify and grade obstacles to fish migration
- Identify location and type of past channel/bank modifications

Juvenile salmonids have specific habitat requirements. For example, water quality, shelter and feeding territory, availability of food and availability of spawning. Table 1 & 2 describes some basic habitats for different life stages of salmon and trout. The precise habitat requirements for each species and life stage is extremely complex.

Table 1: Age class habitat requirements of salmonids

Life stage	Salmon	Trout
Eggs/alevins	Golf ball to tennis ball sized substrate.	Dependent on fish size: Golf ball to tennis ball sized substrate for large brown trout and sea trout, pea to golf ball sized material for smaller trout.
Fry	Golf ball to tennis ball sized substrate, fast flowing, shallow broken water.	Golf ball to tennis ball sized substrate, slow to medium flowing shallow water, often concentrated at stream margins.
Parr	Tennis ball to football sized substrate, fast flowing broken water, often slightly deeper than fry.	Variety of substrate, undercut banks, tree roots, big rocks, deeper slower water.
Smolts	Unknown.	Unknown.
Adults	Deep pools.	Deeper areas, sustained flow but not too fast, undercut banks, tree roots, good instream vegetation and large rocks.

3.1.1 Data recording

During the habitat SFCC survey, data is collected on the following to obtain a full review of the suitability of fish habitat along a river system:

- Water depth
- Water flow type
- Instream characteristics
- Bankside characteristics
- Riparian vegetation
- Surrounding land use

Information may also be collected on potential causes of unsuitable habitat, particularly with a view to taking action against further degradation. Characteristics are collected such as:

- Bankside fencing and grazing
- Bankside erosion and collapse
- Pollution sources
- Bankside and channel modifications

3.1.2 Method

A detailed survey plan is drawn up before commencing a habitat survey and the information to be collected identified.

When out in the field, the river is divided up into stretches using intersections marked on an Ordnance Survey map (1:50000 or 1:25000). SFCC methodology recommends the use of short survey stretches which should be:

- No more than 100m long for rivers of 0m to 4m wide
- No more than 250m long for rivers of >4m to 10m wide
- No more than 500m long for rivers of >10m wide

3.1.3 General definitions

3.1.4 Water depths

The survey stretch wetted are is recorded as percentage depths in four categories

- 0-20cm
- 21-40cm
- 41-80cm
- > 80cm

3.1.5 Substrates

In each survey stretch the percentages of each substrate type is recorded. Substrate is always recorded from the point of view of fish cover.

- High organic - Very fine organic matter

- Silt - Fine, sticky, mostly inorganic material
- Sand - Fine, inorganic particles, <=2mm diameter
- Gravel - Inorganic particles 2-16mm diameter
- Pebble - Inorganic particles 16-64mm diameter
- Cobble - Inorganic particles 64-256mm diameter
- Boulder - Inorganic particles > 256mm diameter
- Bedrock - Continuous rock surface
- Obscured - Something obscuring substrates that cannot physically be moved

3.1.6 Flows

Flow percentages of the survey stretch wetted are recorded.

Table 2: Flow types

Flow type	Description
Still marginal	< 10cm deep, still or eddying
Deep pool	>=30cm deep, water slow flowing, smooth surface appearance
Shallow pool	< 30cm deep, water slow flowing, smooth surface appearance
Deep glide	>=30cm deep, water flow moderate/fast smooth surface appearance
Shallow glide	< 30cm deep, water flow moderate/fast, smooth surface appearance
Run	Water flow fast, unbroken standing waves at surface, water flow silent
Riffle	Water flow fast, broken standing waves at surface, water flow audible
Torrent	White water, chaotic and turbulent flow, noisy and difficult to distinguish substrates

3.1.7 Banksides

Banksides are designated ‘left’ or ‘right’ as appropriate, when facing in a downstream direction.

4. HABITAT SURVEY

4.1 Overview

Loch Dee is an upland loch situated in the Galloway Forest Park in South West Scotland (*Figure 4.1.1*). The loch is 100 ha in area and slightly greater than 2 km in length. The loch drains into the Kirkcudbrightshire Dee basin and drains from South West to North East. The water in the loch contributes to the Galloway Hydro scheme, which is predominantly situated in the Kirkcudbrightshire Dee catchment. The loch is not accessible to migratory salmonids due to the presence of an inaccessible dam at Clatteringshaws.

The loch is divided into two portions by a peninsula that extends into the loch from the South Eastern shore. The South West portion of the loch is the deeper, with depths up to 12 m recorded. The North Easterly part of the loch is much shallower, with depths averaging 2.5 m. This makes the loch quite unusual in that more than half the loch floor is covered by water less than 3 m deep. The shore substrates are generally sand, gravel and boulder.

Figure 4.1.1: Loch Dee from the south

There are a range of land uses in the Loch Dee catchment. Coniferous forestry is a major land use to the North, South and South East of the loch. There is also rough grazing for cattle to the North West of the loch, with sheep grazing the West of the waterbody. However, rough pasture and tall herbs also feature significantly in terms of land use, particularly adjacent to spawning burns.

In the current study, the White Laggan Burn, Black Laggan Burn, Green Burn and Dargall Lane were surveyed. These are the named feeder burns which enter Loch Dee. There are three small unnamed inflows which also enter the loch from the north. These burns were not surveyed as they were either too small or entered at such a steep gradient that they would be unsuitable for spawning.

The burns and total lengths surveyed are provided in *Figure 4.1.2*.

Figure 4.1.2: Burns and total lengths surveyed

Burn	Grid reference (NX)	Length (m)
White Laggan Burn	467783 to 466770	1400
Black Laggan Burn	468777 to 471777	250
Green Burn	477794 to 480787	1100
Dargall Lane	462787 to 449786	1350

4.2 White Laggan Burn

The burn was surveyed when water levels were at medium height following rain during the previous day. To facilitate surveying, the burn was split into sections. Details of these sections are provided in *Figure 4.2*.

Figure 4.2: Sections surveyed on the White Laggan Burn

Section ID	Location	Grid reference (NX)	Length (m)
WLB1	Loch inflow to first riffle section	467783 to 467781	400
WLB2	Riffle section to road bridge	467781 to 468778	200
WLB3	Road bridge to Black Laggan Burn confluence	468778 to 468777	100
WLB4	Black Laggan Burn confluence to confluence with small burn on left bank	468777 to 468774	300
WLB5	Small burn confluence to top of mature island	468774 to 468773	100
WLB6	Top of mature island to end of conifers	468773 to 466770	300

There are two main land uses in this catchment. The first is rough pasture that provides grazing for a low density of sheep. The other is coniferous plantation.

4.2.1 Accessibility and obstructions to fish migration

<u>Overview</u>
The accessibility of spawning burns is critical to ensuring that trout populations are able to reach their spawning grounds. Whilst some trout populations are known to use the shallow water on the margins of lochs for spawning (particularly in areas where gravel substrates occur), most trout will run spawning burns. At Loch Dee, the White Laggan Burn is an important burn for spawning and in its lower reaches a fish trap for capturing broodstock has been situated for many years.

A total of 13 potential obstructions were recorded on the White Laggan Burn (*Figure 4.2.1*). Photographs of obstructions are provided in **Appendix 1**.

Figure 4.2.1: Potential obstructions on the White Laggan Burn

				Grid reference	
Section ID	**ID**	**Obstruction**	**Accessibility**	**Easting**	**Northing**
WLB2	WLBO1	Weir	Yes	246782	578100
WLB2	WLBO2	Bridge apron	Yes (S/F)	246828	577808
WLB5	WLBO3	Waterfall	Yes (S/F)	246821	577392
WLB5	WLBO4	Waterfall	Yes (S/F)	246818	577357
WLB6	WLBO5	Waterfall	No (U)	246800	577312
WLB6	WLBO6	Waterfall	No (U)	246799	577281
WLB6	WLBO7	Waterfall	No (U)	246795	577257
WLB6	WLBO8	Waterfall	No (U)	246797	577240
WLB6	WLBO9	Waterfall	No (U)	246798	577207
WLB6	WLBO10	Waterfall	No (U)	246800	577207
WLB6	WLBO11	Waterfall	No (U)	246808	577210
WLB6	WLBO12	Waterfall	No (U/D)	246751	577146
WLB6	WLBO13	Waterfall	No (U/D)	246682	577018

In the lowest section of the burn surveyed (WLB1), no access issues were recorded. There is little change in gradient within this section, which accounts for the easy fish access. In section WLB2, a weir was recorded at the fish trap site. The weir (WLBO1) is used to retain water within the holding cage of the trap. This weir was judged to be passable. Further upstream, at the road bridge, the bridge apron (WLBO2) was judged to be generally passable but some species/sizes of fish may have difficulty. Fish were most likely to access the apron towards the left bank, where the flow was concentrated. No access issues were recorded in sections WLB3 or WLB4. In section WLB5, two small falls were recorded, both of which were considered to be passable but some species/sizes of fish may have difficulty. In section WLB6, the gradient of the burn began to increase and there was a series of falls in the middle of the section of which the largest was WLBO5. This fall was to be problematic for fish attempting to pass in an upstream direction but an alternative route would be available on the right bank in appropriate (medium to high) water conditions. A further waterfall (WLBO6) was recorded upstream of this point and this was also considered to be problematic for fish attempting to pass in an upstream direction. Obstructions WLBO7 and WLBO8 were considered to be impassable in upstream directions. As bedrock began to become more common in the geology of the burn, more impassable falls were recorded. Obstruction WLBO9 occurred where the burn runs over a sheer bedrock slide – this was considered impassable in an upstream direction. Immediately upstream of this fall was a further impassable fall (WLBO10). Above this point a further system of impassable cascades are impassable in an upstream direction (WLBO11) and there is also a large fall (WLBO12) which is neither passable in an upstream nor downstream direction. At the top of the surveyed section was a large waterfall that was clearly impassable in both directions (WLBO13).

<u>Summary</u>

In summary, in the lower reaches (WLB1 and WLB2) the only potential obstructions to fish movement were man-made. Both the weir at the fish trap and the bridge apron were considered to be passable (species/size dependent). The mid reaches (WLB3 and WLB4) were not considered to be problematic in terms of fish access. The waterfalls in section WLB5 were considered passable in an upstream direction. In section WLB6, all

of the falls recorded were considered to be impassable in an upstream direction with the two uppermost falls also impassable in a downstream direction. It is therefore suggested that in terms of fish access, the area within WLB6 downstream of obstruction WLBO12 is best suited to stocking. This section is suitable as adult trout running the burn are unable to reach this point and competitive interactions between stocked and wild fish could be avoided. However, suitable instream and riparian habitat must also be available for stocking to be successful.

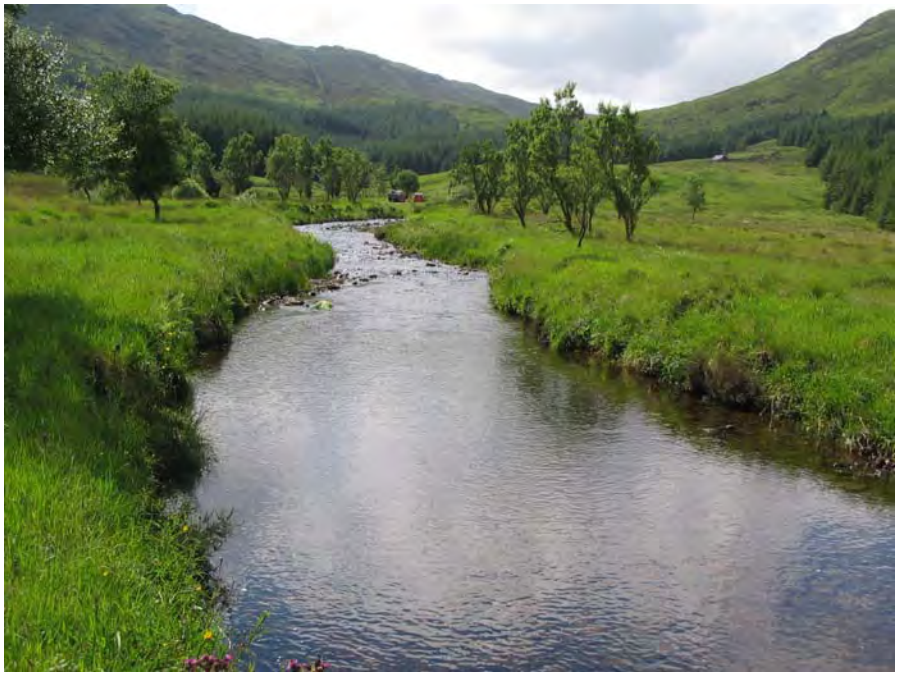
4.2.2 Instream habitat

Overview

The availability of suitable instream habitat and the quality of that habitat are key factors in determining the number of salmonids that a watercourse can support. Substrates and flows that suit one life stage of salmonid may not be acceptable for other life stages and it is important to consider the instream habitat available when undertaking a stocking programme.

In section WLB1, the instream habitat provided good holding areas for adult fish, with deep pool being the predominant habitat. Some areas of deep glide were also present. Most instream cover was provided by aquatic vegetation instream, with substrates being generally small, predominantly cobble and pebble. This section was not considered to offer good juvenile habitat. In section WLB2, areas of riffle and run were present and water depths were shallow. This section offered more benefits to juvenile salmonids, with instream vegetation providing a small amount of cover. Fish cover was generally considered to be moderate due to the small substrates (gravel and pebble) but improved towards the top of the site, where boulders became more common in the substrate matrix (*Figure 4.2.2.1*). There were several deep pools in this section which offered a good holding environment for adult fish.

Figure 4.2.2.1: Section WLB2. An improvement in instream cover due to the presence of boulders can be seen towards the top of the section



In section WLB3, the flow regime was dominated by run, riffle and shallow glide, although deep glide was recorded in the channel on the left bank upstream of the bridge. The substrate was almost entirely cobble but gravel had accumulated in a side bar upstream of the bridge and a small percentage of boulders were also present along the stream margins. This section was most suited to juvenile trout (mainly fry) due to its general shallow nature and small substrates. In section WLB4, the water was shallow (generally below 20 cm depth) with pebble and cobble dominating the substrate matrix. The main flow type was run but some riffle was also present as well as some shallow pool. Instream cover was considered to be moderate until NX 246818 577532, where boulders became more common; instream cover was classed as being good from this point onwards (*Figure 4.2.2.2*). At the start of WLB5, a mature island splits the burn. On the left bank channel, larger substrates combined with the riffle, run and pool habitat and the instream environment was considered to favour parr (*Figure 4.2.2.3*). On the right bank channel, shallower depths (0 - 20cm in depth) combined with pebble, cobble and boulder to provide habitat that suited fry more than parr. Above the island, towards the top of this section, the water becomes deeper (21 - 40cm depth) and even more suitable for parr. At the start of section WLB6, the burn's gradient starts to increase and bedrock becomes evident in some areas. Where bedrock is present, instream cover is reduced. However, the majority of this section had boulders present and, combined with run, riffle and glide flow types, provided good parr habitat over 50% of the surveyed section. There was a smaller amount (20%) of habitat suitable for fry, scattered within the parr habitat. This suggests that some of this section may be suitable for stocking fry, as fry and parr habitat are available in neighbouring areas. Bedrock became dominant instream above NX 246751 577146 and this would represent the upper limit for successful stocking, especially as the waterfall at this point is impassable in both upstream and downstream directions (*Figure 4.2.2.4*).

