

## Chapter 12: Aquatic Ecology - Contents

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Appendix 12.1 – Loch Kemp Baseline Aquatic Surveys

## 12. Aquatic Ecology

### 12.1 Executive Summary

- 12.1.1 This Chapter considers the potential effects, including cumulative effects, of the Proposed Development on aquatic ecology during the construction and operational phases. Where likely significant effects are predicted during construction and operation, appropriate mitigation measures are proposed, and the significance of predicted residual effects are assessed.
- 12.1.2 A baseline assessment detailing existing information relating to protected and notable species and habitats, and designated nature conservation sites was undertaken.
- 12.1.3 Baseline field surveys were undertaken in summer - autumn 2022. Surveys undertaken included riverine macroinvertebrate surveys, loch macroinvertebrate surveys and freshwater lichen surveys. All surveys were undertaken in accordance with relevant good practice guidelines.
- 12.1.4 No designated sites with relevance for aquatic ecology are contained within the site boundary, however there are hydrological links with the River Moriston Special Area of Conservation (SAC), which is located approximately 2 km northwest of the site boundary on the opposite side of Loch Ness. Potential impacts of the Proposed Development on the qualifying features of the River Moriston SAC (including freshwater pearl mussel *Margaritifera margaritifera*) are assessed as part of a Shadow Habitats Regulations Assessment (HRA), which is included as a standalone document to the section 36 application.
- 12.1.5 Potential effects were identified on the important aquatic ecological features during the construction and operational phases of the Proposed Development (including cumulative impacts with other projects) following the implementation of embedded mitigation (as set out in **Section 12.7** and in **paragraph 12.11.2**). However, none of these were deemed to be significant adverse effects and therefore it is not anticipated that any additional mitigation to reduce the significance of these would be required.
- 12.1.6 Embedded mitigation measures to be employed during the construction and operational phase include: A Construction Environmental Management Plan (CEMP), Pollution Prevention Plan (PPP) and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an Aquatic Ecologist / Aquatic Clerk of Works (ACoW). This will include Biosecurity measures which would protect against the spread of Invasive Non-native Species (INNS) during the construction phase. Monitoring will include the Allt a'Chinn Mhonaich and Loch Kemp where aquatic lichen *Spongilla lacustris* was present. Annual monitoring of macroinvertebrates in the rivers and lochs within the development boundary and within Loch Ness in the immediate vicinity of the development boundary will be undertaken to monitor water quality and the spread of invasive species during the construction and operational phase. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.
- 12.1.7 Enhancement measures including the installation of Coarse woody debris (CWD) submerged around loch shoreline areas will create new habitats for loch macroinvertebrates. Areas for CWD submersion would be confirmed in the final Habitat Management Plan, and would comprise retained lochs/lochans which are not subject to rapid water level changes, such as Lochan a Choin Uire, Loch Paiteag, Lochan a Mhonaich, Lochan nan Nighean and Lochan Scristan.

## 12.2 Introduction

- 12.2.1 This Chapter considers the potential effects, including cumulative effects, of the Proposed Development on aquatic ecology during construction and operation. As described in **Chapter 3: Description of 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 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 of predicted residual effects are assessed.
- 12.2.2 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 **Volume 4, Appendix 4.1: EIA Team**, contained within Volume 4 of this EIA Report.
- 12.2.3 Fish and fish habitats are not covered within the aquatic ecology chapter, these can be found within **Chapter 13: Fish**. Only fully aquatic lichens are covered within the aquatic ecology chapter, all other lichen species are addressed within **Chapter 10: Terrestrial Ecology**.

## 12.3 Scope of Assessment

### Study Area

- 12.3.1 The study area encompasses the area over which all desk-based and field data were gathered to inform the assessment presented in this Chapter. Field study areas comprised of watercourses and waterbodies contained within and flowing in and out of the site boundary area, as well as 'control' areas also covered out with the site boundary area on Loch Ness and some sections of the Allt Leachd Gowerie. The watercourses included as part of the study areas are shown in **Volume 4, Appendix 12.1: Loch Kemp Baseline Aquatic Surveys – Figure 1.1**.

### Zone of Influence

- 12.3.2 The 'zone of influence' for a project is the area over which ecological features may be affected by biophysical changes as a result of the proposed project and associated activities. For aquatic features, this is likely to extend beyond the project site, for example where there are ecological or hydrological links beyond the site boundary. 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 12.1: Important Ecological Features (IEF's) Rationale for Consideration and Zones of Influence** below).

**Table 12.1: Important Ecological Features (IEF's) Rationale for Consideration and Zones of Influence**

Important Ecological Feature	Rationale for Selection	Zone of Influence
Riverine Macroinvertebrates	<p>Scoring systems can be used as an indicator of water quality.</p> <p>Species can be of high conservation interest; Red Data Book RDB1 (Endangered), RDB2 (Vulnerable), RDB3 (Rare), or Notable (but not RDB status)</p> <p>Spread of Invasive Non-Native Species (INNS) identified within the Ness Catchment.</p>	<p>Inflowing / outflowing streams to Loch Kemp; Allt Leachd Gowerie, Allt Loch Paiteag (inundated areas only) and Allt an t-Sluichd.</p> <p>Allt a Chinn Mhonaich</p>
Loch Macroinvertebrates	<p>Scoring systems can be used as an indicator of water quality.</p> <p>Species can be of high conservation interest; Red Data Book RDB1 (Endangered), RDB2 (Vulnerable), RDB3 (Rare), or Notable (but not RDB status)</p> <p>Spread of Invasive Non-Native Species (INNS) identified within the Ness Catchment.</p>	Loch Ness, Loch Kemp, Loch Cluanie and Lochan a Choin Urie.
Aquatic Lichens	<p>Aquatic lichen species can be of particular interest such as Nationally Scarce / Rare, Red-listed or otherwise notable.</p> <p>The Acid Watercourses Quality Index (AQUI) was used to assess the lichen assemblages on the three watercourses, and the Rocky Lake Shore, Threatened Near Threatened and Notable Index (TNTN) was used to assess Loch Kemp, which assess whether the lichen communities meet the threshold for SSSI quality.</p>	<p>The 'aquatic zone' of the full length of the three watercourses within Ness Woods SAC: the unnamed burn draining from Lochan a' Choin Uire; the Allt an t-Sluichd; and the Allt a' Chinn Mhonaich and the rocky shore of Loch Kemp.</p>

### Consultation Responses

- 12.3.3 To inform the scope of the assessment for the Proposed Development, consultation was undertaken with statutory and non-statutory bodies. **Table 12.2: Consultation Responses** summarises the scoping and consultation responses relevant to the aquatic ecology and provides information on where and/or how points raised have been addressed in this assessment.
- 12.3.4 Full details on the consultation responses and scoping opinion can be reviewed in **Chapter 5: Scoping and Consultation**, and associated appendices.

