ARUP

Technical Note

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Prepared by	Rhodri Thomas
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4 Pierhead Street Capital Waterside Cardiff CF10 4QP United Kingdom
t +44 29 2047 3727 d +44 29 2026 6524
arup.com

1. Introduction and Purpose

Natural Resources Wales (NRW) have commissioned Arup to undertake the detailed design of the removal of a large, partially collapsed weir on the River Elwy at Llanfair Talhaiarn. Demolition of the weir and the subsequent river reinstatement works are currently planned for 2024.

The outline design of the project was completed in 2020/21 by AECOM. As part of this work a Water Framework Directive (WFD) Screening Note (Appendix A) was prepared.

As part of the design and consenting process, this note has been prepared to supplement the previous screening assessment, particularly given that the design has developed and the Cycle 3 WFD baseline data has been released in the interim.

The projects compliance with the objectives of the WFD will be reviewed as part of the impoundment licencing and flood risk activity permitting processes. This note is intended to provide evidence to support those consent applications.

2. Project Background

A detailed description of the project design and its development can be found in the Design Philosophy report[1]. A summary is provided here. The design intends to fully remove the weir and its wing walls and comprises of the following components:

- The concrete weir, base and wing walls will be demolished. There is uncertainty over the composition of the weir due to the lack of record drawings.
- Once removed, the wing walls are to be regraded at a suitable slope angle (likely between 1 in 2 and 1 in 3). Protection will be added to these slopes to reduce the risk of excessive erosion and slippage of the bank.

[1] Arup. Salmon For Tomorrow 2 – Llanfair Talhaiarn: Design Philosophy. 290013-ARP-CP-LF-GE-0001. September 2023.

- The leat on the right-hand bank will be retained and left open. The leat will be perched well above the regraded river bed and will not receive river flows other than in flood events.
- Due to the lack of information regarding the construction of the weir, it may be prudent to use an observational approach during wing wall removal. The stability of the slope would be assessed throughout demolition whilst the wing wall is removed in stages from the top. This may result in some of the wing wall being left in or other support added. Any instability can be assumed at this stage to be localised to the riverbank.
- There will be one blockstone check weir, 10m downstream of the DCWW water main and 200m upstream of the existing weir.
- Reprofiling of material in the channel is to be minimised. This is to allow the material to redistribute naturally whilst minimising in-river working. Material directly upstream of the weir will be excavated as necessary to allow for removal of the weir. Sampling and testing of the material in accordance with waste disposal regulations has confirmed that the material is suitable for onsite reuse.
- Riverbed material will be able to move freely over time downstream of the check weir.
- The toe of the riverbanks alongside the existing weir and proposed check weir will be stabilised using either rip rap or rock rolls. The riverbanks will be graded and biodegradable coir matting used to provide erosion protection whilst vegetation re-establishes.
- The riverbanks are to naturally re-grade over time following weir removal, following the conclusion drawn in a geotechnical initial assessment of the weir removal option (Arup, 2022). This is possible due to the topography of the site. There is a risk of slope instability during construction and in the following years. A 5-year monitoring plan will be established and allow for reactive mitigation works were risks to materialise.
- Downstream of the weir, an eroded section of the left hand riverbank will be reprofiled to minimise future erosion. Site-won brash and willow will be used to reinstate the bank. The gravel bar opposite the eroded bank will be reprofiled and the gravel re-used as part of the bank reinstatement. This area would be fenced off to allow the vegetation to establish and stabilise the riverbank.
- The existing gate by the weir will be relocated downstream to allow access to the left hand side gravel bar. This may be used for gravel seeding, using material obtained from the Nant Barrog sediment trap, in the future.
- There will be some tree removal and coppicing across the scheme to enable access at the check weir and to the right bank at the weir. One in-channel tree downstream of the weir will also be removed to minimise the risk of future bank erosion. The design and construction access seeks to minimise impacts upon trees as far as practicable.

Drawings showing the existing weir and proposed design are available as part of the consent submission.

2.1 Design changes since the original WFD Screening Note

The following changes have been made:

- The bank protection works to the right bank downstream of the weir, adjacent to the Dwr Cymru treatment works have been removed from the design. Analysis of the hydraulic modelling for the project has deemed this unnecessary.
- The previous design assumed the wing wall of the weir would remain in situ. These are now proposed to be removed.
- The extent of the channel regrading upstream of the weir has been reduced with the intention being that the river can naturally rework much of this material.

