Appendix 7.5

Aquatic Ecology Baseline Report

SCOTTISHPOWER RENEWABLES

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1 Introduction

1.1 Project Background

1. ScottishPower Renewables hereafter referred to as 'the Applicant' is proposing to construct and operate Carrick Windfarm located 6km south of Straiton, South Ayrshire (hereafter 'the Proposed Development'). The Proposed Development will comprise of 13 wind turbines with a maximum height to blade tip of 200 metres (m) and ancillary infrastructure (substation compound, crane pads, temporary construction compounds).

2. The Site is located within the Carrick Forest with Linfern Loch located directly to the south of the Site and the River Stinchar runs from the east to west to the south of the Proposed Development. Linfern Loch is excluded from the Site Boundary. Several smaller watercourses traverse the Site including Pulreoch Burn, Tairlaw Burn and Knockoner Burn. The Site is an existing commercial forest predominately covered by Sitka spruce *Picea sitchensis* plantation. The surrounding habitat is predominately plantation woodland to the south and east. Several lochs are located to the east including Loch Bradan, Loch Riecawr, Loch Finlas and Loch Doon. To the north and west of the Site there is agricultural land predominantly grazing fields. The Site is shown in **Figure 1.1 Site Location** of the Environmental Impact Assessment Report (EIAR).

1.2 Scope of Report

3. This report presents the methods and results of the aquatic ecology desk study and baseline surveys for the Proposed Development. This report covers the fish habitat suitability assessment, quantitative electric fishing surveys and freshwater pearl mussel (FWPM) *Margaritifera margaritifera* surveys.

4. The relevant legislation is outlined within **Annex A**.

2 Methods

2.1 Desk Study

5. A desk study was undertaken in July 2020 to review existing ecological baseline information available in the public domain and to obtain information held by relevant third parties. For the purpose of the desk study exercise, fish records were collated from watercourses that drain the Site where data were available.

6. Information on the location of fish and FWPM records was provided by Ayrshire Rivers Trust (ART). The locations of the electric fishing data provided by ART for the purposes of the desk study are shown in **Figure 7.5.1 Desk Study and Field Survey Locations**.

2.2 Field Survey

2.2.1 Fish Habitat Suitability Survey

7. An initial fish habitat suitability survey was carried out in conjunction with the riparian mammal surveys in order to assess suitable electric fishing locations throughout the Site and to determine further survey requirements.

8. This survey included a general assessment of water depth; channel, bank and bed widths; flow, substrate composition; and bank characteristics of all the watercourses which appear on Ordance Survey (OS) mapping that drain the Site. The vegetation types present, along with percentage canopy cover and percentage fish cover, were also recorded in order to assess the overall habitat suitability for fish and to further recommend fully quantitative surveys for determining fish population sizes.

2.2.2 Electric Fishing Survey

9. Following completion of the fish habitat suitability surveys several watercourses were identified which may be either directly or indirectly affected by the Proposed Development and which had the potential to support fish, in particular salmonids. Consequently, and in consultation with ART, seven sampling locations were identified on five different watercourses upon which to undertake electric fishing surveys in order to establish the presence and relative abundance of fish species. These watercourses were selected on the basis that they provide areas of suitable fish habitat, are ecologically connected to upper tributaries within the Site and are representative of the general habitat type present within each sub-catchment.

10. In addition to the above, a control sampling point was also surveyed in order to provide a dataset for a watercourse outwith the Site which would act as a control against which any future monitoring conducted during and post-construction of the Proposed Development could be compared.

11. The locations of these eight sampling points were as follows and shown on **Figure 7.5.1 Desk Study and Field Survey Locations**:

- Dalqhairn Burn – south west of the Site (NX32809658);
- Palmullan Burn – north west of the Site (NS37070067);
- Knockoner Burn – north of the Site (NS37120063);
- Pulreoch Burn – east of the Site (NX39149897);
- Tairlaw Burn tributary 1 – east of the Site (NX39909805);
- Tairlaw Burn tributary 2 – east of the Site (NX39529905);
- Tairlaw Burn tributary 3 – east of the Site (NX39539939); and
- Balbeg Burn (control site) – north east of the Site (NS38230247).

12. Fish populations at each site were assessed using electrofishing, undertaken by fully qualified staff members of ART. This is a widely used technique to examine freshwater fish communities. The method uses electricity to attract and stun fish, which allows operators to remove them from the water. The fish are transferred to a holding container until they have recovered and then anaesthetised using a mild solution of MS222 (Tricaine Methane Sulphonate). Each individual is then identified, measured and returned unharmed to the area from where they were captured.

13. Battery powered backpack equipment (Hans Grassl model # IG600) was used to carry out each survey. Smooth DC was used at all sites, to maximise catch efficiency, while minimising potential damage to fish and other wildlife. A minimum voltage of 150V was used, to ensure efficient fish capture.

14. In small watercourses, it is possible to cover the entire survey area accurately, and the number of fish captured can therefore be related to the wetted area of the site allowing at least minimum densities to be calculated. All survey protocols were followed to the Scottish Fisheries Co-ordination Centre (SFCC) standards.

15. Sites were sampled using an area-delimited survey so that fish densities could be calculated. All salmon and trout captured during the survey were separated into year classes on the basis of length frequency histograms. As fish grow at very different rates between sites, this was repeated for each site individually. Age classifications were checked by examining the number of annual rings on scales taken from reference fish of each age class. Other fish species found were counted and recorded.

16. A fully quantitative three run protocol was carried out at all sites, as watercourses are small enough to install nets across the watercourse preventing fish leaving or entering the survey site.

17. In this protocol, the entire area is fished three times (with a twenty-minute interval between each run) and all fish caught identified and measured. If there were sufficient fish present, absolute fish densities were calculated using

the Zippin estimation of the fish population, which is a calculation carried out using a depletion method (multiple run fishing). This is an estimate of the fish population density per 100 m^2 of water, including the 95% confidence limits. When the calculation of a Zippin estimate of the population is not possible, a minimum estimate of the fish population is given for that section of river. Thus, data from all the sites can be compared, regardless of whether catch efficiency changes.

18. Throughout this report the following notation has been used to distinguish fish year classes: salmonid fish less than one year old are recorded as 0+ year class or fry, whilst fish one year or older are recorded as 1+, 1++ or parr.