Table 12.2: Consultation Responses

Consultee	Consultation Type	Issue Raised	Response/Action Taken
The Highland Council	Scoping	The EIA Report should address the likely impacts on the nature conservation interests of all the designated sites in the vicinity of the Proposed Development. It should provide proposals for any mitigation that is required to avoid these impacts or to reduce them to a level where they are not significant.	The River Moriston SAC is assessed as part of the standalone Shadow Habitats Regulations Appraisal. This addresses likely impact on Freshwater Pearl Mussel <i>Margaritifera margaritifera</i> within the SAC.
The Highland Council	Scoping	THC advise that the EIA Report 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.	This is considered in <b>Section 12.8.5 – 12.8.9</b> . See <b>Section 12.7</b> for Embedded Mitigation:  A Construction Environmental Management Plan (CEMP), Pollution Prevention Plan (PPP) and Water Quality Monitoring Programme will be implemented by the Principal Contractor and overseen by an Aquatic Ecologist / Aquatic Clerk of Works (ACoW). This will include Biosecurity measures which will protect against the spread of Invasive Non-native Species (INNS) during the construction phase.
SEPA	Scoping	SEPA are aware of the following invasive non-native species in the Ness catchment: Flatworm ( <i>Phagocata woodworthi</i> ), Freshwater shrimp ( <i>Crangonyx pseudogracilis</i> ) and Nuttall's Waterweed ( <i>Elodea Nuttallii</i> ). They ask for an assessment to determine whether the species are already present in the Loch Kemp system and if they are not measures should be outlined to stop the spread.	This issue was addressed in a letter (Ref 120019-L-NDSFB1-1.0.0) on behalf of the applicant to ECU on the 29 <sup>th</sup> April 2022.  In this letter, it is confirmed that surveys to identify whether the invasive non-native species identified by SEPA are already present in the Loch Kemp system would be undertaken as part of the Ecological Impact

			<p>Assessment (EclA) assessment and, where relevant, this EclA Report (<b>Section 12.7 Embedded Mitigation</b>) outlines measures that should be undertaken to stop the spread of these species.</p> <p>No INNS were identified in riverine or loch macroinvertebrate surveys which included both Loch Kemp catchment and Loch Ness (2022 field studies)</p>
SEPA	Scoping	SEPA ask for the assessment to include information on the morphological impact on Loch Kemp.	Following consultation, SEPA responded on the 29 <sup>th</sup> May 2022 to confirm that following further internal discussion, they had concluded an assessment of the morphology is not required.
NatureScot	Scoping	NS would need complete details of the footprint of the Proposed Track – length, full working width – including running width, drainage and any works required to stabilise it. They also ask for details of materials to be used, from where they would be brought in, and where they would be stored on site in order to calculate the area of woodland habitat that would be lost. NS would also need to consider fragmentation effects, and the impact on the Allt a' Chinn Mhonaich, as well as impacts of the materials used on plant communities along the edge of the track.	<p>Access tracks are described in Chapter 3: Description of Development.</p> <p>See <b>Section 12.7 Embedded Mitigation</b>:</p> <p>A CEMP, PPP and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an Aquatic Ecologist / ACoW. An outline CEMP is provided in <b>Volume 4, Appendix 3.3: Outline CEMP</b>. It is anticipated that the full details of the final CEMP will be agreed under a planning condition in consultation with NatureScot.</p>
NatureScot	Scoping	NS expect that the EIA Report to consider and mitigate the risk to the long-term status of the River Moriston SAC, designated for	The River Moriston SAC is assessed as part of the standalone Shadow Habitats Regulations

		Freshwater Pearl mussel and Atlantic Salmon, and request monitoring to determine fish behaviour in Loch Ness. The survey should also take into account potential impacts caused by the Red John pump Storage scheme.	Appraisal. Cumulative effects of Red John pumped storage are also included within this Shadow HRA.  See <b>Chapter 13: Fish</b> for further information on monitoring to determine fish behaviour in Loch Ness.
NatureScot	Scoping	NS recommend using the sitelink facility on their website: <a href="https://sitelink.nature.scot/site/8337">https://sitelink.nature.scot/site/8337</a> to access the most up to date information regarding the status of the designated sites in the area and note the Conservation Advice Package provides the most up to date information on the importance of the site and the conservation objectives against which the proposal will be assessed in a Habitats Regulations Appraisal.	The NatureScot sitelink facility was used for accessing up to date information on designated sites. See desk study <b>Table 12.9: Summary of Desk Study</b> for status of River Moriston Special Area of Conservation (SAC).  A standalone Shadow Habitats Regulations Appraisal has been prepared to support the Section 36 Application.
NatureScot	Scoping	NS advise that the River Moriston SAC is designated for Atlantic Salmon and Freshwater Pearl Mussel (FWPM). Atlantic salmon are also a critical component of FWPM life cycle as host fish. Therefore, impacts on salmon will have indirect impacts on FWPM and this link needs to be considered in any assessment.	See <b>Chapter 13: Fish</b> for impacts on Atlantic salmon. The River Moriston SAC is assessed separately under the standalone Shadow Habitats Regulations Appraisal.
NatureScot	Scoping	There are a number of potential impacts of this scheme on bryophytes that might raise issues of national interest. These are summarised below. The Scoping Report states that "The Proposed Development lies just beyond the edge of the western Scottish Highlands, which are of global importance for bryophytes" (11.1.9). In fact, the site sits within an area of high oceanicity shown in NatureScot Commissioned Report No. 449b Bryological assessment for hydroelectric schemes in the West Highlands (2nd edition) <sup>1</sup> . Hence, there are a number of burns within the Loch Kemp area which have been	Field studies on aquatic lichens, carried out by ██████████ in 2022 are provided in <b>Volume 4, Appendix 10.4: Freshwater Lichen Survey Report</b> . This lichen survey was commissioned to identify lichens and lichenicolous fungi on the watercourses requested by NS.  Aquatic lichens are assessed within this report. All other lichen, including semi-aquatic lichen and bryophyte

		<p>identified as having potential nationally/internationally important flora of uncommon, oceanic, hygrophilous bryophyte species. It is important to note that these oceanic bryophyte communities of the designated sites are also likely to be classed as typical species of this woodland habitat. NS agree with the proposed scope of the bryophyte assessment, with detailed surveys to be carried out on; Allt an t-Sluichd (for the avoidance of doubt the survey should cover the entire length of the burn), the unnamed burn draining from Lochan a'Choin Uire and Allt a'Chinn Mhonaich NS also welcome the additional surveys on the inflows to Loch Kemp that will be inundated by the damming of Loch Kemp.</p>	<p>species are covered within <b>Chapter 10: Terrestrial Ecology</b>.</p>
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#### Issues Scoped Out of Assessment

- 12.3.5 Direct impacts on loch macroinvertebrates at Loch Paiteag have been scoped out of this assessment as this loch would not be affected by the infrastructure or maximum inundation of the Proposed Development.
- 12.3.6 Direct impacts on Freshwater Pearl Mussel have been scoped out of this assessment as the inflowing / outflowing watercourses and surrounding Lochs on the site do not feature any suitable habitat to support the species. The presence of barriers to fish migration due to the topography of the Allt a' Chinn Mhonaich and the Allt an t-Sluichd also impacts on distribution of the species. Impacts on Freshwater Pearl Mussel Populations within the River Moriston Special Area of Conservation (SAC) are covered separately in the standalone Shadow Habitats Regulations Appraisal (HRA), which has been prepared in support of the Section 36 Application.

## 12.4 Legislation, Policy and Guidance

### Legislative Context

- 12.4.1 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;
  - 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); and
  - Planning (Scotland) Act 2019.

### Policy Context

12.4.2 The following policy has been considered in the assessment:

- National Planning Framework 4 (NPF4) (2023).

### Technical Guidance

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

- CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
- Highland Nature: Biodiversity Action Plan 2021 – 2026;
- Inverness and Nairn Local Biodiversity Action Plan (LBAP) 2003;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR);
- SEPA (2010) Engineering in the water environment: good practice guide River crossings Second edition, November 2010; and
- SEPA (2017) Guidance for Pollution Prevention (GPPs).

## 12.5 Methodology

### Desk Study

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

- Existing data on statutory designated sites available through Naturescot Sitelink website for statutory designated sites up to 2 km from the Proposed Development;
- Scotland's environment web for data on SEPA River and loch classifications;
- Thermal Plume Modelling for Loch Ness (Ramboll, 2023); and
- Other pre-existing biological data relevant to the Proposed Development were also searched for to which the authors had access and for which there were no copyright issues associated with their use in a commercial setting.

### Field Study

12.5.2 The Ecological Impact Assessment (EclA) presented here has been informed by a series of technical field surveys, as described in **Volume 4, Appendix 12.1: Loch Kemp Baseline Aquatic Surveys** and **Volume 4, Appendix 10.4: Freshwater Lichen Survey Report**. In summary, the surveys included:

- Riverine Macroinvertebrate Surveys;
- Loch Macroinvertebrate Surveys; and
- Freshwater Lichen Surveys.

