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Fisheries electrofishing survey for Bloch Wind Farm (baseline)

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Summary

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Electrofishing; Bloch; wind farm; salmonids; juvenile surveys; baseline

Background

The Galloway Fisheries Trust (GFT) was commissioned by Renewable Energy Systems Ltd to carry out baseline electrofishing surveys for the Bloch Wind Farm near Langholm in Dumfries and Galloway.

Surveys were undertaken in September 2022 in the Border Esk catchment.

Main findings of the 2022 electrofishing survey

- A total of fourteen sites were surveyed using electrofishing techniques for this study. All sites were located within the Border Esk catchment.
- Twelve sites fell within the wind farm boundaries with two external control sites.
- Of the twelve sites within the wind farm boundaries, Brown trout were present in six sites. Four sites had no fish and two sites were classed as unfishable.
- Brown trout were found within both control sites, with Atlantic salmon present within one of the control sites.
- European eels were encountered at four of the wind farm sites.

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1 INTRODUCTION

Galloway Fisheries Trust (GFT) was commissioned by Renewable Energy Systems Ltd (RES) to undertake baseline electrofishing surveys for the proposed Bloch Wind Farm. Electrofishing surveys were carried out in 2022 to provide baseline data and an overview of the fish populations present in the area of the proposed development and to help inform the overall design and planning.

The proposed development is within the Border Esk catchment in the South West of Scotland. The Border Esk is within the area managed by the Esk and Liddle Improvement Association and is covered by GFT's core working area.

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 of the proposed development. 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 Border Esk catchment.

Atlantic salmon 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. Atlantic salmon are also a species of conservation concern on a UK level.

Brown trout/sea trout are also a UK Biodiversity Action Plan species.

European eels are a priority species under the UK Post-2010 Biodiversity Framework.

2 AIMS

The aims of this work were as follows:

2.1 To undertake electrofishing surveys within the site of the proposed development and two control sites, all on the Border Esk 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 twenty-six Scottish Fishery Trusts and others, including Marine Scotland Science (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 within a section of river various techniques have been developed in the 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, 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 2022 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.

[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 2022 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 site (0 m) to the top. At each site the final width was noted at the upper limit of the surveyed water. From these site measurements the total area fished can be calculated.

3.2.6 Bankside/instream electrofishing site habitat assessment

At each electrofishing 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 favorably 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

Sites were selected and agreed by RES and GFT.

Survey work was carried out in September 2022.

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. Ages of fish were determined from length frequency distributions. Site code, watercourse, 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 2021
Trout Fry (0+):	Young fish less than one year old resulting from spawning at the end of 2021
Salmon Parr (1+ and older (1++)):	Young fish of greater than one year and greater than two years old (where present) from spawning in 2020 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 2020 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) 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 Border Esk catchment lies.

[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

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

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 area 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.

Six out of twelve sites from the electrofishing surveys within the site of the proposed development can be classed as very sensitive.

For a water 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 water to be classified as having an Amber sensitivity ration (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. In this survey, two sites were classified as having an Amber sensitivity due to being in close proximity to watercourses which contain salmonids.

For a water 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 2022. The locations are stated with use of national grid references and include the presence/absence of fish species encountered within each site. A brief description of the physical properties of each 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.

- EWCBL3, Bloch Burn: Grid ref: 333093 581353

Brown trout fry were found in moderate density and Brown trout parr were found in high density. European eel were also present within this site.

- EBL1, Blough Sike: Grid ref: 332130 579242

Brown trout fry were found in moderate density and Brown trout parr were found in low density. Minnow and stoneloach were also present within this site.

- EWCB1, Back Burn: Grid ref: 331461 580955

Brown trout fry and parr were both found in low densities. European eel and stoneloach were also present within this site.

- EWCC1, Cow Sike: Grid ref: 332765 581290

Brown trout parr were found in very low density. European eel were present within this site.

