# Appendix 11F
# Aquatic Surveys

# Aquatic Surveys To Assess Fish Populations, Aquatic Macro Invertebrate Communities And Freshwater Pearl Mussels In The Vicinity Of The Proposed Enoch 2 Wind Farm Site

**Volume 1**
**Baseline survey**
**(2020)**

**Commissioned by**
**WOOD**

**Survey undertaken by**
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Cover photo: Three age classes of trout

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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 south west Scotland. Its source is in Ayrshire and 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, 2002). 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 744 salmon and grilse and 1002 sea trout during 2019 (N.D.S.F.B., 2020).

## 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, 2020).

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, has been assigned a Category 3 status for 2020, based on the recorded catches. This means that no salmon harvest will be taken from the River Nith catchment for conservation reasons. 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 Enoch 2 Proposed Wind Farm

The proposed Enoch 2 Wind Farm site is located within the catchment of the River Nith and consequently, within the jurisdiction of the NDSFB. The footprint of these proposals covers a number of tributaries of the Nith in the north western part of the catchment which in turn flow into the major tributary, Afton Water which is located to the west of the main stem River Nith, in East Ayrshire.

NDSFB holds fisheries data relating to watercourses in the vicinity of the proposed Enoch 2 Wind Farm but some of that data is not current or relevant to the Enoch 2 proposals. A series of aquatic surveys has been designed to provide data specifically relating to the Enoch 2 project. Those surveys include the fish community, Freshwater Pearl Mussel and aquatic invertebrate populations within the watercourses in the vicinity of, or draining the Enoch 2 site. It is customary to conduct these types of surveys in relation to construction projects such as Wind Farms as they form part of the suite of environmental audits to monitor the surrounding environment during construction.

## 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 over fishing, 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 river bed.

#### *Legal Status*

FWPM are afforded protection under a number of 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, as is the case with Enoch 2, 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 a replicable and efficient fully quantitative capture technique for juvenile salmonids and other species of fish which is suitable for the watercourses in the vicinity of the proposed Enoch 2 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 proposed Enoch 2 Wind Farm site.

c) To utilise the standard Scottish Natural Heritage (SNH n.d.) protocol to survey for the presence of FWPM at five sites within the watercourses which drain the land footprint of the proposed Enoch 2 Wind Farm site.

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 proposed Enoch 2 Wind Farm site.

f) To utilise a replicable and standardised kick sampling technique for the collection of aquatic invertebrates in the watercourses within the vicinity of the proposed Enoch 2 Wind Farm site.

g) To produce data which may be used to assess aquatic species 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 Wood and the developers of the Enoch 2 site on how best they can protect those populations of fish, FWPM's and aquatic invertebrates, known to exist in the watercourses in the vicinity of the proposed Enoch 2 Wind Farm site, from an informed position, based on facts.

## 2.2 Feasibility

In order to accurately conduct these aquatic surveys within the vicinity of the proposed Enoch 2 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 in the watercourses located within the Nith catchment draining the proposed Enoch 2 Wind Farm site. The sites were chosen for their accessibility and likelihood of containing the target species. An additional site was selected, located beyond the potential influence of the Enoch 2 site, to act as a control.

## 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 back pack 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).

Figure 1 – Backpack electrofishing equipment and associated equipment

### *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.

### *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.

### *3.1.4 Techniques*

Fully quantitative electrofishing methods were utilized during this survey in order 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. Natural features on the river were selected to provide 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. These fish were then placed on the bank for further processing. 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. The fish from each electrofishing run had their own bucket and care was taken to keep them separated.

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.

