



Cloud Hill Wind Farm

Technical Appendix 7.4 Electrofishing Survey Report

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Technical Appendix A7.4

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Electrofishing Surveys
To Assess Populations of Juvenile Salmonids and
Other Species of Fish
In The Vicinity Of
The Proposed Cloud Hill Wind Farm Site

Volume 1



Commissioned by
MACARTHUR GREEN LTD

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Cover photo: Trout found at Site 4

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1. Introduction

1.1. Background

The River Nith is a river of major importance as a salmon and sea trout fishery, and is the largest river in southwest Scotland. Its source is in Ayrshire and it flows through Dumfriesshire, spanning approximately 100 kilometres (km) to its estuary in the Solway Firth, a total catchment area of 1200 square km.

The annual catch of migratory salmonids is of significant economic importance to this rural area. An economic survey has been conducted and that revealed that the Nith accounts for £2.2 million being spent in the local economy (Leslie, 2000). There are net fishing interests in the estuarial reaches, with Haaf netting a commonly used method. There are a range of fixed nets on the western boundary, still within the Nith District Salmon Fishery Board area of jurisdiction. Angling is widespread over most of the main stem and some larger tributaries of The Nith. Net fishing and angling produced a joint catch of 827 salmon and grilse and 625 sea trout during 2020 (N.D.S.F.B., 2021).

1.2. Nith District Salmon Fishery Board (NDSFB)

The NDSFB is a statutory body constituted under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003, tasked with the management of migratory salmonid species within their catchment area. The Board is empowered to conduct works and execute measures to safeguard, improve and enhance stocks of migratory salmonids within its jurisdictional area. The NDSFB has no remit to manage non-migratory species other than with the permission of riparian owners and only where management of these species would be deemed to be in the furtherance of migratory species. Management of non-migratory species of fish within the Nith catchment is conducted by the Nith Catchment Fishery Trust who works closely with the Board. The NDSFB is active and works in areas of fisheries protection, restocking hatchery programmes, habitat restoration and predator control (NDSFB, 2021).

Salmon populations in the River Nith have dramatically reduced over the last decade. This phenomenon has been experienced right across the range that the species has throughout the north Atlantic region. Recorded catches of salmon in the Nith are down by approximately 80% and this is having a serious economic impact on the rural businesses that rely on the fishery. Unsurprisingly at this time of concern for salmon populations, managers and owners of salmon fishing are scrutinising any potential additional pressure on the

resource and this brings into focus construction projects in parts of the catchment where salmonid species utilise as nursery areas. The reduction in salmon populations throughout Scotland is of such concern to the Scottish Government that they have categorised every river according to their ability to sustain populations of this species. The River Nith, had been assigned a Category 3 status for 2020, based on the recorded catches. This means that no salmon harvest was taken from the River Nith catchment for conservation reasons. Category 3 status has been maintained for the 2021 fishing season. It has never been more important than currently, to establish accurate fishery data and to monitor the potential impact that construction projects or management interventions may have on those populations, to enable validation of mitigation measures employed to protect fish.

1.3. Cloud Hill Wind Farm

The proposed Cloud Hill Wind Farm (the Proposed Development) is located in north Dumfriesshire, west of the town of Sanquhar. The elevated site is currently used for agricultural hill grazing with a limited amount of forestry. The site is traversed by small watercourses which mainly drain to the north into the Euchar Water, a major tributary of the River Nith.

NDSFB have been consulted about the proposals to construct a wind farm at Cloud Hill by MacArthur Green, working on behalf of the Applicant. In accordance with planning legislation in relation to wind farms and similar developments located in remote areas of the Scottish countryside a complete suite of environmental data must be gained to support any planning application. MacArthur Green have commissioned NDSFB to conduct fisheries surveys within the catchment area of the Proposed Development. The purpose of these surveys is to establish a current comprehensive baseline of data which will enable the developers and their consultants to take cognisance of that information as they progress their plans for the site. This data set can be used as a benchmark and may be used for comparison purposes with future surveys relating to the site.

