

# FEARNA STORAGE

## **Fearna Pumped Storage Hydro Scheme EIA Report**

### **Chapter 11 – Aquatic Ecology**

**February 2025**



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## 11.1 Executive Summary

This Chapter considers the potential effects, including cumulative effects, of the Proposed Development on aquatic ecology (including fish fauna, fish habitat, freshwater pearl mussels *Margaritifera margaritifera*, macroinvertebrates and macrophytes) during the construction and operational phases.

The scope of the assessment was informed by scoping responses received from statutory and non-statutory consultees and further consultation undertaken after the formal scoping exercise as the design of the Proposed Development was developed in response to the findings of site surveys.

The assessment of effects within this Chapter is informed by desk based and field survey data. Baseline surveys were undertaken in accordance with relevant good practice guidelines between Spring 2023 and Summer 2024. Baseline water temperature monitoring is ongoing on Loch Quoich and the Gearr Garry having commenced in August 2024. Six months' worth of temperature monitoring data has been considered within this assessment based on the fullest amount of data available at the time of preparation of this report.

Where likely significant effects are predicted during construction and operation, appropriate mitigation measures are proposed to minimise the impact on the nature conservation feature, and the significant predicted residual effects are assessed.

The main conclusions from the impact assessment on aquatic ecology are described below. Potential significant adverse effects prior to mitigation have been identified on several of the important ecological features (IEF) during the construction phase:

### Construction Phase (before mitigation)

- Significant effects on Arctic charr were identified during the construction phase. These included water quality and quarrying (**Moderate, Significant**) and partial dewatering of Loch Quoich (**Major, Significant**).
- Significant effects on Atlantic salmon were identified during the construction phase. These included water quality, quarrying and construction lighting (**Moderate, Significant**).
- Significant effects on Brown trout (ferox trout) were identified during the construction phase. These included partial dewatering of Loch Quoich (**Major, Significant**) water quality and quarrying (**Moderate, Significant**).
- Significant effects on European Eel were identified during the construction phase. These included water quality, quarrying and construction lighting (**Moderate, Significant**).

### Operational Phase (before mitigation)

- Significant effects on Arctic charr were identified during the operational phase. These included Fluctuations in Water levels of Loch Quoich (**Major, Significant**).

### Construction Phase (after mitigation)

Following the implementation of mitigation measures, the residual effect on IEFs during the construction phase were as follows:

- Arctic charr: water quality, quarrying and partial dewatering of Loch Quoich (**Minor, Not Significant**).
- Atlantic salmon: water quality, quarrying and construction lighting (**Minor, Not Significant**).
- Brown trout (ferox trout): partial dewatering of Loch Quoich, water quality and quarrying (**Minor, Not Significant**).
- European Eel: water quality, quarrying, noise & vibration and construction lighting (**Minor, Not Significant**).

### Operational Phase (after mitigation)

Following the implementation of mitigation measures, the residual effect on IEFs during the operational phase were as follows:

- Arctic charr: Fluctuations in water levels of Loch Quoich (**Minor, Not Significant**).

## 11.2 Introduction

- 11.2.1 This Chapter considers the potential effects, including cumulative effects, of the Proposed Development on aquatic ecology during construction and operation.
- 11.2.2 Aquatic ecology survey work was commissioned to inform the Impact Assessment process for the Proposed Development. All surveys undertaken were done in accordance with the relevant Scoping Opinion responses. Surveys were undertaken in accordance with best practice guidelines and methodologies.
- 11.2.3 This Chapter is supported and informed by the following appendices:
- Appendix 11.1 – Fearna PSH Aquatic Ecology Surveys
  - Appendix 11.1.1 - Fearna PSH 2023 Loch Quoich eDNA survey report
  - Appendix 11.2 - Fearna Southern Access Route Aquatic Ecology Surveys
  - Appendix 11.3 - Loch Quoich & Gearr Garry Temperature Monitoring Investigation
  - Appendix 11.4 - Summary of conclusions of Prof. C Adams on Arctic charr
- 11.2.4 As detailed in **Chapter 2 - The Proposed Development**, with proper maintenance the Proposed Development should remain functional indefinitely. If the project were to be decommissioned, it is anticipated that the potential effects on aquatic ecology would be equal to [and/or] lesser than the construction impacts. As such, a separate assessment of potential decommissioning effects on aquatic ecology is not included in this Chapter. Where likely significant effects are predicted during construction and operation, appropriate mitigation measures are proposed, and the significance predicted residual effects are assessed.
- 11.2.5 This assessment has been carried out by Gavia Environmental Ltd. A table presenting relevant qualifications and experience of key staff involved in the preparation of this Chapter is included in **Appendix 1.1 - EIA Specialist Team**.

## 11.3 Scope of Assessment

### Study Area

- 11.3.1 The Study Area encompasses the area over which all desk-based and field data were gathered to inform the assessment presented in this Chapter. The Study Area comprises watercourses and waterbodies contained within and flowing into and out of the planning boundary area, as well as 'control' areas also covered within the red line boundary but outwith the area affected by the Proposed Development.
- 11.3.2 Field work was carried out in both the 'Upper Area' and 'Lower Area' of the Proposed Development and along the Proposed SAR. The 'Upper Area' includes both the Loch Fearna and Allt a' Mheil catchments. This area is affected by proposed dam infrastructure, proposed access tracks and inundation zones. The 'Lower Area' of the Proposed Development includes areas of Loch Quoich within the construction footprint and watercourses including the lower reaches of the Allt a' Mheil and Allt Fearna, potentially impacted by proposed access tracks and run off from construction activities taking place within the Upper Area. Field work in relation to the Proposed SAR was carried out on named watercourses appearing on 1:50,000 Ordnance Survey mapping, up to 100 m upstream and downstream of proposed crossing points.
- 11.3.3 The study area for the desk study is a 10 km radius from the Site boundary for international statutory designated sites, and a 2 km radius for protected and notable species records, national or local statutory designated sites, and non-statutory designated sites. For designated sites for aquatic features, hydrological connectivity is considered when assessing likely significant effect. Areas included are shown on **Figures 11.0.1.0**.

**Zone of Influence**

- 11.3.4 The 'zone of influence' for a project is the area over which ecological features may be affected by biophysical changes which may be a result of the Proposed Development and associated construction and operational activities. For aquatic features, this is likely to extend beyond the planning boundary, for example where there are ecological or hydrological links beyond the Site. The zone of influence will vary for different ecological features depending on their sensitivity to an environmental change. It may therefore be appropriate to identify different zones of influence for different features. The scoping exercise narrowed down the important ecological features. The zone of influence has been set for each one (see **Table 11.1** below).

Table 11.1 Zone of Influence - Important Ecological Features (IEFs)

| Important Ecological Feature              | Nature Conservation Level | Rationale for Selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Zone of Influence                                                                                                                                                                                                                                                           |
|-------------------------------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arctic charr<br><i>Salvelinus alpinus</i> | National                  | <p>Arctic charr are of National UK importance and are a UKBAP Priority species (added in 2007) considered to be 'Vulnerable' (most recent classification 2023').</p> <p>Scotland represents a stronghold for Arctic charr in Europe, with populations recorded in 258 lochs; although populations have undergone declines in recent years.</p> <p>Arctic charr are known to spawn between autumn / late winter / early spring<sup>2</sup>. Populations are known to primarily utilise loch marginal habitat however they have been recorded at a range of depths: 1-3 m (Lake Windemere); 15-20 m (Lake Windemere)<sup>3</sup>; and &lt;1.24 m (average of Irish loughs).</p> <p>Specific populations in Scotland occasionally spawn in riverine habitat.</p> | Affected areas of Loch Quoich (during construction and operation), Loch Poulary and Loch Garry (during construction).                                                                                                                                                       |
| Atlantic salmon<br><i>Salmo salar</i>     | National                  | <p>Atlantic salmon have been reclassified from 'Least Concern' to 'Endangered' in Great Britain (as a result of a 30-50% decline in British populations since 2006 and 50-80% projected between 2010-2025), and from 'Least Concern' to 'Near Threatened' in terms of global populations (as a result of global populations declines of 23% since 2006). Atlantic</p>                                                                                                                                                                                                                                                                                                                                                                                         | <p>Affected areas of Loch Poulary, Loch Garry and tributaries crossed by the proposed access track. There are no migratory fish above Quoich Dam.</p> <p>Atlantic salmon were recorded in the Allt Choire a' Bhalachain, Greenfield Burn, River Kingie and River Enrick</p> |

<sup>1</sup> Nunn, A. D., Ainsworth, R. F., Walton, S., Bean, C. W., Hatton-Ellis, T. W., Brown, A., Evans, R., Atterborne, A., Ottewell, D., Noble, R. A. A. (2023). Extinction risk and threats facing the freshwater fishes of Britain. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 1-17.

<sup>2</sup> Klemetsen, A., Amundsen, P. A., Dempson, J. B., Jonsson, B., Jonsson, N., O'Connell, M. F. and Mortensen, E. (2003). Atlantic salmon *Salmo salar* L., brown trout *Salmo trutta* L. and Arctic charr *Salvelinus alpinus* (L.): a review of aspects of their life histories. *Ecology of Freshwater Fish*. 12: 1-59.

<sup>3</sup> Frost, W.E. (1965). Breeding habits of Windermere charr, *Salvelinus willughbii* (Günther) and their bearing on speciation of these fish. *Proceedings of the Royal Society, Series B*. 163(473). pp. 232-284.

| Important Ecological Feature                                                   | Nature Conservation Level | Rationale for Selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Zone of Influence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                |                           | salmon make use of riverine habitat for refuge, spawning and nursery areas for juvenile fish.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | during electrofishing survey work carried out by the Ness District Salmon Fishery Board in 2018 and 2023.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Brown trout<br><i>Salmo trutta</i>                                             | Local                     | <p>Brown trout are a UKBAP priority species and listed as of National UK importance (JNCC, 2007). Small, isolated populations of resident brown trout are widespread in upland lochs, streams and rivers in the Highland region, and Scotland.</p> <p>Brown trout are predominantly recorded utilising riverine and marginal habitats, and a combination of both to spawn. They are more likely to spawn in rivers than other salmonids (i.e. Arctic charr).</p>                                                                                                   | <p>Affected watercourses crossed by the proposed access track, Loch Poulary, Loch Garry, Loch Quoich and its tributaries (Allt Fearna &amp; unnamed watercourses). Brown trout are considered absent from Loch Fearna, its tributaries and tributaries within the Coire Dubh area affected by the Proposed Development based on electrofishing results and consultation with the land owners and Ness District Salmon Fishery Board regarding Loch Fearna.</p> <p>Brown trout were recorded in the Allt Fionn-dhail, Allt Choire a' Bhalachain, Greenfield Burn, River Kingie, River Enrick during electrofishing survey work carried out by the Ness District Salmon Fishery Board in 2018 and 2023 and in the River Allt Fearna near the confluence with Loch Quoich during survey work carried out by Gavia Environmental in 2023.</p> |
| Brown trout (ferox)<br><i>Salmo trutta</i><br>(Previously <i>Salmo ferox</i> ) | National                  | <p>Ferox trout, as <i>Salmo trutta</i>, are considered of National UK importance and a UKBAP priority species, however, are not specifically mentioned despite being of increased conservation concern due to smaller population densities and occurrence in Scottish Lochs. Location and preferences of ferox brown trout is not well established.</p> <p>Ferox trout are listed on the IUCN red list as 'data deficient'.</p> <p>Loch Quoich is referred to as one of the main Ferox Lochs in Scotland at the time of writing in Williams, 2020.<sup>4</sup></p> | Affected areas of Loch Quoich (during construction and operation) and Loch Garry (during construction).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

<sup>4</sup> Williams. P., (2020) The Post Glacial Relict Salmonids: Charr, Schelly and Ferox Trout in UK waters. Self Published ISBN 978-0-9957216-8-5

| Important Ecological Feature             | Nature Conservation Level | Rationale for Selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Zone of Influence                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| European Eel<br><i>Anguilla anguilla</i> | International             | <p>The status of European eel is of International importance and listed as critically endangered on the IUCN Red List and under Annex V of the OSPAR convention due to recruitment reaching 1-5% of historical figures (IUCN, 2022; OSPAR Commission, 2022).</p> <p>Nationally, European eels are considered a UKBAP priority species (JNCC, 2007), present on the Scottish Biodiversity List (NatureScot, 2020) and designated a Priority Marine Feature where they are considered to be a marine nature conservation priority in Scottish waters. European eel management plans have also been developed by Marine Scotland Science in compliance with Council Regulation (EC) (No 1100/2007) to establish measures for the recovery of the species (Marine Scotland, 2020). Young European eels, or elvers, run into the river in May and June. Silver eels (sexually mature) migrate to sea between August and December.</p> | <p>Affected areas of the Gearr Garry / Loch Poulary / Loch Garry and its tributaries crossed by the proposed access track. There are no migratory fish above Quoich Dam.</p> <p>European eel were recorded in the River Kingie during electrofishing survey work carried out by the Ness District Salmon Fishery Board in 2023.</p> |
| Macroinvertebrates                       | Local                     | All macroinvertebrates have been scoped out of this assessment except where they are present as a food source for other IEFs. This is due to no species of high conservation interest being recorded during field studies. Species recorded were dominated by common and widespread taxa, typical of a range of habitat types.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | All affected watercourses crossed by the proposed access track and within the footprint of the proposed development and marginal loch areas.                                                                                                                                                                                        |
| Macrophytes (higher plants)              | Local                     | Macrophytes support large macroinvertebrate populations. Consideration needs to be given to biosecurity measures if there are any invasive non-native species (INNS) found to be present.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Affected areas of Loch Fearn.                                                                                                                                                                                                                                                                                                       |

- 11.3.5 To inform the scope of the assessment for the Proposed Development, consultation was undertaken with statutory and non-statutory bodies. Table 11.2 summarises the scoping and consultation responses relevant to the Landscape and Visual Assessment and provides information on where and/or how points raised have been addressed in this assessment.
- 11.3.6 Full details on the consultation responses and scoping opinion can be reviewed in Chapter 5: Scoping and Consultation, and associated appendices.

**Table 11.2 Consultation Responses**

| Consultee Reference | Subject                                         | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                  |
|---------------------|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| THC-43              | Ecology - aquatic interests within watercourses | The EIAR needs to address the aquatic interests within local watercourses, including downstream interests that may be affected by the development, for example increases in silt and sediment loads resulting from construction works; pollution risk/incidents during construction; obstruction to upstream and downstream migration both during and after construction; disturbance of spawning beds/timing of works; and other drainage issues. The EIAR should evidence consultation input from the local fishery board(s) where relevant.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Effects during both the construction and operational phases on aquatic ecology are addressed throughout the <b>EIAR Chapter 11: Aquatic Ecology</b> .<br><br>Consultation responses from Ness District Salmon Fishery Board and response / actions taken are also included.                                                                                            |
| NDSFB-01            | Concerns re potential temperature changes       | One of Ness DSFB's main concerns is that PSH schemes have the potential to affect water temperatures in both the upper and lower reservoirs (Bonalmi, et.al, 2012, Harby et al., 2013). PSH has the potential to influence water temperatures through frictional losses during generation and pumping, and by solar radiation transfer e.g. when an empty upper reservoir is filling on a sunny day, and to disrupt thermocline formation and stability. Thermal changes could occur in the opposite direction when upper reservoirs are filled during cold weather. The potential for thermal impacts are high for the Fearna Scheme due to the size of the scheme in relation to the lower reservoir volume. The estimated maximum volume of Loch Quoich is 658M m <sup>3</sup> (when reservoir full), and the Fearna Scheme has the capacity to pump 40Mm <sup>3</sup> over a 24hour period. This is equivalent to 6.1% of the volume of Loch Quoich, meaning that the entire volume of Quoich could be turned over in 16 days. Loch Quoich is rarely full so in reality the turnover time is likely to be less than 14days. Due to the complex topography of Loch Quoich, with potentially limited internal circulation, water close to the offtake will be subject to repeated pumping and generation cycles, potentially resulting in enhanced localised temperatures changes. | Long-term temperature monitoring of Loch Quoich is being carried out at two locations, with sensors placed at different water depths at each location.<br><br>An assessment of the effects of temperature changes associated with the Proposed Development is discussed within <b>EIAR Chapter 11: Aquatic Ecology</b> .                                               |
| NDSFB-02            | Concerns re potential temperature changes       | Concerns about temperatures in Loch Quoich stem from the fact that despite good habitat, and a diverse and abundant invertebrate population, the Gearr Garry (efferent river from Loch Quoich) remains effectively salmon-less. Ness DSFB have been investigating why, and one potential cause may be water temperatures. The entire flow in the Gearr Garry is derived from compensation flows delivered through a valve drawing from the bottom of Loch Quoich. The temperature profile many metres below the reservoir surface is likely to be quite different to those at the surface of the reservoir, in particular during periods when the loch is stratified. Monitoring in autumn 2022 found that water temperatures in the Gearr Garry remained <b>too high for successful salmon spawning</b> throughout the normal spawning season. Subsequent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Long-term temperature monitoring is being carried out on the Gearr Garry simultaneously with the temperature monitoring being carried out on Loch Quoich.<br><br>This will identify any effects of the compensation flow from Loch Quoich on temperature in the Gearr Garry and also the effect of the Quoich Power Station outflow on temperature in the Gearr Garry. |

| Consultee Reference | Subject                         | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     |                                 | monitoring in autumn 2023 found that the high temperatures of the previous year were not repeated. This may cast doubt on the veracity of the 2022 data however, autumn 2023 was much cooler than the previous year. In order to understand this issue, we would expect the developers to commission a study to report on potential impacts of the Fearna scheme on the water temperature profile of Loch Quoich, and on the temperature profile of the compensation flow in the Gearr Garry.                                                                                                                                  | An assessment of the effects of temperature changes associated with the Proposed Development is discussed within <b>EIAR Chapter 11: Aquatic Ecology</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| NDSFB-03            | Surface water intake suggestion | Mitigation measures for this issue could include the installation of a surface water intake for the compensation flow delivered to the Gearr Garry. The design and installation of such a device should be well within the engineering capabilities of the Fearna PSH scheme and could result in significant benefits to the ecology of the Gearr Garry.                                                                                                                                                                                                                                                                       | Mitigation for temperature effects will be informed by the results of the temperature monitoring work and reported in <b>EIAR Chapter 11: Aquatic Ecology</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| NDSFB-05            | Design of SAR                   | Para 1.2.5: The preferred access route for the Fearna PSH development, the Southern Access Route (SAR), crosses most of the Upper Garry tributaries, including the River Kingie and Gearr Garry. Many of these tributaries support salmon populations, although often restricted to the lower reaches. The Kingie and Gearr Garry, are core salmon habitat. The development of SAR will require considerable upgrades to existing forestry tracks, involving many new river crossings. Fish migration issues, and the ongoing management of road run-off, will require careful design and construction, as well as monitoring. | <p>Effects relating to the SAR are assessed under construction phase effects within <b>EIAR Chapter 11: Aquatic Ecology</b>.</p> <p>A Construction Environmental Management Document (CEMD) which would include a Pollution Prevention Plan (PPP), Dust Mitigation Plan and Surface Water Quality Monitoring Programme (SWQMP) would be implemented by the Principal Contractor and best practice measures will be overseen by a suitably experienced Ecological Clerk of Works (ECOW). A water quality sampling programme would be designed to cover likely present pollutants and undertaken at a timescale to allow sufficient actions to be taken in the case of pollution incidents.</p> <p>Aquatic elements will be incorporated into the Construction Noise and Vibration Management Plan (CNVMP) to ensure noise and vibration limits are not in excess of limits capable of causing injury and/or mortality to fishes.</p> |

| Consultee Reference | Subject                                    | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NDSFB-08            | Fish assessments                           | Para 11.1.3 Ness DSFB welcome the detailed fish assessment carried out in 2023. This needs to include eDNA profiling of Loch Fearn, and Quoich, to establish the species present. Long-term monitoring will need to be established to understand the impact of the scheme on fish populations present within the lochs, such as the Arctic charr population in Loch Quoich. Monitoring of Arctic charr, with sufficient power to be able to detect changes in population status, will require careful design and implementation. | Effects on Arctic charr within Loch Quoich are discussed in <b>EIAR Chapter 11: Aquatic Ecology</b> .<br><br>Ness DSFB confirmed via more recent correspondence (20/08/2024) that they are satisfied Loch Fearn is 'fishless'.<br><br>Initial eDNA survey results are included within <b>Appendix 11.1 - Fearn Aquatic Ecology Surveys</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| NDSFB-09            | Invertebrate diversity indices methodology | Para 11.5.1 We are not familiar with the invertebrate diversity indices provided. This section is confusingly written. We suspect the diversity indices are actually abundance figures, and that the taxonomic definitions provided in 11.5.2 are incorrect. We expect the issue of invertebrates to be handled with much great clarity and accuracy, in the EIA.                                                                                                                                                                | Effects on Macroinvertebrates are discussed in <b>EIAR Chapter 11: Aquatic Ecology</b> .<br><br>Macroinvertebrate indices are provided in the Appendices: <b>Appendices: 11.1 - Fearn PSH Aquatic Ecology Surveys</b> and <b>11.2 – Fearn Southern Access Route (SAR) Aquatic Ecology Surveys</b> . A comprehensive suite of biotic indices for each survey location provides:<br><br><ul style="list-style-type: none"> <li>• BMWP - Biological Monitoring Working Party Score</li> <li>• NTAXA (TL1 and TL2) - Count of BMWP family taxa in the sample</li> <li>• ASPT (TL1 and TL2) - Average score per (BMWP/WHPT) taxon</li> <li>• LIFE (TL5 and TL2) - Lotic-Invertebrate index for Flow Evaluation</li> <li>• PSI (TL5 and TL3) - Proportion of Sediment-sensitive Invertebrates</li> </ul> |

