Red John Pumped Storage Hydro Scheme

Volume 2, Chapter 10: Water Environment

ILI (Highlands PSH) Ltd.

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Quality Information

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Revision History

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Distribution List

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10 Water Environment

10.1 Introduction

10.1.1 This chapter of the EIA Report identifies and assesses the potential effects of the Development on surface water quality, groundwater quality and hydromorphology.

10.1.2 There is interaction between topics and therefore this chapter should be read in conjunction with Chapter 5 Geology and Ground Conditions, Chapter 6 Terrestrial Ecology, Chapter 8 Aquatic Ecology, and Chapter 9 Flood Risk and Water Resources, which considers the potential effects on hydrology, flood risk and water resources.

10.1.3 Potential impacts and effects on the receptors have been described for the construction, operation and decommissioning 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.

10.1.4 This chapter is supported by the following figures that can be found in Volume 3:

- Figure 10.1:Surface Water and Groundwater Receptors and Attributes – Wider Context;
- Figure 10.2:Surface Water and Groundwater Receptors and Attributes – Study Area; and
- Figure 10.3: Walkover Survey Photos.

10.1.5 This chapter is also supported by the following technical appendices (which are provided in Volume 5):

- Appendix 10.1: Legislation, Policy and Guidance – Technical Note;
- Appendix 10.2: Licensed Water Abstractions and Discharges Within 2 km of the Development;
- Appendix 10.3: Private Water Supplies;
- Appendix 10.4: Preliminary Water Framework Directive Assessment; and
- Appendix 10.5: Outline Surface Water Management Plan.

10.1.6 Consultation with statutory (e.g. The Scottish Government, SEPA, SNH, THC, Scottish Water and Marine Scotland Science) and non-statutory consultees (e.g. Ness District Salmon Fishery Board and RSPB Scotland) has been undertaken at various stages of the pre-application process. A summary of which is provided in Section 10.3.

10.2 Legislation, Policy and Guidance

Relevant Legislation

10.2.1 A summary of the legislation and planning policy relevant to the assessment of impacts of the Development is provided in this section (for full details please refer to the Planning Statement submitted with the application). The relevant European Directives are the following:

- Water Framework Directive (WFD) 2000/60/EC (European Community)(Ref 1);
- Environmental Liability 2004/35/EC (Ref 2);
- Groundwater Directive 2008/105/EC (Ref 3);

- Groundwater Directive 2006/118/EC (Ref 4);
- Freshwater Fish Directive 2006/44/EC (Ref 5);
- Eel Regulations No 1100/2007 (Ref 6); and
- Priority Substances Directive 2008/105/EC (Ref 7).

10.2.2 The European Directives listed before are implemented in Scotland through a number of pieces of legislation which are named in the Planning Statement submitted with the Section 36 application. These refer to the protection and management of the aquatic environments, habitats and species.

National Legislation

10.2.3 The Water Environment (Controlled Activities) (Scotland) Regulations 2011 as amended in 2013 (Ref 8), and more commonly known as the Controlled Activity Regulations (CAR), apply regulatory controls over activities which may affect Scotland's water environment, including further amendments. The activities relevant to this Development that need CAR authorisation include those susceptible of causing pollution or adverse impacts to the water environment, abstractions, construction and other activities and engineering works in or in the vicinity of inland water or wetlands

Scottish Planning Policy (SPP)

10.2.4 The purpose of the SPP (Ref 9) is to set out national planning policies which reflect Scottish Ministers' priorities for operation of the planning system and for the development and use of land. The relevant Policy Principles to the water environment are the presumption in favour of development that contributes to sustainable development, taking account of protecting and improving the water environment and flood risk.

Planning Policy Guidance

10.2.5 SEPA has published a number of documents and good practice guides to support the implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2013 (Ref 8).

WFD River Basin Management Plan

10.2.6 The River Basin Management Plan (RBMP) for the Scotland River Basin District: 2015–2027 (as amended, 2017) (Ref 10) and additional documents establish the guidelines for compilation of WFD objectives in the Scotland River Basin District.

Local Policy

Highland-Wide Local Development Plan

10.2.7 The Highland-Wide Local Development Plan (HwLDP) (Ref 11) sets out the overarching vision statement, spatial strategy and general planning policies for the whole of The Highland Council area, except the area covered by the Cairngorms National Park Local Plan. The HwLDP should be read alongside the Area Local Development Plan and any Local Plans which may still be in place.

10.2.8 Policies relevant to the water environment within the HwLDP include those regarding sustainable design, protection of the water environment and other important habitats and features as well as need of flood risk management and Sustainable Drainage Systems (SuDS) designed in accordance with The SuDS Manual (CIRIA C753) (Ref 12).

Inner Moray Firth Local Development Plan

10.2.9 The Inner Moray Firth Local Development Plan (IMFLDP) (Ref 13) sets out the policies and land allocations to guide development in the Inner Moray Firth area over the next 20 years. The IMFLDP in combination with the HwLDP and Supplementary Guidance will be used to determine planning applications in the Inner Moray Firth area. The IMFLDP supersedes all or parts of the Local Plans. It does not contain any specific policies for the protection of the water environment.

10.3 Methods

10.3.1 This section of the EIA report covers potential impacts of the Development to the water environment. In undertaking this impact assessment the following tasks have been carried out:

- Identification of the information sources that have been consulted in preparation of this chapter;
- Details of consultation undertaken with respect to water quality and hydromorphology;
- The methodology behind the assessment of water quality and hydromorphology effects, including the criteria for the determination of the significance of the receptor and the magnitude of change from the baseline condition;
- An explanation as to how the identification and assessment of water quality and hydromorphology effects has been reached; and
- The significance criteria and terminology for assessment of the residual effects to water quality and hydromorphology.

Study Area

10.3.2 The Development is surrounded by three main lochs, Loch Ashie, Loch Ness and Loch Duntelchaig, and several small lochs and watercourses associated with them.

10.3.3 The Water Environment Study Area considered is a 1 km buffer from the Development Site boundary, as shown on Figure 10.1 and 10.2 (Development Site boundary –1km buffer).

10.3.4 Due to the nature of the Development and the size of the lochs mentioned in paragraph 10.3.2, it is unlikely that any significant adverse effects will propagate to any other water body beyond these lochs.

Desk Based Research

10.3.5 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):

- Ordnance Survey https://www.ordnancesurvey.co.uk/ (Ref 14);
- Met Office https://www.metoffice.gov.uk (Ref 15);
- SEPA website https://www.sepa.org.uk/ (Ref 16);
- SNH Standing Waters Database http://gateway.snh.gov.uk/ (Ref 17);
- Scotland's Aquaculture website http://aquaculture.scotland.gov.uk/ (Ref 18);
- Scotland's Environment website https://www.environment.gov.scot/maps/scotlands-environment-map/ (Ref 19);
- Scotland's soils website: http://map.environment.gov.scot/Soil_maps/?layer=1 (Ref 20);
- National River Flow Archives https://nrfa.ceh.ac.uk/ (Ref 21);

- British Geological Society (BGS) website http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Ref 22); and
- SEPA data request for:
  - Any available bathymetry, storage-depth curves and surface and depth-profiling water quality data for Loch Ashie, Loch Duntelchaig or Loch Ness;
  - 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 bodies within the 1 km Study Area (Development Site boundary –1km buffer), particularly any incidents of toxic algal blooms in Loch Ashie, Loch Duntelchaig or Loch Ness;
  - Any ecological surveys undertaken for Loch Ashie, Loch Duntelchaig or Loch Ness and feeder streams, including fish, macro-invertebrates, macrophytes etc.;
  - Information on licensed water abstractions and discharges within the 1 km Study Area or affecting Loch Ashie, Loch Duntelchaig or Loch Ness (extended to 2km in Appendix 10.2, Volume 5); and
  - Information on any other attributes of these water bodies that we should be aware of when undertaking the impact assessment.
- Private Water Supply data from THC and private holders (Appendix 10.3, Volume 5);
- Ecology survey data about protected species from Chapter 7: Aquatic Ecology; and
- Consultation with statutory and non-statutory stakeholders (see from 10.3.7 below).

Field Survey Work

10.3.6 A walkover survey of the Study Area was carried out on the 9 May 2018 during cool, dry weather but following a period of heavy rain. The survey was carried out by a team of surveyors consisting of a water quality specialist, 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 bodies 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 of water bodies and the prediction of potential effects from the Development.

Consultations

10.3.7 Details of consultation comments and how they are addressed in the EIA report are summarised in Appendix 4.4 Consultation Tracker (Volume 5). The key issues from the consultation process are summarised below with respect to water quality.

Pre-scoping Consultation (THC Major Pre-Application)

10.3.8 Marine Scotland Science (MSS) refers to the need to include fish assessment in the EIA Report, because of the potential for impacts on the River Moriston SAC, (designated for Atlantic salmon and Freshwater pearl mussel), and the range of important fish species present in Loch Ness. It also mentioned the need for suitable screens in the Tailpond Inlet / Outlet structure to prevent fish being drawn into the system, as well as the need to consider the potential introduction of invasive species.

Scoping Consultation

10.3.9 The Highland Council scoping response refers to the HwLDP that requests assessments of protected sites (Policy 57), protected species (Policy 57) and how the project relates to the River Basin Management Plan (RBMP) for the Scotland River Basin District and the North Highland RBMP (Policy 63).

10.3.10 The Ness District Salmon Fishery Board (Ness DSFB) recognises the importance of Loch Ness and tributaries for Atlantic salmon and Sea trout (migratory salmonids). In this sense, Ness DSFB is concerned about the potential effects on salmonids derived from entrainment and/or impingement of salmon and Sea trout smolts at the Loch Ness inlet; cumulative effects with other existing or planned developments; prevention of fish pass at Ness Weir due to water level reductions in Loch Ness derived from the water intake; and disruption of their migratory behaviour resulting from the outlet discharge. Therefore, Ness DSFB considers that "*the spatial extent of the studies to inform the EIA should cover the entire area of the catchment accessible to salmon, rather than be limited to the Proposed Development area and 'nearby watercourses' as stated in the scoping document. Also, EIA should include an assessment of the likely effects on other key fish species including brown trout, Arctic char, European eel and lamprey species".* This is considered in Chapter 7: Aquatic Ecology.

10.3.11 SEPA informs about the presence of invasive species in the Ness catchment, as well as requests information about the design, potential impacts and mitigation of the different elements of the Development to the water environment such as temporary and permanent infrastructure, watercourse crossings and diversions or other engineering activities.

10.3.12 Scottish Water (SW) requests details about the drainage system, Headpond and associated infrastructure, as well as assessment of the associated effects during construction, operation and decommissioning in the catchment areas of the surrounding lochs. Also the effects of the Development on drinking water abstractions and hydrology need to be discussed in the EIA.

10.3.13 Considerations from SNH refer to salmon and Slavonian grebe (protected species) and presence of non-native invasive species, highlighting the need to consider them for potential impacts.

Significance Criteria

10.3.14 There is no standard guidance in place for the assessment of the likely significant effects on the water environment from developments of this type. Based on professional judgement and experience of other similar schemes, a qualitative assessment of the likely significant effects on surface water quality and water resources has been undertaken.

10.3.15 The significance of effects has been determined using the principles of the guidance and criteria set out in Chapter 4: Approach to EIA. Following these criteria, the magnitude of effect (Table 10.1) and the receptor sensitivity (Table 10.2) are determined independently from each other, and the results from each are then used to determine the overall significance of effects using the matrix presented in Table 10.3.

10.3.16 Where significant adverse effects are predicted, options for mitigation have been considered and committed to where possible. The assessment takes into account all embedded mitigation that is either integrated into the design or a standard control measure (e.g. good practice guidance for construction works). The residual effects of the Development, with any additional mitigation in place are then reported.

10.3.17 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 body. 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. Irrespective of importance, all controlled waters in Scotland are protected by law from being polluted.

Magnitude of Effect

10.3.18 The magnitude of effect will be determined based on the criteria in Table 10.1 taking into account the likelihood of the effect occurring. The likelihood of an effect occurring is based on a scale of certain, likely or unlikely. Consideration is also given to the duration and reversibility of the effect as well as consideration of relevant legislation, policy and guidelines.