- EWCH1, Hope Burn: Grid ref: 331038 580384

Brown trout fry were found in moderate density. European eel and stoneloach were also present within this site.

- EWCL1, Collin Burn: Grid ref: 330180 581193

Brown trout fry were found in low density.

- EKB1, Tributary of Kerr Burn: Grid ref: 333485 579458

Fish were absent from this site.

- EWCBL1, Farrold Sike: Grid ref: 333513 582331

Fish were absent from this site.

- EWCBL2, Yellow Sike: Grid ref: 333134 581329

Fish were absent from this site.

- EWCBL4, Upper Woodie Sike: Grid ref: 333091 580576

Fish were absent from this site.

- EWCBL5, Nether Woodie Sike: Grid ref: 333084 580688

This site was classed as unfishable.

- EWCH2, Peat Sike: Grid ref: 330967 580438

This site was classed as unfishable.

- EEG1, Glendivan Burn (CONTROL): Grid ref: 337144 590934

Atlantic salmon fry were found in low density. Brown trout fry were found in very high density. Stoneloach were also present within this site.

- EEA1, Arkleton Burn (CONTROL): Grid ref: 337584 591511

Brown trout fry were found in very high density and Brown trout parr were found in very low density. European eel and stoneloach were also present within this site.

4.1.4 Detailed electrofishing results

Below are the results from the electrofishing survey which can also be found in Table 4.

- EWCBL3, Bloch Burn

This site was situated downstream of the ford (Figure 1).

This site had poor instream cover. Depths ranged from 0 – 50 cm. Substrates were primarily small and consisted of high organic (20%), gravel (40%), pebbles (30%) and some cobbles (10%). Flows were mixed and consisted of run (30%), riffle (20%), shallow glide (25%), deep glide (20%) and small areas of deep pools (5%). The left bank had 5% of cover from undercuts and the right bank had no cover. This site was situated in a grazed field and the banks were noted as being eroded. The banks had collapsed into the burn in some areas.

Brown trout fry were found in moderate density and Brown trout parr were found in high density (Figure 2). European eel were also encountered at this site.

Figure 1: EWCBL3, Bloch Burn

Figure 2: Brown trout fry and parr from EWCBL3

- EBL1, Blough Sike

This site was situated within the small area of deciduous woodland (Figure 3).

Instream cover was good at this site. Depths ranged from 0 – 50+ cm. Substrates were primarily large at this site and consisted of cobbles (40%), boulders (20%), pebbles (20%) and gravel (20%). Flows were fast at this site and consisted of run (40%), riffle (20%), deep glide (30%) with an area of deep pool (10%). It was noted that this site was running high and coloured with silt following recent heavy rain. The left bank had 40% of cover from areas of undercuts and exposed roots. The right bank had 40% of cover from areas of undercuts. The surrounding landscape was within a deciduous woodland with native broadleaf trees providing shade.

Brown trout fry were found in moderate density and Brown trout parr were found in low density (Figure 4). Minnow and stoneloach were also present within this site.

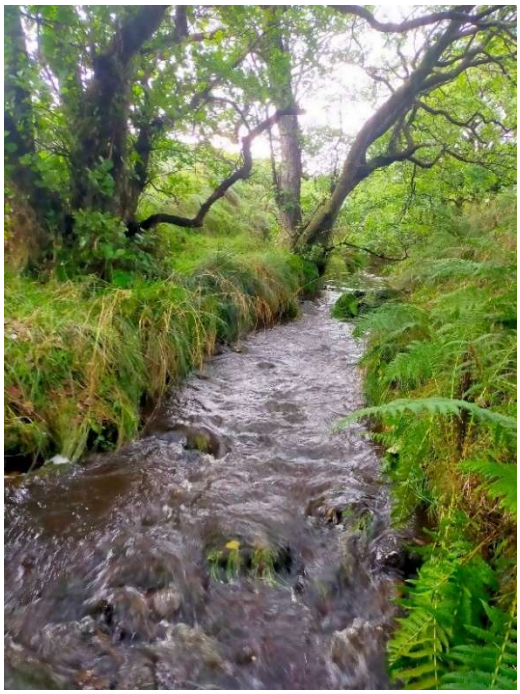

Figure 3: EBL1, Blough Sike

Figure 4: Brown trout fry and parr from EBL1

- EWCB1, Back Burn

This site was situated adjacent to the field near Bigholms Farm (Figure 5).

