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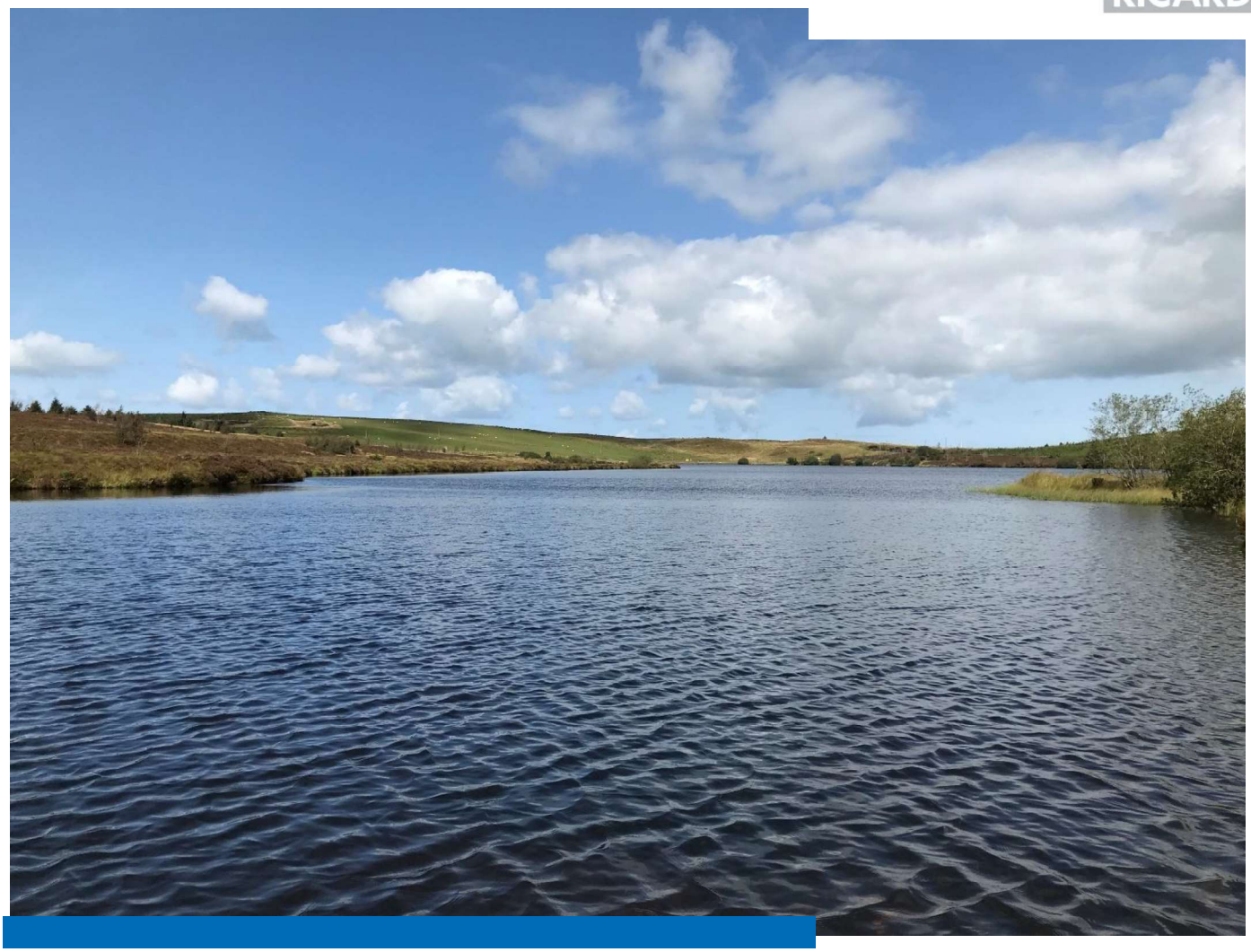

Llyn Bran Environmental Report

Potential impacts and proposed mitigation measures associated with single drawdown event

Report for Dŵr Cymru Welsh Water

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Table of Contents

Table of Tables

1 Introduction

The aim of this report is to provide a summary of the potential impacts associated with a single drawdown event of the Llyn Bran reservoir to minimise and mitigate adverse ecological impacts on species and habitats of principal importance as per Section 7 of the Environment (Wales) Act of 2016[1].

The discontinuance of the Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology has been identified as a compensation measure under Regulation 64 of the Conservation of Habitat and Species Regulations 2017 (as amended) as part of the Habitat Regulation Assessment (HRA) process for the Llyn Anafon Scheme which is associated with the Eryri/Snowdonia Special Area of Conservation (SAC).

This compensation measure was agreed with Natural Resources Wales (NRW) and subsequently an assent under Section 28h of the Wildlife and Countryside Act (1981) was issued by NRW to commence with the Llyn Anafon Scheme.

This assent was subject to the following condition:

The initiation of drawdown in lake level is being assented on the basis that an offsite compensatory measures plan must be fully secured by Dŵr Cymru Welsh Water (DCWW) and agreed with NRW within 18 months of the start of drawdown at Llyn Anafon (September 2020); the compensatory measures, currently expected at Llyn Bran, must have been physically started on site by DCWW within 24 months of the initiation of drawdown (September 2020); and that all elements allowing the compensatory habitat to develop must be in place, and habitat developing, before Llyn Anafon dam is permanently decommissioned.

The discontinuance of Llyn Bran is, therefore, critical in achieving the compensation measures for Llyn Anafon within the required timeline (as stipulated by NRW)

This report was prepared by Ricardo Energy and Environment (Ricardo) in collaboration with Stillwater Associates, Salix River and Wetland Services Limited, Richard Andrews (Andrews Wildlife Consultants Limited) and Ben Goldsmith (Goldsmith Ecology). The proposed engineering process for undertaking and managing the reservoir drawdown has been developed in consultation with an experienced civil engineering contractor.

1.1 Background

DCWW is responsible for the operation and maintenance of the Llyn Anafon reservoir. The reservoir is located in the Snowdonia National Park in North Wales at an altitude of approximately 500m. Since construction, the dam has required remediation works on a number of occasions due to concerns over continued and increasing levels of leakage being monitored at the toe of the dam embankment, internal erosion and the deteriorating condition of both the spillway and embankment.

Under the 1975 Reservoirs Act, the dam is classified as Category B due to the likely loss of life should the dam breach. As such, the project has been set with a statutory deadline of January 2019. A 2016 Section 10 report outlines that '*from a reservoir safety perspective ongoing monitoring and patching* [to address leakage] *is not recommended, particularly in light of the constraints on access to site*.' The inspecting engineer goes on to recommend '*that a long-term solution is developed to address the poor and deteriorating condition of the dam, to the consent of an All Reservoir Panel Engineer*'. The 2016

[1] https://www.biodiversitywales.org.uk/Environment-Wales-Act

report was completed in line with Section 10 of the Reservoirs Act 1975, specifically the requirement for periodic inspections.

Subsequently, DCWW has decided to decommission the reservoir and remove the dam, in order to completely remove the hazard and provide a long-term solution to the risk of dam failure. In doing so, DCWW aims to restore naturalness to the lake.

The site is located within the Eryri/Snowdonia Special Area of Conservation (SAC) and is therefore considered a site of European importance. Any project would therefore need to consider the impact on the European site as set out within Article 6 of the European Commission (EC) Habitats Directive 1992, and interpreted into law by the Conservation of Habitats and Species Regulations 2017 as amended (the Habitats Regulations). Under Regulation 63, any plan or project which is likely to have a significant effect on a European site (either alone or in-combination with other plans or projects) and is not directly connected with, or necessary for the management of the site, must be subject to an appropriate assessment to determine the implications for the site, in view of its conservation objectives ((i.e. a Habitat Regulation Assessment (HRA)). The requirement for HRA is established through Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, hereby referred to as the 'Habitats Directive', in Articles 6(3) and 6(4). The Habitats Directive is transposed into national legislation by the Conservation of Habitats and Species Regulations 2017, as amended[2].

Regulation 63 states that the competent authority (in this case DCWW) shall adopt, or otherwise give effect to, a plan or project only after having ascertained that it will not adversely affect the integrity of a European site, subject to Regulation 64 of the Habitats Regulations as amended in 2017.

1.2 Assessment completed to date

A Stage 1 HRA ((screening of Likely Significant Effects (LSE)) was completed in December 2017 in consultation with Natural Resources Wales (NRW). The Stage 1 report concluded that features likely to be affected by the Proposed Scheme include:

- Annex I habitats that are a primary reason for selection of this site:
    - Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* (which includes the rare aquatic macrophyte species - *Potamogeton* x *gessnacensis*, *P*. x *griffithii* and *P*. *alpinus*, these rarities are classed as “locally distinctive elements” of the site and are assessed as part of the site condition process (JNCC 2015[3]).
- Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site[4]:
    - Northern Atlantic wet heaths with *Erica tetralix*
    - Blanket bogs (* if active bog) * Priority feature

A Stage 2 (Appropriate Assessment) report was completed in August 2018[5] following field investigations. The Stage 2 HRA presents the information required to inform the Appropriate Assessment of the Proposed Scheme. The report concluded that, on the assumption that the mitigation recommendations are successfully implemented, there will be no significant adverse effects, either alone or in combination, on the Conservation Objectives of terrestrial habitats (Northern Atlantic wet

[2] The Conservation of Habitats and Species Regulations 2017
[3] Joint Nature Conservation Committee (JNCC), (2015) Common Standards Monitoring Guidance for Freshwater Lakes Version March 2015. JNCC Report, JNCC, Peterborough [Online] Available from: http://jncc.defra.gov.uk/pdf/0315_CSM_Freshwater_lakes.pdf
[4] In practice, not being a primary reason makes no difference to the status of the feature under HRA or the degree of assessment required.
[5] Ricardo Energy & Environment (2018). Habitats Regulations Assessment Stage 3 and 4. Assessment of alternative solutions and information in relation to a case of imperative reasons of overriding public interest. Report prepared for Dŵr Cymru Welsh Water. March 2018.

heaths with *Erica tetralix* and blanket bog*)*. However, the report concluded that it is not possible to mitigate for the loss of 2.05ha of oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*. As such, undermining of the conservation objectives for this qualifying feature is anticipated and therefore adverse effects on the integrity of the SAC are likely. Furthermore, there remains some uncertainty regarding the effects of the potential increased frequency of low water levels after completion of the Proposed Scheme.

As indicated in Section 1.1, competent authorities (in this case DCWW) cannot consent to or proceed with plans, projects or operations if the Appropriate Assessment concludes that the plan, project or operations may have an adverse effect on the integrity of a European site and alternative solutions may be available. Several alternative options have been considered as part of a Stage 3 HRA (assessment of alternative solutions). It was concluded that the alternative solutions fail to meet the objective of the Proposed Scheme as the solutions are not considered long-term alternatives, cannot be implemented due to engineering constraints or could have an impact on the conservation objectives and favourable condition status of the SAC which is considered greater than the potential effects associated with the Proposed Scheme.

Article 6(4) of the Habitats Directive provides a derogation provision whereby if the relevant competent authority is satisfied that, there being no alternative solutions, a plan or project must be carried out for imperative reasons of overriding public interest ("IROPI"), it may agree to the plan or project notwithstanding a negative assessment of the implications for a European site. Where a site hosts priority natural habitats or species, the available reasons are limited to those relating to human health, public safety or beneficial consequences of primary importance to the environment, unless the competent authority obtains and has regard to an opinion from the European Commission.

Subsequently, an investigation was completed of the potential compensation measures and relevant compensation sites as required under regulation 64 of the habitat regulations and Article 6(4) of the Habitats Directive.

The investigation was completed in consultation with NRW and identified Llyn Bran as a potential compensation site. Llyn Bran is located approximately 10km from Denbigh (grid ref SH96205922) at an altitude of approximately 437m AMSL. The reservoir is approximately 12.6ha in size and in the past was used for water provision in the Denbigh area. Several mitigation measures were identified including:

- The discontinuance of the existing Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology;
- The translocation of hybrid *Potamogeton* species to identified lakes and off-site locations;
- Restoration of the inflow to Llyn Bran and the reinstatement of the original outflow once final water levels are reached;
- Restoration of the terrestrial habitats surrounding the reservoir, some of which could potentially be considered Annex 1 habitats; and
- Removal of the disused buildings and structures.

