

**COIRE GLAS PUMPED STORAGE SCHEME:  
FISH HABITAT AND POPULATION SURVEYS**

Final report

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**Waterside Ecology**

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## 1 Summary

### 1.1 Habitats

- Spawning habitats suited to salmonids and lampreys are present in the lower accessible reaches of the Kilfinnan Burn, close to Loch Lochy.
- The burn may be accessible to migratory fish only in its lower 400m, as the bridge apron at Kilfinnan appears to create a difficult obstacle at most flows.
- Upstream from Kilfinnan the burn is steep with large areas of bedrock and numerous rapids and waterfalls. Salmonid habitat is consequently of poor quality and resident trout populations are likely to persist mainly in fragmented pockets of suitable habitat separated by obstacles.
- The Kilfinnan Fall at NN271976 is clearly impassable. Immediately upstream from the fall there is a long, incised bedrock gorge with several further waterfalls.
- Immediately upstream from the gorge, habitats comprise alternating reaches of boulder and bedrock dominated habitats. Good quality trout habitat is present in the 1.2 km of stream immediately below Loch a' Choire Ghlais.
- Loch a' Choire Ghlais is a shallow, weedy basin that nowhere exceeds 50 cm depth. Substrate is mud and decaying vegetation. It was observed to hold a good number of small trout.
- The inflow stream at NN22819510 at the northwest end of Loch a' Choire Ghlais provides large areas of good quality spawning habitat.

### 1.2 Fish populations

- Juvenile trout were present at all survey sites with the exception of one small stream running into the southwest side of Loch a' Choire Ghlais.
- Juvenile trout were abundant in the lower reaches of the Kilfinnan Burn. Some of these are likely to contribute to the sea trout population. Upstream from impassable obstacles, trout will largely be resident.
- A high density of trout fry was found in the stream running into the northwest side of Loch a' Choire Ghlais, consistent with the presence of spawning habitat in this stream.
- Loch a' Choire Ghlais is considered to be unsuitable for Arctic charr due to its small size, extremely shallow water and lack of suitable substrate.
- Larval lampreys were present only in the lower reaches of the Kilfinnan Burn, accessible from Loch Lochy. These are likely to be brook lampreys.
- Other fish species present in Kilfinnan Burn were eels and minnows. Eels were present at two sites downstream from Kilfinnan Fall. Minnows were found only at the site closest to Loch Lochy. It is likely that the upper catchment of the Kilfinnan Burn is largely inaccessible to eels due to the very high waterfalls and deep gorges.

### 1.3 Loch Lochy shore

- From NN251931 to NN261941 the shoreline substrates of Loch Lochy show consistent depth zonation with a boulder-dominated upper shore, a mixed shallow littoral zone and steep drop off onto mud or sand at a depth of around 4m.
- The exception to the above pattern is in the shallow, weedy bay to the immediate NE of Glas-Dhoire where substrate is composed of sand and cobble.
- Potential spawning habitat for Arctic charr is widespread in the shallow littoral zone. However, it should be noted that no reliable Arctic charr records have ever been identified from Loch Lochy.
- The shallow bay to the northeast of Glas-Dhoire, at NN254934 provides suitable spawning habitat for pike.

## 2 Background

### 2.1 Proposed scheme

The proposed pumped storage scheme will store water from the upper catchment of the Kilfinnan Burn, one of the inflow streams to Loch Lochy. A dam at NN237957 will form a reservoir that will inundate the existing Loch a' Choire Ghlais (NN229951), 1.2 km of its outflow stream and the lower reaches of its inflow streams. This reservoir will provide upper storage while Loch Lochy will provide lower storage. Pipes and tunnels will run downhill from the new reservoir to Loch Lochy where a tailrace and intake structure will be constructed, probably in the area immediately to the northeast of Glas-Dhoire (NN254932). Potential impacts on aquatic habitats include:

- Altered flow regime downstream from dam;
- Construction impacts at location of dam;
- Inundation effects behind dam;
- Damage to nearshore habitats in Loch Lochy.

These effects have implications for fish populations. This document presents the findings of: (i) a fish habitat survey covering stream habitats between Loch Lochy and Loch a' Choire Ghlais, (ii) an electric fishing survey of the same streams, (iii) an assessment of littoral habitats in Loch a' Choire Ghlais and (iv) a shoreline survey of Loch Lochy covering the potential locations of the intake structure and tailrace. All surveys were carried out to inform the Environmental Impact Assessment for the Environmental Statement. It is recognised that as well as the potential impacts listed above, further potential impacts on fish could result from changes in water quality, water temperature or wider hydrology in the Lochy system. These are outwith the scope of this report.

### 2.2 Existing information on fish populations

Salmon and trout spawn in the lower, accessible reaches of the Kilfinnan Burn (Watt *et al.* 1998). Brook lampreys are present in the catchment of the River Lochy (Watt & Ravenscroft 2005) and are likely to be present in the lower, accessible reaches of the Kilfinnan Burn if suitable habitats are present. Minnows are present in Loch Lochy. Pike are listed on a number of angling websites as being present in Loch Lochy, although the National Biodiversity Network (NBN) Gateway shows no records. Eels are likely to be present in all watercourses, although they may be scarce or absent upstream from large waterfalls or other major barriers.

Professor Peter Maitland's early tables of Arctic charr lochs in Scotland include Loch Lochy. However, no records of Arctic charr are listed from Lochy or the Kilfinnan Burn sub-catchment on NBN Gateway<sup>1</sup>. Arctic charr are present in the wider catchment including Loch Arkaig, which is upstream from Loch Lochy.

Brown trout, Arctic charr and salmon are listed on the UK Biodiversity Action Plan (BAP). Salmon and brook lampreys are also listed on Annex IIa of the Habitats Directive and Appendix III of the Bern Convention.

### 2.3 Objectives

The objectives of this report are to:

- (i) Describe the habitats in the Kilfinnan Burn, Allt a' Choire Ghlais, Loch a' Choire Ghlais and the inflow streams to Loch a' Choire Ghlais;
- (ii) Identify the main obstacles to migration in the Kilfinnan Burn and Allt a' Choire Ghlais;
- (iii) Present the results of an electric fishing survey of the Kilfinnan Burn, Allt a' Choire Ghlais and inflow streams to Loch a' Choire Ghlais;
- (iv) Present the findings of a shoreline survey of Loch Lochy, carried out to determine spawning potential for species such as pike and Arctic charr, which if present might be entrained or otherwise impacted e.g. by construction of the tailrace or intake structure.

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<sup>1</sup> The Gateway includes all data collated for the Database and Atlas of Freshwater Fish, including all reliable records held by Professor Maitland.

### 3 Methods

#### 3.1 Habitat survey

A walkover survey of salmonid habitats was carried out on 25th May 2010. This covered approximately 7 km of stream comprising:

- (i) Kilfinnan Burn/Allt a Choire Ghlais from Loch Lochy to Loch a' Choire Ghlais (NN282956 to NN229952)
- (ii) Loch a' Choire Ghlais unnamed inflow streams at NN228950, NN227951 and NN227952.

The survey method was broadly based on the meso-scale method described by Summers *et al.* (1996). This characterises in-stream habitats according to depth, substrate, flow and thus suitability for different age classes of trout. Surveys were based on contiguous sections of approximately 200m in length. Within each survey section areas of juvenile habitat, pools and bedrock were marked on maps. The overall quality and suitability of habitats for juvenile salmonids in each section was scored as good, moderate or poor based on the suitability criteria described by Summers *et al.* Habitat comprising sheet bedrock was scored as unsuitable and unproductive.

Obstacles to migration were recorded and photographed. Their likely permeability for adult trout and/or salmon was assessed. Areas of suitable spawning substrate were recorded.

Other variables to be recorded in each survey section were:

- Up and downstream grid reference
- Wet width
- Stability (of substrate)
- Compaction (of substrate)
- Availability of cover for fish alongside banks

Surveyors also made notes on the broad suitability of each survey section for larval lampreys. These require stable, well-oxygenated areas of fine sand and silt.

#### 3.2 Electric fishing survey

Electric fishing surveys were carried out on 6<sup>th</sup> and 7<sup>th</sup> September 2010. Surveys included semi-quantitative, fully quantitative and qualitative survey in accordance with Scottish Fisheries Coordination Centre protocols (SFCC 2007). Fully quantitative sites were fished through three times. Multiple pass fishing allows absolute fish numbers to be calculated, based on the decline in catch during successive runs. Survey site locations are presented in Table 1. Every effort was made to catch all fish species present during surveys. Fish were held in covered bins prior to processing. Fish were identified and scored separately for each electric fishing run. Salmonid fork length was measured to the nearest 1mm. Scales were collected from trout to assist with age determination. All fish were allowed to recover fully in clean water before being released back into the survey reach.

Table 1 Electric fishing survey sites, Coire Glas hydro scheme.

Site	NGR	General location	Survey type
1	NN2802 9573	Downstream from track. Accessible from Loch Lochy.	Fully-quantitative
2	NN2772 9578	Upstream from track. Possibly inaccessible.	Semi-quantitative
3	NN2532 9629	Upstream from Kilfinnan Falls - inaccessible.	Semi-quantitative
4	NN2358 9561	Downstream from Loch a' Choire Ghlais.	Semi-quantitative
5	NN2278 9508	Loch a' Choire Ghlais inflow stream (section 33), by loch .	Semi-quantitative
6	NN2275 9507	Loch a' Choire Ghlais inflow stream (section 33), upstream.	Semi-quantitative
7	NN2280 9505	Loch a' Choire Ghlais inflow stream (section 34), by loch.	Qualitative

Salmonid densities are presented as the number of fish per 100 square metres of wetted survey area (fish.100m<sup>-2</sup>). The density classifications provided by Godfrey (2006) are used to describe the abundance of trout within a regional context. These classifications are based on large data sets held by SFCC. The 'absolute' quintile ranges of trout densities (Table 2) allow for comparison of fishery performance against regionally based reference points. A second series of 'relative' quintile ranges are

given based on river width, which has a strong influence on expected fish density. The classification system is based on single run minimum density.