Table 10.1 Magnitude of impact criteria (adapted from HD45/09)

Magnitude of impact	Descriptor
Very high	Total loss or major alternation to key elements / features of the baseline conditions such that post development character / composition of baseline condition will be fundamentally changed. For example: • Loss of EC designated salmonid / cyprinid fishery; • Pollution of portable source of abstraction; • Deterioration of a water body leading to a failure to meet Good Ecological Status or Potential (GES / GEP) and reduction in Class; • Significant reduction in yield of a public or private drinking water supply.
High	Loss or alteration to one or more key elements / features of the baseline conditions such that post development character / composition of the baseline condition will be materially changed. For example: • Loss in production of fishery; • Contribution of a significant proportion in the effluent in the receiving river but insufficient to change its water quality status; • Deterioration of a water body leading to failure to meet GES / GEP; • Minor or temporary reduction in yield of a private drinking water supply; • Reduction in yield of a non-potable water abstraction; • Significant or permanent reduction in quantity of groundwater to support Groundwater Dependent Terrestrial Ecosystems (GWDTEs).
Medium	Minor shift away from baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character / composition of the baseline condition will be similar to the pre-development situation. For example: • Effect on water body which may prevent achievement of GES / GEP or other WFD target; • Minor or temporary reduction in the quantity of groundwater to support GWDTEs.
Low	Very little change from baseline conditions. Change is barely distinguishable, approximating to a ‘no change’ situation. For example: • Discharges to watercourse but no significant loss in quality, fishery productivity or biodiversity; • No effect on WFD classification; • No measurable effect on groundwater levels or water abstraction yields.

Receptor Sensitivity

10.3.19 The sensitivity of the baseline conditions is assessed according to the relative importance of existing environmental features on or near to the site, or by the sensitivity of receptors which could potentially be affected by the Development. Criteria for the determination of sensitivity or of importance or value of receptors are established based on approved guidance, legislation, statutory designation and/or professional judgment. Table 10.2 outlines the mechanism by which importance is determined.

Table 10.2 Receptor sensitivity descriptors (reproduced and adapted from Chapter 4)

Sensitivity	General criteria	Groundwater	Surface Water	Hydromorphology
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.	Highly Productive Aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation. Critical social or economic uses (e.g. public water supply and navigation).	EC Designated Salmonid / Cyprinid fishery; WFD Class 'High'; site protected / designated under EC or UK habitat legislation (SAC, SPA, SSSI, WPZ, Ramsar site, Species protected by EC legislation.	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river and lake type.
High	The receptor has low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance.	Moderately Productive Aquifer providing locally important resource or supporting river ecosystem. Important social or economic uses such as private water supply, navigation or mineral extraction; GWDTE with high dependency on groundwater.	WFD Class 'Good'; Major Cyprinid Fishery; Species protected under EC or UK habitat legislation. Critical social or economic uses (e.g. water supply and navigation).	Conforms closely to natural, unaltered state and will often exhibit well-developed and diverse geomorphic forms and processes characteristic of river and lake type. Deviates from natural conditions due to direct and/or indirect channel, floodplain, bank modifications and/or catchment development pressures.
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value or is of regional importance.	Moderately Productive Aquifer, groundwater with little or no commercial use, GWDTE with moderate dependency on groundwater Aquifer providing water for agricultural or industrial use with limited connection to surface water. Aquifer providing water for agricultural or industrial use with limited connection to surface water.	WFD Class 'Moderate'; Important social or economic uses such as water supply, navigation or mineral extraction.	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	The receptor is tolerant of change without detriment to its character, is low environmental value, or local importance.	Rocks with essentially no groundwater.	WFD Class 'Poor' or undesignated in its own right. Low aquatic fauna and flora biodiversity and no protected species. Minimal economic or social uses.	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

Sensitivity	General criteria	Groundwater	Surface Water	Hydromorphology
				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.
Negligible	The receptor is resistant to change and is of little environmental value	Not applicable.	Not applicable.	Not applicable.

Significance of Effect

10.3.20 The significance of effects has been determined using the matrix presented in **Error! Reference source not found.**. Effects classed as moderate or greater are considered 'Significant' in EIA terms. Effects predicted to be Minor are considered to be manageable and such effects are 'Not Significant'.

Table 10.3 Matrix for assessment of significance (reproduced from Chapter 4)

	Sensitivity				
Magnitude	**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

Mitigation Measures Methodology

10.3.21 The methodology taken to identify mitigation measures involved developing an understanding of influences upon each receptor and reviewing the range of options that most effectively respond to any identified adverse effects. The mitigation measures that are expected to deliver the most effective mitigation are described in section 10.7.

Residual Effects Methodology

10.3.22 The assessment of residual (post-mitigation) effects involved developing an understanding of the surface water environment effects once mitigation has been implemented. The same methodology used to identify the significance of effects prior to taking mitigation measures into account has been used.

Limitations

10.3.23 The EIA 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.

10.3.24 This impact assessment is based on existing data and information provided by the SEPA and supplemented by observations made during the walkover survey undertaken by AECOM. For many water bodies in the Study Area there was no water quality or hydrological data and for others the data that was available was limited. No digitial bathymetry or water depth-storage data was provided and therefore the potential effects from the Development on water quality, hydrology and loch stratification has been assessed qualitatively and based on certain assumptions defined in the impact assessment section.

10.3.25 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 Ness, from where it was abstracted. At certain times of the year water quality changes might occur over a period of a few weeks. 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, however this scenario is again highly unlikely.

10.3.26 For the purpose of this assessment it has been assumed that the Development will operate only when there is sufficient water available in Loch Ness to support existing compensatory flows and other resource commitments, and an upper water level defined by the need to manage flood risk downstream, please refer to Chapter 9: Flood Risk and Water Resources for details of the proposed operational levels and controls. These levels are subject to agreement with SEPA as part of the CAR licence conditions.

10.4 Baseline Environment

Study Area Topography, Land Use and Climate

10.4.1 The Development Site is situated between the River Ness and River Nairn water catchment areas. The Site lies on Ashie Moor, a ridge of land between Loch Ness to the north-west, Loch Duntelchaig to the south-west (including the connected small Loch nan Geadas basin and the upstream Loch Ceo Glais), and Loch Ashie to the north-east. In the south-east of the site, there are two small lochs, Loch na Curra and Lochan an Eoin Ruadha. Details about topography and land uses are covered in Chapter 2: Project and Site Description (Volume 2).

10.4.2 There is a Meteorological Office weather station at Inverness, NH668452, 11 km north of the Development Site but close to sea level. Based on the available data from this weather station it is estimated that the Study Area experiences an average of only 733 mm of rainfall per year, with it raining more than 1 mm on around 143 days per year. For more details please see Appendix 9.1: Flood Risk Assessment (Volume 5).

10.4.3 On the National River Flow Archive website, the nearest catchment with rainfall statistics is the Ness at Ness Castle Farm (NH639410), approximately 7 km north of the Development Site. Standard Annual Average Rainfall (SAAR) for the period 1961-1990 is 1779 mm per year, considerably greater annual average rainfall than that registered by the Met Office at the Inverness weather station. It is expected that due to the higher elevation of the Development Site rainfall totals are more likely to be comparable to those recorded at Ness Castle Farm.

Soils and Geology

10.4.4 According to the Scotland's Soils website, the vast majority of the Study Area is underlain by soils described as humus-iron podzols derived from Lower and Middle Old Red Sandstone sandstones.

10.4.5 The bedrock and superficial geology for the Development Site has been identified from a review of the BGS online mapping. The bedrock consists of Inverness Sandstone Group – Sandstone, sedimentary rocks of fluvial origin. The superficial geology consists mainly of Till, Devensian – Diamicton deposits but with peat deposits, alluvium, lacustrine beach deposits and small areas where no superficial deposits are present. Please refer to Chapter 5: Geology and Ground Conditions for full details of the underlying geology.

Groundwater

10.4.6 A Ground Investigation undertaken in August 2018 included four boreholes (x3 down to between 11-12 m and x1 to 20 m depth). The water strikes in these boreholes were at between 3 and 5.5 m depth in the vicinity of the Headpond area and at 1.2 m depth (the 20 m deep borehole) near the Tailpond Inlet / Outlet by Loch Ness. There is limited other hydrogeological information available at this stage.

10.4.7 In general, the Old Red Sandstone (ORS) bedrock in Scotland is known to be a moderate to highly productive aquifers (Ref 23). Groundwater flow is almost entirely via fractures (Ref 24). Even the dominantly sandstone formations are interbedded with finer grained horizons, which restrict intergranular flow. Hydraulic property information for the ORS from the BGS (Ref 25) indicates borehole yields of between 163 and 2,160 m^3/d, and with mean and medium values of 970 and 880 m^3/d respectively (based on Upper and some Middle Devonian Sandstones). Based on twelve boreholes, a Transmissivity of 10 to 608 m^2/d is indicated, with a mean of 198 m^2/d and median of 80 m^2/d. Specific Capacity of 4 to 770 $m^3/d/m$ is indicated, with a mean of 119 $m^3/d/m$ and median of 41 $m^3/d/m$. One core porosity and hydraulic conductivity from the Middle ORS is available from a conglomerate in the Turriff Basin (in the east of the Moray Firth area). The porosity ranged from 8.3 % to 12.4 % and hydraulic conductivity from 0.00002 to 0.0001 m/d.

10.4.8 The superficial deposits (described for the Study Area in paragraphs 10.4.4 to 10.4.6) with the largest storages and highest permeability tend to be in the areas of coarse alluvial gravels along the main rivers. In the Headpond area of the Development the superficial deposits have been observed to be generally peaty. The glaciofluvial or alluvial deposits underlying the peat are expected to be quite sandy, but with some clay content, and are also likely to have been compacted by ice action. In this case a significantly lower permeability than typical glaciofluvial or alluvial deposits is expected. The formation and depositional history of the till will together influence the vulnerability to contamination from surface activities.

10.4.9 The bedrock and the superficial deposits are both known to form important aquifers across the wider Moray Firth area. The Middle ORS is used for public water supply in the Turriff Basin. There are no known public water supplies from groundwater within the Development Site or the immediate surrounding area.

10.4.10 There is one WFD groundwater body underlying the Development Site, the Inverness Groundwater Body (ID: 150670). Based on the information provided on the SEPA website (Ref. 19), it is classified as Good for water quality, water flows and levels, and overall. Future objectives for 2021, 2027 and long term are Good for each criteria.

10.4.11 The use of groundwater may include for industry (e.g. food and drink), agriculture (e.g. irrigation, livestock watering and market gardening) and recreation (e.g. golf courses). In addition, information on private water supplies sourced from groundwater or surface water for properties not served by mains water has been obtained from THC and via public consultation. Details of all known private water supplies within 2 km of the Development Site are provided in Appendix 10.3 (Volume 5) and approximate locations shown on Figure 10.1 and Figure 10.2 (Volume 3). Every effort has been made to identify private water supplies; however it is possible that additional unrecorded supplies are present.

10.4.12 Based on the results of the NVC survey and the site walkover, several GWDTEs have been identified within the Development Site (see Chapter 6: Terrestrial Ecology and Chapter 7: Aquatic Ecology for more details). These include areas of blanket sphagnum bog on Ashie Moor on either side of the C1064 road in the south of the Development area, and areas of flush and spring in the north of the Development Site in the vicinity of Clune Wood.

Surface Water Bodies

10.4.13 The following descriptions of water bodies within the Study Area are based on the field observations made during a site walkover survey on the 9th May 2018 and online data sources as described earlier. The main water bodies within the Study Area (as shown on Figures 10.1 and 10.2, Volume 3) are:

- Loch Ness;
- Loch Ashie;
- Loch Duntelchaig (including the small Loch nan Geadas to which it is connected);
- Loch Ceo Glais;
- Two small lochs in the south-east of the Development Site: Loch na Curra and Lochan an Eoin Ruadha;
- Various small ponds are located within the Development Site. Henceforth referred to as Pond 1 is located at NGR NH 61441 36908, Pond 2 at NH 60038 36034, Pond 3 at NH 61593 36027, Pond 4 at NH 60061 33059, Pond 5 at NH 60727 33196, Pond 6 in NH 62568 33247 and Pond 7 at NH 61195 34252 (please note these ponds are have a different numbering notation in the Chapter 6: Terrestrial Ecology and Appendix 6.4: GCN Survey (Volume 5)); and
- There are a number of watercourses that cross the Development site. These include:
  - The Allt a' Mhinisteir, which flows from Loch na Curra down into Loch Ness at Dores;
  - First order ephemeral stream (Glaic na Ceardaich) that flows south-west to Pond 7 before joining Allt a' Mhinisteir;
  - The Allt Dailinn and tributaries (S8 to S11 on Figure 10.1, Volume 3) drains the centre of the Development around Kindrummond to Loch Ness. The Allt Dailinn features a small waterfall, which is located in the south-west of the Development site;
  - The Allt a' Chruineachd and several unnamed short drains (S3 to S7 on Figure 10.1) flow from the Development Site west to Loch Ness;
  - Streams S8 and S9 either side of Kindrummond flowing west into Allt Dailinn;
  - Big Burn (outside the Development Site Boundary but flows to the south of the Headpond and may be impacted indirectly via a loss of catchment); and
  - Allt a' Chnuic Chonaisg.