1.3 Purpose of this report

Initially it was proposed that the measures to restore and maintain hydrological functioning (discontinuance of Llyn Bran) would be achieved through lowering of the water level in two incremental drawdowns. More recently it was concluded that a two-stage drawdown strategy would require similar mitigation measures whereas a single drawdown will also allow for a more rapid implementation of those measures required, maintain current water quality conditions and enhance and maintain the macrophyte communities. This will reduce the amount of time it would take for the habitats at Llyn Bran to reach the specific targets for favourable conditions for the relevant Annex 1 habitat and will avoid repeated disturbance of sensitive species (e.g. water vole).

In February 2021 representatives from Ricardo and DCWW met with Natural Resources Wales (NRW) to discuss changes in the proposed discontinuance of the Llyn Bran Reservoir. NRW representatives requested that DCWW compile an environmental report presenting the mitigation measures that would be implemented in order to mitigate the impacts of a single drawdown event.

The discontinuance of the existing Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology will require measure to manage siltation. NRW has advised the Local Planning Authority that the activity is located in the catchment of the River Dee and Bala Lake SAC and raised concerns with regards to the impacts of increased phosphate concentrations as a result of the activity. NRW has indicated that the activity should, therefore, be subject to a HRA under Regulation 63 of the habitat regulations.

This report provides an update to the Environmental Report to include further information on those concerns raised by NRW in September 2021 (Ref: 25/2021/0830). This includes:

- Updated information regarding the proposed project and project design.
- Updated information regarding the management of silt and sedimentation during construction.
- A HRA including a screening of LSE and Appropriate Assessment of the implementation of the compensation measures at Llyn Bran that were identified as measures required to compensate of the loss off of 2.05ha of oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* from the Llyn Anafon Reservoir.

2 Proposed Reservoir Discontinuance

The proposed drawdown and discontinuance of Llyn Bran is expected to commence in early April 2022. The preferred approach to discontinuing the reservoir is by complete removal of the concrete gravity dam located at the southern end of the reservoir.

To allow the dam to be demolished it will first be necessary to lower the water level on the upstream side of the dam. Once lowered the water level will need to be controlled at a low level until enough of the central part of the dam has been removed down to streambed level to allow the natural flow of water to continue through the site of the dam. In conjunction with this, it will also be necessary to manage and contain silt/sediment upstream of the dam site to ensure silt is not transported to the downstream river environment. Silt management and containment will need to be continued for as long as necessary and until permanent containment and stabilisation measures have established.

It is anticipated that the demolition of the dam will be carried out in a single activity, to avoid the need for additional remobilisation of plant and continuous/repeated disturbance on sensitive habitats and species. Assuming this can be achieved the demolition and removal of dam material can be expected to take approximately one to two weeks.

2.1 Approach to Reservoir Drawdown

The proposed drawdown approach is detailed below, noting that the rate of drawing down will be dictated by the following factors:

- Inflows:
    - To achieve reservoir drawdown the rate of abstracting water from the reservoir will need to exceed the inflow rate. Options for diverting the inflows around the lake have been considered, but the works and equipment involved would be extensive and costly and would have additional adverse impacts on ecology. Instead, water will be transferred locally around the dam using either pumps or siphon pipes, or a combination of both.
- Reservoir surface area:
    - As the reservoir is drawn down the natural shape of the reservoir basin means that the surface area of water will reduce, meaning that the volume of water needing to be pumped per unit depth will decrease. At Llyn Bran there is a high point in the bed of the reservoir, which historically formed the southern lip/outflow of the natural lake. Once the reservoir has been drawn down to this level the retained natural lake will have formed and only the southern part of the reservoir can be drawn down. Once this level is reached, estimated to be approximately 2.5m below the current normal reservoir water level, the rate of draw down, at the same abstraction rate, will rapidly increase.

It is anticipated that the initial drawdown will involve the use of siphon pipes which would be set up at one or both abutments at the location of the dam. The siphon pipe inlets will be submerged in the reservoir but kept away from the bed of the reservoir to avoid drawing in silt. The downstream ends of the siphon pipes will be positioned to discharge on to the ground either side of the downstream watercourse to provide an element of silt retention, minimising the risk of any suspended solids entering the watercourse.

The benefits of using siphons at this stage of the operation, rather than pumping, are:

- Lower cost;
- No fuels or oils to minimise the risk of pollution;
- No requirement for bringing fuel to site;
- Equipment (pipework) more easily managed than pumps; and
- Reduced attendance required: once siphon are operating: ‘hands-off’ operation.

2.1.1 Initial Drawdown – Siphon Pipes

The following assessment has been carried out to estimate the time taken to drawdown the reservoir (**Table 2.1**). For example, using three 150mm diameter siphon pipes should allow the first 1m depth of water to be removed from the reservoir over a 2 to 3 week period. The siphon inlets would be positioned centrally on the upstream side of the dam, suspended such that they were kept well above the bed of the reservoir to ensure silt from the bed is not drawn in.

Table 2.1: Assessment of abstraction rate to achieve initial reservoir drawdown: siphon pipes

Item	Unit	Value	Source / Comment
Q_{50} inflow Area of reservoir, a	l/s	13	Inflow to the reservoir that can be expected on average for 50% of the days of the year.
	m^3 / day	1,123	
	ha	12.54	
Suggested maximum target rate, D_i	mm / day	100	Assumed maximum rate of drawdown to avoid disturbing silt around lake margins
Daily volume to be evacuated based on target rate, V	m^3 / day	13,663	Q_{50} (m^3/day) + 10 x a x D_i
Maximum daily rate of abstraction adopted	**m^3 / day**	**10,400**	**Limited to 120l/s to avoid excessive flows downstream**
Siphon Pipes			
Estimated nr. of 150mm dia. siphon pipes, assuming 40m pipe length.	nr	3 siphon pipes [11,000 m^3/day]	Hand calc for siphon discharge. Additional pipes may be required depending on lengths and arrangement of pipes.

Drawing water from the upper part of the reservoir should ensure that silt is not drawn through the siphons and no silt management is expected during this stage. However, checks would be carried out at least daily to ensure the siphons were operating as intended and that the flow was clear of silt.

2.1.2 Lower Level Drawdown – Pumping and Silt Management

Once the reservoir has been drawn down by approximately 1m, subject to the discharging water remaining clear and free of silt, the next stage of drawdown would involve the use of temporary pumps to begin local desilting close to the dam, with the aim of creating a de-silted basin area (**Table 2.2**).

Whilst the use of siphon pipes might be preferable, siphons will not operate effectively once the water level on the upstream side of the dam has been drawn down to a low level. Further, the use of pumps at this stage will allow silt laden water to be pumped to a higher level to return silt to be pumped into silt tubes, or to areas behind silt tubes or coir rolls within the southern part of the reservoir basin where the watercourse is to be restored.

Pump inlets (suction pipes) will be located low down in the reservoir adjacent and centrally to the dam, to draw silt from this area. Silt pumped into or behind silt tubes, along the line of the restored watercourse, or behind coir rolls placed along the western shoreline areas within the reservoir basin will be allowed to dewater, the clean water draining back to the restored watercourse and from there flowing downstream.

Precautions will be taken to protect the water environment against loss of fuel or oil.

Table 2.2: Assessment of pump requirements for ongoing drawdown

Item	Units	Value	Source / Comment
Maximum daily rate of abstraction adopted	m^3 / day	10,400	As rate assessed and adopted in Table 2.1
Diesel Pumps			
Estimated nr. of 200 mm diesel pumps	nr	1 nr. pumps [12,960 m^3/day]	A single pump should provide sufficient capacity and will need to be controlled to not exceed maximum flow rate.

Once a desilted area of lakebed has been formed close to the dam wall water will continue to be pumped downstream, monitored to ensure the discharging water is free of silt. If necessary 'Siltbusters' can be used to remove any remaining silt content.

This approach should allow the reservoir to be emptied over a total of approximately 4 to 5 weeks, ready for the dam to be demolished.

During the lake drawdown the area of lakebed at the main inlet, on the eastern side of the lake, will be carefully monitored. The intention is to carry out the discontinuance work during times of low flows, which should help to ensure the minimum of silt disturbance in this area. However, if storms are forecast, which could result in high inflows, measures will be taken to contain silt in this area to minimise disturbance. These measures could, for instance, include the use of pipes to direct flows into the main water body, avoiding water passing over freshly exposed areas of silt in the lakebed margin.

2.2 Silt Management & Revegetation

2.2.1 River Corridor

Once the reservoir is fully drawn down the dam will be completely demolished as a single activity, with the concrete arisings crushed on site. It is anticipated that the contractor will initially remove the central section of dam such that the flow of water through the reservoir basin can pass through the dam site without the need for pumping.

While the remainder of the dam is being demolished pumps will once again be deployed to start removing silt from the sides of the natural route of the newly established watercourse between the retained lake and the dam site, over a distance of approximately 200m. Initially the silt will be pumped into silt tubes laid either side, and following the route of the new reinstated watercourse, set back from the watercourse sufficiently so that pre-vegetated coir matting can be placed to form the banks of the new watercourse (see attached **Figure P1845-201C**). As the silt tubes are filled additional silt material will be pumped to the area behind the silt tubes to marginally raise the levels between the watercourse and the banks of the reservoir.

The silt tubes and matting will provide the stable structure for the route of the watercourse and to retain silt in the areas behind. The silt margins will be seeded to re-establish to a condition similar to the heathland currently surrounding the reservoir (see attached **Figure P1845-201C**).

2.2.2 Retained Lake Margins: Western and Northern Area

It is anticipated that the generally slow and gradual nature of lake level lowering will have minimal impact on any silt around the lake margins. Where silt is disturbed, for instance in the vicinity of lake inflows, the silt would be expected to settle into the deeper areas of the lake.

The exposed western and northern margins of retained lake are not expected to require any movement of silt. Instead, coir matting will be laid and secured along the new shoreline to help protect and stabilise the silt behind (see attached **Figure P1845-201C**).

The extensive area of exposed silt along the western area of the lake will be seeded to help establish vegetation similar to the adjacent heathland.

The proposed treatment of this western shore area is intended to provide the replacement habitat for water voles to repopulate (see Section 3.9).

2.2.3 Retained Lake Margins: Eastern Area

Since there has been no significant indications of water voles along the eastern shoreline of the reservoir there is no proposal to provide any treatment to the eastern area of lake with the exception of the lake inflow which will be stabilised and revegetated using coir rolls and pre-grown coir pallets. The remainder of the eastern shore, which is relatively inaccessible, will be allowed to revegetate naturally into heathland similar to the heathland on the eastern side of the reservoir.

The stabilisation of the inflow and revegetation with coir rolls and pre-grown coir pallets will aim to further ensure that water quality is maintained and enhanced by creating a wetland environment to reduce water quality impacts form the forestry area to the east of Llyn Bran.

3 Environment and Ecology Baseline Results

In October 2018 Ricardo was commissioned by DCWW to undertake an extended Phase 1 habitat survey as part of a Preliminary Ecological Appraisal (PEA) to identify potential ecological constraints to the proposed discontinuance and restoration work at Llyn Bran. This was followed up in 2020 with submission of the Llyn Bran Environmental and Ecology Baseline Report[6] the results of which are summarised in **Table 3.1** and **Table 3.2**.

Table 3.1: Environmental survey summary

Receptor	Legislation	Summary
Water quality	Water Framework Directive 2000/60/EC	During 2019, Llyn Bran met the CSMG targets for dissolved oxygen, pH, nitrogen, and total phosphorus. In 2018 Llyn Bran did not meet the CSMG targets due to elevated phosphorus concentrations.
Lake sediments	Water Framework Directive 2000/60/EC	Particle size distributions of the soft (unconsolidated) bed sediment are dominated by sand and silt. The hard bed in the southern portion of the reservoir is composed predominantly of peat, while the north is predominantly of clay or silt. The marginal sites are predominantly characterised by coarse pebbles, while sites further from the margins are have a substrate of sand and silt.
Peat coring	Environment (Wales) Act 2016	Peat deposits are present in the south-east and south-west margins of the reservoir. The peat is deepest south-west of the reservoir with depths up to 2.8m. The deep areas of peat were on flat areas and close to the lake level and were associated with blanket bog/mire vegetation. The shallow peat is present on sloping areas and is associated with dwarf shrub heath communities.

