Balliemeanoch Pumped Storage Hydro

Environmental Impact Assessment Report

Volume 2: Main Report
Chapter 11: Water Environment

ILI (Borders PSH) Ltd

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Quality information

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Revision History

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1	July 2024	Submission	DL	David Lee	Technical Director

Distribution List

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11 Water Environment

11.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies and assesses the potential effects of the Development on the water environment. For this assessment the water environment includes the water quality of surface water features, fluvial hydromorphology of watercourses and the geomorphology of lochs/lochans, and quality, flows, and levels of groundwater features. Where there are water dependent ecosystems, these are also considered in this assessment when determining the importance of water features.

There is interaction between environmental topics and therefore this chapter should be read in conjunction with:

- Chapter 6 Terrestrial Ecology;
- Chapter 7 Aquatic Ecology;
- Chapter 8 Marine Ecology;
- Chapter 10 Geology and Ground Conditions;
- Chapter 12 Water Resources; and
- Chapter 18 Marine Physical Environment and Coastal Processes.

Potential impacts and effects on the water environment receptors have been described for the construction and operation phases of the Development. Further, the approach to mitigating potential impacts during all phases have been described with reference to good practice guidance and design, which is described later in *Section 11.9*.

This chapter is also supported by the following figures (which are provided in Volume 3: Figures) and technical appendices (which are provided in Volume 5: Appendices):

- Figure 11.1 Surface Water and Groundwater Receptors and Attributes – Wider Context;
- Figure 11.2a Surface Water and Groundwater Receptors and Attributes – Headpond Study Area;
- Figure 11.2b Surface Water and Groundwater Receptors and Attributes – Loch Fyne Study Area
- Figure 11.3a Surface Water and Groundwater Receptors and Attributes – Headpond Study Area;
- Figure 11.3a Surface Water and Groundwater Receptors and Attributes – Loch Fyne Study Area;
- Appendix 11.1 Water Quality Monitoring Results;
- Appendix 11.2 Water Framework Directive Assessment;
- Appendix 11.3 Private Water Supplies Assessment;
- Appendix 11.4 Watercourse Crossings; and
- Appendix 11.5 Outline Water Management Plan.

11.2 Legislation and Policy

Legislation, planning policy and guidance relevant to this assessment and pertinent to the Development is outlined in this section (please note that regulations transferring powers from the European Union to the United Kingdom authorities are not listed).

11.2.1 Legislation

The following national legislation is relevant to the Development and will be considered as part of this assessment:

- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) ('the CAR Regulations') (Ref 11.1);
- Water Environment Water Services ('the WEWS Act') (Scotland) Act 2003 (Ref 11.2);
- Environmental Liability (Scotland) Regulations 2009 (Ref 11.3);
- Pollution Prevention and Control (Scotland) Regulations 2012 (PPC) (Ref 11.4); and

- The Climate Change (Scotland) Act 2009 (Ref 11.5).

11.2.2 Planning Policy

Applications for energy developments in Scotland with an electrical generation capacity in excess of 50 MW are made to and determined by the Scottish Ministers in accordance with the provisions of Section 36 of the Electricity Act (1989) and any direction deeming planning permission to be granted under Section 57(2) of the Town and County Planning (Scotland) Act 1997. (Ref 11.7). There are legal, policy and advice documents which are material considerations to the decision-making process of this process, covering relevant legislation, national and local planning policy, and advise notes/supplementary guidance, and these are described in the following sections.

11.2.3 National Planning Framework 4 (NPF4)

The National Planning Framework 4 (NPF4), published in February 2023 (Ref 11.8), replaces the previous National Planning Framework 3 (NPF3) (Ref 11.12). NPF4 sets out the Scottish Government spatial development principles, regional priorities, national developments and national planning policy, covering six spatial principles which aim to deliver sustainable places, liveable places and productive places.

Pumped Storage Hydro (PSH) is identified in NPF4 as necessary to support energy security, diversity of the electricity supply, and to reduce carbon emissions. This includes refurbishment of existing sites and the development of new the Developments. Policy 11 within the NPF4 outlines that such Energy Developments should demonstrate within their project designs and mitigation that impacts to hydrology, water environment and flood risk are addressed.

11.2.4 Scottish Planning Policy (SPP)

SPP was published in June 2014, its purpose is to set out national planning policies that reflect priorities of the Scottish Ministers for operation of the planning system and the development and use of land through sustainable economic growth (Ref 11.9). SPP aims to promote a planning process that is consistent across Scotland but flexible enough to accommodate local circumstances. SPP demonstrates a commitment to sustainable growth through a balance of development in appropriate places.

SPP outlines that planning should look to '*promote protection and improvement of the water environment, including rivers, lochs, estuaries, wetlands, coastal waters and groundwater, in a sustainable and co-ordinated way*'.

11.2.5 Planning Advice Notes and Specific Advice Sheets

Planning Advice Notes (PANs) and Specific Advice Sheets (Ref 11.10) set out detailed advice from the Scottish Government in relation to a number of planning issues. PANs and Specific Advice Sheets relevant to the Development could include:

Table 11.1 Planning Advice Notes and Specific Advice Sheets

Planning Advice Notes and Specific Advice Sheets	Key Requirements relating to the Water Environment	The Development
PAN 79 Water and Drainage (Ref 11.31)	All new developments require the Sustainable Drainage Schemes (SuDS) to provide treatment to waste water.	Each temporary and permanent compound will incorporate SuDS where possible. The design of surface water drainage systems, incorporating appropriate attenuation and treatment measures, will be undertaken post-consent as part of a Detailed Design Strategy. This could be prepared pursuant to a planning condition.
Hydro the Developments (Ref 11.34)	States that priority should be given to schemes which can provide significant energy contribution but minimise impacts to the water environment. The document suggests that discussions with SEPA to gain advice on water environment protection, especially where significant impacts are identified.	SEPA was contacted to have a meeting concerning the water environment. At the time of writing no meeting was arranged.
Planning and waste management (Ref 11.35)	States that there should be environmental protection considerations to mitigate any potential effects on the water environment.	Mitigation measures are outlined *Section 11.9* of *Chapter 11*, within the CEMP and within oWMP *(Appendix 11.5*).

11.2.6 River Basin Management Plan

The River Basin Management Plan (RBMP) sets out a range of actions to address impacts to the water environment. RBMP outline actions for public bodies and land managers and are produced by SEPA on behalf of the Scottish Government. The Development site is within the RBMP. In summary, the RBMP provides the following:

- The conditions of the water environment;
- Pressures which could or are impacting the water environment; and
- Actions to address any impacts.

11.2.7 Local Planning Policy - Argyll and Bute Local Development Plan

The Argyll and Bute Local Development Plan (LDP2) (Ref 11.14) was formally adopted on 28 February 2024 and provides the local planning framework (excluding the area covered by the Loch Lomond and Trossachs National Park. The this replaces the LDP (Ref 11.13) submitted in 2015. LDP 2 will provide a land use framework for the next 10 years is currently under preparation for which a draft has been made available for consultation.

The LDP 2 includes various policy allocation changes as well as new additions that may be of relevance to the Development and will therefore be considered following its adoption (see *Table 11.2*).

Table 11.2 List of water environment related policies outlined in LPD 2

Policy Number	Description
Policy 04 – Sustainable Development	"*In preparing new development proposals, developers should seek to demonstrate the following sustainable development principles… Avoid having significant adverse impacts on land air and water environment."*
Policy 30 – The Sustainable Growth of Renewables	"*The Council will support renewable energy development where these are consistent with the principles of sustainable development, and it can be adequately demonstrated that there would be no unacceptable environmental effect… will be assessed against the following criteria… effect of hydrology, the water environment and flood risk"*
Policy 59 – Water Quality and the Environment	*Proposals for development that could affect the water environment will be assessed with regard to their potential impact on:* *a) Water quality and quantity, ecological status including morphology and hydrology (i.e. flow rate) chemical and biological status;* *b) Riparian habitats and wildlife;* *c) Geomorphic processes;* *d) Leisure and recreational facilities and users;* *e) Economic activity.* *… Developments that may have a significant detrimental impact on the water environment will not be permitted unless it can demonstrate that the impacts can be fully mitigated"*

11.3 Consultation

Table 11.3 lists the consultation that has taken place in preparing this assessment.

Table 11.3 Summary of Consultation

Consultee	Key Issue	Action Taken
SEPA	Require mapping of proposed buffers, additional flood risk and any related CAR applications. Map and assessment of Groundwater Dependent Terrestrial Ecosystems (GWDTE).	A map of the Groundwater Dependent Terrestrial Ecosystems is included in *Figure 6.5 (Volume 3: Figures)*. Existing CAR licences can also be

Consultee	Key Issue	Action Taken
	"*The site layout must be designed to avoid impacts upon the water environment…. where activities such as watercourse crossings, watercourse diversions or other engineering activities in or impacting on the water environment cannot be avoided… a minimum buffer of 50m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works*"	viewed on these *Figure 11.2 (Volume 3: Figures).* Flood Risk information can be viewed in *Chapter 12: Flood Risk and Water Resources (Volume 2: Main Report)*. A 50 m buffer around each of the lochs/lochans and watercourses has been incorporated into the design. These buffers can be viewed in *Figure 11.3a* and *11.3b (Volume 3: Figures)*. *Table 11.33* lists any breaches of the buffer zones with justification to the breach. Details of each of the watercourse crossing can also be found within *Appendix 11.4 (Volume 5: Appendices).*
SEPA	Meeting held on the 19th of March 2024 between AECOM and SEPA to discuss the key impacts of the Development. The topics of discussion include the potential impact on the hydromorphology of watercourses, effects of thermal stratification on Loch Awe in the Summer, as well as pollution risks during construction works.	No action required from the meeting apart from continued engagement throughout the CAR licensing process.
NatureScot	"*impacts of construction on groundwater dependent terrestrial ecosystems (GWDTE) receptors, peatland habitats, and peat resources is likely to include a loss or a degradation of their hydrological, hydromorphological and ecological characters, associated with the issue of water quality on and off-site*."	The assessment of GWDTE and other terrestrial ecosystems are included in *Chapter 6: Terrestrial Ecology (Volume 2: Main Report)*. A map of the Groundwater Dependent Terrestrial Ecosystems (GWDTE) is included in *Figure 6.5 (Volume 3: Figures)*. Chapter 11 uses the GWDTE to help evaluate the importance of the groundwater aquifers. The assessment on peat can be found within *Chapter 10: Geology and Ground Conditions (Volume 2: Main Report).*
Marine Scotland Science	"*Potential impacts on fish populations associated with construction and operation of the Development include:* *Deterioration of water quality due to the release of sediment associated with the construction of the Embankment, Access Tracks/tunnels and buildings and stockpiled material, the release of hydrocarbons as a result of a fuel spillage and the release of concrete from mixing plants;* *The disturbance and/or removal (through excavation/erosion/deposition) of fish habitat e.g. Allt Beochlich, and Arctic charr spawning areas in Loch Awe;* *…* *Change in water quantity and flow regimes through abstraction/discharge and the creation of impenetrable surfaces e.g. Access Tracks/tunnels and buildings;* *…* *Change in water temperature*"	The assessment on impacts on fish are assessed *Chapter 7: Aquatic Ecology (Volume 2: Main Report).* This assessment within this chapter considers impacts during construction works in *Section 11.7*. Construction works will use good practice measures as outlined in CEMP to ensure impacts to water quality a mitigated. This assessment also considers changes in hydrology and water quality during operation in *sections 11.7.36* to *11.7.77*. This includes consideration of the risk of changes in water temperature.
Argyll and Bute Council	"*The applicant is requested to submit full details of the Water Management Plan and Surface Water Drainage Strategy, including the Emergency Response Management Plan, and* *mitigation measures within their Flood Risk Assessment. It will be important that the Development does not attribute to an increase in excess surface and ground water accumulations. It will also be important that the development does not attribute to an increase in pollution and any siltation/spoil entering Loch Awe, including the Oban and Kintyre groundwater bodies, and private water supplies*." "*The applicant is advised to adhere to good practice measures for working in and near to watercourses during the construction phase, and should include:* *Installation of silt interception traps to minimise unchecked contaminated run-off;* *Appropriate artificial drainage must be designed and installed;* *Fuels and other chemicals must be stored securely within the site construction compound;* *Appropriate wash-out facilities must be available for vehicles and machinery*;	Construction works will use good practice measures as outlined in a CEMP, to ensure impacts to water quality a mitigated. Further details are provided in *Section 11.9*. A Water Management Plan and Surface Water Drainage Strategy will be included as part of the mitigation measures to be prepared subject to a pre-commencement planning condition. An assessment of Flood Risk is provided in *Chapter 12: Flood Risk and Water Resources* (Volume 2).

Consultee	Key Issue	Action Taken
	Trenches and excavations must be covered at the end of each working day."	
Balliemeanoch Public Questionnaires (Private Water Supplies Questionnaire)	A member of the local community identified a Private Water Supply (PWS) which supplied Sonachan Farm and a PWS which supplied two properties (Cruachan View and Sonachan View). They also noted previous works in Sonachan woodland around NN 06667 20040 which impacted the PWS for Sonachan View.	The information provided has been considered in *Appendix 11.2 PWS Assessment (Volume 5*) and in this chapter.
Scottish Water	*"We would request further involvement at the more detailed design stages, to determine the most appropriate proposals and mitigation within the catchment to protect water quality and quantity"*	No action required from the meeting apart from continued engagement.
MOWI Fish Farms	*"We would expect the Water Environment and the Water Resources impact assessments outlined in the Scoping* *Report to be expanded to examine the specific risk to the fish farms and, if required identification of appropriate mitigation measures and actions"* *"We would stress the importance of maintaining water quality throughout the catchment during the construction phase, especially for Loch Awe in respect of the health and welfare of both native and farm raised fish."*	Construction works will use good practice measures as outlined in a CEMP, to ensure impacts to water quality a mitigated. Further details are provided in Section 11.9. A Water Management Plan and Surface Water Drainage Strategy will be included as part of the mitigation measures to be prepared subject to a pre-commencement planning condition. The CEMP, Surface Water Drainage Strategy and the Water Management Plan will be implemented throughout the catchment. The assessment of water levels and impacts to fish farms can be found in *Chapter 12: Flood Risk and Water Resources* (Volume 2).

11.4 Study Area

The Development Site lies within the Argyll and Bute region of western Scotland, south of Portsonachan on the southern margin of Loch Awe, and Inveraray on the northwestern side of Loch Fyne.

For the purpose of this impact assessment, a 1 km study area around areas of new development or temporary works has been used within which water features that may be affected by The Development have been identified. For these water features, the baseline also considers downstream attributes beyond the 1 km study area as water quality impacts can sometimes propagate along watercourses. The distance downstream is usually determined by the nature of the risk, rate of conveyance, dilution and dispersion potential. However, for this the Development the ultimate downstream receptors are considered to be Loch Awe and Loch Fyne. Given the size of these water features it is not expected that any impacts would propagate any further downstream.

Consideration has also been given to any surface water or groundwater bodies or water dependent ecological sites outside this study area up to 2 km from the Development Site boundary if it is considered that they might be hydraulically linked.

The study area is determined by the location of new development and construction works and access routes. This generally consists of a new inlet and outlet structure to Loch Awe at Balliemeanoch, the proposed Headpond area located near Lochan Airigh, a new wharf extending out into Loch Fyne, and new and improved Access Tracks and tunnels in between, together with temporary compound areas.

11.5 Methods

11.5.1 Assessment Scope

As described in the introduction to this chapter, the assessment of potential effects on the water environment includes consideration of impacts on the water quality of surface water features, fluvial hydromorphology of watercourses and the geomorphology of freshwater lochs/lochans, and quality, flows, and levels of groundwater features. Where there are water dependent ecosystems, these are also considered in this assessment when determining the importance of water features. However, impacts on ecological receptors are assessed in *Chapter 7: Aquatic Ecology* and *Chapter 8: Marine Ecology*; impacts on water resources and flood risk are assessed in *Chapter 13: Water Resources*. Impacts from contaminated land on surface or groundwater receptors is presented in *Chapter 10: Geology and Ground Conditions*. The physical impact of works to the edge of Loch Fyne, including the construction of a new jetty, are assessed in *Chapter 18: Marine Physical Environment and Coastal Processes*, with assessment of the physical impact to the shore of Loch Awe assessed in this chapter.

Table 11-4 Scope of Assessment

Impact	Relevant receptors	Development Phase
Groundwater Quality and Flow	Oban and Kintyre Groundwater Body	Construction
		Operation
	Superficial Groundwater Body	Construction
		Operation
Surface Water Quality – Spillage Risk	All surface water features that may be directly or indirectly as identified later	Construction
		Operation
Surface Water Quality – Suspended Fine Sediment	All surface water features that may be directly or indirectly as identified later	Construction
Surface Water Quality – Change in Water Level	Loch Awe	Operation
Surface Water Quality – Thermal Stratification	Loch Awe	Operation
Surface Water Quality – Algal Blooms (not stratified loch conditions)	Loch Awe	Operation
Surface Water Quality – Discharge from Headpond (Temperature)	Loch Awe	Operation
Surface Water Quality – Risk from concrete residue	Loch Awe	Operation
Surface Water Quality – Compensation Flow downstream or the Embankment	Loch Awe, Allt Beochlich and Beochlich Lochan	Operation
Hydromorphology – Construction of Embankments	All surface water features that may be directly or indirectly as identified later	Construction
		Operation
Hydromorphology – watercourse crossings	All surface water features that may be directly or indirectly as identified later	Construction
		Operation
Hydromorphology – sediment runoff	All surface water features that may be directly or indirectly as identified later	Construction
Hydromorphology – hardstanding area	All surface water features that may be directly or indirectly as identified later	Construction
		Operation
Hydromorphology – Tailpond inlet / outlet structure	Loch Awe	Operation

The potential impacts that may occur during decommissioning would be similar to those described for the construction phase, plus the need to dewater the Headpond and restore the Site where structure have been built. Decommissioning of the Development Site should seek to restore the Development Site to its pre-development form, restoring water bodies and features. Although it has been agreed during the EIA scoping process that decommissioning impacts can be excluded from the EIA, on the basis that their scale and type of impact would be consistent with those predicted for the construction phase, the outcome of restoring the site will likely be beneficial overall. Reference to decommissioning and site restoration is therefore included to ensure that appropriate plans, measures and future commitments are recognised and can be captured in any planning consent granted.

11.5.2 Methodology for Determining Baseline Conditions and Importance of Receptors

11.5.2.1 Baseline Data Collection

The following sources of information have been used to inform the baseline upon which effects have been assessed (see references section for hyperlinks and accessed dates):

- Online Ordnance Survey digital maps (Ref 11.15);
- Met Office website (Ref 11.16);
- SEPA website (Ref 11.17);
- SNH Standing Waters Database (Ref 11.18);
- Scotland's Aquaculture website (Ref 11.19);
- Scotland's Environment website (Ref 11.20);
- Scotland's soils website (Ref 11.21);
- National River Flow Archives website (Ref 11.22);
- British Geological Survey (BGS) website (Ref 11.23); and
- SEPA data request for:
  - Any available bathymetry, storage-depth curves and surface and depth-profiling water quality data;
  - Water quality data for any feeder streams to these lochs that are monitored;
  - Information on any water quality models that exist for these lochs;
  - Assessment / comments on water quality differences between these lochs / catchments;
  - Records of any pollution incidents affecting water features within the 1 km Study Area (Development Site boundary –1km buffer);
  - Any ecological surveys undertaken on lochs and feeder streams, including fish, macro-invertebrates, macrophytes etc;
  - Information on licensed water abstractions and discharges within the 1 km Study Area; and
  - Information on any other attributes of these water features that we should be aware of when undertaking the impact assessment.
- PWS data from Argyll and Bute Council;
- Online literature search; and
- Ecology survey data about protected species from *Chapter 7: Aquatic Ecology*.

A walkover survey of the study area was carried out on the 9th and 10th of August 2023 in generally dry weather but with occasional showers. The survey was carried out by a team of surveyors consisting of a hydromorphologist and a hydrogeologist. The purpose of the survey was to identify and characterise surface water receptors, to consider the flow pathways between water features and across the Study Area, and to make general observations about the character of the landscape and other relevant features that could influence the sensitivity and importance of water features and the prediction of potential effects from the Development. Four water quality samples were also collected from Lochan Airigh and Beochlich, and upstream and downstream reaches of Allt Beochlich (see *Figure 11.3a: Surface Water and Groundwater Receptors and Attributes – Headpond Study Area (Volume 3 Figures*).

11.5.3 Methodology for Assessing Construction, Operation and Decommissioning Effects

11.5.3.1 Source-Pathway-Receptor Approach

The qualitative assessment of potential likely significant effects during the construction and operational phases of the Development has been based on a source-pathway-receptor approach. For an impact on the water environment to exist, the following is required:

- An impact source or cause of effect (such as a structure over a watercourse, the release of polluting chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or the loss or damage to all or part of a water feature, cuttings/excavations and associated dewatering activities capable of causing temporary or permanent changes to groundwater level or flow pattern and quality (as in the case of groundwater));
- A receptor that is sensitive to that impact (i.e., water features and the services they support) that could potentially be affected;
- A pathway by which the above two are linked (i.e. all three elements must be present before a potential impact linkage can be realised).

The first stage in applying the source-pathway-receptor approach is to identify the causes or sources of potential impact from a development. The sources have been identified through a review of the details of the Development, including the size and nature of the Development, potential construction methodologies and timescales etc.

The next step in the approach is to undertake a review of the potential receptors; that is, the water environment receptors themselves that have the potential to be affected. Water features, including their attributes, have been identified through desk study and site surveys as described later in *Table 11.24*.

The last stage of the approach is to determine if there is a viable exposure pathway or a 'mechanism' linking the source to the receptor. This is determined in the context of local conditions relative to water receptors within the Red Line Boundary and surrounding environs, such as topography, geology, climatic conditions, land use and the nature of the impact (e.g., the mobility of a liquid pollutant or the proximity to works that may physically impact a water feature or be a source of water pollution).

Activities associated with the future maintenance and management of the may include the full draw down of the Headpond for maintenance but are unlikely in their own right to result in a significant adverse effect. The need to temporarily lower water levels in the Headpond for inspection of the Embankment, or the emergency drainage of the Headpond in the event of an emergency, are considered to be events that are consistent with normal operation, and thus the effects described for operation of the Development reflect these circumstances as well.

Please refer to *Section 11.7* for further details of the impact assessment outcomes.

11.5.4 Assessment Methodology

11.5.4.1 Significance Criteria

The assessment of effect significance outlined within the below sections is consistent with the terminology and criteria outlined within *Chapter 4: Approach to EIAR*.

The sensitivity of receptors, or importance, of the potentially affected water environment features has been established on the basis of a four-point scale, using the criteria presented in *Table 11.5* which has been modified from Design Manual for Roads and Bridges (DMRB) LA 113 Road drainage and the water environment to include hydromorphology (Ref 11.24).

Whilst other disciplines may consider 'receptor sensitivity', 'receptor importance' is considered here. This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water feature. For example, a small drainage ditch of low conservation value and biodiversity with limited other socio-economic attributes is very sensitive to impacts, whereas an important regional scale watercourse, that may have conservation interest of international and national significance and support a wider range of important socio-economic uses, is less sensitive by virtue of its ability to assimilate discharges and physical effects.

The magnitude of adverse or beneficial impacts has been determined by the seven-point scale presented in *Table 11.6* taking DMRB LA 113 Road drainage and the water environment into account (Ref 11.24).

The significance of effects has been determined using the matrix presented in *Table 11.7*. The assessment has considered the magnitude of impacts and the importance of the resources / receptors that could be affected in order to classify the effect. Where the matrix allows a range of effect, professional judgement will be used to determine the residual significance.

Table 11.5 Receptor sensitivity descriptors (reproduced and adapted from Chapter 2 (Volume 2)

Importance	Groundwater	Surface Water	Hydromorphology
Very High	Principal aquifer providing a regionally important resource and/ or supporting a site protected under International and UK legislation Ecology and Nature Conservation Groundwater locally supports Groundwater Dependent Terrestrial Ecosystems (GWDTE).	Watercourse having a WFD classification shown in a River Basin Management Plan (RBMP) and Q951 ≥1.0 m3/s Site protected/ designated under International or UK habitat legislation (SAC, SPA, SSSI, Water Protection Zone (WPZ), Ramsar site. International Designated Salmonid/ Cyprinid fishery. Species protected by international legislation.	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river and loch type.
High	Principal aquifer providing locally important resource or supporting river ecosystem and/ or supporting sensitive habitats of national importance. Groundwater supports a GWDTE.	Watercourse having a WFD classification shown in a RBMP and Q95 m3/s <1.0 m3/s. Major Cyprinid Fishery. Species protected under International or UK legislation Ecology and Nature Conservation	Conforms closely to natural, unaltered state and will often exhibit well-developed and diverse geomorphic forms and processes characteristic of river and loch type. Deviates from natural conditions due to direct and/ or indirect channel, floodplain, bank modifications and/ or catchment development pressures.
Medium	Aquifer providing water for agricultural or industrial use with limited connection to surface water. Secondary Aquifer. Groundwater of limited value because its quality does not allow potable or other quality sensitive uses.	WFD not having a WFD classification shown in a RBMP and Q95 >0.001 m3/s.	Shows signs of previous alteration and/ or minor flow/ water level regulation but still retains some natural features or may be recovering towards conditions indicative of the higher category.
Low	Unproductive Strata	Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001 m3/s.	Substantially modified by past land use, previous engineering works or flow/ water level regulation. Watercourses likely to possess an artificial cross-section (e.g. trapezoidal) and will probably be deficient in bedforms and bankside vegetation. Watercourses may also be realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches will fall into this category.

Table 11.6 Magnitude of Effect

Impact	Criteria
High Adverse	Results in a loss of attribute and/ or quality and integrity of the attribute.
Medium Adverse	Results in impact on integrity of attribute, or loss of part of attribute.
Low Adverse	Results in some measurable change in attribute's quality or vulnerability.
Negligible	Results in impact on attribute, but of insufficient magnitude to affect the use or integrity.
Low Beneficial	Results in some beneficial impact on attribute or a reduced risk of negative impact occurring.
Medium Beneficial	Results in moderate improvement of attribute quality.
High Beneficial	Results in major improvement of attribute quality.
No Change	No change to the quality of the attribute

11.5.4.2 Significance of Effect

The significance of effects has been determined using the matrix presented in *Table 11.7.* Effects classed as moderate or greater are considered 'Significant' in planning terms (shaded in *Table 11.7*).

Table 11.7 Matrix for assessment of significance

Magnitude	Importance				
	Very High	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

The impact is then described as either long-term/short-term, temporary/permanent, direct/indirect and certain/uncertain. These descriptors are defined below.

- Long-term/Short-term: describes length of time an impact is likely to last for.
- Temporary/Permanent: describes whether an impact last or remain indefinitely.
- Direct/indirect: describes whether a receptor is impacted by an impact directly or indirectly.
- Certain/Uncertain: describes the certainty of the impact predicted.

11.5.4.3 Water Framework Directive Assessment

A WFD Assessment *(Appendix 11.2 (Volume 5: Appendices))* has been produced based on a combination of desk study, hydromorphological walkover, aquatic ecology and water quality surveys. This assessment considers whether the Development has the potential to:

- Cause deterioration in ecological status and potential of water bodies.
- Prevent water bodies from meeting their objective of 'Good' ecological status/ potential.
- Prevent or compromise WFD objectives being met in other water bodies or water dependent protected areas downstream of the Development.