### Assessment Methodology

12.5.3 The EclA was undertaken following good practice guidelines current at the time of writing (CIEEM, 2018). 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

12.5.4 Evaluations are applied to those sites, habitats and species (important ecological features) that have been scoped into the assessment and those that are predicted to be affected by the Proposed Development. **Table 12.3: Evaluating Important Ecological Features (IEFs) Geographically** gives examples of how different types of IEFs may be evaluated geographically.

**Table 12.3: Evaluating Important Ecological Features (IEFs) Geographically**

Level of sensitivity or value	Examples
International (including European)	<p>European sites: SPAs and SACs, (p)SPAs and (c)SACs</p> <p>Other International sites: 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 (e.g. 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 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 SBL priority species and habitats.</p>

	<p>Regionally important population/assemblage of an 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 BAP 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

- 12.5.5 An understanding of how ecological features would 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, can be scoped out (CIEEM 2018).

#### Beneficial or Adverse Effects

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

Beneficial – a change which improved 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

- 12.5.7 The extent of an impact refers to the geographical area over which the impact may occur over typically representative conditions (CIEEM, 2018).

#### Frequency and Timing

- 12.5.8 The resulting effect of an impact is influenced by the number of times an activity occurs (CIEEM, 2018). For example, a vehicle driving across sensitive habitat once may have a slight impact, but the 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

- 12.5.9 An impact from which recovery is not possible within a reasonable timescale or for which there is no chance of action to implement successful mitigation, is classed as irreversible. An impact from which spontaneous recovery or from 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 (CIEEM, 2018).

Duration

- 12.5.10 CIEEM (2018) 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 12.4: Duration of Effects** defines the timescales used within this assessment.

**Table 12.4: 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	6 months - 5 years.
Temporary	0-6 months

Sensitivity

- 12.5.11 The sensitivity of an ecological receptor to a particular impact should also be considered as well as the zone of influence. Sensitivity criteria is 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 breeding season (CIEEM, 2018). 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 12.5: Levels of Sensitivity.

**Table 12.5: 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. 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.  Habitats which are considered to have a medium term recovery time.
Low	Species which are regularly subject to human disturbance which result in a brief reaction to a disturbance event.  Habitats which are considered to have a short-term quick recovery time and could readily established.

#### Magnitude

- 12.5.12 The magnitude of an impact refers to the size, intensity, or volume of 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). **Table 12.6: Criteria for describing the magnitude of impact on IEFs** defines the four levels of magnitude used in this assessment; these are generally considered to be adverse unless stated otherwise.

**Table 12.6: Criteria for describing the magnitude of impact 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

- 12.5.13 The combined assessment of both the sensitivity of the receptor and the magnitude of an effect determined whether an effect is likely to be significant (**Table 12.7: Significance of Effects Matrix**). **Table 12.7: Significance of Effects Matrix** 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 are evaluated as ‘not significant’. This assessment also includes effects which are considered to have a significance criteria lower than minor and therefore ‘imperceptible’ These are also evaluated as ‘not significant’. 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 12.8: Significance Criteria**.

Table 12.7: Significance of Effects Matrix

Nature Conservation Value	Magnitude of Potential Impact			
		High	Medium	Low
International	Major	Major	Moderate	Minor
National (Scotland)	Major	Major	Moderate	Minor
Council (Highlands)	Major	Moderate	Minor	Imperceptible
Local (Whitebridge)	Minor	Minor	Minor	Imperceptible
Low (Site)	Imperceptible	Imperceptible	Imperceptible	Imperceptible

Table 12.8: Significance Criteria

Significance Criteria	Definition
Major	Significant effect. 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	Significant effect. 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	No significant effect. 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	No perceptible effect / negligible effect. This is also not a significant effect.

## 12.6 Baseline Conditions

### Existing Baseline

12.6.1 Details of the existing baseline are provided below under 'Desk Study and Designated Sites' and 'Field Study'.

### Desk Study and Designated Sites

12.6.2 The findings of the desk study are presented in **Table 12.9: Summary of Desk Study**.

**Table 12.9: Summary of Desk Study**

Designated Sites / Habitats / Species / Constraints	Source (s)	Relevant Data
River Moriston SAC	NatureScot Sitelink / JNCC	<p>Information on the River Moriston Special Area of Conservation (SAC) which lies approximately 2 km northwest of the Proposed Development.</p> <p>Status: Unfavourable no change. Pearl mussels are known to be present from downstream of a hydro-electric dam to the confluence with Loch Ness.</p> <p>Annex II species that are a primary reason for the selection of this site are Freshwater pearl mussel <i>Margaritifera margaritifera</i>. Annex II species present as a qualifying feature, but not a primary reason for site selection are Atlantic salmon <i>Salmo salar</i>.</p> <p>'The River Moriston flows into the northern side of Loch Ness, and supports a functional freshwater pearl mussel population. Pearl mussels are present from downstream of a hydro-electric dam to the confluence with Loch Ness. Due to illegal pearl-fishing, the population is not abundant but survey results show that 40% of the population is composed of juveniles. This is the highest percentage recorded in any Scottish pearl mussel population and indicates that recent successful recruitment has taken place'<sup>1</sup>.</p>
Loch Kemp	UK Lakes Portal <sup>2</sup>	<p>Loch Kemp (Water Body ID 20328) is a small freshwater lake located in Highland, Scotland. It is generally shallow with low alkalinity and is situated at low altitude. The loch surface area is 26 ha, perimeter is 2 km, mean depth is 8 m with a maximum depth of 15.5 m. The mean conductivity of the water is 52 <math>\mu\text{S}/\text{cm}</math>.</p>

<sup>1</sup> Joint Nature Conservation Committee (2015) River Moriston Designated Special Area of Conservation (SAC). Available: <https://sac.jncc.gov.uk/site/UK0030259> (Last accessed 15/11/2022)

<sup>2</sup> UK Centre for Ecology and Hydrology UK Lakes Portal Loch Kemp Water Body ID 20328. Available: [Loch Kemp - UK Lakes Portal \(ceh.ac.uk\)](https://www.ceh.ac.uk/loch-kemp)

Loch Ness	SEPA River and Loch Classifications	Loch Ness is a lake (ID: 100156), in the River Ness catchment of the Scotland river basin district. It is 55.3 km <sup>2</sup> in area. It is classed as not heavily modified and not artificial. The Loch was last classified in 2020. Classification: Good status / potential
	UK Lakes Portal <sup>3</sup>	Loch Ness (Water Body ID 18767) is a large freshwater lake located in Highlands, Scotland, 7.95 km from sea. It is generally deep with low alkalinity and is situated at low altitude. The loch surface area is 5533 ha, perimeter is 80 km, mean depth is 132 m with a maximum depth of 229.8 m. The mean conductivity of the water is 40 µS/cm.
River Moriston - Loch Ness to Dundreggan Dam	SEPA River and Loch Classifications	River Moriston - Loch Ness to Dundreggan Dam is a river (ID: 23381), in the River Ness catchment of the Scotland river basin district. The main stem is approximately 8.8 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. The river was last classified in 2020 with Moderate ecological potential.
Invasive Non-Native Species (INNS)	Aquatic Ecology Survey Report for Red John Pumped Storage Hydro Scheme  Scoping Report Loch Kemp Pump Storage Scheme	<p><b>Crangonyx pseudogracilis (Freshwater Amphipod)</b></p> <p>This species is known to be present within the Ness catchment and is a relatively widespread and established species.</p> <p>The species is not listed in Schedule 9 of WCA, and therefore there is no legislative restriction on its spread or requirement for its control.</p> <p>Data on the distribution of the species is monitored by SEPA to inform annual Framework Directive (WFD) classifications.</p> <p>There were no recordings of this species within field studies carried out by Gavia Environmental in 2022.</p> <p>This species was recorded at one site on Loch Ness within the aquatic macroinvertebrate surveys for the Red John Pumped Storage Scheme (NH 58618 33194)<sup>4</sup>.</p> <p><b>Phagocata woodworthi (Flatworm)</b></p> <p>This species is known to be present within the Ness catchment<sup>5</sup>.</p> <p>The species is not listed in Schedule 9 of WCA, and therefore there is no legislative restriction on its spread or requirement for its control.</p> <p>There were no recordings of this species within field studies carried out by Gavia Environmental in 2022.</p>