3. Changes to WFD Baseline Data

The original Screening Note was completed in 2021 and is based upon the Cycle 2 (2018) WFD classification data. This data has been superseded by the Cycle 3 data that was released in December 2022.

One river water body, the 'Elwy – Clwyd to Melai' (GB110066060020), and one groundwater body, the 'Clwyd Silurian' (GB41002G200100), were screened into the original assessment. The extent of these water bodies remains the same and no other water bodies need to be screened into this assessment addendum.

For Cycle 3 2021, the 'Elwy – Clwyd to Melai' (GB110066060020) water body remains at Good Ecological Status. The only change from the 2018 Cycle 2 classification is the waterbody has moved from Good to High chemical status. There is no impact upon the WFD compliance of the project because of this change.

The 'Clwyd Silurian' (GB41002G200100) groundwater body also remains at Good Overall Status.

4. Assessment

4.1 Potential impacts to ecological quality elements

The original Screening Note concluded that there were no potential impacts upon ecological quality elements provided that a suitable Construction Environmental Management Plan (CEMP) is produced and adhered to.

An Environmental Action Plan (EAP) has been prepared for the project with sets out best practice measures around pollution management, invasive species control and ecological protection. This includes a requirement for the Contractor (once appointed) to prepare management plans that deal with these risks. There are also anticipated to be restrictions on in-river working periods imposed through the flood risk activity permit in order to protect against impacts upon fish spawning and migration.

It is therefore determined that the conclusion of the original Screening Note remains correct, and that no adverse impact upon ecological quality elements is anticipated. There are potential

beneficial effects upon fish and invertebrates as a result of the improved connectivity and the restoration of natural processes along the Afon Elwy.

4.2 Potential impacts to physio-chemical quality elements

The original Screening Note concluded that there were no potential impacts upon ecological quality elements provided that a suitable Construction Environmental Management Plan (CEMP) is produced and adhered to.

As set out in Section 4.1, an EAP has been produced which includes measures to mitigate the risk of impacts during construction. It is therefore determined that the conclusion of the original Screening Note remains correct, and that no adverse impact upon physio-chemical quality elements is anticipated.

4.3 Potential impacts to hydromorphological quality elements

Construction impacts

The original Screening Note concluded that there were no potential impacts upon hydromorphological quality elements during construction, provided that a suitable Construction Environmental Management Plan (CEMP) is produced and adhered to.

As set out in Section 4.1, an EAP has been produced which includes measures to mitigate the risk of impacts during construction. It is therefore determined that the conclusion of the original Screening Note remains correct, and that no adverse impact upon hydromorphological quality elements is anticipated during construction.

Operational impacts

The original Screening Note concluded that further assessment of potential hydromorphological impacts following weir removal was required once the detailed design of the project was available.

Hydraulic modelling of the project has been undertaken, using a 1D-2D model. The outputs of the model have been reviewed to understand the likely effects of weir removal on the risk of erosion and the transport of sediment.

This modelling has confirmed the requirement for a check weir upstream of the existing weir, to act as a control for the upstream progression of erosion, protecting the buried water main that passes under the channel and the road bridge upstream. There is a risk that the check weir itself becomes detrimental to hydromorphological processes if it forms a knick-point as the river erodes its bed in the formerly impounded section of channel. However a monitoring programme will be implemented following weir removal to determine if this occurs. The project budget anticipates that some remedial works to address erosion may be required, with works to modify the level of the check weir being relatively straightforward should this be required.

There are some relatively minor changes in floodplain connectivity and flows as a result of the weir removal, although these are no protected or sensitive habitats at risk as a result of these changes.

The restoration of natural processes through the river reach is a significant benefit to the local hydromorphological quality. The homogenous impounded reach upstream of the weir will be replaced by a variety of flow types and a more natural channel form and the reach downstream of

the weir will benefit from the re-establishment of sediment transport, which will allow the channel to better sustain habitat features such as riffles, pools, bars and eroding cliffs.

Overall, the project will result in a beneficial impact upon hydromorphological quality elements at a local scale.

4.4 Potential impacts to groundwater

The original Screening Note concluded that the risks to groundwater were low given the minimal excavation required to remove the weir and the lack of pollution sources beyond those typical of any construction site (e.g. spills from plant or fuel storage).

This remains the case and the EAP includes measures (e.g. requirements for bunded tanks, drip trays, spill kits) that reduce the risk of groundwater pollution as a result of the construction activities.