| Consultee Reference | Subject                                                            | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Response/Action Taken                                                                                                                                                                                                                                                                                                                                        |
|---------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     |                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>• E-PSI (FAM and TL5) - Empirically Weighted Proportion of Sediment-sensitive Invertebrates Index</li> <li>• CCI (TL5) - Community Conservation Index (TL5 only)</li> <li>• WHPT (TL2) - Whalley-Hawkes-Paisley-Trigg index</li> </ul>                                                                                |
| NDSFB-10            | Recommended use of CREW methodology for fish population assessment | Para 11.8.1 The Centre of Expertise for Water (CREW) recently organised a workshop on Methodologies for Sampling Fish Populations in Scottish Freshwater Lochs. The report from this workshop will be published in the near future. This report should guide the fish population assessment and monitoring requirements for the Fearna PSH.                                                                                                                                                                                                                                                                                                                                                                                               | The developer has sought expert guidance from Dr Nathan P. Griffiths, one of the lead authors of the CREW paper for the most appropriate survey methodologies in relation to eDNA as well as Professor Colin Adams, an expert in Arctic charr ecology for further advice.                                                                                    |
| NDSFB-11            | Effects on inundated peat deposits                                 | Para 12.3.1 The construction and operation of the Proposed Development has the potential to impact peat deposits. Regular cycles of inundation, and draining, which are normal features of PSH operation will degrade and destroy peat, and other soil deposits, within the inundation area of the upper reservoir. What management is proposed for peats and soils in the inundation zone? Will peats be stripped from this area, for re-use elsewhere? Non-removal means that degraded peats and soils would fragment and be entrained within pumped water, potentially polluting Loch Quoich. Ness DSFB request that the EIA details how peat/erodible soil deposits within the inundated area of the upper reservoir will be managed. | The vast majority of peat would be removed from the Fearna reservoir inundation area as part of the creation of the borrow pits to generate rock to build the dams. This is described in <b>Chapter 2: The Proposed Development</b> .                                                                                                                        |
| NDSFB-12            | Water temperature changes                                          | Para 12.3.1 The Scoping report does not list potential changes in water temperature as a potential significant effect during operation. Ness DSFB disagree and request that a comprehensive study be commissioned to investigate the potential for water temperature changes in the upper, and lower reservoirs, and efferent river. This study should consider long and short-term changes, and the implications of climate change. Dependent on the study findings, regulatory guidance may need to be development to manage PSH thermal impacts.                                                                                                                                                                                       | <p>Long-term temperature monitoring of Loch Quoich and the Gearr Garry is being carried out simultaneously. This will inform an assessment of the effects of the Proposed Development.</p> <p>An assessment of the effects of temperature changes associated with the Proposed Development are discussed within <b>EIAR Chapter 11: Aquatic Ecology</b>.</p> |
| NDSFB-13            | Water quality monitoring                                           | Para 12.4.6 Ness DSFB agree that water quality monitoring will be required prior to, during and post construction if the project were it to be granted planning permission, and this would be specified in the assessment. However, adequate baseline data must                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Long-term temperature monitoring is being carried out on the Gearr Garry simultaneously with the                                                                                                                                                                                                                                                             |

| Consultee Reference | Subject                                        | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                                                                           |
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|                     |                                                | be gathered so that changes arising from the Fearna PSH scheme can be assessed. Water quality includes physio-chemical characteristics such as thermal status. It is important that water temperate data from within Loch Quoich, and in the efferent Garry Garry, is collected for an adequate period of time pre-construction, so that natural inter-annual variation can be established.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | temperature monitoring being carried out on Loch Quoich.<br><br>A water quality monitoring programme will be developed in line with Scottish Government Marine Directorate – Science Evidence Data and Digital (MD– SEDD) guidelines <sup>5</sup> . Baseline monitoring will be carried out at least 12 months prior to construction commencing, during construction and for at least 12 months after construction is complete. |
| NDSFB-15            | Timing of construction drawdown of Loch Quoich | 19.4.4. Ness DSFB understand that SSER are joint venture partners with Gilkes in the development of the Fearna PSH scheme. As such we could expect there to be close cooperation between the operation of the existing Quoich Hydro scheme and the proposed Fearna PSH scheme. We note that a temporary draw down on Loch Quoich may be required to allow the installation of the lower inlet/outlet structure within Loch Quoich. Maintenance of the existing compensation flow arrangements are essential for the ecology of the upper Garry. Due to hydro regulation, natural flow variability in the downstream catchment has largely disappeared. Consequently, generation at Quoich Power station, and Invergarry PS, are highly significant for the sustainability, and viability, of salmon fisheries in the River Garry and Oich. A compounding factor here is abstraction by the Caledonian Canal, at both Culloch locks and at the Laggan end of Loch Oich, which reduces the flow in the River Oich. The Garry & Oich, are mainly spring fisheries and low flows this spring, in particular, have a severe impact on those fisheries. The most critical time for flows for these fisheries is the spring period Feb to May, as this is when most of the salmon population run into that part of the catchment. |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| NDSFB-17            | Timing of construction drawdown of Loch Quoich | In order to avoid any additional stress on the availability of water in the spring Ness DSFB request that if a temporary drawdown on Loch Quoich is required to allow the installation of the lower inlet/outlet structure in the loch, then this should not occur in the spring. The most natural period for such a drawdown would be the summer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | As above comment re timing.                                                                                                                                                                                                                                                                                                                                                                                                     |

<sup>5</sup>Scottish Government (2021) Monitoring watercourses in relation to onshore wind farm developments: generic monitoring programme [Online] Available: [Monitoring watercourses in relation to onshore wind farm developments: generic monitoring programme - gov.scot](https://www.gov.scot/publications/monitoring-watercourses-in-relation-to-onshore-wind-farm-developments-generic-monitoring-programme/pages/2.aspx)

| Consultee Reference | Subject                                        | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| NDSFB-18            | Mitigation for wild salmon                     | Considering the statements made within the recently published Scottish Wild Salmon Strategy it is clear that the Scottish Government considers the iconic Scottish Wild salmon to be in crisis. The downstream impacts of the proposed Fearna PSH on the Garry/Ness salmon populations need to be fully understood, and mitigated if required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No anticipated likely effects on Atlantic salmon from the construction / operation of the Fearna PSH.<br><br>Effects on Atlantic salmon relating to the Southern Access Route (SAR) are assessed in <b>EIAR Chapter 11: Aquatic Ecology</b> .                                                                                                                                                                                                                   |
| RSPB-16             | Potential effects on macroinvertebrates        | The Aquatic Ecology section of the Scoping Report suggests that the dewatering, water level fluctuations or pollution of Loch Fearna will affect the macroinvertebrate populations and predator/prey interactions with a negative effect on fish populations. However, this should also be considered for waterbird populations such as Common Scoter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Effects on aquatic invertebrates in Loch Fearna are covered in the EIAR <b>Chapter 11 – Aquatic Ecology</b> . The knock-on effects on ornithological interests are assessed in <b>Chapter 10 – Ornithology</b> .                                                                                                                                                                                                                                                |
| RSPB-17             | Potential effects of water temperature changes | Assessment of the indirect impacts on the West Inverness-shire Lochs SPA Common Scoter population through changes in water temperature and resulting impacts on invertebrate food as far down the catchment as Loch Garry should also be included in the EIAR.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | An assessment of the effects of temperature changes associated with the Proposed Development are discussed within <b>EIAR Chapter 11: Aquatic Ecology</b> .                                                                                                                                                                                                                                                                                                     |
| GGCC-17             | Section 11. Aquatic Ecology                    | <p>11.2.2: We welcome the chance to be asked for aquatic data. There is much local knowledge regarding the fish and fishing on and around the river Garry. We are aware that the Ness District Salmon Fishery Board (NDSFB) is desperately trying to revive the virtually non-existent Salmon stocks within the rivers Garry and Kingie, by 'seeding' the Kingie. We therefore request that an aquatic assessment is made of the impact of the tracks, roads and bridges over the Kingie and Garry. Further, as we understand it, the NDSFB is responsible for the river Garry system (not the Lochaber District Salmon Fisheries Board). NDSFB should be added to the list of consultees.</p> <p>11.2.6: We are disappointed to note that the fact existing dams have ruined the fish ecology is being used to justify another dam. One quote from the Inverness Courier (1/4/2024): "Loch Quoich is already a degraded environment, a consequence of the construction of a large dam at its outlet in the 1950s. Salmon have been denied access ever since the loch was dammed and the shoreline is regularly subject to large variations in the water level".</p> <p>The Salmon heck at Kingie is now disused because there are no Salmon. The</p> | <p>Potential effects on fish species within the Kingie and Garry relating to the Southern Access Route (SAR) are assessed in <b>EIAR Chapter 11: Aquatic Ecology</b>.</p> <p>Where these impact on ornithological interests, they are assessed in <b>Chapter 10 – Ornithology</b>.</p> <p>The Proposed Development plans a number of biodiversity enhancement measures which would improve habitats for salmon. These are described in Appendix 8.7: OBEMP.</p> |

| Consultee Reference | Subject                                     | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|                     |                                             | unintended consequences of dams are not necessarily known until well after they are built.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| BUG-01              | Proposed scope of macroinvertebrate surveys | <p>The Scoping Report has determined that the Fearna Pumped Storage Hydro Project could result in potentially significant effects to aquatic ecology in Loch Fearn and Loch Quoich. Some of the possible impacts to macroinvertebrates include the effects of drawdown (with the resulting loss of habitat suitability), direct mortality and increased risk of invasive species. Impacts of drawdown are of particular concern. Different invertebrate species have varying degrees of tolerance to water fluctuations making it vital that adequate surveys are undertaken to understand the invertebrate communities that are present to be able to determine the magnitude of impacts. The Scoping Report states that “The water level of Loch Fearn would fluctuate over a range of 60m”. This is an incredibly high range and Buglife asks for clarification if this is correct?</p> <p>Some macroinvertebrate surveys have already been undertaken but the Scoping Report does not provide details of methodology or where samples were undertaken. Buglife would like to query the figures that state “The diversity of taxa was stable and relatively high ranging from 669 to 200 in the proposed upper reservoir (Loch Fearn and tributaries)”. 669 taxa is an incredibly high figure so clarification is needed on if this is what was recorded or a possible abundance number.</p> | <p>Effects on Macroinvertebrates are discussed in <b>EIAR Chapter 11: Aquatic Ecology</b>.</p> <p>Macroinvertebrate survey methodologies, survey locations and indices are provided in the <b>Appendices: 11.1 – Fearn PSH Aquatic Ecology Surveys</b> and <b>11.2 – Fearn Southern Access Route (SAR) Aquatic Ecology Surveys</b>. A comprehensive suite of biotic indices for each survey location provides:</p> <ul style="list-style-type: none"> <li>• BMWP - Biological Monitoring Working Party Score</li> <li>• NTAXA (TL1 and TL2) - Count of BMWP family taxa in the sample</li> <li>• ASPT (TL1 and TL2) - Average score per (BMWP/WHPT) taxon</li> <li>• LIFE (TL5 and TL2) - Lotic-Invertebrate index for Flow Evaluation</li> <li>• PSI (TL5 and TL3) - Proportion of Sediment-sensitive Invertebrates</li> <li>• E-PSI (FAM and TL5) - Empirically Weighted Proportion of Sediment-sensitive Invertebrates Index</li> <li>• CCI (TL5) - Community Conservation Index (TL5 only)</li> </ul> |

| Consultee Reference | Subject                                     | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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|                     |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• WHPT (TL2) - Whalley-Hawkes-Paisley-Trigg index</li> </ul> <p>Buglife is correct to query the 'diversity of taxa' numbers reported in the Scoping report as these are the combined total abundances at each survey location rather than n-taxa values. Full results and discussion are provided in <b>Appendices: 11.1 – Fearna PSH Aquatic Ecology Surveys</b> and <b>11.2 – Fearna Southern Access Route (SAR) Aquatic Ecology Surveys</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| BUG-02              | Proposed scope of macroinvertebrate surveys | <p>Buglife welcomes that further surveys are proposed for macroinvertebrates. These surveys must be comprehensive to ensure a full understanding of impacts. The number of sampling locations should ensure that adequate coverage is achieved of the shorelines of both lochs where drawdown impacts are predicted.</p> <p>Surveys must also ensure they capture seasonal variation to cover the most detectable life stages of species groups such as caddisflies and mayflies. Some useful references to design appropriate surveys are 'Handbook of Conservation Methods'<sup>1</sup>, 'Freshwater Biology and Ecology Handbook'<sup>2</sup> and 'Organising surveys to determine site quality for invertebrates'.<sup>3</sup></p> <p>The Community Conservation Index (CCI)<sup>4</sup> should then be used to determine the conservation value of the affected areas. Buglife recommend that it is key to identify taxa that are intolerant of excessive water fluctuations, as this will be one of the main effects of the scheme.</p> | <p>Further surveys of terrestrial invertebrates were carried out in 2024 and are reported and assessed in the <b>EIAR Chapter 8 – Terrestrial Ecology</b>.</p> <p>Effects on Macroinvertebrates are discussed in <b>EIAR Chapter 11: Aquatic Ecology</b>.</p> <p>Macroinvertebrates samples in lotic environments were collected using the standard SEPA and Environment Agency kick sampling method. The macroinvertebrate sample was collected using a standard Freshwater Biological Association Pond net (mesh diameter 1.0 x 1.0mm). In lentic water systems such as Loch Quoich and Loch Fearna, sweep sampling was the preferred method of sampling. This relied on a disturbance of the substrate and then a sweeping like motion in a figure of eight of the pond net through the water column to collect the sample (Chadd, 2010). Sampling was conducted in Spring 2023 (Fearna PSH) and Autumn 2023 (SAR).</p> <p>A comprehensive suite of biotic indices for each survey location includes the Community Conservation Index (CCI).</p> |

| Consultee Reference | Subject | Issue Raised                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Response/Action Taken                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| BUG-04              |         | If it is possible, we would really value viewing the full taxa lists for the aquatic invertebrate surveys that are mentioned as Appendix K & L. Also, do you have information on the locations of the surveys?                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Full taxa lists are provided in the Appendices: 11.1 – Fearna PSH Aquatic Ecology Surveys and 11.2 – Fearna Southern Access Route (SAR) Aquatic Ecology Surveys.                                                                                                                                                                                                                                                                              |
| BUG-05              |         | As we highlighted in our scoping comments, it is very important that for a full assessment of impacts that the surveys are comprehensive, with the Lochs that have extensive shoreline habitats requiring several sampling locations. Buglife understands it is likely to be the aquatic invertebrate communities in the Lochs that would be most impacted by proposals from the impacts of drawdown. I am unsure if further surveys are planned this year to ensure seasonal variation is also captured? I would also reiterate from our comments that it is important the methodology for surveys and assessment used for the Lochs is appropriate for standing water habitat. | A 3-minute kick / sweep sampling methodology followed by a manual hand search is employed for standing waters. This relied on a disturbance of the substrate and then a sweeping like motion in a figure of eight of the pond net through the water column to collect the sample (Chadd, 2010).<br><br>All macroinvertebrate samples were collected using a standard Freshwater Biological Association pond net (mesh diameter 1.0 x 1.0 mm). |

THC = The Highland Council

ECU = Scottish Government Energy Consents Unit

NS = Naturescot

NDSFB = Ness District Salmon Fisheries Board

GGCC = Glen Garry Community Council

BUG = Buglife

### Issues Scoped out of Assessment

- 11.3.7 Ecological features have been scoped out of further assessment where the feature does not have a level of nature conservation at a local level or above, where there is no potential for significant effect upon the features or it is not subject to legal protection.
- 11.3.8 No invasive non-native macrophyte species (INNS) were identified during the field surveys carried out in August 2024. All macrophyte species recorded were considered common and widespread taxa, typical of highland Scottish lochs.
- 11.3.9 Naturescot suggested there was a possibility that freshwater pearl mussels *Margaritifera margaritifera* (FWPM) could be present in the River Kingie and Gearr Garry and advised that a stretch 50m upstream and 200m down stream of any in-river works or for works which could affect water quality should be surveyed. No FWPM were recorded during subsequent field survey work carried out by Ness District Salmon Fishery Board in 2024. Naturescot also advised that FWPM did not need to be considered above Quoich Dam. FWPM are therefore scoped out of this assessment.

## 11.4 Legislation, Policy and Guidance

### Legislative Context

- 11.4.1 The following legislation has been considered in the assessment:
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora;
  - Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy - the 'Water Framework Directive' (WFD);
  - The Conservation (Natural Habitats, &c.) Regulations 1994 (The Habitat Regulations) as amended in Scotland;
  - The Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003;
  - Wildlife and Countryside Act 1981 (as amended) (the 'WCA');
  - Nature Conservation (Scotland) Act 2004 (as amended);
  - Wildlife and Natural Environment (Scotland) Act 2011 (as amended);
  - Planning (Scotland) Act 2019;
  - Regulation 1143/2014 on invasive alien species (the Invasive Species Regulation) (as amended in Scotland); and
  - Reservoirs (Scotland) Act 2011.

### Policy Context

- 11.4.2 The following policy has been considered in the assessment:
- National Planning Framework 4 (NPF4) (2023)<sup>6</sup>;
  - Highland-wide Local Development Plan (2012): Policies 28 (Sustainable Design); 59 (Other important species); 60 (Other Important Habitats); 63 (Water Environment); 67 (Renewable Energy Developments)<sup>7</sup>; and

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<sup>6</sup> Scottish Government. (2023). National Planning Framework 4. [Online] Available at: <https://www.gov.scot/publications/national-planning-framework-4/> [Accessed in August 2023].

<sup>7</sup> The Highland Council. (2022). Highland Wide Local Development Plan April 2012. [Online] Available at: [https://www.highland.gov.uk/info/178/development\\_plans/199/highland-wide\\_local\\_development\\_plan](https://www.highland.gov.uk/info/178/development_plans/199/highland-wide_local_development_plan) [Accessed in August 2023].

- Highland's Statutory Protected Species Supplementary Guidance<sup>8</sup>.

### Technical Guidance

11.4.3 The following technical guidance has been considered in the assessment:

- Circular 1/2017: Environmental Impact Assessment Regulations<sup>9</sup>;
- CIEEM (2018, amended 2022) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester<sup>10</sup>;
- Environment Agency (2005) Screening for Intake and Outfalls: a best practice guide<sup>11</sup>;
- Highland Nature: Biodiversity Action Plan 2021 – 2026<sup>12</sup>;
- SEPA (2010) Engineering in the water environment: good practice guide River crossings Second edition, November 2010<sup>13</sup>; and
- SEPA (2017) Guidance for Pollution Prevention (GPPs)<sup>14</sup>.

## 11.5 Methodology

### Desk Study

11.5.1 In order to anticipate the potential ecological sensitivities on aquatic features associated with the Proposed Development, a desk study was conducted in advance of the field surveys. This included a review of:

- NatureScot (2023) Sitelink for existing data on designated sites within 10 km (international and national conservation designation) and 2 km (local designations)<sup>15</sup>;
- Scotland's Environment Web (2023) for data on obstacles to fish migration<sup>16</sup>;
- SEPA Water Classification Hub (2023) for river classifications<sup>17</sup>;
- UK Lakes Portal (2024) for information regarding Loch Fearn, Loch Quoich and Loch Garry<sup>18</sup>;

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<sup>8</sup> The Highland Council. (2013). *Highland Statutorily Protected Species Supplementary Guidance*. [Online] Available at: [https://www.highland.gov.uk/downloads/file/3026/highland\\_statutorily\\_protected\\_species\\_supplementary\\_guidance](https://www.highland.gov.uk/downloads/file/3026/highland_statutorily_protected_species_supplementary_guidance) [Accessed in August 2023].

<sup>9</sup> Scottish Government. (2017). Planning Circular 1/2017: Environmental Impact Assessment regulations. [Online] Available at: <https://www.gov.scot/publications/planning-circular-1-2017-environmental-impact-assessment-regulations-2017/>

<sup>10</sup> CIEEM. (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland. [Online] Available at: <https://cieem.net/wp-content/uploads/2018/08/ECIA-Guidelines-2018-Terrestrial-Freshwater-Coastal-and-Marine-V1.2-April-22-Compressed.pdf> [Accessed in August 2023].

<sup>11</sup> Environment Agency. (2005). Screening for Intake and Outfalls: a best practice guide. [Online] Available at: <https://assets.publishing.service.gov.uk/media/5a7c9293ed915d6969f45d2d/scho0205bioc-e-e.pdf> [Accessed in August 2024].

<sup>12</sup> Highland Nature Biodiversity Action Plan. [Online] Available at: <https://www.highlandenvironmentforum.info/biodiversity/action-plan/> [Accessed in August 2024].

<sup>13</sup> SEPA. (2010). Engineering in the water environment: good practice guide. River Crossings. 2<sup>nd</sup> Eds. [Online] Available at: <https://www.sepa.org.uk/media/151036/wat-sg-25.pdf> [Accessed in August 2024].

<sup>14</sup> SEPA. (2017). Guidance for Pollution Prevention and Control (PPC) Technical Guidance. [Online] Available at: <https://www.sepa.org.uk/media/335958/ied-ppc-tg4-ppc-part-a-practical-guide.pdf> [Accessed in August 2024].

<sup>15</sup> NatureScot. (2023). Sitelink. [Online] Available at: <https://sitelink.nature.scot/map> [Accessed in August 2023].

<sup>16</sup> Scotland's Environment Web. (2023). Scotland's Environment Map. [Online] Available at: <https://map.environment.gov.scot/sewebmap/> [Accessed in August 2024].

<sup>17</sup> SEPA. (2023). Water Classification Hub. [Online] Available at: <https://www.sepa.org.uk/data-visualisation/water-classification-hub/> [Accessed in August 2024].

<sup>18</sup> UK Lakes Portal (2024) [Online] Available: [UK Lakes Portal](https://www.uklakesportal.org/) [Accessed in August 2024].

- Other pre-existing biological data relevant to the Proposed Development were also searched for to which the authors had access and were in the public domain and did not have a non-commercial copyright licence (CC-BY-NC) for example data from NBN Atlas (2023)<sup>19</sup>;
- The Joint Nature Conservation Committee (JNCC) (2023) website and NatureScot river macrophyte database and standing waters database were accessed for habitat definitions<sup>20</sup>;
- Ness District Salmon Fishery Board electrofishing records 2018 & 2023 – available records on fish populations on watercourses potentially affected by the proposed access track; and
- Ness District Salmon Fishery Board temperature logger data.

### Field Survey Methodology

- 11.5.2 The Ecological Impact Assessment (EclA) presented here has been informed by a series of technical field surveys, as described in **Section 11.6 Baseline Conditions**.
- 11.5.3 Field work was carried out in both the 'Upper Area' and 'Lower Area' of the Proposed Development and along the Proposed SAR. The 'Upper Area' includes both the Loch Fearn and Allt a' Mheil catchments. This area is affected by proposed dam infrastructure, proposed access tracks and inundation zones. The 'Lower Area' of the Proposed Development includes areas of Loch Quoich within the construction footprint and watercourses including the lower reaches of the Allt a' Mheil and Allt Fearn, potentially impacted by proposed access tracks and run off from construction activities taking place within the Upper Area. Field work in relation to the Proposed SAR was carried out on named watercourses appearing on 1:50,000 Ordnance Survey mapping, up to 100 m upstream and downstream of proposed crossing points.

### Macroinvertebrate Surveys

- 11.5.4 Macroinvertebrate surveys were initially undertaken in relevant watercourses and waterbodies within Spring/May 2023. Survey locations were chosen to be representative of the features in the catchment and to establish good baseline information on areas likely to be affected by the Proposed Development (in line with most recent design information). The proposed Southern Access Route (SAR) for the scheme was added to the Development boundary and therefore survey locations were added to capture any potential effects from the access track construction, these survey locations were sampled in Autumn/November 2023. The methodology employed was the standard Scottish Environment Protection Agency / Environment Agency kick sample method; all individuals collected were identified to mixed taxon / species level.