1.4. Fisheries Surveys

These surveys are carried out to primarily assess the densities of juvenile salmonid species of fish present in the watercourses. The salmonid species targeted are juvenile Atlantic salmon (*Salmo salar*) and Sea/brown trout (*Salmo trutta*). Salmon and sea trout are anadromous, meaning that they spend their adult life at sea and their juvenile life in freshwater. The returning adults migrate back to their natal rivers to spawn in late autumn laying their eggs in the spawning gravels. The adults either die or return to sea to repeat

the process again. The eggs hatch in the riverine substrate after 440-degree days (i.e., 44 days at 10°C) where the young fish (alevins) exist for a number of weeks before emerging out of the gravels in March/April (Hendry and Cragg-Hine, 2003). The young salmonids remain in their natal watercourses for typically two to three years before smolting and migrating to sea, where they will spend their adult lives. Salmonids are a very good biological indicator species as they are sensitive to both direct and diffuse pollution. Silt, high nutrient levels and vibrations can all impact on their survival rate. Salmon are listed in Appendix III of the Bern Convention and Annex II and V of the EC Habitats and Species Directive and both salmon and sea trout are on the UK Biodiversity Action Plan (UKBAP) Priority Species List.

Sea trout and brown trout are the same species (*Salmo trutta*) but brown trout are resident within freshwater and do not migrate to sea during their life history. It is not possible to determine if the juvenile trout captured during a survey are destined to remain as resident brown trout or migrate to sea and become sea trout. Consequently, they are referred to as trout for the purposes of this survey. Brown trout will often be found upstream of impassable falls and these populations will have discrete gene pools. However, the majority of both sea trout and brown trout progeny will migrate to sea to become sea trout due to the lack of available habitat. Although the decision to migrate or not will, in part, be down to genetics, environmental factors are fundamentally important to the choice they make. In a watercourse that has plentiful adult habitat i.e., deep pools, and is rich in food, a larger proportion of the juvenile trout will develop into resident brown trout. However, in a watercourse that has limited adult habitat and has a reduced abundance of food, it is in the best interests of the trout to migrate to sea.

Although the fisheries surveys do not target non-salmonid species they are captured as a matter of course during these surveys. Other species typically found in watercourses within the Nith catchment include eel, stone loach, minnow, lamprey, stickleback and grayling. Of significance to any construction project will be the presence of lamprey or eel due to their protected status. There are three different species of lamprey that reside within the River Nith; sea lamprey, river lamprey and brook lamprey. All three species of lamprey are listed in Annex II of the EU Habitats Directive (River lamprey are also listed in Annex V) and in Appendix III of the Bern Convention. River and sea lamprey are on the UKBAP Priority List. Eels are under threat with their populations declining by 90% over the last two decades.

They are now protected under Scottish law and the EU commission has developed an Eel Recovery Plan. Eels are also on the UKBAP Priority List.

2. This Study

2.1. Aims

This study set out with the following aims:

- a) To utilise the Scottish Fisheries Coordination Centre (SFCC, 2019 & 2014) protocol for electrofishing which is a replicable and efficient capture technique for juvenile salmonids and other species of fish that is suitable for the watercourses in the vicinity of the Development within the catchment of the River Nith.
- b) To assess juvenile salmonid population densities and presence of other species of fish within the vicinity of the Development within the catchment of the River Nith.
- c) To produce data which may be used to assess fish populations when compared with future surveys.
- d) To produce data to assist in the environmental policy, considerations and safeguards which may be implemented for the general protection of the River Nith catchment and its environs.
- e) To make recommendations to the Applicant and their contractors on how best they can protect those populations of fish known to exist in the watercourses draining the site, from an informed position, based on facts.

2.2. Feasibility

To accurately conduct these electrofishing surveys within the vicinity of the Proposed Development, this study had to take account of the time of year when surveying was conducted, the height of water and general conditions at the time of surveying. For these reasons, the surveys were conducted during conducive conditions to ensure efficiency was optimum.

2.3. Site selection

This study conducted surveys within the River Nith catchment at strategic locations within watercourses draining the land footprint of the Proposed Development. The sites were chosen for their accessibility and likelihood of containing the target species.

2.4. Photography

All sites were photographed to provide an accurate record of conditions at time of survey. These photographs are a useful aid in assessing environmental status and to assess the quality of each site with regard to its potential as a salmonid habitat.