Table 3.2: Ecology survey results summary

Receptor	Relevant Legislation	Status on site
Habitats	Environment (Wales) Act 2016	The habitats within the site include unimproved acid grassland, marshy grassland, blanket mire, dwarf shrub heath, swamp and tall herb fen, and coniferous plantation woodland. The site predominantly comprises a mosaic of mire, wet, and dry shrub heath. The communities include wet mires which are likely to be influenced by the current lake level and rain-fed soligenous mires and wetter community mosaics higher up the hill from the lake.
Fish	Water Framework Directive 2000/60/EC	Llyn Bran support a community comprising European perch and northern pike. No protected or notable species were identified in the reservoir.
Great crested newts	Conservation of Habitats and Species Regulations 2019, Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	Likely absent from the site due to absence of suitable breeding habitat within 250m.

[6] Ricardo (2020). Llyn Bran Environmental and Ecology Baseline Report. Report for Dŵr Cymru Welsh Water.

Breeding birds	Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	The site supports bird communities typically associated with moorland/heath, plantation coniferous woodland, and open water. The species recorded at the Site include five red-list and eight amber-listed species, and four species listed under the Environment Wales Act. Four Schedule 1 species were identified in the desk study from within 2km of the Site: hen harrier, merlin, common crossbill, and fieldfare.
Reptiles	Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	The dwarf shrub heath and grassland habitats surrounding Llyn Bran supports a low population of common lizard (*Zootoca vivipara*). Adder (*Vipera berus*) were not identified during surveys but are assumed to be present in low numbers due to suitable habitat and presence in wider environment.
Badgers	Wildlife and Countryside Act 1981, Protection of Badgers Act 1992	Likely absent from the site, no evidence of badger activity during survey in 2019.
Bat roosts	Conservation of Habitats and Species Regulations 2019, Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	No bat roosts were identified in the Utility Building or Boat House during surveys in 2019. Low levels of activity were recorded during emergence/re-entry surveys comprising low numbers of commoner species. Dedicated activity surveys are not considered necessary to inform the required mitigation for this scheme.
Otter	Conservation of Habitats and Species Regulations 2019, Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	Otter activity was confirmed at Llyn Bran during surveys in 2019. No evidence of otter holts, couches, or lay ups was identified.
Water voles	Wildlife and Countryside Act 1981, Environment (Wales) Act 2016	Water voles were identified as being present at Llyn Bran. Water vole activity was concentrated on the west and north-western banks of the reservoir and the reservoir outflow.
Invertebrates	Environment (Wales) Act 2016	The records of protected and notable species received from Cofnod identified seven priority species listed under Section 7 of the Environment (Wales) Act 2016 with 2km of the Site. Two nationally scarce species were also identified.

A summary of mitigation measures proposed in the ecology baseline report is provided in **Table 3.3**.

Table 3.3: Mitigation summary

Receptor	Mitigation required	Timing
Water quality and lake sediments	Sediment management through creation of a sediment trap in the reservoir outflow, phased drawdown and dam removal, CEMP, movement of deep sediments behind dam (if required). Restoration of reservoir inflow channel. Creation of a buffer to reduce run off rates from livestock pasture north of the reservoir. Ongoing water quality monitoring to confirm baseline WFD status prior to works.	Pre commencement monitoring and creation of a sediment trap and buffer. Sediment management and monitoring during works. Post works monitoring.
Habitats and peat	Natural regeneration of exposed shore habitats and restored watercourse should be monitored through walkover botanical surveys three times a year in the first year, twice in the second year, and full NVC surveys annually in years 3 and 5. Restoration of habitats and soils along access track route.	During construction of the access track and post works monitoring.

	Management of self-sown coniferous trees from heath and mire habitats	
Fish	Pollution and sediment control measures.	During dam discontinuance works
Great crested newts	No mitigation required - not present within the Site.	N/A
Breeding birds	Avoid removal of vegetation or building demolition during breeding bird season (March to August inclusive). Where this is not possible, check for breeding birds a maximum of 48 hours before starting clearance/disturbance. Visual barrier between works and adjacent habitats (where possible) to limit disturbance to breeding birds. Restoration of terrestrial habitats following removal of temporary haul road.	Pre-commencement survey 48 hours prior to each section of discontinuance works affecting vegetation or structures.
Reptiles	Displacement of reptiles from access tracks and works areas prior to commencing. Removal of potential hibernacula (where required) outside of the hibernation period. ECoW during vegetation removal and toolbox talk. Restoration of terrestrial habitats following removal of temporary haul road.	Prior to starting track creation or tracking vehicles.
Badgers	No mitigation required - not present within the Site.	N/A
Bats	Building demolition undertaken during winter November-February inclusive to avoid potential risk to roosting bats and nesting birds.	During building demolition and dam removal works.
Otter	Avoid night-time working where possible. If required avoid light spill onto sensitive areas such as waterbodies and woodland. Avoid night-time working to limit disturbance. Maintain habitat connectivity during dam removal and river restoration.	During dam discontinuance works.
Water voles	Avoid night-time working. Pre-works checks for water vole burrows. Displacement of water voles from outflow channel within 15m of works area prior to commencing works. Application of conservation licence to trap and remove water voles from lake. Identification and restoration (if required) of a receptor site. Restoration of outflow channel following drawdown. Restoration of inflow channel. Re-establish vegetation on exposed sediments following drawdown. Monitoring following re-introduction/ removal of fencing.	Pre-commencement (licence application) and during discontinuance works, post completion monitoring following reintroduction.
Invertebrates	Water quality and sedimentation mitigation as identified as above. Restoration of terrestrial habitats following completion of the works as identified above.	No specific mitigation covered by habitat and water quality mitigation.

3.1 Terrestrial habitats

The terrestrial area around the lake supports a mosaic of wet and dry dwarf shrub heath and mire communities. Occasional patches of acid grassland with elements of neutral grassland lie along the northern shore, by the road. Swamp communities lie within the flush in the east of the site and marshy grassland forms a mosaic with mire/flush communities along flushes in the north-west, bank margins in the west, and south of the site by the stream. Two buildings are located on the lake bank in the north-east of the site.

To the west of the lake the heathland is fairly uniform, but patches of hair's-tail cotton grass and a predominance of sphagnum mosses indicates a perched water table and possibly deeper peat along breaks in the slope and flatter areas adjacent to the lake. The heath supports a dominance of ericoids, mostly ling (*Calluna vulgaris*) and bilberry (*Vaccinium myrtillus*) and sphagnum and non-sphagnum mosses and a few native saplings have seeded on the high ground. Fringing the lake is a strip of marshy

grassland/mire, dominated by rushes and mosses behind a fringe of rushes, and a small flush enters the lake from the north-west corner supporting orchids. Overall, the habitat appears to be subject to very light grazing and is relatively undisturbed, evident from the height and density of the heath and low abundance of grassland species within the sward.

3.1.1 Potential Impacts & Proposed Mitigation Measures

Creation of a temporary access track and site compound required during the dam removal will be undertaken in an environmentally sensitive way. The construction of the access track and compound will be informed by a peat survey of the access route which is scheduled to be completed in December 2021. Data captured during the proposed peat survey will provide high resolution data regarding the type and depth of peat along the proposed access track route. Previous peat survey data identified that the peat deposits on the west of Llyn Bran showed a relatively high degree of humification. High humification is associated with lower shear strength and reduces the feasibility of floating access tracks on peat. Once the exact nature of the peat along the access track is confirmed the engineering specification will be determined in order to construct a track that will be suitable for the requirements of the work and is sensitive to the underlying peat and vegetation. The construction design and methodology will be informed by the peat depth survey as well as best practice guidance[7] and will consist of either a bog mat track or stone track and will take into consideration the following mitigation:

- Where possible the access track will be 'floated' on the peat to minimise excavation, disturbance to the soil structure, hydrological regime and priority habitats at the site.
- Alternative track routes and compound locations will be explored were possible to minimise damage.
- Surface vegetation will remain in place were possible to improve the cohesive strength of the surface peat and prevent exposure, reduce compression and prevent the loss of peat during the works.
- Vegetation clearance should follow the mitigation outlined for breeding birds, reptiles, and water voles below.
- If essential, turf may be removed to facilitate the construction of the access track were levelling may be required. Any turfs which are removed will be cut and stored carefully. Turfs will not be stacked and will be placed as close as possible to prevent the edges drying out. Provision will be made so that turfs can be watered during storage over the summer months to prevent drying and "curling" of turf edges.
- The construction of the track will aim to reduce the overall weight applied to the underlying peat by prioritising bog matting and lightweight construction materials over the use of aggregates were practical.
- The weight and traffic along the track will be reduced were possible to reduce compression of the underlying peat. Plant machinery will consist of wide track excavators and dumpers to spread the load of plant machinery and haulage along the track and further reduce compression.
- If required, the construction of a "floating" stone track will be completed utilising aggregate of a type that is similar to the local geology or is not alkali so as to preserve the acidic nature of the peat and prevent impact to the local hydrology.
- If required, stone will be laid upon a strong geotextile and geogrid layer in order to distribute weight and facilitate the removal of stone following the completion of the works.
- Following completion of the works habitat restoration of disturbed areas following removal of the access track will focus on natural regeneration to replicate the existing heath and mire communities. All reinstated areas would subsequently be monitored for germination /regeneration over at least two full growing seasons as part of the CSMG surveys outlined for the exposed lake sediments.

[7] Forestry Civil Engineering & Scottish Natural Heritage (2010). FLOATING ROADS ON PEAT A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with particular reference to Wind Farm Developments in Scotland.

- The proposed monitoring will be used to identify the requirement for additional intervention for vegetation restoration such as seeding, plug plants or soil stabilisation techniques such as use of heather brash, geotextiles etc.

3.2 Fish

Based on the baseline survey results no protected or notable fish species were identified in Llyn Bran. As the fish community within Llyn Bran contains no protected or notable species, mitigation requirements for the fish community are limited to standard pollution and sediment control measures during dam removal and river restoration works to the outflow. As Llyn Bran is considered oligotrophic, the fish community is expected to consist of population with low densities.

3.2.1 Potential Impacts & Proposed Mitigation Measures

Potential mitigation measures to reduce the risk of adverse effects on fish within the Site include:

- Initial siphoning will be undertaken from the margin close to the dam wall until the lake has been drawn down to allow for the sighting a powered pump on the exposed lakebed. Pumping will be undertaken by floating pump inlets located at the surface above the deeper part of the lake in order to reduce the likelihood of fish entrainment.
- Water quality monitoring will be undertaken during the drawdown with the use of in-situ sensors. Fish distress will be monitored, and fish removal or will be considered should there be any indication of stress.

3.3 Great Crested Newts

Great crested newts (*Triturus cristatus*) are highly unlikely to be present within Llyn Bran or the adjacent terrestrial habitats due to the absence of suitable breeding habitat within 250m of the site. No further survey work or mitigation is required for great crested newts as part of this scheme.

3.4 Badgers

No setts or signs of badgers (*Meles meles*) were identified within the Site or 30m of the site boundary. The majority of habitat surrounding the reservoir was wet dwarf shrub heath, dominated by heather and sphagnum. This provides minimal foraging opportunities for badger due to the dense wet vegetation and would provide difficult conditions for sett building. Due to the surrounding woodland outside of the Site providing more suitable habitat for badgers, it is unlikely badgers would utilise the site. Due to the transitory nature of badgers, a pre-commencement walkover should be undertaken by a suitable qualified ecologist before any works start on site to confirm continued absence of badger setts.

3.5 Invertebrates

Although the desk study identified the presence of designated and notable invertebrate species within the wider environment, no dedicated monitoring for terrestrial or aquatic invertebrates are recommended due to the lack of adverse impacts predicted as a result of the proposed works.

3.6 Breeding birds

The baseline report confirmed the presence of five red-list and eight amber-listed bird species at Llyn Bran as well as four species listed under the Environment Wales Act. A further four Schedule 1 species were identified in the desk study as confirmed from within 2km of the Site.