<sup>3</sup> UK Centre for Ecology and Hydrology UK Lakes Portal Loch Ness Water Body ID 18767. Available: [Loch Ness - UK Lakes Portal \(ceh.ac.uk\)](https://ceh.ac.uk/loch-ness-uk-lakes-portal)

<sup>4</sup> AECOM (2018) Volume 5, Appendix 7.1: Aquatic Ecology Survey Report. Red John Pumped Storage Hydro Scheme. Available: [David Ritchie Report Title 2018-03-19 \(redjohnpsh.co.uk\)](https://redjohnpsh.co.uk/report-title-2018-03-19)

<sup>5</sup> Scottish Government (2022) Scoping Opinion On Behalf Of Scottish Ministers Under The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

		<i>Elodea Nuttallii</i> (Nattall's Water Weed) This species is known to be present within the Ness catchment <sup>6</sup> .
	NBN Atlas	One record of <i>Crangonyx pseudogracilis</i> within the Ness catchment on NBN Atlas.  No records of <i>Phagocata woodworthi</i> were present on the NBN Atlas within the Ness catchment.  One record of <i>Elodea Nuttallii</i> within the Ness catchment on NBN Atlas.
	SEPA Classified Waterbodies	Loch Ness is rated as 'Good' for Alien Species in 2020 on the SEPA classification hub.
Aquatic Lichens	Freshwater lichen survey at the proposed Loch Kemp pumped storage scheme	<i>Spongilla lacustris</i> was recorded on Loch Kemp and Allt a' Chinn Mhonaich.

#### Field Study

- 12.6.3 Full details of the field studies on macroinvertebrates, carried out by Gavia Environmental in 2022 are located in **Volume 4, Appendix 12.1: Loch Kemp Baseline Aquatic Surveys**. Macro invertebrate surveys conducted throughout July 2022 and September 2022 were fairly uniform throughout all survey locations. Both family groups *Oligochaeta* and *Chironomidae* were found in high abundance across the majority of sites. This large abundance of *Oligochaeta* is likely due to the high amount of organic silt present across the survey locations. No species of nature conservation interest were noted from the sampling conducted. Of the species recorded, they were common and widespread taxa, typical of a range of habitat types.
- 12.6.4 Full details of the field studies on aquatic lichens, carried out by John R. Douglass in 2022 are provided in **Volume 4, Appendix 10.4: Freshwater Lichen Survey Report**. This lichen survey was commissioned to identify lichens and lichenicolous fungi within, or in close proximity to Loch Kemp, including three watercourses one of which would be directly affected by the Proposed Development. Habitat quality for freshwater lichens was assessed using the Aquatic Watercourses Quality Index (AQWI) and the Rocky Lake Shores Threatened, Near Threatened and Notable Species Indices (Sanderson et al. 2018, JNCC Guidelines for the Selection of Biological SSSIs 2018). All three watercourses and Loch Kemp meet or exceed the threshold scores for potential SSSI designation, however further surveys identified that most species of interest that were identified were also present at other watercourses in the surrounding area, with the exception of two species. See **Chapter 10: Terrestrial Ecology** and **Volume 4, Appendix 10.4: Freshwater Lichen Survey Report** for further details.

<sup>6</sup> Scottish Government (2022) Scoping Opinion On Behalf Of Scottish Ministers Under The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

### Future Baseline

- 12.6.5 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 around 0.7 °C warmer than the 1961-1990 average. Over the past few decades, there has been an increase in rainfall across Scotland, with an increasing proportion due to heavy rainfall events. The average year in the last decade (2010-2019) was 9 % wetter than the 1961-1990 average<sup>7</sup>.
- 12.6.6 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 up to 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 macroinvertebrates 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>8</sup>.
- 12.6.7 Shallower lakes (such as Loch Kemp) with shallow thermoclines (regions of rapid temperature change) may be more susceptible to warming whereas in deeper lochs (such as Loch Ness) higher water temperatures tend to lengthen the period of thermal stratification and deepen the thermocline.
- 12.6.8 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.

### 12.7 Mitigations by Design / Embedded Mitigation

- 12.7.1 A Construction Environmental Management Plan (CEMP), Pollution Prevention Plan (PPP) and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an Aquatic Ecologist / Aquatic Clerk of Works (ACoW). This will include Biosecurity measures which would protect against the spread of Invasive Non-native Species (INNS) during the construction phase. Monitoring will include the Allt a’Chinn Mhonaich and Loch Kemp where aquatic lichen *Spongilla lacustris* was present. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.
- 12.7.2 The outflow from Loch Kemp (Allt an t-Sluichd) would receive a regulated compensation flow to be agreed with SEPA and NatureScot following the building of the Dam, as detailed in **Chapter 7: Water Management**. This could allow for a wetted channel throughout the year, which could have a beneficial effect for aquatic ecological features as very low flows were encountered during the baseline field studies in September 2022 under natural conditions. It is possible this watercourse would dry out during extreme drought conditions without regulation of flow. However, as the Allt an t-Sluichd runs through the Ness Woods SAC, this would need to be considered in parallel with conditions that are considered favourable to qualifying features of the SAC, including bryophyte and

<sup>7</sup> Scotland’s Environment (2021) How has Scotland’s climate changed? Available Online: [Changing climate | Scotland’s environment web](#)

<sup>8</sup> Linda May, Philip Taylor, Iain D. M. Gunn, Stephen J. Thackeray, Laurence R. Carvalho, Peter Hunter, Mairéad Corr, Anne J. Dobel, Alanna Grant, Gemma Nash, Emma Robinson and Bryan M. Spears (2022). Assessing climate change impacts on the water quality of Scottish standing waters. CRW2020\_01. Scotland’s Centre of Expertise for Waters (CREW). Available online with Technical Appendices at: [Assessing climate change impacts on the water quality of Scottish standing waters | CREW | Scotland’s Centre of Expertise for Waters](#)

lichen species (i.e., it would need to be determined whether a dry / drought period in the summer months was beneficial or not to such species). However, during recent consultation with SEPA in relation to the CAR licence for the Proposed Development (see **Chapter 5: Scoping and Consultation**), SEPA suggested that the dry conditions captured by the water gauge, which has been in place at the outflow from Loch Kemp and suggests that this watercourse is dry 20% of the time, seems unlikely and this finding is more likely the result of extreme dry conditions experienced in the Whitebridge area in summer / early autumn 2022, during the monitoring period. Further monitoring is required, but if SEPA's comments are correct, then it may be feasible to maintain a compensatory flow from the Allt an t-Sluichd throughout the summer months, which could be beneficial to both fish and species associated with the Ness Woods SAC.

## 12.8 Potential Significant Effects

12.8.1 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 3: Description of Development**.

### Construction Effects

#### Temporary Works Footprint (Loch Ness and Loch Kemp)

##### *Loch Macroinvertebrates*

12.8.2 Loch macroinvertebrates have the potential to be impacted by the temporary works footprint at Loch Ness and Loch Kemp. It is anticipated that this impact would cause temporary habitat loss, causing mortality or displacement to macroinvertebrates within the immediate vicinity of the temporary works area. Macroinvertebrate communities are widespread within Loch Ness and Loch Kemp and no species of high conservation interest were recorded within the field studies at Loch Ness. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

#### Construction Noise and Vibration

##### *Loch Macroinvertebrates*

12.8.3 Loch macroinvertebrates have the potential to be impacted by noise and vibration during the construction of the temporary cofferdams in Loch Ness and Loch Kemp. There is limited scientific literature on the effects of noise and vibration on macroinvertebrates however it is anticipated that this impact would cause lethal or sub-lethal effects causing mortality, injury or displacement to macroinvertebrates within the immediate vicinity of the cofferdam construction area. Macroinvertebrate communities are widespread within Loch Ness and Loch Kemp and no species of high conservation interest were recorded within field studies. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

#### Dewatering

##### *Loch Macroinvertebrates*

12.8.4 Loch macroinvertebrates have the potential to be impacted by dewatering post the construction of the temporary cofferdams in Loch Ness and Loch Kemp. It is anticipated that this impact would cause temporary habitat loss through loss of wetted area, causing mortality or displacement to macroinvertebrates within the immediate vicinity of the cofferdam construction area.

