4 PROJECT DESCRIPTION

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4.1 Introduction

4.1.1 This chapter provides a description of the Development subject to the DCO application and of its surrounding environment. It also provides an overview of the likely construction methods, the approximate timescale over which various construction activities will take place and an overview of the operational and decommissioning phases of the Development. A description of the generation and placement of excess slate material is also included.

4.1.2 The Chapter is organised as follows:

- Development Description and Summary of Key Development Characteristics – these sections provide a description of the Development for which DCO authorisation is sought.
- Construction, Operation and Decommissioning – these sections provide a description of each phase of the Development's lifetime.

4.1.3 All Figures referred to in this chapter are included in Volume 4 of this ES.

4.2 Development Description

4.2.1 The Development comprises of:

- one headpond (Q1), its dam, access shaft and spillway infrastructure to the Nant Y Betws;
- one tailpond (Q6), its dam, access shaft and spillway infrastructure to Llyn Padarn;
- a pumping station at Llyn Padarn;
- a power house at Glyn Rhonwy Industrial Estate Platform 5 (south of Q6);

- a penstock (connecting Q1 to the power house); and
- a tailrace (connecting the power house to Q6).

4.2.2 Q8 does not form part of the Development but will be in close proximity to the Order Limits. This is shown in Volume 4, Figure 4.1.

4.2.3 Q7 is included within the Order Limits due to some localised reprofiling which may be needed around Q7 for the construction of the Q6 dam and continuation of the existing access road to the upper platforms. A retaining wall will be built to maintain structural integrity for the road. It is proposed not to infill or enter Q7 other than to seal connecting tunnels. It is recognised that there are mature trees with ecological value and trees subject to Tree Preservation Orders (TPOs) within this quarry and so no works are proposed in this quarry.

4.2.4 The Development will be connected to the electricity distribution system network via a new electrical connection. This will be exported from an onsite substation adjacent to the power house to an offsite connection terminating at Pentir. The consenting of the electrical connection is the responsibility of the District Network Operator (SP Manweb) and, as associated development within Wales, it is outside the consenting regime of the Planning Act 2008. SPH has committed to this connection being provided underground and the current grid connection offer being discussed with SP Manweb seeks an underground connection.

4.2.5 The following sections provide a description of the key components of the Development, construction methods and programme. These sections also highlight the status and progress of certain elements of the design including those that are subject to detailed design or those that have a lesser degree of flexibility. Working areas are allocated as per the Works Plans (Document 2.04).

4.2.6 The Development is illustrated on Figures 4.1 to 4.16 within Volume 4, and on the indicative plans, elevations and sections submitted as Documents 2.05 and 2.06. These drawings provide an indication of the Development proposed based on the parameters assessed within this ES.

4.3 Description and Construction of the Reservoirs

Description of the Headpond – Q1

4.3.1 The headpond will be formed at Q1 by the construction of a dam across the south western side of the quarry following excavation, stabilisation and access works to create the operationally safe and functional reservoir containing a working volume of up to 1,300,000m^3 of water.

4.3.2 The dam will have a maximum elevation of 395m AOD, approximately 25m above the existing ground level, and have an impermeable upstream face and a concrete wave wall along the inside crest. The crest will be approximately 4m wide. Additional wave protection will be provided by selected rock armour placed against the upstream slope. The normal maximum operational water level is 392m AOD. The overflow level is 393m AOD which provides up to 1m of freeboard for operating water level fluctuations before any overflow (spilling) would occur. A further 2m of freeboard above the overflow is provided, primarily for wave action.

4.3.3 The outward facing slope of the dam will be faced in slate for landscaping purposes and is likely to have a slope of between 1:1 and 1:2 although this is subject to detailed design and agreement from the Construction Engineer appointed under the Reservoirs Act 1975.

4.3.4 For assessment purposes, a slope of 1:2 has been used in the ES figures and photomontages (Volume 4) and it is considered that any difference in elevation would not affect the impact assessments undertaken. An aerial plan view and an indicative cross section of Q1 dam are provided in Volume 4 of this ES, in Figures 4.2 and 4.3 respectively.

4.3.5 A freestanding combined overflow and relief valve outlet structure (or draw-off tower) will be constructed adjacent to the Q1 dam and within the reservoir. The overflow is provided in case of failure of the pump system or cessation of generation which would result in natural filling of the reservoir. The relief valve outlet (also commonly known as the ‘scour’ within the spillway infrastructure and shown on drawings as such) provides a means

of draining the reservoir to the level of the base of the dam if required in an emergency situation.

4.3.6 The proposed overflow intake is a vertical bellmouth intake structure. The overflow pipes would run under the dam in a tunnel or culvert that would also allow access to open the relief valve for maintenance purposes. This is shown in Figure 4.4 in Volume 4.

4.3.7 The overflow is via an approximately 800mm diameter pipe. The scour pipe is approximately 400mm diameter. These discharge to the watercourse known as Nant y Betws to the south west of the Q1 dam.

4.3.8 The location of the outlet is shown in Figure 4.2. Suitable erosion and energy dissipation measures will be employed at the outlet, as indicatively shown in Figure 4.4. It has been agreed with NRW that this will be a matter for detailed design and therefore is to be agreed though a DCO Requirement.

4.3.9 The Q1 dam will also have a track along the top of the dam which will be used for operational and maintenance access only. Access will be prohibited except for workers at the reservoir. The dam and reservoir area will be fenced off, using post and wire fencing, with a ditch on the inside of the fence line. Locked security gates will be located at the entrance of the access track adjacent to the public road (Green Road).

4.3.10 The track will lead to the dam crest and the penstock inlet / outlet valve shaft and is required for the maintenance of the penstock. The location of the access shaft is shown in Figure 4.2.

Description of the Tailpond – Q6

4.3.11 The tailpond at Q6 will be formed by the construction of a dam across the north eastern end of the existing quarry following excavation, stabilisation and access works to create the operationally safe and functional reservoir. The dam will have a maximum elevation of 156m AOD, approximately 15m above the existing ground level, and a crest width of approximately 4m. Q6 will also hold a working volume of up to 1,300,000m^3 of water.

4.3.12 Additional wave protection will be provided by selected rock armour placed against the upstream slope. The maximum normal operational water level is 154m AOD. The overflow level is 154.5m which provides 0.5m of freeboard for operating water level fluctuations before any overflow (spilling) would occur. A further 1.5m of freeboard (above the overflow) is provided, primarily for wave action.

4.3.13 A plan view and an indicative cross section of Q6 are provided in Figures 4.5 and 4.6 respectively.

4.3.14 A freestanding combined overflow and relief valve outlet structure (or draw-off tower) will be provided within the Q6 reservoir. This would generally operate as per the overflow and relief valve (or 'scour') tower in Q1. The proposed overflow intake is also a vertical bellmouth intake structure. The relief valve outlet or scour pipe also acts as a rising main for water abstraction from Llyn Padarn to Q6. An indicative configuration is shown in Figure 4.7 in Volume 4. The relief valve outlet or scour provides a means of draining the reservoir to the level of the base of the dam if required in an emergency.

4.3.15 The overflow is via an approximately 800mm diameter pipe. The combined scour pipe or rising main is approximately 450mm diameter. These are routed under the dam, around the bombstore (Q8), across the A4086 and discharge to Llyn Padarn. The indicative route of the overflow is shown in Figure 4.1 in Volume 4.

Removal of Water within the Quarries

4.3.16 Both Q1 and Q6 hold water within the existing quarry voids. Bathymetry surveys estimate a depth of 7m in Q1 and 17m in Q6. Water sampling for determining water quality has been undertaken within the quarries and more details are provided in Chapter 9 Water Resources.

4.3.17 Water in Q1 will be pumped out and discharged to Nant Y Betws. If required, the water will be passed through settlement lagoons and / or a 'Siltbuster' (or similar) to minimise the discharge of suspended solids. The

rate and volume of any discharges will be undertaken in line with the required Environmental Permit.

