Chapter 8: Sloy Pumped Hydro Storage Scheme: Aquatic Ecology and Fish

Chapter 8: Aquatic Ecology and Fish - Contents

Figures

There are no figures associated with this Chapter.

Appendices

Appendix 8.1: Aquatic Macrophyte Outline Invasive Non-Native Species Management Plan

8. Aquatic Ecology and Fish

8.1. Executive Summary

An Ecological Impact Assessment (EcIA) has been undertaken to consider the effects of the Proposed Development on aquatic Important Ecological Features (IEFs) including Statutory Designated Sites, Non-Statutory Designated Sites, and notable and protected fish species / species groups. The EcIA has been undertaken by Ecological Consultants at EnviroCentre Limited according to the latest guidance from the Chartered Institute of Ecology and Environmental Management (CIEEM) and informed by comments and information supplied by Loch Lomond & the Trossachs National Park Authority (LLTNPA), Scottish Government Marine Directorate, Scottish Environmental Protection Agency (SEPA), and Scottish Centre for Ecology and the Natural Environment (SCENE).

The assessment considered the potential significant effects of the project and its associated activities on IEFs present within the Proposed Development Area (PDA), and for the Zone of Influence (ZoI) of the IEFs which were scoped in for assessment.

No statutory or non-statutory designated sites with qualifying features relating to aquatic ecology were identified within the site boundary or within 10km of the site during the desk study, and these IEFs were scoped out of the assessment. Aquatic ecological receptors that were identified as being susceptible to impacts as a result of the Proposed Development and scoped into the assessment include Atlantic salmon, brown / sea trout, European eel, and powan, as these species are known to naturally occur within Loch Lomond. Powan and brown trout are recorded as present within Loch Sloy; however, they have been introduced through translocation and historic stocking, respectively.

The potential impacts of aquatic plant invasive non-native species (INNS) Canadian pondweed, Nuttall's pondweed, and New Zealand pigmyweed were assessed due to their presence within the southern basin of Loch Lomond. The absence of these INNS from Loch Sloy and Inveruglas Bay was confirmed by monitoring in 2024. Ruffe, a fish INNS, was included in the assessment due to their presence in Inveruglas Bay and the negative impact ruffe have on powan populations through egg predation. Ruffe are considered absent from Loch Sloy.

Potential significant effects relating to aquatic plant INNS may arise from the movement of water from Loch Lomond to Loch Sloy. However, given the oligotrophic status of the northern basin of Loch Lomond, it is considered unlikely that Nuttall's pondweed, Canadian pondweed, and New Zealand pigmyweed would flourish in Inveruglas Bay, reducing the probability of transfer via pumping operations.

Without appropriate mitigation during the construction period, potential effects on native fish include: noise and vibration caused by rock excavation for the pump house and intake, accidental damage and pollution of Inveruglas Bay through construction activities, and disruption to natural behaviour caused by construction lighting.

Without appropriate mitigation during the operational period, potential effects on native fish include: impingement on screens or entrainment into the pump mechanisms during pumping, changes to hydrological conditions in Loch Sloy through transfer of water from Loch Lomond, and introduction of ruffe to Loch Sloy leading to a reduction in the powan population.

The hydrological conditions in Loch Sloy are not expected to change during operation as both Loch Sloy and the northern basin of Loch Lomond are oligotrophic. The powan population in Loch Sloy currently cope with seasonal drawdown of the water level from operation of the existing hydro station, and the operational range is not expected to change as a result of the Proposed Development.

It is considered that the combination of change in pressure and moving parts within the pump system would likely result in mortality of entrained ruffe. Generation flows would prevent ruffe from entering the tailrace, further limiting the risk of transfer to Loch Sloy. Overall, the predicted impacts of the Proposed Development on the powan population in Loch Sloy are assessed to be non-significant.

Providing that mitigation measures detailed in this chapter are in place, it is considered that the Proposed Development would have a non-significant impact on native fish species in Inveruglas Bay. Mitigation measures include:

- Pollution prevention measures in line with best practice;
- Fish rescue to remove fish from the working area;
- Production of a Construction Environmental Management Plan (CEMP) to minimise impacts during the construction phase; and
- Sensitive design of the intake screen with additional fish behavioural deterrents within the tailrace to minimise impacts during the operational phase.

Whilst there are some uncertainties or limitations in the assessments and/or mitigation proposed, it is anticipated that monitoring during construction and operation would allow for mitigation to be adapted if necessary. Inveruglas Bay and Loch Sloy would be routinely monitored for signs of plant INNS establishment and appropriate control and design measures would be enacted if required.

The cumulative effects of the Proposed Development with other developments in the vicinity are considered to be not significant.

8.2. Introduction

EnviroCentre Limited was commissioned by ASH design + assessment on behalf of SSE to undertake an Ecological Impact Assessment (EcIA) in relation to aquatic ecology for the Proposed Development at the Sloy Hydroelectric Power Station, Inveruglas, Loch Lomond. The assessment was undertaken with support from Dr Ross Glover, Fisheries Specialist at SSE Renewables. The assessment is required in order to identify important ecological features and complete an assessment of baseline data against design, construction and operational proposals to ascertain the significance of predicted effects.

This chapter details the specialist ecological studies undertaken and the results of the assessment. The assessment has been carried out according to the latest guidance from the Chartered Institute of Ecology and Environmental Management (CIEEM). It is supplemented by the figures contained within **Volume 2: Figures** and the technical reports contained within **Volume 4: Technical Appendices** of this EIA Report.

Details of the site and the Proposed Development are provided in **Chapter 4: Description of Development**.

The purpose of this chapter is to:

- Identify and describe the Important Ecological Features (IEFs) which may be impacted by the Proposed Development.
- Describe all potentially significant ecological impacts associated with the Proposed Development.
- Consider the avoidance and mitigation measures to be adopted within the design, construction and operational phases and those required to ensure compliance with nature conservation legislation and to address adverse impacts.
- Provide an assessment of the significance of any residual impacts.
- Set out the requirements for post-construction monitoring.

8.3. Scope of Assessment

Potential impacts on protected and/or notable aquatic species have been considered within this assessment, based on the results of baseline studies.

8.3.1. POTENTIAL IMPACTS AND ZONE OF INFLUENCE

Potential significant impacts considered during Scoping[1] were as follows:

- Spread of aquatic invasive species between Loch Lomond and Loch Sloy.
- Construction noise, vibration and dust from increased traffic and rock excavation could negatively impact species or pollute habitats of Loch Lomond and Loch Sloy.
- Construction lighting may disrupt the normal cycles of aquatic species should waterbodies be illuminated.
- Introduction of non-native ruffe to Loch Sloy which could damage the populations of powan within Loch Sloy.
- Mortality of fish through impingement / entrainment at the pump intake.
- Mixing of Loch Lomond and Loch Sloy waters in Loch Sloy.

The CIEEM Guidelines identify the Zone of Influence (ZoI) as the area over which ecological features may be subject to significant effects as a result of the Proposed Development and associated activities. This is likely to extend beyond the Proposed Development Area (PDA), for example where there are hydrological links beyond the site boundaries. Features found to be present or likely to be present within the predicted ZoI and which have potential to be significantly affected (positively and negatively) by the Proposed Development are included within the scope of this assessment. The features considered, associated ZoI, decision to scope in / out and justification are summarised in **Table 8.1** and **Table 8.2**. Where impacts to features are considered likely to be similar, these have been grouped for succinctness.