Macroinvertebrate communities are widespread within Loch Ness and Loch Kemp and no species of high conservation interest were recorded within field studies at Loch Ness. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

#### Dust and Construction Run Off

##### *Loch Macroinvertebrates*

- 12.8.5 Loch macroinvertebrates have the potential to be impacted during the construction phase through excessive dust or construction run off into Loch Kemp, Loch Ness and Lochan a' Choin Urie. It is anticipated that a major incident of construction run off would cause changes in water quality and habitat causing changes in species assemblages and abundance within the lochs. Macroinvertebrate communities are widespread within Loch Ness and no species of high conservation interest were recorded within field studies at Loch Kemp, Loch Ness and Lochan a' Choin Urie. The embedded mitigation (CEMP) would include a Pollution Prevention Plan (PPP), which would detail mitigation measures to reduce dust and run off. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.

##### *Riverine Macroinvertebrates*

- 12.8.6 Riverine macroinvertebrates have the potential to be impacted during the construction phase through excessive dust or construction run off into the Allt Leachd Gowerie, Allt Loch Paiteag, Allt an t-Sluichd and the Allt a Chinn Mhonaich. It is anticipated that a major incident of this type would cause changes in water quality and habitat causing changes in species assemblages and abundance within the waterbodies. Macroinvertebrate communities are widespread within Loch Ness and no species of high conservation interest were recorded within field studies on Allt Leachd Gowerie, Allt Loch Paiteag, Allt an t-Sluichd and the Allt a Chinn Mhonaich. The embedded mitigation (CEMP) would include a PPP, which would detail mitigation measures to reduce dust and run off. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.

##### *Aquatic Lichens*

- 12.8.7 Aquatic lichen (*Spongilla lacustris*) has the potential to be impacted during the construction phase through excessive dust or construction run off into Loch Kemp and Allt an t-Sluichd. It is anticipated that a major incident of this type would cause changes in water quality and habitat. *Spongilla lacustris* prefer clear water, however a pollution event increasing water turbidity is expected to be temporary and short-lived. The embedded mitigation (CEMP) would include a PPP, which would detail mitigation measures to reduce dust and run off. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)**. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.

#### Spread of Invasive Non-Native Species (INNS)

##### *Loch Macroinvertebrates*

- 12.8.8 Loch Macroinvertebrates have the potential to be impacted during the construction phase through the spread of invasive non-native species (INNS), notably *Crangonyx pseudogracilis* a freshwater amphipod which is known to be present within Loch Ness. INNS may cause changes in native species assemblages at site level. No INNS were recorded during field studies so it is likely that this species

is not present within the vicinity of the works. There is the possibility that INNS could be spread through the importing of materials for construction via barrage. The CEMP would include Biosecurity measures which would protect against the spread of INNS. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.

#### Construction of Dams

##### *Riverine Macroinvertebrates*

- 12.8.9 Riverine macroinvertebrates have the potential to be impacted during the construction phase through the dam construction on the Allt Leachd Gowerie and Allt an t-Sluichd. It is anticipated that this impact would cause habitat loss, causing mortality or displacement to macroinvertebrates within the immediate vicinity of the dam temporary construction footprint. Macroinvertebrate communities are widespread within waterbodies across the site and no species of high conservation interest were recorded within field studies in 2022. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

Table 12.10: Likely Construction Phase Impacts and Effects on IEFs Prior to Mitigation

IEF	Importance Level	Impacts	Effects	Impact Scale	Significance of Effect Prior to Mitigation
Loch Macroinvertebrates	Site	Construction noise and vibration during cofferdam construction (Loch Ness and Loch Kemp).	Lethal or sub-lethal effects causing mortality, injury or displacement.	Temporary <b>Negligible</b> , adverse impact	Imperceptible, Not Significant
		Dewatering for cofferdam construction (Loch Ness and Loch Kemp).	Loss of wetted habitat causing displacement or mortality.	Temporary <b>Negligible</b> , adverse impact	Imperceptible, Not Significant
		Temporary Works Footprint (Loch Ness and Loch Kemp).	Loss of habitat causing displacement or mortality.	Temporary, <b>Negligible</b> , adverse, impact	Imperceptible, Not Significant
		Dust and run off from construction work (e.g. major pollution incident).	Changes in water quality and habitat causing changes in species assemblages and abundances at site level.	Temporary <b>Negligible</b> , adverse impact	Imperceptible, Not Significant
		Spread of INNS such as Crangonyx pseudogracilis	Changes in native species assemblages at site level.	Permanent <b>Low</b> adverse impact	Imperceptible, Not Significant
Riverine Macroinvertebrates	Site	Dust and run off from construction work (e.g., major pollution incident).	Changes in water quality and habitat causing changes in species assemblages and abundances at site level.	Temporary <b>Negligible</b> , adverse impact	Imperceptible, Not Significant

		Construction of Dams 1 and 4.	Changes in water quality and habitat causing changes in species assemblages / abundance at site level.	Temporary <b>Negligible</b> , adverse impact	Imperceptible, Not Significant
Aquatic Lichens	National	Dust and run off from construction work (e.g. major pollution incident).	Changes in water quality and habitat impacting on habitat requirements.	Temporary <b>Negligible</b> , adverse impact	Minor, Not Significant

## Operational Effects

### Permanent Infrastructure

#### *Loch Ness Macroinvertebrates*

- 12.8.10 Loch macroinvertebrates in Loch Ness have the potential to be impacted by the location of the permanent infrastructure on the wetted area of the loch shore. It is anticipated that this impact would cause permanent habitat loss, causing mortality or displacement to macroinvertebrates within the immediate vicinity of infrastructure. Macroinvertebrate communities are widespread within Loch Ness and no species of high conservation interest were recorded within field studies at Loch Ness. The area of permanent infrastructure on the shoreline makes up around <0.5% of the total perimeter of Loch Ness. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

### Erosion of Sediment at the Intakes

#### *Loch Macroinvertebrates*

- 12.8.11 Loch macroinvertebrates have the potential to be impacted by the erosion of sediment at the intakes at Loch Ness and Loch Kemp. It is anticipated that this impact would cause permanent habitat loss, causing mortality or displacement to macroinvertebrates within the immediate vicinity of the tailrace area. Macroinvertebrate communities are widespread within Loch Ness and Loch Kemp and no species of high conservation interest were recorded within field studies at Loch Ness. The area of tailrace makes up around <0.25% of the total perimeter of Loch Ness. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

### Fluctuations in Loch Levels at periods of Maximum / Minimum Inundation

#### *Loch Macroinvertebrates*

- 12.8.12 Loch macroinvertebrates have the potential to be impacted by the constant fluctuations in the water levels at Loch Kemp and Loch Cluanie between maximum and minimum inundation. It is anticipated that this impact would cause unsettled conditions in the littoral zone 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 Kemp or Loch Cluanie. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.
- 12.8.13 Loch macroinvertebrates also have the potential to be impacted by more frequent fluctuations in the water levels at Loch Ness during pumping / generation cycles. It is anticipated that this impact would cause unsettled conditions for macroinvertebrates in the uppermost areas of the littoral zone in Loch Ness. The proposed operational regime of the Proposed Development would operate within the current maximum and minimum range of loch levels in Loch Ness, due to the implementation of stop pumping and stop generating levels (to be agreed with SEPA) enforced through the CAR Licence (see **Chapter 7: Water Management** for further details). The stop pumping level applied to the Proposed Development (through the CAR Licence) would be above the stop pumping level of the existing Foyers PSH on Loch Ness so the loch level would not be reduced to lower levels than existing conditions due to the operation of the Proposed Development, although the loch level would fluctuate more regularly within the maximum and minimum range of Loch Ness.
- 12.8.14 Modelling has been undertaken to predict the water level fluctuations when the Proposed Development undergoes a generating / pumping cycle in isolation (see **Chapter 7: Water**

**Management).** Based on a reasonable worst-case scenario, as described in **Chapter 7: Water Management**, the water level in Loch Ness would rise by **0.1 m** if the Proposed Development were to release water over a four hour period, and pumping for the same duration would lead to a drop in Loch Ness water levels of **0.08 m**. Macroinvertebrate communities are widespread within the local area and no species of high conservation interest were recorded within field studies at Loch Ness. The significance of this effect prior to mitigation is therefore considered to be **Imperceptible (Not Significant)**.