5. Conclusion

The original Screening Note (Appendix A) concluded that:

Further study into the impacts of the scheme on hydromorphological elements will be required as sufficient scheme information is not available at this WFD screening stage to identify that it will not cause an adverse impact. However, no further study into ecological or physico chemical elements is required as the scheme is considered to have a negligible impact on physico chemical elements, and a major beneficial impact on biological elements.

This note has considered updates to the WFD baseline data and the design development since the original Screening Note was produced, findings that its conclusions for biological and physic-chemical quality elements remain valid.

Further assessment of the potential hydromorphological impacts of the project have been undertaken as part of the design, finding that the project will have a localised beneficial impact on hydromorphology.

The project is therefore deemed to the compliant with the objectives of the WFD as it does not impact upon current status, or prevent the future objectives of, the ‘Elwy – Clwyd to Melai’ (GB110066060020) river water body. The project will have a beneficial impact on biological and hydromorphological quality elements, although the water body is already at Good Ecological Status.

Appendix A – Water Framework Directive Screening Note (AECOM, 2021)

Technical Note

Client	Subject	Date	Reason for issue
Natural Resources Wales	Llanfair Talhaiarn Weir Removal WFD screening assessment	24/03/2021	To determine whether further assessment is required with regard to the impact of the proposed scheme on WFD status and objectives.

Prepared by	Checked by	Verified by	Approved by
Liam Rees Consultant	Anna Gee Principal Consultant	Neil Williams Associate Director	Nick Maynard Project Manager

Document Number:
S4T2-ACM-LLAN-XX-RP-CE-100008

Water Framework Directive Screening Assessment

Llanfair Talhaiarn Weir Removal

Introduction, Aims and Objectives

Natural Resources Wales (NRW) is undertaking several fish passage improvement schemes throughout Wales under the Salmon for Tomorrow 2 programme, which aims to address existing fish passage issues.

The Llanfair Talhaiarn site is a weir on the River Elwy (Afon Elwy) in the north east of the village of Llanfair Talhaiarn as shown in Figure 1. The weir is believed to have been built approximately 200 years ago to provide flow to a mill race. The weir is heavily degraded and partially collapsed.

This report comprises a high level WFD Screening Assessment, commensurate with the current phase of planning and the anticipated effects of the proposals on the river environment. The Screening Assessment summarises whether the proposals are low risk activities in WFD terms and could therefore be screened out of further assessment, or whether any impacts are potentially significant and further assessments are recommended.

Figure 1: Llanfair TH site location ***Contains OS data © Crown copyright and database right 2020***

The Water Framework Directive

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 aim to protect and enhance the quality of the water environment. It takes a holistic approach to the sustainable management of water by considering the interactions between surface water, groundwater and water-dependent ecosystems. Ecosystem quality is evaluated according to interactions between biological, physico-chemical and hydromorphological elements.

NRW is the competent authority for implementing the WFD in Wales. As part of its role, NRW must consider whether proposals for new developments have the potential to:

- Cause deterioration of a waterbody from its current status or potential; and/ or
- Prevent future attainment of good status or potential where not already achieved.

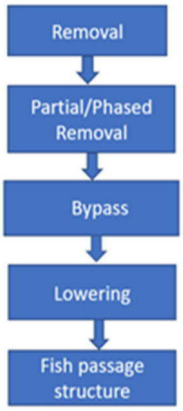
As a result, any developments that have any potential to impact on current or predicted WFD conditions are required to assess their compliance against the WFD objectives of the potentially affected waterbodies.

Site Baseline Description

The existing weir is heavily degraded and partially collapsed (Figure 2). The ramp on the left side of the river (looking downstream) has been undercut, resulting in near entire collapse and the bottom of the right ramp is also starting to show a loss of material. The weir drop is approximately 2.5 m. The existing fish pass is in the centre of the channel and functions poorly. It has five steps, each with a height of around 0.5 m which limits the range of species and sizes of individuals able to pass. In addition to this, the partially collapsed nature of the weir will likely create attraction flows away from the fish pass. Upstream of the weir are two road bridges, the School Lane Bridge dating back to 1766 and the more modern A544 Road Bridge (Elwy Road) built in 1927. The banks downstream of these are steep, tree lined and spill onto the floodplain to the north. There is over 20 km of salmonid spawning habitat upstream of the weir (NRW, 2020, but the weir currently limits migration.

Figure 2 View upstream towards degraded weir

Preferred Option



The improvement of passage for fish and other species is an important component of NRW's core duty of Sustainable Management of Natural Resources as well as other strategic objectives.

NRW's river restoration planning often includes resolving barriers (through weir removal or modification) and in-channel and planform modifications as important steps in addressing reasons for WFD failure.