[1] Volume 4, Appendix 6.1: Scoping Report and Appendix 6.2: Scoping Opinion

Table 8.1 Scoping Summary

IEF	Importance of IEF	ZoI	Present in Site/Locale	Significant effects likely/Scoping Decision	Justification
Invasive Non-Natives Species					
Invasive Non-Native Aquatic Plant Species	Negative	Within and up to 1km from the PDA	Locale	Significant effects are likely. Invasive Non-Natives Species (INNS) have been **scoped in**	Canadian pondweed (*Elodea canadensis*) is known to be present within Inveruglas Bay which is within the ZoI of the Proposed Development. Nuttall's pondweed (*Elodea nuttalli*) is known to be present within Loch Lomond; however, it is unknown if it is found within the ZoI. New Zealand pigmyweed (*Crassula helmsii*) is known to be present within the southern extent of the southern basin of Loch Lomond; however, it is unknown if it is found within the ZoI.
Invasive Non-Native Fish Species	Negative	Within and up to 1km from the Proposed Development area	Survey Area	Significant effects are likely. INNS have been **scoped in**	Ruffe (*Gymnocephalus cernua*) are known to be present within Inveruglas Bay which is within the ZoI.
Fauna and Fauna Species Groups					
Arctic Charr (*Salvelinus alpinus*)	National (Scotland)	Within and up to 1km from the PDA (furthest extent at which pollution impacts are expected)	Not Known	No significant effects likely. Arctic charr have been **scoped out**	There are no records of Arctic charr within the ZoI or surrounding area.
Atlantic Salmon (*Salmo salar*)	National (Scotland)	Within and up to 1km from the PDA (furthest extent at which pollution impacts are expected)	Locale	Significant effects are likely. Atlantic salmon have been **scoped in**	Atlantic salmon are present in Loch Lomond and are likely to be present within the ZoI

IEF	Importance of IEF	ZoI	Present in Site/Locale	Significant effects likely/Scoping Decision	Justification
Brown/Sea Trout (*Salmo trutta*)	National (Scotland)	Within and up to 1km from the PDA (furthest extent at which pollution impacts are expected)	Locale	Significant effects are likely. Brown / sea trout have been **scoped in**	Brown trout are known to be present within Inveruglas Bay and Loch Sloy which are within the ZoI
European Eel (*Anguilla anguilla*)	International	Within and up to 1km from the PDA (furthest extent at which pollution impacts are expected)	Locale	Significant effects are likely. European eel have been **scoped in**	European eel are known to be present within Inveruglas Bay and Loch Sloy which are within the ZoI
Lampreys	National (Scotland)	Within and up to 1km from the PDA (furthest extent at which pollution impacts are expected)	Not Known	No significant effects likely. Lamprey have been **scoped out**	There are no records of lamprey within the ZoI or surrounding area.
Powan (*Coregonus clupeoides*)	National (UK)	Within and up to 1km from the PDA (furthest extent at which pollution impacts are expected)	Site	Significant effects are likely. Powan have been **scoped in**	Powan are known to be present within Loch Lomond and Loch Sloy which are within the ZoI.

8.4. Consultation Responses

Table 8.2: Consultee Responses

Consultee	Issues raised / discussed	Point of Inclusion
Loch Lomond & The Trossachs National Park Authority	The EcIA should include measures to reduce the risk of spread of aquatic INNS and address any adverse impacts.	The 2024 aquatic plant INNS survey of Inveruglas Bay and Loch Sloy is detailed in **Volume 4, Appendix 8.1: Aquatic Macrophyte Outline INNS Management Plan.** Mitigation measures to limit spread of aquatic INNS are included in **Section 8.9.1: INNS**.
	The potential presence of New Zealand pigmyweed (*Crassula helmsii*) and the potential for the proposal to promote its spread should be considered in the EIA	The 2024 aquatic plant INNS survey of Inveruglas Bay and Loch Sloy is detailed in **Volume 4, Appendix 8.1: Aquatic Macrophyte Outline INNS Management Plan.** Mitigation measures to limit spread of aquatic INNS are included in **Section 8.9.1.1: INNS - Aquatic Plants**
Scottish Government. Energy Consents Unit (ECU)	The EcIA should note and address MD-SEDD scoping guidance on impacts on fish.	Possible effects on salmon, brown trout, and European eel are assessed in **Section 8.8.2.1: Native Fish Species in Loch Lomond – including Atlantic Salmon, Brown / Sea Trout, Powan and European Eel**. Possible effects on powan are assessed in **Section 8.8.2.2: Loch Sloy Powan Population**.
Scottish Government. Marine Directorate – Science, Evidence, Data and Digital (MD-SEDD)	Full details of the 2023 fish survey should be presented in the EIA report and a review of the success or failure of the powan translocation to Loch Sloy should be provided.	A review of existing data of powan refuge populations within Argyll and Bute and the 2009 fish survey within Inveruglas Bay is detailed in **Section 8.7.2: Fish**. Possible effects on the powan population as a result of Proposed Development are assessed in **Section 8.8.2.2: Loch Sloy Powan Population**.

	MD-SEDD advise that NS and SEPA should be consulted regarding the potential to transfer ruffe into Loch Sloy and the interaction with the translocated powan populations.	SEPA have been consulted regarding design of the intake screen and potential transfer on INNS.
	MD-SEDD advise that impacts on all fish of high conservation value should be assessed in the EIA and that information should be sought on the fish populations in Loch Lomond in the vicinity of Inveruglas and Loch Sloy which may be of an impact.	Possible effects on salmon, brown trout, and European eel are assessed in **Section 8.8.2.1: Native Fish Species in Loch Lomond – Including Atlantic Salmon, Brown / Sea Trout, Powan and European Eel**.
	MD-SEDD advise that further data should be sought to inform the likely migration pathways of salmon smolts from the river Falloch and the River Endrick and the risk of impingement and/or entrainment at the water intake in Loch Lomond assessed.	Possible effects on salmon, brown / sea trout, and European eel are assessed in **Section 8.8.2.1: Native Fish Species in Loch Lomond - Including Atlantic Salmon, Brown / Sea Trout, Powan and European Eel**.
	The Loch Lomond Fisheries Trust and Loch Lomond Angling Improvement Association should be consulted for information of local fish stocks.	EnviroCentre consulted The Loch Lomond Fisheries Trust and The Loch Lomond Angling Improvement Association on 28 September 2023 seeking a consultee response and enquiring if there had been new fish data since 2009 or any other data regarding fish habitat within Inveruglas Bay. The Loch Lomond Fisheries Trust initially responded but did not follow up with an opinion or data. The Loch Lomond Angling Improvement Association initially responded but did not follow up with an opinion or data.
	Potential cumulative impacts on fish populations as a result of the Proposed Development and other developments (existing and consented) should be considered.	Cumulative impacts are detailed in **Section 8.12: Cumulative Impacts**.
	Appropriate protective/mitigation measures should be presented in the EIA report. All fish of conservation interest should be	Mitigation design measures consented by SEPA regarding fish of conservation interest are included in **Section 8.9.2.1**: **Native Fish Species in Loch Lomond – Including Atlantic Salmon,**

	considered in the design of the screens and the approach velocity of water at the water intake in Loch Lomond and Loch Sloy	**Brown / Sea Trout, Powan and European Eel** and **Section 8.9.2.2: Loch Sloy Powan Population**.
	Post commissioning monitoring should be undertaken for the powan population in Loch Sloy and the functioning of the screens, the approach velocities of water in front of the screen, and the screen cleaning regime as a means of ensuring that the system is operating as an appropriate protective/mitigation measure for fish populations.	Details of post-construction monitoring for Powan is detailed in **Section 8.10.1: Monitoring**.
Scottish Environmental Protection Agency	A Construction Environmental Management Plan (CEMP) should be provided including details of pollution prevention and drainage management and that site specific maps and plans should be submitted that include reference to best practice pollution prevention and construction techniques and regulatory requirements.	A CEMP would be produced, as detailed in **Section 8.10.1: Monitoring**. A draft CEMP is included in **Volume 4, Appendix 4.2: Outline CEMP.**
	The EIA should assess the impact of the Proposed Development leading to the spread of Nuttall's Pondweed to Loch Sloy and to provide mitigation measures to reduce the risk of spread as far as is practical.	Possible effects of introducing aquatic INNS to Loch Sloy are assessed in **Section 8.8.1: INNS**.