Table 2 Trout density classification system for West Region (Godfrey 2006).

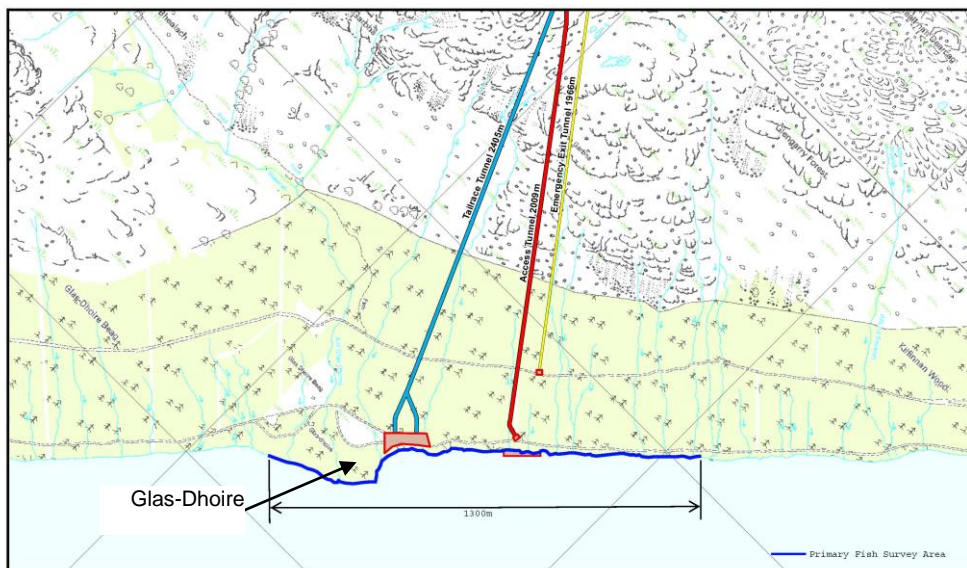
	Absolute density class (all streams)	Relative density based on stream width			
		<4m	4-6m	6-9m	>9m
<b>Trout 0+</b>					
0 <sup>th</sup> percentile	0.24	1.4	0.7	0.5	0.2
20 <sup>th</sup> percentile	1.99	9.9	3.0	1.1	0.8
40 <sup>th</sup> percentile	5.53	28.5	5.0	1.8	1.5
60 <sup>th</sup> percentile	17.29	44.7	12.4	2.7	2.6
80 <sup>th</sup> percentile	50.40	74.4	19.0	5.3	4.0
100 <sup>th</sup> percentile	181.27	181.3	103.5	94.6	9.8
% zero density	15.7	5.0	12.1	18.4	41.2
<b>Trout 1++</b>					
0 <sup>th</sup> percentile	0.49	0.9	0.9	0.8	0.5
20 <sup>th</sup> percentile	1.59	3.9	2.3	1.5	0.7
40 <sup>th</sup> percentile	3.05	5.6	3.3	2.1	0.9
60 <sup>th</sup> percentile	5.28	7.6	5.4	3.2	1.5
80 <sup>th</sup> percentile	8.36	12.1	8.4	4.9	1.8
100 <sup>th</sup> percentile	66.69	66.7	30.3	10.8	6.0
% zero density	16.8	13.8	12.1	18.4	26.5

Timed/area surveys were carried out for larval lampreys at three sites, all close to Loch Lochy. Larval lamprey habitat was largely absent throughout the remaining survey area.

### 3.3 Shoreline and loch surveys

The aim of the shoreline survey of Loch Lochy was to assess the suitability of potential intake and tailrace locations for spawning Arctic charr, trout and pike. The survey was carried out on 26<sup>th</sup> November 2010.

Figure 1 Loch Lochy shoreline survey area.



The surveyor, equipped with a dry suit and snorkel, visually surveyed nearshore habitats from NN251931 to NN261941. An assistant, working from the shore, accompanied the surveyor. Habitats in the littoral zone were described qualitatively. A series of transects were conducted at right angles to the shore, providing quantitative data to underpin habitat descriptions. These transects were conducted at intervals of approximately 100m. Along each transect, the surveyor recorded substrate types (estimated

% area using Wentworth scale), approximate depth and vegetation cover at 10m to 15m intervals. The starting point of each transect was recorded by the assistant using a hand-held GPS.

Similar transects were conducted to describe the habitats in Loch a' Choire Ghlais on 23<sup>rd</sup> April 2011. As the loch is very small, transects ran from the shore out to the middle of the loch. Habitats were described at maximum intervals of 20m, as measured with a range finder.

## 4 Results

### 4.1 Obstacles

There are numerous obstacles to upstream migration in the lower reaches of the Kilfinnan Burn. The most downstream of these is the bridge apron at Kilfinnan (NN27749576), around 400m upstream from Loch Lochy (Table 3 & Figure 1). This is very shallow and water flowing over the apron drops through boulders and broken gabion baskets. It seems likely to be impassable to upstream migrating trout and salmon at most flows. Waterfalls 4.1 and 4.3, about 200m and 400m upstream from the bridge respectively, also seem likely to be impassable, as does the series of waterfalls that create obstacle 6.1 at NN271696455. The Kilfinnan Fall itself, at NN271976, is at least 15m in height and probably much more (it is difficult to approach) and is clearly impassable. Thus it is likely that migratory salmonids are restricted to the lower 600m of the Kilfinnan Burn and, possibly, to the reaches downstream from the bridge.

Upstream from Kilfinnan Fall resident trout populations are likely to be fragmented by several further natural obstacles in survey sections 9 to 24. Trout in Loch a' Choire Ghlais are likely to have downstream access to approximately 1.2 km of stream, as far as the waterfall in section 24, and upstream access into a total of approximately 500m of habitat in the three inflow streams.

Table 3 Obstacles identified during the habitat survey.

Watercourse	Code	NGR	Passable	Type	Notes
Kilfinnan Burn	3.1	NN2774 9576	No (up)?	Shallow bridge apron	No jump pool, broken gabions, probably impassable
Kilfinnan Burn	4.1	NN2748 9594	No (up)?	Waterfall/rapid	2.5m high bedrock chute, probably impassable
Kilfinnan Burn	4.2	NN2745 9597	Unknown	Waterfall	1.2m high shallow sloping bedrock
Kilfinnan Burn	4.3	NN2745 9597	Unknown	3 tier waterfall	1st tier is 1.5m high. 2nd 2.5m twisting - probably impassable. 3rd is 1.5m
Kilfinnan Burn	6.1	NN2718 9622	No (up)?	Series of small falls	Almost certainly impassable, especially at low levels
Kilfinnan Burn	6.2	NN2714 9631	No (up)?	Long bedrock chute	Chute ends with small fall and no pool
Kilfinnan Burn	7.1	NN2716 9639	No (up/down)	Waterfalls	3 m onto rocks, no pool
Kilfinnan Burn	7.2	NN2713 9645	Yes?	Waterfalls	Series of shallow stepped falls, may be passable at high flow
Kilfinnan Burn	8.1	NN2711 9650	No (up/down)	Waterfall	Very high waterfall - Kilfinnan Fall
Allt a' Choire Ghlais	10.1	NN2666 9660	No (up)	Waterfall	Approx 3.5m near vertical, impassable for small trout
Allt a' Choire Ghlais	10.2	NN2662 9658	Unknown	Fall/bedrock chute	Sloping chute - unsafe to examine closely
Allt a' Choire Ghlais	11.1	NN2643 9658	No (up)?	Waterfall	Drops into 1.5m wide cleft, approx. Approx 6m high - unsafe to examine closely
Allt a' Choire Ghlais	12.1	NN2632 9658	No (up)?	3 tier fall	2m vertical in mid, boulder/bedrock chutes above & below
Allt a' Choire Ghlais	13.1	NN2622 9656	Unknown	Bedrock chute	Long sloping chute, possibly passable at high flows?
Allt a' Choire Ghlais	13.2	NN2606 9652	Yes?	Bedrock chute	Long sloping chute, possibly passable at high flows
Allt a' Choire Ghlais	14.1	NN2585 9646	Unknown	Waterfall	Small fall but shallow below
Allt a' Choire Ghlais	15.1	NN2584 9646	No (up)	Bedrock fall	Impassable



Table 3 contd.