4.3.18 There is approximately up to 100,000m^3 of water within Q6 which will be pumped out to the adjacent Llyn Padarn via a temporary pumping main. If required, the water will be passed through settlement lagoons and if necessary a 'Siltbuster' (or similar) to minimise the discharge of suspended solids. The rate and volume of any discharges will be undertaken in line with the required Environmental Permit.

Excavation of the Quarries

4.3.19 To make the quarries Q1 and Q6 safe and operable as reservoirs, excavation and stabilisation will be required. In addition, lining or sealing around the sides and base of the quarry may be required.

4.3.20 The Q1 cross section (shown in Figure 4.3) shows the existing profile and the proposed area of excavation to provide the required operational water storage volume. Approximately 550,000m^3 will be excavated from Q1, which will mostly be required for the construction of the dam. Unsuitable material will be deposited in excess slate mounds to the south of Q1 (further detail in Section 4.9 below).

4.3.21 The Q6 cross section (shown in Figure 4.6) shows the existing profile and the proposed area of excavation to provide the operational water storage volume. Approximately 360,000m^3 will be excavated from Q6, of which approximately 90,000m^3 will be used within the construction of the dam.

4.3.22 Excavation of both broken (previously disturbed) rock material and in situ bedrock will be required. Bedrock is likely to require excavation by blasting. Blasting is used to both excavate and fragment the rock to allow handling, processing and transport by mechanical plant (excavators, dump trucks, crushers, conveyors).

4.3.23 At Q1, excavated rock material will be treated (crushed and graded) and then transported out of the quarry to either the Q1 dam embankment construction or the excess slate mound area.

4.3.24 At Q6, excavated rock material will be treated (crushed and graded) and then transported out of the quarry to either the Q6 dam construction or transported to Q1 (via the penstock utilising a conveyor system) for placement within the excess slate mounds adjacent to Q1.

Stabilisation Works

4.3.25 The sides of the existing quarries Q1 and Q6 are potentially unstable and require stabilisation to allow the safe construction and operation of the reservoirs. Where rock excavation is required then stable slopes will be formed using controlled blasting, with localised remedial works as required. In other areas, stabilisation works will include the remodelling and reprofiling of the current quarry sides to form stable rock faces, excavation will either be by machinery or by controlled blasting or by a combination of these two methods.

4.3.26 Due to a combination of geological variations (rock material types, bedding, fabric, facture pattern and folding) and previous quarry workings, Q1 will be stabilised by reprofiling on the north western side to a 1:1 slope. The south eastern side is to be retained as far as possible with any loose material removed.

4.3.27 Stabilisation works on the northern side of Q6 may have the potential to infringe on the existing slate mound further to the north of Q6. Detailed site investigation works will confirm if this existing mound is stable and also if any stabilisation works have the potential to affect it. Should stabilisation be required this would be achieved by removing the spoil mound area which could be at risk and temporarily relocating this to another area within the existing slate mound. Once stabilisation works are complete the area will be regraded and landscaped.

4.3.28 Other methods of stabilisation potentially include the following:

- Removal – removal or scaling of individual features;
- Containment – localised containment using rock netting or rock traps (these can be permanent or temporary fences, ditches or stand-offs);

- Strengthening – localised reinforcement using rock anchors, bolts or dowels; and
- Support or protection – localised support using retaining walls, buttresses, sprayed concrete or anchored beams.

Unexploded Ordnance (UXO) & Sediment Remedial Works

4.3.29 There is documented evidence of the lower quarries being used historically for military bomb storage and disposal. The bombstore (Q8) was abandoned after the roof collapsed during World War II, but has been subsequently remediated by the former Welsh Development Agency. There are records of ordnance being disposed of in Q6 and also of a later remediation operation in the 1970s by the Ministry of Defence. However, there is the potential for unexploded ordnance (and also spent ordnance scrap) to be present in and around Q6. As part of the development, a recorded Ordnance Management Strategy will be undertaken in full consultation with the appropriate authorities in relation to any potential unexploded ordnance (UXO).

4.3.30 A UXO report is contained within Appendices 8.5 and 8.6 which provides further details, with an assessment contained within Chapter 8 Geology & Ground Conditions.

4.3.31 Sediment collection from Q1 and Q6 was attempted in May 2015, however, no discernible samples were collected due to the absence of any significant depths of sediment. Once drained, should there be any sediment at the base of the quarries, this will be tested and investigated for UXO and contamination. Depending on the level of potential contamination present or ordnance found, this will be remediated as and if required. It is not proposed to remove any contaminated sediments from the Development.

Quarry Lining Works

4.3.32 The amount of seepage or leakage of water from the sides and base of the quarries due to the natural and induced permeability of the rock mass may be unacceptably high without lining or treatment. In addition, a network of

existing quarry drainage exists from the time of their excavation and this will require sealing.

4.3.33 For the base of the quarries, one of the following two methods is intended to be employed (to be confirmed at detailed design):

1. An impermeable High Density Poly-ethylene (HDPE) liner will be constructed in the base of the quarry. A sub-lining drainage system would be required to collect and discharge any leakage and groundwater. This will comprise of the following elements:
    - Landforming of the base;
    - A sub-lining drainage system;
    - Underlying and overlying regulating layers;
    - Impermeable liner;
    - Overlying protection geotextile fleece; and
    - Cover or protection layers.

    This would prevent uplift pressures occurring during drawdown of the pond in generation and would allow the detection of leakage through the base; or
2. Pressure grouting of the base will be undertaken through boreholes in the base of the quarry. The grout would fill in any fractures within the rock mass and therefore reduce permeability.

4.3.34 It is likely that pressure grouting using cementitous grout will be the most appropriate method for the quarry side slopes. The requirement for side slope grouting will be confirmed by permeability testing following detailed site investigation works as part of the enabling stage.

4.3.35 If required, grout treatment will be in a complete ring around the exterior of the quarry up to the elevation of the Top Water Level (TWL) of the reservoir. Grout will be injected at regular intervals in a controlled pattern as required.

Construction of the Dams

4.3.36 Approximately 550,000m^3 is estimated to be excavated from Q1 and 360,000m^3 from Q6.

4.3.37 The 'rockfill' embankment dams will be formed by rock material excavated from the quarries. Following processing (crushing and grading), rock material will be transported to the dam construction site (via a conveyor system or by vehicles using the internal access tracks). The treated rock material will be placed in the dam embankments in a controlled manner, with compaction in layers to build up the structures as required.

4.3.38 The rockfill will be visible in the 'downstream' face of the dam and will be generally similar in appearance to the existing slate mounds present in and around the development. Excess rock material will be available for additional landscaping works in the areas surrounding the reservoirs.

Dam Footprints

4.3.39 The dams will be founded on sound bedrock. This requires any superficial deposits (expected to be non-existent or minimal) and existing quarry spoil to be removed prior to dam construction. The elevation of the bedrock profile is likely to be variable and will only be confirmed following stripping of the existing quarry spoil. Because of the difference between existing ground level and bedrock level, the roots of the dam will extend underground until they meet bedrock. Ground levels will be restored to at or about the existing ground levels (or as otherwise agreed) around the edges of the dams.

Wave Action and Protection

4.3.40 The dams will have a concrete wave wall running along the crest that the upstream impermeable membrane will be tied into. Depending on the type of impermeable membrane used (i.e. if an HDPE geo-membrane is used), surface protection to the upstream face of the dam may be required through the placement of a layer of selected rock, able to resist wave action. This will be underlain by protective and regulating layers between the membrane and a gradation of materials comprising sand through to crushed rock.