8.5. Legislation, Policy and Guidance

The compilation of this chapter has taken cognisance of the legislation, planning policies, conservation initiatives and general guidance presented in **Table 8.3** below:

Table 8.3: Legislation, Policy and Guidance Documents

Scope	Document
International	• International Union for the Conservation of Nature (IUCN) Red List of Threatened Species.
European	• Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (The Habitats Directive). • Environmental Impact Assessment (EIA) Directive (2014/52/EU) on assessing the potential effects of projects on the environment.
Scottish	• Wildlife and Countryside Act 1981 (as amended) (WCA); • The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). • The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017. • National Planning Framework 4[2]. • Scottish Biodiversity List (SBL)[3]. • Scotland's Biodiversity Strategy to 2045[4].
Local Planning Policy & Other Advice Documents	• British Standard (BS) 42020:2013: Biodiversity Code of Practice for Planning and Development 2013. • The Loch Lomond and the Trossachs National Park Local Development Plan, 2017-2021[5]. • The Loch Lomond and the Trossachs National Park Local Development Plan, 2017-2021: Renewable. • Energy Supplementary Guidance. • CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, Version 1.2

[2] Available from: https://www.gov.scot/publications/national-planning-framework-4-revised-draft/ (Accessed March 2024)

[3] Available from: https://www.nature.scot/doc/scottish-biodiversity-list (Accessed March 2024)

[4] Available from: https://www.gov.scot/publications/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/documents/ (Accessed March 2024)

[5] Available from: Our Local Development Plan - Here. Now. All of us. - Loch Lomond & The Trossachs National Park (lochlomond-trossachs.org) (Accessed March 2024)

8.6. Methodology

8.6.1. DESK STUDY

A desk study was conducted in August 2022 to gather aquatic ecology baseline data in relation to the site. The following sources were checked:

- NatureScot Sitelink website[6] for statutory designated sites up to 5km from the site.
- Loch Lomond and The Trossachs National Park Local Development Plan (LDP)[7] for non-statutory designated sites up to 2km from the site.
- Records of ancient woodland and Scottish native woodland available through Scotland's Environment Web[8], within a 2km radius of site.
- Glasgow Museum Biological Records Centre (GMBRC) records for notable or protected species records within a 2km of the site.
- The Scottish Biodiversity List[9] for priority habitats and species.
- The Loch Lomond Local Biodiversity Action Plan (LBAP)[10] for local priority habitats and species; and
- Aerial imagery from Google Earth[11].

8.6.2. FIELD STUDIES

The Scottish Centre for Ecology and the Natural Environment (SCENE) surveyed fish populations in the Inveruglas Bay area by gill netting between May 2008 and January 2009 and 369 fish of seven species were caught. Non-native ruffe dominated the catches. There was no evidence of salmon or sea trout smolts in the entrainment risk area during the peak migration period for these species. There was also no evidence of powan spawning in the entrainment risk area. SCENE therefore concluded that the risk of entrainment from Loch Lomond of the legally protected native species, salmon, sea trout and powan is very low[12].

Since these baseline surveys were carried out, it is highly unlikely that the fish species composition in Loch Lomond would have changed significantly. For the purposes of this assessment, the presence / absence of species is more important than abundance. The previous surveys identified the presence of eels and trout, which are notable native species requiring protection, and ruffe, an INNS that is addressed in this Chapter. Despite no migrating salmon smolts detected in the area in the previous survey, protections have been put in place regardless and are also discussed in this Chapter. The change in the abundance or presence of other fish species not previously recorded would not change the mitigation measures detailed in this Chapter, and so, the previously collected survey data was deemed suitable for the purposes of this assessment and no further survey work was commissioned.

[6] NatureScot Sitelink website. Available from: https://sitelink.nature.scot/map

[7] Loch Lomond and The Trossachs National Park LDP. Available from: https://www.lochlomond-trossachs.org/planning/planning-guidance/local-development-plan/

[8] Scotland's Environment Web. Available at: https://www.environment.gov.scot/maps/scotlands-environment-map/

[9] Available at: https://www.nature.scot/scottish-biodiversity-list

[10] Loch Lomond and The Trossachs National Park LBAP, available to download at https://www.lochlomond-trossachs.org/park-authority/publications/wild-park-our-biodiversity-action-plan/

[11] Available at: https://www.google.com/earth/

[12] Adams C. & Dodd J. (2009) Scottish Centre for Ecology and the Natural Environment University of Glasgow. *The Risk of Entrainment of Fish by a Proposed Pump-Storage Scheme at The Loch Sloy Hydro-Power Generating Station*.

SCENE, on behalf of SSE, have an ongoing conservation monitoring programme of four waterbodies across Argyll to study refuge powan populations following a translocation effort to mitigate against potential impacts on the Loch Sloy powan population as a result of the previously consented pumped hydro storage scheme. Three survey reports have been issued since monitoring commenced during 2011[13,14,15].

A Preliminary Ecological Appraisal (PEA) was undertaken by EnviroCentre Limited on 2nd of September 2022. The survey was designed using the guidelines endorsed by NatureScot and CIEEM[16, 17 & 18] and focussed on appraising habitats on the site and those which have potential to host or provide resource for faunal species in and around the site.

An aquatic macrophyte INNS survey was undertaken by EnviroCentre Limited on 25th June 2024. The survey methodology for this project was tailor-made and site-specific for the presence/absence of Nuttall's and Canadian pondweed and New Zealand pigmyweed. The survey consisted of three components: a strandline survey of species uprooted and washed to the shore, a survey of emergent and marginal species, and a wader survey of the shallow littoral zone, as detailed in **Volume 4, Appendix 8.1: Aquatic Macrophyte Outline INNS Management Plan.**

8.6.3. EVALUATION OF IMPORTANT ECOLOGICAL FEATURES

The evaluations are applied to those sites, habitats and species that have been scoped into the assessment. These are termed Important Ecological Features (IEFs).

European, national and local governments and specialist organisations have together identified a large number of sites, habitats and species that provide the key focus for biodiversity conservation in the UK and Ireland, supported by policy and legislation. These provide an objective starting point for identifying the important ecological features that need to be considered. **Table 8.4** shows a procedure for determining the geographical level of importance of site designations, habitats and species. Where a feature is important at more than one level in the table, its overriding importance is that of the highest level. Usually only the highest level of legal protection is listed.

Table 8.4: Geographical Level of IEFs

Level of Importance	Sites	Habitats	Species
International	Designated, candidate or proposed Special	A viable area of habitat included in Annex I of the	A European Protected Species: an IUCN Red Data Book species that is

[13] Lyle, A, Adams, A., Stuart W., & Dodd, J. (2011) *Establishment of Conservation Refuge Populations of Powan (Coregonus Lavaretus) Phase III*. Scottish Centre for Ecology and the Natural Environment, University of Glasgow.

[14] Adams, C. & Lyle, A. (2015) *Surveys of Powan Introduced to Lochan Shira, Loch Glashan and Loch Tarsan Hydro-Electric Reservoirs.* Scottish Centre for Ecology and the Natural Environment, University of Glasgow.

[15] Lyle, A. & Adams, C. (2023) *Surveys of Powan Introduced to Alt na Lairige, Lochan Shire, Loch Glashan, and Loch Tarsan Hydro-Electric Reservoirs*. Scottish Centre for Ecology and the Natural Environment, University of Glasgow.

[16] CIEEM (2017). Guidelines for Preliminary Ecological Appraisal (GPEA). Retrieved from https://cieem.net/resource/guidance-on-preliminary-ecological-appraisal-gpea/

[17] CIEEM (n.d.). General advice on surveys and methods. Retrieved from https://cieem.net/wp-content/uploads/2019/02/CSS-OVERVIEW-April-2013.pdf

[18] CIEEM (2015). Guidelines for Ecological Report Writing. Retrieved from https://cieem.net/resource/guidelines-for-ecological-report-writing /

Level of Importance	Sites	Habitats	Species
	Areas of Conservation, Special Protection Areas and Ramsar sites; UNESCO (Ecological) World Heritage Sites; UNESCO Biosphere Reserves; Biogenetic Reserves.	EC Habitats Directive; a habitat area that is critical for a part of the life cycle of an internationally important species.	globally Vulnerable, Endangered or Critically Endangered.
National (UK)	Sites of Special Scientific Interest; National Nature Reserve; Marine Conservation Zones (UK offshore).	An area of habitat fulfilling the criteria for designation as an SSSI or MCZ; a habitat area that is critical for a part of the life cycle of a nationally important species.	An IUCN Red Data Book species that is Vulnerable, Endangered or Critically Endangered in the UK; a species that is Rare in the UK (<15 10km grid squares); a Schedule 5 (animal) or Schedule 8 (plant) species included in the WCA 1981; any species protected under national (UK) legislation where there is the potential for a breach of the legislation; a species that is Vulnerable, Endangered or Critically Endangered in The Vascular Plant Red Data List for Great Britain[19].
National (Scotland)	National Parks; Marine Protected Areas; Marine Consultation Areas.	SBL Priority Habitats and Priority Marine Features (PMFs)[20] (Scotland); semi-natural and ancient woodland.	Species of principal importance for biodiversity in the relevant countries[21], including SBL Priority Species and PMFs (Scotland). Species protected under the Marine Scotland Act 2010.
Regional	Regional Parks (Scotland).	Regional Local Biodiversity Action Plan habitats noted as requiring protection.	A species that is Nationally Scarce in the UK (present in 16-100 10km grid squares); a species that is included in the Regional LBAP; an assemblage of regionally scarce species.
County / Metropolitan	Woodland Trust Sites; Royal Society for the Protection of Birds Sites; Scottish Wildlife Sites.	County LBAP habitats noted as requiring protection.	A species that is included in the County LBAP; an assemblage of species that are scarce at the county level.

