# Technical Appendix 11.E: Fisheries Surveys

Galloway Fisheries Trust. January 2022. Fisheries electrofishing survey for Lorg Wind Farm. Galloway Fisheries Trust Report No. – 2022_03:DP

Nith District Salmon Fishery Board. January 2022. Aquatic surveys to assess fish populations, freshwater pearl mussels and aquatic macro-invertebrate communities within the River Nith catchment in the vicinity of the proposed Lorg Wind Farm site.

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**Commissioned Report No. – 2022_03:DP**

# Fisheries electrofishing survey for Lorg Wind Farm

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# Summary

## Fisheries electrofishing survey for Lorg Wind Farm

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**Contractor: Wood plc**
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**Keywords**

Electrofishing; Lorg; Wind Farm; salmonids; juvenile surveys; baseline

**Background**

The Galloway Fisheries Trust (GFT) was commissioned by Wood plc to carry out baseline electrofishing surveys to inform the EIA for the proposed Lorg Wind Farm near Carsphairn in Dumfries and Galloway.

Surveys were undertaken in October 2021 on the upper Dee catchment on tributaries of the Water of Ken.

**Main findings of the 2021 electrofishing survey**

- A total of seven sites were surveyed using electrofishing techniques for this study. All sites were located within the upper Dee catchment.
- All seven sites fell within the wind farm boundaries.
- Of the seven sites within the wind farm boundaries, Brown trout were present in one site with six sites having no fish present.

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**Table of Contents** **Page**

# 1 INTRODUCTION

Galloway Fisheries Trust (GFT) was commissioned by Wood plc to undertake baseline electrofishing surveys to inform the EIA for the proposed Lorg Wind Farm.

Prior to these surveys, GFT were commissioned to carry out a targeted walk-over fish habitat survey in 2013 for the site to assess the potential of these watercourses to support fish populations and to make recommendations regarding whether electrofishing surveys were required.

The habitat survey identified that there were several watercourse sites in the immediate vicinity of the development which contain habitats suitable to potentially support a fish population. It was recommended that electrofishing surveys should be undertaken.

Electrofishing surveys were carried out in 2021 to provide baseline data and an overview of the fish populations present in the area of the proposed development.

The proposed development is within the River Dee catchment in South West of Scotland. The River Dee is within the area managed by the Kirkcudbrightshire Dee District Salmon Fishery Board and is covered by GFT.

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 development mainly occurs during the construction and decommissioning phases of the 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 River Dee 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. Salmon and sea trout are unable to access the upper river above Kendoon Dam due to the lack of a fish pass.

The proposed Lorg Wind Farm site is upstream of the Kendoon Hydro Dam (part of the Galloway Hydro Scheme). This dam contains no fish pass so migratory fish species are unable to access the watercourses at this site.

## 2 AIMS

The aims of this work were as follows:

**2.1** To undertake electrofishing surveys within the boundary of the Lorg Wind Farm Development, on the Dee 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. It also follows the recommendations of the recently publicised Marine Scotland guidance 'Monitoring watercourses in relation to onshore wind farm developments: generic monitoring programme'.

## 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 2020 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 2021 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 by Wood plc and GFT. Sites were directed by the targeted walk-over habitat survey completed in 2013.

Survey work was carried out in October 2021.

# 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 and non-salmonid species 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.

*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 2020 |
| Trout Fry (0+): | Young fish less than one year old resulting from spawning at the end of 2020 |
| Salmon Parr (1+ and older (1++)): | Young fish of greater than one year and greater than two years old (where present) from spawning in 2019 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 2019 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 River Dee 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 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. |

One site across the electrofishing survey can be classed as 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.

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 2021. 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.

- Site 1, Water of Ken: Grid ref: 266722 600474

Both trout fry and parr were found at this site in low density.

- Site 2, Un-named tributary of the Alwhat Burn: Grid ref: 265951 601783

No fish were found within this site.

- Site 3, Alwhat Burn, Water of Ken: Grid ref: 265591 601411

No fish were found within this site.

- Site 4, Small Burn, Altry Burn, Water of Ken: Grid ref: 267066 599624

No fish were found within this site.

- Site 5, Pulmulloch Burn, Water of Ken: Grid ref: 268233 599660

No fish were found within this site.

- Site 6, Pulmulloch Burn, Water of Ken: Grid ref: 268195 600071

No fish were found within this site.

- Site 7, Pulmulloch Burn, Water of Ken: Grid ref: 268546 599687

No fish were found 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.

- Site 1, Water of Ken

Site 1 is situated upstream of the ford (Figure 1).

This watercourse was relatively large, as the average wet width was 7.44 m wide. Instream cover was considered to be good. Substrates are primarily gravel (20%), pebbles (25%), cobbles (35%) and boulders (20%). The depth ranged from <10 to 50 cm. This watercourse has moderate flow and consisted primarily of run (60%) with a deep glide (10%), shallow glide (20%) and riffle (10%). There was 90% bankside cover on the left bank and 10% cover on the right bank with 60% of the left bank being undercut and 30% covered with draped vegetation and the right bank having 10% vegetation rooted instream. The surrounding landscape was cattle and sheep grazed moorland heath with some improved grassland.

Both Brown trout fry and parr were found in low densities in this site, ranging from 0+ years all the way to 3+ years (Figure 2).

*Figure 1: Site 1, upstream of the ford*


*Figure 2: Trout parr caught in site 1*

- Site 2, Alwhat Burn

Site 2 is located upstream of a set of large falls on the Alwhat Burn (Figure 3).

The burn here was small, the average wet width was 2.03 m with relatively poor instream cover. The depths were varied between <10 - 30 cm. The flow was primarily fast with the main flow type being riffle (40%) and run (40%) with the remaining flow type being shallow glide (20%). The substrates were primarily large and consisted of pebbles (15%), gravels (10%), cobbles (45%), and boulders (30%). There was 40% cover on both banks with 20% being undercut and 20% being draped vegetation. The surrounding landscape was open sheep grazed moorland heath.

