TECHNICAL APPENDIX 9.6

Outline Fisheries Management Plan

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Clashindarroch II Wind Farm EIA Report

Chapter 9 Technical Appendix:

9.6 Outline Fisheries Management Plan

November 2019

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1. INTRODUCTION

1.1 Purpose of this Document

1.1.1 This document details the proposed approach and methods to monitor water quality and the health of fish populations within the sub-catchments that Clashindarroch II wind farm (the proposed development) would be located within. Monitoring would be undertaken prior to, during and following the construction of the proposed development.

1.1.2 In combination with the Construction Environmental Management Plan (CEMP) and Outline Construction Method Statements (OCMS), which will set out the proposed approach to protect sensitive aquatic habitats during the construction of the proposed development, the FMP is intended to assist with the key objective of avoiding significant adverse effects on the water quality and ecology of the tributaries of the Rivers Deveron and Bogie.

1.1.3 Also included in this document is a summary of the findings of annual fish population and habitat surveys completed as part of the pre-construction and post-construction monitoring of Clashindarroch wind farm from 2011 to 2017.

1.2 Consultation & Scoping

1.2.1 This outline Fisheries Management Plan (FMP) has been developed in consultation with the Deveron, Bogie and Isla Rivers Charitable Trust (DBIRCT) and Deveron District Salmon Fisheries Board (DDSFB).

1.2.2 The FMP will be developed into a final version, in consultation and agreement with DBIRCT and DDSFB, at least 12 months prior to the commencement of works (i.e. prior to tree felling for the proposed wind farm).

1.2.3 It has been agreed, in consultation with DBIRCT and DDSFB during the EIA scoping process, that the 2011 – 2017 surveys for Clashidarroch wind farm provide a sufficiently detailed baseline dataset (i.e. in spatial and temporal extent) to inform the assessment of the Clashindarroch II proposals.

1.3 Background

Site Context

1.3.1 The proposed Clashindarroch II wind farm development is located entirely within the Clashindarroch Forest, which lies within two main river catchments, the River Bogie to the east and the River Deveron to the west. Some of the tributaries, mainly the Kirkney Water, Lag Burn, Priest's Water and Ealaiche Burn, which form the catchments to these river systems, drain the proposed development area and therefore may be subject to impacts through the different phases of the development.

Previous Baseline Surveys

1.3.2 As part of the monitoring for the construction of Clashindarroch Wind Farm, electrofishing and fish habitat surveys were carried out annually from 2011 to 2017 by DBIRCT. The aim of these annual surveys was to monitor fish populations and habitat / water quality in the rivers and tributaries within the survey area that were considered to be the most sensitive in terms of their suitability for salmonid populations. Two types of survey were carried out:

- habitat surveys: a short walkover survey at each electrofishing sampling point, taking into account characteristics of a watercourse that are likely to affect fish populations, such as water depth and width, substrate type, siltation, pollution, obstructions to the free passage of fish, and main surrounding land use; and
- electrofishing surveys, which involved the use of an electric current to stun fish, allowing them to be safely removed from the water for identification and assessment of populations at each of the sampling points.

1.3.3 The sampling points used for the surveys remained the same each year, and were at locations that are representative of the fish populations and habitats within the survey area. Salmonid fish population and habitat quality surveys were completed by DBIRCT at 21 sampling sites (see Appendix 9.6.1, most of the locations ae shown on Figure 9.6.1).

1.3.4 All salmon and sea trout collected were recorded, measured and categorised into two age classes:

- Fry: Juvenile fish less than one year old; and
- Parr: fish of more than one year old; a result of fish spawning in the catchment the previous year.

1.3.5 For each of the sampling points a habitat survey was carried out in order to record certain characteristics of the watercourse that were likely to affect the suitability of the habitat for salmonids. These characteristics were recorded onto standard forms to allow for a collation of the results following all the surveys.

Key Findings

1.3.6 Both River Deveron and River Bogie support prolific populations of migratory salmonid and provide popular recreational fisheries of importance both regionally and within the national context of Scotland. The fisheries are also visited by overseas anglers that provide contributions to the local tourist industry economy. The river systems are of statutory regulated fish conservation value as they support populations of Atlantic salmon (*Salmo salar*) and brook lamprey (*Lamptera planeri*).

1.3.7 The upper reaches of the River Deveron and Bogie catchments support populations of migratory salmonids Atlantic salmon and sea trout, (*S. trutta*) non-migratory trout, the brown trout, and diadromous species such as the European eel (*Anguilla anguilla*). There are also species that have no angling or commercial value but are of conservation interest, including brook lamprey, three-spined stickleback (*Gasterosteus aculeatus*) and non-native minnows (*Phoxinus phoxinus*).

1.3.8 The 2011-2017 surveys confirmed the presence of juvenile trout within all of the main watercourses draining the area that the proposed development would be located within. Densities of juvenile salmon were generally much lower and more variable than trout within the study area but all of the main watercourses also support populations of this species. There was no evidence of presence of juvenile salmon at the sampling points closest to the proposed development site. Habitat quality for spawning and juvenile salmonids is poor / absent at and above the existing and proposed watercourse crossing points for the wind farm access tracks.

1.3.9 DBIRCT concluded that there was no evidence from the data collected of any long-term adverse effect from the construction of Clashindarroch wind farm on the health

of the salmonid fish populations within the catchments draining the area that the wind farm is located within.

