Blair Hill Wind Farm

Fish Survey Report

Technical Appendix 8.4

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Fisheries electrofishing survey for Blair Hill Wind Farm (Baseline)

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Summary

Fisheries electrofishing survey for Blair Hill Wind Farm (Baseline)

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Electrofishing; Blair Hill; Wind Farm; salmonids; juvenile surveys; baseline

Background

The Galloway Fisheries Trust (GFT) was commissioned by MacArthur Green to carry out baseline electrofishing surveys for the proposed Blair Hill Wind Farm near Newton Stewart in Dumfries and Galloway.

Surveys were undertaken in August 2023 in the River Cree catchment.

Main findings of the 2023 electrofishing survey

- A total of twelve sites within the River Cree catchment were surveyed using electrofishing techniques for this study.
- Eleven sites were found to have sensitive fish populations. One site contained Atlantic salmon and ten sites contained brown trout. One site contained no salmonids, but European eel was present, which are protected.
- One site contained no fish.

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1 INTRODUCTION

Galloway Fisheries Trust (GFT) was commissioned by MacArthur Green to undertake baseline electrofishing surveys for the proposed Blair Hill Wind Farm (hereafter the 'Proposed Development'). Electrofishing surveys were carried out in August 2023 to provide baseline data and an overview of the fish populations present in the area of the Proposed Development.

The Proposed Development lies within the River Cree catchment in the south-west of Scotland.

The possible impacts that any land-based wind farm development and its associated infrastructure could have on surrounding fish populations are well known. The potential for fish species and their habitats to be affected by the Proposed Development mainly occurs during the construction and decommissioning phases. During the construction phase potential impacts include siltation from ground disturbance, accelerated or exacerbated erosion of watercourse banksides, hydrological changes to watercourses and surface water run-off, pollution of watercourses, and the blocking or hindering of the upstream/downstream migration of fish. During the operational phase, concerns include the effects of poor road drainage, accelerated levels of erosion, fish access issues through watercourse crossings such as culverts, and the maintenance of silt traps and watercourse crossings. Potential risks to fish populations and their habitats during the decommissioning phase are broadly similar to those in the construction phase. These potential effects could all impact fish populations by causing direct mortality of juveniles and adults, causing changes in food availability, creating avoidance behaviour resulting in unused habitat, blocking fish migration routes to spawning grounds or causing damage to instream and riparian habitats.

There is a variety of legislation, regulations and guidance in place relating to fish species that may be present in watercourses within the Cree catchment. Atlantic salmon (*Salmo salar*) are an internationally important fish population which is listed under Annex II and V of the European Habitats Directive (1992) (only in freshwater), Appendix III of the Bern Convention (1979) (only in freshwater) and are a local priority species in the Dumfries and Galloway Local Biodiversity Action Plan (LBAP). Atlantic salmon are also a species of conservation concern on a UK level. Brown trout/sea trout (*Salmo trutta*) are a UK Biodiversity Action Plan (UKBAP) species as well as both river lamprey (*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus*). European eels (*Anguilla anguilla*) are protected under the European Eel Regulation (European Commission) No 1100/2007.

2 AIMS

The aims of this work were as follows:

2.1 To undertake electrofishing surveys within the Site of the Proposed Development, on the River Cree catchment.

2.2 Undertake a detailed bankside and habitat survey at each electrofishing survey site.

2.3 To analyse and present results from the surveys in report form, briefly discussing any particular sensitivities and/or issues relating to juvenile salmonids found within the surveys.

3 METHODOLOGY

3.1 Data Recording

The GFT is a partner in the Scottish Fisheries Co-ordination Centre[1] (SFCC), an initiative involving 26 Scottish Fishery Trusts and others, including Marine Directorate (Scottish Government), the Tweed Foundation, the Spey Research Trust, the Tay Foundation and the Cromarty Firth Fisheries Trust.

This group has, in partnership, developed a set of agreed survey and data collection methodologies for electrofishing surveys and an associated database in which to record information gathered from such surveys.

The electrofishing surveys undertaken by GFT for this study have been completed to the high standards that are required by the SFCC and recorded using the agreed methodologies.

3.2 Electrofishing Surveys

To assess the fish population, present in a section of river, various techniques have been developed in recent decades. The main method of determining the status of a juvenile salmonid population is through employing the use of electrofishing equipment.