NRW's weir mitigation option appraisal hierarchy gives preference to structure removal. In line with WFD objectives, NRW recognises the need for technically feasible and cost proportionate solutions to river barriers, and the need to sustain existing water body uses that may place constraints on full river restoration and barrier removal.

The preferred Option 1 (referred to as the 'Proposed Scheme') comprises of the removal of the weir and regrading of the bed.

A description of the works proposed is summarised below, and general arrangement drawings used in this assessment were revision P01 of the following files:

- S4T2-ACM-LLAN-XX-DR-CE-100000 Site location plan
- S4T2-ACM-LLAN-XX-DR-CE-100001 General Arrangement
- S4T2-ACM-LLAN-XX-DR-CE-100003 Temporary Works / Construction Phasing Sheet 1 of 2
- S4T2-ACM-LLAN-XX-DR-CE-100004 Temporary Works / Construction Phasing Sheet 2 of 2
- S4T2-ACM-LLAN-XX-DR-CE-100005 Long section
- S4T2-ACM-LLAN-XX-DR-CE-100011 Utility plan
- S4T2-ACM-LLAN-XX-DR-CE-100012 Site access and compound plan

Bank Protection Works

The right bank immediately downstream of the weir is an area of land owned by Welsh Water for the Wastewater Treatment Works (WWTW). There is no infrastructure close to this bank, but it is considered prudent to protect the land from scour. The watercourse is generally straight through the weir site, but there is a slight left bend that may bring the potential for flows to focus on the right bank. The design therefore includes some low flow protection work on this right bank.

The protection work has not been designed, but is assumed to be a basic rock protection with material deposited on the lower bank area. It is possible that some of the material to be removed from behind the weir may be suitable for this use. If this is the case, then the protection works can be carried out after the weir removal, or initial anchor rocks can be placed first with additional material being added once the weir removal is in process.

The river is less than 25 m wide at this point, so a long arm excavator is likely to be able to place the material from the left bank. In low flow conditions it would also be possible to position plant in the channel for easier access.

Initial Weir Break and Weir Removal

It is proposed that the main weir structure be removed in its entirety, leaving just the wing walls. These have been left in order to simplify the works and also to provide bank stability. The channel width at the weir matches or is greater than the natural channel width downstream and therefore the wingwalls are not considered to constrain the flow at this location.

It is anticipated that the left side of the weir would be removed first, but that the first task would be to break the structure and let the upstream water levels reduce. By reducing the water level behind the weir, the forces on the structure are reduced and the risk of a catastrophic failure are reduced. This would be carried out on the left side of

the structure due to its advanced stage of deterioration. An excavator would be used, removing any loose weir material downstream, removing material from immediately upstream of the weir at the point to be broken, and then breaking the crest of the weir. The works should be carried out during a period of low flow, so that a small break in the weir can allow the upstream waters to drain.

Once the water levels are stable, the remainder of the left side of the weir can be removed, followed by the fish pass structure and the right side of the weir. The works would be carried out from the bank with no flow controls. This is because developing a dry working area would be very difficult on the gravels behind the weir and would not provide a sufficient level of safety for site staff. The proposed method would not require any staff to be in the river but would need to be carried out during the summer in periods of low flow. This would allow the impact of restricted flow through the structure to be minimised, reducing the risk of uncontrolled erosion.

It may be possible to control the flow route through the site by phasing the removal appropriately. This would reduce the impact of freeing sediments as the weir is removed. During the removal works, there will be a need to include pauses in the in-channel work whenever a large sediment plume is created.

There will remain a risk that the structure fails in some way during the works. This may be the failure of the weir structure whilst under flow conditions or the wing walls once the main structure is removed. It is assumed that the wing walls are stable; however, it is possible that they are attached to a base slab of some kind. This would require further assessment to establish, but the options could be to leave it and regrade the channel over it, or remove most of it, leaving a footing in front of each wall.

Upstream Regrading and Erosion Break Structure

Further investigation will be required to establish the depth of material upstream and the extent of channel regrading required. It has been assumed that the channel regrading would extend to the erosion break structure, located downstream of the A544 road bridge and buried utility, with a shorter reach only likely if bedrock is encountered. This investigation should also assess the need of an erosion break structure. It has been assumed that such a system could be fully buried in the channel without encountering rock.

The erosion break structure is recommended to be a line of large boulders, placed in a trench across the channel. This approach simplifies construction and can be implemented by an excavator as an extension of the channel regrading work. It is assumed that some tree clearance will be required on the left bank in order to deliver the boulders to the correct location in the channel. They will then be manoeuvred into position from the channel.