1.3.10 Further detail on the results of the 2011 to 2017 surveys are provided in Appendix 1 to this document. Copies of the annual survey reports are available on request.

1.4 Summary of Relevant Legislation

1.4.1 Atlantic salmon is listed in Annexes II and V of the EC Habitats Directive (94/43/EEC) and as a priority species on the UK Biodiversity Action Plan (UK BAP). Salmon are also listed on the North-East Scotland Local BAP. Further legal protection is provided under the Salmon Conservation (Scotland) Act 2001, [now consolidated into the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003].

1.4.2 The brook lamprey is listed in Annex II of the Habitats Directive, Appendix III of the Bern Convention and is on the Scottish Biodiversity List.

1.4.3 Protection of salmonids and other native fish species of conservation concern is also afforded under the EC Water Framework Directive, incorporated into the Water Environment and Water Services (Scotland) Act 2003, which has the objective of protecting and enhancing the ecological status of water bodies in Scotland.

1.4.4 Brown trout have also been accorded greater priority in recent years by statutory bodies in the UK with management and conservation work targeting the preservation of natural self-sustaining populations. Brown trout and the sea trout are listed as a priority species on the UK BAP and on the Scottish Biodiversity List.

1.4.5 The importance of protecting fish, particularly salmon, sea trout, and brown trout at a river and tributary level has been recognised because there are likely to be genetic differences between stocks even within a river system because of a range of distinct isolated spawning populations.

1.4.6 There are also widespread concerns about declining populations of European eel at both national and international level. European eel is a priority species under the UK BAP and is on the Scottish Biodiversity List.

1.5 Overview of Relevant Mitigation

Potential Impacts

1.5.1 For the purpose of the EIA, all watercourses within the proposed development area are considered sensitive receptors. Potential impacts during the felling and construction phases could include:

- water quality impacts (including direct effects on fish and spawning habitats);
- impacts on flow regime;
- noise and vibration; and
- impediments to fish migration.

1.5.2 An evaluation of the watercourses (and associated sub-catchments) and their fish populations within and adjacent to the wind farm is provided in Chapter 9 of the EIA Report along with an assessment of the potential impacts of the proposed wind farm scheme on these receptors. Potential impacts on hydrology and water quality are also considered in Chapter 11: Hydrology, Hydrogeology and Geology.

Scheme Design

1.5.3 The wind farm layout design has undergone an iterative process to minimise impacts on sensitive environmental receptors including watercourses (see Chapter 2 for further information on the wind farm design process). A minimum 50 m wide protection buffer was applied to all watercourses and no infrastructure (other than necessary access track crossings) were permitted within these zones. Wherever possible existing forestry tracks and watercourse crossings will be used and the number of new watercourse crossings, and upgrading of existing crossings, will be kept to the minimum necessary to construct and operate the proposed wind farm.

Forest Felling

1.5.4 For the assessment of the proposed development it is important that the impacts from clear-felling, which would occur regardless of the scheme, albeit over a longer timeframe, and construction are segregated.

1.5.5 The clear-felling of plantation forestry has the potential to impact upon run-off and water quality in surrounding watercourses, altering sediment load and water chemistry and potentially impacting upon important fish spawning habitats downstream.

1.5.6 Scottish Forestry (SF) and Forestry & Land Scotland (FLS) have agreed to manage felling across the whole of Clashindarroch Forest in order to minimise the potential impact of the wind farm felling on aquatic habitats.

1.5.7 In addition, all felling operations would comply with the Forests and Water Guidelines[1] to minimise short and medium term impacts on the local watercourses.

Construction

1.5.8 The wind farm construction works also have the potential to impact water quality in surrounding watercourses, through the mobilisation of fine sediments and the risk of chemical pollution from construction materials and machinery. The avoidance of such impacts will be a key focus for the construction phase and will be achieved by following recognised best practice during the works. Previous experience with the construction of the existing Clashindarroch wind farm has shown that such impacts on fish habitats and populations can be avoided through good planning and construction site management.

1.5.9 A full time Ecological Clerk of Works (ECoW) will be appointed by the Applicant to oversee the implementation of the measures to protect fish and fish habitats during wind farm construction. The ECoW will have the power to stop works should there be a significant risk to aquatic habitats or should any pollution incidents occur.

1.5.10 The outline CEMP and associated CMS documents set out the proposed approach to the protection of aquatic habitats during the construction of the wind farm. The relevant outline CMS documents are as follows:

- Silt / Suspended solids / Mobilisation of sediments:
  - OCMS 01: Road and Wind Turbine Construction

[1] Forestry Commission (2011) Forests and Water. UK Forestry Standard Guidelines. Forestry Commission, Edinburgh.

  - OCMS 04: Borrow Pits
- Fuel, Oils and Chemicals:
  - OCMS 01: Road and Wind Turbine Construction
  - OCMS 05 : Pollution Prevention
- Water Crossing Design:
  - OCMS 08: Watercourse Crossing Management

2. PROPOSED MONITORING PLAN

2.1 Aims and Objectives

2.1.1 This document outlines methodologies for the following monitoring surveys:

- Water quality monitoring (see section 2.2);
- Fish surveys (see section 2.3); and
- Aquatic macroinvertebrate surveys (see section 2.4).