2.2.3 FWPM Survey

19. From the fish habitat suitability surveys, four watercourses which drain the Site were identified as providing potentially suitable habitat capable of supporting FWPM: Pulreoch Burn, and three tributaries of the Tairlaw Burn. The FWPM surveys covered transects in areas of suitable FWPM habitat along these watercourses within 500m of the nearest wind turbines and within 100m upstream and 500m downstream of any watercourse crossings. The aim of these surveys was to identify the presence or likely absence of FWPM and inform the requirement to undertake a more detailed population estimate survey.

20. The location of various surveyed reaches (i.e. sections with potentially suitable FWPM habitat), are identified in **Table 7.4.5** and shown on **Figure 7.5 1 Desk Study and Field Survey Locations**.

21. The surveys followed Scottish Natural Heritage (SNH) protocol (SNH, n.d.)[1] and was based on that described by Young *et al* (2000).

22. Sites were surveyed during September 2020, in suitable weather conditions. High light levels and low flow conditions are necessary in order to carry out FWPM surveying. A glass-bottomed bucket or 'bathyscope' is used to view the riverbed. Survey transects of 50m x 1m were carried out in areas with suitable FWPM habitat, as suggested by Young *et al* (2000).

2.2.4 Dates and Survey Personnel

23. The fish habitat suitability surveys were completed on the following dates:

- 23-24 June 2020;
- 2 July 2020;
- 6 July 2020; and
- 4 August 2020.

24. The electric fishing and FWPM surveys were completed on the following dates by ART:

- 2 September 2020;
- 4 September 2020 and
- 10 September 2020.

2.3 Notes and Limitations

25. Electrofishing is a common means of obtaining data on fish populations (SEERAD, 2007). The electrofishing techniques used by ART are specifically designed for assessing juvenile salmonid populations therefore fish from other groups may not be quantified effectively.

26. The survey sites chosen were selected to be representative of the general habitat type present within each sub-catchment and to include a range of flow and substrate types. If the site selected is representative of the local habitat the survey should provide a robust estimate of local fish populations. However, it is possible that if fish populations are low or have a clumped distribution, the survey data may not sample the full fish population in that area.

27. It is considered impossible to prove the absence of a fish species by electrofishing, therefore, whilst the failure to capture fish at a site may indicate that the population is absent, it cannot be assumed that they are not present elsewhere in the watercourse.

3 Results

3.1 Desk Study

28. Data from four electric fishing surveys sites in watercourses that were within or as close as possible downstream of the Site were obtained from ART. The details of these surveys are summarised in **Table 7.5.1** below.

Site	Date of Survey	Grid Reference	Species				
			Salmon *Salmo salar*	**Trout** *Salmo trutta*	**Lamprey** *Lampetra sp.*	**Other**	**Total**
River Stinchar	23/10/19	NX 357 952	35	5	2	0	42
Dalqhairn Burn	29/11/19	NX 331 967	15	3	0	0	18
Palmullan Burn	27/07/16	NS 383 016	43	2	0	-	45
Pulreoch Burn	24/09/10	NX 395 992	9	25	0	-	34

Table 7.5.1 Summary of Fish Data

29. FWPM data that was within or downstream of the Site was obtained from ART. Seven locations were provided where FWPM had been recorded, all of which were located over 10km downstream of the Site. Further, location-specific details are not provided here for confidentiality and species-protection purposes and given their distance from the Site are not considered necessary to present in a separate Confidential Annex.

3.2 Field Survey Results

3.2.1 Summary of Fish Habitat Suitability Surveys

30. A large number of watercourses that drained the northern, north-western and south-western parts of the Site were small upland headwaters that had limited salmonid habitat. The upper extents of these headwaters were marshy and flowed through coniferous plantation and forest rides. The small upland headwaters that were present onsite were fed mainly by forestry drains and were typically characterised by overgrown bankside vegetation, poor connectivity and poor substrate heterogeneity, being mostly comprised of peat. Suitable substrate and flow types for juvenile salmonids in these smaller headwaters were identified in localised areas downstream towards the edges of the Site. However, the continuity of available habitat as well as accessibility for fish was restricted due to the above factors. Out with the Site, this collection of headwaters converged downstream to form larger burns, namely the Palmullan Burn, Knockoner Burn and Dalquhairn Burn.

31. Suitable salmonid habitat and sub-optimal FWPM habitat was recorded in some of the larger watercourses that drained the eastern parts of the Site including the Pulreoch Burn, Tairlaw Burn, and two unnamed watercourses which converge with the Tairlaw Burn. These watercourses were mainly characterised by glide and run flow types,

[1] Now known as NatureScot.

a mixture of cobble and pebble substrates and good fish cover provided by undercut banks and draped bankside vegetation. Suitable juvenile salmonid habitat was present consistently within these reaches owing to the above characteristics. All of the above watercourses were culverted beneath existing forestry tracks within the Site. However, these were not considered to pose an obstruction to fish movement.

32. The results from surveys where fish densities are obtained are now classified according to the SFCC Scottish national classification scheme which was derived using data from over 1600 Scottish sites covering the period 1997-2002 (Godfrey, 2005) as shown in **Table 7.5.2** and **Table 7.5.3** below. This allows ART and the reader to interpret local fish populations in a Scotland-wide context. The national classes should be periodically revised as fish populations will inevitably change over time, even on a national scale. It should be noted that the results were based on single run.

Salmon fry (no/100m^2)	Classification	Salmon parr (no/100m^2)
0.0	Absent	0.0
<4.7	E – Very poor	<2.6
4.7 -<10.3	D - Poor	2.6 -<5.1
10.3 - <20.3	C - Moderate	5.1 - <9.1
20.3 - <42.1	B - Good	9.1 - <15.8
>42.1	A - Excellent	>15.8

Table 7.5.2 SFCC Salmon Fry and Parr Classification Breakpoints

Trout fry (no/100m^2)	Classification	Trout parr (no/100m^2)
0.0	Absent	0.0
<2.5	E – Very poor	<1.6
2.5 -<5.3	D - Poor	1.6 -<3.1
5.3 - <12.4	C - Moderate	3.1 - <5.6
12.4 - <30.3	B - Good	5.6 - <10.4
>30.3	A - Excellent	>10.4

Table 7.5.3 SFCC Trout Fry and Parr Classification Breakpoints

3.2.2 Electric Fishing Survey

33. Results from the eight electrofishing survey sites, including a control site on the Balbeg Burn are shown in **Table 7.5.4**. Further information on each surveyed site can be found in **Annex B** Electrofishing Survey Site Information and Fish Capture Data.

