

Strategic Regional Water Resource Solutions: Annex B3.9: Ecosystem resilience, wellbeing and SMNR (Wales) Assessment

Standard Gate Two Submission for River Severn to River Thames Transfer (STT)

Date: November 2022



Severn to Thames Transfer

Ecosystem resilience, wellbeing and SMNR (Wales) assessment

STT-G2-S3-119

November 2022

Disclaimer

This document has been written in line with the requirements of the RAPID Gate 2 Guidance and to comply with the regulatory process pursuant to Thames Water's, Severn Trent Water's and United Utilities' statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solution presented in this document be taken forward, Thames Water, Severn Trent Water and United Utilities will be subject to the statutory duties pursuant to the necessary consenting processes, including environmental assessment and consultation as required. This document should be read with those duties in mind.



SEVERN THAMES TRANSFER SOLUTION

Welsh Biodiversity Duty and SMNR Assessment Report

Ricardo ref. ED15323

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1. INTRODUCTION

1.1 BACKGROUND AND DESCRIPTION OF THE STT SCHEME

1.1.1 The River Severn to River Thames Transfer Description

The aim of the Severn Thames Transfer (STT) is to provide additional raw water resources of 300 to 500MI/d to the South East of England during drought, with 500MI/d preferred by the Water Resources in the South East (WRSE) group’s emerging regional plan. The water would be provided from flows in the River Severn and transferred via an interconnector to the River Thames. For the completion of the Gate 2 assessment, a pipeline “Interconnector” has been selected as the preferred option to transfer water from the River Severn to the River Thames (subject to consultation in the context of WRMP24 and the consenting process).

Due to the risk of concurrent low flow periods in both river catchments, additional sources of water, apart from those naturally occurring in the River Severn, have been identified to augment the baseline flows. These multiple diverse sources of additional water provide resilience in the provision of raw water transfer to the River Thames. A ‘put and take’ arrangement has been agreed in principle with the Environment Agency (EA) and Natural Resources Wales (NRW) which means that if additional source water is ‘put’ into the river, then the Interconnector can ‘take’ that volume, less catchment losses, regardless of the baseline flows in the River Severn itself.

The regional planning process will determine the volume, timing, and utilisation of water to be transferred. The diversity of sources means they can be developed in a phased manner to meet the ultimate demand profile as determined by the regional planning process. These additional sources of water are being provided by United Utilities (UU) and Severn Trent Water (STW) who are working in collaboration with Thames Water (TW) to develop this solution. The additional sources are:

- **Vyrnwy Reservoir:** Release of 25MI/d water licensed to UU from Lake Vyrnwy directly into the River Vyrnwy;
- **Vyrnwy Reservoir:** Utilisation of 155MI/d water licensed to UU from Lake Vyrnwy and transferred via a bypass pipeline (“Vyrnwy Bypass”) to the River Severn;
- **Shrewsbury:** Diversion of 25MI/d treated water from UU’s Oswestry Water Treatment Works (WTW) via an existing emergency transfer (the Llanforda connection), thus enabling a reduction in abstraction from the River Severn at Shelton WTW to remain in the River Severn for abstraction at Deerhurst;
- **Mythe:** 15MI/d of the Severn Trent Water licensed abstraction at Mythe remaining in the River Severn for abstraction at Deerhurst;
- **Minworth:** The transfer of 115MI/d of treated wastewater discharge from Severn Trent Water’s Minworth Wastewater Treatment Works (WwTW) via a pipeline, to the River Severn via the River Avon at Stoneleigh; and
- **Netheridge:** The transfer of 35MI/d of treated wastewater discharge at Severn Trent Water’s Netheridge WwTW to the River Severn at Haw Bridge, via a pipeline, upstream of the current discharge to the River Severn.

The STT Gate 1 submission was assessed by the Regulators’ Alliance for Progressing Infrastructure Development (RAPID) who concluded that it should progress to standard Gate 2. The recommendations and actions received from RAPID and feedback from stakeholders from the Gate 1 process have been reflected in the scheme development and environmental assessments. Note the focus of this report is in Wales and the River Vyrnwy (see Section 1.2 for more details).

1.1.2 Gate 1

The STT Solution was subject to a detailed assessment in Gate 1 with the objective of delivering regulatory assessments of potential environmental effects of the Solution in the context of the All Company Working

Group (ACWG) guidance. This methodology is aligned to the Water Resources Planning Guideline 2024¹ so that there is a consistent approach to evaluating potential effects on environmental aspects.

At Gate 1, using the information available, the environmental appraisals did not identify any ‘material issues’, i.e. any unsurmountable obstacles that mean the scheme is unfeasible due to environmental reasons, at this stage. Both beneficial and adverse effects have been identified, which is to be expected given the scale of the scheme.

These conclusions were reached in the context of identified gaps in understanding, and the stated need for further data and evidence collection to support the Gate 2 investigations, further information on the operation of the scheme, and ongoing dialogue with regulators and other stakeholders.

1.1.2.1 Regulator feedback at Gate 1

Feedback from the regulators was sought before the submission of the Gate 1 submission and incorporated where possible. The environmental regulators also gave feedback as part of their formal Gate 1 review of the scheme. This feedback has informed the approach taken for Gate 2 and as a result this report with a Welsh focus was provided to follow key requirements as outlined in Section 1.3.

1.1.3 Gate 2

The ACWG guidelines set out that Gate 2 builds on Gate 1 activities to improve the detail and breadth of studies for a key decision point for strategic solutions. This includes concept solution designs with reduced uncertainty in costs and benefits and re-testing in revised regional and company models (to support updated decision making and filtering on outputs including those that are mutually exclusive). At the end of Gate 2, the solution should be developed to a standard suitable for submitting into final regional plans and/ or final WRMPs. In this context, this stage (Gate 2) of the programme aims to further enhance the funding portfolio, based on refined and consistent costs and benefits, with suboptimal solutions eliminated and viable solutions carried forward to the pre-planning stage. To support the programme, the potential environmental effects associated with the STT solution identified in Gate 1 have been considered in view of updated scheme design, changes in potential operational patterns, feedback on Gate 1 assessments from various regulators and stakeholders and further data gathering, modelling and assessment work completed since the publication of the Gate 1 assessment report².

Furthermore, it is recognised that there are specific requirements for Wales and specific legislation and duties. This is the key focus of this document and specifically focusing on:

- Environment (Wales) Act (2016) and its SMNR (Sustainable Management of Natural Resources) Principles.
- Wellbeing for Future Generations Act (2015) and its Wellbeing Goals - requiring public bodies in Wales to think about the long-term impact of their decisions, to work better with people, communities and each other, and to prevent persistent problems such as poverty, health inequalities and climate change.
- The Water Resources Planning Guideline 2024 Supplementary Guidance: Environment and Society in decision-making (Wales) December 2020 - ‘making decisions that do not devalue and look to enhance the value of the natural world for society benefit’.
- The Mid Wales Area Statement (covering the STT solution area in Wales).

1.1.3.1 Overview of the environment assessment approach for Gate 2

Figure 1.1 shows the investigations being undertaken for Gate 2 and their interactions, in order to show the full scope of work across both environmental engineering disciplines. Reporting for the environmental investigations is being undertaken in a phased way. The Evidence Reports (shown by the pale blue box in **Figure 1.1**) are produced first, that set out the data and evidence to be used in the assessment. The Assessment Reports use the evidence to determine the potential effect of the STT scheme on the different topics, which is completed later (dark blue box in the figure below). Together with other inputs, these reports feed into the production of the statutory reports and summary reports (yellow boxes, this report).

¹ Water Resources Planning Guideline 2024 Supplementary Guidance: Environment and Society in decision-making (Wales) December 2020 – Final for issue

² [United Utilities - Water Transfers – RAPID Gate 1 Submission](#)

1.1.3.2 Regulator engagement for Gate 2

The environmental assessment team held monthly meetings to engage with the Environment Agency (EA), Natural Resources Wales (NRW) and Natural England (NE) (the regulators) over the approach, evidence collection, monitoring programmes and data analysis for Gate 2. In addition, the team held topic-specific sessions and workshops with technical specialists. The regulators were asked to provide insights and inputs on specific aspects where needed to ensure the work undertaken is as robust as possible.

In the monthly meetings, the programme, progress and deliverables were reviewed; issues were raised for clarification and resolution, and the regulators were asked for their views and advice on different topics or issues.

In the sessions with technical specialists, the proposed approaches and the statutory reports were set out and explained. Drafts of the methodology documents (with technical notes) were issued to the regulators to solicit feedback on the proposed approaches. Regulator feedback on the draft assessment reports were subsequently used to finalise the approaches and inform the wider environmental assessment for Gate 2. In the context of this report, the feedback was used to account more specifically to Welsh biodiversity duties and the SMNR requirements.

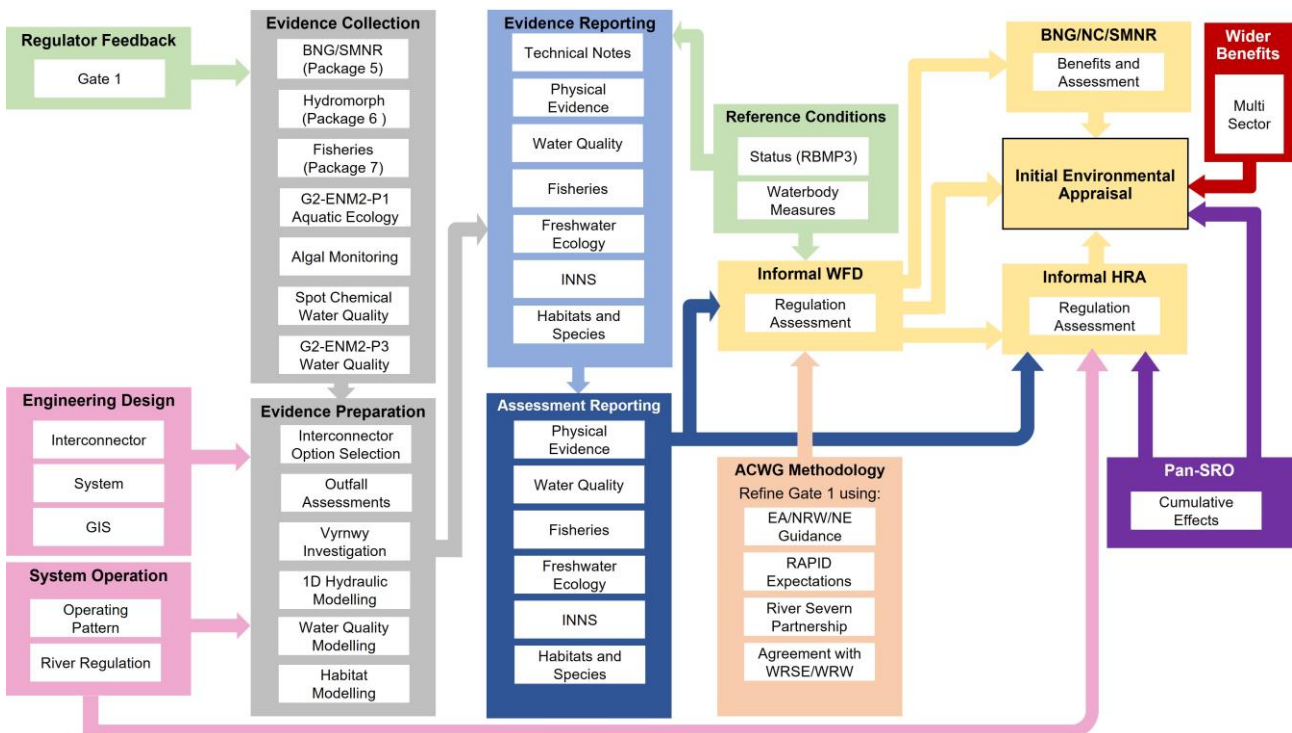


Figure 1.1 Flow chart showing the investigations being undertaken for Gate 2 and their interactions.

1.2 STUDY AREA

The study area for the Gate 2 assessment focuses on specific reaches, as shown in **Figure 1.2**:

1. Lake Vyrnwy Reservoir in Powys (Wales) and the downstream River Vyrnwy catchment to the River Severn confluence;
2. The River Severn catchment (River Severn corridor, from the confluence with the River Vyrnwy to the Severn Estuary), as well as those tributaries of the River Severn which could indirectly be affected by the operation of the STT solution (water quality);
3. The Warwickshire River Avon upstream of Warwick to the River Severn confluence; and
4. The River Thames from Culham to Teddington Weir.

The study area for this report is the River Vyrnwy and River Severn catchments in Wales (as used in the Wider Benefits Study). The River Vyrnwy is the only river considered in this report as it is focussed on the impacts and opportunities in Wales of the STT solution. The potential impacts are from the release of 25Ml/d water licensed to UU from Lake Vyrnwy directly into the River Vyrnwy. The opportunities identified in Wales were related to water quality, river biodiversity, climate regulation (carbon sequestration) and accessible nature

(taken from the Wider Benefits Report) (see Section 2.4). The opportunities were reviewed in relation to Welsh legislation (see Section 1.1.3 for details).

