March 2025

Glen Earrach Pumped Storage Hydro

Environmental Impact Assessment Report

Volume 5: Appendices
Appendix 11.2: Flood Risk Assessment

Glen Earrach Energy Ltd

Glen Earrach AECOM

Quality information

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Issue History

Issue	Issue date	Details	Authorized	Name	Position
1	March 2025	Submission	DL	David Lee	Technical Director – Renewable Energy

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1. Introduction

1.1.1 This appendix to **Chapter 11: Flood Risk and Water Resource (Volume 2: Main Report)** provides an assessment of the flood risk to the Proposed Development as well as the impact it has on flood risk to others. This includes a review of all flooding sources as well as the flooding receptors that could be impacted by the Proposed Development.

1.1.2 This appendix is organised as follows:

- The objective of the assessment (**Section 2: Objectives**)
- A review of legislative and planning policy framework for flood risk in Scotland and The Highland Council (THC) area (**Section 2.4: Legislation and Policy**)
- A summary of the baseline environment (**Section 3: Baseline Environment**)
- Flood risk to the Proposed Development Site and surrounding area based on predevelopment conditions (**Sections 4.1 - 4.8**)
- The impact the Proposed Development has from its construction and operation on flood risk to others (**Section 4.9: Impact of development on flood risk to others**)
- The flood risk and impact on others from Surface Water and Foul Drainage **(Section 4.10: Flooding from Foul Drains and Sewers)**
- The Proposed Development will result in increased hardstanding and as a result surface water runoff. This section sets out an assessment of the drainage requirements and an Outline Drainage Strategy for the Proposed Development Site. This Outline Drainage Strategy sets out the principles to mitigate the impact of increased hardstanding demonstrating that the provision of safe and effective surface water and foul drainage systems for the Proposed Development is possible. **(Section 5: Drainage Impact Assessment)**

1.1.3 The Proposed Development has a number of embedded and additional mitigation measures that address the impact on flood risk. These are summarised together with the impact that they have **(Section 6: Mitigation Measures).**

1.1.4 This appendix should be read in conjunction with **Chapter 11: Flood Risk and Water Resource (Volume 2: Main Report).**

1.1.5 The following terms (and descriptions) are used throughout this Appendix, unless otherwise stated:

- Ness Weir (colloquially known as Dochfour Weir) – The existing weir, located at the mouth of Loch Dochfour and the River Ness;
- Dochfour Weir Upgrade – Upgrade works proposed as additional mitigation to the Proposed Development; these measures are however not part of the Proposed Development application, and
- Ness Weir II – Proposed works to the Ness Weir by Stratera Energy, the developer of the Loch Kemp PSH scheme.

2. Objectives

2.1 Introduction

2.1.1 This appendix presents the findings of the Flood Risk Assessment (FRA) for the Proposed Development. The Proposed Development is described in **Chapter 2: Project and Site Description**, of this EIAR (**Volume 2: Main Report**). The Proposed Development Site location is shown in **Figure 1.1 Location Plan (Volume 3: Figures).**

2.1.2 The objective of this FRA is to assess four main issues in relation to flood risk:

- Risk to the Proposed Development from all forms of flooding;
- Risk of increasing flooding elsewhere due to the construction of the Proposed Development (resulting from increased surface water run-off, changes in flood routing through the Proposed Development and loss of floodplain storage)
- Risk of increasing flooding elsewhere due to the operation of the Proposed Development; and
- Appropriate mitigation measures to reduce the impact of flooding on the Proposed Development and off-site to an acceptable level.

2.2 Sources of data

2.2.1 To inform this study, information has been obtained from the following sources:

- Site information and development proposals;
- Scottish Environment Protection Agency (SEPA) flood risk mapping ;
- Ordnance Survey (OS) mapping; and
- Loch Ness Water Levels – SEPA
- River Ness Flow data – SEPA
- Dochgarroch Lock Water levels (Scottish Canals) -2018 – 2024
- Ness Weir dimension data – Scottish Canals

2.3 Flood risk terminology

2.3.1 In this document (**Appendix 11.2: Flood Risk Assessment**), flood events are defined according to their likelihood of occurrence. The term Annual Exceedance Probability (AEP) is used, meaning the chance of a particular flood event occurring or being exceeded in any given year. The 100-year flood has an AEP of 1%; a 1% chance of occurring or being exceeded in any given year.

2.3.2 Flood risk takes account of both the probability and the consequences of flooding. Probability is usually interpreted in terms of the return period, e.g. 1 in 100 and 1 in 200-year event etc. There is a 1 in 200 (0.5%) chance of a 1 in 200-year flood occurring in a given year.

2.3.3 The consequence of flooding depends on how vulnerable a receptor is to flooding. The components of flood risk can be considered using the source-pathway-receptor model. Sources constitute flood hazards, which are anything with the potential to cause harm through flooding e.g. rainfall, extreme sea levels, and river flows. Pathways represent the mechanism by which the flood hazard would cause harm to a receptor e.g. overtopping and failure of embankments and flood defences, inadequate drainage and inundation of floodplains. Receptors comprise of the people, property, infrastructure and ecosystems that could potentially be affected should a flood occur.

2.3.4 SEPA has created this guidance, Flood Risk and Land Use Vulnerability Guidance to assist in the assessment of the vulnerability to flooding of different types of land use. The guidance classifies land uses according to how they are impacted by flooding, i.e. their relative susceptibility and resilience to flooding, and any wider community impacts caused by their damage or loss.

2.3.5 The term **‘land use vulnerability’** is used in this guidance to differentiate between a range of land uses, taking account of flooding impacts on land uses in terms of their relative susceptibility and resilience to flooding. It also reflects wider community impacts caused by their damage or loss.

2.3.6 Potentially Vulnerable Areas (PVAs) are areas where highest flood risk exists. PVAs were determined from the National Flood Risk Assessment are used to inform flood risk management plans to help understand and prioritise where flood risk work would be most beneficial.

2.4 Legislation and Policy

2.4.1 This section outlines the relevant legislation, planning policy and guidance relevant to this assessment and admissible to the proposed development.

Legislation

2.4.2 Legislation relevant to this assessment includes:

- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) in respect of discharges to surface or groundwater ('the CAR Regulations').
- Flood Risk Management (Scotland) Act 2009
- Flood Risk Management (Flood Protection Schemes), Potentially Vulnerable Areas and Local Plan Districts) (Scotland) Regulations 2010
- Reservoirs (Scotland) Act 2011.

2.4.3 The legislative framework protects and enhances the status of aquatic ecosystems, seeks to prevent further deterioration of such ecosystems, promotes sustainable use of available water resources, and contribute to the mitigation of floods and droughts.

National Planning Policy

2.4.4 National Planning Framework 4 (NPF4) was formally adopted by Scottish Ministers on 13 February 2023. NPF4 sets out Scotland's long-term spatial strategy and provides a framework for addressing national planning priorities, including sustainability, health, and environmental protection.

2.4.5 NPF4 Policy 11 e) requires energy developments to demonstrate how effects on hydrology, the water environment and flood risk are addressed.

2.4.6 NPF4 Policy 22 outlines that:

i. Development proposals at risk of flooding or in a flood risk area will only be supported if they are for:

- *essential infrastructure where the location is required for operational reasons;*
- *water compatible uses;*
- *redevelopment of an existing building or site for an equal or less vulnerable use; or.*
- *redevelopment of previously used sites in built up areas where the LDP has identified a need to bring these into positive use and where proposals demonstrate that long term safety and resilience can be secured in accordance with relevant SEPA advice.*

ii. In such cases, it will be demonstrated by the applicant that:

- *all risks of flooding are understood and addressed;*
- *there is no reduction in floodplain capacity, increased risk for others, or a need for future flood protection schemes;*
- *the development remains safe and operational during floods;*
- *flood resistant and resilient materials and construction methods are used; and*
- *future adaptations can be made to accommodate the effects of climate change.*

iii. Development proposals will:

- *not increase the risk of surface water flooding to others, or itself be at risk.*
- *manage all rain and surface water through sustainable urban drainage systems (SuDS), which should form part of and integrate with proposed and existing blue green infrastructure. All proposals should presume no surface water connection to the combined sewer;*
- *seek to minimise the area of impermeable surface.*

2.4.7 NPF4 defines the 'flood risk area' as the area with an annual probability of being flooded greater than 0.5%, including an appropriate allowance for climate change.

Local Policy

2.4.8 The Highland-wide Local Development Plan was adopted in April 2012 and should be read in conjunction with NPF4. This plan sets out a balanced strategy to support the growth of all communities across the Highlands. However, it is important to ensure that development is, in the first instance, directed to places with sufficient existing or planned infrastructure and facilities to support sustainable development.

Policy 64- Flood Risk

Development proposals should avoid areas susceptible to flooding and promote sustainable flood management.

Development proposals within or bordering medium to high flood risk areas, will need to demonstrate compliance with Scottish Planning Policy (SPP) through the submission of suitable information which may take the form of a Flood Risk Assessment.

Development proposals out with indicative medium to high flood risk areas may be acceptable. However, where:

- *better local flood risk information is available and suggests a higher risk;*
- *a sensitive land use (as specified in the risk framework of Scottish Planning Policy) is proposed, and/or;*
- *the development borders the coast and therefore may be at risk from climate change;*

A Flood Risk Assessment or other suitable information which demonstrates compliance with SPP will be required.

Developments may also be possible where they are in accord with the flood prevention or management measures as specified within a local (development) plan allocation or a development brief. Any developments, particularly those on the flood plain, should not compromise the objectives of the EU Water Framework Directive.

Where flood management measures are required, natural methods such as restoration of floodplains, wetlands and water bodies should be incorporated, or adequate justification should be provided as to why they are impracticable.