3.2.3 FWPM Survey

34. The scope was to survey sections of the Pulreoch and Tairlaw Burns with suitable FWPM habitat, however FWPM surveys were undertaken on all electrofished watercourses draining into the Water of Girvan catchment. Results from the FWPM surveys are shown in **Table 7.5.5**.

Site	Date of Survey	Grid Reference	Fish densities (Number/100m^2)				Other Fish Species
			Salmon *Salmo salar*		Trout *Salmo trutta*		
			0+	1++	0+	1++	
Dalqhairn Burn	02/09/20	NX32809658	56.4	21.2	11.0	0.8	None
Palmullan Burn	10/09/20	NS37070067	0	0	9.8	8.5	None
Knockoner Burn	10/09/20	NS37120063	0	0	18.5	3.6	None
Pulreoch Burn	04/09/20	NX39149897	0	0	6.0	1.0	None
Tairlaw Burn tributary 1	04/09/20	NX39909805	0	0	6.0	3.8	None
Tairlaw Burn tributary 2	04/09/20	NX39529905	0	0	6.0	11.7	None
Tairlaw Burn tributary 3	10/09/20	NX39539939	0	0	34.6	0	None
Balbeg Burn	10/09/20	NS38230247	78.2	4.6	75.2	6.0	None

Table 7.5.4 Electrofishing Survey Data

Site	Downstream Grid Reference	Upstream Grid Reference	Habitat suitable for FWPMs	Accessible to migratory salmonids	Live FWPM	Empty Shells	Notes
Palmullan Burn	NS37070067	NS36660060	No	No	0	0	High flow velocity with steep gradient. High percentage of bedrock.
Knockoner Burn	NS37120063	NS37080054	No	No	0	0	Narrow, steep gradient. Numerous cascade/small waterfalls up and downstream.
Pulreoch Burn	NX39149897	NS38759886	No	No	0	0	Burn located in area of felled conifer plantation. Low salmonid densities.
Tairlaw Burn Tributary 1	NX39909805	NX38889753	Yes	No	0	0	Suitable substrates, high bank with reduced floodplain. Increased gradient.
Tairlaw Burn Tributary 2	NX39529905	NX39559890	Yes	No	0	0	Suitable substrates, high bank with reduced floodplain. Adjacent conifer plantation clearance.
Tairlaw Burn Tributary 3	NX39539939	NX39549923	Yes	No	0	0	Suitable substrates. Flood plain available. Conifer plantation clearance upstream.

Table 7.5.5 FWPM Survey Data

4 Conclusion

35. Fish populations are an integral component of any freshwater watercourse in which they exist. In many instances, salmon and trout act as keystone species, and, by their presence/ absence, or abundance, they can (in conjunction with other biometric assessments) provide an indication of the overall health of a watercourse.

36. Electrofishing surveys undertaken by ART show only brown trout are present in the Palmullan, Knockoner, Tairlaw and Pulreoch Burns. Both salmon and brown trout where present in the Dalquhairn Burn, located on the River Stinchar catchment, and the Balbeg Burn, which is being used as the control site. Some sites recorded lower brown trout populations than others but this is not unusual in the headwater streams of this area where inter-annual variability in egg deposition can affect recruitment and juvenile populations over time. However, these trends highlight the vulnerability associated with fish populations particularly as there are access issues to migratory species through natural constraints including several cascades, waterfalls and the steep gradient of the surveyed watercourses.

37. No FWPM populations were found and the Tairlaw Burn was the only watercourse recognised as providing suitable habitat for FWPMs. FWPM's use salmonids (the preferred species are salmon) to complete their lifecycle with the mussel larvae attaching to the fish gills. Due to the low population of brown trout present within the surveyed watercourses it would be expected that if FWPM's were present their existence could not be sustained.

38. At all sites water quality appeared good with low conductivity and clean un-silted substrates. It should be noted that many of the sites are in close proximity to conifer plantations, and activities such as felling can have adverse consequences including the release of organic materials and acidic flushes which can affect water quality and negatively impact fish populations. Scottish Environment Protection Agency (SEPA), will be able to advise on mitigation measures when applicable.

39. Potential impacts from construction activities include the mechanical clogging of substrates including spawning gravels through elevated silt deposition which affects the quality and quantity of available habitat. Other impacts include decreases in water quality, changes to local hydrology, and construction noise and vibration which has the potential to impact upon the disturbance of all life stages.

5 References

Godfrey, J.D. (2005). Site Condition Monitoring of Atlantic Salmon SACs. Report by the SFCC to Scottish Natural Heritage, Contract F02AC608.

SEERAD (Scottish Executive Environment and Rural Affairs Department) (2007). Agricultural facts and figures. The Scottish Government pdf 2.

Young MR, Hastie LC & Cooksley SL (2003). Monitoring the Freshwater Pearl Mussel, *Margaritifera margaritifera*. Conserving Natura 2000 Rivers Monitoring Series No. 2, English Nature, Peterborough.

NatureScot, undated https://www.nature.scot/sites/default/files/2018-10/Freshwater%20pearl%20mussel%20survey%20-%20protocol%20for%20use%20in%20site%20specific%20projects.pdf

Annex A

Relevant Legislation and Policy

Water Environment (Controlled Activities) (Scotland) Regulations 2011 (known as the Controlled Activities Regulations or 'CAR')

It is an offence to undertake the following activities without obtaining a CAR authorisation from the Scottish Environment Protection Agency:

- any activity liable to cause pollution of the water environment including discharges of polluting matter and disposal of waste;
- abstraction of water from the water environment;
- construction, alteration or operation of impounding works (e.g. dams and weirs) in surface water or wetlands;
- carrying out building or engineering works in inland water (other than groundwater) or wetlands; or in the vicinity of inland water or wetlands and having or likely to have a significant adverse effect on the water environment;
- artificial recharge or augmentation of groundwater;
- the direct or indirect discharge, and any activity likely to cause a direct or indirect discharge, into groundwater of any hazardous substance or other pollutant; or
- any other activity which directly or indirectly has or is likely to have a significant adverse impact on the water environment.

Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003

This Act covers regulation of fisheries in Scotland and includes legislation that covers the introduction of polluting effluents, the obstruction of fish passage (screens, dams, weirs, culverts etc) illegal means of fishing, permitted times of legal fishing and fishing licencing (which covers electric fishing). Of relevance to the construction of the Proposed Development are the following provisions:

- under this act any person who knowingly injures or disturbs salmon spawn or disturbs any spawning bed, bank or shallow in which salmon spawn shall be guilty of an offence
- any person who obstructs or impedes salmon in their passage to any such bed, bank or shallow shall also be guilty of an offence; and
- under his act Scottish Ministers may, after consulting such persons they consider appropriate, make regulations with respect to obstructions in rivers to the passage of salmon.

Freshwater Peal Mussel (FWPM)

FWPM are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), are listed on the European Union Habitats and Species Directive (Annexes II and V), and Appendix III of the Bern Convention 1979. They are also included on the IUCN Invertebrate Red List, where their status is described as Vulnerable.

Scottish Planning Policy 2014 (SPP 14)

SPP 14[2] sets out national planning policy considerations in relation to Scotland's natural heritage. It summarises the main statutory obligations on the conservation of natural heritage and explains, as part of a wider framework for conservation and development, how natural heritage objectives should be reflected in development plans. SPP 14 describes the role of the planning system in safeguarding sites of national and international importance, provides guidance on the approach to be adopted in relation to local and non-statutory designations and draws attention to the importance of safeguarding and enhancing natural heritage beyond the confines of designated areas.

Scottish Planning Policy on Renewable Energy

This planning policy defines factors to be taken into account when considering policies for renewable energy developments or applications for planning permission; includes considerations regarding international and national natural heritage designations and sites out with these.

Scottish Biodiversity Strategy (SBS)

The SBS was originally published in 2004 ('Scotland's Biodiversity: It's in Your Hands (Scottish Government, 2004); and supplemented by an update in 2013 ('2020 Challenge for Scotland's Biodiversity' (Scottish Government, 2013)). Together the two documents form Scotland's biodiversity strategy in response to the Aichi targets. The aims of the 2020 challenge are to:

- protect and restore biodiversity on land and in our seas, and to support healthy ecosystems;
- connect people with the natural world, for their health and well-being, and to involve them more in decision making; and
- maximise the benefits for Scotland of a diverse natural environment and the services it provides, contributing to sustainable economic growth.

NatureScot is tasked by the Scottish Government with leading the delivery of 'Scotland's Biodiversity: A Route Map to 2020' and the SBS working groups. Each working group is entrusted with a specific aspect of biodiversity conservation.

Scottish Biodiversity List

The SBL is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland. By identifying the species and habitats that are of the highest priority for biodiversity conservation, the list helps public bodies carry out their biodiversity duty, including implementation of the SBS.

[2] It is anticipated that SPP 14 will be replaced by National Planning Framework 4 during 2021.

Annex B

Electrofishing Survey Site Information and Fish Capture Data

Dalquhairn Burn

- Wet Width Area (m²): 77.2
- Site Length (m): 22.7
- Conductivity (µs/cm): 69

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
10	30	55	5	0	0

Instream information

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes: excellent habitat, clean and mobile	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
0	0	0	15	50	30	5	0	0

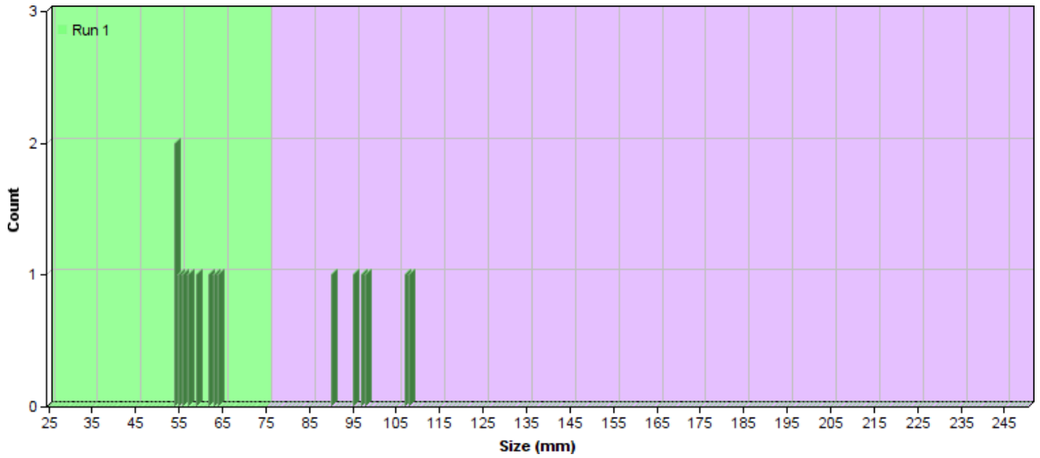
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
0	0	10	0	10	75	5	0

Atlantic Salmon Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

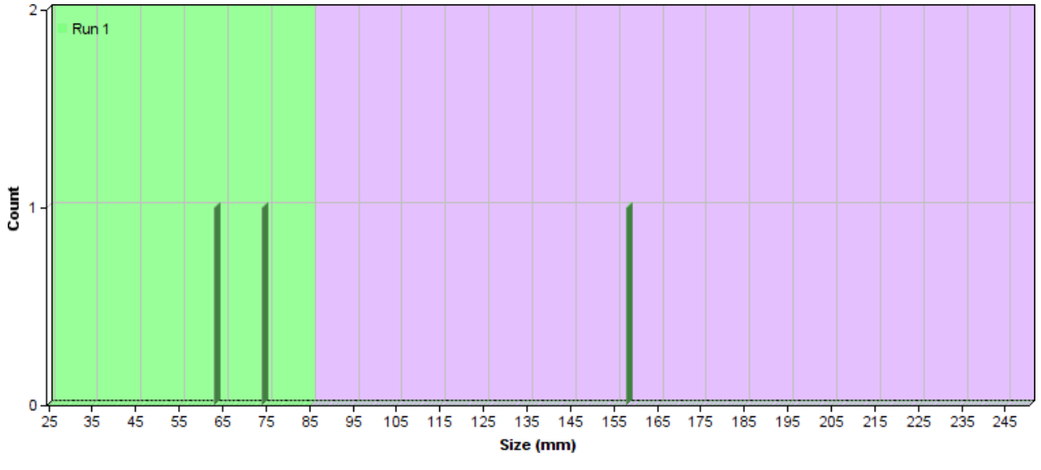
Age	Counts						Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	1 Run	All Runs	Average	Std Dev
0+	9	0	0	0	0	9	11.661	11.661	58	3.930
1++	6	0	0	0	0	6	7.774	7.774	99	7.026
Total	15	0	0	0	0	15				



