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Glen Earrach Pumped Storage Hydro

Environmental Impact Assessment Report

Volume 2: Main Report
Chapter 2: Project and Site Description

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Quality information

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Issue History

Issue	Issue date	Details	Authorized	Name	Position
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2. Project and Site Description

2.1 Introduction

2.1.1 This chapter provides a description of the Proposed Development Site, the Proposed Development (submitted design) and its surrounding environment. It also provides an overview of the likely construction methods, an indicative construction programme, including the Pre-Construction and Enabling Phase, and an overview of the Operational and Decommissioning Phases of the Proposed Development.

2.1.2 This chapter is organised as follows:

- Proposed Development Site description (**Section 2.2: Proposed Development Site Description**);
- Proposed Development description (**Section 2.3: Proposed Development Description**) and **(Section 2.4: Basis of Design)** and summary of key development characteristics (**Sections 2.5: Description of Headpond** to **2.11: Description of the Underground Caverns and Ventilation Shaft)** - these sections provide a description of the submitted design for which consent under Section 36 of the Electricity Act 1989 and deemed planning permission is sought;
- Description of the Grid Connection and Dochfour Weir Upgrade (**Sections 2.12: Description of Grid Connection and 2.13: Description of Dochfour Weir Upgrade**);
- The construction programme (**Section 2.14: Construction Programme**);
- Development phases (**Sections 2.15: Pre-Construction and Enabling to 2.18: Decommissioning Phase)** - these sections provide a description of each phase of the Proposed Development: Pre-Construction and Enabling Phase, Construction Phase, Operational Phase and Decommissioning Phase;
- The construction plan and related matters (**Section 2.19: Construction Plan, Materials, Power and Workforce**); and,
- Explanation of Limits of Deviation.

2.2 Proposed Development Site Description

2.2.1 The Proposed Development Site is located in The Highland Council (THC) area, centred on national grid reference NH 45255 22395, approximately 9.5 km to the south of Drumnadrochit and 6.5 km north of Invermoriston, as shown in **Figure 1.1: Location Plan (Volume 3: Figures)**. The Proposed Development Site is generally characterised as rocky moorland plateau with rough grazing. The Headpond location at Loch nam Breac Dearga sits approximately 485 m above ordnance datum (AOD), with Loch Ness acting as the Tailpond.

2.2.2 The Proposed Development Site is predominantly located within the catchment of the Allt Saigh watercourse. The Allt Saigh is fed by several smaller streams and lochans in the mountains to the west of Loch Ness, which flow into it at Alltsigh. Flow in the upper reaches of the catchment is diverted at a dam to the Livishie power station on the River Moriston.

2.2.3 **Figure 2.1: Constraints (Volume 3: Figures)** shows environmental and recreational constraints within the Proposed Development Site and surrounding area. **Figure 2.2: Utilities (Volume 3: Figures)** shows power utilities within the Proposed Development Site boundary.

Water Features

Surface Water Environment

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

2.2.5 **Table 2-1: Water Features** below lists each of the surface water features within each catchment and sub catchment, these features are also identified within **Figure 10.1: Surface Water Receptors (Volume 3: Figures).**

Table 2-1 Water Features

Sub-catchment	Water Features
Allt Saigh (SW3)	Allt nan Gobhar (SW4)
	Allt Loch an t-Sionnaich and tributaries (SW5)
	Loch an t-sionnaich (SW6)
	Unnamed Water Feature (SW7)
	Loch nam Breac Dearga (SW8)
River Coiltie (SW9)	Divach Burn (SW10)
	Allt Coire an Ruighe (SW11)
	Allt Glas Beag (SW12)
	Allt Glas Mor (SW13)
	Loch nan Oighreagan (SW14)
	Caochan an Loch Dhuibh (SW17)
	Unnamed Water Feature (SW16 and SW18)
Loch Ness	Allt Ghiubhais (SW1)
	Grotaig Burn (SW2)
River Enrick (SW19)	Allt Creag an Fhithich (SW20)
	Caochan na Ruighe Duibhe (SW21)
	Allt na Criche (SW22)
	Allt Luirg nam Broc (SW24)
	Drumclune Burn (SW25)
	Unnamed Water Features

Groundwater Environment

2.2.6 There are two bedrock aquifers shown on the Hydrology 625K Scale Map of the UK within the area of the Proposed Development: the Lower Old Red Sandstone (LORS) and the Glenfinnan Group metamorphic lithologies. **Figure 10.2: Groundwater Receptor (Volume 3: Figures)** displays these key groundwater receptors.

2.2.7 LORS Aquifer has been identified as a moderately productive aquifer which likely supports Groundwater Dependent Terrestrial Ecosystems and private water supplies. By comparison, the Glenfinnan Group Aquifer has a low productivity.

2.2.8 Superficial deposits such as peatland, till alluvium and alluvial fan deposits will also hold small amounts of groundwater. However, this is not widespread across the Proposed Development Site.

2.2.9 Refer to **Chapter 10: Water Environment (Volume 2: EIA Main Report)** for further details on the surface water and groundwater environment.

Topography

2.2.10 The Proposed Development Site is populated with peaks across the Balmacaan Forest. Meall Fuar-mhonaidh to the east of Loch nam Breac Dearga sits at 699 m AOD, mirrored with Glas-bheinn Mhór at 651 m AOD to the west, and the centre of the Loch itself at approximately 480 m AOD in the valley between. The Proposed Development Site slopes from these peaks to the hills surrounding Loch Ness at around 300 m AOD, before a steep decline to between 15-40 m AOD at Loch Ness' shoreline.

2.2.11 The Headpond is located at Loch nam Breac Dearga bounded by the summit of Glas-bheinn Mhor to the northwest and the summit of Meall Fuar-mhonaidh to the southeast.

2.2.12 The Lower Control Works (LCW) are located on the shore of Loch Ness.

2.2.13 **Figure 15.1: Topography (Volume 3: Figures)** shows the topography of the Proposed Development Site based upon a 5 m grid digital terrain model (DTM).

Geology

2.2.14 The bedrock geology of the Proposed Development Site is dominated by Psammite and Semipelite of the Achnaconeran Striped Formation to the west, and sandstone with subsidiary conglomerate, pebbly (gravelly) sandstone and siltstone to the east. The semipelite of the Achnaconeran Striped Formation is described as muscovite-rich and is locally migmatitic.

2.2.15 This formation covers the majority of the Headpond site and the western portion of the Proposed Development Site. To the east the bedrock geology is made up of sandstone with subsidiary conglomerate, pebbly (gravelly) sandstone and siltstone.

Peat

2.2.16 Further investigation using NatureScot's Carbon and Peatland Map 2016[1] indicates that the Proposed Development Site largely consists of peaty gleys with dystrophic semi-confined peat with peaty rankers in the west, and humus-iron podzols with peaty gleyed podzols in the east. Additionally, southeast of the Headpond, on the Meall Fuar-mhonaidh hill, the soil is characterised by peaty rankers with peaty gleyed podzols. The hill to the northwest of the Headpond, Glas-bheinn Mhor, the soil is characterised by subalpine podzols with dystrophic blanket peat. A final variation to the soil type is dystrophic blanket peat, a small pocket of which is found in the northeast of the Proposed Development Site. The prevalence of peat shown in this further investigation warranted a peat survey, discussed in **Chapter 15: Geology and Ground Conditions (Volume 2: Main Report)**.

2.2.17 During the peatland surveys, the following key points were observed:

- Across the Headpond there are large areas of shallow peat and areas with no peat, with a number of small pockets of deeper peat in naturally occurring basins in the bedrock;
- Peat depth only reached > 3 m at a small number of locations tested, with only one point measuring a depth of greater than 5 m; and
- To the north of the Headpond the peat was generally only found in the valleys between hills.

2.2.18 The results of the peat probing surveys undertaken at the Proposed Development Site were used to create a map of the varying depths of the peat surface across the Proposed Development – shown on **Figure 15.5 Peat Depth Interpolation (Volume 3: Figures).**

Land Use

2.2.19 The Proposed Development Site comprises rocky moorland plateau and is used mainly for deer grazing and deer stalking. There is a forested area Creag Nan Eun Forest restricted to the eastern, southern and southwestern boundaries of the Proposed Development Site. The wider landscape includes wooded glen and steep-sided glens. The Headpond location at Loch nam Breac Dearga sits at approximately 480 m AOD. The Tailpond location will be Loch Ness, which is located on the southeast of the Proposed Development Site.

2.2.20 The land capability classification for agriculture is noted as land capable for use as rough grazing with low quality flora. (Hutton Institute).

2.2.21 There is no woodland within the proposed Headpond area in the Proposed Development Site, with woodland pockets restricted to the eastern, southern and southwestern boundaries of the Proposed Development Site. These woodlands include plantation woodland along the eastern boundary of the Proposed Development Site and commercial forestry along the A82 and along the Alltsigh Track.

2.2.22 The Proposed Development Site also includes recreational users, primarily those using access routes including Affric Kintail Way Core Path, Loch Ness 360 and the Great Glen Way. Please refer to **Chapter 16: Socio-Economics and Tourism (Volume 2: Main Report)** for further details.

[1] SNH (2016) Carbon and Peatland Map 2016 (online) Available at: https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/ [Accessed: November 2024]

Designations

2.2.23 There is one scheduled monument within the Proposed Development Site, the Dun Scriben fort, near Grotaig. There are no other designations within the Proposed Development Site. Dubh Lochs Site of Special Scientific Interest (SSSI), also designated as the North Inverness Lochs Special Protection Area (SPA) is located just outside the Proposed Development Site to the northeast.

2.2.24 In the wider area, the Levishie Wood SSSI and the River Moriston Special Area of Conservation (SAC) are approximately 3 km southwest of the Proposed Development Site.

2.2.25 Scotland's Environment Map[2] also shows ancient woodland present along the bank of Loch Ness within the southeastern section of the Proposed Development Site. The Great Glen Way is also routed through this area from northeast to southwest. These are shown on **Figure 2.1: Constraints (Volume 3: Figures)**.

Access

2.2.26 The Proposed Development Site access is proposed from the A831 at Balnain. The A831 runs to the north of the Proposed Development from east to west.

2.2.27 There are no classified roads within the Headpond area. However, the Tailpond is bounded by the classified road A82 at the LCW. The A82 links Invermoriston to Drumnadrochit and continues north to Inverness.

Utilities

2.2.28 An outline search of key utilities within and adjacent to the Proposed Development Site was carried out on electricity distribution; these are shown on **Figure 2.2: Utilities (Volume 3: Figures).** There are no overhead lines within the Proposed Development Site, with a limited number of pole mounted distribution substations within the southeast and southwest sections of the Proposed Development Site but outwith working areas. Existing utilities are not currently considered to pose a constraint to the Proposed Development. The appointed Construction Contractor will be responsible for undertaking a full search of utilities within the Proposed Development Site prior to construction.

Local Community and Economy

2.2.29 The Proposed Development Site is located in a rural part of THC area (which has approximately 52% of the population living in areas classified as rural). Drumnadrochit is located approximately 9 km northeast of the Proposed Development Site (as measured from the LCW along the A82), and is the largest nearby settlement with an estimated population of 1,130. Invermoriston is the next largest settlement and is located approximately 8 km southwest of the LCW along the A82.

2.2.30 Surrounding the Proposed Development Site lie the settlements of Milton, Alltsigh, Grotaig, Bunloit, Achnahannet, Lenie, Foyers and Balnain.

Future Baseline

2.2.31 If the Proposed Development were not to be built, the characteristics and land use within the Proposed Development Site boundary would remain as currently existing. Therefore, the future baseline is not anticipated to differ significantly from the Site Description provided in this **Section 2.2: Proposed Development Site Description**.

2.3 Proposed Development Description

2.3.1 The Proposed Development will have a storage capacity of approximately 34,000 megawatt hours (MWh) subject to final configuration of the Headpond, with approximately 2,000 megawatts (MW) of installed electrical pumping capacity and 1,800 MW of installed electrical generating capacity (both subject to final pump-turbine selection), with an average gross head (vertical distance between Headpond and Tailpond) of approximately 480 m. **Table 2-2: Description of Development Component Parts,** below**,** introduces the terminology and component parts of a typical Pumped Storage Hydro (PSH) scheme and describes these components for the Proposed Development.

[2] https://map.environment.gov.scot/sewebmap/

2.3.2 The above and below ground infrastructure can be seen separately on **Figure 2.3: Above Ground Infrastructure** and **Figure 2.4: Below Ground Infrastructure (Volume 3: Figures)** respectively.

2.3.3 Two options have been developed for the Upper Control Works (UCW), these are referred to as Option A and Option B. The options have been developed to reflect the perceived geological risk. Largely, the above ground infrastructure is identical for both options, however, the location of the UCW within the Headpond footprint varies between the two options. Clarification on which option has been assessed, and how, is explained in each chapter.

2.4 Basis of Design

2.4.1 A detailed description of each component part of the Proposed Development is provided in the following sections. There is some detail that cannot be definitively confirmed at present and will only be finally determined at the detailed design stage. This will be supported by further site investigation (SI) works, which will be progressed on a staged basis from the present to the start of the Construction Phase.

2.4.2 A ‘Rochdale Envelope’ approach has been applied to all Proposed Development features, including those that are temporary, and establishes the maximum (or worst case) dimensions of that component (such as the maximum height of a building or maximum noise limit of a construction vehicle) or their Limits of Deviation (LoD). LoD allow for limited geographical flexibility during the Construction Phase, such as the maximum buffer strip within which construction access will be located to allow for any unexpected ground conditions or other micro-siting. The LoD are outlined in **Section 2.20 Limits of Deviation**.

2.4.3 The description set out in **Table 2-2: Description of Development Component Parts** is based on the level of design at the time of writing. The detailed design and respective detailed descriptions will be confirmed post-consent. These final designs will be submitted to the planning authority ahead of the Construction Phase. It is envisaged that this will be a condition of the consent.