This technique of electrofishing involves the 'stunning' of fish using an electric current which overpowers the nervous system of the fish and enables the operator to remove them from the water. Once captured, the fish recover in a holding container. They are then anaesthetised using a specific fish anaesthetic, identified to species level, measured and recorded, and once recovered, returned unharmed to the area from which they were captured.

The method of fishing involves the anode operator drawing stunned fish downstream to a net held against the current by an assistant. A hand net operator completes the three-man team. Captured fish are then transferred to a water-filled recovery container. The fishing team works its way across the survey section and upstream, thereby thoroughly fishing all the water in the chosen survey area.

To obtain fully quantitative information on the fish populations within an area of interest, each survey site is fished through up to four times consecutively to allow the calculation of a more accurate estimate of the fish population present. A Zippin estimation[2] of a fish population is a common calculation carried out using data derived from the depletion method of fishing (multiple run fishing). The result provides an estimate of the fish population density per 100 m^2 of water, including the 95% confidence limits (information pertaining to the 2023 electrofishing survey is presented in Table 1). When the calculation of a Zippin estimate of the population is not possible, a minimum estimate of the fish population is calculated for that section of river.

After the electrofishing exercise has been completed, a targeted and detailed SFCC habitat survey is completed of the actual fishing site.

For this study, electrofishing was undertaken by three experienced GFT staff at all survey sites. GFT deployed two electrofishing teams on this survey.

[1] http://www.sfcc.co.uk/

[2] Zippin, C. (1958). The Removal Method of Population Estimation. Journal of Wildlife Management, 22. Pp 82-90.

3.2.1 Limitations of electrofishing surveys

The SFCC method of electrofishing was primarily developed to survey juvenile salmonids in relatively shallow running water. Non-salmonid fish species may be present and caught during these surveys, but their populations may not be properly determined using this method of electrofishing. Any non-salmonid fish species are therefore counted but no population estimate is made (see Table 4 for the results of the 2023 electrofishing survey).

Electrofishing will never capture all the fish in a survey site, so densities presented in this report are an estimate - either a minimum estimate, or, where possible, the calculation of a Zippin estimate of the juvenile salmonid population residing within the site has been presented. The absence of fish cannot be ascertained with certainty using electrofishing techniques so a density of zero does not always guarantee fish are altogether absent from the surveyed section of watercourse.

A low density of fish can be assessed with electrofishing techniques; however, it is harder to fully assess the actual population density of the watercourse or the representative site. If there is a low and patchy distribution of fish it may be harder to draw conclusions from the data.

3.2.2 Electrofishing equipment

The location of all the electrofishing survey sites selected for this study required the use of a mobile backpack electrofishing kit. The battery powered E-fish backpack electrofishing kit consists of an electronic controller unit with a linked cathode of braided copper (placed instream) and a linked, mobile, single anode, consisting of a pole-mounted stainless-steel ring and trigger switch which is used instream to capture the fish.

Smooth direct current was used in all survey sites.

3.2.3 Age determination

For this study the electrofishing survey concentrated on assessing the status of juvenile salmonid species. In the majority of cases age determination can be made by assessment of the length of fish present. However, with older fish it is often more difficult to clarify age classes. In these cases, a small number of scale samples can be taken from fish, in addition to taking length assessments, to verify the ages of fish whose age cannot be determined with certainty from the length.

In this study juvenile salmonids are differentiated into fry (age 0+) and parr (age 1++) age groups (see Table 1).

3.2.4 Non-salmonid fish species

At each survey site the presence of non-salmonid fish species is noted. Population densities for these species are not calculated (see Section 3.2.1) but numbers of individuals are counted.

3.2.5 Site measurement

At each survey site a total site length was recorded, and average wet and channel widths calculated.

The average wet width was calculated from five or more individual widths recorded at equidistant intervals from the bottom of the survey site (0 m) to the top. At each survey site

the final width was noted at the upper limit of the surveyed water. From these survey site measurements, the total area fished can be calculated.

3.2.6 Bankside/instream electrofishing site habitat assessment

At each electrofishing survey site, a detailed habitat assessment using SFCC protocol is made of the instream habitat available for older (parr (1++) aged) fish. This assessment grades the instream 'cover' available to salmonids as none, poor, moderate, good or excellent. This grading provides an index of instream cover where diverse substrate compositions will score more favourably than areas of uniform substrate which provides lower levels of cover for individuals.