Fish were absent from this site.

*Figure 3: Site 2, Un-named tributary of the Alwhat Burn*

- Site 3, Alwhat Burn

This site was situated on the upper Alwhat Burn (Figure 4).

This site had poor instream cover and was fast flowing. The average wet width was 1.8 m. Water depths were shallow with the majority being spread over <10 cm (30%), 11 - 20 cm (30%) and 21 - 30 cm (30%), with a slightly deeper section 31 - 40 cm (10%). Substrates were primarily large with gravel (5%), pebbles (10%), cobbles (35%), and boulders (50%). Flows were relatively high throughout the site with areas of deep glide (5%), shallow glide (10%), with larger areas of run

(60%) and riffle (25%). Both banks had 35% cover provided by areas of undercut and draped vegetation. The surrounding landscape was grazed moorland heath.

Fish were absent from this site.

*Figure 4: Site 3, upper Alwhat Burn, Water of Ken*

- Site 4, Small Burn (tributary of the Altry Burn)

This site was located upstream of the confluence (Figure 5).

This site had good instream cover. The average wet width was 0.7 m. Water depths were spread between 0 - 40 cm deep. The substrates were moderately small with gravel (20%), pebbles (40%) and cobbles (40%). The flow was shallow glide (50%) with areas of run (20%), and riffle (30%). Both banks had good fish cover from being 80% undercut and having 100% draped vegetation. The surrounding landscape was cattle and sheep grazed moorland heath and was overgrown with rushes.

Fish were absent from this site.

*Figure 5: Site 4, Small Burn, upstream of confluence*

- Site 5, Pulmulloch Burn

The site was south of the Fans of Altry (Figure 6).

Instream cover was moderate. The average wet width was 1.8 m. Depths varied between 0 - 50 cm with 80% of the site being under 41 cm deep. Substrates were well mixed with gravel (30%), pebbles (30%), cobbles (30%), and boulders (10%). Flows were relatively high, being primarily run (40%) and riffles (30) with some areas of shallow glide (20%) and still marginal pools (10%). Both banks were 50% covered provided by undercuts and draped vegetation. The surrounding landscape was grazed moorland heath.

Fish were absent from this site.

*Figure 6: Site 5, Pulmulloch Burn*

- Site 6, Pulmulloch Burn

The site was situated at the Fans of Altry (Figure 7).

Instream cover was poor within this site. The average wet width was 2.3 m. Depths were varied between 0 - 50+ cm. The substrates were varied throughout with small amounts of gravel (20%), pebble (30%), cobbles (30%) and boulders (20%). The flows were very varied within this site. The flows ranged from deep pools (20%), shallow pools (10%), deep glide (20%), run (20%) and riffle (30%). Both banks were mostly bare, with 30% undercutting on the left bank and 10% undercutting and 10% rocks embedded into the bank on the right bank. There was quite a bit of erosion on both banks. The surrounding landscape was moorland heath.

Fish were absent from this site.

*Figure 7: Site 6, Pulmulloch Burn*

- Site 7, Pulmulloch Burn

The site was situated on a tributary at High Countam (Figure 8).

Instream cover was poor within this site. The average wet width was 1.4 m. Depths were varied between 0 - 50+ cm. The substrates were relatively evenly mixed between sand (10%), gravel (20%), pebbles (20%), cobbles (30%) and boulders (20%). The flows were varied between run (30%), riffle (30%), with areas of deep pool (20%) and shallow pool (20%). Both banks had 30% of cover provided by undercut areas and draped vegetation. The surrounding landscape was moorland heath. Both banks were eroded causing some sections to become steep.

Fish were absent from this site.

*Figure 8:  Site 7, tributary of the Pulmulloch Burn at High Countam*

*Table 4: Results from the 2021 electrofishing survey for Proposed Lorg Wind Farm (*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 | Density per 100 m² * | | | | Sensitivity |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Salmon Fry (0+) | Salmon Parr (1+ and older) | Trout Fry (0+) | Trout Parr (1+ and older) | |
| 1 (DK16) | Dee, Water of Ken | Upstream of the ford | 266722 600474 | 22/10 | NONE | 0 | 0 | 5.849 | 2.952 | FISH |
| 2 (DKLW1) | Dee, Alwhat Burn | Upstream of a set of large falls on the Alwhat Burn | 265951 601783 | 04/10 | NONE | 0 | 0 | 0 | 0 | NONE |
| 3 (DKLW2) | Dee, Alwhat Burn | Upper Alwhat Burn | 265591 601411 | 04/10 | NONE | 0 | 0 | 0 | 0 | NONE |
| 4 (DKAL2) | Dee, Altry Burn, Small Burn | Upstream of the confluence area | 267066 599624 | 22/10 | NONE | 0 | 0 | 0 | 0 | NONE |
| 5 (DKPU2) | Dee, Pulmulloch Burn | South of the Fans of Altry | 268233 599660 | 21/10 | NONE | 0 | 0 | 0 | 0 | NONE |
| 6 (DKPU1) | Dee, Pulmulloch Burn | At the Fans of Altry | 268195 600071 | 21/10 | NONE | 0 | 0 | 0 | 0 | NONE |
| 7 (DKPU3) | Dee, Pulmulloch Burn | On a tributary of the Pulmulloch Burn at high Countam | 268546 599687 | 21/10 | NONE | 0 | 0 | 0 | 0 | NONE |

## 5 DISCUSSION

Seven sites were surveyed within the Dee catchment to gather baseline data for the EIA for the proposed Lorg Wind Farm. All sites were within the wind farm boundaries and surveyed to highlight the watercourses which contain sensitive fish populations which may be impacted during construction.

The main potential impacts, from this development, to surrounding fish populations are most likely to occur during the construction phase. Salmonid populations fall within the wind farm development site. 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. Issues such as watercourse crossings, large scale excavation work (for example for turbine bases) and road 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 development site. 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 2021 surveys looked at specific sites. Although all sites had 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.