The assessment is qualitative and is based on the same source-pathway-receptor approach described earlier. However, the objective of the assessment is to see whether there is compliance with the above objectives rather than a significance of effect.

In undertaking the assessment, consideration has been given to the conservation objectives for any ecologically sensitive sites, where these might be more stringent. The WFD assessment is presented in EIAR *Appendix 11-2*. The WFD Assessment covers all of the freshwater bodies which could be impacted by the scheme. This includes Loch Awe, Allt Beochlich, River Aray and the Oban and Kintyre Groundwater Body.

The following aquatic ecology surveys have taken place; macroinvertebrate, macrophyte, fish, fish eDNA (Loch Awe), fish and freshwater pearl mussel habitat assessment, pond PSYM (Lochan Airigh). Further information can be found within *Chapter 7: Aquatic Ecology (Volume 2: Main Report)* and *Appendix 7.1 (Volume 5: Appendices)*.

11.5.5 Limitations and Assumptions

The EIAR process enables informed decision-making based on the best possible information about the environmental implications of a Development being made available. However, it is common for there to be some uncertainty as to the exact scale and nature of the environmental impacts predicted. Where there is uncertainty of design, reasonable worst-case assumptions have been made, and these are described more in *Section 11.9.*

A data request was made to SEPA in July 2023. However, SEPA did not provide information on existing water quality and hydrological data. Therefore, the assessment is based on data available from online sources and a literature search. For many water bodies in the study area there was no long-term water quality or hydrological data and for others the data that was available was limited or obtained some time ago (and thus may not be wholly representative of current conditions). No digital bathymetry or water depth-storage data was provided by SEPA and therefore the potential effects from the Development on water quality, hydrology and loch stratification has been assessed qualitatively and based on background information and certain assumptions defined in the impact assessment section.

The Private Water Supply (PWS) data was supplied by the Argyll and Bute Council and from a questionnaire completed by members of the public at public exhibition events held at Inveraray Inn on 19th July 2023, with a second event held on 7th August 2023 at Dalmally Community Hall. The data collected from the Argyll and Bute Council does not clarify whether the coordinates correlate to the property served by the PWS or the actual PWS location. For the purposes of this assessment, it has been assumed that the coordinates received from Argyll and Bute Council correspond to the location of the PWS. It is possible that there are unknown PWS.

PWS data was received on the 1st of June 2023 from the Argyll and Bute Council and so only represent the PWS that were recorded at that time. The council confirmed that the data received was up to date on the 28th of February 2024.

Water samples were collected at Allt Beochlich, Beochlich Lochan and Lochan Airigh on the 9th of August 2023 as part from the Development Site walkover survey. A single water sample from each sampling location was collected (See *Appendix 11.1*). This only provides a 'snapshot' of water quality at the time it was taken, including the flow conditions, and the suite of analysis was for key parameters only.

The duration over which water will be stored in the Headpond is not defined and will vary. However, as stated in *Chapter 2: Project and Site Description*, it is unlikely that there will be many days when the Development will complete a full pump / generation cycle, due to fluctuation in energy demand. If it were to be stored for long periods of time (weeks or months) this could potentially alter its water quality character compared to Loch Awe, from where it was abstracted. Shorter timescales between energy generation are less likely to affect water quality. It is assumed that the Development will be used frequently enough that this is not an issue. However, were the Development not to be used for a long period of time (i.e. several months), water quality may need to be checked prior to its re-use. Therefore, for this scenario has also been assessed within the chapter.

The Blarghour Wind Farm Access Track may be used for the Development if it is constructed and the necessary land rights can be secured. For the purposes of this assessment, it has been scoped out of the assessment. It is assumed any impacts from the track will be considered within the separate Blarghour Wind Farm planning documents.

There were no detailed construction methods available at the time of writing this chapter and so assumptions concerning the construction were made. Similarly, only indicative designs for possible watercourse crossings are available reflecting an arch and a pipe culvert option.

11.6 Baseline Environment

11.6.1 Study Area, Topography, Land Use and Climate

The study area is characterised by hilly upland with elevations up to approximately 570 m Above Ordnance Datum (mAOD). The land use is predominantly open moorland, interspersed with large areas of coniferous plantations, and with improved grassland for livestock and small urban developments along the fringes of Loch Awe and Loch Fyne. A complex pattern of watercourses and small lochs drain this upland area towards Loch Awe and Loch Fyne.

The Development Site is situated in a highland area known as Mid Argyll in Western Scotland. The main Development Site (consisting of the Headpond and underground works) lies on the northwest facing slopes above Loch Awe and the hamlet of Balliemeanoch, east of the A819 (see *Figure 11.1 Surface Water and Groundwater Receptors and Attributes – Wider Context*) (*Volume 3 Figures*). Abstraction and discharge infrastructure will be required along the shore of Loch Awe. Two options for the Development Site access of the A819 extend to the northwest and southwest (if the Blarghour Wind Farm extension is permitted, constructed, and the rights secured). Highway works and a new jetty are proposed along the shore of Loch Fyne to the south of Inveraray. Land use within the Development Site and 1 km study area generally consists of upland moors, coniferous forest and open water, with isolated roads, utilities and power lines, and properties.

The proposed Headpond location lies over Loch Airigh and a large portion of the Allt Beochlich at approximately 350 mAOD. The ground elevation reduces towards Loch Awe to the west of the Headpond, to around 40 mAOD.

On the National River Flow Archive website (Ref 11.22), the nearest catchment with rainfall statistics is Abhainn a' Bhealaich at Braevallich (NM957075), approximately 10 km southeast of the Development Site. Standard Annual Average Rainfall (SAAR) for the period 1961-1990 is 2489 mm per year.

The days of rainfall above 1mm is also recorded by the Met Office (Ref 11.40). Dunstaffnage Station located at Loch Linnhe north of Oban is the closest station. *Chart 11-1* shows the average rainfall data from Dunstaffnage Station from 1991 to 2020. October to January have the highest number of rainfall days above 1 mm and rainfall totals, while the spring to mid-summer months of April to July had the lower number of rainfall days above 1 mm and rainfall totals. The rainfall totals are higher than average in a Scotland and UK context and exhibit a distinct trier period from mid-spring to mid-summer.

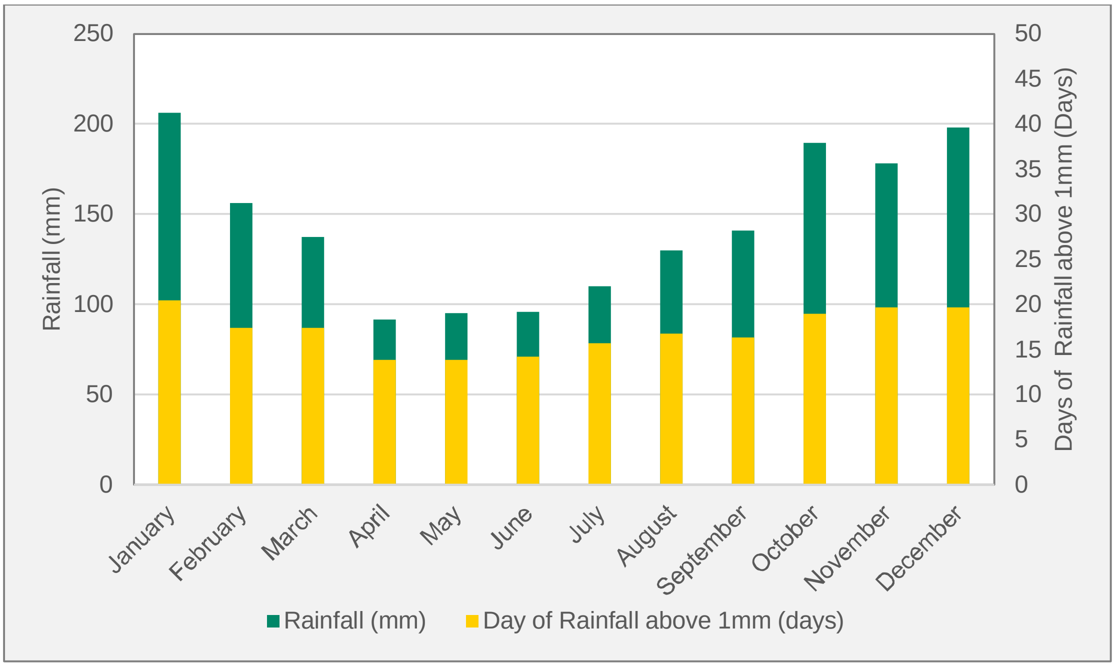


Chart 11-1: Days of rainfall above 1mm (days) sourced from Dunstaffnage Station from 2023 (Ref 11.40)

11.6.2 Geology and Soils

The geology of the area is shown on the Geological Map Sheet No. 37 W – Furnace (Ref 11.25) and also on Geology of Britain GeoIndex Viewer (Ref 11.23). Please refer to *Figure 10.2 Bedrock Geology (Volume 3 Figures)*. Further detail on Geology and Soils can be found within *Chapter 10*.

The bedrock geology of the Development Site is dominated by formations mostly Pre-Cambrian in age (>540 million years (Ma)) that are part of the Dalradian Supergroup. This is a metasedimentary and igneous succession deposited on the eastern edge of Laurentia between the late Neoproterozoic (approximately 800 Ma) and early Cambrian (approximately 510 Ma) periods. Some of these formations are part of the Tayvallich Subgroup, made up of limestones and slates. Another formation in the area is the Loch Avich Grit Formation, consisting of Psammites and Pelites. The thickness of the Tayvallich Subgroup is in the range of 100-250 m in the area, the parent unit (being the Argyll Group) has a thickness of up to 9 km. There are a series of metamorphosed igneous bodies, originally igneous rocks formed by intrusions of silica-poor magma, later altered by low-grade metamorphism. To the south of the Development Site there are younger units, in the form of an igneous dyke suite injected into the country rocks. This is the North Britain Siluro-Devonian Calc-Alkaline Dyke Suite formed approximately 398-423 million years ago in the Devonian and Silurian periods.

A fault runs approximately southwest to northeast through the southern edge of the Development Site for approximately 11 km and terminates approximately 1 km north of Eredine, under Loch Awe.

Figure 10.3 Superficial Geology (Volume 3: Figures) displays that no superficial deposits are identified across the majority of the main Development Site. This is an indication that bedrock is at or near ground surface. Where superficial deposits are identified, they are generally Till, deposits of Alluvium and Peat along the shore of Loch Awe.

According to the Scotland's Soils website (Ref 11.21), the vast majority of the study area is underlain by soils described as 'peaty gleys with peaty rankers' and 'peaty gleyed podzols with peaty gleys with dystrophic semi-confined peat'. Along Loch Awe and Loch Fyne there are 'brown earths with humic gleys' and 'humus-iron podzols with peaty gleys'.

From the peat probing assessments carried out in August 2021 and September 2023 it was found that there were 57 locations with peat depths ranging between 3 m to 7.3 m on the outer eastern edges of the survey extents (see *Figure 10.4: peat Probe Locations (Volume 3: Figures)).*

11.6.3 Hydrogeology

The bedrock hydrogeological information is relatively limited but seems to show that the Dalradian rocks are generally without groundwater except at shallow depths (Ref 11.26). MacDonald (2005) (Ref 11.27) lists the bedrock aquifer productivity of Dalradian rocks as being in the low category (in some cases very low category). For these categories, low is defined as 0.1 to 1 l/s and very low as <0.1 l/s. These quantities would only be suitable for supplying private resources and even then, resources may tend to be variable. The presence of fracture zones in a locality may enhance the yields from any wells, but locating these zones can be difficult. Although hydraulic property information is very difficult to obtain in these areas, it can be assumed that the permeabilities of the bedrock are likely to be low.

The superficial deposits (although limited in extent) and peat are likely to contain groundwater at shallow depths. Flow would likely follow the topography of the surface and underlying bedrock. It is likely that this shallow groundwater is supporting GWDTEs including local watercourses, and maybe in hydrological connectivity with still water features (e.g. Lochan Airigh).

Ecology surveys have identified a number of terrestrial ecosystems which have the potential to be dependent on groundwater (See *Chapter 7: Aquatic Ecology (Volume 2: Main Report)* and *Figure 6.5 (Volume 3: Figures)* for further detail). For this assessment, any habitat that may be dependent on upwelling groundwater, groundwater flow, or a constant or seasonally high groundwater table (including perched) will be considered. *Chapter 6: Terrestrial Ecology (Volume 2: Main Report)* identifies areas as having values of Moderate, High or Moderate to High GWDTE potential. In summary the following areas have been identified as having potential GWDTEs:

- **The Headpond and Embankment** have a mixture of moderate (part only), moderate to high, high (part only) and high classified GWDTE. The majority of these are situated to the northwestern edge of the Headpond and Embankment. There are also a number of High classified GWDTEs along Allt Beochlich and tributaries.
- **Track from Loch Awe to Headpond** has a mixture of moderate, moderate to high and high potential GWDTE. The High potential GWDTE are mostly situated along Allt Beochlich and tributaries. There is also of high (part only) GWDTE situated along the bank of Loch Awe (NN 00870 15815).
- **Blarghour Wind Farm Access Track** has a number of high classified GWDTEs situated around the entrance from A819 (NN 08826 12453) as well as some isolated patches of GWDTEs along the track.
- **Inveraray** has an area of high, moderate to high and moderate GWDTE just south of the Upper Avenue (NN 08711 07960). There is also a moderate (part only) GWDTE situated along Loch Fyne (NN 08895 07433).

The majority of these GWDTE are situated around the northwest side of the proposed Headpond area (NN 03256 16310) and have been classed as High or Moderate. There are also a number of GWDTE located around Allt Beochlich (NN 01895 15524) which have been classed as Moderate, High or Moderate to High. However, as discussed within *Chapter 7: Aquatic Ecology (Volume 2: Figures),* it is likely that the majority of these GWDTE are ombrogenous (rain-fed) especially within the areas of blanket bog.

The whole study area is underlain by the Oban and Kintyre WFD groundwater body (ID: 150698) (Ref 11.28) designated under the RBMP for Scotland (Ref 11.29). This WFD groundwater body covers an area of approximately 2,663 km^2 and is currently classed as Good (2022, Cycle 3) (*Table 11.8*).

Table 11.8 Groundwater WFD Status (Ref 11.41)

RBMP Parameter	Oban and Kintyre groundwater body (ID: 150698) (2022) Cycle 3
Overall status	Good
Quantitative status	Good
Saline Intrusion	Good
Surface Water Interaction	Good
Water balance	Good
Chemical status	Good

RBMP Parameter	Oban and Kintyre groundwater body (ID: 150698) (2022) Cycle 3
Chem – Surface Water Interaction	Good
Specific pollutants	Good
Chromium	Good
Zinc	Good
Manganese	Good
Other Substances	Good
Nitrate	Good
Priority substances	Good
Cadmium	Good
Lead	Good
Drinking Water Protected Area	Good
Priority substances	Good
Atrazine	Good
Simazine	Good
Other Substances	Good
Epoxyconazole	Good
Nitrate	Good
General tests	Good
Priority substances	Good
Atrazine	Good
Simazine	Good
Trichloroethene	Good
Benzene	Good
Specific pollutants	Good
Chromium	Good
Other Substances	Good
Electrical Conductivity	Good
Epoxyconazole	Good
Nitrate	Good
Free Product	Good
Vinyl Chloride	Good
Water quality	Good

11.6.4 Surface Water Features

Surface water features (and their attributes) within the study area and extending to Loch Awe and Loch Fyne are described in this section. Under the WFD, 'water bodies' are the basic management units, defined as all or part of a river system or aquifer. Water bodies form part of larger 'river basin districts' (RBD), for which RBMPs are used to summarise baseline conditions and set broad improvement objectives. This baseline is presented by each water body, noting that some features are present within the catchments of designated WFD water bodies rather than being designated as a WFD water body in their own right. The baseline is also organised first by those water features and WFD water bodies that are within the Loch Awe catchment, before those that are in the Loch Fyne catchment.

As not all the watercourses in the study area are named, and some have multiple tributaries, each watercourse has been given a unique reference number. These can be seen on *Figure 11.1 Surface Water and Groundwater Receptors and Attributes – Wider Context (Volume 3 Figures)* and are referred to in the following baseline summary.

11.6.4.1 Loch Awe Catchment

Within the study area and the Loch Awe catchment there are the following water features. For smaller features we have given them a unique project specific reference (see in brackets below) which are present on *Figure 11.2a Surface Water and Groundwater Receptors and Attributes – Headpond Study Area* and *Figure 11.3a Surface Water and Groundwater Receptors and Attributes – Headpond Study Area* in *(Volume 3: Figures).*

Table 11.9 Summary of Catchment

Sub Catchment	Water Features
Loch Awe	Allt na Cuile Riabhaiche and tributaries (LA2)
	Allt a Chrosaid and small (unnamed) lochan (LA5)
	Allt na Dail Ferna (LA11)
	Allt na Fainge (LA12)
	Allt a' Ghreataidh (LA13)
	Allt Blarghour and tributaries (LA16)
Allt Beochlich and tributaries (LA6)	Loch Breac-liath (LA1)
	Lochan Airigh (LA7)
	Beochlich Lochan (LA8)
	Lochan Dubh (LA9)
	Lochan Romach (LA10)
Alt Mor and tributaries (LA14)	Unnamed Lochs (LA15)
Cladich River (LA17)	Keppochan River and tributaries (LA3)
	Archan River and tributaries (LA4)

The above water features and their attributes are described in more detail in the following sections.

11.6.4.2 Loch Awe

Loch Awe is a loch water body within the River Awe catchment of the Scotland RBD (ID: 10085) (Ref 11.30). The Loch covers an area of around 38.5 km^2 making it the third largest freshwater loch in Scotland. At approximately 41 km in length, it is also the longest freshwater loch in Scotland. The Loch is aligned on a southwest to northeast axis typically 1 km wide, with two arms at the northeast end on either side of the northern basin. The eastern arm extends to the mouth of the River Orchy, which is the largest single fluvial input to the Loch (i.e. around 40% of the Loch's catchment and with an estimated daily mean flow of around 31 m^3/s). The western arm ends at the Loch Awe Barrage and the start of the River Awe, that drains the Loch to the sea. The Loch Awe Barrage is operated by Scottish and Southern Electricity (SSE) who control water levels in order to provide water storage for hydroelectric power generation at Inverawe Power Station. Balliemeanoch Hamlet and the Development is located approximately in the middle on the southern bank of the Loch.

According to '*The Ecology of Scotland's Largest Lochs'* (Ref 11.43), Loch Awe reaches to a maximum depth of around 94 m in the southwest of the Loch southwest of Eredine (southern basin). A second smaller distinct basin is located between Cladich and Loch Awe in the northeast and has a maximum depth of around 75 m (i.e. the northern basin). Between the southern and northern basins, and for more than half the Loch's total length, the Loch bed is undulating but typically does not exceed around 50 m depth. These basins and depressions can also be visualised with Ordnance Survey Maps (Ref 11.15).

Loch Awe is isothermal from late autumn to spring each year, thereafter there is development of stratified conditions until the following autumn (Ref 11.43). Therefore, it is classed as a monomictic loch (i.e. overturning once a year; mixing fully from late autumn and being thermally stratified during the warmer summer months). However, according to Tippett (1978) (Ref 11.44) where water depths are only 25 m deep thermal stratification does not occur.

The depth of the upper limit of thermocline is around 11 m and its maximum development is around June and July. At the surface the temperature of the Loch is around 15˚C in the summer and around 3.4˚C in the winter. It has also been noted that during the winter, Loch Awe water temperatures can drop to around 3.4˚C, although no inverse stratification has been observed (Ref 11.43).

Tippett (1978) (Ref 11.44) investigated the potential impact of the Cruachan pump-storage hydro scheme shortly after it was constructed on Loch Awe, including thermal stratification and therefore water quality and planktonic communities. It was observed that the additional mixing due to water exchange with the Headpond resulted in a local deepening of thermocline and sharpening of the metalimnion early in the season. However, this effect waned later in the summer as the surface water warmed in response to more intense incident sunlight, and the overall depth of the epilimnion deepened. The epilimnion in the northern basin ranged from 8 m early in the summer to up to 18 m towards the end of July.

Chemistry data was requested for Loch Awe from SEPA (requested July 2023), but at the time of writing nothing has been received. However, in *'The Ecology of Scotland's Largest Lochs'* some basic chemistry information was available, see *Table 11.10*. Overall, with a very low conductivity and chemical concentrations it is suggested that Loch Awe is an oligotrophic loch (Ref 11.43). However, Loch Awe has still had a history of algal blooms which is discussed further at *Table 11.10*.

Table 11.10 Chemistry data from Table 4.4 in *The Ecology of Scotland's Largest Lochs* (Ref 11.43)

Parameter	Unit	Mean value from November 1977 to October 1978 (Ref 11.43)
pH	pH units	6.9
Conductivity	µS/cm at 20˚C	41
Alkalinity (as $CaCO_3$)	mg/l 1^{-1}	8.97
Calcium	mg/l 1^{-1}	4.01
Magnesium	mg/l 1^{-1}	0.99
Sodium	mg/l 1^{-1}	4.47
Potassium	mg/l 1^{-1}	0.27

The water body is designated under the WFD as a heavily modified water body due to morphological (impoundment) pressures for hydropower power generation, which cannot be addressed without a significant impact on water storage for hydroelectricity generation. The overall status of the water body has remained as Moderate Ecological Potential between 2015 to 2022 (*Table 11.11 Loch Awe WFD quality (Ref 11.41)*), as not all mitigation/improvement measures have been implemented. However, the overall ecological status is currently Poor, and has been since 2011. The chemical status of Loch Awe is Good (since 2014). The hydromorphology of Loch Awe is also classed as Poor, with the overall hydrology of the water body being classed as Poor (Ref 11.41).

Table 11.11 Loch Awe WFD quality (Ref 11.41)

River Basin Management Plan (RBMP) Parameter	Loch Awe (2022) (Cycle 3)
Overall status	Moderate ecological potential
Pre-HMWB status	Poor
Overall ecology	Poor
Physico-Chem	Good
Dissolved Oxygen	High
Total Phosphorus	Good
Salinity	High
Acid Neutralising Capacity	High
Biological elements	Moderate
Alien species	Good
Fish	Good
Fish ecology	Good
Fish barrier	High
Aquatic plants	Moderate
Phytoplankton	High

River Basin Management Plan (RBMP) Parameter	Loch Awe (2022) (Cycle 3)
Other aquatic plants	Moderate
Macrophytes	Moderate
Specific pollutants	Pass
Ammonium	Pass
Hydromorphology	Poor
Morphology	Moderate
Overall hydrology	Poor
Water quality	Moderate

There are two existing hydro-electric power (HEP) developments operating on Loch Awe. SSE operate the 30.5-megawatt (MW) Inverawe Power Station, which abstracts water from the River Awe Barrage. The other development is the Cruachan Power Station, a 440 MW pumped storage scheme operated by Drax and located at the centre of the east and west arms of the northern basin. In 2023 a Section 36 of the Electricity Act 1989 application was granted for a second power station at Loch Awe ('Cruachan Expansion') which would add a further 600 MW generating capacity.

A review of online aerial photography has identified a fish farm approximately 10 km southwest of the proposed abstraction and discharge point of the Development into Loch Awe just south of Balliemeanoch. This fish farm is Braevallich Fish Farm, operated by MOWI. Elevated phosphorus levels from freshwater fish farming have been identified by SEPA as a pressure on this water body, although measures have been put in place to resolve this by 2024.

Loch Awe is also an important water body for tourism and recreation, including scenic views and heritage. Boats, kayaks and canoes can be hired, and although it is not a designated bathing water, it is known to be popular for wild swimming. Migrating salmon also pass through the Loch, and it is an important location for trout fishing with the season running from the 15th of March to the 6th of October each year (Ref 11.47).

11.6.4.3 Water Features in the Loch Awe Catchment

Within the Loch Awe Catchment, the majority of water features drain directly into Loch Awe. However, there are two sub-catchments; Allt Beochlich (LA7) and Cladich River (LA17) which also capture a number of watercourses and lochans. Loch Breac-liath (LA1), Lochan Airigh (LA7), Beochlich Lochan (LA8), Lochan Dubh (LA9) and Lochan Romach (LA10) all drain into Allt Beochlich (LA7) then towards Loch Awe. Keppochan River (LA3) and Archan River and tributaries (LA4) both flows towards the Cladich River (LA17).

From the site walkover on the 9th and 10th of August 2023, it was observed that Allt Beochlich has a predominantly steep, stable bedrock typology, with a series of waterfalls and numerous smaller steps and pools. In lower gradient reaches, coarse sediment depositional features were noted, which were comprised of gravel and cobbles (Photo 11-1). Historic maps indicate that the watercourse has remained very stable over time, with only minor changes to planform notable (Ref 11.46). Sediment transport is disrupted by the presence of the Allt Beochlich hydro scheme, including a storage reservoir, which has been operational since 1998 (Ref 11.45).

Smaller watercourses have similar geomorphological characteristics to the Allt Beochlich, with generally steep gradients, bedrock or step pool typology with some coarse sediment deposits including gravel and sand sized material.

Two water samples were collected (at NN 02518 15125 and NN 04199 16152) during the Development Site walkover and sampling. Both appeared to have clear water with a slight brown tinge reflective of the humic acids leached from peat rich soils, with no odour. More details of the site walkover can be found in *Appendix 11.1 Water Quality Monitoring and Site Walkover*.

The current flows and velocity of Allt Beochlich and surrounding water features is unknown. However, it is likely that flows are similar to Abhainn a'Bhealaich at Braevallich, which has Q95 flows of around 0.09m^3/s (see *Chapter 13 Water Resources* for more details). The catchment at Abhainn a'Bhealaich is similar to other ungauged catchments in the area, including Allt Beochlich.

Photo 11-1 Images of Allt Beochlich (LA6) at NGR NN 03806 15879 facing southeast (left) and NGR NN 04124 16081 facing northeast on the 9th and 10th of August.

Allt Beochlich also has a number of lochans, and tributaries associated with them which are included in *Table 11.9*. *Table 11.13* displays a list of the water features found within the Loch Awe Catchment alongside their national grid reference (NGR), a description summary, location to the Development and whether they have been scoped in or out for further assessment.

This includes Lochan Airigh (LA7) and Beochlich Lochan (LA8), which can be viewed on Photo 11-2 and Photo 11-3. Lochan Airigh is a small lochan with an area of approximately 24,000 m^2. From the site visit on the 9th and 10th of August 2023, the Lochan was observed to have gravel, sand and cobbles on the base on the Lochan with clear water and with no submerged/floating macrophytes and just small amount of emergency plants in the littoral zone. From Lochan Airigh there is a small watercourse which exits the Lochan at NGR NN 04241 16359 and flows into Allt Beochlich at NGR NN 04202 16148.