3. Methods

3.1. Electrofishing surveys

3.1.1. *Electrofishing apparatus*

NDSFB utilised backpack electrofishing equipment throughout the duration of these surveys. The backpack unit used was a Hans Grassl IG600 backpack linked to a mobile cathode of braided copper (placed in the stream behind the operative) and one mobile anode, which consisted of a two-metre pole with a stainless-steel ring (used to draw fish) and an operator-controlled switch (Figure 1).

3.1.2. *Ancillary equipment*

One banner net was employed where appropriate, and dip nets with 1.3 metre handles attached were used to capture stunned fish which were placed into a water-filled bucket to recover.

Figure 1 – Backpack electrofishing equipment and associated equipment



3.1.3. *Personnel*

To conduct this electrofishing survey, NDSFB utilised the services of their own staff, who are qualified and experienced in the use of electrofishing equipment and capable of conducting

such research. The Scottish Fisheries Co-ordination Centre (SFCC) protocol for electrofishing was adhered to throughout this survey (SFCC, 2019 & 2014).

For their personal protection, all personnel wore waders. All personnel could swim. All members of the team were qualified in first aid, and first aid equipment was available in the Fishery Board vehicle present throughout the survey. Strict adherence of NDSFB's Covid 19 policy for conducting operations in the field was maintained throughout this series of surveys.

3.1.4. Techniques

To accurately assess the populations of fish throughout this survey, a method of electrofishing was adopted which could efficiently capture the appropriate age classes and species likely to be present. The method adopted entailed selecting natural features on the river that provided boundaries to each electrofishing site. Features such as shallow riffles at the top and bottom of a section of river were typically utilised. Once a site had been selected, the electrofishing team systematically worked from downstream to upstream following a carefully agreed pattern removing all fish caught. Working in an upstream direction prevents any sediment caused by wading in the river from obscuring the working area.

The anode operator was able to draw stunned fish downstream, assisted by the current, towards the hand-held dip net which was lifted clear of the water after each sweep, to permit the removal of captured fish for transfer into water-filled buckets.

This method captured all species present in the sites. All fish were returned, unharmed to their original capture sites on completion of examination and data recording.

3.1.5. Data recording

All fish captured were removed from the survey sites, placed in water-filled buckets and allowed to recover from the temporary stunning effects of electrofishing. Each bucket of fish was processed by removing the fish from the water using a small net and placing them into anaesthetic. Once sufficiently anaesthetised, the fish were placed onto a wet measuring board where they were identified and fork lengths were measured. The area electrofished at each site was measured and recorded. Water chemistry and habitat data was recorded. A global positioning system (GPS) was employed to record the exact location of each site.

3.1.6. *Salmonid species*

Salmonid species were counted and recorded as:

- Salmon fry (O⁺) which refers to a young fish less than one-year-old, resulting from spawning at end of 2020.
- Salmon parr (1⁺) which refers to a young fish which is older than one-year-old, resulting from spawning at end of 2018/2019.
- Trout fry (O⁺) which refers to a young fish less than one-year-old, resulting from spawning at end of 2020.
- Trout parr (1⁺) which refers to a young fish which is older than one-year-old, resulting from spawning at end of 2018/2019, or earlier in the case of larger specimens.

Age determination of salmonids has been assessed by the length of individuals captured from each fishing site (Figure 2).

Figure 2 - Salmonids: Salmon and Trout, Parr and Fry



3.1.7. *Non-salmonid species*

The presence and densities of non-salmonid species was recorded at each survey site.

3.1.8. *Data Analysis*

The results from the electrofishing surveys are expressed as the number of fish present within 100m². The densities of fry and parr are then classified using the Scottish Fisheries Co-ordination Centre national classification scheme (Godfrey, 2005). This classification scheme categorises the data according to five categories derived using data from over 1600

Scottish sites. This allows the performance of each site surveyed to be demonstrated graphically.

4. Results and discussion

A total of nine sites were surveyed as part of the baseline fisheries surveys in relation to the Proposed Development. Site 1 was included in this suite of surveys to act as a control site as it is located on the Euchar Water, up catchment and beyond any potential influence from the Proposed Development. Figure 7.10 displays all survey site locations and photographs of each site can be found in Appendix 1. A complete list of all those sites surveyed can be found in Table 1.