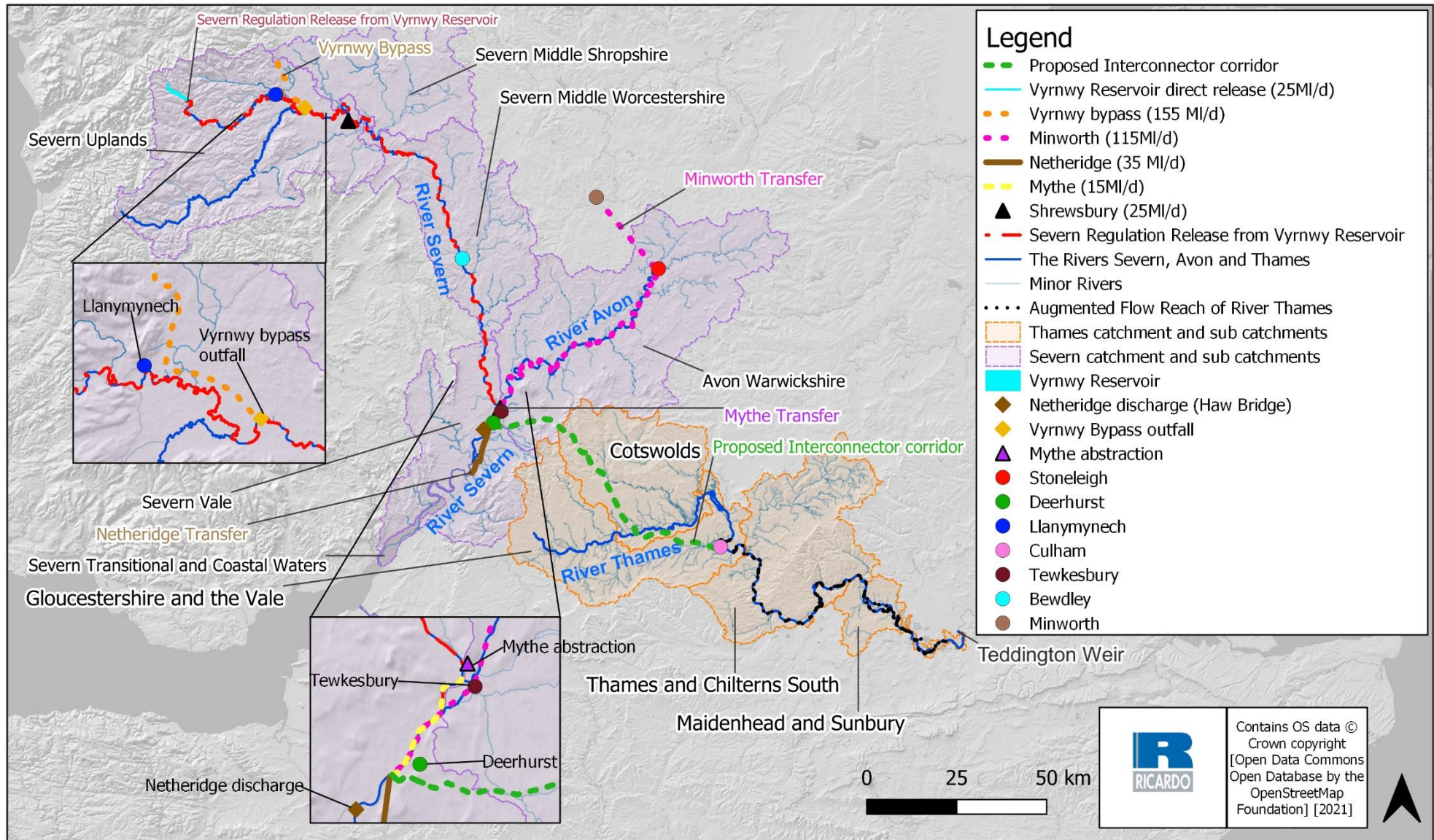


Figure 1.2 Map showing the proposed interconnector corridor

1.3 SUMMARY OF THE SOLUTION COMPONENTS AND OPERATION

The STT solution developed for Gate 2 is described through its engineering components in the Conceptual Design Report. For environmental assessment purposes, as these relate to in-river physical environment effects, the solution has been split into two phases, with and without support, described as (i) an *early phase* of the STT solution, which is without the inclusion of most of the support options that augment flow in the River Severn (see Section 1.1), and (ii) a *full STT* solution, which includes all the support options. The river flow changes that comprise these two phases are set out in **Table 1.1** and **Figure 1.3**

Supporting options would be operational at those times when the STT is transferring water from the River Severn to the River Thames, and when flows in the River Severn are lower than hands-off flow (HoF) thresholds in the River Severn. The EA has advised that a STT abstraction licence would be imposed so flows at Deerhurst flow gauging station do not drop below 2,568 MI/d. Above this HoF, there is a maximum abstraction limit of 172 MI/d, up to the next HoF condition of 3,333 MI/d, where 355 MI/d can be abstracted, in addition to the available 172 MI/d unsupported³. This is summarised in **Table 1.2**.

The EA has advised the STT Group of appropriate values of “in-river losses” to include in the hydraulic modelling⁴ and subsequent environmental assessments. The advised values include a 20% loss in the River Vyrnwy and a 10% loss for water transferred into the River Avon, in the augmented flow reach between Stoneleigh and the River Severn confluence at Tewkesbury, with the loss occurring evenly over the distance. As such, of the total 370MI/d supporting flows augmenting flows into the River Severn catchment for full STT, the equivalent re-abstraction value at Deerhurst used for the environmental assessment is 353MI/d as represented in **Table 1.1**.

Table 1.1 Components of Early Phase and Full STT Operation

Early Phase STT	Full STT
500MI/d interconnector pipeline.	500MI/d interconnector pipeline
Part-time, <i>unsupported</i> abstraction up to 500MI/d from the River Severn at Deerhurst and transferred to the River Thames at Culham, subject to hands-off flow conditions identified by the EA.	Part-time, <i>unsupported</i> abstraction up to 500MI/d from the River Severn at Deerhurst and transferred to the River Thames at Culham, subject to hands-off flow conditions identified by EA
Part-time, <i>supported</i> abstraction up to 35MI/d from the River Severn at Deerhurst and transferred to the River Thames at Culham, at flows constrained by hands-off flow conditions, provided by 35MI/d flow volume from the Netheridge Transfer. The early phase STT solution does not include the full range of support options and as such supported abstraction is limited to the value of the Netheridge Transfer, 35 MI/d.	Part-time, supported abstraction up to 353MI/d from the River Severn at Deerhurst and transferred to the River Thames at Culham, at flows constrained by hands-off flow conditions, and accounting for assumed river transfer losses. Flow provided by UU and STW sources. The order in which these sources are utilised has been determined by optimising the engineering solution and through the regional water resilience modelling by Water Resource South East (WRSE): <ol style="list-style-type: none"> Vyrnwy Reservoir: Release of 25MI/d water licensed to UU from Lake Vyrnwy directly into the River Vyrnwy; Vyrnwy Reservoir: Utilisation of 155MI/d water licensed to UU from Lake Vyrnwy and transferred via a bypass pipeline (“Vyrnwy Bypass”) to the River Severn; Shrewsbury: Diversion of 25MI/d treated water from UU’s Oswestry Water Treatment Works (WTW) via an existing emergency transfer (the Llanforda connection), thus enabling a reduction in abstraction from the River Severn at Shelton WTW to remain in the River Severn for abstraction at Deerhurst;

³ Email from Caroline Howells (Environment Agency Environment Planning Officer) to Peter Blair (Thames Water, Water Resources Modelling Specialist) 27 February 2020.

⁴ Email from Alison Williams (Environment Agency Senior Water Resources Officer) to Helen Gavin (Ricardo) and Valerie Howden (HRW) on 10 February 2022.

Early Phase STT	Full STT
	<ol style="list-style-type: none"> Mythe: 15MI/d of the Severn Trent Water licensed abstraction at Mythe remaining in the River Severn for abstraction at Deerhurst; Minworth: The transfer of 115MI/d of treated wastewater discharge from Severn Trent Water’s Minworth Wastewater Treatment Works (WwTW) via a pipeline, to the River Severn via the River Avon at Stoneleigh; and Netheridge: 35MI/d of the Severn Trent Water licensed abstraction piped to the River Severn for abstraction at Deerhurst.
<p>Continuous abstraction from River Severn at Deerhurst of 20MI/d to provide a pipeline maintenance flow, with continuous transfer to River Thames at Culham:</p> <ul style="list-style-type: none"> Either unsupported abstraction when not limited by hands-off flow conditions; or Supported abstraction by flow volume matching from Netheridge Transfer 	<p>Continuous abstraction from River Severn at Deerhurst of 20MI/d to provide a pipeline maintenance flow, with continuous transfer to River Thames at Culham:</p> <ul style="list-style-type: none"> Either unsupported abstraction when not limited by hands-off flow conditions; or Supported abstraction by flow volume matching from Netheridge Transfer

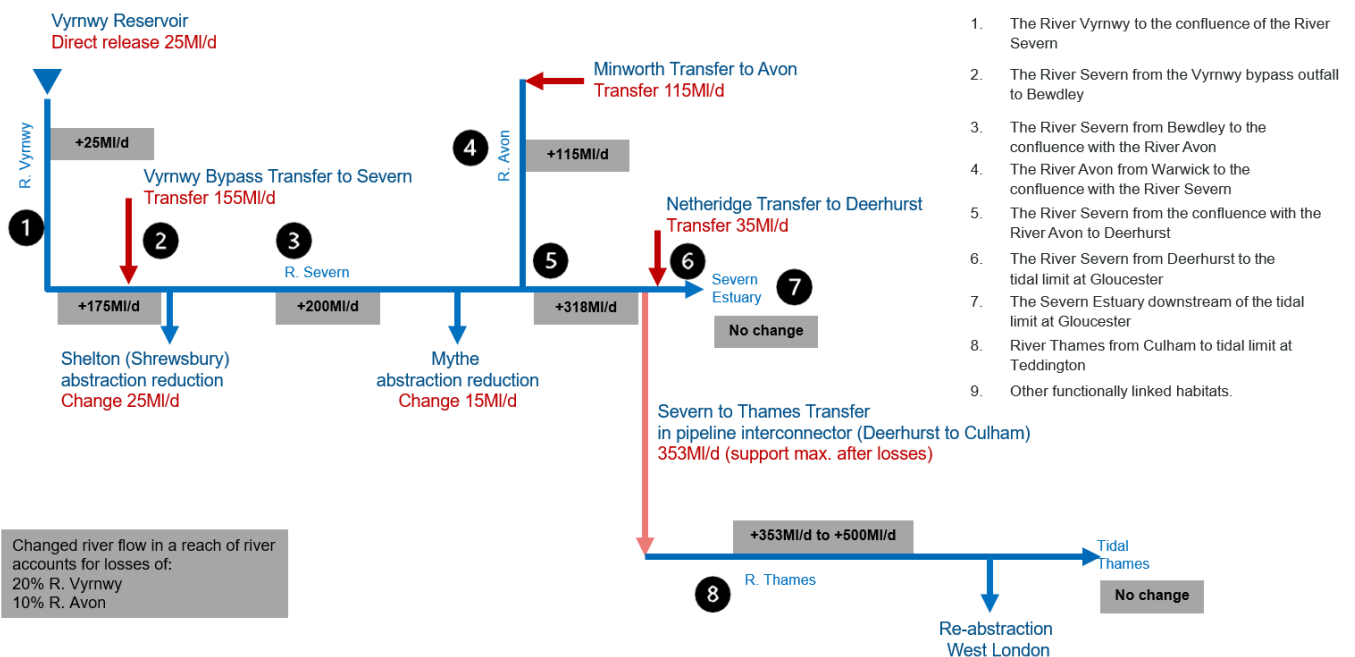


Figure 1.3 Schematic representing flow changes (accounting for losses) of STT Solution

Table 1.2 River Severn at Deerhurst: HoF conditions

HoF	Flow threshold (MI/d)	Maximum abstraction value at flows greater than the threshold (MI/d)
1	2,568	172
2	3,333	527

To support the environmental assessments at Gate 2, an indicative operating pattern has been developed. The approach uses the 19,200-year stochastic flow series developed separately for the River Severn catchment for the Water Resources West (WRW) group and for the River Thames catchment for the WRSE group. The stochastic flow series represent contemporary climate conditions and provide information on the return frequency, or regularity, of both the likely river flow conditions and STT operation. The stochastic years have been made available as 48-year continuous periods, and one of those has been selected as having representative flow characteristics to inform the environmental assessments. The selected 48-year series⁵ includes a suitable range of regular low and moderate low flow periods. It does not include extreme low flows that are considered to be less regular than once every fifty years. This is described further in the Gate 2 STT Physical Environment Assessment Report, with the derived representation of dates with the full STT in operation (for water resources purposes) as used in environmental assessment shown in **Figure 1.4**. It should be noted that this operating pattern is for the STT solution used on its own for Thames Water, without conjunctive use with other Thames Water SROs (such as the South East Strategic Resource Option (SESRO)). It also uses the controlling triggers developed by Thames Water for SESRO based on lower River Thames flows and Thames Water's total London reservoir storage.

The general description in **Figure 1.4** identifies periods in purple when the early phase STT pattern would be in operation: the combined purple and blue periods show the periods when the full STT operation pattern is being deployed. The review of river flows and operating patterns for the environmental assessment has identified that all support options would be on at the same time, rather than any selective or preferential use of support sources. These patterns of river flow and operational need inform the range of likely environmental effects of the scheme. Having identified these patterns, selected return frequencies have been selected for the detailed assessment for Gate 2, which has included hydraulic modelling of different scenarios. The scenarios modelled are:

- a 1:5 return frequency year with moderate-low flows in the River Severn at Deerhurst with a 1:5 return frequency operating pattern in terms of duration and season (model reference A82);
- a 1:20 return frequency year with very low flow years in the River Severn at Deerhurst with a 1:20 return frequency operating pattern in terms of duration and season (model reference M96).

Noting the scheme would only be used on a 1:2 return frequency, these scenarios capture a suitable range of circumstances and have been discussed and reviewed with the regulators during Gate 2.

It should be noted that, in addition to the above, a 1:50 return frequency year of extremely low flows in the River Severn at Deerhurst and with a 1:20 return frequency operating pattern in terms of duration and season (model reference N17), has been prepared and reviewed for the consideration of scheme resilience. Such a low return frequency is outside the regularity of occurrence included in WFD assessments and is thus not described further in this report.

The Gate 2 assessment also incorporates climate change scenarios into 1D hydraulic models for the assessment for the rivers and Severn Estuary pass-forward flows. The A82 Future and M96 Future years are illustrative of the potential types of changes to river flows and operating patterns in the future. This is described further in the STT Gate Physical Environment Assessment Report. At this stage, as the full 19,200 stochastic years have not been reworked as 2070s RCM8.5 futures, it is not possible to derive a suitable 48-year period that is representative of the return frequencies for the environmental assessments.