Figure 4.2.2.2: Instream cover improves from moderate to good in section WLB4

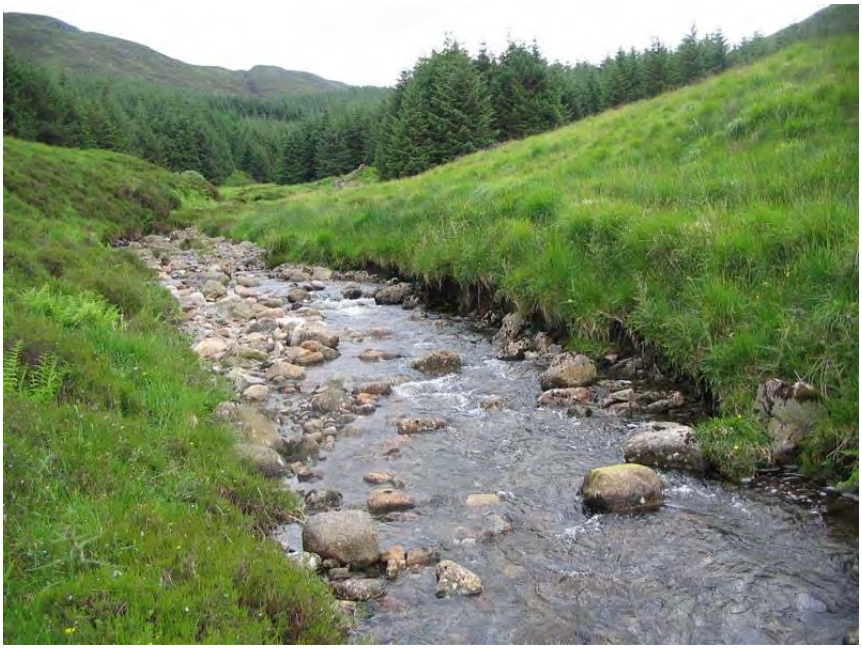


Figure 4.2.2.3: Good parr habitat in section WLB5. Slower deeper water was present, with more boulders to provide Instream cover

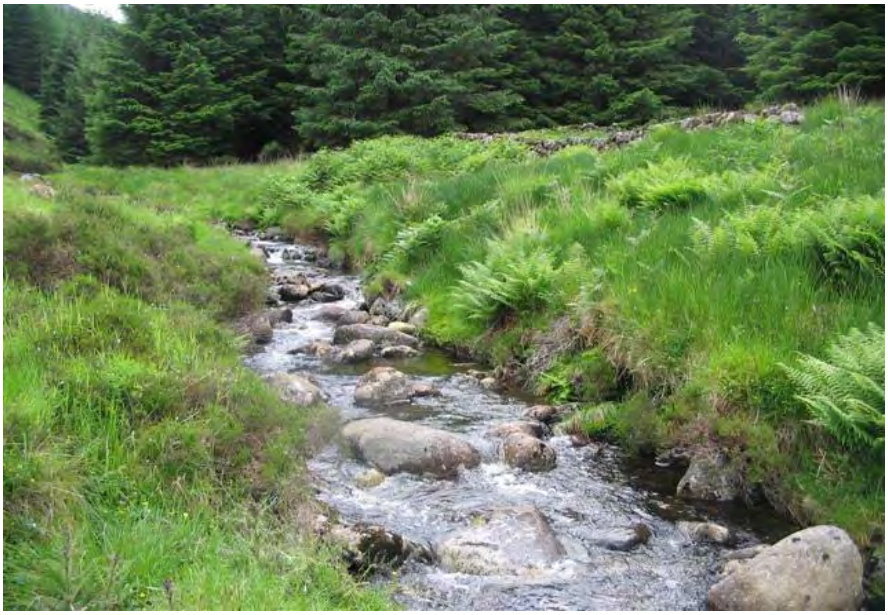
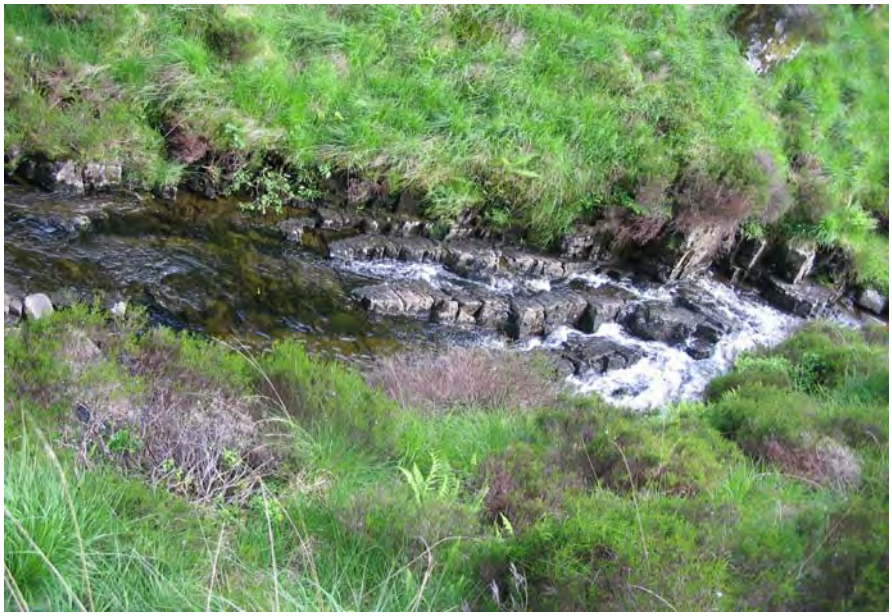


Figure 4.2.2.4: Bedrock becomes more dominant in upper part of section WLB6



Summary

In general, the best instream habitat was recorded in sections WLB4 and WLB5. In these sections, the flow regime was dominated by run riffle and deep glide which combined with larger substrates to provide good cover. Instream habitat in sections WLB3 and WLB4 was considered to be moderate, with some pockets of good cover.

4.2.3 Spawning habitat

Overview

No spawning substrate was recorded in section WLB1. In section WLB2, the presence of spawning substrates (cobble and pebble) combined with shallower water depths and riffle/run flows suggested that spawning would be successful over 80% of this section. In section WLB3 spawning substrates and suitable flows were present over 60% of the section. Section WLB4 provided some discrete spawning areas in around 40% of the section, the dominance of larger substrates in this section reducing spawning potential. In section WLB5, few suitable areas for spawning were recorded and it was considered that spawning could occur in only 10% of the section. Section WLB6 was dominated by large substrates and the presence of bedrock over part of the section meant that spawning potential was limited in this section.

Summary

The best spawning substrates were found lower in the system. This was expected as substrates eroded from the upper reaches will travel down the system during spates, with the smaller substrates tending to travel the furthest. As smaller trout favour gravel and pebble is terms of spawning substrate, sections WLB2 and WLB3 were found to offer the best spawning areas. Larger trout may prefer the larger substrates of section WLB4.

4.2.4 Riparian habitat

Trout are well known to utilise vegetation that overhangs or drapes from the riparian zone as cover. In situations where trees are also part of the riparian zone, tree roots and root wads may also provide an important source of fish cover. Furthermore the shade provided by riparian habitat, as well as the potential source of terrestrial invertebrate foodstuffs further adds to the value that riparian habitat brings to trout populations.

In section WLB1, draped vegetation (consisting mainly of grasses) provided marginal fish cover. There was some undercut banking present and when this was combined with draped vegetation, cover was improved. In section WLB2, grasses again provided marginal cover. In this section, trees were present in the riparian zone but were situated on the bank top and therefore did not contribute to cover. However, there were undercut areas which provided fish cover. The SEPA monitoring station provided some fish cover in the form of the support structure for the station which was situated in the riparian zone. A modification on the left bank, upstream of the SEPA monitoring station also provided some fish cover (*Figure 4.2.4.1*) but would provide more influence when water levels are higher. In section WLB3, the riparian zone starts to become more diverse, with small shrubs becoming more prevalent. However, due to a lack of water this riparian vegetation did not provide cover at the time of the survey (*Figure 4.2.4.2*). In section WLB4, draped vegetation on the right bank provided marginal fish cover at the start of the section although around NX 246837 577637 riparian vegetation (reeds, heathers and ferns) became more prevalent and provided cover. Boulders set into the bankside also provided cover at this point and undercut banks were also recorded. In section WLB5, boulder still provided much of the marginal cover with draped vegetation being locally important in some areas. At the mature island in this section, draped vegetation provides more cover (*Figure 4.2.4.3*) on both banks. In section WLB6, heathers and ferns are locally important in providing cover but at the water level during

the survey, it was generally boulders that made a greater contribution to fish cover. Several willows were present in this section and these provided cover with their roots.

Figure 4.2.4.1: Modification on left bank in WLB2

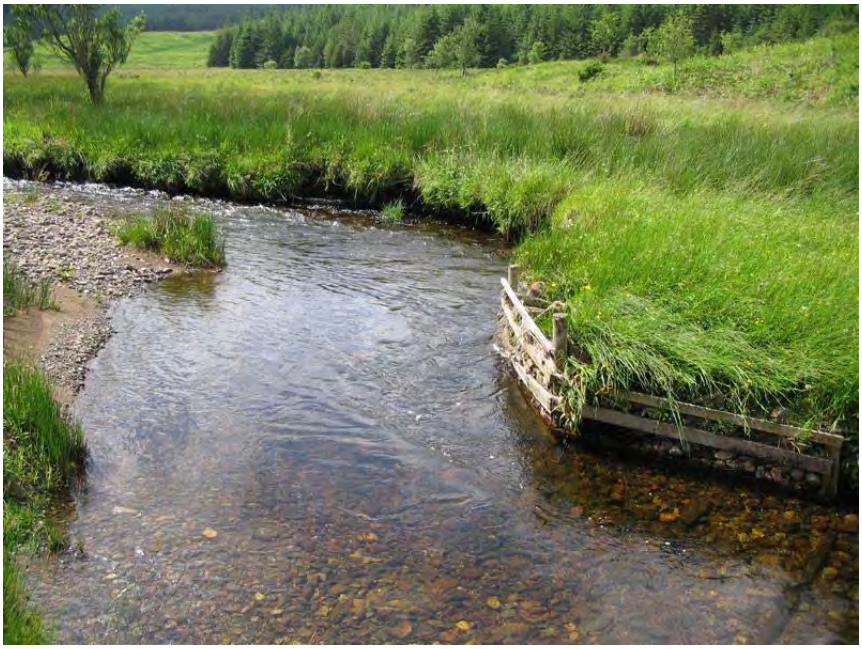


Figure 4.2.4.2: Riparian zone becomes more diverse in WLB3, but due to a lack of water does not provide fish cover

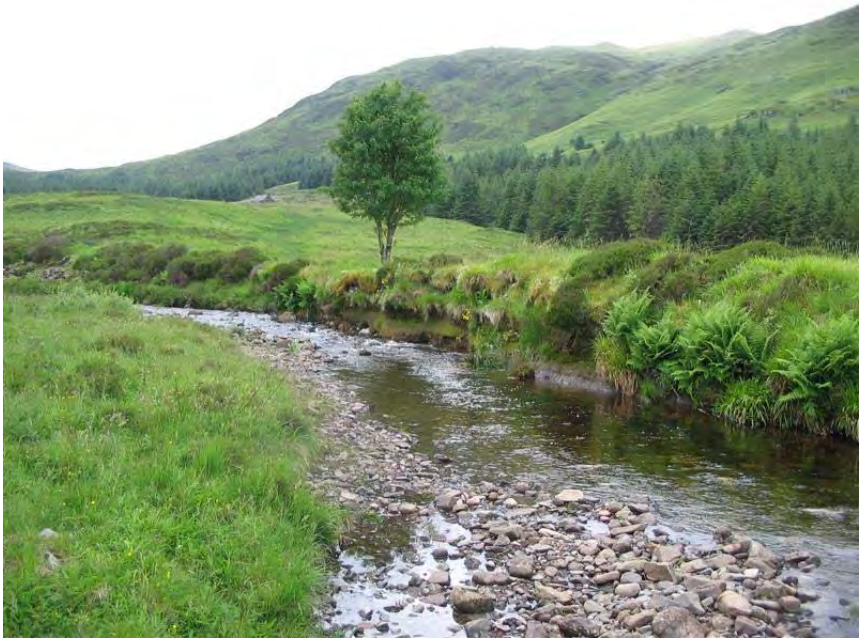
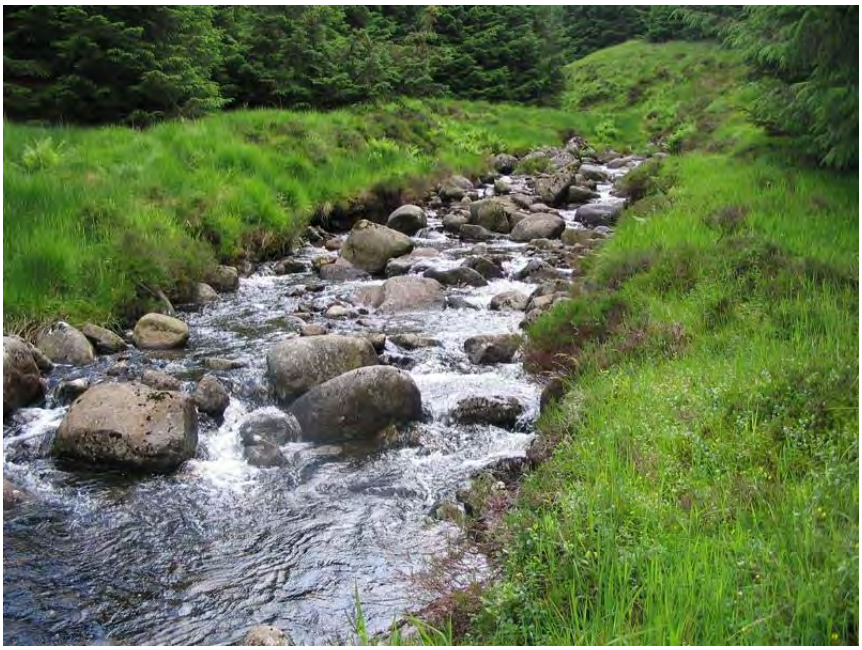


Figure 4.2.3.4: Cover provided by ferns, heathers and boulders in section WLB5

The land use in the upper part of WLB5 and WLB6 was coniferous plantation. Most of the burn in this area was 1 – 2 m in width and in some places exceeds 3 m in width. Under the Forests and Water Guidelines, where a burn is 1 – 2 m wide, trees must be planted at least 10 metres from the bank and where it is 3 m wide trees must be planted 20 m from the water. These planting guidelines do not appear to have been adhered to on the White Laggan Burn, where in a considerable part of section WLB6 conifers have been planted on average around 5 m from the burn (*Figure 4.2.3.5*).

Figure 4.2.3.5: Planting which does not adhere to Forests and Water Guidelines in section WLB6



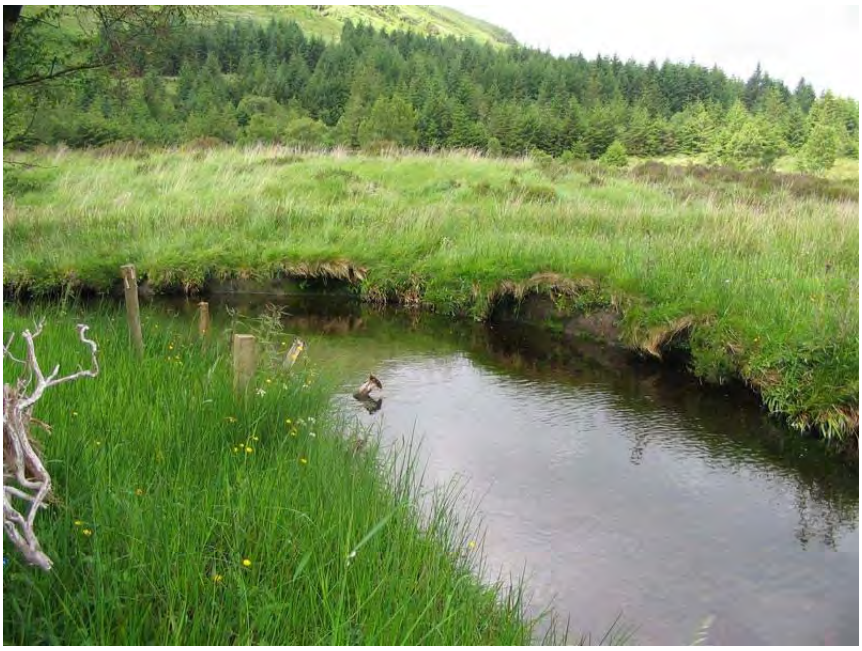
4.2.5 Overshading

No areas of the White Laggan Burn were found to be affected by overshading.

4.2.6 Overgrazing/trampling

Sheep were observed to be grazing on both banks of the White Laggan Burn but at a low density. There was no evidence of overgrazing of trampling. A few areas were identified where banks had collapsed but this was thought to be due to spate conditions rather than the actions of livestock. The force of water was evident upstream of the fish trap, where some collapse on the left bank had been caused by back eddies possibly when water was held back by the trap.

Figure 4.2.6.1: Bank collapse possibly due to presence of fish trap



4.3 Black Laggan Burn

The burn was surveyed when water levels were at medium height following rain the previous day. To facilitate surveying the burn was split into sections. Details of these sections are provided in *Figure 4.3*.

Figure 4.3: Sections surveyed on the Black Laggan Burn

Section ID	Location	Grid reference (NX)	Length (m)
BLB1	At confluence with White Laggan Burn to impassable waterfall	468777 to 470777	150
BLB2	Impassable waterfall to gorge	470777 to 417777	100

The main land use in the catchment of this burn is coniferous plantation, with some rough pasture.

4.3.1 Accessibility and obstructions to fish migration

As mentioned in *Section 4.2.1*, having accessible spawning grounds is critical in the perpetuation of Loch Dee's trout population.

A total of 9 potential obstructions were recorded on the Black Laggan Burn (*Figure 4.3.1*). Photographs of obstructions are provided in **Appendix 2**.

Figure 4.3.1: Potential obstructions on the Black Laggan Burn

				Grid reference	
Section ID	**ID**	**Obstruction**	**Accessibility**	**Easting**	**Northing**
BLB1	BLBO1	Fallen tree	Yes	246848	577742
BLB1	BLBO2	Waterfall	Yes (S/F)	246899	577725
BLB1	BLBO3	Channel	Yes (S/F)	246935	577695
BLB1	BLBO4	Waterfall	Yes (S/F)	247017	577703
BLB1	BLBO5	Waterfall	Yes (S/F)	247016	577707
BLB1	BLBO6	Waterfall	No (U)	247052	577717
BLB2	BLBO7	Debris	Yes	247084	577728
BLB2	BLBO8	Waterfall	Yes (S/F)	247097	577719
BLB2	BLBO9	Waterfall	No (U)	247107	577740

<u>Overview</u>

In section BLB1, a fallen tree was recorded (BLBO1). The branches of the tree extended into the water but it was considered passable in its present state. There was a cascade upstream of this tree (BLBO2), which consisted of one large waterfall followed by two smaller falls. All of the falls were considered to be passable in an upstream direction dependent upon fish size and species. A further potential obstruction (BLBO3) was recorded where a channel had been created between bedrock and a boulder. Due to the fast nature of the flow in this area, it was considered to be only passable dependent upon species/size of fish. A further fall was present upstream of this point (BLBO4). This fall was considered passable on the left bank, due to the depth of the pool at the base of the fall and the presence of convenient 'steps' that would allow fish to

access the height gradually. Upstream of this was a fall (BLBO5) that was also considered passable, dependent upon species and fish size. Obstruction BLBO6 was considered to be impassable in an upstream direction due to the height of the fall and the jutting bedrock below the fall. It is thought, however, that in high flow conditions, the fall would be passable in a downstream direction as the water would cushion the fall. In section BLB2, flood debris (BLBO7) was recorded as being present on a mature island in the centre of the burn. Whilst this was not within the burn channel, it is thought that it had the potential to enter the burn during the next spate and may act as an area for further debris attachment. A further fall (BLBO8) was recorded further upstream. This fall was judged to be passable on the left bank dependent upon species and fish size. Upstream of this was a further potential obstacle to fish movement (BLBO9). This fall was judged to be impassable due to the speed of water and the length of the fall. Above this point the burn enters a gorge where further falls were observed.