[19] Cheffings, C.M. & Farrell, L. (eds), Dines, T.D., Jones, R.A., Leach, S.J., McKean, D.R., Pearman, D.A., Preston, C.D., Rumsey, F.J., Taylor, I. (2005) *The Vascular Plant Red Data List for Great Britain. Species Status No. 7*. JNCC, Peterborough. Available from: https://hub.jncc.gov.uk/assets/cc1e96f8-b105-4dd0-bd87-4a4f60449907 (Accessed March 2024)

[20] In July 2014, Scottish Ministers adopted a list of 81 priority marine features (PMFs) – many of which are features characteristic of the Scottish marine environment. Most are on other conservation status lists so may be valued higher than this.

[21] These are all the species that were identified as requiring action in the UKBAP and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework, including any additions.

Level of Importance	Sites	Habitats	Species
Local		Semi-natural habitats that are unique or important in the local area.	Species as defined by Local Authority lists (if available).
Site		Common and widespread habitats not covered above.	Common and widespread species not covered above.
Negative			An Invasive Non-Native Species (INNS) as defined by the GB Non-Native Species Secretariat (NNSS) and supported by the GB Invasive Non-native Species Strategy (2015).

8.6.4. IMPACT ASSESSMENT

The assessment of impacts describes how the baseline conditions would change as a result of the project and its associated activities and from other developments. The term 'impact' is used commonly throughout the EIA process and is usually defined as a change experienced by a receptor (this can be positive, neutral or negative). The term 'effect' is commonly used at the conclusion of the EIA process and is usually defined as the consequences for the receptor of an impact after mitigation measures have been taken into account. The EIA Regulations specifically require all likely significant effects to be considered. Therefore, impacts and effects are described separately and the effects for the IEFs are assessed as being either significant or not according to the importance and sensitivity of the IEF.

Significant cumulative effects can result from the individually insignificant but collectively significant effects of actions taking place over a period of time or concentrated in a location, for example:

- Additive / incremental; and
- Associated / connected.

8.6.4.1. Assessment Criteria – Magnitude

The CIEEM guidance states that when describing changes/activities and positive or negative impacts, reference should be made to the following parameters where relevant:

- Magnitude;
- Extent;
- Duration;
- Reversibility; and
- Timing and frequency.

Magnitude refers to the size, amount, intensity and volume of an impact, determined on a quantitative basis if possible, but typically expressed in terms of relative severity, such as major, moderate, low or negligible. Extent, duration, reversibility, timing and frequency of the impact can be assessed separately but they tie in to determine the overall magnitude.

Criteria for describing the magnitude of an impact are presented in **Table 8.5** below:

Table 8.5: Criteria for Describing Magnitude of Impact

Magnitude	Description
Major	Total or major loss or alteration to the IEF, such that it will be fundamentally changed and may be lost from the site altogether; and / or loss of a very high or high proportion of the known population or range of the IEF.
Moderate	Loss or alteration to the IEF, such that it will be partially changed; and / or loss of a moderate proportion of the known population or range of the IEF.
Low	Minor shift away from the existing or predicted future baseline conditions. Change arising from the loss or alteration will be discernible but the condition of the IEF will be similar to the pre-development conditions; and / or having a minor impact on the known population or range of the IEF.
Negligible	Very slight change from the existing or predicted future baseline conditions. Change barely discernible, approximating to the 'no change' situation; and / or having a negligible impact on the known population or range of the IEF.

8.6.4.2. Assessment Criteria – Significance

Significance is a concept related to the weight that is attached to effects when decisions are made. For the purposes of EcIA, a 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for IEFs. In broad terms, significant effects encompass effects on the structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution).

Significant effects are quantified with reference to an appropriate geographic scale (see **Table 8.4** above). The CIEEM guidance has one 'level of importance' and a geographical 'scale of significance'. This is to deal with the fact that the geographical scale at which the effect is significant is not necessarily the same as the geographic level of importance of the IEF.

A sensitivity scale is used to assist in the determine the significance of effects, as shown in **Table 8.6** below:

Table 8.6: Sensitivity of Important Ecological Features

Sensitivity	Definition
High	Tolerance: The IEF has a very limited tolerance of the effect.
	Adaptability: The IEF is unable to adapt to the effect.
	Recoverability: The IEF is unable to recover, resulting in permanent or long term (>10 years) change.
Medium	Tolerance: The IEF has limited tolerance of the effect.
	Adaptability: The IEF has limited ability to adapt to the effect.
	Recoverability: The IEF is able to recover to an acceptable status over the medium term (5-10 years).

Sensitivity	Definition
Low	Tolerance: The IEF has some tolerance of the effect.
	Adaptability: The IEF has some ability to adapt to the effect.
	Recoverability: The IEF is able to recover to an acceptable status over the short term (1-5 years).
Negligible	Tolerance: The IEF is generally tolerant of the effect.
	Adaptability: The IEF can completely adapt to the effect with no detectable changes.
	Recoverability: The IEF is able to recover to an acceptable status near instantaneously (<1 year).

Consideration of conservation status is important for assessing the significance of effects of impacts on individual habitats and species. The Habitats Directive provides a helpful definition of conservation status for habitats and species (as defined by Articles 1 (e) and 1(i)):

For habitats, conservation status is determined by the sum of the influences acting on the habitat and its typical species, that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area; and

The conservation status of natural habitats will be taken as 'favourable' when:

- *its natural range and areas it covers within that range are stable or increasing, and*
- *the species structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and*
- *the conservation status of its typical species is favourable as defined in Article 1(i).*

For species, conservation status is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area.

The conservation status of species will be taken as 'favourable' when:

- *population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and*
- *the natural range of the species is neither being reduced for the foreseeable future, and*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.*

The scientific evidence gathered during the assessment process is used along with professional judgement where appropriate to determine the significance of effects according to the guidance above. Where it is not possible to justify a conclusion of no significant effect, a significant effect is assumed based on the Precautionary Principle.

8.6.4.3. Assessment Criteria – Confidence in Predictions

CIEEM does not cover levels of confidence in predictions adequately, therefore an approach has been adopted based on river conservation evaluation[22]. A simple, qualitative index based on professional judgement is assigned to each predicted effect as follows:

A: high confidence.
B: intermediate confidence.
C: low confidence.

Factors influencing confidence include:

- The frequency and effort of field sampling
- Constraints to the field survey
- The completeness of the data (field and desk)
- The age of the data (although recent data are not necessarily always more reliable than old data)
- The state of scientific knowledge relating to the predicted effects of development activities on the IEF (the accuracy of the magnitude assessment); and
- The accuracy of the assessment of significance.

8.6.4.4. Assessment Criteria – Success of Mitigation

The word 'mitigation' has developed a wider meaning and common usage in environmental assessment than its strict meaning related to reducing the severity of something. Mitigation can sometimes be used as a generic term for a wide range of counter-acting measures, all of which, as the Directive and Regulations prescribe, are intended to *prevent, reduce and where possible offset any significant adverse effect on the environment*. Mitigation can be used to encompass measures intended to avoid, minimise or compensate for adverse effects (this is the 'mitigation hierarchy').

Mitigation and compensation measures often carry a degree of uncertainty. Uncertainty associated with a design will vary according to a number of factors, such as:

- The technical feasibility of what is proposed.
- The overall quantity of what is proposed.
- The overall quality of what is proposed.
- The level of commitment provided to achieve what is proposed.
- The provision of long-term management.
- The timescale for predicted benefits.

The following objective scale is used for the success of mitigation:

- Certain/near certain: probability estimated at 95% chance or higher.
- Probable: probability estimated above 50% but below 95%.
- Unlikely: probability estimated above 5% but less than 50%.
- Extremely unlikely: probability estimated at less than 5%.

[22] NatureScot (Scottish Natural Heritage) (2001) SERCON: System for Evaluating Rivers for Conservation, Version 2, Technical Manual.

8.7. Baseline

8.7.1. INVASIVE NON-NATIVE SPECIES

8.7.1.1. Nuttall's Pondweed

Nuttall's pondweed is an aquatic invasive non-native plant known to be present within the shallower southern basin of Loch Lomond which is mesotrophic in condition and more nutrient rich than the deeper oligotrophic northern basin[23]. Nuttall's pondweed is often found in richly fertile sites[24] (Ellenberg Reaction value of 7) and is more often recorded within lowland waterbodies; however, it has been infrequently recorded in upland lochs within the west of Scotland which are likely to be oligotrophic in condition[25]. An Aquatic INNS survey undertaken in June 2024 did not detect the presence of Nuttall's pondweed within Inveruglas Bay or within Loch Sloy, as detailed in **Volume 4, Appendix 8.1: Aquatic Macrophyte Outline INNS Management Plan**.