Table 2-2 Description of Development Component Parts

Arrangement	Component	Description
Above Ground (as shown on Figure 2.3)	Headpond	The Headpond is the upper reservoir. The Headpond will be constructed through a combination of excavation and the creation of three dams and a Spillway. The existing topography is utilised in the design to reduce dam size and length as far as practically possible. Components of the Headpond include: • Headpond – referring to the waterbody and incorporating the existing Loch nam Breac Dearga. • Main Dam. • Saddle Dam 1. • Saddle Dam 2. • Spillway - The Spillway allows for water to flow out of the Headpond in the event that water level reaches design maximum. Location: NH 45875 22865. • UCW - Where the Waterways exit the Headpond. The location of the UCW differs between Options A and B: – Option A: NH 45588 22682. – Option B: NH 45275 22928. • Borrow Pit Area - Location: NH 45255 22395.
	Secondary Bund	Small earthen / concrete dam downstream of the Main Dam. NH 44263 21792.
	Borrow Pit Search Area 2	A general area identified by Forestry and Land Scotland (FLS) on their landholding for the potential acquisition of material to be used in the construction of the Proposed Development.
	Compounds	Areas for equipment and material storage, site office and welfare facilities and Temporary Workers Accommodation. There will be a number of compounds at various locations across the Proposed Development Site to facilitate different construction works. Ancillary components for the operation of the Proposed Development such as access to the Tunnels and the GIS Switchyard (see below) will be located within the footprint of the Permanent Compounds. Access to the Valve Cavern (see below) will be from one of the site access tracks. Further details of the Permanent and Temporary Compounds, including NGRs, can be found within **Table 2-3: Proposed Construction Compounds – Locations, Functions and Sizes, and Table 2-4: Proposed Permanent Compounds – Locations, Functions and Sizes,** in **Section 2.6 Description of the Compounds,** below.
	Gas Insulated Switchyard (GIS)	A secure Permanent Compound housing High Voltage (HV), Medium Voltage (MV), electrical switching and control equipment housed in purpose-built buildings. Location: NGR NH 45668 26287.
	Valve House	A secure Permanent Compound containing a small control building sited over scour and compensation valving at the foot of the Main Dam. Location: NGR NH 44510 21928.
	Temporary Workers Accommodation	Temporary Workers Accommodation will be required to temporarily house construction workers during the Construction Phase of the Proposed Development. This will be removed and all land reinstated post-construction. Location: NGR NH 45724 26403.
	Development Site Access	Where the on-site access joins the public transport network.

Arrangement	Component	Description
		The main access is proposed off the A831 at Balnain via unclassified existing track through Forestry Land Scotland (FLS) plantation, terminating at the River Coiltie. Sections of this existing track would be repaired and upgraded where required. A new track is proposed to link the unclassified existing track at the River Coiltie to the Headpond. Additional permanent access will be required for the LCW on Loch Ness from the A82.
	Access Tracks	Permanent and Temporary internal Access Tracks across the Proposed Development Site. The Permanent Access Tracks link the existing track from the River Coiltie to the Headpond and the A82 to the LCW. A small section of permanent track will be added to the existing track from Alltsigh to the Main Dam. The Temporary Access Tracks are within the Headpond area to allow construction of the Proposed Development. These will be reinstated upon completion of construction works except where below the minimum Headpond operating level. Further details of the access tracks can be found in **Section 2.7 Description of the Permanent and Temporary Access,** below.
	Watercourse Crossings	Part of the access track works involves upgrading or creating new watercourse crossings. The upgrading of watercourse crossings is required to accommodate for the higher vehicular loads and increased amounts of passage. The creation of new watercourse crossings is necessary to avoid diverting the existing access tracks and keeping the length of new tracks to a minimum. Further details of all proposed watercourse crossings can be found within **Table 2-5** in **Section 2.7: Description of the Permanent and Temporary Access** below.
	Temporary Core Path Diversion	The temporary realignment of core paths that currently intersect with the routes along the FLS track designated as the main access route into the Proposed Development Site.
	Tailpond	The Tailpond is the lower reservoir, and in the case of this Proposed Development, will be the existing body of Loch Ness. Location: NGR NH 54114 28417
	LCW	Where the Waterways enter the Tailpond, comprised of a partially submerged structure constructed into Loch Ness with access provisions, separated smolt and trashrack screens and provisions for isolation of the Waterways using bulkhead gates. Location: NGR NH 48086 21775
Below Ground (as shown on Figure 2.4)	Waterways	Transfer water between the Headpond and the Tailpond. The Waterways consists of: • Two Headrace Tunnels (low pressure) – connecting the Headpond via the UCW to the Valve Cavern and the Pressure Shaft. • Two Tailrace Tunnels (low pressure) – connecting the pump turbines to the LCW at the Tailpond. • Pressure Shaft – vertical shaft connecting the Headrace Tunnels to the underground Power Caverns. • Surge Tanks / Chambers - Underground safety features that accommodate changes in pressure along the Tailrace Tunnels. The location of the Waterways differs between Option A and B and can be seen on **Figure 2.4: Below Ground Infrastructure (Sheets 1 -2) (Volume 3: Figures).**
	Dry Tunnels	Tunnels for construction access, for permanent access to the Power Cavern and for power import/export which will be used in operation. The design and alignment of the dry tunnels may vary depending on specific tunnelling technique. • Main Access Tunnel - underground tunnel providing access (construction and operation) to the Power Caverns. • Cable Tunnels (2 No.) – underground tunnels housing the 400 kV electrical cables and/or ventilation for the Proposed Development. During the Construction Phase, the Cable Tunnels will be used as construction access and ventilation tunnels. During the Operational Phase they will also be used for emergency access/egress. • Valve Cavern Access Tunnel – to allow permanent and construction access to the Valve Cavern on the Headrace Tunnels. • Cross adits between tunnels.

Arrangement	Component	Description
		• Ancillary tunnels around the Power Cavern to facilitate construction and allow ventilation and emergency egress. The location of the Dry Tunnels differs between Options A and B as can be seen on **Figure 2.4 Below Ground Infrastructure (Sheets 1-2) (Volume 3: Figures).**
	Underground Caverns	• Power Cavern Complex - contains the mechanical and electrical equipment for generating electricity. The turbines/pumps and generator/motors will be housed within the Power Cavern and the transformers within the Transformer Cavern, connected by service galleries. The location of the powerhouse complex differs between Options A and B: The Power Cavern may be one single cavern, or it may be in two adjacent sections that are connected. – Option A: Location of cavern east of Loch nam Breac Dearga. – Option B: Location of cavern northeast of Loch nam Breac Dearga. • Valve Cavern – Contains the means of isolating the Headrace Tunnel, located between the UCW and the vertical Pressure Shaft. • Ventilation Shaft – Means of transferring air from the Power Cavern Complex to the atmosphere (surface level) if required. The Ventilation Shaft can also be used to draw fresh air into the Power Cavern if required. Location: NH 45479 23508.
Grid Connection	Permanent connection	The grid connection for the Proposed Development will be via the new GIS switchyard located within the Proposed Development Site. The grid connection will be subject to its own separate planning consent and does not form part of this Application. A worst-case scenario of an overhead line connection to the switchyard has been used within the cumulative assessments for the grid connection.

2.5 Description of the Headpond

Introduction

2.5.1 The Headpond is located within the valley between the hills of Meall Fuar-mhonaidh, Nighean a Mhill and Glas-bheinn Mhor. The Headpond consists of an existing body of water (Loch nam Breac Dearga) contained within the topographical landscape, modified by the creation of three embankments (Main Dam, Saddle Dam 1 and Saddle Dam 2). The Headpond also includes a Spillway (described below) and the UCW (described below). A Borrow Pit Search Area is located within the Headpond to provide material for dam construction and will be underwater when the Headpond is full (described below).

Headpond Waterbody

2.5.2 The Headpond is designed to have a working volume of 29 Mm^3. **Figure 2.9: Headpond – Indicative Arrangement (Volume 3: Figures)** provides a general arrangement of the Headpond.

2.5.3 The working bottom water level (BWL) will be 475 m AOD, and the working top water level (TWL) will be 518 m AOD giving a maximum operational drawdown of 43 m. The water levels can be viewed on **Figure 2.10: Headpond Cross Sections (Volume 3: Figures)**.

Embankments and Spillway

2.5.4 Four retaining structures will retain the Headpond waterbody, as follows:

- Main Dam – Located at the southwest end of the Headpond, between the reliefs created by Meall Fuar-mhonaidh and Glas-bheinn Mhor. The Main Dam is approximately 1,000 m in length, with a maximum height above existing ground of approximately 59 m;
- Saddle Dam 1 – Located at the northwest end of the Headpond, Saddle Dam 1 is approximately 410 m in length, with a maximum height above existing ground of approximately 24 m. The Saddle Dams together span the gap between Glas-bheinn Mhor and Nighean a Mhill;
- Saddle Dam 2 – Located at the northeast end of the Headpond, Saddle Dam 2 is approximately 370 m in length, with a maximum height above existing ground of approximately 24 m. The Saddle Dams together span the gap between Glas-bheinn Mhor and Nighean a Mhill; and,
- Spillway – Located at the northeast extremity of the Headpond and adjacent to Meall Fuar-mhonaidh, fills a low point and will allow the Headpond to spill safely in the event of unusually high water level and will therefore protect the dams.

2.5.5 The three main embankments (Main Dam and Saddle Dams 1 and 2) will be Concrete Faced Rockfill Dams (CFRD) with external slopes of 1:2 (V:H). The crest level of these embankments is 520 m AOD. The Spillway structure will be of reinforced concrete construction with a lower “spill” level of 518.4 m AOD.

2.5.6 The embankments can be viewed on **Figure 2.10 Headpond Cross Sections** and **Figure 2.11: Headpond Embankments Typical Detail (Volume 3: Figures)**.

Upper Control Works

2.5.7 The UCW is where both (1) water enters the Waterways via the UCW when generating electricity and (2) where the Waterways exit into the Headpond when pumping water up from Loch Ness. Two location options for the UCW are presented due to uncertainties with ground conditions. Following further ground investigations a decision will be made on the preferred options.

2.5.8 Option A – The UCW is located at NH 45588 22682 within the Headpond and is southwest of the Spillway. Option A UCW consists of the following infrastructure:

- UCW Inlet Channel – The UCW Inlet Channel is required to house the UCW diffuser structures in the Headpond at an elevation of 482.5 m AOD. The channel is approximately 300 m in length, 200 m in width and sits at 458 m AOD at its lowest elevation (at the diffusers);
- 2No. UCW Diffusers – The UCW diffusers are the physical water intake structures. The diffusers will be reinforced concrete structures approximately 105 m in length, 17.5 m in height and 45 m in width at the widest

point. The Diffusers will include coarse screens, provisions for the use of bulkhead gates, a deck area with parapet wall and manholes for maintenance access; and,

- UCW Access – A Permanent Access Track will be established to the UCW along one of the construction benches formed for the inlet channel. The Access Track would be below water level during operation and only accessible when the Headpond water level is drawn down in a maintenance scenario.

2.5.9 Option B – The UCW is located at NH 45275 22928 within the Headpond and is located between Saddle Dam 1 and Saddle Dam 2. For Option B the UCW feature consists of the same infrastructure and dimensions as Option A.

2.5.10 The UCW can be viewed on **Figure 2.13: Upper Control Works Plan, Figure 2.14 Upper Control Works Section (Volume 3: Figures)** and **Figure 2.22 Waterways Plan and Section (Volume 3: Figures).** Note that these figures present Option B, the design will be adapted accordingly should Option A be taken forward. Clarification on which option has been assessed, and how, is explained in each chapter.

Borrow Pit Search Area

2.5.11 The Headpond will include one Borrow Pit Search Area within its footprint. This is an area designated for the acquisition of material to be used in the Construction Phase of the Proposed Development.

2.5.12 The Borrow Pit Search Area will not be infilled on completion of Construction and will be inundated once the Headpond is filled with water.

Description of the Secondary Bund

2.5.13 The Secondary Bund will be a small earthen or concrete dam downstream of the Main Dam. This structure will be installed to protect the downstream watercourses during the periodic scour valve tests at the Valve Cavern (**Section 2.11 Description of the Underground Caverns and Ventilation Shaft**). The Secondary Bund is expected to be utilised every 6 months (for testing of the scour valve) and for the resulting water discharge to dissipate naturally into the downstream watercourse. It will attenuate approximately 4,000 m^3 of released storage water, with final dimensions and volumes to be determined in the detailed design stage.

Description of Borrow Pit Search Area 2

2.5.14 A secondary Borrow Pit may be required for the Construction of the Proposed Development. This would consist of re-opening an existing Borrow Pit along the existing FLS access track or opening a new Borrow Pit in the same area. The details and locations to be confirmed once the requirement is determined in detailed design stage. Borrow Pit construction will be undertaken in accordance with the Quarries Regulations 1999[3] and Explosives Regulations 2014 (as amended)[4] as appropriate.

2.6 Description of the Compounds

2.6.1 There will be both Temporary and Permanent Compounds required for the Proposed Development. Temporary Compounds will be required to facilitate the Construction of the Proposed Development, as shown on **Figure 2.3: Above Ground Infrastructure (Volume 3: Figures).**

2.6.2 The compounds are anticipated to be unsealed (stone, aggregate or gravel surface) in nature and will be either floated (over peat) or built into the hillside depending on the site conditions and anticipated loads. All compounds will be fenced for safety and security purposes.

Temporary Compounds During Construction Phase

2.6.3 Eleven Temporary Compounds are anticipated to be required for the Construction Phase. The proposed location, use and approximated size of each of the compounds are detailed in **Table 2-3: Proposed Construction Compounds – Locations, Functions and Sizes**, below.

2.6.4 The indicative arrangement and design principles for the Temporary Construction Compounds at the Proposed Development Site can be seen on **Figure 2.26: Indicative Construction Compound Layout (Volume 3: Figures)**. Additionally, the indicative plan and sections of the Temporary Workers Accommodation can be seen

[3] https://www.legislation.gov.uk/uksi/1999/2024/contents/made
[4] https://www.legislation.gov.uk/uksi/2014/1638/contents

on **Figure 2.28: Temporary Workers Accommodation Plan** and **Figure 2.29: Temporary Workers Accommodation Section (Volume 3: Figures)**.

2.6.5 Construction at the Headpond is considered to be an area of high activity and will have suitable temporary amenities to support the works. As such, the Headpond is considered to be a Temporary Construction Compound (TC13).

2.6.6 Following the completion of the Construction Phase, all Temporary Compounds will be removed and the ground fully reinstated.