2.1.2 The proposed monitoring will focus on relevant tributaries within the Bogie and Deveron catchments during all phases of the development including pre-works baseline surveys.

2.1.3 Where possible, sampling locations that formed part of the monitoring of Clashindarroch wind farm have been adopted for the proposed monitoring under this FMP. Some additional locations have been agreed with DBIRCT to ensure that there is sufficient coverage to monitor the potential effects from the tree felling and construction of Clashindarroch II.

2.1.4 The following table provides a summary of the proposed monitoring programme:

Table 9.6.1: Proposed Schedule of Survey and Water Quality Monitoring

	No. Sampling Points (inc. control sites)	Frequency	Pre-construction (ideally 2 years, 12 months minimum)	Felling / Construction Phase	Monitoring Years Post-Construction			
					1	2	3	4
Water quality scheduled sampling	10	Monthly	✓	✓	✓*	✓*	✓*	✓*
Water quality monitoring (data loggers)**	3	Continuous	✓	✓	✓*	✓*	✓*	✓*
Water quality monitoring (ECoW)	As required	As required		✓				
Water quality (operational phase)	As required	Quarterly			✓*	✓*	✓*	✓*
Electrofishing	10	Annual	✓	✓	✓*	✓*	✓*	✓*
Fish Habitat	10	Annual	✓	✓	✓*	✓*	✓*	✓*
Aquatic Macroinvertebrates	10	Annual	✓	✓	✓*	✓*	✓*	✓*

** The detailed scope, duration and frequency of post-construction monitoring will be agreed in consultation with SEPA and the Deveron District Salmon Fishery Board / The Deveron, Bogie and Isla Rivers Charitable Trust.*

*** The locations of the continuous data loggers will be agreed with SEPA and the Deveron District Salmon Fishery Board / The Deveron, Bogie and Isla Rivers Charitable Trust prior to deployment.*

2.2 Water Quality Monitoring

2.2.1 The rationale behind the proposed water quality monitoring is provided in Chapter 11 of the EIA Report. The locations of the proposed water quality monitoring sites are listed in Table 9.6.2 and shown on Figure 9.6.1. Details of the water quality monitoring methods, programme, water chemistry parameters and exceedance thresholds will be agreed in advance of the commencement of the proposed development in consultation with SEPA, DDSFB and DBIRCT.

2.2.2 It is anticipated that water quality monitoring would be completed monthly at c. 10 locations (see Table 9.6.2) during a minimum 12-month period prior to wind farm related felling commencing on the site. Monitoring would then continue through the construction phase of the proposed development. Post-construction monitoring would continue for a minimum of 4 years following completion of the construction phase.

2.2.3 In addition to the scheduled monitoring, visual inspections and checking using hand-held water quality monitoring equipment, would be undertaken by the full-time ECoW, particularly for works in the vicinity of watercourses. This will also involve regular visual inspection of the efficacy of the surface water pollution prevention measures. Regular checking and water quality visual inspection allows mitigation measures to be applied in a flexible and proactive manner as dictated by site conditions.

2.2.4 Regular operational phase inspection of all watercourses in the vicinity of the wind farm infrastructure will be completed during periods of high rainfall. It is proposed that these inspections will be carried out on a quarterly basis for the first 4 years of wind farm operation.

2.3 Fish Surveys

Fish Population Surveys

2.3.1 The proposed locations for the fish population surveys are shown on Figure 9.6.1 and the grid references are provided in Table 9.6.2. These locations largely replicate the fish population surveys undertaken by DBIRCT between 2011 and 2017 as part of the monitoring programme for Clashindarroch wind farm and will therefore allow comparisons to be made with previous results.

2.3.2 One of the locations (B1) on the Water of Bogie is to be moved to a more appropriate upstream location. A new sampling site would be established on the Corrylair Burn to monitor potential effects from the proposed borrow pit operations. Additionally, control sites would be established on the Burn of Easaiche, just downstream of Rhynie, and at one other location (possibly at a suitable site on the River Deveron, this to be confirmed in consultation with DBIRCT, in advance of pre-construction monitoring commencing).

2.3.3 A minimum of one round of pre-works (i.e. prior to wind farm related tree felling) baseline electrofishing surveys would be completed for each monitoring site. If possible two years of pre-works monitoring would be completed to minimise the potential for anomalous results from a single year to affect the validity of the baseline data. Two control sites, out with the potential influence of the proposed development, will be included to account for annual variability not related to the works. Repeat surveys would be completed during the felling / construction phases and for at least 4 years following completion of the wind farm.

2.3.4 In each year of monitoring, in order to establish the composition and abundance of the fish populations, it is proposed that a series of fully quantitative triple catch (3-run) samplings[2] will be conducted at the 10 locations, following the same methods as previous surveys undertaken by the DBIRCT to monitor Clashindarroch wind farm.