⁵ Note these are 48 calendar years. The environmental assessment period has been selected as a water resources year (1 April to 31 March) and as such the selected period includes 47 water resources years from the 48 calendar years,

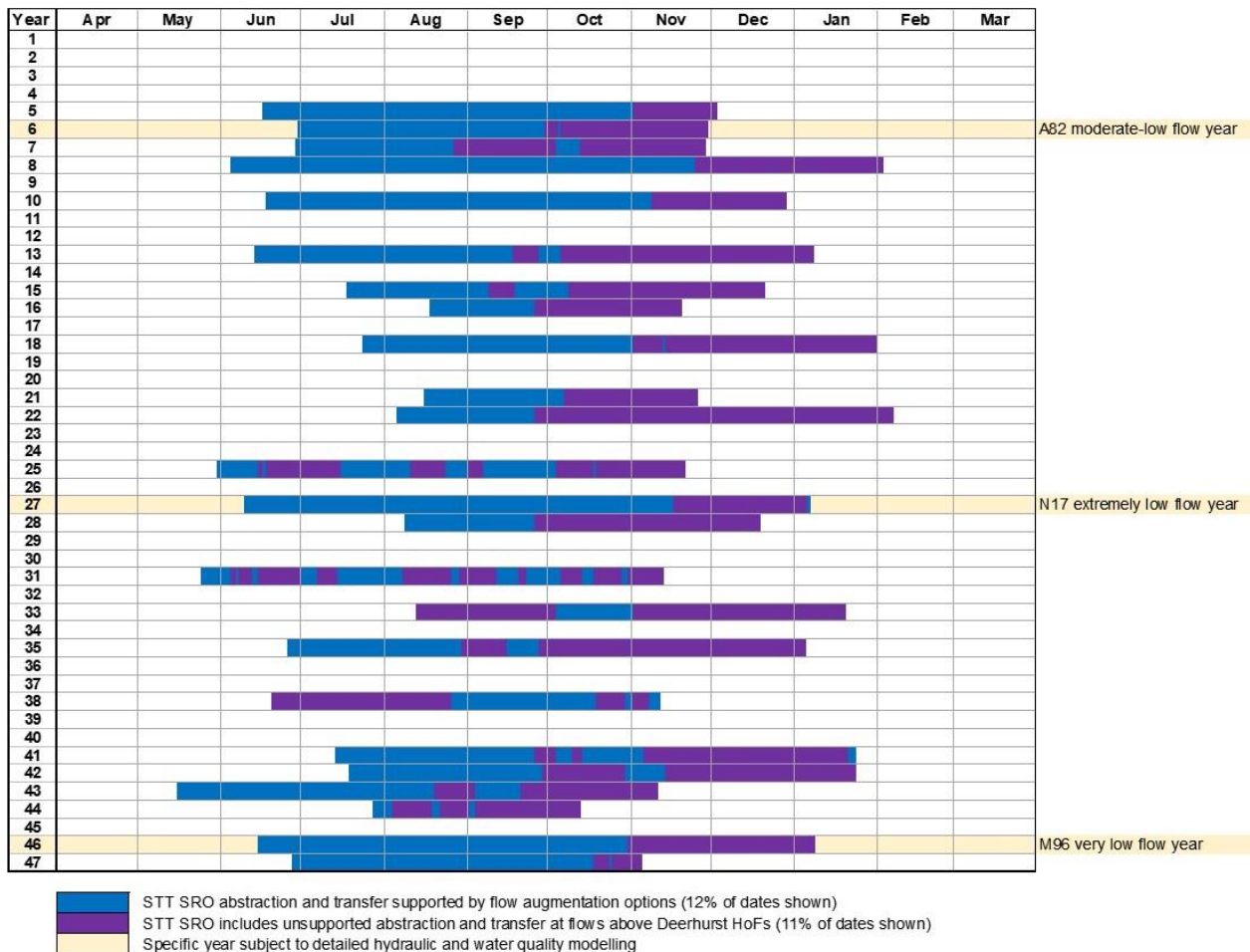


Figure 1.4 Representation of dates full STT solution would be on (for water resources purposes) as used in the environmental assessment

Where: purple indicates periods when the early phase STT would be in operation (unsupported abstraction); and the combined purple and blue periods (supported abstraction) indicate the full STT

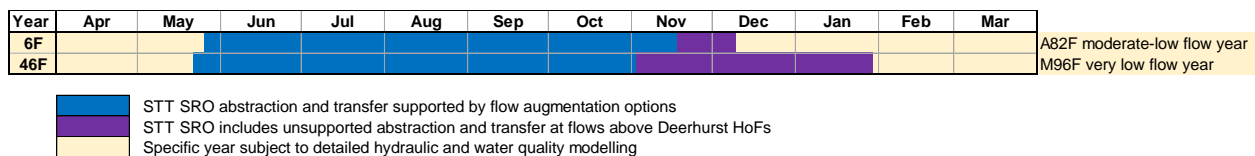


Figure 1.5 Representation of dates full STT solution would be on (for water resources purposes) for selected future scenarios as used in the environmental assessment

Where: purple indicates periods of unsupported abstraction and blue indicates periods of supported abstraction

1.4 SCOPE OF THIS REPORT

This assessment is high level and based on the requirements for Gate 2. This report presents analysis and findings from the examination of baseline data as set out in the Evidence Report and Assessment Report outputs, to estimate any potential impacts and environmental and societal opportunities related to the STT solution on the River Vyrnwy (see Section 1.2 for details on the study area).

The remainder of the STT scheme is located in England and has therefore undergone a full biodiversity net gain using the Defra's Biodiversity Metric 3.0⁶ and a full monetised Natural Capital Account⁷.

This report also identifies where more confidence could be placed in the results, through further evidence collection and analysis throughout Gate 2 (see Section 4.1 and Section 4.2) as part of the summary outputs.

1.4.1 Aspects covered by other Gate 2 Reports

Various Gate 2 reports have fed into this assessment to explore the potential multiple benefits arising from, and any opportunities or impacts related to, the STT solution. Specifically, this assessment has used the outputs and findings outlined in the following:

- Physical Environment Assessment Report⁸
- Water Quality Assessment Report⁹
- Macroinvertebrates and Other Ecology Assessment Report¹⁰
- Fisheries Assessment Report¹¹
- Invasive Non-Native Species Assessment Report (INNS)¹²
- Protected Species Assessment Report¹³
- Protected Habitat Assessment¹⁴
- WFD Regulations Compliance¹⁵
- Informal Habitats Regulations Assessment Report¹⁶
- Wider Benefits Study¹⁷

⁶ <http://nepubprod.appspot.com/publication/5850908674228224>

⁷ <https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca-guidance/enabling-a-natural-capital-approach-guidance>

⁸ STT-G2-S3-112-Physical Environment Assessment

⁹ STT-G2-S3-113-Water Quality Assessment

¹⁰ STT-G2-S3-115-Macroinvertebrates / Other Freshwater Ecology Assessment

¹¹ STT-G2-S3-114-Fisheries Assessment

¹² STT-G2-S3-116-INNS Assessment

¹³ STT-G2-S3-124-Protected Species Assessment

¹⁴ STT-G2-S3-117-Protected Habitat Assessment

¹⁵ STT-G2-S3-122-Water Framework Directive (WFD) Assessment

¹⁶ STT-G2-S3 -121 •Informal Habitats Regulations Assessment Report

¹⁷ STT-G2-S3-125-Wider Benefits Study

2. ASSESSMENT

2.1 SUMMARY OF THE APPROACH

Given the study area, this assessment is based on Welsh Biodiversity Duties and underpinned by SMNR Principles and Wellbeing Goals. This is discussed further in Section 2.2.

Section 2.3 sets out the findings from the assessment reports listed in Section 1.4.1 to highlight the impacts/potential changes in the water course related to the STT scheme in the context of a 25 MI/d direct release from Vyrnwy Reservoir at selected times.

Also, Section 2.3 sets out selected potential actions and resilience opportunities, based on the data collated from the separate work completed for the STT Gate 2 Wider Benefits Study¹⁷. The spatial analysis undertaken for the Wider Benefits Study has provided the foundation for this report's Welsh-based priority assessment.

Using this information, plus knowledge gained from Area Statements and River Basin Management Plans (RBMP) where available, as well as other local data based on open source information, a Red, Amber, Green (RAG) traffic light type analysis was conducted to align the selected actions from the Wider Benefits Study with the SMNR principles, Wellbeing Goals, and various environmental aspects including water quality, physical environment, fisheries, ecology, protected species and habitats, and INNS.

Details of the outcomes including the demonstration of links to key Natural Capital criteria are provided in Section 2.4.

2.2 SMNR PRINCIPLES AND WELLBEING GOALS

2.2.1 Background

The SMNR Principles (see **Table 2.1**) aim to utilise natural resources in a way, and at a rate that, maintains and enhances the resilience of ecosystems and the benefits they provide. In doing so, the needs of present generations are met without compromising the ability of future generations to meet their needs¹⁸. The Wellbeing Goals were set out in the Wellbeing of Future Generations (Wales) Act 2015 to improve the social, economic, environmental and cultural wellbeing of Wales¹⁹ (see **Figure 2.1**). The application of the SMNR Principles and wellbeing approach can help to identify solutions which provide multiple benefits under appropriate management.

2.2.2 Selection for use in the RAG analysis

Table 2.2 highlights whether it has or has not been feasible to consider all SMNR Principles and Wellbeing Goals in this analysis at this Gate 2 stage, noting that adaptive management, public participation, long term and preventative action from the SMNR Principles and 'a Wales of vibrant culture and thriving Welsh language' from the Wellbeing Goals have been excluded from the high-level RAG analysis. Whilst it is recognised that these elements are critically important for developing SMNR and Wellbeing opportunities, until further scheme development has taken place it is not feasible to engage/collaborate with public bodies on these specific matters and hence also not feasible to adequately assess those elements not yet included. It is, however, recognised that all these elements may need to be considered in detail at Gate 3, in addition to ongoing engagement.

¹⁸ <https://naturalresources.wales/media/678063/introducing-smnr-booklet-english-final.pdf>

¹⁹ <https://gov.wales/well-being-future-generations-act-essentials-html#section-60668>

Table 2.1 A summary of the SMNR Principles and wellbeing goals that have been considered in the analysis.

SMNR aims	Safeguarded Natural Resources	
	Resilient Ecosystems	
	A Healthy Environment for People	
	A Regenerative Economy	
SMNR principles	Adaptive management	Manage adaptively by planning, monitoring, reviewing and where appropriate, changing actions
	Scale	Consider the appropriate spatial scale for action
	Collaboration and engagement	Promote and engage in collaboration and cooperation
	Public Participation	Make appropriate arrangements for public participation in decision-making
	Evidence	Take account of all relevant evidence, and gather evidence in respect of uncertainties
	Multiple benefits	Take account of the benefits and intrinsic value of natural resources and ecosystems
	Long term	Take account of the short, medium and long term consequences of actions.
	Preventative action	Take action to prevent significant damage to ecosystems
	Building resilience	(i) diversity between and within ecosystems; (ii) the connections between and within ecosystems; (iii) the scale of ecosystems; (iv) the condition of ecosystems (including their structure and functioning); (v) the adaptability of ecosystems
Welsh Wellbeing Goals	A globally responsible Wales	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.
	A prosperous Wales	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including action on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.
	A Wales of vibrant culture and thriving Welsh language	A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, sports and recreation.
	A Wales of cohesive communities	Attractive, viable, safe and well-connected communities.
	A more equal Wales	A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio-economic background and circumstances).
	A healthier Wales	A society in which people’s physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.
	A resilient Wales	A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).



Figure 2.1 Wellbeing Goals

Table 2.2 A summary of the Welsh SMNR Principles and Wellbeing Goals that have been considered, next steps beyond this assessment and benefits to date

SMNR Principles and Wellbeing Goals	Included in RAG analysis?	Consideration of SMNR Principles and Wellbeing Goals in RAG analysis	Next steps to be considered beyond this assessment and benefits to date
Adaptive management	No	More information is required on the scheme / further scheme development needs to take place before this can be considered further. However, the data sets compiled at this stage can be monitored and reviewed over time to support future adaptive management. The current data provides a baseline against which any future appropriate management can be implemented.	The geospatial approach from the Wider Benefits Study can be further developed as new or revised datasets are available and fit to different queries to support this requirement. See Section 4.3 for Gate 3 recommendations.
Scale	Yes	The geospatial approach (from the Wider Benefits Study) has allowed the identification of opportunity areas.	The identification of a more appropriate scale for action will be at Gate 3 with a more detailed planning process.
Collaboration and engagement	Yes	The alignment of actions with the Mid Wales Area Statement and local projects were considered. The results can be used to further promote collaboration and engagement across a number of stakeholders because of the variety of opportunities identified.	Currently this is focused on key stakeholders (Natural Resources Wales, Severn Trent PLC, RSPB). However, the method allows for further collaboration and engagement with relevant stakeholders if required. At the moment, due to the scale of the project, the geospatial analysis is at a high level, however if required the data can be more closely scrutinised for different areas. It is recommended that further analysis continues into Gate 3.
Public participation	No	Public participation was not feasible at this stage, Gate 2, because the opportunity areas for restoration are being explored. However, the Wider Benefits Study's opportunity areas approach (see Section 2.4.2) used open-source data which provides a platform for future participation.	Public participation is more appropriate at Gate 3 once the scheme is further developed. This does not preclude discussion around opportunities, however, participation will be required for multiple years, given the future programme of work associated with the planning and construction of the solution.
Evidence	Yes	The geospatial approach has incorporated relevant available datasets to capture benefits. The datasets are all publicly available and are published by credible bodies. Where there are limitations at this stage, they have been highlighted in the RAG analysis.	This work uses the best data available at this scale. The approach developed allows for other data/updates to be added when available so that all evidence is in one place. As more data are provided throughout Gate 3 this can be added to the assessment (see Section 4.3).
Multiple benefits	Yes	The geospatial analysis captures multiple benefits that cover benefits from ecosystem services and benefits to the public.	This is currently at a high-level scale and based on available open-source data. The approach provides a platform for discussing benefits as part of the planning process in Gate 3 (see Section 4.3).
Long term	No	The long term consequences of the STT scheme have been considered by modelling the changes up until 2070 under different scenarios. The Wider Benefits Study's approach uses data that can be updated over time. Many of the datasets used are updated frequently meaning comparison over time can be undertaken.	This should be considered further at Gate 3 incorporating local information from stakeholders and updates to Area Statements.
Preventative action	No	This is currently something that cannot be addressed as more detailed local data are required in order to understand the pressures and drivers of change on the ecosystem services. Investigations for the STT ecological assessment has revealed the presence of freshwater pearl mussel but there is uncertainty over the viability of any population present. Further surveys will be undertaken to remove uncertainties and understand the need for any preventative measures.	Data collection at the local scale would be needed to understand this further. Habitat and MoRPh (Modular River Physical) surveys should be carried out at Gate 3 to understand local condition and extent.