2.6.7 All Temporary Compounds will have timed floodlights which will be installed with motion sensors. These will only be operational in hours of darkness or when light is fading and not operational during daylight hours or out with permitted Construction hours.

Table 2-3 Proposed Construction Compounds – Locations, Functions and Sizes

Construction No.	Use	Approximate Location	Approximate Max Size of Working Area (m^2)
TC01	Material Storage, Plant and Equipment, Welfare, and Site Offices.	NH 46557 26767	7,000
TC02	Material Storage, Plant and Equipment, Welfare.	NH 46405 26600	3,150
TC03	Material Storage, Plant and Equipment, Welfare.	NH 46095 26510	3,150
TC05	Temporary Workers Accommodation including long term and short-term accommodation, welfare, amenities, medical facilities and waste and water works.	NH 45791 26270	215,920
TC06	Temporary firefighting compound including firefighting facilities, generator facilities, industrial cleaning, parking and security.	NH 46092 26287	9,200
TC09	Satellite compound for material storage, plant and equipment and welfare.	NH 46132 25367	2,700
TC10	Satellite compound for material storage, plant and equipment and welfare.	NH 45431 24782	1,250
TC11	Satellite compound for material storage, plant and equipment and welfare.	NH 44877 24339	1,250
TC13	Headpond construction compound for welfare, batching, material storage, quarrying and plant and equipment.	NH 44803 22244	10,000 (estimated, to be confirmed)
TC16	LCW Construction Compound. Material Storage, Plant and Equipment, Welfare.	NH 48133 21803	4,800
TC17	Pressure Shaft Construction Compound. Material Storage, Plant and Equipment, Welfare.	NH 45312 23520	2,000

Permanent Compounds

2.6.8 Six Permanent Compounds are required to remain for the lifespan of the Proposed Development. These are detailed in **Table 2-4: Proposed Permanent Compounds – Locations, Functions and Sizes**, below.

2.6.9 Lighting requirements at the Permanent Compounds differs between compounds, details of lighting requirements have been included within the table below.

Table 2-4 Proposed Permanent Compounds – Locations, Functions and Sizes

Construction No.	Use	Approximate Location	Approximate Max Size of Working Area (m^2)
PC04	Above Ground GIS Switchyard. Motion-sensor lighting.	NH 45668 26287	14,985
PC07	Tunnel Portal 1. Timed floodlights with non-motion sensor within the hours of	NH 46348 26086	2,650

Construction No.	Use	Approximate Location	Approximate Max Size of Working Area (m^2)
	dawn/dusk/darkness will be installed during construction. During operation motion-sensor lighting will be operational.		
PC08	Tunnel Portals 2 & 3. Timed floodlights with non-motion sensor within the hours of dawn/dusk/darkness will be installed during construction. During operation motion-sensor lighting will be operational.	NH 46552 26254	4,170
PC12	Main Dam Valve House Timed floodlights with non-motion sensor within the hours of dawn/dusk/darkness will be installed during construction. During operation motion-sensor lighting will be operational.	NH 44485 21945	875
PC14	Ventilation Shaft Compound. Timed floodlights with non-motion sensor within the hours of dawn/dusk/darkness will be installed during construction and remain during operation.	NH 45557 23498	600
PC15	Valve Cavern Access Tunnel Portal. Timed floodlights with non-motion sensor within the hours of dawn/dusk/darkness will be installed during construction. During operation motion-sensor lighting will be operational.	NH 45092 24262	3,150

GIS Switchyard

2.6.10 The GIS Switchyard will consist of secured electrical compounds (one controlled by the project and one controlled by the Transmission System Operator (TSO)), in which electrical equipment will be housed. The GIS Switchyard will consist of control building(s), switchgear, busbars, perimeter fence, and overhead or underground cables.

2.6.11 The GIS Switchyard will be constructed in PC04 within a compound area of approximately 185 m x 81 m. The GIS buildings will be approximately 48 m x 24 m with equipment up to 15 m in height. Refer to **Figure 2.27: GIS Switchyard Plan (Volume 3: Figures)**.

2.6.12 The final equipment to be included in the GIS Switchyard will be determined at the detailed design stage.

Valve House

2.6.13 The Valve House will consist of: a small control building sited over a submerged discharge valve in an outlet chamber approximately 10 m deep, and car parking. The discharge (scour) valve is utilised during the Operational Phase if, for any reason, the Headpond needs to be drawn down in circumstances where this cannot be done through the Power Cavern. It can therefore provide a secondary means to drain the Headpond and aid in the removal of deposited sediments if necessary and as regulated by separate consents. As a safety critical feature, it is also routinely tested. The Valve House also contains a smaller discharge valve to maintain compensation flow.

2.6.14 The Valve House will be accessed only occasionally during the Operational Phase, and via the existing access at the southwest of the Development Site from Alltsigh.

2.6.15 The Valve House will be constructed in PC12 with a compound area of approximately 35 m x 25 m. The final building size and equipment to be housed in the Valve House will be determined at the detailed design stage.

Temporary Workers Accommodation

2.6.16 The Proposed Development includes accommodation and facilities for up to 1,000 persons and will be located within the northern section of the Proposed Development Site, approximately 425 m south of the River Coiltie access crossing point.

2.6.17 The Temporary Workers Accommodation will be designed to provide a family-friendly environment, supporting the well-being of workers and promoting a positive living atmosphere during their time on site.

2.6.18 The Temporary Workers Accommodation will be constructed in phases according to the construction programme and will contain all necessary infrastructure to support the resident workers throughout the Preconstruction and Enabling Phase and then the Construction Phase, minimising travel off-site.

2.6.19 Infrastructure provision will include medical facilities, shops, catering, gym and sports facilities, site offices, firefighting facilities, water treatment and distribution infrastructure, waste management and recycling facilities, gas storage and distribution infrastructure. Compound staff will also be housed on-site, and a park and ride system will be implemented. Please refer to **Figures 2.28 Temporary Workers Accommodation Plan** and **Figure 2.29 Temporary Workers Accommodation Section (Volume 3: Figures**).

2.7 Description of the Permanent and Temporary Access

Proposed Development Site Access

2.7.1 With the exception of the LCW, the Proposed Development Site access is proposed from the A831 at Balnain via an existing priority junction. This access junction is to be widened and modified to allow two-way construction traffic movement while maintaining access for other users.

2.7.2 The A831 links to the trunk road network at the A82 in Drumnadrochit to the east. It is anticipated that HGV construction traffic will approach the Proposed Development Site from the east via the A831, with the majority routing from the north on the A82. Some construction traffic is also expected to route via the A82 to the south and the A833. Most Construction Phase personnel will be housed on site throughout the Construction period, minimising the use of car / LGV movements. Car / LGV movements will also be via the Balnain site access.

2.7.3 A secondary Operational Phase access to the Proposed Development will come from the A82 at Alltsigh. This will serve as an emergency access only and will not be routinely used by Proposed Development construction traffic.

2.7.4 The LCW will be a marine construction project as far as possible with most heavy construction plant and materials transported by water via Loch Ness. An LCW access junction for lighter vehicles, plant and operational traffic will be formed from the A82. This will be a simple priority-controlled access junction that will be constructed as far as possible from the Tailpond side.

Permanent Access Tracks

2.7.5 Access to the Proposed Development Site will be via an existing Forestry and Land Scotland (FLS) track off the A831 near Balnain, hereafter referred to as the 'Balnain Main Access'. This route utilises the existing FLS access and the Balmacaan Estate track, extending to its current termination at the River Coiltie. A new section of track will be constructed to cross the River Coiltie. Additionally, the existing FLS track will be widened and upgraded in agreement with FLS.

2.7.6 From the River Coiltie Crossing new Permanent Access Tracks are routed to the north and east of the Headpond to provide permanent access to the crest of the Main Dam, Saddle Dam 1, Saddle Dam 2 and the area around the Spillway. Additionally, permanent access will be provided to the UCW, however, this section of the track will only be usable when the Headpond is drawn down to its minimum level (475 m AOD).

2.7.7 To the west of the Headpond, a new section of Access Track will also be constructed from the existing Alltsigh Track to the toe of the Main Dam to provide access to the Valve House (PC12). The section of existing Alltsigh Track will not be required to be widened as this section will only be used infrequently by smaller vehicles during operation and is considered to be sufficient for this purpose.

2.7.8 The construction corridor required for new Permanent Access Tracks will be a maximum of 30 m to allow for two-way vehicular traffic, drainage and peat storage. Post Construction, the access tracks will be reduced in width to a single-track road, with passing places retained at suitable increments. All access track alignments have been designed utilising the local natural topography along with environmental constraints, as identified in this EIAR.

2.7.9 Access to the LCW will be a permanent access road directly from the A82 via a single priority junction, allowing 2-way access for Construction and Operation.

2.7.10 Refer to **Figure 2.31 Excavated Access Track Detail** and **Figure 2.32 Floating Access Track Detail (Volume 3: Figures)**.

Temporary Access Tracks

2.7.11 Temporary Access Tracks will be established around the inside of the Headpond and off the new Permanent Access Track near the River Coiltie to access the Temporary Workers Accommodation compound.

2.7.12 Post construction, the Temporary Access Tracks will be reinstated completely.

Watercourse Crossings

2.7.13 Several Temporary and Permanent Access Tracks are proposed as part of the Proposed Development. Where there are existing access tracks, with associated watercourse crossings, these may require upgrading to widen the tracks, resulting in a longer length of culvert at each of these crossings. Where new Temporary and Permanent Access Tracks are required, new open bottom or culvert watercourse crossings will be created in line with the standard detail in **Figure 2.33 Water Crossing Detail (Volume 3: Figures).**

2.7.14 The routes of the access tracks have been selected to minimise watercourse crossings, whilst balancing other considerations including but not limited to the presence of peat, topography, buildability and terrestrial and hydro-geomorphological habitat. All crossings will adhere to Controlled Activities Regulations (CAR) requirements. For further details on watercourse crossings, refer to **Appendix 10.3: Geomorphic Baseline and Watercourse Crossings (Volume 5: Appendices).**

Table 2-5 Watercourse Crossings

Watercourse Crossing No.	NGR	Upgraded, Existing or New	Type of Crossing	Approx. Length (m)	Approx Width/Diam. (m)
SW27 Crossing 1	NH45050 29830	New temporary	Bottomless culvert	11 m	1 m
SW19 Crossing 1	NH45008 29834	New temporary	Bridge	11 m	14 m
SW20 Crossing 1	NH45183 29549	Upgrade	Concrete bottomless box culvert	11 m	3.3m
SW21 Crossing 1	NH45255 29549	Upgrade	Pipe culvert	11 m	0.45 m
SW28 Crossing 1	NH45477 29475	Upgrade	Pipe culvert	11 m	0.3 m
SW22 Crossing 1	NH45741 29415	Upgrade	Pipe culvert	11 m	1.5 m
SW23 Crossing 1	NH46498 29484	Upgrade	Pipe culvert	11 m	0.45 m
SW24 Crossing 1	NH46924 29606	Upgrade	Pipe culvert	11 m	0.9 m
SW29 Crossing 1	NH47010 29652	Upgrade	Pipe culvert	11 m	0.45 m
SW30 Crossing 1	NH47599 29698	Upgrade	Pipe culvert	11 m	0.6 m
SW25 Crossing 1	NH47940 29438	Upgrade	Assumed pipe culvert	11 m	0.45 m
SW26 Crossing 1	NH49374 29433	Upgrade	Pipe culvert	11 m	0.6 m
SW18 Crossing 1	NH47412 27489	Upgrade	Assumed pipe culvert	11 m	0.3 m
SW17 Crossing 1	NH46691 27021	Upgrade	Pipe culvert	11 m	0.9 m
SW9 Crossing 1	NH46489 26715	New	Bottomless culvert	11 m	9.5 m
SW12-C Crossing 1	NH 46026 26415	New	Bottomless arch culvert	11 m	0.6 m
SW12-C Crossing 2	NH 45962 26352	New	Bottomless arch culvert	11 m	0.6 m
SW12-B Crossing 1	NH 46185 26070	New	Bottomless arch culvert	11 m	1.2 m
SW12 Crossing 1	NH 46132 25072	New	Bottomless arch culvert	11 m	0.9 m
SW11-B Crossing 1	NH 45635 23347	New	Bottomless arch culvert	11 m	0.75 m

Watercourse Crossing No.	NGR	Upgraded, Existing or New	Type of Crossing	Approx. Length (m)	Approx Width/Diam. (m)
SW11-B Crossing 2	NH 45652 23217	New	Bottomless arch culvert	11 m	0.9 m
SW3 Crossing 1	NH45591 19142	Upgrade	Bridge	11 m	9 m
SW3-D Crossing 1	NH44313 19287	Upgrade	Pipe culvert	11 m	8.5 m
SW3-F Crossing 1	NH44047 19197	Upgrade	Bridge	11 m	0.45 m
SW3 Crossing 2	NH43731 19254	Upgrade	Bridge	11 m	6 m
SW3-H Crossing 1	NH43385 19324	Upgrade	Assumed pipe culvert	11 m	0.3 m
SW5 Crossing 1	NH 43495 20814	Upgrade	Bridge	11 m	6 m
SW7 Crossing 1	NH 43417 21321	Upgrade	Pipe culvert	11 m	0.9 m
SW5-E Crossing 1	NH 44494 22702	New	Bottomless arch culvert	11 m	0.6 m
SW5-E Crossing 2	NH 44505 22690	New	Bottomless arch culvert	11 m	0.6 m
SW5-E Crossing 3	NH 44441 22475	New	Bottomless arch culvert	11 m	0.6 m
SW5-D Crossing 1	NH 44247 22088	New	Bottomless arch culvert	11 m	0.45 m
SW5-B Crossing 1	NH 43749 21993	New	Bottomless arch culvert	11 m	1.2 m
SW13 Crossing 1	NH 44627 23729	New	Bottomless arch culvert	11 m	0.6 m
SW13 Crossing 2	NH 44574 23681	New	Bottomless arch culvert	11 m	0.6 m
SW 31 Crossing 1	NH 48159 21879	New	Bottomless arch culvert	11 m	0.6 m

Please note that all culvert lengths are approximated based on a maximum access track width of 10 m with a 0.5 m buffer allowance on each side. Channel widths have been approximated from site visits / site visit photographs, Ordnance Survey mapping and aerial imagery.