### Water Quality Monitoring

- 11.5.5 *In-situ* water quality was assessed in tandem with electrofishing and macroinvertebrate survey locations in relevant watercourse and waterbody locations in 2023. Parameters monitored included: Temperature (°C); pH; Electrical conductivity (µS/cm); Dissolved oxygen (mg/L) and (%); Dissolved Oxygen (expressed as mg/l and %); Turbidity (Nephelometric turbidity units); and Oxidative Reduction Potential (mV). *Ex-situ* monitoring was not conducted as part of this report.

### Fish Habitat Surveys

- 11.5.6 Watercourse fish habitat was categorised in accordance with an adapted 'SEPA fish and fish habitat guidance' methodology (in line with the Scoping Opinion on other pumped storage schemes) in July 2023. Using the SEPA approach, habitat types are classified under four main categories; Bedrock channels, Lamprey habitat, Productive habitat and Obstructions to migration. This method was adapted to sub-divide Productive habitat into *Productive: Good* and *Productive:*

<sup>19</sup> NBN Atlas. (2023). Locations. [Online] Available at: <https://nbnatlas.org/>

<sup>20</sup> Joint Nature Conservation Committee. (2023). River Macrophytes Database. [Online] Available at: <https://hub.jncc.gov.uk/assets/0a26368d-400c-44e1-beaf-d4b89b7badcd#:~:text=The%20macrophyte%20survey%20method%20records,is%20used%20to%20aid%20recording> [Accessed in August 2024].

*Moderate*. A category for 'Unproductive' was added and sub-divided into *Unproductive: Bedrock* and *Unproductive: Other*. Any areas suitable for salmonid spawning were additionally noted.

### Fish Population Surveys

11.5.7 Fish population surveys were undertaken to establish distribution, species and populations present throughout the watercourses in both the 'Upper Area' and 'Lower Area' of the Proposed Development and along the Proposed SAR, as defined in **Section 11.5.3**. Electrofishing surveys conducted in July 2023; fully-quantitative methods were employed in watercourses in accordance with best practice guidance from the SFCC. Electrofishing was undertaken on the following watercourses:

- inflowing tributaries to Loch Fearnna and the outflow (Allt Fearnna);
- watercourses flowing through the Coire Dubh area (Allt a' Mheil catchment);
- inflowing tributaries to Loch Quoich in the development footprint (Allt Fearnna); and
- on watercourses potentially affected by the Southern Access Route (SAR) (data provided by the Ness District Salmon Fishery Board).

### Macrophyte Surveys

11.5.8 Macrophyte (Higher Plant) surveys were undertaken in August 2024 on Loch Fearnna, specifically to establish the presence of any invasive non-native species that may be spread to additional waterbodies via the transfer of water between the upper and lower loch.

### Water Temperature Investigation

11.5.9 A water temperature and water level monitoring programme is currently being carried out in Loch Quoich and the River Gearr Garry. Three in-situ water temperature sensors are located downstream of Quoich Dam, one immediately downstream of the dam, and one further downstream before the confluence of the Gearr Garry with the Kingie Pool, and one below the Quoich Power Station.

11.5.10 Seven in-situ temperature loggers are located at two locations within Loch Quoich at different depths to create a water temperature profile of the loch, both near the construction works area, and within the wider loch environment. One set of sensors is within the vicinity of the dam/construction area and one within deeper water out in the main body of the loch. Temperature monitoring within Loch Quoich in deeper water (>50m depth) will additionally provide information regarding any current temperature stratification within the loch, to inform how the proposed development may affect this.

### Assessment Methodology

11.5.11 The EcIA was undertaken following good practice guidelines current at the time of writing (CIEEM, 2018 as amended). A summary of this methodology is provided below:

- Identify and characterise Important Ecological Features (IEFs);
- Identify and characterise impacts and their effects;
- Identify measures to avoid and mitigate effects;
- Assess the significance of any residual effects after mitigation;
- Identify appropriate compensation measures to offset significant residual effects; and
- Identify opportunities for ecological enhancement and monitoring.

### Evaluation of Important Ecological Features

11.5.12 Evaluation of IEFs are applied to those sites, habitats and species (IEFs) that have been scoped into the assessment and those that are predicted to be affected by the Proposed Development. **Table 11.3** gives examples of how different types of IEFs may be evaluated geographically.

**Table 11.3 Evaluating Important Ecological Features (IEFs) Geographically**

| Level of Nature Conservation Value    | Examples of Receptors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| International<br>(including European) | <p>European sites:</p> <p>Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), potential Special Protection Areas (p)SPAs and candidate Special Areas of Conservation (c)SACs</p> <p>Other International sites:</p> <p>Ramsar wetlands</p> <p>Habitats and populations of species that represent the qualifying interests of internationally designated sites.</p>                                                                                                                                                                                                                          |
| National                              | <p>Site of Special Scientific interest (SSSI) (biological).</p> <p>All populations of Wildlife and Countryside Act (1981) (as amended in Scotland) Schedule 8 plants.</p> <p>Presence of Annex 1 habitat (i.e., a. blanket bog and Groundwater Dependent Terrestrial Ecosystems (GWDTE)).</p> <p>All viable populations of species listed as Critically Endangered, Endangered, Vulnerable or Threatened in relevant Red Data Books.</p> <p>Nationally important population /assemblage of an European Protected Species (EPS), Schedule 1 and/or 5 species.</p>                                                 |
| Council                               | <p>Sites/populations that meet SSSI designation criteria but have not been designated due to there having been better examples in the relevant Area of Search.</p> <p>Regionally important population/area of a species and habitat of Principal Importance or Scottish Biodiversity List (SBL) priority species and habitats.</p> <p>Regionally important population/assemblage of an European Protected Species (EPS), Schedule 1 and/or 5 species.</p> <p>Regionally important assemblages of other species. Regionally designated geodiversity sites. Regionally important assemblages of other species.</p> |
| Local                                 | <p>A breeding population of a species or a viable area of a habitat that is listed in a Local Biodiversity Action Plan because of its rarity in the locality.</p> <p>A breeding population of a species on the Scottish Biodiversity List has been identified by the local authority as being a material consideration in terms of its planning process.</p> <p>All breeding populations of an EPS, Schedule 1 and/or 5 species that have not been captured in higher categories above.</p> <p>Assemblages of other species that are of importance in the context of the local authority area.</p>               |
| Site                                  | <p>Other species and habitats which are, in the opinion of the assessor, of note and for which mitigation measures could be recommended as a good practice measure.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                          |

### Criteria for Assessment of Impacts

- 11.5.13 An understanding of how ecological features will respond to the Proposed Development is required to determine the magnitude of any likely impacts which may arise through construction or operational phases. It is only necessary to describe in detail the effects which are likely to be significant and impacts/effects which are unlikely to occur, or if they did happen would unlikely be significant and can be scoped out (CIEEM, 2018 as amended).

**Beneficial or Adverse Effects**

- 11.5.14 Beneficial and adverse effects are determined whether the change is in accordance with the following nature conservation policy and objectives:

**Beneficial** – a change which improves the quality of the environment, for example, increasing species diversity or extending / improving habitat extent. This can also include reducing the rate of existing environmental decline; and

**Adverse** – a change which results in a reduction of the quality of the environment, for example, habitat destruction, habitat fragmentation, loss of species or pollution events.

**Extent**

- 11.5.15 The extent of an impact refers to the geographical area over which the impact may occur over typically representative conditions. For example, increased sediment run-off in watercourses.

**Frequency and Timing**

- 11.5.16 The resulting effect of an impact is influenced by the number of times an activity occurs. For example, a vehicle driving across sensitive habitat; one vehicle may have a small irreversible impact (habitat may recover), however, frequent vehicle passes may significantly degrade the habitat to the point where it may not recover and be permanently lost.

**Reversibility**

- 11.5.17 An impact from which recovery is not possible within a reasonable timescale or there is no chance of action to implement successful mitigation, the impact is classed as irreversible. An impact from which spontaneous recovery or with which recovery is possible through successful mitigation is classed as reversible. It should be noted that in some cases the same activity can cause impacts which are both irreversible and reversible.

**Duration**

- 11.5.18 CIEEM, 2018 as amended, states that duration is defined in the relative context of ecological traits, such as the lifecycle of a species. The duration of an activity may differ from the duration of the resulting effect caused by the activity. Table [4.4] defines the timescales used within this Chapter and Ecological Impact Assessment.

**Table 11.4 Duration of Effects**

| Duration    | Definition                                                                                                                                                                                                           |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Permanent   | Effects continuing indefinitely beyond the span of one human generation (30+ years), except where there is likely to be substantial improvement after this period in which case the Long Term maybe more applicable. |
| Long term   | Between 15 years up to (and including) 30 years.                                                                                                                                                                     |
| Medium term | Between 5 years up to (but not including) 15 years.                                                                                                                                                                  |
| Short term  | < 5 years.                                                                                                                                                                                                           |
| Temporary   | No short-term effect.                                                                                                                                                                                                |

**Sensitivity**

- 11.5.19 The sensitivity of an ecological receptor to a particular impact should also be considered as well as the zone of influence. Sensitivity criteria are variable across the taxonomic groups and behavioural sensitivity can also vary across individuals of the same species. Sensitivity can also be dependent on species' activity, for example, species are more likely to be susceptible to disturbance during the spawning seasons. As such, professional judgement is used when assigning sensitivity to an ecological receptor. Sensitivity is determined according to the species' behaviour, outlined using the criteria in Table 11.5.

**Table 11.5 Levels of Sensitivity**

| Level of Sensitivity | Definition                                                                                                                                                                                                                       |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High                 | Species in remote areas, away from human disturbance which would result in a long-lasting reaction to a disturbance event.<br><br>Habitats which are considered to have a slow recovery time and could not re-establish quickly. |
| Medium               | Species which are tolerant to human activity which result in a short-term reaction to a disturbance event.<br><br>Habitats which are considered to have a moderate recovery time.                                                |
| Low                  | Species which are regularly subject to human disturbance which result in a brief reaction to a disturbance event.<br><br>Habitats which are considered to have a quick recovery time and could readily established.              |

**Magnitude**

- 11.5.20 The magnitude of an impact refers to the size, intensity, or volume of an impact and should be quantified where possible in absolute or relative terms. For example, exact areas of habitat loss or percentage of species population decline (CIEEM, 2018 as amended). Table 11.6 defines the four levels of magnitude used in this assessment; these are generally considered to be adverse unless stated otherwise.

**Table 11.6 Criteria for describing the magnitude of impacts on IEFs**

| Magnitude of Impact | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High                | High impacts may include those that result in large-scale, permanent (or at least the lifetime of the Proposed Development) changes in an IEF, and likely to change its ecological integrity. These impacts are likely to result in overall changes in the conservation status of a species population or habitat type at the location(s) or geographical scale under consideration.                                                                            |
| Medium              | Medium impacts may include moderate-scale, permanent (with respect to the lifetime of the Proposed Development) changes in an IEF, or larger-scale temporary changes, but the integrity of the feature is not affected. This may mean that there are temporary changes in the conservation status of a species-population or habitat type at the location(s) or geographical scale under consideration, but these are unlikely to be irreversible or long-term. |
| Low                 | Low impacts may include those that are small in magnitude, have medium-scale temporary changes, and where integrity is not affected. These impacts are unlikely to result in overall changes in the conservation status of a species population or habitat type at the location(s) under consideration, but it does not exclude the possibility that mitigation or compensation will be required.                                                               |
| Negligible          | There is no perceptible change in the ecological feature.                                                                                                                                                                                                                                                                                                                                                                                                       |

### Significance of Effects

- 11.5.21 The combined assessment of both the sensitivity of the receptor (Nature Conservation Value) and the magnitude of potential impact determines whether an effect is likely to be significant (Table 11.7). Table 11.7 describes the significance of each effect. Effects categorised as **Moderate or Major** significance are evaluated as ‘**significant**’ under EIA Regulations, whilst those categorised as Minor or Imperceptible significance are evaluated as ‘not significant’ and not discussed further in this Chapter.

**Table 11.7 Significance of Effects Matrix**

| Nature Conservation Value | Magnitude of Potential Impact |                                 |                                 |                                 |                                 |
|---------------------------|-------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|                           |                               | High                            | Medium                          | Low                             | Negligible                      |
|                           | International                 | Major                           | Major                           | Moderate                        | Minor                           |
|                           | National (Scotland)           | Major                           | Major                           | Moderate                        | Minor                           |
|                           | Council (Highlands)           | Major                           | Moderate                        | Minor                           | Imperceptible (Not Significant) |
|                           | Local (Ness Catchment)        | Minor                           | Minor                           | Minor                           | Imperceptible (Not Significant) |
|                           | Low (Site)                    | Imperceptible (Not Significant) | Imperceptible (Not Significant) | Imperceptible (Not Significant) | Imperceptible (Not Significant) |

- 11.5.22 Where potential effects are identified as being significant, the mitigation hierarchy (avoid, mitigate, compensate, enhance) is applied to mitigate for these significant effects. Significance criteria is defined in Table 11.8.

**Table 11.8 Significance Criteria**

| Significance Criteria | Definition                                                                                                                                                                                                                                                                                                                  |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Major                 | <b>Significant effect.</b> The effect is likely to result in a permanent/long term and a highly significant effect on the integrity of the feature. Usually only applied to adverse effects.                                                                                                                                |
| Moderate              | <b>Significant effect.</b> The effect is likely to result in a medium-term with a high/medium extent. These beneficial or adverse effects are considered to be critical factors and are likely to be material in the decision-making process.                                                                               |
| Minor                 | <b>No significant effect.</b> Likely effect the feature at an insignificant level by virtue of its limited duration and/or extent, but there would probably be no effect on its integrity. May become a decision-making issue if leading to an increase in the overall adverse effect on a particular resource or receptor. |
| Imperceptible         | <b>No significant effect.</b> No perceptible effect / negligible effect.                                                                                                                                                                                                                                                    |

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**Assumptions and Limitations**

- 11.5.23 Survey limitations were encountered when surveying for the Proposed Development but are not considered to affect the outcome of this EIAR.
- 11.5.24 Surveys undertaken are representative of the conditions present during the duration of the survey and due to this, definitive findings are not always possible. It is feasible that species may use the site seasonally and/or be in populations too low for detection and are therefore not represented in the survey findings or presence is under/overexaggerated. It is considered that any such recording is unlikely to alter the conclusions gained in this chapter and therefore any under recording is only likely to reflect a slight limitation in this EIAR.
- 11.5.25 It is assumed that Loch Fearna, associated tributaries and the tributaries affected within Coire Dubh are devoid of fish. This is based on an absence of fish in electrofishing surveys and is further supported by anecdotal feedback from local land managers, the NDSFB and the RSPB, who have advised that they do not believe there is a fish population in Loch Fearna.
- 11.5.26 It is assumed that Atlantic salmon are present within the Gearr Garry
- 11.5.27 It is considered that Freshwater Pearl Mussels (*Margaritifera margaritifera*) are not present within the Proposed Development footprint in light of consultation with NatureScot regarding the areas above Quoich Dam and the survey findings from the Gearr Garry and River Kingie.
- 11.5.28 No population data exists for ferox trout on Loch Quoich, however literature review within the desk study found that the loch is known to contain ferox, therefore, under the precautionary principle, ferox are considered present. There is often a sympatry in waterbodies between ferox trout and Arctic charr which they utilise as a food source.
- 11.5.29 For the purpose of this assessment and based on a review of current and historic data we have concluded that there are no migratory fish (Atlantic salmon, *Salmo salar*; Sea trout, *Salmo trutta*; migratory lamprey, *Petromyzon marinus* and *Lampetra fluviatilis*; European eel, *Anguilla anguilla*) present above Quoich Dam. These fish species are likely to have been present prior to the construction of the dam in the 1950s, however the presence of the dam now presents an impassable barrier to migratory fish. No European eel was detected in eDNA surveys that were carried out above Quoich dam in 2019 as part of the Amber project or within electrofishing surveys carried out by Gavia Environmental in 2023.
- 11.5.30 Where species specific information regarding species tolerances of environmental conditions (e.g., temperature, noise and/or blasting) is unavailable, tolerance thresholds of similar species may be used (e.g. Atlantic salmon as a proxy for brown trout and/or Arctic charr).

## 11.6 Baseline Conditions

### Existing Baseline

#### Designated Sites

- 11.6.1 No designated sites with relevance to aquatic ecology were recorded within 10km of the Proposed Development boundary.

#### Desk Study

Results of the desk study are summarised in **Table 11.9**.

**Table 11.9 Summary of Desk Study**

| Habitats / Species / Constraints | Source (s)                          | Relevant Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aquatic Plants                   | SEPA River and Loch Classifications | Loch Quoich and Loch Garry are classified as 'High' for aquatic plants. Loch Fearna is unclassified. The data was requested from SEPA but no response has yet been received.                                                                                                                                                                                                                                                                                                                                                              |
| Loch Quoich                      | UK Lakes Portal                     | Loch Quoich (Water body ID 20828) is a large freshwater lake located in Highland, Scotland. It is generally deep with low alkalinity and is situated at mid altitude.<br><br>It has a surface area of 1746 ha, with a mean depth of 31.9 m. It sits at an elevation of 203 m A.O.D.                                                                                                                                                                                                                                                       |
|                                  | SEPA River and Loch Classifications | Loch Quoich is a lake (ID: 100186), in the River Ness catchment of the Scotland river basin district. It is 17.5 square kilometres in area. The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation (Quoich Dam). The Loch is classed as Poor for Fish and Fish barrier, Good for water quality and High for aquatic plants and has an overall status of Good Ecological Potential. |
| Loch Fearna                      | UK Lakes Portal                     | Loch Fearna (Water body ID 20976) is a small freshwater lake located in Highland, Scotland. It is generally shallow with low alkalinity and is situated at mid altitude.<br><br>It has a surface area of 10 ha, with a mean depth of 6.6 m. It sits at an elevation of 543 m A.O.D.                                                                                                                                                                                                                                                       |
|                                  | SEPA River and Loch Classifications | N/A – Not classified by SEPA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Loch Garry                       | UK Lakes Portal                     | Loch Garry (ID 21023) is a large freshwater lake located in Highland, Scotland. It is generally deep with low alkalinity and is situated at low altitude.<br><br>It has a surface area of 686 ha, with a mean depth of 23.8 m. It sits at an elevation of 83 m AOD.                                                                                                                                                                                                                                                                       |
|                                  | SEPA River and Loch Classifications | Loch Garry is a lake (ID: 100190), in the River Ness catchment of the Scotland River basin district. It is 6.9 square kilometres in area. The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation. SEPA data from 2022 reveals that the waterbody was classified as High for fish barriers, fish and macroinvertebrates (CPET), however, it noted only a Good                       |

| Habitats / Species / Constraints | Source (s)                          | Relevant Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |                                     | macroinvertebrate (acid) and good water quality classification. The overall ecological potential of the waterbody was Good.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Watercourses                     | SEPA River and Loch Classifications | <p>River Garry - Loch Poulary to Loch Quoich is a river (ID: 20256), in the River Ness catchment of the Scotland river basin district. The main stem is approximately 7.3 kilometres in length. The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation. This section of river is classed as Poor for Fish, Fish Ecology and has an overall status of Poor Ecological Potential.</p> <p>River Garry - Loch Garry to Loch Poulary is a river (ID: 20255), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 4.6 kilometres in length. This section of river has been classed as high for fish barriers, fish, macroinvertebrates, Good for water quality and has an overall status of Good Ecological Potential.</p> <p>Allt Ladaidh is a river (ID: 20298), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 9.0 kilometres in length. This section of river was classed as High for fish barriers and macroinvertebrates, Good for water quality and Moderate for fish ecology. Overall, this section is classed as Moderate for Ecological Potential.</p> <p>Greenfield Burn is a river (ID: 20299), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 7.1 kilometres in length. This section of river is classed as High for fish barrier and macroinvertebrate, Moderate fish ecology. Good water quality and is classed as Moderate for overall Ecological Potential.</p> <p>Allt Lon Glas Bheinn is a river (ID: 20300), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 10.3 kilometres in length. This section of river is classed as High for fish barriers and macroinvertebrates, Poor fish ecology, Good water quality and has an overall Poor Ecological Potential.</p> <p>Allt Choire a Bhalachain is a river (ID: 20301), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 9.2 kilometres in length. This section of river is classed as High for fish barrier and macroinvertebrates, Moderate fish ecology, Good water quality and an overall Moderate Ecological Potential.</p> <p>River Kingie is a river (ID: 20302), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 23.6 kilometres in length. This section of river is classed as High for fish barrier and macroinvertebrates, Moderate fish ecology, Good water quality and has an overall Moderate Ecological status.</p> |
| Obstacles to fish migration      | Scotland's Environment Web          | <p>Allt Ladaidh – One impassable natural waterfall (OBJECTID:1177) located downstream of crossing point 3 along the Proposed Access Track at NH 23339 01192.</p> <p>Greenfield Burn – One impassable natural waterfall (OBJECTID:3685) located upstream of crossing point 8 along the Proposed Access Track at NH 19912 00386.</p> <p>Allt Lon Glas Bheinn – One impassable natural waterfall (OBJECTID:2425) located downstream of crossing point 9 along the Proposed Access Track at NH 17058 00413.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Habitats / Species / Constraints | Source (s)                                                                  | Relevant Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |                                                                             | <p>Allt Choire a Bhalachain - 1 impassable natural waterfall (OBJECTID:3687) located downstream of crossing point 11 along the Proposed Access Track at NH 13150 00273.</p> <p>River Garry - Loch Poulary to Loch Quoich – 1 passable artificial barrier (OBJECTID:4260) located upstream of crossing point 12 along the Proposed Access Track at NH 10911 01016. It should be noted that this point was impassable until 2004.</p> <p>Gearr Garry – 1 impassable artificial barrier (OBJECTID:2672) located at the hydro power dam upstream of crossing point 13 along the Proposed Access Track at NH 07055 02289.</p>                                                        |
| Invasive Non-Native Species      | NBN Atlas                                                                   | No invasive aquatic features were identified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                  | SEPA River and Loch Classifications                                         | Loch Quoich, Loch Fearna and the Garry catchments are unclassified by SEPA for alien species.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arctic charr                     | Maitland & Adams                                                            | <p>No population data exists other than limited angling records.</p> <p>1957 - 'One fish from Niall Campbell'</p> <p>1995 - 'Arctic charr angled from Loch Quoich'<sup>21</sup></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                  | Amber Project <sup>22</sup>                                                 | Charr detected in Loch Quoich above Quoich Dam in eDNA surveys in 2018.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                  | Godfrey et. al, 2007<br>Hydroacoustic surveys of five Scottish lochs. 2: 7. | Hydroacoustic surveys were conducted in Loch Quoich during 2007, noting a dominance of fish in water 35m in depth <sup>23</sup> . A reduction of fish numbers was recorded in deeper loch areas with fish presence at depths greater than 40 m considered scarce (indicating an absence of benthic fish). No sign of a deleterious impact of regulated hydrology on fish densities were noted.                                                                                                                                                                                                                                                                                  |
| Atlantic salmon                  | Marine Scotland – National Marine Plan Interactive Map <sup>24</sup>        | Marine Scotland historic data shows salmon presence within Loch Garry and into the efferent rivers, however, no salmon presence was noted beyond the impassable barriers on the map. There is also salmon presence in the River Kingie at the proposed SAR crossing point. No salmon presence was recorded on the River Gearr Garry however there were no barriers recorded to impede their migration into this part of the catchment. The Gearr Garry was also stocked with eyed ova in 2023 and 2024 as part of the Upper Garry Restoration Project and subsequent monitoring work in 2024 has recorded juvenile Atlantic salmon in this part of the catchment. <sup>25</sup> |

<sup>21</sup> Adams, C. E. and Maitland, P. S. (2018). Arctic charr in the Lochs of Scotland, An Assessment of Distribution and Status.