The most suitable habitats on Site for supporting breeding birds include the areas of mire and dwarf shrub heath, particularly to the north-east of the reservoir, the woodland strip to the west, and the conifer plantations to the south-east or the reservoir. During the breeding bird surveys, these habitats showed the highest species diversity and levels of breeding behaviour such as singing or sightings of pairs of

birds. Bird abundance and species diversity was lowest in the areas of clear-felled planation south-east of the reservoir. Swallows were observed nesting in both the Utility Building and Boat House during the bat emergence/re-entry surveys undertaken on the buildings.

3.6.1 Potential Impacts & Proposed Mitigation Measures

Potential mitigation measures to reduce the risk of adverse effects on breeding birds within the Site include:

- Vegetation clearance contractors to be given an ecology toolbox talk prior to site clearance work;
- Demolition of the Utility Building should only be undertaken between October-February to avoid the bird nesting season;
- Use of visual and acoustic barriers to minimise noise transmission and disturbance of surrounding habitats during dam removal;
- Vegetation clearance or tracking over with vehicles required for the access track creation and building demolition should ideally be undertaken outside of the bird breeding season (March to August) – the ideal time for such work is late September to February inclusive. Alternatively, if this is not possible, a thorough check for any nesting birds should be undertaken by a suitably qualified ecologist within 48 hours prior to works. If any active bird nests are found, then works with the potential to impact on the nest must cease and an appropriate buffer zone (minimum 5m radius) should be established until the young have fledged and the nest is no longer in use. Should any Schedule 1 species be identified nesting within or adjacent to the works areas, the mitigation will need to be reassessed with the buffer required dependant on the species present.

3.7 Reptiles

Low numbers of common lizard (*Zootoca vivipara*) were recorded during the baseline surveys . Although adder (*Vipera berus*) were not recorded during baselines surveys they are assumed to be present in low densities based on the habitat suitability and their known presence in the region.

3.7.1 Potential Impacts & Proposed Mitigation Measures

The proposed works, including building demolition, dam removal, access track creation, and plant movement, have the potential to kill and injure common lizard which have been confirmed within the site.

Common lizard and adder are partially protected under the Wildlife and Countryside Act 1981 (as amended). Under this legislation it is an offence to intentionally kill, injure or take any reptile. Consequently, mitigation will be required during implementation of the proposed discontinuance works.

Due to the likely low population density present and the small area that will be directly affected during dam removal, trapping and removal of common lizards is not considered necessary. Instead, it is considered that phased vegetation clearance (sometimes referred to as habitat manipulation) would be the most pragmatic and proportional approach to avoid impacts to the species:

- Clearance of vegetation (where required) should be undertaken during the active season for reptiles, between late April and September during suitably warm and dry conditions, to make the habitat unsuitable for reptiles. This should be overseen by an ecologist;
- Potential hibernacula (piles of stones, logs, etc.) should not be disturbed between November and March to avoid unnecessary disturbance during hibernation. The route of the proposed access track should be cleared of potential hibernacula under supervision of ECoW prior to phased clearance;
- The vegetation should first be cut to 15cm in height (being careful to avoid any ground impact), followed by a second cut to ground level after a period of 48 hours, with arisings removed from

the works area to retained habitat and piled up in sunny locations near cover within DCWW's land ownership boundary to provide potential refuges;
- The vegetation should be cut working in the direction of the retained habitat. This will persuade any reptiles present to move of their own accord to adjacent habitat;
- Any animals found during clearance should be relocated to the adjacent retained habitat by the ecologist;
- Where plant movements and groundworks will occur, vegetation should then be kept short throughout the implementation period to keep the Site unsuitable for protected species. This would not require ecological supervision; and
- Arisings from any tree removal should be stacked in a safe area, outside of the construction zone, but within the ownership boundary, to create refuges for reptiles, amphibians, small mammals, and invertebrates.

Although the discontinuance works will cause short-term disturbance and temporary small-scale habitat loss, the reduction in lake level and revegetation of the newly exposed lake margins will result in an overall increase in available habitat for reptiles.

3.8 Bats

No evidence of roosting bats was identified by the dusk emergence and dawn re-entry surveys at the Utility Building or Boat House. A total of four bat species were recorded foraging in the habitats surrounding the buildings: common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), noctule (*Nyctalus noctula*), and an unidentified Myotis species likely to be Daubenton's bat (*Myotis daubentonii*) based on the calls recorded and habitat

3.8.1 Potential Impacts & Proposed Mitigation Measures

The proposed discontinuance is unlikely to significantly alter the suitability of the Site for foraging bats in the long-term as the lake will be retained (albeit smaller surface area), there will be an increase in water course length of reservoir outflow, and there will be a restoration of exposed terrestrial habitats following draw down.

No bats roosts were identified in the Utility Building and Boat House during the baseline surveys conducted in July and August 2019. Due to the delay between the baseline surveys and the proposed demolition in 2022 it is recommended that emergence and re-entry surveys be repeated on the Utility Building and Boat House during the 2021 bat survey season (May and September) in order to provide adequate time for a bat license application to be submitted should it be required.

3.9 Eurasian otter (*Lutra lutra*)

Eurasian otters were confirmed to be present at Llyn Bran as otter spraints were identified on the reservoir margins and dam wall in August and September 2019. No evidence of otter holts, couches, or lay ups were identified during the surveys. As otter have a large home range, they are assumed to utilise Llyn Bran only occasionally for foraging and are likely to be more dependent on the larger downstream Llyn Brenig reservoir. This is also evidenced by the absence of field signs of otters during the initial survey in June 2019. The reservoir provides suitable foraging and feeding habitat whereas the outflow channel is likely to be used as commuting corridor for otter rather than a foraging resource.

3.9.1 Potential Impacts & Proposed Mitigation Measures

As no otter holts or layups were identified during surveys is it predicted that impacts are likely to be limited to disturbance during the proposed works and temporary loss of habitat during construction. In order to minimise this to an acceptable level, the following mitigation measures will be implemented.

A pre-construction check of habitats within 50m of the works should be undertaken to ensure the continued absence of any otter holts or couches that might be disturbed. If any such features are recorded during this check, construction work in the vicinity may require application for a mitigation licence from NRW and additional mitigation prior to and during dam discontinuance works; this could include, but not be limited to, amendments to construction methodology, timing and exact position of the works.

As otters are typically more active at night, there is to be no night working adjacent to the reservoir, dam, or reservoir outflow. If generators do need to be used, they need to be placed in acoustic enclosures to limit disturbance. Where fencing is required to protect members of the public, this should be designed to limit obstruction to otters commuting up the outflow to Llyn Bran.

It will not be possible to mitigate for the loss in foraging habitat due to the reduction in lake level and area. However, as the reservoir is isolated at the top of the catchment and connected to Llyn Brenig which contains a large suitable foraging area it is unlikely that otters present would be significantly adversely affected by the reduction in foraging habitat and food resource.

3.10 Water vole (Arvicola amphibius)

Water vole activity including latrines, feeding remains and burrows was recorded during both surveys at Llyn Bran in 2019. The field signs indicate that water vole activity was highest on the west and north banks of the reservoir with activity also recorded along the reservoir outflow. No evidence of water vole activity was recorded along the eastern side of the reservoir, this is likely to be due to the lack of suitable habitat due to the high eroding banks and shallow margins.

3.10.1 Potential Impacts & Proposed Mitigation Measures

To provide the water vole mitigation strategy Ricardo have partnered with Salix River and Wetland Services Ltd. who supply coir products for river restoration and habitat creation. Salix grow and supply various UK native wetland plant species and have extensive experience working on habitat creation and restoration for water voles.

The drawdown in lake level poses a substantial threat to water voles. As the water level recedes, bare ground will appear between the habitat that contains their burrows and their food source and the lake margin. Although the existing terrestrial habitats will remain, the increased distance to water will make the water voles present in these areas more susceptible to predation[8].

Because a two-stage drawdown will require the same mitigation measures as a single drawdown but will extend the duration of disturbance, a more direct approach is now proposed that will aim to re-establish the water vole population at its current level by the middle of summer 2022. By adopting this approach, the water vole habitat will be re-established within weeks and not over several years.

The approach will consist of the following (see attached **Figure P1845-201C**):

- A conservation licence will be obtained from NRW prior to commencement of discontinuance works;
- Capture and temporary *ex situ* management of resident water vole population with the aim of mid-summer re-introduction to Llyn Bran;
- Re-establishment of vegetation along the new lake margin, inflow and outflow using pre-established Coir Pallets planted with high quality native plant species;

[8] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series). Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.

- Re-seeding of exposed margins away from the water edge using seed harvested from the adjacent heathland and heather brash.

3.10.1.1 Water vole capture, husbandry and release (under license from NRW)

Water vole capture will commence in early March 2022 and will continue until 5 clear trapping days have been recorded. The water voles will be placed in transport cages and relocated to Wildwood Trust in Kent where they will be cared for until the habitat at the site is suitable for release. It is expected that will be cared for at Wildwood Trust for a maximum of 3 months before they will be returned to Lyn Bran and released. Wildwood Trust will provide expert care of the water voles during this period including routine veterinary care, monitoring and record keeping.

Once the habitat at Llyn Bran has been assessed and identified as suitable for release, the voles will be returned to site and the release programme will commence. The aim is to release the voles by end of July 2022, in order to provide them with sufficient time to establish burrows prior to the autumn and winter. Monitoring of the water vole population will commence upon release and will continue for two full seasons (March to October).

3.10.1.2 Re-establishment of vegetation along new lake margin

The re-establishment of the vegetation along the new lake margin, inflow and outflow will commence once the lake drawdown has been completed. Vegetation re-establishment will consist of a two-pronged approach comprising the use of pre-established Coir Pallets planted with high quality native plant species and the re-vegetation of the exposed margins using seeds harvested from the adjacent area and heather brash. Unvegetated coir matting will also be laid and secured along the new shoreline to help protect and stabilise the silt behind.

Coir Pallets are composed from coir fibre which is a sustainable waste product from the husk of the coconut shell. The pallets are planted at a high density and grown off site in a nursery to ensure that the vegetation is a dense and hardy cover. Once the drawdown has commenced the vegetated pallets will be transported to site and fixed in place.

The vegetation community that will be used to vegetate the Coir Pallets will consist of 80% grasses and sedges (G) and 20% UK Native Wildflowers. The community will comprise:

- 2% *Achillea millefolium*;
- 6% *Agrostis capillaris* (G);
- 6% *Alopecurus pratensis* (G);
- 4% *Anthoxanthum odoratum* (G);
- 0.5% *Calluna vulgaris;*
- 16% *Dactylis glomerata* (G);
- 40% *Festuca rubra ssp's* (G);
- 8% *Holcus lanatus* (G);
- 3.5% *Lotus pedunculatus*;
- 6% *Plantago lanceolata;*
- 2% *Ranunculus repens;*
- 2% *Rumex acetosella;*
- 1% *Urtica dioica;*
- 1% *Juncus articulates;*
- 1% *Juncus effusus;*
- 1% *Molinia caerulea; and*
- 1% *Carex otrubae.*

3.11 Aquatic macrophytes

One of the targets which Llyn Bran failed in terms of meeting the specific target for favourable conditions for the Annex 1 habitat was related to the macrophyte community structure. The CSMG target for the macrophyte community structure requires that ≥ 6/10 (>60%) sample spots (boat & wader survey) have ≥ 1 species considered characteristic of oligotrophic-mesotrophic lakes. Of the 142 vegetated survey points at Llyn bran, currently only 54% had one or more characteristic species present. The macrophyte community at Llyn Bran included five "characteristic" oligotrophic species, but of those, only *Littorella uniflora* was common, with *Isoetes lacustris* confined to a single area on the east side and growing no deeper than 70 cm depth. **Table 3.4** shows the five oligotrophic species recorded at Llyn Bran, as well as their % frequencies during the 2018 survey.

Table 3.4: Characteristic oligotrophic species recorded at Llyn Bran during the 2018 surveys

Submerged and floating vegetation	21/07/2018 % Frequency (n=142)*
Apium inundatum	0.7
Isoetes lacustris	1.4
Isolepis (*Eleogiton*) *fluitans*	+
Littorella uniflora	52.1
Sparganium angustifolium	1.4

Llyn Bran also failed to achieve the CSMG target for indicators of local distinctiveness.