Brown Trout (Sea Trout) Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	1 Run	All Runs	Average	Std Dev
0+	2	0	0	0	0	2	2.591	2.591	68	7.778
1++	1	0	0	0	0	1	1.296	1.296	158	
Total	3	0	0	0	0	3				



Palmullan Burn

- Wet Width Area (m²): 102.6
- Site Length (m): 24.9
- Conductivity (µs/cm): 74

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
2	28	45	10	10	5

Instream information

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes:	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
0	0	1	2	7	65	20	5	0

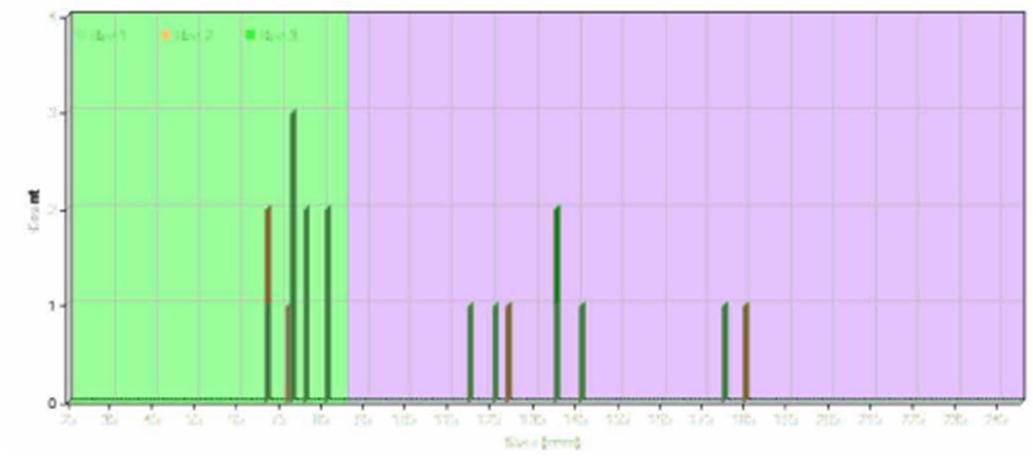
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
0	0	10	15	25	40	10	0

Brown Trout (Sea Trout) Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	8	2	0	0	0	10	9.804	9.748	7.798	9.748	78	4.841
1++	5	2	1	0	0	8	8.497	7.798	4.874	7.798	145	24.241
Total	13	4	1	0	0	18						



Knockoner Burn

- Wet Width Area (m²): 86.4
- Site Length (m): 29.4
- Conductivity (µs/cm): 71

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
5	25	50	15	5	0

Instream information

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes: good clean substrates, some moss on surface of stones	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
0	1	2	7	20	30	25	15	0

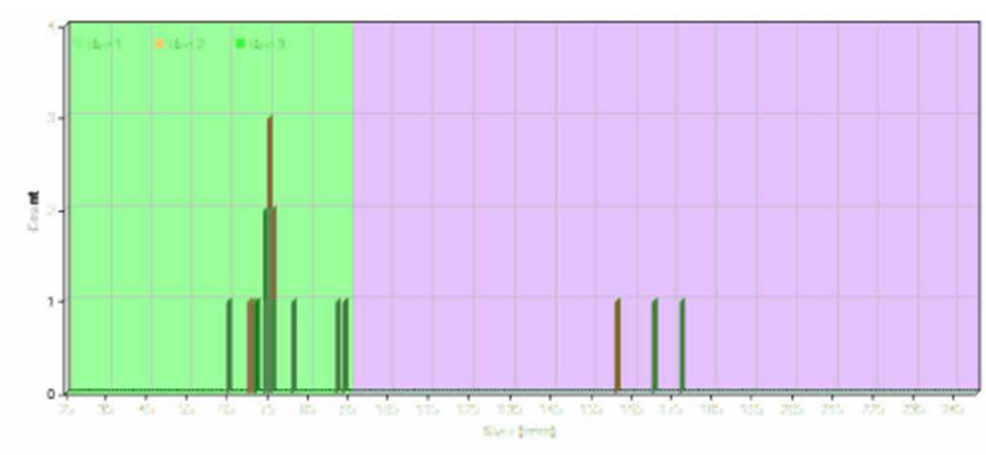
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
5	0	5	5	10	55	20	0

Brown Trout (Sea Trout) Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	8	4	2	0	0	14	18.51	16.196	9.255	16.196	76	7.900
1++	2	1	0	0	0	3	3.557	3.471	2.314	3.471	169	8.021
Total	10	5	2	0	0	17						



Pulreoch Burn

- Wet Width Area (m²): 100.6
- Site Length (m): 64.6
- Conductivity (µs/cm): 54

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
15	35	20	20	5	5

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes: Moss on substrates. Clean substrates, no obvious signs of silt	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
0	2	3	20	50	20	3	0	2