#### *Riverine Macroinvertebrates*

- 12.8.15 Riverine macroinvertebrates have the potential to be impacted by the constant fluctuations in the water levels at the Allt Leachd Gowerie and the Allt Loch Paiteag between maximum and minimum inundation across the areas of inundation where existing river channels would become periodically flooded. It is anticipated that this impact would cause unsettled conditions in the existing river channels and potential loss of original nursery habitat. Macroinvertebrate communities are widespread within the local area and no species of high conservation interest were recorded within field studies on the Allt Leachd Gowerie and the Allt Loch Paiteag. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

#### *Aquatic Lichens*

- 12.8.16 Aquatic lichens, notably *Spongilla lacustris* have the potential to be impacted by the constant fluctuations in the water levels at Loch Kemp between maximum and minimum inundation. It is anticipated that this impact would cause unsettled conditions across the shoreline, however the species should retain wetted cover even at periods of minimum inundation as the loch level would not drop below current natural levels under the operation of the scheme. The significance of this effect prior to mitigation is considered to be **Minor (Not Significant)**.

#### Spread of Invasive Non-Native Species (INNS)

##### *Loch Macroinvertebrates*

- 12.8.17 Loch Macroinvertebrates have the potential to be impacted during the operational phase through the spread of INNS, notably freshwater amphipod *Crangonyx pseudogracilis* and Flatworm *Phagocata woodworthi* which are known to be present within Loch Ness. INNS may cause changes in native species assemblages at site level. No INNS were recorded during field studies so it is likely that this species is not present within the vicinity of the Proposed Development. There is however the possibility that INNS could be spread through the transfer of water between Loch Ness and Loch Kemp. Any INNS that were able to spread to from Loch Ness to Loch Kemp would be expected to remain within Loch Kemp and its tributaries. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

#### Permanent Dams

##### *Riverine Macroinvertebrates*

- 12.8.18 Riverine macroinvertebrates on the Allt Leachd Gowerie and the Allt an t-Sluichd would be impacted by the permanent dams which would be present during the operational phase through loss of nursery habitat within the dam footprint. The dam footprint would also include an area on the Allt Leachd Gowerie immediately upstream of Dam 4 where water would back up and be periodically flushed out, creating unsettled river conditions. Macroinvertebrate communities are widespread within the local area and no species of high conservation interest were recorded within field studies

on the Allt Leachd Gowerie or the Allt an t-Sluichd. Water levels in the Allt an t-Sluichd were noted as extremely low in September 2022 with very little flow. The Allt an t-Sluichd will receive a compensation flow from Loch Kemp during the operational phase which will maintain a wetted channel, a beneficial impact for all aquatic life, including riverine macroinvertebrates, as a consequence of Dam 1 being constructed. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

#### Temperature Changes through Water Transfer

##### *Loch Macroinvertebrates*

- 12.8.19 Loch Macroinvertebrates have the potential to be impacted in the immediate vicinity of the tailrace (Loch Ness) and within Loch Kemp during the operational phase through changes in temperature as a result of continual water transfer between Loch Ness and Loch Kemp. Increased temperature would have the potential to cause lethal and sub-lethal effects on Macroinvertebrates. Exposure to temperatures outside of a species' critical range can result in stress, reduced metabolic activity, impaired growth and reproduction or mortality. Continual fluctuations in temperature may also cause sub-lethal effects such as displacement. Cox *et. al* 1999 found that at constant temperature 50% mortality occurred at  $24.2 \pm 0.9^{\circ}\text{C}$  for mayflies and  $31.0 \pm 0.6^{\circ}\text{C}$  for snails<sup>9</sup>. Mayflies, stoneflies, diptera and crustaceans have typical temperature ranges of between 5-25°C.
- 12.8.20 Modelling has shown the water outlet may increase the water temperature 200 m into Loch Ness from the shoreline, and around 2 km along the shoreline to the northeast and 600 m to the southwest. Temperatures up to a worst-case 20°C have been predicted within the modelled plume. The area experiencing temperatures greater than 15°C is limited to 140 m to the southwest of the plume location, 360 m to the northeast and up to 65 m away from the loch shoreline<sup>10</sup>. The area experiencing temperature fluctuation makes up a very small proportion of the total available habitat in Loch Ness. Modelled temperatures are within the typical temperature ranges for macroinvertebrates but there may still be effects from the rapid fluctuation of temperature. Macroinvertebrate communities are widespread within Loch Ness and the surrounding area and no species of high conservation interest were recorded within field studies at Loch Ness or Loch Kemp. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

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<sup>9</sup> Cox, T. J. & Rutherford, C. (2000) Thermal tolerances of two stream invertebrates exposed to diurnally varying temperature, New Zealand Journal of Marine and Freshwater Research, 34:2, 203-208, DOI: 10.1080/00288330.2000.9516926

<sup>10</sup> Otton, H. and Gaskell, S. (2023) Technical Note: Thermal Plume Modelling Loch Ness.

Table 12.11: Likely Operational Phase Impacts and Effects on IEFs Prior to Mitigation

IEF	Importance Level	Impacts	Effects	Impact Scale	Significance of Effect Prior to Mitigation
Loch Macroinvertebrates	Site	Erosion of the sediment at the intakes (Loch Ness and Loch Kemp).	Net loss of nursery habitat in Loch Ness.	Permanent, <b>Negligible</b> , adverse, impact.	Imperceptible, Not Significant
		Permanent Infrastructure (Loch Ness).	Loss of nursery habitat in Loch Ness.	Permanent, <b>Negligible</b> , adverse, impact	Imperceptible, Not Significant
		Fluctuations in loch level and flooding of original shoreline habitat at periods of maximum inundation. (Loch Kemp and Loch Cluanie).	Unsettled conditions and potential loss of original nursery habitat.	Permanent, <b>Negligible</b> , adverse, impact	Imperceptible, Not Significant
		Fluctuations in loch level impacting on shoreline habitat (Loch Ness).	Unsettled conditions and potential loss of original nursery habitat.	Permanent, <b>Low</b> , adverse, impact	Imperceptible, Not Significant
		Spread of INNS such as <i>Crangonyx pseudogracilis</i> known to be present within Loch Ness (water pumped between Loch Ness and Loch Kemp).	Changes in native species assemblages at site level (Loch Kemp).	Permanent <b>Low</b> adverse impact	Imperceptible, Not Significant
		Temperature changes through water transfer (Loch Kemp and Loch Ness).	Lethal / sub-lethal effects (Loch Ness and Loch Kemp).	Permanent, <b>Negligible</b> , adverse, impact.	Imperceptible, Not Significant
Riverine Macroinvertebrates	Site	Fluctuations in loch level and flooding of original river channels during periods of maximum inundation (Allt Leachd Gowerie and Allt Loch Paiteag).	Unsettled conditions and loss of original riverine nursery habitat.	Permanent, <b>Low</b> adverse, impact	Imperceptible, Not Significant

IEF	Importance Level	Impacts	Effects	Impact Scale	Significance of Effect Prior to Mitigation
		Construction of permanent dams 1 and 4.	Loss of nursery habitat within dam footprint.	Permanent, <b>Negligible</b> , adverse, impact	Imperceptible, Not Significant
Aquatic Lichens	National	Fluctuations in loch level and flooding of original shoreline habitat at periods of maximum inundation (Loch Kemp).	Unsettled conditions and potential loss of original habitat.	Permanent, <b>Negligible</b> , adverse, impact	Minor, Not Significant

#### Cumulative Effects Construction

- 12.8.21 No cumulative effects during the construction phase have been identified at this stage.

