

Strategic Regional Water Resource Solutions: Annex B2.3 Fisheries Evidence Report

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

Date: November 2022



Severn to Thames Transfer

Fisheries evidence report

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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

Fisheries Evidence Report

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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 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.

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. 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.

1.1.2 Gate 1

The STT Solution was subject to an 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: Working Version for Water Resource Management Plan 2024 (WRMP24) 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.

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 will include 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 optimal 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 will be 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 report¹.

RAPID issued a guidance document² in April 2022 to describe the Gate 2 process and set out the expectations for solutions at standard Gate 2.

The guidance stated the environmental assessment methodologies should be consistent with any relevant legislation and guidance, and follow best practice. This includes, where relevant, Water Resource Management Plan (WRMP) guidance for 2024, All Company Working Group (ACWG) guidance³ and the Environment Agency Invasive Non-native Species risk assessment tool.

1.1.3.1 Overview of the environment assessment approach for Gate 2

Figure 1.1 shows the investigations 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 undertaken a phased way. The Evidence reports (pale blue box in the figure below, and this report) are produced first, that set out the data and evidence to be used in the assessment. The Assessment Reports which use the evidence to determine the potential effect of the STT scheme on the different topics, is produced 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).

1.1.3.2 Regulator engagement for Gate 2

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

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

In the sessions with technical specialists, each of the proposed approaches to the topics and statutory reports have been set out and explained. Drafts of the methodology documents have been issued, plus other technical

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

² RAPID (2022) Strategic regional water resource solutions guidance for Gate 2

³ All Companies Working Group (2020) WRMP environmental assessment guidance and applicability with SROs

notes, to the regulators to solicit feedback on the proposed approaches. Feedback on the drafts have been used to finalise the approach, and inform the wider environmental assessment for Gate 2.