The break structure has been located approximately 30 m downstream of the potable water main that crosses under the river approximately 40 m downstream of the bridge. This leaves approximately a 190 m reach of regrading to the weir crest. This location allows the regrading to achieve a channel gradient of 1% which is considered shallow enough to mitigate sudden, uncontrolled erosion.

The regrading will focus on the middle of the channel and will provide a roughly constant gradient from the buried break structure to the weir location. It may also be possible to extend the regrading beyond the weir, if preferred. By focussing the regrading in the middle of the channel, the river will be given the opportunity to create the width of channel it requires without unnecessarily impacting the existing banks. This will minimise any risk of bank instability as a result of increasing the channel depth.

Ensuring Physical Works Protect and Improve the Water Environment

To consent the proposals, NRW operational and regulatory teams would need to be confident that:

- Works will not lead to deterioration in the quality of a water body.
- Works will not prevent the future improvement of a water body.
- Works will not impact a protected nature conservation area or priority habitat.
- Works will not impact a protected or priority species.
- Heritage, landscape and fisheries interests and the need for an Environmental Impact Assessment have been considered.
- Opportunities have been sought to improve the water environment.

Some water bodies are designated as artificial or heavily modified under the WFD. These water bodies have been substantially altered to provide specific benefits (uses) for human society, for example urbanisation, flood protection embankments or other flood defence measures. Where certain criteria are met, these physically altered waterbodies can be designated as 'artificial' or 'heavily modified'. Artificial and heavily modified water bodies have an objective to meet good ecological potential rather than good ecological status. They must still meet good chemical status. Good ecological potential is when every effort has been taken to allow the water body to support the best ecology it can, given its specified use(s) taking into account technical feasibility and disproportionate cost.

The scheme will need to ensure that these criteria are fulfilled with respect to the WFD baseline conditions and objectives described below.

WFD Baseline and Water Body Screening

Works for the Proposed Scheme will take place on the Afon Elwy. The Afon Elwy at this location falls within the Clwyd Management Catchment within the Western Wales River Basin Management District (RBMD). The Llanfair TH weir is located on the "Elwy – Clwyd to Melai" waterbody which is not classified as heavily modified or artificial. It is currently at good overall WFD status (2018 classification).

Baseline WFD data for Elwy – Clwyd to Melai (GB110066060020) have been summarised from NRW's Water Watch Wales website[1] in Table 1.

Table 1: Current WFD Classification for Elwy – Clwyd to Melai (GB110066060020)

RBMP Parameter	Classification
Waterbody Name, ID, Category	Elwy – Clwyd to Melai, GB110066060020, River
Current Overall Status	Good
Current Hydromorphological Condition	Not designated Artificial or Heavily Modified
Current Ecological Status	Good
Current Chemical Status	Good
Supporting Elements (surface water & hydromorphology)	Hydrological regime- Not High Morphology- Not assessed
Objectives	Good by 2015
Protected Area Designation	N/A

The water body is currently classified as having overall Good status. To comply with WFD objectives, the requirement for the waterbody would be no deterioration from Good status.

The Proposed Scheme falls within the region of the Clwyd Silurian groundwater body. Baseline Groundwater Body data have been summarised from the NRW Water Watch Wales website [2] and presented in Table 2.

Table 2: Current Groundwater Body Classification for Clwyd Silurian (GB41002G200100)

GWB Parameter	Classification
Name, ID, Category	Clwyd Silurian, GB41002G200100, Groundwater Body
Area	556.16km^2
Current Overall Classification	Good
Current Quantitative Status	Good
Current Chemical (GW) Status	Good
Objectives	Good by 2015 (prevent deterioration between 2015 and 2021)
Protected Area Designation	Drinking Water Protected Area Directive

The latest available data (2016, Cycle 2) show the groundwater body to be at overall Good status. To comply with WFD objectives, the requirement for the groundwater body would be no deterioration from Good status.

[1] https://waterwatchwales.naturalresourceswales.gov.uk/en/. Accessed: 30.11.2020
[2] https://waterwatchwales.naturalresourceswales.gov.uk/en/. Accessed: 30.11.2020

Low Risk WFD Activities

Certain activities on or near waterbodies are generally classified as low risk activities, as summarised in Table 3.