Summary

In summary, in the section of the Black Laggan Burn surveyed there were nine potential obstructions. Waterfalls were the most common type of obstruction and whilst these were generally passable (dependent upon fish size/species), two falls were impassable in an upstream direction. It should be assumed that given suitable access, adult fish spawn in the area downstream of these impassable falls. An electrofishing survey may be useful in this area to determine what densities of trout this area currently supports. If densities are below what would be expected, it may be possible to undertake some supplementary stocking in this section, although the potential competitive interactions between wild and stocked fish (even those originating from wild broodstock) should be considered. Stocked fish are usually released at a size larger than that of their wild counterparts (due to the constant availability of food within a hatchery) and may find it easier to assume territories due to their larger size. It is suggested that stocking could take place upstream of the first impassable fall (BLBO6) although consideration would need to be given to whether this was a good use of resources as there is only a small area that could be stocked before the upper limit for stocking is reached and the habitat does not appear ideal for fry. The upper limit for stocking is probably at the downstream limit of the gorge (NX 247107 577740) as above this point the water is very fast flowing and turbulent and unsuitable for fry.

4.3.2 Instream habitat

Overview

As mentioned in *Section 4.2.2*, the quality of instream habitat determines the number of salmonids that a watercourse can support.

In section BLB1, the instream habitat was most suited to supporting juvenile trout, with riffle and run being the predominant flow types but some areas of pool also being present. Glide was recorded in some parts of the burn and, in the upper part of the section, torrent was observed downstream of several waterfalls. In the areas directly below waterfalls, deep pools were present in most cases which would serve as holding areas for adult fish, given suitable access. Instream cover was judged to be generally excellent in the lower part of the section whilst in the upper part of the section it was classed as good. This change in classification is related to the change in gradient of the section; in steeper parts of this burn section, there is more bedrock which tends to be poorer in terms of instream cover than more mobile substrates (*Figures 4.3.2.1* and *4.3.2.2*). The water depth in section BLB1 was generally in the 21 - 40cm range. Substrates in BLB1 were a mix of pebble, cobble and boulder in the lower part of the

section, with cobble, boulder and bedrock being more dominant in the upper part of the section. A stable braided section of the burn was recorded at NX 246899 577725. The substrate types and depths recorded in section BLB1 indicate that both fry and parr could be accommodated within this section. This strongly suggests that this area could provide good quality stocking habitat, if desired.

Figure 4.3.2.1: Instream cover is excellent in the lower part of BLB1, with a variety of large substrates present in the substrate matrix and a range of depths

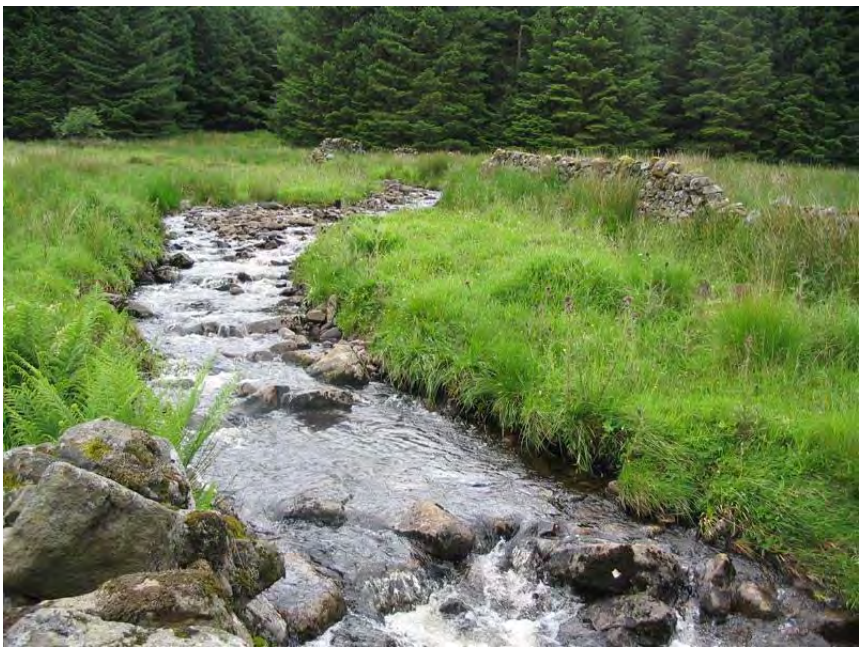
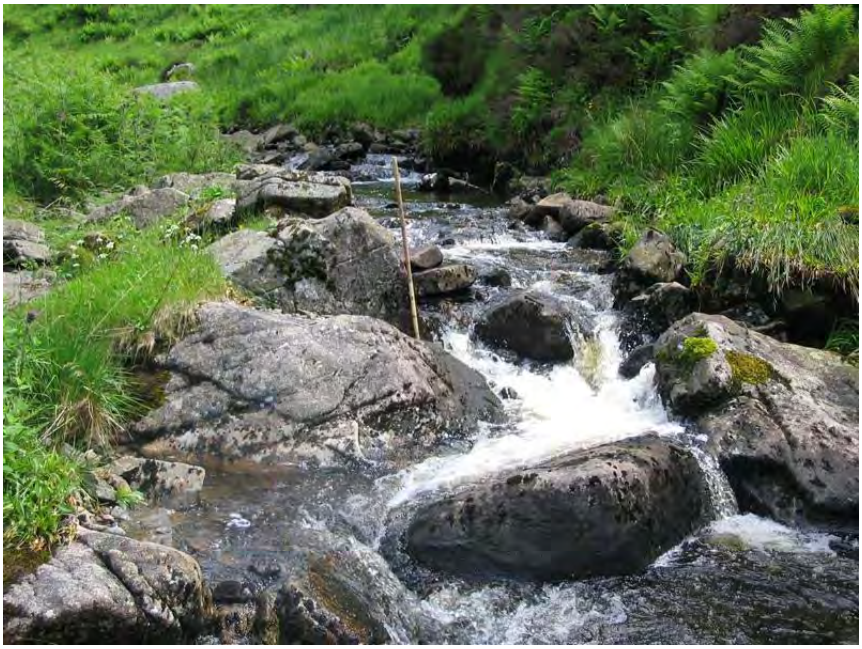


Figure 4.3.2.2: In the upper part of BLB1, the burn's gradient increases and bedrock becomes more common in the geology



In BLB2, the instream habitat favoured parr more than fry. Substrates were generally large with boulder being the most commonly encountered substrate although there were also significant amounts of cobble and bedrock. Boulders physically separated the flow of water in parts of this section, providing an ideal environment in which parr could form territories (*Figure 4.3.2.3*), particularly where pools formed. The environment was dominated by faster flows, riffle and torrent being common although there were significant amounts of deep glide. Instream cover was judged to be good overall, as the boulder sections were interspersed with bedrock which provided little in the way of cover. Depths were mainly in the range 21 – 40 cm but there were some areas where shallower water was recorded, particularly upon initial entrance to the gorge section.

Figure 4.3.2.3: Boulders in BLB2 break up the flow of water and separate the burn into territories

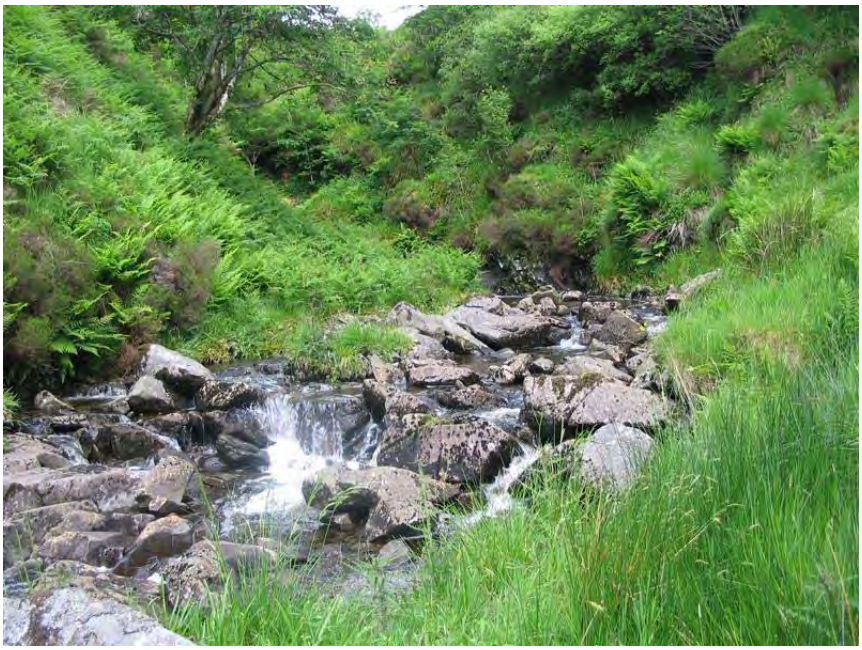


Figure 4.3.2.4: The upper part of BLB2, where the burn passes through a gorge, is dominated by boulders and bedrock

Summary

In summary, in the section of the Black Laggan Burn surveyed, the instream habitat favoured juvenile salmonids. Parr were the main life stage favoured due to the availability of deeper glide and variety of substrates. Although potentially good for parr throughout the section, the upper part of the burn was less favourable due to the presence of bedrock that reduced cover. The best environment for parr was found in areas where pools had formed adjacent to boulders.

4.3.3 Spawning habitat

Overview

Spawning habitat was present only in section BLB1, being entirely absent from section BLB2 due to the predominant type of substrates present and a flow regime that could be potentially destructive to redds. In BLB1, pebble and cobble were present in the lower part of the section. In this part of the section, there were also areas of shallower, faster flowing water which would be suitable for spawning. However, it was considered that only 40% of BLB1 would be suitable for spawning due to the larger substrates recorded at the upper part of the section.

Summary

The only areas that were suitable for spawning were in the lower part of section BLB1. In the upper section of BLB2, substrates were too large to allow spawning.

4.3.4 Riparian habitat

Overview

As highlighted in *Section 4.2.4*, riparian habitat provides an important influence on the characteristics of a watercourse and the organisms that inhabit that watercourse.

In section BLB1, bankside cover was considered to be generally poor in the lower reaches of the section. Some undercut banking was present in small amounts on the right bank and small amounts of draped vegetation were present on the left bank but in general water levels were too low to allow bankside vegetation to provide cover. In the lower part of this section, the riparian zone was dominated by grasses, with occasional ferns and very occasional heathers. Broadleaved trees were present in a very low density on the lower gradient sections but as the gradient increased, more broadleaved trees (particularly rowan and willow) were recorded. At the top of the section, the riparian zone was more diverse, with banktop vegetation now being classed as complex. Boulders were also present within the banksides at this point which provided further cover. At the start of section BLB2, bankside vegetation was classed as being simple, with a diverse riparian zone that did not generally include trees. However, towards the middle and upper part of this section, broadleaved trees became very common and the banktop vegetation was classed as complex. A moderate amount of cover was provided by bankside vegetation but in general undercut banking and boulders within the banksides gave more important cover. In the gorge section, steep bedrock on both sides of the burn reduced bankside cover, which was only available where the rock had fractured leaving shelves for fish to shelter beneath.

Summary

Banksides were generally classed as being simple in the lower reaches and complex in the upper reaches of the Black Laggan Burn. Some cover is provided by banksides, but in general undercut banking and boulders are more important sources of cover. There are some areas which may benefit from selectively planting a low density of native broadleaved trees. In BLB1, upstream of the fall at NX 246899 577725, riparian vegetation is limited to only grasses and it may be beneficial to plant shrubs or trees to encourage a more diverse riparian zone at this point.

4.3.5 Overshading

In the section of the Black Laggan Burn that was surveyed, no overshading was recorded.

4.3.6 Overgrazing/ trampling

No overgrazing was recorded on the banks of the Black Laggan Burn. There was some evidence of deer having been present and tree guards should be considered when trees are planted.

4.4 Green Burn

The burn was surveyed when water levels were at summer low height. To facilitate surveying the burn was split into sections. Details of these sections are provided in *Figure 4.4*.

Figure 4.4: Sections surveyed on the Green Burn

Section ID	Location	Grid reference (NX)	Length (m)
GB1	Loch inflow to first boulders	477794 to 478793	300
GB2	First boulders to first waterfall	478793 to 479792	100
GB3	First waterfall to road culvert	479792 to 480789	300
GB4	Upstream road to	480789 to 480787	400

The main land use in the catchment of this burn is coniferous plantation, with some rough pasture.

4.4.1 Accessibility and obstructions to fish migration

Overview

As mentioned in *Section 4.2.1*, accessibility is a key factor in determining the distribution of salmonids. Over the area surveyed, the Green Burn was relatively low gradient and therefore there were not the same number of access issues on this burn as there were on the other feeder burns surveyed.

A total of 11 potential obstructions were recorded on the Green Burn (*Figure 4.4.1*). Photographs of obstructions are provided in **Appendix 3**.

Figure 4.4.1: Potential obstructions on the Green Burn

				Grid reference	
Section ID	**ID**	**Obstruction**	**Accessibility**	**Easting**	**Northing**
GB3	GBO1	Waterfall	Yes	247931	579259
GB3	GBO2	Bedrock	Yes	247932	579243
GB3	GBO3	Culvert	Yes	248077	578973
GB4	GBO4	Bedrock	Yes (S/F)	248859	578917
GB4	GBO5	Waterfall	Yes (S/F)	248065	578908
GB4	GBO6	Waterfall	Yes (S/F)	248068	578900
GB4	GBO7	Waterfall	Yes (S/F)	248062	578879
GB4	GBO8	Bedrock	Yes (S/F)	248062	578870
GB4	GB09	Waterfall	Yes (S/F)	248039	578864
GB4	GBO10	Waterfall	Yes (S/F)	248019	578860
GB4	GBO11	Waterfall	Yes (S/F)	248008	578822

In sections GB1 and GB2 no obstructions to fish access were recorded. This is likely to be due to the low gradient of this part of the burn. In section GB3, a small fall (GBO1) was recorded but was not considered to be problematic, especially as there was a deep pool downstream whose outflow was constricted and water would be expected to be retained there in high water allowing easier access. An area of bedrock (GBO2) was also observed. In low water conditions this could present a problem to fish but under

normal flow conditions it would not represent a problem. At the road crossing, a culvert was recorded (GBO3). This culvert was considered to be passable, as it had been positioned level with the burn substrate and had sufficient depth of water to allow access. Bedrock was again present in the burn in section GB4 where it created a potential obstruction (GBO4) dependent upon the size/species of fish attempting access. A further fall was recorded (GBO5) which was also considered passable dependent on fish species/size. Upstream of this area, bedrock was again present within the burn which created a potential obstruction (GBO6). However, this was considered passable dependent upon fish species/size. A further fall (GBO7) was recorded upstream. This fall was considered passable (dependent upon fish species/size). Bedrock was again present in the bed of the burn further upstream (GBO8). This was considered to be potentially problematic in low flows and would possibly be difficult for smaller fish to access. A further fall (GBO9) was considered to be passable for fish accessing close to the left bank. Two falls (GBO10) were recorded at NX 248019 578860 both of which were considered to be passable dependent on the fish species/size of fish. A waterfall further upstream (GBO11) was considered to be passable by large trout but may be problematic for smaller trout. A deep pool (30 cm depth) was present below this fall.

Summary

In summary, 11 potential obstructions to fish movement were identified on the Green Burn. None of these were considered to be impassable but some could be potentially problematic to small trout. Sections GB1 and GB2 were such low gradient that there were no obstructions to fish access. Section GB3 had the widest variety of potential obstructions, including a man made culvert. However in section GB4, which was where the burn's gradient began to increase sharply, more potential access problems were recorded.

4.4.2 Instream habitat

Overview

Section GB1 was predominantly deep pool, with a peaty substrate. Water depths were greater than 1m in depth, suggesting suitability for use as adult holding pools. Instream, the only cover that was available was provided by submerged instream vegetation that was rooted in the centre of the channel and moderate cover was provided by this vegetation. The channel was recorded as being 3m in width. At the start of section GB2, two boulders were present. The water in this area was shallow (0 – 20 cm in depth) and gravels dominated the substrate matrix with a lesser amount of cobble also being present. The flow regime was still predominantly pool and the water was generally deep (41 – 80 cm in depth). At NX 247852 579347 some run was recorded, with the water reducing in depth at this point. At NX 248670 579301 the burn became noticeably reduced in width (only 1m wide) and pebbles and cobbles were the dominant substrate. Instream cover was considered to be poor within this section. The first riffle was recorded at the start of Section GB3. The water in this part of the burn was generally more shallow in nature (21 – 40 cm in depth) but there were also some holding pools (41 – 80 cm depth) for adult trout. Further upstream in this section, riffle and run were recorded in alternation with pools, which represented a better habitat for juvenile trout. However, the burn became much narrower in this section which meant that the level of erosion increased where the faster flow regime. Pebbles and cobbles were the most dominant substrate types but boulders were also scattered throughout this section. Instream cover was regarded as being poor in the lower part of section GB3, due to the small size of instream substrates (*Figure 4.4.2.1*). As the gradient increased slightly and cobbles started to dominate over pebbles, instream cover improved and was judged to

be moderate. In the upper part of GB3, instream cover improved as the percentage of boulders increased and cover was classed as good (*Figure 4.4.2.2*).