10.4.14 Watercourse S1 and S2 (a tributary of the Allt a' Mhinisteir watercourse) as shown on Figure 10.1 (Volume 3) rise just within the Development Site boundary but away from any proposed works and then flow northwards away from the Site. These will therefore not be impacted by the Development and have not been considered any further. Similarly, Loch Ruthven is located approximately 3 km south-east of the Development site and not hydrologically linked to it, as such it will not be considered any further.

10.4.15 The main water bodies identified within the Study Area and with the potential to be impacted by the Development are described in the following sections.

Loch Ness

10.4.16 Loch Ness is a large glacially eroded freshwater loch covering approximately 55 km^2. It lies close to sea level (water level is around 16 m Above Ordnance Datum (AOD)) and is approximately 22.5 km long with a north-east to south-west axis along the Great Glen Fault. It is very deep with a maximum depth of around 230 m. Due to its physical characteristics and a review of aerial photography in addition to the walkover, the loch is likely to be dimictic, meaning that it overturns twice each year, typically during the spring and autumn, which will exert a strong control on water quality and habitat conditions.

10.4.17 Loch Ness is oligotrophic meaning that it is characterised by low primary productivity and low biomass associated with low concentrations of nutrients (i.e. nitrogen and phosphorus) and generally well oxygenated water that is likely to support fish species such as Atlantic salmon (*Salmo salar*), Sea trout (*Salmo trutta*), Brown / Ferox trout (*Salmo trutta / ferox*), and Arctic charr (*Salvelinus alpinus*). Other fish species that may be found in the loch include European eel (Anguilla anguilla), Northern pike (*Esox lucius*), Three-spined stickleback (*Gasterosteus aculeatus*), Brook lamprey (*Lampetra planeri*) and Eurasian minnow (*Phoxinus phoxinus*), as raised in the Scoping Opinion (Appendix 4.3). Atlantic salmon and Brook lamprey are Annex II species designated under the EC Habitats Directive (92/43/EEC) as implemented in Scotland through the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Unusually for an oligotrophic water body, water clarity is very poor due to the presence of humic acids leached from the peat rich soils in the surrounding catchment.

10.4.18 Loch Ness is a water source for the northern section of the Caledonian Canal and provides a location for various recreational activities. Please see Chapter 9 Hydrology and Flood Risk for further details, including water resources and water balance in Loch Ness and a discussion of any future changes to local water supply arrangements.

10.4.19 Since 1999 the 600 m long gravel / sandy beach at Dores has been designated as a bathing water under the original Bathing Waters Directive (76/160/EC) and the current Revised Bathing Waters Directive (2006/7/EC). According to SEPA's online Bathing Water Profile for Dores (Ref 24), the beach is very popular with tourists, particular in the summer season. SEPA monitor the quality of water (for faecal indicator organisms) throughout the bathing water season (May to September) from NH 59671 35000 and the current bathing water quality at Dores is Good (period 2017/18). The Bathing Water Profile also shows the location of a small sewage treatment works discharging to Loch Ness to the south of Dores at approximately NH 59640 34450 including a sewage outfall, combined sewer and emergency overflows). It also states that algal blooms have occurred on the loch, including those formed of cyanobacteria (i.e. blue-green algae) that can be toxic, although the loch is not considered sensitive to an overproduction of filamentous algae or phytoplankton.

10.4.20 A commercial fish farm operates on the southern shore of Loch Ness approximately 1 km from the centre of Dores at NGR NH591 337. The fish farm is operated by Marine Harvest Ltd under Controlled Activities Licence (CAR) Licence CAR/L/100896. The farm is for Atlantic salmon smolts and consists of up to 18 freshwater cages, each a 48 m plastic circle connected by a central pontoon and moored close to the loch's southern bank.

10.4.21 Other activities on Loch Ness include various recreational water sports such as kayaking, (there is an important kayak route through the loch), bank and boat fishing, and loch cruises. In addition, water is abstracted from the loch for bottled water by Loch Ness Water Ltd, although the location of this abstraction is not yet known.

10.4.22 Finally, there are also existing hydro-electric schemes in operation on Loch Ness, located at the south-western end of the loch nearer to Fort Augustus – Foyers pumped storage scheme, and Glendoe and Glenmoriston conventional hydro schemes.

Loch Duntelchaig, Loch nan Geadas and Loch Ceo Glais

10.4.23 Loch Duntelchaig (NH 61122 30774) is a freshwater loch approximately 5 km long and approximately 1.75 km wide at its widest point, with a surface area of approximately 5.55 km^2. According to Ordnance Survey data, Loch Duntelchaig has a maximum depth of around 60 m, which despite being significantly shallower than Loch Ness is still considered deep and seasonal stratification is expected. Loch Duntelchaig is connected to Loch Ceo Glais further upstream by the WFD designated Feith Ghlas watercourse (ID 20314), although both Loch Ceo Glais and Feith Ghlas water bodies will not be affected and are not considered any further.

10.4.24 Loch Duntelchaig forms part of the upper catchment of the River Nairn and the contributing area feeding the loch is small relative to the surface area of the loch resulting in significant attenuation of any flood flows from the upper catchment.

10.4.25 Loch Duntelchaig in conjunction with Loch Ashie (both Drinking Water Protected Areas (DWPA)) is the main potable water supply loch for Inverness. The loch is also important for local recreational activity and water sports.

10.4.26 Loch nan Geadas (NH 60004 30691), is located south-east of Loch Duntelchaig, to which is connected through a water channel. The small freshwater body has an ellipsoidal shape of about 120-172 m diameter, with a surface area of 0.0173 km^2.

10.4.27 Loch Ceo Glais (NH 58868 28817) is a freshwater body of around 1.4 km long and 130-180 m wide, with a surface area of approximately 0.1935 km^2. The outflow from this loch travels north-east around 800 m to Loch Duntelchaig.

Loch Ashie

10.4.28 Loch Ashie is a freshwater body of around 2.5 km long and 500-700 m wide, with a surface area of approximately 1.4 km^2. It forms part of the upper catchment of Big Burn, a tributary of the River Ness that joins at the upstream end of Inverness. Loch Ashie feeds into an area that is classed as being a Potentially Vulnerable Area with regard to flood risk – PVA 01/21 Inverness and the Great Glen. Loch Ashie is at the upper part of the catchment and the contributing area feeding the reservoir is small relative to the surface area of the loch, which is likely fed from groundwater, resulting in significant attenuation of any flood flows from the upper catchment.

10.4.29 Loch Ashie in conjunction with Loch Duntelchaig forms the main portable water supply for Inverness. The current arrangement is under pressure to meet future demand.

10.4.30 Loch Ashie is included within a Drinking Water Protected Zone and provides a secondary supply to Inverness. A water treatment works is located at the bottom of the loch close to the overflow to Allt Mor. Loch Ashie is principally fed from Big Burn, a WFD watercourse (ID 20261).

Loch na Curra and Lochan an Eoin Ruadha

10.4.31 There is very limited background data on the water quality and hydrology of Loch na Curra and Lochan an Eoin Ruadha, and the surrounding moorland. These two small lochs are listed on the SNH Scottish Standing Waters Database and some limited online data is available when they were last surveyed in 1988.

10.4.32 According to the online database and AECOM survey (July 2017), Loch na Curra has a surface areas of approximately 0.045 km^2 , with a maximum depth of 2.65 m, and is likely to be typical of a mid-altitude circumneutral lake, with a high diversity of plants. However, the survey data from 1988 suggests a larger surface area and more acidic water. Lochan an Eoin Ruadha is recorded as having a 14 ha surface area, a maximum depth of over 15 m and described as a slightly acid upland lake supporting a diversity of plant species.

10.4.33 Neither water body is designated as a site for nature conservation or under the WFD, according to information from SEPA.

Watercourses and Small Standing Water Bodies

10.4.34 From a review of online Ordnance Survey maps and aerial imagery, and based on observations on Site, the watercourses and standing water bodies within the Study Area, or affected by the Development are described below. These features are shown on Figure 10.1, Figure 10.2 and Figure 10.3 (Volume 3).

10.4.35 Loch na Curra overflows into the headwaters of the Allt a' Mhinisteir stream. This stream flows northwards through Dirr Wood and into Loch Ness at Dores. In the upper reaches, the watercourse is characterised by a low gradient, with in-channel vegetation, overgrown banks, sluggish flow in places and coarse sediment forming steps and pools. The burn is culverted in a number of locations across forestry roads by corrugated metal pipes (NGR NH 60748 33291, NH 60764 33338, NH 60965 34017 and NH 60631 34289). Material in the channel is likely to be a mixture of eroded bank material (glacial till and alluvium) and material from construction of the forestry road. The gradient becomes steeper around NGR NH 61034 33957, with woody debris forming pools and causing accumulations of gravel. There are pronounced bedrock and boulder steps in this reach and the material is predominantly cobble to boulder sized and angular in nature with moss and lichen on some upper surfaces, indicating that it has come from local sources and flows are not competent of transporting it downstream. However in high flows, some of the smaller material may be moved to some degree, and therefore clean surfaces were observed. Downstream of the third forestry road crossing at NGR NH 60965 34017 the channel is incised, with bedrock exposed in the banks. This area has been recently felled, with woody debris in the channel. In the section downstream of the inflow from Pond 7 (see paragraph below), the channel morphology is similar to the previous reach, with bedrock exposed in the channel and gravel-cobble steps formed. This continues downstream of the fourth forestry road crossing to Dores, where the gradient becomes shallower and the channel has been historically realigned as part of a mill dam and sluice system (outwith the red line boundary).

10.4.36 Pond 7 is located at NGR NH 61195 34252, which may overflow towards the watercourse through Dirr Wood when water levels are high, although no obvious flow was observed on Site. The pond was historically used as a mill pond with a sluice control (Ordnance Survey map 1975). A small inflow to the pond was observed around NGR NH 61258 34266. This is a small channel, likely rising from boggy ground, with low gradient close to the pond and possible step pool morphology. The pond was observed in May 2018 during which there was evidence of extensive stands of emergent vegetation starting to appear above the water line. Although no water quality data was available, the surrounding forestry and the recently clear felled slopes to the south of the pond may have introduced excessive fine sediment and nutrients, which may be accelerating natural succession.

10.4.37 Two other first order streams (the headwaters of Allt Dailinn from pond P4 and its tributary stream S8, see Figure 10.2, Volume 3) rise a short distance to the west of Loch na Curra either side of Kindrummond and flow west coalescing in Drummond as the Allt Dailinn stream that eventually discharges to Loch Ness within Erchite Wood. Upstream of Kindrummond, these watercourses rise from boggy ground, and once they become distinct channels they have low gradient, are straightened and over-wide in places, with poaching by livestock evident. Between Kindrummond and Drummond, the channel is smaller but remains straightened and sluggish. Downstream of Drummond the gradient steepens as the burn flows to Loch Ness. There is a waterfall in this reach and the morphology is likely to be a range of step pool and cascade.

10.4.38 The Big Burn is a first order stream which rises to the south-west of Loch Ashie and has a length of approximately 0.9 km. The watercourse is designated under the WFD as it is an inflow to Loch Ashie, and has 'high' status in all categories. The channel is small (approximately 1 m across), flowing through a fire break in an area of commercial forestry. Big Burn (or Allt Mor) continues as the outflow from Loch Ashie.

10.4.39 Other minor watercourses drain the immediate slopes to Loch Ness (e.g. Allt a' Chnuic Chonaisg and Allt a' Chruineachd). An unnamed watercourse rises around NGR NH 60633 34137 and flows steeply towards Dores, where it discharges to Loch Ness. The trees on the slopes around the upper reaches have recently been cleared (observed during walkover survey in May 2018) and there was evidence of fine sediment and soil in the channel. This area of felling continues for the majority of the catchment, to the crossing at the B862 road. The Allt a' Chnuic Chonaisg has a small catchment, draining the steep slope above Loch Ness from Park farm. The channel is small (<1m across) and is likely to have step pool morphology for much of its length. The Allt a' Chruineachd drains a small catchment between the B862 road and Loch Ness. It is likely to have step pool morphology for much of its length, with a steep gradient. Close to the crossing with the B852, there is a good supply of gravel, with some accumulations around fallen trees and at the existing track crossing at NGR NH 59001 33205 and NH 60245 33049 (a gravel ford).