Beochlich Lochan is an artificial/heavily modified lochan and located online with Allt Beochlich. The timeframe of its creation was unavailable on satellite imagery and on historic maps. It was observed from the Development Site walkover to have a silty base with clear water and with no submerged/floating macrophytes and just small amount of emergency plants in the littoral zone. It has an area of approximately 30,000 m^2 and on the western side is dammed with a small hydro scheme. During the time of the site walkover on the 9th and 10th of August 2023 the Lochan appeared to be drawn down. More details on the Development Site walkover can be viewed in *Appendix 11.1 Water Quality Monitoring and Site Walkover.*

Photo 11-2: Beochlich Lochan (LA8) at NGR NN 02900 15396 facing east on the 9th of August

Photo 11-3: Lochan Airigh (LA7) at NGR NN 04250 16351 facing north on the 9th of August

There are three WFD classified watercourses found within in the Loch Awe catchment, these include Allt Beochlich (ID: 10275), Allt Blarghour (ID: 10274) and Cladich River (ID: 10281) (LA6, LA16 and LA17 on *Figure 11.1 Surface Water and Groundwater Receptors and Attributes – Wider Context (Volume 3 Figures)).* Allt Blarghour is approximately 8.5 km in length, Allt Beochlich is 7.7 km long and Cladich River is 13.1 km long. Cladich River has also been classified as a heavily modified water body due to a water storage hydropower scheme.

Table 11.12 Loch Awe Catchment Rivers WFD Quality (Ref 11.41)

River Basin Management Plan (RBMP) Parameter	Allt Blarghour (2022) Cycle 3	Allt Beochlich (2022) Cycle 3	Cladich River/Allt an Stacain (2022) Cycle 3
Overall status	Moderate	Moderate	Moderate
Pre-HMWB status	Moderate	Moderate	Moderate
Overall ecology	Moderate	Moderate	Moderate
Physico-Chem	Good	Good	n/a
Temperature	High	High	n/a
Reactive phosphorus	High	High	n/a
Dissolved Oxygen	High	High	n/a
Acidity	Good	Good	n/a
pH	Good	Good	n/a
Biological elements	Good	Good	High
Invertebrate animals	Good	Good	n/a
Macroinvertebrates (RiCT/WHPT)	Good	Good	n/a
Macroinvertebrates (ASPT)	Good	Good	n/a
Macroinvertebrates (NTAXA)	High	High	n/a
Fish	High	High	High
Fish barrier	High	High	High
Hydromorphology	Moderate	Moderate	Moderate
Morphology	High	High	High
Overall hydrology	Moderate	Moderate	Moderate
Modelled hydrology	Poor	Poor	Bad
Hydrology (medium/high flows)	Poor	Poor	Bad
Hydrology (low flows)	High	High	Bad
Ecological indicators	n/a	Pass	Pass
Water quality	Good	Good	n/a

Table 11.13 displays a list of the water features found within the Loch Awe Catchment alongside their national grid reference (NGR), a description summary, proximity to the Development and whether they have been scoped in or out for further assessment. All water features listed below will be assessed, including scoped out features, during pre-construction surveys to identify any other flow pathways not identified below. All features will be mitigated against all temporary construction impacts through the implementation of CEMP and the oWMP *(Appendix 11.5 (Volume 5: Appendices)).*

Table 11.13 Surface Water Bodies Within the Loch Awe Catchment (Ref 11.41)

Loch Awe Catchment	ID as labelled in Figure 11.1, 11.2a and 11.3a	NGR	Description Summary	Direction and Distance to the Development	Scoped in/out and justification
Loch Awe	N/A	NN 00437 16188	A loch water body within the River Awe with an area of 38 km^2. Important for migratory Atlantic salmon, brown trout and other fish species.	All water features within the Main Area drain into Loch Awe. There is a Tailpond inlet / outlet where water will be abstracted and discharged.	**Scoped In** Proximity to works
Loch Breac-liath	LA1	NN 03446 16419	Small lochan approximately 16,000 m^2. Small watercourse drains from LA1 to LA11 in a southwestern direction. This lochan is a part of the Allt Beochlich (LA6) catchment area.	200 m upgradient of proposed Embankment and 270 m, 300 m and 400 m downgradient of PC17, PC18 and PC19.	Scoped Out No identified flow paths
Allt na Cuile Riabhaiche and tributaries	LA2	NN 06346 19768	Watercourse to the northeast of the Headpond with approximately six tributaries. Drains into Loch Awe and is sourced from approximately NN 04467 17403.	Tributaries cross the Upper Sonachan / Keppochan Forest track that will be used for access.	**Scoped In** Permanent works to existing or new Access Track and any temporary pollution risks associated with that.
Keppochan River and tributaries	LA3	NN 07270 19990	Watercourse to the northeast of the Headpond flowing into the Archan River (LA4) at NN 08243 20949. Sourced from approximately NN 06805 18264.	Crosses the Upper Sonachan / Keppochan Forest track that may be used for access.	**Scoped In** Permanent works to existing or new Access Track and any temporary pollution risks associated with that.
Archan River and tributaries	LA4	NN 08466 20254	Sourced from NN 07567 19267 and drains into the Cladich River which then flows into Loch Awe.	Crosses the Upper Sonachan / Keppochan Forest track that may be used for access	**Scoped In** Permanent works to existing or new Access Track and any temporary pollution risks associated with that.
Allt a Chrosaid and small upstream (unnamed) lochan	LA5	NN 02937 16523	Sourced from a small lochan at NN 03543 16978 and drains into Loch Awe.	PC21 is situated 29.1 m south of LA5. Upgrade to the existing B840 crossing	**Scoped In** Permanent works to existing or new Access Track, permanent compound within 50m of feature. Temporary pollution risks associated with works.
Allt Beochlich and tributaries	LA6	NN 03502 15714	LA6 flows from Lochan Dubh (LA10) and into Beochlich Lochan	Situated within the Red Line Boundary, tributaries cross the	**Scoped In** Permanent change to catchment and

Loch Awe Catchment	ID as labelled in Figure 11.1, 11.2a and 11.3a	NGR	Description Summary	Direction and Distance to the Development	Scoped in/out and justification
			(LA8) with approximately 11 tributaries flowing into LA6 including the tributary sourced from LA8. From Beochlich Lochan (LA8), the watercourse flows into Loch Awe.	proposed Access Track and temporary works area. LA6 and tributaries are within the proposed Headpond, and Embankment locations thus will be lost to the Development. Compensation flow will be provided downstream of Headpond.	temporary pollutions risks associated
Lochan Airigh	LA7	NN 04278 16440	LA7 is a small lochan with 23,700 m² area. On the site visit it was observed to have gravel and cobbles on the base on the lochan and to have clear water.	Situated within the location of the proposed Headpond, thus will be lost to the Development	**Scoped In** Permanent removal of lochan. Temporary pollutions risks associated
Beochlich Lochan	LA8	NN 03030 15414	LA6 drains into LA8 at NN 03136 15420 and is dammed on the western end at NN 02926 15391 where a small hydropower scheme is situated.	TC07 will be located 33.2 m upgradient of LA8. PC09 is situated upstream of lochan. Construction of the Headpond and associated activities are within the catchment.	**Scoped In** Permanent works to existing or new Access Track. Temporary pollution risks associated with works.
Lochan Dubh	LA9	NN 06699 16031	Situated north of the Headpond area, LA6 is sourced from the lochan (LA9). It has an area of approximately 70,000 m².	Situated 1300 m upstream of Headpond area	Scoped Out More than 1000 m upstream from proposed works.
Lochan Romach	LA10	NN 02811 15735	Small lochan with an area of 23,800 m²	PC20 and Access Track crossing situated 100 m upstream of LA10.	**Scoped In** Permanent works to new Access Track. Temporary pollution risks associated with works.
Allt na Dail Ferna	LA11	NN 04325 17712	Sourced from NN 04274 17563 and drains into Loch Awe. There are approximately five tributaries.	200 m downgradient of PC13	Scoped Out No Flow Paths identified
Allt na Fainge	LA12	NN 01216 16501	Drains into Loch Awe and is the convergence of two unnamed watercourses which are sourced from NN 02669 16737 and NN 01721 16753 respectively.	Upgrade to the existing B840 crossing	**Scoped In** Permanent works to existing or new Access Track. Temporary pollution risks associated with works.
Allt a' Ghreataidh	LA13	NN 01200 16313	Drains to Loch Awe and is sourced from NN 01721 16753	Upgrade to the existing B840 crossing	**Scoped In** Permanent works to existing or new Access Track.

Loch Awe Catchment	ID as labelled in Figure 11.1, 11.2a and 11.3a	NGR	Description Summary	Direction and Distance to the Development	Scoped in/out and justification
					Temporary pollution risks associated with works.
Alt Mor	LA14	NN 01160 16630	Drains to Loch Awe and is sourced from an unnamed loch at NN 03598 17435 (LA16).	Upgrade to the existing B840 crossing	**Scoped In** Permanent works to existing or new Access Track. Temporary pollution risks associated with works.
Unnamed Lochs	LA15	NN 03507 17306	Three unnamed lochs, one having the largest area of 18,000 m^2	LA15 270 m downgradient of PC19	Scoped Out No identified flow paths
Allt Blarghour	LA16	NN 02500 13006	Approximately 8.5 km in length and is sourced from the south of Cruach Mhor and flows into Loch Awe near Blarghour.	The proposed Blarghour Wind Farm extension access route, which may be used for the Development	Scoped Out Blarghour Wind Farm extension not considered in this assessment
Cladich River/Allt an Stacain	LA17	NN 09638 22424	Heavily modified river sourced from Lochan Sron Mor and flows into Loch Awe.	600 m downstream of Sonachan / Keppochan Forest track that may be used for access. But may be affected by any impacts to LA3 and LA4 as they are hydraulically linked.	**Scoped In** By indirect water quality and temporary risks from LA3 and LA4
Unnamed Water course	LA18	NN 01125 15692	Small stream sourced from approximately NN 01190 15648 and flows into Loch Awe at NN 00726 15673	Upgrade to the existing B840 crossing	**Scoped In** Permanent works to existing or new Access Track. Temporary pollution risks associated with works.

11.6.4.4 Loch Fyne Catchment

Within the study area and the Loch Awe catchment there are the following water features (with project specific reference in brackets). See *Figure 11.1 Surface Water and Groundwater Receptors and Attributes – Wider Context (Volume 3: Figures).*

Table 11.14 Summary of Catchments within Loch Fyne

Sub Catchment	Water Features
Loch Fyne	Crom Allt and tributaries (LF2)
River Aray and tributaries (LF1)	Allt Riabhachan (LF3)
	Allt Bail' a' Ghobhainn (LF4)
	Erallich Water (LF5)
	Allt Phàruig (LF6)

The above water features and their attributes are described in more detail in the following sections.

11.6.4.5 Loch Fyne

Loch Fyne is a sea loch off the Firth of Clyde and forms part of the coast of the Cowal Peninsula. Loch Fyne is both the longest and the deepest of Scotland's sea lochs, with a length of approximately 70 km and a maximum depth of around 185 m (Ref 11.15). Water depths are in excess of 130 m off Inveraray in the upper loch, becoming shallower (i.e. < 50 m) in the lower loch, before deepening again as the Loch widens south of Castleton (Ref 11.48). *Chapter 8 Marine Ecology* and *Chapter 18 Marine Physical Environment and Coastal Processes (Volume 2)* provide more details on marine ecology and physical processes in Loch Fyne, with these topics only summarised in this section where they are relevant to the water quality assessment.

From the site walk walkover conducted on the 9th and 10th of August 2023 and a review of online Ordnance Survey maps and aerial imagery (Ref 11.15), the main water features located within the study area and the Loch Fyne catchment have been identified in *Table 11.17*.

Loch Fyne is a WFD designated water body with a Good Overall status (2022) Cycle 3 (*Table 11.15*). The upper Loch Fyne is a marine protected area which is designated for the protection of flame shell beds (*Limaria hians*), horse mussel (*Modiolus modiolus*), and ocean quahog (*Arctica islandica*). It is also a designated shellfish water and supports migratory fish like salmon and sea trout. The Loch also has marine mammals such as bottlenose dolphins and harbour seals which sometimes temporarily visit (See *Chapter 8 Marine Ecology* for more details).

Table 11.15 Loch Fyne WFD Classification (Ref 11.41)

River Basin Management Plan (RBMP) Parameter	Loch Fyne (2022) Cycle 3
Overall status	Good
Pre-HMWB status	Good
Overall ecology	Good
Physico-Chem	High
Dissolved Oxygen	High
Dissolved inorganic nitrogen	High
Biological elements	Good
Invertebrate animals	Good
Benthic invertebrates (IQI)	Good
Alien species	Good
Macroalgae	Good
Macroalgae (FSL)	Good
Macroalgae (RSL)	Good
Phytoplankton	High
Specific pollutants	Pass
Unionised ammonia	Pass
Hydromorphology	High
Morphology	High
Water quality	Good

11.6.4.6 Water Features in the Loch Fyne Catchment

The majority of watercourses within the Loch Fyne catchment drain into River Aray (*Photo 11-4*), this includes Erallich Water, Allt Riabhachan, Allt Bail' a' Ghobhainn and Allt Phàruig. The River Aray is approximately 13.4 km in length and is sourced NGR NN 08442 19859 and drains into Loch Fyne. From the Development Site surveys conducted in August 2023 it was noted that River Aray is a relatively wide river (approximately 20 m wide). The river appears to have been historically modified through straightening, embanking and the construction of several weirs which remain in place in the present day. Coarse sediment deposition was noted downstream of the minor road crossing adjacent to Garden Cottage. Depositional features are dominated by gravel and cobble sized material. Upstream of the bridge, this reach of the river is straight, wide and with a uniform bed profile. Downstream of the bridge, the river has a more natural form. There is no gauge situated on the River Aray, therefore no reliable Q95 data. Using gauges in the surrounding area with rivers with similar catchments, the river is assumed to a Q95 value of around 0.2 to 0.4 m^3/s.

The Erallich Water (*Photo 11-5*) has a steep, stable, bedrock typology, with numerous stable boulders. According to OS maps (Ref 11.15), Erallich Water has around 12 tributaries including Allt nan Ord, Allt an t-Sluichd and Allt Criche. OS Maps also note a number of waterfalls on some of the upstream tributaries (Ref 11.15).

Allt Riabhachan, Allt Bail' a' Ghobhainn and Allt Phàruig are smaller watercourses. Allt Riabhachan includes a number of lochans upstream such as at NGR NN 07082 09158, NN 07696 08713 and NN 06151 08142.

Crom Allt and tributaries (LF2) is a series of small drains and watercourses situated to the west of Inveraray and which flow directly into Loch Fyne.

Photo 11-4: A left and B right: Images of River Aray taken on the 9th of August 2023 at NGR NN 09165 09859. A looks upstream and B looks downstream towards the minor road bridge.

Photo 11-5: Image of Erallich Water at NGR NN 07790 11867 27th of September 2023 taken during an aquatic ecology survey looking downstream.

The River Aray (ID: 10224) (LF1) (*Photo 11-4*) and Erallich Water (ID: 10225) (LF5) have been classified as having an overall Moderate Ecological Status (2022). *Table 11.16* provide details of the latest WFD classification (2022) for these water bodies (Ref 11.41).

Table 11.16 Loch Fyne Catchment WFD Quality (Ref 11.41)

River Basin Management Plan (RBMP) Parameter	River Aray (2022) Cycle 3	Erallich Water (2022) Cycle 3
Overall status	Moderate	Moderate
Pre-HMWB status	Moderate	Moderate
Overall ecology	Moderate	Moderate
Physico-Chem	Good	Moderate
Temperature	High	n/a
Reactive phosphorus	High	n/a
Dissolved Oxygen	High	n/a
Acidity	Good	n/a
pH	Good	n/a
Biological elements	Moderate	n/a
Invertebrate animals	High	n/a
Macroinvertebrates (RiCT/WHPT)	High	n/a
Macroinvertebrates (ASPT)	High	n/a

River Basin Management Plan (RBMP) Parameter	River Aray (2022) Cycle 3	Erallich Water (2022) Cycle 3
Macroinvertebrates (NTAXA)	High	n/a
Fish	Moderate	Moderate
Fish ecology	Moderate	Moderate
Fish barrier	High	High
Hydromorphology	Good	High
Morphology	Good	High
Overall hydrology	Good	High
Modelled hydrology	Good	High
Hydrology (medium/high flows)	High	High
Hydrology (low flows)	Good	High
Water quality	Good	n/a

Table 11.17 displays a list of the water features found within the Loch Awe Catchment alongside their national grid reference (NGR), a descriptive summary, proximity to the Development and whether they have been scoped in or out for further assessment. All water features listed below will be assessed, including scoped out features, during pre-construction surveys to identify any other flow pathways not identified below. All features will be mitigated against all temporary construction impacts through the implementation of CEMP and the oWMP *(Appendix 11.5 (Volume 5: Appendices)).*

Table 11.17 Surface Water Bodies Within the Loch Fyne Catchment

Loch Fyne Catchment	ID	NGR	Description Summary	Direction and Distance to the Development	Scoped in/out
Loch Fyne	N/A	NN 09845 07941	Sea loch off the Firth of Clyde, forming part of the coast of the Cowal Peninsula. Loch Fyne is both the longest and the deepest of Scotland's sea lochs, with a length of approximately 70 km and a maximum depth of around 185 m.	Jetty to be for the delivery of materials and equipment located within Loch Fyne	**Scoped In** This chapter considered water quality impacts. Physical impacts are assessed within *Chapter 8: Marine Ecology* and *Chapter 18: Marine Physical Environment and Coastal Processes* (Volume 2)
River Aray and tributaries	LF1	NN 09003 10169	Approximately 13.4 km in length, sourced north of Loch Fyne around NN 08442 19859. It drains into Loch Fyne at NN 09809 09049. LF1 has approximately 13 tributaries which drain into it.	Proposed road upgrades cross the River Aray at NN 09165 09855.	**Scoped In** Permanent works to existing Access Track. Temporary pollution risks associated with works.
Crom Allt and tributaries	LF2	NN 08592 07409	A small drain sourced from NN 07391 07522 with around five ditches/watercourses flowing into it.	Temporary works and proposed Access Tracks cross part of Crom Allt at NN 08415 07691	**Scoped In** Permanent works to existing or new Access Track. Temporary pollution risks associated with works. Within the vicinity of jetty works.
Allt Riabhachan	LF3	NN 08433 09902	A tributary to River Aray, forms at the convergence of two watercourses. One is sourced from a lochan at NN 05600 07946 and passes through two other lochan at NN 06082 08126 and NN 07670 08698. The other is sourced at NN 06377 09325 and passes through one lochan at NN 07065 09119.	Application Boundary is situated 275 m downstream of the receptor.	Scoped Out Due to distance between the works and the receptor and no known flow pathways.
Allt Bail' a' Ghobhainn	LF4	NN 08308 10695	A tributary to River Aray and is sourced at NN 05424 09119.	Application Boundary is 650 m downstream (south) and 1100 m north (upgradient).	Scoped Out Due to distance between the works and the receptor and no known flow pathways.

Loch Fyne Catchment	ID	NGR	Description Summary	Direction and Distance to the Development	Scoped in/out
Erallich Water	LF5	NN 08926 12373	Rises from around NN 03063 10620 and drains in River Aray at NN 08926 12373. LF5 is approximately 8.4m in length and has multiple tributaries flowing into it.	Situated within red line boundary and approximately 150 m south (downstream) of the Blarghour Wind Farm Access route. However, has a number of tributaries which cross the access route.	Scoped Out The Blarghour Wind Farm Access not considered in this assessment. This route will only be used for the Development if the Blarghour Wind Farm extension is consented.
Allt Phàruig	LF6	NN 09101 12612	A tributary to River Aray and is sourced at NN 10749 12759.	Situated 230 m east of the Application Boundary and proposed Blarghour Wind Farm Extension Access track.	Scoped Out All construction activity is situated to the west of the River Aray, while the Allt Phàruig is situated to the east so no known pathways.

11.6.4.7 Surface Water Quality

Appendix 11.1 displays the observational and laboratory results from the Development Site walkover conducted on the 9th and 10th of August 2023. Four water samples were collected from Beochlich Lochan, Loch Airigh and Allt Beochlich (upstream and downstream of Beochlich Lochan). In summary, the following points can be made:

- While on the Development Site, all samples were clear or clear with a slight brown tinge (reflecting humic acids leached from peat rich catchments) with no odour or evidence of pollution.
- Samples were compared to their corresponding Environmental Quality Standard (EQS) (Ref 11.42). All samples which had a EQS were below the level or were at their limit of detection.
- Each of the locations have a similar overall chemistry with a neutral pH and a relatively low electrical conductivity.
- Beochlich Lochan, Lochan Airigh and Allt Beochlich (downstream of Beochlich Lochan) all had a low turbidity ranging from <1.0 NTU to 1.2 NTU. While the sample collected from Allt Beochlich upstream of Beochlich Lochan was slightly higher at 4.8 NTU. Both river samples were recorded at <2 mg/l for Total Suspended Solids (TSS) while the loch samples had a slightly higher TSS measured as 3 mg/l, although in all cases this is very low.
- Biochemical Oxygen Demand (BOD) at the sampling locations was low between <1.0 mg/l to 1.2mg/l reflecting natural, unperturbed conditions.
- Dissolved Organic Carbon (DOC) ranged from 9 mg/l to 11 mg/l.
- Nitrate as NO3 at the sampling locations ranged between 0.71 mg/l to 0.76 mg/l, which is very low.
- Ammoniacal Nitrogen at the loch samples were measured as 22 µg/l, which is higher than at Allt Beochlich which was measured at 15 µg/l, although both are relatively low.
- All semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), Petroleum Hydrocarbons, Monoaromatics and Oxygenates were below their limit of detection.
- The majority of heavy metals arsenic, chromium, cadmium, lead, mercury and nickel are below their limit of detection.

Although a single water sample from each sampling location only provides a 'snapshot' of water quality at the time it was taken, including the flow conditions, and the suite of analysis was for key parameters only, as a whole the data suggest the quality of water in water features in the study area is generally very good and unpolluted, as would be expected in a rural, upland area such as this.

SEPA has three non-routine water quality monitoring points located close on Cladich River, and the western and eastern tributaries to Cladich River. These samples were collected in 2017 and show the water chemistry to be similar to the samples collected in August 2023 for nearby water features. The results are summarised in *Table 11.18* and these locations can be viewed in *Figure 11.1 Surface Water and Groundwater Receptors and Attributes – Wider Context (Volume 3 Figures)*. Concentrations of chloride were slightly higher and there were higher values recorded for BOD, nitrate, total phosphorous, ammoniacal nitrogen and Total Dissolved Solids (TDS) than in the limited data collected for this baseline, suggesting that this watercourse may be more affected by discharges of treated sewerage or diffuse agricultural pollutants in surface water runoff.

Table 11.18 SEPA Monitoring Locations on Cladich River and Tributaries

Description	Unit	SEPA.1 Western Tributary of Cladich River NN 09140 20701	SEPA.2 Eastern Tributary of Cladich River NN 09221 20711	SEPA.3 Cladich River Impoundment NN 09457 20944
Nitrite (as N)	mg/L	<0.007	<0.007	<0.007
Reactive Phosphorus (as P)	mg/L	<0.008	<0.024	<0.008
Ammoniacal Nitrogen (as N)	mg/L	<0.024	<0.148	<0.024
Total Phosphorus (as P)	mg/L	0.027	<0.148	0.0795
Nitrate (as N)	mg/L	<0.148	0.166	<0.148
Total Oxidised Nitrogen (as N)	mg/L	<0.148	0.351	<0.148
Biochemical Oxygen Demand - ATU suppressed	ATU	<2.8	5.48	6.54
Suspended Solids (105°C)	mg/L	3.2	14	6.9
Cadmium (filtered using 0.45µm membrane)	mg/L	6.28	19.4	7.6
Lead (filtered using 0.45µm membrane)	pH units	6.6	26	9.28
Chloride	mg/L	10.6	86	49.3
Chemical Oxygen Demand	mg/L	42.4	110	73
Electrical conductivity (at 20°C)	µS/cm	51.7	260	106

11.6.5 Environmental Impact Events

SEPA supplied information related to environmental impact events that occurred in Loch Awe and Loch Fyne in the past five years and details are provided in *Table 11.19*.

Table 11.19 Environmental Events

Event	Loch	Date	Description	Impact	Cause
ENV/0892170	Loch Awe	27/05/2018	Blue Green Algae	Category 3 - Minor	Naturally Occurring
ENV/0886903	Loch Awe	05/07/2017	Portsonachan Hotel sedimentation of water supply	Category 4 - other	Operational Failure
ENV/0886182	Loch Awe	29/05/2017	Blue Green Algae	Category 4 - other	Naturally Occurring
ENV/0889988	Loch Fyne	05/02/2018	Oil from Semples Inveraray overflowing into surface drain and into Loch Fyne	Category 4 - other	Other
ENV/0892935	Loch Fyne	26/06/2018	Brown effluent Leaching into ground causing algal bloom in ditch near Inveraray	Category 4 - other	Duty of Care

Data sources provided by SEPA also note that blue-green algal blooms have been an annual problem within Loch Awe. These are listed in *Table 11.20*, however, were not included in the list of environmental events provided by SEPA. This may be because they are observations from members of the public and so may not be classified as 'events'.

Table 11.20 Blue-Green Algae Records

Date	Blue green recorded location
29th May 2021	Loch Awe

19th July 2021	Loch Awe
22nd July 2021	Loch Awe
25th July 2021	Loch Awe, Dalavich
15th October 2021	Loch Awe
30th May 2022	Loch Awe
23rd July 2022	Loch Awe
23rd June 2022	Loch Awe
28th August 2022	Loch Awe
29th September 2022	Loch Awe, Dalavich
29th November 2022	Lochaweside Cabins
12th June 2023	Loch Awe, Dalavich

11.6.6 Private Water Supplies (PWS)

Argyll and Bute Council supplied PWS data within the Site and surrounding area. The locations of these can be viewed on *Figure 11.1 Surface Water and Groundwater Receptors and Attributes – Wider Context (Volume 3 Figures)*, and full details and assessment of each of the PWS is presented in *Appendix 11.3 Private Water Supplies (Volume 5: Appendices).*

From the PWS assessment found in *Appendix 11.3 (Volume 5),* all PWS can be scoped out of further assessment. This is because they are either distant from the nearest works, situated along the Blarghour Wind Farm Access Track, which is not considered in this assessment as it is assumed to be constructed, or have no pathways present as identified in the PWS assessment in *Appendix 11.3 (Volume 5).*

11.6.7 Other Abstractions

There are a number of CAR abstraction licences situated within the 1 km Study Area (noting that Cruachan power station (CAR/L/1012107) is outside of this distance). They are summarised in *Table 11.21* and can be viewed in *Figure 11.2a Surface Water and Groundwater Receptors and Attributes – Headpond Study Area (Volume 3 Figures)* (note unique reference number in *Table 11.21*).

Table 11.21 SEPA CAR Abstraction Licences

Ref. (see Figure 11.2a)	Authorisation Number	Site	Authorisation Status Date	Site NGR
C1	CAR/L/1010507	Beochlich Hydro, Balliemeanoch, Dalmally, PA33 1BW	April 1, 2006	NN 01183 16536
C2	CAR/L/1115819	Allt Mor Hydro, Balliemeanoch	December 23, 2013	NN 01260 16820
C3	CAR/L/1115821	Allt a'Chrosaid Hydro, Balliemeanoch	December 23, 2013	NN 01190 16110

11.6.8 Aquatic Ecology and Protected Species

Information provided by SEPA indicates that there are several species present in the study area. *Table 11.22* shows that Atlantic salmon and brown trout were found in both River Aray (LF1) and Erallich Water (LF5).