Nuttall's pondweed is listed on the *EU Invasive Species Regulation*[26] and is of negative importance to the site.

8.7.1.2. Canadian Pondweed

Canadian pondweed is an aquatic non-native plant known to be present within the southern basin of Loch Lomond and in a number of other mesotrophic lochs throughout the Argyll and Bute local authority area and the wider Highland area. Canadian pondweed is known to tolerate slightly less fertile sites than Nuttall's pondweed, however, still requires at least intermediate fertility (Ellenberg Reaction value of 6) and cannot tolerate infertile sites[24]. An Aquatic INNS survey undertaken in June 2024 did not detect Canadian pondweed within Inveruglas Bay or within Loch Sloy, as detailed in **Volume 4, Appendix 8.1: Aquatic Macrophyte Outline INNS Management Plan**.

Canadian pondweed is listed under Schedule 9 of the WCA (1981) as amended by the Nature Conservation (Scotland) Act (2004) and the Wildlife and Natural Environment (Scotland) Act (2011) and is of negative importance to the site.

8.7.1.3. New Zealand Pigmyweed

New Zealand pigmyweed is a small, (semi-)aquatic succulent which forms dense carpets across damp ground and still or slow-moving waterbodies. With vigorous year-round growth and a prolific dispersal rate, it quickly leads to total dominance over native vegetation. New Zealand pigmyweed is known to be present within the southern extent of the southern basin of Loch Lomond. An Aquatic INNS survey undertaken in June 2024 did not detect the presence of New Zealand pigmyweed within Inveruglas Bay

[23] Habib, Olfat & Tippett, R. & Murphy, Kevin. (1997). Seasonal changes in phytoplankton community structure in relation to physico-chemical factors in Loch Lomond, Scotland. Hydrobiologia. 350. 63-79. 10.1023/A:1003037012226. (Accessed March 2024)

[24] Ellenberg indicator values are detailed in MO Hill, JO Mountford, DB Roy, RGH Bunce. (1999). Ellenberg's indicator values for British plants. ECOFACT Volume 2 Technical Annex/. Available from: Ellenberg's indicator values for British plants. ECOFACT Volume 2 Technical Annex | Biological Records Centre (brc.ac.uk). (Accessed March 2024)

[25] Search: SPECIES: Elodea nuttallii | Occurrence records | NBN Atlas (Accessed March 2024)

[26] The Invasive Alien Species Regulation (Regulation (EU) 1143/2014). Available from: Regulation - 1143/2014 - EN - EUR-Lex (europa.eu.) (Accessed March 2024)

or within Loch Sloy, as detailed in Volume 4, Appendix 8.1: Aquatic Macrophyte Outline INNS Management Plan.

New Zealand pigmyweed is listed under Schedule 9 of the WCA (1981) as amended by the Nature Conservation (Scotland) Act (2004) and the Wildlife and Natural Environment (Scotland) Act (2011) and is of negative importance to the site.

8.7.1.4. Ruffe

Ruffe were recorded in Inveruglas Bay during aquatic surveys undertaken in 2008. This species is known to be well established throughout Loch Lomond and its tributaries. Ruffe are not known to be present within Loch Sloy. Ruffe are listed on Schedule 9 of the WCA (1981). Releasing or allowing them to escape into the wild is an offence under Section 14 (1) of the Act. Ruffe are considered to be of negative importance to the site as they consume the eggs of other species, including powan.

8.7.2. FISH

Atlantic Salmon and Brown / Sea Trout

Loch Lomond and associated river systems within the catchment are known to support Atlantic salmon and sea trout. Brown trout are known to be present in Loch Sloy, likely due to historic stocking for recreation. The Inveruglas Water (the outflow from Loch Sloy) was used for a stock enhancement programme, and it is likely that Atlantic salmon and sea trout smolts are present in the vicinity of the proposed intake and tailrace. However, there was no evidence of Atlantic salmon in the area during the 2008 and 2009 sampling period. Brown and sea trout were recorded infrequently (<2% of total catch) and it was considered that there was no evidence that the area adjacent to the tailrace is used by migrating smolts of sea trout or salmon[12].

Atlantic salmon and sea trout have experienced declines throughout their range due to several factors, including habitat degradation, overfishing, climate change, predation, and disruption of habitat connectivity as a result of anthropogenic barriers.

Atlantic salmon and the migratory sub-species of brown trout (sea trout) are listed in Annex IIa and Va in the EU Habitats Directive and in the SBL. Brown trout are listed as priority species for conservation in the SBL.

European Eel

Loch Lomond, Loch Sloy and associated river systems within the catchment are known to support European eel. European eel were recorded infrequently (<2% of total catch) within the Inveruglas Bay area during the 2008 and 2009 sampling period[12].

European eel is listed as critically endangered on the IUCN Red List of Threatened Species and are listed as priority species for conservation in the SBL.

Powan

Powan occur naturally in Loch Lomond and were introduced to Loch Sloy during 1988 to 1990 as part of a conservation scheme and a refuge powan population has now established within the waterbody. Within Loch Lomond, powan were recorded infrequently (<2% of total catch) within the Inveruglas Bay during the 2008 and 2009 sampling period undertaken by SCENE. The SCENE report concluded although there was some evidence of summer use of Inveruglas Bay by powan, there was no evidence of use as a spawning area, when powan are at their most vulnerable[12].

Four other conservation refuge powan populations were established in reservoirs operated by SSE Renewables within the Argyll and Bute local authority via a three-phase translocation programme

completed between 2008 and 2011. The translocation was undertaken to mitigate potential impacts on the Loch Sloy powan population as a result of the previously consented pumped hydro storage scheme. Two of these reservoirs, Lochan Shira and Allt na Lairige are situated at similar altitude to Loch Sloy (+/- 50 m) and have similar land-cover use and nutrient supply. Most recently, these reservoirs underwent monitoring during 2023 to assess the status of the translocated powan populations. Overall, the reservoirs most similar in their geography to Loch Sloy showed evidence of relatively poor nutritional status (Lochan Shira) and small powan population size (Allt na Lairige); however, it was noted that these populations have survived for 14 years since introduction and continue to provide a reserve gene pool for the Loch Lomond powan[27]. Environmental DNA (eDNA) surveys of Loch Sloy, Lochan Shira, Allt na Lairige, Loch Tarsan, and Loch Glashan were carried out in early 2024 to estimate the relative abundance of powan by comparing netting results from three reservoirs in summer 2023 with winter eDNA concentrations. Results of the eDNA surveys were not available at the time of writing.

Powan are listed on Schedule 5 of the WCA (1981) and are thereby given extensive legal protection under Section 9 of the WCA. Powan is listed as priority species for conservation in the SBL.

8.7.3. EVALUATION

The evaluations have been applied only to those designated sites, habitats and species that have been scoped into the assessment and those where there is the potential for impacts that could result in significant adverse ecological effects as a result of the Proposed Development. The IEFs and the evaluations are presented in **Table 8.7** below.

[27] Lyle, A. & Adams, C. (2023) *Surveys of Powan Introduced to Alt na Lairige, Lochan Shire, Loch Glashan, and Loch Tarsan Hydro-Electric Reservoirs*. Scottish Centre for Ecology and the Natural Environment, University of Glasgow.

Table 8.7: Evaluation of Important Ecological Features

IEF	Present on site?	Present in wider area?	Importance	Justification
Invasive Non-Native Species				
Canadian Pondweed	N	Y	Negative	An invasive non-native species
Nuttall's Pondweed	N	Y	Negative	An invasive non-native species
New Zealand Pigmyweed	N	Y	Negative	An invasive non-native species
Ruffe	Y	Y	Negative	An invasive non-native species
Native Fish Species				
Atlantic Salmon	Likely	Y	National (Scotland)	EU Habitats Directive Annex 2 and 5
Brown/Sea Trout	Y	Y	National (Scotland)	Included in the SBL
European Eel	Y	Y	International	Critically endangered on the IUCN Red List of Threatened Species;
Powan	Y	Y	National (UK)	WCA (1981) Schedule 5 species

8.8. Potential Effects

The following assessment is made assuming no avoidance mitigation or compensatory strategies are applied.