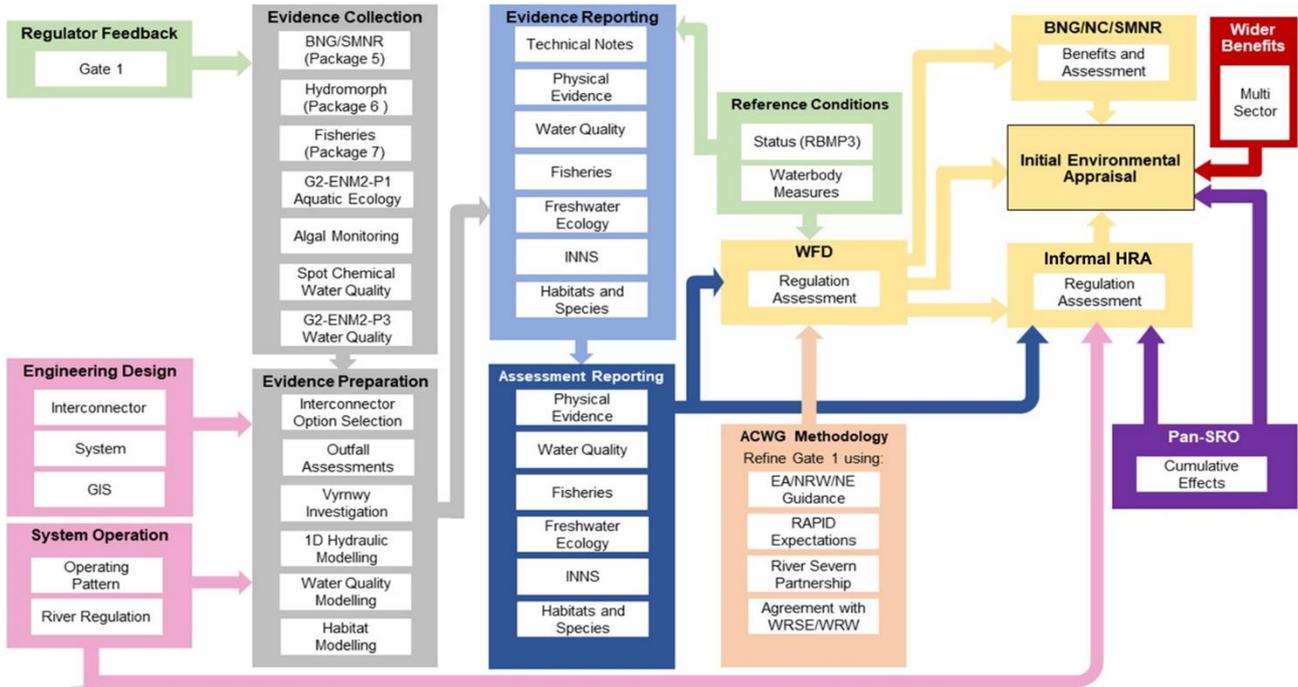


Figure 1.1 Flow chart showing the investigations undertaken for Gate 2 and their interactions

1.2 STUDY AREA

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

1. The River Vyrnwy catchment (River Vyrnwy from Vyrnwy Reservoir to the confluence with the River Severn);
2. The River Severn catchment (River Severn 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;
3. The Warwickshire River Avon upstream of Warwick to the River Severn confluence; and
4. The River Thames catchment (River Thames from Culham to Teddington Weir).

It should be noted that the consideration of impacts in the River Tame and Trent, from the transfer of treated discharge from Minworth WwTW to the River Avon, is included in the ST Minworth Solution and therefore excluded from the STT scheme assessment.

1.3 AIM OF THIS REPORT

The assessment of potential impacts on the fish communities as a result of the operation of the STT should be considered in the context of the ecological requirements of the baseline community, and the extent to which these requirements will be effected as a result of the operation of the STT Solution.

This note provides the evidence and data catalogue that will be used to inform the baseline for fish communities associated with the proposed STT Solution. The baseline fish community will inform the ecological requirements that should be considered in the assessment of the magnitude and significance of any potential impacts associated with the STT Solution. Adopting a precautionary approach, the baseline fish community represents populations that are historically/currently observed within the associated waterbodies, and those species that could potentially be observed in the waterbodies in the future as result of projects such as *Unlocking The River Severn*. Furthermore, this report identifies the remaining data and evidence gaps in respect of fish, and provides a summary of a proposed programme of work to address them as part of RAPID’s gated assessment for the Solution.