Figure 4.4.2.1: Instream substrates are small at the start of section GB3, meaning instream cover is classed as poor

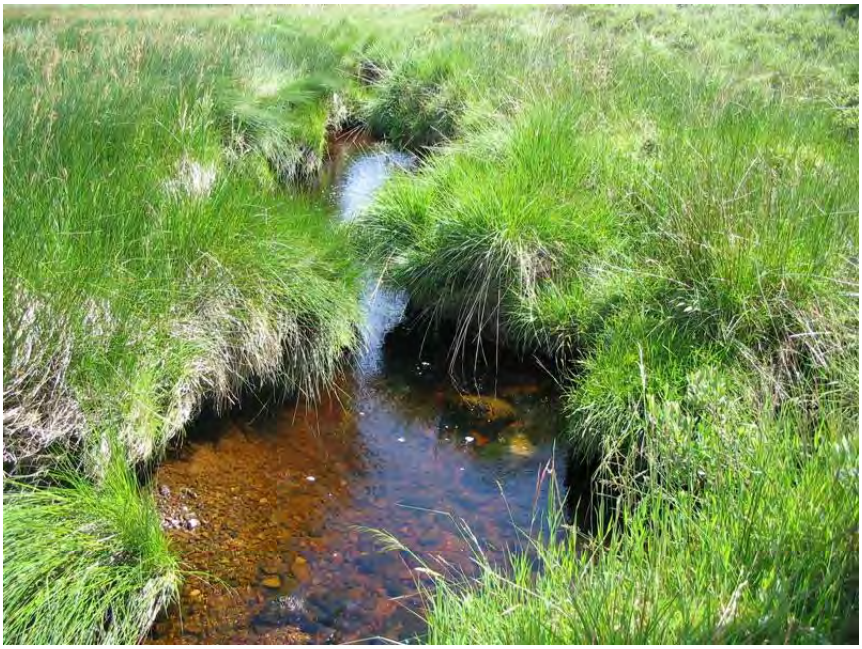
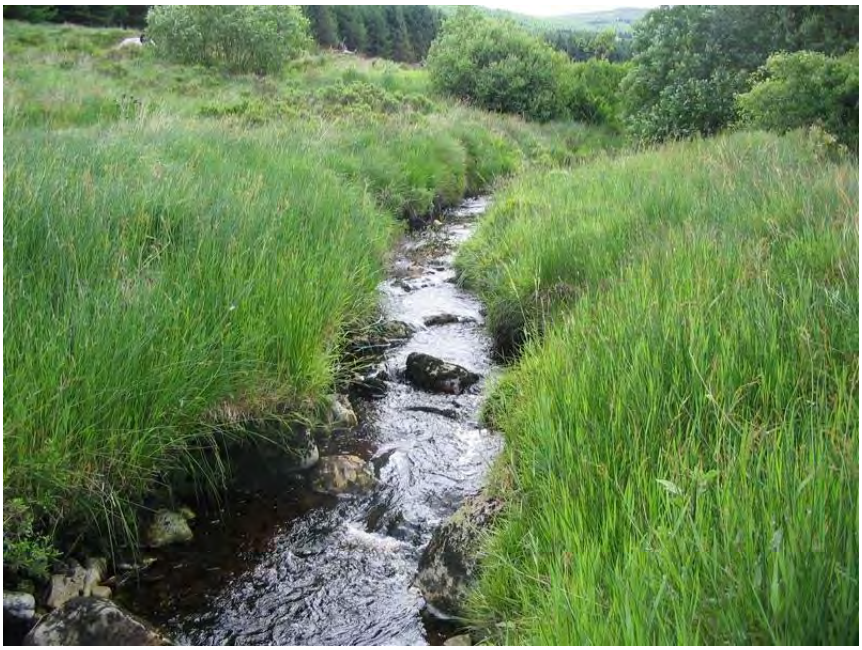


Figure 4.4.2.2: Instream cover improves towards the top of section GB3, with the addition of boulders to the instream environment



In section GB4, the main flow types recorded in the lower section were riffle and run, with pools interspersed between these faster flows. Similarly fast flows separated by slower sections were recorded in the upper part of this section, where still marginal flows

were also observed. Instream cover was classed as good, with boulders and cobbles being the most dominant substrate types. Numerous small natural weirs were formed by these substrates in the area around NX 248068 578941 but all were considered to be passable under normal flow conditions. As the gradient increased, more bedrock was recorded instream. Depths varied within section GB4, with shallower areas (0 – 20 cm in depth) more common in the lower reaches and deep pools (21 – 40 cm in depth) being present in the upper burn section to the point at which the survey ceased. At NX 248007 578805 sand was observed to be lying on top of bedrock instream. This may be an effect of the recent felling that had occurred on the right and left banks.

Summary

In summary instream cover, in the sections of the Green Burn surveyed, improved in an upstream direction. In its lower reaches, substrates were small and instream cover was provided only by a small amount of instream vegetation. This part of the burn was deep and provided suitable adult holding areas. However, in section GB3, the burn became more shallow and substrates increased in size. In this section instream cover improved, providing an ideal nursery area for fry and parr. In section GB4, there was a continuance of the good instream habitat but bedrock started to occur more often in the bed of the burn. This suggests that sections GB3 and GB4 would be best suited to stocking, if desired.

4.4.3 Spawning habitat

Overview

No spawning substrate was recorded in GB1. In GB2, a small amount of spawning habitat (less than 0.5 m^2) was recorded at NX 247852 579347 but in general the water was too deep and slow throughout most of the section for spawning. At the end of this section, more spawning substrates and shallower, faster water was available. However, in GB3 although suitable substrates were present they were recorded as being partly compacted in some areas. In section GB3, 60% of the section was considered suitable for spawning. In section GB4, spawning habitat was available in the lower part of the section; however, around NX 248007 578805 sand was observed to be lying on top of bedrock instream and substrates in this area were found to be compacted. It was estimated that 30% of the section was suitable for spawning due to the compacted nature of the available substrate and the presence of bedrock within the section.

Summary

In summary, the best area surveyed for spawning appeared to be section GB3 where flows and substrates were suited to spawning. Downstream of this section, the flow of water was generally too slow for spawning and upstream of this point compacted substrate and bedrock would be likely to limit spawning activity.

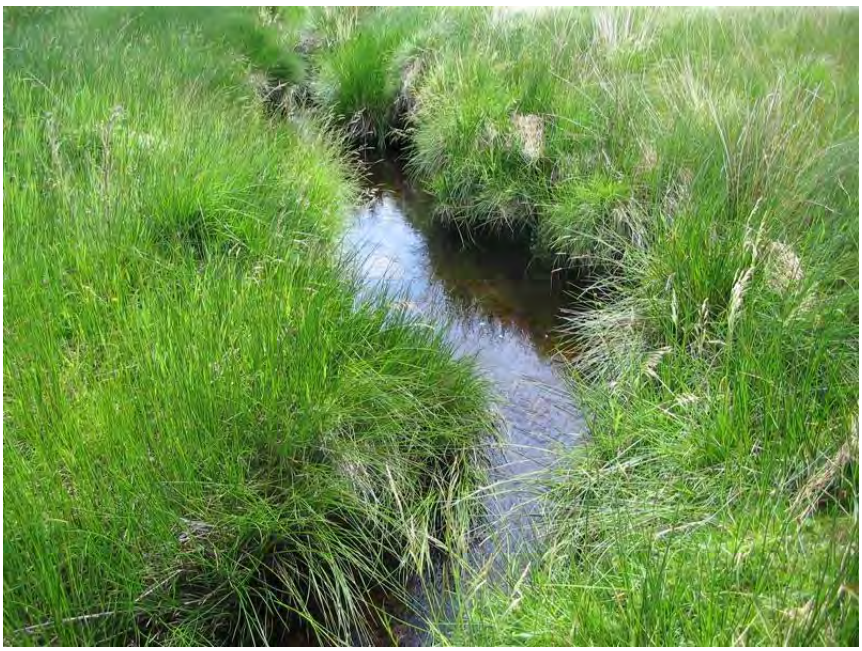
4.4.4 Riparian habitat

Overview

The riparian zone in GB1 was vegetated exclusively by grasses. In some areas these draped over the banksides (10% of the section) but it was generally undercut bankings that provided the most cover in this section (40%). In section GB2, undercut banking provided cover over 50% of the site and was expected to provide ideal habitat for trout parr, where undercut banks were situated adjacent to pools. Draped vegetation was important in providing cover over 60% of this section (*Figure 4.4.1*) but in some places water levels were too low to allow full use of this cover. Grasses were the main type of

vegetation on bankfaces and banktops although several ferns were also recorded. Broadleaved trees had been recently planted on the banktops but at some distance from the burn channel. At the start of GB3, grasses were still recorded as providing bankside cover but low shrubs such as heathers were also important. Undercut banking was present in this area as well. At NX 248019 579222 a section of banking had become separated from the main bank, creating an island in the centre of the channel. This feature increased the amount of draped vegetation in this area, as the island was fully vegetated with long grasses. Overall, draped vegetation was recorded as providing cover over 90% of section GB3. However, at NX 248060 579137, the right bank is devoid of cover as the water level is too low. At NX 248046 579104, the SEPA gauging station provided a small amount of cover on the left bank, through its support structures.

Figure 4.4.4.1: Draped vegetation provides important bankside cover in GB2

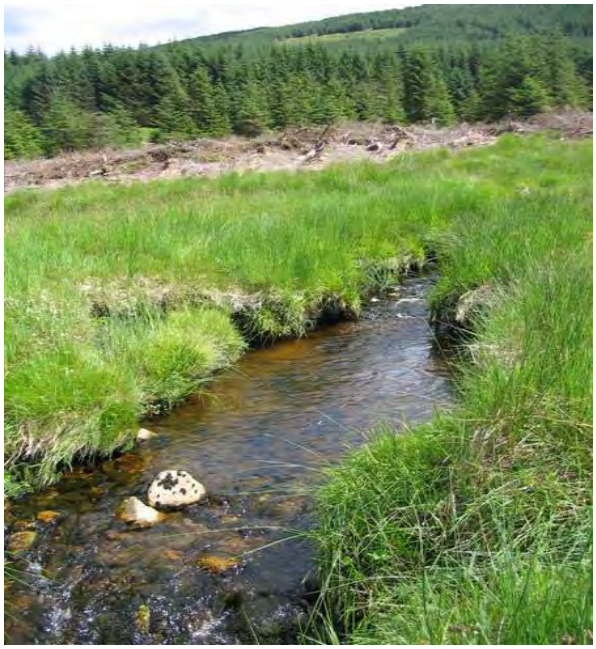


At the uppermost part of section GB3, broadleaved trees and shrubs were present on both banks. This was important in providing riparian cover for the burn. These trees and shrubs continued into the area immediately upstream of the road in section GB4. A willow was observed to be within the riparian zone at NX 248067 578930, which may be useful for providing willow slips for planting in the vicinity. Draped cover was observed to be at a maximum in the lower gradient part of section GB4; in the higher gradient areas (above 248068 578900), the water level was too low to allow fish to use draped vegetation as cover. It was a similar situation with regard to undercut banking, with less undercut banks being available for use as cover in the higher gradient areas.

Conifers had recently been felled on the right bank and left banks at NX 248007 578805. It was clear that before this felling, the trees had been more than 10 m from the bank (*Figure 4.4.2*) which is an appropriate distance under the Forests and Water Guidelines for a watercourse of 1 - 2 m width.

A low density of broadleaved trees have been planted recently (estimated within the last 5 years) on both banks of the Green Burn. In most cases, these trees have not been planted near to the bankside but have been placed several metres from the banks.

Figure 4.4.4.2: Conifer felling on the right bank in section GB4



Summary

In summary, the lower riparian areas (GB1 and GB2) of the Green Burn are almost entirely dominated by grasses and although broadleaved trees have been recently planted at a low density, these trees do not exert an influence on the burn. Bankside cover in these lower sections is provided by undercut banking and draped grasses. In section GB3, broadleaved trees become more important to the riparian zone and provide shade and cover, especially in the area around the road. Upstream of the road (in section GB4) most bankside cover in the lower part of the section is provided by grasses. Some broadleaved trees are present on the banktop and some have been recently planted. However most of the recently planted trees do not influence the burn as they are planted several metres from the water. It may be beneficial to plant a low density of broadleaved trees near fall at NX 247931 579259. Also it may be useful to undertake willow planting at NX 248060 579137 where a back eddy occurs during spates, to stabilise bank. Further planting could be undertaken on the right bank at NX 248005 578798 where a boulder in the left bank encourages erosion. At NX 247970 578785 it may be worthwhile planting a low density of broadleaved trees on the left bank corner.

4.4.5 Overshading

No overshading of the burn was recorded during the survey of the Green Burn. In the only survey section where broadleaved trees influenced the burn (section GB4), the shade provided by these trees was dappled and is well below the 50% recommended in the Forests and Water Guidelines and therefore no tree maintenance is required.

4.4.6 Overgrazing/ trampling

No overgrazing or trampling was recorded on the Green Burn.

4.5 Dargall Lane

The burn was surveyed when water levels were at summer low height. To facilitate surveying the burn was split into sections. Details of these sections are provided in *Figure 4.5*.

Figure 4.5: Sections surveyed on the Dargall Lane

Section ID	Location	Grid reference (NX)	Length (m)
DL1	Loch inflow to first riffle	463787 to 459787	300
DL2	First riffle to large boulder on right bank	459787 to 457787	200
DL3	Large boulder on right bank to small burn confluence	457787 to 456786	100
DL4	Small unnamed burn	456786 to 455786	50
DL5	Small burn confluence to field boundary	456786 to 455787	200
DL6	Field boundary to field boundary	455787 to 454787	100
DL7	Field boundary to field boundary	454787 to 454787	50
DL8	Field boundary to field boundary	454787 to 453787	50
DL9	Field boundary to field boundary	453787 to 452787	100
DL10	Field boundary to field boundary	452787 to 450786	100
DL11	Field boundary to road culvert	450786 to 449786	100

The main land use in the catchment of this burn is rough pasture, with sheep grazing at a low intensity within the catchment.

4.2.1 Accessibility and obstructions to fish migration

As mentioned in *Section 4.2.1* and other sections, accessibility is important in determining the distribution of trout populations. In the Dargall Lane, a great deal of the burn was low gradient and therefore less obstructions were recorded in this catchment in comparison to the others surveyed.

The Dargall Lane in one of only three stream sites in Scotland for the UK Acid Water Monitoring Network. (AWMN). The AWMN has been running since 1988 and was formed to monitor the ecological impact of acid deposition in areas of the UK believed to be sensitive to acidification. Over nineteen years on, its data-base provides a long-term record of water chemistry and biology which is unique for upland freshwater systems in the UK. The full network consists of 11 streams and 11 still waters (see http://www.ukawmn.ucl.ac.uk/ for further details). The watercourse's importance as a long term monitoring site reduces the capacity to undertake enhancement works (such as tree planting or stocking) on this burn, as these works may affect fish populations and compound monitoring of ecological changes representative of the burn's recovery from acidification. However, there have been recent indications that the AWMN may be discontinued and the site's capacity for improvement may increase.

A total of 12 potential obstructions were recorded on the Dargall Lane (*Figure 4.5.1*). Photographs of potential obstructions are provided in **Appendix 4**.

Figure 4.5.1: Potential obstructions on the Dargall Lane

				Grid reference	
Section ID	**ID**	**Obstruction**	**Accessibility**	**Easting**	**Northing**
DL1	DLO1	Waterfall	Yes	245625	578624
DL5	DLO2	Waterfall	Yes	245598	578722
DL7	DLO3	Waterfall	Yes	245482	578746
DL7	DLO4	Waterfall	Yes (S/F)	245456	578718
DL7	DLO5	Waterfall	Yes (S/F)	245423	578732
DL7	DLO6	Waterfall	Yes (S/F)	245419	578732
DL8	DLO7	Waterfall	Yes (S/F)	245415	578735
DL8	DLO8	Bedrock	Yes (S/F)	245391	578745
DL8	DLO9	Waterfall	Yes	245371	578742
DL8	DLO10	Waterfall	No (U/D)	245343	578734
DL9	DLO11	Waterfall	No (U)	245284	578709
DL11	DLO12	Bridge sill	Yes	244986	578618

In sections DL1 and DL2, no obstructions were recorded. In section DL3, a small fall was recorded (DLO1). This fall was judged to be passable, especially on the right bank. No obstructions were recorded in section DL4. A series of small falls (DLO2) was present in section DL5, all of which were judged to be passable. No obstructions were recorded in section DL6. In DL7, a small fall (DLO3) was recorded. This fall was judged to be passable. A further fall (DLO4) was recorded slightly upstream. This fall was created by a stone with a vertical face and was judged to be difficult for fish to negotiate due to its height (40 cm vertical height). However, the presence of a deep pool below this fall may assist with access. It was judged to be passable but dependent upon fish size/species. Boulders were scattered throughout the burn, creating another series of falls (DLO5) which were judged to be only accessible dependent upon fish species /size. No pools were available below these falls only areas of run and, combined with the relatively shallow depth of water (<20 cm), this area was thought to be potentially problematic for some fish. A larger fall was recorded upstream of this point (DLO6). This fall was 40 cm in height vertically and if fish were to pass on the left bank, access would be difficult especially as the water depth beneath the fall was only 30 cm. However an alternative route was available on the right bank which did not involve negotiating such a height and the fall was judged to be passable due to the presence of this alternative route. Section DL8 started with a large fall (DLO7) which was considered to be passable dependent upon fish size/species. The fall was around 30 cm in height and the water was fast which was thought to be potentially problematic. An area of bedrock (DLO8) was present within the bed within the middle of section DL8. This was judged to be probably passable under summer low to medium water conditions, but the velocity would be expected to increase during high water and may provide more difficult access for smaller fish. A small fall was recorded upstream (DLO9) but was judged to be passable. A large fall (DLO10) was present upstream of this point. This fall was impassable in an upstream and downstream direction, due to the height of the fall and the presence of boulders/bedrock below the fall. A fall (DLO11) was present in section DL9, which was judged to be impassable in an upstream direction. No potential obstructions were recorded in section DL10. In section DL11, the only potential

obstruction recorded was the bridge sill (DLO12) on the road bridge. Water was spread in a thin layer (3 – 5 cm depth) over the sill, which is likely to make upstream fish access difficult but not impossible. Downstream of the bridge, where the sill meets the burn substrate, there is a concrete lip. The flow adjacent to the concrete lip was judged to be varied enough for the lip to be accessible to fish.