SMNR Principles and Wellbeing Goals	Included in RAG analysis?	Consideration of SMNR Principles and Wellbeing Goals in RAG analysis	Next steps to be considered beyond this assessment and benefits to date
		Early analysis of detailed flow data in the River Vyrnwy revealed that the original scheme design of the direct release of 75 MI/d from the Vyrnwy reservoir from the R Vyrnwy would have the potential to affect the integrity of the designated species and functionally linked habitats for the R. Severn SAC. As a result, the scheme design was changed to reduce the volume to 25 MI/d and the analysis presented in the STT environmental assessed reports is based on this reduced volume. NB the direct release of water from the Vyrnwy reservoir for the purposes of the STT scheme has been modelled and assessed as occurring on top of the Severn Regulation and compensation flow releases, where appropriate.	
Building resilience	Yes	The geospatial approach looks at the importance of the quality of the environment and not just the extent. It does this by including relevant data such as water quality as measured by the WFD status.	When datasets on the state and condition of the natural environment become available they can be integrated into the approach.
A globally responsible Wales	Yes	The Wider Benefits Study's geospatial outputs highlight areas with the greatest opportunities in terms of climate regulation/carbon sequestration. They also include river biodiversity opportunity areas.	The approach can be further developed when more data becomes available that indicate the quality or condition of the natural environment.
A prosperous Wales	Yes	The Wider Benefits Study's geospatial analysis used data from the Welsh Indices of Multiple Deprivation (see the STT Gate 2 Wider Benefits Study for details). Furthermore, the STT solution is likely to boost employment, through construction works or the various actions associated with the opportunity areas, as well as skills and knowledge. This in turn boosts the local economy.	To determine potential learning and development opportunities, engagement is needed with water company stakeholders on whether planned innovation and research and development will likely contribute to improvements in skills, and whether there are opportunities for local supply chain and local employment. This cannot be completed for this high level study but the approach provides a platform for starting these conversations at Gate 3.
A Wales of vibrant culture and thriving Welsh language	No	How the STT solution will benefit the Welsh language and the culture is not possible to capture at this stage as this will require more confidence on the precise details of the STT scheme and planning, since this has a direct impact of precise location and hence identification of key stakeholders. This in turn, in the next steps provide a good understanding of local ambition in this context.	Currently, we are not able to measure this as the actions to improve certain areas aren't currently known so we can't estimate the impact on Welsh language and culture. However, in Gate 3 once we understand the actions to be put in place in the opportunity areas there will be an opportunity to look at the potential impact on Welsh language and culture.
A Wales of cohesive communities	Yes	The Wider Benefits Study's geospatial approach used data from the Welsh Indices of Multiple Deprivation.	This high-level study provides some indication of areas of focus. It will be possible during Gate 3 and beyond to give focus to opportunities for local group engagement (volunteers) and options to increase cohesive communities such as providing access linkages etc.
A more equal Wales	Yes	The Wider Benefits geospatial approach used data from the Welsh Indices of Multiple Deprivation.	As above for cohesive communities.
A healthier Wales	Yes	Opportunity areas for improving access to greenspace have been mapped using the Accessible Natural Greenspace Standards. These standards include the need for at least 0.5ha of greenspace within 200m; local natural green spaces of at least 2ha within 300 m; and neighbourhood natural green spaces of at least 10ha within 1 km; and all within a 15-minute walk zone from home. Mapping these areas enables the identification of locations within Wales where opportunities exist to improve physical activity.	The approach provides a high-level assessment to improve accessibility and enhance greenspaces. It is recommended that this is explored in more detail at Gate 3, taking account of the ambitions stated in the Area Statements.

2.3 RESULTS FROM THE PREVIOUS ASSESSMENTS

This section sets out the results in Wales from the other assessments in terms of whether the STT solution has an effect on WFD compliance, water quality, physical environment, fisheries, macroinvertebrates and other ecology and MoRPh5 (Modular River Physical) surveys. This baseline is needed to understand the state of the environment and hence support the SMNR Resilient Ecosystems aim. There is also a subsection on the Wider Benefits Study findings showing findings from local plans, landownership and opportunity areas. These results feed into the RAG analysis in Section 3.

2.3.1 The operation of the STT solution

In this study reach (the River Vyrnwy), the STT solution would augment flows through a 25 Ml/d direct release from Vyrnwy Reservoir at selected times. Analysis presented in the STT Physical Environment Assessment Report²⁰ shows that under contemporary moderate - low flow conditions in the River Severn (the A82 scenario, representing a 1:5 year return period), the estimated operation of the STT Solution might involve a continuous 105-day period of flow augmentation from late June to early October. Under contemporary very flow conditions in the River Severn (the M96 scenario, representing a 1:20 year return period) this might include a continuous 144-day period of flow augmentation from mid-June to early November.

2.3.2 Assessment of compliance with WFD objectives

The River Vyrnwy, from the Vyrnwy Reservoir to Llanymynech reach, was assessed for the potential to not comply with WFD objectives (see the WFD Regulations Assessment²¹). This has been completed for four specific waterbodies in Wales (see **Figure 2.2**) with results presented in **Table 2.3**.

²⁰ STT-G2-S3-112- Physical Environment Assessment Report

²¹ STT-G2-S3-122-Water Framework Directive (WFD) Assessment

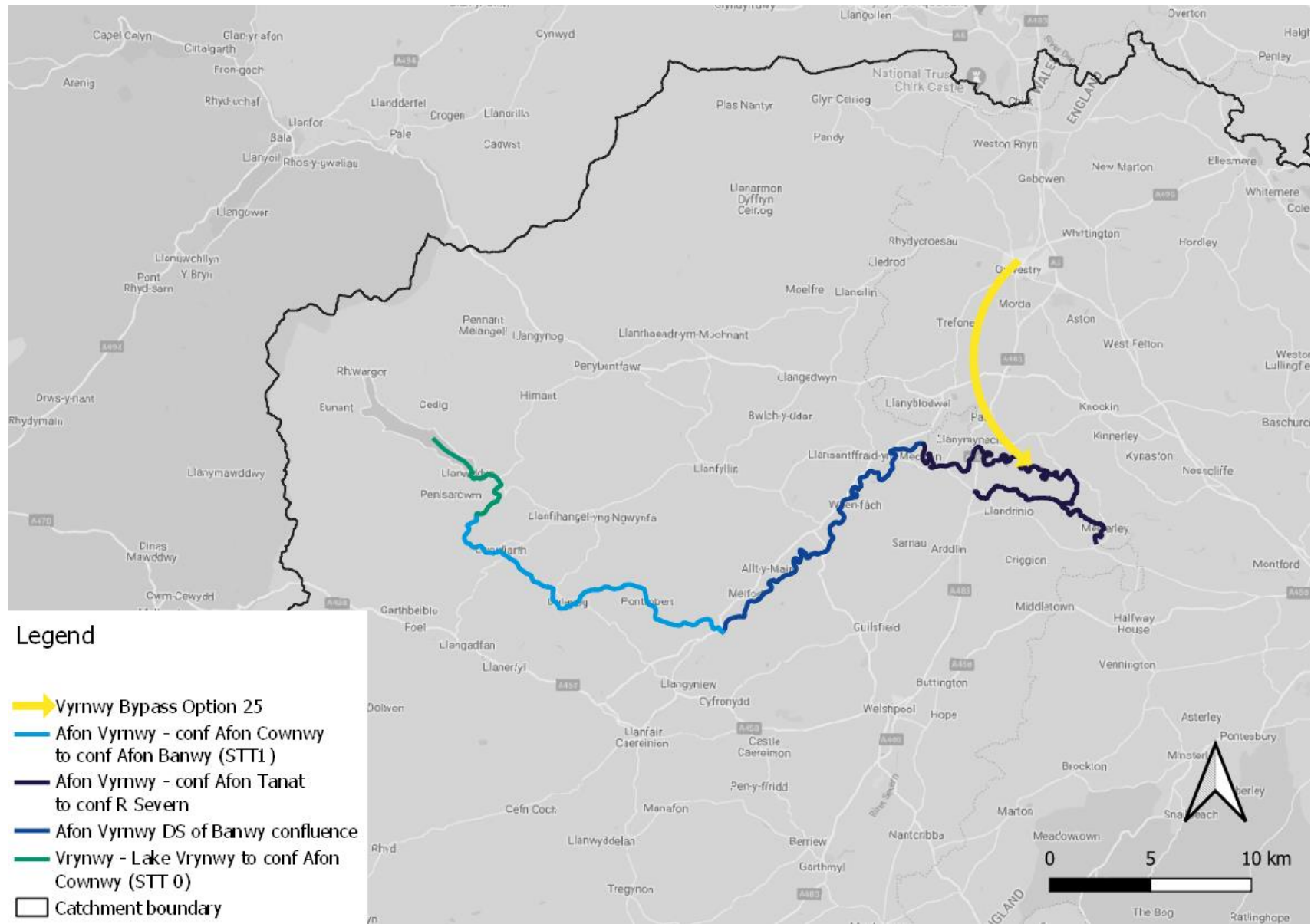


Figure 2.2 WFD waterbody locations and MoRPH waterbody locations

Table 2.3 WFD compliance assessment summary - River Vyrnwy from the Vyrnwy Reservoir to Llanymynech.

WFD Waterbody	Waterbody I.D	WFD compliant against assessed WFD objectives	Potential non-compliant issue
Vyrnwy - Lake Vyrnwy to conf Afon Cownwy	GB109054049720	Yes (medium confidence)	None
Afon Vyrnwy - conf Afon Cownwy to conf Afon Banwy	GB109054049852	Yes (medium confidence)	None
Afon Vyrnwy DS of Banwy confluence	GB109054049800	Yes (medium confidence)	None
Afon Vyrnwy - conf Afon Tanat to conf R Severn	GB109054049142	Yes (medium confidence)	None

2.3.3 Water quality

There is no pathway of environmental water quality change in this reach from STT operation²². This is because the water in this reach is from the same source (the Vyrnwy Reservoir). Therefore, no change to water quality is expected under the current conditions. The potential for water quality benefits in this reach associated with the enhanced dilution of polluting pressures, from the flow augmentation are not included in this assessment. The Gate 2 Water Quality Evidence Report²³ and Assessment Report²² presents the data and analysis for general water quality parameters: pH, acid neutralising capacity, biochemical oxygen demand, ammoniacal nitrogen, nutrients (reactive phosphate).

2.3.3.1 Chemicals

There is no pathway of chemical change in this reach from STT operation. The reservoir scour valves would not be used to support the STT solution. As such, flow released from Vyrnwy Reservoir into the River Vyrnwy would remain at exactly the same quality with or without the STT solution, with only the flow rate changed. The water comes from the upper River Vyrnwy catchment and as such the chemical composition is considered appropriate for the River Vyrnwy. As such no assessment is included at Gate 2 in this reach and no baseline information is described here. Information on chemical quality for the entire suite of WFD chemicals is available to be reviewed in the STT Gate 2 Environmental Water Quality Evidence Report.

2.3.3.2 Olfaction

There is no pathway of chemical change in this reach from STT operation. As such no assessment is included at Gate 2 in this reach and no baseline information is described here. The bespoke olfactory inhibitor monitoring suite has not been included in the analysis for this reach.

2.3.4 Physical environment

The flow changes (i.e. reducing from 75 to 25 Ml/d) have been considered minor in the context of the range of normal flows in the River Vyrnwy and the context of Severn Regulation releases which also exert a managed flow regime on the River Vyrnwy. The conclusion from the assessment of the potential effect of the scheme on in-channel habitat for a range of species²⁴ have shown that when taken over the large scale (246km for the Vyrnwy release study reach), there are not likely to be significant wholesale changes of habitat throughout the study reaches caused by the flow releases. Further, at the local scale in the upper Vyrnwy study reach (initial ~50km), the modelling indicates that there is likely to be only localised and very limited loss of flow habitats for a range of fish species under the different release conditions. This supports field observations and measurements taken in the River Vyrnwy during 2020 and 2021.

2.3.5 River MoRPh surveys

The baseline MoRPh5 condition data for two waterbodies “River Vyrnwy: Lake Vyrnwy to conf Afon Cownwy” and “Afon Vyrnwy: confluence of the Afon Cownwy to the confluence to Afon Banwy” (MoRPh survey references STT 0 and STT 1 respectively, shown in [Table 2.4](#) and [Figure 2.2](#)) were reviewed and amended based on the impact pathways identified above, to provide an indication of the potential change in condition

²² STT-G2-S3-113-Water Quality Assessment

²³ STT-G2-S3-105-Water Quality Evidence

²⁴ STT-G2-S3-112-Physical Environment Assessment, Annex A

caused by the operation of STT. The results of this assessment are provided in Appendix 1 where blue cells show no change between baseline and operation and white cells indicate potential change.

Table 2.4 MoRPh5 survey locations, WFD waterbody names, ID, ecological condition and length of reach potentially affected by the operation of STT

WFD Waterbody name	Waterbody ID	WFD ecological condition	MoRPh survey reference	MoRPh5 (Module 1 and 5 OS NGR)	Length potentially affected (km)
R Vyrnwy – Lake Vrynwy to conf Afon Cownwy	GB109054049720	Moderate	STT 0	SJ 03032 19103 SJ 03170 18975	4.89
Afon Vyrnwy – conf Afon Cownwy to conf Afon Banwy	GB109054049852	Good	STT 1	SJ 03227 15396 SJ 03200 15400	19.1

The results (Appendix 1) show that there may be a slight *negative* change during operation of the scheme related to:

- The channel margin aquatic vegetation extent;
- Aquatic morphotype richness;
- Physical feature extent and richness; and
- Channel bed natural features extent due to the increased flow.

However, the increase in flow will remain in the normal flow envelope and is unlikely to cause a discernible impact²⁵.

In addition, the waterbody from the confluence of the Afon Cownwy to the confluence with the Afon Banwy (MoRPh survey reference: STT 1) the increase in flow may have a minor *positive* impact on channel bed siltation locally although the overall quality of physical habitat and functioning of the river system remains the same.