Surface Water Quality

10.4.40 **Error! Reference source not found.** provides a summary of the current WFD classifications for Loch Ness, Loch Ashie, and Loch Duntelchaig, based on results from Cycle 2 WFD Management Plans (2016) (Ref 24). Please refer to Appendix 10.4: Preliminary WFD Assessment (Volume 5) for a description of WFD classification classes. Please also note that the classification of Loch Ashie and Big Burn are mainly calculated from similar water bodies in the wider area based on SEPA information, as no sampling or surveys have been done in those WFD waterbodies directly. None of the small watercourses flowing through the Development are designated under the WFD. Upstream and downstream of these three lochs, principle feeder / overflow channels are designated under the WFD, but as they will not be affected by the Development, these adjacent water bodies have not been discussed further in this Chapter (please refer to Appendix 10.4 Preliminary WFD Assessment for further details and justification for this).

Table 10.4 Surface Water Body Classification Details –Lochs Ness, Ashie and Duntelchaig

River Basin Management Plan (RBMP) Parameter	Loch Ness (Cycle 2 2016)	Loch Ashie (Cycle 2 2016)	Loch Duntelchaig (Cycle 2 2016)	Big Burn (Cycle 2 2017)
RBMP	Scotland River Basin District	Scotland River Basin District	Scotland River Basin District	Scotland River Basin District
Waterbody Name and ID	Loch Ness, ID100156	Loch Ashie, ID100159	Loch Duntelchaig ID100161	Big Burn - Loch Ashie to source ID 20261
Water Body Type	Lake	Heavily modified	Heavily modified	River
Size (Area or Length)	Area 55.3 km^2	Area 1.4 km^2	Area 5.6 km^2	0.4 km long
Overall Ecological Status / Potential	**Good**	**Bad**	**Poor**	**High**
Chemical Status	**Pass**	**Pass***	**Pass**	N/A
Downstream Waterbody	River Ness	Big Burn	River Nairn	Loch Ashie
Biological Quality Elements	**Good**	**High***	**Good**	**High***
Invertebrates	High	N/A	N/A	High
Aquatic plants	High	N/A	Good	N/A
Other aquatic plants	High (Phytobenthos)	N/A	Good (macrophytes)	N/A
Alien Species	Good	N/A	N/A	N/A
Fish barrier	High	High	High	High
Fish	N/A	N/A	N/A	High*
Phytoplankton	High	N/A	N/A	N/A
Phytobenthos	High	N/A	N/A	N/A
Physico-Chemical Parameters	***High***	***High****	***High***	***High****
Acid Neutralising Capacity	High	High*	High	High**
Dissolved Oxygen	High	N/A	High	High*
Total Phosphorus	High	High*	High	N/A
Reactive Phosphorus	N/A	N/A	N/A	High*
Salinity	High	High*	High	N/A
Temperature	N/A	N/A	N/A	High*
pH	N/A	N/A	N/A	High*
Hydromorphological Parameters	*High*	*Bad**	*Poor*	*High**
Morphology	High	Poor*	Good	High*
Overall hydrology	High	Bad*	Poor	High*
Specific pollutants	Pass	N/A	Pass	N/A

* Calculated, data from a similar WFD waterbody in the catchment

** Default status, no data available

10.4.41 Loch Ness is designated under the WFD as a distinct lake water body (100156), included in the WFD typology of deep and large lowland lake of low alkalinity. It is currently classified as at Good Ecological Status and passing Good Chemical Status (2016). The future target is to maintain Good Status through ensuring that deterioration does not occur, unless caused by a new activity providing significant specified benefits to society or the wider environment.

10.4.42 Loch Duntelchaig is designated under the WFD as a mid-altitude, large, medium alkalinity and deep lake water body (ID 100161). It is heavily modified (due to water supply) and currently at Good Ecological Potential and Pass Chemical Status (2016), as all mitigation measures have been implemented (control pattern / timing of abstraction), despite its overall ecological status being Poor because of Poor 'Overall Hydrology'. Loch Duntelchaig is also within a salmonid water catchment.

10.4.43 Loch Ashie is also a WFD waterbody (ID 100159) characterised by being a mid-altitude, large, medium alkalinity and deep lake (with water depths greater than 10 m according to Ordnance Survey maps). Loch Ashie may exhibit a different seasonal stratification pattern to both Loch Ness and Loch Duntelchaig due to its shallower water depth. Like Loch Duntelchaig the loch is heavily modified (water supply) and is currently at Bad Ecological Potential but passing Good Chemical Status. SEPA has set a target of Poor Ecological Potential by 2021, and Good Ecological Potential by 2027. Mitigation measures have been implemented in this loch, including control of abstraction and flow regulation, and improvement to condition of channel / bed and shoreline.

Water Uses

10.4.44 Loch Duntelchaig and Loch Ashie are both Drinking Water Protected Areas that supply local Water Treatment Works (WTW). Water from Loch Ness also supplies local WTW when required.

10.4.45 According to the data provided by SEPA, there is one licensed surface water abstraction in Loch Ness (fish farm freshwater cage), and 11 discharge licences in the vicinity of the Development, which are summarised in Appendix 10.2 (Volume 5). These include several Waste Water Treatment Plants (WwTP) and private sewage discharges into Loch Ness, several small watercourses and groundwater within 2 km of the Development.

10.4.46 Information from THC and public consultation about presence of Private Water Supplies (PWS) is summarised in Appendix 10.3 (Volume 5). These include mainly well / borehole and two spring abstractions for domestic use.

10.4.47 According to the information provided by SEPA, there is record of eight pollution events for the Study Area. However, SEPA's procedures do not allow them to provide any additional information.

Ecology and Nature Conservation

10.4.48 When determining the importance of water bodies, it is important to consider the quality of aquatic habitats and species that each water body supports.

10.4.49 There are no statutory ecological designations within the Development Site. However, there are two statutory nature conservation designations covering water bodies within the Study Area and just outside of the Development Site boundary:

- Loch Ashie Site of Special Scientific Interest (SSSI) and Special Protected Area (SPA) which is designated for its importance as a passage habitat for the Slovenian grebe

(*Podiceps auritus*), borders the Development site to the north. The Joint Nature Conservation Committee website describes Loch Ashie as "*a large, open, mesotrophic loch located south-east of the Great Glen in the Scottish Highlands. Much of the shoreline is stony and exposed, with only small patches of emergent vegetation. Where the shore is more sheltered, small beds of Bottle Sedge Carex rostrata have developed. The loch is the most important site in Britain for Slavonian Grebe Podiceps auritus gathering during the pre- and post-breeding periods. In addition, the loch supports a population of breeding Slavonian Grebe of European importance*"; and

- Loch Ruthven, which is approximately 2 km south-east of the Development site, is designated as a SSSI, SPA, Special Area of Conservation (SAC) and under the RAMSAR convention for its breeding Slavonian grebe population, SAC freshwater habitat and otter population.
- The River Moriston SAC, although located 22 km south-west of the Development, is important for supporting Atlantic salmon and Freshwater pearl mussel (which depend on the juvenile salmon for part of their lifecycle) traveling to Loch Ness in their migration to the sea. The most recent monitoring for the River Moriston SAC considers Atlantic salmon to be 'at Unfavourable, No Change' condition.

10.4.50 SEPA has provided data on fish for Loch Duntelchaig and Loch Ashie, phytoplankton and macrophytes for Loch Ness, and diatoms and macroinvertebrates for Loch Duntelchaig and Loch Ness. Also, ecological attributes in the study area and their potential impacts and mitigation are covered in Chapter 7: Aquatic Ecology.

10.4.51 The only fish ecology sampling that has been carried out on Loch Duntelchaig and Loch Ashie is eDNA sampling (draft reports following on from eDNA sampling in 2017/18 by SEPA).

10.4.52 The following species were found in Loch Duntelchaig: European eel (*Anguilla anguilla*), Northern pike (*Esox lucius)*, Three-spined stickleback (*Gasterosteus aculeatus*), European river lamprey (*Lampetra fluviatilis)*, European perch (*Perca fluviatilis)*, Sea / Brown trout (*Salmo trutta*), and Arctic charr (*Salvelinus alpinus)*. In Loch Ashie the following species were found: European eel, Three-spined stickleback, European perch, Sea / Brown trout, and Arctic charr. SEPA was unable to provide data for any of the other water bodies.

10.4.53 Several of the present fish species are protected by the European and Scottish legislation: sea trout under The Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 (Commencement) Order 2005, while eel in the European Council Regulation No 1100/2007 and river lamprey is listed on Schedule 3 of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).

10.4.54 Consultation with Marine Scotland Science and Ness District Salmon Fishery Board (Chapter 7: Aquatic Ecology) advised the presence of priority species salmon, Arctic charr, European eel and pike and Brown trout in Loch Ness, this last one also found in Loch na Curra.

10.4.55 The most up to date records of phytoplankton in Loch Ness were obtained in July 2016, where a very diverse community was recorded, with a low presence of cyanobacteria (Ecological Quality Ratio (EQR) normalised 0.8) and a general EQR of 1.02, corresponding with High Status communities.

10.4.56 Regarding cyanobacteria presence, Anabaena sp. was found in Loch Duntelchaig in August 2011 in a concentration of 14,980 cells/ml. Anabaena sp. Cyanobacteria can produce neurotoxins that can be harmful to wildlife and recreation users. The World Health Organisation guidelines for safe-practice in managing recreational waters indicate that at cyanobacterial concentrations of 20,000 cyanobacterial cells/ml there may be short-term adverse health outcomes: e.g. skin irritations and gastrointestinal illness. This is further detailed in the Scottish Executive revised guidance document "*Blue-green algae (Cyanobacteria) in inland waters: assessment and control of risks to public health*" (Ref 25).

10.4.57 Macrophyte survey data was available for Loch Duntelchaig and Loch Ness. The latest survey in Loch Duntelchaig was undertaken in 2017. This had a Lake Macrophyte Nutrient Index (LMNI) score of 3.85, meaning presence of species sensitive to nutrient pollution. Diversity was relatively high, with 12 truly aquatic taxa present, 6 out of a total of 18 functional groups present and low presence of filamentous algae (0.24). In Loch Ness, the latest results are from 2015, with a LMNI value of 4.55, 17 truly aquatic taxa present, seven functional groups and 0.65 for Green Filamentous Algae (ALG) – See Chapter 7: Aquatic Ecology for more details on aquatic species counts. These results indicate a slightly higher nutrient enrichment and presence of algae with respect to Loch Duntelchaig, although diversity is higher in Loch Ness.

10.4.58 Benthic invertebrates were assessed through the Chironomid Pupal Exuviae (cast-off skins of the pupae of non-biting midges) Technique (CPET). Results for Loch Ness in 2016 show an average EQR of 0.87, which corresponds with High quality. CPET value for Loch Duntelchaig in 2017 shows similar results, with an EQR of 0.97. Also Biological Monitoring Working Party (BMWP), a procedure for assessing water quality by examining macroinvertebrate communities, was calculated for Loch Ness, with an annual average score of 127 in 2016, indicating presence of species very sensitive to pollution and so un-impacted loch character.

10.4.59 The most recent survey for diatoms in Loch Ness was in 2012, with an annual EQR average value of 0.9, which corresponds with Good quality.

10.4.60 Information about invasive non-native species present in the Study Area is presented in Chapter 7: Aquatic Ecology.

10.4.61 Pond 7 was covered in the baseline surveys summarised in Chapter 6: Terrestrial Ecology and Chapter 7: Aquatic Ecology. No protected or notable macrophyte or macroinvertebrate species, or potential habitat to support protected or notable fish species were present and therefore it was considered of negligible value.

10.4.62 With respect to the watercourses present, no rare or notable species were recorded during ecological surveys more details in Chapter 7: Aquatic Ecology. Regarding presence of Great crested newt (GCN), Appendix 6.4 GCN Survey Report (Volume 5) eDNA results were negative for all the waterbodies assessed in this chapter except for Lochan an Eoin Ruadha.

Importance of Water Bodies

10.4.63 **Error! Reference source not found.** lists the various surface water bodies that have been considered by this assessment and their importance in terms of water quality and morphology.