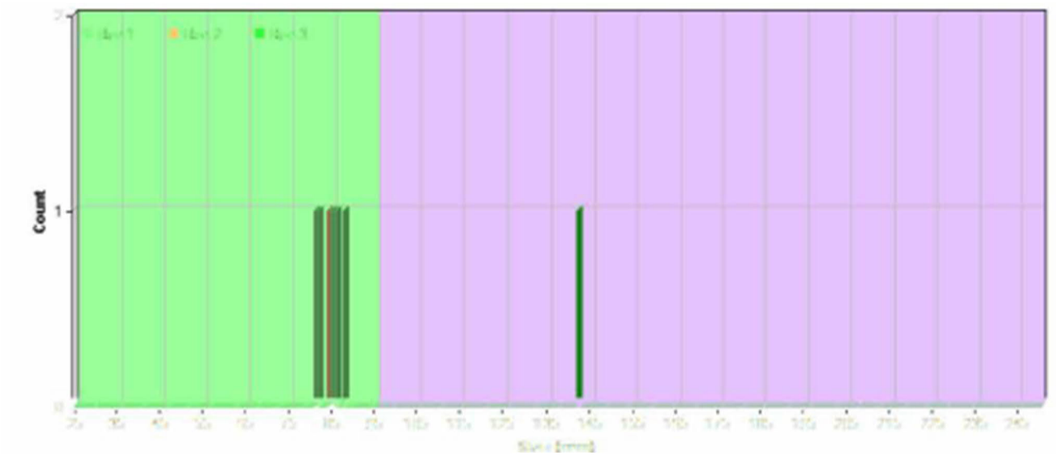
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
0	5	0	0	75	15	5	0

Brown Trout (Sea Trout) Density Report

- The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	5	1	0	0	0	6	5.985	5.965	4.971	5.965	84	2.582
1++	0	0	1	0	0	1			0.000	0.994	142	
Total	5	1	1	0	0	7						



Tairlaw Burn 1

- Wet Width Area (m²): 100.5
- Site Length (m): 46.1
- Conductivity (µs/cm): 48

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
20	40	30	5	5	0

Instream

Instream Vegetation (%): 10	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes:	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
0	0	0	20	40	35	5	0	0

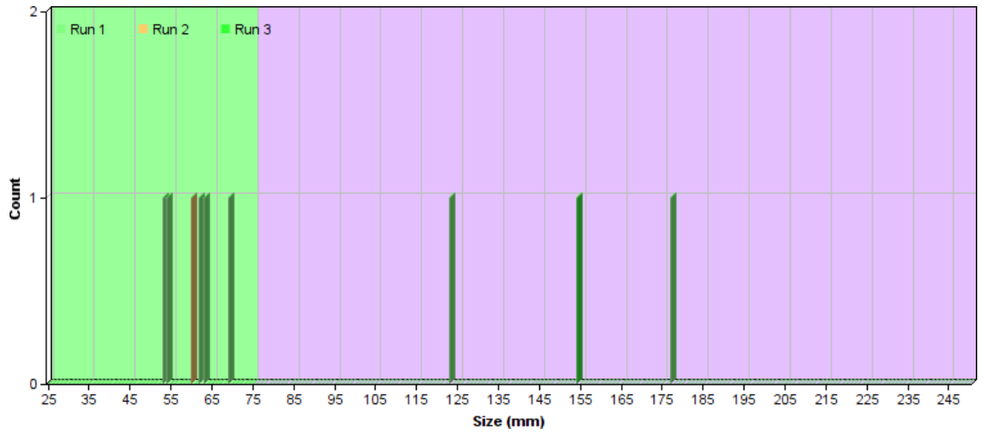
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
0	0	5	0	20	70	5	0

Brown Trout (Sea Trout) Density Report

- The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	5	1	0	0	0	6	5.991	5.97	4.975	5.970	60	5.981
1++	2	0	1	0	0	3	3.777	2.985	1.990	2.985	151	27.099
Total	7	1	1	0	0	9						



Tairlaw Burn 2

- Wet Width Area (m²): 100.1
- Site Length (m): 32.3
- Conductivity (µs/cm): 53

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
5	20	30	10	15	20

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes: Some mosses covering substrates	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
0	0	0	10	35	45	10	0	0

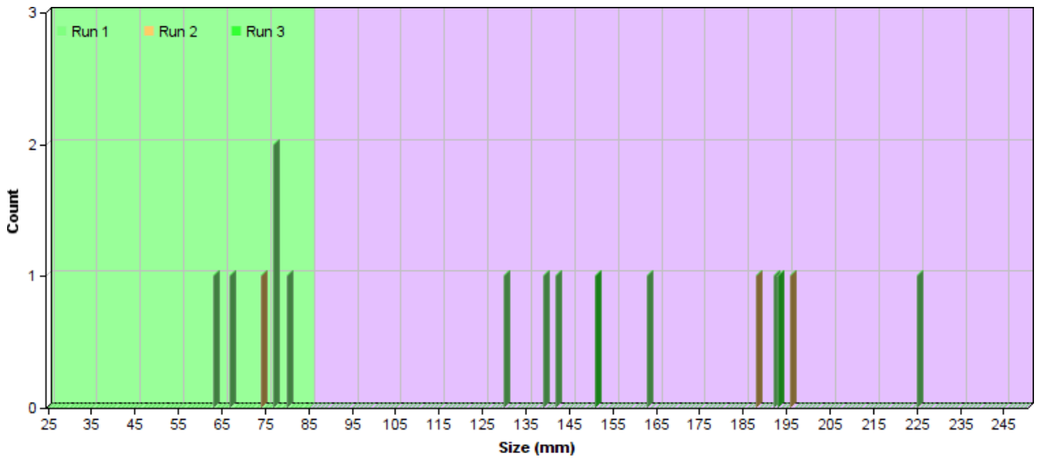
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
0	30	20	0	10	30	10	0

Brown Trout (Sea Trout) Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	5	1	0	0	0	6	6.013	5.992	4.994	5.992	73	6.603
1++	6	2	2	0	0	10	11.711	9.987	5.992	9.987	171	31.193
Total	11	3	2	0	0	16						



Tairlaw Burn 3

- Wet Width Area (m²): 104.8
- Site Length (m): 27.0
- Conductivity (µs/cm): 41

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
20	30	45	5	0	0

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes: loose, mobile substrates: good trout spawning site	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
0	0	1	4	50	30	15	0	0