3.11.1 Potential Impacts & Proposed Mitigation Measures

The impact of water level lowering on the aquatic and wetland plants at Llyn Bran requires further consideration within the wider ecological mitigation plan. In particular, the requirement to reset the marginal habitat quickly and within a single drawdown event to protect the water vole population, necessitates a fully evidenced mitigation plan for the macrophyte population. A drawdown of 2.5 m will leave the majority of the current aquatic macrophyte community above the final water level.

The 2018 survey recorded only *Nitella flexilis* agg., *Chara virgata* and a single occurrence of *Myriophyllum alterniflorum* at water depths greater than 2.5 m below top water level. All the remaining macrophytes, inclusive of those considered as favourable "characteristic" species for oligo/mesotrophic lakes in Wales (*Apium inundatum*, *Isoetes lacustris*, *Isolepis fluitans, Littorella uniflora* and *Sparganium angustifolium*) all occurred in areas that will be above the final water level. Desiccation is a major threat to most aquatic plants. Some species are tolerant to periods of drying (e.g. *L. uniflora*, *A. inundatum*, *I. fluitans* & *S. angustifolium*) while others will survive only hours or days once exposed above the water line (e.g. *I. lacustris*, *N. flexilis*, *C. virgata*). For this reason, a series of species-specific mitigation plans are required to help facilitate the future survival of the characteristic flora within Llyn Bran after drawdown. The mitigation plans should include an understanding of the current distribution of each species within the site and the local habitat requirements where they are found (inclusive of water depth, substrate types, shading & fetch). The information on local factors can then be combined with the known autecology to devise the most effective means of mitigation for each species, supported by case studies where available. In addition to water level change, other potential factors affecting the success of macrophyte mitigation will include water quality and water clarity; both which are likely to be impacted due to the local disturbance and resuspension of exposed and shallow-water sediments. Physicochemical and ecological monitoring before, during and after the water level lowering will therefore form a vital part of informing the macrophyte mitigation plans.

The mitigation plan will be for macrophyte species characteristic of oligotrophic habitats will include methods such as *ex situ* population being established (preferably in on-site tanks) and species translocations (within-site) during the drawdown. Post-drawdown monitoring will continue for several

years and the translocation of characteristic species from suitable donor sites will be considered (if required).

4 Discussion & conclusions

This report provides an update to the Environmental Report to include further information on those concerns raised by NRW in September 2021 (Ref: 25/2021/0830). This includes:

- Updated information regarding the proposed project and project design.
- Updated information regarding the management of silt and sedimentation during construction.
- A HRA including a screening of LSE and appropriate assessment of the implementation of the compensation measures at Llyn Bran that were identified as measures required to compensate of the loss off of 2.05ha of oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea.*

The discontinuance of a reservoir and the associated drawdown of the water level represents a substantial change to an ecosystem. The most substantial change is the establishment of a new lake margin well away from its current location. This can represent a significant impact for sensitive species, such as water voles, that now find their burrows up to 50 m away from the water's edge with a substantial expanse of open ground, free of vegetative cover separating them from the water, moving them away from their food resource and exposing them to increased risk of predation. Aquatic macrophytes such as *Isoetes lacustris,* characteristic of oligotrophic habitats and confined to a single location at Llyn Bran in water no deeper than 70cm, may now be perched well above the new water level.

A two-stage drawdown strategy, with a period of a year or more between drawdown events may appear to represent a less substantial impact however most of the same mitigation measures will be required and such an approach will result in repeated disturbance of the sensitive features. The drawdown of water level at Llyn Bran, once discontinuance has been completed, is expected to be around 2.5m. A staged drawdown of 1.25m, aimed to reduce the significance of the impact on water voles will still leave water vole burrows 25m away from the water's edge in some places and *I. lacustris* perched above the new water level.

A single drawdown event would be advantageous as it would allow for a single disturbance event and would speed up the process of implementation of all of the compensation measures related to Llyn Anafon. This would allow for all measures to be secured prior to the final discontinuance of Llyn Anafon.

Implementation of the following measures discussed above and summarised below would mitigate the impacts of the proposed single drawdown event:

- Mitigation measures for the terrestrial habitats include the following:
    - Surface vegetation would be turf-cut and stored. The topsoil or peat which contains the seedbank will be stripped and stored in clearly defined stockpiles for the duration of the works.
    - Soil horizons will be excavated where required and stored separately.
    - Stockpiles will be located away from water courses to avoid sediment contamination.
    - Any imported ballast material should be pH neutral; alkali material such as limestone or other stone which could affect the soil pH should not be used.
    - Vegetation establishing on stockpiles should be monitored and controlled mechanically where required with no use of herbicides.
    - Backfill following removal of the track will ensure soil and peat horizons are maintained through use of the separate stockpiles.

  - All reinstated areas would subsequently be monitored for germination /regeneration over at least two full growing seasons as part of the CSMG surveys outlined for the exposed lake sediments.
  - Vegetation clearance should follow the mitigation outlined for breeding birds, reptiles, and water voles below.
- As the fish community within Llyn Bran contains no protected or notable species, mitigation requirements for the fish community are limited to standard pollution and sediment control measures during dam removal and river restoration works to the outflow;
- Great crested newts and badgers were found to be absent from Llyn Bran, therefore no further mitigation measures are required;
- No dedicated mitigation monitoring for terrestrial or aquatic invertebrates are recommended due to the lack of adverse impacts predicted as a result of the proposed works;
- Mitigation measures for breeding birds consists of the following:
  - Vegetation clearance contractors to be given an ecology toolbox talk prior to site clearance work;
  - Demolition of the Utility Building should only be undertaken between October-February to avoid the bird nesting season;
  - Use of visual and acoustic barriers to minimise noise transmission and disturbance of surrounding habitats during dam removal;
  - Vegetation clearance or tracking over with vehicles required for the access track creation and building demolition should ideally be undertaken outside of the bird breeding season (March to August) – the ideal time for such work is late September to February inclusive. Alternatively, if this is not possible, a thorough check for any nesting birds should be undertaken by a suitably qualified ecologist within 48 hours prior to works. If any active bird nests are found, then works with the potential to impact on the nest must cease and an appropriate buffer zone (minimum 5m radius) should be established until the young have fledged and the nest is no longer in use. Should any Schedule 1 species be identified nesting within or adjacent to the works areas, the mitigation will need to be reassessed with the buffer required dependant on the species present;
- Mitigation measures for reptiles consists of the following:
- Clearance of vegetation (where required) should be undertaken during the active season for reptiles, between late April and September during suitably warm and dry conditions, to make the habitat unsuitable for reptiles. This should be overseen by an ecologist;
  - Potential hibernacula (piles of stones, logs, etc.) should not be disturbed between November and March to avoid unnecessary disturbance during hibernation. The route of the proposed access track should be cleared of potential hibernacula under supervision of ECoW prior to phased clearance;
  - The vegetation should first be cut to 15cm in height (being careful to avoid any ground impact), followed by a second cut to ground level after a period of 48 hours, with arisings removed from the works area to retained habitat and piled up in sunny locations near cover within DCWW's land ownership boundary to provide potential refuges;
  - The vegetation should be cut working in the direction of the retained habitat. This will persuade any reptiles present to move of their own accord to adjacent habitat;
  - Any animals found during clearance should be relocated to the adjacent retained habitat by the ecologist;
  - Where plant movements and groundworks will occur, vegetation should then be kept short throughout the implementation period to keep the Site unsuitable for protected species. This would not require ecological supervision; and

    - Arisings from tree removal should be stacked in a safe area, outside of the construction zone, but within the ownership boundary, to create refuges for reptiles, amphibians, small mammals, and invertebrates.
- Due to the delay between the baseline bat surveys and the proposed demolition in 2022 it is recommended that emergence and re-entry surveys be repeated on the Utility Building and Boat House during the 2021 bat survey season (May and September) in order to provide adequate time for a bat license application to be submitted should it be required;
- A pre-construction check of habitats within 50m of the works should be undertaken to ensure the continued absence of any otter holts or couches that might be disturbed;
- The mitigation strategy for water voles consists of the following:
    - Capture and temporary *ex situ* husbandry of water voles population along the shore of Llyn Bran with the aim of mid-summer re-introduction to Llyn Bran;
    - Re-establishment of vegetation along the new lake margin, inflow and outflow using a mixture of pre-established Coir Pallets planted with high quality native plant species;
- A mitigation plan for macrophyte species characteristic of oligotrophic habitats may include *ex situ* populations being established (preferably in on-site tanks), species translocations (within-site) during the drawdown and post-drawdown monitoring.

A1 Appendix A – Habitat Regulation Assessment

A1.1 Background

As noted in Section 1 of the main report, the discontinuance of the existing Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology will require measures to manage siltation. The discontinuance of the Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology has been identified as a compensation measure for the loss off of 2.05ha of oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* from the Llyn Anafon reservoir. The compensation measures were identified under Regulation 64 of the Conservation of Habitat and Species Regulations 2017 (as amended) (referred to hereafter as the Habitats Regulations) as part of the Habitat Regulation Assessment (HRA) process for the Llyn Anafon Scheme which is associated with the Eryri/Snowdonia Special Area of Conservation (SAC).

NRW has advised the Local Planning Authority (The Denbighshire County Council) that the activity is located in the catchment of the River Dee and Bala Lake/Afon Dyfrydwy A Llyn Tegid SAC and raised concerns with regards to the impacts of increased phosphate concentrations as a result of the activity. NRW has indicated that the activity should, therefore, be subject to a HRA under Regulation 63 of the habitat regulations.

Therefore this Appendix provides the HRA for, and sets out the screening of Likely Significant Effects (LSE) and Appropriate Assessment of the discontinuance of the Llyn Bran reservoir and removal of the existing dam structure.

A1.2 Methodology

The HRA has been undertaken in accordance with currently available guidance[9,10,11,12,] and has been based on a precautionary approach as required under the Habitats Regulations. Independent best practice[13] encourages the use of a four-stage process to allow navigation of the tests described in the Regulations. This four-stage process consists of the following:

- Stage 1 - Screening is undertaken to identify whether the project is likely to have significant effects on European sites.
- Stage 2 - Where a significant effect is likely (noting the precautionary principle), an Appropriate Assessment is then undertaken, to determine whether the project would adversely affect the integrity of the European site(s), either alone or in-combination with other plans and projects, taking into account available mitigation measures.
- Stage 3 - Where adverse effects on the integrity of a European site are identified at the Appropriate Assessment stage, feasible alternative solutions would be examined that meet the project objectives but have less damaging effects on the integrity of the European site.

[9] Tyldesley, D. & Chapman, C. (2013). The Habitats Regulations Assessment Handbook, October 2021 edition UK. DTA Publications Limited.
[10] Court of Justice for the European Union's ruling on People Over Wind and Sweetman ('Sweetman II') vs Coillte Teoranta, Case C-323/17.
[11] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government (2019). Appropriate Assessment, Guidance on the use of Habitats Regulations Assessment. UK Government. Accessed from: Appropriate assessment - GOV.UK (www.gov.uk)
[12] UK Government (2019). The Conservation of Habitats and Species Regulations (Amendment) (EU Exit) Regulations 2019. Accessed from: The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (legislation.gov.uk)
[13] Tyldesley, D & Chapman, C. (2013). The Habitats Regulations Assessment Handbook, October 2021 edition UK. DTA Publications Limited.

- Stage 4 - If no alternative solutions are identified during Stage 3, an assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest, it is deemed that the project should proceed.

Stage 3 and 4 were not required as part of this HRA.

A1.2.1 Stage 1 - Screening

The potential for LSEs as a result of the discontinuance of the existing Llyn Bran reservoir on European sites, includes consideration of Special Protection Areas (SPAs) and SACs. Prior to leaving the European Union (EU), SPAs and SACs formed the Natura 2000 network. The term 'national site network' was introduced into the 2017 Habitats Regulations by the 2019 Amendment Regulations. Since leaving the EU, all designated or classified UK sites and any new sites classified or designated after Exit Day have become part of the National Site Network[14].