Watercourse	Code	NGR	Passable	Type	Notes
Allt a' Choire Ghlais	15.2	NN2575 9638	No (up)	Bedrock fall	Impassable
Allt a' Choire Ghlais	16.1	NN2569 9636	Unknown	Bedrock fall	60m of bedrock falls
Allt a' Choire Ghlais	18.1	NN2515 9625	Unknown	Channel below rocks	Channel disappears below rocks - impassable at low flows
Allt a' Choire Ghlais	18.2	Various	Yes	Bedrock chutes	Number of small bedrock chutes in lower section
Allt a' Choire Ghlais	19.1	NN2494 9619	Unknown	Waterfall	Long bedrock fall possibly impassable
Allt a' Choire Ghlais	23.1	NN2434 9595	No (up)	Waterfall	Drop onto shallow rock then twisting shallow bedrock chute
Allt a' Choire Ghlais	23.2	NN2432 9595	Yes(S/F)	Shallow bedrock	Shallow drop over bedrock
Allt a' Choire Ghlais	24.1	NN2415 9586	Unknown	Waterfall	2.2m with jump at shallow sloping bedrock - difficult
Allt a' Choire Ghlais	25.1	NN2399 9580	No (up)	Waterfall	Series of shallow cascades
West inflow	33.1	NN2253 9512	Unknown	Waterfall	1m jump broken boulder strewn channel difficult
West inflow	33.2	NN2246 9517	No (up/down)	Cascades	>150m bedrock slide
South inflow	34.1	NN2279 9500	No (up/down)	Underground	Stretch underground to NN2277 9496
South inflow	34.1	NN2278 9494	No (up/down)	Waterfalls	Above bedrock fall, stream comes out of cliff at NN2279 9488

#### 4.2 Spawning habitats

Spawning habitat distribution is summarised in Table 4. Large areas of good quality spawning substrate are present in section 1, close to Loch Lochy. Further upstream, spawning habitat is mainly present as small patches among coarser substrates. The main exception is the western inflow to Loch a' Choire Ghlais (section 33), where there are large areas of high quality trout spawning habitat throughout the lower reaches. Spawning habitat quality and distribution is further described in the following sections.

#### 4.3 Stream habitat

##### 4.3.1 Kilfinnan Burn sections 1 and 2 (NN28259562 to NN22809575)

This is the 400m of stream immediately upstream from Loch Lochy. The lower parts of the section are braided with substrates of gravel and pebble (see Appendices 1 & 2), providing good spawning opportunities for salmon and trout (Table 4). Towards the upstream end of section 1 and throughout section 2 the stream is steeper and substrates are primarily cobble and boulder, providing good cover for juvenile salmonids. Some small patches of habitat suitable for larval lampreys are present in section 1 near the loch inflow. Wet width varies from 4m to 9m and bed width from 10m to 15m. Some of the braided areas appear to quite unstable.

##### 4.3.2 Kilfinnan Burn section 3 (NN22809575 to NN27529591)

This section of stream is around 7m in wet width. It is fast flowing with substrates of large boulder surrounded by pebble and gravel. Depth is typically between 15cm and 30cm and there is good cover for juvenile salmonids. The bridge apron at the road at Kilfinnan is shallow and broken, with a vertical downstream face and may be impassable.

##### 4.3.3 Kilfinnan Burn sections 4 to 8 (NN27529591 to NN27069664)

These sections comprise gorge-like, bedrock habitats interspersed with sections of cobble and boulder. The latter provide some suitable habitat for trout and small pockets of gravel and pebble among the boulders offer spawning substrate. The flow in many places is torrential, although quieter pools are present. Substrate is rather unstable. There are many small rapids, cascades and waterfalls, several of which may be impassable. These culminate at Kilfinnan Fall itself, an impressive vertical drop that is unquestionably impassable upstream and appears likely to be lethal for downstream migrants. Larval lamprey habitat is absent throughout these sections.

Table 4 Areas of suitable spawning habitat identified during the survey.

Section	Code	Grid Ref	Area (m <sup>2</sup> )	Salmon	Trout	Washout	Notes
1	1.1	NN28259562	40	Moderate	Moderate	Possible	A bit unstable
2	2.1	NN27949578	3	Poor	Poor	Possible	Patchy gravel among boulder, fry present
2	2.2	NN27889578	3	Poor	Poor	Possible	Patches
3	3.1	NN27529591	2.5	Poor	Poor	Yes	Unstable gravel & pebble in small pool
6	6.1	Various	10	na	Poor	Yes	Unstable patches behind boulders and in pools. Fry present.
7	7.1	Various	4.5	na	Poor	Yes	Small pockets in juvenile habitat or pools. Unstable.
13	13.1	Various	nq	na	Poor	Possible	Tiny patches throughout - unstable?
19	19.1	NN24959619	1	na	Poor	No	Edge pool, may dry out
21	21.1	NN24759611	1	na	Moderate	No	Left side of channel
22	22.1	NN24489601	1.5	na	Moderate	No	
24	24.1	NN24139585	2	na	Moderate	No	Bit coarse for small trout in parts
24	24.2	Various	nq	na	Moderate	No	Patches in glide/riffle
25	25.1	NN24019581	1	na	Moderate	No	Left side of channel
25	25.2	NN23929572	3	na	Moderate	No	Patches through 70m of riffle and shallow glide
26	26.1	NN23879571	2.5	na	Moderate	No	Patches
26	26.2	NN23759565	1.5	na	good	No	Excellent trout spawning right side
27	27.1	Various	3	na	Moderate	No	Scattered patches
27	27.2	NN23609562	1.5	na	Moderate	No	Edge of channel, shallow, may dry up?
28	28.1	Various	2	na	Poor	No	Pockets throughout
29	29.1	Various	1.5	na	Poor	Possible	Scattered tiny patches
30	30.1	Various	nq	na	Poor	Possible	Scattered tiny patches
31	31.1	NN23089527	1	na	Moderate	N	In pool, may dry out at side
31	31.2	Various	nq	na	Poor	N	Patches around boulders and in mixed habitat, may dry out
32	32.1	NN22769513	1	na	Poor	N	Very silted, thin layer over peat, poor.
32	32.2	NN22769515	5	na	Moderate	Y	Patches through 60-70m of pebbly habitat
33	33.1	NN22809508	20	na	Good	No	Excellent in the first 75m immediately up from loch
34	34.1	NN22819506	3	na	Poor	No	Patch at stream mouth may dry out

na = not accessible

nq = not quantifiable (scattered tiny patches)