This site had moderate instream cover. Depths ranged from 0 – 30 cm. Substrates consisted of primarily cobbles (60%) with gravel (20%) and pebbles (20%). The flows were fast and consisted of run (65%) and riffle (35%). Both banks had 70% of cover from undercuts and draped vegetation. The surrounding landscape was classed as improved grassland.

Brown trout fry and parr were both found in very low densities (Figure 6).

Figure 5: EWCB1, Back Burn

Figure 6: Brown trout fry from EWCB1

- EWCC1, Cow Sike

This site was located downstream of the road and culvert which was classed as impassable (Figure 7). There may be a more suitable site upstream of the road, however it was unclear from the generic grid reference where the site should lie and there were cows with calves in the field upstream of the road. The land owner was wary of being close to mothering cows. There would be no access to migratory fish upstream due to the impassable culvert, however there may be resident Brown trout upstream.

This site had poor instream cover. Depths ranged from 0 – 30 cm. Substrates were composed of gravel (30%), pebbles (30%), cobbles (30%) with some areas of high organic (10%). Flows consisted primarily of shallow glide (60%) with areas of run (20%), riffle (10%) and shallow pool (10%). There was 100% cover on both banks from draped vegetation. The site was heavily overgrown. The fish were only present in the pool directly downstream of the culvert. If repeated, this site should be moved to upstream of the road.

Brown trout parr were found in very low density (Figure 8). European eel were also present within this site.

Figure 7: EWCC1, Cow Sike

Figure 8: Brown trout parr from EWCC1

- EWCH1, Hope Burn

The site was located upstream of the bridge (Figure 9).

This site had moderate instream cover. Depths ranged from 10 – 50+ cm. Substrates consisted of gravel (30%), pebbles (30%), cobbles (30%) and boulders (10%). Flows were primarily run (50%) with deep glide (30%) and riffle (20%). Both banks had 60% of cover from undercuts. This site was situated in a grazed field.

Brown trout fry were found in moderate density (Figure 10).

Figure 9: EWCH1, Hope Burn

Figure 10: Brown trout fry from EWCH1

- EWCL1, Collin Burn

This site is located upstream of the channel split (Figure 11).

This site had moderate instream cover. Depths ranged from 0 – 30 cm. Substrates consisted of gravel (30%), pebbles (30%), cobbles (30%) with some areas of sand (10%). This site consisted mostly of shallow pool (70%) with areas of run (20%) and riffle (10%). Both banks had 70% of cover from undercuts and draped vegetation.

Brown trout fry were found in low density (Figure 12).

Figure 11: EWCL1, Colin Burn

Figure 12: Brown trout fry from EWCL1

- EKB1, Tributary of Kerr Burn

This site is located adjacent to Kerr Plantation (Figure 13).

This site had good instream cover. Depths ranged from 10 – 50+ cm. Substrates were mixed and consisted of gravel (20%), pebbles (30%), cobbles (30%) and boulders (20%). Flows consisted of run (40%), riffle (20%), shallow glide (20%), and deep glide (20%). Both banks had 100% of cover from undercuts. There were conifer trees regen in close proximity to the watercourse on the banks.

Fish were absent from this site. It was noted that this site appeared suitable for Brown trout and that Brown trout were expected within this site.

Figure 13: EKB1, tributary of Kerr Burn

- EWCBL1, Farrold Sike

This site is located upstream of the confluence with Bloch Burn (Figure 14).