In accordance with SFCC protocols, percentage estimates of depths, substrate type and flow type are made at each electrofishing site. Additionally, percentage estimates of the quantity of the bankside cover features such as undercut banks, draped vegetation, bare banks and marginal vegetation are made.

When any reference to left or right bank is made, it is always classed as left and right bank when facing downstream.

3.2.7 Survey areas and site selection

Survey sites were agreed between GFT and MacArthur Green.

Survey work was carried out in August 2023.

4 RESULTS

4.1 Electrofishing Survey

The results of the electrofishing survey are outlined in this section and presented in detail in Table 4, which provides information on the population densities of juvenile salmonids at each survey site. The ages of fish were determined from length frequency distributions. Survey site code, watercourse, survey site location, O.S. grid reference, survey date, non-salmonid species and area fished (m^2) are also shown in Table 4.

With regard to the juvenile salmonid age classes, these are separated into four categories, which are defined in Table 1 below.

Table 1: Salmonid age classifications referred to in this report

Salmon Fry (0+):	Young fish less than one year old resulting from spawning at the end of 2022.
Trout Fry (0+):	Young fish less than one year old resulting from spawning at the end of 2022.
Salmon Parr (1+ and older (1++)):	Young fish of greater than one year and greater than two years old (where present) from spawning in 2021 or previously.
Trout Parr (1+ and older (1++)):	Young fish of greater than one year and greater than two years old (where present) from spawning in 2021 or previously. Trout of up to three or four years old are also included in this category.

Along with classifying salmonids into age brackets within the electrofishing results, juvenile salmonid numbers recorded have also been classified into several 'density' categories. A classification scheme for densities of salmonids was previously generated by the SFCC using data collected from 1,638 Scottish electrofishing survey sites covering the period 1997 to 2002 (SFCC, 2006[3]). From this, regional figures were created to allow more accurate local 'density ranges'. The categories referred to in this report are based on quintile ranges for one-run electrofishing events in the Solway region (Solway Salmon Fishery Statistical Region).

4.1.1 Survey limitations

The juvenile salmonid density classification scheme (SFCC, 2006)[3] is based solely on data from surveyed sites containing fish in 1997 to 2002 and refers to regional conditions at that time; it must only be used as a very relative guide and not be used to draw conclusions. Moreover, the figures for juvenile trout are less reliable for various reasons (e.g., some surveyed populations of trout are isolated; sea trout contributing to stock in some areas etc.) and so can only be used as a relative indication of numbers. Table 2 shows these quintile ranges for the Solway region, within which the Cree catchment lies.

Table 2: Quintile ranges for juvenile salmonids (per 100 m^2 of water) based on one-run electrofishing events, calculated on densities >0 over 291 sites in the Solway Statistical Region

	Salmon 0+	Salmon 1++	Trout 0+	Trout 1++
Minimum (Very Low)	0.22	0.38	0.38	0.35
20th Percentile (Low)	5.21	2.86	4.14	2.27
40th Percentile (Moderate)	12.68	5.87	12.09	4.71
60th Percentile (High)	25.28	9.12	26.63	8.25
80th Percentile (Very High)	46.53	15.03	56.49	16.28

[3] Godfrey, J. D. (2006), Site Condition Monitoring of Atlantic Salmon SACs: Report by the SFCC to Scottish Natural Heritage, Contract F02AC608 http://www.gov.scot/resource/doc/295194/0096508.pdf

Electrofishing and habitat information for all electrofishing survey sites surveyed is discussed in Section 4.1.4.

4.1.2 Site sensitivity

Data from across the survey was analysed and a traffic light sensitivity rating was added to Table 4.

Table 3: Showing traffic light rating of sensitivity based on densities of juvenile salmonids found at each location

Traffic Light Rating	**Description**
Green	Not sensitive for fish at the survey location and unlikely to cause a localised effect. Works could still potentially cause downstream impact, so mitigations still need to be in place. No fish rescue required for any instream works.
Amber	Moderately sensitive for fish at the survey location as non-salmonid fish species are present. Fish rescue will be required prior to any instream work such as culvert placement. May cause a localised and downstream impact so strict pollution requirements still stand.
Red	Very sensitive for fish at the survey location and work could potentially cause a localised and downstream impact on fish populations. Fish rescue required prior to any instream works.