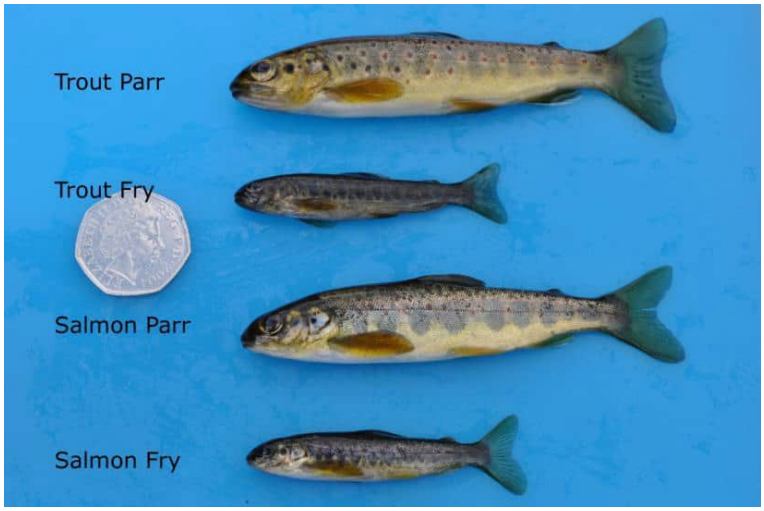
### *3.1.6 Salmonid species*

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 2019.
- Salmon parr ($1^+$) which refers to a young fish which is older than one-year-old, resulting from spawning at end of 2017/2018.
- Trout fry ($O^+$) which refers to a young fish less than one-year-old, resulting from spawning at end of 2019.
- Trout parr ($1^+$) which refers to a young fish which is older than one-year-old, resulting from spawning at end of 2017/2018, 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 - 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 Scottish Natural Heritage Freshwater Pearl Mussel Survey protocol for use in site-specific projects (SNH n.d.) 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. In smaller watercourses, a quadrat was not used.

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 with Bathyscope

### *3.2.1 Data recording*

The standard SNH 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 guidelines (S.E.P.A. 2001). 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*

At each site, riffles were selected and kick sampling was undertaken for 3 minutes using a 25cm wide kick sample net with a 1mm mesh. 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 4 – Kick sampling for aquatic invertebrates

# 4 Results and discussion

A total of eight sites were surveyed as part of the baseline aquatic surveys in relation to the proposed Enoch 2 Wind Farm. Site 8 is the control site and is located on the Afton Water. Map 1 displays all survey site locations and photographs of each site can be found in Appendix 1. A complete list of all of 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 shows the densities of salmonids for each site, displayed per 100m$^2$. All densities marked with an asterisk denotes that there was sufficient data available to allow the densities to be calculated according to Zippins estimate of density. The table also includes the site numbers, general site descriptions, grid reference to 12-digit co-ordinates, date of survey and other species present. Of the eight sites surveyed, seven contained fish. Site 5, located on the Upper Carcow Burn, did not contain any fish. There was no obstruction to fish reaching this location, however, habitat limitations dictated that they were absent from this length of watercourse.

Two sites contained salmon, Site 1 on the Carcow Burn and Site 8 on the Afton Water. Salmon were present at these locations because they are at lower altitudes with good access for this species. The other sites were located high in the river catchment where the watercourses are smaller and their course is interrupted by a series of natural falls and rock obstructions. Salmon are often denied access to these high-altitude sections of watercourse and accordingly, trout, which are smaller, take advantage of the available habitat. In the seven sites where trout were present, their population densities were good to excellent. The progeny of these trout will most likely smolt as a survival mechanism for the species due to the fact that habitat and sufficient food is not available for them to attain their full potential. A single European eel was found in the Carcow Burn at Site 1. No other species of fish was found throughout this series of electrofishing surveys. This is not uncommon when surveying sites at altitude within the River Nith catchment.

Over the course of a typical survey season NDSFB will survey in excess of 150 sites, spread over the catchment of the River Nith. This enables NDSFB to compare the Enoch 2 results against data gained from the entire catchment. 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.

### 4.2 Freshwater Pearl Mussel survey results and discussion

Freshwater Pearl Mussel surveys were conducted at sites 2, 3, 5, 6 and 8. 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. Areas of suitable habitat were present at the survey sites however large areas of the watercourses, where sites 2, 3 and 5 were located, were found to be unstable and consisted of substrate which was small i.e. small cobbles, pebbles and gravel. FWPM require stable substrate which generally consists of larger cobbles and boulders, interspaced by smaller pebbles and gravel. Good FWPM habitat was present at sites 6 and 8.

