Ricardo Energy & Environment

Llyn Bran Environmental Report

Assessment of Potential Impacts and Proposed Mitigation Measures Associated with Single Drawdown Event

Report for Dŵr Cymru Welsh Water

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Executive summary

This report was prepared by Ricardo Energy and Environment (REE) in collaboration with Stillwater Associates Ltd, Salix River and Wetland Services, Richard Andrews from Andrews Wildlife Consultants Ltd and Ben Goldsmith from Goldsmith Ecology. Ricardo & Richard Andrews also engaged with the Wildwood Trust in Kent in order to compile the water vole mitigation strategy.

The principal focus of this assessment is on species of principal importance, as listed in Section 7 of the Environment (Wales) Act of 2016. The objective of this report is to discuss the advantages and disadvantages of a single drawdown event at Llyn Bran verses a two-stage drawdown as part of the process to discontinue the reservoir. This report also presents measures proposed to mitigate the impacts of a single drawdown event on species of principal importance.

The discontinuance of a reservoir and the associated drawdown of the water level represents a substantial change to an ecosystem. One of the substantial changes is the establishment of a new lake margin well away from its current location. This can have a significant impact on organisms 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. This separation exposes 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 would simply need to be repeated to address the same impacts. A two-stage drawdown strategy would necessitate a 2nd mobilisation to site with the potential for disturbance of habitat and species.

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 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 achieving compensation status for Llyn Anafon with an anticipated overall reduced net impact compared to two drawdown events.

This report presents the proposed methodology for the reservoir discontinuance and provides details of the mitigation measures and methodologies needed for:

- Silt management;
- Re-establishment of vegetation along the new lake margin;
- Mitigation of impacts on water voles, breeding birds, reptiles, bats and Eurasian otter.
- A mitigation plan will be compiled for macrophyte species characteristic of oligotrophic habitats upon completion of the July 2021 macrophyte and annual lake condition assessment. Potential mitigation measures may include *ex situ* populations being established (preferably in on-site tanks), species translocations (within-site) during the drawdown and post-drawdown monitoring.

Table of contents

1 Introduction 4
1.1 Background 4
1.2 Objectives 6

2 Proposed Reservoir Discontinuance 7
2.1 Approach to Reservoir Drawdown 7
2.1.1 Initial Drawdown – Siphon Pipes 8
2.1.2 Lower Level Drawdown – Pumping and Silt Management 8
2.2 Silt Management & Revegetation 9
2.2.1 River Corridor 9
2.2.2 Retained Lake Margins: Western and Northern Area 9
2.2.3 Retained Lake Margins: Eastern Area 10

3 Environment and Ecology Baseline Results 12
3.1 Fish 15
3.2 Great Crested Newts 15
3.3 Badgers 15
3.4 Invertebrates 16
3.5 Breeding birds 16
3.5.1 Potential Impacts & Proposed Mitigation Measures 16
3.6 Reptiles 16
3.6.1 Potential Impacts & Proposed Mitigation Measures 16
3.7 Bats 17
3.7.1 Potential Impacts & Proposed Mitigation Measures 17
3.8 Eurasian otter (*Lutra lutra*) 18
3.8.1 Potential Impacts & Proposed Mitigation Measures 18
3.9 Water vole (*Arvicola amphibius*) 18
3.9.1 Potential Impacts & Proposed Mitigation Measures 18
3.9.1.1 Water vole capture, husbandry and release (under license from NRW) 19
3.9.1.2 Re-establishment of vegetation along new lake margin 19
3.10 Aquatic macrophytes 22
3.10.1 Potential Impacts & Proposed Mitigation Measures 23

4 Discussion & conclusions 24

1 Introduction

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). Ricardo and Richard Andrews engaged with the Wildwood Trust in Kent to compile a water vole (*Arvicola amphibius*) mitigation strategy. The proposed engineering process for undertaking and managing the reservoir drawdown has been developed in consultation with an experienced civil engineering contractor.