Eleven of the 12 sites surveyed can be classed as very sensitive.

For a watercourse to be classified as having a Green sensitivity rating (Low Sensitivity) it was found to contain any of the following: no fish present, site is a field ditch/drain, has unsuitable habitat to support fish, no watercourse visible during the surveys.

For a watercourse to be classified as having an Amber sensitivity rating (Moderately Sensitive) it was found to contain any of the following: only non-salmonid species of fish. In general, the habitat was not suitable to support salmon or trout populations.

For a watercourse to be classified as having a Red sensitivity rating (Very Sensitive) it was found to contain any of the following: presence of salmonids in any density or display habitats of particular significance.

All watercourses which have an Amber or Red sensitivity rating should be monitored during construction and post construction phases.

4.1.3 Electrofishing results summary

Below is the information for each site surveyed in 2023 (see also Table 4 below). The locations are stated with the use of national grid references and include the presence/absence of fish species encountered within each site.

- CB1, Cordorcan Burn (lower): Grid ref: 238425 571059

Brown trout fry were found in low density and trout parr were found in moderate density.

- CB2, Cordorcan Burn (middle): Grid ref: 239738 572136

Brown trout fry and parr were both found in very low densities.

- CB3, Black Burn: Grid ref: 241677 572747

Fish were absent from this site.

- CSB1, Un-named Tributary of Coldstream Burn: Grid ref: 239040 569945

European eels were encountered at this site. No salmonids were present.

- CSB2, Un-named Tributary of Coldstream Burn: Grid ref: 240084 570652

Brown trout parr were found in moderate density.

- PB1, Castle Burn, tributary of Penkiln Burn: Grid ref: 242163 569026

Brown trout fry were found in moderate density and trout parr were found in high density. European eels were also present.

- PB2, Peat Rig Strand, tributary of Penkiln Burn: Grid ref: 242700 569321

Atlantic salmon parr were found in very low density. Brown trout fry were found in low density and trout parr were found in high density. European eels were also present.

- PB3, Glenshalloch Burn (middle): Grid ref: 243233 570066

Brown trout fry were found in moderate density and brown trout parr were found in high density. European eels were also present.

- PB4, Glenshalloch Burn (upper): Grid ref: 242555 571306

Brown trout parr were found in low density.

- PB5, Glenshalloch Burn (upper): Grid ref: 242690 571285

Brown trout parr were found in high density. European eels were also present.

- WB1, Washing Burn (lower): Grid ref: 238875 570403

Brown trout fry were found in low density and trout parr were found in very high density.

- WB2, Washing Burn (upper): Grid ref: 239929 572162

Brown trout fry and parr were found in very low density. European eels were also present.

4.1.4 Detailed electrofishing results

Below are the results from the electrofishing survey which can also be found in Table 4. A brief description of the physical properties of each survey site is included with site photos and some photos of fish caught during this survey. Table 4 includes the recorded data relevant to fish capture and highlights sites which may be impacted by wind farm construction.

- CB1, Cordorcan Burn (lower)

This survey site was located next to the footpath and above the waterfalls (Figure 1).

This survey site had moderate instream cover. Depths ranged from 0 - >50 cm. Substrates consisted primarily of bedrock (40%), with cobbles (20%), pebbles (20%), gravel (10%) and boulders (10%).

Flows were evenly mixed between run (25%), riffle (25%), and shallow glide (25%), with some deep glide (10%), and small areas of shallow pools (5%), deep pools (5%) and still marginal (5%). The left bank had 65% cover provided by rocks embedded in the banking and a small amount of undercut areas. The right bank had 60% of cover provided by rocks embedded in the banking. The surrounding landscape was an oak woodland.

Brown trout fry were present in low density and trout parr were found in moderate density (Figure 2).

Figure 1: CB1, Cordorcan Burn

Figure 2: Brown trout fry and parr caught at CB1

- CB2, Cordorcan Burn (middle)

This survey site was located by an ash tree and upstream of three large boulders (Figure 3).

This survey site had good instream cover. Depths ranged from 0 – >50 cm. Substrates consisted of an even mix of cobbles (30%), boulders (30%) and bedrock (30%) with a small amount of gravel and pebble (5% each). Flows consisted of run (30%), deep glide (30%), shallow glide (20%) and riffle (20%). Both bankings had no cover present for fish. The surrounding landscape was broadleaf trees and tall herbs/rank vegetation.