Policy 66- Surface Water Drainage

All proposed development must be drained by Sustainable Drainage Systems (SuDS) designed in accordance with The SuDS Manual (CIRIA C697) and, where appropriate, the Sewers for Scotland Manual 2nd Edition. Planning applications should be submitted with information in accordance with Planning Advice Note 69: Planning and Building Standards Advice on Flooding paragraphs 23 and 24. Each drainage scheme design must be accompanied by particulars of proposals for ensuring long-term maintenance of the scheme".

2.4.9 It is worth noting that this policy has references that are outdated. The SuDS manual has since been updated to C753 and the Sewers for Scotland Manual has been updated from the 2nd edition to the 4th edition which indicates why this LDP is currently under review and in the process of updating.

SEPA Guidance

2.4.10 SEPA has published guidance documents to provide planning advice related to flood risk. SEPA Technical Flood Risk Guidance for Stakeholders (version 13, 2022) sets out SEPA's requirements for undertaking flood risk assessments. This guidance document is currently being reviewed and updated in response to the National Planning Framework 4. As a result, this information - while useful - is potentially out of date.

2.4.11 SEPA's Land Use Vulnerability Guidance classifies developments into five classes - Most Vulnerable, Highly Vulnerable, Least Vulnerable, Essential Infrastructure and Water Compatible - based on the recognition that the damages and knock-on effects from flooding will vary between land uses. Following this guidance, the Proposed Development falls into the category of essential infrastructure.

2.4.12 Policy 11 of NPF4, essential infrastructure may be located in a flood risk area if required for operational reasons, provided the risks of flooding to the Proposed Development Site are assessed and no additional flood risk to others is generated.

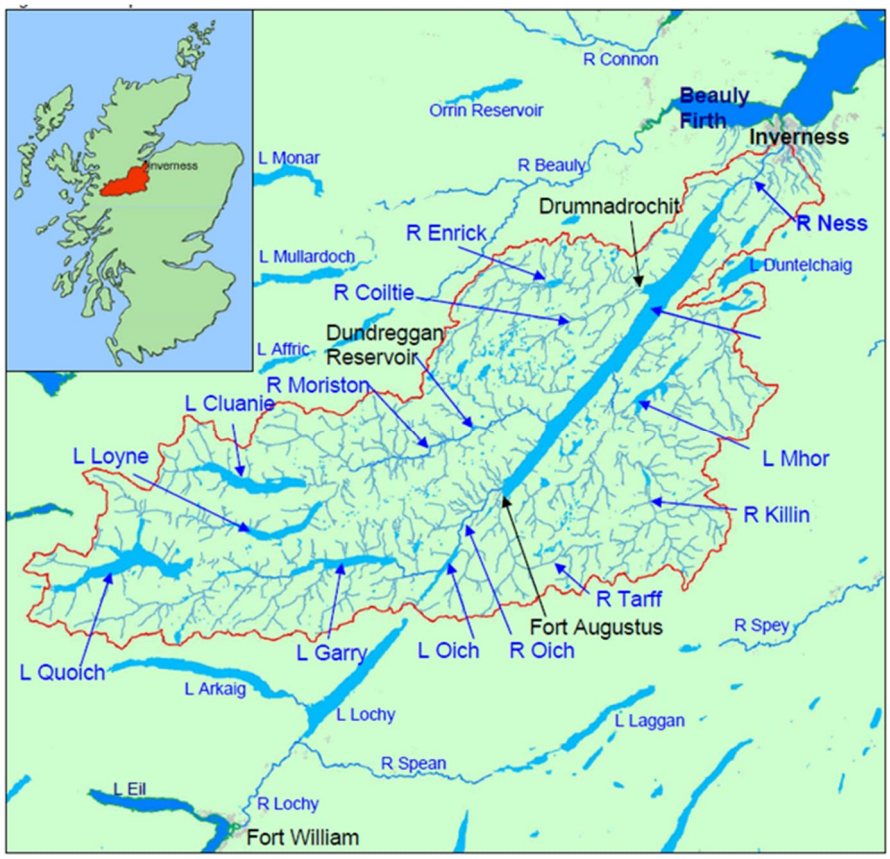
2.4.13 The modelling approach in this FRA is in line with SEPA's Modelling Guidance for Responsible Authorities (version 1.1).

3. Baseline Environment

3.1 Catchment Area

3.1.1 The Proposed Development Site is situated on the western side of the Loch Ness catchment. The Headpond and associated Waterways lie between two sub catchments of Loch Ness; Allt Saigh in the south and River Coiltie to the north. An access track from the A831 to the Headpond lies within the River Enrick catchment and the River Coiltie catchment. An existing track running along Allt Saigh would also be used during the operation of the Proposed Development. These rivers all flow into Loch Ness from the western shore. The River Coiltie is also a tributary of the River Enrick, with the confluence occurring just before the point at which they flow into Loch Ness at Drumnadrochit.

3.1.2 The Proposed Development is part of the Loch Ness catchment. The Loch Ness catchment spans the Great Glen, and several valleys to the west together with the eastern slopes of the Monadhliath Mountains as indicated in **Insert 1 Loch Ness catchment overview** . The total catchment is some 1,790 km2, 56.4 km2 of which is direct open water in Loch Ness and Loch Dochfour with the remaining catchment predominantly shrubland, pasture and forested based on the UKCEH Land Cover Maps 2023.



Insert 1 Loch Ness catchment overview[1]

3.1.3 In addition to Loch Ness, the Catchment contains several other significant lochs, including Quoich, Cluanie, Loyne, Garry and Mhór, all of which are controlled for hydropower generation. **Table 1 Ness catchment reservoirs** gives the major loch surface areas and the active storage volumes available for hydropower generation. All of these lochs already provide a significant amount of attenuation of flows through the catchment, reducing the peak flow in the River Ness considerably. The drainage catchment areas for various sub-catchments are given in **Table 2 Loch Ness sub-catchments**.

Table 1 Ness catchment reservoirs

Ness Catchment Reservoirs

Reservoir	Surface Area (km^2)	Active Storage Volume (Mm^3)
Loch Ness (not dammed for hydropower generation)	56	N/A
Loch Quoich	18	360
Loch Cluanie	11	200
Loch Loyne	7	43
Loch Garry	6	22
Loch Mhor	4	14

Table 2 Loch Ness sub-catchments

Sub Catchment	Catchment Area (km^2)	Proportion of total catchment
River Ness at Inverness	1,860	100
Loch Ness at Dochfour Weir	1,790	96%
River Oich at Fort Augustus	498	27%
River Morriston at Invermoriston	401	22%
Loch Garry	367	20%
River Foyers (including River Killen and Loch Mhor)	276	15%
River Enrick at Drumnadrochit	148	8%
Loch Quoich	132	7%
River Farigaig at Inverfarigaig	93	5%
Loch Cluanie	85	5%
River Tarff at Fort Augustus	80	4%
River Coiltie at Drumnadrochit	51	3%

Surface Water Bodies

3.1.4 The following descriptions of water bodies around the Proposed Development are based on the field observations made during a site walkover survey on the 9th of May 2024 and online data sources. The main water bodies surrounding the Proposed Development are:

- Loch Ness;
- Allt Saigh and its tributary Allt Loch an t-Sionnaich

Loch Ness

3.1.5 Loch Ness is a large glacially eroded freshwater loch covering approximately 56.4 km². It lies close to sea level (water level is around 16 m Above Ordnance Datum (AOD)) and is approximately 22.5 km long

[1] Ness flood scheme report, Mott MacDonald

with a northeast to southwest axis along the Great Glen Fault. It is very deep with a maximum depth of around 230 m.

3.1.6 Loch Ness is a water source for the northern section of the Caledonian Canal and provides a location for various recreational activities.

3.1.7 Loch Ness and its upstream catchment feeds flood water into a Potentially Vulnerable Area (PVA) with regard to flood risk – PVA 02/01/17 Inverness. Significant flooding has been experienced in Inverness from the River Ness. This has resulted in THC constructing the recently completed River Ness Flood Protection Scheme to protect low lying areas of Inverness from both tidal and fluvial flooding.

3.1.8 There are two existing large-scale hydro-electric schemes in operation on Loch Ness, located at the southwestern end of the loch nearer to Fort Augustus – Foyers and Glendoe.

Allt Saigh

3.1.9 Allt Saigh is situated on the southwestern end of the Proposed Development Site and drains much of the region south of the proposed Headpond location. The watercourse is approx. 12 km long and is sourced from two small Lochans: Loch Carn Tarsuinn at NGR NH 38137 21482 and an unnamed lochan at NGR NH 37339 21369 within the vicinity of Bhlaraidh Wind Farm. The Allt Saigh flows through approximately eight other lochs and lochans before entering Loch Ness at NGR NH 45625 18882.

3.1.10 The watercourse has been classified as heavily modified due to water storage for hydropower generation. The water intake point is located some 1 km downstream of Loch nam Breac Dearga at NGR NH 41365 19932. This forms part of the wider Great Glen scheme and feeds the Livishie Power Station.

3.1.11 In the upper catchment, there are numerous small lochs. Peat is also present across the surrounding area. The channel meanders through relatively low gradient moorland between areas of high ground. Downstream of Loch a' Mheig, the Allt Saigh has a steep bedrock channel with boulders present and cobbles and gravels which may be transportable. The river in this reach flows through a confined valley, with trees along much of the riparian corridor down to the outflow at Loch Ness. Loch nam Breac Dearga and Allt Loch an t-Sionnaich are both located within Allt Saigh catchment.