A number of species including Atlantic salmon, brown trout, lampetra and arctic char were found within Loch Awe. Although brown trout, lampetra and arctic char are not considered protected species, they are included in Scotland's Biodiversity List and so therefore should be consideration when assessing the importance of features.

The non-native rainbow trout *Oncorhynchus mykiss* was also identified, although it is assumed specimens are escaped stocked fish or farmed fish, as there are no self-sustaining populations within Scotland.

Table 11.22 Fish Species (SEPA data) (Protected Species in Red[1])

Water feature	Survey	Species Found
Loch Awe	N/a	Stone loach, northern pike, three-spined stickleback, lampetra, rainbow trout, European perch, common minnow, common roach, Atlantic salmon, Brown trout and arctic char.
River Aray (LF1)	August 2018	Atlantic Salmon and brown trout
Erallich Water (LF5) (Scoped out of further assessment)	August and September 2018	

No protected macrophyte species were identified in the desk study. Species previously listed under the International Union for Conservation of Nature (IUCN) Red List are now all listed as Least Concern.

A number of invertebrates have been identified in Allt Beochlich and River Cladich, see *Table 11.23*. No macroinvertebrate species with national or local designation were identified within the study area.

Table 11.23 Invertebrates Species (SEPA data)

Water Feature/Course	Survey	Species Found
Allt Beochlich (LA7)	October 2014	Ecdyonurus, Heptageniidae, Rhithrogena semicolorata, Baetis rhodani, Paraleptophlebia submarginata, Dicranota, Leptophlebiidae, Chironomidae, Simuliidae, Oligochaeta, Polycentropus flavomaculatus, Chloroperla tripunctata, Protonemura meyeri, Leuctra, Hydraena gracilis
River Cladich (LA17)	June 2014	Serratella ignita, Hydropsyche siltalai, Riolus, Hydraena gracilis, Hydropsyche pellucidula, Baetis rhodani, Scirtidae, Simuliidae, Alainites muticus, Baetis scambus, Chironomidae, Empididae, Oligochaeta, Veliidae, Leptophlebiidae, Diura bicaudate, Paraleptophlebia, Ecdyonurus, Electrogena lateralis, Leuctra fusca, Leuctra, Isoperla grammatica, Lepidostoma hirtum, Rhyacophila dorsalis, Caenis rivulorum, Hydroptila, Elmis aenea, Oulimnius, Limnius volckmari, Hydroptilidae, Sericostoma personatum, Polycentropus flavomaculatus, Rhyacophila dorsalis, Caenis rivulorum, Lepidostoma hirtum, Mystacides, Ecdyonurus, Baetis rhodani, Simuliidae, Paraleptophlebia submarginata, Oligochaeta, Limnius volckmari, Chironomidae, Scirtidae, Gammarus pulex, Oulimnius tuberculatus, Lymnaea peregra, Protonemura praecox, Hydraena gracilis, Perlodes microcephala, Isoperla grammatica, Leuctra hippopus, Chloroperla tripunctata, Hydropsyche pellucidula, Hydropsyche siltalai

AECOM conducted a number of aquatic ecology surveys including Freshwater Pearl Mussel survey, eDNA surveys, macrophyte surveys, macroinvertebrate surveys, fish and fish habitat surveys. Further details can be found within *Chapter 7: Aquatic Ecology* (*Volume 2: Main Report*) and *Appendix 7.1 (Volume 5: Appendices).* From the results the following can be concluded:

- No optimal riverbed Freshwater Pearl Mussel habitat (boulder-stabilised deposits of clean sand) was observed at any of the surveyed sites;
- No rare or notable macrophyte species were recorded within any of the watercourses. The macrophyte communities encountered are considered to be of no greater than local nature conservation value;
- No rare or notable macrophyte species were recorded within either of the survey sites on Loch Awe, Lochan Airigh (LA7) or Lochan Breac-Laith (LA1);
- The majority of survey sites were classified as having Moderate conservation values for macroinvertabrates, while three sites (Erallich Water, Allt Beochlich and tributary of River Aray) received relatively high conservation values. The sites of Loch Awe received a Low conservation value at NGR NN 00683 15657, at the site of the inlet, and very high conservation value at NGR NN 07693 26840, near the confluence of Loch Awe and River Awe;
- Due to the high gradient, steep banks and the number of impassable barriers for migration throughout the catchment, migratory species including salmon, sea trout, sea lamprey and river lamprey are considered unlikely to be present and utilising the flowing water features for spawning throughout the west of the Site. Watercourses throughout the study area did contain brown trout. Atlantic salmon were also found in one watercourse Allt Criche, a tributary of Erallich Water (LF5); and
- There were two eDNA sampling locations for 2021 and 2023 for Loch Awe. Species found during these surveys included: european eel, carp, chub, stone loach, northern pike, minnow, roach, perch, rainbow

[1] Listed in Annex II of the Habitats Directive and in the Conservation (Natural Habitats, &c.) Regulations 1994 (Ref 11.49)

trout, Atlantic salmon and brown trout. Non-native rainbow trout is likely present due to the proximity of the sampling site to the fish farm, from which numerous escapes have been documented in the past.

11.6.9 Other Designations

The entire study area (excluding Loch Fyne) is within the Oban and Kintyre Groundwater Drinking Water Protected Area. These have been defined by the SEPA in line with the requirements of the Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013 to fulfil the requirements of the WFD. These are areas where land use is causing pollution of the raw water and action is being undertaken to reduce this risk to reduce the need for extra treatment of raw water.

There are no other designations (SSSI, SPA, Ramsar, SAC) within the study area.

11.6.10 Importance of Water Features

Table 11.24 shows the importance of the water features assessed from the above baseline information.

Table 11.24 Water Feature Receptor and their Importance

Water Feature	Water Quality Importance	Hydromorphology Importance
Loch Awe	**High Importance -** Classified as having a moderate WFD status. The Loch is a large water feature with relevance at the national scale. It has migratory fish passing through it, such as brown trout, arctic char and Atlantic salmon, which are either protected species or are on Scotland Biodiversity List, plus European eel was detected in eDNA sampling. However, the loch itself is not designated as a national or international nature conservation site. It is also not a designated bathing water, but is known to be popular for wild swimming and other recreational activities including water sports/fishing. There are also two other hydro developments drawing water from it or using it as a Tailpond, and a commercial fishery operated by MOWI in the southern basin. On balance, Loch Awe is considered to be of high importance for water quality.	**Medium Importance -** The Loch has a WFD classification of Moderate for morphology and is classified as a Heavily Modified Water body.
Loch Fyne	**High Importance -** Loch Fyne is both the longest and the deepest of Scotland's sea lochs. It is a marine protected area hosting species such as horse mussel, flame shell, and ocean quahog.	n/a
Bedrock Aquifer - Oban and Kintyre groundwater body	**Low Importance -** Essentially unproductive, with some minor fracture flow at shallow depths in the weathered zone.	n/a
Superficial Aquifers – Peat	**Medium Importance -** Supports a number of groundwater springs which supply PWS (see *Appendix 11.3 (Volume 5)*). Areas of wet heath, rushy marsh and wet woodland have also been identified on site walkovers as potential GWDTEs details of their location can be viewed in *Figure 6.5 (Volume 3)*. However, has been classified as medium importance as the aquifer does not cover the entirety of the site and the majority of GWDTE will likely be rain-fed rather than groundwater supported.	n/a
River Aray and tributaries (LF1)	**High Importance -** LF1 has moderate WFD classification and SEPA has also identified Atlantic salmon and brown trout within the water body, therefore giving the watercourse a High Importance	**High Importance -** LF1 conforms closely to a natural, unaltered state and exhibits well-developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Some reaches show deviation from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures.
Crom Allt and tributaries (LF2)	**Low Importance -** A collection of small ditches and watercourses. Does not have its own WFD classification. Therefore, has been considered as Low Importance.	**Low Importance -** Minor, partly artificial watercourse.
Allt na Cuile Riabhaiche and tributaries (LA2)	**Low Importance -** A relatively small watercourse which drains into Loch Awe that does not have its own WFD status.	**Low Importance -** Minor, relatively unmodified watercourse.
Keppochan River and tributaries (LA3)	**Low Importance -** A relatively small watercourse which drains into the Archan River (LA4) and does not have its own WFD status.	**Low Importance -** Minor, relatively unmodified watercourse.

Water Feature	Water Quality Importance	Hydromorphology Importance
Archan River and tributaries (LA4)	**Low Importance -** A relatively small watercourse which drains into Loch Awe that does not have its own WFD status.	**Low Importance -** Minor, relatively unmodified watercourse.
Allt a Chrosaid and small lochan (LA5)	**Low Importance -** A relatively small water body which is a part of the Allt Beochlich catchment. The lochan does not have its own WFD status	**Low Importance -** Minor, relatively unmodified watercourse.
Allt Beochlich and tributaries (LA6)	**Medium Importance -** A Moderate status classified water body and supports a small hydro the Development (CAR/L/1010507). No salmon was found within the watercourse only brown trout. It also has an estimated Q95 flow of 0.09m^3/s.	**Medium Importance -** A relatively natural watercourse, however there are modifications in terms of the construction of a small artificial lochan and changes to the flow regime for a small 1 MW local hydro scheme that has an impact on the status.
Lochan Airigh (LA7)	**Low Importance –** A relatively small water body which is a part of the Allt Beochlich catchment. The lochan does not have its own WFD status	n/a
Lochan Beochlich (LA8)	**Low Importance -** A relatively small water body which is a part of the Allt Beochlich catchment. The lochan does not have its own WFD status. The water body is dammed at its western side, which is to support a small hydro scheme.	n/a
Lochan Romach (LA10)	**Low Importance -** A relatively small water body which is a part of the Allt Beochlich catchment. The lochan does not have its own WFD status.	n/a
Allt na Fainge (LA12)	**Low Importance -** A relatively small watercourse which flows into Loch Awe that does not have its own WFD status.	**Low Importance -** Minor, relatively unmodified watercourse.
Allt a' Ghreataidh (LA13)	**Low Importance -** A relatively small watercourse which flows into Loch Awe that does not have its own WFD status.	**Low Importance -** Minor, relatively unmodified watercourse.
Alt Mor (LA14)	**Medium Importance -** A relatively small watercourse that does not have a WFD status but does support an abstraction licence for the Alt Mor Hydro the Development (CAR/L/1115819).	**Low Importance -** A relatively natural watercourse, however, modifications for a small hydro scheme has an impacted on the status.
Cladich River/Allt an Stacain (LA17)	**Medium Importance -** Heavily modified river sourced from Lochan Sron Mor and flows into Loch Awe with a Moderate WFD classification.	**Medium Importance -** A relatively large watercourse which is heavily modified on account of hydrological impacts related to hydropower generation.
Unnamed Watercourse (LA18)	**Low Importance -** Small stream sourced from approximately NN 01190 15648 and flows into Loch Awe at NN 00726 15673.	**Low Importance -** Minor, relatively unmodified watercourse.

11.7 Assessment of Effects

This section presents the findings of the assessment for the construction/demolition phases and the operational phase. The approach to the assessment is based on the methodology set out earlier in *Section 11.5.*

11.7.1 Assessment of Construction Effects

During the construction phase there is the potential for adverse effects on the water environment from site run-off contaminated by excessive fine sediments (including the potential wash out of fine sediment from temporary spoil storage, Embankments, and Access Tracks), which may reduce water quality, smother habitats and physically impact aquatic organisms; chemical spillages; and physical changes to the form and function of water features as a consequence of:

- Vegetation clearance, topsoil/subsoil stripping and stockpiling.
- General construction activities including runoff and activities at temporary Construction Compounds, the movement of plant and other vehicles, and their maintenance and cleaning.
- Large scale earthworks including construction Embankments and use of large temporary material storage areas.

- Works in, over, under and adjacent to water features including construction of the Tailpond inlet / outlet in Loch Awe, temporary jetty in Loch Fyne, the Embankments and Headpond, and multiple watercourse crossings (as identified in *Appendix 11.4 (Volume 5: Appendices)* and in *Figure 11.3a: Surface Water and Groundwater Receptors and Attributes – Headpond Study Area* and *Figure 11.3b: Surface Water and Groundwater Receptors and Attributes – Loch Fyne Study Area (Volume 3: Figures)).*
- Excavation of tunnel portals and tunnelling of the Waterways, Access and Construction Tunnels.
- Temporary and permanent watercourse diversions and impoundments.
- Dewatering and abstraction operations for underground works.
- Excavation, crushing and transportation by overland conveyors of excavated materials to temporary stockpile locations.
- The batching and use of concrete and other cementitious products including the washing out of plant and equipment.
- Construction of temporary and permanent Access Tracks.

11.7.2 Effects on Groundwater

The high-pressure and low-pressure tunnels are to be constructed using drill and blast. The tunnels will be lined with either precast concrete, steel segments or reinforced shotcrete and this will prevent groundwater from entering the tunnels. Once constructed, the tunnel lining and the circular cross-sectional shape of the tunnels will allow groundwater to flow smoothly around them. The Power Cavern Complex is likely to be constructed using drill and blast techniques.

As shown on *Figure 2.11 Cross-section of Development (Volume 3: Figures)*, the depth of the low-pressure tunnel below existing ground level will range between approximately 20 mAOD at the Tailpond inlet / outlet end to approximately -50 mAOD (at its deepest point) at the Power Cavern Complex, after which the high-pressure tunnel starts and rises to approximately 350 mAOD into the Headpond. PC05, PC06 and PC14 will be used as the tunnel portal compounds.

The construction and ongoing presence of the tunnels have the potential to affect both shallow and deeper groundwater. However, as stated in the baseline there is only minor fracture flow within the Oban and Kintyre groundwater body. Therefore, it is unlikely that the bedrock aquifer will be impacted. Where individual fissures result in inflows, spray concrete will be used to seal the cavern walls. This process will unlikely cause any impacts to groundwater flow of the aquifer, as the aquifer has a low productivity and so there will unlikely be any abstraction/pumping required.

The portals for the construction and Access Tunnels are to be located along the Access Track. The portals will be constructed by excavation into the bedrock, and as such, it is not envisaged that sheet piling will be required.

The construction of the Headpond will require excavations down to bedrock, with the potential to interact with shallow groundwater. Any effects are likely to be temporary until the Headpond has been lined and filled, when the system will become ‘effectively closed’.

There could be some small impacts from contaminated run-off from fuels, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances which might be stored and/or used on the Development Site infiltrating the aquifer. Main areas of risk include the Headpond area, underground tunnels and the Power Cavern Complex. However, as the aquifer has a low productivity and low permeability this is unlikely to be a major impact.

For the low importance Oban and Kintyre groundwater body, negligible adverse impacts are predicted from construction of Headpond, underground tunnels and the Power Cavern Complex, when considering the low productivity of the aquifer. Therefore, these construction works are predicted to result in a **negligible adverse effect (not significant)** for both water quality and groundwater flow impacts.

The construction tunnels, Waterways and Power Cavern Complex will be too deep to significantly impact the superficial aquifer. However, there may be some small impacts from contaminated run-off from fuels, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances will be stored and/or used on the Development Site infiltrating the aquifer. In particular, at PC05, PC06 and PC14 where there will be a lot of activity to construct the portals and within the Headpond area where there will be a lot of earthworks. The Headpond area, PC06 and PC13 both also have potential GWDTE situated nearby. However, as mentioned earlier in this chapter, many of the identified GWDTE will likely be rainwater fed rather than by groundwater supported. The superficial aquifer is also not widespread across the Development Site, instead will be situated within small areas of peat, gravel and other superficial deposits. This, alongside Good Practice Mitigation outlined in Section 11.9, any contaminated run-off from any of the works will not be widespread, resulting in a low adverse impact. Therefore, for the medium importance superficial aquifer there is a short term and temporary **minor adverse effect (not significant).** Direct impact and effects concerning the GWDTE are assessed in more detail in *Chapter 6: Terrestrial Ecology (Volume 5: Main Report).*

As mentioned, the superficial aquifer is not widespread across the Development Site. Therefore, works will unlikely have any impact to groundwater flow within the medium importance superficial aquifer, and only a negligible adverse impact is predicted, resulting in a **negligible adverse effect (not significant).**

As mentioned, the superficial aquifer is not widespread across the site. Therefore, works will unlikely have any impact to groundwater flow within the medium importance superficial aquifer resulting in a Negligible impact, and thus a **negligible adverse effect (not significant).**

11.7.3 Effects to Surface Water Quality

11.7.3.1 Construction Site Run-off - Excess Fine Sediments

The water environment and the flora and fauna that it supports may be adversely affected by excessive fine sediment contained within construction site run-off, dewatering activities or from works directly affecting water features. Run-off laden with fine sediment is principally generated by rainfall falling onto land that has been cleared of any vegetation where the ground may be compacted, reducing infiltration. Surface water runoff from the temporary compound areas, Headpond, stockpiles, Access Tracks and mud deposited on the main road accesses to the Development Site are also all potential sources. Other potential sources of fine sediment contaminated water include that which is generated by the construction activities themselves (e.g. vehicle washing), debris from the use of overland conveyors to move spoil from below ground works to temporary stockpile locations, dewatering of excavations, and from works directly within water features themselves.

Generally, excessive fine sediment in run-off is chemically inert and affects the water environment through smothering riverbeds and plants, temporarily changing water quality (e.g. increased turbidity and reducing photosynthesis), and by causing physical and physiological adverse impacts on aquatic organisms (e.g. abrasion, irritation etc.). However, where powdered grouts and cements are used this may also contaminate site run-off if not carefully used and may result in significant changes in pH and have other toxic effects on fauna and flora (for example, cement is quite high in chromium). Sediment in run-off may also be a vector for other chemicals, with hydrocarbons known to have a high affinity to adsorb to the surface of sediment particles, although the risk of chemical spillages is primary considered separately in the next section. In addition, sediment-laden run-off also has the potential to impact fish (e.g. Atlantic salmon and lamprey) present in any watercourses. However, whilst the presence of protected fish species is considered in the importance setting of water features such as Loch Awe, any potential impact on fish such as Atlantic salmon (e.g. direct mortality or physical injury and disruption of their migratory pathway) is considered in *Chapter 7: Aquatic Ecology*.

Section 11.8 provides details of the embedded mitigation measures that are taken into account in this initial impact assessment. This includes the implementation of good practice, standard pollution prevention measures that will be described in a Construction Environmental Management Plan (CEMP), Water Management Plan (WMP) and Sediment Management Plan (SMP). An outline WMP (oWMP) is provided in *Appendix 11.5 (Volume 5: Appendices).*

The risk of water pollution depends on many factors such as the type of development, its location, the timing and duration of the works, and any measures that are implemented to provide mitigation. The risk will also vary at different times during the works and locations across the Development Site. This is a reason why the oWMP (See *Appendix 11.5, (Volume 5: Appendices)*) does not prescribe measures for the contractor but sets the outcomes to be achieved and a pallet of options to be considered. The greatest risk of adverse impacts to water features from this Development will likely occur from the construction of the Headpond and its Embankments, made more challenging due to the presence of a number of watercourses flowing through that location and needing to be carefully managed during the works. Management of spoil from underground construction of tunnels and the Power Cavern Complex, and any works in, over and immediately adjacent to water features represent the highest risk. Please refer to *Chapter 10: Geology and Soils* for further details on materials generation and management.

Furthermore, as part of the pre-construction works, trees and other shrubs (most of the Development Site is covered by grassland) will be removed from the working area, which would increase the potential for soil erosion and reduces the buffering effect on any uncontrolled site run-off. However, this effect will likely be temporary during the construction period.

Table 11.25 displays the potential impacts and effects from construction site runoff containing high levels of fine sediments or direct works in or over water features.

Table 11.25 Impacts and Effects on Surface Water Feature from Construction Site Runoff Containing High Levels of Fine Sediments or Direct Works in or Over Water Features

Water feature	NGR	Direction and Distance to the Development	Importance	Impact	Effect
Loch Awe	NN 00437 16188	All water features within the Main Area drain into Loch Awe. There is a Tailpond inlet / outlet where water will be abstracted and discharged.	High	**Low adverse impact -** Sediment laden runoff could enter Loch Awe from water features draining into it, such as LA6, causing an indirect temporary impact. However, through the implementation of a CEMP, a WMP and a SMP risks can be effectively managed. Construction works associated with the Tailpond inlet / outlet works could also lead to increased sediment run-off and disturbance of sediments in the Loch itself. This includes dredging of the bed to deepen the water adjacent to the Tailpond inlet / outlet, although this will be undertaken in a dry working environment behind a cofferdam and a silt curtain. Overall, a direct, short term and temporary but uncertain low adverse impact is predicted.	**Moderate Adverse (significant)**
Loch Fyne	NN 09845 07941	New jetty to be constructed and used for the delivery of materials and equipment, particularly abnormal loads.	High	**Low adverse impact -** Works associated to jetty would lead to works directly in the Loch that may disturb sediment temporarily while vibro-driven piles are installed. There may also be associated areas of new hard standing that would involve vegetation clearance. Particulates may also wash off the jetty during its use. No dredging will be required at the jetty. Overall, a direct, short term and temporary but uncertain low adverse impact is predicted.	**Moderate Adverse (significant)**
Allt na Cuile Riabhaiche and tributaries (LA2)	NN 06346 19768	Tributaries cross the Upper Sonachan / Keppochan Forest track that will be used for access.	Low	**Negligible adverse impact -** Some sediment-runoff could indirectly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Keppochan River and tributaries (LA3)	NN 07270 19990	Crosses the Upper Sonachan / Keppochan Forest track that may be used for access.	Low	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Archan River and tributaries (LA4)	NN 08466 20254	Crosses the Upper Sonachan / Keppochan Forest track that may be used for access.	Low	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Allt a Chrosaid and small lochan (LA5)	NN 02937 16523	PC21 is situated approx. 30 m south of LA5. Upgrade to the existing B840 crossing.	Low	**Negligible adverse impact -** Some sediment-runoff could indirectly and directly wash from new crossings and upgrades to the existing track. Sediment runoff could also occur from works associated to the permanent compound. However, this will likely only be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Allt Beochlich and tributaries (LA6)	NN 03502 15714	Situated within the Development Planning Boundary, tributaries cross the proposed Access Track and temporary	Medium	**Medium adverse impact –** There will be a significant amount of earthworks and intrusive construction works directly to the Allt Beochlich catchment within the Headpond area, including challenges maintaining downstream flows while constructing the	**Moderate Adverse (significant)**

Water feature	NGR	Direction and Distance to the Development	Importance	Impact	Effect
		works area. LA6 and tributaries are within the proposed Headpond, and Embankment locations thus will be lost to the Development but will remain receptors downstream while it is being constructed.		Embankments and Headpond infrastructure. There will be at time large slopes and areas of bare earth that may create significant volumes of sediment-laden runoff. Standard mitigation measures can be effective, but they will need to be implemented on a large scale. Proprietary measures in addition to construction SuDS are expected to be required. The impact downstream of Lochan Beochlich (LA8) will only be permanent, long term, certain, Low Adverse as that lochan as fine sediment is likely to be deposited in the basin.	
Lochan Airigh (LA7)	NN 04278 16440	Situated within the location of the proposed Headpond, thus will be lost to the Development.	Low	**No impact** as this water feature will be lost to the Development. Loss of this water feature is considered under permanent hydromorphological effects in the 'Operation' impact assessment section that follows.	N/A
Lochan Beochlich (LA8)	NN 03030 15414	TC07 will be located approximately 33 m upgradient of LA8. PC09 is situated upstream of lochan. Construction of the Headpond and associated activities are within the catchment.	Low	**Medium adverse impact -** Lochan Beochlich is an artificial lochan located online with the Allt Beochlich. All of the works described for 'Allt Beochlich and tributaries (LA6) catchment' above apply, plus runoff from TC07 (PC09 is downstream), which together could lead to the introduction of fine sediment, that is likely to be washed and deposited in this lochan as it is the first Stillwater basin downstream.	Minor Adverse (not significant)
Lochan Romach (LA10)	NN 02811 15735	PC20 and Access Track crossing situated 100 m upstream of LA10.	Low	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Allt na Fainge (LA12)	NN 01216 16501	Upgrade to the existing B840 crossing.	Low	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Allt a' Ghreataidh (LA13)	NN 01200 16313	Upgrade to the existing B840 crossing.	Low	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Alt Mor (LA14)	NN 01160 16630	Upgrade to the existing B840 crossing.	Medium	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)
Cladich River/Allt an Stacain (LA17)	NN 09638 22424	600 m downstream of Sonachan / Keppochan Forest track that may be used for access. This watercourse may be impacted indirectly via any impacts to LA3 or LA4 as they are hydraulically linked.	Medium	**Negligible adverse impact -** Sediment laden run-off could indirectly wash into Cladich River from Keppochan River (LA3) and Archan River (LA4). However, this will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only. There would also be increased dilution and dispersion further downstream.	Negligible adverse (not significant)
River Aray and tributaries	NN 09003 10169	Proposed road upgrades cross the	High	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with	Minor adverse (not significant)

Water feature	NGR	Direction and Distance to the Development	Importance	Impact	Effect
(LF1)		River Aray at NN 09165 09855.		standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	
Crom Allt and tributaries (LF2)	NN 08592 07409	Temporary works and proposed Access Tracks cross part of Crom Allt at NN 08415 07691	Low	**Negligible adverse impact -** Some sediment-runoff could directly and indirectly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with mitigation, is predicted to have a temporary negligible adverse impact only. There may also be some works associated with jetty construction which could increase sediment run-off. Such as increased areas of hardstanding. This will also likely only be small amounts, and thus has a short term, temporary, uncertain negligible adverse impact.	Negligible adverse (not significant)
Unnamed watercourse (LA18)	NN 01125 15692	Upgrade to the existing B840 crossing.	Low	**Negligible adverse impact -** Some sediment-runoff could directly wash from new crossings and upgrades to the existing track. This will likely be small amounts, and with standard mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only.	Negligible adverse (not significant)

11.7.3.2 Construction Site Run-Off – Spillage Risk

During construction, fuel, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances will be stored and/or used on the Development Site. Leaks and spillages of these substances could pollute nearby surface water features if their use is not carefully controlled and if spillages enter existing flow pathways. Like excessive fine sediment in construction site run-off, the risk is greatest where works occur close to and within water features.

To allow such substances to enter a watercourse could be in breach of the Pollution 13 Prevention and Control (Scotland) Regulations 2012 (Ref 11.36), the Environment Act 2021(Ref 11.37) and Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Scotland) Regulations 2003 (Ref 11.38), and therefore measures to control the storage, handling and disposal of such substances will need to be in place prior to and during construction.

As with the risk from construction site run-off, the risk to the water environment is greatest where these activities occur close to and within water features. The areas most at risk include water features listed in *Table 11.26*.