Q1 Outlet Valve Access Shaft, Headworks and Ancillary Works

4.3.41 To isolate the penstock for maintenance, there will be a valve near the outlet from Q1. This will accessed via a shaft adjacent to Q1. This is shown in Figure 4.2. This will incorporate:

- closure valves;
- ventilation pipes – to allow air to be vented or drawn in when filing or emptying the penstock;
- maintenance access for internal inspection;
- level control system which includes a series of water level sensors linked to the pump controls and alarms in the power house control room.

4.3.42 An access shaft and/or tunnel may be required for penstock construction and maintenance to the south west of the power house. This is shown in Figure 4.5.

4.3.43 The headworks at the base of each reservoir provide the outlet and intake from the penstock. The headworks are located in the eastern end of the headpond and will be constructed in a localised sump formed in the base of Q1. It comprises an apron with a stone trap, a reinforced concrete superstructure, a coarse screen (trash screen) and face or sluice gate. The coarse screen is included to ensure that no large debris from Q1 is drawn in to the penstock and therefore through to the turbines. At Q6 this includes facilities for isolating the penstock pipe when required for maintenance.

4.4 Description and Construction of the Penstock and Tailrace

4.4.1 The penstock is a pipe which will convey the flow of water between the headpond and power house (and vice versa). The tailrace (or ‘draft tube’) is a pipe which will convey water from the power house to Q6 (and vice versa). The penstock will include a bifurcation in the approach to the power house, this is shown in Figure 4.5.

4.4.2 The penstock and tailrace will both be excavated using a tunnelling method. The penstock will be up to 4.5m finished internal diameter, which is shown in Figure 4.8.

4.4.3 The plan length of the penstock will be approximately 1600m from its origin at Q1 to the power house, although this may deviate up to a total length of 1800m dependent upon ground conditions. The indicative route is shown in Volume 4, Figure 4.1. An indicative cross section of the depth of the penstock is shown in Figure 4.8.

4.4.4 The outlet from Q1 is at an elevation of approximately 335m AOD (approximately 50m below current ground levels). Where the penstock enters the shaft for the turbine hall at the power house it is at an elevation of approximately 60m AOD (approximately 90m below current ground level) It should be noted that the elevation of the penstock may change underground during detailed design of the scheme dependent on the ground conditions and particular technical requirements, including the pump-turbines selected.

4.4.5 The penstock design, including the precise route, dimensions lining and other matters, is subject to confirmation depending on geology and preferred turbine supplier.

Excavation Method

4.4.6 The proposed tunnelling method is to use either a tunnel boring machine (TBM) or drill and blast methods. Due to information gained from the adjacent Dinorwig pumped storage scheme and the confirmed presence of potentially extensive doleritic intrusions within the bedrock, it is likely to be either drill and blast or a combination of the two approaches. This will be confirmed upon instruction of a Principal Contractor (PC). Other factors such as cost, tunnel length, ground conditions, ease of construction, lining requirements and required shape of the tunnel must be given consideration when eventually deciding upon a tunnelling method.

4.4.7 A TBM is a cylindrical machine with a circular rotating cutter head that uses discs to excavate a circular profile through rock as the machine advances.

4.4.8 Drill and blast methods involve drilling a carefully constructed pattern of holes into the rock which are then filled with explosives. The timing, depth and position of the holes together with the amount and type of explosives, is

designed to form the tunnel with the minimum of overbreak (unwanted excavation). Once detonated, the fractured rock and rubble is removed and the newly formed sides of the tunnel surface are reinforced, potentially including rock bolts or anchors and sprayed concrete. This is repeated until the full length of the tunnel is finished. It is anticipated that progress using this technique could be up to 15m per day in good conditions. Given the potential for complex geology, a figure of 125m per month has been assumed for the preliminary construction programme shown in Table 4-2.

4.4.9 It is proposed that the tunnelling operation would take up to 12 months and will not involve any above ground works along the route between Q1 and Q6. Any ventilation required will be via forced ventilation and would not involve any drilling of vent holes along the penstock route as shown in Volume 4, Figure 4.1.

4.4.10 Depending on the programme requirements for different elements of the construction, tunnelling could be advanced from either Q1 towards the power house or vice versa (or even both).

4.4.11 Once commenced, the drilling activity is likely to be a 24 hour operation but wholly beneath ground level. However, blasting would only occur during the day during the normal working hours outlined in section 4.11.22.

Lining

4.4.12 The penstock and tailrace will require lining to protect their integrity. The inner face of the penstock lining is required to be smooth to prevent friction losses. In addition, a pressure lining is required where the pressure from the head of water exceeds the overburden pressure (the pressure due to rock cover above the penstock) and to protect the penstock against pressure surges (also known as water hammer effects).

4.4.13 A primary lining will be installed following tunnel excavation to provide support to the rock mass and to allow safe installation of the secondary lining. The primary lining is likely to comprise sprayed concrete with rock bolts, a system that can be readily adapted to varying geological conditions encountered in the tunnel. Where pressure lining is not required (see

below), the secondary lining is likely to be a cast in situ reinforced concrete lining (with a smooth internal face).

4.4.14 It is currently anticipated that at least the lower half of the penstock will require pressure lining (a length of approximately 750m) but this may be lesser or greater depending on the detailed design, analysis and ground conditions. Installation of pressure tunnel lining is expensive. It has currently been assumed that the pressure lining will be steel but it may be formed from heavily reinforced cast in situ concrete (with a smooth internal face). The selection of the pressure lining will be based on the technical requirements and economics.

4.5 Description and Construction of the Power House

4.5.1 The power house building is located above ground on Platform 5 of the Glyn Rhonwy Industrial Estate and consists of the following:

Power House Building

4.5.2 The power house is an above ground building with offices, plant hall, crane(s), workshop, welfare facilities and a control room. This building is approximately 15m high to its apex, 60m long and 27m wide. The power house straddles the shaft that contains the turbine hall which houses the turbine-pumps and generators.

4.5.3 It is likely to be faced and roofed in slate, however, final external design and appearance, including building materials and elevation finishes, will be subject to a DCO Requirement.

4.5.4 An indicative plan view is shown in Figure 4.9 with an indicative elevation shown in Figure 4.10.

4.5.5 The construction of the power house building (and the adjacent switchgear building) will follow once the shaft has been completed.

Electrical Substation Building and Transformers

4.5.6 The switchgear building is adjacent to the power house and is again likely to be faced and roofed in slate. The final building materials and finishes will be subject to a DCO Requirement. The switchgear will contain 11kV and

400V electrical distribution equipment and will measure approximately 10m high, 18m wide and 30m long.

4.5.7 SPH are currently in discussions with SP Manweb regarding the exact location, insulation method and size of the GIS substation but the current requirement and offer from SP Manweb is for gas-insulated equipment. This building will be approximately 12m high to apex, 12m wide and 30m long.

4.5.8 The external transformer compound will have provision for a single 11kV/400V transformer and two 11kV/132kV transformers for the 132kV electrical connection. Only the building required to house the substation equipment will be included within and authorised by the DCO.

4.5.9 The current design shows these buildings above ground. However it may be possible that some of this infrastructure is placed underground within the turbine hall or within the power house. Therefore the above ground orientation is shown as the worst case scenario.

Underground Turbine Hall & Access Shaft

4.5.10 The above ground power house covers a shaft and underground turbine hall, which will be up to approximately 90m below the ground level. This is shown in Figure 4.11.

4.5.11 The depth of the turbine hall is nominally determined by the “net positive suction head” (NPSH) of approximately 30m, which means that the turbine needs to be at least 30m below the minimum normal operational water level in the tail pond. Below the turbine is the draft tube arrangement plus drainage sumps which all require additional consideration when determining the depth. A drainage system will be provided in the deepest part of the below ground shaft. This will house a dewatering system to keep the underground areas dry at all times, and to provide the ability to drain water from the penstock or draught tubes if required for maintenance. The water would be pumped into Q6.