Brown trout fry and parr were both present in very low densities (Figure 4).

Figure 3: CB2, Cordorcan Burn

Figure 4: Brown trout fry and parr caught at CB2

- CB3, Black Burn

This survey site was located downstream of the conifer trees (Figure 5).

This survey site had poor instream cover. Depths ranged from 10 – 50 cm. Substrates consisted primarily of gravel (40%) and pebbles (40%) with some cobbles also present (20%). Flows consisted primarily of run (50%) with shallow glide (25%) and deep glide (25%). Both bankings had 50% fish cover provided by areas of undercuts and draped vegetation. The surrounding landscape was moorland heath.

Fish were absent from this survey site.

Figure 5: CB3, Black Burn

- CSB1, Un-named Tributary of Coldstream Burn

This survey site was situated upstream of the stone wall (Figure 6).

This survey site had poor instream cover. Depths were shallow and did not exceed 20 cm. Substrates consisted of cobbles (40%), pebbles (30%), gravel (20%) and boulders (10%). Flows were primarily run (40%) and riffle (40%) with some shallow glide (20%). Both banks had 50% of cover for fish provided by marginal and draped vegetation. The surrounding landscape was rough pasture and broadleaf trees.

One European eel was found at this survey site (Figure 7).

Figure 6: CSB1, Un-named tributary

Figure 7: Eel caught at CSB1

- CSB2, Un-named Tributary of Coldstream Burn

This survey site was situated down through the young plantation (Figure 8).

Instream cover was good at this survey site. Depths ranged from 0 – 40 cm. Substrates consisted primarily of cobbles (45%) with pebbles (25%), gravel (20%) and boulders (10%). Flows consisted primarily of run (65%) with some shallow glide (20%) and riffle (15%). Both bankings provided no fish cover and the surrounding landscape was a conifer plantation.

Brown trout parr were found in moderate density (Figure 9).

Figure 8: CSB2, Un-named tributary

Figure 9: Brown trout parr caught at CSB2

- PB1, Castle Burn, tributary of Penkiln Burn

This survey site was situated upstream of the footbridge (Figure 10).

This survey site had good instream cover. Water depths ranged from 0 – 30 cm. Substrates consisted primarily of cobbles (45%) and pebbles (40%) with a small amount of gravel (10%) and boulders (5%). Flows consisted of shallow pools (50%) with shallow glide (25%), riffle (15%) and some still marginal (5%). The left bank had 40% cover and the right bank had 50% cover, both provided by areas of undercuts. he surrounding landscape was moorland heath.

Brown trout fry were found in moderate density and trout parr were found in high density (Figure 11).

Figure 10: PB1, Castle Burn, tributary of Penkiln Burn

Figure 11: Brown trout fry and parr caught at PB1

- PB2, Peat Rig Strand, tributary of Penkiln Burn

This survey site was located downstream of the quadbike ford (Figure 12).

This survey site had good instream cover. Depths ranged from 0 – 40 cm. Substrates primarily consisted of cobbles (55%) with boulders (20%), pebbles (20%) and some gravel (5%). Flows consisted of shallow pools (30%), shallow glide (20%), run (20%), deep pools (15%), riffle (10%) and still marginal (5%). The left bank had 60% cover and the right bank had 50% cover, both provided by areas of undercuts, draped vegetation, and rocks embedded in the banking. The surrounding landscape was moorland heath.

Atlantic salmon parr were found in very low density. Brown trout fry were found in low density and trout parr were found in high density (Figure 13).

Figure 12: PB2, Peat Rig Strand, tributary of Penkiln Burn

Figure 13: Atlantic salmon parr, Brown trout fry and parr caught at PB2

- PB3, Glenshalloch Burn (middle)

The survey site was located just past the house (Figure 14).

This survey site had good instream cover. Depths ranged from 0 – 40 cm. Substrates consisted largely of cobbles (70%), with some pebbles (20%) and boulders (10%). Flows were primarily run (40%) with areas of riffle (15%), shallow pools (15%), shallow glide (10%), deep glide (10%), and deep pools (10%). The left bank had 20% cover and the right bank had 30% cover, both provided by areas of undercut and draped vegetation. The surrounding landscape was moorland heath.

Brown trout fry were found in moderate density and trout parr were found in high density (Figure 15).