Core Path Realignment

2.7.15 To maintain public safety during the Construction Phase, temporary safety signage will be established along walking routes, core paths and long-distance routes.

2.7.16 The Affric Kintail Way (core path) currently runs along the FLS access track to be used as the main Construction access to the Proposed Development Site. For safety purposes, the Affric Kintail Way will be temporarily rerouted adjacent to the FLS track, through FLS commercial forestry, to provide safe segregation of construction traffic and recreational users. The diversion will, however, cross the main Construction route in one location where temporary safety signage will be established. Please refer to **Figure 2.30: Temporary Core Path Diversion (Volume 3: Figures**).

2.7.17 A full description of the local path network within the Proposed Development Site and the surrounding area is provided within **Chapter 16: Socio-Economics and Tourism (Volume 2: Main Report)** and can be viewed within **Appendix 16.1: Outline Access Management Plan (Volume 5: Appendices)**.

2.8 Description of Tailpond Structures

Lower Control Works

2.8.1 The Waterways will terminate at the LCW situated on the eastern bank of Loch Ness at approximately NH 48086 21775 and can be viewed on **Figure 2.15: Lower Control Works – 3D Visualisation, Figure 2.16 Lower Control Works Plan and 2.17 Lower Control Works Section (Volume 3: Figures).**

2.8.2 The LCW consists of 4No. discrete intake-outlet structures and a road providing access to the structures from the A82. In addition to the main intake-outlet structures, the LCW has a Smolt Screen that is separated from the main structure. The detailed design of the LCW intake-outlet structures will be finalised at detailed design stage to allow for optimising flows of water discharging into Loch Ness.

2.8.3 Navigational lighting of the LCW will likely be required. A marker in the water should be lit to warn of the presence of the Smolt Screen structure. This will be agreed at detailed design stage in consultation with the relevant Authority.

2.8.4 Lighting during Construction and Operation Phases will be required at the LCW. Timed floodlights with non-motion sensors will be deployed to allow work during the approved construction window within the hours of dawn/dusk/darkness. During the Operational Phase motion-sensor lighting will be in operation.

2.8.5 The proposed arrangement for the LCW platform is a level platform, approximately 262 m long and 32 m wide, beneath which the 4No. intake-outlet structures are arranged at regular intervals of 60 m spacing. The finished level for the platform has been set at 18.5 m AOD, being 2.65 m above an average loch water level of 15.85 m AOD. The finished level of the platform at the Smolt Screen has been reduced to 17.5 m AOD to limit the visual impact of the structure on the loch.

2.8.6 At the proposed site for the LCW platform, the level of the existing A82 is between 28 m and 29 m AOD i.e. approximately 10 m above the proposed finished platform level of 18.5 m AOD. The narrow width of the foreshore combined with the steeply sloping ground will necessitate the introduction of a retaining wall at the rear of the platform, to ensure stability of the slope above, including the A82. The most appropriate form of wall is anticipated to be a near vertical anchored wall secured by either soil nails or rock anchors depending on the ground conditions.

2.8.7 The Smolt Screen, required to prevent the entrainment of salmon smolts into the intake-outlet structure, is decoupled at a distance of approximately 53 m from the main structure. The flow velocity through the screen will be approximately 0.3 m/s at maximum abstraction flowrate. The screen comprises a series of mesh panels placed between supports spanning the height of the screen; this is similar to the Smolt Screen arrangements at the existing PSH schemes of Cruachan and Foyers. The top of the screen is supported off the front face of a platform providing access for cleaning and maintenance of the screens.

2.8.8 Proprietary lifting equipment will be used for screen cleaning which can be deployed from either the platform behind the screen or from a barge in front of the screen.

2.8.9 The proposed means of gaining vehicular access to the LCW platform will be directly from the A82 via a single priority junction, allowing 2-way access for elements of Construction, Operation and maintenance of the scheme. The chosen location of the proposed junction on the A82 has been governed by the location of the platform, the geometry of the A82, and associated driver visibility. As the proposed access road needs to drop 10 m in elevation to tie in with the LCW platform, the junction with the A82 has been positioned to the north of the platform, at a distance of 310 m, to ensure gradients of the access road are not excessive.

2.9 Description of the Waterways

2.9.1 The Waterways connect the Headpond and Tailpond, comprising the low-pressure Headrace Tunnels, the Pressure Shafts, the high-pressure Headrace Tunnels, and the low-pressure Tailrace Tunnels.

2.9.2 For the Proposed Development there are two largely duplicated, waterway systems connecting the Headpond and Tailpond. As such, the description below describes one of the two systems. The estimations of length are based on the longest sections. This is shown on **Figure 2.22: Waterways Plan Section (Volume 3: Figures).**

2.9.3 There are two options presented for the Waterways, Option A and Option B **(Figure 2.4: Below Ground Infrastructure (Sheets 1-2) (Volume 3: Figures))**. The option taken forward will depend on the outcomes of further ground investigation works. Option B is considered within the assessments as the “worst case” option as it is longer. The following sections provide a general description of the Waterways. However, the option, final length and routing of the Waterways tunnels discussed below will be determined in the final design along with the lining requirements; the specification of which will depend on the underlying geology.

Headrace Tunnels

2.9.4 The Headrace Tunnel connects the Headpond UCW to the pump turbines within the Power Cavern Complex and is made up of low-pressure and high-pressure tunnels, connected by a Pressure Shaft (see **Section Pressure Shaft:** below for details).

2.9.5 Two low-pressure tunnels (one for each hydraulic system) start at the UCW and pass through the Valve Cavern before the Pressure Shaft. At the bottom of the Pressure Shaft, the High-Pressure Tunnel starts and splits to feed the turbines. Flow along the split tunnels will be controlled by the main inlet valves (MIV) located within the Power Cavern.

2.9.6 For Option A, and with reference to **Figure 2.8: Development Cross Section (Volume 3: Figures)**, the low-pressure Headrace Tunnel 1 is approximately 885 m in length, and the low-pressure Headrace Tunnel 2 is approximately 620 m in length. These tunnels have a maximum internal diameter of approximately 6.3 m. Both high-pressure Headrace Tunnels and manifolds 1 and 2 have lengths of approximately 662 m each, with a maximum internal diameter of approximately 6.9 m.

2.9.7 For Option B, and with reference to **Figure 2.8: Development Cross Section (Volume 3: Figures)**, the low-pressure Headrace Tunnel 1 is approximately 1,060 m in length, and the low-pressure Headrace Tunnel 2 is approximately 900 m in length. These tunnels have a maximum internal diameter of approximately 6.3 m. Both high-pressure Headrace Tunnel and manifolds 1 and 2 have lengths of approximately 662 m each, with a maximum internal diameter of approximately 6.9 m.

Tailrace Tunnels

2.9.8 The Tailrace Tunnel connects the Power Cavern Complex to the LCW on Loch Ness.

2.9.9 The Tailrace Tunnel starts at the downstream side of the Power Cavern and proceeds towards the Tailpond. At the end of the Tailrace Tunnel, the tunnel will bifurcate (from 1No. tunnels to 2No. tunnels) and enter the LCW.

2.9.10 For Option A, and with reference to **Figure 2.8: Development Cross Section (Volume 3: Figures)**, the low-pressure Tailrace Tunnel 1 is approximately 2,015 m in length, and the low-pressure Tailrace tunnel 2 is approximately 1,990 m in length. These tunnels have a maximum internal diameter of approximately 9 m.

2.9.11 For Option B, and with reference to **Figure 2.8: Development Cross Section (Volume 3: Figures)**, the low-pressure Tailrace Tunnel 1 is approximately 2,790 m in length, and the low-pressure Tailrace Tunnel 2 is approximately 2,815 m in length. This tunnel has a maximum internal diameter of approximately 9 m.

Pressure Shaft

2.9.12 The Pressure Shaft is a vertical shaft that connects the headrace low-pressure and high-pressure tunnels. There will be 2 No., one on each waterway.

2.9.13 Each Pressure Shaft is approximately 460 m in length and will have a maximum internal diameter of approximately 6.3 m. The Pressure Shaft will generally be lined with reinforced concrete, the specification and lining of which will depend on the underlying geology.

Surge Tanks / Chambers

2.9.14 The Surge Tanks are vertical shafts that branch off the main Waterways; there are 2 in total, one on each Tailrace Tunnel, downstream of the Power Cavern Complex. They are underground structures and are used to minimise large pressure fluctuations in the wet tunnel system caused by the opening and closing of valves, and fast changes in pump-turbine speed such as those seen in a load rejection scenario.

2.9.15 The Surge Tanks are each approximately 100 m in length, and will have an internal diameter of approximately 24 m. They will be lined with reinforced concrete, the specification of which will depend on the underlying geology.

2.10 Description of the Dry Tunnels

2.10.1 The Dry Tunnels comprise the Main Access Tunnel, up to 2No. Cable/Ventilation Tunnels, the Valve Cavern Access Tunnel, cross adits between tunnels and enabling tunnels around the Power Cavern. The indicative routes

and sections of tunnels can be viewed on **Figure 2.18: Dry Tunnel Plan and Section** and **Figure 2.20: Valve Cavern Access Tunnel Plan and Section (Volume 3: Figures).**

2.10.2 There are two options presented for the Dry Tunnels, Option A and Option B (**Figure 2.4: Below Ground Infrastructure (Sheets 1-2) (Volume 3: Figures).** The Option taken forward will depend on the outcomes of further ground investigation works. Option B is considered within the assessments as it is the longer of the two options. The sections below summarise the general arrangement of the Dry Tunnels. It should be noted that the option, final length and routing of the Dry Tunnels discussed below will be determined through the detailed design, along with the lining, paving and ventilation requirements.

Main Access Tunnel

2.10.3 The Main Access Tunnel will be approximately 3,320 m in length for Option A, and approximately 3,200 m in length for Option B. For both Options it will be a 'D' shaped tunnel approximately 8 m in width and 8 m in height. The tunnel will be used for the Pre-Construction, Construction and Operation of the Proposed Development and is therefore considered as a permanent feature of the Proposed Development.

2.10.4 The Main Access Tunnel will be constructed during the Pre-Construction and Enabling Phase of the project.

2.10.5 During Construction, the Main Access Tunnel will be used as a construction tunnel and will facilitate the delivery of all large equipment including abnormal indivisible loads (AILs), the removal of excavated spoil material and the movement of personnel to the Power Cavern Complex.

Cable Tunnels 1 & 2

2.10.6 For Option A, Cable Tunnel 1 will be approximately 3,340 m in length and Cable Tunnel 2 will be approximately 3,880 m in length. For Option B, Cable Tunnel 1 will be approximately 3,210 m in length and Cable Tunnel 2 will be approximately 3,760 m in length. For both Options, both Cable Tunnels will be a 'D' shaped tunnel that is approximately 6 m wide and 6 m high. The tunnels will be used for the Construction and Operation of the Proposed Development and are therefore considered permanent features.

2.10.7 During Construction, the Cable Tunnels will be used as construction tunnels and will facilitate ventilation and the movement of material from the below ground excavation works to the surface.

2.10.8 During Operation, the Cable Tunnels will house the power cables for exporting energy to the grid and will provide egress options in the event of an emergency.

Valve Cavern Access Tunnel

2.10.9 The Valve Cavern Access Tunnel will be approximately 1,600 m in length for Option A and 990 m in length for Option B and be a 'D' shaped tunnel approximately 6 m in width and 6 m in height. The tunnel will be used for Construction and Operation of the Valve Cavern component of the Proposed Development and is therefore considered as a permanent feature.

2.10.10 During Construction, the Valve Cavern Access Tunnel will be used as a construction tunnel and will be used to access the Valve Cavern and facilitate the movement of material from the below ground excavation works to the surface.

Cross Adits Between Tunnels

2.10.11 The cross adits are small additional tunnels between the major dry tunnels that may be used to enable access and construction works. Following construction, they may facilitate ventilation or egress options. As they will be used for Construction and Operation of the Proposed Development, they constitute permanent features.

Ancillary Tunnels Around Power Cavern

2.10.12 These are additional tunnels used to enable access and construction works. They will be used for the Construction Phase and Operational Phase of the Proposed Development, making them permanent features.

2.11 Description of the Underground Caverns and Ventilation Shaft

2.11.1 There are two separate underground cavern locations which are required for the Proposed Development Site, as follows:

- Power Cavern Complex (This is the main underground operational area, and comprises the main power cavern, the transformer cavern and inter-connecting galleries, it also has an associated Ventilation Shaft); and,
- Valve Cavern (this is a smaller operational area to access the Headrace isolation valves).

2.11.2 Refer to Figure **2.23: Power Cavern Plan, Figure 2.24 Power Cavern Section** and **Figure 2.25 Valve Cavern Plan and Section (Volume 3: Figures)**.

2.11.3 Currently there are two Options for the location of the Power Cavern Complex.

- Option A: Location of cavern east of Loch nam Breac Dearga, underneath the bulk of Meall Fuar-mhonaidh.
- Option B: Location of cavern northeast of Loch nam Breac Dearga.

2.11.4 Refer to **Figure 2.4: Below Ground Infrastructure (Sheets 1-2) (Volume 3: Figures).**

Power Cavern Complex

2.11.5 The Power Cavern Complex is located at approximately -75 m AOD, around 595 m below ground level and is accessible via the Main Access Tunnel. The precise arrangement and design of the Power Cavern Complex will be subject to ground investigation and detailed design.

2.11.6 The Power Cavern will be the largest section of the Power Cavern Complex, measuring approximately 300 m long, 30 m wide and 55 m high, and will contain the Main Inlet Valves (MIVs), pump-turbines, draft tube gates, generators/motors, compressors, gantry cranes, cable gallery, ancillary systems, offices and the control room.

2.11.7 The Transformer Cavern will be approximately 60 m from the Power Cavern and will be approximately 300 m long, 25 m wide and 20 m high. The transformers will be housed within the transformer cavern, along with a gantry crane and switchgear. The Transformer Cavern will be accessed via galleries connecting the Power Cavern to the Transformer Cavern and via the Cable Tunnels.

Valve Cavern

2.11.8 The means of isolating the Headrace Tunnels will be contained within the Valve Cavern, located below ground between the UCW and the Pressure Shaft.

2.11.9 The Valve Cavern will be approximately 120 m long, 10 m wide and 20 m high and the precise orientation of the cavern will be subject to detailed design and further ground investigation.