4.1. Electrofishing results and discussion

The results of the electrofishing surveys are presented in Table 2 which show the densities of salmonids per 100m². The table also includes the site numbers, general site descriptions, grid reference to 12-digit co-ordinates, date of survey and other species present. Five of the nine sites surveyed did contain salmonid species of fish. In general terms, fish presence in some of the watercourses surveyed throughout this series of surveys was remarkable considering the size of some of the watercourses surveyed and the extremes of drought conditions that persisted during the summer of 2021. Whilst trout were present in some of the sites surveyed on the hill ground the absence of non-salmonids in these sites is thought due to the gradients and multiple obstructions on these watercourses. The absence of salmonid species of fish in some of the minor hill burns was thought due to the gradient and presence of natural barriers to fish migration. Where access was afforded, trout were present.

Salmon and trout, parr and fry aged fish were present in the lower section of the Euchar Water at site 8. Other species of fish were also present at this location including Stoneloach and Minnow. Site 9, located in the main stem of the River Nith, contained salmon fry and parr. Other species of fish including Stoneloach, Minnow and Grayling were also present.

The densities, species composition and age classes of fish found in sites throughout this series of surveys, were comparable to those found in similar watercourses throughout the Nith catchment during 2021.

5. Conclusions

This series of surveys at the Site concludes:

- That five of the nine sites surveyed contained fish.
- That water quality has been sustained at a consistently high standard to maintain those species and age classes of salmonid fish.
- That the absence of fish at sites 2, 5, 6 and 7 is considered due to a combination of watercourse gradient and natural rock obstructions to fish migration.
- That salmonid and other species of fish exist in watercourses down catchment from the Proposed Development.

6. Recommendations

This study recommends that if the Proposed Development proceeds to the construction phase:

- That the information gained from this series of aquatic surveys should be used to inform construction method statements on appropriate mitigation to be employed throughout the build phase of the Proposed Development.
- That this suite of surveys be repeated, no more than 12 months prior to construction commencing on the Proposed Development and repeated annually during the construction phase.
- That post construction and commissioning surveys are repeated. Thus, an assessment of overall impacts can be made on the fish communities now known to exist in the vicinity of the Proposed Development.
- That construction activity either in or in proximity of a watercourse, be discussed with the Scottish Environment Protection Agency (SEPA) and NDSFB.
- That any instream construction procedures, such as culverting, are notified to NDSFB prior to works commencing to ensure that appropriate fisheries mitigation measures are adopted.

7. Acknowledgements

Mr Robert Whiteford, Burnfoot Farm, Sanquhar, Dumfriesshire

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Table 1: List of Sites Surveyed – Cloud Hill Wind Farm 2021

Watercourse	Site code	Location description	Easting	Northing	Altitude (m)	Wet width (m)	Water Temp (°C)	Conductivity (µS)	pH	Surveys conducted
Euchan Water – control	1	Downstream of forestry gates at Euchanhead	271024	606477	334	8.0	17.9	70	6.92	Fisheries
Glenlarie Burn	2	300m U/S of confluence with Euchan Water	273717	606948	299	2.10	13.9	110	6.65	Fisheries
Glen Burn	3	U/S of track crossing	274378	607318	212	0.50	14.8	130	6.27	Fisheries
Glen Burn	4	U/S from Glenmaddie Cottage	274216	606869	265	4.75	16.5	150	6.37	Fisheries
Cramley Burn	5	D/S of old ruin	275282	606695	334	0.40	16.8	150	6.02	Fisheries
Glenmaddie Burn	6	D/S of confluence with Cow Burn	275043	606905	316	3.20	15.8	170	6.65	Fisheries
Glenmaddie Burn	7	At track crossing	275516	607979	203	2.50	13.0	120	6.09	Fisheries
Euchan Water	8	Upstream from confluence with River Nith	277946	609149	125	10.24	15.5	80	6.12	Fisheries
River Nith	9	East side of island at South Mains	278664	608502	121	14.20	14.6	400	7.50	Fisheries