#### Cumulative Effects Operational

- 12.8.22 Potential cumulative effects during the operational phase have been identified.

##### Foyers PSH (Operational)

- 12.8.23 The operational 300 MW Foyers PSH (see **Volume 2, Figure 1.2: Site Context**) presents similar adverse effects highlighted for macroinvertebrates during the operational phase of the Proposed Development. Foyers PSH raises / reduces the water level in Loch Ness by up to 266 mm during a single discharge or abstraction cycle.

##### Red John PSH (Consented)

- 12.8.24 The consented 450 MW Red John PSH (Planning Ref: ECU00000728) (see **Volume 2, Figure 1.2: Site Context**) would also present the same adverse effects highlighted for macroinvertebrates during the operational phase of the Proposed Development, although the upper reservoir of the Red John PSH has a smaller capacity than Foyers PSH and would only raise / reduce the loch level of Loch Ness by up to 90 mm during a single discharge or abstraction cycle.

##### Fluctuations in Loch Levels at periods of Maximum / Minimum Inundation

- 12.8.25 The Proposed Development, Foyers PSH and Red John PSH would all operate within the current maximum and minimum range of loch levels in Loch Ness, due to the implementation of stop pumping and stop generating levels enforced through their CAR Licences. Modelling has been undertaken to predict the water level fluctuations within Loch Ness when existing and consented pumped storage schemes are operating in combination with the Proposed Development. The stop pumping level applied to the Proposed Development and the consented Red John PSH (through their respective CAR Licences) would be above the stop pumping level of the existing Foyers PSH. Consequently, the loch level would not reduce below existing levels as a result of the operation of multiple PSH on Loch Ness simultaneously, although the loch level would fluctuate more regularly within the maximum and minimum range of the loch. Based on a reasonable worst case scenario, as described in **Chapter 7: Water Management**, if all three PSH schemes were to release water simultaneously, the water level in Loch Ness would rise by **0.21m** over four hours, and pumping for the same duration would lead to a drop in Loch Ness water levels of **0.15m**.

##### *Loch Macroinvertebrates*

- 12.8.26 Loch Ness macroinvertebrates have the potential to be impacted by more frequent fluctuations in the water levels at Loch Ness during the pumping cycles of multiple PSH. It is anticipated that this impact would cause unsettled conditions for macroinvertebrates in the uppermost areas of the littoral zone. Based on a sensible worst case scenario, where all three pumped storage schemes were operating simultaneously over a 4 hour period, as described in **paragraph 12.8.25** above, only macroinvertebrates using the shallowest areas of the shoreline would be expected to be impacted by water fluctuation. Macroinvertebrate communities are widespread within the local area and no species of high conservation interest were recorded within field studies at Loch Ness. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

### Temperature Changes through Water Transfer

#### *Loch Macroinvertebrates*

- 12.8.27 Loch Ness Macroinvertebrates have the potential to be impacted during the operational phase through changes in temperature as a result of multiple PSH's continually transferring water to and from Loch Ness. Localised temperature increases would be associated with water being released into the loch during generating phases. Increased temperature would have the potential to cause lethal and sub-lethal effects on Macroinvertebrates. Exposure to temperatures outside of a species' critical range can result in stress, reduced metabolic activity, impaired growth and reproduction or mortality. Continual fluctuations in temperature may also cause sub-lethal effects such as displacement. Cox *et. al* 1999 found that at constant temperature 50% mortality occurred at  $24.2 \pm 0.9^\circ\text{C}$  for mayflies and  $31.0 \pm 0.6^\circ\text{C}$  for snails<sup>11</sup>. Mayflies, stoneflies, diptera and crustaceans have typical temperature ranges of between 5-25°C.

Modelling has shown the water outlet of the Proposed Development may increase the water temperature, 200 m into Loch Ness from the shoreline and around 2 km along the shoreline to the northeast and 600 m to the southwest. Temperatures up to a worst-case 20°C have been predicted within the modelled plume. The area experiencing temperatures greater than 15°C is limited to 140 m to the southwest of the plume location, 360 m to the northeast and up to 65 m away from the loch shoreline<sup>12</sup>. Temperature increases would be expected from other schemes including Foyers PSH. Temperature increase associated with Red John PSH is an estimated 5.5°C<sup>13</sup>.

The total cumulative area experiencing temperature fluctuation would make up a very small proportion of the total available habitat in Loch Ness and discharges would be short lived and quickly buffered by the Loch. Temperature changes would be localised to each development. There is not expected to be an overlap in warmer water emanating from the Proposed Development and Foyers PSH due to the considerable distance between the developments (>7 km along the shoreline). Modelled temperatures are within the typical temperature ranges for macroinvertebrates but there may still be effects from the rapid fluctuation of temperature. Macroinvertebrate communities are widespread within Loch Ness and the surrounding area and no species of high conservation interest were recorded within field studies at Loch Ness or Loch Kemp. The significance of this effect prior to mitigation is considered to be **Imperceptible (Not Significant)**.

## 12.9 Mitigation

### Mitigation during Construction Phase

- 12.9.1 No significant effects were identified in relation to the construction phase of the Proposed Development therefore no additional mitigation has been proposed.
- 12.9.2 As noted in **Section 12.7: Embedded Mitigation**, a CEMP, PPP and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an Aquatic Ecologist

<sup>11</sup> Cox, T. J. & Rutherford, C. (2000) Thermal tolerances of two stream invertebrates exposed to diurnally varying temperature, New Zealand Journal of Marine and Freshwater Research, 34:2, 203-208, DOI: 10.1080/00288330.2000.9516926

<sup>12</sup> Otton, H. and Gaskell, S. (2023) Technical Note: Thermal Plume Modelling Loch Ness.

<sup>13</sup> Caceres (2018) Impact on Water Temperature in Loch Ness *in*: Red John Pumped Storage Hydro Scheme Volume 2, Chapter 10: Water Environment pp10-31 Available: [Volume 2 - Chapter 10 - Water Environment.pdf \(redjohnpsh.co.uk\)](https://www.redjohnpsh.co.uk/Volume%20-%20Chapter%2010-%20Water%20Environment.pdf)

/ ACoW. This will include Biosecurity measures which would protect against the spread of INNS during the construction phase. Monitoring by the ACoW would include the Allt a' Chinn Mhonaich and Loch Kemp where aquatic lichen *Spongilla lacustris* was present during surveys. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.

- 12.9.3 Annual monitoring of macroinvertebrates in the rivers and lochs within the development boundary and within Loch Ness in the immediate vicinity of the development boundary will be undertaken to monitor water quality and the spread of invasive species during the construction phase.

#### Mitigation During Operational Phase

- 12.9.4 No significant effects were identified in relation to the operational phase of the Proposed Development therefore no additional mitigation has been proposed. Good practice and enhancement measures are listed below.

- 12.9.5 As noted in **Section 12.7: Embedded Mitigation**, a Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an Aquatic Ecologist / ACoW. This will include annual monitoring of macroinvertebrates within Loch Kemp catchment (Loch Kemp, Allt a' Loch Paiteag, Allt an t-Sluichd and Allt Leachd Gowerie) to monitor water quality changes and the spread of invasive species from Loch Ness.