Table 9.6.2: Proposed Fish / Fish Habitat Survey, Aquatic Macroinvertebrate Survey and Water Quality Sampling Locations

Site Code	Easting	Northing	Catchment
P 2	347600	834700	Priest's Water
Lg 0	344000	832950	Lag Burn
Lg 1	345200	832800	Lag Burn
Lg10	348400	834200	Lag Burn
P 8	349409	834328	Lag Burn / Priest's Water
B 1	348642	824498	Water of Bogie
K 28	348976	831863	Kirkney Water
Ea 6	345022	830611	Ealaiche Burn
Cor3	346770	834386	New site on Corrylair Burn to monitor potential effects from the proposed borrow pit.
Tn5	349582	827507	Control site on Ealaiche Burn, just downstream of Rhynie.*

**A further suitable control site would be included in the monitoring programme, the exact location to be confirmed in consultation with DBIRCT prior to the FMP being finalised and implemented.*

2.3.5 Electrofishing is the preferred technique to determine the species present and health of a fish population. The technique involves using specialist equipment that allows an electric current to be passed through the water to stun the fish, which enables the operator to remove the fish from the water unharmed. Once captured the fish recover in a holding container. They are then anaesthetised using a specific fish anaesthetic, identified, measured and recorded, and once recovered, returned unharmed to the area of capture. Further analysis allows the number and density to be calculated for all species and life stages within the monitoring site.

2.3.6 The surveys will be carried out by suitably qualified fisheries biologists accredited by the Scottish Fisheries Co-ordination Centre (SFCC) and in accordance with SFCC best practice methods. The SFCC has an agreed set of methodologies and data recording sheets that are used when electrofishing by all members to promote consistency and best practice.

Fish Habitat Surveys

2.3.7 Standard fish habitat surveys will also be completed on the following watercourses at the electrofishing locations and adjacent to site infrastructure:

- Priest's Water;
- Lag Burn;

[2] Following the standard SFCC Protocol [see https://www.sfcc.co.uk/]

- Water of Bogie;
- Kirkney Water;
- Ealaiche Burn;
- Corrylair Burn; and
- Burn of Easaiche.

2.3.8 A short walk-over survey of each electrofishing site will be completed. This involves a combination of a linear survey and a point survey. In the linear survey the relative proportions of different fish habitat characteristics, such as substrate and flow types, are estimated within the selected river stretch. The point survey is used to record features that lie at a particular location, or 'point', within each river stretch, such as obstacles to migration and pollution sources.

2.3.9 In total eight categories of information are recorded for each survey stretch. These are divided into sections on the record sheets as follows:

- Part A: General locational and context information about the survey stretch.
- Linear Survey -
  - Part B: Information on the channel characteristics
  - Part C: Information on the characteristics of the left river bank
  - Part D: Information on the characteristics of the right river bank
  - Part E: Photographic information for the survey stretch
- Point survey -
  - Part F: Information on point pollution sources
  - Part G: Information on obstacles to migration
  - Part H: Information on channel and bank modifications

2.3.10 The data collected throughout the eight categories can be used by trained and experienced interpreters to evaluate, for example, the quality of habitat for juvenile salmon, to identify potential spawning locations, to identify areas of excessive silt loading and/or to identify pollution sources.

2.4 Aquatic Macroinvertebrate Surveys

Sampling Programme

2.4.1 The proposed benthic aquatic macroinvertebrate sampling and analysis is intended to supplement the water chemistry and suspended sediment monitoring. Changes to aquatic invertebrate communities, as a result of non-natural perturbations to water quality, provide a longer-term indicator of stream health; potentially long-after the pollutants have been flushed from the watercourse.

2.4.2 Aquatic macroinvertebrate monitoring will be completed during the pre-works, felling / construction and post-construction phases. In each year of monitoring, in order to establish the aquatic invertebrate communities that are present, and analyse biological water quality, a total of at least 10 sites will be monitored (see Table 9.6.2).

2.4.3 A minimum of one year of pre-works survey would be completed for each of the monitoring sites (i.e. replicating the electrofishing locations). If possible two years of pre-works monitoring would be completed to minimise the potential for anomalous results from a single year to affect the validity of the baseline data. Repeat surveys would be completed during the felling / construction phases and for at least 4 years following completion of the wind farm.

Sampling Method

2.4.4 The sampling method will follow those set out in the monitoring reports for the Clashindarroch wind farm. In summary, aquatic macroinvertebrates will be collected using the SEPA approved kick sampling technique in normal to low flow conditions during the late summer / autumn. This is the standard semi-quantitative method for obtaining benthic macroinvertebrate community data for water quality monitoring and nature conservation purposes.

2.4.5 The typical sampling method for streams and rivers involves a 3-minute kick/sweep sample using a standard 1 mm mesh pond (hand) net, followed by a one minute stone search and examination of the water surface. The different habitat types in the stream are sampled proportionately to their occurrence (e.g. fast moving riffles, shallow water, slow water, weeds and tree roots) to ensure that the full complement of invertebrates at the site is represented in the sample. The invertebrates in the sample will be carefully collected and preserved for later sorting, identification and analysis.

2.4.6 Various environmental parameters of each sampling location will also be recorded (e.g. stream bed width, depth, flow and substrate type). The exact location (i.e. sampling area) that the samples were taken will be recorded using hand-help GPS (accuracy of c. +/- 7m). Representative photographs of the sampling area will also be taken.

Sample Analysis

2.4.7 For each sample the Biological Monitoring Working Party (BMWP) score will be determined following the standard scoring system. The scoring system is designed to reflect the variation in sensitivity of different aquatic invertebrates to pollution (i.e. primarily organic pollution, which can reduce the availability of dissolved oxygen in the water).