### 4.3 Invertebrate survey results and discussion

Invertebrate surveys were conducted at sites 2, 3, 5, 6 and 8. 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 Average Score Per Taxa (ASPT) indicate that the water quality at all sites is good to excellent and that they haven't been subject to any pollution incidents recently. The diversity and composition of the aquatic invertebrate communities found to be present are comparable with those found during surveys conducted during the late summer/early autumn, at similar altitudes and geomorphological substrate formations found throughout the Nith catchment. No rare species were found to be present.

## 5 Conclusions

This survey concludes that in the watercourses surveyed within the vicinity of the proposed Enoch 2 Wind Farm site:

- That seven of the eight sites surveyed contained fish.
- That those populations of fish, both species and diversity, were consistent with those found at similar watercourses and altitudes throughout the Nith catchment.
- That no Freshwater Pearl Mussels were found to be present throughout this series of surveys.

- That the aquatic invertebrate populations and diversity of species was entirely consistent with those found at similar locations throughout the Nith catchment.

## 6 Recommendations

This study recommends that if the Enoch 2 Wind Farm project proceeds to construction:

- 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 follow up surveys are repeated, during construction and following completion of construction activities. Thus, an assessment of overall impacts can be made on the aquatic species now known to exist in the vicinity of the Enoch 2 Wind Farm.
- That construction activity either in or in proximity of a watercourse, be discussed with the Scottish Environment Protection Agency (SEPA).
- That any instream construction procedures, such as culverting, are notified to NDSFB prior to works commencing to ensure that appropriate mitigation measures are adopted to protect those species now known to exist in the vicinity of the Enoch 2 Wind Farm site.

## 7 Acknowledgements

Forestry and Land Scotland, Creebridge, Newton Stewart, DG8 6AJ

Angus Campbell, Dalhanna Farming Company, Over Cairn Farm, Cumnock KA18 4NW

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**Table 1: List of survey sites within the vicinity of the proposed Enoch Wind Farm – Baseline survey 2020**

| Watercourse | Site code | Location description | Easting | Northing | Altitude (m) | Wet width (m) | Water Temp (©) | Conductivity (µS) | pH | Surveys conducted |
|---|---|---|---|---|---|---|---|---|---|---|
| Carcow Burn | 1 | Downstream of Afton Road Bridge | 261834 | 610139 | 225 | 3.80 | 19.9 | 50 | 6.92 | Electrofishing |
| Carcow Burn | 2 | Downstream of confluence with Glenhastel Burn | 259471 | 607098 | 362 | 1.10 | 20.1 | 50 | 6.42 | Electrofishing, Aquatic invertebrate and FWPM |
| Carcow Burn | 3 | Downstream from culvert | 259321 | 606994 | 369 | 1.00 | 19.9 | 50 | 6.46 | Electrofishing, Aquatic invertebrate and FWPM |
| Tributary of Carcow Burn | 4 | Downstream of fence below Monquhill Farm | 259167 | 606735 | 381 | 0.50 | 20.1 | 50 | 6.78 | Electrofishing |
| Carcow Burn | 5 | Upstream from confluence with tributary from Monquhill Farm | 259129 | 606690 | 381 | 0.60 | 17.5 | 40 | 6.04 | Electrofishing, Aquatic invertebrate and FWPM |
| Glenshalloch Burn | 6 | 50m downstream from track culvert | 260893 | 607443 | 364 | 1.90 | 18.6 | 40 | 5.98 | Electrofishing, Aquatic invertebrate and FWPM |
| Connel Burn | 7 | Downstream from corner of Monquhill Forest | 258446 | 607516 | 348 | 1.70 | 19.2 | 80 | 7.03 | Electrofishing |
| Afton Water | 8 | Upstream of Blackcraig Bridge | 263158 | 608025 | 257 | 5.00 | 14.0 | 60 | 7.94 | Electrofishing, Aquatic invertebrate and FWPM |