This baseline fisheries survey provides an important dataset and should direct the future Fish Monitoring Plan (FMP) which would monitor fish populations during the construction phase and highlight any impacts. When repeated, comparisons can be made during construction and post-construction. This will provide a robust FMP to enable any impacts to be highlighted and mitigation measures carried out. If impacts are identified, then the report should outline necessary mitigation works. For the FMP only site 1 on the Water of Ken would need repeated from the baseline survey but additional sites would be recommended including a further Water of Ken site and two control sites.

# Aquatic Surveys To Assess Fish Populations, Freshwater Pearl Mussels And Aquatic Macro Invertebrate Communities Within The River Nith Catchment In The Vicinity Of The Proposed Lorg Wind Farm Site

**Volume 1**
**Baseline survey**
**(2021)**

**Commissioned by**
**WOOD GROUP UK LIMITED**
**Survey undertaken by**
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Nith District SALMON Fishery Board

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Cover photo: Trout

**Contents**

# 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. It's source is in Ayrshire and it flows through Dumfriesshire, spanning approximately one hundred kilometres to its estuary in the Solway Firth, a total catchment area of 1200 square kilometres.

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 had 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 Lorg Wind Farm

Lorg Wind Farm site is located in East Ayrshire near to the public water supply facility at Afton reservoir in southwest Scotland. In common with many wind farms, Lorg's site footprint, straddles a few river catchments including the River Nith. The watercourses draining the wind farm site into the River Nith fall within the jurisdiction of NDSFB. The land use in the vicinity of Lorg Wind Farm has traditionally been hill grazing with minimal impacts on the aquatic environment.

NDSFB have been in discussions with Wood Ltd, consultants, working on the Lorg project and it has been considered appropriate that the proposed wind farm is supported by a suite of aquatic surveys to provide environmental data specific to that project. NDSFB have been commissioned to conduct aquatic surveys in watercourses that drain the site into the River Nith catchment. It has been decided that the suite of aquatic surveys will include fish and their habitats, Freshwater Pearl Mussels and aquatic invertebrates. 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 current benchmark and may be used for comparison purposes with future surveys relating to the site.

## 1.4 Aquatic sampling conducted

### *1.4.1 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.

### *1.4.2 Freshwater Pearl Mussel surveys (Margaritifera margaritifera L.)*

Freshwater Pearl Mussels (FWPM) are a long-lived species of bi-valve, potentially living in excess of 100 hundred years and are currently in decline generally. The reasons for this trend include overfishing, use of pesticides, agricultural practise and engineering (Young 1991). FWPM do exist in Scotland and it is considered that half of the worlds populations of these species reside in Scottish watercourses (Young *et al* 2001).

#### *Lifecycle*

FWPM and salmonid species of fish survive together in watercourses. Part of the FWPM's lifecycle depends on the presence of salmonid species of fish (Hastie & Young, 2003). and both species require high quality water for their survival.

Unfertilised eggs present in brood pouches of female FWPM in early summer are exposed to sperm which is present in the watercourse at this time of the year. The sperm is ingested into these bi-valves by the action of taking in water to gain nutrients. In the late summer the incubated glochidia are expressed out into the watercourse following a pumping motion. The glochidia need to encounter a host fish, either salmon or trout and settle on their gills. This procedure is left completely to chance and, for survival of the species, perhaps explains why millions of glochidia are expressed into the watercourse.

At this stage of their life cycle, the glochidia attachment to the gills of salmonid fish, this is referred to as encysting. The encysted gills of fish do not seem to harm the host and can be seen, if the gill covers of hosts are gently lifted, like grains of salt against the red gills. The life cycle stage of attachment to the gills of fish can last for several months until the young mussels detach from the host and, again by chance, fall off and are swept by the current of the watercourse to find suitable habitat on the riverbed.

#### *Legal Status*

FWPM are afforded protection under several legislative listings including Annex II & IV of the EC Habitats Directive and Appendix II of the Bern Convention and schedule 5 section 9

(1) Wildlife and Countryside Act (1981). They are also listed as a priority species in the UKBAP. In order that this legislation is not unintentionally breached during construction works in, or near to, a watercourse it is appropriate that the area is surveyed by a qualified person licenced to conduct such surveys. The presence of FWPM is always conducted well in advance of any planned construction work in order that due consideration can be taken of the survey results gained.

*Habitat*

FWPM require a mix of habitats in which to survive the various stages of their lifecycles (Skinner et al. 2003). They are typically found in fast flowing streams of high-water quality containing salmonid species of fish (Young 2005). This reliance of salmonid species dictates that watercourses that suit the various stages of salmonid life cycle i.e. gravels for spawning, streams for fry stages, riffles and runs for parr stages and pools for adult stages can accommodate FWPMs. An essential criterion for the survival of FWPM is the presence of stable substrate on which the mussels can anchor and not get swept away on the current.

### *1.4.3 Aquatic Macro Invertebrate surveys*

The composition of freshwater macro invertebrate communities can provide an insight into the health of a watercourse. Certain species of invertebrates are more tolerant to pollution than others, both organic and inorganic, as such their presence/absence provides an indication of water quality. Changes in invertebrate communities over a period of time can indicate a pollution event, both point source or diffuse. These surveys are of particular importance when any type of construction activity is occurring within a river catchment as they can assist in the long-term monitoring of the health of the watercourse.

# 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 Lorg Wind Farm site 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 Lorg Wind Farm site within the catchment of the River Nith.

c) To utilise the standard NatureScot (NatureScot, 2018) protocol to survey for the presence of FWPM at two sites within watercourses which drain the land footprint of the Lorg Wind Farm site within the catchment of the River Nith.

d) To consider population life stages of any FWPM found throughout this series of surveys.

e) To record habitat data to determine the potential for Freshwater Pearl Mussels to be present in the watercourses which drain the catchment area of the Lorg Wind Farm site within the catchment of the River Nith.

f) To utilise the Scottish Environment Protection Agency's (S.E.P.A., 2011) standardised kick sampling technique for the collection of aquatic invertebrates in the watercourses within the vicinity of the Lorg Wind Farm site within the catchment of the River Nith.

g) To produce data which may be used to assess fish, FWPM populations and aquatic invertebrate populations when compared with future surveys.

h) 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.

i) To make recommendations to the developers of the Lorg Wind Farm and their contractors on how best they can protect those populations of aquatic species known to exist in the watercourses draining the site, from an informed position, based on facts.