2.11.10 Within the Valve Cavern, there will be mechanical equipment used to isolate the Headrace tunnels which will likely be in the form of large diameter butterfly valves. Associated ancillary equipment includes a gantry crane. Refer to **Figure: 2.25 Valve Cavern Plan and Section (Volume 3: Figures).**

2.11.11 Access to the Valve Cavern will be made via the Valve Cavern Access Tunnel, as detailed in **Section 2.10: Description of the Dry Tunnels** and shown on **Figure 2.20: Valve Cavern Access Tunnel Plan and Section (Volume 3: Figures)**.

Ventilation Shaft

2.11.12 There is a Ventilation Shaft from the Power Cavern Complex to surface level to provide the means of transferring heat generated in the Power Cavern Complex to the atmosphere (surface level).

2.11.13 The Ventilation Shaft is approximately 500 m in length and will have a finished diameter of approximately 6 m.

2.11.14 At the surface, the shaft will be enclosed within a permanent compound (PC14) and cordoned off by appropriate safety measures.

2.12 Description of the Grid Connection

2.12.1 The grid connection route is anticipated to be to Bingally substation at NH 30340 24171, which is located approximately 15 km to the west of the Proposed Development Site. The exact route and nature of the connection will be established by the Transmission System Operator (TSO) and subject to a separate planning application by them and does not form part of this Application. A grid connection agreement has been accepted for the Proposed Development between the Applicant and SSEN.

2.12.2 Within the Proposed Development Site, the high voltage (HV) cables will be routed from the underground Transformer Cavern through the 2No. Cable Tunnels to surface level. At surface level, the cables will be undergrounded in trenches alongside the new Permanent Access Track to the GIS Switchyard (PC04).

2.12.3 As noted above, the exact route and type of the grid connection from the Proposed Development Site to Bingally is currently unconfirmed. The connection may be via an underground cable, however, for the purposes of the assessment it has been assessed on a “worst case” scenario, i.e. that it will be via an overhead line.

2.13 Description of Dochfour Weir Upgrade

2.13.1 The Proposed Development has been progressed alongside broader engagement on the potential for effects on water levels in Loch Ness and consequently downstream flows in the River Ness. The existing Dochfour Weir, originally constructed as part of the Caledonian Canal system, plays a key role in managing water levels for navigation, environmental flows, and fish passage. Engagement with Scottish Canals, as the statutory navigation authority, has confirmed shared objectives to modernise the weir to increase resilience to climate change, support improved ecological outcomes (notably for migratory salmon), and maintain the navigability of the Caledonian Canal.

2.13.2 Amendments to the Dochfour Weir are therefore proposed in order to mitigate effects on environmental features in Loch Ness, with particular attention to salmon. The intention of these amendments is to improve fish passage, to prevent salmon smolts passing down the Caledonian Canal, to regularise fluctuations in Loch Ness water levels and to improve control of water volumes flowing into the River Ness please refer to **Appendix 2.1 Weir Upgrade Description** and **Appendix 2.2 Scottish Canals Letter (Volume 5: Appendices),** for further details.

2.13.3 The Dochfour Weir Upgrade will be subject to its own separate application under TCP(S)A and does not form part of this S36 Application.

2.14 Construction Programme

2.14.1 The lifespan of the Proposed Development has been broken into four distinct phases:

1. Pre-Construction and Enabling Phase – initial works that enable the construction of the Proposed Development;
2. Construction Phase – the building and commissioning of the Proposed Development;
3. Operational Phase – the period when the Proposed Development is active and has the potential to use and generate electricity; and,
4. Decommissioning Phase– the end of operational use and the removal and/ or making safe of the Proposed Development.

2.14.2 **Sections 2.15: Pre-Construction and Enabling Phase** to **2.18: Decommissioning Phase** set out the different phases of the Proposed Development and the works required by each component part.

2.14.3 A more detailed construction methodology and schedule will be produced by the Construction Contractor for the Proposed Development post-consent.

Timescales

2.14.4 Construction is expected to last up to 8 years, including the Pre-Construction and Enabling Phase. The Construction work is anticipated to peak within years 2 to 4 as the tunnelling works and the Headpond construction are the two largest operations, which are likely to be sequenced in parallel. It is expected that the tunnelling work will be a 24-hour operation. **Table 2-6: Indicative Construction Programme** below shows an indicative

programme of the Construction Phase for the main components. This will be updated in consultation with the Construction Contractor but reflects a reasonable “worst case” duration.

Table 2-6 Indicative Construction Programme

Phase	Activity	Detail	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Pre-Construction and Enabling Phase	General Mobilisation																																	
	Existing Access Improvements	FLS Track (Site Entrance) including realignment of the Affric Kintail Core Path																																
	Main Access Tunnel																																	
	River Coiltie Area	Set up of temporary construction compounds (including workers accommodation), construction of permanent access tracks and associated watercourse crossings.																																
Construction	Access	Site-wide access tracks																																
	Headpond	Site Clearance																																
		Headpond formation and stabilisation works																																
		Main Dam																																
		Saddle Dam 1																																
		Saddle Dam 2																																
		Spillway construction																																
	Tailpond	Preparatory works including access from A82, cofferdam and working platform set up, dredging and removal of soft material and creating a pump sump and pumping station																																
		Excavation and A82 stabilisation work																																
		Creating a hard standing area between the cofferdam and LCW																																
		Excavation bifurcation tunnels																																
		Outlet structures																																
		Installation of Smolt Screen																																
	Tunnelling works	Cable Tunnels																																

Phase	Activity	Detail	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
		Headrace Tunnel (low pressure)																																
		Headrace Tunnel (high pressure)																																
		Tailrace Tunnel (low pressure)																																
	(GIS Switchyard																																	
	Power Cavern Complex																																	
Commissioning		Equipment Installation and Commissioning																																
		First Power																																

2.15 Pre-Construction and Enabling Phase

2.15.1 A Pre-Construction Phase and Enabling Phase is envisaged prior to the commencement of the main works to allow the main works period to be as short as reasonably possible thus helping to minimise disruption.

2.15.2 The Pre-Construction and Enabling Phase incorporates the following activities:

- Access improvements at Site Entrance on the existing FLS track;
- Site clearance within the River Coiltie Area;
- Compound (TC01, TC02, TC03, TC05 and TC06) set up within the River Coiltie Area, including the TC05 (Temporary Workers Accommodation;
- Establishment of borrow pit on access track;
- Construction of new access track from existing FLS track to the Main Access Tunnel Portal;
- Temporary Core Path Diversion; and,
- Construction of the Main Access Tunnel.

2.15.3 Summary details are provided in the following sections.

Site Clearance

2.15.4 Prior to the commencement of works, vegetation will be cleared, including tree felling where necessary. Trees will be retained wherever possible. To facilitate this, the Proposed Development Site will be surveyed to determine the extent of forestry removal.

2.15.5 Tree felling will be conducted in accordance with the measures outlined in **Chapter 18: Forestry (Volume 2: Main Report)** with the timber removed from the Proposed Development Site. Should temporary timber storage be required, this will be located within the Construction Compounds. Generally, the tree stumps will then be removed and shredded on-site along with any remaining brash wood. This processed material will also be removed from the Proposed Development Site.

2.15.6 Once trees and other vegetation are removed, soil will be excavated in a sequential manner. Turves, topsoil and subsoil will be excavated as required and stored individually. Stockpiles of soil will be compacted and sealed in accordance with good practice.

Compound Set Up

2.15.7 The topsoil that has been excavated will be temporarily stored nearby so that it can be reused to dress off the Construction Compound areas post-construction. Vegetation will be preserved, where practicable, to assist post-construction restoration. The Construction Compounds will be constructed with material won on-site.

2.15.8 A key compound to be established in this stage is the Temporary Workers Accommodation (TC05). This will be cleared, levelled and constructed in stages throughout the construction programme as the number of workers required on site increases.

Borrow Pit Search Areas

2.15.9 To minimise the requirement to import material at the start of Construction, material will be won on-site through the establishment of new Borrow Pit Search Areas (BP01) or the re-opening of existing borrow pits (BP02).

2.15.10 Material from the Borrow Pit Search Areas is anticipated to be predominantly used for the construction of compounds and access tracks.

Access Tracks including Core Path Realignment

2.15.11 Access to the Proposed Development Site will be via Balnain along the existing FLS forestry track. This will be required to be upgraded in areas to accommodate construction vehicles. Prior to upgrade, to ensure continuous access to the Affric Kintail Core Path, this will be realigned as shown on **Figure 2.30: Temporary Core Path Diversion (Volume 3: Figures).**

2.15.12 From the existing FLS track, construction of a new access track to the Main Access Tunnel Portal compound (PC07) will be required. Once the required areas are cleared, the route of the permanent Access Track will be marked out and the ground prepared. Drainage will be installed along the full length of the Access Tracks before stone is placed and covered with a base and wearing course. The temporary and permanent Access Tracks will generally be left unsealed during Construction. This section of Access Track will be excavated as shown on **Figure 2.3: Above Ground Infrastructure (Volume 3: Figures).**

2.15.13 Temporary and permanent Access Tracks will generally require a construction corridor approximately 30 m in width, occasionally wider for lay-byes and embankment/cut sections. New and upgraded watercourse crossings will be required along these sections of Access Tracks. Details can be found within **Section 2.7: Description of the Permanent and Temporary Access**.

2.15.14 The majority of the material for the Access Tracks is anticipated to be generated within the Proposed Development Site. This will be from re-opening / expanding existing borrow pits within the area in the first instance. There may be a need for materials to be sourced or imported from a nearby borrow pit depending on the finalised construction programme determined by the Construction Contractor, but this is considered unlikely.

2.15.15 Should ancillary temporary tracks be required, those not already established or those requiring upgrading will be made up of bog mats or trackway systems. These alternate road construction materials will be employed where the ground may be saturated. Floating road construction may be employed if longer construction durations are necessary.

Main Access Tunnel

2.15.16 Prior to the tunnelling works, the tunnel portal areas will be excavated and prepared for the drilling equipment. This operation will involve localised breaking, excavating and rock stabilisation. The tunnel portal compound will also require parking and a plant and equipment laydown / storage area.

2.15.17 The Main Access Tunnel portal and Main Access Tunnel will be one of the first components to start being constructed. The starting point for the Main Access Tunnel is from PC08. The construction method for the Main Access Tunnel is anticipated to be by a conventional drill and blast method. It is noted that there is likely to be some inter-action between the Main Access Tunnel and the construction of Cable Tunnels, in which case the proportion of each that will be constructed in this phase may vary and will be determined on appointment of the Construction Contractor.

2.15.18 The drill and blast tunnelling technique involves drilling holes on the desired rock face before loading a series of explosives in the holes to break up the rock. Following the blasting of the rock, the face is then ventilated and mucked out to remove loose material. This material will then be transported to the tunnel portal for intended re-use. The tunnel excavation will then generally have a shotcrete Main Access liner installed to stabilise the excavated area. Following the securing of the excavation, a new set of holes will be drilled and the cycle repeated until the desired length of tunnels is reached. Rock bolting of the area around the tunnel will follow some way behind the tunnel face.

2.15.19 It is anticipated that the underground tunnelling will be a 24-hour operation. The anticipated blast cycle is likely to be two blasts per 24 hours.

2.15.20 The geology along the route of the tunnels is currently unproven and will require further site investigation works to confirm the rock types and properties in more detail.

Sustainable Drainage Systems (SuDS)

2.15.21 During the Pre-Construction and Enabling Phase, on-site SuDS will be implemented in accordance with good practice along Access Tracks and within the vicinity of the River Coiltie. Additional SuDS required for the Construction Phase will also be necessary within the wider construction area. This is anticipated to include, but is not limited to:

- SuDS ponds/settlement lagoons;
- Temporary ditches;
- Silt fences;
- Silt busters;

- Dewatering / sediment bags;
- Silt curtains; and,
- Designated bunded fuelling areas.

2.15.22 There will be SuDS along all of the Access Tracks including downslope silt fences and temporary ditches.

2.15.23 Further details on proposed extent, positions, size and filtration methods that will be used are available within **Appendix 10.4: Outline Water Management Plan (Volume 5: Appendices)**.

2.16 Construction Phase

2.16.1 The Construction Phase will follow the Pre-Construction and Enabling Phase and incorporates:

- Access tracks;
- Public path diversions;
- Headpond (including Borrow Pit Search Area as necessary);
- LCW;
- Dry Tunnelling works;
- Wet Tunnelling works;
- GIS Switchyard;
- Power Cavern Complex; and,
- Electro-mechanical and ancillary equipment installation and commissioning.

2.16.2 Final design of all components will be confirmed at the detailed design stage. The details set out below focus on the major components of the project and are indicative in nature and will be refined.

Access Tracks

Construction

2.16.3 Construction methodology of the temporary and permanent Access Tracks will be as set out within **Section 2.15: Pre-Construction and Enabling Phase**. Access track and Core Path details can be found on **Figure 2.3: Above Ground Infrastructure, Figure 2.30: Temporary Core Path Diversion** and **Figure 2.31: Excavated Access Track Detail (Volume 3: Figures).**

Maintenance

2.16.4 During the Construction Phase, the temporary and permanent Access Tracks will require occasional maintenance. With the proposed construction traffic and the duration of usage, it is anticipated that local resurfacing and maintenance, such as the filling of potholes, will be required. In the worst case, there may be sections that will need to be re-constructed from the subgrade level.

2.16.5 The SuDS associated with the Access Tracks will be inspected and maintained on a regular basis and settlement ponds, silt fences and ditches will be monitored and cleaned when required. Details on SuDS are within **Section 2.15: Pre-Construction and Enabling Phase.**

Public Path Diversions

2.16.6 During the Construction Phase, temporary diversions for the following core paths will be implemented:

- Core Path IN13.02 Cnoc a Bhuachaille;
- Core Path IN13.01 Drumnadrochit to Balnain; and,
- Coiltie Loop Trail.

2.16.7 The proposed diversion routes for these paths are available to view in **Appendix 16.1: Outline Access Management Plan (Volume 5: Appendices).** The path diversions will be constructed using material sourced from the on-site Borrow Pit Search Area.