**Table 2: Results of Electrofishing Surveys – Enoch 2 Wind Farm Baseline survey 2020**

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| Carcow Burn | 1 | Downstream of Afton Road Bridge | 261834 | 610139 | 12/08/20 | 0.00 | 1.88 | 14.27* | 3.76 | Eel x 1 |
| Carcow Burn | 2 | Downstream of confluence with Glenhastel Burn | 259471 | 607098 | 13/08/20 | 0.00 | 0.00 | 21.56* | 8.26 | - |
| Carcow Burn | 3 | Downstream from culvert | 259321 | 606994 | 13/08/20 | 0.00 | 0.00 | 47.41* | 0.00 | - |
| Tributary of Carcow Burn | 4 | Downstream of fence below Monquhill Farm | 259167 | 606735 | 13/08/20 | 0.00 | 0.00 | 0.00 | 9.09 | - |
| Carcow Burn | 5 | Upstream from confluence with tributary from Monquhill Farm | 259129 | 606690 | 13/08/20 | 0.00 | 0.00 | 0.00 | 0.00 | - |
| Glenshalloch Burn | 6 | 50m downstream from track culvert | 260893 | 607443 | 13/08/20 | 0.00 | 0.00 | 2.77 | 28.21* | - |
| Connel Burn | 7 | Downstream from corner of Monquhill Forest | 258446 | 607516 | 13/08/20 | 0.00 | 0.00 | 35.42* | 11.77 | - |
| Afton Water (control) | 8 | Upstream of Blackcraig Bridge | 263158 | 608025 | 12/08/20 | 63.15* | 35.36* | 2.35 | 16.51* | - |

* 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 100m$^2$

| absent | very poor | poor | moderate | good | excellent |
|---|---|---|---|---|---|