2.4.8 The ASPT (Average Score Per Taxon) score will also be calculated. The ASPT method is much less sensitive to natural variation in invertebrate diversity and is therefore considered to provide a much more reliable index of pollution impact than the BMWP score.

2.4.9 The samples will also be scored using the WHPT (Whalley, Hawkes, Paisley, Trigg) metric. The WHPT classification method allows for the assessment of benthic invertebrate communities in rivers in relation to degradation of ecological status, including from organic pollution. WHPT metrics have replaced BMWP scores for the purposes of river status monitoring under the Water Framework Directive (WFD).

2.4.10 In order to determine WFD Class, the online River Invertebrate Classification Tool (RICT) will be used.

2.4.11 Additionally, the invertebrate samples can be scored using the PSI (Proportion of Sediment-sensitive Invertebrates) index at the family level. This scoring system

measures the abundance-weighted proportional frequency of taxa which are sensitive to fine sediment deposition.

2.5 Reporting

2.5.1 The results of the electrofishing, fish habitat and aquatic macroinvertebrate monitoring surveys would be provided to the relevant authorities and organisations via annual reports.

2.5.2 The results of the water quality monitoring would be provided to the relevant authorities and organisations (including the DBIRCT) via monthly reports and final reports following completion of the pre-works, construction and post-construction monitoring phases.

3. REFERENCES

DBICRT (2011). Clashindarroch Wind Farm 2011 Electro fishing Survey. Report by the Deveron, Bogie and Isla Rivers Charitable Trust, prepared for: Vattenfall Wind Power.

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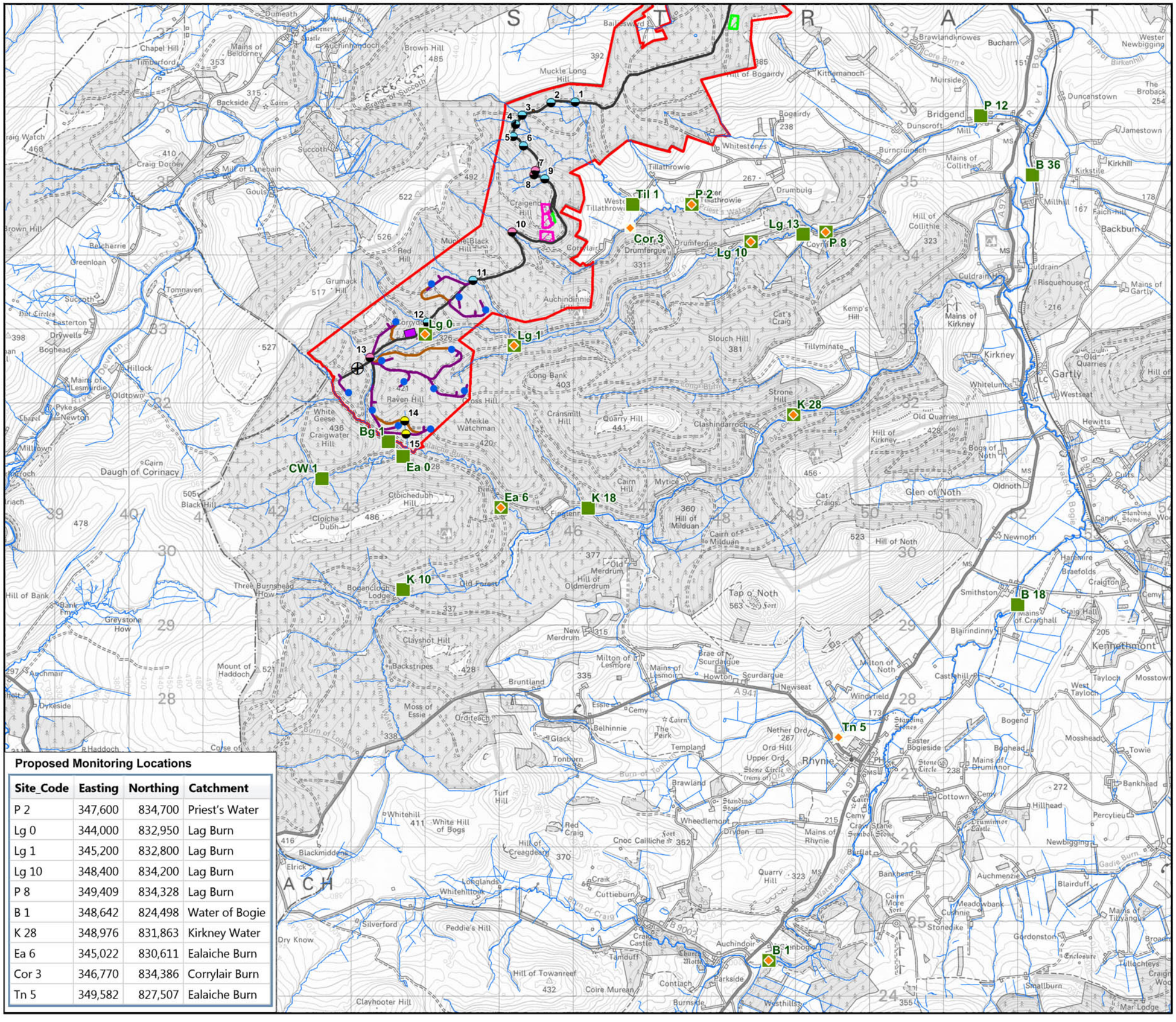
SFCC (2007). Electrofishing Survey Training Course Manual. Scottish Fisheries Co-ordination Centre, Pitlochry.