This site had moderate instream cover. Depths were <10 cm throughout the entire site. Substrates consisted of gravel (20%), pebbles (30%), cobbles (30%) and boulders (20%). The flows were fast and consisted of run (70%), riffle (20%) with areas of still marginal pools (10%). Both banks were 100% bare with no cover and the site was situated in a grazed field. Access to this site was heavily limited due to the majority of this site being unfishable. Only 12 m of length was accessible to electrofish.

Fish were absent from this site. It was noted that the confluence with Bloch Burn was around 30 m downstream where Brown trout were confirmed to be with a presence/absence electrofishing survey. Farrold Sike was classed as being inaccessible due to the confluence being blocked and very small. However, this site can still be classed as sensitive due to the close proximity to Bloch Burn; any pollution to Farrold Sike would run off into Bloch Burn and pose risk to the Brown trout population in the burn.

Figure 14: EWCBL1, Farrold Sike

- EWCBL2, Yellow Sike

This site is located upstream of the watergate (Figure 15).

This site had poor instream cover. Depths ranged from 0 – 30 cm. Substrates were primarily small and consisted of gravel (30%), pebbles (30%), cobbles (20%) and high organic (20%). Flows consisted of run (40%), riffle (30%) and shallow glide (30%). Both banks had no cover and it was noted that the banks were eroded and areas had collapsed into the burn. This site was situated in a grazed field.

Fish were absent from this site. It was noted that the confluence with Bloch Burn was around 50 m downstream where Brown trout were confirmed to be (Site EWCBL3). It was also noted that Yellow Sike could potentially be accessed by Brown trout in high water.

Figure 15: EWCBL2, Yellow Sike

- EWCBL4, Upper Woodie Sike

This site is located in a field near Bloch Farm (Figure 16).

This site had poor instream cover. Depths ranged from 0 – 30 cm. Substrates consisted of cobbles (40%), high organic (40%) and pebbles (20%). Flows were primarily run (60%) with areas of riffle (20%), shallow glide (10%) and shallow pool (10%). Both banks had 70% of cover provided by undercuts and draped vegetation. This site had very limited access due to the burn going underground in areas.

Fish were absent from this site. It was noted that this site was likely inaccessible to fish due to the small size and the areas going underground.

Figure 16: EWCBL4, Upper Woodie Sike

- EWCBL5, Nether Woodie Sike

This site is located in a field near Bloch Farm (Figure 17).

This site had poor instream cover. Depths were <10 cm throughout the entire site. Substrates were primarily small and consisted of gravel (40%), pebbles (40%) and cobbles (20%). Flows were primarily shallow glide (80%) with areas of run (20%). Both banks had 100% of cover provided by draped vegetation. This site was so small that it was overgrown by grass.

This site was classed as being unfishable.

Figure 17: EWCBL5, Nether Woodie Sike

- EWCH2, Peat Sike

This site is located by the bridge (Figure 18).

A habitat survey could not be carried out at this site due to it being entirely overgrown by dense vegetation. There is a very small watercourse at this site, however it does not flow into Hope Burn and instead ends as small pools in the field.

This site was classed as being unfishable.

Figure 18: EWCH2, Peat Sike

- EEG1, Glendivan Burn (CONTROL)

This site is located downstream of the farm bridge (Figure 19). The provided grid reference originally suggested the site was upstream of the bridge. However this was moved as the burn was modified and exposed upstream of the bridge. Downstream of the bridge had more favorable habitat for salmonids.

This site had moderate instream cover. Depths ranged from 0 – 30 cm. Substrates consisted of gravel (30%), pebbles (40%), cobbles (20%) and boulders (10%). Flows consisted of run (40%), riffle (30%) and shallow glide (30%). The left bank had 20% of cover from draped and marginal vegetation. The right bank had 30% of cover from draped and marginal vegetation. The surrounding landscape was native deciduous woodland.

Atlantic salmon fry were found in low density and Brown trout fry were found in very high density (Figure 20). Stoneloach were also present within this site.