Table 10.5 Water Body Receptors and their Importance

Water Body	Baseline Summary	Water Quality Importance	Hydro-morphology Importance
Loch Ness	This waterbody is considered to be an oligotrophic loch that is at Good Ecological Status under the WFD. It is also important for salmon and other important fish species migration as well as supporting water supply, flow along the Caledonian Canal and recreation activities at a regional scale. There is a designated bathing water at Dores. The loch supports commercial fish farming, bottled water, and other hydroelectric power generating installations. The loch also has very important cultural and historical significance.	Very High	High
Loch Ashie	This waterbody is at Bad Ecological Potential under the WFD, but has an objective to increase this to Good by 2027. It is a Drinking Water Protected Area (DWPA).	Very High	Not applicable
Loch Duntelchaig	This waterbody is at Good Ecological Potential under the WFD and is considered a DWPA. It is also important for recreation at a local level.	Very High	Not applicable
Loch nan Geadas, Loch na Curra, Lochan an Eoin Ruadha	These small lochs are not designated under the WFD and there is no water quality data, although they appear to be humic rich. They may support local fish populations and possibly have some significance in terms of local recreational fishing.	Medium	Not applicable
Pond 7	This waterbody is of small scale, shallow and sedimented, plus there is limited or no known or potential socio-economic uses or amenity value.	Low	Medium
Loch Ceo Glais, Feith Ghlas watercourse	These watercourses are located upstream of the Development and will not be affected, and thus are not considered further.	Not applicable	Not applicable
Big Burn	Big Burn is at High Ecological Status under the WFD and flows into Loch Ashie, which is a storage loch for potable water supply within a DWPA, and is therefore considered to be of very high importance for water quality. Despite there being only a poorly defined channel, Big Burn may be contributing to water supply storage in Loch Ashie and thus for hydromorphology the importance is High.	Very High	High (hydrology effects only)

Water Body	Baseline Summary	Water Quality Importance	Hydro-morphology Importance
Allt a' Mhinisteir Allt Dailinn, Allt a' Chnuic Chonaisg Allt a' Chruineachd and watercourses S1-S11 on Figure 10.1	Watercourses are generally small and predominantly have stable morphology (step pool, bedrock and cascade) with steep gradients. There are some areas where impacts of forestry or farming activities are seen including excess nutrients and sedimentation (poaching of banks by livestock), culverting, widening and straightening. Flows are not thought to be impacted by abstraction and water quality is generally good. They are not classified under WFD but flow to Loch Ness which is classified. None of these watercourses are covered by any wildlife designations. A precautionary medium importance has been attributed to these water bodies.	Medium	Medium
The Inverness Groundwater Body (ID: 150670)	The SEPA website confirms that the Overall Condition, the Water Quality and the Water Flows and Levels are all classified as Good in 2014. The projected condition for each criteria is also Good for 2021 and 2027	High	Not applicable
Private Water Supplies (summarised in Appendix 10.3)	Private water supplies, sourced from groundwater or surface water (springs or surface water bodies). Stated uses include drinking, stock watering and general non-potable.	High	Not applicable
GWDTEs	Areas of blanket sphagnum bog are present on Ashie Moor on either side of the C1064 road in the south of the Development area, and areas of flush and spring are present in the north of the Development area in the vicinity of Clune Wood.	Medium	Not applicable

10.5 Assessment of Effects

Assessment of Construction Phase Effects

10.5.1 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 also smother habitats and physically impact aquatic organisms, chemical spillages, and physical changes to water bodies as a consequence of:

- Path and watercourses diversions;
- Dewatering and abstraction operations associated with the cofferdam in Loch Ness at the Tailpond Inlet / Outlet Structure;
- Works directly within water bodies (including the construction of a temporary Cofferdam and Jetty, when equipment and materials are brought to the site via the Caledonian Canal and Loch Ness);
- Excavation and crushing of excavated materials;
- Vegetation clearance;
- Works to realign the C1064;
- Construction of Temporary and Permanent Access Tracks;
- Excavation of tunnel portals and tunnelling of the Waterways, Access and Construction tunnels;
- Earthworks, construction of the Embankment and Landscape Embankment and the creation of temporary material storage; and
- Other general construction activities e.g. stripping of vegetation, movement of plant and batching of concrete etc.

Effects on Groundwater - Waterways & Power Cavern

10.5.2 The High-Pressure and Low-Pressure Tunnels are to be constructed using a TBM. The tunnels will be lined as the TBM progresses 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 is likely to be constructed using drill & blast techniques after the TBM reaches depth (as shown on Figure 2.14, Volume 3 - approx. 200 m below ground level at its highest point).

10.5.3 As shown on Figure 2.14, 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 -40 mAOD (at its deepest point) at the Power Cavern, after which the High-Pressure Tunnel starts and rises to approximately 230 mAOD into the Headpond. Therefore, the construction and ongoing presence of the tunnels have the potential to affect both shallow and deeper groundwater. Whilst the Power Cavern may affect deeper groundwater, it is expected that at depth the amount of fracturing will reduce and so inflow will reduce also. Where individual fissures results in inflows, then spray concrete will be used to seal the cavern walls.

10.5.4 The groundwater receptors in closest proximity to the Waterways and Power Cavern are the private water supplies at Balachladaich, approximately 350 m away (distance at ground level) from the Tailpond Inlet / Outlet end of the Low-Pressure Tunnel and at Kindrummond, approximately 625 m away (distance at ground level) from the Low-Pressure Tunnel at its closest point. These PWS are sourced from boreholes, the depth details of which are unknown, however it is assumed that they have a depth of no more than 50 m for the purposes of this assessment. Considering the combined factors of distance from the Waterways and Power Cavern and their position across the hydraulic gradient with respect to the Low-Pressure Tunnel, the magnitude of impact is considered to be Low, resulting in a **Moderate Adverse Effect (Significant)** considering the High Importance of the PWS**.**

Effects on Groundwater - Access and Construction Tunnels

10.5.5 The portals for the construction and access tunnels are to be located within the Compound 1 area. The portals will be constructed by excavation into the bedrock, and as such, it is not envisaged that sheet piling will be required.

10.5.6 The closest groundwater receptors to the portals and the access and construction tunnels are the private water supplies at Dirr Cottage and Ness View Cottage which are both approximately 900 m away (distance at ground level). The magnitude of impact to these receptors is considered to be Low, resulting in a **Moderate Adverse Effect (Significant)** considering the High Importance of the underlying groundwater body.

10.5.7 Areas of flush and spring are present between 500 m and 1 km north-east of the proposed tunnel portal locations. Based on the relative positions with respect to topography and distances between these GWDTEs and the tunnel portals, the magnitude of impact is considered to be Low, resulting in a **Negligible Adverse Effect (Not Significant)** considering the Medium Importance of the GWDTEs**.**

Effects on Groundwater - Headpond

10.5.8 The construction of the headpond will require excavations down to bedrock, with the potential to interact with shallow groundwater and also surface watercourses. Any effects are likely to be temporary until the Headpond has been lined and filled, when the system will become “effectively closed”.

10.5.9 It is also likely the main temporary effect will be on water quality. The magnitude of impact to receptors is considered to be Low, resulting in a **Moderate Adverse Effect (Significant)** considering the High importance of the underlying groundwater body.

General Construction Activities

10.5.10 The general construction activities have the potential to introduce contaminative substances to groundwater if such substances are lost to ground e.g. a spill, or mobilised e.g. earthworks and excavation). This has the potential to detrimentally affect groundwater quality locally.

10.5.11 The groundwater receptors in closest proximity and down hydraulic gradient of these activities are the private water supplies at Balachladaich, Dirr Cottage and Ness View Cottage. The magnitude of impact on groundwater receptors taking into account embedded mitigation is considered to be Low, resulting in a **Moderate Adverse Effect (Significant)** considering the High Importance of the PWS**.**

<u>Effects to Surface Water Quality</u>

Construction Site Run-off - Suspended Fine Sediments

10.5.12 The water environment and the flora and fauna that it supports may be adversely affected by excessive levels of fine sediment contained within construction site run-off, dewaters or from works directly affecting water bodies. Run-off laden with fine sediment is principally generated by rainfall falling onto land that has been cleared of any vegetation and the ground potentially compacted, reducing infiltration. Other potential sources of fine sediment contaminated water include run-off from earth stockpiles, dewatering of excavations, mud deposited on site and local access roads, and that which is generated by the construction works themselves (e.g. vehicle washing).

10.5.13 Generally, excessive fine sediment in run-off is chemically inert and affects the water environment through smothering river beds and plants, temporarily changing water quality e.g. increased turbidity and reduced photosynthesis, and 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. Sediment in run-off may also be associated with other chemicals, although the risk of chemical spillages is considered separately.

10.5.14 The Development will generate a significant volume of materials that needs to be managed appropriately on the Development Site, including storage and transportation. Please refer to Chapter 5: Geology and Ground Conditions for further details on materials generation.

10.5.15 As part of the pre-construction works, trees and other shrubs will be removed from the working area which would increase the potential for soil erosion and reduce the buffering effect on any uncontrolled site run-off. However, this effect will be temporary until the Headpond has been lined and filled, and slopes and surrounding temporary work areas reinstated.

10.5.16 The risk to the water environment is greatest where these activities occur close to and within water bodies. The greatest potential risk is for the works adjacent to and within Loch Ness, and mitigation measures to create a dry working area within a temporary Cofferdam and with a silt curtain are proposed.

10.5.17 Although the presence of the fish farm close to the inlet / outlet works in Loch Ness has been taken into consideration by the importance setting of Loch Ness, it is expected that the fish farm will be relocated along the shore. Any impact on the economic viability of this business is considered in Chapter 14 Socio-economic and Tourism. It is also likely that salmon will be present in the vicinity of the cofferdam during their migration, and again, whilst they are considered in the importance setting of Loch Ness, any potential impacts on salmon (and lamprey) (e.g. direct mortality or physical injury and disruption of their migratory pathway) is considered in Chapter 07: Aquatic Ecology and within the Statement to Inform an Appropriate Assessment.

10.5.18 Beyond Loch Ness, the greatest risk is to Allt a' Mhinisteir watercourse and Pond 7. With the implementation of the CEMP and SWMP the magnitude of impact will be of Low magnitude, resulting in:

- **Moderate Adverse Effect** (**Significant)** on Loch Ness, of very High importance;
- **Minor Adverse Effect (Not Significant)** on Allt a' Mhinisteir, Allt a’ Chnuic Chonaisg, Allt a’ Chruineachd, S3 and S6 watercourses, all of Medium importance;
- **Negligible Effect (Not Significant)** on Pond 7 of Low importance; and
- No impacts are predicted on any other water body.

Construction Site Run-off – Spillage Risk

10.5.19 During construction, fuel, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances will be stored and/or used on site. Leaks and spillages of these substances could pollute the nearby surface watercourses and waterbodies 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 bodies.

10.5.20 To allow such substances to enter a watercourse could be in breach of the Pollution 13 Prevention & Control (Scotland) Regulations 2012 (Ref 26), the Environment Act 1995 (Ref 27) and Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Scotland) Regulations 2003 (Ref 28), and therefore measures to control the storage, handling and disposal of such substances will need to be in place prior to and during construction.

10.5.21 As with the risk from sediment-laden construction site run-off, the risk to the water environment is greatest where these activities occur close to and within water bodies. Perhaps the greatest risk is for the works adjacent to and within Loch Ness, and here special mitigation measures to create a dry working area within a cofferdam with an outer site-specific silt curtain are proposed. Elsewhere, the greatest risk is to the Allt a' Mhinisteir watercourse and Pond 7, and then to the Big Burn and Loch Ashie, although these are buffered by dense mature coniferous forests.

10.5.22 To minimize 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 spilt, propagating from the Site without treatment.

10.5.23 Construction compounds will be constructed with a mixture of imported material and material generated from other construction activities such as Headpond works (as outlined in Section 2.9 of Chapter 2: Project & Site Description).

10.5.24 With the implementation of the CEMP and SWMP the magnitude of impact on Loch Ness, Allt a' Mhinisteir watercourse and Pond 7 from accidental spillage is Low magnitude, resulting in:

- **Moderate Adverse Effect (Significant)** on Loch Ness, of Very High importance;
- **Minor Adverse Effect (Not Significant)** on Allt a' Mhinisteir, Allt a' Chnuic Chonaisg, Allt a' Chruineachd, S3 and S6 watercourses, all of Medium importance;
- **Negligible Adverse Effect (Not Significant)** on Pond 7 of Low importance; and
- No impacts are predicted on any other water body.

Bathing Water

10.5.25 The cobble beach at Dores at the north-eastern point of Loch Ness is a designated Bathing Waters. The bathing season typically runs from late April to early September and requires certain water quality parameters to be met. These are focused on bacterial concentrations (faecal indicator organisms) during summer season. As the temporary welfare facilities installed during construction will have implemented the measures established in the Outline CEMP (Appendix 3.1, Volume 5) to collect, treat and dispose waste waters appropriately, no discharges of foul water to local watercourses will occur. Taking this into account alongside the risk presented by the nature of the works and its duration, the impact is assessed as **Negligible**.

Effects on Hydromorphology

10.5.26 There is potential for adverse impacts to the hydromorphology of the surface water bodies from new or upgraded watercourse crossings, increased hardstand area and tree felling at construction stage.

10.5.27 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 approximately four watercourse crossings identified to be upgraded / created as part of the Development. These are:

- Within construction Compound 1 at NGR NH 60926 34054 and NGR NH 60904 34101 on the Allt a' Mhinisteir (new temporary crossings);
- At NGR NH 59772 33517 (existing) on the Allt a' Chnuic Chonaisg (new temporary crossing); and
- At NGR NH 59023 33194 on the Allt a' Chruineachd (existing, potentially to be upgraded).