4.5.12 The turbine shaft shown in Figure 4.11 is an indicative example of the turbine shaft, but could contain two smaller shafts, or a narrower shaft with larger turbine hall. Optimisation will be undertaken at detailed design stage.

4.5.13 Below ground level, the turbine hall will contain the following:

- Fire lift shaft;
- Generator/pump hall;
- Up to two turbines with a combined net output capacity of 99.9MW;
- Incoming and outgoing penstocks and draught tube; and
- Pumped drainage system

4.5.14 Pumped storage schemes are required to operate across a wide range of pressures, arising from the varying levels of water in the upper reservoir during operation. The key defining feature of the generating station in terms of capacity will be its export capacity at the meter within the site, just before the electricity enters the distribution network. The turbines at Glyn Rhonwy will be selected to ensure that they have the capability to generate power at a rate of 99.9MW across the full range of normal operating pressures, after taking account of any electrical losses incurred within the normal operation of the station.

4.5.15 It is considered that the most appropriate way to define and control the capacity of the scheme is for the Authorised Development wording to refer to "a pumped storage generating station with a net output capacity of up to 99.9MW" and for this to be reinforced by a Requirement in the DCO. Accordingly, Requirement 3 states:

"The generating station shall not export at a power rate greater than 99.9MW net of any station load electrical losses."

4.5.16 This output capacity limitation will also ensure that the project can secure an exemption from Ofgem from the need for a generation licence.

4.5.17 Turbine installation is likely to involve excavation (and possibly rock blasting) to obtain the correct level for the turbines, whilst using specialist heavy lifting equipment and cranes for the placement of equipment.

4.5.18 The turbines and generators will be delivered by road and may require abnormal load deliveries, although most associated parts will be brought to Q6 in a modular fashion.

Access

4.5.19 Access to Q6 will be via the existing industrial estate roads which are already in situ, and which will include constructing a retaining wall on the toe of the Q6 dam. This is shown in Volume 4, Figure 4.1.

4.6 Description and Construction of the Spillway Infrastructure and Pumping Station

Spillway Infrastructure Q6 to Llyn Padarn

4.6.1 The spillway infrastructure contains an overflow from Q6 which will be connected to Llyn Padarn directly with an approximately 800mm diameter pipe. The spillway infrastructure also contains a combined scour and rising main as a separate pipe approximately 450mm in diameter.

4.6.2 Valving will allow the relief or scour to discharge direct to Llyn Padarn (bypassing the pumping station). The purpose of the overflow is to discharge excess water collected within the reservoir(s) during operation. The purpose of the scour is to allow drawing-down of the water level in the reservoir to the base of the dam, including in an emergency situation. Any relief or overflow discharges will be gravity fed.

4.6.3 The indicative route of the overflow and combined scour or rising main is shown in Volume 4, Figure 4.12. The valving arrangement adjacent to the pumping station is shown in Figure 4.13.

4.6.4 The outtake pipe extends from the pumping station into Llyn Padarn, with the outtake structure itself at a minimum depth of 5m below the minimum recorded water surface level in Llyn Padarn. It was agreed with NRW that the approved scheme would keep the depth of the outlet pipes above the thermocline so that effects on Arctic Char would be minimised but would be of sufficient depth that adverse effects to recreational users in Llyn Padarn would be avoided.

4.6.5 Surface buoys would mark the location of the pipe terminals. There will be a fine mesh screen on the pipes to avoid any wildlife, detritus or material from entering the pipe.

4.6.6 The rising main is required to provide a means of abstraction from Llyn Padarn (for initial filling and top-up during operation). It is connected to Llyn Padarn via a pumping station located to the south west of Llyn Padarn. The indicative arrangement for the pumping station is indicated in Figure 4.13.

Pumping Station

4.6.7 The pumping station is required so that water may be abstracted from Llyn Padarn into Q6 in order to fill up the Development as part of the commissioning process and also to 'top up' levels if required. It will only be in operation when water is required to be pumped from Llyn Padarn.

4.6.8 The pumping station is connected to an intake in Llyn Padarn and valving allows pumping of water from Llyn Padarn through the combined scour or rising main into Q6. The valving arrangement adjacent to the pumping station is shown in Figure 4.13.

4.6.9 The likely location of the proposed pumping station is in a vegetated area away from the shore of Llyn Padarn, adjacent to the existing car parking area. An alternative location is also being considered and is immediately adjacent to the toilet block in front of the access to the bombstore. SPH are currently in discussions with utility companies regarding easements (this alternative location is outlined in Works Plan 4F (Document 2.04)).

4.6.10 The Order Limits show a minimum 20m corridor for the overflow along its entire route to account for the required working width, localised constraints, ground conditions and utilities.

4.6.11 The pumping station will comprise of a below ground wet well, valve chamber and cable pit, and above ground kiosk / control box. The majority of the structure is below ground and can be located so as to avoid any areas normally used by users of the car park and lagoon area.

4.6.12 The pumping station size will depend on the final location but will be completely underground and located at depth. A small above ground kiosk / control box would be present and this is likely to be approximately 2m long by 1.6m high by up to 0.8m deep and would resemble a communications control box, most likely covered in British Standard 14-C-39 Green (subject

to DCO Requirement). A manhole cover and grid plate is also required to gain access to the pumping station for maintenance purposes. A cross section is provided in Figure 4.13

4.6.13 There would be no operational requirement for fencing around the control box and no operational lighting. The pumping station will only be operational when water is required to be pumped from Llyn Padarn into the Development and will not be operational when water is discharged to Llyn Padarn. The underground pumping station will be equipped with sufficient acoustic attenuation to minimise any disturbance above ground.

Construction of the Overflow from Q6 Dam to the Pumping Station

4.6.14 The overflow and combined scour or rising main pipes will be culverted under the Q6 dam and will be buried in an opencut trench for the full route to the pumping station and then to Llyn Padarn. The route around the south side of the bombstore, and across the A4086, to the pumping station (which is bypassed by the overflow and relief or scour outlet) and then to Llyn Padarn is indicated in Figure 4.12. The spillway infrastructure extends from adjacent to the pumping station into Llyn Padarn, with the outlet structure itself at a minimum depth of 5m below the minimum recorded water surface level in Llyn Padarn.

4.6.15 From the Q6 dam, a microsited route will be identified and the vegetation and trees cleared as appropriate, preferably outside the breeding bird season, otherwise a watching brief will be implemented.

4.6.16 A route corridor above and below the A4086 will then be fenced off with crossing points for public access where appropriate, for example at Llyn Padarn to enable access through the car parks and to the lagoons.

4.6.17 Topsoil (where present) will then be stripped and stored within the fenced off easement. The trench will be excavated to receive the pipe work.

4.6.18 Local dewatering may be required for construction east of the A4086 to Llyn Padarn due to the highly permeable ground conditions (slate waste). The PC will develop detailed method statements for managing this process. If

required, the water will be passed through settlement tanks and potentially a 'Siltbuster' (or similar) to minimise the discharge of suspended solids.

4.6.19 The pipes will then be "strung out" along the excavation and laid on appropriate bedding material. These will be connected and then back filled and compacted with the excavated material. Concrete anti-floating haunching may be required and this will be confirmed as part of the detailed design as it is dependent upon ground conditions and the level of the groundwater.

4.6.20 An area of the car park will be required for a small construction compound and material and plant storage. Any lighting required will be for security purposes and it is proposed to store the vast majority of material and plant in the construction compound for Q6 to minimise impacts to the lagoon area.

Construction of the Pumping Station

4.6.21 Once the location of the pumping station is confirmed and all required pre-commencement surveys have been completed, the topsoil will be stripped and sheet piling will be installed to form a safe environment for the installation of the pumping station, namely a 'coffer dam'.

4.6.22 The material within the sheet piling will be excavated and removed to the Q6 site. This will subject to appropriate geoenvironmental and geotechnical testing to confirm suitability for future uses.