SFCC (2007). Habitat Surveys Training Course Manual. Scottish Fisheries Co-ordination Centre, Pitlochry.

FIGURE



Proposed Monitoring Locations

Site_Code	Easting	Northing	Catchment
P 2	347,600	834,700	Priest's Water
Lg 0	344,000	832,950	Lag Burn
Lg 1	345,200	832,800	Lag Burn
Lg 10	348,400	834,200	Lag Burn
P 8	349,409	834,328	Lag Burn
B 1	348,642	824,498	Water of Bogie
K 28	348,976	831,863	Kirkney Water
Ea 6	345,022	830,611	Ealaiche Burn
Cor 3	346,770	834,386	Corrylair Burn
Tn 5	349,582	827,507	Ealaiche Burn

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CLASHINDARROCH II WIND FARM EIA

FIGURE 9.6.1
Proposed Fish Population and Water Quality Monitoring Locations

- Site Boundary
- Proposed Turbine Locations (SLR L046)
- Proposed Met Mast Location
- Proposed Access Track
- Alternative Access Track
- Existing Access Track
- Existing Substation
- Proposed Substation
- Proposed Laydown Area
- Existing Borrow Pit
- Proposed Borrow Pit
- Existing Water Crossing
- Existing Water Crossing with Additional Works
- New Water Crossing
- Watercourse
- Clashindarroch Wind Farm Monitoring Location
- Proposed Fish Population and Water Quality Monitoring Location *

* an additional suitable control site will be included. The exact location to be confirmed prior to the Fish Management Plan being finalised and implemented.

Original A3 plot scale 1:50,000

Client / Project No.		Vattenfall / 063.022	
Rev. By	CR/SR	Drg. No.	N/A
Chk. By	PB	Date	06/11/2019
Appr. By	PB	Layout	L046

Figure 9.6.1

APPENDICES

Appendix 9.6.1: Summary Results of Fish Population & Habitat Surveys (2011 – 2017)

Background

Atlantic salmon (*Salmo salar*) are an internationally important species which is listed under Annex II and V of the European Habitats Directive (1992) (only in freshwater), and Appendix III of the Bern Convention (1979) (only in freshwater). Both Atlantic salmon and brown/sea trout (*S. trutta*) are on the Scottish Biodiversity List and were identified as priority species for conservation under the UK Biodiversity Action Plan.

Scottish rivers are an important stronghold for Atlantic salmon in Europe. Salmon populations are of economic value and of conservation concern. The Clashindarroch II wind farm site is situated between the River Deveron (to the east) and Water of Bogie (to the west), both of which are important rivers for salmon and sea trout, and both fish species are known to use the tributaries of these rivers for spawning, some of which are within the study area for the proposed wind farm site.

The construction and operation of a wind farm can have a number of impacts on fish populations. These impacts may include disturbance due to noise, vibration, siltation, pollution, the introduction of obstacles into channels that may impede the free passage of fish, and changes to water quality, substrate type or peat systems. Species such as salmon have a complex life cycle and these potential effects could impact on various life stages, causing direct mortality of juveniles and adults, changes in invertebrate prey abundance, avoidance behaviour resulting in unused habitat, blocking or restriction of migration routes to/from spawning beds or the damage of in stream/riparian habitat.

As part of the Environmental Impact Assessment for the Clashindarroch Wind Farm, electrofishing and aquatic habitat surveys were carried out annually from 2011 and ending in 2017. The aim of these surveys was to monitor fish populations (in particular, Atlantic salmon and sea trout) and habitat / water quality at fixed sampling points on sections of watercourse that provided suitable habitat for salmonid populations and were at potential risk of impact from the wind farm construction works.

Two types of survey were carried out:

- Habitat survey: a short walkover survey at each electrofishing sampling point, taking into account characteristics of a watercourse that are likely to affect fish populations, such as water depth and width, substrate type, siltation, pollution, obstructions to the free passage of fish, and main surrounding land use; and
- Electrofishing survey: involves the use of an electric current to stun fish, allowing them to be safely removed from the water for identification and assessment of the density of juvenile fish populations at each of the sampling points.

The sampling points used for the surveys detailed in this report remained the same each year, and were selected as locations that are representative of the fish populations and habitats within the survey area. The sampling points included in this report are those that were used for the study for the main Clashindarroch Wind Farm site and which are considered to be relevant to the assessment of the proposed development.

This document provides a summary of the key findings from the 2011 to 2017 surveys based on annual reports provided by the Deveron, Bogie and Isla Rivers Charitable Trust (2011-2017).

Methods

Sampling Locations

The sampling points from the 2011-2017 surveys for the main Clashindarroch wind farm site, and which are considered relevant to the Clashindarroch II wind farm study area, are listed in Table 1 below and shown on Figure 9.6.1. The sampling points include a control site on the Water of Bogie, which is approximately 8.8 km to the south-west of the Clashindarroch II wind farm study area. The sampling points remained the same for each year of survey.