Figure 14: PB3 Glenshalloch Burn (middle)

Figure 15: Brown trout parr caught at PB3

- PB4, Glenshalloch Burn (upper)

This survey site was located upstream of the fallen conifer trees (Figure 16).

This survey site had moderate instream cover. Depths ranged from 0 – 30 cm. Substrates primarily consisted of cobbles (60%) with pebbles (20%), gravel (10%) and boulders (10%). Flows consisted largely of riffle (70%), with run (20%) and shallow glide (10%). Both banks had 100% of cover provided by areas of undercuts, draped vegetation, and rocks embedded in the banking. The surrounding landscape was conifer plantations and moorland heath.

Brown trout parr were found in low density (Figure 17).

Figure 16: PB4, Glenshalloch Burn (upper)

Figure 17: Brown trout parr caught at PB4

- PB5, Glenshalloch Burn (upper)

This survey site was located upstream of the confluence with an un-named tributary (Figure 18).

This site had good instream cover. Depths ranged from 0 – 50 cm. Substrates consisted of cobbles (40%), pebbles (25%), boulders (20%) and gravel (15%). Flows consisted of riffle (50%) and run (25%), with areas of deep pools (10%), still marginal (10%) and some shallow pools (5%). Both banks had 50% of cover provided by areas of undercuts, draped vegetation, and rocks embedded in the banking. The surrounding landscape was conifer plantations and moorland heath.

Brown trout parr were found in high density (Figure 19).

Figure 18: PB5, Glenshalloch Burn (upper)

Figure 19: Brown trout parr caught at PB5

- WB1, Washing Burn (lower)

This survey site was located upstream of the pipe bridge (Figure 20).

This survey site had good instream cover. Depths ranged from 0 – 40 cm. Substrates consisted primarily of cobbles (40%) with pebbles (30%), boulders (20%) and gravel (10%). Flows consisted of run (55%), riffle (25%), shallow glide (15%) and deep glide (5%). Both banks had 30% of cover provided by areas of undercuts, draped vegetation, and roots embedded in the banking. The surrounding landscape was broadleaf trees and improved grassland.

Brown trout fry were present in low density and trout parr were found in very high density (Figure 21).

Figure 20: WB1, Washing Burn (lower)

Figure 21: Brown trout fry and parr caught at WB1

- WB2, Washing Burn (upper)

This survey site was located upstream of the culvert (Figure 22).

This survey site had good instream cover. Depths ranged from 0 – 20 cm. Substrates consisted primarily of gravel (40%) and pebbles (40%) with some cobbles (15%) and boulders (5%). Flows consisted primarily of run (45%) and shallow glide (40%) with some riffle (15%). Both banks had 10% cover provided by rocks embedded in the banking. The surrounding landscape was a conifer plantation and a road.

Brown trout fry and parr were both found in very low densities (Figure 23).

Figure 22: WB2, Washing Burn (upper)

Figure 23: Brown trout fry and parr caught at WB2

*Table 4: Results from the 2023 electrofishing survey for the Proposed Development (*Where a Zippin (1958)[2] calculation could be carried out, 95% confidence limits are shown. Where only the number appears, a Zippin estimation could not be carried out. In these cases, the number represents a minimum estimate of fish density per 100 m²). Traffic light colour coding represents sensitivity of sites with regards to fish, with red indicating very sensitive, amber moderately sensitive and green not sensitive).*