Existing Infrastructure

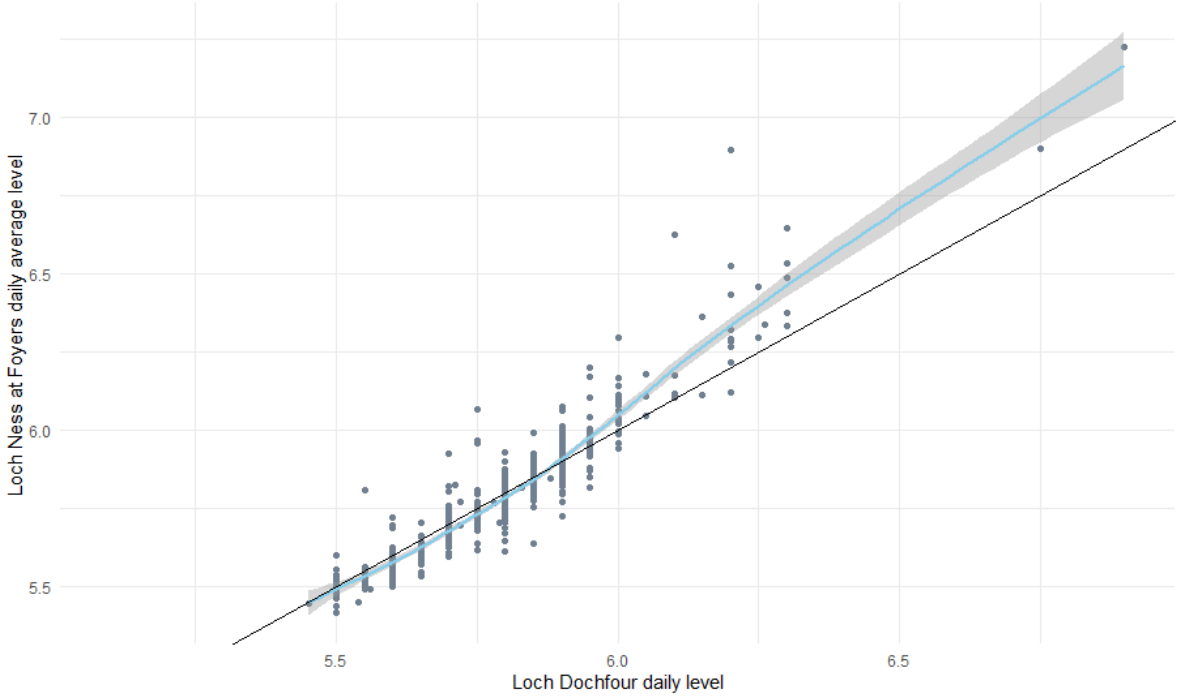
Great Glen Overview

3.1.12 The Loch Ness catchment spans the Great Glen, and several valleys to the west which flow into it. Over the decades the Great Glen has been modified by humans resulting in changes to flow regimes and attenuation. The major interventions are the Caledonian Canal and then more recently the Great Glen hydro arrangements and Foyers PSH scheme.

Caledonian Canal

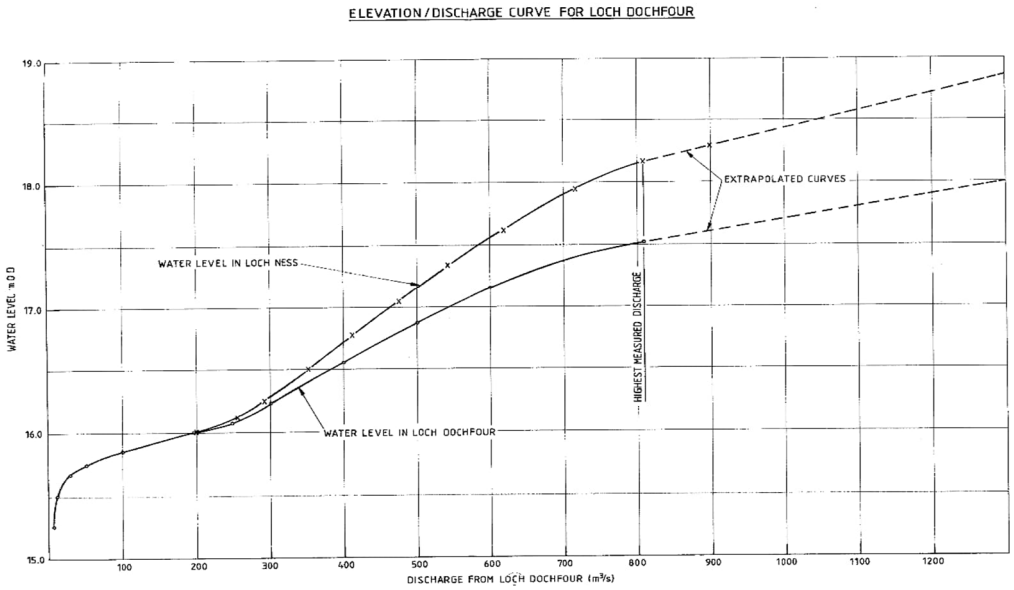
3.1.13 As part of the Caledonian Canal works, water levels are controlled in Loch Oich and Loch Ness in the Ness catchment together with Loch Lochy further west to feed the canalised sections between the lochs.

3.1.14 Water levels are further controlled in Loch Ness during higher water levels by the hydraulic constraint of the Bona Narrows next to Lochend. A review of the relationship between water levels at Loch Dochfour next the canal lock gate (SC data) and Loch Ness at Foyers (SEPA data, as shown in **Insert 2 Divergence in water levels between Loch Ness and Loch Dochfour**), indicates divergence when water levels exceed 6 m based on local datum.



Insert 2 Divergence in water levels between Loch Ness and Loch Dochfour

3.1.15 **Insert 3 Level-discharge Curves for Lochs Dochfour and Ness** looks at more extreme historic flood events which show the level difference continuing to increase. As these levels are well outside the normal range of Loch Ness, this hydraulic constraint is more relevant for conducting a flood risk assessment for the Proposed Development.



Insert 3 Level-discharge Curves for Lochs Dochfour and Ness[2]

Hydro Electric Schemes

3.1.16 The catchment has several hydro schemes which have some influence on flow. The Great Glen hydro scheme includes a series of dams and power stations which control flow from the western side of the catchment, as shown in **Insert 4 Great Glen hydro scheme .**

[2] Loch Dochfour Reservoirs Act Section 10 Inspection Report 1987

Insert 4 Great Glen hydro scheme[3]

3.1.17 There is an existing pumped storage hydro scheme on Loch Ness at Foyers. Two further schemes are under development or at planning stage; Loch Kemp and Loch na Cathrach.

3.1.18 Flows in the tributaries feeding Loch Ness are heavily influenced by impoundments and diversions through hydro generation. Significant impoundments can impact on flows both during summer and winter months. Within the Allt Saigh catchment a number of small intake structures are located that divert water to the Livishie Power Station and away from its natural catchment. One of the water intake points is located some 1 km downstream of Loch nam Breac Dearga. Details of the abstraction arrangement and the impact on downstream flows are unknown. The abstraction removes flow from the catchment resulting in reduced flows downstream from this point.

4. Flood Risk Assessment

4.1 Flood Risk Sources

4.1.1 In accordance with flood risk guidance (SEPA Technical Flood Risk Guidance for Stakeholders), the flood risk has been assessed for all sources of flooding. Fluvial flood risk is the greatest risk for the Proposed Development and downstream areas through flood lift in Loch Ness and flood flows down the River Ness.

4.1.2 SEPA's Land Use Vulnerability Guidance classifies developments into five classes. The Proposed Development falls into the category of essential infrastructure. Essential infrastructure may be located in a flood risk areas if required for operational reasons as set out in NPF4 Policy 11, provided the risks of flooding to the Proposed Development Site are assessed and no additional flood risk to others is generated.

4.1.3 In accordance with THC's Flood Risk & Drainage Impact, supplementary guidance, flood risk must be assessed for all sources of flooding. It should also be demonstrated that development will not increase the risk of flooding elsewhere.

4.1.4 This section identifies all other potential sources of flooding and assesses the flood risk associated with each source of flooding and what impact the development will have on flood risk elsewhere.

[3] Power from the Glens: SSE (formerly Scottish Hydro Electric)

4.2 Risk Classification

4.2.1 For planning purposes as defined in NPF4, “at risk of flooding” or “in a flood risk area” means land or built form with an annual probability of being flooded of greater than 0.5% which must include an appropriate allowance for future climate change. This does not necessarily mean there is no risk of flooding from a more extreme event. However, for the purposes of this flood risk assessment, classifications of “at risk” or “not at risk” are used.

4.3 Tidal Flood Risk

4.3.1 The local watercourses and water bodies are not tidally influenced, and the Proposed Development Site and surrounding area are at an elevation of at least 15 mAOD. The Proposed Development is not at risk of tidal flooding and the Proposed Development itself will have no influence on tidal flooding elsewhere.

4.4 Fluvial Flood Risk

Direct Fluvial Flood Risk to the Proposed Development

4.4.1 The Proposed Development Site extends from the banks of Loch Ness up to the higher ground on the Balmacaan Forest. A review of the SEPA flood risk maps (https://map.sepa.org.uk/floodmaps) shows that the Lower Control Works (LCW) at Loch Ness by its nature falls within an area of high flood risk. In a similar manner the Headpond is located in high flood risk area associated with Loch nam Breac Dearga. However, these elements of the Proposed Development need to be within this zone and are water compatible development. They are designed to be operational when inundated. The remaining area of the Proposed Development is regarded as being of a lower risk than the 0.1% AEP (Low flood risk).

4.4.2 Temporary Construction Compounds and Temporary Workers Accommodation (TC05) are located outwith the indicative fluvial flood inundation extents based on the SEPA flood maps. The compound areas are therefore regarded as not being at risk from fluvial flooding.

4.4.3 The SEPA flood maps do not give any indication of flood risk from smaller watercourses; therefore, further consideration has been given to the watercourses in close proximity to the Proposed Development Site. The watercourses around the Proposed Development Site are relatively small and are close to their upstream source with relatively small catchments; therefore, the flows are not expected to be large under flow conditions.