The aim of this report is to discuss the advantages and disadvantages of a single drawdown event at Llyn Bran in comparison to a two-stage drawdown, with specific emphasis on determining which approach would have the least adverse ecological impacts on species of principal importance as per Section 7 of the Environment (Wales) Act of 2016[1].

In addition, this report also presents the measures proposed to mitigate the potential impacts associated with the drawdown on species of principal importance.

1.1 Background

Llyn Anafon reservoir is located in the Snowdonia National Park in North Wales at an altitude of approximately 500m. The dam was created in about 1931 and 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. The objective of the Llyn Anafon Reservoir Project (*the Proposed Scheme*), is therefore, to develop a **long-term solution** to minimise the **risk of loss of life** associated with the failure of the dam whilst restoring **naturalness** of the lake. To completely remove the hazard and provide a long-term solution to the risk of dam failure, the reservoir will need to be decommissioned and the dam removed.

The site is located within the Eryri/Snowdonia Special Area of Conservation (SAC) and is therefore considered a site of European importance. Under Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (amended), often referred to as the 'Habitats Regulations', a competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a 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 make an Appropriate Assessment of the implications of the plan or project for that site in view of that site's conservation objectives. For the Proposed Scheme, the competent authority is Dŵr Cymru Welsh Water (DCWW).

The objective of an Appropriate Assessment is to determine the implications of a plan or project, in view of the site's conservation objectives, in light of the best scientific knowledge in the field.

The Appropriate Assessment for the discontinuance of Llyn Anafon was completed in August 2018[2]. The assessment concluded that it is not possible to mitigate for the loss of 2.05 ha of Annex 1 habitat (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.

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

[2] Ricardo (2018). Llyn Anafon Habitats Regulations Assessment Stage 2 – Information to Inform the Appropriate Assessment for the Proposed Llyn Anafon Scheme. Report prepared for Dŵr Cymru Welsh Water. 3 August 2018

Regulation 64(1) of the Habitats Regulations provides for a derogation process which would allow a plan or project to be approved in limited circumstances and subject to meeting three sequential tests:

- There must be no feasible, reasonable alternative solutions to the plan or project which are less damaging to the affected European site(s)
- There must be "imperative reasons of overriding public interest" (IROPI) for the plan or project to proceed – this must involve a balancing of factors such that the harm (or risk of harm) to the European site must be outweighed, or overridden, by the reasons for agreeing to the plan or project
- All necessary compensatory measures must be secured to ensure that the overall coherence of the network of European sites is protected.

These sequential tests form Stages 3 and 4 of the HRA process (as set out in national HRA guidance[3]).

The Stage 3 HRA[4] (assessment of alternative solutions) 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 adverse effect on the conservation objectives and favourable condition status of the SAC which is considered greater than the potential effects associated with the Proposed Scheme. Stage 4 of the HRA concluded that the project must be carried out for Imperative Reasons of Overriding Public Interest (IROPI).

Regulation 68 of the Habitat Directives states that, where in accordance with Regulation 64, a plan or project is agreed to, notwithstanding a negative assessment of the implications for a European site or a European offshore marine site, or a decision, or a consent, permission or other authorisation, is affirmed on review, notwithstanding such an assessment the appropriate authority (in this case, the Welsh Ministers) must secure that any necessary compensation measures are taken to ensure that the overall coherence of the national network is protected.

Although Llyn Bran did not initially meet the specific targets for favourable conditions for the Annex 1 habitat, as defined by the Common Standards for Monitoring (CSM) for the particular habitat, it was identified as a potential compensation site for Llyn Anafon pending the implementation of specific compensation measures.

The required compensation measures were identified through a condition assessment following the Common Standards Monitoring Guidance (CSMG[5]) approach for lakes where lakes are a notified or qualifying feature of a SAC. The condition assessment used specific targets and attributes and identified that Llyn Anafon was sub-optimal due to a number of attributes not being met. This includes:

- Hydrological regime (related to connectivity and not water level fluctuation), and
- Aquatic macrophyte community structure (including indicators of local distinctiveness).