10.5.28 Where there are existing crossings, there is not anticipated to be any adverse impact due to impact caused by the existing restriction. On the Allt a' Chnuic Chonaisg, the catchment above the proposed crossing is small and therefore it is not anticipated that there will be excess accumulation or downstream erosion as the channel is unlikely to have sufficient energy to transport large volumes of gravel. The rate of coarse sediment movement in this burn is likely to be slow due to its small size, therefore as the crossing is temporary, it is also anticipated that there will be no long term effect on hydromorphology in this reach. Therefore, the magnitude of impact is assessed to be **Negligible**, which given the **Medium** importance of the receptors for hydromorphology, results in a **Negligible** effect.

10.5.29 The Allt a' Mhinisteir flows through the proposed Compound 1 and there will be two temporary crossings constructed on the watercourse within this compound. The channel of the burn in this location is dominated by bedrock and therefore has a low sensitivity to modifications such as crossings. The banks are likely to be stable and the channel is capable of conveying coarse sediment at high flows in this reach due to the channel type and steep gradient. It is therefore assessed that the impact of two new temporary crossings in this reach will be **Negligible**, which given the **Medium** importance of the receptors for hydromorphology, results in a **Negligible** effect.

10.5.30 Site clearance works (including tree felling and scrub clearance) has the potential to increase run-off to watercourses in the Study Area. Where there are dense woodlands, the trees and understorey can have a buffering effect on flood flows within a catchment, reducing direct run-off through interception, transpiration and increased infiltration to the soil. The removal of woodland can therefore produce the opposite effects exacerbating the increased run-off that would be expected, due to the site clearance and compaction of soils (Ref 29). Changes in hydrology, especially at peak flows, can therefore result in greater erosion, transportation and redistribution of coarse sediment. The removal of vegetation may also destabilise soils or create more readily eroded surfaces leading to increased fine sediment deposition in nearby watercourses, which may further impact channel morphology and erosion risks, especially further down the catchment when gradients decrease and fine sediment may be deposited.

10.5.31 The Allt a' Mhinisteir is at greatest risk from these impacts due to the amount of construction activity that will be undertaken close to it and within its catchment. However, the channel of this watercourse is relatively stable and the coarse sediments are rarely moved by peak flows. The Outline SWMP (Appendix 10.5, Volume 5) also includes measures to attenuate construction site run-off and manage the risk of fine sediment being deposited in the channel. Therefore, in the context of the Development Site and proposed embedded mitigation, a **Negligible** effect is predicted, which given the **Medium** importance of the Allt a' Mhinisteir for hydromorphology, results in a **Negligible** effect.

10.5.32 The other water body that may be at risk from this impact is the Big Burn. However, construction works are at least 125 m from the channel with no direct flow pathways and dense woodland in-between. Big Burn is also a smaller watercourse with only limited coarse sediment deposits that it is unlikely to ever transport. Therefore, for Big Burn, any increase in run-off would have a **Negligible** effect, which given its **High** importance, results in adverse effect of **Minor** significance only **(Not Significant)**.

10.5.33 The construction of hardstand areas within the catchment of the Allt a' Mhinisteir has the potential to increase run-off to the watercourse, which could cause erosion downstream. The area of hardstand to be introduced is approximately 1 % of the catchment area of the watercourse downstream of the compound and is therefore unlikely to cause a detectable increase in flows. Therefore the effect is assessed to be **Negligible.** The **Medium** importance of the Allt a' Mhinisteir for hydromorphology, results in a **Negligible** effect.

<u>Assessment of Operation Phase Effects</u>

Effects on surface water quality

10.5.34 The main pathway for impacts to the water environment during operation of the Development will be derived from the movement of water between the Headpond and Loch Ness. The normal drawdown of the Headpond will be 20 m (between 249 and 269 mAOD) and equate to around 4.9 Mm^3, but this may not be an everyday occurrence. The outflow during generation at the Tailpond Inlet / Outlet will be up to 250 cubic metres per second (m^3/s) with a proposed discharge velocity of approximately 0.15 metres per second (m/s). The inflow during pumping will be up to 170 m^3/s also with a design velocity of less than 0.15 m/s.

10.5.35 The operation of the Development will vary depending on energy market demand and the availability of water in Loch Ness. When generation is proposed, in order to avoid an impact on Loch Ness based on both flood risk and drought scenarios, and water supply to existing users, the current proposed operating parameters have been set as follows:

- The maximum water level in Loch Ness where generation can occur is 17.6 mAOD. This is equal to the current 1 in 10 year flood level; and
- The minimum water level in Loch Ness for a maximum abstraction by the proposed Development is 15.43 mAOD. This includes a 60 mm buffer above the 'hands off level' of 15.33 m AOD in Loch Ness.

10.5.36 During operation there could be potential impacts on thermal stratification and water quality in Loch Ness (direct and indirect by changing water levels) that need to be considered (e.g. water temperature, pH, total suspended solids and sensitivity to algal blooms). In terms of normal operation, and within the upper and lower boundaries of water availability, this will be determined by energy markets / demand and it is not possible to define specifically at this stage. To account for this two reasonable worst case scenarios have been considered as follows:

- Scenario 1 assumes frequent operation where there is regular abstraction and discharges into Loch Ness with daily cycles for many weeks at a time; and

- Scenario 2 assumes that water is abstracted to fill the Headpond but is then stored there for a prolonged period of time such as many weeks to months (this scenario is highly unlikely).

10.5.37 Dewatering of the Headpond for maintenance or under an emergency situation would be similar to operation with the rate of discharge to Loch Ness comparable to normal operation. Therefore, this operation scenario has not been considered any further.

10.5.38 Whilst the Development may have a large abstraction and discharge to Loch Ness, this needs to be assessed in the context of the large size and volume of Loch Ness, which will buffer any discharge through dilution and dispersion. Similarly, it is also important to consider the different potential effects of the operation of the Development during initial start-up, when there could be washing off of concrete residue from the Headpond, medium and long term as inorganic and organic sediments begin to build up within the Headpond.

Impact on Water Quality in Loch Ness from changes in Water Level

10.5.39 Significant changes in water level can potentially lead to the concentration of pollutants in a still water body. Operation of the Development may lead to water level changes of approximately 87 mm across Loch Ness, which is small compared to the natural variation in water levels. It is also unlikely to result in any change in water quality given the depth and very large volume of water stored within Loch Ness. Therefore, **no impact** is predicted.

Impact on Thermal Stratification in Loch Ness

10.5.40 Due to its size and depth Loch Ness will exhibit seasonal thermal stratification and is expected to be dimictic, meaning that it stratifies twice per year, normally in the spring and autumn. Warming in the spring creates a warmer well mixed upper layer known as the epilimnion during the summer, which would be expected to be tens of metres deep. Beneath the epilimnion is the deeper and colder hypolimnion, which is separated from the epilimnion by a transition zone known as the metalimnion. During the autumn cooling of the epilimnion and wind induced turbulence results in an overturn that will mix the water column and induce deeper circulation.

10.5.41 The risk to thermal stratification would only occur during the late spring to early autumn, and would increase with more frequent operation. However, it is unlikely that discharges from the Development will impact the formation and maintaining of thermal stratification due to the relative size of Loch Ness, the expected depth of the thermocline relative to the elevation of the Inlet / Outlet structure, the relatively slow rate of discharge (< 0.15 m/s) (which would be similar to the discharge of a comparably sized watercourse and potential wind induced currents), and since the water temperature of the discharged water is not expected to have increased significantly above background see ‘Water Temperature Changes’ below. Overall, a **Negligible** impact is predicted on Loch Ness, which is of **Very High** importance, resulting in a **Minor Adverse Effect (Not Significant)**. However the likelihood of this effect is highly unlikely.

Impact on Water Temperature in Loch Ness

10.5.42 Changes in water temperature of the discharge water will be minimised by:

- The size and depth of water in the Headpond, which is also at a slightly higher elevation (cooler), is unlikely to warm differently to the upper layers of Loch Ness; and
- Based on the geothermal gradient, 27.5 ^{o}C/km, there could be an increase of 5.5 ^{o}C to the bedrock surrounding the Waterways. However, the Waterways 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 Waterways. During operation, although highly unlikely, should there be extended periods of time that the system does not operate, this may provide time for heat to be transferred from the bedrock to the Waterways and in turn, could be then transferred to the water if contained in the Waterways (again this is unlikely). The potential effect in this scenario would be that the water manages to heats up by the estimated 5.5 ^{o}C during an extended dormant period and is then discharged into Loch Ness. Nonetheless, this temperature range is considered to be within the natural fluctuation of surface water in Loch Ness.

10.5.43 In addition to the above the discharge would be above the thermocline in the well-mixed zone (when Loch Ness is thermally stratified) where water with a slightly different temperature can be quickly assimilated. During the winter, should the water temperature within Loch Ness be elevated above what would be expected naturally, the relatively low rate and volume of any discharge will be effectively buffered by the much large volume of water within Loch Ness, which would be unstratified and generally well mixed. Overall, a localised **Negligible** adverse impact is predicted on Loch Ness, which is off **Very High** importance, resulting in a **Minor Adverse Effect (Not Significant)**.

Risk from concrete residues

10.5.44 When first constructed there may be a concrete residue left on the basin forming the Headpond that might increase the pH of the water in the Headpond slightly. 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. As the Development will be operated through a number of initial cycles this residue would be washed off and rapidly diluted and dispersed in Loch Ness. Water quality in Loch Ness is believed to be slightly alkaline (although no water quality data has been provided by SEPA) and thus the introduction of slightly alkaline water is unlikely to have any significant impact. Based on observations the high humic content of the water in Loch Ness may also provide a buffering capacity. As a precautionary assessment, reflecting the data limitations and uncertainty of this qualitative assessment, a **Low Adverse** impact on the **Very High** importance Loch Ness is predicted, resulting in a short-term, temporary but **Moderate Adverse Effect (Significant)**.

Risk of Algal Blooms

10.5.45 Standing waterbodies such as lochs and reservoirs follow yearly cycles of stratification when a temperature gradient is created due to high temperatures, also freezing conditions can cause stratifications. During stratification, two separated layers are created: an epilimnion close to the surface, with higher temperatures and primary production activity (phytoplankton) and a cold layer, hypolimnion, with colder temperatures and nutrients accumulation since light cannot penetrate and so algae cannot develop. When high volumes of water are discharged into a standing waterbody during stratification, especially when the frequency of pumping / discharge cycles is high (Scenario 1), this can alter the stability of the water column, especially when water enters at higher temperature and velocity that can mobilise nutrients from existing bed sediments. These conditions increase water turbulence, promoting the mobilisation of nutrients and making them more available for phytoplankton, thus increasing the potential for an algal bloom to occur. However, it is predicted that the risk of this occurring in this situation is low because:

- The water temperature of water discharged from the Headpond is not expected to be significantly higher than that in Loch Ness (see section on ‘Water Temperature Changes’);
- Loch Ness is a low nutrient / productivity water body and it is not anticipated that water in the Headpond will be significantly enriched by nutrients (see section ‘Sediment Accumulation in the Headpond’), although this may increase in the longer term as organic sediments accumulate in the Headpond;
- There is likely to be a high dilution and dispersion potential, even when Loch Ness is thermally stratified; and
- A concrete apron will be provided to prevent scouring of the loch bed, which is also expected to deepen quickly with distance from the shore.

10.5.46 For Scenario 2, water column stability will not be affected due to the infrequent discharges, but an algal bloom could develop if water in the Headpond became stagnant for an extended period of time and nutrients were allowed to build up (operational phase observation would not allow this to happen but the scenario is presented for assessment purposes). The risk of this occurring would be greater in the longer term when organic sediments have built up in the Headpond. If the Headpond is then discharged this could propagate the bloom into Loch Ness together with any potentially toxic substances. Decomposition of the bloom in Loch Ness could affect dissolved oxygen levels and pH, which could be locally significant until it is dispersed and diluted. Although the impact would not be long lasting, it would result in short term deterioration in water quality and potentially prevent use of the bathing beach at Dores. However, stagnation and algal blooms development in the Headpond is unlikely to occur as the volume left after full drawdown remains large (i.e. 100,000 m^3) to dilute nutrients, and as mentioned in the previous paragraph, the nutrient content of water in the Headpond is not expected to be high.

10.5.47 Overall, for both scenarios and considering the Very High importance of Loch Ness, the magnitude of impact is predicted to be **Low**, resulting in a **Moderate Adverse Effect (Significant)** without mitigation.