It should be noted the MoRPh5 operational predictions were based on expert judgement through qualitative assessment using site knowledge, baseline survey results and numerical model outputs of the predicted flow changes for the schemes in the river.

2.3.6 Fisheries

The potential changes in velocity and depth are not considered to be of a magnitude to result in impacts on habitat availability for the fish community in this reach. This is because the velocity and depths that would be observed under a fully supported STT remain similar to baseline conditions and remain within the preferred and optimum requirements for the baseline fish community associated with the reach²⁶.

The available data indicate that the fish community within the River Vyrnwy from Vyrnwy Reservoir to Llanymynech, comprise largely of brown trout, bullhead and Atlantic salmon, with records of European eel, lamprey species), stone loach (*Barbatula barbatula*), minnow (*Phoxinus phoxinus*), three spined stickleback (*Gasterosteus aculeatus*) and grayling (*Thymallus thymallus*). In the lower sections of this reach, several coarse fish species such as barbel (*Barbus barbus*) Chub (*Squalius cephalus*) and Dace (*Leuciscus leuciscus*) have also been recorded.

It is well known that the waterfalls at Dolanog create a natural barrier that represents the upstream limit for migratory species such as Atlantic salmon, sea lamprey), river lamprey and European eel. Upstream of the waterfall, the fish community is dominated by brown trout and bullhead. Habitat mapping suggests that suitable shad spawning habitat is present throughout the River Vyrnwy.

²⁵ STT-G2-S3-112-Physical Environment Assessment

²⁶ STT-G2-S3-114-Fisheries Assessment

2.3.7 Macroinvertebrates and other ecology

No adverse effects on the macroinvertebrate, macrophyte and phytobenthos communities as a result of hydrological and hydraulic changes in this reach are expected under the current conditions. Furthermore, there is no pathway for environmental water quality change and, therefore, no impact on aquatic communities in this regard²⁷.

2.3.8 Protected species and habitats

From the assessment results, it is evident that the change in flow is not considered discernible and falls within the inter annual variations that would be observed under reference conditions. As a result, the changes in flow will not affect protected species associated with water dependent habitats (SSSIs and priority habitats) as no significant change in water level or velocity is predicted to occur and the relative height difference between the protected habitats and the baseline river levels is not significant. The hydrological modelling and flood assessment did not identify changes in the frequency, extent or duration of winter inundation that could have potential to alter the extent, quality or distribution of potential functionally linked habitat identified within 100m of the impacted reaches²⁸.

2.3.9 INNS

The potential transfer of Invasive Non-Native Species (INNS) from Lake Vyrnwy to the River Vyrnwy was not assessed by EA's SRO Aquatic INNS Risk Assessment Tool (SAI-RAT) because there was no predicted impact from STT scheme²⁹. Within the River Vyrnwy catchment, the most recorded INNS is Himalayan balsam (*Impatiens glandulifera*), which was recorded 71 times. Other notable species include Butterfly Bush (*Buddleja davidii*), Canadian Pondweed (*Elodea canadensis*) and Japanese Knotweed (*Fallopia japonica*).

2.3.10 Habitat Regulations Assessment

The informal screening identified the risk of likely significant effects (LSE) associated with the construction of the STT solution. There were no LSE on designated sites or supporting habitats in Wales from the Vyrnwy Bypass as shown in **Table 2-5**.

Table 2-5 European designated sites potentially affected by Severn to Thames Transfer Elements

European designated site	Associated components	Risk of LSE (alone or in-combination)
Berwyn and South Clywd Mountains SAC	Vyrnwy Bypass	No
Berwyn SPA	Vyrnwy Bypass	No
Montgomery Canal SAC	Vyrnwy Bypass	No
Tanat and Vyrnwy Bat sites SAC	Vyrnwy Bypass	No

2.3.11 Overall impact from the STT scheme

Overall, the release of 25 Ml/d from Vyrnwy Reservoir is likely to have a very limited impact on the aquatic ecology or the physical environment or water quality. The MoRPh5 survey however, indicated there could be some limited effects such as a reduction in silt improving water quality and potential changes to the channel margin.

2.4 WIDER BENEFITS

2.4.1 Assessment of area statements and land ownership

The STT Gate 2 Wider Benefits Study examined published Area Statements for the focus area. Each area statement outlines the key challenges facing that particular locality, what can be done to meet those

²⁷ STT-G2-S3-115-Macroinvertebrates / Other Freshwater Ecology Assessment

²⁸ STT-G2-S3-117-Protected Habitat Assessment and STT-G2-S3-124-Protected Species Assessment

²⁹ STT-G2-S3-116-INNS Assessment

challenges, and how natural resources can be managed for the benefit of future generations. The themes for the Mid Wales Area Statement (which covers the STT solution area) are:

- Improving biodiversity;
 - Identifying the main causes of the nature emergency including what needs to be done, by whom and where;
 - Improving the Favourable Conservation Status of designated sites;
 - Identifying opportunities for connectivity between those sites and other areas;
 - Making nature a priority through planning, policy and practical measures;
 - Seeking innovative measures and alternative options for tackling invasive non-native species (see Section 2.3.9) especially near water courses;
- Sustainable land, water and air;
 - Support farm businesses through ways of working that minimise impacts on the environment;
 - Take measures to reduce pollution incidents through better management of potential sources of pollution (such as slurry & manure stores);
 - Work with businesses, communities and policy makers to review current agricultural policies and schemes and explore new options for Payment for Ecosystem Services;
 - Manage our water resources to improve the quality and quantity of available water, without causing detriment to the natural environment;
 - Help to create adaptive and resilient communities in response to adverse weather events and climate change;
- Reconnecting people and places – improving health, wellbeing and the economy;
 - Promote sustainable tourism opportunities to help boost the local economy;
 - Promote, encourage and support sustainable recreation, reconnect local people and visitors with access to the natural environment;
 - Look for new ways in which people can connect with their local environment to help improve their health and well-being;
 - Work with different organisations to develop opportunities for using the natural environment on our doorstep as a tool in preventative medicine;
 - Develop the evidence base to further support the theories around health and well-being and links to the natural environment;
- Forest resources – managing timber resources effectively;
 - Managing forest resources sustainably, while also supporting the timber industry;
 - Increasing woodland cover with conifer, broadleaved and mixed woodland, following the ‘right tree, right place’ principle (which ensures that important areas that are already storing significant carbon, support priority habitats and species, or are protected sites are not planted with trees where there are negative effects on the interest of the site);
 - Supporting training and local employment opportunities in forest management and skills;
 - Valuing woodlands for their commercial, recreational and biodiversity value;
 - Adapting to the impacts of tree disease and climate change;
 - Working with policy makers to balance the need for re-stocking upland forests whilst avoiding damage to natural peatland habitats;
 - Seeking opportunities for carbon capture and storage through well managed woodlands; and
- Climate emergency – adaptation and mitigation across the four previous themes³⁰.

The ambitions varied per local authority but were in the form of either written policies or specific mapped opportunity areas and can be mapped to the key ecosystem services highlighted for consistency with Water Resources Planning Guidance as shown in **Table 2.7**. This has included an assessment of opportunities for coordination or contribution to other regional and national strategic priorities – for example areas statements, wider planning ambitions, natural recovery networks and SMNR priorities. There are large areas for mineral safeguarding which are important to highlight given there are restrictions for non-minerals development and

³⁰ <https://naturalresources.wales/about-us/area-statements/mid-wales-area-statement/?lang=en>

potential for minerals development in the future (pale blue areas)³¹ (**Figure 2.3**). There are also large national nature reserves (although no local nature reserves in this area) in dark blue. Although these were not mapped, there are some pre-assessed areas for wind energy (one of which is in the south of the catchment boundary). In addition, there is a Severn Trent PLC peatland restoration project in the peatland surrounding Lake Vrynwy. There are also some flood investments within the catchment boundary³². Land ownership was also investigated. **Figure 2.4** shows there is a very large RSPB reserve in Wales (Lake Vrynwy).

The Severn River Basin Management Plan has objectives for the Welsh part of the Severn River Basin District to:

- Improve 22 water bodies to good status by 2033 or 2039 as a result of measures already in place or planned in the next cycle; and
- To improve an additional 147 waterbodies to good status by 2027.

Achieving these objectives would also safeguard the quality of drinking water sources in drinking water protected areas, achieve improvement objectives for bathing waters, and help protect the water bodies for the conservation of internationally important wildlife³³.

³¹ <https://www.gov.uk/guidance/minerals>

³² <https://datamap.gov.wales/maps/wales-flood-and-coastal-capital-investment-2022-23/view#/>

³³ <https://www.gov.uk/government/publications/severn-draft-river-basin-management-plan-summary-and-cross-border-catchments-england-and-wales/severn-draft-river-basin-management-plan-summary-and-cross-border-catchments-england-and-wales>