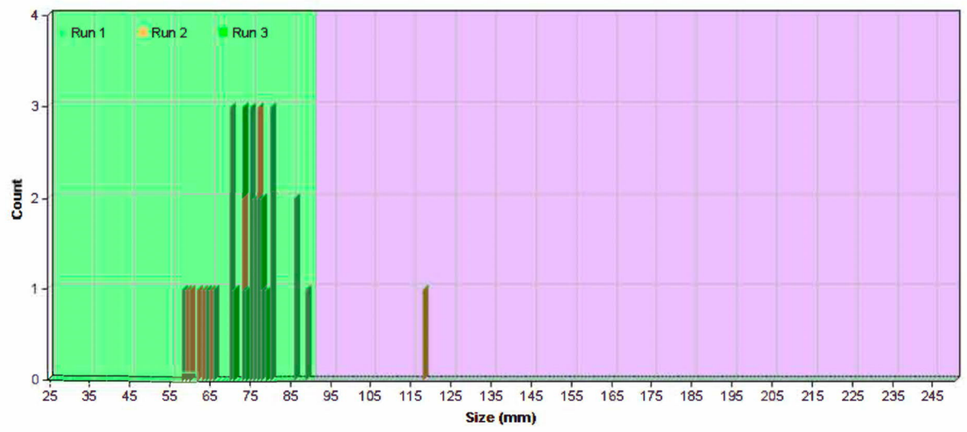
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
5	0	5	0	25	60	5	0

Brown Trout (Sea Trout) Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	21	7	5	0	0	33	34.613	33.41	20.046	31.501	73	7.788
1++	0	1	0	0	0	1			0.000	0.955	118	
Total	21	8	5	0	0	34						



Balbeg Burn

- Wet Width Area (m²): 87.1
- Site Length (m): 34.3
- Conductivity (µs/cm): 100

Watercourse Depth

< 10	11-20	21-30	31-40	41-50	> 50
15	55	24	6	0	0

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes: some moss on substrates	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB
5	0	0	15	45	25	10	0	0

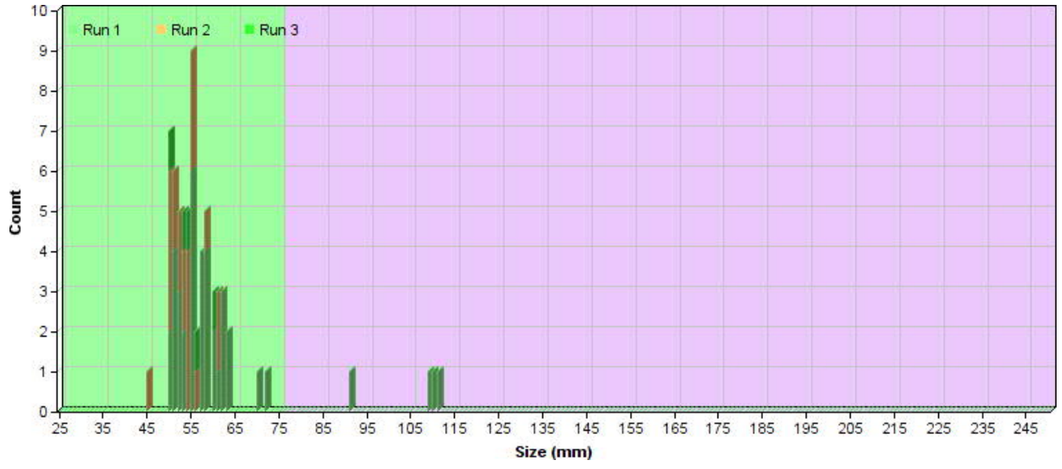
Flow

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO
0	0	5	0	15	75	5	0

Atlantic Salmon Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

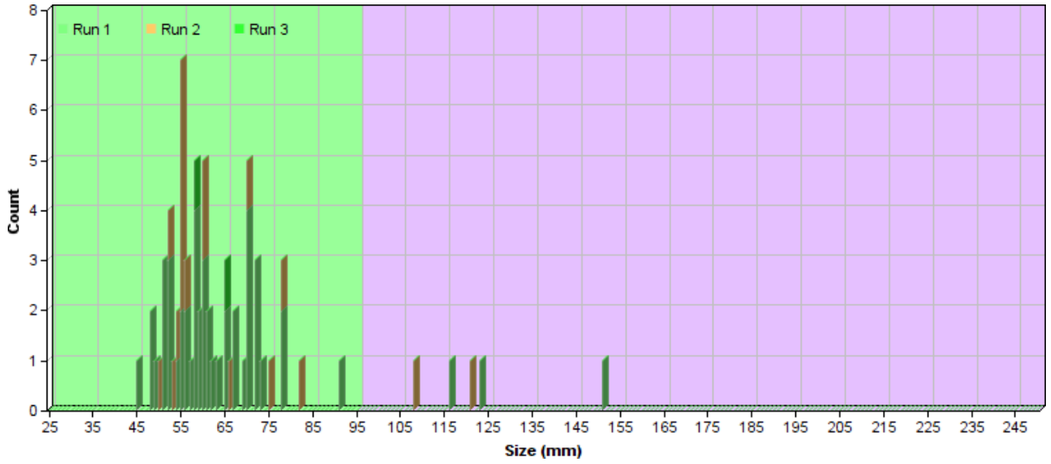
Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	35	22	5	0	0	62	78.249	76.905	40.174	71.166	55	4.898
1++	4	0	0	0	0	4			4.591	4.591	105	9.535
Total	39	22	5	0	0	66						



Brown Trout (Sea Trout) Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length	
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev
0+	45	17	2	0	0	64	75.222	74.61	51.653	73.462	61	9.407
1++	3	2	0	0	0	5	5.989	5.739	3.444	5.739	123	16.270
Total	48	19	2	0	0	69						