## 2.2 Feasibility

In order to accurately conduct these aquatic surveys within the vicinity of the Lorg Wind Farm site, 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 Lorg Wind Farm. 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. The access into the watercourses draining the Lorg site within the River Nith catchment, over which surveying within this document is discussed, is controlled by Scottish Water. At the time of surveying, Scottish water was undertaking engineering repairs to the road infrastructure around Afton Reservoir. Accordingly additional Health & Safety control measures were applied as a condition of entry to the survey area. These measures included site induction and signing in and out of the site each day.

### *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.

Fully quantitative electrofishing methods were utilized during this survey to accurately assess the population of juvenile salmonids. This involved fishing the identified site multiple times, depletion sampling, to provide an estimate of the density of juvenile salmonids within the survey site. If fish were present within the first run it was fished again, a minimum of two times and up to a maximum of four times. The electrofishing team systematically worked from downstream to upstream following a carefully agreed pattern removing all fish captured. 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. Electrofishing continued at each site until a depletion rate could be identified. At least 30% of the fish should be caught during each run for an accurate estimate to be achieved.

This method of capture for salmonids also captured all other 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 anesthetised, 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 was employed to record the exact location of each site.

### *3.1.6 Salmonid species*

It is acknowledged that no Atlantic Salmon were expected to be present in the sites surveyed upstream of Afton Reservoir due to the inability of this species to migrate past the reservoir dam. However, this species is listed below for their inclusion and relevance with regards to the control site on the Dalwhat Water (site 6).

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*

Estimates of density are calculated using the Zippin (1956) method of estimation. This provides an estimate of density expressed as the number of fish present within 100m$^2$. If no fish were found during the second run it is not possible to use Zippin's method to estimate densities, instead a minimum density can be estimated and expressed per 100m$^2$. All densities which have been calculated using the Zippin method of estimation are marked with an asterisk * beside them.

The densities of fry and parr were 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.

## 3.2 Freshwater Pearl Mussel survey methodology

The methodology employed is the standard NatureScot Freshwater Pearl Mussel Survey protocol for use in site-specific projects (NatureScot, 2018). Each FWPM survey commenced at the predetermined sites and extended directly downstream to include the entire bed of the watercourse. The survey protocol entailed laying a 1m x 1m quadrat on the bed of the river and a visual search for FWPM was made using a bathyscope.

The protocol dictates that any FWPM found during the initial search are counted and measured in each quadrat. Detailed searches for any hidden and juvenile mussels are then conducted in 20% of the quadrats where visible mussels were found.

Following the initial survey in the area directly downstream from the predetermined survey site, the FWPM survey was extended to 100m upstream and 500m downstream. This extended survey identified FWPM habitat which was then visually inspected for their presence. Any FWPM found during the extended search would then result in a 50m transect being subject to a more detailed survey, as per the protocol.

**Figure 3 – Surveying for Freshwater Pearl Mussels using a bathyscope**

### *3.2.1 Data recording*

The standard NatureScot protocol for recording FWPM was followed throughout this series of surveys. Field data sheets were populated at individual sites which included habitat, FWPM presence/abundance and general environmental data.

### *3.2.2 Data Analysis*

Abundance of FWPM can be calculated using the following categories:

| Number of live mussels per 50m x 1m transect | Abundance level |
|---|---|
| 0 | E |
| 1-49 | D |
| 50-499 | C |
| 500-999 | B |
| ≥1000 | A |

### *3.2.3 Personnel*

NDSFB utilised the services of their own staff, who are qualified and licenced to conduct surveys for FWPM.

## 3.3 Invertebrate surveys

### *3.3.1 Invertebrate sampling apparatus*

Sampling was carried out using standard kick sampling methodologies in accordance with SEPA protocol (S.E.P.A. 2011). The apparatus used included one 25cm wide kick sampling net strung with 1mm mesh, one aquarium hand net strung with 0.5 mm mesh, one standard size bucket, 60 ml storage pots and 95% denatured alcohol.

### *3.3.2 Personnel*

To conduct this aquatic invertebrate survey, NDSFB utilised the services of their Biologist who is qualified and experienced in conducting such research. The Biologist was accompanied and supported at all times by NDSFB staff whilst in the field.

### *3.3.3 Techniques*

Survey sites were identified where riffles were selected and kick sampling was undertaken for 3 minutes using a 25cm wide kick sample net with a 1mm mesh **(Figure 3)**. The kick net was held downstream of the sampler's feet and the bed of the river was disturbed by kicking the substrate to dislodge any invertebrates present. During these three minutes all habitats within the selected site were sampled. The kick sampling was followed by a further minute of manual search where stones, submerged plants, logs and other instream objects were examined for attached invertebrates such as cased caddis and molluscs.

The invertebrate samples were placed into sample bottles containing 95% ethanol. This included any plant material or substrate collected during the kick sampling process. Samples were transported back to the NDSFB facilities and stored for future identification.

### *3.3.4 Invertebrate identification*

In the laboratory, the samples of aquatic invertebrates were placed into large plastic trays and cleaned of any plant material or substrate. The samples were then sorted according to broad taxonomic groups. Invertebrates were then identified to family level using a Brunel SX10D Stereo Dissecting Digital Microscope at x 10 - 40 magnification and dichotomous keys (Dobson et al. 2012., Pawley et al. 2014., Macadam & Bennett, 2010.).