- SPAs are classified under the European Council Directive 'on the conservation of wild birds' (2009/147/EC; 'Birds Directive') for the protection of wild birds and their habitats (including particularly rare and vulnerable species listed in Annex 1 of the Birds Directive, and migratory species).
- SACs are designated under the Habitats Directive (92/43/EEC) and target particular habitats (Annex 1) and/or species (Annex II) identified as being of European importance.
- The Government also expects potential SPAs (pSPAs), possible/ proposed SACs (pSACs), compensation habitat and Ramsar sites to be included within the assessment.
- Ramsar sites support internationally important wetland habitats and are listed under the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention, 1971).

For ease of reference through the HRA process, these designations are collectively referred to as European sites, despite Ramsar designations being made at the international level.

The purpose of the screening stage is to determine whether any part of the project in question (in this case implementation of the compensation measures) is likely to have a significant effect on any European site. This refers to a possible significant effect whose occurrence cannot be excluded on the basis of objective information and would undermine the conservation objectives for the European site[15]. There must be credible evidence that there is a real risk of an LSE on a European site, rather than a hypothetical risk. This is judged in terms of the implications of the plan on a site's conservation objectives, which relate to its 'qualifying features' (i.e. those Annex I habitats, Annex II species, and Annex I bird populations[16], or Ramsar criterion, for which it has been designated). Significantly, HRA is based on a rigorous application of the precautionary principle. Where uncertainty or doubt remains, an impact should be assumed, triggering the requirement for appropriate assessment of that project.

The screening stage also has to conclude whether any in-combination effects would result from the project in-combination with other plans and projects, and whether these would adversely affect the integrity of a European site.

In April 2018[17] there was an important judgment in the Court of Justice of the European Union (CJEU) which ruled that Article 6(3) of the Habitats Directive must be interpreted as meaning that mitigation

[14] Tyldesley, D. & Chapman, C. (2013). The Habitats Regulations Assessment Handbook, October 2021 edition UK. DTA Publications Limited.
[15] Tyldesley, D. & Chapman, C. (2013). The Habitats Regulations Assessment Handbook, October 2021 edition UK. DTA Publications Limited.
[16] Annexes are contained within the relevant EC Directive.
[17] Court of Justice for the European Union's ruling on People Over Wind and Sweetman ('Sweetman II') vs Coillte Teoranta, Case C-323/17.

measures should be assessed within the framework of an appropriate assessment and that it is not permissible to take account of mitigation measures at the screening stage.

A1.2.2 Stage 2 – Appropriate Assessment

Where a risk of LSE was identified at the screening stage (noting the precautionary principle), the project was subject to a Stage 2 Appropriate Assessment. Further assessment was, therefore, undertaken to identify the specific attributes and targets of each qualifying feature that could be adversely affected by the project and, if required, identify potential mitigation measures to prevent adverse effects. This considered the project alone and in-combination.

The Appropriate Assessment considered the potentially damaging aspects of the project during both construction and operation, and the potential effects on the associated European site's qualifying features and achievement of the conservation objectives. The impacts were characterised in terms of their likelihood, nature, scale, severity and duration (see Section A1.2.2.1).

The potential for adverse effects on the integrity (AEoI) of a European site depends on the scale and magnitude of the action and its predicted impacts, taking into account the distribution of the qualifying features across the site in relation to the predicted impact and the location, timing and duration of the proposed activity and the level of understanding of the effect, such as whether it has been recorded before and, based on current ecological knowledge, whether it can be expected to operate at the site in question.

A1.2.2.1 Impacts

To help determine adverse effects on site integrity, the following parameters were firstly used to define the impact (i.e., mechanism by which effects are caused):

- Impact type - direct or indirect, positive or negative
- Magnitude of impact – the 'amount' or intensity of an impact. This may sometimes be synonymous with 'extent' (see below) for certain impacts, such as habitat loss.
- Extent of impact – the area over which the impact will be felt.
- Duration of impact – how long it will occur. The guidelines suggest that ecological impact durations should be described in terms of ecological characteristics (e.g. species lifecycles/ longevity) rather than human timeframes.
- Timing of impact – when it will occur, taking note of seasonality.
- Frequency of impact – how often it will occur.
- Reversibility of impact – whether recovery or reinstatement is possible

The identification and description of impacts is used as a process to help identify effects on the conservation objectives that support the sites' qualifying features. However, it is ultimately the likely *effect* on the European site's Conservation Objectives that is critical to decision making through the HRA process.

A1.2.2.2 Adverse Effect

The possible impacts associated with the project were considered in the context of the effect on the qualifying features for the European sites under consideration.

An AEoI is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of designation. In addition, an adverse effect would be one which caused a detectable reduction of the features for which a site was designated, at the scale of the site rather than at the scale of the location of the impact.

The Habitats Directive defines the conservation status of habitats as 'favourable' when:

- Its natural range and area it covers within that range are stable or increasing; and
- The species structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future.
- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;
- The natural range of the species is neither being reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

A1.2.2.3 Integrity Test

The integrity test is the conclusion of an Appropriate Assessment and requires the competent authority to ascertain whether the proposed project (either alone or in-combination with other plans or projects), will have no adverse effect on site integrity. The following definition of site integrity is provided bythe Habitats Regulations Assessment Handbook: the integrity of the site is "*the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which the site is (or will be) designated*[18].

A1.2.3 Mitigation Measures

The assessment considered mitigation measures that may be available to reduce the likelihood, magnitude, scale, and duration of the effect to a lower level, which can be applied at the appropriate assessment stage to inform the overall integrity test[19].

A1.2.4 Review of Potential In-combination Effects

Under Regulation 63 and 64 of the Conservation of Habitats and Species Regulations 2017 amended an in-combination assessment of the proposed plan with other plans or projects is required where low level, residual effects are identified during Stage 1 screening and/ or Stage 2 Appropriate Assessment. The review has therefore considered the in-combination effects of the project with other plans or projects which will be completed within the same time-scales.

A1.3 HRA Stage 1 – Screening Results

A1.3.1 Likely Significant Effects

The qualifying habitats and species of European sites are vulnerable to a wide range of impacts such as physical loss or damage of habitat, disturbance from noise, light, human presence, changes in hydrology (e.g., changes in water levels/flow, flooding), changes in water or air quality and biological disturbance (e.g., direct mortality, introduction of disease or non-native species).

Screening for LSEs reviewed the proximity of the project location to each European site(s), as well as hydrological connectivity via surface water and groundwater. Firstly, to provide an indication of LSEs on a European site(s), European sites within 10km of a or hydrologically connected have been identified (see **Figure A-1**). This distance-based threshold has been used in accordance with UKWIR guidance**Error! Bookmark not defined.**. There are no European sites within 10km of Llyn Bran. As indicated above, NRW has noted that the activity is in the catchment of the River Dee and Bala Lake/Afon Dyfrydwy A Llyn Tegid SAC and has raised concerns with regards to the potential of increased phosphorus levels in the SAC. As such, screening was undertaken to determine LSE on the SAC, as detailed in Table A1. The SAC is approximately 30km downstream of Llyn Anafon.

[18] Tyldesley, D. & Chapman, C. (2013). The Habitats Regulations Assessment Handbook, October 2021 edition UK. DTA Publications Limited.
[19] The "People over Wind" or "Sweetman" judgment ruled that Article 6(3) of the Habitats Directive must be interpreted as meaning that mitigation measures should be assessed within the framework of an Appropriate Assessment and that it is not permissible to take account of mitigation measures at the screening stage.

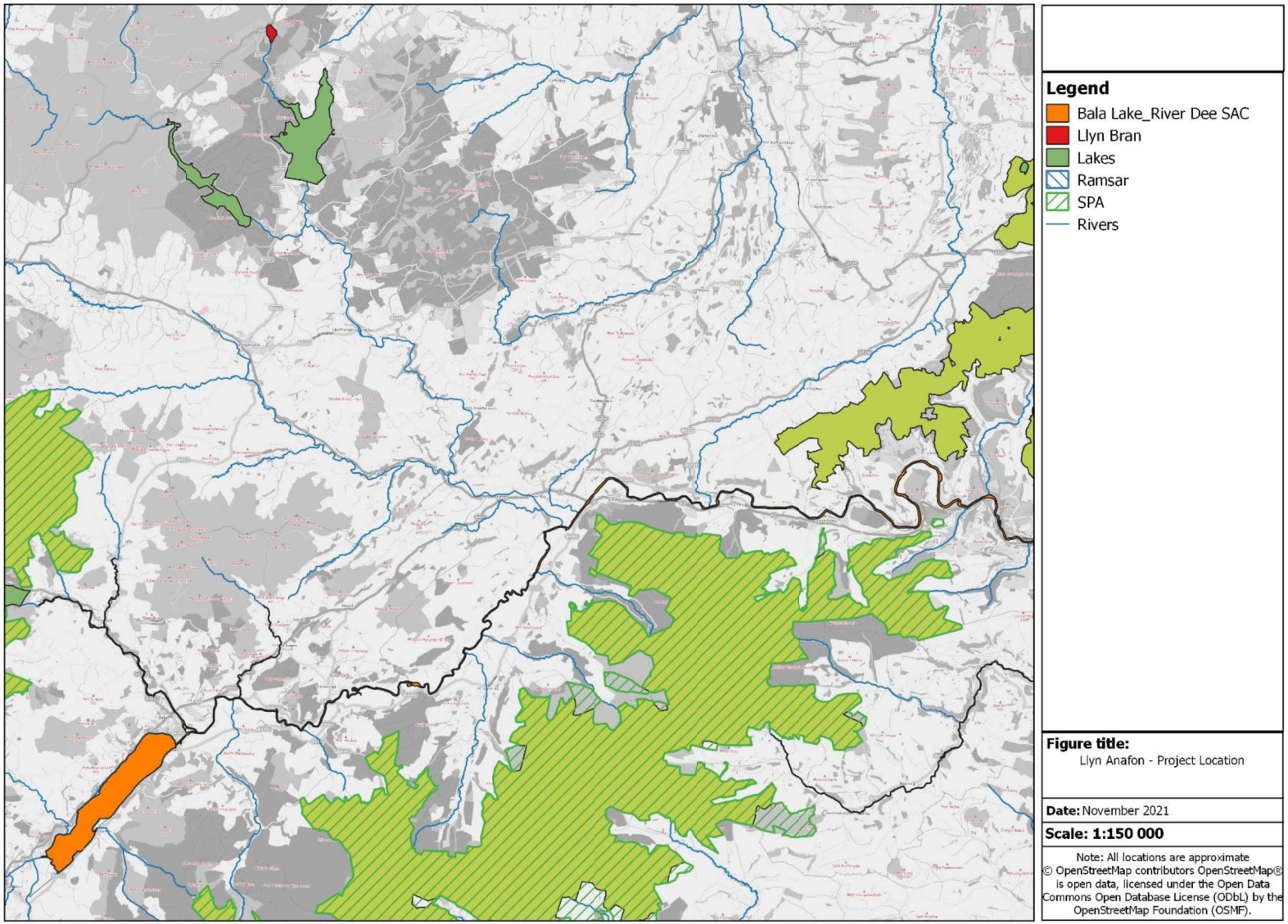

Figure A1 **Llyn Bran project location and study area**

Table A1 Likely Significant Effects on River Dee and Bala Lake/Afon Dyfrydwy A Llyn Tegid SAC