Table 11.26 Impacts and Effects to Surface Water Feature from Site Run-off – Spillage Risk

Water feature	NGR	Direction and Distance to the Development	Importance	Impact	Effect
Loch Awe	NN 00437 16188	All water features within the Main Area drain into Loch Awe. There is a Tailpond inlet / outlet where water will be abstracted and discharged.	High	**Low adverse impact -** Contaminated runoff could indirectly enter Loch Awe from water features draining into it, such as LA6. Chemical spillages from works associated with the Tailpond inlet / outlet could also directly occur. However, with the implementation of good practice and standard mitigation measures, a low adverse short term, temporary, uncertain impact is predicted.	**Moderate adverse (significant)**
Loch Fyne	NN 09845 07941	New jetty to be constructed and used for the delivery of materials and equipment, particularly abnormal loads.	High	**Low adverse impact -** Works associated with the construction and operation of the jetty could lead to spillages of chemical substances. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain low adverse impact is predicted.	**Moderate adverse (significant)**
Allt na Cuile Riabhaiche and tributaries (LA2)	NN 06346 19768	Tributaries cross the Upper Sonachan / Keppochan Forest track that will be used for access.	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, an indirect, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (not significant)

Water feature	NGR	Direction and Distance to the Development	Importance	Impact	Effect
Keppochan River and tributaries (LA3)	NN 07270 19990	Crosses the Upper Sonachan / Keppochan Forest track that may be used for access.	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain low adverse impact is predicted.	Negligible adverse (not significant)
Archan River and tributaries (LA4)	NN 08466 20254	Crosses the Upper Sonachan / Keppochan Forest track that may be used for access.	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain low adverse impact is predicted.	Negligible adverse (not significant)
Allt a Chrosaid and small lochan (LA5)	NN 02937 16523	PC21 is situated approx. 30 m south of LA5. Upgrade to the existing B840 crossing.	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain low adverse impact is predicted.	Negligible adverse (not significant)
Allt Beochlich and tributaries (LA6)	NN 03502 15714	Situated within the Development Planning Boundary, tributaries cross the proposed Access Track and temporary works area. LA6 and tributaries are within the proposed Headpond, and Embankment locations thus will be lost to the Development but will remain receptors downstream while it is being constructed.	Medium	**Medium adverse impact -** There will be a significant amount of construction and intrusive works to the Allt Beochlich catchment within the Headpond area, including challenges maintaining downstream flows while constructing the Embankments and Headpond infrastructure. Standard mitigation measures can be effective, but they will need to be implemented on a large scale. Proprietary measures in addition to construction SuDS are expected to be required.	**Moderate Adverse (significant)**
Lochan Airigh (LA7)	NN 04278 16440	Situated within the location of the proposed Headpond, thus will be lost to the Development	Low	**No impact** as this water feature will be lost to the Development. Loss of this water feature is considered under permanent hydromorphological effects in the 'Operation' impact assessment section that follows.	N/A
Lochan Beochlich (LA8)	NN 03030 15414	TC07 will be located approximately 33 m upgradient of LA8. PC09 is also situated upstream of lochan. Construction of the Headpond and associated activities are within the catchment.	Low	**Medium adverse impact -** Lochan Beochlich is an artificial lochan located online with the Allt Beochlich. All of the works described for 'Allt Beochlich and tributaries (LA6) catchment' above apply, plus direct runoff from TC07 and PC09. A direct, short term, temporary, uncertain medium adverse impact Is predicted.	Minor Adverse (not significant)
Lochan Romach (LA10)	NN 02811 15735	PC19 and Access Track crossing situated 100 m upstream of LA10.	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (not significant)
Allt na Fainge (LA12)	NN 01216 16501	Upgrade to the existing B840 crossing	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (not significant)
Allt a' Ghreataidh (LA13)	NN 01200 16313	Upgrade to the existing B840 crossing	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (Not significant)

Water feature	NGR	Direction and Distance to the Development	Importance	Impact	Effect
Alt Mor (LA14)	NN 01160 16630	Upgrade to the existing B840 crossing	Medium	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (not significant)
Cladich River/Allt an Stacain (LA17)	NN 09638 22424	600 m downstream of Sonachan / Keppochan Forest track that may be used for access. This watercourse may be impacted indirectly via any impacts to LA3 or LA4 as they are hydraulically linked.	Medium	**Negligible adverse impact -** Contaminated run-off could indirectly wash into Cladich River from Keppochan River (LA3) and Archan River (LA4). However, this will likely be small amounts, and with mitigation, is predicted to have a short term, temporary, uncertain negligible adverse impact only. There would also be increased dilution and dispersion further downstream.	Minor adverse (not significant)
River Aray and tributaries (LF1)	NN 09003 10169	Proposed road upgrades cross the River Aray at NN 09165 09855.	High	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (not significant)
Crom Allt and tributaries (LF2)	NN 08592 07409	Temporary works and proposed Access Tracks cross part of Crom Allt at NN 08415 07691	Low	**Low adverse impact –** Works associated with the jetty and movement of equipment and materials could result in chemical spillages affected this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (not significant)
Unnamed watercourse (LA18)	NN 01125 15692	Upgrade to the existing B840 crossing.	Low	**Negligible adverse impact -** Chemical spillages could occur during works to upgrade the existing track including new crossing of this watercourse. However, with the implementation of good practice and standard mitigation measures, a direct, short term, temporary, uncertain negligible adverse impact is predicted.	Negligible adverse (not significant)

11.7.3.3 Water Supply and Foul Drainage

It is assumed that water will be tankered in for temporary and permanent compounds and that foul waste will be collected disposed of off-site. Therefore, there will be no impacts to any of the surrounding water features.

If there is an alternative method this would require a CAR licence and would be subject to a temporary foul drainage strategy.

11.7.4 Effects on Hydromorphology

There is potential for adverse impacts to the hydromorphology of surface water features from construction works, especially from the new Embankments for the Headpond and upgraded watercourse crossings, works to the shore of Loch Awe, but also from fine sediment deposition that may be introduced into the channel via surface water runoff from new hardstanding and exposed areas stripped of vegetation and where the soil may become compacted due to the movement of construction vehicles.

11.7.5 Construction of Embankments and Headpond

The main Embankment to be constructed to create the Headpond is proposed to cross the Allt Beochlich, which will completely block its natural course. The channel of the watercourse in this location and downstream is dominated by bedrock and therefore it is very stable and has a low sensitivity to physical modifications. Construction of the Embankment is likely to require the construction of a temporary culvert to convey the flow while the Embankment is constructed, resulting in disruption to sediment transport depending on the design of the culvert and likely changes to the flow regime.

Significant geomorphological change events normally occur in watercourses around a 50% Annual Exceedance Probability Event (AEP). The construction of the temporary culvert and Embankment may result in changes to the natural flow regime and reduce the occurrence of these events during construction. Coarse sediment transported within the channel upstream of the Embankment may be blocked, resulting in a reduced sediment load to downstream reaches. However, this impact already occurs due to the presence of the reservoir and small hydropower scheme approximately 1.5 km downstream of the proposed Embankment location. It is therefore assessed that the impact of the Embankment construction on sediment transport in this reach downstream of the proposed Embankment will be low adverse, which given the medium importance of the Allt Beochlich for hydromorphology, results in a direct, long term, permanent **minor adverse effect** (**not significant**).

11.7.6 Watercourse Crossings

Watercourse crossings have the potential to prevent movement of coarse sediment, which could lead to excess accumulation upstream and starvation of supply downstream that could trigger localised erosion. There are several access route options proposed as part of the Development, which will be either created or upgraded depending on a number of factors. Effects will be permanent for the majority of crossings, as Access Tracks will be retained through the operation phase. The potential watercourse crossings identified are shown on *Figure 11.3a: Surface Water and Groundwater Receptors and Attributes – Headpond Study Area* and *Figure 11.3b: Surface Water and Groundwater Receptors and Attributes – Loch Fyne Study Area (Volume 3 Figures)* and presented in *Appendix 11.4 (Volume 5 Appendices)*. The number and types of crossings listed by potential access route are summarised

Table 11.27. The watercourse crossings are grouped into the following routes Balliemeanoch to Headpond (labelled B#), Forest Access (labelled F#), Castle Access (labelled C#) and Inveraray Access (labelled I#).

Where there are existing crossings, culverts are currently in place, with track widths of approximately 3 m – 5 m. It is proposed to widen the track to 10 m width for construction, using a pipe culvert, in keeping with the current arrangements. There will be local impact to watercourses due to the length of the affected bed and banks being increased. However, in the context of the overall watercourse length this is not significant. In addition, no significant deposition or erosion was noted upstream or downstream of existing crossings, indicating that the existing crossings are not currently causing major geomorphological impacts. Therefore, the magnitude of impact is assessed to be negligible adverse, which given the low or medium importance of the receptors for hydromorphology, results in a **negligible adverse effect (not significant)**.

New crossings are proposed on small tributaries, using an open culvert structure (i.e. an arch) with a minimum width of 10 m for the construction phase. Many of these tributaries have small catchments above the proposed crossing locations and therefore it is not anticipated that there will be excess sediment accumulation or downstream erosion. Watercourses tend to be steep and with bedrock or step pool typology and very limited superficial deposits. This means that there will be limited coarse, transportable material that can be eroded into the channel. Where multiple crossings are proposed at different locations on the same watercourse, the cumulative loss of channel and banks has been assessed, for the Allt Beochlich, the loss is approximately 0.02% of the main stem length. All other watercourses with multiple crossings will be subject to even lower percentage impact. Therefore, new watercourse crossings are unlikely to significantly impact sediment transport processes. Therefore, the magnitude of impact is assessed to be negligible adverse, which given the low or medium importance of the receptors for hydromorphology, results in a **negligible adverse effect (not significant)**.

Table 11.27 Watercourse Crossings by Route

Route	Water feature	Watercourse Crossings affected (upgrades)	Water feature	Watercourse Crossings affected (New Crossings)
Balliemeanoch to Headpond	Allt na Fainge (LA12)	B1	Allt Beochlich trib (LA6)	B8
	Allt a' Ghreataidh (LA13)	B2	Lochan Romach trib (LA10)	B9
	Allt a Chrosaid (LA5)	B3	Allt Beochlich trib (LA6)	B10
	Unnamed (LA18)	B4	Allt Beochlich trib (LA6)	B11
	Unnamed (LA18)	B5	Allt Beochlich (LA6)	B12
	Allt Beochlich trib (LA6)	B6	Allt Beochlich (LA6)	B13
	Allt Beochlich trib (LA6)	B7	Allt Beochlich (LA6)	B14
			Allt Beochlich (LA6)	B15
			Allt Beochlich trib (LA6)	B16
			Allt Beochlich trib (LA6)	B17
			Allt Beochlich trib (LA6)	B18
			Allt Beochlich trib (LA6)	B19
			Allt Beochlich trib (LA6)	B20
			Allt Beochlich trib (LA6)	B21
			Allt Beochlich (LA6)	B22
			Allt Beochlich trib (LA6)	B23

Route	Water feature	Watercourse Crossings affected (upgrades)	Water feature	Watercourse Crossings affected (New Crossings)
			Allt Beochlich trib (LA6) Allt Beochlich trib (LA6) Allt Beochlich trib (LA6) Allt Beochlich trib (LA6) Allt Beochlich trib (LA6)	B24 B25 B26 B27 B28
Forest Access	Allt na Cuile Riabhaiche trib (LA2) Allt na Cuile Riabhaiche trib (LA2) Keppochan River trib (LA3) Keppochan River trib (LA3) Archan River and trib (LA4) Archan River and trib (LA4) Cladich River/Allt an Stacain trib (LA17)	F5 F6 F7 F8 F10 F11 F12	Allt na Cuile Riabhaiche trib (LA2) Allt na Cuile Riabhaiche and tributaries (LA2) Allt na Cuile Riabhaiche and tributaries (LA2) Allt na Cuile Riabhaiche and tributaries (LA2) Archan River and trib (LA4)	F1 F2 F3 F4 F9
Castle Access	All crossing River Aray and tributaries (LF1) including a temporary bridge	C1 C2 C3 C4	Not applicable	Not applicable
Inveraray Access	All crossing Crom Allt and tributaries (LF2)	IN1 IN2 IN3 IN4	Not applicable	Not applicable

11.7.7 Sediment Runoff

During construction, soil and fine sediment runoff can impact watercourses by unnaturally increasing sediment load. In some river systems, this can change the nature of the channel bed features, with the potential to trigger erosion and instigate channel change. The Outline SWMP (*Appendix 10.5 (Volume 5: Appendices)*) includes measures to attenuate construction site run-off and manage the risk of fine sediment being deposited in the channel. This has the potential to affect the Allt Beochlich (LA8), its tributaries and other watercourses outlined in *Table 11.24*, however the steep gradient and bedrock typology will result in rapid flushing of fine sediment through the system. Therefore, in the context of the Development Site and proposed embedded mitigation, a negligible adverse impact is predicted, which given the **medium** importance of the Allt Beochlich for hydromorphology, results in a **negligible adverse effect (not significant)**.

The construction of hardstand areas has the potential to increase run-off to watercourses, which could cause increased flows and erosion downstream. The proposed temporary compounds and potentially affected watercourses are listed in *Table 11.28*. The area of hardstanding to be introduced is small within the context of the catchment area of the watercourses downstream of the proposed compounds and is therefore unlikely to cause a detectable increase in flows. Surface water runoff from temporary compounds will also be attenuated and treated using SuDS. Therefore, the impact is assessed to be negligible in all cases.

Table 11.28 Temporary Compounds and Affected Water Features

Compound Name	Affected Watercourse	Direction and distance between compound and water feature	Importance	Impact	Effect
TC01 and TC02	Loch Awe	50-60 m upgradient	High	**Negligible adverse**	Minor adverse effect (not significant)
TC02	Allt a Chrosaid (LA5) and Allt a Geataidh	Approx. 20 m to north and approx. 15 m to south and approx. (respectively)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC03	Allt a Chrosaid (LA5) and Allt a Geataidh	Approx. 60 m to north and approx. 80 m to south and approx. (respectively)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)

Compound Name	Affected Watercourse	Direction and distance between compound and water feature	Importance	Impact	Effect
TC04	Allt a Chrosaid (LA5)	Approx. 20 m to south (across slope)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC05	Unnamed tributary discharging directly to Loch Awe	Approx. 70 m to north (across slope)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC06	Small tributary to Allt Beochlich (LA6)	Approx. 30 m to north (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
TC07	Allt Beochlich (LA6)	Approx. 65 m to north (upgradient)	Medium Importance	**Negligible adverse**	Negligible adverse effect (not significant)
TC08	Small tributary to Allt Beochlich (LA6)	0m (on upgradient side)	Medium Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC09	Allt Beochlich (LA6)	0 m	Medium Importance	**Negligible adverse**	Negligible adverse effect (not significant)
TC10	Tributary to Allt Mor (tributary to Allt Beochlich (LA6))	Approx. 70 m to south (upgradient)	Medium Importance	**Negligible adverse**	Negligible adverse effect (not significant)
TC11	Small tributary to Allt Beochlich (LA6)	Approx. 50 m to north (upgradient)	Medium Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC14	Allt na Cuile Riabhaiche and tributaries (LA2)	Approx. 55 m to northwest (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC15	Allt na Cuile Riabhaiche and tributaries (LA2)	Approx. 80 m to southeast (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
TC16	Small tributary to Allt Beochlich (LA6)	Approx. 50 m to west (upgradient)	Medium Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC17	Unnamed tributary to Loch Airigh	150 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC18	Unnamed small lochan and tributary to Loch Airigh	110 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC19	Unnamed small lochan and tributary to Loch Airigh	110 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC20	Unnamed tributary to Lochan Romach	100 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC21	Allt a Chrosaid	30 m to south (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)

11.7.8 Assessment of Operational Effects

The main pathway for impacts to water quality in Loch Awe during operation of the Development is from, and as a consequence of, the exchange of water between the Headpond and the Loch. Before describing the potential impacts and determining the significance of effects, it is worth considering the design and parameters of operation.

11.7.8.1 Tailpond Inlet / Outlet Design

The Headpond will hold c. 53 M m3 of water with the maximum drawdown associated with normal operation being 46 m (i.e. between 274 and 420 mAOD), but this may not be an everyday occurrence. This corresponds with a maximum discharge from the outlet of around 494 cubic m3/s. To maintain a design discharge and abstraction velocity of no greater than 0.3 m/s (which is required to minimise the risk of sediment scour and entrainment of salmon smolts) and a suitably sized screen mesh, the Tailpond inlet / outlet screen will be 148 m wide and 19 m high. This also requires the loch bed to be reprofiled and dredged to depth of c. 18.2 m AOD. Bathymetric survey undertaken of the shoreline for the Development shows water depths of around 40 m deep offshore from the Tailpond inlet / outlet. This is consistent with the contours shown on online OS maps, which show water depths in the portion of the Loch close to the Tailpond inlet / outlet structure up to around 50 m (Ref 11.15).

11.7.8.2 Tailpond Inlet / Outlet Operation

The operation of the Development will depend on water level constraints within Loch Awe as well as electricity generation market conditions. The time required to fully discharge or fill the Headpond is around 30 hours of continuous operation. However, the duration and frequency of operation will reflect energy generation needs at a particular time and cannot be predicted with certainty. Water quality impacts on Loch Awe will depend on the operation of the Development. For example, more frequent and larger discharges may have more influence on water quality in Loch Awe or disrupt seasonal thermal stratification. On the other hand, holding the water in the Headpond for longer may lead to greater alteration in quality from that in Loch Awe before it is discharged back. There will also be periods where water levels need to be drawn down for maintenance or inspections of the Embankments, or potentially in the unlikely event of an emergency, although the rate of discharge to Loch Awe would be comparable to normal operation and so this is not assessed separately. Similarly, during drought conditions, the scheme will not operate, thus this scenario is not considered any further. Overall, where appropriate, the following impact assessment considers the range of different operating conditions and applies the precautionary principle.

11.7.8.3 Potential Water Quality Impacts

During operation of the Development there could be water quality impacts on Loch Awe as a result of the following impact mechanisms:

- A reduction in water levels resulting in changes in water quality through the concentration of existing chemical compounds and reduced dilution.
- Changes to the seasonal thermal stratification of the water column and associated impacts on water quality and risk of algal blooms.
- Potential impact on Loch Awe directly from operational discharges (e.g. temperature, nutrients and concrete residues post construction).
- Pollution risk from chemicals and sediment in routine surface water runoff from, or spillages on, new impermeable surfaces.

Although the above water quality impact mechanisms have been itemised for ease of discussion, they would not happen in isolation of each other, and the overall effect on Loch Awe would be a product of the synergies of them all.

In addition, as is the nature of impacts on water quality, they are unlikely to be constant and will vary over time. Changes in water quality may also influence ecological processes and populations of different species, which may lead to additional, indirect changes in water quality, which are difficult to predict. For an assessment of impacts on aquatic ecology as a consequence of the above water quality impact mechanisms please see *Chapter 7: Aquatic Ecology*.

11.7.8.4 Impact on Water Quality in Loch Awe From Changes in Water Level

Significant changes in water level can potentially lead to the concentration of pollutants in a still water body. However, operation of the Development will be limited to between a loch water level of 35.3 mAOD and 36.4 mAOD (i.e. a water level range of 1.1 m), given that other third-party abstractors and compensation flows along the River Awe need to be considered (see *Chapter 13: Water Resources*). Comparing the maximum volume of discharge and water level operation restrictions the following can be stated:

- Maximum water depth close to the outlet is up to 50 m, and so a c. 1 m change is unlikely to significant concentrate any chemical substances in the water column. The risk would be slightly greater between June/July and mid-late autumn when the Loch is likely to be stratified. This is because when there is a shallower epilimnion, there would be a smaller volume of water to dilute chemical compounds. However, even under these circumstances the epilimnion may still be up to approximately 20 m deep (Ref 11-44).
- Regardless of the operating conditions referred to in the above point, the volume of the Headpond is approximately 53M m^3, which if it was all abstracted from Loch Awe (which has a surface area of around 38.5 km^2) would result in an average level change across the total surface area of Loch Awe of around 1.37 m (assuming a relatively flat gradient across the loch and no inflows). Again, the risk would be greater during periods of thermal stratification.
- Related to point two above, the maximum abstraction is approximately 0.45% of the total estimated 1.2 km^3 of water held in Loch Awe at any given time.

In practice, the maximum abstraction from Loch Awe to the Headpond is unlikely to occur, plus inflowing streams and any direct rainfall will constantly be replenishing the Loch. For example, operation of five hours would be expected to result in a lowering of water level in Loch Awe of around 0.18 m only. The drawdown for 10 hours of operation would be 0.36 m, and for 15 hours of operation, 0.53 m, respectively. On the basis of the above, fluctuations in water level alone are unlikely to materially alter water quality in Loch Awe. Therefore, an indirect, long term, permanent but unlikely negligible adverse impact is predicted. On a high importance receptor this results in a **minor adverse effect (not significant)**.

11.7.8.5 Impact on Thermal Stratification in Loch Awe

Thermal Stratification in a Monomictic Loch and Water Quality

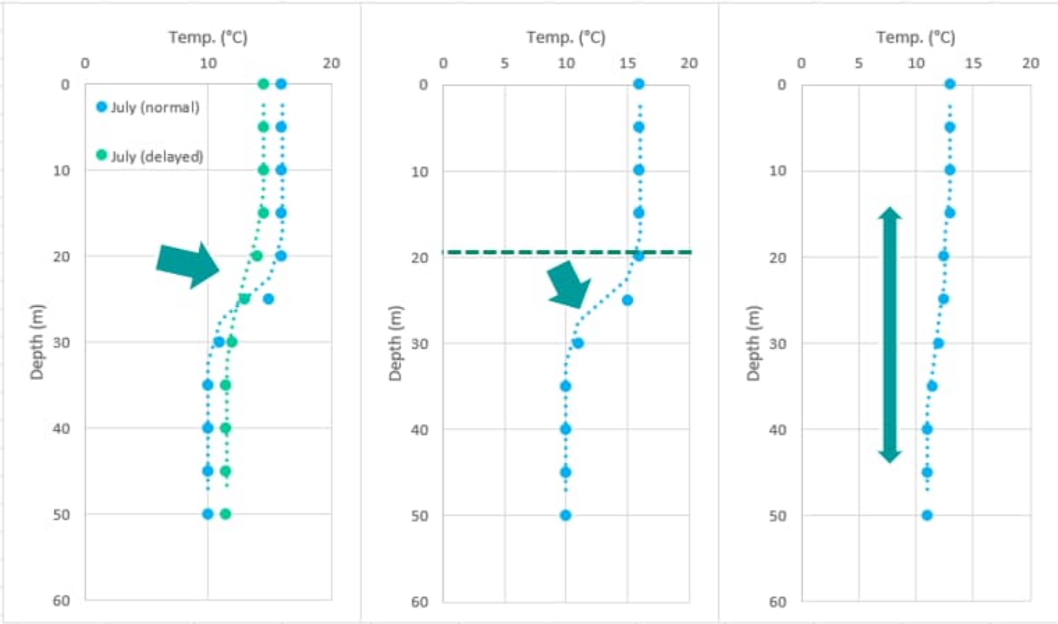
Due to its size and depth, Loch Awe exhibits monomictic seasonal thermal stratification over the summer (typically from late June/July until an overturn event around mid-late autumn). More intense solar radiation in the summer creates a warmer, well mixed upper layer known as the epilimnion. Background data for Loch Awe suggests that this is around 10 m deep early in the summer, increasing to around 20 m deep later in the summer (Ref 11-44), although it will vary 'year on year' and spatially across the Loch at any given time. Beneath the epilimnion is the deeper and colder hypolimnion, separated from the epilimnion by a transition zone known as the metalimnion (or otherwise referred to as the 'thermocline'), which is characterised by a steep temperature gradient. During the autumn, cooling of the epilimnion and wind induced turbulence results in an overturn event that mixes the water column and induces deeper circulation. In monomictic lochs like Loch Awe, this then persists until the formation of thermal stratification the following summer.

Although a natural phenomenon, thermal stratification is generally negative for water quality. Temperature has a significant influence on chemical and biological reactions, and strong temperature gradients (i.e. the thermocline) can significantly limit the diffusion of dissolved oxygen from the water's surface to the bottom of the Loch. There is also reduced mixing by advection and currents between the epilimnion and the hypolimnion. Over time, respiration by aquatic organisms and the aerobic decomposition of organic matter progressively uses up the available dissolved oxygen in the hypolimnion, which is not replaced. In addition to the anoxic conditions that develop, this can lead to the build-up of ammonia that can be toxic to aquatic organisms; the release of sediment-derived bioavailable phosphorus and / or nitrogen; and the reduction of metals in bottom sediments into more soluble, and potentially toxic, forms, such as the formation of methylmercury. Thus, after a period of thermal stratification the water quality in the hypolimnion is expected to be significantly poorer than in the overlying epilimnion. At the same time, there is less dilution and dispersion available in the epilimnion of catchment derived chemical compounds and nutrients (assuming the inflowing water is not so cold and dense that it plunges immediately down into the hypolimnion), which can result in a higher risk of algal blooms occurring under certain conditions (noting that the factors that control such events are complex and varied).

Although there can be intermittent periods of entrainment of hypolimnion water into the epilimnion in monomictic water bodies during a period of thermal stratification (such as from a wind induced internal seiche), at some point in the autumn, the combination of evaporation, air cooling and wind induced mixing of the surface water results in destabilisation of the distinct water layers and permanent overturning until the next summer. This effectively releases the poorer quality water of the hypolimnion low in dissolved oxygen but nutrient rich in bioavailable phosphorous with the epilimnion. Depending on the balance with catchment derived phosphorus, this can encourage the growth of primary produces and potentially result in algal blooms under certain climatic conditions and assuming no other limiting factor (such as the availability of nitrogen) (Ref .11-55). Where a bloom does not occur, there is the potential that higher levels of nutrients persist that 'prime' the loch for early spring blooms the following year. However, overturn does re-oxygenate bottom waters stopping the release of sediment-derived phosphorus and permitting its precipitation (i.e. $FePO4$) as well as carrying algal mass from the epilimnion to lower depths where photosynthesis is more difficult.

11.7.8.6 Potential Impact of the Development

A discussed in the baseline, the increased mixing of the water column due to the exchange of water with a pumped-storage scheme can influence the stability of thermal stratification. Assessing the Cruachan 1 pumped-storage hydro scheme shortly after opening, Tippett (1978) (Ref 11.44) identified that the increased mixing of the upper water column had the effect of delaying the unset of stratification and deepening the thermocline, at least during the early part of the summer before more intense solar radiation compensated for the impact. The dimensions of the existing Cruachan 1 outlet structure are not known, although for the recently consented Cruachan Expansion, the outlet is estimated to be around 18 m wide and 5 m high and discharges into the northern basin of Loch Awe where maximum water depths are up to around 74 m deep. In contrast, the outlet for the Development would be approximately 148 m wide and 19 m high, and located in water that is only up to 50 m deep (but still deep enough for stratification to form). The total discharge and volume of water exchange with Loch Awe is larger for the Development than the current Cruachan 1 pumped-storage hydro scheme, and the consented Cruachan Expansion. Therefore, some impact on the stability of thermal stratification and the position of the thermocline is expected locally in the vicinity of the outlet. Potential outcomes are illustrated in *Diagram 11-1*.