### *3.3.5 Data Analysis*

The Biological Monitoring Working Party (BMWP) scoring system was used in order to calculate the biotic index of the water quality. This scoring system assigns a score to each family of aquatic invertebrates identified depending on its sensitivity to pollution. A score of 1 – 10 is given, with those families most tolerant to pollution being scored as 1 and those most sensitive as 10. The sum of those scores gives a BMWP score for a site. **Table A** shows the BMWP scores and the categories associated with each score. The higher the BMWP score the higher the quality of the water. Low scores indicate that pollution, either diffuse or point source, has occurred.

The second scoring technique utilised for this survey is the Average Score Per Taxon (ASPT). This divides the BMWP score by the number of taxa present in the sample and provides an average score for each group. **Table B** shows ASPT scores and the categories associated with each score. The ASPT is considered a more stable and reliable index of pollution as it is influenced less by the physical nature of the watercourse or variations in sampling effort.

**Table A - Biological Monitoring Work Party (BMWP) categories**

| BMWP score | Category | Interpretation |
|---|---|---|
| >100 | A1 | Excellent |
| 71-100 | A2 | Good |
| 41-70 | B | Moderate |
| 11-40 | C | Poor |
| 0-10 | D | Seriously polluted |

**Table B - Average Score Per Taxon (ASPT) categories**

| ASPT | Category | Interpretation |
|---|---|---|
| ≥6.0 | A1 | Excellent |
| 5.0-5.9 | A2 | Good |
| 4.2-4.9 | B | Moderate |
| 3.0-4.1 | C | Poor |
| <3 | D | Seriously polluted |
| | | |

**Figure 3 – Kick sampling for aquatic invertebrates**

# 4 Results and discussion

A total of six sites were surveyed as part of the baseline aquatic surveys in relation to Lorg Wind Farm. Site 6 is located on the Dalwhat Water which is fed from a different catchment from the other sites and beyond any potential influence of the wind farm or any associated construction works. Accordingly, this site acts as an ideal control site for the wind farm at Lorg. **Map 1** displays all survey site locations and photographs of each site can be found in **Appendix 1**. A complete list of all those sites surveyed and the type of surveys conducted 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 100m$^2$. The table also includes the site numbers, general site descriptions, grid reference to 12-digit co-ordinates, date of survey and other species present.

Four of the sites surveyed in watercourses that drain the Lorg Wind Farm footprint did contain salmonid species of fish, trout. One site (site 5) draining the same area contained no fish. The control site (site 6) also contained salmonid species of fish, salmon and trout. In addition to the salmonid species of fish found in site 1 on the Afton Water, a stone loach was also found at this location.

**Site 1 Afton Water** Two age classes of trout were found to be present at this location, fry and parr. Suitable habitat existed within the survey site to accommodate both age classes

of fish. Gravelled areas suitable for spawning was present with other sections of the site consisting of larger substrate types suitable for parr aged fish.

**Site 2 Alwhat Burn** Three age classes of trout were present in this site, fry and two age classes of parr. Spawning gravels were present in the lower reaches of the site with deeper sections fringed with draped cover, favoured by trout parr extended over much of the banks.

**Site 3 Afton Water** Two age classes of trout were present in this site, fry and parr. The habitat did favour fry with only limited available habitat for parr aged fish.

**Site 4 Afton Water** Only trout parr were found at this site, albeit that two-year classes of this stage in salmonid development were found. The habitat did not favour fry at this location consisting of deeper water and larger substrate.

**Site 5 Alwhat Burn** No fish were present at this location. The watercourse falls from a steep gradient at this stage in its course and fish would have difficulty in migrating the many solid rock falls which could potentially be impassable to fish.

The presence and age classes of fish found throughout this series of surveys was as anticipated at this altitude and location, upstream of the Afton Reservoir which will pose as a barrier to upstream migration of fish. NDSFB considers that adult trout in Afton Reservoir will be utilising the watercourses that flow into the reservoir, namely the Alwhat and Afton, as spawning tributaries. Once the resulting juvenile trout attain a size and stage in their life cycle then they will migrate downstream and enter the reservoir. They may remain in the reservoir or choose to swim over the spillway to migrate down the Nith catchment to become sea trout.

The presence of stoneloach at site1 on the Afton Water is most likely to be the result of anglers discarding bait fish used when fishing for larger specimens in Afton Reservoir.

## 4.2 Freshwater Pearl Mussel survey results and discussion

Freshwater Pearl Mussel surveys were conducted at site 2 on the Alwhat Burn and site 3 on the Afton Water. The results from these surveys can be found in **Table 3**. Instream habitat information can also be found in **Table 3** and assists in determining if suitable habitat for fish and freshwater pearl mussels was present.

No Freshwater Pearl Mussels were found during this series of surveys. FWPM require stable substrate which generally consists of larger cobbles and boulders, interspaced by smaller pebbles and gravel. Suitable FWPM habitat was present at both sites surveyed. Throughout this series of surveys NDSFB did not see any evidence of the presence of FWPM i.e. broken shells or criminal activity.

## 4.3 Invertebrate survey results and discussion

Invertebrate surveys were conducted at sites 2, 3 and 6. The results of the invertebrate surveys are presented in **Table 4**. The results show that healthy populations of aquatic invertebrates are present at all the sites surveyed. The diversity and composition of the aquatic invertebrate communities found to be present within this suite of surveys are comparable with those found at similar altitudes and geomorphological substrate formations found throughout the Nith catchment. No rare species were found to be present.

# 5 Conclusions

This series of surveys in the vicinity of Lorg Wind Farm site concludes:

- That five of the six sites surveyed contained salmonid species of fish.
- That one site surveyed contained non salmonid species of fish.
- That in general terms this suite of surveys has produced predictable densities of trout populations which are very dependant on specific habitat requirements in minor watercourses at these altitudes.
- That no FWPM are present in the sites surveyed.
- That the diversity and quality of the aquatic invertebrate communities indicates high water quality in the watercourses draining the wind farm site.