Summary

In summary, fish access in the Dargall Lane is closely linked to the gradient of the burn. In the lower reaches of the catchment (sections DL1-6) there is little in the way of potential obstacles to migration. However in sections DL7 and DL8, where the gradient begins to increase sharply, several falls were recorded. Of the falls recorded, only one was considered to be impassable in both upstream and downstream directions; the other fall was passable in a downstream direction. Any stocking that may be undertaken in future should consider the fall at NX 245343 678734 as the upper limit for stocking.

4.5.2 Instream habitat

Overview

As mentioned in previous sections, the quality of the instream environment available will determine the density of salmonids within the burn.

Section DL1 was most suited to supporting adult trout, with the section being characterised by deep pool, with some areas of glide. The section was dominated by a boulder and cobble substrate in the lower part of the section, with submerged vegetation contributing to instream cover as well as emergent vegetation (reeds) providing some cover at the burn margins. The burn was 2.5 m wide at the start of the section. Instream cover was judged to be excellent due to the presence of large substrates and instream vegetation. The water was very clear, with substrates on the bed viewed without difficulty. At NX 246009 678740 the burn became shallower and narrower (only 1m in width). The substrate in this area was dominated by sand with a lesser amount of gravel occasionally recorded but instream vegetation was still available for use as cover. A small area of riffle was recorded at the very upper point of this section. In section DL2, the flow regime was dominated by deep pool in the lower part of the section and run/ pool in the upper part of the section. The main substrate was sand with some boulder (10%). Again, there was a great deal of instream vegetation to provide cover. Emergent vegetation (reeds) were present within the stream margins to provide cover. Overall, the section was judged to provide good instream cover. The substrate in section DL3 was sand and gravel at the start of the section but this was rapidly supplemented by boulder and cobble. Instream cover was judged to be good despite the predominantly sandy geology due to the presence of larger substrates and instream vegetation (*Figure 4.5.2.1*). The flow regime in this section generally varied between deep pool and run but at NX 245684 678682 the first area of riffle was recorded. The majority of the section was most suitable for juvenile trout but the deeper areas would be suitable as holding areas for adult fish. Section DL4 was narrow in width (40 cm width), which had a predominantly sandy geology. Instream cover was poor due to the small nature of the substrates. The flow was still marginal at the time of the survey. In section DL5, the majority of the cover at the start of the section was provided by cobble but boulder became more prevalent in its upper reaches. In a pool at the start of the section, cover was also provided by pieces of collapsed banking which had been washed into the main burn from section DL4 (*Figure 4.5.2.3*). Trout were observed to be using this for cover.

Figure 4.5.2.1: Instream vegetation and larger substrates combine with draped bankside vegetation, to provide excellent cover overall in section DL3

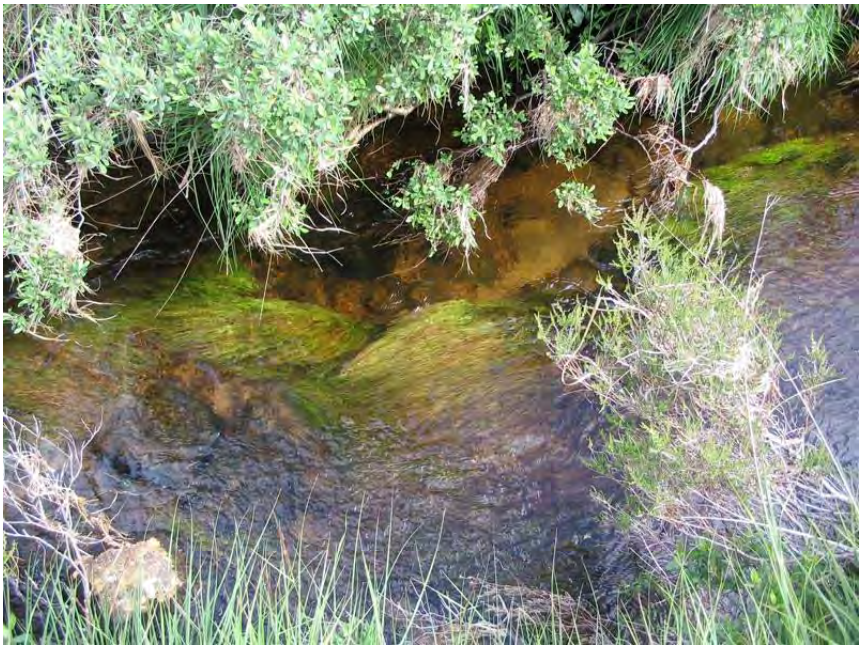
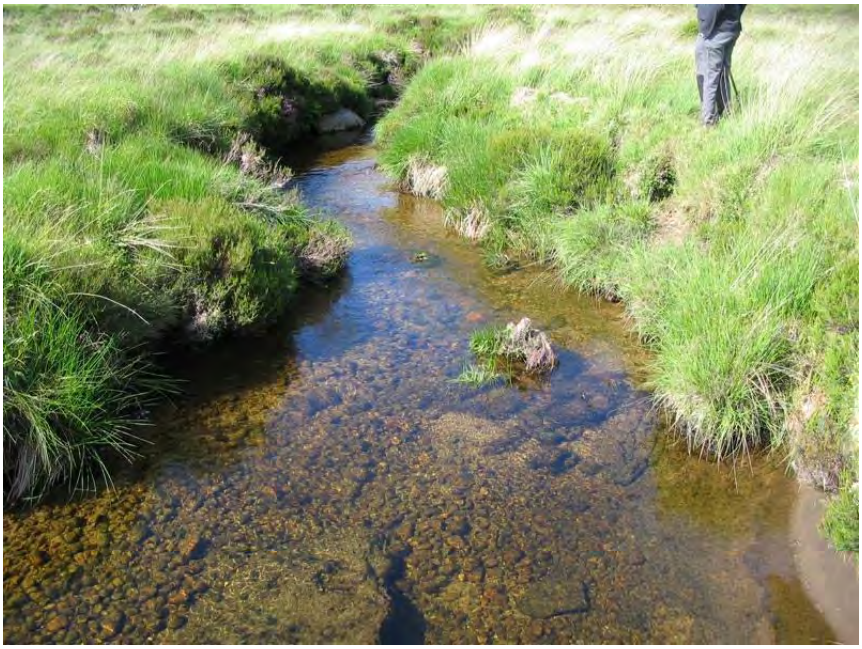


Figure 4.5.2.3: Instream cover at the start of section DL5 is moderate, with cover being provided by cobbles and collapsed banking, eroded from section DL4



The flow regime in section DL5 was pool and riffle. Section DL6 was dominated by cobbles although lesser amounts of pebbles and boulder were also recorded. Instream cover was judged to be good. Water was shallow in this section, being only 15 cm in depth. The main flow type was run, with smaller amounts of riffle and pool. In section DL7, the gradient started to increase and boulder became much more common in the geology. Substrates tended to be larger than previously recorded on the burn, but

cobble was still the most dominant substrate type. Instream cover was judged to be good, due to the presence of boulders in the banksides and centre of the channel. The flow regime in this section was pool-riffle. Section DL8 was dominated by faster water (riffle and torrent), with fewer pools than in previous sections. Again, this was due to an increase in gradient. Boulders were recorded as being very commonly encountered although the main mobile substrate was cobble. Instream cover was judged to be good. Section DL9 was less steep than the previous two sections and as a result of this, smaller substrates (such as sand and pebble) were again present in the substrate matrix. Despite smaller substrates being recorded, overall instream cover was judged to be good with cobble and boulder being the most dominant substrate types. The main flow type was run, with some torrent below the major fall and riffle in areas where boulders had broken the surface. This area was judged to provide good habitat for trout fry and would also be suitable for parr. In section DL10, the main flow type recorded was riffle and run, with some deeper pools. There was also one shallow pool section. Boulders and cobbles were the most commonly recorded substrate types. Instream cover was judged to be good in this section and would favour parr, due to the generally deeper site and the presence of large substrates. In section DL11, the main flow types were pool and riffle, although there was also a section of pool. The main substrates were cobble and pebble, with boulder becoming less prevalent in comparison to the previous three sections. Instream cover was generally good.

Summary

The Dargall Lane was characterised by deep pool in its lower reaches (section DL1), which combined with excellent instream cover to provide areas suitable for use as adult holding areas. In sections DL2 and DL3 the flow regime was dominated by run and pools with a predominantly sandy geology that was supplemented by boulder and cobble. Instream cover was judged to be good. This would provide a suitable environment for supporting juvenile trout, with parr tending to be found in the pools and fry at the margins of the faster sections. In section DL5, trout parr were observed to be using collapsed banks as cover instream in one part of the section. The predominant flow types in this section were pool and riffle. In section DL6 the main flow type recorded was run, which combined with boulders to provide good instream cover and an environment suitable for trout fry. Sections 7 and 8 were higher gradient but still provided good habitat for trout, with boulders breaking up the faster flows and providing refuges adjacent to pools. Section 9 and 10 both contained run, with some pools and substrates that provided good instream cover. Section 11 also provided suitable habitat for juvenile trout, with instream cover being classified as generally good.

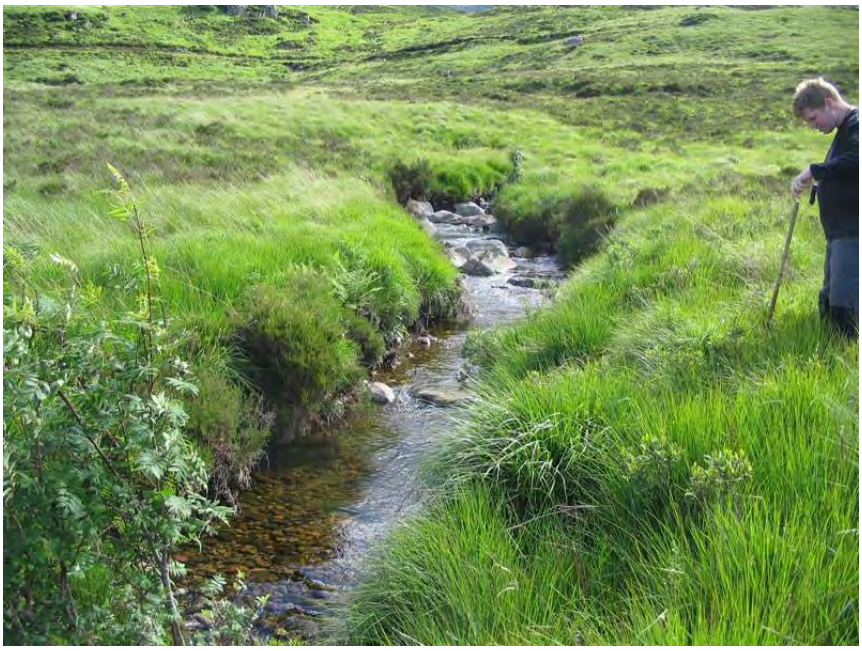
4.5.3 Spawning habitat

Overview

In section DL1, most of the section was dominated by deep pool and large substrates which were not suitable for spawning. However at the upper part of the section, where the burn shallowed, a small amount of gravel was recorded (1% of section length). It is possible that spawning could take place in this very localised area but only a small amount of spawning would be possible given the limited spawning substrates. Section DL2 had a small amount of spawning substrates present (5% of section length) but in general the substrate was not suitable. In section DL3, the first larger area of potential spawning substrates was recorded at NX 245625 578697. In this area, a combination of riffle and potential spawning substrates (such as pebble/cobble) were present over 20% of the section. In section DL4, the substrate was small (predominantly sand) and it was not considered suitable for spawning. In section DL5, potential spawning substrates

were present over 60% of the section. The flow regime (riffle, run and shallow pool) also provided suitable conditions for spawning. In section DL6, further spawning habitat was available over 80% of the section. Spawning habitat was again available in the lower part of section DL7 (*Figure 4.5.3.1),* but its availability decreased in the upper part of the section where boulders and falls decreased the suitability of the section for spawning. In section DL8, the presence of smaller substrates meant that more potential spawning habitat was available. Spawning habitat tended to be available in discrete areas rather than whole sections but habitat was judged to be available over 40% of the section.

Figure 4.5.3.1: The lower part of DL7 some areas suitable for spawning. The substrate can be seen in the left hand corner of the photograph



In section DL9, the burn became steeper and was dominated by boulders, although cobble was still available in some areas. Spawning habitat was limited in this area, being present over around 50% of the section. The faster flows recorded meant that potential spawning substrates were well washed. In section DL10, some discrete spawning areas were recorded over 40% of the section. The main area for spawning was a long, shallow pool whose substrate was dominated by cobble. In section DL11, spawning habitat was recorded over 40% of the section.

<u>Summary</u>

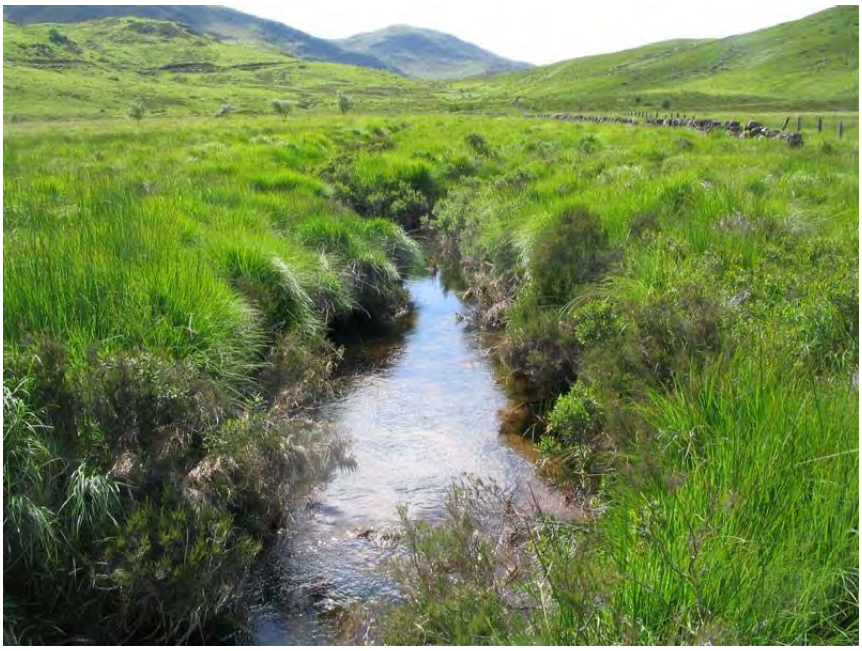
The Dargall Lane was considered to offer some of the best spawning habitat recorded during the Loch Dee survey. Spawning substrate was limited in the lower sections (DL1 and DL2), due to the predominantly sandy geology. However, in the mid sections of the burn, substrates became larger and this increased spawning potential. The maximum amount of spawning potential in a section was recorded in section DL6. In the mid to upper sections of the burns, the amount of spawning habitat decreased, generally due to unsuitable substrates but was still available in a significant amount.

4.5.4 Riparian habitat

Overview

In section DL1, the predominant vegetation in the riparian zone was grass with some small shrubs. Draped vegetation was present over the entire section but in the lower part of the section it did not touch the water. In the upper part of the section, the vegetation reached the water and overall, draped cover was present over 60% of the section. In higher water levels, more cover would be available in the lower section. Undercut bankings were present over 70% of the section. Draped vegetation (grasses, shrubs and ferns) was present over 90% of Section DL2 (see *Figure 4.5.4.1*). Undercut bankings were available over 80% of the section, providing excellent bankside cover.