Table 1: Clashindarroch Wind Farm Fish Population Monitoring Locations (those relevant to the Clashindarroch II Wind Farm Study Area are highlighted in bold).

Watercourse	Site Code	Grid Reference
Bogrotten Burn	**Bg 1**	**3435 8315**
Craigwater	CW1	3426 8310
Glen	G7	3478 8393
Collonach	Cal	3484 8398
River Deveron	D 5	3381 8285
Priest's Water	**P 2**	**3476 8347**
Priest's Water	**P 8**	**3494 8344**
Ness Bogie	P 12	3515 8359
Tillathrowie	Til 1	3468 8347
Lag Burn	**Lg 0**	**3440 8329**
Lag Burn	**Lg 1**	**3452 8328**
Lag Burn	**Lg10**	**3484 8342**
Lag Burn	**Lg 13**	**3491 8343**
Water of Bogie (Control)	B 1	3488 8245
Water of Bogie	B 18	3520 8293
Water of Bogie	B 36	3522 8351
Kirkney Water	K 10	3437 8295
Kirkney Water	**K 18**	**3462 8306**
Kirkney Water	**K 28**	**3489 8318**
Ealaiche Burn	**Ea 0**	**3437 8313**
Ealaiche Burn	**Ea 6**	**3450 8306**

Habitat Assessment

The habitat assessment was carried out by qualified surveyors in accordance with best practice guidance provided by the Scottish Fisheries Co-ordination centre (SFCC 2007).

For each of the sampling points selected for the electrofishing survey, a walkover habitat survey was carried out in order to record certain characteristics of the watercourse that were likely to affect the suitability of the habitat for salmonids. The characteristics that were taken into account are as follows:

- Altitude;
- Average depth range;
- Average wet width;
- Predominant substrate (substrate type and diameter of such);
- Area affected by siltation;
- Average canopy cover;
- Main surrounding land use;
- Number of pollution points;
- Number of obstructions; and
- Level of instream cover.

These factors of each sampling point were recorded onto standard forms to allow for a collation of the results following all the surveys.

Electrofishing

The electrofishing surveys were carried out by qualified surveyors in accordance with best practice guidance provided by the Scottish Fisheries Co-ordination centre (SFCC 2007).

At each of the sampling points, surveying for salmonid fish was carried out by passing an electric current through the water to stun the fish, which were then removed unharmed from the water to allow for identification and aging, and to gain an understanding of the likely size of the population of salmonid fish species within each watercourse.

All Atlantic salmon and sea trout collected were recorded, measured and categorised into two age classes:

- Fry: Juvenile fish less than one year old
- Parr: fish of more than one year old; a result of fish spawning in the catchment the previous year.

Summary of Survey Results

Habitats

Overall, the watercourses surveyed were recorded as being free of pollution and siltation, had no obstructions to the free movement of fish up or downstream, and all had some form of instream cover. With the exception of sampling point P 2, where a change in wet width and substrate type were recorded from 2014 onwards (the more recent figures are shown in brackets), there were no changes to the habitat characteristics and quality at any of the sampling points within the survey area or at the control point.

A summary of the results of the habitat surveys carried out in 2011-17 is provided in Table 2 below.

Table 2: Summary of the Fish Habitat Assessment Results

Site	Altitude (m)	Ave. depth range (cm)	Ave. wet width (m)	Subst-rate	% Silta-tion	Ave. canopy cover (%)	Main land use	No. obstruct-tions	No. pollution points	In-stream cover
Bg1	330	11-20	1.2	Pebble	0	0	Felled woodland	0	0	Good
Lg0	324	<10	1.3	Pebble	0	100	Conifer plantation	0	0	Moderate
Lg1	290	11-20	2.3	Pebble	0	0	Conifer plantation	0	0	Moderate
Lg10	189	21-30	2	Cobble	0	0	Rough pasture	0	0	Good
Lg13	174	21-30	2.1	Pebble	0	10	Rough pasture	0	0	Good
Ea0	326	11-20	1.9	Pebble	0	0	Conifer plantation	0	0	Moderate
Ea6	302	11-20	3.1	Pebble	0	30	Conifer plantation	0	0	Good
P2	207	21-30	1.5 (2)	Gravel (Cobble)	0	0	Conifer plantation	0	0	Good
K18	274	21-30	4.4	Pebble	0	0	Conifer plantation	0	0	Good
K28	225	21-30	5.4	Boulder	0	0	Conifer plantation	0	0	Good

Juvenile salmonids have specific habitat requirements such as high water quality, good food availability and shelter. The precise habitat requirements of each species and each life stage are often extremely complex. However, several general habitat features are considered to be important predictors of juvenile salmon numbers, including: depth, current, substrate and cover (Heggenes 1990). Salmon fry are associated with a water depth typically within the range 5-65 cm and a pebble and cobble substrate. A wide variety of cover types are used including deep/turbulent water, undercut banks, fallen logs, submerged or overhanging vegetation, rocks and other submerged objects. Salmon parr are typically associated with slightly faster water velocities, slightly deeper water (20-70cm), and slightly larger substrate size with cover also being important (Armstrong *et al*. 2003).