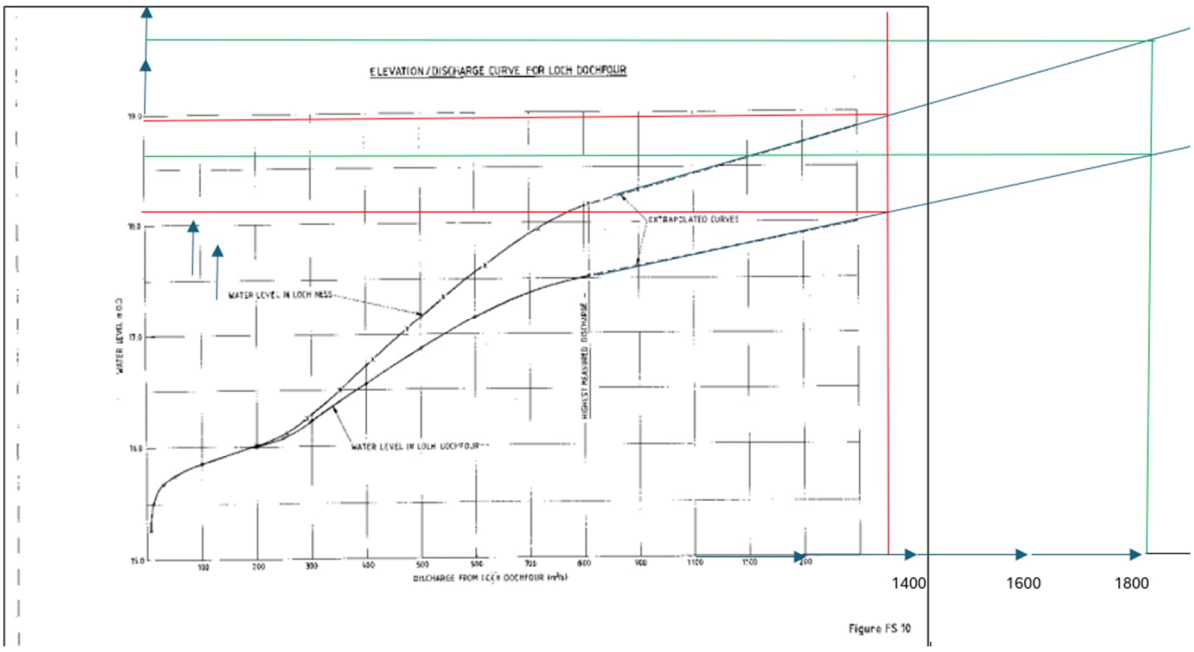
4.4.4 The watercourses are likely to have a quick response to rainfall events which may lead to a rapid rise in flow, but the likelihood of this causing flooding on the steeply graded slopes around the Proposed Development Site is considered low.

4.4.5 Based on the above, the Proposed Development is not at risk of fluvial flooding.

Lower Control Works

4.4.6 The proposed LCW at Loch Ness is located between the B852 and the shore of Loch Ness. The minimum ground levels at the LCW are to be set at 18.5 mAOD.

4.4.7 A review of the River Ness Flood Protection Scheme shows the peak flows at Ness side to be 954.2 m^3/s and 1,283.6 m^3/s during the 1 in 200 and 1 in 1000-year event, respectively. These increase to 1,336 m^3/s and 1,798 m^3/s with a 40% climate change allowance uplift in peak flows in line with SEPA guidance. Based on the Loch Dochfour and Loch Ness stage discharge curves (**Insert 5 Dochfour Weir Stage Discharge Curve**) the flood levels in Loch Ness flood related to the flows in the River Ness are stated in **Table 3 Loch Ness and Loch Dochfour Flood Levels**.



Insert 5 Dochfour Weir Stage Discharge Curve[4]

Table 3 Loch Ness and Loch Dochfour Flood Levels

Flood event	Discharge (m^3/s)	Loch Ness level (mAOD)	Loch Dochfour level (mAOD)
1 in 200 year	954	18.30	17.64
1 in 200 year + climate change	1145	18.65	17.83
1 in 1000yr	1283	18.80	18.00
1 in 1000yr + climate change	1540	19.20	18.20
1989 flood event	-	-	17.50
1849 flood event	-	-	17.60
1 in 200 year + 40%	1336.	19.00*	18.20*
1 in 1000yr + 40%	1798	19.70*	18.70*

* Interpolated sections

4.4.8 The LCW is partially located within Loch Ness. The smolt screen is water compatible and therefore is not vulnerable to flood risk. Any mechanical or electrical equipment will be located a minimum of 600 mm above the 1 in 1000-year flood level with an allowance for climate change. The access to the LCW is from the A82 which has elevations in excess of 20 mAOD along this length.

4.4.9 The Proposed Development is not at risk from flooding from Loch Ness, with the exception of the LCW, but this is water compatible.

4.5 Pluvial Flood Risk to the Proposed Development

4.5.1 The Temporary Workers Accommodation (TC05) is located on the northern slopes of Carn Ban. Whilst pluvial overland flow paths are noted on the SEPA flood map the area is regarded as being suitable on the basis that overland flow paths are maintained and appropriate surface water drainage for the compound is put in place. **Section 5.2 Surface Water Drainage** sets out the Outline Surface Water

[4] Figure FS10 of Loch Dochfour Reservoirs Act Section 10 Inspection Report 1987

Drainage Strategy for the Proposed Development. The implementation of the Outline Surface Water Drainage Strategy, which will be finalised at detailed design stage, will ensure that the compound site is appropriately protected from pluvial flood sources and that the risk is regarded as being Low Risk and acceptable.

4.6 Risk to Development from Existing Reservoirs

4.6.1 SEPA published a Reservoirs flood risk map (Reservoirs Map) to show the largest area which would be flooded in the event of existing reservoir failure. From the map it can be seen that the Proposed Development Site itself (with the exception of the LCW) is not in an area which would be at risk of flooding in such an event.

4.6.2 Interrogation of the online map reveals eleven potential sources of reservoir flood risk in the vicinity of the Proposed Development Site, with varying degrees of downstream influence. The reservoirs are as follows:

Table 4 Potential sources of reservoir risk

Name	Description	Maximum Cubic Capacity of Reservoir at Top Water Level
Cluanie Reservoir	Hydroelectric reservoir operated by SSE located upstream of Loch Ness	203,000,000 m^3.
Quoich Reservoir	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	360,000,000 m^3
Loch a' Chrathaich	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	2,700,000 m^3
Loch ma Stac Reservoir	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	3,500,000 m^3
Loyne Reservoir	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	45,500,000 m^3
Loch Dundreggan	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	1,640,000 m^3
Loch Mhor	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	14,500,000 m^3
Bhlaraidh Reservoir	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	300,000 m^3
Liath Reservoir	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	1,620,000 m^3
Loch Garry	Hydro-electric reservoir operated by SSE located upstream of Loch Ness	163,272,000 m^3
Loch Oich	Raised natural reservoir that feeds the Caledonian Canal. Operated by Scottish Canals	25,000,000 m^3

4.6.3 There is negligible risk of flooding from these reservoirs impacting on the safety of the Proposed Development. Although the LCW may be at risk in the event of flooding from the upstream reservoirs feeding into Loch Ness the likelihood of such an event is considered unlikely and would not impact on the safe operation of the Proposed Development.

4.6.4 The risk of existing reservoir flooding to the Proposed Development is considered low and acceptable.

4.7 Pluvial Flooding

4.7.1 Due to the steeply graded and semi-impermeable nature of the Proposed Development Site and surrounding area, it is expected that local storm events produce rapid surface water run-off. The addition of hardstanding areas and new tracks, as part of the Proposed Development, also has the potential to change natural flow paths and increase surface water run-off from these areas. It is also recognised that during the winter, surface water run-off could be increased by melting snow.

4.7.2 A review of the SEPA pluvial flood maps show that pluvial flows are directed towards the existing channels and are well contained. Watercourse crossings will be designed in line with good practice guidance as set out in the **Drainage Impact Assessment** in **Section 5**.

4.7.3 The Proposed Development is not at risk from pluvial flooding.

4.8 Groundwater Flooding

4.8.1 No groundwater flooding has been reported as being experienced at the Proposed Development Site.

Below Ground Infrastructure

4.8.2 The groundwater flows in the sub-surface have the potential to affect the Below Ground Infrastructure such as that within the Power Cavern and Tunnels.

4.8.3 Potential groundwater flows have been embedded in the design of the Below Ground Infrastructure. Appropriate lining and / or drainage is embedded to ensure the inflow does not pose a risk to users of the below ground areas during construction and operation.

4.8.4 A pumped system will serve the below ground areas of the Power Cavern complex to ensure that any groundwater inflows do not cause flooding. In the event of failure of the pumping system groundwater inflows could pose a flood risk to the below ground area. Any pumping system will be a fundamental part of the overall operation and will be linked by telemetry to the control room, to warn of high levels / pump failure. Regular inspection and maintenance would ensure the pumped systems remain in a suitable condition, thereby mitigating the risk of this area becoming flooded.

4.8.5 Based on the above, the Below Ground Infrastructure is not at risk of ground water flooding.

4.9 Impact of Development on Flood Risk to Others

Risk of Development Increasing Fluvial Flood Risk Downstream

4.9.1 Several flood receptors are located downstream of the scheme outlet and therefore may be at risk in the event of additional flows being discharged into the system. Downstream receptors that may be impacted by flooding are:

- Loch Ness and the communities around its banks
- River Ness and Inverness which is classified as a PVA under the Local Flood Risk Management Strategy and Plan ‘Inverness (PVA 02/01/17)

4.9.2 Extensive works have been undertaken to reduce flood risk within the City of Inverness through the construction of the River Ness Flood Protection Scheme. This has increased the standard of protection from the River Ness downstream of Ness Bridge from tidal flooding. Areas between the Ness Bridge and Ness Islands are not defended as part of the scheme and remain at risk during extreme fluvial flood events Based on the SEPA Flood Maps.