4.6.23 A concrete base and superstructure will be cast and the pumps installed. The area within the sheet piling will then be backfilled and the sheet piles removed. The control cabinet, entry grid and manholes will then be installed.

Construction of the Spillway Infrastructure to Llyn Padarn

4.6.24 The spillway infrastructure into Llyn Padarn will require a working area of approximately 5m by 20m into Llyn Padarn. This will be sheet piled to ensure a safe, water tight environment for the installation of the spillway infrastructure as this will be at depth.

4.6.25 Where the spillway infrastructure enters Llyn Padarn through the tree line, the working width will be minimised as much as possible to minimise any impacts to tree root systems. A tree survey will be undertaken prior to construction commencing to microsite the pipe through this area. Any trees that are removed will be subject to mitigation measures outlined in the Habitat Management Plan (HMP).

4.6.26 Where construction enters Llyn Padarn, access around this immediate area will be temporarily restricted to maintain a safe environment to the users of Llyn Padarn. This is expected to last up to 12 weeks.

4.6.27 There are potentially two options for the construction of the spillway infrastructure into Llyn Padarn, as follows:

Option 1

4.6.28 Using the coffer dam area, as outlined above, the pipes will be “strung out” and sunk in place with pre-cast concrete weights.

4.6.29 Once the pipe is laid and the dry area reflooded, reinstated and coffer dam removed, access will be allowed. It is expected that this element of the construction of the pumping station and spillway infrastructure will be short and temporary in nature. It is paramount that the health of safety of the construction is managed correctly due to the nature of the works.

Option 2

4.6.30 A smaller coffer dam would be used but a small boat or barge would then be used to string out the pipes and then connect to the onshore pipework once the pipe is sunk using pre-cast concrete weights. Access to this area would again be temporarily restricted whilst these works are ongoing to maintain the health and safety of users and construction workers.

Commissioning

4.6.31 Once the pumping station and spillway infrastructure is in place, pressure testing will be undertaken. This will be a temporary occurrence and last a few weeks. Once the Q6 reservoir is ready to receive water, the abstraction from Llyn Padarn will commence.

4.6.32 On the basis of 1,300,000m^3 required, this will take 394 days on the basis of 3300m^3 per day. An abstraction license has been granted on the basis of 1,100,000m^3 and a variation to this license will be submitted to NRW prior to the start of the Examination in relation to the1,300,000m^3 volume. .

Programme

4.6.33 It is proposed not to work within the main summer school holidays to minimise any significant adverse effects to users of Llyn Padarn and the lagoons. Outside school holidays, it is proposed to construct the overflow and pumping station sequentially to minimise any disturbance to users of Llyn Padarn and the lagoons. A small construction compound may be required and access for cycle and vehicle users on the shore will not be impeded. It is not proposed to block off or sever any existing routes for Llyn Padarn users but some traffic management will be in place during critical activities.

4.6.34 There is no requirement for night time lighting during construction outside working hours other than for security purposes.

4.7 Electrical Connection

4.7.1 A distribution connection will be required to connect the pumped storage facility to the national grid. This is likely to be a 132kV connection, which as associated development in Wales, will not be consented under the Act. It may be possible to complete the works under SP Manweb's permitted development rights, or through the formal grant of planning permission under the Town and Country Planning Act 1990. The application for the appropriate consents will be made by SPH, an Independent Connection Provider (ICP) or SP Manweb as appropriate. A high level intra-project assessment has been undertaken on the indicative route and this is reported in Chapter 17 Cumulative Effects. This assessment is based on the current grid connection agreement which was applicable at the time of submission.

4.7.2 The likely route of the electrical connection, as assessed, is shown in Volume 4, Figure 4.14. An underground route has been assumed.

4.8 Drainage Works to Q5

4.8.1 The 2012 ES noted that Q2 to Q8 are in hydrological continuity. This was in response to anecdotal evidence provided by Gwynedd Council (GC) from their investigations of drainage to Llyn Padarn. It is unclear whether artificial drainage exists between Q1 (which is in a separate catchment) and Q2 and the other quarries. In the absence of any firm data, SPH are taking the precautionary approach that blocking-up of tunnels between Q5 and Q6 could potentially result in a disruption to the drainage from the upper quarries and ponding in Q5.

4.8.2 Previous attempts by GC, before QBC and SPH presented proposals for the quarries, to investigate the drainage scheme have failed to find the source and routes of the quarry drainage towards Llyn Padarn.

4.8.3 However, it is recognised that drainage works may be needed between Q5 and Q6, and this can only be confirmed once the main construction works have commenced.

4.8.4 Further investigations are ongoing to source the true elevation of the base of Q5 and whether this is above the proposed maximum normal operating level in the Q6 reservoir. In Q5 the topography, trees and other vegetation have prevented survey using LiDAR or laser scanning. Therefore SPH are investigating other options.

4.8.5 As a worst case scenario for assessment in this ES, should drainage be required this is likely to involve excavating a tunnel from Q6 into Q5 at a level which will provide drainage from Q5 into Q6 but that does not allow Q5 to be back-flooded when Q6 is at its maximum normal operating level. This engineering solution would not impinge on the current bat mitigation and enhancement measures located in Q5. In addition, the direction of the excavation will be from Q6 into Q5 and therefore the archaeological features of the quarry can be retained. The Order Limits have been drawn to allow for this possibility.

4.9 Permanent Excess Slate Mounds

4.9.1 Material will be generated from the excavation of the Q1 and Q6 quarries to form the headpond and tailpond reservoirs. This material will be crushed and graded with only suitable material utilised in the construction of the dam(s), with less suitable material used for landscaping purposes or incorporated into the new excess slate mounds south west of Q1.

4.9.2 There is approximately 100,000m^3 of material within the existing slate mound to the south-west of Q1 shown on Figure 1.2.

4.9.3 Table 4-1 outlines the potential sources of material from the Development – please note that these are unbulked and bulked figures depending on the origin and handling of the material and will not necessarily add up to the end figure. To derive the figures above a bulking factor of 1.6 has been applied to all excavation and a compaction factor of 1.3 has been applied to all material to be used in construction e.g. dams and excess slate mounds:

Table 4-1 Sources and Uses of Material

Source / Use	Quantity (m^3 in situ)	Quantity (m3 bulked or bulked equiv)	Excess spoil (m3 bulked)	Comments
Q1 excavation	550,000	880,000		Bedrock and virgin material
Q1 Dam (fill)	630,000	820,000	60,000	Assumed excess of 60,000m^3 (excavation less fill)
Q1 existing slate mounds	100,000 (est.)	100,000	100,000	No bulking or recompaction factors applied
Net surplus at Q1			**160,000**	
Penstock excavation	25,000	40,000	40,000	Assumed single 4.5m diameter tunnel
Power House shaft	65,000	105,000	105,000	Assumed as per Figure 4.11
Q6 excavation	360,000	575,000		Assumes all virgin material

Table 4-1 Sources and Uses of Material				
Source / Use	**Quantity (m^3 in situ)**	**Quantity (m3 bulked or bulked equiv)**	**Excess spoil (m3 bulked)**	**Comments**
Q6 dam (fill)	(90,000)	(120,000)	455,000	Assumed excess of 455,000m^3 (excavation less fill)
Q6 existing slate mounds		50,000	50,000	No bulking or recompaction factors applied
Net surplus at Q6			**650,000**	Bulked figure due to excavation
TOTAL EXCESS			**810,000**	

4.9.4 Up to two excess slate mounds will be created south of Q1 with a volume of up to 935,000m^3. This will consist of a new slate tip to the south of the existing mound, and an extension to the existing mound. The different between the total excess outlined in Table 4-1 and the volume allowable within the area of the new slate mounds will account for any bulking or if further material is unsuitable for reuse than that assumed above.

4.9.5 The location of the excess slate mounds is shown in Volume 4, Figure 4.1 and a cross section is shown in Figure 4.15.