## 6 Recommendations

This study recommends that if the Lorg Wind Farm project 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 Wind Farm.
- That this suite of surveys (fish and invertebrates only) be repeated, no more than 12 months prior to construction commencing on the wind farm 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 and aquatic invertebrates now known to exist in the vicinity of the Lorg Wind Farm site.
- 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

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**Table 1: List of survey sites within the vicinity of Lorg Wind Farm – Baseline survey 2021**

| Watercourse | Site code | Location description | Easting | Northing | Altitude (m) | Surveys conducted | Sampling date/s | Wet width (m) | Water Temp (©) | Conductivity (µS) | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Afton Water | 01 | Upstream of Road Bridge | 263965 | 603275 | 419 | Fisheries | 28/09/21 | 4.3 | 11.5 | 40 | 4.48 |
| Alwhat Burn | 02 | Upstream of forestry | 264089 | 603000 | 426 | Fisheries, Invertebrate and FWPM | 05/10/21 | 1.1 | 7.8 | 50 | 5.44 |
| Afton Water | 03 | 50m Upstream of Watergate | 264038 | 602978 | 429 | Fisheries, Invertebrate and FWPM | 05/10/21 | 3.7 | 8.6 | 40 | 6.14 |
| Afton Water | 04 | Upstream from sheep holding unit | 263942 | 602665 | 441 | Fisheries | 05/10/21 | 2.7 | 7.9 | 30 | 4.77 |
| Alwhat Burn | 05 | 500m upstream from forestry | 264232 | 602807 | 442 | Fisheries | 05/10/21 | 0.8 | 7.6 | 50 | 5.39 |
| Dalwhat Water | 06 | Upstream from Bailwood Loch | 271106 | 595647 | 216 | Fisheries and Invertebrate | 28/09/21 | 2.3 | 19.0 | 70 | 7.1 |

**Table 2: Results of Electrofishing Surveys – Lorg Wind Farm Baseline survey 2021**

| Watercourse | Site code | Location description | Easting | Northing | Salmon fry (/100m²) | Salmon parr (/100m²) | Trout fry (/100m²) | Trout parr (/100m²) | Other species present |
|---|---|---|---|---|---|---|---|---|---|
| Afton Water | 01 | Upstream of Road Bridge | 263965 | 603275 | 0.00 | 0.00 | 3.97* | 2.58 | SL |
| Alwhat Burn | 02 | Upstream of forestry | 264089 | 603000 | 0.00 | 0.00 | 44.03* | 10.10 | - |
| Afton Water | 03 | 50m Upstream of Watergate | 264038 | 602978 | 0.00 | 0.00 | 9.15* | 1.29 | - |
| Afton Water | 04 | Upstream from sheep holding unit | 263942 | 602665 | 0.00 | 0.00 | 0.00 | 8.32* | - |
| Alwhat Burn | 05 | 500m upstream from forestry | 264232 | 602807 | 0.00 | 0.00 | 0.00 | 0.00 | - |
| Dalwhat Water | 06 | Upstream from Bailwood Loch | 271106 | 595647 | 7.86* | 0.00 | 2.56 | 28.53* | - |

* 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 |
|---|---|---|---|---|---|

**Table 3: Results of FWPM surveys with associated habitat data – Lorg Wind Farm Baseline survey 2021**

| | | | | | | Left Bank fish cover | | | | | | | Right Bank fish cover | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site code | FWPM present | Instream Parr Cover | Bank face vegetation | Bank top vegetation | Canopy cover % | UC % | DR % | BA % | MA % | RT % | RK % | OTH % | UC % | DR % | BA % | MA % | RT % | RK % | OTH % |
| 01 | - | Excellent | Simple | Complex | 0 | 60 | 30 | 40 | 0 | 0 | 0 | 0 | 60 | 35 | 40 | 0 | 0 | 0 | 0 |
| 02 | No | Excellent | Simple | Simple | 0 | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | 0 | 0 | 0 | 0 | 0 |
| 03 | No | Excellent | Bare | Uniform | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 |
| 04 | - | Excellent | Simple | Simple | 0 | 40 | 15 | 60 | 0 | 0 | 0 | 0 | 35 | 20 | 65 | 0 | 0 | 0 | 0 |
| 05 | - | Excellent | Complex | Complex | 0 | 20 | 21 | 80 | 0 | 0 | 0 | 0 | 20 | 10 | 80 | 0 | 0 | 0 | 0 |
| 06 | - | Good | Complex | Complex | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 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.
Bankside fish cover: UC – Undercut, DR – Draped, BA – Bare, MA – Marginal plants, RT – Roots, RK - Rocks, OTH - Other

**Table 3 continued: Results of Habitat Surveys 2021**

| | Depths (cm) | | | | | | Substrate | | | | | | | | Flow type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site code** | **<10 %** | **11-20 %** | **21-30 %** | **31-40 %** | **41-50 %** | **50> %** | **HO %** | **SI %** | **SA %** | **GR %** | **PE %** | **CO %** | **BO %** | **BE %** | **SM %** | **DP %** | **SP %** | **DG %** | **SG %** | **RU %** | **RI %** | **TO %** | **Notes** |
| 01 | 0 | 0 | 50 | 50 | 0 | 0 | 0 | 0 | 0 | 20 | 25 | 35 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 | - |
| 02 | 0 | 60 | 40 | 0 | 0 | 0 | 0 | 0 | 5 | 25 | 35 | 25 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 20 | 0 | - |
| 03 | 15 | 65 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 20 | 55 | 15 | 0 | 5 | 0 | 15 | 0 | 15 | 35 | 30 | 0 | - |
| 04 | 0 | 30 | 60 | 10 | 0 | 0 | 0 | 0 | 0 | 5 | 10 | 40 | 35 | 10 | 0 | 0 | 20 | 0 | 0 | 50 | 30 | 0 | - |
| 05 | 10 | 50 | 30 | 10 | 0 | 0 | 0 | 0 | 5 | 15 | 15 | 30 | 15 | 20 | 0 | 15 | 35 | 0 | 0 | 20 | 30 | 0 | - |
| 06 | 0 | 0 | 70 | 30 | 0 | 0 | 0 | 0 | 0 | 10 | 20 | 30 | 40 | 0 | 0 | 0 | 10 | 0 | 0 | 60 | 30 | 0 | - |

Key to habitat:
Substrate: HO – High organic, SI – Silt, SA – Sand, GR – Gravel, PE – Pebbles, CO – Cobbles, BO – Boulders, BE – Bedrock.
Flow type: SM – shallow marginal, DP – deep pool, SP – shallow pool, DG – deep glide, SG – shallow glide, RU – run, RI – riffle, TO – torrent.