4.9.3 The detailed modelling carried out as part of the River Ness Scheme shows that the area between Ness Bridge and Ness Island currently has a standard of protection of between 1 in 10 and 1 in 25 years.

4.9.4 As part of this FRA a flood routing model of Loch Ness and Loch Dochfour has been constructed to assess the impact of generation and pumping activities.

4.9.5 In order to avoid having a detrimental impact on the flood risk to others and compromise the standard of protection provided by the River Ness Scheme, an upper operating level (stop generation) of 17.6 mAOD is proposed and forms the basis of this assessment. This is the current 1 in 10 year flood level in Loch Ness.

4.9.6 A water balance model has been constructed for Loch Ness as part of this assessment to look at the impact of pumped storage scheme operation on water levels in Loch Ness and the pass-forward flows in the River Ness over an extended period of time. The model was run for a 10 year period from October 2014 to September 2024. Details of the water balance model can be found in **Appendix 11.1: Water Resource Assessment (Volume 5 Appendices)**.

4.9.7 During this period a flood event occurred in October 2014. This had a corresponding flow of 600 m^3/s in the River Ness, an event with a return period of approximately 1 in 10 years. The modelled flood level in the baseline conditions had a flood level of 17.6 mAOD which correlated with that recorded at Loch Ness at Foyers and 17.2 mAOD at Loch Dochfour which again correlated with that recorded at Dochgarroch Locks.

4.9.8 The lowest level receptor next to Loch Dochfour is the A82 which at its lowest point is an elevation of 17.4 mAOD. This is 200 mm above the hands-off level for the scheme. The A82 will therefore not be at any greater risk of flooding than currently.

4.9.9 With the operation of the Proposed Development in line with the calculated generation profile, the peak flood level was reduced from the recorded level of 17.35mAOD in the March 2015 flood event to a level of 17.26 mAOD. This event corresponds with the highest recorded flow in the River Ness over the last 50 years.

4.9.10 A similar exercise was carried out with the cumulative impact of the consented, but yet to be constructed Loch na Cathrach scheme and the proposed Loch Kemp scheme.

4.9.11 With the operation of the Proposed Development in line with the calculated generation profile together with the Loch na Cathrach and Loch Kemp scheme with adjusted profile taking account of the scheme characteristics the peak flood levels were reduced to 17.26 mAOD at Loch Ness.

4.9.12 There is no detrimental impact from the operation of the Proposed Development during flood events. This would be expected based on generation flows being curtailed during such events and that the only possible operation, depending on market conditions would be the pumping of water from Loch Ness to the Headpond of the Proposed Development and Headponds of other schemes linked to Loch Ness.

4.9.13 The operation of the Proposed Development either alone or cumulatively with other proposed schemes will not have a detrimental impact on flood risk to others.

Dochfour Weir Proposal

4.9.14 The introduction of a variable weir at Dochfour Weir to regulate pass-forward flows into the River Ness and isolate the River Ness flows from PSH operations has been assessed based on the Proposed Development and in combination with the Loch na Cathrach PSH and Loch Kemp PSH.

4.9.15 The operation of the Proposed Development would result in raised water levels on average in Loch Ness. Initial modelling simulation of the March 2015 flood event with the inclusion of the operation of the Proposed Development and the variable weir at Dochfour Weir operated on an all year basis results in increased water levels in Loch Ness. This would increase risk to communities around Loch Ness as well as increasing the risk of the Loch Dochfour embankment being overtopped. This would be a significant and unacceptable increase in flood risk and therefore this option has been discounted.

4.9.16 A review of the Annual Maximum Events and Peaks over Threshold events on the River Ness using the Ness-side gauging station data showed that all historic flooding events have occurred in late autumn, winter and early spring. This is expected as it is long duration frontal rainfall events that occur in these periods of the year that result in flood conditions over the Loch Ness catchment.

4.9.17 Further simulations were therefore carried out with the weir only operational from April to September. These show no detrimental impact on flood risk at Loch Ness as the Dochfour Weir will retain its current hydraulic characteristics during the critical winter period.

Flood Risk to others from the Headpond

4.9.18 The Proposed Development includes the creation of a new Headpond through impounding and raising the water level of Loch nam Breac Dearga. As this structure will impound a significant volume of water, there is an inherent risk of flooding associated with it. However, the probability of flooding from the Headpond occurring is considered extremely low due to the high standard of design, management, and maintenance required under law and provided by any responsible operator.

4.9.19 This section details the assessments which have been made to determine the risk associated with the Headpond and its associated Embankments, and to provide a balanced assessment of the flood risk associated with the Proposed Development.

Reservoirs (Scotland) Act 2011

4.9.20 The Reservoirs (Scotland) Act 2011 (herein referred to as 'the Act' throughout this appendix) applies to reservoirs that hold more than 25,000 m^3 of water.

4.9.21 The Act sets out a legal framework with regards to responsibilities and requirements for inspection and maintenance of reservoirs, in order to ensure the risk presented by such structures is acceptable.

4.9.22 Under the Act reservoir owners have ultimate responsibility for the safety of reservoirs. Reservoir owners must appoint a Panel Engineer to supervise the design and construction of the reservoir and to supervise inspection and maintenance of the reservoir, which is the Headpond for this Development.

4.9.23 The Headpond will be of a volume by which it is regulated under the Act. The proposed Embankments will be designed in accordance with the requirements of the Act. When in operation, inspection and maintenance will be undertaken in accordance with the requirements of the Act. An assessment of the areas at risk from the Headpond indicates it would be categorised as High Risk designation based on the SEPA reservoir risk designation process.

4.9.24 The design parameters for the conveyance of flood flows will be based on the guidance set out in the Flood and Reservoir Safety Guidance by the ICE. The Headpond will be classed as a Category A reservoir and therefore would be subject to the most stringent design standard with the capability to convey safely the Probable Maximum Flood (PMF) as a design flood.

4.9.25 Design, inspection and maintenance in accordance with the legislative framework of the Act will ensure that the risk of failure of the proposed Headpond remains low throughout its working life.

Breach Analysis and Flood Routing

4.9.26 The Headpond is classed as High Risk reservoir based on the consequence of an uncontrolled release of water and the effect that this could have on the surrounding area below the reservoir. As a result, the Headpond will be designed to the highest standards and regularly inspected in line with the Reservoirs (Scotland) Act 2011 to maintain that standard.

4.9.27 The required ability to convey flood flows for such a reservoir is significantly higher standard than those assessed with regard to planning. The flood risk to others from the Headpond overtopping is regarded as being negligible based on the extremely low likelihood of occurrence.

4.9.28 An emergency spillway has been located to the northeast of the reservoir

4.9.29 The probability of a breach of the reservoir is again very low and orders of magnitude below the probability of occurrence defined as a flood risk area under NPF4 and The Highland Council Flood Risk Guidance, an annual probability of being flooded of greater than 0.5%.

4.9.30 The flood risk to others from such an event is regarded as being negligible. A breach assessment will be undertaken as part of the reservoir registration process under the Reservoirs (Scotland) Act 2011 to aid emergency planning.

4.9.31 An emergency spillway has been located at the northeast corner of the Headpond. The spillway sill level has been set 400 mm above the top water level in the Headpond based on operating levels. Detail of the spillway location and arrangement can be seen in **Figure 2.9 – Headpond Arrangement Plan** and **Figure 2.19 – Spillway Section**.

4.9.32 An assessment of the potential flood lift in the reservoir during extreme flood events has been carried out taking account of the runoff from the catchment feeding directly into the Headpond and the direct rainfall on the Headpond over a 48 hours period. This is a conservative assessment based on no other discharge from the Headpond over this period. In addition, Water levels in the Headpond will generally sit below the operational top water level based on ongoing operation of the scheme within the operational constraints set out based on Loch Ness water levels.

4.9.33 A flood lift of 200mm has been calculated in the 1 in 200 year plus climate change allowance event and a flood lift of 400mm has been calculated in the 1 in 1,000 year plus climate change. In both scenarios flood water in contained within the Headpond. The flood risk from the Headpond spilling, whilst based on a conservative set of parameters is therefore regarded as negligible.

Other Discharges from the Reservoir

4.9.34 In addition to uncontrolled discharge in the event of a breach, a controlled release arrangement is proposed into the Allt Saigh catchment through the scour arrangement. This will allow the reservoir to be drawn down in the case of an emergency. Whilst the two Waterways between the Headpond and the Tailpond are the primary drawdown arrangement directly into Loch Ness a secondary arrangement is also included based on a Low Level Outlet via the Valve House.

4.9.35 In line with guidance as set out in the 'Guide to drawdown capacity for reservoir safety and emergency planning' the basic recommended standard for a Category A dam is the ability to draw down the water level by 1 m per day. This equates to a discharge of 1.1 Mm^3 over a 24-hour period based on an outflow of 13 m^3/s.

4.9.36 Given the size of the watercourse immediately downstream of the scour outlet, full operation of the drawdown facility would cause localised flooding and potential damage to infrastructure, including roads and access bridges together with an inlet structure. A secondary bund is therefore proposed with a culvert arrangement to attenuate flows down to a flow less than the natural Qmed flow in the watercourse (1 in 2 year event). The bunded arrangement will have the ability to allow the scour valve to be operated for a few minutes in line with regular maintenance requirements of the reservoir. It is likely that the valve will be operated once or twice a year. This will provide benefit of an occasional spate flow down the channel.

4.9.37 In the very unlikely event of an emergency and the need to drawdown the reservoir, localised flooding from the scour flows would be better than the far greater consequences of dam failure which may occur if the drawdown rate is restricted. The flood risk from other discharges from the Headpond are negligible.

Flooding from Surface Water Drainage

4.9.38 The Proposed Development may increase the impermeable areas on-site. Additionally, a predicted increase in rainfall intensity of 42% due to climate change over the lifetime of the development is likely to increase surface water run-off from the Proposed Development Site over its lifetime.