<sup>22</sup> Amber (2020) D4.2 Report of Case Studies Demonstrating the Effects of Barrier Removal, Mitigation and Installation. [Online] Available: [amberinternational.com/wp-content/uploads/2020/07/D4.2-Report-of-Case-Studies-Demonstrating-the-Effects-of-Barrier-Removal-Mitigation-and-Installation.pdf#page=8.82](https://www.amberinternational.com/wp-content/uploads/2020/07/D4.2-Report-of-Case-Studies-Demonstrating-the-Effects-of-Barrier-Removal-Mitigation-and-Installation.pdf#page=8.82)

<sup>23</sup> Godfrey, J. D., Thorne, A. E. and Youngson, A. F. (2007). Hydroacoustic surveys of five Scottish lochs. 2: 7.

<sup>24</sup> Marine Scotland. (2025) National Marine Plan Interactive Map [Marine Scotland - National Marine Plan Interactive](https://www.marinescotland.gov.uk/national-marine-plan-interactive-map)

<sup>25</sup> Ness District Salmon Fishery Board 2024 Gearr Garry Facebook Post [We visited the Gearr... - Ness District Salmon Fishery Board | Facebook](https://www.facebook.com/nessdistrictsalmonfisheryboard/)

| Habitats / Species / Constraints | Source (s)                              | Relevant Data                                                                                                                                                                                                                              |
|----------------------------------|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Brown trout                      | Amber Project                           | Brown trout detected in Gearr Garry, River Kingie, Loch Garry and River Garry Loch Quoich above Quoich Dam in eDNA surveys in 2018.                                                                                                        |
| Ferox trout                      | Greer et al., 2009<br>Internet searches | Presence of ferox trout in Loch Quoich noted in Greer et al., 2009 <sup>26</sup> and Williams, 2020.<br><br>Angling forums with photographs of captured ferox trout.                                                                       |
| European eel                     | Amber Project                           | European eel detected in Gearr Garry, River Kingie and Loch Garry in eDNA surveys in 2018. No eel detected above Quoich Dam.                                                                                                               |
| Macroinvertebrates               | NBN Atlas                               | No recent information on species presence and/or abundance was available within the Zone of Influence. Unverified and unpublished resources were made available but were used for reference only and not incorporated into the assessment. |
| Designated sites/features        | NatureScot Sitelink                     | No designated sites have been taken forward for assessment.                                                                                                                                                                                |

### Field Survey Results

- 11.6.2 The Ecological Impact Assessment (EclA) presented here has been informed by a series of technical field surveys, as described in **Appendix 11.1 – Fearna PSH Aquatic Ecology Surveys** and **Appendix 11.2 – Fearna Southern Access Route (SAR) Aquatic Ecology Surveys**. In summary, the surveys included:

#### Fish Habitat Assessment

- 11.6.3 On the initial assessment of the fish habitat on the Proposed Development (excluding the Southern Access Route (SAR)) a total of four habitat types were identified within the total accessible area surveyed covering 8,107.50 m<sup>2</sup> across the tributaries of Loch Fearn, tributaries within Coire Dubh and tributaries of Loch Quoich crossed by the proposed access track. Results are presented in **Table 11.10**, and detail identified Productive (Good), Productive (Moderate), Unproductive (Bedrock), and Unproductive (Other) habitat.
- 11.6.4 The footprint of the Proposed Development on these habitat types is illustrated in **Appendix 11.1: Fearna PSH Aquatic Ecology Surveys - Figure 2.1**.

<sup>26</sup> Greer. R. B., Thorne. A, MacDonald. A., (2009) Ferox trout: A Predator worthy of Pursuit and Protection. Available [Online]: [wildtrout.org/assets/files/about\\_trout/Greer et al 2009 ISACF 8 14 20 B.pdf](http://wildtrout.org/assets/files/about_trout/Greer%20et%20al%202009%20ISACF%208%2014%2020%20B.pdf)

**Table 11.10 Summary of Salmonid Fish Habitat Types**

| Habitat Type           | Total Area (m <sup>2</sup> ) | Percentage of Total Habitat Assessed (%) |
|------------------------|------------------------------|------------------------------------------|
| Productive (Good)      | 1,462.50                     | 18.03 %                                  |
| Productive (Moderate)  | 1,184.00                     | 14.60 %                                  |
| Unproductive (Bedrock) | 2,154.50                     | 26.57 %                                  |
| Unproductive (Other)   | 3,306.50                     | 40.78 %                                  |
| Total:                 | <b>8,107.50</b>              | <b>100 %</b>                             |

- 11.6.1 Fish habitat 100m upstream and downstream of water crossings was assessed following the inclusion of the SAR within the development boundary. A total of three habitat types were identified within the areas surveyed covering 8,566 m<sup>2</sup>. Results are presented in Table 11.11, and detail identified Productive (Good), Productive (Moderate), Unproductive (Bedrock), and Unproductive (other) habitat.
- 11.6.2 The footprint of the SAR on these habitat types is illustrated in **Appendix 11.2: Fearna Southern Access Route (SAR) Aquatic Ecology Surveys - Figures 2.1**.

**Table 11.11 Summary of Salmonid Fish Habitat Types (Southern Access Route Crossing Points)**

| Habitat Type           | Total Area (m <sup>2</sup> ) | Percentage of Total Habitat Assessed (%) | Length (m)  | Percentage of Total Habitat Assessed (%) |
|------------------------|------------------------------|------------------------------------------|-------------|------------------------------------------|
| Productive (Good)      | 6,028.68**                   | 70.38 %**                                | 300         | 11.538 %                                 |
| Productive (Moderate)  | 1,939.88                     | 22.64 %                                  | 1780        | 68.462 %                                 |
| Unproductive (Bedrock) | 597.89                       | 6.98 %                                   | 520         | 20 %                                     |
| Unproductive (Other)   | 0                            | 0 %                                      | 0           | 0 %                                      |
| Total:                 | <b>8566</b>                  | <b>100 %</b>                             | <b>2600</b> | <b>100 %</b>                             |

**\*\*note that Productive: Good habitat is biased by the considerable width of the Gear Garry watercourse at the crossing point, which increased the area surveyed compared with other watercourses. Length is expressed as a percentage for comparison.**

**Fish Population Surveys**

- 11.6.3 A total of five species were identified during fish population surveys: Atlantic salmon, brown trout, Eurasian minnows, European eel and pike. This included survey work carried out by the Ness District Salmon Fishery Board.
- 11.6.4 No fish were captured within the tributaries of Loch Fearn or the Coire Dubh area during electrofishing work carried out by Gavia Environmental in 2023.
- 11.6.5 Atlantic salmon were recorded in the Allt Choire a' Bhalachain, Greenfield Burn and River Kingie during electrofishing survey work carried out by the Ness District Salmon Fishery Board in 2018 and 2023.
- 11.6.6 Brown trout were recorded in the Allt Fionn-dhail, Allt Choire a' Bhalachain, Greenfield Burn, River Kingie during electrofishing survey work carried out by the Ness District Salmon Fishery Board in 2018 and 2023 and in the Allt Fearn near the confluence with Loch Quoich during survey work carried out by Gavia Environmental in 2023.
- 11.6.7 European eel were recorded in the River Kingie during electrofishing survey work carried out by the Ness District Salmon Fishery Board in 2023.
- 11.6.8 Eurasian minnow were captured in the adjoining tributaries of Loch Quoich, during electrofishing work carried out by Gavia Environmental in 2023. They were displaying breeding colours. These would be considered an invasive non-native species in Loch Fearn for the purposes of the EIA.
- 11.6.9 The full results of fish population surveys are available in **Appendix 11.1 – Fearn PSH Aquatic Ecology Surveys** and **Appendix 11.2 - Fearn Southern Access Route (SAR) Aquatic Ecology Surveys**.

**eDNA Surveys**

- 11.6.10 An initial environmental DNA (hereafter 'eDNA') survey was conducted in Loch Fearn and Loch Quoich during 2023. The results were deemed to be inconclusive following discussion with the University of Glasgow who carried out the analysis of samples. An absence of Arctic charr however was confirmed in the samples taken from Loch Fearn. Given the absence of juvenile trout during electrofishing work carried out by Gavia Environmental in 2023 in any of the burns which contained supporting habitat, it is considered unlikely that there is a fish population present in the loch. This was further supported by anecdotal feedback from local land managers, the NDSFB and the RSPB, who have advised that they do not believe there is a fish population in Loch Fearn. Local land managers also confirmed that the loch has never been stocked with rainbow trout. The combination of existing hydroacoustic data and eDNA is considered sufficient to advise on presence and likely distribution of Arctic charr in the water column in Loch Quoich.

**Macroinvertebrate Surveys**

- 11.6.11 The Macroinvertebrate Population Assessment indices scores were variable across each of the sampling locations. Three sampling locations (FE1, FE2 and FE 4) were classed with the BMWP (TL1) analysis score as *Very Good*, with one significantly above the >100 threshold at 120 (FE1). Four Sampling Locations (FE3, FE6, FE7 and FE9) were classed as *Good*. Sampling location FE5 was classed as *Moderate* and FE8 as *Poor*. Regarding the PSI (TL5) analysis score, six sampling locations (FE1, FE2, FE3, FE6, FE7 and FE8) were classed as *Minimally Sedimented*. Two sampling locations (FE4 and FE5) as *Slightly Sedimented* and one Sampling Location (FE9) as *Sedimented*. Furthermore, on the PSI (FAM) (TL3) analysis score, five Sampling Locations (FE1, FE3, FE5, FE6 and FE8) were classed as *Minimally Sedimented* and the remaining Sampling Locations (FE2, FE4, FE7 and FE9) were classed as *Slightly Sedimented*. The Sampling Locations FE1, FE2, FE3, FE4, FE5, FE6, FE7 and FE8 were classed as *Minimally Sedimented* for the E-PSI (FAM) analysis score and Sampling Location FE9 was classed as *Slightly Sedimented*. The results are the same for the E-PSI (TL5) analysis scores except Sampling Locations FE5 and FE9 were classed as *Slightly Sedimented*. One Sampling Location (FE8) was classed as *High Conservation Value* on the Community Conservation Index (CCI) analysis score however this score is skewed by a low number of taxa present (5). Two Sampling Locations (FE1 and FE5) were classed as *Fairly High Conservation Value* and the remaining six Sampling Locations (FE2, FE3, FE4, FE6, FE7 and

FE9) were classed as *Moderate Conservation Value*. WHPT scores ranged from 27.1 (FE8) to 150 (FE1).

- 11.6.12 No species identified during the survey were classified as Near Threatened or above according to the IUCN database and JNCC's main Conservation Designations for UK Taxa spreadsheet containing the taxa's Global, GB and England red data. The red listing includes listing based on pre-1994, 1994 and 2001 IUCN guidelines.
- 11.6.13 Macroinvertebrate results were variable across each of the Proposed SAR crossing points. Only one sampling location, downstream from crossing point 7, had a Good BMWP score with the remaining crossing points showing a range between 15 (Poor) and 61 (Moderate), upstream from crossing point 9 and downstream from crossing point 6 respectively. PSI (TL5) analysis categorised all sampling locations as Unsedimented except for downstream of crossing point 1 which was categorised as Slightly Sedimented. PSI (FAM/TL3) indicates a slightly lower index score across most of the sampling locations with the lowest scores now indicating Sedimented categorisations downstream of crossing point 1 and upstream of crossing point 2. Downstream of crossing point 6 and 8 also show Moderately Sedimented categorisations. Two locations show Very High Conservation Value according to the CCI scores with downstream of crossing point 5 slightly exceeding the >20 threshold and upstream of crossing point 12 significantly exceeding the threshold with a score of 49. Higher CCI scores should be viewed with caution as scores can be skewed by low numbers of taxa recorded.
- 11.6.14 No species identified during the survey were classified as Near Threatened or above according to the IUCN database and JNCC's main Conservation Designations for UK Taxa spreadsheet containing the taxa's Global, GB and England red data. The red listing includes listing based on pre-1994, 1994 and 2001 IUCN guidelines.
- 11.6.15 The full results of macroinvertebrate surveys are available in **Appendix 11.1 – Fearna PSH Aquatic Ecology Surveys** and **Appendix 11.2 - Fearna Southern Access Route (SAR) Aquatic Ecology Surveys**.

#### Macrophyte Surveys

- 11.6.16 In total 11 species were identified throughout the waterbody sampled: 9 submerged/floating; and 4 emergent/edge species (*Juncus bulbosus* & *Littorella uniflora* were identified in both submerged and emergent communities). All species were classified as 'Least Concern' or 'Data deficient' for their conservation value according to the IUCN red list. Complete species lists are available in **Appendix 11.1 – Fearna PSH Aquatic Ecology Surveys**.
- 11.6.17 No invasive non-native species were identified in any of the lochs sampled.
- 11.6.18 National vegetation communities around the loch survey areas were generally dominated by wet heath M15 *Scirpus cespitosum-Erica tetralix* wet heath, with the aquatic communities largely split between A14 *Myriophyllum alterniflorum* community and A24 *Juncus bulbosus* community.
- 11.6.19 Macrophyte surveys were limited to Loch Fearna. A survey was not conducted on Loch Quoich as during the 2024 optimal survey window, the Loch levels were much higher than normal resulting in marginal areas which are normally dry due to the existing Quoich Power Station operation and devoid of aquatic vegetation were flooded. This would have meant that data collected along transects in marginal areas would have been likely meaningless. JNCC guidance states that 'If on the day of survey, water levels are obviously raised or lowered, survey should be postponed as results are unlikely to be comparable' (JNCC 2015).
- 11.6.20 The full results of macrophyte surveys are available in **Appendix 11.1 – Fearna PSH Aquatic Ecology Surveys**.

**In-situ Water Quality**

- 11.6.21 Water Quality results indicated high ambient water quality. No parameters observed were indicative of underlying pollution. All parameters conformed to standards suitable to support salmonids (of parameters available).
- 11.6.22 The full results of macrophyte surveys are available in **Appendix 11.1 – Fearna PSH Aquatic Ecology Surveys** and **Appendix 11.2 – Fearna Southern Access Route (SAR) Aquatic Ecology Surveys**.

**Water Temperature**

- 11.6.23 A water temperature investigation has been undertaken on Loch Quoich and the Gearr Garry. The full results are available in **Appendix 11.3 – Fearna PSH Loch Quoich and Gearr Garry water temperature investigation**. This investigation indicates the water temperature regime in Loch Quoich is highly stable, albeit seasonally variable. Any impact from the Proposed Development would be expected to be minimal, and localised to the area immediately adjacent to the Lower Area and Loch Fearna. The water temperature regime in the Gearr Garry is observed to be dominated by prevailing air temperatures, albeit the existing Quoich hydro scheme can be observed to moderate river water temperatures when sub-zero air temperatures endure for prolonged periods. The existing water transfers as part of the existing hydro scheme have been observed to neither increase nor decrease water temperatures lower down the catchment.

**Future Baseline**

- 11.6.24 This section details what the future baseline conditions of the site would be like without the Proposed Development being consented and presents an objective assessment to explore whether mitigation and enhancement measures within the Proposed Development could address the future baseline condition, particularly if the future baseline could be negatively impacted in the near future.
- 11.6.25 Trends in population declines should be considered when determining a future baseline. Arctic charr populations are considered to be likely to continue to decline in response to climate change given sensitivities to increases in water temperature and the location of Scotland at the southern extremity of its global range<sup>27</sup>. However given the high altitude of Loch Quoich, this effect may be more limited when compared to lochs at lower altitudes in Scotland.
- 11.6.26 Atlantic salmon populations are considered to be likely to continue to decline in response to climate change given sensitivities to increases in water temperature both in freshwater and marine habitats.
- 11.6.27 European eel populations are considered to be likely to continue to decline in response to climate change. 'Modifications of oceanic physical conditions appear to be impacting hatching, survival and drift of larvae towards European coasts'<sup>28</sup>.
- 11.6.28 Climate change has impacts on aquatic ecosystems. The ten warmest years on record in Scotland have all occurred since 1997. The average temperature in the last decade (2010-2019) was approximately 0.7 °C warmer than the 1961-1990 average. In recent decades, there has been an increase in rainfall across Scotland, with an increasing proportion due to heavy rainfall events. Average annual rainfall in the last decade (2010-2019) was 9% wetter than the 1961-1990 average<sup>29</sup>.

<sup>27</sup> Nunn, A. D., Ainsworth, R. F., Walton, S., Bean, C. W., Hatton-Ellis, T. W., Brown, A., Evans, R., Atterborne, A., Ottewell, D. and Noble, R. A. A. (2023). Extinction risks and threats facing the freshwater fishes of Britain. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 1-7.

<sup>28</sup> Drouineau, H., Durif, C., Castonguay, M., Mateo, M., Rochard, E., Verreault, G., Yokouchi, K., Lambert, P., (2018) Freshwater eels: A symbol of the effects of global change. [Online] Available: [Freshwater eels: A symbol of the effects of global change - Drouineau - 2018 - Fish and Fisheries - Wiley Online Library](#) [Last accessed 22/10/2024]

<sup>29</sup> Scotland's Environment (2021) How has Scotland's climate changed? [Online] Available at: Changing climate | Scotland's environment web

- 11.6.29 A report published by Scotland's Centre of Expertise for Waters (CREW) showed that between 2015 and 2019, 97% of monitored Scottish lochs and reservoirs increased in temperature. While most warmed by 0.25 - 1.0 °C per year over this period, 9% increased by more than that – some by up to 1.3 °C per year. These changes increase the risk of harmful algal blooms developing, which could impact on ecological features including fish and their habitats. It is expected that waters in the south and east of Scotland are expected to warm the most at first, however this climate-related impact will reach all parts of the country by 2040<sup>30</sup>.
- 11.6.30 Predicted effects of climate change include average temperatures increasing across all seasons, typical summers will be warmer and drier, typical winters will be milder and wetter and intense, heavy rainfall events will increase in both winter and summer.
- 11.6.31 These effects have impacts on fish including reduction in dissolved oxygen levels and reduced river flow and loch levels in summer for fish. In winter there will be a greater risk of egg washout in watercourses during heavy rainfall events. Temperature fluctuations will also have impacts on egg incubation, hatch times and may alter seasonal behaviour of fish.
- 11.6.32 Utilising renewable energy sources, facilitated by pumped storage hydro schemes, has the potential to slow and/or reduce the negative water temperature rises associated with climate change. Renewable energy sources limit greenhouse gas emissions associated with non-renewable energy sources, e.g. carbon dioxide with coal fired power stations, that absorbs and radiates heat warming the atmosphere. This will aid in mitigating against population declines of a species, such as Arctic charr and Atlantic salmon which are reliant on colder environments, by reducing temperature increases. This has the potential to provide a beneficial effect on fish populations.

## 11.7 Mitigation by Design

- 11.7.1 The Proposed Development has been subject to a number of design iterations based on initial data provided through baseline studies. The purpose of the identification of constraints at an early stages of the scheme design is to reduce environmental effects in relation to aquatic IEFs has been covered in **Chapter 3: Consideration of Alternatives and Design Evolution**. The following design changes have been incorporated to avoid or minimise negative effects:
- The approach velocity of water across the Quoich reservoir intake screen during abstraction / pumping mode will be <0.3 m/s. This will ensure that most adult fish species will be able to overcome the effect of entrainment / impingement at the screens.
  - Appropriately designed vertical bar screens of maximum 12.5 mm aperture to cover the intake/outlet will be installed to prevent fish from entering the underground waterway system at Loch Quoich and Loch Fearn. This will prevent the risk of fish entrainment, injury and mortality, and of transfer of individuals between waterbodies. It is possible that smaller fish (i.e. juvenile brown trout, juvenile Arctic charr or European minnows) may be able to pass through the 12.5 mm mesh aperture, however, an aperture to prevent all life stages (e.g. 1 mm) will result in continual foliage / debris build up and increase velocities across the screen, likely increasing the overall impact on fish. It is plausible that breeding fish populations could establish in the upper reservoir, once constructed, but due to the impacts of ongoing water level fluctuation and sediment deposition, potential spawning habitats are likely to be limited.

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<sup>30</sup> May, L., Taylor, P., Gunn, I.D.M., Thackeray, S.J., Carvalho, L.R., Hunter, P., Corr, M., Dobel, A.J., Grant, A., Nash, G., Robinson, E. and Spears, B.M.(2022). Assessing climate change impacts on the water quality of Scottish standing waters. CRW2020\_01. Scotland's Centre of Expertise for Waters (CREW). [Online] Available at: [Assessing climate change impacts on the water quality of Scottish standing waters] | CREW | Scotland's Centre of Expertise for Waters

## 11.8 Potential Significant Effects

- 11.8.1 This section considers the potential impacts and associated effect significance of the construction, and operation of the Proposed Development based on the typical activities described in **Chapter 2: the Proposed Development**. As the project is predicted to have an indefinite lifespan, decommissioning impacts are not covered by this assessment but if eventually this was to occur it is likely that impacts would need to be assessed and it is considered likely that the decommissioning impacts would be of the same magnitude and significance as the construction stage effects.

### Construction Effects

- 11.8.2 The sections below detail the potential effects during the construction phase of the Proposed Development. The effects have been assessed only for IEFs of Local or higher nature conservation value or species protected by wildlife legislation. The construction phase is predicted to last up to six years, consequently the duration of individual effects are predicted to range from temporary to short to medium term. The impacts during the construction phase are detailed below:

#### Construction Footprint

- 11.8.3 The potential effects, i.e. permanent habitat loss, from permanent fixtures such as dams, water level inundation and culverts are discussed separately under *Operational Effects*.
- 11.8.4 No instream works will be required to facilitate the installation of bridges along the SAR. New crossings will be of single span construction which is preferable to avoid impacts on Atlantic salmon, brown trout and European eel and their in-stream habitats.
- 11.8.5 Brown trout within Loch Quoich have the potential to be impacted by the construction footprint in the works area. Displacement and / or mortality is possible in the absence of mitigation. If there is any dewatering required, there is the possibility of fish disturbance / strandings / mortality. For context, the construction footprint only covers around 500m of shoreline which is approximately 0.86% of the total shoreline of Loch Quoich. Arctic charr and ferox trout are less likely to be affected due to their preference for deeper water >30m. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)** for all species within Loch Quoich.