Table 3: WFD Low Activities Register (from Environment Agency Position Statement 488_10)

Activity	Type of Modification
Maintenance of existing structures	Re-pointing (brick work / block work structures)
	Void filling ('solid' structures)
	Re-positioning (rock or rubble or block work on an existing structures)
	Replacing elements of an existing structure (not whole structure, or iterative replacement of the whole structure)
	Re-facing, skimming or covering an existing structure
	Works to repair an existing structure
	Works to repair, maintain or replace components of an existing structure
	Cleaning and/or painting of a structure and graffiti removal
	Maintenance of pumps at pumping station (including pumps that operate outside of 'normal' parameters
	Blockage / obstruction removal at a structure (or within 10m upstream or downstream)
	Removal of young trees, shrubs and grass that may affect the structural stability / integrity of a structure (localised)
	Vermin control
Temporary works (that normally have a defined end date, and are normally operational for less than 6 months in one continuous period)	Temporary flood defences
	Temporary scaffolding to enable bridge re-pointing
	Temporary clear span bridge with abutments set-back from bank top
	Temporary coffer dam (if eel/ fish passage not impeded)
	Temporary flow diversion (if fish/ eel passage not impeded) such as flumes, porta-dams, cutting new temporary channels, overspill side weirs, over-pumping etc.
	Excavation of trial pits of boreholes
	Temporary structural investigation works such as intrusive tests and non-intrusive surveys
	Temporary abstraction
Bridges and Crossings (including service crossings)	Permanent clear span bridge, with abutments set-back from bank top
	Bridge deck/ parapet replacement/ repair works
	Replacing road, rail, footpath or other surface on a bridge
	Installing a service crossing over a river. This includes those attached directly to an existing bridge structure, its parapets or encapsulated within the bridge's footpath or road
	Service crossing over a river. This includes those attached to the parapets of a bridge or encapsulated within the bridge's footpath or road
	Replacement or dismantling of any pipes, cables or service crossings over a watercourse
Other Structures	Fishing platforms
	Fish/eel pass on existing structure (where <2% water body length is impacted)
	Cattle drinks
	Mink rafts
	Fencing (if open panel/chicken wire) in byelaw margin parallel to the river
Trash Removal	Removal of urban trash from channel and banks. This does not include the removal of gravel or woody debris

As the works proposed have the potential to affect WFD elements, a WFD screening assessment has been undertaken to determine the level of assessment appropriate to the Proposed Scheme.

WFD Screening Assessment

For non-low risk activities, a screening assessment is used to rationalise which activities could affect the various WFD elements, and thereby rationalise and screen out waterbody elements and Proposed Scheme elements that would not be impacted by the proposals.

A summary of the potential impacts of the Proposed Scheme is provided below. This includes an assessment of temporary and non-temporary effects associated with the construction and operational phases of the Proposed Scheme set out by watercourse.

For the screening assessment the main focuses are:

- Identifying particular WFD elements that will not be impacted by particular scheme elements; i.e. that are not applicable to WFD assessment.
- Identifying elements for which there is high confidence of negligible WFD impact without additional investigation; i.e. that are applicable to investigation, but there is no appreciable risk.

Where risks cannot be screened out, they will need to be carried forward for Impact Assessment at the appropriate project stage.

Potential Ecological Impacts

Construction Impacts

Weir removal, regrading works, bank protection works and construction of the erosion break require in-channel works. This means that there is potential for negative impacts on water quality and ecology, for example through spillage of hazardous chemicals (such as fuel, grout, etc) during construction. Construction works could mobilise fine sediments which may enter the watercourse and have negative impacts on bed habitats. It should be feasible for the contractor to mitigate these risks using an approved Construction Environmental Management Plan (CEMP) and appropriate site management techniques.

Regrading the channel may temporarily remove bed habitats which could have a negative impact on biological elements. However, this will be a temporary impact, and new habitat will form naturally once works are completed.

Trees will need to be removed from the left bank to allow the boulders for the erosion break structure to be installed. This will have a negative impact on bank/ riparian habitat, and new trees should be planted once construction works are completed. Therefore, this is considered to be a temporary impact.

Operational Impacts

The removal of the weir and poorly functioning fish pass will improve fish passage on the River Elwy, opening up the upstream reaches for spawning. This will allow a greater number of fish species to pass through this reach as the existing fish pass structure has five 0.5m high steps, limiting the range of species and size of individuals able to pass.