#### Enhancement

- 12.9.6 Coarse woody debris (CWD) would be submerged around loch shoreline areas and secured in place to create new habitats for loch macroinvertebrates. Broadleaved trees removed during the construction of the Proposed Development could be reused for this purpose. This would also provide an added benefit for fish. Areas for CWD submersion would be confirmed in the final HMP, and would comprise retained riverine habitat, and lochs/lochans which are not subject to rapid water level changes, such as Lochan a Choin Uire, Loch Paiteag, Lochan a Mhonaich, Lochan nan Nighean and Lochan Scristan. An outline HMP is provided in **Volume 4, Appendix 10.7: Outline Habitat Management Plan (non-SAC)**.

## 12.10 Residual Effects

- 12.10.1 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 12.9**.

#### Construction Phase Residual Effects

- 12.10.2 A summary of the construction phase residual effects on each IEF, prior and post avoidance, mitigation, compensation and enhancement is shown in **Table 12.12: Construction Phase Residual Effects**.

Table 12.12: Construction Phase Residual Effects

IEF	Impact	Significance of Effect Prior to Mitigation	Avoidance	Mitigation	Compensation / Enhancement	Residual Significance of Effect
Loch Macroinvertebrates	Construction noise and vibration during cofferdam construction (Loch Ness and Loch Kemp).	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant
	Dewatering for cofferdam construction (Loch Ness and Loch Kemp).	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant
	Temporary Works Footprint (Loch Ness and Loch Kemp).	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant
	Dust and run off from construction work (e.g. major pollution incident).	Imperceptible, Not Significant	N/A	A Construction Environmental Management Plan (CEMP), Pollution Prevention Plan (PPP) and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an	N/A	Imperceptible, Not Significant

				Aquatic Clerk of Works (ACoW).		
	Spread of INNS such as Crangonyx pseudogracilis	Imperceptible, Not Significant	N/A	A CEMP with Biosecurity measures would be implemented by the Principal Contractor and overseen by an ACoW.  Annual monitoring during construction of macroinvertebrates within Loch Kemp catchment to monitor the spread of invasive species.	N/A	Imperceptible, Not Significant
Riverine Macroinvertebrates	Dust and run off from construction work (e.g., major pollution incident).	Imperceptible, Not Significant	N/A	A CEMP, PPP and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an ACoW.	N/A	Imperceptible, Not Significant
	Construction of Dams 1 and 4.	Imperceptible, Not Significant	N/A	A CEMP, PPP and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an ACoW.	N/A	Imperceptible, Not Significant
Aquatic Lichens	Dust and run off from construction work (e.g. major pollution incident).	Minor, Not Significant	N/A	A (CEMP, PPP and Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an ACoW. Monitoring would include the	N/A	Imperceptible, Not Significant

				Allt a'Chinn Mhonaich and Loch Kemp where <i>Spongilla lacustris</i> was present.		
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### Operational Phase Residual Effects

12.10.3 A summary of the operational phase residual effects on each IEF, prior and post avoidance, mitigation, compensation and enhancement is shown in **Table 12.13: Operational Phase Residual Effects**.

**Table 12.13: Operational Phase Residual Effects**

IEF	Impact	Significance of Effect Prior to Mitigation	Avoidance	Mitigation	Compensation / Enhancement	Residual Significance of Effect
Loch Macroinvertebrates	Erosion of the sediment at the intakes (Loch Ness and Loch Kemp).	Imperceptible, Not Significant	N/A	N/A	Coarse woody debris (CWD) would be submerged around shoreline areas within the Site Boundary to create new habitats for loch macroinvertebrates. Trees removed during the construction of the Proposed Development can be reused for this purpose. This can also provide an added benefit for fish.	Imperceptible, Not Significant
	Permanent Infrastructure (Loch Ness).	Imperceptible, Not Significant	N/A	N/A	CWD would be submerged around shoreline areas within the Site Boundary to create new habitats for loch macroinvertebrates. Trees removed during the construction of the Proposed Development can be	Imperceptible, Not Significant

					reused for this purpose. This can also provide an added benefit for fish.	
	Fluctuations in loch level and flooding of original shoreline habitat at periods of maximum inundation. (Loch Kemp and Loch Cluanie)	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant
	Fluctuations in loch level impacting on shoreline habitat (Loch Ness).	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant
	Spread of INNS such as <i>Crangonyx pseudogracilis</i> known to be present within Loch Ness (water pumped between Loch Ness and Loch Kemp).	Imperceptible, Not Significant	N/A	Annual monitoring of macroinvertebrates within Loch Kemp catchment (Loch Kemp, Allt a' Loch Paiteag, Allt an t-Sluichd and Allt Leachd Gowerie) to monitor the spread of invasive species from Loch Ness.	N/A	Imperceptible, Not Significant
	Temperature changes through water transfer	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant

	(Loch Kemp and Loch Ness).					
Riverine Macroinvertebrates	Fluctuations in loch level and flooding of original river channels during periods of maximum inundation (Allt Leachd Gowerie and Allt Loch Paiteag).	Imperceptible, Not Significant	N/A	N/A	Coarse woody debris (CWD) would be submerged in riverine areas to create new habitats for riverine macroinvertebrates. Native trees removed during the construction of the Proposed Development can be reused for this purpose. This can also provide an added benefit for fish.	Imperceptible, Not Significant
	Construction of permanent dams 1 and 4.	Imperceptible, Not Significant	N/A	N/A	Coarse woody debris (CWD) would be submerged in riverine areas to create new habitats for riverine macroinvertebrates. Trees removed during the construction of the Proposed Development can be reused for this purpose. This can also provide an added benefit for fish.	Imperceptible, Not Significant
Aquatic Lichens	Fluctuations in loch level and flooding of original shoreline habitat at periods of maximum inundation. (Loch Kemp)	Minor, Imperceptible, Not Significant	N/A	N/A	N/A	Minor, Not Significant

### Operational Phase Residual Cumulative Effects

- 12.10.4 A summary of the operational phase residual cumulative effects on each IEF, prior and post avoidance, mitigation, compensation and enhancement is shown in **Table 12.14 Operational Phase Residual Cumulative Effects**.

**Table 12.14 Operational Phase Residual Cumulative Effects**

IEF	Impact	Significance of Effect Prior to Mitigation	Avoidance	Mitigation	Compensation / Enhancement	Residual Significance of Effect
Loch Macroinvertebrates	Fluctuations in loch level impacting on shoreline habitat (Loch Ness).	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant
	Temperature changes through water transfer (Loch Kemp and Loch Ness).	Imperceptible, Not Significant	N/A	N/A	N/A	Imperceptible, Not Significant

## 12.11 Conclusion

- 12.11.1 Potential effects were identified on the important aquatic ecological features during the construction and operational phases of the Proposed Development (including cumulative impacts with other projects). Following the implementation of embedded mitigation (as set out in **Section 12.7 and paragraph 12.11.2**), none of these were deemed to be significant adverse effects and therefore additional mitigation to reduce the significance of these would not be required.
- 12.11.2 The Proposed Development would have embedded mitigation including a CEMP, a PPP and a Water Quality Monitoring Programme would be implemented by the Principal Contractor and overseen by an Aquatic Ecologist / ACoW. These measures would include Biosecurity measures which will protect against the spread of INNS during the construction phase. An outline CEMP is provided in **Volume 4, Appendix 3.3: Outline Construction Environmental Management Plan (CEMP)**.
- 12.11.3 Enhancement measures including the installation of Coarse woody debris (CWD) submerged around loch shoreline and riverine areas will create new habitats for loch and riverine macroinvertebrates. Areas for CWD submersion would be confirmed in the final HMP, and would comprise retained riverine habitat, and lochs/lochans which are not subject to rapid water level changes, such as Lochan a Choin Uire, Loch Paiteag, Lochan a Mhonaich, Lochan nan Nighean and Lochan Scristan.