A) Delayed onset of thermal stratification

B) Deepening of thermal stratification

C) Prevention of the formation of thermal stratification – fully mixed water column

Diagram 11-1 Potential outcomes to thermal stratification close to the Tailpond inlet / outlet during operation of the Development

From a thermal stratification perspective, the prevention of thermal stratification would be the absolute worst case (scenario C in *Diagram 11-1*). However, this option would require the greatest disturbance of the water column, and thus is considered the least likely outcome. Disturbance would also likely need to be very regular to maintain the fully mixed water column from stratifying. This was not something that was observed for Cruchan Hydro Scheme (Ref 11-44). More likely is that the disturbance of the water column during operation in the summer may result is the deepening of the thermocline or the delayed onset (scenarios A and B in *Diagram 11-1*). The impact in any given year would depend on the operating regime and many other factors (e.g. weather conditions) and thus would vary. However, although a fundamental characteristic of Loch Awe, this would not necessarily result in an adverse water quality impact as in all cases it would reduce the risk of anoxic bottom waters forming.

The flows along major watercourses draining into Loch Awe have also been examined as they may be considered analogous for the discharge of the Headpond, with some differences (e.g. flow velocity would be greater from the watercourses). Although the operation of the Development will be intermittent; have a control maximum discharge velocity; and enter in relatively deep water, there are some similarities with inflowing watercourses and how they may also interact with a thermally stratified water column. *Table 11.29* provides estimated daily mean flow statistics for a selection of watercourses that flow into Loch Awe.

Table 11.29 Estimated Flows for Certain Loch Awe Inflowing Watercourses

Watercourse and location	Estimated daily mean flow statistics (m^3/s)								
	Min	Q95	Q75	Median/ Q50	Q25	Q10	Max	Mean	STD*
Abhainn a' Bhealaich at Braevallich	0.01	0.09	0.24	0.56	1.78	3.65	48.37	1.40	2.09
Strae at Glen Strae	0.03	0.15	0.47	1.42	4.02	7.97	45.80	3.02	4.06
Avich at Barnaline Lodge	0.06	0.25	0.71	1.49	2.82	4.32	16.65	1.97	1.66
Orchy combined flow (calculated)	0.62	1.98	5.68	12.71	34.59	80.42	681.86	31.08	48.81

Note*: STD standard for standard deviation.

In comparison to the flow rates from the watercourses listed in *Table 11.29*, the flow rate from the Development would be a maximum of 494 m3/s. This is an order of magnitude greater than the maximum flow from the streams entering Loch Awe that are located close to where the Tailpond inlet / outlet structure would be constructed (e.g. Allt Beochlich). However, the maximum flow from the Loch's principle inflowing watercourse, the River Orchy, is estimated to exceed this flow. The width of the channel at the point where the River Orchy flows into the northern basin of Loch Awe is approximately 190 m wide, which is comparable to the width of the Tailpond inlet / outlet structure, and although the depth of river flow would not be as deep as the outlet (i.e. 20 m high), the velocity of the inflow would be much greater than the maximum velocity allowed from the Development (i.e. 0.3 m/s). This illustrates that on occasions Loch Awe may experience a point inflow that is comparable to that from the Development, although flows of this magnitude along the River Orchy would be much less frequent, and more likely to occur at times when Loch Awe is not thermally stratified (i.e. winter).

Given the very large cross-sectional area of the outlet, the volume of water discharged during generation, and the maximum duration that it might occur over (i.e. 30 hours), there is the possibility for local disruption of the stability of thermal stratification in the vicinity of the outlet. Shorter periods of operation or less frequent discharges would likely have a smaller impact on the stability of any stratification. The slow discharge velocity and assumed non-turbulent flow of the discharge would also potentially serve to attenuate any disruptive effects. Furthermore, the water temperature of the discharge (and therefore density) may encourage the discharge to either rise to the surface of the epilimnion forming a temporary plume of warmer water or if colder and more dense, it may sink into the hypolimnion. In either case, this may reduce the spatial extent of any disruption but may encourage mixing locally. Following completion of the generation cycle and the cessation of the discharge, the natural factors controlling the formation of thermal stratification in Loch Awe are expected to re-assert themselves, and over time thermal stratification in the vicinity of the outlet is likely to re-establish. However, this depends on the frequency of the Developments operation. Regular operation and operation for longer durations are more likely to continuously disrupt thermal stratification, depress the thermocline, or delay onset of stratification in the vicinity of the outfall.

11.7.8.7 Summary

It is difficult to predict how the routine operation of the Development will influence the seasonal thermal stratification in Loch Awe as this depends on many natural and operational variables at any given time. The depth of the Tailpond inlet / outlet structure is expected to exceed the typical depth of the thermocline in Loch Awe when thermally stratified, but this is based on limited and fairly old data; we are unaware of any recent water quality data recording the depth of the thermocline in this Loch and in particular the basin nearest the proposed outlet, and later there are recommendations for future monitoring to be undertaken.

There are many variables controlling the formation and spatial extent of seasonal thermal stratification in Loch Awe, and the subsequent deterioration of water quality in the hypolimnion, and these are difficult to predict. Similarly, there are multiple parameters related to the operation of the Development that will also influence how discharges from the outlet may influence seasonal thermal stratification in Loch Awe. Given this uncertainty, it is important that the precautionary principle is applied to any assessment, but also that future operation of the Development is carefully monitored and adjusted as necessary. Overall, the operation of the Development has the potential to influence thermal stratification in Loch Awe as set out earlier, but the impact would be limited to the core summer months of June-August after which overturn is expected to occur with autumn cooling and increased incidence of storms, with no impact at other times of the year when the water column would naturally be fully mixed. The impact is also likely to be restricted to the basin into which the outlet discharges in the central part of the loch, and should not affect the deeper northern or southern basins (noting that shallower water between the Tailpond and the northern basin may not stratify).

Although this impact represents a potential disruption of a natural process, from a water quality perspective it may not actually result in any particular deterioration in water quality. This is because thermal stratification (and subsequent overturn) tends to be associated with a reduction in water quality. Reduced stratification or maintaining a fully mixed water column reduces the potential for poorer water quality to form in bottom waters, particularly the release of bioavailable nutrients that can lead to algal blooms occurring under certain conditions. Indeed, preventing thermal stratification is one method that can be applied to control algal blooms where internal recycling of nutrients is a primary factor (Toffolon et al; 2013) by preventing the release of sediment-derived nutrients and increasing the mixing depth of nuisance blue-green algae (Dodds, 2002). However, it remains important that water quality conditions in Loch Awe are investigated before and during the operation of the Development and any changes in water quality aquatic ecology monitored. This data can then be used to optimise operation to minimise any significant adverse effects.

Based on the above appraisal of the risk from the Development, the seasonality of the impact and its expected restricted spatial extent, a low adverse impact is predicted on Loch Awe, which on a water feature of high importance, results in a **moderate adverse effect (significant)**.

11.7.8.8 Impact on Water Quality in Loch Awe – Headpond Discharges (Temperature)

Separately to the potential changes to the stability of seasonal thermal stratification as discussed above, consideration has also been given to whether the temperature of the water discharged from the Headpond might alter water temperature in Loch Awe outside of seasonal stratification.

The temperature regime of a loch is controlled by climatic factors as well as the volume and bathymetry of the loch. Solar radiation warms the water, whilst convection heat loss cools the water, with the net balance of the two controlling the surface water temperature at any given time. A loch with a small surface area to depth ratio will tend to receive less solar radiation to volume of water and thus may be expected to be cooler than a loch with a large surface area and shallow depth. There are many other factors that will moderate the balance of solar radiation to heat convection, such as wind induced mixing, water quality (e.g. turbidity levels can influence how deep solar radiation can penetrate into the water column), loch aspect and shading (e.g. by local topography, trees etc.), and locally by inflowing streams. Overall, the combination of climate and bathymetry, moderated by these other lesser factors, controls loch water temperature.

The Headpond will be filled repeatedly with water abstracted from Loch Awe as the Development generates and re-charges. Once in the Headpond the abstracted water will begin to take on the character reflective of the environmental characteristics of the Headpond. The longer the water is stored in the Headpond at any time the greater potential for differences in water quality between Loch Awe and the Headpond to develop. It is difficult to predict these changes with any certainty but there are factors that can be considered to determine how likely water temperature may change. Water will also pass through deep tunnels and generator turbines prior to discharge, and this could also contribute to any changes in water temperature observed in Loch Awe:

- Based on the volume and bathymetry of the Headpond it is not expected that water temperature will be significantly different to that in Loch Awe. The Headpond will remain a large and deep water body, and at slightly higher elevation surrounding air temperature may also be slightly cooler. Freshening flows from feeder streams associated with the Allt Beochlich catchment that will be severed by the filling of the Headpond will also help to moderate water temperature in the Headpond.
- During power generation water would pass through tunnels deep beneath the hillside. At a maximum depth of around 400 m below ground level there could be an increase of 10-20oC to the temperature of bedrock surrounding the tunnels. The tunnels will be lined with either concrete or steel. Concrete has a high thermal conductivity and steel has a very high thermal conductivity so this heat could be transferred to the water in the tunnels. However, water would pass through the tunnels relatively quickly and the large volumes will likely have a cooling effect on the tunnels themselves.
- If the discharged water is warmer than that in Loch Awe it would likely rise and form a plume across the surface of Loch Awe dissipating and dispersing the further from the outlet, and increasingly so once the Headpond has emptied (as it is a non-continuous discharge). In the less likely event that the water is cooler upon discharge, it is likely to plunge deeper into the Loch, before dissipating and dispersing. Under both scenarios, once the Headpond has emptied it is expected that after a short period of time water temperature conditions would return to ambient reflective of the balance of solar radiation and convection heat loss as moderated by a range of other factors at any given time.

Overall, a localised negligible adverse impact is predicted on Loch Awe, which is of high importance or water quality, resulting in a **minor adverse effect (not significant).**

11.7.8.9 Impact on Water Quality in Loch Awe – Risk from Concrete Residues

When first constructed there may be a concrete residue left on the Embankment damming the Headpond, which will be lined with concrete. The vast majority of the Headpond basin will not be lined with concrete. During commissioning of the Headpond this concrete residue may be washed off and that might lead to a small increase in pH of the water in the Headpond. However, due to the large storage volume it is expected that this effect would be small and would be short-term as any residue is washed off over time. As the Development will be operated through a number of initial cycles this residue would be washed off and further diluted and dispersed in Loch Awe. Overall, a negligible adverse impact on the high importance Loch Awe is predicted, resulting in a short-term, temporary but **minor adverse effect (not significant).**

11.7.8.10 Impact on Water Quality in Loch Awe – Increased Risk of Algal Blooms (Not Stratified Loch Conditions)

Loch Awe has a history of blue-green algae blooms as outlined in *Section 11.6 Baseline Environment*. Therefore, it is also important to consider whether the operation of the Development might increase the frequency of such events occurring in the future. This section considers the risk of increasing the frequency and duration of algal blooms when Loch Awe is not stratified. The impact of the Development on thermal stratification, and implication for the risk if algal blooms was discussed earlier.

Algae blooms are the rapid growth of algae or algae-like bacteria in a water body. In some lochs, algal blooms are a natural occurrence, particularly where there is an abundance of nutrients and periods of quiescent climatic conditions. However, harmful algal blooms occur when colonies of algae grow at a rapid rate and produce toxins or have other harmful effects on people, marine animals, terrestrial animals, birds and water quality. Many harmful algal blooms occur due to excessive growth of blue-green algae (i.e. cyanobacteria). However, non-toxic algae blooms can also deplete oxygen levels within a water body as they decay, and other than toxins produced by some forms of cyanobacteria, this is perhaps the most significant water quality risk. In addition, as algae grow, they consume carbon dioxide and this can result in significant increases in water pH, which is also relevant to a range of water quality and biological processes. Large and dense algal blooms may also smother littoral habitats and substrates within a water body and reduce light availability for photosynthesis by blocking sunlight at the surface. Where the water body thermally stratifies, the decay and decomposition of algae can accelerate the depletion of dissolved oxygen in the hypolimnion, and thus may exacerbate the risks to water quality upon overturn as discussed earlier. This includes encouraging further release of sediment-derived nutrients and the potential to seed additional algae blooms following overturn.

Tippett (1978) (Ref 11.44) found that the productivity of phytoplankton reduced around the vicinity of the Cruachan Hydro Scheme power station. It was also found that phytoplankton populations within the Headpond are much lower and less diverse than Loch Awe (Ref 11.44). It is not clear what the causal mechanisms were for these effects, but the regular passing of water between the Headpond and Loch Awe via turbines and screens, the increased mixing in the vicinity of the Tailpond inlet / outlet, and other possible changes to the local aquatic ecosystem may be influencing factors. It is possible that similar changes to the phytoplankton populations occurs in the vicinity of the Tailpond inlet / outlet for the Development during operation. This would imply that the risk from algal blooms from the operation of the Development would be lower, although this is a complex issue.

Furthermore, regardless of species, algal blooms respond in similar ways to key environmental factors such as nutrients, temperature and light, by employing similar growth and defence strategies to maximise growth (Wehr et al 2014). However, this is not to say that the factors controlling algal blooms are not numerous or the processes complex, which they are. Excluding changes to thermal stratification, which has been discussed above, water temperature and nutrient levels are the two principal factors that the Development may influence during its operation. However, it is predicted that the operation of the Development is unlikely to significantly encourage more frequent algae blooms because:

- The water temperature of water discharged from the Headpond is not expected to be significantly warmer than that in Loch Awe (see section on ‘Impact on water quality in Loch Awe – Headpond discharges (temperature)’ above).
- It is not anticipated that water in the Headpond will be significantly enriched by nutrients as the water in the Headpond would be abstracted from Loch Awe or otherwise from small feeder streams draining an upland catchment that is not expected to have a high nutrient load. The flow from these streams would also otherwise drain to Loch Awe naturally.
- Overtime, sediment may build up in the Headpond, which raises the possibility of persistent recycling of nutrients and an increasing source of excess nutrients to Loch Awe. However, sediment build up rates are expected to be low because of the character of the upland catchment and likely low primary productivity in the Headpond. Regular generation cycles will also reduce the risk of anoxic bottom water conditions developing that encourage the release of sediment-derived phosphorus. The build-up of sediments could be monitored and at an appropriate point in the future, excess sediment could be removed for disposal in accordance with waste legislation prevailing at the time.
- The risk of nutrient enrichment is greater if water in the Headpond became stagnant for an extended period of time and nutrients were allowed to build up, particularly in the longer term when there may be more sediment stored in the basin that could be a source of nutrients under certain conditions, and if the Headpond is not recharged. However, regular operation would prevent this, and even after full draw down, the volume of water left in the Headpond remains large (i.e. > 6 Mm^3 to dilute nutrients). As mentioned previously, the nutrient levels in the Headpond are not expected to be high.
- There is a high dilution and dispersion potential in un unstratified Loch Awe.

Overall, a long term but intermitted negligible adverse impact is predicted, which on the high importance Loch Awe, results in a **minor adverse effect (not significant)** without mitigation.

11.7.8.11 Surface Water Runoff and Spillage Risk During Operation

During operation there is a low risk that small quantities of oil or fuel may be spilled from service vehicles and the routine maintenance of fixed plant. The greatest risk would be for any works undertaken to fixed plant as part of the outlet / inlet structure due to the proximity to Loch Awe or to the Headpond. This risk would apply permanently and for the long term during the operation of the Development, but any impact would be more temporary, short term and unlikely to occur. To manage the risk, all maintenance operations would be carried out in accordance with the Operators Environmental Management System, which will include measures to avoid spillages of chemical substances. There will be SuDS measures implemented on above ground installations (where possible or otherwise proprietary measures included) that will help capture and treat runoff from new impermeable surfaces. The design of surface water drainage systems, incorporating appropriate attenuation and treatment measures, will be undertaken post-consent as part of a Detailed Design Strategy. This could be prepared pursuant to a planning condition. *Table 11.30* outlines the potential impacts and effects to water features from potential spillage risks during operation.

Table 11.30 Impacts and effects to surface water feature from surface water runoff and spillage risk from new urban surfaces

Loch Awe Catchment	NGR	Direction and Distance to the Development	Importance	Impact	Effect
Loch Awe	NN 00437 16188	All water features within the Main Area drain into Loch Awe. There is a Tailpond inlet / outlet where water will be abstracted and discharged.	High	**Negligible adverse impact -** Potential spillages from works associated to the Tailpond inlet / outlet structure. A Low, uncertain, direct impact is predicted in the long-term.	Minor Adverse (Not significant)
Allt na Cuile Riabhaiche and tributaries (LA2)	NN 06346 19768	Runoff and spillage risk from Access Tracks that also cross the Upper Sonachan / Keppochan Forest.	Low Importance	**Negligible adverse impact -** Potential spillages from Access Track. A direct but unlikely negligible impact is predicted in the long-term..	Negligible (Not significant)
Keppochan River and tributaries (LA3)	NN 07270 19990	Runoff and spillage risk from Access Tracks that also cross the Upper Sonachan / Keppochan Forest.	Low Importance	**Negligible adverse impact -** Potential spillages from Access Track. A direct but unlikely negligible impact is predicted in the long-term.	Negligible (Not significant)
Archan River and tributaries (LA4)	NN 08466 20254	Runoff and spillage risk from Access Tracks that also cross the Upper Sonachan / Keppochan Forest.	Low Importance	**Negligible adverse impact -** Potential spillages from Access Track. A direct but unlikely negligible impact is predicted in the long-term, although any impact from a spillage would be temporary.	Negligible (Not significant)
Allt a Chrosaid and small lochan (LA5)	NN 02937 16523	Runoff and spillage risk from PC21 and upgraded crossing of B840 crossing. PC21 is situated approximately 29 m south of LA5.	Low Importance	**Negligible adverse impact -** Potential chemical spillages from Access Track and in surface water runoff from PC21. A direct but unlikely negligible impact is predicted in the long-term, although any impact from a spillage would be temporary.	Negligible (Not significant)
Allt Beochlich and tributaries (LA6)	NN 03502 15714	Runoff and spillage risk from Access Track and PC09.	Medium Importance	**Negligible adverse impact -** Potential spillages from Access Track and PC09. A direct but unlikely negligible impact is predicted in the long-term, although any impact from a spillage would be temporary.	Negligible (Not significant)
Lochan Beochlich (LA8)	NN 03030 15414	Runoff and spillage risk from PC09 situated upstream of lochan.	Low Importance	**Negligible adverse impact -** Potential spillages from Access Track and PC09. A direct but unlikely negligible impact is predicted in the long-term, although any impact from a spillage would be temporary.	Negligible (Not significant)
Lochan Romach (LA10)	NN 02811 15735	Runoff and spillage risk from PC19 and Access Track that is situated 100 m upstream of LA10.	Low Importance	**Negligible adverse impact -** Potential spillages from Access Track and PC19. A direct but unlikely negligible impact is predicted in the long-term, although any impact from a spillage would be temporary.	Negligible (Not significant)
Allt na Fainge (LA12)	NN 01216 16501	Runoff and spillage risk from upgraded B840 crossing.	Low Importance	**No Impact –** No material changes in traffic flows serving the development and the area of road effected is small.	N/A

Loch Awe Catchment	NGR	Direction and Distance to the Development	Importance	Impact	Effect
Allt a' Ghreataidh (LA13)	NN 01200 16313	Runoff and spillage risk from upgraded B840 crossing.	Low Importance	**No Impact –** No material changes in traffic flows serving the development and the area of road effected is small.	N/A
Alt Mor (LA14)	NN 01160 16630	Runoff and spillage risk from upgraded B840 crossing.	Medium Importance	**No Impact –** No material changes in traffic flows serving the development and the area of road effected is small.	N/A
Cladich River/Allt an Stacain (LA17)	NN 09638 22424	600 m downstream of Sonachan / Keppochan Forest track that may be used for access. But may be affected by any impacts to LA3 or LA4 as they are hydraulically linked.	Medium Importance	**Negligible adverse impact -** Contaminated run-off could wash into Cladich River from Keppochan River (LA3) and Archan River (LA4). A Low, uncertain, direct impact is predicted in the long-term.	Negligible (Not significant)
Unnamed watercourse (LA18)	NN 01125 15692	Runoff and spillage risk from upgraded B840 crossing.	Low	**No Impact –** No material changes in traffic flows serving the development and the area of road effected is small.	N/A
River Aray and tributaries (LF1)	NN 09003 10169	Runoff and spillage risk from upgraded road across the River Aray at NN 09165 09855.	High Importance	**No Impact –** No material changes in traffic flows serving the development and the area of road effected is small.	N/A
Crom Allt and tributaries (LF2)	NN 08592 07409	Runoff and spillage risk from proposed Access Tracks that also cross part of Crom Allt at NN 08415 07691	Low Importance	**No Impact –** No material changes in traffic flows serving the development and the area of road effected is small.	N/A

11.7.8.12 Compensation Flow Downstream of the Embankment

The Development lies within the catchment of the Buinne Dhubh watercourse, which becomes the Allt Beochlich watercourse (LA6) downstream of a man-made impoundment (referred to as Beochlich Lochan) at around NN 03034 15412. Beochlich Lochan (LA8) is approximately 1.8 ha in area and supplies a local 1MW 'run of river' hydroelectric power (HEP) scheme that opened in 1998. Allt Beochlich and Buinne Dhubh watercourse is also a WFD designated water body (both considered within LA6).

The construction of the Headpond will result in the loss of approximately 5.4 km^2 of LA6 catchment (approximately 45%) broadly upstream of the confluence of the overflow from Lochan Airigh (LA7) to the Buinne Dhubh watercourse. This includes flows from Lochan Dubh and a number of 1st and 2nd order tributaries of the Buinne Dhubh watercourse that drain the west facing slopes of Cruach na Gearr choise mountain (see *Figure 2a Surface Water and Groundwater Receptors and Attributes – Headpond Study Area (Volume 3: Figures)*).

The loss of a large proportion of the catchment could result in significant changes in hydrology and the flow regime downstream of the Headpond impoundment. Without a compensation flow the remaining downstream reach would be depleted with reduced flows when compared to the current baseline. Depending on the morphology of the channel at any given location, reduced flows may correspond to a drying up of parts of the bed with the reduced wetted permitter corresponding with reduced aquatic habitat along the river corridor. Reduced flows may also mean less dilution of chemical substances or the flushing of excess fine sediment. During prolonged warm weather there may also be longer periods of lower flows and lower oxygen levels, when compared to the baseline situation.

The impact of the loss of catchment would be most significant closest to the impoundment and upstream of any unaffected tributaries. A significant tributary flows into the Buinne Dhubh watercourse just upstream of the Beochlich Lochan. Thus, the worst affected reach would be around 600-700 m long (i.e. between the Headpond Embankment and the confluence with this tributary). The impact downstream of the man-made impoundment at Beochlich Lochan would be less pronounced as the flow regime is already modified by the operation of the local HEP scheme. Other tributaries regularly join the main channel of Allt Beochlich including those draining north from woodland to the south and from Lochan Romach to the northeast. However, without a compensation flow, the future flow regime will be depressed.

The Development abstracts water from Loch Awe and thus unlike conventional hydro-power schemes does not require use of any flow from within the catchment. Given the storage volumes in the Headpond there will always be a source of water from which to provide a compensatory flow. During detailed design, a passive structure will be designed that allows a compensatory flow to be passed forward. Details of this can be determined as part of a future CAR licence application. Overall, although a compensation flow can be provided, the construction of the Headpond and its operation is expected to result in a flow regime along the Allt Beochlich that is further altered from that as a result of the local HEP scheme. However, the impact would be most pronounced between the Headpond Embankment and the first major downstream tributary of the Allt Beochlich which is a reach of around

700-800 m. A permanent, long term and direct medium adverse impact is predicted on the medium importance Allt Beochlich resulting in **minor adverse effect (not significant)**.

11.7.8.13 Impact on Groundwater

The key factor identified affecting groundwater during the operation phase is the ongoing presence of the Waterways, Power Cavern Complex and Access Tunnels. As the Waterway will be lined, the risk of groundwater entering the tunnels or pumped water leaking to ground is minimal. At the depth of Power Cavern Complex, the amount of fracturing will reduce and so the inflow will also reduce (especially with the construction methods mentioned under section 11.7.2 Effects on groundwater). The magnitude of impact on all groundwater receptors is considered to be negligible adverse, resulting in a **negligible adverse effect (not significant**), considering the low importance of groundwater in this study area.

The Headpond Embankment will be concrete-lined and filled with water fed from Loch Awe (i.e. it will be a 'closed' system and should not interfere with local groundwater). No groundwater resource or water quality issues are expected during the operation phase. The magnitude of impact on all groundwater receptors is considered to be negligible, which on the low importance underlying bedrock groundwater body results in a **negligible adverse effect (not significant)**. On the high importance superficial groundwater body a negligible adverse impact also results in a **negligible adverse effect (not significant).**

11.7.8.14 Effects on Hydromorphology

The Development will result in the loss of some water features, as well as having the potential for other adverse impacts to their hydromorphology from loss of discrete channels, changes to the flow regime, permanent watercourse crossings, and changes in rate and volume of runoff from permanent above ground installations during the operation phase.

11.7.8.14.1 Construction of Embankments and Headpond

The main Embankment for the proposed Headpond will cross the Allt Beochlich and will completely block its natural course and infill the entire valley. The subsequent flooding of the Headpond will inundate the valley, resulting in the permanent loss of the main channel, a number of first and second order tributaries, and Lochan Airigh. Loch Airigh is considered to be of low importance for water quality. Its loss is a high adverse impact, which results in a **moderate adverse effect (Significant).** The construction of the Headpond will also result in changes to the flow regime downstream and the associated capacity of the watercourse to transport coarse sediment. The design will include a structure to allow natural flows to be passed forward to the downstream channel (i.e. a compensation flow). When the reservoir is full, the scheme will affect approximately 1.7 km of the main stem channel (from the proposed Embankment site to the proposed top water level) and several tributaries to the Allt Beochlich. The affected reaches will be drowned within the reservoir and will not be functional as discrete watercourses. It is therefore assessed that the permanent impact of the Headpond would be medium adverse, which given the medium importance of Allt Beochlich for hydromorphology, results in a **moderate adverse effect (Significant).**

The impact of the change to the transport capacity of the Allt Beochlich downstream of the main Headpond Embankment will be limited, assuming as natural a flow regime as possible can be maintained Drowning of reaches of the watercourses upstream may however impede sediment transport through the flow route. Sediment transport is also already disrupted due to the presence of the reservoir (i.e. Lochan Beochlich, LA8) and a small hydropower scheme approximately 1.5 km downstream of the proposed Embankment location. The channel of the watercourse in this location is dominated by bedrock and therefore it is very stable and has a low sensitivity to physical modifications therefore significant channel change is not anticipated. It is therefore assessed that the permanent impact of the Embankment on sediment transport in this reach will be medium adverse, which given the medium importance of the receptor for hydromorphology, results in a **moderate adverse effect (Significant).**

Permanent compound PC09 is located over the Allt Beochlich, downstream of the main Headpond Embankment. It is assumed that the watercourse would be diverted around the compound, resulting in a long term, permanent impact, affecting around 80m of the channel length. In this location, the channel has a shallower gradient than upstream, and coarse sediment depositional features are present. An appropriate channel design will be required, including translocation of existing coarse sediment and maintenance of the current channel gradient where possible. It is therefore assessed that the permanent impact of the diversion of the Allt Beochlich around PC09 will be low adverse, which given the medium importance of the receptor for hydromorphology, results in a **minor adverse effect (not significant).**

11.7.8.14.2 Watercourse Crossings

The majority of the river crossings outlined Section 11.7.6 in will be retained as permanent routes, therefore the operation phase impact has already been assessed.