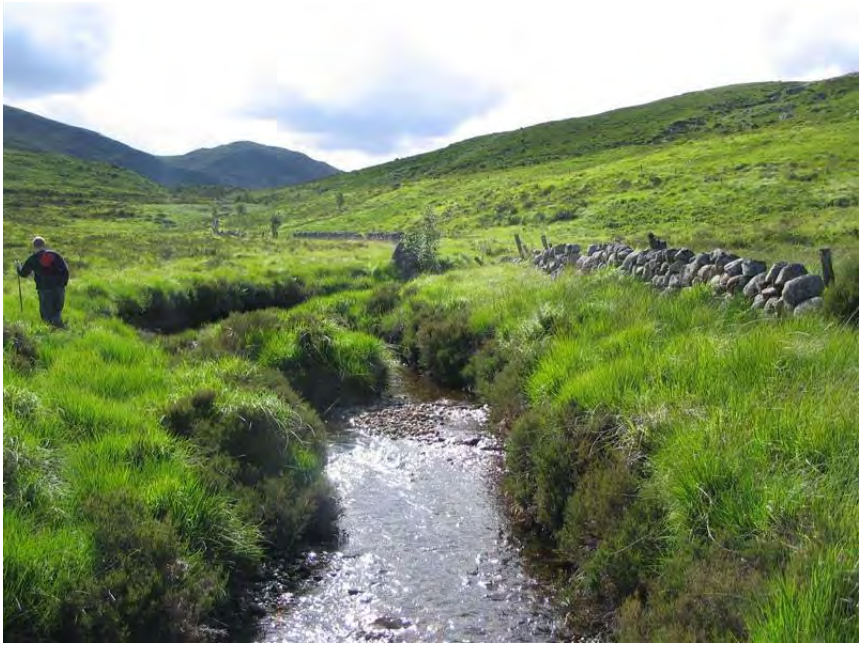
Figure 4.5.4.1: Draped vegetation in section DL2



In section DL3, the riparian zone was generally simple, with mosses, grasses, heathers and shrubs being present. Bankside cover was 100% across the section. A willow was recorded in the area around NX 245684 578632, which overhung the burn and provided some cover. In section DL4, due to the burn's narrow width (40 cm), draped vegetation provided cover over almost all of the water surface along both banks. The burn's steep gradient in its upper reaches, also left the lower section vulnerable to increased erosion during spates. There was evidence of bankside collapse immediately upstream of the burn's confluence with the main watercourse. In section DL5, boulder started to become more common in the banksides of the watercourse. This provided cover and stabilised the banksides, to the extent that larger shrubs and trees were recorded. Draped vegetation was present over the entire section, but only reached the water over 70% of the site. In higher water conditions, bankside cover would increase. A mature island was present at NX 245570 578746 and this provided bankside cover from grasses and undercut banking on both sides of the island (*Figure 4.5.4.2*). In section DL6, bankside cover was judged to be good with draped vegetation overhanging both banks providing the most in the way of bankside cover. Undercut banking was not recorded as often in

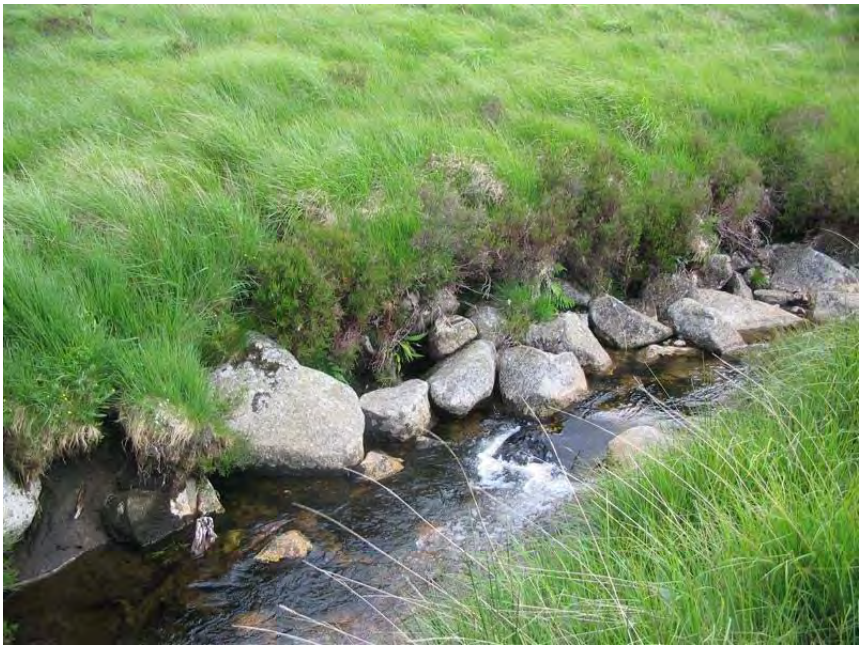
this section as it was in the lower sections of the burn and was present over only around 20% of the site.

Figure 4.5.4.2: A mature island was present at the top of section DL5, which provided bankside cover from draped grasses and undercut banks



The riparian zone in section DL7 was dominated by grasses with some ferns, heathers and shrubs also being recorded. In this section, the gradient started to increase and, as a consequence of this, banksides became steeper and riparian vegetation did not reach the water's surface as easily as in the burn's lower reaches. Undercut bankings and boulder in the bankside improved the cover in the riparian zone but overall, less bankside cover was judged to be present than in lower sections. In section DL8, the riparian zone was complex, being composed of grasses, ferns, heathers and shrubs with trees also being present in some parts of the section. The presence of boulders in the bankside further contributed to bankside cover. However, it was in the upper part of the section that bankside cover exerted it greatest influence, with vegetation not reaching the water in the lower part of the section. In section DL9, the majority of the draped vegetation available as cover was unused as water levels were too low to allow its use (*Figure 4.5.4.3*). However, the presence of boulder along the banksides provided cover for juvenile trout. In section DL10, draped vegetation (mainly grasses), boulders and undercut bankings continued to provide good bankside cover. In this section, draped vegetation was able to reach the water and provided a great deal of cover. Section DL11's riparian zone was generally simple in terms of vegetation. Again, where vegetation draped over the banksides, it did not generally reach the water as the water level was too low.

Figure 4.5.4.3: Draped vegetation tended to be above the water level in section DL9, with boulders providing important bankside cover



Summary

In summary, draped vegetation and undercut bankings provided up to 100% bankside cover in the lower reaches of the Dargall Lane. The riparian vegetation was predominantly simple in these areas. In section DL5, boulders became more commonly recorded in the banksides, stabilising the areas and allowing shrubs to achieve greater sizes as well as trees to become established. In the upper reaches, the bankside was less important in terms of providing cover than instream environment. In most of the upper section (with the exception of section DL10) draped vegetation did not meet the surface of the water and was therefore unable to provide cover.

4.5.5 Overshading

None of the Dargall Lane was recorded as being overshaded, as few trees (willow and rowans) were recorded during the survey.

4.5.6 Overgrazing/ trampling

No overgrazing or trampling was recorded during the Dargall Lane survey.

5. DISCUSSION

The spawning burns surveyed at Loch Dee were generally considered to offer good quality habitat for juvenile trout.

The main potential obstructions to fish movement recorded during the survey were waterfalls, although bedrock, fallen trees, a weir, culverts and bridge sills were also present in some areas. The high number of waterfalls recorded is related to the steep gradient over which most of the burns rise. Whilst the falls can reduce accessibility to some parts of the burn systems, they are also vital in breaking up the flow of water and providing an oxygen rich environment for the trout.

In terms of actions that could be taken, most of the potential obstructions are natural and remedial works would not be appropriate. The falls will have naturally segregated the trout populations that inhabit the spawning burns and whilst some progeny could be expected to migrate downstream into the loch, the fishes that remain as residents in particular areas have the capacity to be genetically distinct from the other trout in the burn. These sub populations are important and their presence in the Loch Dee catchment could be vital in ensuring the continued genetic diversity of the loch's trout population. On the White Laggan Burn, the only man-made potential obstruction was the bridge apron at NX 246828 577808 and was considered to be passable dependent upon fish species or size. No remedial works are suggested for this potential obstruction. On the Black Laggan Burn, there was more potential for works to be undertaken. A fallen tree was recorded at NX 246848 577742 and it is suggested that this is removed. At the current time, this tree was recorded as being passable but if other debris/vegetation becomes attached to the tree, it could become a significant obstruction. Whilst woody debris is often important in providing cover and a habitat for some aquatic invertebrates, in an upland system such as the Black Laggan Burn, debris is unlikely to be retained within the burn due to the high energy nature of the system. The accumulation of flood debris on an island in the upper part of the system (at NX 247084 577728) should also be considered for removal. On the Green Burn, the only potential man-made obstacle was a culvert at NX 248077 578973. This culvert was considered to be passable and no remedial work is suggested. On the Dargall Lane, the only potential man-made obstruction was the bridge sill at NX 244986 578618. This sill was considered to be passable and no remedial work is suggested.

In terms of instream habitat, most of the burns were suited to supporting juvenile trout in their middle reaches. On the White Laggan Burn, sections WLB4 and WLB5 had the best instream habitat whilst on the Black Laggan Burn most of the burn was considered suitable with the exception of the upper reaches where bedrock was more common. On the Green Burn, the catchment upstream of section GB3 provided the best habitat for juvenile trout. On the Dargall Lane, the majority of the burn was judged to provide good habitat for juvenile trout.

In terms of actions that could be taken, no suggestions regarding the improvement of instream habitat are made. The burns vary in their capacity to support juvenile trout but this variation is natural and in no burn was the instream environment felt to be limiting densities to a level that would require intervention.

Spawning habitat was found to be available in all of the burns. In the White Laggan, most small trout were expected to spawn in sections WLB2 and WLB3, whilst larger fish may spawn upstream of this point. On the Black Laggan Burn, only a small part of section BLB1 was considered suitable for spawning. On the Green Burn, the best section for spawning was found at GB3. Downstream of this section flows were felt to be too slow whilst upstream of this area, substrates were compacted in some places and bedrock was more common. The Dargall Lane was considered to be the best spawning burn surveyed, with the most suitable areas being in the mid to upper reaches of the catchment (DL6, DL8, DL9, DL10 and DL11).

Stocking is a further factor for consideration. Stocking of fed fry has been undertaken for the last 4 years and was also previously undertaken in the 1980s. Broodfish are taken from a trap situated on the White Laggan Burn, but downstream of the confluence with the Black Laggan Burn. It is presumed that the fish caught in the trap are a mixture of White Laggan / Black Laggan stock. Broodstock used in the production of fed fry must be native to the Loch Dee system, in order for the progeny to be best adapted to this environment. It is important to ensure that stocked fry do not compete with wild spawned fry, especially as stocked fry are often larger upon initial stocking that their wild counterparts. This is one reason why it may be beneficial to stock hatchery fed fry habitat upstream of falls that are considered impassable in an upstream direction. On the White Laggan Burn, the area within WLB6, downstream of obstruction WLBO12 is considered suitable for stocking. Downstream of this point, it is likely that any fed fry stocked into the burn will compete with wild fry. Prior to commencing stocking in this area it is vital to confirm that conifers will not be replanted as close to the watercourse in future and that a larger buffer zone is maintained. On the Black Laggan Burn, it is suggested that stocking could take place upstream of the first impassable fall (BLBO6) although consideration would need to be given to whether this was a good use of resources as there is only a small area that could be stocked before the upper limit for stocking is reached and the habitat does not appear ideal for fry. The upper limit for stocking is probably at the downstream limit of the gorge (NX 247107 577740) as above this point the water is very fast flowing and turbulent and unsuitable for fry. On the Green Burn, no impassable obstructions were recorded. This suggests that wild fish have free run of this relatively low gradient burn and that stocking should be focused on other burns in the first instance. This is likely to be especially important as the fry are taken from stock that has its origins in the high gradient White and Black Laggan Burns and the progeny may not be as well suited to the low gradient environment of the Green Burn. The Dargall Lane has a large fall at NX 245343 578734, which is impassable in both upstream and downstream directions. This suggests that any stocking would have to be undertaken downstream of this point. It may be possible to undertake a low density stocking of this area but it is vitally important to confirm whether the Dargall Lane is being used as a monitoring site for AWMN. If it is not, stocking could be undertaken but if it is, no stocking should be carried out as this will affect the results of the long term monitoring programme.

In general, the availability of spawning substrates was not found to be limiting in the burns surveyed. There was variation in terms of the amount of substrate available but this was considered to generally be related to other factors (such as gradient) and is therefore a natural feature of these burns.

The riparian zone offered the greatest opportunities for improvements to be made. The land uses in the catchments of the burns are coniferous plantation and rough pasture,

which supports low intensity grazing by sheep. In general, the riparian zones of the burns were simple (2 - 3 vegetation types, with or without scrub or trees) with only some areas being complex. In many ways, the riparian zones recorded during the survey represent the environment that will always have bordered the burns at Loch Dee. However the exception to this rule is the coniferous plantation. The White Laggan, Black Laggan and Green Burns all had parts of their catchment afforested, with the Dargall Lane being the only burn without plantation. Given the base poor geology of the area, conifers have the potential to affect the water chemistry of these burns. It is important to ensure that the Forests and Water Guidelines are adhered to, to maximise the burns' protection. On the White Laggan Burn in sections WLB5 and WLB6, conifers have been planted too close to the burn. Given the burn's width in this section (which varies between 1 – 3 m) conifers should be planted a minimum of 10m from the bank. During the survey, it was recorded that conifers were on average planted 5 m from the burn. It is important to ensure that replanting does not occur as close to the burn and, if possible, FC(S) should be encouraged to fell the trees that are adjacent to the burn as soon as possible. It is, however, recognised that these trees will be difficult to fell, as felling access is only available from the banksides of the burn until the rest of the compartment is felled. On the Black Laggan Burn, conifers did not appear to be planted as close as on the White Laggan. This may be due to the presence of bedrock strata in the riparian zone, which would provide difficult conditions for planting. On the Green Burn, efforts have been made to reduce the amount of forestry adjacent to the burn. In the section of the burn surveyed, there was evidence of recent felling and also the planting of broadleaved trees in some areas. In the burn downstream of the areas where felling had occurred, some silts were recorded on the surface of the bed. It is important to ensure that siltation of spawning beds does not occur in areas adjacent to felling operations.

There are opportunities to increase the number of broadleaved trees present in the burns' riparian zones. Planting should take place at a low density and trees should be clustered rather than planted in a single line along the burn edge. It is important not to plant too many trees as this would represent the creation of an artificial riparian zone; rather, trees should be planted to benefit the burn, either by stabilised eroding bank faces or by providing shade over pools. Trees should always be planted with guards, due to the presence of deer in the area.

No particular areas were identified for tree planting on the White Laggan Burn. On the Black Laggan Burn, it was suggested that a more diverse riparian zone should be encouraged upstream of the fall at NX 246899 577725. On the Green Burn, it may be beneficial to plant a low density of broadleaved trees near fall at NX 247931 579259. Also it may be useful to undertake willow planting at NX 248060 579137 where a back eddy occurs during spates, to stabilise bank. Further planting could be undertaken on the right bank at NX 248005 578798 where a boulder in the left bank encourages erosion. At NX 247970 578785 it may be worthwhile planting a low density of broadleaved trees on the left bank corner. On the Dargall Lane, no areas were specifically identified as requiring planting. However, given the simple vegetation types recorded in the lower reaches of the burn and the relatively low number of broadleaved trees, it may be beneficial to undertake planting at a low density in the area around NX245684 578682. A large willow is present in this area which may provide material for planting.

Overshading and overgrazing/trampling were not recorded as being issues in the Loch Dee spawning burns. All of the burns had only a few broadleaved trees along their margins and overshading was not an issue. Overgrazing was not considered to be a problem given the low intensity sheep grazing and trampling was also not recorded.

6. CONCLUSION

There are a number of conclusions that can be drawn from the habitat survey.

1. The Loch Dee spawning burns generally support good habitat for juvenile trout.

2. The potential obstructions to trout access are natural waterfalls, bedrock, fallen trees, a weir, culverts and bridge sills. Of these potential obstructions, only the natural waterfalls were judged to be impassable in upstream (or upstream and downstream) directions.

3. The Dargall Lane was considered to provide the best spawning habitat but sufficient spawning habitat was available in all burns.