The mitigation set out in **Section 8.9** will detail the adopted strategies proposed to minimise effects as far as possible.

8.8.1. INNS

8.8.1.1. Spread Of Aquatic Plant Inns To Loch Sloy

Potential significant effects relating to aquatic INNS may arise from the movement of water between catchments resulting in the transportation and introduction of INNS plants and / or INNS plant fragments from Loch Lomond to Loch Sloy. The pressure changes associated with pump entrainment are unlikely to destroy all plants cells. Therefore, plant fragments could be viable when they reach Loch Sloy.

In suitable conditions, Nuttall's pondweed, Canadian pondweed, and New Zealand pigmyweed can spread and establish dense carpets where they outcompete most native species and can cause fluctuations in the amount of oxygen within the waterbody, causing potential harm to fish and invertebrates.

It is not anticipated that the introduction of a pumped hydro storage scheme to Loch Sloy would have the potential to significantly change the hydrological conditions of Loch Sloy and create conditions favourable for Nuttall's pondweed, Canadian pondweed, or New Zealand pigmyweed. Loch Sloy's storage capacity is approx. 36 million m^3, resulting in a significant dilution factor for any water that is introduced by pumping. The proposed pumps would transfer up to $36m^3/s$ and would generally run for between 1 and 10 hours at a time around Sloy's existing generation regime. After the conversion to pumped storage, it is anticipated that Sloy Power Station would generate on average for 4-5 hours per day. A 10-hour pumping operation would transfer approx. 1.3 million m^3 of water which represents approximately 3% of Loch Sloy's volume. There would be additional dilution caused by significant natural / diverted catchment inflow; approx. 7.5 m^3/s mean annual inflow, i.e. equivalent to approx. 20% of a pumping volume of $36m^3/s$. Furthermore, water pumped from Loch Lomond would be a Loch Lomond / Loch Sloy blend due to generation flows of up to $80m^3/s$ for up to 20% of the day. The pumping discharge / generation abstraction point at Loch Sloy is at the dam and the station would cycle regularly between generation (up to $80m^3/s$) and pumping (up to $36m^3/s$) operations, reducing the time that the pumped water would have to fully mix.

Given the oligotrophic status of the northern basin of Loch Lomond, it is considered unlikely that Nuttall's pondweed, Canadian pondweed, and New Zealand pigmyweed would flourish in the vicinity of the proposed development, as these species are more adapted to the mesotrophic conditions present within the southern basin of Loch Lomond. It is considered that the oligotrophic conditions in Loch Sloy are not conducive to the establishment of these INNS. Furthermore, the boulder substratum and seasonal drawdown regime in Loch Sloy is likely to prohibit growth. No presence of the target INNS were detected during the baseline survey of Loch Sloy and Inveruglas Bay detailed in **Volume 4, Appendix 8.1: Aquatic Macrophyte Outline INNS.**

The presence of aquatic plant INNS as an IEF (of negative importance) is assessed as the impact the feature can have on other IEFs. The impacts relating to the establishment and spread of Nuttall's pondweed, Canadian pondweed and New Zealand pigmyweed into Loch Sloy, a waterbody not currently host to these species, as a result of the Proposed Development are considered to be of **low magnitude** on an IEF of **medium** sensitivity. The confidence level for this assessment is **intermediate**.

8.8.1.2. Spread Of Fish Inns To Loch Sloy

Potential significant effects relating to ruffe may arise from the transportation of ruffe and ruffe eggs through the movement of water between catchments from Loch Lomond to Loch Sloy, leading to a decline in the biodiversity of Loch Sloy. There is evidence that ruffe impact negatively on powan populations due to egg predation, this is covered in 8.8.2.2 below.

It is not anticipated that there would be a significant transfer risk of aquatic INNS (fish) due to the following reasons:

- Transfer risk would only occur during pumping operations, however, any life-stages of fish passing into the tailrace and subsequently through the intake screens would be subject to a rapid increase in pressure from around 1 bar to 28 bar as water passes through a multi-stage impeller pump running at approximately 400 rpm.
- Although the rapid change in pressure alone is unlikely to completely destroy ruffe eggs or juveniles, the combined impact of the macerating action of the multi-stage pump will likely result in mortality.
- Furthermore, strong generation flows (approx. 80m³/s) for up to 20% of an average 24-hour period will wash any non-swimming (i.e. egg) or early developmental stages of ruffe away from the intake and Inveruglas Bay.

The presence of the INNS ruffe as an IEF (of negative importance) is assessed as the impact the feature can have on other IEFs. The impacts relating to the establishment and spread of aquatic non-native invasive fish species within Loch Sloy as a result of the Proposed Development are considered to be of **low** magnitude on an IEF of **medium** sensitivity. The confidence level for this assessment is **intermediate**.

8.8.2. FISH

8.8.2.1. Native Fish Species In Loch Lomond – Including Atlantic Salmon, Brown / Sea Trout, Powan And European Eel

Death, Injury, and / or Disturbance to Fish During the Construction Phase due to Noise, Vibration and Construction Lighting

Construction noise is likely to affect fish in Inveruglas Bay, although underwater noise may propagate further out into Loch Lomond. The effects of noise on fish can be behavioural, sub-lethal or lethal, depending on the magnitude of the sound level. Sound travels much faster in water than in air and the pressures associated with underwater sounds tend to be much higher than in air.

Construction lighting may disrupt the normal cycles of aquatic species should waterbodies be illuminated.

The impacts on native fish species during the construction phase from the Proposed Development are considered to be of **moderate** magnitude on an IEF of **medium** sensitivity. The confidence level for this assessment is **high**.

Death, Injury, and / or Disturbance to Fish During the Operational Phase due to Impingement in Entrainment

There is a risk to native fish from entrainment in the pumping mechanism and subsequent damage or death caused by absent or inadequate screening of the intake. The 2009 SCENE study concluded that there was no evidence of salmon or sea trout smolts in the entrainment risk area during the peak migration period for these species[12]. Due to Inveruglas Bay not forming part of the migratory route, it is not anticipated that pumping operations would attract smolts to the intake.

Native fish species could be killed though impingement on poorly designed screens or by screens not functioning correctly due to the accumulation of debris.

The impacts on native fish species during the operational phase from the Proposed Development are considered to be of **moderate** magnitude on an IEF of **medium** sensitivity. The confidence level for this assessment is **high**.

Pollution of Loch Sloy and / or Loch Lomond During the Construction and Operational Phase

Deterioration of water quality due to the release of sediment or dust associated with excavation works and stockpiled material or the release of hydrocarbons as a result of fuel or oil spillage could result in habitat loss and / or deterioration for native fish species.

Potentially permanent habitat degradation may result from accidental damage and pollution events due to increased traffic and construction activities during the construction phase.

The impacts on native fish species during the construction and operational phase from the Proposed Development are considered to be of **moderate** magnitude on an IEF of **medium** sensitivity. The confidence level for this assessment is **high**.

8.8.2.2. Loch Sloy Powan Population

Damage or Destruction of Powan Population in Loch Sloy by Ruffe

The risk of transfer of ruffe from Loch Lomond to Loch Sloy is detailed in 8.8.1.2. Potential transfer and subsequent establishment of ruffe could occur following transfer of water from Loch Lomond to Loch Sloy during the operational phase of the proposed pumped hydro storage scheme. However unlikely, if ruffe establish, there is a risk of predation of powan eggs within Loch Sloy, resulting in a potential reduction in powan population size.

The impacts relating to the potential reduction of the powan population in Loch Sloy through egg predation by ruffe, during the operational phase of the Proposed Development are considered to be of **moderate** magnitude on an IEF of **high** sensitivity. The confidence level for this assessment is **intermediate**.

Changes to Hydrological Conditions within Loch Sloy

Powan are susceptible to declines in water quality, trophic status, increased siltation and de-oxygenation. However, it is not anticipated that pumping operations will cause increased siltation or de-oxygenation of Loch Sloy.

Due to the location of the Sloy Hydroelectric Power Station within the oligotrophic northern basin of Loch Lomond, the trophic conditions of both water bodies are considered to be similar and upstream transfer of water from Loch Lomond to Loch Sloy is not expected to impact the existing trophic status[28]. This is further detailed in **Section 8.8.1.1**.

The impacts relating to powan being affected by potential changes in the hydrological condition of Loch Sloy during the operational phase of the Proposed Development are considered to be of **low** magnitude on an IEF of **high** sensitivity. The confidence level for this assessment is **high**.