There may be a permanent loss of bank habitats associated with the bank protection works on the right bank, immediately downstream of the weir. However, this bank protection will only be installed on the lower bank for a length of approximately 40m, so the impact would be minor at the waterbody scale. Furthermore, the installation of this bank protection is considered to be an essential part of the weir removal works to protect the WWTW on the right bank. Since the removal of the weir will open up the river to a greater range of species, it is considered that the benefits associated with its removal outweigh the negative impact of the minor loss of bank habitat, and support WFD objectives.

No further assessment of ecological impacts is considered necessary, provided that a suitable CEMP is produced and adhered to.

Potential Physio-Chemical Impacts

Construction Impacts

Localised temporary impacts, particularly in terms of runoff containing possible contaminants associated with the construction (e.g. cement / fuel). However, these impacts are considered to be low risk (Table 3) and it is considered

that risks can be prevented or mitigated through the implementation of an appropriate CEMP (see Mitigation Measures section).

Weir removal, regrading works, bank protection works and construction of the erosion break require in-channel works. This means that there is potential for negative impacts on water quality and ecology, for example through spillage of hazardous chemicals (such as fuel, grout etc) during construction. Implementation of an appropriate CEMP should prevent or mitigate such risks.

Although there will be some excavation works, it is not anticipated that this will impact groundwater quality. The geology consists of a low productivity aquifer with limited groundwater, and local boreholes recorded groundwater levels to be greater than 70m below ground level. Therefore, interaction with the groundwater table is not anticipated and construction impacts are considered negligible.

Operational Impacts

The Proposed Scheme is not considered likely to have a permanent impact on groundwater – surface interactions in terms of flows or pollutant pathways, and as such will not have a negative impact on groundwater quality or the ability of the Groundwater body to achieve the objective of no deterioration.

It is not anticipated that there will be any overall adverse effect on the surface or ground water quality at the

waterbody scale during the construction or operational phases.

No further assessment of physico-chemical impacts is considered necessary, provided that a suitable CEMP is produced and adhered to.

Potential Hydromorphological Impacts

Construction Impacts

Works will be undertaken during low flows and from the banks where possible, so there should not be a need to create a dry working area, which would reduce potential impacts on hydromorphology.

The removal of the weir will be undertaken in stages, the first of which will be the breaking of the structure to allow the upstream water levels to reduce. The next stage will be the removal of the left side of the weir, followed by the fish pass and the right side of the weir. Although each stage will significantly alter flow patterns and geomorphological processes, they are considered temporary. The phased approach will help to reduce the likelihood of a catastrophic failure of the weir structure which could lead to significant erosion downstream.

Works could mobilise fine sediment which could enter the watercourse and increase the fine sediment load. However, this can be managed with an appropriate CEMP and site management techniques.

Operational Impacts

The removal of the weir and channel regrading will have a significant impact on geomorphological processes. These should be beneficial, since the works would restore hydromorphological and sediment transport continuity across the existing impoundment. However, the potential river response is not fully understood at this stage, and it is possible that hard engineering could be required to protect nearby assets. This could limit the potential environmental enhancement, and poorly designed engineering could cause environmental deterioration.

Initial modelling has indicated that there will be an increase in flow velocities downstream of the weir, which has the potential to increase erosion on the outer banks of the meander bends. Bank protection on the right bank is proposed to protect the WWTW, which could alter flow patterns and initiate erosion on the opposite bank.

Removal of the weir would help to improve sediment transport through the reach, which is currently highly impacted by the weir with a significant volume of sediment being stored upstream of the structure, while downstream the watercourse has incised in response to sediment starvation. Removal of the weir and regrading of the bed would help restore a more natural sediment regime.

The proposed weir break structure upstream could help to protect upstream reaches from erosion if the channel regrading is found to encourage erosion in this reach. However, it could also result in a potentially impassable step in the channel by preventing replenishment of the bed as it is eroded downstream. This could require additional erosion protection on the bed, which would have negative hydromorphological impacts.

Initial modelling results have shown that floodplain connection in the upstream reaches is decreased during flood events. This could be detrimental to increase flow concentration and erosion in the channel downstream, and could negatively impact floodplain habitats. The disconnection of the upstream floodplain could result in an increase in fine

sediment load within the channel due to a reduction in floodplain sediment storage, and through the increased erosion of banks as a result of greater velocities.

Further assessment into hydromorphological impacts will be required once detailed designs and modelling of the scheme.

Mitigation Measures

Mitigation measures should be incorporated into the scheme design to minimise potential adverse impacts, particularly during the construction phase. The proposed scheme should also be viewed as an opportunity to make improvements to the local environment where possible. Mitigation measures should therefore be designed to equivalent or greater extents than the proposed scheme impacts within the waterbody.