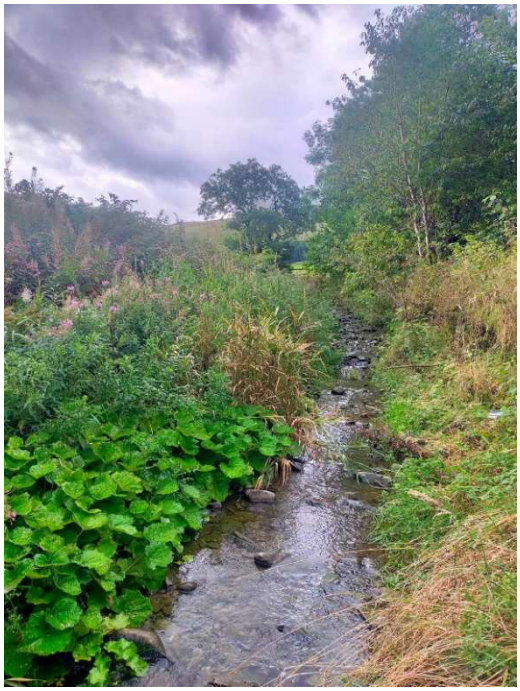

Figure 19: EEG1, Glendivan Burn (CONTROL)

Figure 20: Atlantic salmon and Brown trout fry from EEG1

- EEA1, Arkleton Burn (CONTROL)

This site is located upstream of the quad bike track (Figure 21).

This site had moderate instream cover. Depths ranged from 0 – 30 cm. Substrates consisted of gravel (50%), pebbles (30%), cobbles (15%) with some boulders (5%). Flows consisted of run (60%), riffle (20%) and shallow glide (20%). The left bank had 10% of cover provided by marginal vegetation and the right bank had 10% of cover provided by a pile of cut tree branches. The surrounding landscape was native deciduous woodland. It was noted that the right banking was heavily eroded.

Brown trout fry were found in very high density and Brown trout parr were found in very low density (Figure 22). European eel were also present within this site.