**Table 3: Results of FWPM surveys with associated habitat data – Enoch 2 Wind Farm Baseline survey 2020**

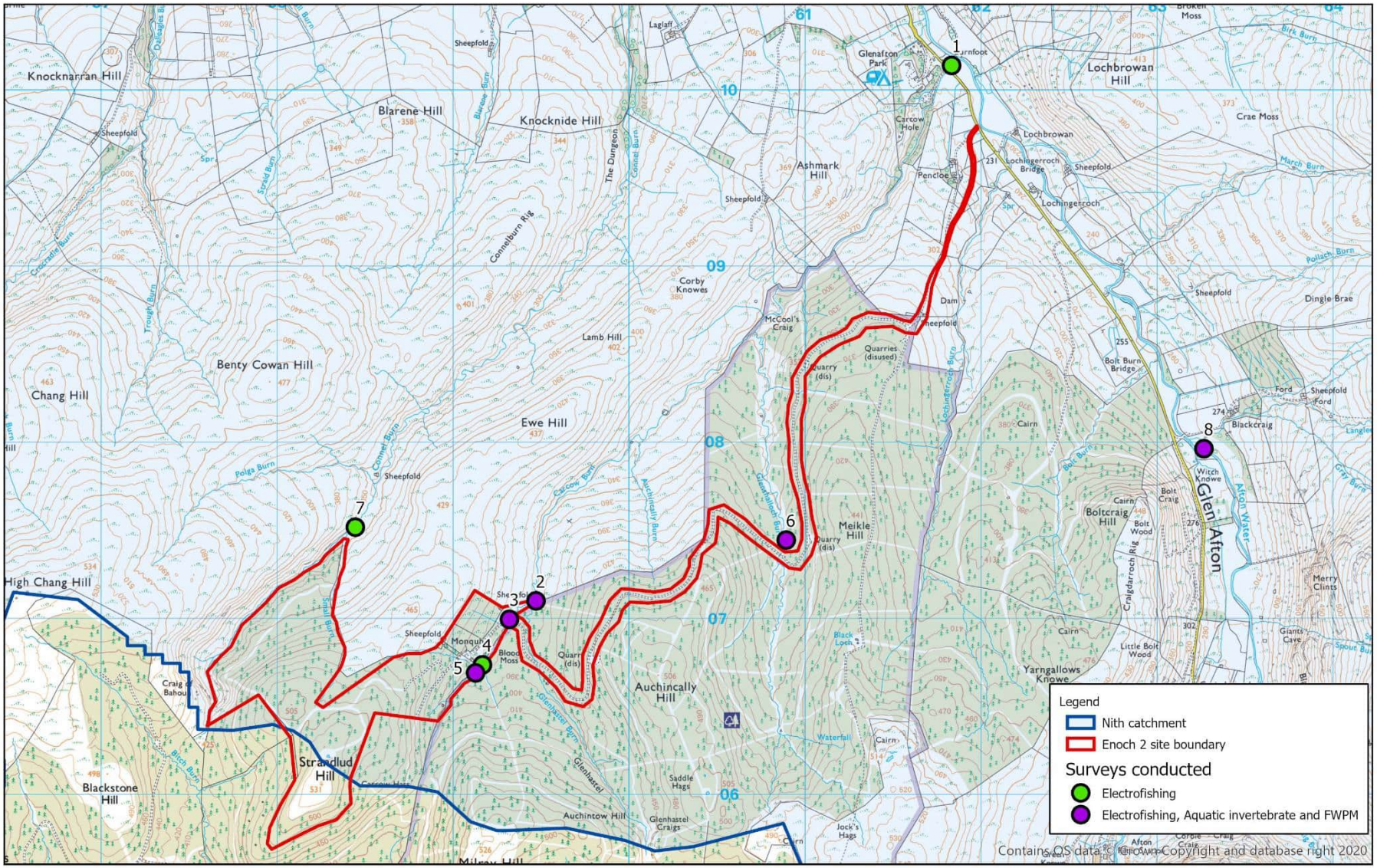
| | | | | | Substrate | | | | | | | | Flow type | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site code | FWPM present | Instream cover | Bank face vegetation | Bank top vegetation | HO % | SI % | SA % | GR % | PE % | CO % | BO % | BE % | SM % | DP % | SP % | DG % | SG % | RU % | RI % | TO % |
| 1 | - | Excellent | Complex | Complex | 0 | 0 | 5 | 10 | 20 | 30 | 35 | 0 | 10 | 0 | 10 | 0 | 0 | 40 | 40 | 0 |
| 2 | No | Good | Simple | Simple | 0 | 0 | 0 | 25 | 40 | 15 | 15 | 5 | 0 | 0 | 10 | 0 | 0 | 60 | 30 | 0 |
| 3 | No | Good | Complex | Complex | 0 | 0 | 10 | 80 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 50 | 0 |
| 4 | - | Good | Simple | Simple | 0 | 0 | 15 | 25 | 30 | 40 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 60 | 20 | 0 |
| 5 | No | Moderate | Simple | Simple | 0 | 0 | 0 | 40 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 60 | 0 | 0 |
| 6 | No | Excellent | Simple | Simple | 0 | 0 | 0 | 20 | 20 | 40 | 20 | 0 | 0 | 30 | 10 | 0 | 20 | 30 | 10 | 0 |
| 7 | - | Excellent | Simple | Simple | 0 | 5 | 0 | 20 | 30 | 40 | 5 | 0 | 0 | 0 | 0 | 0 | 90 | 0 | 10 | 0 |
| 8 | No | Excellent | Complex | Complex | 0 | 0 | 5 | 25 | 25 | 25 | 20 | 0 | 5 | 0 | 0 | 30 | 0 | 55 | 10 | 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.
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 2020**

| Site code | Watercourse | BMWP score /Classification | NTAXA | ASPT score /Classification |
|---|---|---|---|---|
| 2 | Carcow Burn | 47 – B (Moderate) | 8 | 5.88 – A2 (Good) |
| 3 | Carcow Burn | 57 – B (Moderate) | 10 | 5.70 – A2 (Good) |
| 5 | Carcow Burn | 51 – B (Moderate) | 8 | 6.38 – A1 (Excellent) |
| 6 | Glenshalloch Burn | 55 – B (Moderate) | 9 | 6.11 – A1 (Excellent) |
| 8 | Afton Water (control) | 52 – B (Moderate) | 8 | 6.50 – A1 (Excellent) |

**Map 1 – Enoch 2 Wind Farm survey site locations**




Enoch 2 Wind Farm
Survey site locations
Nith catchment
August 2020

N

Scale: 1:27,000

0 0.3 0.6 1.2 Kilometers

Nith District Salmon Fishery Board

## Appendix 1 - Photographs of sites surveyed

Site 1 – Carcow Burn

Site 2 – Carcow Burn

Site 3 – Carcow Burn

Site 4 – Tributary of Carcow Burn

Site 5 – Carcow Burn

Site 6 – Glenshalloch Burn

**Photographs of sites continued**

Site 7 - Connel Burn

Site 8 – Afton Water