The following measures are recommended as guiding principles, and should be augmented with additional mitigation tailored to individual locations where specific risks have been identified:

- Construction works should avoid peak fish migration and spawning seasons (see below)
- Construction best practices should be applied throughout the project. Appropriate Construction Management Plans and Construction Method Statements need to be developed at the detailed design stage to ensure that riparian and aquatic environments are not degraded during construction.
- Pollution control measures should be in place for the duration of the works in accordance with Construction Industry best standards. These should include designated fuelling areas well away from the watercourse, spill kits in all plant / vehicles on site suitable for fuel and wet trade spillages, and any bowsers for fuelling, pumps, generators, or similar to sit on drip trays to avoid any runoff of fuels. Particular care should be taken where in-channel working is required.
- Sediment / runoff control measures will be required throughout the duration of the construction phase. This will limit the impact of sediment mobilisation or any contaminated runoff.
- Bio-security measures will be required to ensure that no invasive species are brought onto site. Measures will need to include checks of plant/vehicles and footwear to ensure clean and clear of potential contaminants with best practice implemented as necessary.
- All mitigation measures should be subject to design and approval by construction managers for health and safety and environment, and by appropriate regulators for environmental impacts.

Construction works should avoid peak fish migration and spawning seasons for key species. The Preliminary Environmental Assessment desk studies for Salmon for Tomorrow 2 identified trout and salmon in the Afon Elwy which are protected families / species. The river is also potential habitat for protected species of lamprey and eel. Peak migration for these species are summarised in Table 4, and spawning periods are summarised in Table 5.

Table 4: Peak fish migration periods

Common name	Latin name	Life stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sea trout	*Salmo trutta*	Adult (US)				■	■	■	■	■	■			
Sea trout	*Salmo trutta*	Smolt (DS)				■	■							
Atlantic salmon	*Salmo salar*	Adult (US)				■	■	■	■	■	■			
Atlantic salmon	*Salmo salar*	Smolt (DS)				■	■							
Eel	*Anguilla anguilla*	Adult (silver eel) (DS)								■	■	■		
Eel	*Anguilla anguilla*	Juvenile (elvers) (US)				■	■	■	■	■	■	■		
River lamprey	*Lampetra fluviatilis*	Adult (US)										■	■	■
Sea lamprey	*Petromyzon marinus*	Adult (US)				■	■							
Sea lamprey	*Petromyzon marinus*	Adult (DS)							■	■	■			

Table 5: Spawning periods

Common name	Latin name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Spawning substrate
River lamprey	*Lampetra fluviatilis*				■	■								Gravel
Sea lamprey	*Petromyzon marinus*						■	■						Gravel
Atlantic salmon	*Salmo salar*	■									■	■	■	Gravel
Brown / sea trout	*Salmo trutta*										■			Gravel

Conclusions

The Proposed Scheme comprises the removal of a weir structure to benefit fish passage in the Elwy – Clwyd to Melai WFD waterbody.

This WFD Screening Assessment has been undertaken to identify the potential impacts of the preferred option and its compliance with the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, which aims to protect and enhance the quality of the water environment.

Table 6 summarises the WFD Screening Assessment outcome. The proposals support a key aim of the WFD.

However, further analysis of hydromorphological processes, impacts and mitigation is recommended to inform the scheme design. The removal of the weir should be geomorphologically beneficial, since the works would restore sediment transport continuity across the existing impoundment, but at this stage, the potential river response is not fully understood. It is possible that hard engineering could be required to protect nearby assets. This could limit the potential environmental enhancement, and poorly designed engineering could cause environmental deterioration.

Table 6: WFD Screening Assessment Summary

		WFD Status Element				
Proposed scheme name	**Watercourse**	**Biological**	**Physico – Chemical**	**Hydromorphological**	**Overall Impact**	**Recommendation**
Llanfair Talhaiarn weir removal	River (Afon) Elwy	Major beneficial impact	Negligible impact	Potential for adverse impacts- further study required	Potential for adverse impacts- further study required	**Further assessment required into hydromorphological impacts**

Key

	Major adverse impact
	Moderate adverse impact
	Minor adverse impact
	Negligible impact
	Minor beneficial impact
	Major beneficial impact

In conclusion, further study into the impacts of the scheme on hydromorphological elements will be required as sufficient scheme information is not available at this WFD screening stage to identify that it will not cause an adverse impact. However, no further study into ecological or physico chemical elements is required as the scheme is considered to have a negligible impact on physico chemical elements, and a major beneficial impact on biological elements.