4. The habitat surveyed during the survey does not appear to be limiting juvenile production.

Recommended Actions

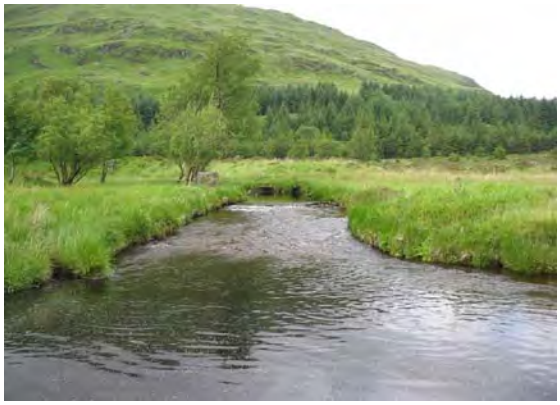
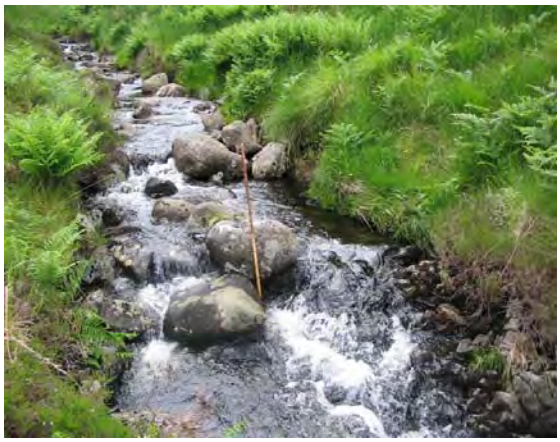
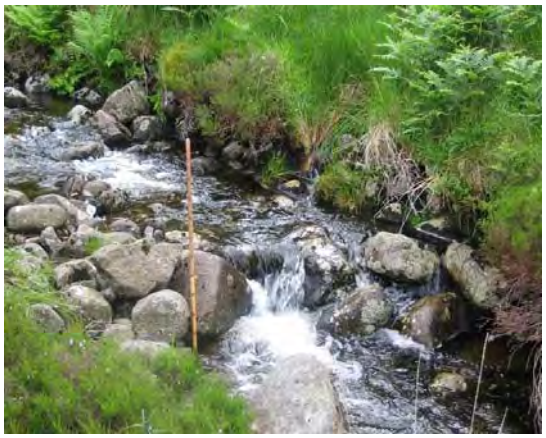
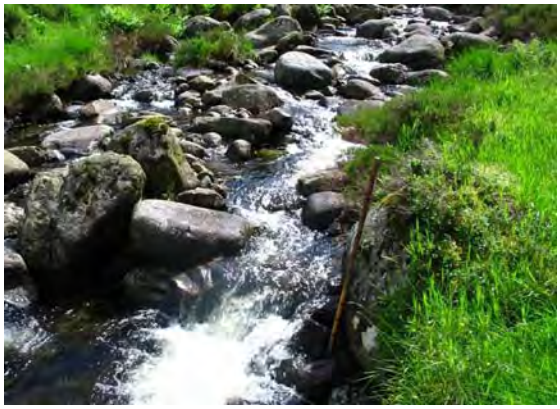
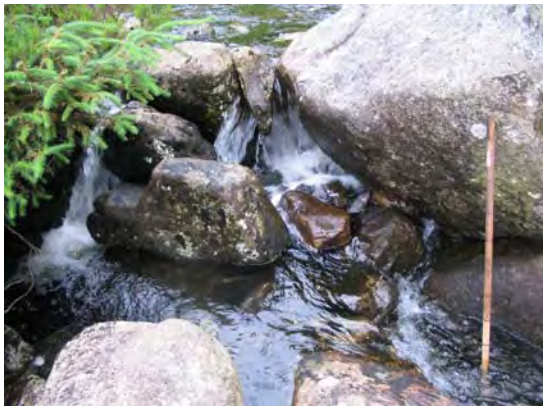
1. Undertake broadleaved tree planting in key locations (identified in **Section 6**)

2. Undertake electrofishing survey of the Black Laggan Burn (sections BLB05 and BLB06) to ascertain whether fish can access the fall at NX 247052 577717 and also quantify the numbers of trout present.

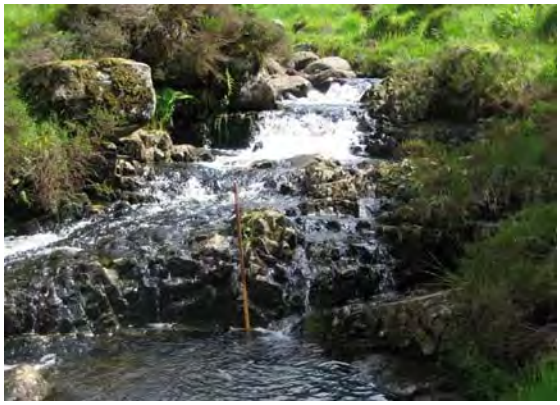
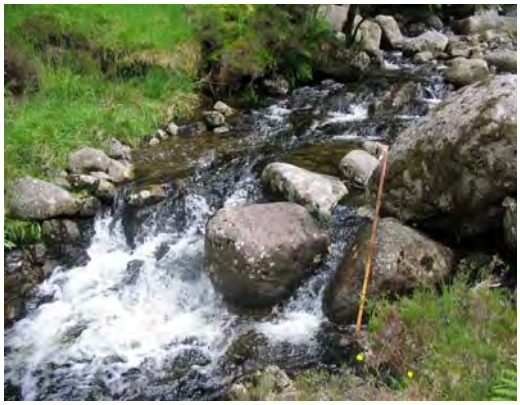
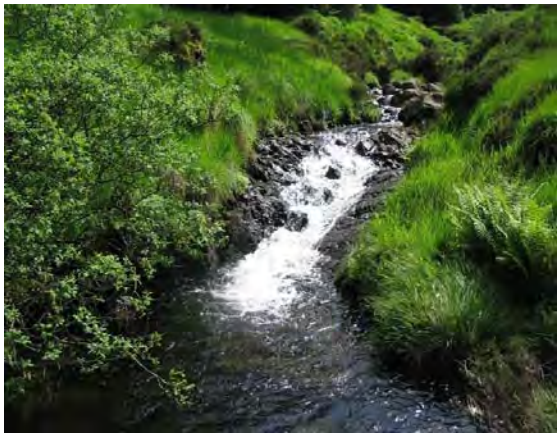
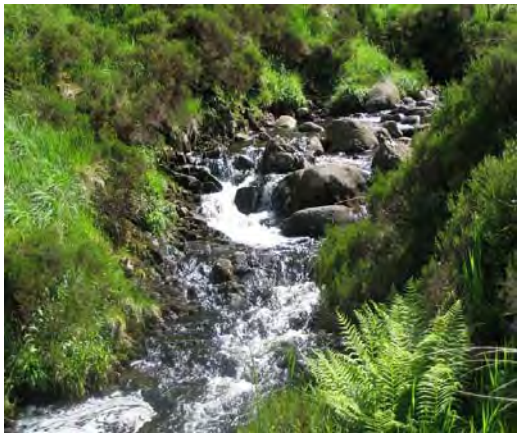
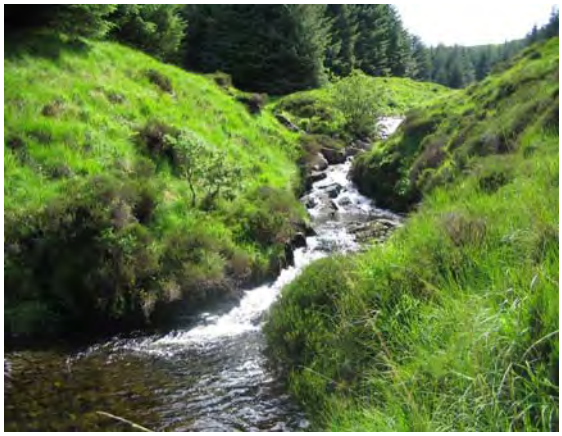
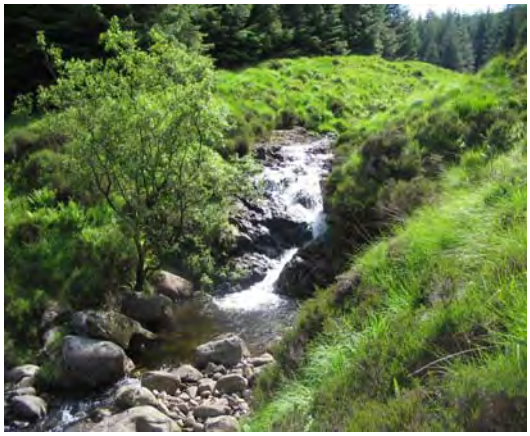
3. Undertake electrofishing survey on an annual basis downstream of road bridge on the White Laggan Burn, to monitor numbers of juvenile trout in the burn.

4. Continue to undertake broodstock collection as necessary and stock fish only into areas identified in **Section 6** to avoid competing with the burns' main spawning habitat.

APPENDIX 1

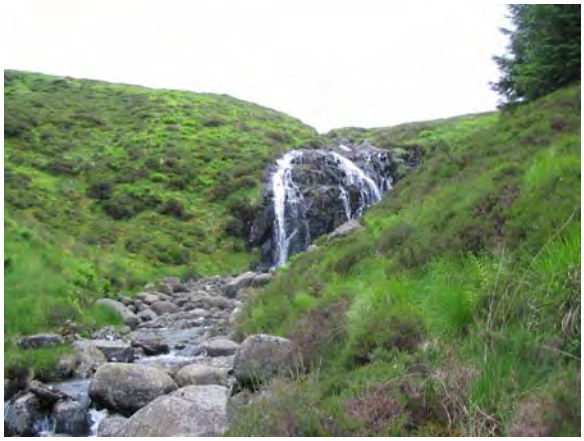
WLBO1 	WLBO2 
WLBO3 	WLBO4 
WLBO5 	WLBO6 

APPENDIX 1 (cont.)

WLBO7 	WLBO8 
WLBO9 	WLBO10 
WLBO11 	WLBO12 

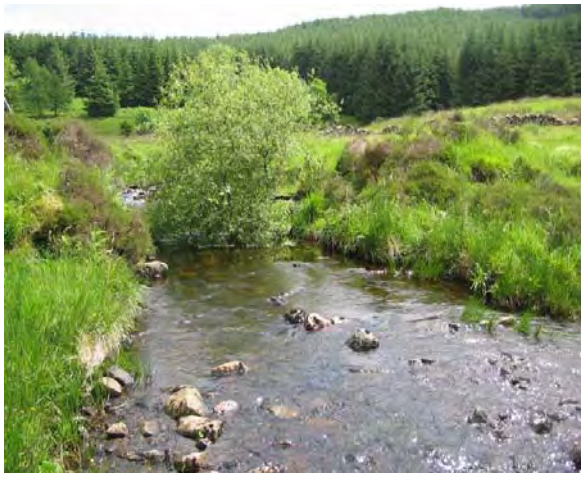
APPENDIX 1 (cont.)

WLBO13



APPENDIX 2

BLBO1



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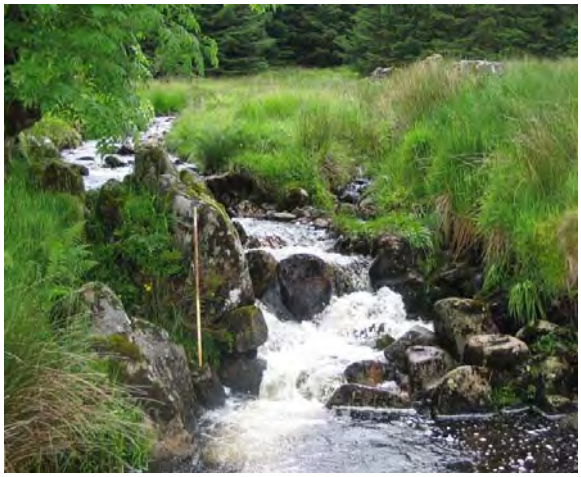

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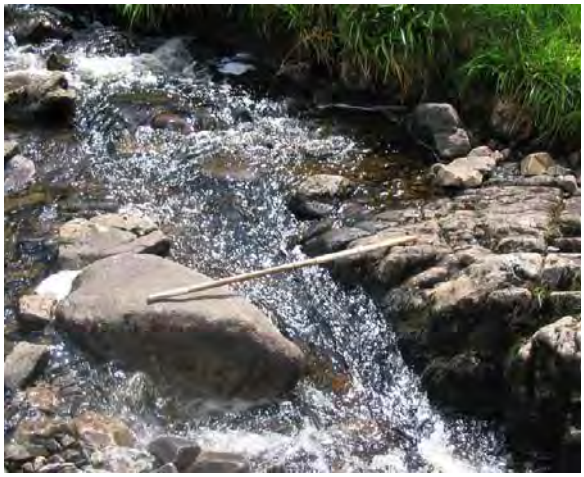

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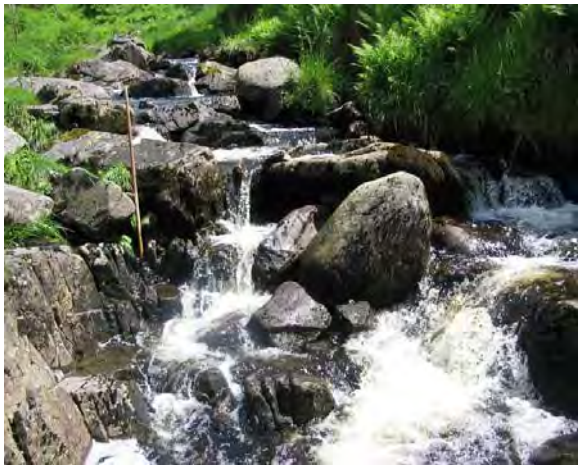

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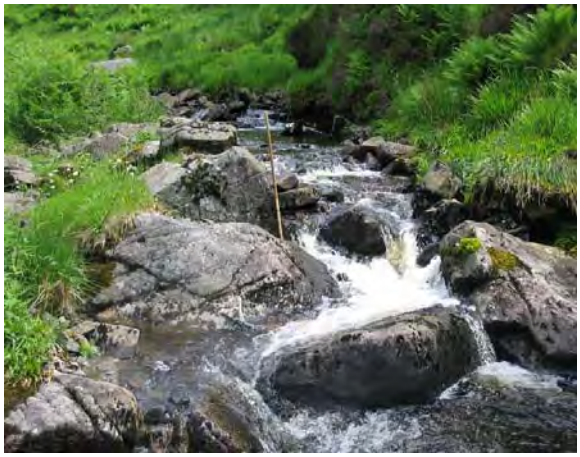

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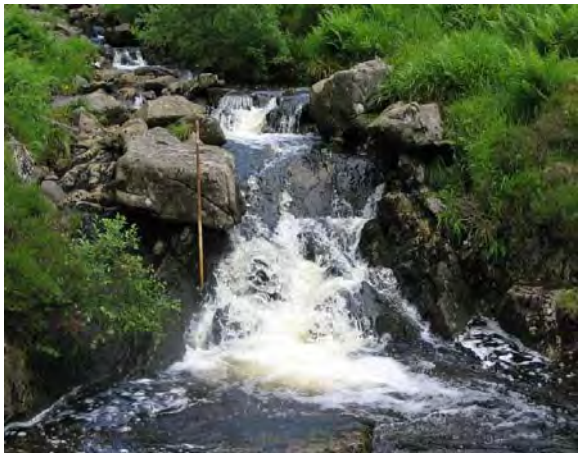

APPENDIX 2 (cont.)

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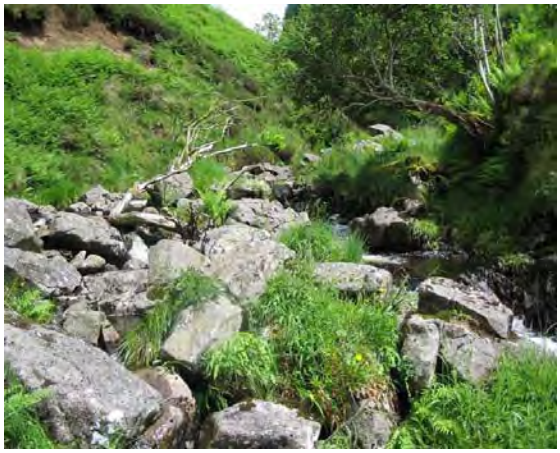

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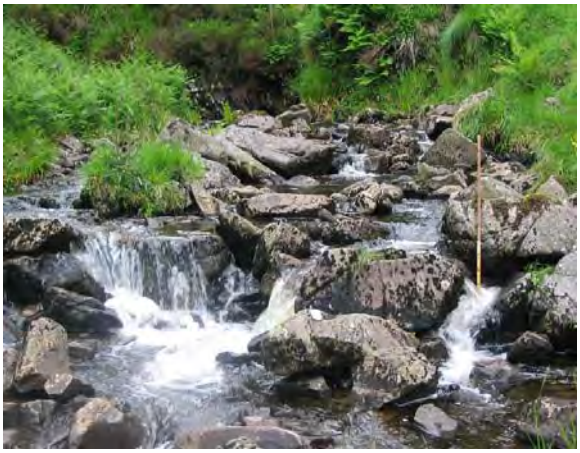

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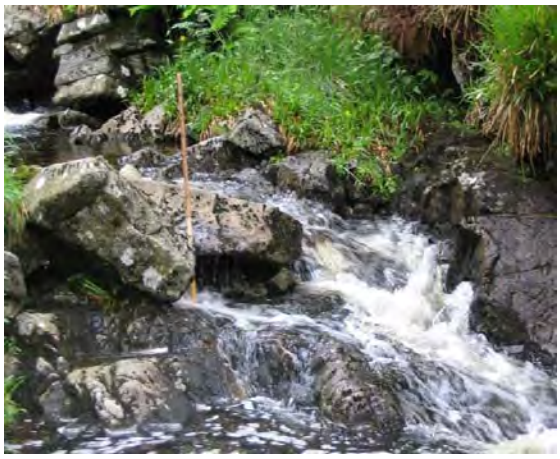
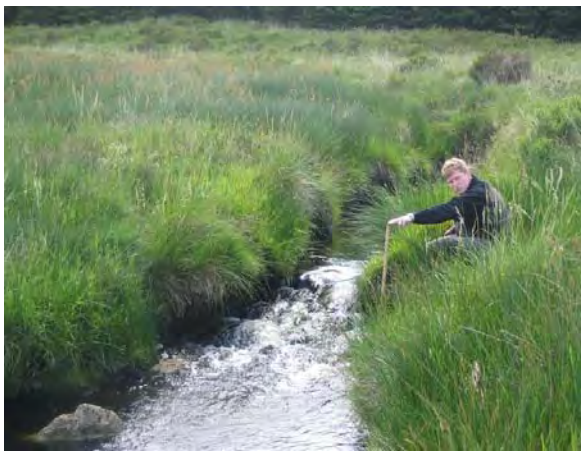