## Table 4: Results of Invertebrate surveys - BMWP/ASPT scores 2021

| Watercourse | Site code | Sampling date | BMWP score | BMWP classification | NTAXA | ASPT score | ASPT classification |
|---|---|---|---|---|---|---|---|
| Alwhat Water | 2 | 05/10/21 | 49 | B – Moderate | 7 | 7.00 | A1 – Excellent |
| Afton Water | 3 | 05/10/21 | 106 | A1 – Excellent | 16 | 6.63 | A1 – Excellent |
| Dalwhat | 6 | 28/09/21 | 86 | A2 – Good | 14 | 6.14 | A1 - Excellent |

**Key:**

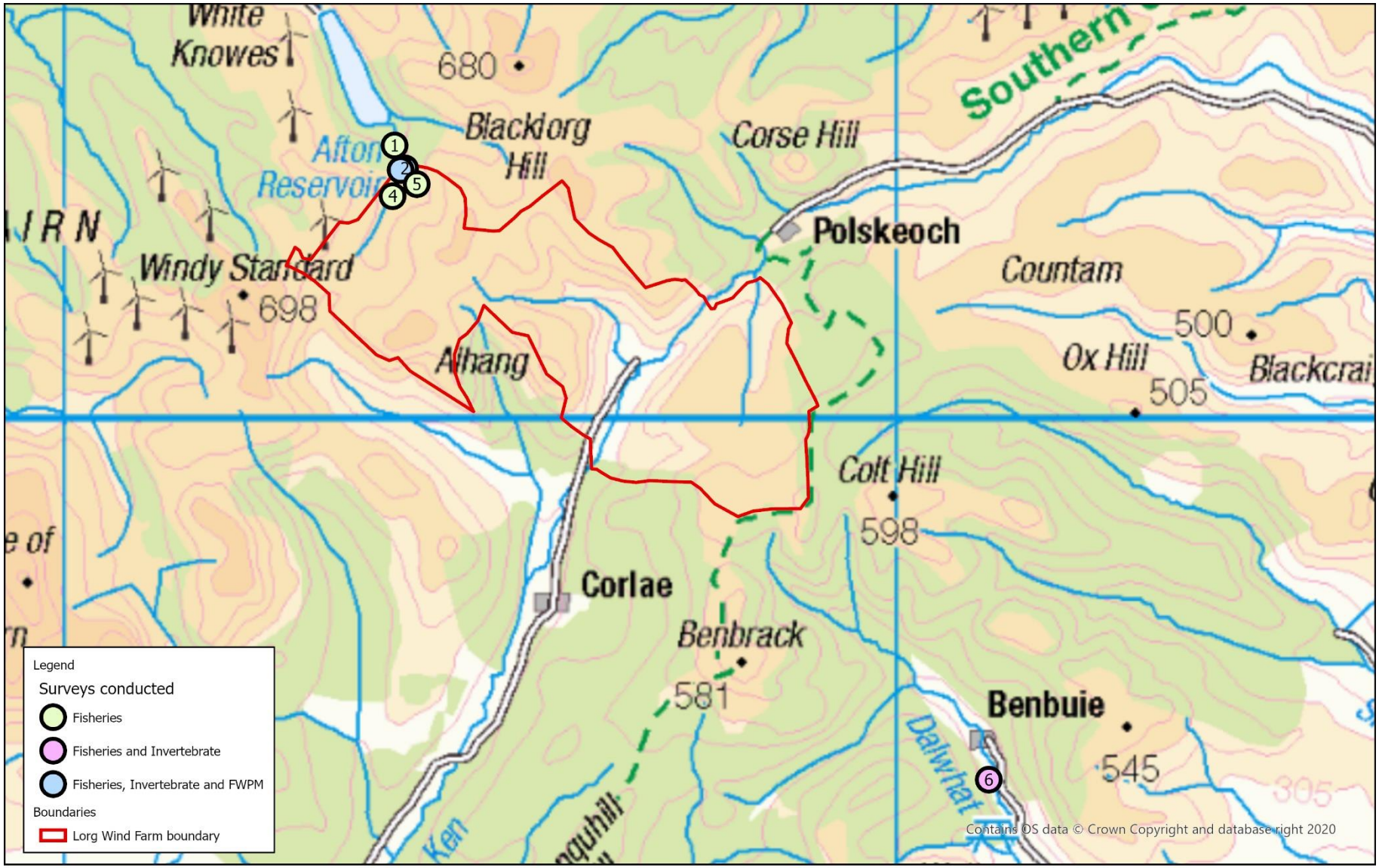
| BMWP score | Category | Interpretation |
|---|---|---|
| >100 | A1 | Excellent |
| 71-100 | A2 | Good |
| 41-70 | B | Moderate |
| 11-40 | C | Poor |
| 0-10 | D | Seriously polluted |

| ASPT score | Category | Interpretation |
|---|---|---|
| ≥6.0 | A1 | Excellent |
| 5.0-5.9 | A2 | Good |
| 4.2-4.9 | B | Moderate |
| 3.0-4.1 | C | Poor |
| <3 | D | Seriously polluted |