4.9.39 In addition to proposed impermeable areas, the proposed surface water drainage system will need to consider potential pluvial flows from within and outside the Proposed Development Site and any expected groundwater flows above ground. The design must be particularly robust in the provision of drainage to areas where the consequences of surface water inundation would be greater. This includes locations where flows could enter below ground infrastructure.

4.9.40 Surface water drains for the Proposed Development will be designed to the SEPA regulatory method on SuDS, THC Supplementary Guidance and in accordance with other current good practice and legislation. It is demonstrated in **Section 5** that safe discharge of surface water is possible, with the implementation of SuDS where practicable.

4.9.41 The volume and location of surface water attenuation storage needs to be carefully considered at the detailed design stage. If proposals for storage above ground are developed, careful consideration needs to be given to protecting buildings from flooding by the use of appropriate containment and appropriate landscaping across the Proposed Development Site. Consideration also needs to be given to suitable access and egress routes from the areas to be used to accommodate flood storage. These details are to be agreed with THC and SEPA before construction takes place.

4.9.42 The drainage system will be designed and constructed to these standards. As a result, the Proposed Development will not have a detrimental impact on surface water flood risk on and off-site.

4.9.43 A residual risk remains from blockage of the drainage system or exceedance of its capacity. Mitigation, as described in **Section 6.3** reduces the impact of these risks further.

4.9.44 In addition to increased surface water runoff as a result of the proposed new / upgraded access roads, new water course crossings could lead to increased flood risk. The crossings will be designed in line with latest guidance and will be designed to convey the 1 in 200 year flows with an allowance for climate change and appropriate freeboard allowance. Where appropriate and not cost prohibitive, the crossing arrangements will be designed based on structures in line with the GBR or Simple Licence as set out under the CAR General Guidance.

4.9.45 A Drainage Impact Assessment is set out in **Section 5 Drainage Impact Assessment,** setting out the main principles to be adopted in the development of the Detailed Drainage Strategy and detail design. Detailed flow and hydraulic calculations will be undertaken during the detailed design stage and submitted to THC to discharge drainage conditions attached to the consent for the Proposed Development.

4.10 Flooding from Foul Drains and Sewers

Existing Foul Drainage

4.10.1 There is no existing drainage in the area.

Proposed Foul Drainage

4.10.2 Foul wastewater may be discharged to the public sewerage infrastructure off-site, treated on-site or stored temporarily on-site in a cesspit for appropriate disposal.

4.10.3 Any system for disposal to the public sewer will be designed in accordance with the requirements of Scottish Water to ensure that there is no detrimental impact on the existing public sewer system. The drainage designer will undertake a more detailed assessment of the foul drainage requirements and agree on the allowable foul discharges with SW at the detailed design stage.

4.10.4 Foul drains for the Proposed Development will be designed in accordance with Scottish Water, The Highland Council and SEPA requirements. A drainage system will be designed and constructed to these standards. As a result, the Proposed Development will not have a detrimental impact on foul drainage flood risk on and off-site.

4.10.5 A residual risk remains from blockage of the drainage system or exceedance of its capacity. Mitigation, as described in **Section 6.3** reduces the impact of these risks further.

5. Drainage Impact Assessment

5.1 Introduction

5.1.1 In line with The Highland Council guidance Flood Risk and Drainage Impact a Drainage Impact Assessment is required to demonstrate that a suitable means of providing drainage is available for the Proposed Development. The following Outline Drainage Strategy sets out how the Proposed Development is able to discharge foul and surface wastewater flows without increasing the flood risk both on and off-site. A Detailed Drainage Strategy will be confirmed at the detailed design stage and prior to construction. This assessment considers the following:

- Existing drainage arrangements;
- Potential foul and surface water drainage arrangements;
- Climate change; and

- The mitigation measures needed for surface water and foul water disposal.

5.1.2 A Detailed Drainage Strategy will be prepared during detailed design considering foul and surface water drainage for both the Construction and Operational phases. Potential methods of wastewater management and disposal have been considered as part of this Outline Drainage Strategy. All details and proposals will be developed further at detailed design stage and agreed with THC, SEPA and Scottish Water (SW) as appropriate to ensure the most suitable and sustainable drainage strategy for the Proposed Development is in place.

5.2 Surface Water Drainage

Existing Surface Water Drainage

5.2.1 The Proposed Development Site is an undeveloped area, no existing surface water drainage arrangement therefore exists.

Proposed Surface Water Drainage

5.2.2 In order to ensure that the Proposed Development Site is adequately drained, a suitable surface water management strategy for the Proposed Development is required. This section sets out an Outline Drainage Strategy addressing surface water drainage relevant to the Proposed Development. In addition to local rainfall, the surface water drainage design must consider the potential for overland flow paths from permeable and impermeable areas outside of those areas which are to be formally developed, including from outside of the Proposed Development Site. Potential groundwater flows must be considered if they may be expected to break ground.

5.2.3 The drainage design must be particularly robust in more vulnerable areas such as potential points of entry to below ground infrastructure to protect personnel and equipment from flooding.

Methods of Surface Water Disposal

5.2.4 Surface water disposal for the development will be designed to SEPA regulatory method on SuDS and in line with The Highland Council guidance Flood Risk and Drainage Assessment.

5.2.5 For the purpose of the initial assessment, it is assumed that the opportunity for infiltration is limited. The Outline Surface Water Drainage Strategy is therefore based on the disposal of surface water drainage into local watercourses / bodies and dispersed overland.

5.2.6 The Proposed Development Site is in close proximity to a number of watercourses which naturally drain the local catchments. These may provide the most appropriate point of surface water drainage disposal.

5.2.7 Based on the principle that surface water drainage should follow the natural catchments, it is likely that a number of separate surface water systems, each with at least one separate point of discharge will be required.

5.2.8 Temporary surface water management arrangements will be constructed to take account of construction stage increased hardstanding.

Attenuation Requirements

5.2.9 If surface water drainage from the Proposed Development is to be discharged to local watercourses, there may be a requirement to restrict the discharge of surface water to an appropriate rate, to be agreed with The Highland Council and SEPA. Any requirement for attenuation from a new development is normally based on the principle that the development should not create additional run-off to the watercourse, compared to the existing situation, and therefore does not lead to an increase in flood risk elsewhere. The likelihood of attenuation requirements is limited and will be accommodated local to the drained parts of the Proposed Development.

5.2.10 Due to the nature of the Proposed Development Site, careful consideration of the natural catchments, likely existing run-off, and likely change in run-off will be required to establish an appropriate limit for each discharge. Discussion with SEPA will be undertaken at the detailed design stage to agree on the most appropriate method of assessment.

Storage Requirements

5.2.11 Surface water should be stored within the drainage system either below ground or in formal above ground systems for the 1 in 30 year storm event with an allowance for climate change. In excess of this up to the 1 in 200 year plus climate change event, ponding is tolerated above ground on the Proposed Development Site. Any ponding would need to be contained in areas such as formal landscaping or car park areas.

5.2.12 The volume of storage required will depend on the final impermeable area within the Proposed Development and the hydraulic characteristics of the drainage system, including whether attenuation of the discharge is required. The volume should be confirmed at the detailed design stage when an accurate assessment of the impermeable area has been made, and further discussions with the SEPA and THC regarding the requirements for attenuation have taken place.

5.2.13 Attenuation storage could be in the form of a detention basin, retention basin, geo-cellular storage modules, a formal concrete tank or other appropriate SuDS systems.

Climate Change

5.2.14 SEPA published ‘Climate change allowances for flood risk assessment in land use planning’ guidance. The document outlines the approach to climate change uplifts based on geographic location and catchment size. Catchments under 30 km^2 should have uplift applied to peak rainfall, whereas catchments over 50 km^2 should have uplifts applied to peak flow.

5.2.15 Catchments in between these values should undertake both assessments and apply the greater of the two. A range of uplifts are provided based on a west/ east split for rainfall and by river basin regions for flow. The Loch Ness catchment is more than 50 km^2 and located in the North Highland Region. On reviewing the guidance, peak flow for the Loch Ness Catchment was uplifted by 40%.

Sustainable Drainage Systems (SuDS)

5.2.16 NPF4 direct developers towards the use of SuDS wherever possible. SEPA encourages the use of SuDS where practicable, and THC encourages their use in their Supplementary Planning Guidance.

5.2.17 In order to protect the receiving aquifer, watercourse or sewer from pollution, CIRIA Report C753 (The SuDS Manual) suggests an approach for setting the level of treatment that surface water run-off will pass through before being discharged based on treatment indices.

5.2.18 These systems must be maintained correctly to ensure their safe operation and that flood risk to the Proposed Development Site or off-site is not increased. Design guidance for SuDS is currently provided by CIRIA Report C753 (The SuDS Manual).

5.2.19 **Table 5 SuDS Techniques** outlines the type of SuDS that could potentially be used on the Proposed Development Site. It should be noted that not all SuDS methods are suitable or necessary for all developments. Many factors, such as available space and ground conditions, will influence the choice of methods for a particular development. Those considered relevant to the Proposed Development are set out within **Table 5 SuDS Techniques,** below.