Table 2: Results of Electrofishing Surveys – Cloud Hill Wind Farm 2021

Watercourse	Site code	Location	Easting	Northing	Sampling date	Salmon fry (/100m ²)	Salmon parr (/100m ²)	Trout fry (/100m ²)	Trout parr (/100m ²)	Other species present
Euchan Water - control	1	Downstream of forestry gates at Euchanhead	271024	606477	02/09/2021	0.00	0.00	2.50	2.50	-
Glenlarie Burn	2	300m U/S of confluence with Euchan Water	273717	606948	03/09/2021	0.00	0.00	0.00	0.00	-
Glen Burn	3	U/S of track crossing	274378	607318	03/09/2021	0.00	0.00	0.00	9.05	-
Glen Burn	4	U/S from Glenmaddie Cottage	274216	606869	06/09/2021	0.00	0.00	7.02	24.56*	-
Cramley Burn	5	D/S of old ruin	275282	606695	06/09/2021	0.00	0.00	0.00	0.00	-
Glenmaddie Burn	6	D/S of confluence with Cow Burn	275043	606905	06/09/2021	0.00	0.00	0.00	0.00	-
Glenmaddie Burn	7	At track crossing	275516	607979	03/09/2021	0.00	0.00	0.00	0.00	-
Euchan Water	8	Upstream from confluence with River Nith	277946	609149	10/08/2021	42.20*	1.6*	5.42*	1.47	SL, M
River Nith	9	Upstream from South Mains	278664	608502	02/09/2021	192.67*	6.37*	0.00	0.00	SL, M, G

* Calculated using Zippin's estimate of density. All other densities are minimum densities.

Key to other species: E – Eel, M – Minnow, SL - Stone Loach, L – Lamprey, SB – Stickleback, G – Grayling, F – Flounder, P – Pike.

Key to classification of salmonids per 100m²

Absent	Very poor	Poor	Moderate	Good	Excellent
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Table 3: Habitat data – Cloud Hill Wind Farm 2021

Site code	Instream cover	Bank face vegetation	Bank top vegetation	Substrate									Flow type							
				HO %	SI %	SA %	GR %	PE %	CO %	BO %	BE %	OB %	SM %	DP %	SP %	DG %	SG %	RU %	RI %	TO %
1	Excellent	Uniform	Uniform	0	0	0	20	20	30	30	0	0	10	0	20	0	10	20	40	0
2	Good	Complex	Complex	0	0	0	10	10	20	20	40	0	20	10	30	0	0	20	20	0
3	Good	Complex	Complex	0	0	0	0	30	40	20	10	0	30	0	70	0	0	0	0	0
4	Poor	Complex	Complex	0	0	0	5	15	10	5	65	0	20	35	25	0	0	10	10	0
5	Poor	Uniform	Uniform	10	20	20	30	10	10	0	0	0	10	0	20	0	50	0	20	0
6	Poor	Bare	Simple	30	0	0	20	20	10	0	0	20	0	30	30	0	30	0	10	0
7	Moderate	Complex	Complex	0	0	0	0	10	20	20	50	0	0	0	100	0	0	0	0	0
8	Excellent	Complex	Complex	0	0	5	15	25	4	15	0	0	5	0	0	0	10	65	20	0
9	Excellent	Complex	Complex	0	0	0	0	15	55	30	0	0	5	0	0	0	0	35	60	0

Key to habitat:

Vegetation: Bare – Bare ground, Uniform – One vegetation type, Simple – 2-3 vegetation types, Complex – 4 or more vegetation types including scrub/trees.

Substrate: HO - High organic, SI – Silt, SA – Sand, GR – Gravel, PE – Pebbles, CO – Cobbles, BO – Boulders, BE – Bedrock, OB – Obstructed.

Flow type: SM – shallow marginal, DP – deep pool, SP – shallow pool, DG – deep glide, SG – shallow glide, RU – run, RI – riffle, TO – torrent.

Appendix 1 - Photographs of sites surveyed



Site 1 – Euchar Water – control site



Site 2 – Glenlarie Burn



Site 3 – Lower Glen Burn



Site 4 – Upper Glen Burn



Site 5 – Cramley Burn



Site 6 – Upper Glenmaddie Burn

Photographs of sites continued



Site 7 – Lower Glenmaddie Burn



Site 8 – Lower Echan Water



Site 9 – River Nith

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