Annex C

Electrofishing Survey Site Photographs

Site 1: Dalquhairn Burn

Site 2: Palmullan Burn

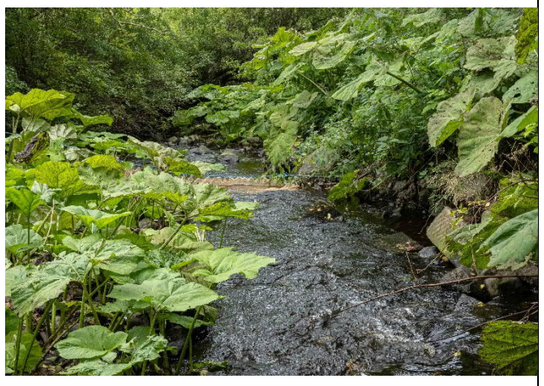
Site 3: Knockoner Burn

Site 4: Pulreoch Burn

Site 5: Tairlaw Burn 1

Site 6: Tairlaw Burn 2

Site 7: Tairlaw Burn 3



Site 8: Balbeg Burn

Annex D
Figures

Figure 7.5.1: Desk Study and Field Survey Locations

Carrick Windfarm Project Team

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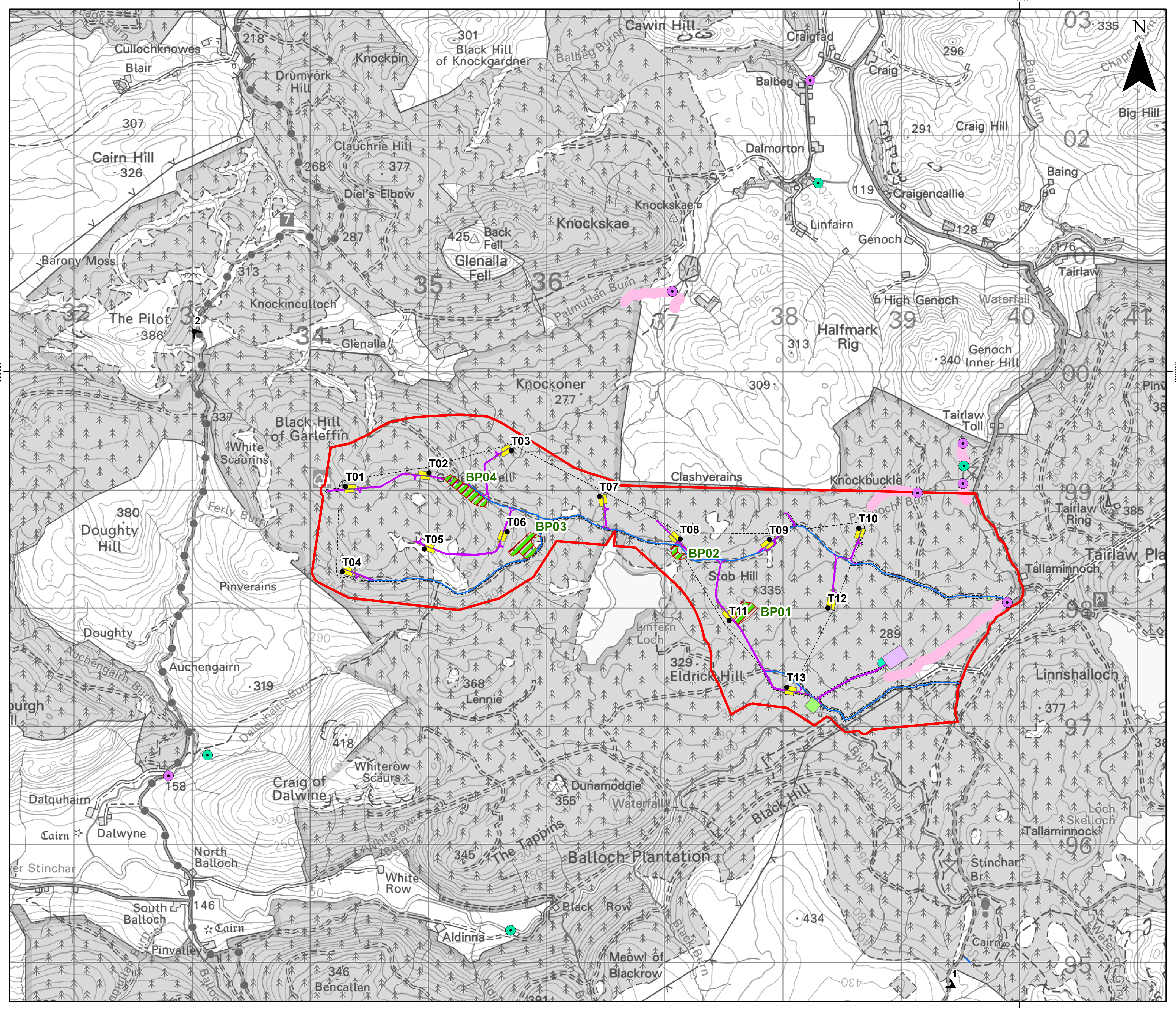
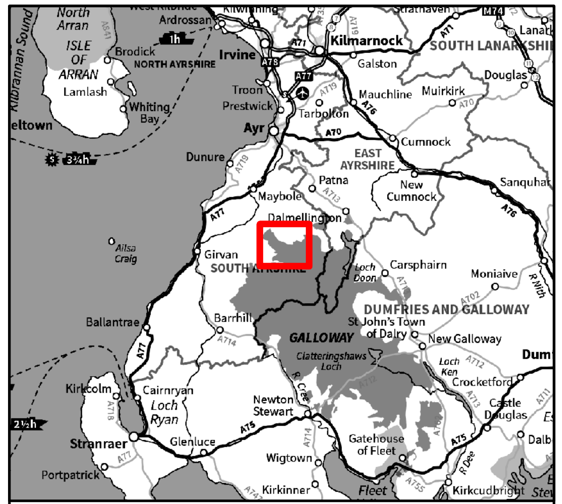
9th Floor
320 St Vincent Street
Glasgow
G2 5AD

carrickwindfarm@scottishpower.com

SCOTTISHPOWER
RENEWABLES





Legend

- Site Boundary
- Proposed Development Area
- Desk Study Fish Monitoring Locations
- Electrofishing Survey Locations
- Freshwater Pearl Mussel Survey Reach

Proposed Infrastructure

- Substation Compound
- Temporary Construction Compound
- Crane Pad
- Hardstanding
- Temporary SPEN Construction Compound
- Borrow Pit Search Area
- Wind Turbine
- Carrick Access Track - New Construction
- Carrick Access Track - Existing Forestry Track to be Upgraded

Km 0 0.75 1.5

Rev	Date	By	Comment
C	29/10/2021	JO	Third Issue
B	19/11/2020	BG	Second Issue
A	17/11/2020	BG	First Issue.

SCOTTISHPOWER RENEWABLES

Carrick Windfarm

Figure 7.5.1 Desk Study and Field Survey Locations

Drg No	Carrick-WSP-I-157
Rev	C
Date	17/12/2021
Scale	1:30,000 @ A3