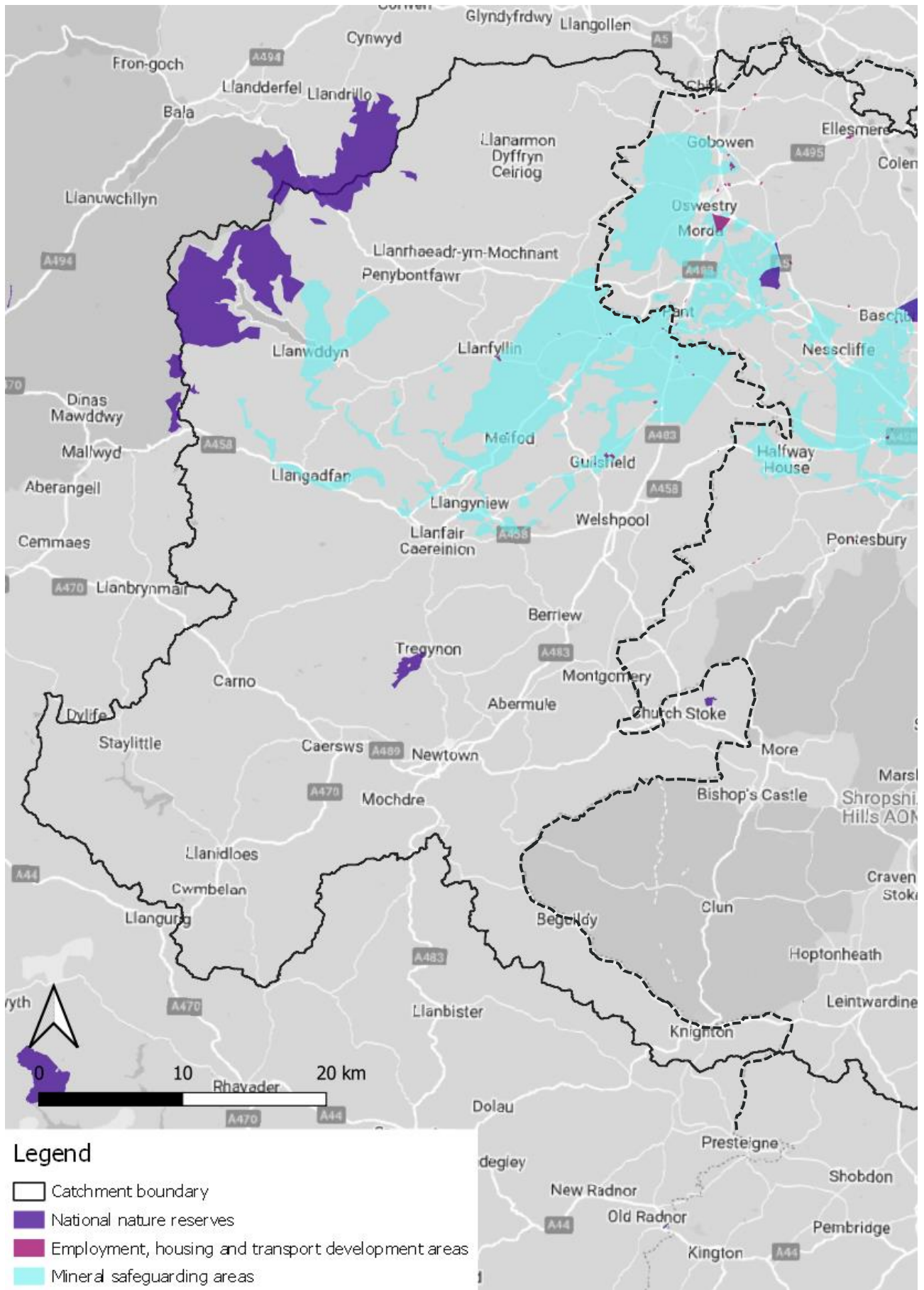


Figure 2.3 Data extracted from Area Statements

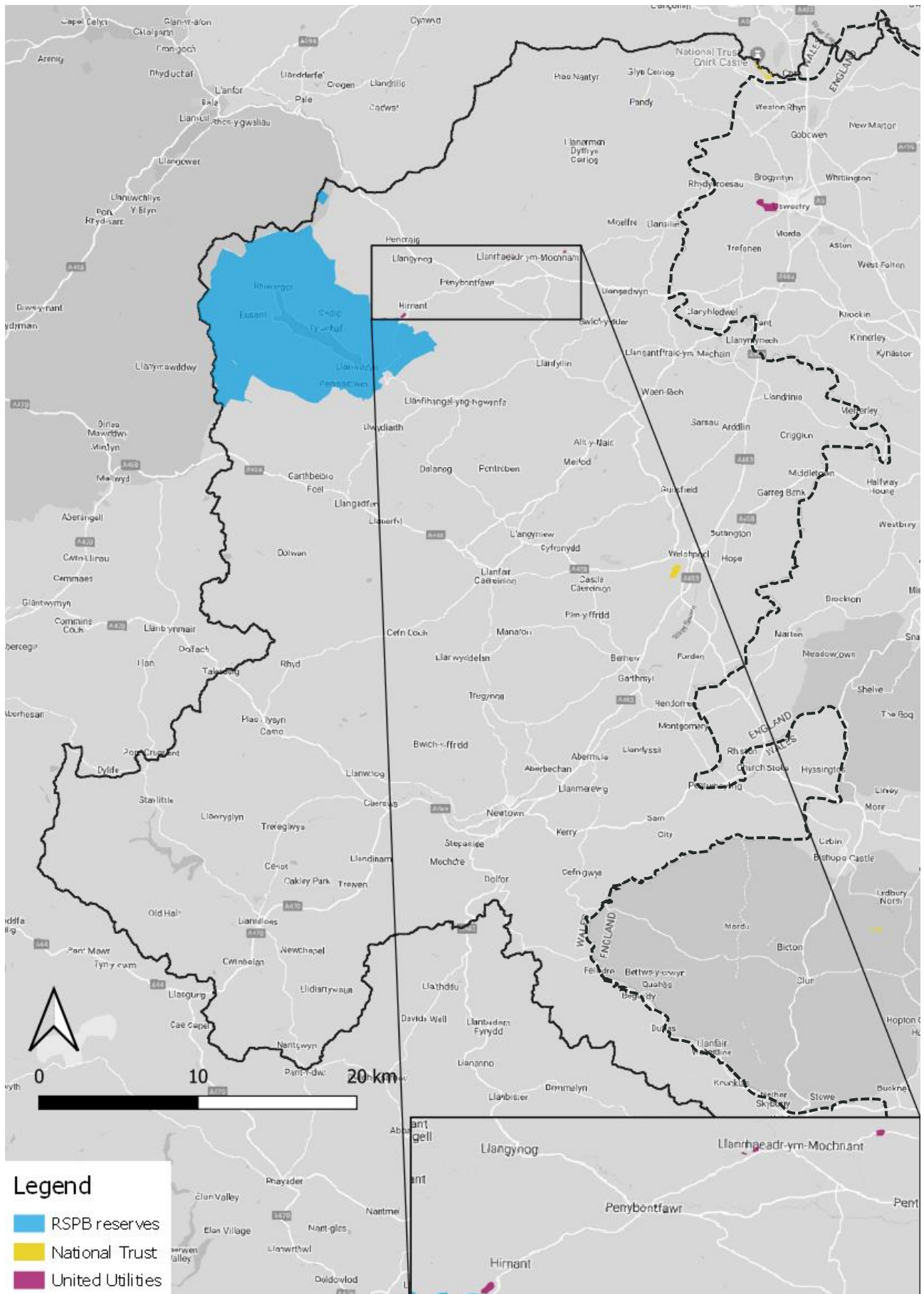


Figure 2.4 Land ownership of United Utilities, the National Trust and the RSPB in Wales

2.4.2 Opportunity areas

The Wider Benefits Study identified many opportunity areas in Wales to enhance water quality, flood regulation, carbon sequestration, river biodiversity and access to nature. The recommended actions for these opportunity areas are set out in **Table 2.6**.

The links of the recommended actions to the Mid Wales Area Statement themes and main focus areas are set out in **Table 2.7**.

Table 2.6 Recommended actions identified from the Wider Benefits Study in Wales

Recommended actions	Identification of opportunity areas	Specific actions
Improving water quality	Pasture in the catchment of rivers with livestock-related diffuse pollution were identified.	<ul style="list-style-type: none"> - Reducing livestock numbers in those areas (particularly where there is high runoff risk) - Planting trees and hedgerows - Reducing soil compaction
River barriers to fish migration	River barriers over 1.4 m were identified as barriers to fish migration (particularly Atlantic Salmon migration).	The locations of the barriers show opportunity areas for barrier removal, fish pass construction and the replacement of existing fish passes that are inefficient or could be improved.
Enhancing rivers with bad ecological status	Rivers with bad ecological status were identified.	Depending on the cause of bad status the following actions could be recommended: <ul style="list-style-type: none"> - Removal of INNS - Restoring the natural flow and levels of water - Improving water quality
Peatland restoration	Areas were scored according to soil type (deep peat, shallow peat, peaty pockets and mineral soil) and carbon flux (negative values indicating sequestration to positive values with carbon emissions). Deeper peat and higher flux were higher priority areas.	Restoration actions could include: <ul style="list-style-type: none"> - spreading mixed peatland vegetation fragments onto the peatland surface - rewetting peatland (raising the water table)³⁴
Runoff reduction	A proxy for runoff risk was determined by assigning Manning's roughness coefficients to landcover, slope, annual rainfall average and distance from watercourse using Whitebox. Flood risk maps were compiled using available planning data on flood zones 2 and 3 which indicated medium and high flood risk (respectively). Areas with a greater than average runoff risk were overlaid with the flood zone areas and given scores to show the relative importance of flood regulation opportunity areas.	The four key underlying mechanisms of Natural Flood Management could be applied in these areas: <ul style="list-style-type: none"> - increasing storage e.g. wetland and pond creation, reconnecting functioning flood plains - increasing catchment and channel roughness e.g. planting trees and hedgerows - increasing losses e.g. improving soil structure, reducing soil compaction - de-synchronising peak flows from tributaries³⁵
Enhancing greenspace and making it more accessible	Terrestrial habitats with no public rights of way, and those which were closest to green spaces, were each given scores according to Accessible Natural Greenspace Standard (ANGSt) buffers from urban areas which did not have access to greenspace according to the ANGSt methodology.	<ul style="list-style-type: none"> - Adding public rights of way and improving accessibility for disabled people if it is appropriate i.e. protected species will not be harmed - Improving biodiversity - Planting trees or hedges to reduce noise and air pollution and provide shade and local climate regulation

³⁴

https://www.conservationevidence.com/data/index?terms=%22%22%22%22%22%22%22%22peatland%22%22%22%22%22%22&yt0=&sort=relevance_desc#interventions

³⁵ <https://catchmentbasedapproach.org/learn/what-is-natural-flood-management/>

Table 2.7 Recommended actions identified from the Wider Benefits Study in Wales and their links to the Mid Wales Area Statement themes and main focus areas.

Recommended actions	Links to Mid Wales Area Statement	Key (bold) and secondary ecosystem services associated with Natural Capital Benefits*
Improving water quality – areas which are responsible for livestock diffuse pollution	Improving biodiversity: <ul style="list-style-type: none"> - Identifying the main causes of the nature emergency including what needs to be done, by whom and where Sustainable land, water and air: <ul style="list-style-type: none"> - Support farm businesses through ways of working that minimise impacts on the environment - Take measures to reduce pollution incidents through better management of potential sources of pollution (such as slurry & manure stores) - Manage our water resources to improve the quality and quantity of available water, without causing detriment to the natural environment 	Water purification, biodiversity, agriculture
River barriers to fish migration (over 1.4 m)	Improving biodiversity <ul style="list-style-type: none"> - Identifying opportunities for connectivity between designated sites and other areas 	Biodiversity
Enhancing rivers with bad ecological status	Improving biodiversity <ul style="list-style-type: none"> - Identifying the main causes of the nature emergency including what needs to be done, by whom and where - Making nature a priority through planning, policy and practical measures - Seeking innovative measures and alternative options for tackling invasive non-native species, especially near water courses 	Biodiversity
Peatland restoration	Climate emergency – adaptation and mitigation Sustainable land, water and air <ul style="list-style-type: none"> - Help to create adaptive and resilient communities in response to adverse weather events and climate change 	Climate Regulation, Biodiversity, Natural Hazard Regulation, Water purification, air quality,
Runoff reduction (where there is high runoff risk and flood risk)	Sustainable land, water and air <ul style="list-style-type: none"> - Help to create adaptive and resilient communities in response to adverse weather events and climate change 	
Enhancing greenspace and making it more accessible	Reconnecting people and places – improving health, wellbeing and the economy <ul style="list-style-type: none"> - Promote, encourage and support sustainable recreation, reconnect local people and visitors with access to the natural environment - Look for new ways in which people can connect with their local environment to help improve their health and well-being - Work with different organisations to develop opportunities for using the natural environment on our doorstep as a tool in preventative medicine 	Recreation and Tourism Climate regulation, Biodiversity
	Forest resources – managing timber resources effectively <ul style="list-style-type: none"> - Valuing woodlands for their commercial, recreational and biodiversity value 	

*As highlighted in the Water Resources Planning Guideline 2024 Supplementary Guidance: Environment and Society in decision-making (Wales) December 2020 and noting that water regulation has not been considered specifically since it is the key principle behind the STT water transfer solution. Additional Ecosystem services have been highlighted including air quality and agriculture.

The opportunity areas in **Sector A (Figure 2.6)** are on a large area of RSPB owned land (RSPB Lake Vyrnwy). This increased the priority score given there is a greater chance of work being carried out (see the STT Gate 2 Wider Benefits Study for the methodology). There are opportunities for peatland restoration where there is deep (and shallow) peat which have benefits for climate regulation but also for flood management regulation^{36,37}. As mentioned previously, it appears there is already a Severn Trent PLC peatland restoration project in this area³⁸. Given there is high pluvial flood risk in this sector, these are important opportunities. The

³⁶ <https://www.sciencedirect.com/science/article/pii/S2589915518300063>

³⁷ <https://www.sciencedirect.com/science/article/pii/S0009254116301243>

³⁸ <https://www.stwater.co.uk/news/news-releases/severn-trent-plc-announces-restoration-of-over-2-000-acres-of-pe/>

areas highlighted in dark green are opportunities for tree, hedge, and scrub planting (while taking account of, and minimising risks to, biodiversity) to reduce runoff risk which is high in this area but also for climate regulation (particularly where there is carbon emitting agricultural land). Opportunities in bright green have predominantly access to nature opportunities through enhancing accessibility (within the 5 km buffer). There are also opportunities to enhance fish migration where barriers are over 1.4 m and enhance river biodiversity in Hirddu Fach which flows into Lake Vyrnwy which has bad ecological status.

In **Sector B (Figure 2.7)**, there is a scattering of opportunity areas for peatland restoration and rivers where fish migration can be enhanced through barrier removal, fish pass construction and the replacement of existing fish passes that are inefficient or could be improved. It should be noted that fish barrier data is likely to be less reliable.

In **Sector C (Figure 2.8)** there are mainly accessible nature opportunity areas within the 5km buffer including large areas near Llansantffraid-ym-Mechain and Meifod where there are fields of improved grassland and a high score for nature inaccessibility (not meeting several of the Accessible Nature Greenspace Standards). There are also some small peatland restoration opportunity areas.

In **Sector D (Figure 2.9)** the River Camlad has bad ecological status and diffuse pollution from livestock. This is the most significant opportunity in this sector. There are also small peatland, flood management and fish migration opportunity areas in this sector. It should be noted that no rivers with bad ecological status were found in the study area (poor and moderate were excluded from the identification of opportunity areas). However, there are 22 rivers in the Severn River Basin District that are being restored by 2033 and 2039 and a further 147 that have an objective of being restored by 2027 (although this is unlikely).