[28] May, L. & Hare, M. (2005) *Changes in Rotifer Species Composition and Abundance along a Trophic Gradient in Loch Lomond, Scotland, UK*. Hydrobiologia 546, 397–404

Changing Water Level Fluctuations in Loch Sloy

Powan are susceptible to water level fluctuation as they spawn and feed in shallow areas. The addition of pumping could lead to more frequent fluctuations in water levels. However, as 6 hours of pumping would raise Loch Sloy's surface level by approximately 70cm, it is not anticipated that these short-term operational water level fluctuations would significantly impact on the water depth required for feeding powan (<4m).

The impacts relating to powan being affected by the potential water level fluctuations of Loch Sloy during the operational phase of the Proposed Development are considered to be of **low** magnitude on an IEF of **high** sensitivity. The confidence level for this assessment is **high**.

8.9. Mitigation and Compensation

8.9.1. INNS

The control and eradication of terrestrial INNS is considered to be a site-level positive impact.

8.9.1.1. Spread Of Aquatic Plant Inns To Loch Sloy

It is not anticipated that there would be a significant transfer risk of aquatic INNS (plants) due to the following reasons:

- The seasonal drawdown of Loch Sloy is likely to be a limiting factor for plant establishment.
- The intake screen would be routinely monitored during the operational phase for aquatic invasive plant debris by SSE staff who are trained to identify a range of plant matter which may collect at this location.
- SSE would commission biennial INNS plant surveys of the shore of Inveruglas bay and Loch Sloy. In the event that an INNS is discovered on site, a suitably qualified ecologist would be consulted to provide species specific best management practices. Potential management measures for control of Canadian pondweed, Nuttal's pondweed, and New Zealand pigmyweed are detailed in **Volume 4**, **Appendix 8.1: Aquatic Macrophyte Outline INNS Management Plan**, and include:
  - Mechanical or hand removal of Nuttal's pondweed and New Zealand pigmyweed could be used. Cutting once per year in early spring has been shown to be effective. Every precaution would be taken during the removal not to leave fragments behind, as these fragments will repopulate the area. Fine mesh netting (0.4mm) would be installed around the target area.
  - Multiple layers of light-excluding jute matting could be used to shade out Canadian pondweed, Nuttall's pondweed, and New Zealand pigmyweed. The jute also compresses the plant. The matting would be left for up to 17 months to allow the plant material to decompose. During the 17 months, the jute matting may need to be changed for fresh material, as the jute is designed to decompose[29]. The removed jute material would be placed in sealed hazardous bags to be incinerated.
  - High applications of lime, concentrations to pH 10.8-11[30], has been highly effective against Canadian pondweed by suppressing root growth and significantly reducing biomass. This method

[29] Caffrey, J. M., Millane, M., Evers, S., Moron, H. and Butler, M. 2010. A novel approach to aquatic weed control and habitat restoration using biodegradable jute matting. Aquatic Invasions 5: 123-129.

[30] James, W.F. 2008. Effects of lime-induced inorganic carbon reduction on the growth of three aquatic macrophyte species. Aquatic Botany 88: 99-104.

would also have other ramifications for the water body and would need to be sealed in a cell before applying.
  - SSE would consult with SEPA during the detailed design phase to develop a control plan and would consider design changes that would further reduce the risk of plant INNS transfer.

Assuming the mitigation measures detailed are in place during the operational phase, the residual effects on Loch Sloy of transfer of plant INNS are assessed to be **low** with the success of mitigation being **probable**.

8.9.1.2. Spread Of Fish INNS To Loch Sloy

Despite the low likelihood of ruffe surviving pump entrainment and transfer to Loch Sloy (detailed in 8.8.1.2), in consultation with SEPA, additional measures to deter fish from entering the tailrace would be explored, including the use of acoustic, light and bubble systems during pumping operations.

Assuming the mitigation measures detailed are in place during the operational phase, the residual effects on Loch Sloy of transfer of fish INNS are assessed to be **low** with the success of mitigation being **probable**.

8.9.2. FISH

8.9.2.1. Native Fish Species In Loch Lomond – Including Atlantic Salmon, Brown / Sea Trout, Powan And European Eel

Mitigation measures to be implemented during the construction phase include:

- A combination of fyke netting and electro-fishing would be utilised within the construction area for removal of fish to facilitate construction.
- The project CEMP will align with Guidance for Pollution Prevention (GPP)31,32,33 and construction water quality monitoring would be undertaken.
- The project CEMP will include measures to avoid illumination of water such as directional lighting.
- An intake screen with an 8mm flat bar and 12mm bar aperture would be installed which would exclude smolts >99mm in length, and eels >318mm in length34. Salmon smolts in the Loch Lomond catchment have been recorded over 200mm in length35. Sea trout smolts are typically larger than salmon smolts36 and would exceed the minimum size threshold for exclusion by 12mm aperture screens.

[31] Works and maintenance in or near water: GPP 5. Version 1.2 February 2018. Available at: gpp-5-works-and-maintenance-in-or-near-water.pdf (netregs.org.uk) (Accessed July 2024).

[32] Vehicle Washing and Cleaning GPP 13. Version 1.2 June 2021. Available at guidance-for-pollution-prevention-13-2022-update-v2.pdf (netregs.org.uk) (Accessed July 2024).

[33] Dealing with spills: GPP 22. October 2018 (Version 1.). Available at: gpp-22-dealing-with-spills.pdf (netregs.org.uk) (accessed July 2024).

[34] Turnpenny, A. (1981). An Analysis of Mesh Sizes Required for Screening Fishes at Water Intakes. Estuaries, 4(4), 363–368. Available at: https://doi.org/10.2307/1352161

[35] Lilly, et al. (2022). Combining acoustic telemetry with a mechanistic model to investigate characteristics unique to successful Atlantic salmon smolt migrants through a standing body of water. Environ. Biol. Fish. **105**, 2045–2063. Available at: https://doi.org/10.1007/s10641-021-01172-x

[36] Jonsson, B. & Jonsson, N. (2011). Habitats as Template for Life Histories. In: Ecology of Atlantic Salmon and Brown Trout. Fish & Fisheries Series, 33. Springer, Dordrecht. Available at: https://doi.org/10.1007/978-94-007-1189-1_1

- Following early-design phase consultation with SEPA, it has been agreed that the maximum approach velocity at the intake would be 0.45m/s. Previous guidance recommending 0.3m/s through-velocities to prevent entrainment of salmon smolts is based on studies using hatchery-reared smolts, which are weaker than their wild counterparts37. Wild salmon smolts can swim against currents up to 1.26m/s indefinitely, maintain velocities of 1.64m/s for short periods, and achieve bursts of up to 1.95m/s38. Screen sizes would be based on the proposed approach velocities with additional surface area to account for blinding.
- Intake screens would be regularly cleaned by automated cleaning devices to avoid the build-up of debris.
- Additional measures to deter fish from entering the tailrace would be investigated, including the use of acoustic, light, and bubble systems during pumping operations.

Assuming the mitigation measures detailed are in place during the construction and operational phases, the residual effects on native fish species in Loch Lomond are assessed to be **low** with the success of mitigation being **probable**.

8.9.2.2. Loch Sloy Powan Population

Despite the low likelihood of ruffe surviving pump entrainment and transfer to Loch Sloy (detailed in 8.8.1.2), additional measures to deter fish from entering the tailrace would be explored, including the use of acoustic, light and bubble systems during pumping.

Assuming the mitigation measures detailed are in place during the operational phase, the residual effects on powan in Loch Sloy are assessed to be **low** with the success of mitigation being **probable**.

8.10. Monitoring and Licencing

8.10.1. MONITORING

Ongoing monitoring is required to determine the success of mitigation and enhancement measures. This will provide quantitative data on how to best implement adaptive management if objectives are not being achieved. It is anticipated that the following monitoring would be required during the construction and operational phases. The results of annual monitoring would be included in a short-form technical report that would be shared with LLTNPA, as requested.

- Inveruglas Bay and Loch Sloy would be monitored biennially for signs of Nuttal's pondweed, Canadian pondweed, and New Zealand pigmyweed establishment. This would utilise strandline observations, bathyscape survey, and underwater (video) cameras during the construction and operational phases. Appropriate control measures would be enacted if required.
- A programme of drinking water quality monitoring would be undertaken in Loch Sloy during the initial period of the operational phase, as agreed with Scottish Water. The results of this would enable monitoring of the trophic status.
- Monitoring of Loch Sloy for the presence of ruffe.