To ensure that Llyn Bran sufficiently compensates for the loss of habitat at Llyn Anafon and that Llyn Bran is of similar (or better) quality than Llyn Anafon, the objective of the compensation measures would be to ensure that the attributes listed above are restored and maintained thereby achieving the aim of compensating for the loss of the Annex 1 habitat.

To restore and maintain the features and supporting processes the following measures have been identified:

- Measures to restore and maintain hydrological functioning

[3] Tyldesley, D. and Chapman C. The Habitats Regulations Assessment Handbook. Published and regularly updated online by DTA Publications Limited. http://www.dtapublications.co.uk/handbooks

[4] Ricardo (2019). Llyn Anafon 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. 14 March 2019

[5] Joint Nature Conservation Committee (2015). Common Standard Monitoring Guidelines for Freshwater Lakes. JNCC, Peterborough.

- Measures to enhance and maintain the macrophyte communities

It should also be noted that, although Llyn Bran currently achieves the water quality targets as determined in the CSMG for the Annex 1 habitat, several current catchment activities could in the long-term effect nutrient concentrations:

- As such, measure to maintain current water quality conditions will also be required.

1.2 Objectives

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 Ricardo compile an environmental report presenting the mitigation measures that would be implemented in order to mitigate the impacts of a single drawdown event.

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 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 four 150mm diameter siphon pipes should allow the first 1m depth of water to be removed from the reservoir over a two-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	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	
Area of reservoir, a	ha	12.54	
Suggested target rate, D_i	mm / day	100	Assumed rate of drawdown to avoid disturbing silt around lake margins
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
Siphon Pipes			
Estimated nr. of 150mm dia. siphon pipes, assuming 40m pipe length.	nr	4 siphon pipes [14,800 m^3/day]	Hand calc for siphon discharge

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 into lagoons where the silt can settle out, the clean water draining either back to the reservoir or downstream of the dam.

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

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 lagoons created on the area to the west of the reservoir where turfs will previously have been removed (see Section 3.9) and set aside for habitat creation in the western margins of the lake (see Figure 2-1). These lagoons will initially be created using silt tubes to contain silt in the lagoons behind. As the lagoons dewater the water will flow overland (further ensuring silt is removed) back to the reservoir. To some extent at this stage there will be recirculating water which may reduce the rate of reservoir lowering for a period of time.

Table 2-2: Assessment of pump requirements for ongoing drawdown

Item	Units	Value	Source / Comment
Volume to be evacuated based on target rate, V	m^3 / day	13,663	As rate assessed in Table 1
Diesel Pumps			
Estimated nr. of 200 mm diesel pumps	nr	2 nr. pumps [25,920 m^3/day]	Two pumps operating will exceed required pumping rate and can be controlled accordingly

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. If necessary 'Siltbusters' can be used to remove any remaining silt content.

This approach should allow the reservoir to be emptied over a further two to three 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.

Once the discontinuance process is complete the areas used for silt lagoons will be managed and replanted to return them to their original condition.

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. 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.

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 and turfs lifted from the western area behind the reservoir will be laid along the new shoreline to help protect and stabilise the silt behind.

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 matting and translocation of turf. 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 matting and turf translocation will aim to further ensure that water quality is maintained and enhanced by creating a wetland environment to reduced water quality impacts form the forestry area to the east of Llyn Bran.