APPENDIX 3

GBO1



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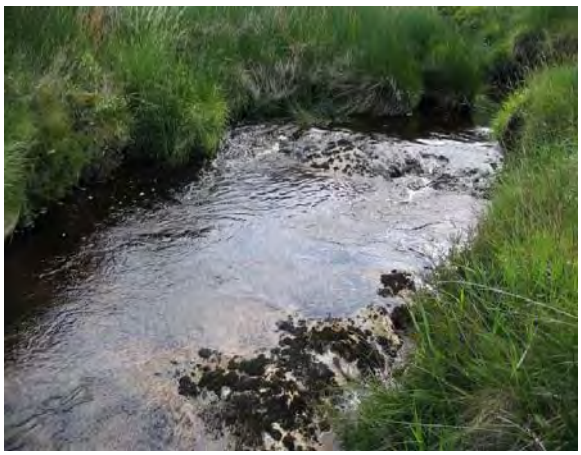
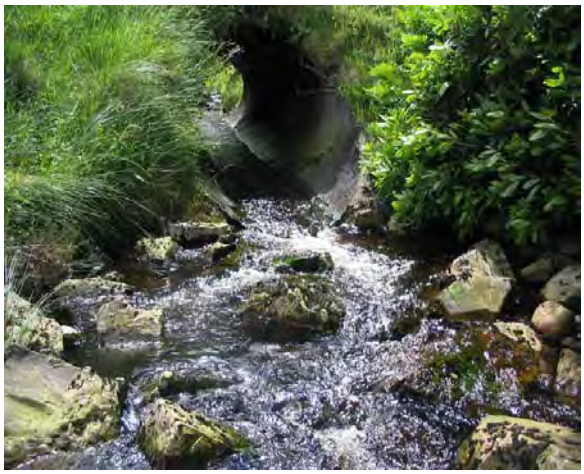


GBO3



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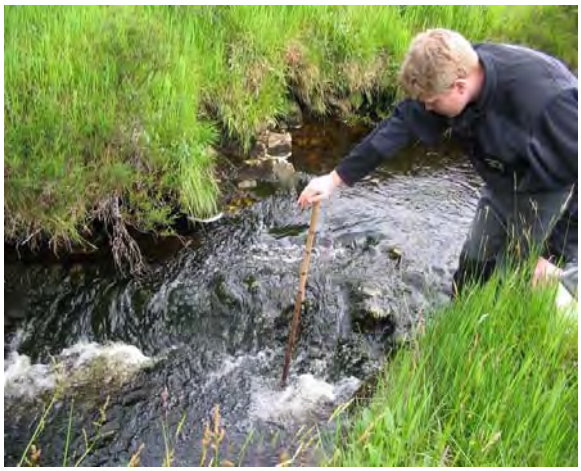

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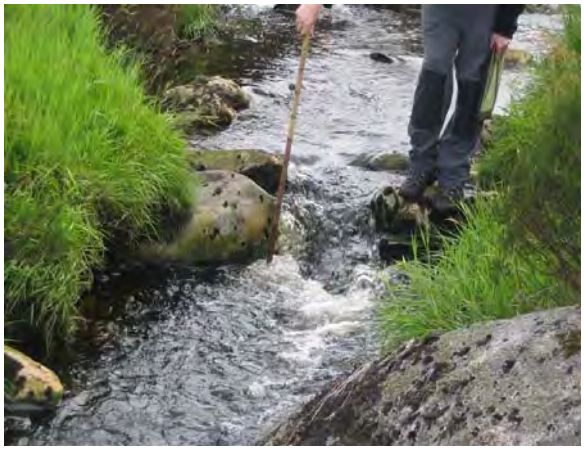

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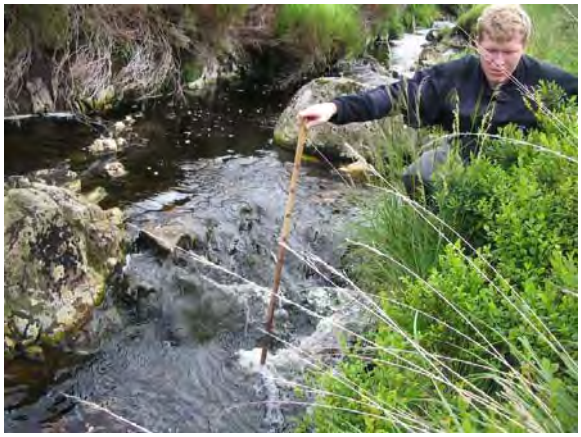

APPENDIX 3 (cont.)

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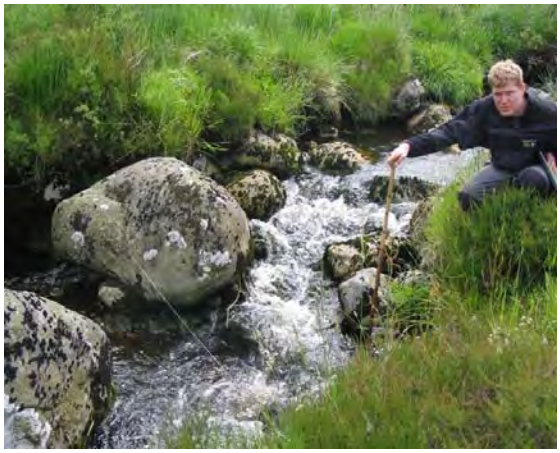

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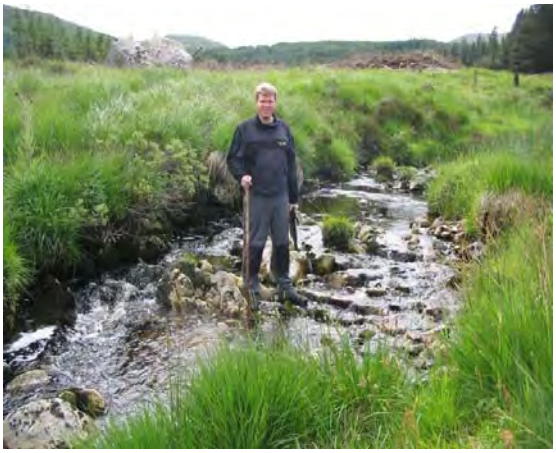

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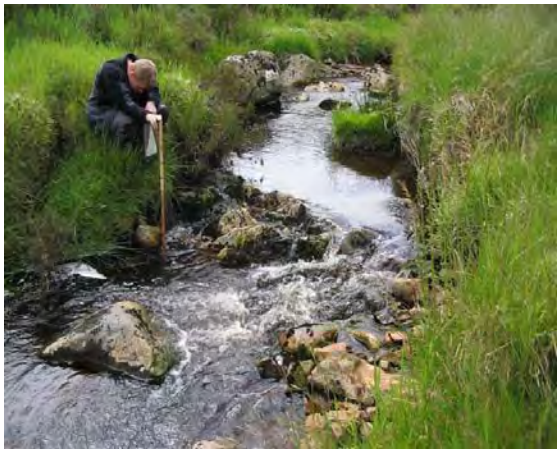

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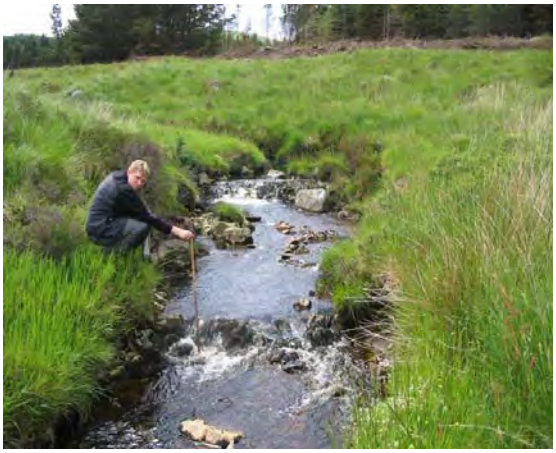

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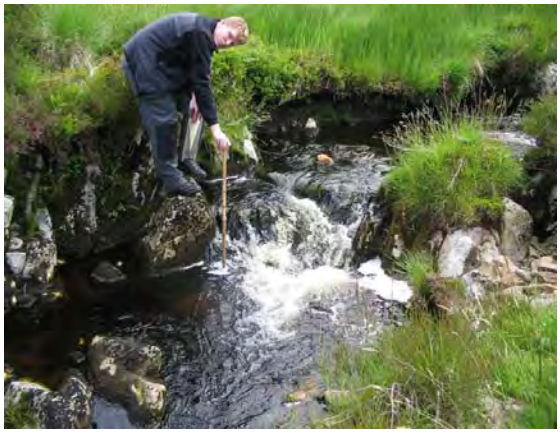
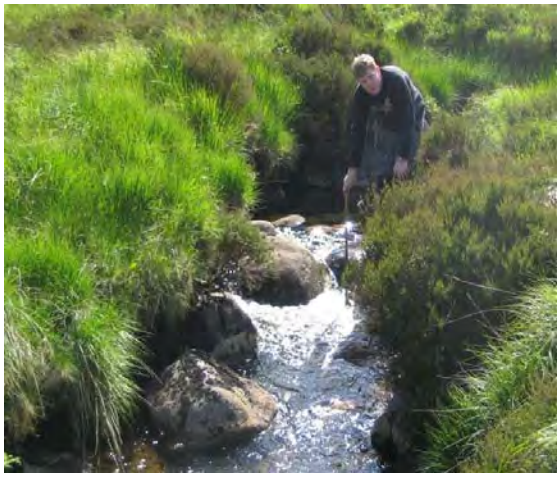


APPENDIX 4

DLO1



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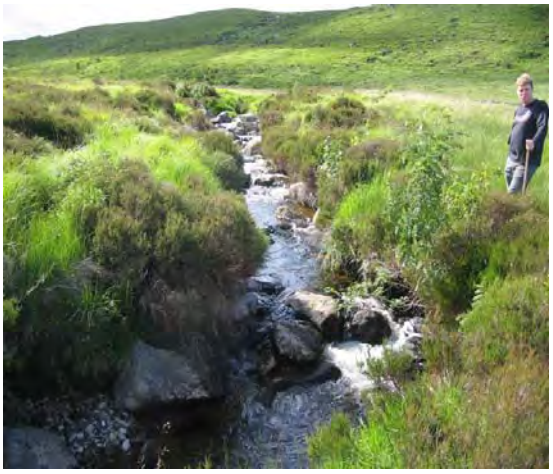
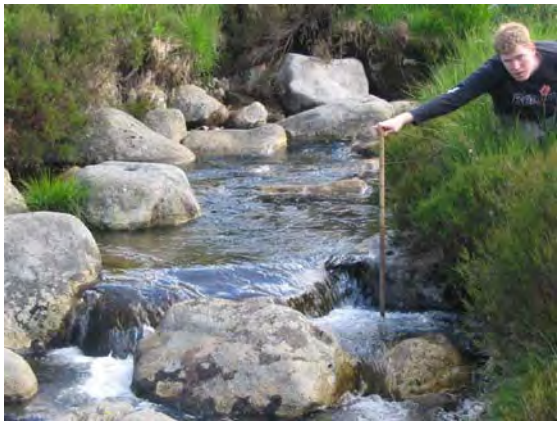
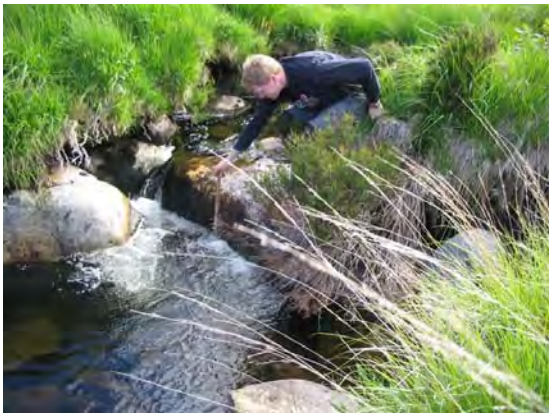


DLO3



DLO4



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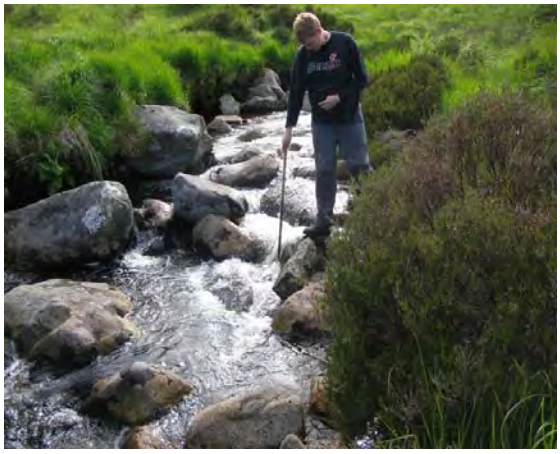

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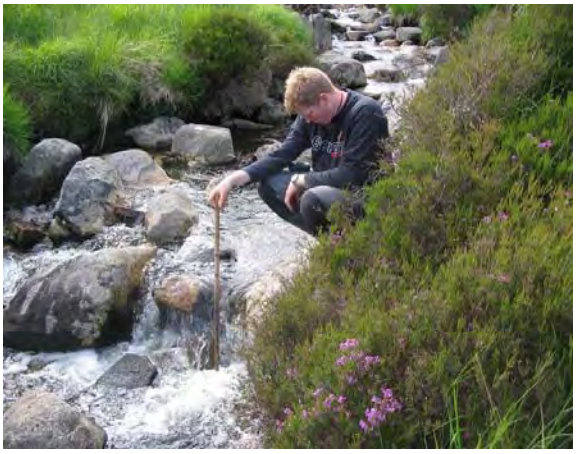

APPENDIX 4 (cont.)

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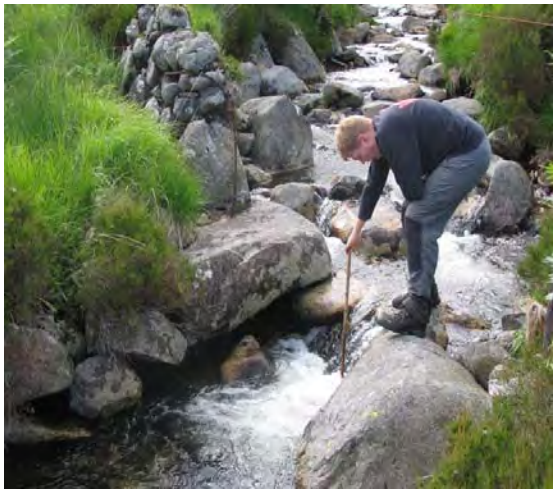

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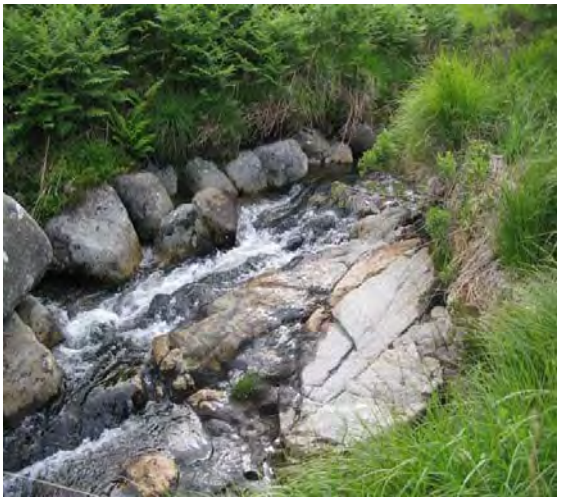

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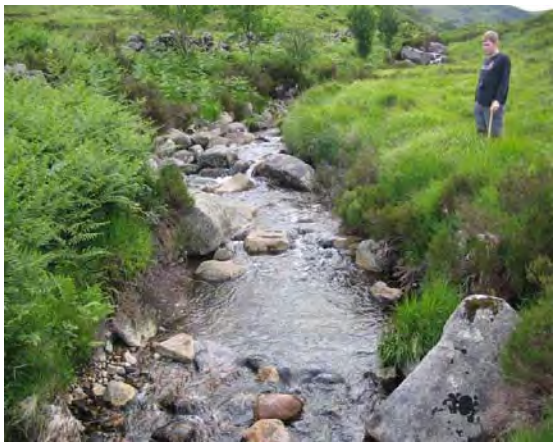

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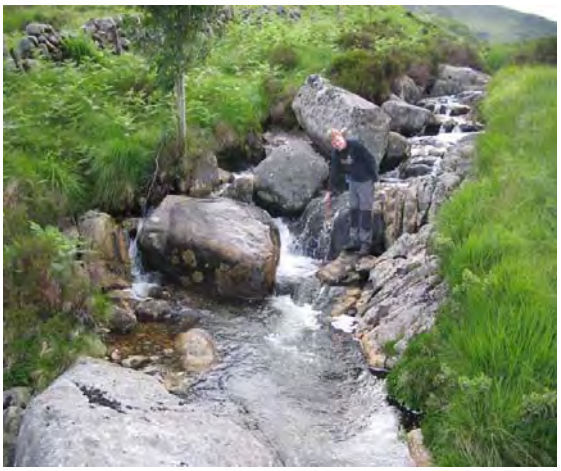

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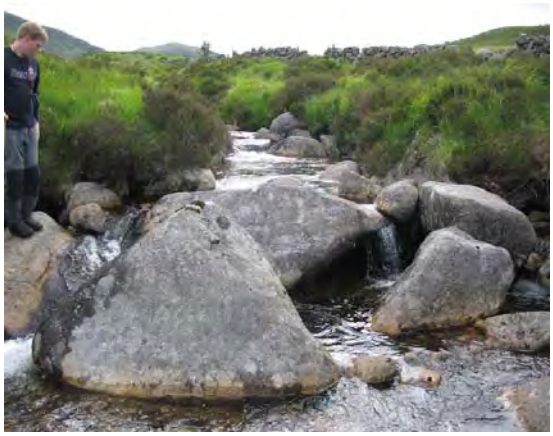

DLO12