Site Code	Watercourse/ River Order	Site Location	Grid Ref	Survey Date	Presence of Other Species	Area Fished (m²)	Density per 100 m² *				Sensitivity
							Salmon Fry (0+)	Salmon Parr (1+ and older)	Trout Fry (0+)	Trout Parr (1+ and older)	
CB1	Cordorcan Burn (lower)	Next to footpath	238425 571059	15/08	NONE	96.2	0	0	4.158	7.486 ± 1.324	FISH
CB2	Cordorcan Burn (middle)	Upstream of large boulders by ash tree	239738 572136	14/08	NONE	60.1	0	0	1.663	1.663	FISH
CB3	Cordorcan Burn (upper)	Downstream of conifers	241677 572747	14/08	NONE	40.3	0	0	0	0	NONE
CSB1	Un-named tributary	Upstream of stone wall	239040 569945	15/08	1x eel	23.2	0	0	0	0	FISH
CSB2	Un-named tributary	Down from track	240084 570652	15/08	NONE	37.1	0	0	0	5.398	FISH
PB1	Castle Burn, tributary of Penkiln Burn	Upstream of bridge	242163 569026	15/08	3x eels	58.3	0	0	15.437	15.682 ± 1.68	FISH
PB2	Peat Rig Strand, tributary of Penkiln Burn	Downstream of ford	242700 569321	15/08	4x eels	86.7	0	1.154	5.769	10.396 ± 0.238	FISH
PB3	Glenshalloch Burn (middle)	Just past house	243233 570066	15/08	1x eel	73.6	0	0	20.380	14.493 ± 3.819	FISH
PB4	Glenshalloch Burn (upper)	Upstream fallen conifers	242555 571306	16/08	NONE	78	0	0	0	2.564	FISH
PB5	Glenshalloch Burn (upper)	Upstream of confluence with un-named tributary	242690 571285	16/08	2x eels	76	0	0	0	13.325 ± 1.182	FISH
WB1	Washing Burn (lower)	Upstream of pipe bridge	238875 570403	14/08	NONE	60.6	0	0	11.553	18.155	FISH
WB2	Washing Burn (upper)	Upstream of culvert	239929 572162	14/08	1x eel	55.7	0	0	1.794	1.794	FISH

5 DISCUSSION

Twelve sites were surveyed within the River Cree catchment to gather baseline data for the Proposed Development. All sites were within or close to the site and surveyed to highlight the watercourses which contain sensitive fish populations which could be impacted during construction. Eleven of the 12 sites surveyed contained sensitive fish populations.

The main potential impacts, from wind farm developments, to surrounding fish populations are most likely to occur during the construction phase. Salmonid populations are present within the Site.

The following have the potential to impact on fish species and their habitats (including water quality) and should be considered when designing the Proposed Development:

- access track layout in relation to the proximity to sensitive fish habitat (e.g., spawning habitat);
- the number and location of watercourse crossings (new and upgraded);
- new and upgraded watercourse crossing type, design, and structure, including information relating to the installation of each crossing point (e.g. maintaining the existing gradient, maintaining fish access at all water heights etc.);
- construction methodology for new tracks, trackside drainage plans and designs especially in relation to increased run off rates;
- turbine base locations;
- turbine base excavation and associated run off from loose ground;
- peat depth information in relation to water quality, peat slides or ground slips;
- borrow pit locations;
- changes to instream hydrological conditions and flush zones;
- exacerbated erosion and/or elevated levels of suspended silt to watercourses during construction activities;
- pollution to watercourses in the form of silt pollution;
- pollution to watercourses in the form of chemical pollution;
- reduction in quantity and quality of instream habitat;
- adverse changes to instream morphology;
- direct mortality of fish species;
- mitigation measures to protect fish population and their habitats from the impact from all of the above;
- timings of specific works such as new track building, new watercourse crossing installation, upgrading of existing watercourse crossings;
- has suitable baseline data been collected to be able to understand sensitivity of watercourses and to be able to assess for potential impacts; and
- are adequate monitoring programmes planned to monitor potential impacts on water quality, aquatic invertebrates and fish (that follow Marine Directorate guidance https://www.gov.scot/publications/monitoring-watercourses-in-relation-to-onshore-wind-farm-developments-generic-monitoring-programme/)

Where construction will take place directly next to sites where fish populations are found, fish rescues will be required to reduce the risk of impacting sensitive fish populations.

This baseline fisheries survey provides an important dataset and if the Proposed Development was to proceed then the survey sites that supported fish should be subject to repeat surveys prior to, during and post construction to monitor fish populations. Additional sites would need to be added to consider possible downstream impacts. When surveys are repeated, comparisons can be made between pre, during and post construction phases. A robust Fish

Monitoring Plan enables any impacts to be highlighted. If impacts are identified, then the report should outline necessary mitigation works required to address the impact.

No control sites were included in the baseline surveys. Control sites are important in fieldwork surveys because they provide a baseline for comparison while minimising bias and they can also help identify other influencing factors. Including control sites enhances the reliability, validity, and generalisability of results. Suitable control sites will need to be selected for future surveys as part of any Fish Monitoring Plan. This will help to identify if any potential decreases in fish populations are due to impacts caused by the Proposed Development or if there are external causes.