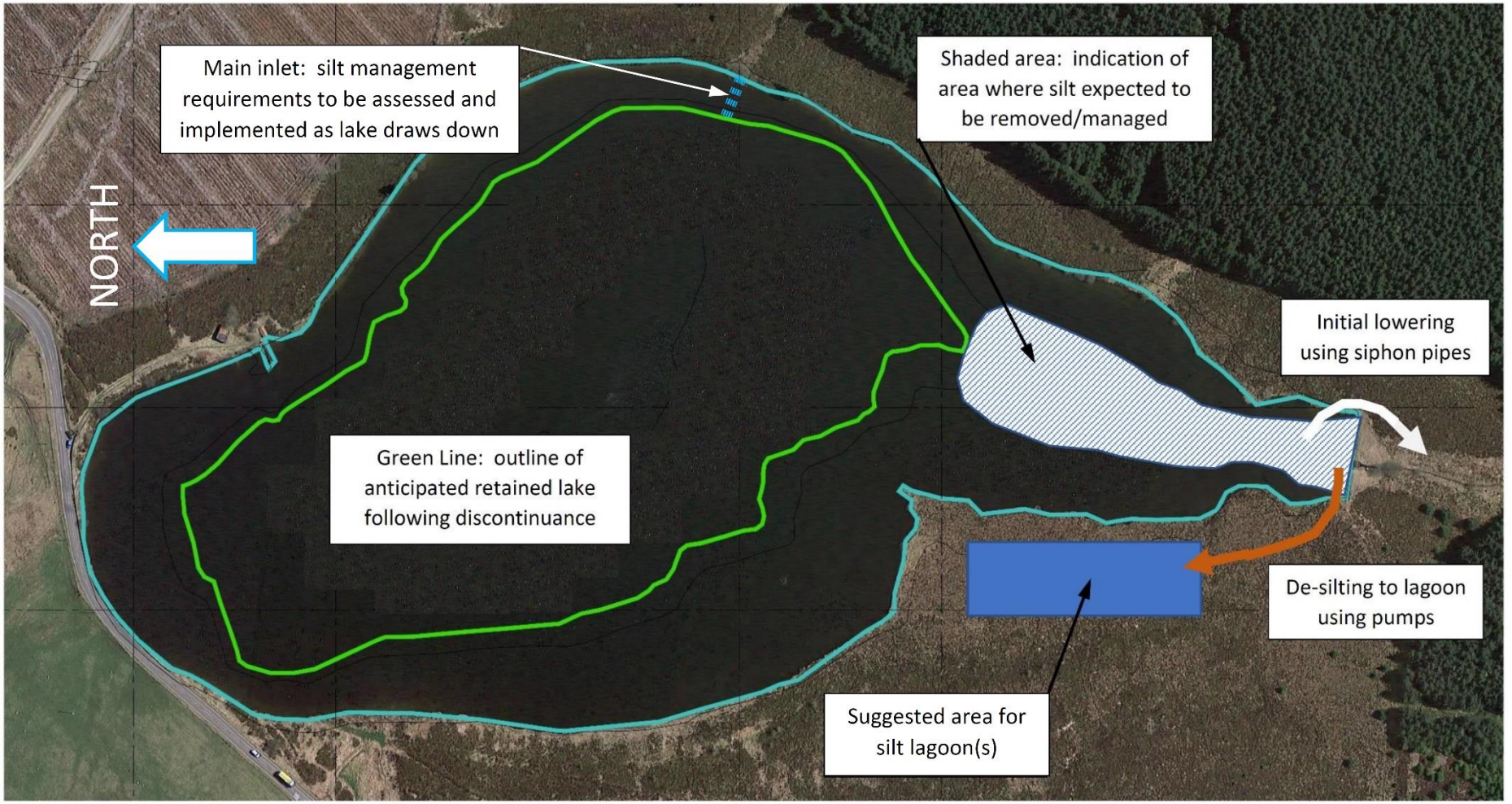

Figure 2-1: Proposed scheme for reservoir lowering and silt management during discontinuance operation

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.

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

Receptor	Relevant Legislation	Status on site
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.
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. Management of self-sown coniferous trees from heath and mire habitats	During construction of the access track and post works monitoring.
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.

Receptor	Mitigation required	Timing
	Avoid night-time working where possible. If required avoid light spill onto sensitive areas such as waterbodies and woodland.	
Otter	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 re-introduction.
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 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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 (Table 3-2). 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.