#### Partial Dewatering of Loch Quoich

- 11.8.6 Arctic charr have the potential to be affected by partial dewatering required in Loch Quoich to facilitate the installation of temporary works. The risk from this effect is that dewatering during the egg incubation period has the potential to result in developing eggs laid in the shallow littoral zone becoming dry and thus dying (see **Appendix 11.4**). The significance of this effect prior to mitigation is considered to be **Major (Significant)** for Arctic charr within Loch Quoich.
- 11.8.7 Riverine spawning brown trout and ferox trout have the potential to be impacted by the partial dewatering of Loch Quoich. Given the topography of the loch basin, there may be instances where access to certain spawning burns is cut off due to impassable barriers to fish migration presenting as a result of the water level drawdown. Although no evidence exists within Loch Quoich, there is some evidence of Arctic charr spawning in rivers, therefore under the precautionary principle, Arctic charr are included as potentially affected. It is likely these effects would occur during one spawning season. It is worth noting that with the existing Loch Quoich having been created by an impoundment, there will be former natural river channels which may become more visible as the water level recedes but this is now likely to be highly sedimented and unsuitable for spawning. Main river channels on shallower gradients may still be navigable but fish accustomed to spawning in higher altitude reaches may be hindered by aforementioned drop offs which are normally accessible under the operational regime of the existing hydroscheme. The significance of this effect prior to mitigation is considered to be **Major (Significant)** for Arctic charr and ferox trout and **Minor (Not Significant)** for brown trout.

Water Quality

- 11.8.8 All fish species within the Proposed Development and zone of influence have the potential to be impacted by water quality changes as a result of dust, run off, chemical/fuel spills and/or concrete washout from construction works without mitigation. Water quality parameters likely to be affected include, but are not limited to, turbidity, total dissolved solids, total suspended solids, pH, conductivity and temperature. The significance of this effect prior to mitigation is considered to be **Moderate (Significant)** for Arctic charr, Atlantic salmon, European eel and ferox trout and **Minor (Not Significant)** for brown trout.
- 11.8.9 Brown trout populations in the lower reaches of the Allt Fearn, downstream of impassable barriers to migration may experience increased levels of siltation due to dewatering and over-pumping of the water from Loch Fearn to facilitate the construction of Fearn Dam. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)** for brown trout.
- 11.8.10 Areas surrounding both waterbodies and watercourses (e.g. dam footprint areas) are particularly prone to dust pollution as a result of construction works being situated close to **borrow pit** locations with associated increased traffic and crushing of aggregates concentrating dust on Site. This has the potential to deteriorate water quality (as in Section 11.8.7), notably with increased suspended solids. Without mitigation this has the potential to impact all aquatic IEFs. Due to the absence of fish within Loch Fearn, the risk for fish is limited to Loch Quoich and watercourses along the Proposed SAR. The significance of this effect prior to mitigation is considered to be **Moderate (Significant)** for Arctic charr, Atlantic salmon, ferox trout, European eel and **Minor (Not Significant)** for brown trout.
- 11.8.11 Macroinvertebrates, have the potential to be impacted by changes in water quality as a result of construction works around Loch Fearn, Loch Quoich and the watercourses crossed by the proposed access track. Increases in suspended siltation and/or silt accumulating on the watercourse may be detrimental to macroinvertebrate life via oxygen deprivation. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)** for macroinvertebrates.
- 11.8.12 Macrophytes in Loch Fearn have the potential to be impacted by changes in water quality during the construction phase. Increases in suspended siltation and/or silt accumulating on the loch bed may deplete oxygen and changes in pH balance may create unsuitable conditions for plants to survive. Macrophyte communities in Loch Fearn are not considered of conservation value with the taxa categorised as 'Least concern', therefore significance of effect is considered **Minor (Not Significant)**.

Water Temperature

- 11.8.13 The water temperature investigation undertaken (see **Appendix 11.3**) has demonstrated that water temperatures within Loch Quoich are highly stable, and resistant to significant change. Prevailing air temperature has been demonstrated to be the dominant driving mechanism. Construction activity related to the Proposed Development is not expected to have any impact on the water temperature regime, therefore the significance of effect is considered **Negligible (Insignificant)**.

Partial Dewatering of Loch Fearn to facilitate Fearn Dam Construction

- 11.8.14 Partial dewatering of Loch Fearn will lower the average water level considerably resulting in the prolonged aerial exposure of the littoral zone. This is likely to have a temporary, high magnitude effect on macrophyte and macroinvertebrate abundance and distribution. This high magnitude effect is then predicted to be permanent during the operational phase.
- 11.8.15 Macrophytes are unlikely to survive prolonged aerial exposure without frequent submergence. Macrophyte communities in Loch Fearn are not considered of conservation value with the taxa categorised as 'Least concern', therefore significance of effect is considered **Minor (Not Significant)**.
- 11.8.16 The macrophytes in the littoral zone are likely to establish / remain in the new, lowered littoral zone at lower water levels, however, dewatering is a temporary measure and future operational water level fluctuations are predicted to affect macrophyte growth.

- 11.8.17 Macroinvertebrates in the outflowing watercourse the Allt Fearna are unlikely to be affected by dewatering as water flows will be maintained. Macroinvertebrates within the littoral zone of Loch Fearna are likely to be affected given the extent of water drawdown, less than 20 m (location dependent). The majority of macroinvertebrates are unable to track receding water levels and are predicted to become stranded within the drawdown zone where mortality and/or predation is likely to occur. No macroinvertebrate with high conservation interest (i.e. Red Data Book Vulnerable, Rare, Endangered) were identified within Loch Fearna consequently significance of effect is considered to be **Minor** (Not Significant).

#### Quarrying

- 11.8.18 Aggregates and crushed rock would be sourced from the powerhouse excavation, from the excavation of the underground waterway systems, and where required from a number of quarried borrow pits.
- 11.8.19 Quarrying will cause no loss of aquatic habitat however Surface run-off of dust and pollutants has the potential to impact water quality of the waterbodies in the vicinity of borrow pits (refer to paragraphs on water quality 11.8.7 - 11.8.11).
- 11.8.20 Increased traffic and works near the waterbodies and/or watercourses has the potential to increase dust and/ or surface run-off of suspended solids, however, reduced distance between aggregate sources (i.e. borrow pits) and dams reduces disturbance to other IEFs (see **Chapter 8: Terrestrial Ecology** and **Chapter 10: Ornithology**). The significance of this effect prior to mitigation is considered to be **Moderate** (Significant) for Arctic charr, Atlantic salmon, European eel and ferox trout and **Minor** (Not Significant) for brown trout, macroinvertebrates and macrophytes.

#### Noise

- 11.8.21 Fish species in Loch Quoich within the vicinity of the works area have the potential to be impacted by noise from construction works including: quarrying for borrow pits; blasting in relation to the powerhouse and tunnels, access track construction; and transportation of aggregate around the construction site. Effects of noise associated with such works are considered to lead to negative behavioural responses (e.g. avoidance response), sub-lethal (e.g. shifts in hearing thresholds and/or disorientation) and/or lethal (e.g. mortality). The magnitude of impact is proportional to the sound level, distance between noise source and fish receptor and species of fish. In relation to noise and salmonid fish, Atlantic salmon (*Salmo salar*) are known to detect low frequency acoustic stimuli below 380 Hz, this correlates to dominant frequencies produced from piling operations, 100 Hz to 2kHz<sup>31</sup>. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)** for brown trout. Brown trout are the primary IEF inhabiting the pelagic and littoral zones as well as inflowing watercourses and therefore most sensitive to noise pollution. Arctic charr and ferox trout are not predicted to be affected as they inhabit deeper water at around 35m, increasing the distance between noise and receptor. During spawning periods Arctic charr may migrate to shallower littoral zones to spawn in the loch margins where they may come into contact with louder noise as a result of the construction. Ferox trout may also migrate into inflowing watercourses in closer proximity to the works area. Exposure to noise is likely to be low in frequency and duration, and in volumes not sufficient to cause injury and/or mortality, therefore significance of effect for Arctic charr and ferox trout is considered to be **Minor (Not Significant)**.
- 11.8.22 During upgrades to the access track, construction of new bridges and movement of aggregates along access tracks, Atlantic salmon brown trout and European eel have the potential to be exposed to higher levels of noise. Effects are considered to be temporary in nature, causing avoidance responses. There is no potential for sub-lethal / lethal effects as instream works are not required, the significance of effect prior to mitigation is considered to be **Imperceptible (Not Significant)** for brown trout and **Minor (Not Significant)** for Atlantic salmon and European eel.

<sup>31</sup> Scottish Government. (2016). Measurement of Hearing in the Atlantic salmon (*Salmo salar*). [Online] Available at: [https://www.gov.scot/publications/measurement-hearing-atlantic-salmon-salmo-salar/#:~:text=Atlantic%20salmon%20are%20known%20to,et%20al.%2C%202015\).](https://www.gov.scot/publications/measurement-hearing-atlantic-salmon-salmo-salar/#:~:text=Atlantic%20salmon%20are%20known%20to,et%20al.%2C%202015).)

- 11.8.23 Perception of noise for different species of fish and at different life stage is critical in determining extent of impact. For example, variation in noise perception is proportional to the distance between the swim bladder and the inner ear. In smaller species, or fish in younger life stages associated with smaller physical appearances, this distance is smaller resulting in more acute noise perception.
- 11.8.24 Cumulative noise from construction activity should not exceed 60 dB at its maximum, general cumulative noise on the estate is predicted to be below 50 dB (see Chapter 18: Noise and Vibration).
- 11.8.25 Acoustic propagation modelling would be required to display the current and potential soundscape of the underwater environment in Loch Quoich to determine the extent / distance to which noise travels laterally and horizontally within the water column, and the interaction of noise with environmental variables. This has not been conducted within this assessment.
- 11.8.26 Construction noise and vibration would be managed through a Construction Noise and Vibration Management Plan (CNVMP) which would be agreed prior to construction works.

#### Vibration

- 11.8.27 Piling is anticipated to be required during the construction of the powerhouse, but is primarily limited to terrestrial habitats and instream use will be kept to a minimum; effects are therefore expected to be minimal (if present). Vibratory piling (as suggested in Chapter 18: Noise and Vibration) has been shown to have no obvious signs of trauma or startle responses in brown trout<sup>32</sup>. Equivalent vibratory studies for other species are not available, however, it is anticipated that vibration will likely have a reduced effect on Arctic charr and ferox trout (when compared to brown trout) due to the species' preference for deeper water.
- 11.8.28 Blasting activities during construction have the potential to cause barotrauma (notably to swim bladders)<sup>33</sup>. Blasting guidelines established that blast induced pressures should not exceed 2.7 psi (lbs/in, 19 kPa) in the water and vibrations should not exceed 0.5 in/s (13 mm/s) in spawning gravels when fish or embryos are present. Mitigation measures proposed in the CNVMP would limit the number of blasting related activities and noise levels, and take into consideration aquatic features.
- 11.8.29 As stated above, brown trout inhabiting pelagic and littoral zones as well as inflowing watercourses are therefore more sensitive to noise pollution versus Arctic charr and ferox trout which carry a higher conservation value. The significance of this effect prior to mitigation is therefore considered to be **Minor (Not Significant)** for Arctic charr, brown trout and ferox trout.
- 11.8.30 During upgrades to the access track, construction of new bridges, Atlantic salmon brown trout and European eel have the potential to be exposed to higher levels of vibration. Effects are considered to be temporary in nature, causing avoidance responses. There is no potential for sub-lethal / lethal effects as no instream works are required, e.g. piling. The significance of effect prior to mitigation is considered to be **Imperceptible (Not Significant)** for brown trout and **Minor (Not Significant)** for Atlantic salmon and European eel.

<sup>32</sup> Nedwell, J., Turnpenny, A., Lovell, J. and Edwards, B. (2006). An Investigation into the Effects of Underwater Piling Noise on Salmonids. *Journal of the Acoustical Society of America*. 120(5). pp. 2550-2554.

<sup>33</sup> Kolden, K. D. and Aimone-Martin, C. (2013). Blasting Effects on Salmonids. Alaska Department of Fish & Game.

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Construction Lighting

- 11.8.31 For safety reasons, temporary lighting would be required for all external construction activities during hours of darkness and low natural light. Lighting would also be required at the construction compounds.
- 11.8.32 Brown trout are the primary IEF inhabiting the pelagic and littoral zones of Loch Quoich and therefore more sensitive to light pollution than Arctic charr and ferox trout which typically reside in deeper water, notably where existing populations are not habituated to artificial light sources.
- 11.8.33 Within Loch Quoich, the significance of this effect prior to mitigation is considered to be **Minor (Not Significant)** for brown trout. Arctic charr and ferox are more likely to be occupying deeper areas (>30m depth) of the Loch and light is unlikely to reach benthic habitats, and at a level sufficient to cause harm, therefore effects are considered to be **Minor (Not Significant)**.
- 11.8.34 Atlantic salmon, brown trout and European eel also have the potential to be affected at crossing points along the proposed access track where lighting may be required during bridge construction. Floodlit watercourses and/or waterbodies increase the likelihood of displacement and / or predation of fish as well as affecting migration behaviours<sup>34</sup>. Any areas affected by excess lighting will compromise a small area in the context of the waterbodies and the wider catchment.
- 11.8.35 At watercourse crossings along the proposed access track the significance of effect is prior to mitigation is considered to be **Moderate (Significant)** for Atlantic salmon and European eel and **Minor (Not Significant)** for brown trout.
- 11.8.36 The final Construction Environmental Management Document (CEMD), to be prepared by the appointed Principal Contractor, will include a detailed description of lighting requirements for construction activities and measures that would be implemented during construction to minimise illumination, glare or light spillage to nearby receptors.
- 11.8.37 Zooplankton are known sensitive receptors to artificial light pollution. This has the potential to disrupt natural rhythms on a daily, lunar (monthly) and seasonal scale which may influence feeding, breeding and/or natural movement patterns. This has the potential to reduce and fragment populations but it is predicted this will be an across a negligible area of Loch Quoich within the vicinity of the powerhouse construction. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)**.
- 11.8.38 Macroinvertebrates are known sensitive receptors to artificial light pollution, similar to their prey species (e.g. zooplankton). This has the potential to disrupt natural rhythms on a daily, lunar (monthly) and seasonal scale as they mimic change in patterns in line with prey species distribution. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)**. This additionally has the potential to impact prey availability for fish and avian/mammal predators (e.g. divers and otters). For effect on reduction of fish as a prey species refer to **Chapter 8: Terrestrial Ecology**.

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<sup>34</sup> Vowles. A. S. and Kemp. P. S., (2021) Artificial light at night (ALAN) affects the downstream movement behaviour of the critically endangered European eel, *Anguilla anguilla*, Environmental Pollution, Volume 274, 116585, ISSN 0269-7491, [Online] Available at: <https://www.sciencedirect.com/science/article/pii/S0269749121001639>

Invasive non-native species

- 11.8.39 Inadvertent introduction of invasive non-native species (INNS) may occur through increased traffic and importing of materials during the construction phase. Transfer of non-native fish species and pathogens is considered very unlikely on the project given that materials will be transported to site over land. Species such as American signal crayfish can have deleterious effects on fish populations as they predate on fish eggs, burrow into riverbanks causing erosion and compete with fish for prey items. There are no records of this species within the Ness catchment however the species can survive out of water under certain conditions for short periods of time so may have the potential to be introduced between catchments in the absence of consideration for biosecurity (species is present in neighbouring Nairn catchment<sup>35</sup>). The transfer of invasive plant species (e.g. giant hogweed *Heracleum mantegazzianum*, Himalayan balsam *Impatiens glandulifera*, Japanese knotweed *Fallopia japonica*, American skunk cabbage *Lysichiton americanus*, and white butterbur *Petasites albus*) is considered more of a risk. Introduction of INNS will be mitigated within the CEMD via a biosecurity plan.

**Table 11.13 Summary of likely Construction Phase Impacts and effects on IEFs Prior to Mitigation**

| IEF/<br>Importance Level | Impacts                           | Effect                                                                        | Impact Scale                            | Significance of Effect Prior to Mitigation |
|--------------------------|-----------------------------------|-------------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------|
| Arctic charr<br>National | Construction footprint            | Displacement, mortality and/or displacement (Loch Quoich works area).         | Medium term, Negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                          | Partial Dewatering of Loch Quoich | Lowering of water level causing aerial exposure and desiccation of laid eggs. | Short term, medium adverse effect       | <b>Major</b> , Significant                 |
|                          |                                   | Lowering of water level preventing access to spawning burns.                  | Short term, medium adverse effect       | <b>Major</b> , Significant                 |
|                          | Water quality                     | Dust and pollution run off.<br><br>Changes in water quality and fish habitat. | Medium term, low, adverse effect        | <b>Moderate</b> , Significant              |
|                          | Quarrying                         | Changes in water quality and fish habitat.                                    | Medium term, low, adverse effect        | <b>Moderate</b> , Significant              |
|                          | Noise                             | Behavioural responses of avoidance.<br>Acute                                  | Medium term, negligible,                | <b>Minor</b> , Not Significant             |

<sup>35</sup> NDSFB (2021) Ness Catchment Biosecurity Plan (2021 – 2030) [Online] Available: [invasivespecies.scot/sites/sisi8/files/Ness-Biosecurity-Plan-2020-v1.1-161220.pdf](https://invasivespecies.scot/sites/sisi8/files/Ness-Biosecurity-Plan-2020-v1.1-161220.pdf) [Last Accessed 13/02/2025]

| IEF/<br>Importance Level    | Impacts                              | Effect                                                                                 | Impact<br>Scale                                     | Significance of<br>Effect Prior to<br>Mitigation |
|-----------------------------|--------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------------|
|                             |                                      | physical injury<br>or mortality.                                                       | adverse<br>effect                                   |                                                  |
|                             | Vibration                            | Behavioural<br>responses of<br>avoidance.<br>Acute<br>physical injury<br>or mortality. | Medium<br>term,<br>negligible,<br>adverse<br>effect | <b>Minor</b> , Not<br>Significant                |
|                             | Construction lighting                | Displacement<br>and increased<br>predation risk.                                       | Medium<br>term,<br>negligible,<br>adverse<br>effect | <b>Minor</b> , Not<br>Significant                |
| Atlantic salmon<br>National | Water quality                        | Dust and<br>pollution run<br>off.                                                      | Medium<br>term, low,<br>adverse<br>effect           | <b>Moderate</b> ,<br>Significant                 |
|                             | Quarrying                            | Changes in<br>water quality<br>and fish<br>habitat.                                    | Medium<br>term, low,<br>adverse<br>effect           | <b>Moderate</b> ,<br>Significant                 |
|                             | Noise                                | Behavioural<br>responses of<br>avoidance.<br>Acute<br>physical injury<br>or mortality. | Medium<br>term, low,<br>adverse<br>effect           | <b>Minor</b> , Not<br>Significant                |
|                             | Vibration                            | Behavioural<br>responses of<br>avoidance.<br>Acute<br>physical injury<br>or mortality. | Medium<br>term, low,<br>adverse<br>effect           | <b>Minor</b> , Not<br>Significant                |
|                             | Construction lighting                | Displacement<br>and increased<br>predation risk                                        | Temporary,<br>low<br>adverse<br>effect              | <b>Moderate</b> ,<br>Significant                 |
| Brown trout<br>Local        | Construction<br>footprint            | Displacement,<br>mortality<br>and/or<br>displacement<br>(Loch Quoich<br>works area).   | Medium<br>term, Low,<br>adverse<br>effect           | <b>Minor</b> , Not<br>Significant                |
|                             |                                      | Instream<br>works for<br>installation of<br>bridges along<br>access track.             | Temporary,<br>Low, adverse<br>effect                | <b>Minor</b> , Not<br>Significant                |
|                             | Partial dewatering of<br>Loch Quoich | Lowering of<br>water level<br>preventing<br>access to<br>spawning<br>burns.            | Short term,<br>medium<br>adverse<br>effect          | <b>Minor</b> , Not<br>Significant                |

| IEF/<br>Importance Level        | Impacts                           | Effect                                                                                                            | Impact<br>Scale                                                      | Significance of<br>Effect Prior to<br>Mitigation |
|---------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------|
|                                 | Water quality                     | Dust and pollution run off                                                                                        | Medium term, medium, adverse effect                                  | <b>Minor</b> , Not Significant                   |
|                                 | Quarrying                         | Changes in water quality and fish habitat.                                                                        | Medium term, low, adverse effect                                     | <b>Minor</b> , Not Significant                   |
|                                 | Noise                             | Behavioural responses of avoidance. Acute physical injury or mortality.                                           | Medium term, medium, adverse effect                                  | <b>Minor</b> , Not Significant                   |
|                                 | Vibration                         | Behavioural responses of avoidance. Acute physical injury or mortality.                                           | Medium term, medium, adverse effect                                  | <b>Minor</b> , Not Significant                   |
|                                 | Construction lighting             | Displacement and increased predation risk                                                                         | Medium term (loch) and temporary (access track), low, adverse effect | <b>Minor</b> , Not Significant                   |
| Brown trout (ferox)<br>National | Construction footprint            | Displacement, mortality and/or displacement (Loch Quoich works area (Unlikely due to preference for deeper water) | Medium term, negligible, adverse effect                              | <b>Minor</b> , Not Significant                   |
|                                 | Partial dewatering of Loch Quoich | Lowering of water level preventing access to spawning burns.                                                      | Short term, medium adverse effect                                    | <b>Major</b> , Significant                       |
|                                 | Water quality                     | Dust and pollution run off                                                                                        | Medium term, low, adverse effect                                     | <b>Moderate</b> , Significant                    |
|                                 | Quarrying                         | Changes in water quality and fish habitat.                                                                        | Medium term, low, adverse effect                                     | <b>Moderate</b> , Significant                    |
|                                 | Noise                             | Behavioural responses of avoidance. Acute                                                                         | Medium term, negligible,                                             | <b>Minor</b> , Not Significant                   |

| IEF/<br>Importance Level      | Impacts                           | Effect                                                                             | Impact Scale                            | Significance of Effect Prior to Mitigation |
|-------------------------------|-----------------------------------|------------------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------|
|                               |                                   | physical injury or mortality.                                                      | adverse effect                          |                                            |
|                               | Vibration                         | Behavioural responses of avoidance.<br>Acute physical injury or mortality.         | Medium term, negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                               | Construction lighting             | Displacement and increased predation risk                                          | Medium term, Negligible, adverse effect | <b>Minor</b> , Not Significant             |
| European eel<br>International | Water quality                     | Dust and pollution run off.                                                        | Medium term, low, adverse effect        | <b>Moderate</b> , Significant              |
|                               | Quarrying                         | Changes in water quality and fish habitat.                                         | Medium term, low, adverse effect        | <b>Moderate</b> , Significant              |
|                               | Noise                             | Behavioural responses of avoidance.<br>Acute physical injury or mortality.         | Medium term, low, adverse effect        | <b>Minor</b> , Not Significant             |
|                               | Vibration                         | Behavioural responses of avoidance.<br>Acute physical injury or mortality.         | Medium term, low, adverse effect        | <b>Minor</b> , Not Significant             |
|                               | Construction lighting             | Displacement and increased predation risk                                          | Temporary, low, adverse effect          | <b>Moderate</b> , Significant              |
| Macroinvertebrates<br>Local   | Quarrying                         | Changes in water quality and habitat.                                              | Medium term, low, adverse effect        | <b>Minor</b> , Not Significant             |
|                               | Dewatering of Loch Fearna         | Lowering of water level, concentrating populations and reducing available habitat. | Medium term, medium, adverse effect     | <b>Minor</b> , Not Significant             |
|                               | Partial Dewatering of Loch Quoich | Lowering of water level, concentrating populations and reducing                    | Short term, medium adverse effect       | <b>Minor</b> , Not Significant             |

| IEF/<br>Importance Level | Impacts                   | Effect                                                                                                                          | Impact<br>Scale                     | Significance of<br>Effect Prior to<br>Mitigation |
|--------------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------|
|                          |                           | available habitat.                                                                                                              |                                     |                                                  |
|                          | Construction lighting     | Disruption to natural rhythms and prey species movement patterns, impacting feeding, breeding and/or natural movement patterns, | Medium term, low, adverse effect    | <b>Minor</b> , Not Significant                   |
|                          | Water quality             | Dust and pollution run off.                                                                                                     | Medium term, medium, adverse effect | <b>Minor</b> , Not Significant                   |
| Macrophytes<br>Local     | Quarrying                 | Changes in water quality.                                                                                                       | Medium term, low, adverse effect    | <b>Minor</b> , Not Significant                   |
|                          | Dewatering of Loch Fearna | Loss of available littoral zone habitat.                                                                                        | Medium term, medium, adverse effect | <b>Minor</b> , Not Significant                   |
|                          | Water quality             | Dust and pollution run off.                                                                                                     | Medium term, medium, adverse effect | <b>Minor</b> , Not Significant                   |
|                          | Introduction of INNS      | Changes to species assemblages or habitat.                                                                                      | Permanent, high, adverse effect     | <b>Minor</b> , Not Significant                   |

### Operational Effects

- 11.8.40 The operation phase is predicted to last indefinitely, consequently all duration of effects are predicted to be permanent (30+ years).