Electrofishing Surveys

The collated results of the electrofishing surveys at each sampling point relevant to the proposed development site are summarised in Table 3 below, the locations are shown on Figure 9.6.1. All sampling points, with the exception of one, were surveyed in each year from 2011 to 2017. Sampling point Lg 13 could not be accessed in 2017.

Table 3: Summary Electrofishing Results from Annual surveys, 2011 to 2017 (median and maximum densities [per 100m^2] of juvenile salmon and trout recorded at each site)

	Juvenile salmon densities				Juvenile trout densities			
	Fry (median)	Fry (max)	Parr (median)	Parr (max)	Fry (median)	Fry (max)	Parr (median)	Parr (max)
Bg 1	0.00	0.00	0.00	0.00	54.00	101.00	10.00	20.00
Lg 0	0.00	0.00	0.00	0.00	0.00	9.00	2.00	9.00
Lg 1	0.00	0.00	0.00	0.00	1.00	148.00	6.00	23.00

	Juvenile salmon densities				Juvenile trout densities			
	Fry (median)	Fry (max)	Parr (median)	Parr (max)	Fry (median)	Fry (max)	Parr (median)	Parr (max)
Lg 10	0.00	51.00	0.00	10.00	123.00	167.00	37.00	59.00
Lg 13*	0.00	171.00	2.00	13.00	106.50	180.00	28.00	76.00
Ea 0	0.00	0.00	0.00	0.00	5.00	62.00	5.00	17.00
Ea 6	0.00	26.00	0.00	2.00	74.00	113.00	11.00	16.00
P 2	0.00	2.00	0.00	2.00	124.00	162.00	26.00	41.00
P 8	28.00	71.00	6.00	17.00	106.00	192.00	29.00	37.00
K 18	0.00	5.00	2.00	9.00	34.00	68.00	15.00	18.00
K 28	4.00	10.00	3.00	6.00	42.00	123.00	11.00	26.00

**Site not surveyed in 2017*

The results of the electrofishing surveys confirm that all of the watercourses within the Clashindarroch II wind farm study area supported populations of juvenile trout, with relatively high median densities of fry and parr recorded at four of the sampling points on the Lag Burn / Priest's Water (Lg 10, Lg 13, P2 and P8). Comparatively low densities of trout fry and parr were recorded at most of the sampling points closest to the proposed development (i.e. Lg 0, Lg 1 and Ea 0). There were no sampling points located upstream of the existing or proposed watercourse crossings (see Figure 9.6.1) due to the general absence of suitable habitat. The near-by downstream sampling results also indicate that there is unlikely to be any important spawning or juvenile trout habitat above these locations.

Juvenile salmon were not recorded in any year at the sampling locations closest to the proposed development (i.e. Bg1, Ea 0, Lg 0, Lg 1). As was the case with trout, there were no sampling points located upstream of the existing or proposed watercourse crossings due to an absence of suitable habitat. Juvenile Salmon were recorded at all of the downstream sites on the Lag Burn / Priest's Water and Ealaiche Burn / Kirkney Water. The densities were generally much more variable from year-to-year in comparison to trout.

Pre- and Post-Construction Comparison

DBIRCT considered the pre- and post-construction data for Clashindarroch wind farm to determine if there was any evidence of an adverse effect on salmonid fish populations from the felling and construction works. Data from the control sites was used to account for natural and anthropogenic factors that can also influence variation in annual densities of juvenile salmonids. Pre-works surveys were completed during 2011 & 2012. Initial felling works associated with the wind farm construction began in June 2013. Full construction commenced in July 2013, continuing throughout 2014 and the windfarm officially opened in June 2015.

During 2016 three of the four sampling locations near to the operational wind farm site (i.e. Bg 1, Ea 0 and Ea 6) had decreases in trout fry when compared to the 2015 and pre-works baseline surveys. During 2017, the three sites close to the operational wind farm showed significant increases in trout fry, suggesting that the 2016 decline had no clear association with the construction or operation of the windfarm. The 2017 electrofishing and habitat data, collected 26 months after the windfarm became operational, confirmed that habitats within the Clashindarroch windfarm area and at the control sites were being consistently used by adult trout and salmon for spawning.

Conclusions

Salmonid fish population and habitat quality surveys were completed by DBIRCT over 7 years, from 2011 to 2017, at 21 sampling sites as part of the monitoring programme for the construction of Clashindarroch wind farm. The survey methods followed best practice guidance published by the Scottish Fisheries Coordination Centre (2007). It was agreed during the EIA scoping process that this extensive dataset would be adequate to also act as the baseline for the assessment of the Clashindarroch II wind farm proposals.

The surveys confirmed the presence of juvenile trout within all of the main watercourses draining the area that the proposed development would be located within. Densities of juvenile salmon were generally much lower and more variable than trout within the study area but all of the main watercourses also support populations of this species. There was no evidence of presence of juvenile salmon at the sampling points closest to the proposed development site. Habitat quality for spawning and juvenile salmonids is poor / absent at and above the existing and proposed watercourse crossing points for the wind farm access tracks.

The water quality and the characteristics of the watercourses within the study area appear to be stable, with no discernible changes over time to the categories that were assessed during the 2011-17 surveys.

DBIRCT concluded that there was no evidence, from the data collected, of any long-term adverse effect from the construction of Clashindarroch wind farm on the health of the salmonid fish populations within the catchments draining the area that the wind farm is located within.

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