Table 5 SuDS Techniques[5]

Technique	Description	Management Train Suitability						Water Quantity				Water Quality									Environmental Benefits		
		Prevention	Conveyance	Pre-treatment	Source control	Site Control	Regional Control	Conveyance	Detention	Infiltration	Water Harvesting	Sedimentation	Filtration	Adsorption	Biodegradation	Volatilisation	Precipitation	Uptake by plants	Nitrification	Aesthetics	Amenity	Ecology
Water butts, site layout and management	Good housekeeping and design practices.	■	▲		■			▲	▲	■	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Pervious pavement	Allow infiltration of rainwater into underlying construction/soil.	■			■	▲			■	■	▲	■	■	■	■	■				▲	▲	▲
Filter drain	Linear drains/ trenches filled with a permeable, often with a perforated pipe at the base of the trench.		■		■	▲		■	■				■	■	■	■						
Filter strips	Vegetated strips of gently sloping ground designed to drain water from impermeable areas and filter out silt and other particulates.			■	■			▲	▲	▲		■	■	■	■					▲	▲	▲
Swales	Shallow vegetated channels that conduct and/or retain water (and can permit infiltration when underlined). The vegetation filters particulates.		■		■	■		■	■	▲		■	■	■	■			▲		▲	▲	▲
Ponds	Depressions used for storing and treating water. They have a permanent pool and bankside emergent and aquatic vegetation.					■	■		■	▲	■	■	■	■	■	■	■	■	■	■	■	■
Wetlands	As ponds, but the run-off flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds.		▲			■	■	▲	■	▲	■	■	■	■	■	■	■	■	■	■	■	■
Detention Basin	Dry depressions designed to store water for a specified retention time.					■	■		■			■	▲	▲	■			■		▲	▲	▲
Soakaways	Sub-surface structures that store and dispose of water via infiltration.				■					■			■	■	■							
Infiltration Trenches	As filter drains but allowing infiltration through trench base and sides.		▲		■	■		▲	■	■			■	■	■	■						
Infiltration basins	Depressions that store and dispose of water via infiltration.					■	■		■	■			■	■	■	■				▲	▲	▲
Green roofs	Vegetated roofs that reduce run-off volume and rate.	■		■	■				■				■	■	■	■	■	■	■	■	■	■
Bioretention areas	Vegetated areas for collecting and treating water before discharge downstream, or to the ground via infiltration.				■	■			■	■		■	■	■	■	■	■	■	■	■	■	■
Sand filters	Treatment devices using sand beds as filter media.			■		■	▲		■	▲			■	■	■	■	■					
Silt removal devices	Manhole and/or proprietary devices to remove silt.			■								■										
Pipes, subsurface storage	Conduits and their accessories as conveyance measures and/or storage. Water quality can be targeted using sedimentation and filter media.		■			■		■	■			▲	▲	▲								

Key
■ Recommended
▲ Some opportunities, subject to design

[5] Extract from The SuDS Manual (C753), Table 1.7

Design Standard and Approval

5.2.20 The Outline Surface Water Drainage Strategy shall be confirmed at the detailed design stage and shall ensure that the Proposed Development Site is adequately drained without posing a risk of flooding on-site or off-site. The drainage scheme shall be submitted to The Highland Council for approval following consultation with SEPA.

5.3 Foul Drainage

Existing Foul Drainage

5.3.1 There is no known foul drainage system on the existing Proposed Development Site.

Proposed Foul Drainage

5.3.2 The following elements of the Proposed Development are expected to generate an element of foul flow:

- Staff welfare facilities within the Cavern Complex and from the Construction Compounds where these have been identified; and
- Foul wastewater is either to be discharged to the public sewerage infrastructure off-site, stored temporarily on-site for appropriate disposal or treated on-site.
- For disposal to the public sewer, the drainage designer shall undertake a more detailed assessment of the foul drainage requirements and agree the allowable foul discharges and suitable points of connection with Scottish Water at the detailed design stage.

5.3.3 This section of the Outline Drainage Strategy sets out the elements in relation to foul drainage. No design of foul drainage has been undertaken at this stage, as such a Detailed Drainage Strategy will be prepared during detailed design considering foul drainage for both the construction and operation phases, in agreement with THC and Scottish Water as required. If possible, foul drainage will be connected to the public sewer. However, if this is not possible alternative options may be considered following general principles such as:

- Collection in sealed septic tanks with foul wastewater pumped out on a regular basis for disposal at a suitable licenced waste facility. The foul drainage system will be managed and maintained by a specialise waste management company for the life of the Proposed Development.
- On-site treatment and disposal such as a septic tank system or bespoke/package treatment works. Given the numbers of workers on the Proposed Development Site during construction it is expected that an on-site package treatment works will be required. However, in the longer term a septic tank system may be more appropriate. Both options will require suitable environmental assessment and authorisation from SEPA through the CAR process. The foul drainage systems will also need to be managed and maintained by a specialist waste management company for the life of the Proposed Development.

5.3.4 If on-site treatment is proposed, and final treated effluent is to be discharged to a watercourse, the design of the outfall will be in accordance with the good practice discussed under **Section 5.2: Surface Water Drainage.**

5.3.5 At this stage the requirement for a pumping station to convey foul flows from the Proposed Development cannot be ruled out. A pumping station may also be required to serve below ground elements of the Proposed Development. Emergency storage and telemetry to warn of high levels / pump failure shall be included in any pumping station design.

5.3.6 Foul drains for the Proposed Development shall be designed to The Building (Scotland) Regulations 2004

5.3.7 All foul drainage proposals should be agreed in full with The Highland Council and Scottish Water at the detailed design stage together with SEPA where such a system will discharge to ground or to a waterbody.

5.4 Summary

5.4.1 The above Drainage Impact Assessment including an Outline Drainage Strategy demonstrates that the provision of safe and effective surface water and foul drainage systems for the Proposed Development is possible, provided any proposed systems are designed and managed appropriately.

5.4.2 A more Detailed Drainage Strategy will be developed at the detailed design stage. The strategy shall be agreed in full with SEPA, Scottish Water and THC as appropriate to ensure all flow rates, storage volumes, and points of discharge are satisfactory.

6. Mitigation Measures

6.1 Operational Regime

6.1.1 This section outlines the measures to:

- mitigate the flood risks identified in **Section 4** associated with the operation of the scheme; and
- protect the key receptors identified including people and property together with the wider environment on-site and off-site from the effects of flooding.

6.1.2 A robust operational regime is required to ensure that the Proposed Development does not have a detrimental impact on flood risk

6.1.3 Whilst extensive areas next to the River Ness in Inverness benefit from an increased standard of flood protection as a result of the River Ness Flood Protection Scheme, properties further upstream between Ness Bridge and Ness Island remain at risk during lower return period events. Properties are shown to be at risk during High likelihood events based on the SEPA flood risk maps and in the 1 in 25 year event based on current conditions on the flood modelling undertaken for the River Ness Flood Protection Scheme.

6.1.4 Any increase in flood flows in the River Ness during extreme flood events will exacerbate the flood risk. In order to avoid such increase, discharge into Loch Ness should be limited to periods when water levels are below the current 1 in 10 year flood level. This equates to 17.2 mAOD at Loch Dochfour and 17.6 mAOD at Loch Ness. Whilst Loch Dochfour and Loch Ness are two large, connected water bodies during periods of raised water levels increased hydraulic losses through the Bona Narrows leads to a difference in water levels and hence the different levels.

6.1.5 Setting the operational regime based on water levels will ensure that it is robust and is resilient to climate change. This approach allows for the Proposed Development to accommodate and adapt to fluctuations in rainfall over its Operational lifespan of circa 125 years.

6.2 Emergency Planning

6.2.1 Although it has been demonstrated that the flood risk from the Headpond and its associated embankment will be low, effective local emergency planning will need to be implemented to ensure an appropriate response in the unlikely event of a failure. An appropriate Emergency Response Plan will be developed in conjunction with the SEPA and THC to ensure that an effective and coordinated response to any emergency can be implemented to further mitigate the potential consequences of such an event.

6.3 Residual Risk of Flooding from On-Site Drainage Systems

6.3.1 There is a residual risk of flooding from blockage of the proposed drainage systems, including any SuDS components, if poorly maintained. Regular inspection and maintenance should be undertaken to ensure drainage infrastructure, including SuDS, remains in a suitable condition.

6.3.2 There is a residual risk of flooding to the Proposed Development's buildings if the capacity of the surface water drainage system is exceeded. Finished floor levels for buildings on the Proposed Development should be located at least 150 mm above external ground levels in accordance with standard practice, to ensure any such flows cannot enter buildings.

6.3.3 Assuming implementation of an inspection and maintenance and the raising of building floor levels within the Proposed Development , the residual risk of flooding from the proposed drainage systems is therefore considered to be low and acceptable.

6.4 Access track Watercourse crossings

6.4.1 In addition to increased surface water runoff as a result of the proposed new / upgraded access roads new water course crossings could lead to increased flood risk. The crossings are to be designed in line with latest guidance and should be designed to convey the 1 in 200 year flows with an allowance for climate change and appropriate freeboard allowance. Where appropriate and not cost prohibitive the crossings arrangements will be designed based on structures in line with the GBR or Simple Licence as set out under the CAR General Binding Rules.

6.4.2 Detailed flow and hydraulic calculations will be undertaken during detail design to confirm and to inform applications for CAR authorisation.

6.4.3 The watercourse crossings along the access track should be inspected periodically and following any extreme rainfall event.

6.5 Dochfour Weir Upgrades

6.5.1 The Dochfour Weir Upgrades, whilst not part of the Proposed Development has been considered as part of this assessment. The upgrades consist of the construction and operation of a variable weir that will adjust the height of the weir to contain the pumped storage hydro operation flows within Loch Ness and isolate the flows in the River Ness from the impact of the PSH activities. The weir should be restricted to summer operation only (April to September) to avoid the potential to increase flood risk if operated all year. This restriction should remain until an appropriate regime can be developed that will not increase flood risk. This could include the use of forecasting information and a limited operation of the variable weir such as it is not raised any further than the maximum volume that can be lowered to the existing Ness Weir sill level in one day so as not to increase the flood risk. Any such proposal will be assessed in detail to ensure that such operation does not impact on flood risk at Loch Ness or along the River Ness.

6.5.2 The Dochfour Weir Upgrades is not part of the application for the Proposed Development and will be subject to a separate application. Details of the Dochfour Weir Upgrade can be seen in **Appendix 2.1 Dochfour Weir Upgrade Description (Volume 5: Appemdices)**.