Figure 2 Habitat survey sections 1 to 18

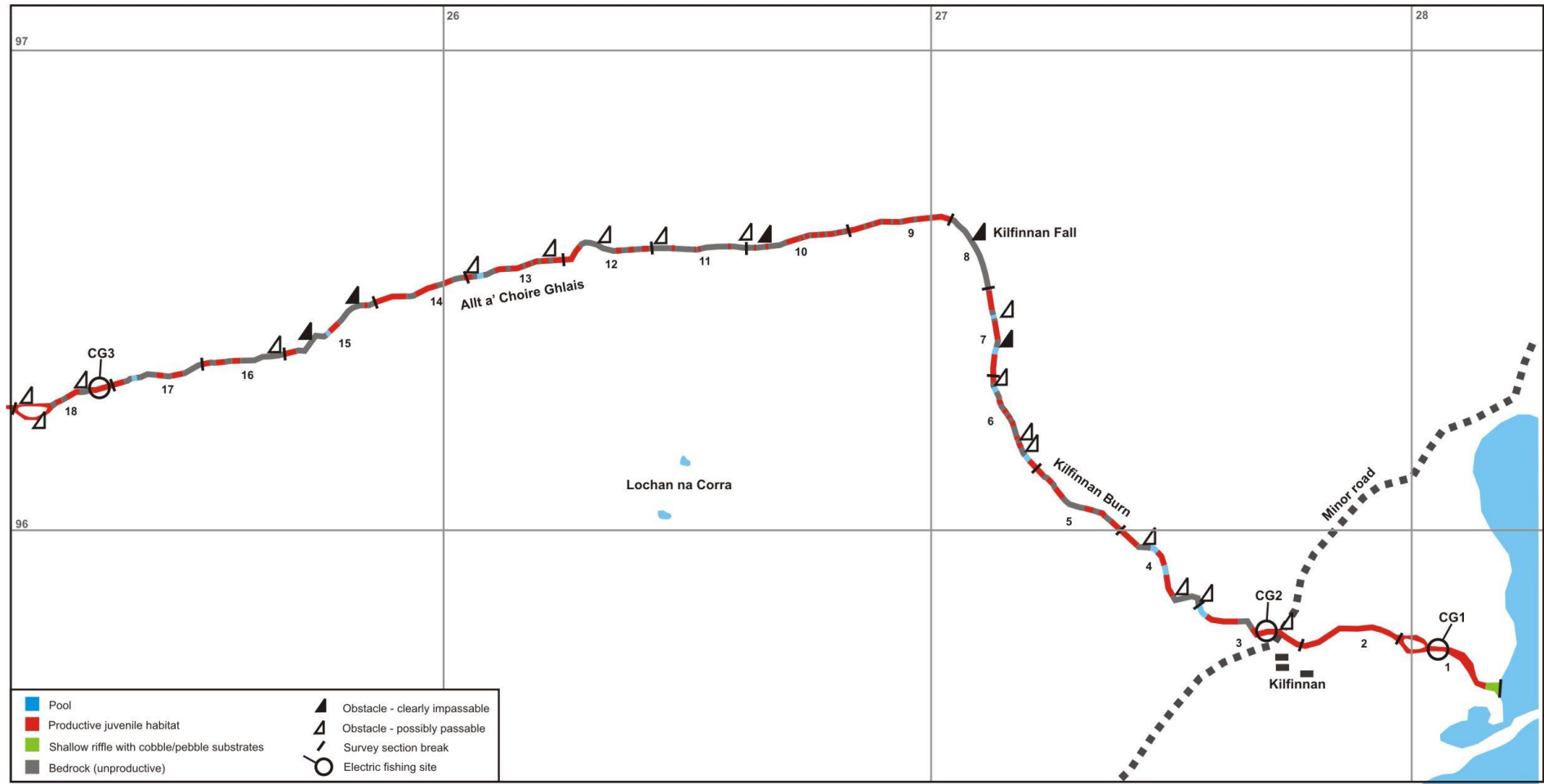
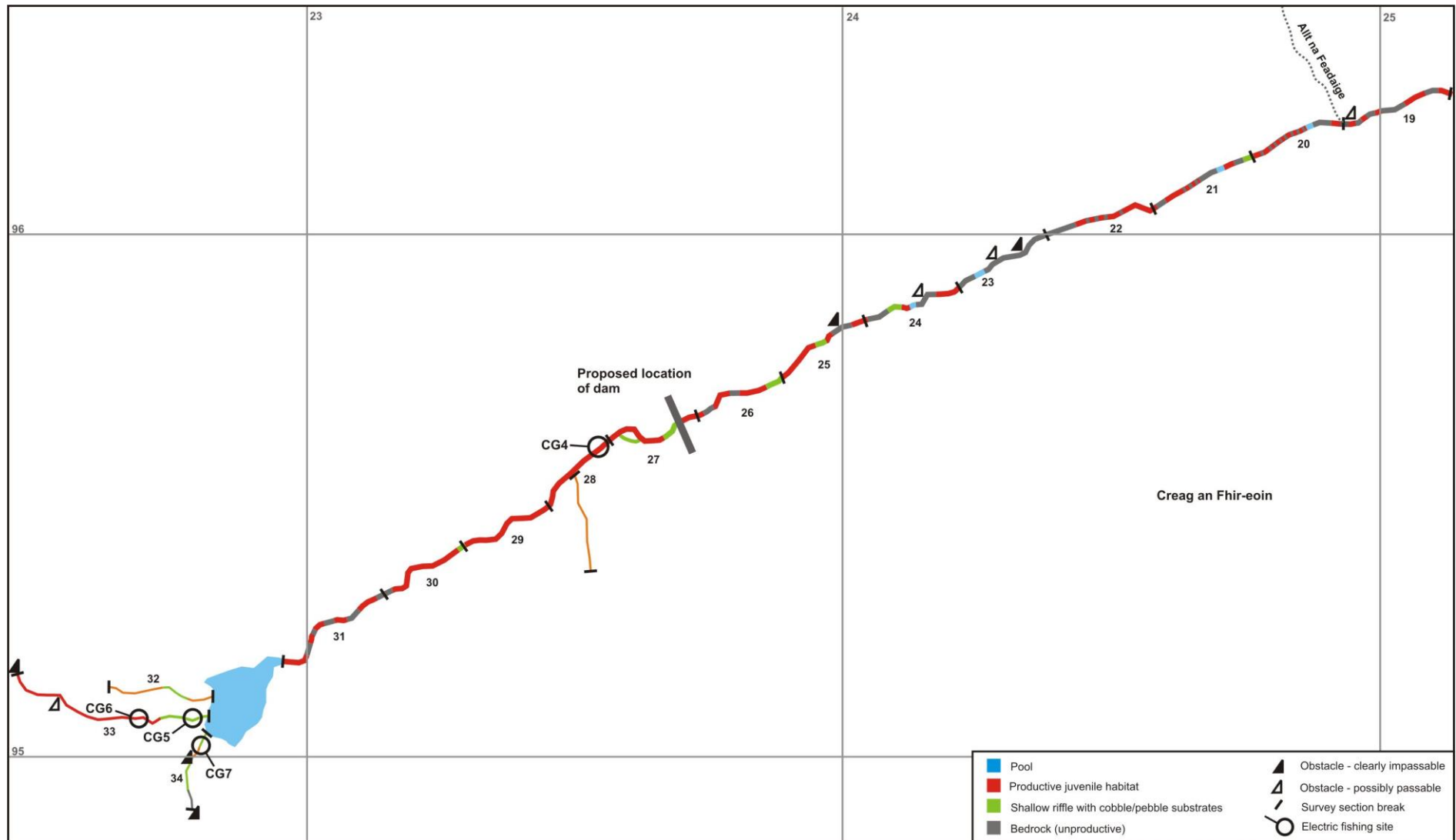


Figure 3 Habitat survey sections 19 to 34



#### 4.3.4 Allt a Choire Ghlais sections 9 to 12 (NN27529591 to NN26249656)

These sections comprise the incised, bedrock gorge extending upstream for approximately 850m from Kilfinann Fall. The sides are steep and in places of precipitous bedrock, so that these sections could not be fully surveyed due to concerns over safety. All four sections were inspected from the south bank. It was clear that the habitat is dominated by sheet bedrock with some sections of unstable boulder and pebble. There are a number of deep pools. At least three waterfalls were recorded that present significant obstacles to upstream migration (Table 3).

#### 4.3.5 Allt a Choire Ghlais sections 13 to 24 (NN26249656 to NN24059582)

Upstream from the gorge there is about 2.5km of steep, fast flowing stream with alternating sections of bedrock and boulder. Smaller substrates of pebble and cobble are present in the boulder-dominated areas and these parts of the stream provide suitable habitat for young trout. Pockets of gravel and pebble are present, where spawning could take place. Adult trout may find refuge in the deeper pools. This type of habitat makes up around 40% of the total through these sections, the remainder being mainly bedrock that provides very poor fish habitat. Waterfalls in sections 13, 16, 19, 23 and 24 may be impassable at most or all flows. Larval lamprey habitat is absent. Wet width is typically between 3m and 5m.

#### 4.3.6 Allt a Choire Ghlais sections 25 to 31 (NN24059582 to NN22949518)

These sections are the 1.2km of stream immediately downstream from Loch a' Choire Ghlais. Most of this reach has a moderate gradient and substrates dominated by cobbles, pebble and scattered boulders. Riffle, run and pool sequences are present and draped heather provides some cover along the margins. Much of this part of the stream provides good quality habitat for juvenile trout. There are several areas that provide suitable habitat for spawning (Table 4). Juvenile trout appeared to be numerous. A bedrock shelf in section 31, about 150m downstream from Loch a' Choire Ghlais, may impede movements of fish between the stream and the loch at some flows. The stream is typically 3m to 4m wet width with a bank base width of about 5m. Depth is mainly between 10cm and 25cm. Larval lamprey habitat is very scarce, existing only as a few thin strips of unstable sand along the margins.

#### 4.3.7 Section 32 (NN22809514 to NN22689500)

This is the small, unnamed inflow stream on the northwest side of Loch a' Choire Ghlais. The lower 150m is accessible to fish at higher flows. Some small patches of pebble and cobble are present, but these are mainly set in peat and do not provide spawning habitat. Some of the stream flows below the peat. Wet width is about 0.5m. Overall, the stream provides little suitable trout habitat and no fish were seen.

#### 4.3.8 Section 33 (NN22819510 to NN22469517)

This is the unnamed stream flowing into the northwest side of Loch a' Choire Ghlais. The lower 300m of the stream are accessible from the loch. Wet width is between 1m and 1.5m. The 75m of stream immediately upstream from the loch provides large areas of good spawning habitat for trout (Table 4), with stable substrates of pebble and gravel. Further upstream there is cover for young trout among cobbles and boulders. A small waterfall (height ~ 1m) at NN22539512 may prevent access further upstream, as the jump-off area is broken, shallow and boulder strewn. Suitable trout habitat extends a further 110m further upstream above this, beyond which the stream is entirely unsuited fish, being a steep cascade over bedrock. This stream is likely to be an important spawning area for trout in Loch a' Choire Ghlais.

#### 4.3.9 Section 34 (NN22809506 to NN22799488)

This is the small, unnamed inflow stream at the southwest end of Loch a' Choire Ghlais. It is around 0.5m wet width. The lower 200m provide some suitable habitat for trout fry and small pockets of habitat may permit spawning. However, due to its small size it seems probable that this stream will at times run nearly dry. Some of the channel flows beneath the turf. The upstream limit of the section is the point at which the burn cascades down from the cliffs of Sron a Choire Ghairbh.

### 4.4 Loch a' Choire Ghlais

Loch a' Choire Glais forms a shallow, muddy basin with a depth that never exceeds 0.5m (see Appendix 4). Substrate across the full width of the loch, except for a few shallow marginal areas, is very soft and seems to be composed of peat, silt and decomposed vegetation. The submerged vegetation forms a dense mat across the entire loch, with the exception of a few marginal areas, and areas of bare

substrates are absent. Vegetation is dominated by bulbous rush *Juncus bulbosus* with patches of spike-rush *Eleocharis palustris* and broad-leaved pondweed *Potamogeton natans*.

There is a narrow strip around the loch margin where vegetation is scarce or lacking. This extends some 5m from the shore to a depth of approximately 0.10m. The northern and western loch margins are dominated by silt and sand with scattered boulders and cobbles. The eastern and southern shores have a higher proportion of coarse substrates with a few patches of gravel, pebble and coarse sand that might permit marginal spawning by trout. All potential spawning habitats that were identified were in less than 0.15m water depth and located less than 2m from the loch shore. Spawning habitat suitable for trout, or any other salmonid species, is entirely lacking from the rest of the loch. Numerous small trout were seen in the loch during all surveys.

#### 4.5 Loch Lochy shoreline survey

Despite good light and a prolonged period of dry weather reducing runoff from inflow streams, maximum vertical visibility was restricted to about 5m depth. The survey therefore covered nearshore littoral habitats only.