2.16.8 Recreational users on the Coiltie loop will also be diverted to follow a diversion along the existing section of Core Path IN13.02, which extends across commercial forestry land. Please refer to **Figure 2.30: Temporary Core Path Diversion (Volume 3: Figures).**

2.16.9 Path closures will be advertised locally as well as being announced by signage at route ends. Crossings will be provided at designated points and will be managed to ensure public safety. Details of crossing locations and management are specified in **Appendix 16.1: Outline Access Management Plan (Volume 5: Appendices).**

Headpond

Borrow Pit Search Area

2.16.10 One Borrow Pit Search Area (BP01) will be created within the Headpond to win material and minimise the requirement to import material at the start of Construction. Material from the Borrow Pit Search Area is anticipated to be used for the construction of the Headpond embankments (Main Dam, Saddle Dam 1 and Saddle Dam 2) and Construction Compounds. Access to the Borrow Pit Search Area will be via the Access Road and other permanent access roads around the Headpond. Exact location of entry to the Borrow Pit Search Area will be determined during the detailed design stage.

Construction sequencing

2.16.11 The material available from excavations required to construct the UCW and underground works is insufficient to meet overall requirements for the dams and it is therefore expected that the Borrow Pit Search Area at the Headpond site will be used to balance earthworks sequencing requirements.

Main Dam

2.16.12 A concrete faced rockfill dam (CFRD) design has been selected as the preferred dam type for Main Dam, Saddle Dam 1 and Saddle Dam 2. There are four principal elements relating to the construction of the Main Dam as follows: the diversion of the existing watercourse though the footprint of the dam so that works can take place in the dry; the preparation of the dam foundation; the placing of the dam rockfill material and the construction of the concrete face. These are expanded in the following section.

2.16.13 The typical sequence of works to construct the dam is as follows:

- Provide access ways for construction;
- Strip superficial deposits from the footprint of the dam and working area;
- Construction of diversion culvert and associated catchwater bunds. The existing watercourse is modest, and diversion culvert would be built off the line of this water course. Once the culvert is completed flow will be diverted through it;
- Excavate foundation for toe plinth;
- Profiling works, slush grouting and concrete to formation level of plinth;
- Construction of toe plinth;
- Grouting works to toe plinth;
- Placement of fill to the embankment. This will commence in at the lowest point and be brought up in horizontal layers across the entire cross section until crest elevation is reached;
- Construct upstream concrete face; and,
- Crest works and wave wall.

2.16.14 Once the dam is completed and impoundment is ready to commence the upstream entrance of the culvert will be plugged and converted to a low-level outlet by the provision of internal pipework which will be utilised during the operation of the dam to provide compensation flow, drain the reservoir and aid in removal of sediments. Access to compensation and scour valves will be from a small Valve House at the downstream toe of the dam. A small bunded impoundment will be constructed downstream of the Valve House to control water released from the Headpond during testing of the scour valve.

Saddle Dams 1 & 2

2.16.15 The construction sequence of Saddle Dam 1 and Saddle Dam 2 will be very similar to the Main Dam, with the exception of the stream diversion works and valving, and typically follow the sequence as outlined below:

- Provide access ways for construction;
- Strip superficial deposits from the footprint of the dam and working area;
- Establish catchwater bunds for interception and diversion of surface water runoff;
- Excavate foundation for toe plinth;
- Profiling works, slush grouting and concrete to formation level of plinth;
- Construction of toe plinth;
- Grouting works to toe plinth;
- Placement of fill to the embankment will commence at the lowest point and be brought up in horizontal layers across the entire cross section until crest elevation is reached;
- Upstream concrete face slab; and
- Crest works and wave wall.

2.16.16 The existing ground levels at these structures are circa 498 m AOD, the existing Loch top water level is approximately 482 m AOD. The upstream toe of Saddle Dam 1 is some 400 m offset from the edge of the existing Loch whereas Saddle Dam 2 is approximately 170 m from the edge. At this initial stage it is inferred that the foundation works for these dams could progress without significant interaction with the Loch and no water course diversion works would be required to enable construction.

Spillway

2.16.17 The Spillway will be made from reinforced concrete cast in-situ.

2.16.18 It is proposed to construct the Spillway in the natural saddle between the ridges of Meall Fuar-mhonaidh and Nighean a' Mhill to the northeast of the existing Loch.

2.16.19 In order to restrict discharge due to flooding in accordance with SEPA guidance, the level of the Spillway has been set to be above that of the 1 in 200 plus climate change flood. The Spillway has therefore been set to a level of 518.4 m AOD. Please refer to **Chapter 11: Water Resources and Flood Risk (Volume: 2 Main Report)**.

Excavation Works

2.16.20 Under the footprint of each dam there is a requirement to excavate any compressible layer of peat to expose the underlying rock. An overpall average 2 m thickness of peat is assumed, based on results of the available peat probing. The proposed geophysical survey shall provide a greater understanding of peat thickness and also that of any extremely weathered rock. The dams are predominately underlain by Psammite, although Saddle Dam 2 is also underlain by Sandstone and the F1A fault which delineates the two rock groups. The Psammite and Sandstone will typically provide a competent foundation, but weathered and brecciated material may need to be removed.

2.16.21 The toe plinth is ideally to be founded on hard, non-erodible sound rock which can be grouted. It is possible for the toe plinth to be founded on less competent deposits and exact details will be dependent upon further ground investigation. The aim is to eliminate the possibility of erosion in the foundation. Careful excavation is required to minimise fracturing of the rock surface on which the toe plinth is placed.

2.16.22 The excavated peat and any other material not suitable for incorporation into the dams will be stockpiled and used to form landscaped areas and to infill/restore the Borrow Pit Search Areas. The design of the Headpond means that the excavations in the Headpond and the construction of the dams can be sequenced together. Where possible, material excavated from the Headpond will be used to construct the Embankment. Due to the size of the excavation and the material anticipated to be handled, the Headpond works will be constructed under the Quarries Regulations 1999[5] and Explosives Regulations 2014 (as amended)[6].

Slush Grout and Grouting

2.16.23 Slush grout is a neat cement grout or sand-cement slurry that will need to be applied to any cracks identified under the dam foundations, particularly its upstream shoulder and along the line of the toe plinth.

2.16.24 Typically, a grout curtain is provided underneath the upstream toe plinth of a CFRD dam to reduce hydraulic gradients to acceptable levels, the extent of which is dependent on the quality of the bedrock. It consists of a

[5] https://www.legislation.gov.uk/uksi/1999/2024/contents/made
[6] https://www.legislation.gov.uk/uksi/2014/1638/contents

single row of grout holes which are drilled and grouted to the base of the permeable rock, or to such depths that acceptable hydraulic gradients are achieved.

2.16.25 The required grout holes would be drilled and grouted in sequence to allow testing of the foundation. Typically, Main Access holes will be drilled first at 3 m centres to a depth of 2/3 stored water height but not less than 10 m. Depending on grout takes a row of secondary holes will then be drilled, at 3 m centres but staggered to the Main Access holes. Tertiary holes will be drilled as appropriate. The final grout hole spacing will likely be in the order of 1.5 m to 3 m.

2.16.26 Consolidation or 'blanket' grouting of the upper layer of more fractured rock will be required upstream and downstream of the grout curtain. The blanket grouting should be carried to depths sufficient to penetrate any surface zone of open fissures or higher permeability (typically the upper 5 to 15 m).

2.16.27 The results of the proposed site investigation and seepage analysis shall be to be used to inform the extent of grouting required.

Toe Plinth

2.16.28 It is important that the plinth is not subjected to abrupt changes in level or direction and, in isolated areas, where the foundation is low, backfill concrete will be placed to achieve a uniform foundation surface profile for the plinth.

2.16.29 The stability of the plinth is essential, and the plinth will be designed to be stable against sliding and overturning. Ground anchors may be required to pin the concrete to the rock, assuring good contact with the foundation and not to resist any given uplift loads.

Face Slab

2.16.30 The Main Access water barrier of the CFRD consists of a concrete face slab cast in situ on the underlying rockfill of the dam. The face slab is fully supported by the underlying rockfill.

2.16.31 The face slabs are supported by well compacted and well graded layers of crushed rock that provides continuous support under reservoir loading. In the Proposed Development:

- A constant slab thickness of 0.3 m has been adopted for the Main Dam; and,
- A constant face slab thickness of 0.25 m is to be used for the Saddle Dams.

2.16.32 As the construction of the Dams progresses, the shoulders of the Dams will be dressed off with topsoil that was generated during excavation.

2.16.33 Material that is unable to be used in the Headpond Dams construction will be transported to compounds to be used for reinstatement, dressing and bunding of compounds, or for the GIS Switchyard construction.

2.16.34 A 750 m construction buffer will be imposed due to the presence of breeding birds near Saddle Dam 1 and Saddle Dam 2. All works within the Headpond will be phased accordingly to the buffer zone.

Upper Control Works

2.16.35 The inlet/outlet diffusers are designed to manage the flow of water entering the Headrace Tunnels in the generating mode and diverging the flow into the upper reservoir in the pumping mode. To ensure optimal hydraulic performance, it is standard practice to incorporate a vaned diffuser. These vanes not only enhance hydraulic efficiency but also provide structural support to the roof of the diffuser and the coarse screens positioned at the diffuser's inlet/outlet.

2.16.36 The construction of the entire UCW structure is planned to be completed without drawing down Loch nam Breac Dearga.

2.16.37 The approach channel to the UCW is approximately 300 m long and 200 m wide. An initial section, approximately 25m in length will be excavated into Loch nam Breac Dearga.

2.16.38 The depth of the channel excavation will vary significantly, ranging from around 10 m near the existing Loch nam Breac Dearga edge to approximately 50 m at the end of the channel, where the inlet/outlet structures will be located.

2.16.39 The initial section, approximately 50 m from Loch Nam Breac Dearga, will be excavated to maintain the invert level at 475 m AOD. The rest of the channel will be excavated with a maximum slope of 12% to accommodate

maintenance vehicle access in the future. The final section will be excavated flat with 458 m AOD in the area where the inlet/outlet structures will be founded.

2.16.40 It is proposed to construct the initial section of the Headrace Tunnel section using cut and cover construction, with a 1 m thick concrete lining and compacted backfill up to 475.5 m AOD. Beyond this section towards the powerhouse, there will be sufficient overburden for tunnel construction using drill and blast methods.

2.16.41 Approximately 2Mm³ of excavated material from the UCW excavation will be available for constructing the dams at the headpond.

Tailpond

Lower Control Works

2.16.42 Located on the western shore of Loch Ness, the LCW for the Proposed Development comprise the intake-outlet structures between the Tailrace Tunnels and the Tailpond (Loch Ness), a Smolt Screen and an access road from the A82.

2.16.43 The presence of the A82 constrains the Site, limiting the width of foreshore to around 25 m. Above and below the A82 the ground continues to rise and fall steeply at a gradient of around 1:2. Available construction space is further limited by the need to minimise the loss of ancient woodland and the requirement to mitigate the potentially adverse visual impact of the LCW platform on the surrounding landscape.

2.16.44 Achieving adequate submergence necessitates founding the intake-outlet structure at a depth of around -6.0 m AOD; approximately 24 m below the proposed LCW platform level of 18.5 m AOD. The temporary works considered most appropriate for constructing a structure at this depth is a cofferdam with curved faces.

Construction Sequencing

2.16.45 The final arrangement is subject to detailed design, but the following outlined construction sequence has been developed specifically for an arched retaining wall, supported off abutments located either side of the intake-outlet structure for the LCW platform:

- Construct a retaining wall to the rear platform down to the 18 m AOD level. Create a level platform at the 18 m AOD level along the foreshore. Pre-bore the ground at the locations where steel sheet piling is required. Install the steel sheet piling for the abutments and the arched cofferdam. Construct the lower and upper concrete diaphragms within the abutments;
- Construct the upper waling to the rear of the arch and concrete in place the toes of the piles for the arched cofferdam;
- Dewater the excavation and excavate down to the 9 m AOD level. Construct the lower waling to the rear of the arch and carry out initial ground treatment and install sump pumps;
- Construct the ring beam and form the shaft for the intake-outlet structure;
- Construct the lower part of the intake-outlet structure up the 9 m AOD level;
- Backfill the lower part of the intake-outlet structure up the 9 m AOD level;
- Construct the upper part of the intake-outlet structure above the 9 m AOD level and the wing walls tying in the intake-outlet structure to the adjacent sheet pile abutments; and,
- Backfill the upper part of the intake-outlet structure up to the 18.5 m AOD level. Flood the excavation in front of the intake-outlet structure and remove the temporary works.

Access Road

2.16.46 The proposed access is a private, gated road, approximately 200m in length from the A82 to the interface with the LCW platform. The road ties into the LCW platform at an elevation of 18.5 m AOD with a maximum vertical gradient of approximately 6.3% and will be supported by a landscape embankment where required. However, for up to 70 m length of the road, a bridge structure will be required. The overall requirements and design of this will be undertaken in the detailed design stage.

Dry Tunnelling Works

2.16.47 As set out in **Section 2.15: Pre-Construction and Enabling Phase** the Main Access Tunnel will be one of the first components to start being constructed during the Pre-Construction and Enabling Phase.

2.16.48 During the Construction Phase, the remaining dry tunnels will be constructed (as listed within **Section 2.10 Description of the Dry Tunnels**) and any finishing works to the Main Access Tunnel completed. The method of construction will be as described in **Section 2.15: Pre-Construction and Enabling Phase, sub-section: Main Access Tunnel** by means of excavation using the drill and blast method. The geology along the route of the tunnels is still to be finally confirmed and will require further site investigation works to determine the rock types in more detail.

2.16.49 Prior to the tunnelling works, the tunnel portal areas will be excavated and prepared for the drilling equipment. This operation will involve localised breaking, excavating and rock stabilisation.

2.16.50 It is anticipated that the underground tunnelling will be a 24-hour operation.

2.16.51 Should cross adits be preferred by the Construction Contractor, these will be constructed between parallel tunnels using drill and blast methodology as set out in **Section 2.10 Description of Dry Tunnels**.

Ventilation Shaft

2.16.52 The Ventilation Shaft connects the Power Cavern Complex to the ground level to provide the means of transferring heat generated in the Power Cavern Complex to the atmosphere (surface level). It is expected that the shaft will be constructed by the raise boring technique from PC14 at surface level. The material that is generated from the construction of the Ventilation Shaft will be transported to the Main Access Tunnel poral for re-use unless it can be included in the batching process for tunnel lining concrete.