3.5.1 Potential Impacts & Proposed Mitigation Measures

Cutting of turf strips used for revegetating the new lake margin may result in loss of habitat and disturbance of breeding birds.

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.

3.6 Reptiles

Low numbers of common lizard (*Zootoca vivipara*) were recorded during the baseline surveys (Table 3-2). 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.

3.6.1 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.

3.7 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

3.7.1 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.

3.8 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.

3.8.1 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.

3.9 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.

3.9.1 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[7].

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:

1. A conservation licence will be obtained from NRW prior to commencement of discontinuance works;
2. Capture and temporary *ex situ* management of resident water vole population with the aim of mid-summer re-introduction to Llyn Bran;
3. Re-establishment of vegetation along the new lake margin, inflow and outflow using:
    a. Pre-established Coir Pallets planted with high quality native plant species;
    b. Translocation of vegetated turf from the current to the new lake margin;
4. Re-seeding of exposed margins away from the water edge using seed harvested from the adjacent heathland.

3.9.1.1 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).

3.9.1.2 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 translocation of vegetated turf from the western shore of Llyn Bran.

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:

[7] 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.

- 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.*

Translocation of vegetated turf will commence once the reservoir drawdown has been completed (Figure 3-1). An ecologist will identify suitable turf and undertake a survey prior to any turf being cut. A suitably experienced and qualified ECoW will mark out the turf to be cut and will be present on site during all turf cutting

Figure 3-1: Mechanised harvesting of vegetated turf

Turf will be loaded onto flat backed ultra low ground pressure tracked dumpers (Figure 3-2). The route from the donor site to the receptor site will be marked out and agreed to by the ECoW prior to movements of machines. If the route starts to cut up or vegetation becomes damaged, then new routes will be used. If the ground is too soft for tracked dumpers at the time of works then temporary trackway will be laid. A key unknown is how firm the lakebed sediments will be. If a tracked dumper is unable to track down over the exposed lake sediment, then a second amphibious machine may be needed to ferry turfs down to the receptor site.

Figure 3-2: Harvested turf will be loaded onto flat backed ultra low ground pressure tracked dumpers

An amphibious excavator will be fitted with a flat plate bucked in order to unload and place the turf without damaging it (Figure 3-3).

Figure 3-3: An amphibious excavator will be used to unload and place the turf without damaging it.

The aim is to have the pre-vegetated Coir Pallets and translocated turf in place by end of May / early June 2022 and it is expected that the vegetation will be established enough for the water voles to be returned to the newly established and vegetated lake margin by the end of July/ early August 2022.

3.10 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.

3.10.1 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. Physico-chemical and ecological monitoring before, during and after the water level lowering will therefore form a vital part of informing themacrophyte mitigation plans.

The mitigation plan will be compiled for macrophyte species characteristic of oligotrophic habitats upon completion of the July 2021 macrophyte and annual lake condition assessment survey. Proposed mitigation measures may include methods such as *ex situ* population being established (preferably in on-site tanks), species translocations (within-site) during the drawdown and post-drawdown monitoring.

4 Discussion & conclusions

The objective of this environmental report is to discuss the advantages and disadvantages of a single drawdown event at Llyn Bran verses a two-stage drawdown with specific emphasis on species of principal importance. In addition, this report also presents the measures proposed to mitigate the potential impacts associated with the drawdown on species of principal importance.

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:

- 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;
        - Translocation of vegetated turf from the current to the new lake margin;
    - Re-seeding of exposed margins away from the water edge using seed harvested from the adjacent heathland.
- A mitigation plan will be compiled for macrophyte species characteristic of oligotrophic habitats upon completion of the July 2021 macrophyte and annual lake condition assessment. Potential mitigation measures may include *ex situ* populations being established (preferably in on-site

tanks), species translocations (within-site) during the drawdown and post-drawdown monitoring.

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