A clear and relatively consistent depth zonation of substrate type was evident along most of the surveyed area. The upper shore is composed largely of boulder with wave-washed gravel and pebble. There are occasional outcrops of bedrock, but these are not abundant. In 1m to 2m depth of water the substrates are composed of scattered boulders with more pebble, coarse sand and cobble than is visible on the upper shore. This habitat appears quite stable, with occasional small patches of vegetation. At a distance of 20m to 30m offshore and a depth of about 3m the gradient of the littoral zone increases in a classic “drop-off”. The first part of the down-slope is composed almost entirely of cobble with a rapid transition to sand or mud at a depth of  $\leq 4$ m. This sandy/muddy substrate extends down to the limit of visibility. Available bathymetry suggests that the steep gradient continues, with a depth of 30m attained at a distance of around 50m to 75m from the shore.

The chief exception to the above pattern is found in the bay to the northeast of Glas-Dhoire (see Figure 2), from NN25449337 to NN25519350. Here the nearshore substrate is composed of sand and cobble with abundant vegetation (*Myriophyllum sp.* and *Littorella sp.*) and woody debris. Such habitat extends some 40m offshore before shelving off into deeper water. This environment is presumably created by fine material and organic matter, propelled by local currents and the prevailing southwesterly winds, depositing behind the spit that runs out into the loch from the Allt Glas-Dhoire.

#### 4.6 Fish populations

Trout fry and parr were present at all survey sites (Table 5), with the exception of site CG7 where no fish were captured.

Table 5 Electric fishing survey results.

Site	Area	Trout (fish.100m <sup>-2</sup> )		Salmon (fish.100m <sup>-2</sup> )		Other fish species
		<i>Fry</i>	<i>Parr</i>	<i>Fry</i>	<i>Parr</i>	
CG1	112.7	<i>76.7 ± 2.7</i>	<i>51.9 ± 1.4</i>	0.0	0.0	4 minnow, 3 eels
CG2	196.0	15.3	19.9	0.0	0.0	2 eels
CG3	110.3	4.5	8.2	0.0	0.0	None
CG4	107.3	8.4	14.0	0.0	0.0	None
CG5	20.0	60.0	20.0	0.0	0.0	None
CG6	66.0	1.5	33.3	0.0	0.0	None
CG7	NA	Absent	Absent	Absent	Absent	None

Note: *Italics indicate Zippin densities ± 95% confidence limits. Other densities are based on single run fishing.*

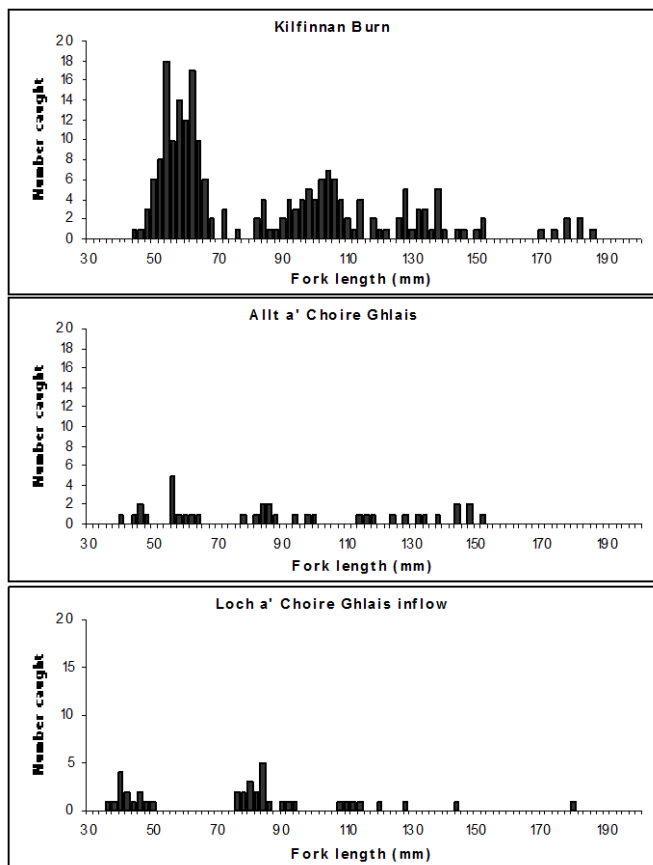
Trout numbers were high in the Kilfinnan Burn. At sites CG1 and CG2 the densities of trout fry and parr would be considered excellent by regional standards (Godfrey 2006). Site CG1 is accessible from Loch Lochy and it would be expected that a proportion of trout at this site will become sea trout. Site CG2 is located upstream from the road bridge at Kilfinnan. The high density of juvenile trout at this site may suggest that it is accessible to adult trout from the loch at some flows, although, as noted above, the bridge apron appears to create a significant barrier.

In the Allt a' Choire Ghlais, trout fry densities at sites CG3 and CG4 were rather poor for a stream of this size, but moderate densities of parr were present. These sites are upstream from waterfalls and are

clearly inaccessible to migratory fish. Site CG4 is probably accessible from Loch a' Choire Ghlais however, and is in an area of relatively good quality trout habitat.

A high density of trout fry was present in the lower reaches of the unnamed inflow at the northwest end of Loch a' Choire Ghlais (site CG5 in habitat survey section 33). This is consistent with the presence of good quality spawning habitat in the lower reaches of this stream. Further upstream at site CG6, trout parr density was high but few fry were present. These data suggest that trout spawn mainly in the lower reaches of this stream and that some fry or parr migrate upstream from the spawning areas. The majority of fry are likely to drop downstream into the Loch a' Choire Ghlais. No fish were present at site CG7, in the little stream flowing into the loch from the southwest

Figure 4 Trout size distributions



Mean length of trout fry in the Kilfinnan Burn was 58.7mm ( $\pm 5.5$ mm s.d.). Further upstream in Allt a' Choire Ghlais and the loch inflow streams the trout fry were smaller with mean lengths of 53.9mm  $\pm 7.2$ mm and 43.1mm  $\pm 4.0$ mm respectively (see Figure 4). A similar trend was evident in the length of 1+ trout parr.

Salmon were absent from all sites. Only sites CG1 and, perhaps, CG2 would be expected to be accessible to salmon.

Eels were present in low numbers at sites CG1 and CG2 but they were absent from all sites upstream from Kilfinnan Fall. It is likely that the gorges and waterfalls in sections 8 to 10 present an insurmountable barrier, even to the migratory abilities of eels.

Minnnows were present at site CG1 only.

Larval lampreys were present in three patches of larval habitat at NN28239562 near Loch Lochy (Table 6). Density in these patches ranged from 2 to 13.8 larvae.m<sup>-2</sup>. All of the larvae caught were *Lampetra* species i.e. either brook or river lampreys. No transformers were captured that would have allowed reliable identification to species. Spot checks at other electric fishing sites found no larvae.

Table 6 Lamprey survey results (all sites close together at NN28239562).

Description	Time fished	Area (m <sup>2</sup> )	Larvae (n)	Minimum density (larvae.m <sup>-2</sup> )	Length range (mm)
Downstream end of island right bank	10 mins.	4	55	13.8	15 - 124
Left bank below willow	6 mins.	2	5	2.5	63 - 112
Side channel bay to north of main channel	2.5 mins.	1	2	2.0	67 - 116

## 5 Interpretation

### 5.1 Fish populations of the Kilfinnan Burn/Allt a' Choire Ghlais

Trout dominate the fish population of the Kilfinnan Burn and, other than in the reaches that are accessible from Loch Lochy, seem to be the only fish species present. In those parts of the stream that are accessible from Loch Lochy it is probable that some of the juvenile trout that are present will migrate as sea trout. Upstream from impassable barriers, the majority of trout will be non migratory. Due to the

presence of several insurmountable barriers, the non-migratory trout within the study area are likely to persist as a number of largely discrete sub-populations. Trout in Loch Lochy and the lower reaches of the burn cannot penetrate upstream of Kilfinnan Fall and may be largely restricted to the lowest reaches by the bridge apron at Kilfinnan and the waterfalls in section 4. Upstream from Kilfinnan Fall, further impassable barriers in sections 11, 12, 15, 23 and 25 further limit movement between various sections of the stream. In between these obstacles trout will persist as fragmented sub-populations, each probably supplemented by downstream displacement of juveniles from habitats further upstream.

Lamprey larvae and minnows captured at CG1, the most downstream site, do not appear to penetrate far upstream, where steep gradients result in habitats that are unsuited to either species. It is likely that the lamprey species present is the brook lamprey *Lampetra planeri*. This is the only *Lampetra* species known to be present in the River Lochy catchment (Watt & Ravenscroft 2005) and it seems unlikely that any of the migratory species would ascend the fish pass at Mucomir into Loch Lochy.

Eels were found only at the two most downstream sites. While eels can move overland through wet vegetation to circumvent impassable obstacles, the Kilfinnan Fall may be a complete barrier. To move around the waterfall would require an ascent of the steep, heather clad sides of the gorge and passage through several hundred metres of heath, also dominated by mature heather. This would be a major challenge, even to the renowned migratory powers of an eel. It therefore seems likely that eels are absent, or at least extremely scarce, upstream from Kilfinnan Fall.

Previous surveys have found salmon in the lower reaches of the Kilfinnan Burn (Watt *et al.* 1998) and their absence during the current survey may suggest that spawning by salmon in this stream is intermittent. Nevertheless it is apparent that the spawning substrates identified in the lower reaches of the Kilfinnan Burn are suitable for salmon as well as being utilised by trout. At the time of survey, there was a very high fry density at site CG1. The alluvial fan at the lower end of the stream also provides the only area of suitable habitat for larval lampreys that was recorded during the survey, as well as the best spawning habitat for lampreys.