4.9.6 The methods employed for the reinstatement and restoration of the excess slate mounds is discussed in greater detail in Chapter 6 Landscape Character and Visual Amenity and Chapter 16 Environmental Management. Slate has been reused locally as a building material, more recently in 2007 for the Marchlyn Mawr Additional Stored Energy Project for the Dinorwig pumped storage scheme (MWH Technical Paper, no date).

4.10 Permanent and Temporary Access

4.10.1 Access to Q1 will be via the existing unclassified road (known as the Green Road) from the A4086 and through Waunfawr. Upgrades will be made from the A4086 to the Q1 site compound with temporary access tracks from the compound to the quarry. This is shown in Volume 4, Figure 4.16.

4.10.2 GC required upgrades be made to this road as part of the approved scheme. The upgrade works required for the Development will be agreed with the Council and as associated development will be subject to a planning application to the Council as Local Planning Authority. Based on dialogue with the Council to date, it is envisaged that the road will retain its single track status with several passing places will be constructed for vehicle movements. The improvements to the Green Road will be undertaken before construction and the road will be fully reinstated to adoptable road standards after construction is complete. Further detail can be found in Chapter 12 Traffic and Transportation.

4.10.3 Access to Q6 will be through the existing road network off the A4085 to within the existing Glyn Rhonwy Industrial Estate. Minor amendments may be made to the A4085 and Industrial Estate junction for delivery of plant and materials during construction although these will be reinstated post-construction, unless their retention is agreed with the Highways Authority.

4.10.4 Ffordd Clegir (translated as Clegir Road), which runs between Q5 and Q6, will not be used for any construction or operational traffic, although it may be subject to a temporary closure during the drilling phase. Advance notice will be given to the local residents, appropriate signage provided on the road and approval of GC as Highways Authority will be gained prior to any works commencing.

4.11 Construction Phase

Timescales

4.11.1 Construction is expected to last up to 4 years with large scale plant and machinery used in construction of the dams, reprofiling the quarries and tunnelling of the penstock pipes.

4.11.2 Table 4-2 outlines an indicative simplified phasing plan of the Development. Please note that several activities have been incorporated together which in reality will be distinctly separate in the programme. Whilst a PC has not yet been appointed, it is envisaged that the following indicative construction sequence will be followed:

Table 4-2 Indicative Construction Programme																		
Phase	**Location**	**Activity**	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
			1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Enabling Works	Q1 & Q6	Offsite access road improvements, creation of replacement temporary car park																
		Establish construction compounds including fencing and security.																
		Onsite general Mobilisation (and potential GI works) and site clearance																
Dewatering	Q1 & Q6	Dewatering of quarries																
Reservoir Works	Q1	Access made to quarry floor and reprofiling including blasting, drilling, lining, excavation and rock bolting and grout curtain construction																
		Partial removal of existing spoil mounds and crushing of excavated materials																
		Construction of dam																
		Construction of scour tower, overflow / relief valves and spill, inlet / outlet works and chambers																
		Placement of excess material in new slate mounds																
		Construction of spillway infrastructure to Nant Y Betws																
	Q6	Access made to quarry floor and reprofiling including blasting, drilling, lining, excavation and rock bolting and grout curtain construction																
		Partial removal of existing spoil mounds and crushing of excavated materials																
		UXO Remedial works																
		Construction of dam and placement of excess material																
		Construction of scour tower, overflow / relief valves and associated pipework, inlet / outlet works and chambers																
		Fill reservoir from abstraction and rainfall																
Pumping Station	Llyn Padarn	Construction of spillway infrastructure to Llyn Padarn and pumping station																
Penstock Construction	Penstock	Sink launch shaft from platform 5																
		Excavation of penstock, bifurcation value and chambers																
		Line tunnel																
	Conveyor	Setup and movement of material from Q6 to Q1																
Power House	Platform 5/6 Glyn Rhonwy Industrial Estate	Sink turbine shaft and construction of tailrace																
		Lining works and fit out shaft infrastructure																
		Construct power house superstructure, including crane and fit out power house																
		Install turbines and electrical infrastructure below ground and above ground.																
		Test and commission																
De-mobilisation	Q1 & Q6	Removal of site compounds and equipment from site. Reinstatement of access road improvement works.																

Site Preparation Works

4.11.3 These works will include the highway improvements which are required to the Green Road and internally within the Glyn Rhonwy Industrial Estate.

4.11.4 In addition, the PRoWs which are affected by the construction phase will be temporarily diverted. The diversions will be in place prior to the construction phase commencing.

Enabling Works

4.11.5 Once the highway improvements have been completed and PRoW diversions are in place, enabling works will commence. This will include the site setup of temporary construction compounds, installation of security fencing and delivery of plant.

4.11.6 It is likely that this will start at Q6 as this is the larger area and also where most of the welfare and office facilities will be.

4.11.7 This period will also include the delivery of machinery and larger plant, including abnormal loads. This will indicatively follow the timescales in Table 4-2.

4.11.8 There is potential for the PC to carry out additional detailed site investigations works which will confirm their chosen method of construction for the main components of the Development. This will roughly follow the same scope of works for the preliminary GI works but be more detailed. This is the only element of the Development which will include works above ground along the penstock route.

Construction Vehicles

4.11.9 Several different types of plant and equipment will be required to facilitate the construction of the Development. These include, but are not be limited to:

- Low loaders – for delivery of plant and equipment;
- Moxy, standard dumper trucks – dumper trucks for transportation of materials internally in quarries and externally to storage areas;
- Wheeled and tracked 360 Excavators – for excavations works;

- Mobile crushing and screening plant;
- Bulldozers;
- Graders;
- Compaction plant; and
- Cranes.

4.11.10 The main vehicle movements would occur during the first half of the construction period whilst the site is being setup which would include abnormal loads being delivered to Q1 and Q6.

4.11.11 Should TBM be used as the penstock excavation method, this will be brought to site in a modular fashion on the back of a low loader.

4.11.12 Other machinery and equipment may include, but not be limited to:

- Concrete batching plant;
- Welfare units and portacabins;
- Pipework (in sections);
- Temporary fencing;
- Generators (at Q1 for electrical supply unless locally available); and
- Bowsers.

Temporary Construction Compounds

4.11.13 It is envisaged that the main temporary construction compounds will be located on existing platforms at the Glyn Rhonwy Industrial Estate for the construction of the dam at Q6. Construction compounds will also be required for Q1 which will be in close proximity to the south part of the site and this is shown in Volume 4, Figure 4.1. They will consist of the following:

- Site offices and meeting rooms;
- Staff welfare facilities including toilets, kitchen, drying room and mess room;
- Storage and laydown areas for construction vehicles, plant, parking, equipment and other materials;

- Appropriately bunded areas to be used for the storage of oils and other fuels or other liquids;
- Wheel washing facilities to be used by construction vehicles and plant; and
- Aggregate recycling and concrete batching facilities, if required.

4.11.14 These temporary compounds will accommodate the facilities described above and provide sufficient parking for the PC's workforce, deliveries and visitors. There will be no onsite accommodation and no ability for workers to remain overnight. The only overnight attendance will be for security.

4.11.15 Areas of the compounds which are considered to present an increased pollution risk such as fuel or oil storage areas would be bunded and the area drainage collected for treatment and disposal. The exact make up, layout and dimensions of the temporary compound will be finalised post-consent following appointment of a PC.

4.11.16 Utilities are established at the Q6 compound due to its location within the existing Glyn Rhonwy Industrial Estate. However, some services (electricity and communications) may need to be established at Q1 although it is assumed that these are available from nearby Waunfawr.

Fencing

4.11.17 The temporary construction compounds will be contained within a secure fence. Palisade fencing or similar will be located around the compounds to provide security.

Lighting

4.11.18 It is recognised that there is no current lighting at Q1 or Q6 but that some will be required for security measures during the construction phase.