#### Fish attraction to the intake

- 11.8.41 The fish present do not typically display migratory pathways within waterbodies, therefore under the precautionary principle it is assumed that fish will likely be present around the proposed location of the intake structure. Brown trout are known to demonstrate a rheotactic movement response to currents/flowing water<sup>36</sup>, however, this may not be as strong a response as other migratory salmonids (e.g. Atlantic salmon or sea trout). Attraction towards the screen during abstraction periods would increase energy expenditure and make fish more vulnerable to predation from mammalian (e.g. otter) and avian predators (e.g. divers).
- 11.8.42 Ingress and entrainment of fishes through the reversible pumps and into underground waterway system presents risk of injury, mortality and/or transfer of individuals between Loch Quoich and Loch Fearn. Given high morphological and phenotypic variations in Arctic charr recorded within other lochs in Scotland<sup>37</sup>, it is considered under the precautionary principle that individuals in Loch Quoich are also genetically distinct. The intake will feature screens to prevent debris and the entrainment of fish. The best practice guide for screening for intakes and outfalls recommend screen mesh aperture of  $\leq 12.5$  mm to protect migratory salmonids from hydro scheme infrastructure<sup>38</sup>, a maximum mesh aperture size of 12.5 mm will be employed at the intake. Smaller mesh aperture sizes can pose problems with continual foliage / debris build up and increase velocities across the screen, likely increasing the overall impact on fish. Brown trout in the locality of the screens may be more susceptible to attraction to the intake versus Arctic charr and ferox trout which prefer deeper areas of the loch. The significance of this effect for Arctic charr, brown trout and ferox trout prior to mitigation is **Minor (Not Significant)**.
- 11.8.43 Eurasian minnow are present in Loch Quoich, and the transfer of live individuals poses a risk of introducing this invasive non-native species (INNS) to the upper reservoir, which is currently known to be devoid of fish. Eurasian minnows compete with brown trout for food and habitat, and they are also known to prey on salmonid eggs and fry in shallow waters. However, these impacts are unlikely to occur at Loch Fearn, as there is no existing population of brown trout. The introduction of Eurasian minnow may also provide a potential food source for fish-eating birds such as divers and common scoter.
- 11.8.44 Fish present near the intake screens pose a risk of impingement against intake screens. The sustained swimming speed of an Arctic charr of 0.10 m body length is 0.411 m/s and the designed maximum velocity approaching the intake is less than 0.3 m/s, therefore juvenile Arctic charr would have the ability to overcome the draw of the intake velocity voluntarily preventing any injury / mortality associated with impingement on the screens. Similarly, brown trout of 0.10 m body length have a sustained swimming speed of 0.598 m/s<sup>39</sup>. Larger Arctic charr and brown trout have greater sustained swimming speeds. Regular clearing of the intake screen should prevent debris build-up that may increase approach velocities across the screen outwith escapable velocities. The significance of this effect for Arctic charr, ferox trout and brown trout prior to mitigation is **Minor (Not Significant)**.

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<sup>36</sup> O'Keeffe, N. & Turnpenny, A.W.H. (2005) Screening for Inlet and Outlets: a best practice guide. Science Report SC030231. Environment Agency: Bristol

<sup>37</sup> Maitland, P. S. and Adams, C. E. (2017). Arctic Charr in the Lochs of Scotland: An Assessment of Distribution and Status.

<sup>38</sup> Turnpenny, A.W.H. and O'Keeffe, N. (2005). Screening for Intake and Outfalls: a best practice guide. [Online] Available at: Microsoft Word - W6\_103 TR \_amended\_\_1.doc (publishing.servici.e aov.uk)

<sup>39</sup> Peake, S. J., (2008) Swimming performance and behaviour of fish species endemic to Newfoundland and Labrador: A literature review for the purpose of establishing design and water velocity criteria for fishways and culverts. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2843 pp. 8 and 33.

*Fluctuations in Water Levels*

- 11.8.45 A study of the PSH in relation to Arctic charr in Loch Quoich has been carried out by Professor Colin Adams to inform this assessment and is attached at **Appendix 11.4: Loch Fearn Pumped Storage Hydroscheme: Summary of the status and mitigation of impact upon Arctic charr.**
- 11.8.46 Impacts of the fluctuations in water levels within Loch Quoich are considered below. The PSH will operate within the current licenced operational range of the loch which is controlled by SSE for hydroelectric generation at Quoich Dam. While the PSH will follow the natural level fluctuations of Loch Quoich, it is expected to increase water level variability by up to 2.5–3.2 meters (worst case scenario) around the future baseline level, depending on demand from the PSH for pumping and generation. Although fluctuations will become more frequent compared to current operations, the water levels will still remain within the loch's established operational range. Embedded mitigation in the form of regulated stop-pumping and stop-generating levels, will be applied via a SEPA CAR Licence application to prevent variations beyond the baseline loch levels.
- 11.8.47 The water level fluctuations in Loch Quoich that result from the combination of the operation of the existing Quoich hydro generation dam and natural variation in hydrological conditions, have been examined during spawning and incubation periods of Arctic charr from between 2016 and 2024. These data show that in five of the eight years, water levels fell between the likely spawning period and end of the incubation period, potentially leaving Arctic charr eggs aurally exposed. The maximum decline in water level between these periods was 5.5 m and the lowest was 0.77m. In the remaining three years, water levels were higher during the incubation period than during the spawning period (range 0.2 m to 0.81m). These range fluctuations are all well within the operating constraints of the existing hydro dam of 26 m. As Arctic charr in Loch Quoich are likely to spawn in the depth range of 1 to 10 m, it is probable that in four of the years when water levels declined, there was a negative effect on spawning success resulting from egg mortality. In years when the decline was less than 1 m, or there was a water level rise, egg stranding was unlikely to be a source of mortality.
- 11.8.48 The operation of the proposed PSH has the potential to superimpose a shorter duration (hours to days) higher frequency water level change on top of the longer term existing pattern of change. The maximum water level change resulting from the proposed operation of the PSH is 3.2 m within 24 hours. If, as is likely, a drawdown of this magnitude occurs during the egg incubation period, then there is the likelihood of aerial exposure of deposited eggs. Hindcasting this effect to years for which there are data (from 2016 to 2024) a 3.2 m drawdown (worst case) would likely impact all years; that is both in years where there was an increase in water level between egg laying and incubation (because the water level rise is relatively modest (<1m)) and in years where there was a water level decline. In none of these years (2016 to 2024) would it be likely that all eggs in the spawning area would be stranded and lost, but in some years a reasonably high proportion may be<sup>40</sup>. The significance of this effect for Arctic charr prior to mitigation is considered to be **Major (Significant)**.
- 11.8.49 Riverine spawning brown trout and ferox trout have the potential to be impacted by water level fluctuations ( $\pm 3.2$  m under a worst case scenario) as a result of the pumping cycles of the PSH. Given the topography of the loch basin, there may be instances where access to certain steeper spawning burns is temporarily cut off due to impassable barriers to fish migration presenting as a result of the water level drawdown. Although no evidence exists within Loch Quoich, there is some evidence of Arctic charr spawning in rivers, therefore under the precautionary principle, Arctic charr are included as potentially affected. It is worth noting that with Loch Quoich being created by an artificial impoundment, there may be formerly natural river channels which may become more visible as the water level recedes but this is likely to be highly sedimented and unsuitable for spawning. Main river channels on shallower gradients may still be navigable but fish accustomed to spawning in higher altitude reaches may be hindered by aforementioned drop offs which are normally accessible under the operational regime of the existing hydroscheme. Due to the fluctuating nature of the operation of the PSH, this effect is likely to only cause temporary delays to

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<sup>40</sup> Adams. C. E., (2025) Loch Fearn Pumped Storage Hydroscheme: Summary of the status and mitigation of impact upon Arctic charr.

migration (hours to days) during the spawning period versus the baseline conditions. Access will become available for fish once when the PSH returns to a generation cycle and the level of Loch Quoich rises. There may also be instances where the PSH operation causes the level of Loch Quoich to be raised above the normal baseline, which could present improved accessibility of certain spawning burns for fish. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)** for Arctic charr and ferox trout and **Imperceptible (Not Significant)** for brown trout.

- 11.8.50 Fish occupying newly flooded areas of Loch Quoich post generating periods may become stranded on the dry shore when the water level recedes during pumping periods. This would place individuals at greater risk of injury, mortality and/or predation. It is anticipated that this would be an unlikely occurrence as most fish would track receding water levels during pumping periods and that trout are unlikely to be feeding over areas of the littoral zone which have been previously dry, due to a lack of aquatic invertebrates. Arctic charr and ferox trout are only anticipated to be potentially impacted during spawning periods (September – December) given their tendency to occupy deeper loch areas around 35m depth (and not the littoral zones primarily affected). Impacts on spawning are discussed separately. The significance of this effect for Arctic charr, ferox trout and brown trout is considered to be **Minor (Not Significant)** due to the differences in location preferences of these fish versus the likely impact.
- 11.8.51 Although many Arctic charr populations spawn in the littoral zone, some spawn at greater depths. Studies in Lake Windermere suggested a spawning depth of 1-3 m were used by Autumn spawners (peak in November) whilst deeper spawning grounds ranged from 15-20 m in depth<sup>41</sup>. It is likely that Arctic Charr in Loch Quoich spawn within a depth range of 1-10 m<sup>42</sup>. In Scotland, some Arctic charr, like brown trout, are also known to utilise streams for spawning<sup>43</sup>. Adaptation to different spawning locations may be out of necessity for survival on lochs which have been affected by hydro drawdown.
- 11.8.52 Arctic charr, brown trout and ferox trout utilising inflowing streams to Loch Quoich for spawning may be impacted by fluctuations in water level. The lower reaches of the inflowing streams may be prone to more rapid water level fluctuation, resulting in unsettled conditions for spawning. However due to the baseline operating regime of Loch Quoich, these areas are already affected by water level fluctuations. Long term water level data show that even during the sensitive period for spawning and egg development, the Loch features water level fluctuations of up to 7m increase and 3m decrease under the current Loch Quoich operational regime. It is anticipated that any eggs deposited in these stream areas would remain safe in the gravel during fluctuating water levels, remaining wetted with sufficient oxygen levels due to wave action in marginal areas and the influence of the existing inflowing streams. It is expected that juvenile salmonid fish residing in these streams already either adapt to fluctuation in water levels or choose not to use these areas for refuge in the affected areas within the operational range of the reservoir. Brown trout are known to exhibit movements within streams<sup>44</sup> and may have the ability to adapt to changing conditions in these transitional areas as well as natural changes to their environment. The significance of this effect for Arctic charr and ferox trout is considered to be **Minor (Not Significant)** and **Imperceptible (Not Significant)** for brown trout.
- 11.8.53 Plankton species are unlikely to be affected by fluctuating water levels compared to littoral zone species likely to be affected by water level change. This is unlikely to impact plankton feeding Arctic charr morphs, however, zoobenthos, favoured by brown trout are likely to be significantly

<sup>41</sup> Frost, W.E. (1965). Breeding habits of Windermere charr, *Salvelinus willughbii* (Günther) and their bearing on speciation of these fish. Proceedings of the Royal Society, Series B 163: 473 232-284.

<sup>42</sup> Adams, C. E., (2025) Loch Fearn Pumped Storage Hydroscheme: Summary of the status and mitigation of impact upon Arctic charr. University of Glasgow.

<sup>43</sup> Walker, A. F. (2006). Stream spawning of Arctic charr in Scotland. Ecology of Freshwater Fish. 16(1): 47-53.

<sup>44</sup> Aparicio E, Rocaspana R, de Sostoa A, Palau-Ibars A, Alcaraz C. Movements and dispersal of brown trout (*Salmo trutta* Linnaeus, 1758) in Mediterranean streams: influence of habitat and biotic factors. [Online] Available at: [Movements and dispersal of brown trout \(Salmo trutta Linnaeus, 1758\) in Mediterranean streams: influence of habitat and biotic factors - PMC](#)

affected<sup>45,46</sup>. As described in **section 11.8.37**, due to the baseline operating regime of Loch Quoich, these areas are already affected by water level fluctuations under the baseline scenario due to the operation of Quoich dam. The significance of this effect is considered to be **Minor (Not Significant)** for Arctic charr and brown trout.

- 11.8.54 Macroinvertebrates are likely to be affected by more frequent and rapid water level variations within the littoral zone of Loch Quoich. As discussed, these areas are already impacted by fluctuation in water level due to the operational regime of Quoich Dam. Macroinvertebrate populations in hydro scheme drawdown zones tend to be low in species richness<sup>47</sup>. Macroinvertebrate samples showed a low number of taxa and species richness in the shoreline of Loch Quoich. Macroinvertebrates may not be able to track receding water levels and may be at greater risk of mortality and this effect will be exacerbated by more rapid and frequent fluctuations with the operation of the Proposed Development. The significance of this effect is considered to be **Minor (Not Significant)** for macroinvertebrates.
- 11.8.55 Macroinvertebrates in Loch Fearn have the potential to be impacted by the constant fluctuations in the water levels between maximum and minimum inundation levels. It is anticipated that this impact would cause unsettled conditions in the current littoral zone during inundation and potential loss of original nursery habitat within the lochs for species preferring shoreline habitats. Macroinvertebrate communities are widespread within the local area and no species of high conservation interest were recorded within field studies at Loch Fearn. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)**.
- 11.8.56 Macrophyte species are likely to be affected with fluctuating levels within Loch Fearn as the photic zone where plants are currently rooted to the bottom will become inundated by a water level rise of up to 62m, putting these plants frequently outwith their optimal range and unable to obtain light for photosynthesis. Macrophyte communities in Loch Fearn are not considered of conservation value with the taxa categorised as 'Least concern', therefore significance of effect is considered **Minor (Not Significant)**.

#### Dams

- 11.8.57 Once constructed, the Fearn Dam and the Coire Dubh Dam will have regulated compensation flows, mimicking natural flow conditions which will be beneficial to the aquatic features within the watercourses, maintaining wetted habitat throughout.
- 11.8.58 There were no fish detected within the vicinity of the proposed dams during baseline surveys and therefore no permanent impacts on fish are expected once the dams are operational.
- 11.8.59 Riverine macroinvertebrates on the uppermost reaches of the Allt Fearn and an unnamed watercourse (a tributary of the Allt a' Mheil) would be impacted by presence of permanent dams (Fearn Dam and Coire Dubh Dam) during the operational phase through loss of nursery habitat within the dam footprint. Instream habitat for macroinvertebrates in the upper reaches of the Allt Fearn is limited for macroinvertebrates due to presence of bedrock substrate. Macroinvertebrate communities are widespread within the local area but no species of high conservation interest were recorded within field studies in the surrounding lochs and watercourses. The significance of this effect is considered to be **Minor (Not Significant)** for macroinvertebrates.
- 11.8.60 Catastrophic failure of the Fearn Dam and Coire Dubh Dams would be likely to result in a significant surge of water (volume dependent on generation cycle) from Loch Fearn, affecting the adjacent water courses Allt Fearn, Allt a' Mheil, unnamed watercourses and Loch Quoich. Such water movement is likely to wash out substrate, fishes and macroinvertebrates in the watercourses,

<sup>45</sup> Maitland, P. S. and Adams, C. E. (2017). Arctic Charr in the Lochs of Scotland: An Assessment of Distribution and Status.

<sup>46</sup> Maitland, P. S. (1992). The status of Arctic Charr *Salvelinus alpinus*, (L.). In Southern Scotland: A Cause For Concern. Freshwater Forum 2: pp. 8.

<sup>47</sup> Simmons, O. M., Foldvik, A., Sundt-Hansen, L., & Aronsen, T. (2023). A review of the environmental impacts of proposed pumped storage hydropower projects in Loch Ness: implications for migrating Atlantic salmon. NINA Report 2318. Norwegian Institute for Nature Research.

resulting in (expected) total loss of species present. Additionally, Loch Quoich downstream is likely to be affected by a significant water surge that may displace aquatic life resulting in injury and/or mortality with a significant deterioration in water quality within the eastern end of the Loch. Catastrophic failure is considered extremely unlikely due to the high standard of design, management, and maintenance required under the Reservoirs (Scotland) Act 2011. As required by the Act, routine inspection of the dams would be undertaken. Therefore the significance of this effect is considered to be **Not Significant** for all species.

#### Noise and Vibration

- 11.8.61 Arctic charr, brown trout and ferox trout in Loch Quoich have the potential to be impacted by operational noise and vibration associated with the operation of the Proposed Development. Anticipated effects are expected to be non-lethal for fish but may cause temporary displacement and avoidance of the area around the inlet/outlet. Positive effects may be experienced in that displacement resulting from noise and vibration avoidance would help to mitigate effects associated with abstraction and generation (e.g. impingement). The significance of this effect for all species is considered to be **Not Significant / Minor (Not Significant)**.
- 11.8.62 Limited staff presence and maintenance during the operational period, and associated road traffic noise, is likely to have a negligible impact on IEFs and has been scoped out of the assessment.

#### Light

- 11.8.63 Arctic charr, brown trout and ferox trout in Loch Quoich have potential to be affected by artificial lighting during crepuscular/nocturnal periods. The powerhouse building will not have permanent lighting or Passive Infrared Sensors (PIR), and light will not escape from the building during operation. The use of light outside will be restricted to specific external tasks and require manual operation of light. Anticipated effects are expected to be local displacement and avoidance of the area around the Proposed Development during periods of use, however, this is minimal both in duration of use and area of loch affected. The significance of this effect for all species prior to mitigation is considered to be **Minor (Not Significant) / Imperceptible (Not Significant)** due to low magnitude of impact and temporary duration.
- 11.8.64 Macroinvertebrates are known sensitive receptors to artificial light pollution. Light has the potential to disrupt natural rhythms on a daily, lunar (monthly) and seasonal scale which may influence feeding, breeding and/or natural movement patterns with the potential to reduce and fragment populations. Due to the lack of light pollution and expected infrequent short-duration use and the limited extent of Loch Quoich this will effect, the significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

#### Temperature Changes Through Water Transfer

- 11.8.65 A study of water temperatures in Loch Quoich and The Gearr Garry has been carried out and is attached at **Appendix 11.3: Loch Quoich & Gearr Garry Temperature Monitoring Investigation**.
- 11.8.66 Fish species have the potential to be impacted by temperature changes through water transfer between Loch Fearn and Loch Quoich.
- 11.8.67 Minimal variation was observed in surface water temperatures between Loch Fearn and Loch Quoich during baseline surveys (variation of averages during May sampling was Loch Fearn 8.4°C -10.5°C and Loch Quoich 11.3°C. Although Fearn is at a higher altitude likely to be colder, the slight difference in temperature may be in part due to surface temperature levels rising as Loch Fearn was sampled in the morning and Loch Quoich was sampled in the afternoon. Water temperature monitoring completed on Loch Quoich has confirmed that significant temperature variation occurs on an hour by hour basis, however this effect is restricted to upper 1 – 2m of the water column. A colder, deeper strata of water has been confirmed to be present below depths of approximately 20m, but only during the months of April/June to November. This strata appears to be bathymetrically isolated from the construction area of the Proposed Development.
- 11.8.68 Further long term temperature logging studies are ongoing in relation to the proposed development. Based on the data available at the time of preparation (approximately six months'

worth), an improved understanding of the water temperature regime within Loch Quoich is possible. A homogeneous relatively warm layer (at least 20m deep) (the 'epilimnion') exists within the PSH lower control works area at the eastern end of Loch Quoich during Summer and Autumn months. This layer is colder than existing temperatures in the Gearr Garry, and is likely to be marginally warmer than baseline temperatures in Loch Fearn. The water temperature profile of Loch Quoich becomes thoroughly well mixed during Winter and Spring. Loch Quoich has been observed to act as a moderating influence on water temperature downstream in the Gearr Garry and lower catchment.