[37] Thorpe, J. & Morgan, R. (1978). Periodicity in Atlantic salmon Salmo salar L. smolt migration. Journal of Fish Biology, 12, 541-548. https://doi.org/10.1111/j.1095-8649.1978.tb04200.x

[38] Peake, S. & McKinley, R. (1998). A re-evaluation of swimming performance in juvenile salmonids relative to downstream migration. Canadian Journal of Fisheries and Aquatic Sciences. 55(3), 682-687. Available at: https://doi.org/10.1139/f97-264

- Monitoring of the powan population in Loch Sloy and the two refuge reservoirs from the 2009 translocation that received powan of Loch Lomond genetic origin (Lochan Shira and Allt na Lairige).

8.10.2. Licencing

A Marine Directorate licence[39] would be in place prior to a pre-construction fish rescue utilising otherwise unlawful methods (fyke netting and electro-fishing).

A NatureScot licence would be in place during the construction phase where the Proposed Development could directly impact powan in Inveruglas Bay.

8.11. Residual Effects

Table 8.8 below summarises the assessment of potential impacts on each IEF, proposed mitigation and the assessed residual effects where all recommended mitigation and enhancements are implemented:

[39] Available at: wat-sg-75.pdf (sepa.org.uk) (Accessed July 2024)

Table 8.8: Summary of Residual Effects

Important Ecological Feature	Potential Impact and Effects (before mitigation)	Avoidance, Mitigation and Compensation Measures	Residual Effect After Mitigation and Enhancement	Requirement for Further Survey Work/Licencing
INNS – Aquatic Plants	Spread of aquatic plant INNS to Loch Sloy	Routine monitoring of intake screens for aquatic invasives during construction and operation. Consultation with SEPA during the subsequent design phase to explore methods to reduce the risk of INNS transfer and develop a control plan. Biennial INNS plant survey of the shore of Inveruglas Bay and Loch Sloy. In the event that INNS plants are discovered on-site, a suitable qualified ecologist would be consulted to provide species specific best management practices.	Low (Non-Significant)	Monitoring of INNS plant species' presence in Inveruglas Bay and Loch Sloy.
INNS – Fish	Spread of fish INNS to Loch Sloy	Consultation with SEPA during the subsequent design phase to explore fish deterrents within the tailrace to reduce the risk of INNS fish transfer.	Low (Non-Significant)	Monitoring of ruffe presence in Loch Sloy.
Native fish species in loch Lomond including Atlantic salmon, brown / sea trout, powan and European eel	Death, injury, and / or disturbance to fish during the operational phase	12mm intake screen to exclude smolts >99mm and eels >318mm. Maximum approach velocity of 0.45m/s is escapable by wild smolts and migrating silver eels. Consultation with SEPA during the subsequent design phase to explore fish deterrents within the tailrace.	Low (Non-Significant)	N/A

Important Ecological Feature	Potential Impact and Effects (before mitigation)	Avoidance, Mitigation and Compensation Measures	Residual Effect After Mitigation and Enhancement	Requirement for Further Survey Work/Licencing
	Pollution of Loch Lomond during the construction phase.	Pollution prevention measures as detailed in outline CEMP.	Low (Non-Significant)	Monitoring of water quality in Loch Lomond during the construction phase in-line with best practice.
	Death, injury, and / or disturbance to fish during the construction phase.	A combination of fyke netting and electro-fishing would be utilised within the construction area for removal of fish to facilitate construction. The project CEMP will include measures to avoid illumination of water such as directional lighting.	Low (Non-Significant)	Any required licences will be obtained prior to works commencing.
Loch Sloy Powan Population	Changes to hydrological conditions within Loch Sloy	N/A	Low (Non-Significant)	Monitoring of water quality in Loch Sloy during the initial operational period, as agreed with Scottish Water.
	Fluctuations in water level of Loch Sloy	N/A	Low (Non-Significant)	N/A
	Damage or destruction of powan population in Loch Sloy by ruffe	Consultation with SEPA during the subsequent design phase to explore fish deterrents within the tailrace to reduce the risk of INNS fish transfer.	Low (Non-Significant)	Monitoring of ruffe presence in Loch Sloy. Monitoring of the powan population in Loch Sloy.

8.12. Cumulative Impacts

Cumulative effects can occur where a proposed development results in individually insignificant impacts that, when considered in-combination with impacts of other proposed or permitted plans and projects, can result in significant effects.

This section of the EcIA assesses the ecological effects of the Proposed Development cumulatively with the ecological effects of other developments that have either received planning permission or are the subject of a planning application which has not yet been determined.

The Argyll and Bute Council Interactive Planning Map[40] was utilised to identify nearby developments. The recent developments (registered / approved within the past 5 years) listed below were identified within 5km of the site, where development could lead to potential cumulative impacts on IEFs associated with the Sloy Pumped Hydro Storage Scheme.

8.12.1. DEVELOPMENT WITH PLANNING APPROVAL

8.12.1.1. Cruach-Tairbeirt Forestry Works

2021/0451/NOT

Planning application 2021/0451/NOT pertains to a proposed development located 1.3 km to the southwest of the Sloy PHS development and which includes the construction of 7200m of new forestry road, including eight turning points and four passing places to provide access to the Cruach-Tairbeirt forest block. This would facilitate tree felling, including the felling of larch trees infected with or expected to become infected with *Phytophthora ramorum*. The new road will also provide access for deer control and other work that will take place after felling. It is anticipated that felling and replanting will have a positive impact on biodiversity because the restocking will result in increased age class, species and habitat diversity.

The total plan area for Cruich Tairbeirt occupies c. 895 ha of mainly productive conifer plantation, and also native broadleaf woodland including Gen Lion Woods SAC and SSSI and Kenmore Woods. It is a 5-year plan to remove infected Larch following an SPHN notice served in 2022.

Overall, there is no expected cumulative effects to IEFs identified within this assessment.

2022/0258/NOT

Planning application 2022/0258/NOT pertains to a proposed development located 1.8km to the southwest of the Sloy PHS development and includes the construction of 1850m of forestry road, including eight turning points and two laybys on land At Dubh Chnoc, Inveruglas, to facilitate tree felling.

Overall, there is no expected cumulative effects to IEFs identified within this assessment.

8.12.2. DEVELOPMENT WITHOUT PLANNING APPROVAL

The following planning application has also been reviewed to assess cumulative impacts. However, due to its early stage, limited details regarding, proposed development, presence of notable flora or fauna, or mitigation is available.

[40] Loch Lomond & The Trossachs National Park *Planning – Map Search,* [Online]. Available from: Map Search (lochlomond-trossachs.org) (Accessed April 2024).

8.12.2.1. Sloy Transformer Replacement Project

Pre-planning consultation 2023/0149/PAC covers the development of a new substation platform including earthworks and tree clearance, construction of the substation and associated infrastructure, and removal of redundant overhead line apparatus. LLTNPA state that a planning application must be submitted no later than 27 October 2024. Without further ecological assessment, further cumulative effects of IEFs identified within this assessment cannot be predicted.

8.13. Summary and Conclusion

No significant effects on aquatic Important Ecological Features are predicted.

It is considered that the operational characteristics of the pump system, the increase in generation duration, and potential additional fish deterrent measures would prevent transfer of invasive non-native ruffe into Loch Sloy, and that the Loch Sloy powan population are unlikely to be negatively impacted through ruffe establishment. The conditions within Loch Sloy are considered sub-optimal for aquatic invasive plant species, Nuttall's pondweed, Canadian pondweed, and New Zealand pigmyweed. The intake screens, Inveruglas Bay, and Loch Sloy would be subject to regular monitoring during the construction and operational phase for establishment of aquatic invasive plant species.

The trophic status of Loch Sloy is not expected to change during operation as Loch Sloy has a relatively large catchment inflow, with proposed pumped volumes representing a small proportion of Loch Sloy's storage capacity. Additionally, both Loch Sloy and the northern basin of Loch Lomond are oligotrophic.

Screening would be installed at the pump intake to reduce death and injury to Atlantic salmon, brown trout, European eel, and powan by impingement and / or entrainment. Additional measures to deter fish from entering the tailrace would also be explored including the use of acoustic, light and bubble systems during pumping operations.

Whilst there are some uncertainties or limitations in the assessments and / or mitigation proposed, it is anticipated that monitoring both during construction and through operation would allow for mitigation to be adapted if necessary.

The cumulative effects of the Proposed Development in combination with other developments in the vicinity are considered to be non-significant.