4.11.19 Due to the proximity to residents' dwellings, sensitive habitats and species (specifically bats) and the potential Snowdonia National Park Dark Skies Reserve it is not proposed to employ any flood lighting outside of working hours, and to provide sufficient lighting to maintain a secure presence.

4.11.20 Workplace lighting at the onsite temporary compounds will have due regard to UK guidelines on construction lighting, namely Health and Safety Executive guidance *HSG38 Lighting at Work* and also Bat Conservation Trust *Statement on the Impact and Design of Artificial Light on Bats (May 2011).*

4.11.21 There is likely to be night vision security cameras on both temporary compounds with 24 hour security present.

Working Hours

4.11.22 For the purposes of the EIA, construction activities have been assumed to take place 07.00 – 19.00 Monday to Friday and 07.00 – 13.00 on Saturday. Where construction activities are required outside these hours, then this will be undertaken only with the prior approval of GC.

4.11.23 Deliveries of plant and equipment and abnormal loads will be timed to avoid key commuting and school transportation times.

4.11.24 In addition, the residents within close proximity to the Development including Waunfawr, Llanberis and Cwm y Glo, and those who may be disrupted across the adjacent valley such as Deiniolen, Fachwen and Brynrefail will be notified of key construction activities such as blasting, large deliverables and abnormal loads, at least six weeks in advance, to minimise disruption.

Site Environmental Management

4.11.25 The 2012 ES proposed a Construction Environmental Management Plan (CEMP) which the PC will be required to operate under. This has been translated into a Code of Construction Practice (CoCP) submitted in support of the DCO application (Volume 3, Appendix 16.1). This will implement all of the principles of the mitigation measures identified within the 2012 ES, the T&CPA planning conditions, and any additional measures identified in this Final ES.

4.11.26 Further details are found in Chapter 16 Environmental Management.

Health & Safety and Public Access

4.11.27 Access around the two working areas and the existing and diverted PRoWs will be maintained during construction wherever possible to recreational and common land users. The car park at Q1 will be temporarily relocated near the temporary PRoW diversion so that these links can still be used.

4.11.28 Temporary closures of the PRoWs may occur and access to land may be controlled during certain times in the construction phase for critical path activities such as blasting or drilling. This is due to health and safety for users, residents and the onsite workers. Appropriate signage will be deployed on all PRoW diversions and the appropriate notice provided for any closures.

4.11.29 In addition, the two working areas around Q1 and Q6 will have 24 hour security to prevent public access with appropriate fencing, signage, lighting and CCTV installed.

Construction Staffing

4.11.30 The number of construction staff on site will vary according to the construction phase and activities being undertaken, and will be confirmed by the PC upon instruction. However it is expected that up to 250 people will be employed during the construction phase at its peak, after which it will then generally decrease as construction is progressed through to the commissioning phase. However this will be subject to the requirements of the PC and therefore could change.

Site Restoration & Enhancement

4.11.31 At the end of the construction period all temporary facilities will be removed from the temporary compound areas.

4.11.32 The excess slate mounds at Q1 will be graded ready for colonisation, in line with the *Restoring Habitats of High Conservation Value after Quarrying, Best Practice Manual (Bangor University et al, 2003).*

4.11.33 The reinstatement and establishment of the excess slate mounds and slate faced dams will be undertaken in line with the proposed Reinstatement and Landscaping Plan (which will be subject to approval by GC under a requirement of the DCO).

4.11.34 Appropriate mitigation will be undertaken for any trees affected or removed by the Development and subject to a Tree Preservation Order (TPO), through a Habitat Management Plan (HMP) (which will be subject to approval by GC under a requirement of the DCO).

4.11.35 A bat mitigation strategy was agreed as part of the approved scheme and a bat license has been granted on the basis of this mitigation being implemented prior to the construction phase commencing of the Development.

4.11.36 All temporary PRoW diversions will be reinstated to their new or existing permanent routes.

Commissioning

4.11.37 There will also be a period of commissioning and testing prior to full operational start up, this is known as “dry commissioning”.

4.11.38 During this period the components (dam leakage control, valves, motors, pumps and electrical control systems) will be tested for functionality with no water in the reservoirs. Once satisfied that everything is in order, the Q6 reservoir will be filled by allowing rainwater to pond in the reservoir and by use of the pumping station at Llyn Padarn.

4.11.39 Once there is sufficient water in Q6 there will be a period of wet commissioning which will repeat the dry commissioning tests but with water in the system to allow the full functionality of the pump turbines to be tested. This, together with commissioning of the grid connection will allow the facility to operate in a reduced capacity, if market conditions allow, until full functionality testing can occur when the water in the system is at full volume.

4.11.40 In order to fill the reservoirs, it is proposed to abstract water from Llyn Padarn and also supplement this from rainfall. An abstraction license has been approved by NRW for the abstraction of up to 2000m^3 per day from Llyn Padarn and a variation will be submitted to NRW prior to Examination in order to increase this abstraction to 1,300,000m^3 at a rate of 3300m^3 per day.

4.12 Operational Phase

Operational Lifetime

4.12.1 A pumped storage scheme can have an operational lifetime of up to 125 years subject to market forces, durability and maintenance. Regular maintenance will be undertaken on all machinery including scans and assessments made of underground pipework and above ground installations.

Maintenance

Dams

4.12.2 The dams will be subject to the statutory inspection regime prescribed in the Reservoirs Act 1975. This includes “routine” inspections by a qualified third party “All Reservoirs Panel” Engineer every year with a major inspection every 10 years. During these inspections, the Engineer will examine the critical safety features including overflow and scour arrangements, the condition of the major elements and the operating records.

Reservoirs

4.12.3 The reservoirs will be inspected every day by the operator to check for signs of slope erosion. This is made relatively easy due to the normal drawdown arrangement revealing most of the reservoir sides and base. It may become necessary to draw one or other of the reservoirs down completely to make minor repairs or to conduct occasional maintenance e.g. to clear the stone traps at the inlet and outlets, and the facility is configured to allow this to happen.

Tunnels

4.12.4 The tunnels will be subject to a five yearly inspection and the valving is arranged such that this can be conducted safely. Remote sensing equipment will be included so that monitoring can be maintained for routine purposes.

Pumping Station and Scour and Abstraction Pipework

4.12.5 The pumps will be inspected and tested routinely in line with a predetermined maintenance schedule. This is particularly important as operation will be intermittent.

Turbines and Generators

4.12.6 Maintenance activities at predetermined time intervals are necessary to ensure the following:

- 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 shutdowns by using planned and periodic shutdowns to inspect all equipment.

4.12.7 Adequate access and maintenance will be provided for operation and daily monitoring of the equipment.

4.12.8 In order to achieve the above maintenance objectives, sufficient time will be allotted for each machine. Specific periodicity and maintenance procedures will be as recommended by the manufacturer of the equipment. However, experience of pump and turbine operators has shown that normally there will be daily, weekly, monthly and quarterly checks as per the maintenance schedules, with major refurbishment works not expected more frequently than five year intervals.

4.12.9 At this time the generators and turbine rotors will be lifted to the surface via the internal crane. It may be necessary to send some components off site for refurbishment but it is more likely, due to the need to minimise any downtime, that these will be replaced for new parts as soon a possible. As there will be two sets of pump turbine generator they are unlikely to be removed at the same time, thus allowing normal operations to continue, albeit at reduced capacity.

Operational Workforce

4.12.10 SPH estimate that approximately 35 people will be employed during the operational lifetime of the Development.

Site Environmental Management

4.12.11 The site will be subject to its Environmental Policy which will require regular monitoring and auditing.

Health & Safety

4.12.12 Appropriate fencing will be installed around Q1 and Q6 reservoirs to minimise disturbance by vandalism and to maintain safe access to the numerous PRoWs which traverse the site.