6.6 Design Recommendations

6.6.1 It is recommended that the following are incorporated or considered in the design for the Proposed Development to ensure that it is subject to a low and acceptable risk of flooding:

- Attenuation of surface water flows may be required. Discharge limits and locations to be discussed and agreed in full with The Highland Council and SEPA at detailed design, and appropriate storage to be provided within drainage design if necessary.
- Storage, to account for attenuated surface water, should be accommodated within the drainage system either below ground or above ground systems for the 1 in 30 year storm event with an allowance for climate change. In excess of this up to the 1 in 200 year plus climate change event, surface water should be stored in controlled areas within the development.
- The drainage strategy for the Proposed Development should incorporate SuDS where practicable.
- The surface water drainage design should consider the potential for overland flow from outside of the Proposed Development Site and any groundwater flows which are expected to break ground.

- Landscaping and drainage of the Proposed Development should be designed to route flood flows away from the proposed buildings, towards the less vulnerable open areas or to drainage systems.
- Finished floor levels on the Proposed Development should be located 150 mm above external ground levels in accordance with standard practice, to ensure residual flows cannot enter buildings.
- Regular inspection and maintenance of drainage systems should be undertaken during Operation of the Proposed Development.
- FRA to be revisited at the detailed design stage to ensure all available information is taken into account and further mitigation included if necessary.
- The proposed Dochfour Weir Upgrade variable weir arrangement has the potential to increase flood risk if operated all year. The operation of the weir should therefore be restricted to summer operation only (April to September) until an appropriate regime can be developed that will not increase flood risk.
- Further refinement should also be made to the proposed weir arrangement and operation to optimise the scheme potential. This could include the use of forecasting information and a limited operation of the variable weir in winter months. Any such proposal will be assessed in detail to ensure that such operation does not impact on flood risk at Loch Ness or along the River Ness

7. Conclusion

7.1 Flood Risk to the Proposed Development

7.1.1 All the potential sources of flooding to the Proposed Development have been considered, including sea, river, groundwater, land drainage, overland flow, artificial sources, reservoirs and foul and surface water drainage arrangements. Climate change has also been considered, which is expected to increase the peak rainfall intensity by 42% and peak river flow by 40% over the lifetime of the Proposed Development.

7.1.2 With the exception of the Lower Control Works on the banks of Loch Ness, the SEPA flood maps show that the Proposed Development is located outside of the indicative flood risk inundation extent. **The development is therefore not at risk of flooding.**

7.2 Flood Risk Impact of the proposed Development

7.2.1 The FRA has demonstrated that the risk of the Proposed Development increasing fluvial flooding locally is considered to be low and acceptable with the implementation of an upper operating level (stop generation) of 17.6 mAOD at Loch Ness. This will be measured at the LCW and at the SEPA level gauge at Foyers on Loch Ness. This is the current 1 in 10 year flood level in Loch Ness. **The impact of the operation of the Proposed Development will not have a detrimental impact on flood risk to others.** The impact is regarded as **Negligible and therefore not significant.**

7.2.2 The Headpond is classed as a High Risk reservoir under the Reservoir (Scotland) Act based on the consequence of an uncontrolled release of water and the effect that this could have on the surrounding area downstream of the reservoir. As a result, the Headpond is designed based on a Category A Reservoir in line with Floods and Reservoir Safety, the most stringent category and regularly inspected in line with the Reservoirs (Scotland) Act 2011 to maintain that standard.

7.2.3 The required ability to convey flood flows for such a reservoir is significantly higher than those assessed with regard to planning. The Headpond is designed based on a Category A reservoir and therefore has the ability to convey flood flows without overtopping orders of magnitude greater than those set out probability of occurrence defined as a flood risk area under NPF4. The flood risk to others from the Headpond overtopping is regarded as being **Negligible and therefore not significant.**

7.2.4 The headpond spillway is set at a level that can accommodate a 1 in 1,000 year flood event with an allowance for climate change. No flood water will therefore spill form the Headpond in such an event. This is in excess of the event that is defined as the flood risk standard under NPF4 and The Highland Council Flood Risk Guidance, an annual probability of being flooded of greater than 0.5%. The flood risk to others as a result of flood water spilling from the Headpond is regarded as being **negligible**.

7.2.5 The probability of a breach of the reservoir is again very low and orders of magnitude below the probability of occurrence defined as a flood risk area under NPF4 and The Highland Council Flood Risk Guidance, an annual probability of being flooded of greater than 0.5%. The flood risk to others from such an event is regarded as being **negligible**. A breach assessment will be undertaken as part of the reservoir registration process under the Reservoirs (Scotland) Act 2011 to allow The Highland Council and emergency services to form an Emergency Response Plan and for SEPA to confirm the risk categorisation of the Headpond under the Reservoirs (Scotland) Act 2011. The likelihood of flood risk increase from this mechanism is **Negligible and therefore not significant**.

7.2.6 Within the Valve House a controlled release arrangement forms part of the Headpond arrangement and discharges into Allt Saigh catchment to allow the reservoir to be drawn down in the case of an emergency. A primary valve together with a secondary guard valve will be included in the arrangement to provide backup from any failure of the valve. Given the size of the watercourse immediately downstream of the scour outlet, full operation of the drawdown facility would cause localised flooding and potential damage to infrastructure. A secondary bund is therefore proposed with a culvert arrangement to attenuate flows down to a flow less than the natural Qmed flow in the watercourse (1 in 2 year event). The bunded arrangement will have the ability to allow the scour valve to be operated for a few minutes in line with regular maintenance requirement of the reservoir. The likelihood of flood risk increase from this mechanism is **Negligible and therefore not significant.**

7.2.7 This Assessment demonstrates that appropriate management measures for foul and surface water drainage from the Proposed Development is feasible provided that the proposed systems is designed and managed appropriately. Detailed drainage design for the Proposed Development shall be developed in accordance with the recommendations of the FRA, and the proposed drainage arrangements will be agreed in full in advance of construction with THC, Scottish Water and SEPA as necessary. Additionally, wherever possible the development will use SuDS to manage surface water run-off. The suitability of the Proposed Development for the use of SuDS shall be determined fully from the results of site investigations and infiltration testing at the detailed design stage. The maximum discharge rates to watercourses from surface water systems, and any required attenuation volumes shall be discussed with and agreed in full with SEPA at the detailed design stage. The flood risk posed by the drainage arrangement is therefore regarded as **Negligible and therefore not significant.**

7.2.8 This Assessment demonstrates that it is possible to mitigate the identified risks through the application of appropriate design principles at the detailed design stage and appropriate system management principles in operation. The mitigation measures outlined within this Assessment are designed to protect the users of the Proposed Development, the Proposed Development itself, and off-site people, properties and habitats from the effects of flooding.

7.2.9 This Assessment has set out the guiding principles by which the design will be undertaken to ensure that there is no unacceptable increase in flood risk from the Proposed Development.

8. References

1. EU Directive 2000/60/EC (Water Framework Directive (WFD))
2. Flood Risk Management (Scotland) Act 2009 and the Flood Risk Management (Flood Protection Schemes Potentially Vulnerable Areas and Local Plan Districts) (Scotland) Regulations 2010 ('the Flood Risk Management Act')
3. Reservoirs (Scotland) Act 2011
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5. PAN 61 – Planning and Sustainable Urban Drainage Systems, Scottish Government Planning Department (2001)
6. PAN 79 – Water and Drainage, Scottish Government Planning Department (2006)
7. PAN 1/2013 – Environmental Impact Assessment, Scottish Government Planning Department
8. UK Climate Projections (UKCP18) website. [Online]. Available: http://ukclimateprojections.metoffice.gov.uk/21678
9. The Highland Council (2013). Supplementary Guidance, Flood Risk & Drainage Impact.
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13. Loch Dochfour, 1987, Reservoirs Act 1975, British Waterways Board.
14. Climate change allowances for flood risk assessment in land use planning Version 5, August 2024, SEPA
15. Guide to drawdown capacity for reservoir safety and emergency planning - SC130001 Volume 1 – main guide: DEFRA
16. Flood Risk and Land Use Vulnerability Guidance – version 4, SEPA
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18. SEPA Flood Risk Maps website: Flood maps | Beta | SEPA | Scottish Environment Protection Agency
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25. Loch Dochfour Reservoirs Act Section 10 Inspection Report 1987
26. Power from the Glens: SSE (formerly Scottish Hydro Electric)
27. Floods and Reservoir Safety, Fourth edition – ICE
28. Guidance on SEPA's reservoir risk designation process – Reservoirs (Scotland) Act 2011 – SEPA
29. UKCEH aggregated Land Cover Maps 2023 – viewed online on the nrfa.ceh.ac.uk/data/station/spatial/6007

Annex A. THC Compliance Certificate

The Highland Council
Comhairle na Gàidhealtachd

FRA and DIA Guidance

Assessment Compliance Certificate

I certify that all reasonable skill, care and attention to be expected of a qualified and experienced professional in this field have been exercised in carrying out the attached Assessment. I also confirm that I maintain the required Professional Indemnity Insurance*. The report has been prepared in support of the below named development in accordance with the reporting requirements issued by The Highland Council.

Please select Assessment type:

Flood Risk Assessment	[x]	Drainage impact Assessment	[x]

Additional Information

Assessment Ref No:	Volume 5, Appendix 11.2 Flood Risk Assessment
Assessment Revision:	
Assessment Date:	March 2025
Planning Application No:	Section 36 ECU00005121
Name of Development:	Glen Earrach Pumped Hydro Scheme
Address of Development:	9.5 km to the south of Drumnadrochit and 6.5 km north of Invermoriston, Loch Ness, Highland Region
Name of Developer:	Glen Earrach Energy
Name and Address of Organisation preparing this assessment:	AECOM, 1 Tanfield, Edinburgh, EH3 5DA
Name of Approver:	Dylan Huws
Signed:	
Date:	25th March 2025

Glen Earrach AECOM