Potential impact on water quality from sediment accumulation in the Headpond

10.5.48 Over the longer term, it would be expected that inorganic and organic sediment derived from the water abstracted from Loch Ness, the immediate surrounds to the Headpond, and windblown leaf matter, will accumulate within the Headpond. The accumulation of sediment within the Headpond could increasingly influence, and potentially reduce, the quality of water within the Headpond either through mobilisation of fine sediment into the water column increasing turbidity, nutrient enrichment and oxygen depletion. Reduced water quality would be more likely to occur when water is held in the Headpond for a long period of time. In addition, under the right conditions, the build-up of organic rich sediment in the Headpond may also increase the potential for algal blooms to occur. However, it is not expected that the rate of accumulation would be rapid as the water from Loch Ness has a relatively low turbidity and productivity (it is classed as oligotrophic meaning low in nutrients), there is limited direct run-off into the Headpond to introduce allochthonous nutrients, and although there are existing areas of dense woodland nearby, they do not overhang the Headpond and would be downslope. Sediment build up would also be monitored and when necessary sediment would be removed for appropriate disposal in accordance with waste legislation, although this is likely to be a very infrequent requirement. Overall, a long term **Negligible** impact is predicted on Loch Ness resulting in a **Minor Adverse Effect (Not Significant)**.

Spillage risk during operation

10.5.49 During operation there is a low risk that small quantities of oil or fuel may be spilt from service vehicles and routine maintenance of fixed plant. 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. The greatest risk would be for any works undertaken to fixed plant as part of the outlet / inlet structure. Overall, a **Negligible** impact is predicted on the **Very High** importance Loch Ness, resulting in a **Minor Adverse Effect (Not Significant),** and a **Negligible Effect (Not Significant)** on the **Medium** importance Allt a' Mhinisteir watercourse.

Surface Water Run-off from the Development

10.5.50 Surface Water Run-off from the realigned public road where the Headpond is proposed will be directed as it does currently, over the edge to a new ditch. As the traffic flows along this minor road are very low, no impact on water quality is predicted.

10.5.51 Surface water run-off from the Landscape Embankment will be intercepted by catch drains and the run-off directed to Loch Ashie. The run-off should not contain any significant concentrations of pollutants and no impact on water quality in Loch Ashie is predicted.

10.5.52 Surface water run-off from the future permanent compounds will be passed through purpose built SuDS to treat run-off and provide spillage containment. The Battery House at Compound 1 will be fully enclosed and the switching bay on impermeable hardstanding. If required, an oil separator could be provided. Therefore, a **Negligible** impact on the Allt a' Mhinisteir watercourse (**Medium** importance) is predicted resulting in a **Negligible Effect (Not Significant).**

Potential impact on Dores Bathing Water

10.5.53 The operation of the Development will not discharge any foul water from welfare facilities into any watercourses. Waste water from the permanent operational facilities on-site will be stored in a sealed tank so it can be pumped out for disposal at a suitably licensed waste facility by an approved specialist Construction Contractor. Therefore, the impact on the Dores Bathing Waters is assessed as **Negligible Effect (Not Significant).**

Effects on groundwater

10.5.54 The key factor identified affecting groundwater during the operation phase is the ongoing presence of the Waterways, Power Cavern 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, the amount of fracturing will reduce and so inflow will reduce also (especially with the construction methods mentioned under Construction Effects on Groundwater – Waterways & Power Caverns). The magnitude of impact on all groundwater receptors is considered to be Negligible, resulting in a **Minor Adverse Effect (Not Significant),** considering the High importance of the receptor.

10.5.55 The Headpond will be concrete-lined and filled with water fed from Loch Ness (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. The magnitude of impact on all groundwater receptors is considered to be Negligible, resulting in a **Minor**

Adverse Effect (Not Significant) considering the High importance of the underlying groundwater body.

Effects on hydromorphology

10.5.56 There is potential for adverse impacts to the hydromorphology of the surface water bodies from fluctuations in water level, permanent watercourse crossings, hardstand areas and loss of catchment at operation stage.

10.5.57 It is proposed to construct a concrete apron in advance of the Tailpond Inlet / Outlet Structure to avoid any scouring of the loch bed. The area of the apron will be determined at a later stage following detailed bathymetric surveys of the loch bed in this location. Intake and discharge flow rates will be less than 0.15 m/s, which assuming frequent operation, should prevent the build-up of any sediment (clay to gravel) on top of the apron. Either side of the apron will be rock armour. A Spillway Outlet is also proposed, but no concrete apron will be provided resulting in no further loss of loch bed. Under operation discharges from the Spillway may result in some sediment erosion in front of the Outlet, although this only likely to be rarely used. A new concrete Jetty will also be constructed. Overall, the physical footprint of the Inlet / Outlet Structure, apron and ancillary facilities is small compared to the total area of littoral margin around Loch Ness and a permanent low adverse impact is predicted due to the loss of a small area of loch bed, resulting in a **Moderate Adverse Effect (Significant).**

10.5.58 The Allt a' Chruineachd watercourse currently flows into Loch Ness in the centre of the proposed Tailpond works location. To accommodate the new Inlet / Outlet Structure it will be necessary to slightly divert approximately 50 m of this small watercourse around the Development. The new channel will be constructed in keeping with the existing channel form, although it will need to be passed under new concrete hardstanding via a culvert. The impact of this diversion on the hydromorphology of the watercourse is likely to be minimal due to the existing modification through culverting below the B852 road and likely straightening downstream of this road. Overall, a Low Adverse impact is predicted, which on a Medium importance waterbody would result in a **Minor Adverse Effect (Not Significant)**.

10.5.59 Permanent site Compounds 1 and 4 will include areas of hardstand and roofs which could cause increase run-off to the Allt a' Mhinisteir. As discussed earlier, changes in the rate and volume of surface water run-off can have impacts on channel morphology. However, within the context of the catchment area and the relatively small area of each compounds, and the application of measures to attenuate run-off, this impact is predicted to be Negligible. As the importance of the receptor is **Medium**, a significance of effect of **Neutral (Not Significant)** is predicted.

10.5.60 Loss of part of the Allt a' Mhinisteir catchment (approximately 7%) due to the Headpond could impact flows, and the associated capacity of the watercourse to transport coarse sediment. The nature of the watercourse is such that cobble-sized material is transported only at high flows and is deposited at bedrock steps and there are accumulations of coarse sediment upstream of structures in some locations. The channel is very stable due to the presence of bedrock and therefore significant erosion is unlikely to occur should there be a greater accumulation of sediment. It is therefore unlikely that the proposed loss of catchment would significantly reduce the transport capacity of the watercourse. Therefore, the magnitude of impact is assessed to be Low, and given the Medium importance of the burn, the significance of effect is **Minor Adverse (Not Significant)**.

10.5.61 Reduced flow from loss of catchment in the Big Burn could affect the transport of sediment in the channel (please refer to Figure 9.2, Volume 5 for a plan showing the catchment area for Loch Ashie, into which Big Burn flows). However, due to the existing small catchment and channel size, it is unlikely that there is significant erosion, deposition and transport of material within the channel. Therefore, reduced flow is unlikely to have a significant impact on sediment transport and hydromorphology. No impact is predicted to water levels in Loch Ashie and the buffering effect of Loch Ashie also ensures no impact to the Big Burn downstream of the loch. Similarly, given the small size of Big Burn it is unlikely to be making a significant contribution to water supply to Loch Ashie and no impact on water levels and shoreline exposure is predicted. Given the **High** importance of the Big Burn, the **Negligible** impact of loss of catchment results in an adverse effect of **Minor** significance.

Decommissioning Phase

10.5.62 It is assumed that the decommissioning of the Development will require similar activities to construction, potentially with additional crushing of construction materials and removal of drainage pipework containing residual water and sediment, although it would be expected that the Headpond would remain in situ and would not need to be infilled (as per Section 2.16 of Chapter 2: Project and Site Description). These works could result in run-off containing excessive amount of fine sediment of chemicals such as fuel oil entering the surrounding lochs, watercourses and other drainage ditches present on the Development Site. Without mitigation, a short-term and temporary **Moderate Adverse** impact is predicted from run-off containing excessive fine sediment and from spillage risk on these waterbodies.

10.6 Cumulative Effects

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

Intra-Project Cumulative Effects

10.6.2 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 bodies 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.

10.6.3 No protected species or important and sensitive ecological receptors have been identified in water bodies across the Site and so these effects are considered **Negligible** (**Not Significant**).

Inter-Project Cumulative Effects

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

10.6.1 Table 4.8 in Chapter 4 lists all the committed developments in the wider area around the Site of the proposed Development that have been considered by this EIA.

10.6.2 The following proposed residential developments are located on the southwestern edge and fringe of Inverness and relatively close to the River Ness and Caledonian Canal: Tulloch Homes (17/02007/FUL), Ness Castle (phase 2) (17/01189/MSC), and Scainport (17/02446/PIP). The housing development by Tulloch Homes is in the process of being constructed. These developments will not have any impact on water bodies assessed as part of this study and therefore there is no potential for cumulative effects. It is assumed that the construction of these schemes will also be compliant with good practice mitigation measures.

10.6.3 Scottish Water are proposing to construct a new underground water main between Dores and the Loch Ashie WTW. No application has been submitted but the development has been confirmed as non-EIA (meaning it is unlikely to have significant effects on the environment) (16/05768/SCRE). The route of the new main is uncertain, but it is possible that part of its construction could be in close proximity to the main stem channel of the Allt a' Mhinisteir watercourse. However, given the relatively small scale of the works and the application of standard mitigation meausres no significant adverse impacts would be predicted from the works. Any impact would also be short term and temporary. Therefore, no cumulative impacts are predicted.

10.6.4 SSE has planning permission for a 600 MW pumped storage scheme at Coire Glas 53 km to the south-west and are applying to amend this project to 1500 MW (18/01564/S36). The project involves construction of a new headpond at Loch a' Choire Ghlais, which will be circulated with Loch Lochy as the tailpond. Due to the large distance between the location of this project at the proposed Development, and since the same water bodies are not affected, no cumulative impacts are predicted.

10.7 Mitigation and Monitoring

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

Embedded Mitigation

10.7.2 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.

10.7.3 Mitigation measures have been designed into the Development and are therefore considered as 'embedded mitigation' and 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 below.

10.7.4 A CEMP (Appendix 3.1, Volume 5) is included to avoid impacts from construction works to the water environment. Please refer to Section 10.7 'Mitigation and Monitoring' and the outline SWMP presented in Appendix 10.5 (Volume 5) for further details.

10.7.5 The Development Components have been sited to avoid waterbodies where possible. The position, depth and design of the Tailpond Inlet / Outlet structure and the design of watercourse crossings have been designed to minimise adverse impacts on waterbodies.

For example, the overflow from the Headpond returns water back to Loch Ness instead of taking the shorter route to Loch Duntelchaig. This therefore avoids any cross catchment transfer as it operates as a closed loop system as described in Chapter 3: Design Evolution and Alternatives.

10.7.6 Surface water management will use a combination of SuDS and proprietary measures (e.g. spill containment for a new substation at Compound 1) to treat surface water run-off from the Development during operation.

10.7.7 To avoid fish and debris entrainment, the Tailpond Inlet / Outlet structure where the Waterways terminate into Loch Ness, will incorporate a screen with 2 mm apertures. The screen also acts as an energy dissipation measure to reduce the velocity of the water discharging from the Development, and therefore limits the potential impacts on water thermal stability, especially when stratified. 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.

10.7.8 A temporary drainage system will be implemented during construction using sustainable drainage systems where possible to manage the risk of flooding and to treat run-off. Measures may include temporary earth ponds / settlement lagoons, ditches, 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.

10.7.9 Certain regulatory processes will also apply to the Development and will influence the way pollution risks during construction and operation are managed. A CAR Licence from SEPA under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) will be required for the construction site and for temporary and permanent works to water bodies (e.g. abstractions and discharges). Through consultation with SEPA, appropriate treatment measures for construction-site run-off, conditions on operational discharges, limits and conditions on abstractions will be determined.

10.7.10 A concrete apron will be installed on the bed of Loch Ness in front of the Tailpond Inlet / Outlet structure. The area will depend on site-specific bathymetry survey to be undertaken at a later stage. The purpose of the apron is to avoid any scour of the bed.

10.7.11 During construction, measures will be implemented through a Surface Water Management Plan (SWMP) to be included in the CEMP prepared pursuant to a condition of the permission for reserved matters applications. An outline SWMP has been provided in Appendix 10.5 (Volume 5) and includes the principles of mitigation and the measures outlined in the following sections.

General Considerations

10.7.12 The final SWMP will be prepared prior to the construction of any aspect of the Development. The SWMP will describe 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.

10.7.13 The SWMP will be developed and implemented by the Construction Contractor and would support the 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.

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

10.7.15 The Construction Contractor will aim to stem any uncontrolled water ingress into waterways, the Power Cavern 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 so inflow will reduce also.