Designated site name:	**River Dee and Bala Lake (UK0030252)**	
Designation type: (SAC, SPA, Ramsar):	**SAC**	
Qualifying features:	3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.1106 Atlantic salmon *Salmo salar* 1831 Floating water-plantain *Luronium natans* 1095 Sea lamprey *Petromyzon marinus* 1096 Brook lamprey *Lampetra planeri* 1099 River lamprey *Lampetra fluviatilis* 1163 Bullhead *Cottus gobio* 1355 Otter *Lutra lutra*	**Water Dependency:** Habitats and species identified as water dependent[20]: All
Current conservation status:	**3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation: Bad and deteriorating –** (range: favourable, area: inadequate, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures: pollution, hydrological interventions, physical interventions and biological interventions. Main threats: pollution, hydrological interventions, physical interventions, biological interventions and climate change. **1106 Atlantic salmon *Salmo salar:* Unfavourable - inadequate (**Range: favourable, Population: unfavourable – inadequate, habitat for the species: favourable, Future prospects: unfavourable – inadequate). Main pressures: modification of hydrological flow or physical alteration of water bodies for agriculture (excluding development and operation of dams), roads, paths, railroads and related infrastructure (e.g. bridges, viaducts, tunnels), illegal shooting/killing, bycatch and incidental killing (due to fishing and hunting activities), mixed source pollution to surface and ground waters (limnic and terrestrial) and mixed source marine water pollution (marine and coastal). Main threats: use of plant protection chemicals in agriculture, modification of hydrological flow or physical alteration of water bodies for agriculture (excluding development and operation of dams), roads, paths, railroads and related infrastructure (e.g. bridges, viaducts, tunnels), illegal shooting/killing, bycatch and incidental killing (due to fishing and hunting activities), mixed source pollution to surface and ground waters (limnic and terrestrial), mixed source marine water pollution (marine and coastal), and abstraction from groundwater and surface water or mixed water. **1831 Floating water-plantain *Luronium* natans: Deteriorating (**Range: unfavourable - inadequate, Population: unfavourable – inadequate, habitat for the species: unknown, Future prospects: unfavourable – inadequate). Main pressures: agricultural activities point source water pollution, agricultural diffuse water pollution, invasive alien species, problematic native species, development and operation of dams, modification of hydrological flow and natural succession. Main threats: agricultural diffuse water pollution, air pollution, management of fishing stocks and game, invasive alien species, problematic native species (I04), mixed source water pollution, flow modification and natural succession. **1095 Sea lamprey *Petromyzon marinus*: Unknown** (Range: unknown, Population: unknown, habitat for the species: unknown, Future prospects: unknown). Main pressures: agricultural activities generating point source pollution to surface or ground waters, agricultural activities generating diffuse pollution to surface or ground waters, forestry activities generating pollution to surface or ground waters, hydropower (dams, weirs, run-off-the-river), including infrastructure and discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water. Main threats: same as main pressures. **S1096 Brook lamprey *Lampetra planeri*: Inadequate but improving –** (range: favourable, population: unknown, habitat: inadequate but improving, future prospects: favourable). Main pressures: bait digging, sand and gravel extraction, water pollution, management of aquatic and bank vegetation for drainage purposes, removal of sediments, canalisation, modification of hydrographic functioning, general, modifying structures of inland water courses, management of water levels, drying out / accumulation of organic material, eutrophication, acidification, invasion by a species, competition; introduction of disease. Main threats: bait digging, sand and gravel extraction, water pollution, management of aquatic and bank vegetation for drainage purposes, Removal of sediments, canalisation,	

[20] UKTAG (2003). *Guidance on the Identification of Natura Protected Areas [Final]*. UK Technical Advisory Group on the Water Framework Directive. TAG Work Programme Task 4.a, 1 – 20.

Designated site name:	**River Dee and Bala Lake (UK0030252)**		
	modification of hydrographic functioning, general, modifying structures of inland water courses, management of water levels, drying out / accumulation of organic material, eutrophication, acidification, invasion by a species, competition and introduction of disease. **1099 River lamprey *Lampetra fluviatilis*: Favourable –** (range: favourable, population: favourable, habitat: unknown, future prospects: favourable). Main pressures: Agricultural activities generating point source pollution to surface or ground waters, Agricultural activities generating diffuse pollution to surface or ground waters, Hydropower (dams, weirs, run-off-the-river), including infrastructure, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water, Mixed source pollution to surface and ground waters (limnic and terrestrial) , Drainage, Development and operation of dams, Modification of hydrological flow, Physical alteration of water bodies, and Change of habitat location, size, and / or quality due to climate change. Main threats: same as main pressures. **S1163 Bullhead *Cottus gobio*: Unknown –** (range: favourable, population: unknown, habitat: unknown, future prospects: unknown) - main pressures: Fish and Shellfish Aquaculture; Sand and gravel extraction; water pollution; management of aquatic and bank vegetation for drainage purposes; Canalisation; Modification of hydrographic functioning, general; modifying structures of inland water courses; management of water levels; Erosion; Silting up; predation; competition. Main threats: same as pressures. **1355 Otter *Lutra lutra*: Stable –** (range: favourable, population: favourable, habitat: favourable, future prospects: favourable). Main Pressures: modification of hydrological flow or physical alteration of water bodies for agriculture (excluding development and operation of dams), roads, paths, railroads and related infrastructure (e.g. bridges, viaducts, tunnels), illegal shooting/killing, bycatch and incidental killing (due to fishing and hunting activities), mixed source pollution to surface and ground waters (limnic and terrestrial), mixed source marine water pollution (marine and coastal). Main threats: use of plant protection chemicals in agriculture, modification of hydrological flow or physical alteration of water bodies for agriculture (excluding development and operation of dams), roads, paths, railroads and related infrastructure, illegal shooting/killing, bycatch and incidental killing (due to fishing and hunting activities), mixed source pollution to surface and ground waters (limnic and terrestrial), mixed source marine water pollution (marine and coastal), and abstraction from groundwater, surface water or mixed water.		
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; • The extent and distribution of qualifying natural habitats and habitats of qualifying species • The structure and function (including typical species) of qualifying natural habitats • The structure and function of the habitats of qualifying species • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • The populations of qualifying species, and, • The distribution of qualifying species within the site.		
SSSI Condition assessment:	River Dee (England) SSSI: 59.65% Favourable and 40.35% Unfavourable – no change.		
Potential Effects			
The proposed project will not result in direct impacts on the SAC such as direct habitat loss. Any impacts will be indirect through changes in water quality as a result of sedimentation. As noted above, NRW has also identified that there is a concern with		**Likely Significant Effects Alone**	**Likely Significant Effects In-Combination**

Designated site name:	**River Dee and Bala Lake (UK0030252)**		
regards to increased phosphate concentrations. Elevated nutrient levels interfere with competitive interactions between higher plant species and between higher plants and algae, leading to dominance by attached forms of algae and a loss of characteristic plant species (which may include lower plants such as mosses and liverworts). Through changes to plant growth and plant community composition and structure they also affect the wider food web, altering the balance between species with different feeding and behavioural strategies. Increased phosphate concentrations are could impact on the conservation objectives of the SAC. In particular, increased phosphate concentrations could effect the following: • Extent of the Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation within the site • Impact on the restore the natural nutrient regime of the river. Any anthropogenic enrichment above natural/background concentrations should be limited to levels at which adverse effects on characteristic biodiversity are unlikely. • Water quality changes and sediment impacts could also impact on the aquatic communities associated with the SAC, including: sea lamprey, brook lamprey, river lamprey, bullhead and otter It is noted that Llyn Brenig is located approximately 5km downstream of Llyn Bran and the River Dee and Bala Lake SAC is located an additional 25 km downstream of Llyn Brenig (via the Afon Alwen). The reservoir's purpose is to protect the water supply for North West England and north-east Wales, particularly Liverpool and its surrounding area. Its surface area of 3.7 km^2 makes it the fourth largest lake in Wales. This reservoir will be a significant barrier to any sediment/slit and will likely avoid any silt and phosphate issues in the SAC. However, adopting the precautionary approach it has been assumed that, in the absence of mitigation measures, there is a risk to increased nutrient concentrations in the River Dee and Bala Lake SAC. Floating water-plantain *Luronium natans* features are limited to the reaches upstream of the confluence with the Afon Alwen and with no hydrological connection, LSE on this feature is not possible.	Yes	No

A1.3.2 Conclusion

Screening of LSE identified that, in the absence of mitigation measures, the proposed project could result in increased sedimentation downstream of the Llyn Bran which could result in the subsequent increase in nutrient concentrations in the River Dee and Bala Lake SAC.

As such, an Appropriate Assessment is required to determine whether the project meets the requirements of the integrity test and whether mitigation measures are required.

A1.4 HRA Stage 2 – Appropriate Assessment

A1.4.1 Relevant Targets and Attributes

Recent advice from NRW[21] indicates that the Habitats Regulations impose a condition on permissions granted by under Article 3 of the Town and Country Planning (General Permitted Development) Order (GPDO) 1995 so that development likely to have a significant effect on a SAC must not commence until the LPA has given written approval. The LPA must consult NRW on the proposed GPDO development and take account of any representations. If NRW consider the proposed development to have a LSE, the LPA must make an Appropriate Assessment of the implications of the development for the SAC.

The discontinuance of the existing Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies could result in the exposure and mobilisation of large quantities of silt currently trapped behind the existing dam structure.

As noted above screening of LSE identified that, in the absence of mitigation measures, the proposed project could result in increased sedimentation downstream of the Llyn Bran which could result in the subsequent increase in nutrient concentrations in the River Dee and Bala Lake/Afon Dyfrydwy A Llyn Tegid SAC.

There are number of attribute targets associated with the conservation objectives of the SAC that could be impacted by increased nutrient concentrations[22]. These include the following:

- Extent of the feature within the site: restoration of the total extent of the water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation habitat within the site.
- Riparian habitat mosaic: restoration of the extent and pattern of in-channel and riparian biotopes (habitats) to that characteristic of natural fluvial processes.
- Sediment regime: restoration of the natural supply of coarse and fine sediment to the river.
- Invasive non- native and/or introduced species: ensuring non-native species categorised as 'high-impact' in the UK under the Water Framework Directive are either rare or absent but if present are causing minimal damage to the feature
- Supporting off-site habitat: habitats beyond the site boundary upon which characteristic biological communities of the site depend should be restored in a state that does not impair the full expression of the characteristic biota within the site.
- Key structural, influential and/or distinctive species: restoration of the abundance of the species listed to enable each of them to be a viable component of the Annex I habitat feature. This includes plant communities characterised by pond water crowfoot *Ranunculus peltatus* and associated aquatic herbs and grasses, populations of fish species including bullhead (*Cottus gobio*), Atlantic salmon (*Salmo salar*), river lamprey (*Lampetra fluviatilis*), sea lamprey (*Petromyzon marinus*) and brook lamprey (*Lampetra planeri*) and club tailed dragonfly (*Gomphus vulgatissimus*)

[21] Letter Received from NRW on 14 September 2021. Ref Nr. CAS-163733-N1K7
[22] Natural England (2019). European Site Conservation Objectives: Supplementary advice on conserving and restoring site features River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid Special Area of Conservation (SAC) UK0030252. Date of Publication: 24 March 2019

- Vegetation structure - cover of submerged macrophytes: maintenance of a sufficient proportion of all aquatic macrophytes to allow them to reproduce in suitable habitat and unaffected by river management practices.
- Water quality – nutrients: restoration of the natural nutrient regime of the river should be protected, with any anthropogenic enrichment above natural/background concentrations should be limited to levels at which adverse effects on characteristic biodiversity are unlikely.
- Water quality - organic pollution: organic pollution levels should be controlled to levels that have minimal impact on the characteristic biota
- Impacts on physical, chemical or hydrological integrity of the River Dee, or from non-native species, may also impact on the fish communities associated with the SAC, In particular, such changes could impact on the ability to restore and or maintain the densities and abundances of adult and juvenile fish to those expected under unimpacted conditions throughout the site, taking into account natural habitat conditions and allowing for natural fluctuations

A1.4.2 Llyn Bran baseline conditions

To understand the significance of the potential impact of changes in water quality and increased sediment loads, the current baseline conditions of Llyn Bran were considered. These data could inform the potential magnitude of any impact.

A baseline monitoring programme for water quality was undertaken to inform the suitability of Llyn Bran as a compensation site for decommissioning Llyn Bran. The water quality results were used to inform the extent to which Llyn Bran was attaining favourable conditions in view of the Common Standards Monitoring Guidelines (CSMG) water quality targets for oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*. CSMG targets for Total Phosphorus concentrations are 10 – 15 µg/l for deep lakes such as Llyn Bran.

Surface water quality samples and in-situ field readings were collected at three locations during each field survey. These locations included a sample site near the existing Boat House (Site 1 - NGR SH 96047 59435), near the centre of the lake (Site 2 - NGR SH SH 96372 59211) and near the outflow (dam wall, NGR SH 96203 58909). Water samples were collected in clean polyethylene containers and sent to NLS where they were analysed for: alkalinity, total phosphorus as P, soluble reactive phosphorus (SRP), ammoniacal nitrogen as N, nitrate as N, nitrite as N, turbidity, chlorophyll a and colour (in Hazen Units). At each of the sample locations, in-situ water quality readings were taken using a YSI Multiparameter Sonde to measure temperature and dissolved oxygen.