11.7.8.14.3 Runoff from Hardstand Areas

Surface water runoff from permanent compounds will need to be managed and this may require new surface water outfalls to watercourses where infiltration is not possible. The construction of new hardstanding areas also has the potential to increase run-off to watercourses, which could cause erosion downstream. The area of hardstanding to be introduced is small within the context of the catchment areas of the watercourses downstream of the compound and is therefore unlikely to cause a detectable increase in flows. Surface water runoff from permanent compound areas will also be attenuated and treated using SuDS or other proprietary measures. Finally, the watercourses that might receive flows are predominantly stable, with bedrock typology, and will be generally resistant to severe erosion. The proposed permanent compounds and potentially affected watercourses are listed in *Table 11.31* below.

Table 11.31 Permanent Compounds and Affected Watercourses

Compound Name	Affected Watercourse	Direction and distance between compound and water feature	Hydro-morphological Importance	Impact	Effect
PC03	Allt a Chrosaid (LA5) and Allt a Geataidh	Approx. 60 m to north and approx. 80 m to south and approx. (respectively)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC05	Unnamed tributary discharging directly to Loch Awe	Approx. 70 m to north (across slope)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC06	Small tributary to Allt Beochlich (LA6)	Approx. 30 m to north (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC09	Allt Beochlich (LA6)	0 m	Medium Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC14	Allt na Cuile Riabhaiche and tributaries (LA2)	Approx. 55 m to northwest (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC17	Unnamed tributary to Loch Airigh	150 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC18	Unnamed small lochan and tributary to Loch Airigh	110 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC19	Unnamed small lochan and tributary to Loch Airigh	110 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC20	Unnamed tributary to Lochan Romach	100 m to west (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)
PC21	Allt a Chrosaid	30 m to south (upgradient)	Low Importance	**Negligible adverse**	Negligible adverse effect (not significant)

11.7.8.14.4 Loch Awe Tailpond Inlet / Outlet Structure

The permanent Tailpond inlet / outlet structure on the shore of Loch Awe will not alter the size, shape or morphology of the Loch. However, there will be approximately 150 m of bank modified from natural green bank to artificial grey bank, due to the presence of the structure. There will be some loss of the marginal zone of the Loch over this length, with the water close to the outlet becoming deeper than at present. Within the size and scale of Loch Awe the impact is assessed to be negligible. As Loch Awe has been classified as medium importance for hydromorphology, this results in a **negligible adverse effect (not significant).**

11.7.9 Decommissioning Phase

Hydropower assets are very durable and, consequently, it is very rare for large-scale hydro projects to be decommissioned. Rather, they may be refurbished or adapted. However, it is assumed that if the decommissioning of the Development is required, then similar activities to the construction, potentially with additional crushing of construction materials and removal of drainage pipework containing residual water and sediment (as per *Chapter*

2: Project and Site Description). These works could result in similar impacts on the water environment as during the construction phase, albeit at a lower scale and smaller spatial distribution, and with minimal excavation and earthworks.

It is likely that the following decommissions activities would occur:

- Water could be drained from the Headpond and released at an agreed rate and timescale through the appropriate licensing regime into Loch Awe;
- The Waterways and tunnel portal entrances will be blocked off with local spoil;
- The Tailpond inlet / outlet structure will be removed;
- The control building, substation and battery housing will be removed;
- To prevent any incident with the Headpond filling up, the scour valves will remain open, and the spillway pipe and the Headpond inlet / outlet structure will be left in place.

During decommissioning, surface water run-off containing excessive amount of fine sediment or chemicals such as fuel oil may enter and contaminate nearby water features such as Loch Awe if the works are not managed correctly. It is assumed that the works would be undertaken in accordance with a Decommissioning Environmental Management Plan (DEMP) which would have a similar scope to the CEMP and also refer to good practice guidance, as set out later in *Section 11.9*. It is also assumed that a Sediment Management Plan would be agreed with SEPA, and relevant actions would be implemented at decommissioning stage. However, with standard mitigation, the potential impacts and effects as described for the construction phase would typically occur. Following decommissioning of the infrastructure on site, a Water Features Restoration Plan should be implemented, to allow for reinstatement of river processes in the affected reaches. This may require removal of fine sediment and replanting. The reinstatement should be informed by preconstruction photographic survey and mapping. This could result in significant beneficial effects to the water environment if implemented.

As decommissioning is expected to require its own consents and licences at the time, it is assumed that any management plans that are required will be prepared at a later stage.

11.8 Cumulative Effects

Intra-relationship and inter-relationship cumulative effects have been considered as part of this water environment impact assessment, and the results presented below.

11.8.1 Inter-Cumulative Effects

The cumulative effects assessment is based on the Developments identified in *Chapter 4: Approach to EIA.* The Cumulative Developments identified are those that are reasonably foreseeable - i.e. in the public domain (e.g. at scoping stage or has been consented but not yet under construction / constructed at the point of writing the assessment / at submission).

Inter-relationship cumulative effects have assessed qualitatively where committed development is proposed that could have cumulative effects with water features that may be affected by the Development, either during construction or operation phases.

Table 4.8 in *Chapter 4: Approach to EIAR* lists all the committed developments in the wider area around the Development Site that have been considered by this EIAR. *Table 11.32* provides a summary of potential cumulative effects with these committed developments.

Table 11.32 Cumulative Effects

Development	ECU/ABC Reference	Description	Distance to Tailpond and Tunnel Portals (m)	Distance to Headpond (m)	Cumulative Effect
Cruachan Hydro Scheme	unknown	440 MW pumped storage hydro scheme that uses Loch Awe as a Tailpond. Operational since 1965	10689	11017	Cumulative impacts on water level within Loch Awe, which could influence water quality. Disturbance of the water column during seasonal thermal stratification could also lead to more widespread changes in Loch Awe.

Development	ECU/ABC Reference	Description	Distance to Tailpond and Tunnel Portals (m)	Distance to Headpond (m)	Cumulative Effect
Cruachan Expansion	ECU00004492	Increasing the capacity of the existing PSH scheme by up to 600 MW.	10674	11003	However, Cruachan Power Station is situated within the north basin over 17 km from the Development. Thus, there will unlikely be any interaction between the operation of the two pumped storage schemes and therefore cumulative effects in terms of water quality.
Blarghour Wind Farm - Consented	EC00005267	Wind farm development comprising 17 turbines with a total installed capacity of 57.8 MW.	1105	169	If built and the necessary land rights secured, the wind farm Access Track will also be used to access the Balliemeanoch Main the Development Site. Therefore, there may be inter-cumulative effects with increased traffic flow. Which could lead to potential contamination impacts at water crossings. However, appropriate mitigation measures will limit this. Additionally, the Balliemenaoch vehicles movements on the track will likely be very low, thus a very low impact.
Blarghour Wind Farm Variation	ECU00004481/ ECU00004754 / 23/00537/S36	To increase the height from 136.5 m to 180 m.			

11.8.2 Intra-Cumulative Effects

There is the potential for intra-relationship effects between the assessment of effects of water quality, morphology and ecology. Firstly, it is important that the biological value of water features is carefully taken into account and that any physical modifications or river enhancements also consider the effects on ecological receptors. Generally, it is assumed that by improving water quality, hydraulic conditions and morphological diversity there would be associated biological benefits. Alternatively, on rare occasions, modified river morphology may support a sensitive ecological receptor or have heritage value, and these themselves may be important features that then restrict the type of hydromorphological improvements that can be made.

There are also potential intra-relationship effects which occur between shallow superficial aquifers, GWDTEs and geology/ground conditions. The removal of peat could impact the natural flow regime of rain-derived superficial aquifers and thus GWDTEs.

11.9 Mitigation and Monitoring

The following section describes the mitigation and monitoring that is proposed to avoid, minimise, reduce and compensate for predicted adverse effects to acceptable levels or to ameliorate non-significant effects in accordance with good practice.

11.9.1 Embedded Mitigation

There are a number of potential water quality, morphological, hydrological and drainage impacts that could occur as a result of the Development. With mitigation however, the potential impacts could be avoided, minimised and/or reduced. Mitigation measures that have been designed into the Development and are therefore considered as 'embedded mitigation' have been taken into consideration in the assessment of the significance of effects on the water environment. A more detailed description of the embedded mitigation relevant to a particular effect / receptor is provided in this section. Details of the Development and other mitigation measures can be found within *Chapter 2: Project and Site Description* and the scheme drawings can be found within *Volume 3: Figures* of this EIAR Chapter, *Figures 2.5* to *2.18.*

11.9.1.1 50 m Water Feature Buffer

The Development Components have been sited to avoid water features where possible, although for large spatial components such as the Headpond, this is practically not possible. As per the advice from SEPA (see *Table 11.3*) all water features have had a 50 m buffer applied to them to ensure that wherever possible new permanent infrastructure or temporary compounds are set back. This will help to mitigate the risk from construction and operation phase runoff (including chemical spillages) as well as avoid physical impacts. However, in addition to the Headpond, there are some locations where it is not possible to maintain this 50 m buffer zone. Many of these occurrences relate to watercourse crossings (either new crossings or where an existing crossing may need to be modified), but there are others. In their EIA scoping opinion response SEPA requested that where the 50 m buffer could not be maintained that these breaches should be clearly identified in the EIAR. Each breach is listed in *Table 11.33* alongside the justification for the breach. They are also shown on *Figure 11.2a: Surface Water and Groundwater Receptors and Attributes – Headpond Study Area* and *Figure 11.2b: Surface Water and Groundwater Receptors and Attributes – Loch Fyne Study Area (Volume 3 Figures).*

Table 11.33 Breaches of 50 m buffer zone

Water Feature	Proposed Works/Component	Proximity to works	Justification for breach of 50 m buffer zone
Loch Awe	TC02	Bank edge	Compounds are located to facilitate the construction of the Tailpond inlet / outlet structure that is located on the margins of Loch Awe and thus need to be located within the 50 m buffer zone.
	PC03	Compound 46.5m from Loch Awe	
River Aray and tributaries (LF1)	Upgrade existing watercourse crossing - C1, C2 and C3 *(Appendix 11.4 (Volume 5: Appendices))*	Crosses watercourse	Cannot be moved as access required to avoid vehicles moving through Inveraray.
Crom Allt and tributaries (LF2)	Upgrade existing watercourse crossing – IN1, IN2, IN3 and IN4 *(Appendix 11.4 (Volume 5: Appendices))*	Crosses watercourse	Cannot be moved, access required to avoid vehicles moving through Inveraray.
Allt na Cuile Riabhaiche and tributaries (LA2)	New watercourse crossing – F1, F2 and F3 Upgrade existing watercourse crossing - F4, F5 and F6 *(Appendix 11.4 (Volume 5: Appendices))*	Crosses watercourse	Cannot be moved as required for access to the Development Site.
Keppochan River and tributaries (LA3)	Upgrade existing watercourse crossing – F7 and F8 *(Appendix 11.4 (Volume 5: Appendices))*	Crosses watercourse	Cannot be moved as required for access to the Development Site.
Archan River and tributaries (LA4)	Upgrade existing watercourse crossing – F11 *(Appendix 11.4 (Volume 5: Appendices)*	Crosses watercourse	Cannot be moved as required for access to the Development Site.
Allt a Chrosaid and small lochan (LA5)	PC21	Compound approx. 29 m upgradient from water feature	Located to avoid impacts to other environmental receptors such as peat.
	Upgrade existing watercourse crossing – B3 *(Appendix 11.4 (Volume 5: Appendices)*	Crosses watercourse	B840 crossing.
Allt Beochlich and tributaries (LA6)	Embankment and Headpond	Cuts off Allt Beochlich catchment area	Cannot be moved as a major component of the design.
	PC09	Compound area includes a reach of Allt Beochlich upstream of proposed Embankment	Located to incorporate area for the compensation flow scheme to compensate the downstream flow to LA6 thus must be positioned close to the watercourse.
	TC08	Situated immediately upgradient of a tributary of Allt Beochlich	Located to incorporate area for the compensation flow scheme to compensate the downstream flow to LA6 thus must be positioned close to the watercourse.

Water Feature	Proposed Works/Component	Proximity to works	Justification for breach of 50 m buffer zone
	PC06	Compound is approx. 33 m upgradient from a tributary of Allt Beochlich	Portal for tunnel. Located to avoid impacts to other environmental receptors such as peat.
	Upgrade existing watercourse crossing – B4, B5, B6 and B7 New watercourse crossing - B10, B11 and B12, New watercourse crossing - B17, B18, B19, B20, B21, B22, B23, B24, B25 and B26 (Appendix 11.4 Volume 5)	Crosses watercourse	Crossings required for Access Tracks.
Lochan Airigh (LA7)	Embankment and Headpond	Lochan Airigh will be completely lost to the Development	Cannot be moved as a major component of the design.
Lochan Beochlich (LA8)	TC07	Compound is approx. 33 m upgradient from Lochan Beochlich	Located to avoid impacts to other environmental receptors such as peat.
Allt na Fainge (LA12)	Upgrade existing watercourse crossing – B1 (Appendix 11.4 Volume 5)	Crosses watercourse	Existing B840 crossing.
Allt a' Ghreataidh (LA13)	Upgrade existing watercourse crossing – B2 (Appendix 11.4 Volume 5)	Crosses watercourse	Existing B840 crossing.
Unnamed Watercourse (LA18)	Upgrade existing watercourse crossing – B4 and B5 (Appendix 11.4 Volume 5)	Crosses watercourse	Existing B840 crossing.

11.9.1.2 Management of Water Quality Risks From Permanent Development

Each of the permanent and temporary compounds will include sustainable drainage and / or proprietary drainage measures to intercept and treat surface water run-off from the Development during construction and operation.

During construction, measures may include temporary earth ponds / settlement lagoons, ditches, fabric silt fences, the use of silt busters or lamella clarifiers, dewatering / sediment bags (e.g. silt tubes), silt curtains, and measures to manage spillage risks such as designated bunded refuelling areas. Spoil storage and processing from the construction of the Headpond will be within the Headpond area at TC15. Further details are provided later in this section under 'Standard Mitigation.'

To minimise the risk of chemical spillages, a cut off drain will be installed at the toe of the new Embankment to collect water run-off during construction and prevent it, and any chemicals that may have been spilled, propagating from the Development Site without treatment.

During operation, surface water runoff from permanent above ground facilities will be treated using sustainable drainage systems (e.g. ditches, swales, ponds etc.) where possible or otherwise proprietary treatment measures will be considered (e.g. filter drains, vortex flow separators). The Access Tracks will have swales to capture and treat any runoff. The design of surface water drainage systems, incorporating appropriate attenuation and treatment measures, will be undertaken post-consent as part of a Detailed Design Strategy. This could be prepared pursuant to a planning condition. The type of treatment measure and the number of treatment train components will be determined during detailed design. This will be informed by a water quality risk assessment applying the Simple Index Approach described in C753, The SuDS Manual (Ref 11.51).

11.9.1.3 Headpond and Interception of Watercourses

Allt Beochlich will be intercepted from around NN 03855 15923 by the Embankment. This will cut off much of Allt Beochlich Catchment area including multiple tributaries and Lochan Airigh. This area will be completely lost to the Development. Flow downstream of NN 03855 15923, will be compensated with a compensation flow scheme. More details of this can be found below at, 'Compensation Flow'.

11.9.1.4 Embankment Construction Method

At this stage there is no detailed construction method for the construction of any of the two proposed Embankments For this assessment it has been assumed that a concrete box culvert will be constructed offline in the location of the main Embankment along the face of the Headpond but adjacent to the Allt Beochlich. The Allt Beochlich will then be diverted through the culvert, which will allow flows to be maintained while the Embankment is constructed either side and over the culvert. The culvert will be plugged to allow the Headpond to fill once construction of the Embankments and associated infrastructure is complete.

11.9.1.5 Tailpond Inlet / Outlet

To avoid fish and debris entrainment, the Tailpond inlet / outlet structure where the Waterways terminate into Loch Awe, will incorporate a suitably sized screen mesh. The screen also acts as an energy dissipation measure to reduce the velocity of the water discharging from the Development. This ensures that the 0.3 m/s maximum discharge velocity is not exceeded. Also, the spillway outlet will contain energy dissipation components to reduce the force of the water entering the Loch and causing scour of the bed.

The loch bed of Loch Awe will be reprofiled to accommodate a new level of 18.2 m AOD. The Tailpond inlet / outlet structure will be approximately 18 m deep (within the bank of Loch Awe). The tailrace divides into Loch Awe from the Lower Gatehouse just upstream of the outlet which is fronted by two sets of screens 74 m wide and around 19 m high. The majority of the structure is either sub-surface within the bank of Loch Awe or beneath the water level of the Loch (as shown on *Figure 2.16 Indicative Tailpond inlet / outlet Cross Section (Volume 3: Figures)*). The Tailpond inlet / outlet structure consists of an inclined screen and a screen cleaning mechanism, stoplog, rock armour and silting chamber.

11.9.1.6 Allt Beochlich Compensation Flow

To ensure that significant impacts on the downstream flow regime for LA6 are avoided, including ecology and the local HEP scheme, it is proposed to ensure that a suitable compensation flow is maintained at all times. Unlike other HEP schemes, water for the pumped storage scheme is abstracted from Loch Awe rather than the catchment in which the Headpond is located. Flow into the catchment from further upstream can be effectively passed forward to maintain downstream flows and the existing flow regime as far as practically possible. The outlet from the Headpond to the LA6 watercourse downstream of the Embankment will be set at a low elevation within the Headpond so that a source of water is always present regardless of whether the Headpond is in a charged or uncharged state. There are options for how the compensation flow is defined. It could be linked to a control catchment or water level in the Beochlich Lochan so that a penstock is automatically opened or closed to allow a certain flow through the compensation outlet, or a defined flow could be maintained at all times.

It is proposed that the compensation flow will be determined at a later stage as part of the CAR Licence application. In advance of this, a programme of water level and flow monitoring will be undertaken on the LA6 (and tributaries) as well as potentially level monitoring in the LA8 (if such data is not already recorded for the local HEP scheme). This data will inform determination of a suitable compensation flow regime that maintains as close to the current flow regime as is practical. This also the potential to benefit hydromorphological processes, as the compensation flow structure could be designed with a natural bed, to allow transport of coarse sediment from the upstream catchment to the downstream reach.

11.9.1.7 Design of Watercourse Crossings

Two types of watercourse crossings are proposed, outlined on Drawing S03-Z0-02-DR-CE-300601. Closed pipe culverts will be used where existing crossings are to be upgraded and open arch culverts will be used where new crossings are required. During the site survey, a number of existing crossings were viewed and photographed. The crossing type at the visited sites were closed pipe culverts, which appear to have minimal impact on flow and geomorphological processes due to the channel typology (See *Appendix 11.4*). SEPA have created guidance on good practice for river crossings (Ref 11.52) which describes the impact on rivers from different types, replicated in *Diagram 11-2* below. The figure shows that single span structures which retain the natural channel bed have less impact than closed culverts. Therefore, it is proposed that arched culverts will be used for new crossings, to minimise the impact of new Access Tracks.

General increase in impact		
↓	I. Single span structures (bridge or pre cast structures with natural bed - no artificial invert)	V. Pipe or cables under watercourse
	II. Span structures with in-stream supports (bridge or pre cast structures with natural bed - no artificial invert)	
	III. Closed culverts (structures with artificial invert)	
	IV. Fords	

Diagram 11-2 River crossing types extracted from SEPA document wat-sg-25

All crossings are proposed to be permanent, except for B27 and B28 located on a tributary to the Buinne Dhubh, where the temporary construction track on the north side of the Headpond will be constructed. Watercourse crossings are described in *Appendix 11.4*, including which are existing crossings to be upgraded and which will be new.

Wherever there above ground installation, the nearest water body might have an outfall. The detailed drainage strategy will provide this information.

11.9.1.8 Loch Fyne Jetty

A jetty will be constructed within Loch Fyne which will be used for delivery of abnormal indivisible loads (AILs) of materials and equipment during construction, removed post construction and reassembled during operation for maintenance when required. The jetty will be used for delivery of a maximum of 10 shipments (estimated based on a combination of the number of AILs and units that can be carried on a barge appropriate for the size of the Marine Facility) and only at high tide due to the tidal nature of the Loch and the design of the jetty.

The jetty will be constructed with driven piles (not drill and grout) to reduce impacts from dispersion of fine suspended material. Runoff from the jetty is assumed to flow directly to the Loch.

Mitigation measures outlining the protection measures for marine ecologies is described within *Chapter 8: Marine Ecology (Volume 2: Main Report)* and for measures protecting the marine physical environment see *Chapter 18: Marine Physical Environment and Coastal Processes (Volume 2: Main Report)*.

11.9.1.9 Management of Groundwater

The contractor will aim to stem any uncontrolled water/ ingress into Waterways, the Power Cavern Complex and Access Tunnels using a combination of sprayed concrete and/or other forms of lining as appropriate. A significant amount of the construction will be at great depth, where the amount of fracturing will reduce, and therefore inflow will also reduce.

The amount of interaction with the underlying groundwater body will be minimal. Although no springs have been found in this area, if during construction water ingress to the Headpond is discovered, the possible installation of a granular fill beneath the lining may be required.

11.9.2 Standard Mitigation

The Outline Water Management Plan (oWMP) (See *Appendix 11.5, (Volume 5: Appendices)*) describes all measures required to avoid, reduce and minimise adverse impacts on the water environment during construction, including setting out the scope in detail of any water quality or other relevant monitoring.

The oWMP has been developed and will be implemented by the contractor and would support the Construction Environmental Management Plan (CEMP) by describing the measures to protect the water environment during the construction works in greater detail, with reference to specific construction activities and programme e.g. for earthworks or works affecting specific waterbodies.

The mitigation listed in this section will be implemented in accordance with the CEMP and oWMP, and reflect any conditions imposed by SEPA or other statutory consultees through the consenting and future CAR application processes.

11.9.2.1 Control of Construction Water Environment Risks

A CEMP referring to a range of standard mitigation measures will be prepared and implemented by the Contractor as necessary to protect the water environment from pollution and physical impacts during construction works.

Pollution prevention mitigation measures that accord with legal compliance and good practice guidance are to be implemented to:

- Control and minimise the risk of pollution to surface waters and groundwater by managing construction site runoff and the risk of chemical spillages;
- Control the storage, handling and disposal of potentially polluting substances during construction;
- Manage water removed from excavations to ensure to protect nearby water features from any pollution risk but also to support flows if there is a risk of reductions to baseflow.
- If necessary, provide compensatory discharges to surface water features or GWDTEs that are groundwater fed to minimise impacts on the water level and flows to these receptors and any third-party users; and
- Avoid and minimise the risk of damage to physical form and processes of water features.

11.9.3 Secondary Consents

The construction of the Development will be undertaken in accordance with good practice as detailed below. It is assumed that all temporary works will be carried out under the necessary consents/permits (e.g. CAR licences as required under the Water Environment (Controlled Activities) Regulations 2011, (Ref 11.1), and that the contractor will comply with any conditions imposed by any relevant permission. The contractor will ensure that all permits/consents are obtained in advance of any relevant works in, over, under or near watercourses.

11.9.4 Standard Good Practice

There are many ways in which construction pollution risks to the water environment can be dealt with. All works to be undertaken in line with the CEMP for the Development, which shall be developed in the design phase and refined for the consented project in advance of and during construction. Central to this will be a programme of water quality monitoring (described later under *section 11.9.4 Additional Mitigation)* and the implementation of a temporary drainage system. The temporary drainage system will be prepared in accordance with good practice guidance. There will be no direct discharges to groundwater or surface waters without appropriate treatment (where required to meet consent standards); the contractor will ensure that there is adequate space to ensure that appropriate drainage control measures can be implemented for the duration of the construction works; and all secondary consents will be complied with. Further details are provided in the following sections.

11.9.4.1 Management of Construction Site Run-Off

Mitigation measures to management run-off are detailed in the oWMP and are therefore not repeated here in detail. Below is a summary of measures:

- Avoidance of wet weather working where practical, especially site clearance, earthworks and works to water features;
- Appropriate separate storage of topsoil/subsoil and materials, and at least 20 m from water Features on flat ground;
- Any earth bund/ stockpile to be present for longer than two weeks will be either seeded, covered using geotextiles, or other pressures provided to ensure it is not a source of excessive fine sediment in runoff to water features;
- The implementation of a temporary drainage system and other measures to manage pollution risk during construction (e.g., fabric silt fences, lagoons, bunds, straw bales, sandbags, lamella clarifiers or other proprietary measures as may be required) etc.;
- Any dewatering of excavations will include measures where necessary to filter the water prior to discharge to a watercourse or ground (there shall be no discharge of any construction site runoff to existing ponds); and
- The control of mud deposits at entry and exits to the Site using wheel washing facilities and/ or road sweepers operating during earthworks or other times as considered necessary.

Construction works directly affecting water features will require careful management and the implementation of stringent working practices and mitigation. This applies to the construction of the Tailpond inlet / outlet structure within Loch Awe, and to other minor watercourses that may be crossed by new or upgraded Access Tracks, or to which new surface water drainage connections are made.

All works within Loch Awe are to be undertaken behind two levels of containment. Firstly, it is proposed to install a site-specific silt curtain around the working area that would be designed so that it is tailored to the shoreline and anchored to the bed. Secondly, and once the silt curtain has been installed, a cofferdam would be constructed. Any fine sediment mobilised during the construction of the cofferdam would be contained within the silt curtain and would not propagate from the close vicinity of the work and will over time resettle to the bed. Water behind the cofferdam would be pumped out using baffles to prevent any bed / bank erosion or further disturbance of any fine sediment on the loch bed.

Any works in the channels of smaller watercourses will be undertaken in a dry working environment, where possible, with flow temporarily over-pumped or flumed or isolated from the working area using sand/ pea gravel bags or other similar and inert barrier.

11.9.4.2 Management of Spillage Risk

To prevent chemicals, fuels / oils and other such substances from entering the water environment, measures to control the storage, handling and disposal of these substances would be put in place prior to and during construction. The CEMP and oWMP provide detailed information relating to the control of spillages and leaks, and these are not repeated here. However, in summary they include:

- Spill kits will be available on the site in watertight containers (e.g. works near watercourses) and carried on all mobile plant. They would be regularly checked and topped up, especially after use. Appropriate training would be given to all construction workers in their use.
- Storage of fuel and chemicals would be in accordance with GPP 8: Safe storage and disposal of used oils (Ref 11.39).
- Surface water drains on local roads or within the Development compound area will be identified by the contractor and where there is a risk that fine particulates or spillages could enter them, they would be protected (e.g. covers or sandbags).
- Any containers/tanks of contaminating substances (e.g. fuel) onsite would be leak-proof and kept in a safe and secure building or compound from which they cannot leak, spill or be open to vandalism. The containers would be protected by temporary impermeable bunds (or drip trays for small containers) with a capacity of 110% of the maximum stored volume. Areas for transfer of contaminating substances (including refuelling areas) would be similarly protected.
- Any permanent oil storage tanks and temporary storage of 201 litres or more of oil in drums and mobile bowsers, and ancillary pipe work, valve, filters, sight gauges and equipment requiring secondary containment, e.g. bunding or drip trays.
- No oil would be stored within 20 m of a watercourse and potentially further if ground is angled towards a water body except for fixed/large plant associated with the construction of new bridges/culverts or hand tools.
- Where possible re-fuelling will be undertaken in designated areas within main compounds or satellite compounds. It is possible that refuelling of mobile plant may be required by mobile fuel bowser. This will not be undertaken within 20 m of a water feature, and only on flat land (or otherwise a greater distance and other measures may be required subject to an on-site risk assessment) and with a drip tray/plant nappy. Certain semi-mobile very large plant (e.g. crane) may need to be located close to watercourses and potentially within 20 m. Due to the difficulties in moving plant such as this they may need to be refuelled in situ. Again, a site-specific risk assessment will need to be undertaken by the contractor.
- Biodegradable hydraulic oils would be used where possible in all plant and only in equipment working in or over watercourses.
- Any plant, machinery or vehicles would be regularly inspected and maintained to ensure they are in good working order and clean for use in a sensitive environment. This maintenance is to take place offsite if possible or only at designated areas in the site compound.
- All fixed plant used on the Development Site to be self-bunded.
- Mobile plant to be in good working order, kept clean and fitted with plant 'nappies' at all times.
- An Emergency Response Plan or similar titled plan would be prepared and included in the CEMP.