10.7.16 The amount of interaction with 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.

Management of Construction Site Run-off

10.7.17 Mitigation measures to management run-off are detailed in the Outline SWMP (Appendix 10.5, Volume 5) and are therefore not repeated here.

10.7.18 Construction works directly affecting water bodies will require careful management and the implementation of stringent working practices and mitigation. This applies to the construction of the Inlet / Outlet structure within Loch Ness, and to other minor watercourses that may be crossed by new or upgraded access tracks.

10.7.19 All works within Loch Ness 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 coffer dam would be constructed. Any fine sediment mobilised during the construction of the coffer dam 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 coffer dam would be pumped out using baffles to prevent any bed / bank erosion or further disturbance of any fine sediment on the loch bed.

10.7.20 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 bags or other similar barrier.

Management of Spillage Risk

10.7.21 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 Outline SWMP provide detailed information relating to the control of spillages and leaks.

Concrete Batching Plants

10.7.22 Any on-site concrete batching facilities will be located at least 50 m from any water body, 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.

10.7.23 Suitable facilities for concrete wash water e.g. geotextile wrapped sealed skip, container or earth-bunded area would be adequately contained, prevented from entering any drain, and removed from the Development for appropriate disposal at a suitably licensed waste facility.

10.7.24 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.

10.7.25 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 body. 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 that is lined with a geotextile to prevent infiltration to ground. Such washing would not be allowed to flow into any drain and the CEMP 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 proposed site for appropriate disposal at a suitably licensed waste facility.

Water Quality Monitoring

10.7.26 During construction it is proposed to undertake a water quality monitoring programme to ensure that mitigation measures are operating as planned and preventing pollution. The purpose of the monitoring programme will also be 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. With regard to the identified private water supplies sourced from groundwater, water levels should be monitored to identify any reduction in supply.

10.7.27 The water quality monitoring programme will be developed by the Construction Contractor in consultation with SEPA and other relevant stakeholders during the process of obtaining CAR licences for works affecting, or for temporary discharges to, the waterbodies and watercourses in and around the Development. It is expected that this will include a combination of daily observations and monitoring using a calibrated hand held water quality probe downstream of the Development Site, and regular water quality sampling on a periodic basis or ad hoc depending on circumstances. 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 six separate visits over a few months and taking in a range of flow conditions.

Mitigation of Operation-Phase Effects

10.7.28 It is proposed that the water quality within the Headpond is monitored on a routine basis including observations, in-situ measurements using a probe and/or Secchi disk for turbidity, and regular water samples for laboratory analysis. The purpose of the monitoring is to build up an understanding of how water quality changes whilst stored in the Headpond in comparison to background water quality in Loch Ness.

10.7.29 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. The design of the Headpond access is such that a full observation of the Headpond water body can be made from all angles.

10.7.30 This preventative measure will support decisions about operation to ensure that unforeseen water quality impacts on Loch Ness 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.

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

Mitigation of Decommissioning Phase Effects

10.7.32 Section 2.16 of Chapter 2: Project and Site Description outlines the potential method of decommissioning of the Development at the end of its operational life time.

10.8 Residual Effects

10.8.1 Table 10.6 and Table 10.7 presents 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.

10.8.2 A pWFD Assessment has been provided in Appendix 10.4 (Volume 5). This concludes that, based on the current understanding of the Development and availability of data, only localised or temporary adverse impacts to WFD relevant water bodies may occur to Loch Ness and associated undesignated waterbodies (ID 100156) and the Inverness Groundwater Body (ID 150670), with no significant impact to any other water body as long as mitigation measures are implemented. Therefore, the Proposed Development is compliant with the WFD objectives for the Loch Ness, Loch Ashie, Loch Duntelchaig, Big Burn and the Inverness Groundwater Body.

10.8.3 Due to the operational period being in excess of 100 years, it is proposed that a Decommissioning Plan be prepared, detailing all the mitigation measures and procedures to protect the environment in line with the confirmed method of decommissioning. As the standards, legislation and policies for environmental protection are expected to be no less rigorous then required at present, a temporary **Minor Adverse** effect is therefore predicted, which is **Not Significant**.

Table 10.6 Summary of Residual Effects – Construction Phase

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
Borehole drinking PWS at Balachladaich and Kindrummond	Construction of Waterways & Power Cavern – potential impact on groundwater levels and reduction in abstraction yield, Short term & temporary	Moderate Adverse	Pre-construction and construction phase monitoring	Negligible	Not Significant
Borehole drinking PWS at Dirr Cottage and Ness View Cottage	Access and construction tunnel portals – potential impact on groundwater levels and reduction in abstraction yield, Short term & temporary	Moderate Adverse	Pre-construction and construction phase monitoring	Negligible	Not Significant
GWDTEs to the north-east of tunnel portals	Potential impact on availability of groundwater to support the GWDTEs, Short term & temporary	Negligible	No mitigation is proposed	Negligible	Not Significant
Borehole drinking PWS at Balachladaich, Dirr Cottage and Ness View Cottage	General construction activities – potential impact on groundwater quality, Short term & temporary	Minor Adverse	Pre-construction and construction phase monitoring	Negligible	Not Significant
Inverness Groundwater Body	Construction of Headpond – potential impact on groundwater quality. Short term & temporary	Moderate Adverse	Pre-construction and construction phase monitoring	Negligible	Not Significant
PWS (x3) and Inverness Groundwater Body	Operation of Waterways, Tunnels & Power Caverns – potential ingress of groundwater. Long term & permanent	Minor Adverse	Operational monitoring for ingress to be undertaken	Minor Adverse	Not Significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
Loch Ness	Construction site run-off – suspended fine sediments, Short term & temporary	Moderate Adverse	The Development includes best practice measures to manage formation of excessive sediment in run-off and to provide treatment prior to discharge under permit to Controlled Waters to be described in a Surface Water Management Plan	Moderate Adverse	Significant
	Construction site run-off – chemical spillages, Short term & temporary	Moderate Adverse	The Development includes best practice measures to reduce the risk of chemical spillages such as bunded fuel tanks, spill kits, plant nappies on static plant, and the implementation of an Emergency Response Plan	Moderate Adverse	Significant
Loch Ness - Bathing Water at Dores	Water quality (foul waste water) during construction long term and permanent	Negligible	No foul waste water to be discharged to any watercourse flowing to Loch Ness. Foul water to be stored on Site and disposed of at a licensed waste facility by a suitably qualified specialist Contractor.	Negligible	Not Significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
Allt a' Chnuic Chonaisg, Allt a' Chruineachd, S3 and S6 (as shown on Figure 10.1)	Construction site run-off – suspended fine sediments, Short term & temporary	Minor Adverse	The Development includes best practice measures to manage formation of excessive sediment in run-off and to provide treatment prior to discharge under permit to Controlled Waters to be described in a Surface Water Management Plan	Minor Adverse	Not Significant
	Construction site run-off – chemical spillages, Short term & temporary	Minor Adverse	The Development includes best practice measures to reduce the risk of chemical spillages such as bunded fuel tanks, spill kits, plant nappies on static plant, and the implementation of an Emergency Response Plan	Minor Adverse	Not Significant
Allt a' Mhinisteir	Hydromorphological changes from new or upgraded watercourse crossings and diversion–disruption of sediment transport processes, permanent	Negligible	No mitigation is proposed	Negligible	Not Significant
	Construction site run-off – Changes in morphology due to temporary increases in peak flows and fine sediment deposition , Short term & temporary	Negligible	The Outline SWMP includes measures to attenuate construction site run-off and remove fine sediments	Negligible	Not Significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
Allt a' Mhinisteir (cont.)	Construction site run-off – suspended fine sediments, Short term & temporary	Minor Adverse	The Development includes best practice measures to manage formation of excessive sediment in run-off and to provide treatment prior to discharge under permit to Controlled Waters to be described in a Surface Water Management Plan	Minor Adverse	Not Significant
	Construction site run-off – chemical spillages, Short term & temporary	Minor Adverse	The Development includes best practice measures to reduce the risk of chemical spillages such as bunded fuel tanks, spill kits, plant nappies on static plant, and the implementation of an Emergency Response Plan	Minor Adverse	Not Significant
	Construction site run-off – Changes in morphology due to temporary increases in peak flows and fine sediment deposition , Short term & temporary	Negligible	The Outline SWMP includes measures to attenuate construction site run-off and remove fine sediments	Negligible	Not Significant
Pond 7	Construction site run-off – suspended fine sediments, Short term & temporary	Negligible	The Development includes best practice measures to manage formation of excessive sediment in run-off and to provide treatment prior to discharge under permit to Controlled Waters to be described in a Surface Water Management Plan	Negligible	Not Significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
	Construction site run-off – chemical spillages, Short term & temporary	Negligible	The Development includes best practice measures to reduce the risk of chemical spillages such as bunded fuel tanks, spill kits, plant nappies on static plant, and the implementation of an Emergency Response Plan	Negligible	Neutral
Big Burn	Construction site run-off – Changes in morphology due to temporary increases in peak flows and fine sediment deposition , Short term & temporary	Minor Adverse	The Outline SWMP includes measures to attenuate construction site run-off and remove fine sediments	Minor Adverse	Not Significant
	Hydromorphological changes – loss of catchment area, permanent	Minor Adverse	No mitigation is proposed	Minor Adverse	Not Significant
Allt a' Chruineachd	Diversion of approximately the final 50 m before it flows into Loch Ness including a section to be culverted, permanent	Minor Adverse	The new channel will be designed in keeping with the existing channel	Minor Adverse	Not Significant
Allt a' Chnuic Chonaisg	Hydromorphological effects from new temporary crossing	Negligible	Temporary crossing will be designed in accordance with best practice	Negligible	Not Significant

Table 10.7 Summary of Residual Effects – Operational Phase

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
Inverness Groundwater Body	Operation of Headpond – potential impact on water resources and water quality. Long term & permanent	Minor Adverse	Operational monitoring of headpond system for inflows and water quality in surrounding monitoring boreholes	Minor Adverse	Not Significant
Loch Ness	Changes in water level resulting in changes in water quality	No impact	No mitigation is proposed	No impact	Not Significant
	Destabilisation of summer thermal stratification from water discharges at the Outlet, long term & permanent	Minor Adverse	No mitigation proposed (impact is negligible)	Minor Adverse	Not Significant
	Water temperature changes from water discharges at the Outlet, long term & permanent	Minor Adverse	No mitigation proposed (impact is negligible)	Minor Adverse	Not Significant
	Concrete residues from Headpond construction, short term & temporary	Moderate Adverse	No mitigation is proposed (impact is uncertain and precautionary and would be very short term and temporary)	Moderate Adverse	Significant (precautionary)
	Algal blooms from thermal stratification disruption, organic sediments discharge from the Headpond, long term, permanent but episodic	Moderate Adverse	Water quality monitoring of the Headpond	Minor Adverse	Not Significant
	Sediments discharge from the Headpond, long term & permanent	Minor Adverse	Water quality and sediment build up monitoring of the Headpond. Sediment removal if needed	Negligible	Not Significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
	Spillage risk, long term & temporary	Minor Adverse	Maintenance operations in accordance with the Operators Environmental Management System	Negligible	Not Significant
	Loss of loch bed due to construction of new structures in the littoral zone, long term & permanent	Moderate Adverse	The size of the new structures has been minimised and scour protection proposed only where considered absolutely necessary	Moderate	Significant
Loch Ness - Bathing Water at Dores	Water quality (foul waste water) during operation long term and permanent	Negligible	No foul waste water to be discharged to any watercourse flowing to Loch Ness. Foul water to be stored on Site and disposed of at a licensed waste facility by a suitably qualified specialist Contractor.	Negligible	Not Significant
Allt a' Mhinisteir	Operational – Spillage risk, long term & temporary	Negligible	Maintenance operations in accordance with the Operators Environmental Management System	Negligible	Not Significant
	Operational –potential water quality impacts from surface water run-off, long term & permanent	Negligible	Interception ditches to be provided along permanent access roads and the realigned public road; Catch drains along embankment slopes, and SuDS / proprietary measures to treat run-off and contain surface water run-off and chemical spillages from permanent compounds	Negligible	Not Significant

Receptor	Description of Effect	Effect	Additional Mitigation	Residual Effect	Significance
	Hydromorphological changes – loss of catchment area, permanent	Minor Adverse	No mitigation is proposed	Minor Adverse	Not Significant
Loch Ashie	Surface water run-off, long term & permanent	Negligible	Interception ditches to be provided along permanent access roads and the realigned public road and catch drains along embankment slopes	Negligible	Not Significant
Big Burn	Hydromorphological changes – loss of catchment area, permanent	Minor Adverse	No mitigation is proposed	Minor Adverse	Not Significant

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