## 5.2 Loch a' Choire Ghlais

It was apparent during all three visits that Loch a' Choire Ghlais is well populated with small trout, as are the lower reaches of the stream that flows into it from the northeast. This stream provides plentiful, high quality spawning substrate and further spawning opportunities are present in the outflow stream. The substrate of the loch itself is composed almost entirely of mud and decomposing vegetation, and the water depth is less than 50cm across its full width. Such habitat would be considered unsuited to Arctic charr, which require the presence of hard substrates for spawning. Cobble and boulder substrates are also considered important for lake dwelling juvenile and adult Arctic charr (Bradbury *et al.* 1999), although the latter also inhabit pelagic habitats. Such habitats are lacking from Loch a' Choire Ghlais, except in the margins in less than 10cm of water. Furthermore, in situations where Arctic charr co-exist with brown trout, they are generally confined to deeper epibenthic or pelagic habitats where they feed on zooplankton and deep water zoobenthos (Hindar and Jonsson 1982; Klemetsen *et al.* 2003; L'Abée-Lund *et al.* 1992). The lack of such habitats and abundance of brown trout in Loch a' Choire Ghlais further decrease the likelihood that a Arctic charr population could persist in this small loch. It can be concluded that Loch a' Choire Ghlais is unsuited to Arctic charr.

## 5.3 Loch Lochy shoreline

Much of the shoreline survey area appeared to offer some limited spawning opportunity for Arctic charr, with widespread patches of gravel, coarse sand and pebble among the larger substrates, mainly at a depth of 1m – 2m. These potential spawning habitats are present in the form of scattered patches among otherwise unsuitable habitat. Such patches are very widespread and could not be quantified. No redds were noted, but as there are no reliable records of Arctic charr from Loch Lochy this is unsurprising.

Pike spawn in the spring when water temperature is rising and reaches between 4°C and 11°C. Pike may make quite long migrations to reach suitable spawning areas, with the males migrating first. Ideal spawning habitat is densely vegetated and spawning occurs among a wide variety of vegetation types including both submerged and emergent species. Frost and Kipling (1969) describe typical spawning sites in Lake Windermere as sheltered areas with a gritty or silty substrate with stands of submerged vegetation, a description that would also fit the sandy, weedy bay near Glas-Dhoire (NN255934). It is highly likely that pike in Loch Lochy use this bay for spawning.



## 6 Potential impacts

### 6.1 Evaluation of fish populations

The two fish populations occurring in the survey area that are of most conservation interest are those of trout and brook lamprey. Trout are a priority species on the UK Biodiversity Action Plan (BAP), so are categorised as being of 'Medium Importance' within the context of SEPA's supporting guidance for impact assessment (SEPA 2009). Brook lampreys are categorised as being of 'Low Importance' in SEPA's assessment procedures, as they are listed on the local BAP, but they are not a UK BAP species. They are however listed on Annex II of the Habitats Directive. Salmon are known to spawn in the lower reaches of the Kilfinnan Burn during some years. The Atlantic salmon is also listed under Annex II of the Habitats and Species Directive and, like trout, is a UK BAP priority species.

### 6.2 Potential impacts of inundation

Inundation behind the proposed dam will have profound effects on the habitats in Loch a' Choire Ghlais and in sections 27 to 31 of the Allt a' Choire Ghlais. Sections 27 to 31 of the Allt a' Choire Ghlais contain much of the better quality trout habitat upstream from the Kilfinnan Fall. Habitats further downstream are generally steeper and less stable, with a higher proportion of boulder and bedrock. The potential impacts of water level fluctuations both during the construction and operational phases of the proposed development seem likely to result in the loss of the majority of suitable spawning habitats for trout in the above reaches as well as in the Loch a' Choire Ghlais inflow streams. Furthermore, rapidly fluctuating water levels in the proposed reservoir are likely to devastate the littoral flora and fauna of the loch (see Smith *et al.* 1987). As trout mainly feed in the littoral area, this too will be expected to have serious negative consequences for the trout population.

Whether the existing population will manage to persist in the new reservoir is debatable and will depend on (i) the potential impacts of construction and (ii) the nature of the post-development habitat. It is worth noting that a trout population is present in Loch Cruachan, the artificially created upper reservoir for the Cruachan pumped storage scheme. These fish, as well as the Arctic charr, eels, minnows, perch and three-spined sticklebacks also present in Loch Cruachan, must originally have been pumped up from Loch Awe (Maitland & Campbell 1997). It is conceivable that even if the trout population behind the dam at Coire Glas is extirpated, a fish fauna may become reestablished via transfer from Loch Lochy.

### 6.3 Potential impacts of fish transfer

If transferred, e.g. by entrainment, to Loch a' Choire Ghlais, pike would be expected to impact any remaining trout populations through predation. Minnows may compete for space and food with trout fry and can have detrimental impacts on trout populations in some circumstances.

### 6.4 Potential impacts downstream from the proposed dam

Potential impacts on the fish fauna downstream from the dam can be expected during construction, unless suitable mitigation is put in place to minimise pollution, siltation and changes to flow. The post-construction flow regime is likely to be significantly altered and this too may impact on fish. At present, no information on the likely level of compensation flow is available. The habitat immediately downstream from the dam is of moderate quality for trout and habitat quality tends to decline further as one progresses downstream, with unstable substrate, a lack of cover alongside the banks, and increasing amounts of bedrock as the gradient becomes steeper (see Appendix 1). Assuming that adequate compensation flow can be provided to maintain the wetted stream habitat, it is probable that trout will persist through these reaches. Indeed, it might be argued that the ameliorating effect of the proposed dam on spates may reduce substrate instability with positive effects e.g. on spawning and over-wintering habitats. However, any such effect would have to be balanced against the partial loss of flushing flows, which can be important in maintaining spawning habitat quality. Loss of flushing flows will be particularly significant in sections 20 to 26, which will not benefit from unaltered flows in the Allt na Feadaige, a large tributary from the north (see Figure 2).

Construction of the dam may also be expected to have potential impacts on the supply of sediments to the reaches further downstream. Any winnowing away of sediments would tend to begin immediately downstream from the dam, impacting the better habitat first. As habitats further downstream are already somewhat unstable, these may ultimately become very poor were inputs of new material to cease or slow. Any reduction in sediment supply could have impacts on all reaches downstream from the dam, including potential impacts on the alluvial fan and the accessible lower reaches of the stream. At present, no information on the morphological impacts of the scheme are available.

### 6.5 Potential impacts on the habitats in Loch Lochy

While no records of Arctic charr have been identified from Loch Lochy, the littoral zone was surveyed for potential Arctic charr spawning habitat as a precaution. Due to the very widespread presence of potential spawning habitat in the littoral zone it is not possible to identify any particularly sensitive areas of shoreline that should be avoided during tailrace or intake construction. Some suitable spawning habitat would be disrupted by construction at most locations within the survey area, other than the bay to the northeast of Glas-Dhoire. However, the shallow weedy habitats in this bay add significantly to the diversity of the nearshore habitat and, from a fisheries perspective, provide good foraging habitat for adult and juvenile trout. It is also probable that larval lampreys are present at low density in the softer areas of sediment. Given that there are no reliable records of Arctic charr from Loch Lochy, and since potential spawning habitats for Arctic charr are very widespread throughout the rest of the survey reach, the loss to construction of a relatively small proportion of the littoral zone further north and east may be preferable to damaging the locally scarce habitats of this bay.

The lower reaches of the Allt Glas-Dhoire were briefly inspected and seem to offer a few patches of spawning habitat likely to be utilised by trout and, perhaps, occasional salmon. Construction of an intake at this location would increase the chances of entrainment of juvenile trout and (possibly) salmon parr as they descend from Allt Glas-Dhoire into Loch Lochy. Ideally, construction of the intake should avoid the area immediately in front of this stream.

The weedy bay near Glas-Dhoire (NN255934) provides suitable spawning habitat for pike. Construction of an intake close to this area may increase the probability that pike eggs or larvae will be transferred up to the proposed Loch a' Choire Ghlais reservoir.

### 6.6 Wider impacts on loch levels and flows

Water management in the catchment of the River Lochy is complex. Water levels in the River Lochy itself are affected by major abstractions for aluminium smelting and by the operation of the Mucomir barrage at the south end of Loch Lochy. Superimposing a pumped storage scheme on these existing modifications has the potential to further alter flow regimes, with the potential to affect both fish populations and fisheries in the river. An assessment of these impacts is outside the scope of this report but, it is understood, will form part of the wider assessment of overall scheme impacts.