Wet Tunnelling (Waterways) Works

2.16.53 As there are effectively two almost identical Waterways only one will be described in the following sections. Each Waterway is divided into three main parts, the low-pressure headrace, the Pressure Shaft and The Tailrace. The entire Waterway will be lined with concrete with the highest pressure section from the bottom of the Pressure Shaft to the Power Cavern Complex also lined with steel. A cross section of the underground features can be seen in **Figure 2.8: Development Cross-Section (Volume 3: Figures).**

2.16.54 Prior to the commencement of tunnelling from the UCW for the low-pressure Headrace Tunnels, the tunnel portal area will be excavated and prepared to provide a suitable surface for drill and blast to take place. The low-pressure Tailrace Tunnels will be constructed from the power cavern via a short by-pass tunnel to allow spoil removal via the Dry Tunnels to avoid spoil arising at Loch Ness.

Pressure Shaft

2.16.55 The Pressure Shaft is the vertical component of the scheme and connects the low-pressure and high-pressure sections of the headrace. It is expected that the shaft will be constructed by the raise boring technique from the valve cavern positioned at the top of the shaft. The material that is generated from the construction will be transported to the Main Access Tunnel portal for re-use unless it can be included in the batching process for tunnel lining concrete.

Surge Tanks / Chambers

2.16.56 Unlike the Pressure Shaft, the Surge Tanks / Chambers do not extend to the surface, as such it will be excavated using a drill and blast method. It will be built adjacent to the Power Cavern Complex within the Tailrace section of the Waterway tunnel.

Power Cavern Complex

2.16.57 The Power Cavern Complex consists of the Power Cavern and the Transformer Cavern, connected by galleries. The Power Cavern Complex will be accessed from PC07 via the Main Access Tunnel, from PC08 via Cable Tunnel 1 and also via Cable Tunnel 2. A number of ancillary tunnels will also be connected to facilitate construction and ventilation.

2.16.58 The Power Cavern Complex will be excavated using conventional drill and blast methods. The main power cavern will be excavated from the top down.

2.16.59 The blasting will be carried out in a controlled sequence in accordance with a blast plan. The rate of blasting is dependent on the rock type, space, and orientation of excavation. However, it has been assumed that around four blasts could occur per day, assuming 24 hour working. If required, following blasting, there may be some localised scaling. This will be carried out by hydraulic breaking equipment and will ensure the size, shape and

position of the excavation is correct. Once it is safe to do so, the rubble that is produced from the blasting will be removed. Excavated material will be transported to the surface by conveyors or dump trucks via the dry tunnels.

2.16.60 Exposed rock within the Power Cavern Complex will likely be lined, as a minimum, with reinforced shotcrete with ground anchors drilled in to support the roof and walls as necessary.

2.16.61 To fully form the Power Cavern Complex, horizontal galleries will be excavated, using conventional drill and blast methods, to connect the Power Cavern and the Transformer Cavern.

2.16.62 Mechanical lifting (overhead gantry cranes) and operating equipment will be installed in the Power Cavern Complex. These will be used for the installation of the pump-turbines and associated mechanical equipment. Temporary cranes will also be used during equipment installation.

2.16.63 The draft tubes, draft tube gates and the pump-turbines will be delivered through the Main Access Tunnel to the Power Cavern where they will be lifted and installed in sections.

2.16.64 The generators / motors will be fitted on top of the turbines and connected to the turbine shaft. The transformers and associated electrical cabling will be installed connecting to and in the transformer cavern. The high voltage cable circuits will be installed through the Cable Tunnels to connect the HV transformers to the GIS Switchyard at the surface.

2.16.65 Multiple ancillary systems will be installed in the Power Cavern Complex to allow safe operation.

Valve Cavern

2.16.66 The Valve Cavern will be accessed from PC15 via the Valve Cavern Access Tunnel. The cavern will be excavated following the same methodology set out for the Power Cavern Complex construction

GIS Switchyard and Grid Connection

2.16.67 The switching station will have two parts, being that constructed as part of the Proposed Development and that constructed by the TSO. The latter will be subject to a separate application, but space will be allocated as part of the Proposed Development. The construction of the GIS Switchyard will take place in three main sections, these are: the ground works, the GIS switch station building, and the installation of the GIS switchyard.

2.16.68 The ground works will involve the preparation of the ground to be suitable for the required electrical equipment. The infrastructure for the switching station building will consist of the erection of the permanent welfare facilities, in addition to the switchyard control and metering room.

2.16.69 The GIS Switchyard section will be built following the completion of the switch station building, and the ground works, and will involve the installation of the required 400kV electrical equipment.

2.16.70 The export cables from the transformers, will be routed along Cable Tunnel 1 and Cable Tunnel 2 to bring the cables to surface level. Once at surface level, the cables will be installed in cable trenches or ducts. The trenches or ducts will likely run parallel to the access tracks and terminate at the GIS Switchyard, where they will connect into the operator side of the GIS Switchyard.

Equipment Installation and Commissioning

2.16.71 The Proposed Development will be commissioned in stages commencing with a period of “dry commissioning”. During this period the Proposed Development components such as dam leakage control, valves, motors, pumps, screens, stop-logs, gates, and electrical control systems will be tested for functionality. Construction of elements which are not operation critical will be ongoing in other parts of the site during the dry commissioning stage.

2.16.72 Once dry commissioning is complete, the existing water within the Headpond will be used to facilitate wet commissioning. The Headpond will already contain sufficient water from its natural state to enable this process; however, if required, temporary pumping from Loch Ness may be used to supplement water levels and support commissioning activities.

2.16.73 Once the Headpond contains sufficient water, the “wet commissioning” of the mechanical and electrical equipment can take place. This, together with the sufficient commissioning of the grid connection will allow the Proposed Development to operate, initially in a reduced capacity and then incrementally increasing until full functionality testing can occur at full operating capacity for pumping and generating electricity.

2.17 Operational Phase

Operational Lifetime

2.17.1 It is expected that the civil works (dams, dry tunnels, shafts, caverns and inlet / outlets structures) will, with periodic maintenance and repair, have an operational life of approximately 125 years. However, throughout this period it is expected that the mechanical/electrical plant will require refurbishment or major overhaul every 15 to 30 years, depending on component.

Maintenance Requirements

2.17.2 Once commissioned, PSH schemes typically require relatively little maintenance. Further details on the expected maintenance requirements and inspections of the Proposed Development are set out in **Table 2-7: Likely Maintenance Requirements**, below.

Table 2-7 Likely Maintenance Requirements

Component	Objectives	Inspections Carried out by	Frequency
Headpond (Embankment)	Examine the critical safety features including, Embankment structure, Spillway, screens and scour arrangements, the condition of the major elements and the operating records.	A qualified third-party Panel Engineer, Supervising Engineer and / or the Operator	• Routine and Surveillance (Operator) – Minimum once or twice weekly. • Inspection (Supervising Engineer) – Annually. Inspection (Inspecting Engineer) – at a minimum of every 2 years.
Access Tunnels	Tunnel inspection, maintenance, and performance	Operator	10 years
Pump / Turbines and Generators	Reliable operation of equipment in the service environment – achieved through planned, periodic inspection and checking of components and systems, together with replacement or rectification of parts wherever required. Maximum availability of equipment and a minimum of unplanned shut-downs by using planned / periodic shutdowns to inspect all equipment	Operator / turbine supplier	As recommended by the manufacturer, likely to be daily, weekly, monthly and quarterly checks as per the maintenance schedules, with major refurbishment works not expected more frequently than five year intervals.
UCW and LCW Structure Screen	Maintain operation of UCW and LCW. Cleaning screen. Inspecting structure. Replacing screen.	Operator	• Routine cleaning of the screen – Maximum weekly. • Full Inspection – 10 years. Replacing Screen – 20 years.
Access Tracks	General maintenance, ensure fit for purpose and replacing	Operator	General Maintenance - Annually
GIS Switchyard	General maintenance, servicing, replacing	Operator / DNO	• Routine and Surveillance (Operator) – Minimum once or twice weekly. • Inspection – Annually. Major Service – 20 years.

Operational Workforce

2.17.3 After the initial Construction of the Development, it is estimated that there will be a gross number of 42 direct permanent jobs generated by the Proposed Development, all of which will be within The Highland Council area, plus external contractors from time to time.

Operational Environmental Management

2.17.4 The Proposed Development will be subject to an Environmental Policy / Environmental Management System (EMS) that will require regular monitoring and auditing.

Operational Lighting Requirements

2.17.5 There will be internal lighting provided within: the Valve House at the Main Dam, the Valve Cavern, the GIS Switchyard, the Access Tunnels and the Power Cavern Complex. Further to this, external lighting is required at the GIS Switchyard and Tunnel Portals. Hazard warning lights will be provided at the LCW.

Operational Discharges and Abstractions

2.17.6 Once the Proposed Development is fully commissioned, the working water volume will be able to pass between the Headpond and Loch Ness in order to store electricity when it is available and generate electricity when it is required. It will also provide other services that the grid may require from time to time.

2.17.7 The outflow during generation at the Tailpond inlet / outlet will be up to 455 cubic metres per second (m^3/s) with a velocity of approximately 0.3 metres per second (m/s) at the Smolt Screen. The inflow during pumping will be up to 407 m^3/s with a velocity of less than 0.3 m/s, at the Tailpond Smolt Screen. It should be noted that a PSH scheme will operate on full or part cycles that are dictated by the energy market so both the duration and quantity of water discharge and abstraction will vary over both the very short and very long term.

2.17.8 An application for a Controlled Activities Regulation (CAR) licence will be made shortly after the submission of the Application. The Applicant has been in consultation with SEPA over the requirement and extent of the CAR licence.

Access Tracks - Operation

2.17.9 The permanent Access Tracks will continue to be maintained after the completion of the Construction Phase. During the Operational Phase, the permanent Access Tracks will comprise a maximum 3.65 m wide road, plus drainage ditches, as shown on **Figure 2.31 Excavated Access Track Detail** and **Figure 2.32 Floating Access Track Detail (Volume 3: Figures).**

2.17.10 The Temporary Access Tracks will be removed and fully reinstated after the completion of the Construction Phase.

2.17.11 The UCW Access Track will be below water level during operation and is only accessible when the Headpond water level is completely drawn down in either an emergency or maintenance scenario. Therefore, this track will be left in situ. Due to degradation resulting from the fluctuation in water levels this access track may need to be reinstated for use.

Public Paths - Operation

2.17.12 During the Operational Phase access to the temporarily diverted core paths will be reinstated or diversions made permanent, depending on the results of consultation with the local community.

2.17.13 The details of the on-site path network during the Operational Phase are set out within **Appendix 16.1: Outline Access Management Plan (Volume 5: Appendices)**.

2.17.14 All access controls will be designed in accordance with British Standard 5709:2018 "*Gaps, Gates and Stiles".*

2.18 Decommissioning Phase

2.18.1 Hydropower assets are very durable and, consequently, it is very rare for large-scale hydro projects to be decommissioned. Rather, they may be refurbished or adapted. However, if decommissioning became necessary, then it is envisaged that at the end of its operational life, the Proposed Development can be decommissioned as follows:

- Water would be drained from the Headpond and released at an agreed rate and timescale through the appropriate licencing regime into Loch Ness;
- The pump turbines and associated mechanical and electrical plant will be removed;

- The Power Cavern Complex will be stripped of equipment and the entrances blocked off;
- The Waterways and tunnel portal entrances will be blocked off with local spoil;
- The Tailpond inlet / outlet structure will be permanently blocked and the Smolt Screen removed;
- The GIS Switchyard will be removed and the compound reinstated;
- To prevent any incident with the Headpond filling up, the scour valves will remain open and the Spillway will remain in place;
- The Headpond inlet/outlet structure will be blocked with local spoil material; and,
- Access tracks will remain in place for Estate use.

2.18.2 Under the Reservoirs (Scotland) Act 2011[7], the Headpond does not need to be fully drained, as long as ongoing maintenance is undertaken. However, as noted above amended water levels may be agreed in the event of a suitable ongoing maintenance agreement or the reservoir emptied below minimum dam level. In the latter scenario the final water level is likely to revert to close to the current level of Loch nam Breac Dearga.

2.18.3 Decommissioning Phase effects would be those which would occur as a result of the dismantling and draining of the Proposed Development at the end of its operational life (as outlined above) and would typically be similar to those assessed for Construction but at orders of magnitude less impactful as most of the constructed components (dams, intakes, tunnels and caverns) will be left in place. Any construction type effects will also be of much shorter duration. The Proposed Development has a design life of 125 years but it is anticipated that rather than be decommissioned, its components would be replaced to extend its operational life. Given the lifespan of the Proposed Development, with the effects of decommissioning being similar but extremely diminished in magnitude to that of Construction, decommissioning effects have been scoped out of assessment.

2.19 Construction Plan, Materials, Power and Workforce

Construction Vehicles, Plan and Equipment

2.19.1 The Construction of the Proposed Development will require task-specific vehicles, plant and equipment in addition to general construction equipment. Equipment potentially required on-site includes, but is not limited to:

- Concrete – on site batching plant, concrete mixers, concrete pavers, concrete pumps, concrete wagons, planers;
- Cable reels and cabling equipment;
- Cranes – crawler cranes, dock cranes, gantry cranes, tower cranes and winches;
- Crushers and screening equipment;
- Dozers, grader, pavers, road brush, rollers and sheep foot rollers;
- Drill and blast equipment and hydraulic breakers;
- Excavators, long reach excavators, wheeled and tracked excavators;
- Rigs – grouting rig, loading rig, piling rig, sequential/ impact drill rig;
- Scaffolding, formwork and mobile elevated working platforms (MEWPs);
- Shotcrete spraying machines and rock bolters;
- Silt fence, de-watering pumps, bog mats, low ground pressure (LGP) equipment, wheel wash and dust suppression;
- Site set up equipment such as traffic lights, portable buildings, generators, toilets and temporary utilities (lighting, ventilation, power);
- Transporting equipment – articulated dump trucks, flatbeds, HGVs, HIABs, load haul dumpers, tracked dump trucks, tractors, trailers, tipper wagons, Unimogs and conveyors;
- Tree felling and site clearance equipment such as harvesters, mulchers and logging wagons; and,

[7] https://www.legislation.gov.uk/asp/2011/9/contents

- Vessels for marine works at LCW (including transport) such as jack-up rig, barges and tugs.