- 11.8.69 The ongoing temperature monitoring studies have provided some insight into the effect of large scale water transfers, based on the pre-existing tunnel which links Quoich Dam and Quoich Power Station. The water temperature link between the reservoir and power station is only clearly evident for short periods during Winter cold spells, however it appears that the conveyance of up to 18 m<sup>3</sup> s<sup>-1</sup> of water along 4km of concrete lined tunnel followed by passage through a turbine-generator neither significantly increases nor decreases water temperatures in the receiving watercourse. From this, it is considered unlikely that the water transfers envisaged as part of the Proposed Development will meaningfully affect water temperatures in the receiving waters.
- 11.8.70 Where receptive bodies vary in temperature, small variations are unlikely to be sufficient to cause thermal shock to individuals, with temperatures likely to return quickly to ambient levels given the relative volume of Loch Quoich. Regular generation cycles will prevent large differences in water temperature from developing due to the very slow rate at which large volumes of water become heated or cooled. Optimal Arctic charr temperature ranges between 4.5°C to 11.6°C<sup>48,49</sup> and are tolerant of lower temperature ranges. The deeper parts of Loch Quoich fall midway within this range (7 - 8 °C). Ongoing temperature monitoring within Loch Quoich indicates that shallow water temperatures (the upper 20m+) may currently be only marginally suitable for Arctic charr during the peak spawning season, with stable temperatures in excess of 10 °C persisting until late October.
- 11.8.71 Sudden temperature variation of up to 2°C can modify physiology and behaviour<sup>50</sup>. Due to the localised nature, limited extent and duration of water temperature changes, and based on the emerging evidence of the ongoing temperature monitoring studies, the significance of this effect for Arctic Charr is **Minor (Not Significant)** and for brown trout is considered to be **Not Significant**.
- 11.8.72 Compensation flow released from the Fearn and Coire Dubh dams into the Allt Fearn and an unnamed tributary of the Allt a' Mheil would be low in temperature due to the discharge pipe being located at the bottom of the dam where temperature would be lowest. No fish were recorded in the Allt Fearn in the area where Fearn Dam will be constructed or within the Allt a' Mheil downstream of the proposed Coire Dubh Dam, therefore there may only be limited effect on fish further down the catchments at the confluences with Loch Quoich, where fish can access, by which point there would be a temperature buffering effect due to distance from pipe source and the influence of other adjoining tributaries. Water downstream may decrease in average temperature influencing productivity of the streams, however, in light of projected water temperature increases with climate change this may be beneficial in buffering warm water temperatures during the summer months in future. Due to the localised nature of the effect on only two watercourses and potential positive effect during a future warming climate, the significance of this effect for brown trout is considered to be **Minor (Not Significant)**.
- 11.8.73 The ongoing temperature monitoring studies have provided some insight into the water temperature regime downstream of the Quoich Dam in the Gearr Garry. The water temperature regime in the Gearr Garry appears to be dominated by prevailing air temperature, except where in

<sup>48</sup> Larsson, S., Forseth, T., Berglund, I., Jensen, A.J., Näslund, I., Elliott, J.M. And Jonsson, B. (2005), Thermal adaptation of Arctic charr: experimental studies of growth in eleven charr populations from Sweden, Norway and Britain. *Freshwater Biology*, 50: 353-368. <https://doi.org/10.1111/j.1365-2427.2004.01326.x>

<sup>49</sup> Siikavuopio, S. I., Sæther, B.S., Johnsen, H. et al. (2014) Temperature preference of juvenile Arctic charr originating from different thermal environments. *Aquatic Ecology*. 48, 313–320. <https://doi.org/10.1007/s10452-014-9485-0>

<sup>50</sup> Leblanc, C. A., Horri, K., Skúlason, S., Benhaim, D. (2019) Subtle temperature increase can interact with individual size and social context in shaping phenotypic traits of a coldwater fish PLoS ONE 14(3): e0213061. <https://doi.org/10.1371/journal.pone.0213061>

close proximity to a hydro scheme outflows. It is not anticipated that the Proposed Development will significantly alter the existing water temperature regime in the Gearr Garry or lower catchment. The evidence so far available suggests that current water temperatures in the Gearr Garry may already be sub-optimal for salmonid fish species. The presence of the existing hydro scheme appears to moderate water temperatures lower down the catchment relative to those which would prevail in an unmodified catchment. based on the emerging evidence of the ongoing temperature monitoring studies, the significance of this effect for salmonid fish is considered to be **Not Significant**.

#### Water Quality

- 11.8.74 Increased water level fluctuation and reduction in macrophyte growth (Loch Fearn) may lead to destabilisation of the drawdown zone and a consequent erosion of marginal substrate. This may lead to increases in water quality parameters within thresholds capable of impacting on macroinvertebrates (e.g. total dissolved solids and/or turbidity). The drawdown zone within Loch Fearn would comprise of predominantly the cut faces of the proposed borrow pits. Therefore, these areas will be mostly bare rock which will reduce the potential for erosion and sedimentation. Also due to the impact occurring over months/seasons, water quality deterioration is likely to be gradual and not in concentrations consistent with major pollution events. The significance of this effect for macrophytes is considered **Minor (Not Significant)**. Macrophyte reduction is likely to affect macroinvertebrate that reside in areas of macrophyte growth. The significance of this effect for macroinvertebrates and is **Minor (Not Significant)**.
- 11.8.75 Generating/pumping periods may increase silt mobilisation within the water column resulting in increased turbidity localised at the inlet/outlet. Due to predicted deterrence of fishes from the area due to operational noise and vibration it is unlikely fishes will be present within the affected area. Due to the localised nature, limited extent and duration of likely turbidity increases, the significance of this effect for Arctic Charr and ferox trout is **Minor (Not Significant)** and for brown trout is considered to be **Imperceptible (Not Significant)**.
- 11.8.76 Given the localised nature of any increased turbidity impacts anticipated around the inlet/outlet, increased siltation and or water quality impacts downstream of Quoich Dam on the lower catchment are not anticipated. The significance of this effect is considered to be **Imperceptible (Not Significant)**.

#### Access Track Crossing Points

- 11.8.77 The permanent installation of the new bridge structures across the River Kingie and Gearr Garry have the potential to impact on fish migration and fish habitats. Fish habitat at these crossing points was described as Productive (Moderate) on the River Kingie and Unproductive (Bedrock) on the Gearr Garry. Where possible, single span bridge structures are preferable to span structures with instream supports which require instream engineering works. Instream structures have the potential to affect fish migration and cause loss of fish habitat and erosion. Both the River Kingie and Gearr Garry crossings are to be single span structures that will be installed with no operational impacts on instream fish habitats or migration. There are therefore no predicted effects of these crossing points on Atlantic salmon, brown trout or European eel during the operational phase.

**Table 11.14 Summary of Operational Phase Impacts and Effects on IEFs Prior to Mitigation**

| IEF / Importance Level   | Impacts                   | Effect                                                      | Impact Scale                          | Significance of Effect Prior to Mitigation |
|--------------------------|---------------------------|-------------------------------------------------------------|---------------------------------------|--------------------------------------------|
| Arctic charr<br>National | Fish attraction to intake | Entrainment, injury, mortality and/or translocation of fish | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |

| IEF / Importance Level  | Impacts                      | Effect                                                                | Impact Scale                          | Significance of Effect Prior to Mitigation |
|-------------------------|------------------------------|-----------------------------------------------------------------------|---------------------------------------|--------------------------------------------|
|                         | Fluctuations in Water levels | Stranding in drawdown zone, injury, mortality and/or predation        | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                         |                              | Aerial exposure of deposited eggs, resulting in mortality             | Permanent, adverse effect             | <b>Major</b> , Significant                 |
|                         |                              | Temporary loss of connectivity to riverine spawning habitat           | Temporary, negligible adverse effect  | <b>Minor</b> , Not Significant             |
|                         | Noise and Vibration          | Local displacement, injury, mortality                                 | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                         | Light                        | Local displacement                                                    | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                         | Water Quality                | Increased turbidity resulting in habitat quality deterioration        | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
| Brown trout<br>Local    | Fish attraction to intake    | Entrainment, injury, mortality and/or translocation of fish           | Permanent, low, adverse effect        | <b>Minor</b> , Not Significant             |
|                         | Fluctuations in Water levels | Aerial stranding in drawdown zone, injury, mortality and/or predation | Permanent, medium, adverse effect     | <b>Minor</b> , Not Significant             |
|                         |                              | Temporary loss of connectivity to riverine spawning habitat           | Temporary negligible, adverse effect  | <b>Imperceptible</b> , Not Significant     |
|                         | Noise and Vibration          | Local displacement, injury, mortality                                 | Permanent, low, adverse effect        | <b>Imperceptible</b> , Not Significant     |
|                         | Light                        | Local displacement                                                    | Permanent, negligible, adverse effect | <b>Imperceptible</b> , Not Significant     |
|                         | Water Quality                | Increased turbidity resulting in habitat quality deterioration        | Permanent, negligible, adverse effect | <b>Imperceptible</b> , Not Significant     |
| Ferox trout<br>National | Fish attraction to intake    | Entrainment, injury, mortality and/or translocation of fish           | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |

| IEF / Importance Level      | Impacts                      | Effect                                                                                            | Impact Scale                          | Significance of Effect Prior to Mitigation |
|-----------------------------|------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------|
|                             | Fluctuations in Water levels | Stranding in drawdown zone, injury, mortality and/or predation                                    | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                             |                              | Temporary loss of connectivity to riverine spawning habitat                                       | Temporary, negligible adverse effect  | <b>Minor</b> , Not Significant             |
|                             | Noise and Vibration          | Local displacement, injury, mortality.                                                            | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                             | Light                        | Local displacement.                                                                               | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
|                             | Water Quality                | Increased turbidity resulting in habitat quality deterioration.                                   | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
| Macroinvertebrates<br>Local | Fluctuations in Water levels | Aerial stranding in drawdown zone of Loch Quoich, injury, mortality and/or predation.             | Permanent, medium, adverse effect     | <b>Minor</b> , Not Significant             |
|                             |                              | Unsettled conditions due to water level fluctuation                                               | Permanent, medium, adverse effect     | <b>Minor</b> , Not Significant             |
|                             | Dams                         | Permanent loss of habitat due to dam footprint                                                    | Permanent, medium, adverse effect     | <b>Minor</b> , Not Significant             |
|                             | Light                        | Disrupting natural rhythms which may influence feeding, breeding and/or natural movement patterns | Permanent, negligible, adverse effect | <b>Imperceptible</b> , Not Significant     |
|                             | Water Quality                | Increased turbidity resulting in habitat quality deterioration.                                   | Permanent, negligible, adverse effect | <b>Minor</b> , Not Significant             |
| Macrophytes<br>Local        | Fluctuations in Water levels | Water level becoming frequently out with photic zone at maximum inundation.                       | Permanent, high, adverse effect       | <b>Minor</b> , Not Significant             |
|                             | Water Quality                | Increased turbidity resulting in habitat quality deterioration                                    | Permanent, low, adverse effect        | <b>Minor</b> , Not Significant             |

### Cumulative Effects

- 11.8.78 This section details the cumulative effects of other potential developments, e.g. those which are operational, consented, submitted for planning approval, in combination with the Proposed Development. These effects are those which are additional to those of the Proposed Development in its own right. There must be a clear route to potential cumulative effects due to the following :
1. Other developments within or adjacent to the same catchments as the Proposed Development; and
  2. Other developments affecting the same habitats and migratory species within 5km of the Proposed Development.
- 11.8.79 The operational Quoich Power station which affects the level of Loch Quoich via Quoich Dam. Operational effects of the two schemes working in parallel are discussed in **Section 11.8.45 - 11.8.56**. The cumulative effect of the Proposed Development is unlikely to significantly increase the effects on aquatic ecology due to the Proposed Development operating strictly within the existing regulated operational range of Loch Quoich, having regulated stop pumping and stop generating levels and closely following the future baseline level of the loch level  $\pm 3.2\text{m}$  (under a worst case scenario) which is already affected by water level fluctuation in marginal areas due to drawdown.
- 11.8.80 The Proposed Development would have no impact on volumes of compensation flow which are discharged below Quoich Dam to the River Gear Garry, these would remain as at present.
- 11.8.81 Bunloinn Wind Farm (approved), Beinneun Wind Farm (constructed), Millenium Wind Farm (constructed), Millenium East Wind Farm (scoping), Culachy Wind Farm (in planning), and Beinn Bheag Wind Farm (in scoping) are located within 10km of the proposed development.
- 11.8.82 Constructed / operational wind farms are unlikely to give rise to cumulative effects due to limited construction activity however new developments may give rise to cumulative pollution effects during the construction phase. Despite the proximity of these sites being within 10km of the Proposed Development and all within the wider Ness catchment, the sub-catchments that drain the land where these developments are situated flow to areas well outwith this distance, therefore it is unlikely that the same watercourses will experience effects from multiple sources in the unlikely event of multiple pollution events occurring simultaneously. As the Beinn Bheag Wind Farm is currently only at the scoping stage, there is no certainty of the details of the scheme and if it would even proceed, so it is not considered further here, despite its proximity to the Proposed Development.
- 11.8.83 As with the Proposed Development, each of the developments listed above will be controlled by a Construction Environmental Management Document (CEMD) which will mitigate against the risk of pollution, advising appropriate pollution prevention measures, biosecurity measures and water quality monitoring measures. An Environmental Clerk of Works (ECOW) will be present during the construction phase of each of the developments to ensure compliance with best practice.
- 11.8.84 It is anticipated that given the number of large bodies of standing water throughout the Ness catchment between the location of the Proposed Development and the sea (i.e Loch Quoich, Loch Garry, Loch Oich and Loch Ness) there would be a considerable buffering effect of any pollution run off which did occur (under a worst case scenario) due to the magnitude of these still waterbodies and the dilution effect that would take place within them. Pollution effects are likely to remain very localised, especially where development is taking place adjacent to lochs (i.e. pumped storage schemes). This reduces the cumulative effect of siltation events happening simultaneously within the catchment at the same time.

## 11.9 Mitigation

### Mitigation During Construction

- 11.9.1 This section considers good practice measures and generic mitigation that will be employed during the construction and operational phases.

- 11.9.2 A Construction Environmental Management Document (CEMD) which would include a Pollution Prevention Plan (PPP), Dust Mitigation Plan and Surface Water Quality Monitoring Programme (SWQMP) would be implemented by the Principal Contractor and best practice measures will be overseen by a suitably experienced Ecological Clerk of Works (ECOW). A water quality sampling programme would be designed to cover likely present pollutants and undertaken at a timescale to allow sufficient actions to be taken in the case of pollution incidents. Correct implementation of the PPP and the SWQMP should result in negligible observable effect to IEFs.
- 11.9.3 The CEMD will also include a Project Biosecurity Plan to protect against the risk of spread of invasive non-native species (INNS) on the project. This will be developed in line with the Ness Catchment Biosecurity Plan (2021 – 2030).
- 11.9.4 Aquatic elements will be incorporated into the Construction Noise and Vibration Management Plan (CNVMP) to ensure noise and vibration limits are not in excess of limits capable of causing injury and/or mortality to fishes. This will reference any blasting likely to occur within marginal areas of watercourses and waterbodies.
- 11.9.5 In relation to the partial dewatering of Loch Quoich, the dewatering should be timed to avoid the sensitive egg incubation period from October to late April. This will prevent any laid Arctic charr eggs from becoming aerially exposed and dying. Works should be planned for May (i.e. as early as possible) to allow sufficient time to carry out the necessary temporary works and installation of other mitigation (see mitigation during operation), and for water levels to subsequently begin to rebound.
- 11.9.6 This restriction on timing of the drawdown will also alleviate the effect of access to certain spawning burns being cut off during the sensitive spawning period when Arctic charr, brown trout and ferox trout are migrating into spawning burns, so long as the level of Loch Quoich is built back up again prior to the spawning period.
- 11.9.7 Instream works in the zone of influence for fish would be avoided where practical, during sensitive spawning and localised migration periods for fish. Sensitive periods are October – June to cover salmonid spawning, egg development in gravels and hatching as well as smolt movements. For areas above Quoich Dam where there is an absence of migratory fish and smolts, these periods can be reduced from October – April. Due to the programme of works, there are instances where instream works cannot be avoided during sensitive spawning and migration periods for fish and appropriate additional mitigation would be provided where this is the case however no instream works are planned downstream of Quoich Dam in relation to the Proposed SAR.
- 11.9.8 For any instream engineering works to facilitate the installation of any culverts / bridge span structures on the proposed access tracks (none are planned), fish rescue and relocations would be undertaken prior to the temporary damming / dewatering of the watercourse section. This applies to watercourses containing fish (lower reaches of the Allt Fearn, Gear Garry and tributaries). This would protect any fish populations in the vicinity of the works from harm. This would also allow work to be carried out in a dry channel which would reduce any short term pollution effects during construction.
- 11.9.9 If any localised dewatering works are required at Loch Quoich to facilitate the installation of infrastructure, for example the lower control works structures, a fish rescue and relocation would be carried out prior to dewatering to prevent potential fish disturbance, strandings and subsequent mortalities.
- 11.9.10 In line with Marine Scotland guidance for the monitoring of watercourses in relation to onshore wind farm developments: generic monitoring programme<sup>51</sup>, the following monitoring measures would be employed. Guidance specific to large pumped storage hydro schemes does not exist and it is

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<sup>51</sup> Marine Scotland. (2021). Monitoring watercourses in relation to onshore wind farm developments: generic monitoring programme. [Online] Available at: <https://www.gov.scot/publications/monitoring-watercourses-in-relation-to-onshore-wind-farm-developments-generic-monitoring-programme/>

considered that pollution pathways would be similar, thus the guidance is applicable to the Proposed Development:

- To develop a reasonable baseline dataset from which to detect change it is important that sampling takes place during construction and for a period of at least a year after construction. Sampling would take place at intervals no greater than one month unless sensitive periods / constraints have been identified, e.g. concrete batching or known acidification problems. More frequent sampling of selected parameters, e.g. pH and turbidity would occur more frequently and can be undertaken *in-situ* by the ECoW.
  - *Ex-situ* water analysis would be undertaken by an appropriately qualified laboratory (e.g. United Kingdom Accredited Service (UKAS)). Water quality parameters included would be: turbidity (NTU) in relation to site disturbance; dissolved organic carbon (DOC) ( $\text{mg l}^{-1}$  ppm) in relation to site disturbance and peat deposits; pH, alkalinity ( $\mu\text{eq l}^{-1}$ ), acid neutralising capacity ( $\mu\text{eq l}^{-1}$ ) and aluminium ( $\mu\text{g l}^{-1}$ ) in relation to changes in hydrology, DOC export and acidification; total oxidised nitrogen (nitrate and nitrite) ( $\text{mg l}^{-1}$ ) and phosphate in relation to nutrient leaching ( $\mu\text{l}^{-1}$ ); stream height; temperature; and dissolved oxygen concentration ( $\text{mg l}^{-1}$ ) and biological oxygen demand to indicate health of water. Sampling would occur pre-construction to provide a robust data set and monthly during construction.
  - Regular visual inspections of all watercourses (flow conditions, discolouration, collection of debris, fish in distress/floating) would be presented in a monthly water quality report and advised by an independent suitably qualified ECoW.
  - Macroinvertebrate sampling would occur during construction on relevant watercourses, and at least one control site, at a minimum of once a year, preferably in Spring.
  - Electrofishing would be undertaken once a year during construction and at least once a year after. Surveys would be fully-quantitative and include at least one control site. Surveys would be conducted late in the survey season to allow brown trout and Arctic charr fry to be distinguished.
- 11.9.11 Construction lighting would emit light from a broad spectrum of light with high UV components avoided; most invertebrates are sensitive to short wavelengths of light where greatest behavioural change occur. Lighting would additionally face away from watercourse/waterbodies where it is practical to do so.
- 11.9.12 Any lighting used during construction would be directed away from loch edges and watercourses to prevent the risk of increased predation of fish during the hours of darkness.
- 11.9.13 Any piling or overwater drilling operations would adopt a 'soft start' approach to allow adult fish within the immediate vicinity of works area to disperse unharmed. The ECoW would monitor loch areas in the vicinity of the works for any fish kills in relation to works producing underwater noise.
- 11.9.14 De-watering operations at Loch Fearna and the construction of Fearna and Coire Dubh dams would have suitably designed drainage and silt mitigation measures (e.g. cut off ditches / silt fencing / silt buster) to prevent a deterioration of water quality during the construction phase via surface run-off. This would be detailed in the Pollution Prevention Plan (PPP).

### Mitigation During Operation

- 11.9.15 Creation of high quality artificial spawning areas in deeper water beyond the drawdown depth of the combination effect of the pumped storage operation and the existing hydro generation. In addition to simply mitigating the effect of the pump storage it is highly likely that a well-conceived mitigation plan would result in an environmental net gain, compared with the current position for Arctic charr. Given the likely depth that artificial spawning habitat would be placed at, these areas will need a mechanism to enable flushing of the substrate of the very small particle size silts that are most damaging for successful spawning. Flushing could comprise either a permanently located sub-bed water jet system that will allow for periodic substrate flushing from a shore based pump system, or a vessel mounted vacuum dredger that will access the spawning areas during low water levels to remove silts by light suction. The advantage of this mitigation is that it will provide optimal spawning and incubation substrates at a depth below the drawdown zone.
- 11.9.16 Riparian planting would occur along watercourses not affected by inundation levels as well as peat restoration works. This would aid in improving instream habitat quality by providing instream and bankside cover for fish and would aid in preventing water temperature increases, notably in light of future predicted baselines. Leaf litter deposits from riparian tree cover would help to increase productivity in streams as some riverine macroinvertebrates (shredders) which use leaf litter as refuge and a food source, break leaf litter down into fine particulate organic matter (FPOM), providing resources for other organisms<sup>52</sup>. This has a beneficial effect for fish within the streams which use macroinvertebrates as a main food source.
- 11.9.17 Compensation flow would be always maintained from the Fearn Dam and Coire Dubh Dam to the Allt Fearn and an unnamed tributary of the Allt a' Mheil. Natural flow regimes would be mimicked by matching compensation flow to typical flow; this would vary monthly. This is considered more natural than typical feshet events used to mimic natural flow regimes.
- 11.9.18 Water quality monitoring post-construction and during the first years of operation would be conducted in line with Marine Scotland guidance as stipulated in Section 11.9.7. In situ sondes and dataloggers with data telemetry units could be installed to provide long term real time data if required.
- 11.9.19 Inspection, management, and maintenance of the Fearn and Coire Dubh dams required under the Reservoirs (Scotland) Act 2011 would provide mitigation against the potential failure of these dams.

### 11.10 Residual Effects

- 11.10.1 This section considers the potential residual effects and associated effect significance of the construction and operation of the Proposed Development, following the implementation of the mitigation measures proposed in Section 11.9.

#### Construction Residual Effects

- 11.10.2 Following the implementation of mitigation measures, there are no predicted **Significant** residual effects during the construction phase.
- 11.10.3 Residual effects on water quality are likely to remain as a result of prolonged construction works. Effects will be mitigated through the implementation of the aforementioned CEMD, PPP and SWQMP.