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Appendix 1. Stream survey sections and habitat description and assessment of overall quality for juvenile salmonids

Section Code	NGR		Instream habitat	Banks	Quality
	Downstream	Upstream			
1	NN2825 9562	NN2297 9577	Spawning/fry habitat in lower, upper good cover boulders, stable, 10-20 cm deep	Heavily grazed among riparian alders	Moderate
2	NN2297 9577	NN2280 9575	Stable boulders surround by unstable pebble, good cover, edge habitat for fry, 15-30 cm deep	Riparian trees and scrub, rocky reinforced bank faces	Good
3	NN2280 9575	NN2752 9591	Stable boulder/unstable pebble & cobble. Spawning scattered gravel (<0.5 m), decent cover	Steep stable boulder banks	Moderate
4	NN2752 9591	NN2728 9605	Torrent/pool/run - large stable boulder. Small substrates unstable. Pockets gravel provide unstable spawning.	Light grazing, stable mossy boulder faces	Moderate
5	NN2728 9605	NN2717 9620	Steeper, torrent/pool, boulder, bedrock. Unstable pebble/cobble. Decent cover but little spawning	Stable mossy boulder	Moderate
6	NN2717 9620	NN2713 9632	Falls/torrents/bedrock chutes with some pools and juvenile trout habitat between. Gravel behind boulders provides unstable spawning	Large boulder or bedrock, bare or short moss	Poor
7	NN2713 9632	NN2711 9650	Similar to section 6 with less bedrock. Large boulders, gravel pockets, few cobbles, small pools.	Large boulder or bedrock, bare or short moss	Poor
8	NN2711 9650	NN2711 9650	Steep with bedrock and falls/torrents. Large boulders	Bedrock gorge	Poor
9 to 12	NN2711 9650	NN2628 9657	Deep incised gorge, pools/deep linns. Unstable boulder/pebble/cobble over bedrock. Fish seen	Steep or vertical bedrock	Poor
13	NN2628 9657	NN2604 9652	Lower 30 m wide low gradient mixed juvenile habitat. Top is steep with bedrock & chutes. 1 large pool	Faces bedrock, tops short grazed grass, heather & few trees	Poor
14	NN2604 9652	NN2585 9646	Lower cobble/gravel/boulder over bedrock, mid low gradient mixed habitat, upper mixed & few falls	Faces bare, tops steep, long vegetation, mixed herb/blaeberry	Moderate
15	NN2585 9646	NN2569 9636	Lower all bedrock, patch mixed habitat then bedrock falls and pools, top 20m mixed	Bank faces bare, tops heathery, trees along bank top	Poor
16	NN2569 9636	NN2552 9634	Steep bedrock lower, shallow gradient bedrock large boulder/cobble top, tiny patches spawning	Bare bank faces, heather on top does not hang over channel	Poor
17	NN2552 9634	NN2533 9630	Bedrock chutes, tiny stretches mixed habitat. Parr seen in very deep bedrock pool at top	Bank faces bare, tops long heather	Poor
18	NN2533 9630	NN2513 9625	More mixed than downstream. Stretches of shallow cobbles/pebbles and occasional boulder.	As downstream	Moderate
19	NN2513 9625	NN2493 9620	Steep mixed juvenile cobble/pebble/boulder. Upper parts has bedrock chutes & shallow bedrock pools	Heather/grass, some undercuts but mostly still bare faces	Moderate
20	NN2493 9620	NN2475 9611	Unstable cobble/pebble over bedrock, large stable boulders, 5-20 cm deep, few deeper pools.	Mature heather does not overhang wetted area	Moderate

Appendix 1. Stream survey sections and habitat description

Section Code	NGR		Instream habitat	Banks	Quality
	Downstream	Upstream			
21	NN2475 9611	NN2459 9603	Decent fry/parr habitat at top. Patchy bedrock. 10-20cm deep. A few pools & pockets of spawning. Fish seen	As above	Moderate
22	NN2459 9603	NN2438 9599	Decent juvenile habitat in run/riffle/glide/pool sequences. 10-25cm deep. Stable. Spawning habitat present. Fish present	Mature heather does not overhang wetted area	Good
23	NN2438 9599	NN2423 9589	Bedrock, very poor, mainly shallow with one deep pool.	Bedrock bank faces predominate	Poor
24	NN2423 9589	NN2405 9582	Some good juvenile habitat interspersed with bedrock, 10-20cm deep, some spawning, fish seen.	Wetted often to banks and some undercuts	Moderate
25	NN2405 9582	NN2388 9571	Lower end bedrock & cascades for 50m. Upstream is pebble & cobble in riffle/run/glide sequences. Lower gradient than sections downstream.	Grass & heather	Good
26	NN2388 9571	NN2369 9564	Good reasonably stable, low gradient cobble/pebble/scattered boulder, run/riffle/glide. Spawning habitat present.	Grass and heather providing little cover, low stable banks	Good
27	NN2369 9564	NN2355 9558	Good quality juvenile trout habitat. Similar to 26	Grass and heather providing little cover, low stable banks	Good
28	NN2355 9558	NN2344 9549	Stable pebble, cobble & scattered boulder. Riffle/run/shallow pool sequences. Good cover.	Low stable banks, grass and heather	Good
29	NN2344 9549	NN2323 9538	Good habitat for fry and parr throughout, as 26 to 28	As 26 to 28	Good
30	NN2323 9538	NN2313 9531	Much very shallow mixed run/riffle over boulder and cobble. Some deeper runs.	Grass and heather overhanging but do not reach water	Good
31	NN2313 9531	NN2294 9518	Lower part of section good mixed juvenile, then bedrock with pools. Top opens out into shallow run. Fish seen.	Grass and heather overhanging but do not reach water	Good
32	NN2280 9514	NN2268 9520	Lower 150m accessible on high flows. Some tunnelled peat. No fish seen.		Poor
33	NN2281 9509	NN2246 9517	Many trout seen between loch and obstacle. Good spawning in lower reaches and pockets right up to obstacle 33.1.		Good
34	NN2280 9506	NN2279 9488	Lower part of reach is fry habitat. Very unstable. Soon becomes steep. Runs underground in places.	Short heather, grass, no good undercuts or overhangs	Poor

Appendix 2. Stream survey data

Section Code	Length (m)	Width (m)		Substrate		Bankside cover		Area (m <sup>2</sup> )	
		Wet	Bank	Stability	Compaction	Left	Right	Productive	Unproductive
1	270	5	12	Partly	Uncompacted	Poor	Poor	1350	0
2	250	9	15	Partly	Uncompacted	Poor	Poor	2250	0
3	250	7	12	Unstable	Uncompacted	Poor	Poor	1470	280
4	250	5	10	Unstable	Uncompacted	Poor	Poor	750	500
5	250	4	10	Unstable	Uncompacted	Poor	Poor	560	440
6	200	4	8	Unstable	Uncompacted	Poor	Poor	400	400
7	200	3	7	Unstable	Uncompacted	Poor	Poor	420	180
8	200	3	6	Unstable	Uncompacted	Poor	Poor	150	450
9 to 12	840	3	7	Unstable	Uncompacted	Poor	Poor	1290	1230
13	205	5	8	Unstable	Uncompacted	Poor	Poor	675	350
14	200	5	8	Unstable	Uncompacted	Poor	Poor	700	300
15	220	6	7	Unstable	Uncompacted	Poor	Poor	420	900
16	200	4	5	Unstable	Uncompacted	Poor	Poor	200	600
17	200	3	5	Unstable	Uncompacted	Poor	Poor	270	330
18	200	2.5	6	Partly	Uncompacted	Poor	Poor	375	125
19	210	4	6	Unstable	Uncompacted	Poor	Poor	340	500
20	200	3	5	Unstable	Uncompacted	Poor	Poor	330	270
21	200	3.5	5	Unstable	Uncompacted	Poor	Poor	420	280
22	210	3	4.5	Partly	Uncompacted	Poor	Poor	390	240
23	200	3	6	Partly	Uncompacted	Poor	Poor	75	525
24	200	4.5	5	Partly	Uncompacted	Mod.	Mod.	450	450
25	200	3	6	Partly	Uncompacted	Poor	Poor	390	210
26	200	4.2	6.5	Partly	Uncompacted	Poor	Poor	630	210
27	200	4	5.5	Stable	Uncompacted	Mod.	Mod.	240	560
28	170	4	5.5	Stable	Uncompacted	Poor	Poor	680	0
29	200	3.8	5	Stable	Uncompacted	Poor	Poor	760	0
30	200	3.5	4	Stable	Uncompacted	Poor	Poor	647	52
31	250	5	7	Stable	Uncompacted	Poor	Poor	500	750
32	200	0.5	0.6	Partly	Uncompacted	Good	Good	25	75
33	400	1	1.5	Partly	Uncompacted	Mod.	Mod.	400	0
34	200	0.5	0.8	Unstable	Uncompacted	Poor	Poor	35	65

Appendix 3. Loch a' Choire Ghlais transect data.

Transect No.	NGR at shore	Direction from shore	Distance from shore	Substrate								Vegetation (%)	Depth (cm)	Notes
				Si	Sa	Gr	Pe	Co	Bo	Be	Ob			
1	NN22909518	206°	0	5	75	0	0	20	0	0	0	0	10	Very shallow with dense mat of emergent vegetation at approx 10 m to 20m from shore. Remaining loch bed covered in dense mat of submerged vegetation dominated by bulbous rush.
			10								100	20		
			20								100	20		
			40								100	40		
			60								100	40		
			80								100	40		
2	NN22829517	140°	0	50	50	0	0	0	0	0	0	5	10	Silt and sand margin. Remaining loch bed covered in dense mat of vegetation. Loch bed very soft - deep, oozy 'mud' apparently composed of peat and decomposed vegetation. Patches of <i>Potamogeton</i> in deeper water.
			10								100	20		
			20								100	40		
			40								100	40		
			60								100	40		
			80								100	40		
3	NN22309510	84°	0	100	0	0	0	0	0	0	0	30	5	As above. Dominated by bulbous rush with 10% <i>Potamogeton</i> at 60m from shore.
			10								100	20		
			20								100	15		
			40								100	30		
			60								100	40		
4	NN22819307	46°	0	100	0	0	0	0	0	0	0	20	20	As transect 3 above.
			10	15	5						80	80	20	
			20								100	90	20	
			40								100	100	30	
			60								100	100	40	
			70								100	100	40	
5	NN22899439	7°	0	20	60	0	0	20	0	0	0	0	10	As transect 4 above.
			10								100	100	15	
			20								100	100	25	
			40								100	100	40	
			60								100	100	40	
			70								100	100	40	
6	NN22919509	308°	0	5	65	5	5	20	0	0	0	0	5	Largely as transect 5 but up to 25% <i>Potamogeton</i> in deeper water at 20 to 45m from shore.
			10								100	100		
			20								100	100		

Appndix 3 contd.