4.12.13 It is likely that this will encompass a combination of 2m high stock proof fencing and a ditch, with appropriate warning signage at Q1, to maintain the agricultural and open nature of the area. A regular maintenance and inspection programme will be put in place to ensure health and safety is maintained.

4.12.14 Palisade fencing, up to 3m high, will be installed at Q6 similar to that already in situ and with any breaks or damage repaired. Due to the operational nature of the facility, there will be an onsite presence by staff 24 hours a day, for both operational purposes and security. CCTV will be installed to ensure public safety and security of the Development.

4.12.15 In addition, under the Reservoirs Act, there will need to be regular inspections of the Development as well as annual reporting and checks.

Lighting

4.12.16 As per the construction phase, the operational lighting strategy will have due regard for residents, ecology and health and safety. It is proposed that this is agreed as part of a DCO Requirement. Again workplace lighting at the onsite temporary compounds will have due regard to UK guidelines on construction lighting, namely Heath and Safety Executive guidance *HSG38 Lighting at Work* and also Bat Conservation Trust *Statement on the Impact and Design of Artificial Light on Bats (May 2011).*

4.12.17 Given the operational nature of the reservoirs, there is likely to be night vision security cameras on both reservoirs with 24 hour security present.

Operational Discharges and Abstractions

4.12.18 Once the Development is fully commissioned with 1,300,000m^3 of water, this will pass between Q1 and Q6 in order to provide the battery storage and generate electricity at peak times.

4.12.19 Operational discharges will be intermittent and dependant on rainfall and operational requirements. An essential component of any raised reservoir is the ability to lower the water level behind the dam (draw-down); emptying the reservoir to the point where there is no hydraulic load on the structure. For the purpose of reservoir safety this facility must be available at all times.

4.12.20 At times of normal operation, the main and primary mechanism for draw down for the Q1 reservoir is through the penstock to Q6. The penstock pipe has the capacity to provide draw-down of the reservoir in approximately 7 hours at a rate in the order of 46 m^3/s. This is more than adequate to serve the draw-down need for the Q1 reservoir.

4.12.21 At times of normal operation, the main and primary mechanism for draw down for the Q6 reservoir is through the penstock to Q1, using the turbines in the turbine house in pumping mode.

4.12.22 However, because of the variables in operation and maintenance of the scheme, and the need to have a draw-down capacity at all times; it is considered prudent to include a facility to lower the reservoir independent of the penstock and powerhouse.

4.12.23 Therefore both dams provide a secondary method for draw down, with water being discharged to the Nant y Betws at Q1 and to Llyn Padarn at Q6. This will only occur if the penstock was unavailable. The relief valves are sized to allow the reservoir(s) to be drawn down to 50% of the volume impounded by the dam(s) within 7 days. These discharges would be controlled through the required discharge consent.

4.12.24 The relief valves are manually activated i.e. they will only be opened when the operator intervenes. Such intervention will only take place in one of two scenarios as follows:

a. when the there is a need to lower the water level behind the dam and the water cannot, for whatever reason, be drawn down through the penstock i.e. it would only be in an unusual situation when drawdown of the reservoir is required and this cannot be achieved through the penstock.

b. for maintenance; to ensure the valves are operational as part of the dam safety regime, it will be necessary from time to time to briefly operate the valves.

4.12.25 In short, emergency valve operation is considered an extremely unlikely situation and, other than infrequent small amounts for valve testing, are not part of the normal operation of the scheme and would be very unlikely, possibly never, in an unplanned situation.

4.12.26 In the maintenance scenario (b above) the discharge would be managed as per the requirements of the discharge consent. In this scenario the valve can be used in a controlled manner, when the flows in Nant-y-Betws and the Afon Gwyrfai are low enough to accept the flows from the reservoir without causing an increased risk of flooding from the watercourses.

4.12.27 No water is directly discharged into Llyn Padarn from the turbines and so it is unlikely that the discharge will be heated.

4.12.28 A number of the responses received as part of the statutory consultation on the Development, drew comparisons between the existing Dinorwig pumped storage facility and the Development. The two schemes are very different and, for clarity, the key differences are set out below:

- **Scale** - The scale of the Development is considerably smaller than that of Dinorwig. This is in terms of both the power output (99.9MW compared to 1800MW) and, more importantly, the volume of water that is processed and discharged. Llyn Peris is the tailpond for the Dinorwig scheme whereas Llyn Padarn only receives intermittent overflow from

the much smaller Development. Consequently, any potential impact of the Development will be significantly reduced in comparison to that of Dinorwig.

- **Heat source: Solar exposure** - The bathymetry of Llyn Peris, the lower reservoir at the Dinorwig facility is a relatively shallow and wide. This basin undergoes significant drawdown during operation, exposing dark rocks to heating from the sun. It may be possible that this is a driver for increased water temperature in Llyn Peris, as the heat stored is transferred to the surrounding water once re-filled. The Glyn Rhonwy Development is quite different. The lower volume at Q6 is much more narrow, deep and shaded. It is therefore more likely that the water in Q6 will remain cool. While Llyn Peris has an area of around 60 hectares, Q6 has an area of around 3 hectares. Llyn Peris stores 7,000,000 m^3 of water, while Glyn Rhonwy will store 1,300,000 m^3, so the Development has 1/7 the volume but 1/20 the surface area. This very different volume to surface area ratio means the water in Glyn Rhonwy is much less exposed to the sun than the water of Llyn Peris.
- **Heat source: Geothermal gradient** - The penstock proposed for the Development is shallower than that used by Dinorwig. This may be relevant because generally the deeper the tunnel, the warmer it gets with the average gradient around 25^{o}C to 30^{o}C per km depth. Though heat transfer from the rocks to the water will be limited by the surface area of contact, and the conductivity of the surrounding rocks, it is possible that the water in Llyn Peris is warmed by the mountain itself. The tunnels of Dinorwig reach a depth of some 450m, and are roughly 2.4km long. At Glyn Rhonwy the tunnels will be between 50 and 80m deep and are around 1.6km long.
- **Configuration** - The configuration of the Development is considerably different. Once the water has passed through the turbine it will flow into Q6 where it will be stored until it is ready to be pumped back up to Q1. Only when there is excess water during periods of high rainfall will water discharge from the Development into Llyn Padarn be required. It is

considered that the discharge will be very similar in terms of rate and temperature as to present drainage conditions as the overflow is close to the maximum water level within the reservoirs.

4.12.29 An Excess Water Management Plan will be developed with NRW as part of a DCO Requirement.

4.12.30 Any operational abstraction required from Llyn Padarn to "top up" the reservoir volume will be undertaken under the conditions of the environmental permit.

4.13 Decommissioning

4.13.1 At the end of the 125 year operational life, the Development will be decommissioned:

- Assessment of any buildings that are to be removed, including ecology;
- Removal of all above ground structures, notably the power house;
- Water will be drained from Q1 to Q6 and released at an agreed rate and timescale through the appropriate licensing regime into Llyn Padarn;
- Pumping station will be removed, although the overflow pipework at Q6 will remain in situ after being sealed;
- Dams to remain in situ;
- Access tracks will be left in situ;
- Security fences will remain although access through the dam structures will be secured;
- Penstock pipework between Q1 and Q6 will remain in situ and sealed; and
- Overflow pipework at Q1

4.13.2 It is proposed that due to the anticipated lifespan of the Development, a Decommissioning Plan will be required by the relevant authorities at the point of decommissioning this Development. This will therefore be a Requirement of the DCO.

4.14 References

Welsh Assembly Government (2008) Môn a Menai Action Plan

Restoring Habitats of High Conservation Value after Quarrying, Best Practice Manual (Bangor University et al, 2003).

Bat Conservation Trust (May 2011) Statement on the Impact and Design of Artificial Light on Bats)

Health and Safety Executive Guidance HSG38 Lighting at Work