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<sup>52</sup> Oester. R., Dos Reis Oliveira. P.C., Moretti. M.S., Altermatt. F., Bruder. A. (2022) Leaf-associated macroinvertebrate assemblage and leaf litter breakdown in headwater streams depend on local riparian vegetation. *Hydrobiologia*. 2023;850(15):3359-3374. doi: 10.1007/s10750-022-05049-7. Epub 2022 Oct 18. PMID: 37397167; PMCID: PMC10307707. [Online] Available at: [Leaf-associated macroinvertebrate assemblage and leaf litter breakdown in headwater streams depend on local riparian vegetation - PMC](#) [Last accessed 25/10/2024]

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- 11.10.4 Residual impacts to macroinvertebrate and macrophyte species due to the temporary partial de-watering of Loch Fearna would be likely to remain as a result of habitat loss and volume of water resulting in less space and increased competition for resources.
- 11.10.5 Residual noise and vibration effects would be likely to affect species notably brown trout, feeding in littoral zones and closest to construction works at Loch Quoich. The implementation of a suitable CNVMP would mitigate against noise levels specific to the IEFs identified and employ best practice techniques such as soft start piling.
- 11.10.6 Residual effects during the construction phase with the implementation of mitigation measures are shown in **Table 11.15**

#### **Operational Residual Effects**

- 11.10.7 Following the implementation of mitigation measures, there are no predicted **Significant** residual effects during the operational phase.
- 11.10.8 Residual effects during the operational phase with the implementation of mitigation measures are shown in **Table 11.16**.

#### **Cumulative Residual Effects**

- 11.10.9 No cumulative residual effects were identified.

Table 11.15 Residual effects (Construction Phase)

| IEF                          | Impacts                                                                                          | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                         | Compensation / Enhancement | Residual Significance of Effect |
|------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------|
| Arctic Charr<br><br>National | Construction footprint                                                                           | <b>Minor</b> , Not Significant             | Not Applicable | If any dewatering works are required at Loch Quoich to facilitate the installation of infrastructure, a fish rescue and relocation would be carried out prior to dewatering to prevent potential fish disturbance, strandings and subsequent mortalities.<br><br>The timing of dewatering should be scheduled to avoid the sensitive egg incubation period from October to late April (inclusive). | Not Applicable             | <b>Minor</b> , Not Significant  |
|                              | Partial dewatering of Loch Quoich<br><br>(shoreline egg incubation and riverine spawning access) | <b>Major</b> , Significant                 | Not Applicable | The timing of dewatering should be avoided during the sensitive spawning and egg incubation period from October to late April (inclusive).                                                                                                                                                                                                                                                         | Not Applicable             | <b>Minor</b> , Not Significant  |
|                              | Water quality                                                                                    | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                                                                                                                                                                   | Not Applicable             | <b>Minor</b> , Not Significant  |

| IEF | Impacts               | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Compensation / Enhancement | Residual Significance of Effect |
|-----|-----------------------|--------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------|
|     | Quarrying             | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Not Applicable             | <b>Minor</b> , Not Significant  |
|     | Noise & vibration     | <b>Minor</b> , Not Significant             | Not Applicable | <p>Piling operations would adopt a 'soft start' approach to allow fish in the immediate vicinity of the works to disperse. The ECoW would monitor loch areas in the vicinity of the works for any effects on fish in relation to works producing underwater noise.</p> <p>Aquatic elements would be incorporated into the Construction Noise and Vibration Management Plan (CNVMP) to ensure noise and vibration limits are not in excess of limits capable of causing injury and/or mortality to fishes. This would reference any blasting likely to occur within marginal areas of watercourses and waterbodies.</p> | Not Applicable             | <b>Minor</b> , Not Significant  |
|     | Construction lighting | <b>Minor</b> , Not Significant             | Not Applicable | Any floodlighting used during construction would be directed away from loch edges and watercourses to prevent the risk of increased predation of fish during the hours of darkness.                                                                                                                                                                                                                                                                                                                                                                                                                                    | Not Applicable             | <b>Minor</b> , Not Significant  |

| IEF                         | Impacts               | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Compensation / Enhancement | Residual Significance of Effect |
|-----------------------------|-----------------------|--------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------|
| Atlantic Salmon<br>National | Water quality         | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                                                                                                                                                                                                                                                                                                                      | Not Applicable             | <b>Minor</b> , Not Significant  |
|                             | Quarrying             | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                                                                                                                                                                                                                                                                                                                      | Not Applicable             | <b>Minor</b> , Not Significant  |
|                             | Noise & vibration     | <b>Minor</b> , Not Significant             | Not Applicable | Aquatic elements would be incorporated into the Construction Noise and Vibration Management Plan (CNVMP) to ensure noise and vibration limits are not in excess of limits capable of causing injury and/or mortality to fishes. This would reference any blasting likely to occur within marginal areas of watercourses and waterbodies.<br><br>For any instream engineering works required along the proposed access tracks, fish rescue and relocations would be undertaken prior to the temporary damming / dewatering of the watercourse section. | Not Applicable             | <b>Minor</b> , Not Significant  |
|                             | Construction lighting | <b>Moderate</b> , Significant              | Not Applicable | Any floodlighting used during construction would be directed away from loch edges and watercourses to                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant  |

| IEF                      | Impacts                           | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                               | Compensation / Enhancement | Residual Significance of Effect        |
|--------------------------|-----------------------------------|--------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
|                          |                                   |                                            |                | prevent the risk of increased predation of fish during the hours of darkness.                                                                                                                                                                            |                            |                                        |
| Brown Trout<br><br>Local | Construction footprint            | <b>Minor</b> , Not Significant             | Not Applicable | If any dewatering works are required at Loch Quoich to facilitate the installation of infrastructure, a fish rescue and relocation would be carried out prior to dewatering to prevent potential fish disturbance, strandings and subsequent mortalities | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                          |                                   | <b>Minor</b> , Not Significant             | Not Applicable | For any instream engineering works required along the proposed access tracks, fish rescue and relocations would be undertaken prior to the temporary damming / dewatering of the watercourse section.                                                    | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                          | Partial dewatering of Loch Quoich | <b>Minor</b> , Not Significant             | Not Applicable | The timing of dewatering should be avoided during the sensitive spawning and egg incubation period from October to late April (inclusive).                                                                                                               | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                          | Water quality                     | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                         | Not Applicable             | <b>Imperceptible</b> , Not Significant |

| IEF | Impacts           | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Compensation / Enhancement | Residual Significance of Effect        |
|-----|-------------------|--------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
|     | Quarrying         | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|     | Noise & vibration | <b>Minor</b> , Not Significant             | Not Applicable | <p>Piling operations would adopt a 'soft start' approach to allow fish in the immediate vicinity of the works to disperse. The ECoW would monitor loch areas in the vicinity of the works for any effects on fish in relation to works producing underwater noise.</p> <p>Aquatic elements would be incorporated into the Construction Noise and Vibration Management Plan (CNVMP) to ensure noise and vibration limits are not in excess of limits capable of causing injury and/or mortality to fishes. This would reference any blasting likely to occur within marginal areas of watercourses and waterbodies.</p> <p>If any dewatering works are required at Loch Quoich to facilitate the installation of infrastructure, a fish rescue and relocation would be carried out prior to dewatering to prevent potential fish disturbance, strandings and subsequent mortalities</p> | Not Applicable             | <b>Imperceptible</b> , Not Significant |

| IEF                                 | Impacts                           | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                               | Compensation / Enhancement | Residual Significance of Effect        |
|-------------------------------------|-----------------------------------|--------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
|                                     | Construction lighting             | <b>Minor</b> , Not Significant             | Not Applicable | Any floodlighting used during construction would be directed away from loch edges and watercourses to prevent the risk of increased predation of fish during the hours of darkness.                                                                      | Not Applicable             | <b>Imperceptible</b> , Not Significant |
| Brown Trout (ferox)<br><br>National | Construction footprint            | <b>Minor</b> , Not Significant             | Not Applicable | If any dewatering works are required at Loch Quoich to facilitate the installation of infrastructure, a fish rescue and relocation would be carried out prior to dewatering to prevent potential fish disturbance, strandings and subsequent mortalities | Not Applicable             | <b>Minor</b> , Not Significant         |
|                                     | Partial dewatering of Loch Quoich | <b>Major</b> , Significant                 | Not Applicable | The timing of dewatering should be avoided during the sensitive spawning and egg incubation period from October to late April (inclusive).                                                                                                               | Not Applicable             | <b>Minor</b> , Not Significant         |
|                                     | Water quality                     | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                         | Not Applicable             | <b>Minor</b> , Not Significant         |
|                                     | Quarrying                         | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                         | Not Applicable             | <b>Minor</b> , Not Significant         |

| IEF                           | Impacts               | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Compensation / Enhancement | Residual Significance of Effect |
|-------------------------------|-----------------------|--------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------|
|                               | Noise & Vibration     | <b>Minor</b> , Not Significant             | Not Applicable | <p>Piling operations would adopt a 'soft start' approach to allow fish in the immediate vicinity of the works to disperse. The ECoW would monitor loch areas in the vicinity of the works for any fish kills in relation to works producing underwater noise.</p> <p>Aquatic elements would be incorporated into the Construction Noise and Vibration Management Plan (CNVMP) to ensure noise and vibration limits are not in excess of limits capable of causing injury and/or mortality to fishes. This would reference any blasting likely to occur within marginal areas of watercourses and waterbodies.</p> | Not Applicable             | <b>Minor</b> , Not Significant  |
|                               | Construction lighting | <b>Minor</b> , Not Significant             | Not Applicable | Any floodlighting used during construction would be directed away from loch edges and watercourses to prevent the risk of increased predation of fish during the hours of darkness.                                                                                                                                                                                                                                                                                                                                                                                                                               | Not Applicable             | <b>Minor</b> , Not Significant  |
| European Eel<br>International | Water quality         | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Not Applicable             | <b>Minor</b> , Not Significant  |

| IEF                | Impacts               | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Compensation / Enhancement | Residual Significance of Effect        |
|--------------------|-----------------------|--------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
|                    | Quarrying             | <b>Moderate</b> , Significant              | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                                                                                                                                                                                                                                                                                                                                                                                          | Not Applicable             | <b>Minor</b> , Not Significant         |
|                    | Noise & vibration     | <b>Moderate</b> , Significant              | Not Applicable | <p>Aquatic elements will be incorporated into the Construction Noise and Vibration Management Plan (CNVMP) to ensure noise and vibration limits are not in excess of limits capable of causing injury and/or mortality to fishes. This will reference any blasting likely to occur within marginal areas of watercourses and waterbodies.</p> <p>For any instream engineering works required along the proposed access tracks, fish rescue and relocations will be undertaken prior to the temporary damming / dewatering of the watercourse section.</p> | Not Applicable             | <b>Minor</b> , Not Significant         |
|                    | Construction lighting | <b>Moderate</b> , Significant              | Not Applicable | Any floodlighting used during construction should be directed away from loch edges and watercourses to prevent the risk of increased predation of fish during the hours of darkness.                                                                                                                                                                                                                                                                                                                                                                      | Not Applicable             | <b>Minor</b> , Not Significant         |
| Macroinvertebrates | Quarrying             | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Not Applicable             | <b>Imperceptible</b> , Not Significant |

| IEF                  | Impacts                  | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                           | Compensation / Enhancement | Residual Significance of Effect        |
|----------------------|--------------------------|--------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
| Local                |                          |                                            |                | and best practice measures would be overseen by an ECoW.                                                                                                                             |                            |                                        |
|                      | Dewatering of Loch Fearn | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                     | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                      | Construction lighting    | <b>Minor</b> , Not Significant             | Not Applicable | Any floodlighting used during construction should be directed away from loch edges and watercourses to prevent the risk of increased predation of fish during the hours of darkness. | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                      | Water quality            | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                     | Not Applicable             | <b>Imperceptible</b> , Not Significant |
| Macrophytes<br>Local | Quarrying                | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                     | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                      | Dewatering of Loch Fearn | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                     | Not Applicable             | <b>Imperceptible</b> , Not Significant |

| IEF | Impacts              | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                      | Compensation / Enhancement | Residual Significance of Effect        |
|-----|----------------------|--------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
|     | Water quality        | <b>Minor</b> , Not Significant             | Not Applicable | A CEMD, PPP, and SWQMP would be implemented by the Principal Contractor and best practice measures would be overseen by an ECoW.                                                | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|     | Introduction of INNS | <b>Minor</b> , Not Significant             | Not Applicable | As part of the CEMD, a Biosecurity Plan will be produced in line with the Ness Catchment Biosecurity Plan (2021 – 2030) and best practice measures will be overseen by an ECoW. | Not Applicable             | <b>Imperceptible</b> , Not Significant |

**Table 11.16 Residual effects (Operational Phase)**

| IEF                          | Impacts                                    | Significance of Effect Prior to Mitigation                         | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Compensation / Enhancement | Residual Significance of Effect |
|------------------------------|--------------------------------------------|--------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------|
| Arctic Charr<br><br>National | Fish attraction to intake                  | <b>Minor</b> , Not Significant                                     | Not Applicable | <p>Embedded mitigation - The approach velocity of water across the intake screen during abstraction / pumping mode would be &lt;0.3 m/s. This would ensure that Arctic charr in excess of 10 cm would be able to overcome the effect of entrainment / impingement at the screens.</p> <p>Embedded mitigation - Appropriately designed vertical bar screens of maximum 12.5 mm mesh aperture to cover the intake/outlet would be installed to prevent fish from entering into the underground waterway system at Loch Quoich. This would prevent the risks of fish entrapment, injury and mortality or translocation.</p> | Not Applicable             | <b>Minor</b> , Not Significant  |
|                              | Fluctuations in Water levels (Loch Quoich) | <b>Minor</b> , Not Significant<br><br>(Stranding in drawdown zone) | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Not Applicable             | <b>Minor</b> , Not Significant  |
|                              |                                            | <b>Major</b> , Significant<br><br>(Aerial exposure of eggs)        | Not Applicable | Creation of high quality artificial spawning areas in deeper water beyond the drawdown depth of the combination effect of the pump storage operation and the existing hydro generation.                                                                                                                                                                                                                                                                                                                                                                                                                                  | Not Applicable             | <b>Minor</b> , Not Significant  |

| IEF                      | Impacts                   | Significance of Effect Prior to Mitigation                                                          | Avoidance      | Mitigation                                                                                                                                                      | Compensation / Enhancement | Residual Significance of Effect |
|--------------------------|---------------------------|-----------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------|
|                          |                           |                                                                                                     |                | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation)                                                                             |                            |                                 |
|                          |                           | <b>Minor</b> , Not Significant<br><br>(Temporary loss of connectivity to riverine spawning habitat) | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation)                                                                             | Not Applicable             | <b>Minor</b> , Not Significant  |
|                          | Noise and Vibration       | <b>Minor</b> , Not Significant                                                                      | Not Applicable | Not Applicable                                                                                                                                                  | Not Applicable             | <b>Minor</b> , Not Significant  |
|                          | Light                     | <b>Minor</b> , Not Significant                                                                      | Not Applicable | Not Applicable                                                                                                                                                  | Not Applicable             | <b>Minor</b> , Not Significant  |
|                          | Temperature variation     | <b>Minor</b> , Not Significant                                                                      | Not Applicable | Not Applicable                                                                                                                                                  | Not Applicable             | <b>Minor</b> , Not Significant  |
|                          | Water Quality             | <b>Minor</b> , Not Significant                                                                      | Not Applicable | Not Applicable                                                                                                                                                  | Not Applicable             | <b>Minor</b> , Not Significant  |
| Brown Trout<br><br>Local | Fish attraction to intake | <b>Minor</b> , Not Significant                                                                      | Not Applicable | Embedded mitigation - The approach velocity of water across the intake screen during abstraction / pumping mode would be <0.3 m/s. This would ensure that brown | Not Applicable             | <b>Minor</b> , Not Significant  |

| IEF | Impacts                      | Significance of Effect Prior to Mitigation                                                                          | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                          | Compensation / Enhancement | Residual Significance of Effect        |
|-----|------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
|     |                              |                                                                                                                     |                | <p>trout would be able to overcome the effect of entrainment / impingement at the screens.</p> <p>Embedded mitigation - Appropriately designed vertical bar screens of maximum 12.5 mm mesh aperture to cover the intake/outlet would be implemented to prevent fish from entering into the underground waterway system at Loch Quoich. This would prevent the risks of fish entrapment, injury and mortality or translocation.</p> |                            |                                        |
|     | Fluctuations in Water levels | <p><b>Minor</b>, Not Significant</p> <p>(Aerial stranding in drawdown zone, injury, mortality and/or predation)</p> | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation)                                                                                                                                                                                                                                                                                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant         |
|     | Fluctuations in Water levels | <p><b>Imperceptible</b>, Not Significant</p> <p>(Temporary loss of connectivity to riverine spawning habitat)</p>   | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation)                                                                                                                                                                                                                                                                                                                                                 | Not Applicable             | <b>Imperceptible</b> , Not Significant |

| IEF                                 | Impacts                   | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Compensation / Enhancement | Residual Significance of Effect        |
|-------------------------------------|---------------------------|--------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
|                                     | Noise and Vibration       | <b>Imperceptible</b> , Not Significant     | Not Applicable | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                                     | Light                     | <b>Imperceptible</b> , Not Significant     | Not Applicable | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                                     | Temperature variation     | <b>Imperceptible</b> , Not Significant     | Not Applicable | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                                     | Water Quality             | <b>Imperceptible</b> , Not Significant     | Not Applicable | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Not Applicable             | <b>Imperceptible</b> , Not Significant |
| Brown Trout (ferox)<br><br>National | Fish attraction to intake | <b>Minor</b> , Not Significant             | Not Applicable | <p>Embedded mitigation - The approach velocity of water across the intake screen during abstraction / pumping mode would be &lt;0.3 m/s. This would ensure that ferox would be able to overcome the effect of entrainment / impingement at the screens.</p> <p>Embedded mitigation - Appropriately designed vertical bar screens of maximum 12.5 mm mesh aperture to cover the intake/outlet would be implemented to prevent fish from entering into the underground waterway system at Loch Quoich. This would prevent the risks of fish entrapment, injury and mortality or translocation.</p> | Not Applicable             | <b>Minor</b> , Not Significant         |

| IEF | Impacts                      | Significance of Effect Prior to Mitigation                                                             | Avoidance      | Mitigation                                                                          | Compensation / Enhancement | Residual Significance of Effect |
|-----|------------------------------|--------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------|----------------------------|---------------------------------|
|     | Fluctuations in Water levels | <b>Minor</b> , Not Significant<br><br>(Stranding in drawdown zone, injury, mortality and/or predation) | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation) | Not Applicable             | <b>Minor</b> , Not Significant  |
|     | Fluctuations in Water levels | <b>Minor</b> , Not Significant<br><br>(Temporary loss of connectivity to riverine spawning habitat)    | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation) | Not Applicable             | <b>Minor</b> , Not Significant  |
|     | Noise and Vibration          | <b>Minor</b> , Not Significant                                                                         | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant  |
|     | Light                        | <b>Minor</b> , Not Significant                                                                         | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant  |
|     | Temperature variation        | <b>Minor</b> , Not Significant                                                                         | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant  |
|     | Water Quality                | <b>Minor</b> , Not Significant                                                                         | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant  |

| IEF                         | Impacts                        | Significance of Effect Prior to Mitigation                                                                                   | Avoidance      | Mitigation                                                                          | Compensation / Enhancement | Residual Significance of Effect        |
|-----------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------|----------------------------|----------------------------------------|
| Macroinvertebrates<br>Local | Fluctuations in Water levels - | <b>Minor</b> , Not Significant<br><br>(Aerial stranding in drawdown zone of Loch Quoich, injury, mortality and/or predation) | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation) | Not Applicable             | <b>Minor</b> , Not Significant         |
|                             | Fluctuations in Water levels   | <b>Minor</b> , Not Significant<br><br>(Unsettled conditions due to water level fluctuation)                                  | Not Applicable | Operational limits would be agreed as part of CAR licence (see Embedded Mitigation) | Not Applicable             | <b>Minor</b> , Not Significant         |
|                             | Dams                           | <b>Minor</b> , Not Significant                                                                                               | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant         |
|                             | Light                          | <b>Imperceptible</b> , Not Significant                                                                                       | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Imperceptible</b> , Not Significant |
|                             | Water Quality                  | <b>Minor</b> , Not Significant                                                                                               | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant         |
| Macrophytes                 | Fluctuations in Water levels   | <b>Minor</b> , Not Significant                                                                                               | Not Applicable | N/A                                                                                 | Not Applicable             | <b>Minor</b> , Not Significant         |

| IEF   | Impacts       | Significance of Effect Prior to Mitigation | Avoidance      | Mitigation | Compensation / Enhancement | Residual Significance of Effect |
|-------|---------------|--------------------------------------------|----------------|------------|----------------------------|---------------------------------|
| Local | Dams          | Minor, Not Significant                     | Not Applicable | N/A        | Not Applicable             | Minor, Not Significant          |
|       | Water Quality | Minor, Not Significant                     | Not Applicable | N/A        | Not Applicable             | Minor, Not Significant          |

## 11.11 Conclusion

- 11.11.1 The main conclusions from the impact assessment on aquatic ecology are described below:

Significant adverse effects have been identified on several of the important ecological features during both the construction and operational phases:

### Construction Phase (before mitigation)

- 11.11.2 Significant effects on Arctic charr were identified during the construction phase. These included water quality and quarrying (**Moderate, Significant**) and partial dewatering of Loch Quoich (**Major, Significant**).
- 11.11.3 Significant effects on Atlantic salmon were identified during the construction phase. These included water quality, quarrying and construction lighting (**Moderate, Significant**).
- 11.11.4 Significant effects on Brown trout (ferox trout) were identified during the construction phase. These included partial dewatering of Loch Quoich (**Major, Significant**) water quality and quarrying (**Moderate, Significant**).
- 11.11.5 Significant effects on European Eel were identified during the construction phase. These included water quality, quarrying and construction lighting (**Moderate, Significant**).

### Operational Phase

- 11.11.6 Significant effects on Arctic charr were identified during the operational phase. These included Fluctuations in Water levels of Loch Quoich (**Major, Significant**).

### Construction Phase (after mitigation)

- 11.11.7 Following the implementation of mitigation measures, the residual effect on IEFs during the construction phase were as follows:
- Arctic charr: water quality, quarrying and partial dewatering of Loch Quoich (**Minor, Not Significant**);
  - Atlantic salmon: water quality, quarrying and construction lighting (**Minor, Not Significant**);
  - Brown trout (ferox trout): partial dewatering of Loch Quoich, water quality and quarrying (**Minor, Not Significant**);
  - European Eel: water quality, quarrying, noise & vibration and construction lighting (**Minor, Not Significant**).

### Operational Phase (after mitigation)

- 11.11.8 Following the implementation of mitigation measures, the residual effect on IEFs during the operational phase were as follows:
- Arctic charr: Fluctuations in water levels of Loch Quoich (**Minor, Not Significant**);
  - The impact of temperature variation upon all IEFs during the operational phases were assessed as being **Imperceptible**, Not Significant.