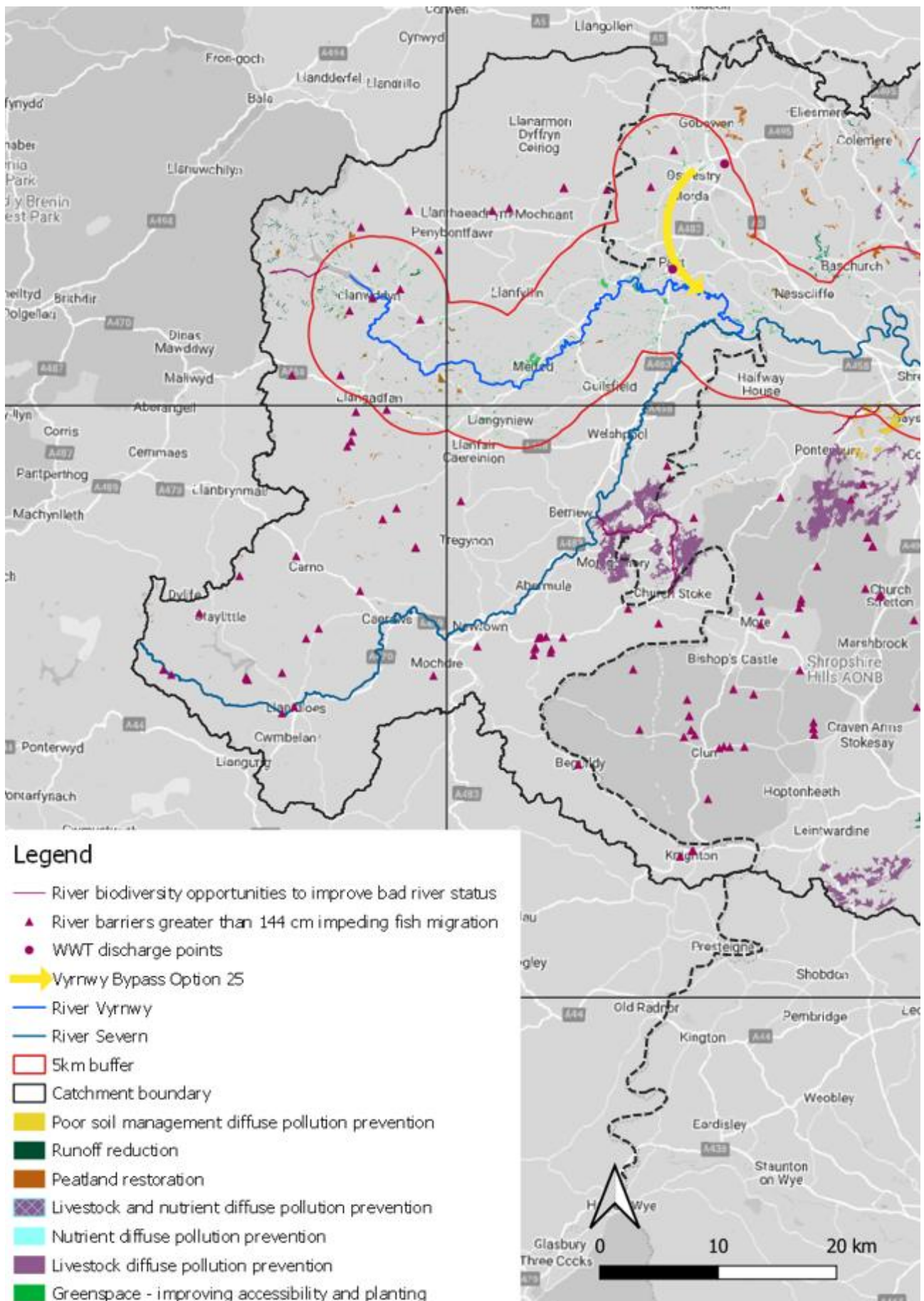


Figure 2.5 Wider benefits maximum opportunity areas in Wales

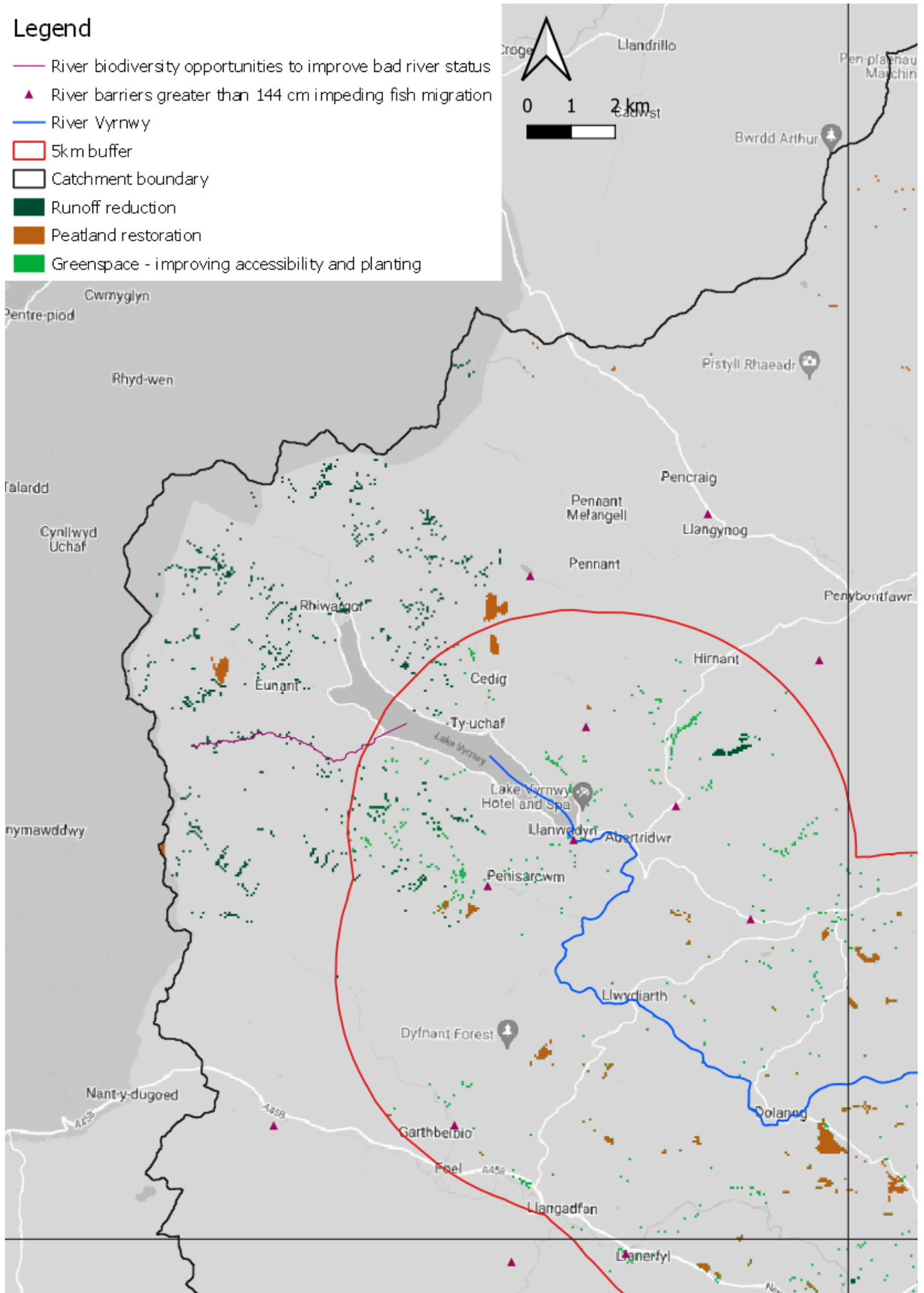


Figure 2.6 Wider benefits maximum opportunity areas in Wales – Sector A

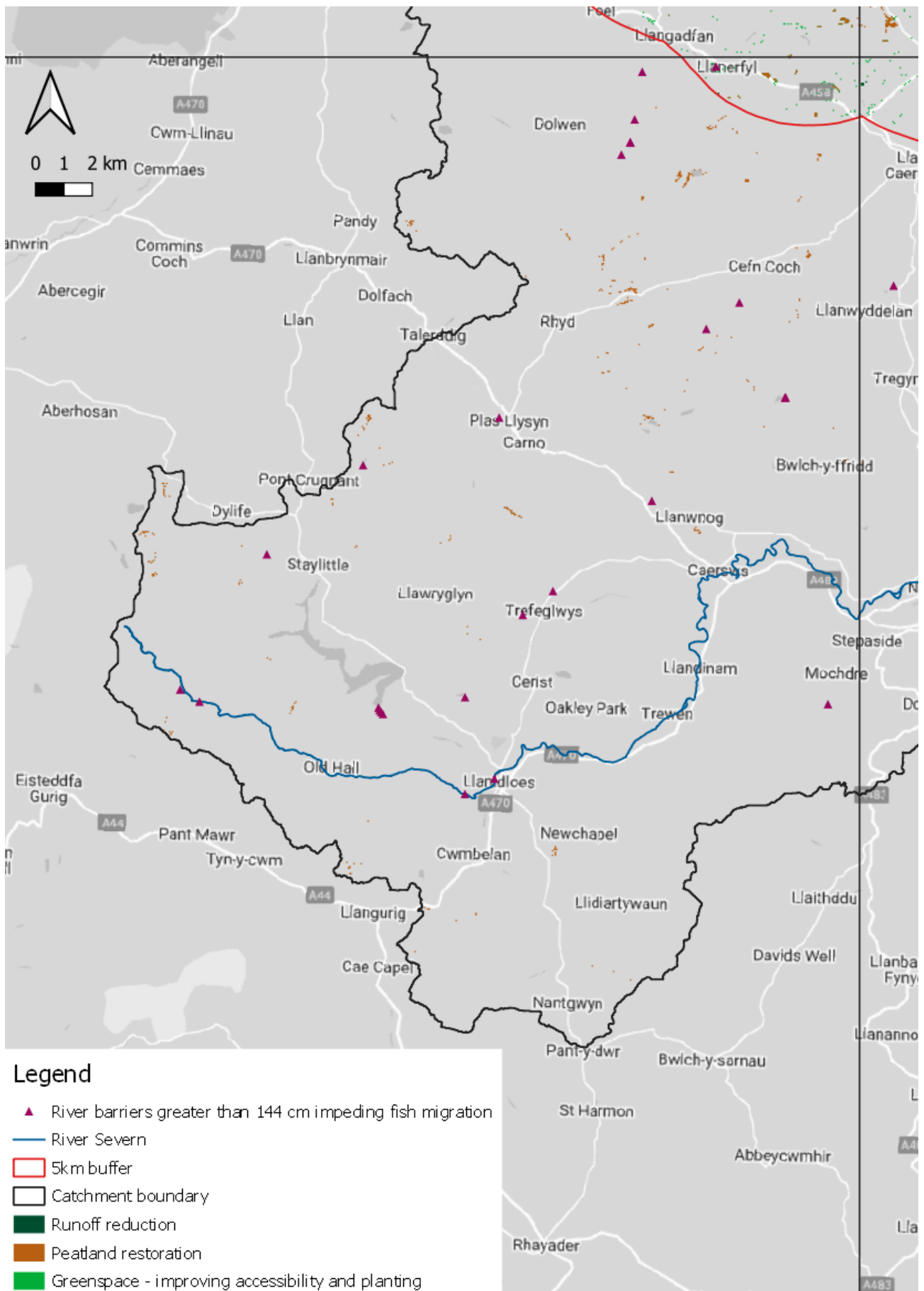


Figure 2.7 Wider benefits maximum opportunity areas in Wales – Sector B

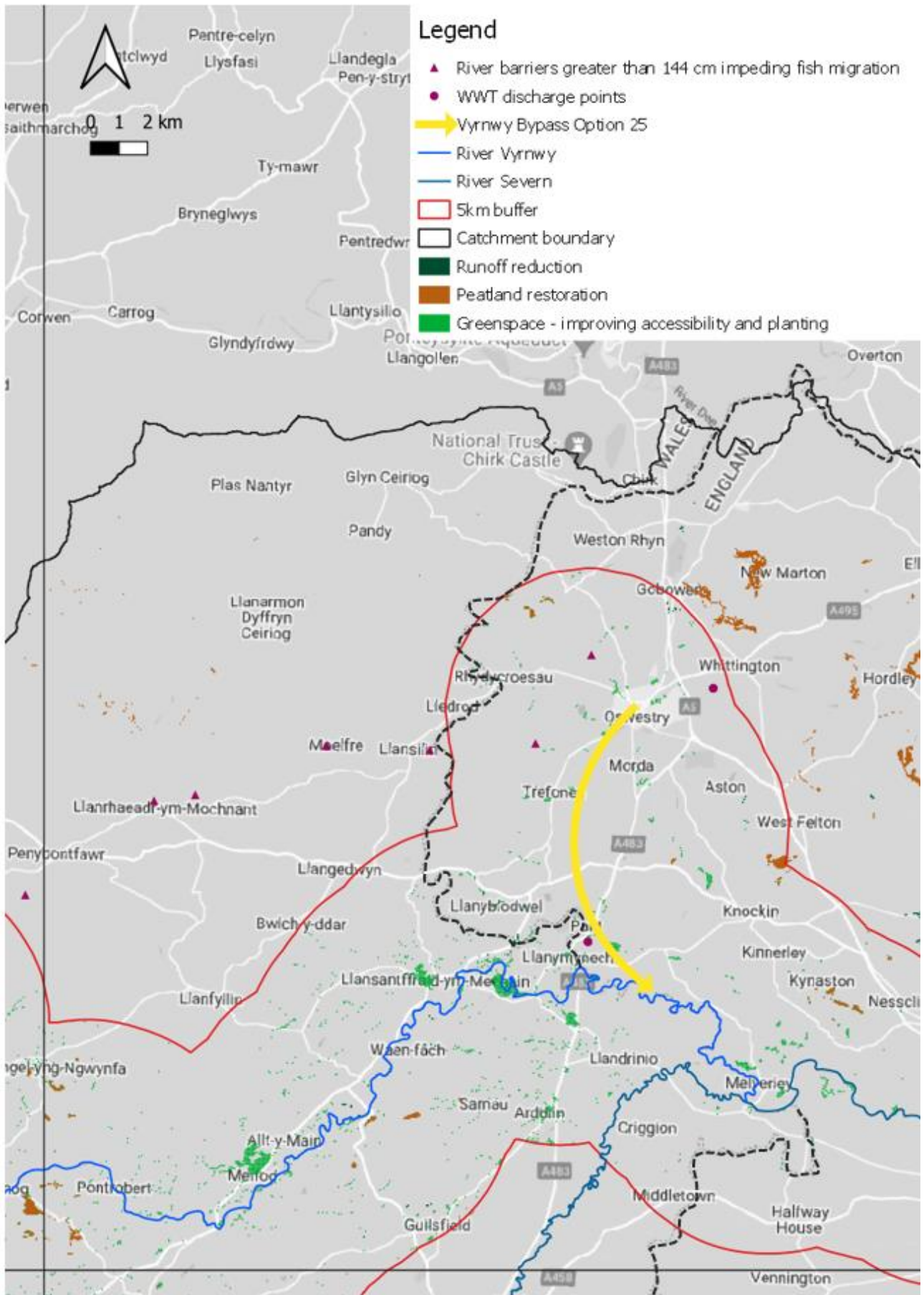


Figure 2.8 Wider benefits maximum opportunity areas in Wales – Sector C

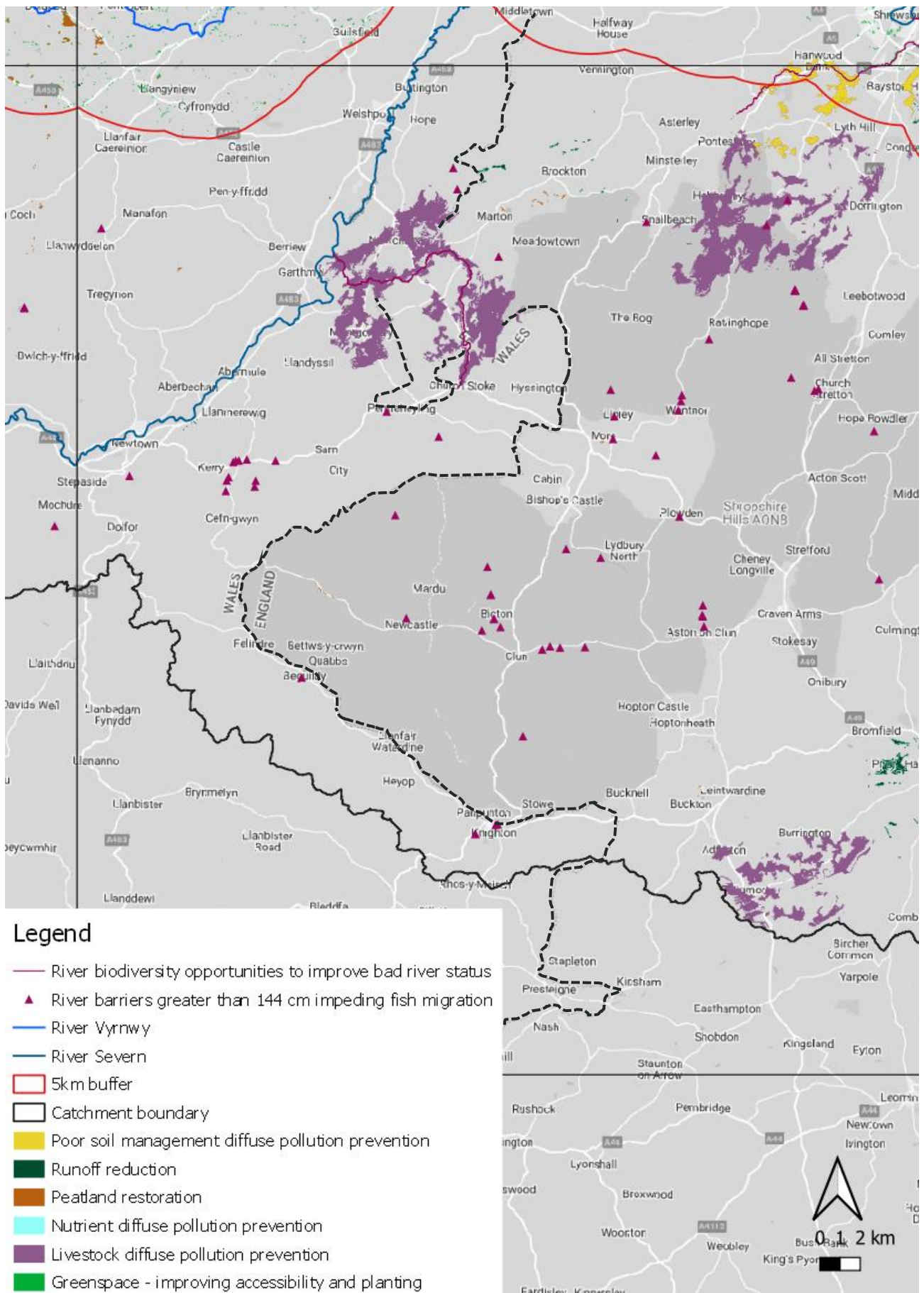


Figure 2.9 Wider benefits maximum opportunity areas in Wales – Sector D

3. RESULTS

3.1 RAG ANALYSIS

The RAG analysis was carried out for the actions selected from the STT Gate 2 Wider Benefits Study that are of relevance to Wales (see **Table 3.1**) where actions that are relevant to this part of the Vyrnwy have been cross referenced with key Natural Capital benefits. Certain SMNR Principles and Wellbeing Goals were excluded from the analysis as highlighted in **Table 2.2** and will need further review at Gate 3 (see Section 4.3). In **Table 3.2**, the colour green was given for actions that have substantial benefits, amber denotes some benefits, pink indicates limited benefits, red highlights any potential negative impact and white shows where negligible or no benefits were identified.

Table 3.1 The benefits selected from the STT Gate 2 Wider Benefits Study of relevance to Wales

Action No.	Action
1	Improving water quality – areas which are responsible for livestock diffuse pollution
2	River barriers to fish migration (over 1.4 m)
3	Enhancing rivers with bad ecological status
4	Peatland restoration
5	Runoff reduction (where there is high runoff risk and flood risk)
6	Enhancing greenspace and making it more accessible

Table 3.2 RAG analysis

Where: green shows substantial benefits, amber denotes some benefits, pink indicates limited benefits, red highlights any potential negative impact and white shows where negligible or no benefits

Principles and environmental aspects		Action					
		1	2	3	4	5	6
SMNR aims	Safeguarded Natural Resources	+++	++	+++	+++	++	++
	Resilient Ecosystems	+++	+	+++	+++	++	+
	A Healthy Environment for People	++	0	++	+++	+++	+++
	A Regenerative Economy	+	+	+	+++	+++	+++
SMNR Principles	Collaboration and engagement	++	++	++	+++	++	+++
	Scale	++	+	++	++	+	+
	Evidence	+++	+	+++	+++	+++	+++
	Multiple benefits	+++	++	+++	+++	+++	+++
	Building resilience i) diversity between and within ecosystems	+	++	+++	+++	+	+
	(ii) the connections between and within ecosystems	+++	+++	+	+++	+	+
Wellbeing Goals	(iii) the scale of ecosystems	+	++	+	+++	0	+
	(iv) the condition of ecosystems (including their structure and functioning)	+++	++	+++	+++	++	+
	(v) the adaptability of ecosystems	+	++	+++	+++	0	+
	A globally responsible Wales	0	+	++	++	0	0
	A prosperous Wales	+	+	+	+++	+++	+++
Environmental	A Wales of cohesive communities	0	0	0	0	0	+++
	A more equal Wales	+	0	0	0	0	+++
	A healthier Wales	+	0	0	++	0	+++
	A resilient Wales	+++	+++	+++	+++	+++	0
	WFD	+++	+	+++	+++	++	0
	Water quality	+++	0	+	+++	+++	0
Environmental	Physical environment	+++	+++	0	+++	++	++
	Fisheries	+++	+++	++	+++	++	0
	Ecology	+++	+++	+++	+++	++	+
	INNS	0	-	++	0	0	0
	Protected species	+++	+++	+++	+	++	+



3.1.1 SMNR Principles

Peatland restoration (Action 4) had the most substantial benefits in terms of the SMNR Principles particularly for the 'Building resilience' Principle. This was followed by Action 3 Enhancing rivers with bad ecological status and Action 1 Improving water quality (areas which are responsible for livestock diffuse pollution) which scored slightly less for 'Building resilience'. Runoff reduction (Action 5) had the least substantial benefits followed closely by Enhancing greenspace and making it more accessible (Action 6) because there were fewer 'Building resilience' benefits associated with these actions (although Action 6 like Action 4 had the greatest potential for collaboration and engagement). Action 2 River barriers to fish migration had moderate SMNR benefits.

3.1.2 Wellbeing Goals

Action 6 Enhancing greenspace and making it more accessible had the most substantial benefits in terms of the Wellbeing Goals scoring highly across all of them (apart from 'A resilient Wales'). This action was followed closely by Action 4 Peatland restoration. Action 2 River barriers to fish migration had the least substantial benefits followed closely by the rest of the actions although all of these actions scored highly for 'A resilient Wales'.

3.1.3 Environmental

Action 1 Improving water quality had the most substantial environmental benefits followed by Action 4 Peatland restoration. Action 6 Enhancing greenspace and making it more accessible had the least substantial environmental benefits. Action 2, 3 and 5 had some substantial benefits.

4. CONCLUSIONS

4.1 SUMMARY OF THE FINDINGS

This assessment is high level and is based on the requirements for Gate 2 taking into account the Welsh legislation (see Section 1.1.3 and 2.4.1 for details). The new methodology developed for this assessment has taken a geospatial approach generating maps for review, and support a high-level RAG assessment.

Analysis of the potential effect of a direct release of 25 MI/d from Vyrnwy Reservoir into the River Vyrnwy has shown that there is likely to be negligible impact on WFD compliance, water quality, the physical environment, fisheries, macroinvertebrates and other ecology, protected habitats and species and the potential for the transfer of INNS.

Multiple opportunity areas have been identified in Wales from the STT Wider Benefits Study, with the appropriate actions identified as:

- Improving water quality – areas which are responsible for livestock diffuse pollution;
- River barriers to fish migration (over 1.4 m);
- Enhancing rivers with bad ecological status;
- Peatland restoration;
- Runoff reduction (where there is high runoff risk and flood risk); and
- Enhancing greenspace and making it more accessible.

These actions were assessed in a RAG analysis against SMNR Principles, Wellbeing Goals and other environmental aspects.

Peatland restoration had by far the most substantial benefits in terms of SMNR Principles (and overall). Peatland restoration had substantial benefits for all the principles apart from for ‘Scale’.

Enhancing greenspace and making it more accessible had the most substantial benefits in terms of the Wellbeing Goals scoring highly across all of them (apart from ‘A resilient Wales’).

Improving water quality in reaches where there is diffuse pollution from livestock had the most substantial environmental benefits (scoring highly for all aspects apart from INNS). This action could be complimented by enhancing rivers with bad ecological status which also had substantial benefits.