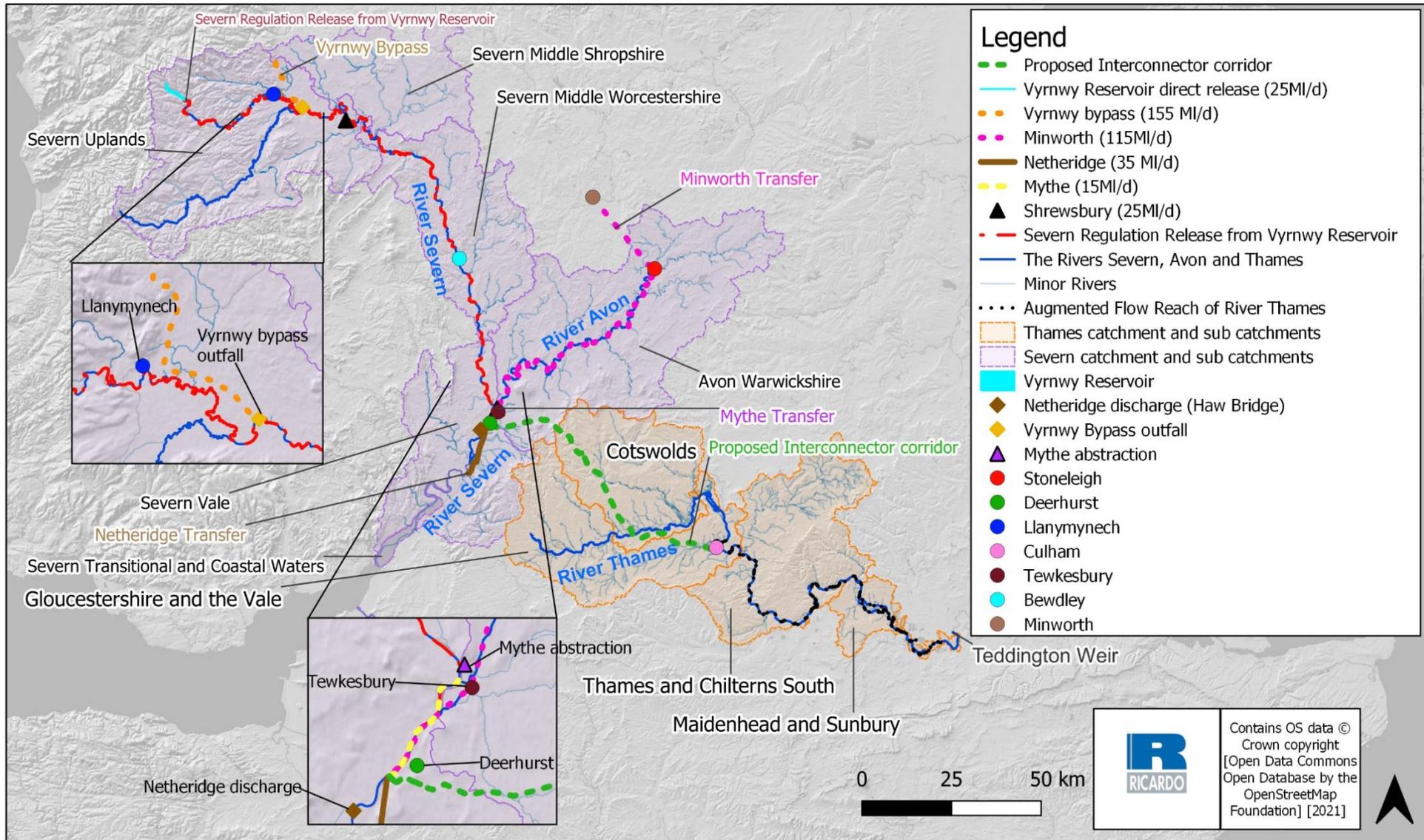


Figure 1.2 Map showing the proposed interconnector corridor

2. EVIDENCE BASE FOR, AND APPROACH TO, THE GATE 2 FISHERIES ASSESSMENT

Gate 1 of the STT Solution identified several datasets and studies that form the evidence base for the assessment of effects on fish communities. The Gate 1 process also identified where additional data would be required to undertake the assessments for Gate 2. Stakeholder consultation with the environmental regulators for England and Wales also identified additional datasets and studies that are necessary to improve the fisheries evidence base for the Gate 2 assessments.

This section:

1. Outlines the scope and approach to the fisheries assessment tasks that will be undertaken;
2. Summarises the additional data and evidence collection tasks that were completed for Gates 1 and 2 in respect of fisheries; and
3. Confirms the evidence base that will be used in the assessment of potential impacts on fish communities in Gate 2.

2.1 SCOPE AND APPROACH TO GATE 2 ASSESSMENT AND EVIDENCE BASE

The scope of the assessment on fish communities required for Gate 2 and the approach to undertaking these assessments is described in **Table 2-1**. This table also includes a summary of the evidence base that will be used to inform the ecological/environmental elements/receptors that require assessment in terms of how they may be altered as a result of the construction and/or operation of the STT Solution.

The evidence base has been summarised in an Excel workbook supplied separately, named “**STT Fisheries Evidence Workbook**”. These data were also used to inform the extent of any remaining data/evidence gaps that would result in any uncertainty in the assessments of the potential impacts of the STT Solution on fish communities.

2.2 ADDITIONAL DATA COLLECTED DURING GATE 1 AND GATE 2

2.2.1 Electrofishing surveys

To provide the necessary Gate 1 data and evidence to inform the environmental assessments associated with the STT Solution, target electrofishing surveys were implemented by the STT Group in June 2020 (*the ‘2020 monitoring programme’*). This monitoring programme initially consisted of six (6) surveys at sites across the Severn catchment. The electrofishing surveys were again completed in Summer 2021. A total of 21 sites have been surveyed located within the River Vyrnwy, Avon, Severn, Frome and Gloucester and Sharpness canal.