## Table 5: List of Families present for each site 2021

| Site 2 | Site 3 | Site 6 |
|---|---|---|
| *Oligochaeta* – Worm<br>*Baetidae* – Mayfly<br>*Heptageniidae* – Mayfly<br>*Leptophlebiidae* – Mayfly<br>*Nemouridae* – Stonefly<br>*Perlodidae* – Stonefly<br>*Rhyacophilidae* – Caddisfly | *Oligochaeta* – Worm<br>*Baetidae* – Mayfly<br>*Heptageniidae* – Mayfly<br>*Leptophlebiidae* – Mayfly<br>*Nemouridae* – Stonefly<br>*Leuctridae* – Stonefly<br>*Perlodidae* – Stonefly<br>*Perlidae* – Stonefly<br>*Scirtidae* – Water Beetle<br>*Elmidae* – Riffle Beetle<br>*Rhyacophilidae* – Caddisfly<br>*Philoptamidae* – Caddisfly<br>*Hydropsychidae* – Caddisfly<br>*Limnephilidae* - Caddisfly<br>*Chironomidae* – Non-biting midge<br>*Simuliidae* – Black fly | *Planariidae* – Flatworm<br>*Oligochaeta* – Worm<br>*Gammaridae* – Freshwater shrimp<br>*Baetidae* – Mayfly<br>*Heptageniidae* – Mayfly<br>*Nemouridae* – Stonefly<br>*Leuctridae* – Stonefly<br>*Perlodidae* – Stonefly<br>*Perlidae* – Stonefly<br>*Dytiscidae* – Diving Beetle<br>*Elmidae* – Riffle beetle<br>*Glossosomatidae* – Caddisfly<br>*Hydropsychidae* – Caddisfly<br>*Chironomidae* – Non-biting midge |

**Map 1 – Lorg Wind Farm aquatic survey site locations**




Lorg Wind Farm
Aquatic Survey
Site Locations

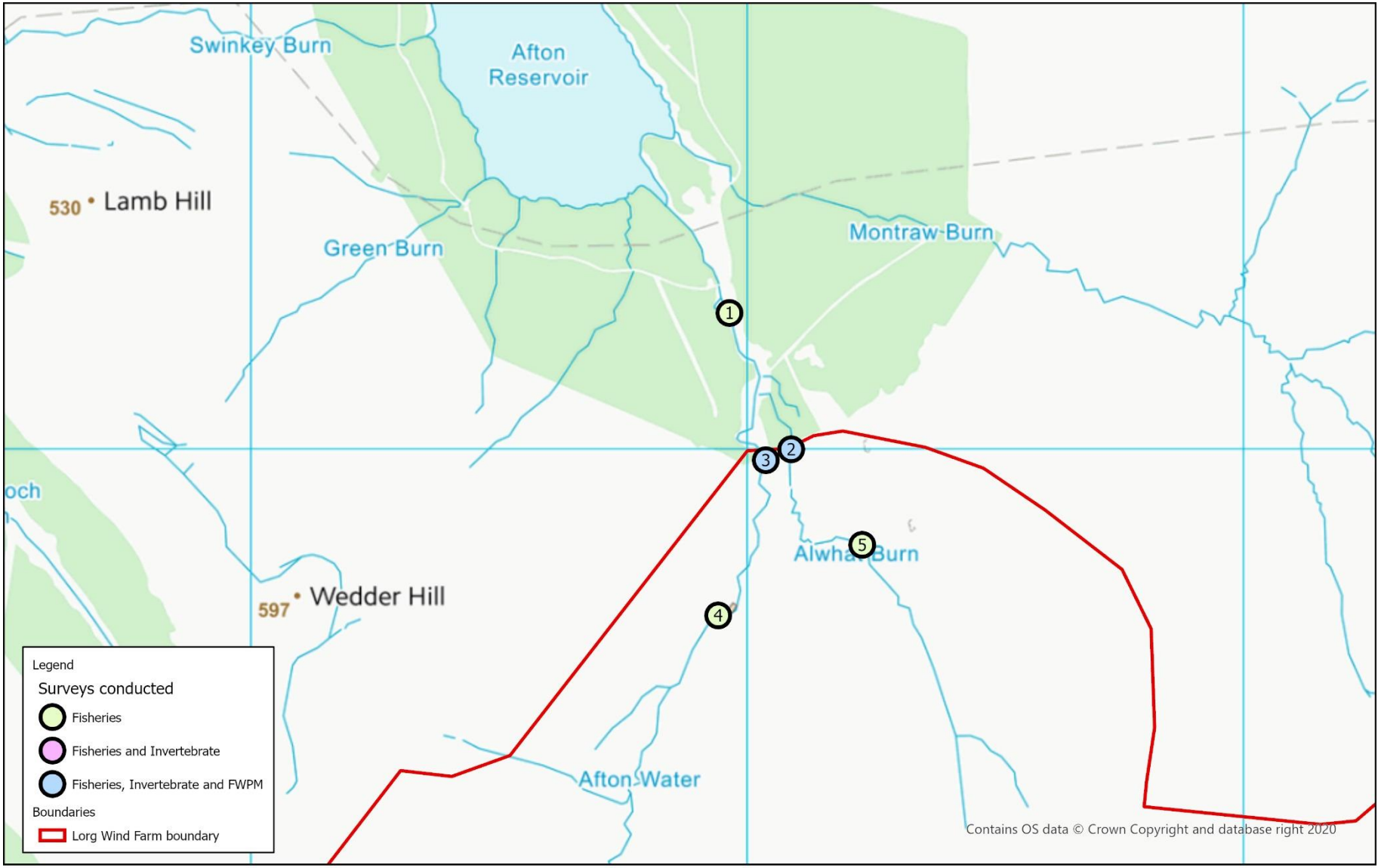
N

Scale: 1:57,220

0 0.5 1 2 Kilometers

Nith District SALMON Fishery Board

**Map 2 – Lorg Wind Farm aquatic survey site locations – detailed map**



## Appendix 1 - Photographs of sites surveyed

Site 1 – Afton Water

Site 2 – Alwhat Burn

Site 3 – Afton Water

Site 4 – Afton Water

Site 5 – Alwhat Burn

Site 6 – Dalwhat Water