Enhancing greenspace and making it more accessible and runoff reduction had the least substantial benefits. However, the former action had the greatest contribution to the Wellbeing Goals.

These actions link to the Mid Wales Area Statement themes of ‘Improving biodiversity’, ‘Sustainable land, water and air’ and ‘Climate emergency – adaptation and mitigation’. It should be noted that these conclusions are based on the data we have at the present time and more analysis is needed in Gate 3 (see Section 4.3).

4.2 UNCERTAINTY, CONFIDENCE, DATA GAPS

The following data gaps have been identified during completion of the Gate 2 SMNR Report:

- Hydraulic river habitat surveys were conducted along the River Vyrnwy for 75 MI/d releases. Due to the potential ecological impacts of a 75 MI/d release from Vyrnwy Reservoir, the volume was reduced to 25 MI/d. No hydraulic river habitat surveys have been conducted to collect empirical data with which to assess the potential impacts of a 25 MI/d release; instead expert judgement has been applied to assess the impact using site knowledge, baseline survey results, and numerical model outputs of the predicted flow changes for the schemes in the river;
- MoRPh5 surveys have been limited to two sites in the River Vyrnwy. Upon understanding the extent of impact within a river reach, further MoRPh surveys should be completed to ensure at least 20% of the length of impacted reach have been surveyed;
- More stakeholder engagement is needed particularly in reviewing the opportunity areas (under the SMNR Principles of ‘Public participation’ and ‘Collaboration and engagement’);

- The SMNR Principles ‘Adaptive management’, ‘Long term’ and ‘Preventative action’ and the Wellbeing Goal ‘A Wales of vibrant culture and thriving Welsh language’ were excluded from the RAG analysis (see Section 4.3 for recommendations for Gate 3).
- The river barrier dataset needs to be reviewed as this is thought to be limited and it is understood that there is more detailed non-open source data available; and
- A more detailed understanding of the landownership is needed to better understand the viability or ease of implementing particular actions.

4.3 RECOMMENDATIONS FOR GATE 3

Based on the data gaps identified above, the following recommendations have been made to inform Gate 3:

- More precise opportunity areas and specific recommended actions to be developed.
- Detailed knowledge of land ownership for opportunity areas will be required.
- Biodiversity enhancement opportunities in the six actions requires clarification.
- Recreational enhancement opportunities in the six actions requires more detail through public participation and community involvement.
- Net gain for SMNR/biodiversity/wellbeing needs to be assessed.
- Revised hydraulic river habitat surveys for 25 Ml/d releases to be completed along the River Vyrnwy;
- Additional MoRPh5 surveys along the River Vyrnwy to cover at least 20% of the length of impacted reach informed by the STT Gate 2 Assessment Reports and associated modelling;
- The SMNR Principle ‘Adaptive management’ was excluded from the RAG analysis. Planning, monitoring and changing action will need to be embedded in future assessment;
- The SMNR Principle ‘Long term’ was excluded at this stage due to limited knowledge of precise locations on-the-ground. Once more stakeholder engagement has been undertaken the short, medium and long term consequences of actions can be assessed;
- The SMNR Principle ‘Preventative action’ was excluded at Gate 2 since more detailed local data are required in order to understand the pressures and drivers of change on the ecosystem services;
- The Wellbeing Goal ‘A Wales of vibrant culture and thriving Welsh language’ will need to be considered at Gate 3. Until actions on-the-ground are agreed and locations finalised, the full benefit on Welsh language and culture is difficult to assess. The same applies to ‘A Wales of cohesive communities’, ‘A more equal Wales’ and ‘A Healthier Wales’ all which should be underpinned by the ambitions stated in the Area Statements; and
- The Wellbeing Goal ‘A prosperous Wales’ will be assessed in more depth at Gate 3. To determine potential learning and development opportunities, engagement is needed with water company and wider stakeholders on whether planned innovation and research and development will likely contribute to improvements in skills, and whether there are opportunities for local supply chain and local employment. This cannot be completed for this high-level study but the approach provides a platform for stakeholder engagement and updating with any changes to RMBP, Area Statements and other local projects.

Appendix 1

Table A.1 MoRPh5 survey results

Note: Blue cells indicate no change between baseline and operation and white cells indicate potential change. Where:

STT 0 = R Vyrnwy – Lake Vyrnwy to conf Afon Cownwy

STT 1 = Afon Vyrnwy – conf Afon Cownwy to conf Afon Banwy

Code	Indicator name	Positive / Negative type	STT 0 baseline	STT 0 operational	STT 1 baseline	STT 1 operational
B1	Bank top vegetation structure	Positive	3	3	4	4
B2	Bank top tree feature richness	Positive	0	0	3	3
B3	Bank top water related features	Positive	0	0	0	0
B4	Bank top NNIPS cover	Negative	-2	-2	-1	-1
B5	Bank top managed ground cover	Negative	-3	-3	-3	-3
C1	Bank face riparian vegetation structure	Positive	4	4	4	4
C2	Bank face tree feature richness	Positive	4	4	4	4
C3	Bank face natural bank profile extent	Positive	2	2	2	2
C4	Bank face natural bank profile richness	Positive	4	4	4	4
C5	Bank face natural bank material richness	Positive	3	3	3	3
C6	Bank face bare sediment extent	Positive	1	1	1	1
C7	Bank face artificial bank profile extent	Negative	0	0	0	0
C8	Bank face reinforcement extent	Negative	-1	-1	0	0
C9	Bank face reinforcement material severity	Negative	-2	-2	0	0
C10	Bank face NNIPS cover	Negative	0	0	-1	-1
D1	Channel margin aquatic vegetation extent	Positive	2	1	2	1
D2	Channel margin aquatic morphotype richness	Positive	3	2	4	3
D3	Channel margin physical feature extent	Positive	1	0	4	3
D4	Channel margin physical feature richness	Positive	2	1	3	2
D5	Channel margin artificial features	Negative	0	0	-1	-1
E1	Channel bed aquatic morphotype richness	Positive	3	3	2	2
E2	Channel bed tree features richness	Positive	2	2	2	2
E3	Channel bed hydraulic features richness	Positive	2	2	2	2
E4	Channel bed natural features extent	Positive	3	2	3	2
E5	Channel bed natural features richness	Positive	2	2	2	2
E6	Channel bed material richness	Positive	3	3	3	3
E7	Channel bed siltation	Negative	-1	-1	0	1
E8	Channel bed reinforcement extent	Negative	0	0	0	0
E9	Channel bed reinforcement severity	Negative	0	0	0	0
E10	Channel bed artificial features severity	Negative	-3	-3	-1	-1
E11	Channel bed NNIPS extent	Negative	0	0	0	0
E12	Channel bed filamentous algae extent	Negative	-1	-1	-1	-1
Preliminary condition score:			1.32	1.05	2.12	1.94
River condition category:			Moderate	Moderate	Good	Good