2.19.2 Specialised variants of the plant listed above may be required for the construction of specific components of the Proposed Development and the most suitable equipment for the task will be identified.

Materials Management

2.19.3 One of the key design principles for the Proposed Development has been to minimise any surplus or deficit of material by balancing the material that is generated from the cutting, drilling and excavation activities with that required to construct the features of the Proposed Development.

2.19.4 Granular construction materials will preferably be sourced locally from the site. The required materials include rockfill and aggregates for concrete, filters, access road construction and drainage, details of which are outlined below and in **Appendix 15.1: Material Management Appraisal (Volume 5: Appendices)**.

Material Sources

2.19.5 The principal source of material for the three dams will come from either material won from underground excavations (Sandstone, Conglomerate and Psammite) or from the Headpond excavations - the designated borrow area and the UCW (Psammite). Material required for upgrading the access will come from the FLS Borrow Pit and from tunnelling spoil. A summary of material sources is provided below, further details are provided in **Chapter 15: Geology (Volume 2: Main Report).**

Upper control works

2.19.6 The volume of the excavation at the UCW is currently estimated to be in excess of 2.3 Mm^3.

2.19.7 The location of the UCW Option B places it in the Psammite and applying the appropriate bulking factor indicates a potential total volume of available material in excess of 4.0 Mm^3. Due allowance for losses due to excavation, handling, general wastage and compaction have made in supply demand assessment.

Underground works

2.19.8 The material won from underground works including tunnelling and excavation for the power cavern, transformer cavern and the various other shafts and tunnels will be variable in type, size and quality.

2.19.9 The Waterway tunnels are inferred to be in Psammite and Sandstone, which accounting for bulking will generate over 800,000 m^3 of material for Option A. For Option B, the equivalent excavations in Psammite and Sandstone (also accounting for bulking) will generate approximately 1,000,000 m^3.

2.19.10 The dry tunnels are inferred to be in Psammite, which accounting for bulking will generate a total excavated volume in excess of 1 Mm^3 for both Options A and B.

2.19.11 The caverns are inferred to be in Psammite, which accounting for bulking will generate a total volume in excess of 1.1 Mm^3 for both Options A and B.

2.19.12 It is estimated that approximately 3.0 Mm^3 of material will be won from underground excavations for Option A, and 3.2 Mm^3 for Option B.

2.19.13 Based on available data the inferred composition of the material from the underground works will be approximately 70% Psammite and 30% Sandstone. This will be verified by further ground investigation works.

2.19.14 The tunnel excavations are currently assumed to be undertaken by drill and blast methods, producing a variable coarse size range of source rock. While some of this material is expected to be suitable for use in the CFRD dams as excavated, further processing, including crushing and grading, will be required for portions of the rock to meet the final specification for its intended applications.

Borrow Pit Search Area

2.19.15 An area of the site near the right abutment of the Main Dam has been selected as a potential Borrow Pit Search Area. Provisionally a Borrow Pit Search Area that is approximately 20 m deep and 250 x 600 m in plan has been accounted for in the design that will provide approximately 1.30 Mm^3 of excavated volume. The location of the Borrow Pit Search Area places it in the Psammite and applying the appropriate bulking factor indicates a potential total in excess of 2.2 Mm^3. Due allowance for losses due to excavation, handling, general wastage and compaction will need to be made in supply demand assessment.

Available quantities

2.19.16 The large material demand for rockfill should ideally be satisfied from material obtained directly from the excavation while minimising the need for processing. The aim is to produce a well graded rockfill that can be compacted to meet the specification. The size and grading of rock after blasting depends on rock jointing, but can be somewhat controlled by the blasting techniques adopted, charge used, depth, hole diameter and spacing of blast hole, etc. The size and grading achievable will be confirmed by site trials.

2.19.17 It is anticipated that materials generated from drill and blast activities associated with the tunnelling works will be transported by conveyor to the tunnel portals, stored in temporary compounds near the location of tunnelling and transported to the Headpond by dump trucks. The material will be processed and sorted for re-use within the Headpond for the embankment (Main Dam, Saddle Dam 1 and Saddle Dam 2) construction. If material cannot be re-used within the embankments, then other uses will be sought so that only residual material will remain for appropriate disposal, if any remains.

2.19.18 Although the Materials Management Appraisal (MMA) shows an excess volume, it is anticipated that there will be a negligible excess volume of material during construction as the Borrow Pit Search Area will only be excavated on a needs-must basis. While on the Proposed Development Site, should there be excess material, this will be used across the Proposed Development Site for:

- Construction Compounds – reinstatement, dressing and bunding;
- Access tracks – resurfacing of existing surfaces on-site; and,
- GIS Switchyard – use for construction of hardstanding/ internal tracks.

Power

2.19.19 Electrical power will be required on the Proposed Development for various aspects of construction. It may be possible for a temporary connection to be made to the local distribution network. A grid connection would reduce fuel consumption on the Proposed Development Site and reduce noise from on-site generators. However, it is anticipated that this will not be available across the whole Proposed Development Site or for the full duration of Pre-Construction and Enabling and Construction Phases. Therefore, it has been assumed that construction power will be supplied by portable generators fuelled by natural gas or diesel. It is assumed that most of the smaller works, not requiring the use of construction plant or machines, will use portable petrol generators and equipment.

2.19.20 Management measures for the use of generators on-site are set out within **Appendix 3.1: Outline CEMP (Volume 5: Appendices).**

Construction Workforce

2.19.21 The number of construction staff on the Proposed Development Site will vary according to the construction activities being undertaken and will be confirmed by the Construction Contractor upon appointment. These will range from administration and transportation of staff to construction labour and machine operators. It is expected that up to 1,000 personnel will be employed on site during the Construction Phase at its peak. The average number of personnel working on the Proposed Development Site over the construction period will be approximately 500 over a nominal period of 8 years. As this will be subject to the requirements of the Construction Contractor this estimate could change.

2.19.22 Temporary Workers Accommodation (TC05) will be located at NH 45791 26270 to the north of the Proposed Development Site and can be viewed on **Figure 2.28: Temporary Workers Accommodation Plan** and **Figure 2.29 Temporary Workers Accommodation Section (Volume 3: Figures)**. The proposed compound is in a generally flat area, with limited vegetation and positioned to be accessible by the project road network, whilst also being in a discreet location in terms of landscape and visual impacts.

2.19.23 To support up to 1,000 workers, the following have been scoped into the design of the accommodation:

- Accommodation: 1,000 single rooms with individual toilet facilities along with communal laundry facilities;
- Catering and Dining: Catering and dining facilities with a kitchen with necessary storage, freezer, preparation and cleaning amenities;
- Health & Safety: Medical facilities;
- Project Management: Site offices and meeting rooms;

- Utilities: Gas and electric utilities along with potable and wastewater management;
- Parking and Transportation: Coach parking for up to 12 no. coaches and limited individual vehicle parking along with bicycle stores;
- Social and Physical Amenities: Indoor gym, outdoor all-weather sports pitches, hospitality venues and convenience stores;
- Security Infrastructure: Security measures including perimeter controls, access management systems, and CCTV;
- Fire Safety Systems: Fire detection, alarm, and suppression systems;
- Waste Management Facilities: Solid waste handling, sorting, recycling facilities, and hazardous waste management;
- Telecommunications Infrastructure: Internet connectivity, mobile phone coverage, and telecommunications systems;
- Emergency Response Facilities: Emergency response equipment, rescue services, and evacuation protocols;
- Religious or Cultural Facilities: Spaces accommodating diverse religious and cultural needs; and,
- Education or Training Facilities: Facilities for continuing education and workforce training.

2.20 Limits of Deviation

2.20.1 The matter of design uncertainty has been addressed within this EIAR by adopting a precautionary approach to identifying significant environmental effects, through the establishment of a series of maximum development extents known as a ‘Rochdale Envelope’ or design envelope.

2.20.2 The Rochdale Envelope is named after a UK planning law case. It is an established principle that allows a development to be described by broad or alternative parameters. Its adoption allows meaningful EIA to be undertaken by defining a ’realistic worst case’ scenario that decision-makers can consider when determining the acceptability or otherwise of the environmental effects of a proposed development.

2.20.3 The principle is based on the assumption that as long as the technical and engineering parameters of a development fall within the limits of the envelope, and the EIA has considered the likely significant effects of that envelope, then flexibility within those parameters is deemed to be permissible within the terms of any consent granted for the development.

2.20.4 The realistic worst-case scenario reflects the most environmentally detrimental parameter for assessment within the EIA. Where multiple options, or a range, are provided for a parameter it is assumed that one or other of the parameters will have a more significant adverse effect than the alternatives. The realistic worst case can differ depending on the environmental resource or receptor being assessed, and this has been highlighted where relevant.

2.20.5 In line with this approach, a series of parameters have been established across a number of aspects relating to the design and construction of the Proposed Development to manage design uncertainty and provide flexibility for deviation where needed, for example to enable minor design refinements to be made by the Applicant and/ or their appointed Construction Contractor within the overall parameters of any consent granted.

2.20.6 These parameters are presented below and include matters such as defining the maximum extent of land required to mitigate environmental effects, and the identification of horizontal and vertical limits of deviation within which the design of the Proposed Development can be adjusted, if necessary, for example, in response to local ground conditions.

2.20.7 This approach to managing uncertainty within defined parameters and limits ensures that any design changes that may arise post-submission of the Application will not be of an order that results in the significance of effects being greater than those assessed within this EIAR, or which renders the content of this EIAR inadequate or invalid.

Limits of Deviation – Permanent Access Tracks

2.20.8 The Permanent Access Tracks are shown on **Figure 2.31 Excavated Access Track Detail** and **Figure 2.32 Floating Access Track Detail (Volume 3: Figures)**. The existing forestry Access Track from Balnain will be upgraded to up to 10 m wide with an addition of up to 2 m peat / topsoil mounds requiring a total working width of up to 15 m. A new section of Access Track will be required to join the existing forestry track in the area of the River Coiltie. New sections will be either excavated or floating depending on ground conditions. The permanent Access Tracks will partially incorporate the existing forestry road and so it is proposed to apply a 50 m limit of deviation either side of the existing track. This would allow a 100 m buffer for the proposed Permanent Access Track, and allow for micro-siting for local ground conditions, topography, forestry, and watercourses.

Limits of Deviation – Temporary Access Tracks

2.20.9 Temporary Access Tracks will be required during construction as shown on **Figure 2.3 Above Ground Infrastructure (Volume 3: Figures)**. The construction corridor required for Temporary Access Tracks will be a maximum of 10 m wide to allow for two-way vehicular traffic, drainage and peat mounds.

2.20.10 The Temporary Access Tracks will typically be unsealed in nature and will be removed following the completion of the Construction Phase.

2.20.11 The Temporary Access Tracks have been minimised as far as reasonably practicable, and in places follows the routing of informal existing Access Tracks. However, to account for the topography and watercourses it is proposed to have a 15 m buffer either side of the indicative route of the Temporary Access Track. This would allow for a 30 m buffer for the proposed 10 m Access Track.

Limits of Deviation – Temporary Compounds

2.20.12 Temporary Construction Compounds will be required during construction, as shown on **Figure 2.3 Above Ground Infrastructure (Volume 3: Figures).** Compounds vary in dimensions but will consist of material stockpiles, welfare facilities, machine and plant storage and parking. The Temporary Construction compounds will be unsealed in nature with Sustainable Drainage System installed and will be removed following the completion of the Construction Phase.

2.20.13 The Temporary Construction Compounds have been minimised as far as reasonably practicable for a project of this size. However, to account for topography, ground conditions and the variability of the below ground infrastructure arrangement, it is proposed that a limit of deviation of 50 m is applied.

Limits of Deviation – Permanent Compounds

2.20.14 Permanent Compounds will be required during construction, as shown on **Figure 2.3 Above Ground Infrastructure (Volume 3: Figures)**. The Permanent Compounds will be at the Tunnel Portals, Ventilation Shaft, Valve House and Gas Insulated Switchyard. The compounds will have either unbound or bound surfaces and be retained throughout the life of the project.

2.20.15 The Permanent Compounds have been minimised as far as reasonably practicable for a project of this size. However, to account for topography, ground conditions and the variability of the below ground infrastructure arrangement, it is proposed that a limit of deviation of 50 m is applied.

Limits of Deviation – Temporary Core Path Diversion

2.20.16 As described in **Chapter 2: Project and Site Description**, the Construction of the Proposed Development will result in the temporary realignment of Core Paths. The orientation and indicative plan view on **Figure 2.30 Temporary Core Path Diversion (Volume 3: Figures**) which shows the realigned core path being approximately 2 m at its widest point (on the running surface). In order to micro-site the Core Path in response to ground conditions (such as peat) and for detailed design, subject to consultation with FLS, it is proposed that a working width of 50 m is applied to the proposed alignment as a limit of deviation.

Limits of Deviation – Generation and Reuse of Material

2.20.17 The Development will generate in excess of 9,000,000 m³ of material that will be excavated during construction. This material will primarily be used to construct the Headpond Embankments, with a possible excess of excavated

material of up to 3,000,000 m³. It has been recognised that the material generated from the Proposed Development will be excavated using different methods and be sourced from rock of varying characteristics. Therefore, to provide flexibility and allow for any optimisation during detailed design, approximate volumes have been calculated using standard methods, on a reasonable assumption of the likely size required for the infrastructure and then rounded up to the next ten thousand to provide a likely worse case for the purposes of the assessment. This is explained in detail within the **Materials Management Appraisal (Appendix 15.1 Materials Management Appraisal (Volume 5: Appendices))**.

Limits of Deviation – Upper Control Works

2.20.18 As described above, the UCW is where the Waterways exit into the Headpond via the High-Pressure Tunnels. Two options for the UCW are presented due to uncertainties with ground conditions. Following further ground investigations, should ground conditions be suitable Option A would be taken forward, if ground conditions are unsuitable Option B would be progressed. Notwithstanding, within either option, it is proposed that a 200 m micro siting buffer from the current proposed position is applied as a limit of deviation to allow for flexibility with the alignment of the Waterways due to geological uncertainty.

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