Transect No.	NGR at shore	Direction from shore	Distance from shore	Substrate								Vegetation (%)	Depth (cm)	Notes
				Si	Sa	Gr	Pe	Co	Bo	Be	Ob			
6			40									100		
			50									100		
7	NN22929513	262°	0	0	5	65	10	20	10	0	0	0	10	As 6 above.
			10									100	45	
			20									100	30	
			40									100	40	
			60									100	45	



Appendix 4. Loch Lochy transect data.

Transect No.	NGR at shore	Distance from shore (approx.)	Substrate composition (%)					Vegetation cover (%)	Approx. depth (m)	Notes	
			Silt & sand	Gravel	Pebble	Cobble	Boulder				Bedrock
1	NN25159314	0	0	25	25	25	25	0	0	0	
1		15	0	25	10	35	30	0	0	1.5	Start of drop-off
1		30	100	0	0	0	0	0	0	3.5	Top of slope
1		35	0	0	0	100	0	0	0	4.5	Slopes onto sand/silt
1		45	100	0	0	0	0	0	0	5	
2	NN25259318	0	0	20	20	0	60	0	0	0	
2		15	5	0	0	75	20	0	0	1.5	
2		30	50	0	0	25	25	0	0	3.5	
2		45	50	0	0	25	25	0	0	4.5	
3	NN25349322	0	0	0	15	25	25	35	0	0	
3		15	10	5	5	40	40	0	0	1.2	Start of drop-off
3		30	2	0	10	38	50	0	0	2.5	Deep and dark
3		35									Off burn mouth
4	NN25399323	0	0	0	0	0	60	40	0	0	
4		15	5	20	20	30	25	0	0	0.8	Drop off
4		20	20	0	0	40	40	0	0	5	
5	NN25469329	0	5	10	30	55	0	0	0	0	Steep drop off into deeps
5		7.5	5	10	30	55	0	0	0	5	
6	NN25439341	0	10	5	25	60	0	0	0	0	
6		15	45	5	0	50	0	0	40	1.2	Bay with extensive weed cover at 1-2m depth.
6		30	90	0	0	10	0	0	50	1.8	
6		40	100	0	0	0	0	0	5	5	
7	NN25529350	0	0	5	5	0	90	0	0	0	At drop-off
7		15	80	0	0	20	0	0	40	2.5	Typically slopes gently to cobble slope
7		20	80	0	0	20	0	0	5	5	
8	NN25599358	0	0	5	5	0	0	90	0	0	
8		15	100	0	0	0	0	0	0	2	
8		30	95	0	0	0	5	0	0	4	
8		35		100	0	0	0	0	0	5	
8a	NN25639362	7									Large areas of gravel and coarse sand create suitable salmonid spawning habitat

Appendix 4 contd.

Transect No.	NGR at shore	Distance from shore (approx.)	Substrate composition (%)					Vegetation cover (%)	Approx. depth (m)	Notes	
			Silt & sand	Gravel	Pebble	Cobble	Boulder				Bedrock
9	NN25689367	0	0	0	20	20	0	60	0	0	Bedrock reef
9		15	60	20	10	0	10	0	0	1.8	
9		30	10		0	0	0	0	10	4	
9		35	0	0	0	0	0	100	0	5	
10	NN25779374	0	0	5	5	0	90	0	0	0	
10		15	10	5	10	55	20	0	0	1.5	
10		30	100	0	0	0	0	0	3	3.5	
11	NN25869384	0	5	40	5	20	30	0	0	0	
11		15	45	0	5	35	15	0	0	1.6	
11		30	90	0	0	5	5	0	0	4	
11		40	90	0	0	5	5	0	0	5	
12	NN25939390	0	12	13	0	0	15	60	0	0.1	
12		15	20	0	0	80	0	0	0	2	
12		30	100	0	0	0	0	0	0	5	
13	NN26019398	15	5	2	3	90	0	0		1.5	
13		30	10	5	15	70	0	0	5	3	
13		40	25	10	20	45	0	0	0	5	
14	NN26119407	15	0	0	5	75	20	0	0	1.5	
14		30	10	0	0	90	0	0	0	3	
14		35	100	0	0	0	0	0	0	5	



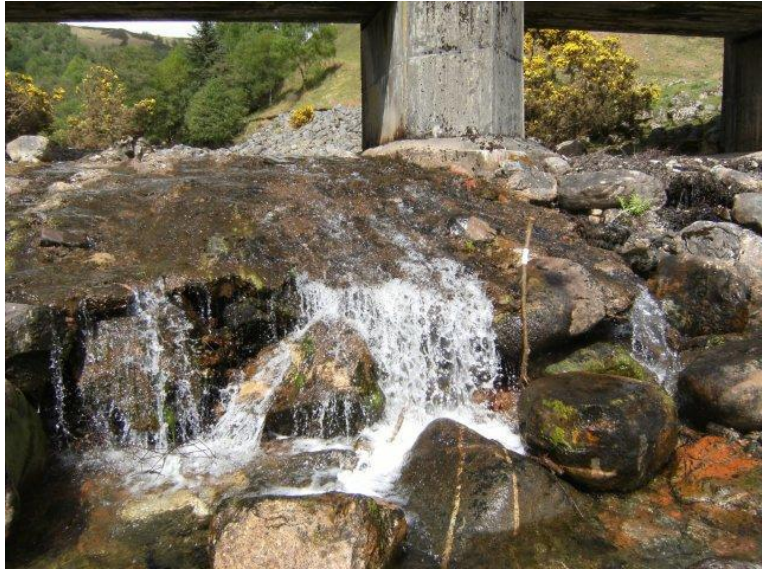
Appendix 5. Electric fishing event details.

Site	Date	NGR	Location	Runs	Width	Length	Equipment	Voltage	Conductivity	Temp	Level	Colour
CG1	07/09/2010	NN2802 9573	Downstream from road. Large alder on left bank. Four boulders 3m into site near downstream end.	3	4.9	23	Backpack	320	47	12.6	low	clear
CG2	07/09/2010	NN2772 9578	From top of bridge. Start at the gabion basket and fish up to natural narrow break	1	5.6	35	Backpack	320	47	12.2	low	clear
CG3	06/09/2010	NN2532 9629	Downstream end marked by large boulder pile and a dead rowan tree (right bank). Three 3 boulders on right bank at upstream end.	1	6.3	17.5	Backpack	300	31	12.3	low	clear
CG4	06/09/2010	NN2358 9561	Site is upstream of island. Starts 6m downstream from large boulder. Ends at boulder with a white spot.	1	3.9	27.5	Backpack	320	23	13	low	clear
CG5	06/09/2010	NN2278 9508	Habitat survey section 33. Start at loch.	1	0.5	40	Backpack	280	25	10.4	low	clear
CG6	06/09/2010	NN2275 9507	Habitat survey section 33. Start at the S-bend and fish up to the bend to right (looking upstream).	1	1.2	55	Backpack	280	25	10.4	low	clear
CG7	06/09/2010	NN2280 9505	Stream 34, lower end starting at loch.	1	Qualitative survey. Approx 50m length.		Backpack	280	19	10.1	low	clear




Appendix 6. Depletions attained at electric fishing site CG1.

Site	Number 0+ trout fry caught			Number 1++ trout parr caught		
	run 1	run 2	run 3	run 1	run 2	run 3
CG1	62	21	2	47	9	2




Appendix 7: Selected photographs

	<p>Kilfinnan Burn section 1. Spawning habitats are present in the reaches near Loch Lochy. Electric fishing found that trout fry and parr were abundant in this area along with eels, larval lampreys and minnows.</p>
	<p>Kilfinnan Burn, section 2. Typical boulder and pebble habitats in accessible reaches</p>
	<p>Bridge apron in section 3, at the Kilfinnan road, may be impassable.</p>






	<p>Obstacle in section 4. One of several difficult obstacles to upstream migration.</p>
	<p>Kilfinnan Burn, section 5. In sections 4 to 8, boulder-dominated habitats such as this are interspersed with steeper bedrock habitat such as that shown above.</p>
	<p>Kilfinnan Fall, in section 8.</p>



	<p>Gorge and waterfalls in sections 8 and 9. A deep, incised gorge extends upstream for a further 0.8km.</p>
	<p>Allt a Choire Ghlais section 16. Survey sections 13 to 24 are characterised by mixed boulder and bedrock habitats.</p>
	<p>Allt a Choire Ghlais, section 28. The 1.2km immediately downstream from Loch a' Choire Ghlais have some of the better trout habitat in the stream.</p>



	<p>Allt a Choire Ghlais section 31, looking upstream to Loch a' Choire Ghlais.</p>
	<p>Feeder stream to Loch a' Choire Ghlais, section 33. This stream provides much habitat suited to spawning trout and trout fry. A high density of trout fry was found electric fishing.</p>
	<p>Typical substrate in Loch a' Choire Ghlais showing thick layer of vegetation (photo taken April 2011).</p>