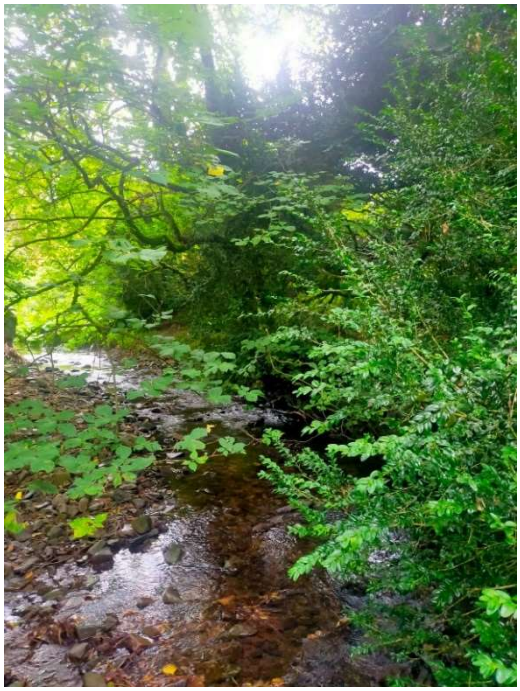

Figure 21: EEA1, Arkleton Burn

Figure 22: Brown trout fry and parr from EEA1

*Table 4: Results from the 2022 electrofishing survey for the proposed development (*Where a Zippin (1958) 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 m^2). 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 (m^2)	Density per 100 m^2 *				Sensitivity
							Salmon Fry (0+)	Salmon Parr (1+ and older)	Trout Fry (0+)	Trout Parr (1+ and older)	
EWCBL3	Border Esk, Bloch Burn	Downstream ford	333093 581353	07/09	Eel (1)	61.6	0	0	15.912 ± 5.464	11.69 ± 2.067	FISH
EBL1	Border Esk, Blough Sike	In woodland	332130 579242	06/09	Minnow (16), Stoneloach (1)	56.3	0	0	19.531	3.551	FISH
EWCB1	Border Esk, Back Burn	In field	331461 580955	07/09	Eel (1), Stoneloach (36)	49.6	0	0	8.058	2.015	FISH
EWCC1	Border Esk, Cow Sike	Downstream of the road and culvert	332765 581290	07/09	Eel (1)	58.7	0	0	0	1.705	FISH
EWCH1	Border Esk, Hope Burn	Upstream of the bridge	331038 580384	08/09	Eel (1), Stoneloach (13)	42	0	0	4.763	0	FISH
EWCL1	Border Esk, Collin Burn	Upstream of channel split	330180 581193	07/09	NONE	47	0	0	8.5013	0	FISH
EKB1	Border Esk, Trib of Kerr Burn	Adjacent to Kerr Plantation	333485 579458	06/09	NONE	53.5	0	0	0	0	NONE
EWCBL1	Border Esk, Farrold Sike	Upstream confluence with Bloch Burn	333513 582331	07/09	NONE	11.4	0	0	0	0	FISH DOWNSTREAM
EWCBL2	Border Esk, Yellow Sike	Upstream watergate and confluence with Bloch Burn	333134 581329	07/09	NONE	33.1	0	0	0	0	FISH DOWNSTREAM
EWCBL4	Border Esk, Upper Woodie Sike	In field	333091 580576	07/09	NONE	14.7	0	0	0	0	NONE
EWCBL5	Border Esk, Nether Woodie Sike	In field	333084 580688	07/09	NONE	N/A	0	0	0	0	NONE

EWCH2	Border Esk, Peat Sike	By bridge	330967 580438	08/09	NONE	N/A	0	0	0	0	NONE
EEG1	Border Esk, Glendivan Burn (CONTROL)	Downstream bridge	337144 590934	06/09	Stoneloach (2)	57	7.020	0	68.555 ± 17.988	0	N/A (CONTROL)
EEA1	Border Esk, Arkleton Burn (CONTROL)	Upstream quad bike track	337584 591511	06/09	Eel (2)	65.3	0	0	127 ± 15.267	1.532	N/A (CONTROL)

5 DISCUSSION

Fourteen sites were surveyed within the Border Esk catchment to gather baseline data for the proposed development. Twelve sites were within the site of the proposed development and surveyed to highlight the watercourses which contain sensitive fish populations which may be impacted during construction. Two control sites were included which were also within the Border Esk catchment and away from any wind farm influence.

The main potential impacts, from this proposed development, to surrounding fish populations are most likely to occur during the construction phase. Salmonid populations fall within the site of the proposed development. If pollution entered any of the watercourses at these sites it could, in the worst case, kill fish, their prey items and potentially degrade habitats. Works such as constructing watercourse crossings, large scale excavation work (for example for wind turbine foundations) and track and hardstand drainage must be carefully considered and designed to ensure minimal disturbance to fish species residing in the watercourses in the vicinity and downstream of the site of the proposed development. In the opinion of GFT it should be possible to mitigate against these impacts through the design and utilising best practice protocols to address potential fish access issues, silt management and pollution risks. Where construction will take place directly next to sites where fish populations are found, it is suggested that fish rescues are carried out by GFT to reduce the risk of impacting sensitive populations.

The 2022 surveys looked at specific sites. Although some sites had very few or no fish, these results cannot be used to conclude that there are no fish populations upstream or downstream of the surveyed sites. Appropriate protocols should always be followed when working in or near water to ensure no harm is done to potential populations near the work site. Where a site was deemed unfishable or had no fish, there is still the potential to pollute larger watercourses and affect fish populations downstream.

This baseline fisheries survey provides an important dataset and should be repeated prior to and during the construction phase to monitor fish populations throughout this development. When repeated, comparisons can be made during construction and post-construction. This will provide a robust Fish Monitoring Plan to enable any impacts to be highlighted and mitigation measures carried out. If impacts are identified, then the report should outline necessary mitigation works.