A total of 10 surveys has been carried out, once per month from May 2019 through to February 2020. As seen from **Table A.2Error! Reference source not found.**, the water quality data gathered during this time has been summarised in order to ascertain whether the lake's water quality is representative of an Oligotrophic to Mesotrophic type lake.

Based on the available water quality data for Llyn Bran, the average measurements for pH, nitrogen and total phosphorous concentrations are within the target ranges as identified by Common Standards Monitoring Guidance (CSMG) for oligotrophic lakes. The CSMG targets for oligotrophic lakes are shown in **Table A.3**.

Table A.2: Water quality summary for Llyn Bran

Variable	Unit	Average (May 2019 – February 2020)
Total Phosphorus	µg/l	12.1
Nitrate as N	mg/l	0.25
Nitrite as N	mg/l	<0.004
SRP Ortho Phosphate as P	µg/l	6
Ammoniacal Nitrogen as N	mg/l	<0.03
Total Alkalinity as CaCO3	mg/l	14.3
Dissolved Organic Carbon	mg/l	4.21
Electrical Conductivity @25 °C	uS/cm	100
pH	pH units	7.26

Variable	Unit	Average (May 2019 – February 2020)
Turbidity	NTU	2.5
Chlorophyll	ug/l	10.7

Table A.3: CSMG water quality standards for oligotrophic lakes

Water Quality Parameter		CSMG Targets
pH (units)		5.5 - 9
Total Phosphorus (µg/l)		10 - 15
Nitrogen (mg/l)		<1.5

Lake sediment sampling was also completed to inform the extent of mitigation required during the implementation of the compensation measures. A summary is provided in Table A.3. These surveys were completed in June 2019. Grab sampling and core sampling were used to sample bed sediments around the reservoir margin in water 2m deep or shallower. A total of 21 sample sites were used. These sites were selected to provide good coverage of the marginal area of the reservoir but were also selected based on the proximity to key features that could have influenced particle size distribution, sediment quality and sediment thickness, such as the inflowing stream to the east of the lake, the road to the north of the reservoir and close to the impounding structure at the south.

Table A.4: Summary of sediment quality data for Llyn Bran

Analyte	*Units*	*Average*
Nitrite: Dry Wt as N	mg/kg	<0.65
Nitrogen: Total Oxidised: Dry Wt as N	mg/kg	37
Orthophosphate: Dry Wt as P	mg/kg	29.38
pH: Solid sample	pH Units	6.63
Nitrate: Dry Wt as N	mg/kg	<20
Sorting Coefficient	Unitless	1.699
Particle Diameter: Median	mm	0.13212
Grain Size Inclusive Mean	mm	0.11967
Particle Diameter: Mean	mm	0.2441

A1.4.3 Potential Adverse Effects

The supplementary advice on the conservation objectives for the River Dee and Bala Lake/Afon Dyfrydwy A Llyn Tegid SAC notes that elevated nutrient levels interfere with competitive interactions between higher plant species and between higher plants and algae, leading to dominance by attached forms of algae and a loss of characteristic plant species (which may include lower plants such as mosses and liverworts). Through changes to plant growth and plant community composition and structure they also affect the wider food web, altering the balance between species with different feeding and behavioural strategies. The respiration of artificially large growths of benthic or floating algae may generate large diurnal sags in dissolved oxygen and poor substrate conditions (increased siltation) for fish and invertebrate species.

The management focus for nutrients is typically on phosphorus concentrations in rivers, on the assumption that it can be more easily controlled at levels that limit the growth of plant species. However, nitrogen may also be important in river eutrophication and ideally co-limitation would be the management aim.

Current annual mean SRP concentrations are within the water quality target in the upstream reaches of the Dee SSSI/SAC at all monitoring locations and almost double the target concentration in downstream reaches.

While specific targets are not included for phosphates for the SAC, a recent study is available on the compliance of SAC rivers across Wales[23]. The study also notes that the phosphate targets have not yet been incorporated into the River Dee and Bala Lake SAC management plan and targets in the NRW assessment that was undertaken should therefore be seen as draft. The assessment indicated that there are localised phosphorus failures in the River Dee. The magnitude of these failures is low to moderate.

The data suggest that the River Dee downstream of the confluence with the Afon Alwen (of which the Afon Brenig is a major tributary) shows a low magnitude of failure with average annual concentrations of < 10µg/l.

In the absence of any mitigation measures, there is a risk that the discontinuance of Llyn Bran could result in increased sediment loads in the Afon Brenig upstream of Llyn Brenig. Due to the size of Llyn Brenig it is most likely that the reservoir will act as a sink for any sediment and will prevent any sediment from moving downstream into the River Dee. It is possible that, during extreme low and high flows, some of the sediment in Llyn Brenig could be re-suspended which could increase nutrient concentrations (in particular phosphate concentrations) in the Afon Brenig and eventually the River Dee. The risk of this occurring is very low considering that the catchment area of Llyn Brenig does not have capacity to refill the reservoir within one annual hydrological cycle. It can take several years for the reservoir to refill again after its water level has been drawn down.

Any additional phosphate inputs could further prevent the SAC from attaining the relevant phosphate targets for SAC rivers which will result in failure to attain favourable condition status. However, from the baseline data for Llyn Bran it is evident that the lake is considered oligotrophic with nutrient concentrations sufficiently low to ensure that the lake actually attains the CSMG for designated lakes. Furthermore, the reservoir is already in connectivity with the downstream waterbodies under baseline conditions and the discharge of water from the reservoir will not alter the existing baseline conditions or prevent the River Dee and Bala Lake SAC from attaining favourable conditions status for nutrient concentrations.

The amount of mobile phosphate in the surface sediment is an important parameter for predicting future internal loading and the subsequent export of phosphate downstream from lake sediments which may act as a source even after the reduction of external loading[24]. The concentration of mobile phosphate will decline with sediment depth owing to transport (diffusion) upwards towards the sediment surface. However, studies have indicated that that oligotrophic lakes exhibit a trend with increasing concentrations of permanently buried P with sediment depth[25]. As such, the upper layers of sediment that will be exposed during the drawdown is unlikely to be a significant source of phosphate.

There are no standards/targets available for the concentrations of nutrients within sediments and data on nutrient concentrations of lakes within Wales is very limited. Setting environmental targets for phosphates and silt in water in different types of waterbodies is problematical because they are naturally occurring substances that vary in their bioavailability and behaviour. They do not act through the type of toxic dose-response relationships that are the foundation of traditional water quality target-setting protocols [26].

Previous studies have shown that mean total phosphorus concentrations for mesotrophic lakes range between 1000 – 2000mg/kg[27]. Data from the Slapton Ley National Nature Reserve (NNR) in Devon which contains the largest natural freshwater lake in south-west England indicates Total Phosphorus concentrations of ~1200mg/kg. From the baseline conditions it is evident that the average nitrogen and

[23] Hatton-Ellis TW, Jones TG. 2021. Compliance Assessment of Welsh River SACs against Phosphorus Targets. NRW Evidence Report No: 489, 96pp, Natural Resources Wales, Bangor.
[24] Ramm K and Scheps V (1997). Phosphorus balance of a polytrophic shallow lake with the consideration of phosphorus release. Hydrobiologia 342/343, 43-53
[25] Carey, C.C. and Rydin, E. (2011) Lake trophic status can be determined by the depth distribution of sediment phosphorus. Limnology and oceanography, 56(6), pp.2051- 2063.
[26] Mainstone CP, Dils RM and Withers PJA (2008). Controlling sediment and phosphorus transfer to receiving waters – A strategic management perspective for England and Wales. Journal of Hydrology (2008) 350, 131– 143
[27] Goodrich S and Goldsmith B (2017). Heath Lake SSSI, Berkshire: Report on Sediment Analysis 2016. Final Report to Atkins, 2017. ECRC Research Report Number 179

phosphate concentrations within the sediments of Llyn Bran are 37mg/kg and 29.38 mg/kg respectively. This is expected as data from the British Geological Survey[28] indicates that the majority of Llyn Bran and its catchment in the 50th percentile for phosphate with a value of ~0.08-0.09mg/kg of soil (i.e., within the 50th percentile for the UK)

From the baseline results it is evident that current nutrient concentrations within the water column and the sediments associated with Llyn Bran is very low and the risk of increased phosphate downstream of Llyn Brenig (which will act as a sink for any sediment) is very low. However, several mitigation measures will be adopted to prevent any sediment inputs downstream of Llyn Bran to further reduce the low risk of water quality impacts or any impacts on the instream habitat downstream of Llyn Brenig.

It should also be considered that the drawdown will occur in the late spring/early summer during low rainfall periods to ensure that the reservoir could be sufficiently drawn down and inflow is at a minimum. The lake is expected to attain final lake levels with a relative short period (6-8 weeks) and the mitigation measures will remain in place until the natural lake levels are achieved and the watercourse fully restored.

Considering the mitigation measures, the magnitude of the impact is considered low, and the impact is considered short-term and temporary.

A1.4.4 Mitigation

Several mitigation measures have been identified in Section 2.2 of this report. These measures can be summarised as follows:

- Siphons will be used to lower the water level and once the reservoir has been drawn down by approximately 1m.
- The siphon pipe inlets will be submerged in the reservoir but kept away from the bed of the reservoir to avoid drawing in silt.
- The downstream ends of the siphon pipes will be positioned to discharge on to the ground either side of the downstream watercourse to provide an element of silt retention, minimising the risk of any suspended solids entering the watercourse.
- The drawdown rate will be limited to 120l/s to avoid excessive flows downstream and any erosions/scouring of the downstream watercourses.
- Once the reservoir has been drawn down by approximately 1m, the next stage of drawdown would involve the use of temporary pumps to begin local desilting close to the dam, with the aim of creating a de-silted basin area.
- The pump inlets will be located low down in the reservoir adjacent and centrally to the dam, to draw silt from this area. The silt laden water will be pumped to exposed margins of the lake with silt retained through the use of unvegetated coir rolls and/or silt tubes.
- Clean water will be draining back to the restored watercourse and from there flowing downstream.
- Once a desilted area of lakebed has been formed close to the dam water will continue to be pumped downstream, monitored to ensure the discharging water is free of silt.
- Only once the reservoir is fully drawn down the dam will be completely demolished as a single activity.
- While the remainder of the dam is being demolished pumps will once again be deployed to start removing silt from the sides of the natural route of the newly established watercourse between the retained lake and the dam site, over a distance of approximately 200m.
- Initially the silt will be pumped into silt tubes laid either side, and following the route of the new reinstated watercourse, set back from the watercourse sufficiently so that pre-vegetated coir matting can be placed to form the banks of the new watercourse.
- As the silt tubes are filled additional silt material will be pumped to the area behind the silt tubes to marginally raise the levels between the watercourse and the banks of the reservoir.

[28] Rawlins BG, McGrath SP Scheib AJ, Breward N, Cave M, Lister TR, Ingham M, Gowing C and Carter S (2012). The Advanced Soil Geochemical Atlas of England and Wales.

- The silt tubes and matting will provide the stable structure for the route of the watercourse and to retain silt in the areas behind.
- The silt margins will be seeded to re-establish to a condition similar to the heathland currently surrounding the reservoir.
- Since there has been no significant indications of water voles along the eastern shoreline of the reservoir there is no proposal to provide any treatment to the eastern area of lake with the exception of the lake inflow which will be stabilised and revegetated using coir rolls and pre-grown coir pallets
- The stabilisation of the inflow and revegetation with coir rolls and pre-grown coir pallets will aim to further ensure that water quality is maintained and enhanced by creating a wetland environment to reduce water quality impacts form the forestry area to the east of Llyn Bran

A1.4.5 Integrity test

It is therefore concluded that the discontinuance of the existing Llyn Bran reservoir and the complete removal of the dam structure to restore connectivity with downstream waterbodies and restore natural lake hydrology will have no adverse effects on the integrity of the River Dee and Bala Lake SAC.

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