- Spill kits and oil absorbent material to be carried by mobile plant and located at high-risk locations across the Development Site and regularly topped up.
- All construction workers would receive spill response training.
- The Development Site is to be secure to prevent any vandalism that could lead to a pollution incident.
- Construction waste/ debris are to be prevented from entering any surface water drainage or water feature.
- Any site welfare facilities would be appropriately managed, and all foul waste disposed of by an appropriate contractor to a suitably licensed facility. The main compound will have accommodation and welfare facilities. It is expected that a suitably sized storage tank will be provided that would be periodically pumped out by a specialist contractor so that the water could be disposed of at a suitably licensed waste facility.

11.9.4.3 Concrete Batching Plants and Use

Any on-site concrete batching facilities will be located at least 50 m from any water feature, on flat ground, and suitable impermeable hardstanding, so that surface water run-off can be intercepted for either treatment or disposal off-site at an appropriate licensed waste facility. It is assumed that water for use in the process will be delivered to the site from a commercial source rather than abstracted locally. If a local abstraction is proposed in the future, this will be subject to an abstraction licence from SEPA, and thus will not be granted if it is to have significant adverse effects on the water environment or any third-party users.

Significant amounts of concrete will be required for various construction components. This will be a mixture of precast and cast in-situ. Where possible, concrete would not be batched on-site and would instead be delivered on an ‘as and when’ basis in ready mixed lorries. If on-site batching is required these facilities would be located on flat impermeable hardstanding at least 50 m from any watercourse and with a surface water drainage system that is isolated so that no run-off may enter any natural water feature.

Particular care would be taken with the delivery and use of concrete and cement as it is highly corrosive and alkaline. No washing out of delivery vehicles to take place on site without suitable provision for the washing out water and provision of a suitable location (e.g. geotextile wrapped sealed skip, container or earth-bunded area) that is lined with a geotextile to prevent infiltration to ground. Such washing would not be allowed to flow into any drain and the final CEMP/ WMP would contain a methodology for dealing with any washing out water, or wheel wash. Wash water would be adequately contained, prevented from entering any drain, and removed from the Development Site for appropriate disposal at a suitably licensed waste facility.

11.9.5 Additional Mitigation

11.9.5.1 Water Quality and Flow Monitoring Plan

A Water Quality and Flow Monitoring Plan and subsequent delivery of that monitoring is proposed for the following requirements:

- Due to the nature and scale of the Development and the proximity of works to numerous water features and some PWS, it is necessary that a programme of water quality monitoring is carried out in advance of and during the construction phase.
- There is limited data available on water quality, phytoplankton composition and thermal stratification of Loch Awe, and thus it is necessary to gather additional baseline data in advance of the commissioning of the Development in order that subsequent monitoring during initial years of operation have a baseline reference.
- The construction of the Headpond and severance of the upper Allt Beochlich catchment requires the determination of a suitable compensation flow, and this will require flow monitoring of the catchment to generate a baseline flow duration curve.

The following sections describe the need and requirements of the above monitoring in further detail.

11.9.5.2 Pre-construction and Construction Phase Water Quality Monitoring – Water Features

During construction it is proposed to undertake a water quality monitoring programme to ensure that mitigation measures are operating as planned and managing the risk of water pollution effectively. Monitoring will help to ensure that should pollution occur it is identified as quickly as possible and appropriate action is taken in line with the Emergency Response Plan. To support the construction phase monitoring, a pre-construction baseline will need to be determined.

The scope of the water quality monitoring programme will be developed at a post-consent stage and in consultation with SEPA and other relevant stakeholders. Water quality monitoring will be required of all potentially affected water features and may include daily visual and olfactory observations or after heavy or prolonged rainfall, in situ monitoring using a calibrated hand-held probe, and potentially grab samples on a regular or ad hoc basis for analysis at an accredited laboratory.

To ensure that monitoring during construction is effective it will be necessary to carry out pre-construction monitoring. There is no guidance on how long or frequent this should be, but it is recommended that as a minimum there are 12 monthly visits taking in a range of flow and weather conditions. The scope of pre-construction water quality monitoring, and monitoring during construction will be set out in the Water Quality and Flow Monitoring Plan, likely pursuant to a pre-commencement planning condition.

Any secondary permissions that are required for works affecting, or for temporary discharges to, the water features and watercourses in and around the Development, such as a CAR or water abstraction licences, will be obtained prior to any relevant works taking place on site, and preferably in advance of all works (save enabling works where not relevant to these secondary consents).

11.9.5.3 Pre-Construction and Construction Phase Water Quality Monitoring – PWS

The PWS identified within *Appendix 11.3 (Volume 5: Appendices)* were mostly sourced from surface water or from groundwater springs. A visit to each of the PWS will be carried out to confirm the source of each of the PWS and to inform subsequent pre-construction and construction phase monitoring. With regards to the identified PWS sourced from groundwater, water levels will also be monitored prior to any construction activities to determine the normal response pattern and then during construction to identify any changes to supply. Water quality should also be monitored pre-construction and during construction.

To ensure that monitoring during construction is effective it will also be necessary to carry out pre-construction monitoring. In keeping with the monitoring for water features, it is recommended that as a minimum there are 12 monthly visits prior to construction starting. The scope of pre-construction and construction phase water quality monitoring of PWS will also be set out in the Water Quality and Flow Monitoring Plan, which we assume would be required pursuant to a pre-commencement planning condition.

Finally, if it were to be determined that any effects were due to construction, then the provision of an alternate supply would be needed to be provided. It is advised that trigger levels for both levels and quality are set after the pre-construction monitoring has been undertaken.

11.9.5.4 Flow Monitoring

The construction of the Headpond and severance of the upper Allt Beochlich catchment requires the determination of a suitable compensation flow for aquatic habitats and the continued and uninterrupted operation of the small local HEP scheme. The basis of this compensation flow will require the generation of a flow duration curve, which will require monitoring of the flow at multiple locations. This may involve continuous stage monitoring combined with spot flow gauging or other suitable method depending on site constraints to data collection. It is recommended that this data is collected over a minimum of 12 months prior to any works occurring in order for a robust baseline flow duration curve to be generated. The data will also need to be interpreted in the context of the weather conditions during the monitoring period, to account for whether the monitoring was carried out in a drier or wetter year than average, as well as consider the future influence of climate change.

11.9.5.5 Baseline Water Quality Monitoring During Pre-Commissioning

The scope of baseline water quality monitoring of Loch Awe pre-commissioning of the Development will be defined in the Water Quality and Flow Monitoring Plan.

In the absence of any additional data from SEPA, it is recommended that water temperature profiling of Loch Awe is undertaken to establish a baseline for any thermal stratification of the Loch in the basin nearest to the Tailpond inlet / outlet. This will establish when thermal stratification occurs and the depth of the thermocline during the period of stratification prior to overturn sometime in the autumn. It is expected that this monitoring can be achieved by installing one or two monitoring buoys fitted with a temperature sonde and an automated variable depth measuring system plus telemetry. The monitoring should be implemented so that at least two seasons of data can be collected prior to commissioning of the Development. Monitoring should cover the period May through to post overturn in the autumn.

In addition to temperature profiling of the water column, it is also recommended that baseline water quality and phytoplankton samples are collected from the Loch over a 12 month period. Samples will need to be collected from near the surface and at depth so that the effects of thermal stratification can be assessed. Samples below the surface can be collected using a van dorn sampler or similar. The frequency of sampling may need to be reasonably high during the period of thermal stratification (e.g. every two weeks). It may be possible to add additional sondes to the monitoring buoys, although some analysis may require collection of grab samples for laboratory analysis.

11.9.5.6 Baseline Water Quality Monitoring During Post-Commissioning

Water quality monitoring of Loch Awe as described above should continue during the initial years of operation to determine actual changes in stratification to inform management measures. In addition, it is proposed that the water quality within the Headpond is also monitored on a routine basis during operation of the Development. Visual / olfactory observations, in-situ measurements using either a hand-held or permanently installed water quality probe, and regular water samples for laboratory analysis may be required (including phytoplankton). The purpose of the monitoring is to build up an understanding of how water quality changes whilst it is stored in the Headpond as well as out this may influence water quality in Loch Awe upon discharge.

These measures are in addition to the operational requirements and daily observations which will be undertaken in the Headpond and Tailpond inlet / outlet, and the introduction of the screens at both inlet / outlets to prevent debris entrainment.

This preventative measure will support decisions about operation to ensure that unforeseen water quality impacts on Loch Awe are avoided. If water quality monitoring results remain stable and operation of the Development is consistent it may be possible to reduce or even stop routine water quality monitoring.

The monitoring of water ingress to Power Cavern Complex may also be required during the operation phase.

11.9.5.7 Sediment Management Plan

Although it is predicted that sediment transport along the Allt Beochlich will be relatively unaffected due to steep gradient, low sediment load and the commitment to provide a suitable compensation flow downstream of the Headpond Embankment, in keeping with good practice a Sediment Management Plan will be prepared. This will consider the impact of the Development in the long term on downstream sediment transport and include measures to ameliorate any adverse impacts. The Sediment Management Plan will also set out details of how frequent sediment in the Headpond will be monitored and when action to remove sediment may be required (also informed by long term water quality monitoring). It is assumed that the plan can be prepared pursuant to a pre-construction planning condition in consultation with SEPA.

11.9.5.8 Water Features Restoration Plan (Decommissioning)

Following decommissioning of the infrastructure on site, a Water Features Restoration Plan should be implemented, to allow for reinstatement of river processes in the affected reaches. This may require removal of fine sediment and replanting. The reinstatement should be informed by preconstruction photographic survey and mapping.

11.9.5.9 Summary of List of Commitments

To summarise the additional mitigation measures, the following will be produced and may be secured through an appropriate planning condition:

- Water Quality and Flow Monitoring Plan (and subsequent baseline, pre-construction and construction phase water quality, PWS and flow monitoring).
- Water Management Plan including an Emergency Response Plan.
- Detailed Drainage Strategy.
- Sediment Management Plan.

In addition to the above:

- A CAR Licence and a Water Abstraction Licence (Scotland) will be required for permission to impound and divert watercourses, abstract and discharge water to and from Loch Awe, temporary works in, over, under water features, and to determine what compensation flow will be required downstream of the main Headpond Embankment and along the Allt Beochlich.
- A Water Features Restoration Plan will be required following decommissioning of the infrastructure on site to inform the reinstatement of river processes in the affected reaches. This may be defined and included as part of a future planning application to cover the decommissioning of the Development rather than this application.
- Details of SuDDS and culverts will be included in the detailed design strategy.

11.10 Residual Effects

A WFD Assessment has been provided in *Appendix 11.2 (Volume 5: Appendices)* which focuses on the following WFD water bodies; Loch Awe, Allt Beochlich, River Aray and the Oban and Kintyre groundwater body. Overall, it concludes that, based on the current understanding of the Development and availability of data only localised and temporary adverse impacts to the Oban and Kintyre groundwater body, River Aray and Loch Awe. However, Allt Beochlich consists of a permanent alteration and loss of the catchment area. Therefore, the physical changes could lower its current WFD status as well as the entire flow regime.

Table 11.34 and *Table 11.35* present a summary of the residual effects of the construction and operation of the Development on the water quality and hydromorphology of surface and groundwater bodies. Table 11.34 Summary of Effects: Construction

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
Loch Awe	**Water Quality – Sediment Runoff** Potential contamination associated with: • Sediment-laden runoff associated to earthworks; and • Sediment washing downstream from Allt Beochlich and other water courses within the catchment.	Moderate adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP. Additional mitigation includes a programme of water quality monitoring pre- and during construction works.	Minor adverse	Not significant
	Water Quality – Contaminated Runoff Potential contamination associated with runoff of chemical spillages from PC03 and TC01. Pollutants also associated to Allt Beochlich and other water courses within the catchment which wash downstream	Moderate adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP. Additional mitigation includes a programme of water quality monitoring pre- and during construction works.	Minor adverse	Not significant
Loch Fyne	**Water Quality – Sediment Runoff** Increased areas of hardstanding/bare earth could lead to an inflow of sediment	Moderate adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP. Additional mitigation includes a programme of water quality monitoring pre- and during construction works.	Minor adverse	Not significant
	Water Quality – Contaminated Runoff Works associated with the jetty may involve various fuels and construction chemicals which could be at risk of entering Loch Fyne	Moderate adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP. Additional mitigation includes a programme of water quality monitoring pre- and during construction works.	Minor adverse	Not significant
Bedrock Aquifer - Oban and Kintyre groundwater body	**Groundwater Quality** Potential contamination to aquifer during the drilling of the power tunnels and excavation of the Headpond	Negligible	Tunnel will be lined during progress. Good Practice Guidelines will be followed to limit contamination	Negligible	Not significant
	Groundwater Flow Change to the groundwater flow	Negligible	No abstraction required; no other mitigation required	Negligible	Not significant
Superficial Aquifers	**Groundwater Quality** Potential contamination from surface runoff from Access Tracks, compounds and Headpond.	Minor adverse	Good Practice guidelines outlined in the above mitigation section, the CEMP and within the oWMP	Negligible	Not significant
	Groundwater Flow Change to the groundwater flow	Negligible	Aquifer is not widespread across the site. Therefore, the Development will not change flow direction. No mitigation required.	Negligible	Not significant
River Aray and tributaries (LF1)	**Water Quality - Sediment Runoff** Potential contamination sediment-laden runoff from Inveraray bypass	Minor adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Minor adverse	Not significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
	Water Quality – Contaminated Runoff Chemical spillages associated to Access Tracks	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Hydromorphology Potential widening or replacement of the road bridge and associated disruption of sediment transport processes.	Negligible	Retain the same type of bridge or improve for morphology or use a temporary bridge	Negligible	Not significant
Crom Allt and tributaries (LF2)	**Water Quality - Sediment Runoff** Sediment-laden run-off from works associated to Inveraray Jetty and water course crossing. **Water Quality – Contaminated Runoff** Chemical spillages associated to Access Tracks	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Hydromorphology Potential lengthening or replacement of Access Track culvert. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology.	Negligible	Not significant
Allt na Cuile Riabhaiche and tributaries (LA2)	**Water Quality - Sediment Runoff** Construction Site Run-off from Keppochan forest Access Track. Sediment-laden run-off also has the potential to contaminate receptor. **Water Quality - Contaminated Runoff** Construction Site Run-off from Keppochan forest Access Track. This could include accidental spillages from fuels and other construction chemicals.	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Hydromorphology Potential lengthening or replacement of existing Access Track culvert on three tributaries. Creation of new crossings on two tributaries. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology for existing crossings. For new crossings, a natural channel bed should be retained.	Negligible	Not significant
Keppochan River and tributaries (LA3)	**Water Quality - Sediment Runoff** Construction Site Run-off from Keppochan forest Access Track. Sediment-laden run-off also has the potential to contaminate receptor. **Water Quality - Contaminated Runoff** Construction Site Run-off from Keppochan forest Access Track. This could include accidental spillages from fuels and other construction chemicals.	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Hydromorphology Potential lengthening or replacement of existing Access Track culvert in two locations. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology.	Negligible	Not significant
Archan River and tributaries (LA4)	**Water Quality - Sediment Runoff** Construction Site Run-off from Keppochan forest Access Track. Sediment-laden run-off also has the potential to contaminate receptor.	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
	Water Quality - Contaminated Runoff Construction Site Run-off from Keppochan forest Access Track. This could include accidental spillages from fuels and other construction chemicals.				
	Hydromorphology Potential lengthening or replacement of existing Access Track culvert in two locations. Creation of a new crossings on one tributary. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology for existing crossings. For new crossings, a natural channel bed should be retained.	Negligible	Not significant
Allt a Chrosaid and small lochan (LA5)	**Water Quality – Sediment Runoff** Sediment laden runoff from construction Site Run-off from B840 diversion, and PC21 (PC21) **Water Quality – Contaminated Runoff** Accidental spillages from construction chemicals and materials entering LA5 from the B840 upgrade tracks and crossings or from PC21	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Hydromorphology Potential lengthening or replacement of Access Track culvert. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology.	Negligible	Not significant
Allt Beochlich and tributaries (LA6)	**Water Quality – Sediment Runoff** Potential sediment inflow could be associated with the following: • The Access Tracks; • Increased hardstanding areas from compounds (PC06, TC07, TC08, PC09, TC16, PC17, PC18, PC19 and TC11) increasing runoff; • Inflow of sediment laden runoff from Headpond excavations **Water Quality – Contaminated Runoff** Potential contamination could be associated with the following: • Contaminated runoff from compound PC06, TC07, TC08, PC09, TC16, PC17, PC18, PC19 and TC11; and • Contaminated runoff from Access Tracks.	Moderate adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP. Additional mitigation includes a programme of water quality monitoring pre- and during construction works.	Minor adverse	Not significant
	Hydromorphology Construction of Embankment and heapond	Low adverse	No additional mitigation proposed.	Minor adverse	Not significant
	Hydromorphology Creation of a new crossings and potential for disruption of sediment transport processes.	Negligible	A natural channel bed should be retained.	Negligible	Not significant
	Hydromorphology Diversion or over pumping of river during construction resulting in disruption to sediment transport.	Low adverse	No mitigation proposed.	Minor adverse	Not significant
Lochan Airigh (LA7)	**Water Quality – Sediment Runoff** No impact as this water feature will be lost to the Development. Loss of this water feature is considered under	N/A	N/A	N/A	N/A

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
	permanent hydromorphological effects in the 'Operation' impact assessment section that follows.				
	Water Quality – Contaminated Runoff No impact as this water feature will be lost to the Development. Loss of this water feature is considered under permanent hydromorphological effects in the 'Operation' impact assessment section that follows.	N/A	N/A	N/A	N/A
Lochan Beochlich (LA8)	**Water Quality – Sediment Runoff** Potential sediment inflow associated to run-off from works associated to Headpond and Embankment construction. This also includes works being carried out at TC07 and PC09.	Minor adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Minor adverse	Not significant
	Water Quality – Contaminated Runoff Contaminated run-off from spillages associated to Embankment and Headpond construction				
Lochan Romach (LA10)	**Water Quality – Sediment Runoff** Some sediment-runoff could wash from new crossings and upgrades to the existing track into the lochan.	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Water Quality – Contaminated Runoff Spillages of construction materials from Access Track and watercourse crossing				
Allt na Fainge (LA12)	**Water Quality – Sediment Runoff** Potential contamination associated to run-off from works associated to B840 Access Track and crossings. Sediment laden run-off also has the potential to contaminate water feature.	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Water Quality – Contaminated Runoff Spillages of construction materials from Access Track and watercourse crossing				
	Hydromorphology Potential lengthening or replacement of Access Track culvert. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology.	Negligible	Not significant
Allt a' Ghreataidh (LA13)	**Water Quality – Sediment Runoff** Potential contamination associated to run-off from works associated to B840 Access Track and crossings. Sediment laden run-off also has the potential to contaminate water feature.	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Water Quality – Contaminated Runoff Spillages of construction materials from Access Track and watercourse crossing				
	Hydromorphology Potential lengthening or replacement of Access Track culvert. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology.	Negligible	Not significant
	Water Quality – Sediment Runoff	Negligible		Negligible	Not significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
Alt Mor (LA14)	Potential contamination associated to run-off from works associated to B840 Access Track and crossings. Sediment laden run-off also has the potential to contaminate water feature.		Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.		
	Water Quality – Contaminated Runoff Spillages of construction materials from Access Track and watercourse crossing				
	Hydromorphology Potential lengthening or replacement of Access Track culvert. Potential for disruption of sediment transport processes.	Negligible	Retain the same type of culvert or improve for morphology.	Negligible	Not significant
Cladich River/Allt an Stacain (LA17)	**Water Quality – Sediment Runoff** Potential sediment inflow associated to LA3 and LA4	Minor adverse	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP. Additional mitigation includes a programme of water quality monitoring pre- and during construction works.	Negligible	Not significant
	Water Quality – Contaminated Runoff Potential contaminated runoff associated to LA3 and LA4				
Unnamed watercourse (LA18)	**Water Quality – Sediment Runoff** Potential sediment inflow associated to B840 crossing	Negligible	Embedded mitigation includes good Practice guidelines outlined in the above mitigation section including reference to a CEMP, WMP and a SMP.	Negligible	Not significant
	Water Quality – Contaminated Runoff Potential contaminated runoff associated to B840 crossing				

Table 11.35: Summary of Effects: Operation

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
Loch Awe	**Water Quality** Changes in water level leading to a concentration of pollutants in a still water body.	Minor adverse	A programme of water quality monitoring is proposed that will be defined in a Water Quality and Flow Monitoring Plan.	Minor adverse	Not significant
	Water Quality Thermal Stratification	Moderate adverse	A programme of water quality monitoring is proposed that will be defined in a Water Quality and Flow Monitoring Plan.	Moderate adverse	**Significant**
	Water Quality Headpond discharges (temperature)	Minor	A programme of water quality monitoring is proposed that will be defined in a Water Quality and Flow Monitoring Plan.	Minor adverse	Not significant
	Water Quality Discharge of concrete residues from Headpond	Minor adverse	No mitigation is proposed (impact is uncertain and precautionary and would be very short term and temporary)	Minor adverse	Not significant
	Water Quality Potential risk of algal blooms	Minor adverse	A programme of water quality monitoring is proposed that will be defined in a Water Quality and Flow Monitoring Plan.	Minor adverse	Not Significant
	Hydromorphology Loss of approximately 150m of natural bank and marginal area due to the Tailpond inlet / outlet structure.	Negligible	No mitigation is proposed	Negligible	Not significant
Bedrock Aquifer - Oban and Kintyre	The key factor identified affecting groundwater during the operation phase is the ongoing presence of the Waterways, Power Cavern and	Negligible	The Waterway and Headpond will be lined so will be within a 'closed' system. No other mitigation required.	Negligible	Not significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
groundwater body	Access Tunnels. The Headpond will be concrete-lined and filled with water fed from Loch Awe (i.e. it will be a 'closed' system and should not interfere with local groundwater). No groundwater water resource or water quality issues are expected during the operational phase.				
Superficial Aquifers – Peat	The Headpond will be concrete-lined and filled with water fed from Loch Awe (i.e. it will be a 'closed' system and should not interfere with local groundwater). No groundwater water resource or water quality issues are expected during the operational phase.	Negligible	The Waterway and Headpond will be lined so will be within a 'closed' system. No other mitigation required.	Negligible	Not significant
Allt na Cuile Riabhaiche and tributaries (LA2)	**Water Quality** Contamination from potential spillages from the Keppochan Forest Access Track	No Impact	N/a	N/A	N/A
	Hydromorphology Potential lengthening or replacement of existing Access Track culvert on three tributaries. Creation of new crossings on two tributaries. Potential for disruption of sediment transport processes.	Negligible	No mitigation is proposed	Negligible	Not significant
Keppochan River and tributaries (LA3)	**Water Quality** Contamination from potential spillages from the Keppochan Forest Access Track	Negligible	Proposed operational process and spillage risk management measures	Negligible	Not significant
	Hydromorphology Potential lengthening or replacement of existing Access Track culvert in two locations. Potential for disruption of sediment transport processes.	Negligible	No mitigation is proposed	Negligible	Not significant
Archan River and tributaries (LA4)	**Water Quality** Contamination from potential spillages from the Keppochan Forest Access Track	No Impact	N/a	N/A	N/A
	Hydromorphology Potential lengthening or replacement of existing Access Track culvert in two locations. Creation of a new crossings on one tributary. Potential for disruption of sediment transport processes.	Negligible	No mitigation is proposed	Negligible	Not significant
Allt a Chrosaid and small lochan (LA5)	**Water Quality** Contamination from potential spillages from PC18 and PC19	Negligible	Proposed operational process and spillage risk management measures	Negligible	Not significant
	Hydromorphology Potential lengthening or replacement of Access Track culvert. Potential for disruption of sediment transport processes.	Negligible	No mitigation is proposed	Negligible	Not significant
Allt Beochlich and tributaries (LA6)	**Water Quality** Sediment build-up from Headpond discharge	Negligible	Sediment build-up would also be monitored and when necessary (at an appropriate point in the future), could be removed for disposal in accordance with waste legislation prevailing at the time.	Negligible	Not significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effects	Significance
	Water Quality Contamination from potential spillages from PC09 and Access Track.	Negligible	Proposed operational process and spillage risk management measures	Negligible	Not significant
	Hydromorphology Creation of a new crossings and potential for disruption of sediment transport processes	Negligible	No mitigation is proposed	Negligible	Not significant
	Hydromorphology Loss of 5.4 km^2 of catchment with numerous tributaries, resulting in changes to the downstream flow regime due to the Embankment. Reduction in sediment transport downstream due to the Embankment and inundation of reaches.	Moderate adverse	Large opening in the emankment with a natural channel bed to allow for the current flow regime to be retained.	Minor adverse	Not significant
Lochan Beochlich (LA8)	**Water Quality** Sediment build-up from Headpond discharge	Negligible	Sediment build-up would also be monitored and when necessary (at an appropriate point in the future), could be removed for disposal in accordance with waste legislation prevailing at the time.	Negligible	Not significant
	Water Quality Contamination from potential spillages from PC09 and Access Track.	Negligible	Proposed operational process and spillage risk management measures	Negligible	Not significant
Lochan Romach (LA9)	**Water Quality** Contamination from potential spillages from PC20 and Access Track.	Negligible	Proposed operational process and spillage risk management measures	Negligible	Not significant
Allt na Fainge (LA12)	**Water Quality** Contamination from potential spillages from Access Track.	No Impact	N/a	N/A	N/A
	Hydromorphology Creation of a new crossings and potential for disruption of sediment transport processes.	Negligible	No mitigation is proposed	Negligible	Not significant
Allt a' Ghreataidh (LA13)	**Water Quality** Contamination from potential spillages from Access Track.	No Impact	N/a	N/A	N/A
	Hydromorphology Creation of a new crossings and potential for disruption of sediment transport processes.	Negligible	No mitigation is proposed	Negligible	Not significant
Alt Mor (LA14)	**Water Quality** Contamination from potential spillages from Access Track.	No Impact	N/a	N/A	N/A
	Hydromorphology Creation of a new crossing and potential for disruption of sediment transport processes.	Negligible	No mitigation is proposed	Negligible	Not significant
Cladich River/Allt an Stacain (LA17)	**Water Quality** Contamination from LA3 and LA4 could wash into LA17	No Impact	N/a	N/A	N/A

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