As noted in Section 2.1, the survey locations are presented in the supporting Excel workbook (“*STT Fisheries Evidence Workbook*”).

The surveys consisted of qualitative, semi-quantitative and fully quantitative surveys, depending on the site locations. The data from these surveys have been included in the accompanying Excel workbook.

2.2.2 Targeted surveys

The Gate 1 environmental assessments identified that the 2020 monitoring programme should be updated to include additional surveys and features. This was because of the following findings:

- Targeted lamprey surveys were limited. As such, the extent to which the associated waterbodies provide functionally linked habitat remained uncertain;
- The information on the distribution of sub-optimal and optimal lamprey ammocoete or spawning habitat for the associated reaches was very limited. As such, the significance of the potential risk to this feature and the extent and quality of functionally linked habitat for this feature remained uncertain;
- There was limited information available regarding the distribution of salmonid spawning and nursery habitat in the River Vyrnwy;
- There was limited information available regarding the current distribution of spawning habitat for twaite and allis shad in the associated reaches of the River Vyrnwy and the River Severn;

- Consideration was required regarding the habitats which may become accessible with the addition of fish passes, or removal of weirs at obstacles which pose a current migratory barrier for the migratory species (including habitats for shad species); and
- More details were required regarding the nature of barriers and passability during different flow conditions within the River Avon.

Subsequently, a targeted monitoring programme was undertaken between March 2021 and November 2021 to address the data and evidence gaps.

2.2.3 The results of these surveys were provided as stand-alone reports and will also be included as part of the evidence base for assessing the potential impacts associated with the construction and operation of the STT Solution. Engagement with Stakeholders

The potential impacts on the fish communities associated with a STT scheme has been subject to extensive consultation with various regulators. A summary is provided below.

A meeting was held in December 2015 with TW, UU, EA and NRW, along with TW's consultants (Mott MacDonald and Cascade Consulting (now Ricardo Energy & Environment), to discuss the Vyrnwy Reservoir river flow support scheme and identify the potential issues with operation of such a scheme.

Following this initial meeting, a scoping report for the environmental assessment was issued in June 2016 and finalised following receipt of comments. Additional consultation was undertaken with NRW and EA at a workshop in April 2017.

In July 2017 NRW was consulted on the outcomes of the additional assessment on river flow accretion and the potential impacts of the river flow support scheme on the fish communities in the River Vyrnwy.

A draft Environmental Assessment Report was issued to NRW in summer 2018 and feedback on the report was discussed at a meeting between NRW and Thames Water in July 2018. This revised report provided a basis for further technical discussions between all the parties, as part of the ongoing dialogue on the Thames Water WRMP19.

The STT was again subject to workshops in November 2019 and February 2020. The workshops aimed to discuss the environmental implications of the Vyrnwy Reservoir releases, the environmental issues associated with Severn Trent's Minworth supporting option and the environmental issues associated with the canal transfer option as opposed to the pipeline. The aim of these workshops was to obtain stakeholder inputs into further studies and investigations required.

The regulators were again consulted in June and September 2020 on the scope of the Gate 1 monitoring programmes (scope, site selection and methodologies). The regulators were also consulted in June and July 2020 on the proposed methodologies and approaches that were to be applied during the trial releases to inform physical losses associated with the Vyrnwy Reservoir releases.

The Gate 1 evidence and assessment reports were also subject to extensive review by the various regulators. This included the Gate 1 gap analysis report which informed the scope of the Gate 2 assessments, the remaining gaps and uncertainties as well as the survey and modelling requirements for Gate 2

The regulators were again consulted in April 2021 on the methodologies and site selection process for the targeted surveys. This included targeted surveys for selected fish species, habitats and barrier assessments. This also includes the proposed approach to collection of the hydrological, habitat and physical water quality data to inform the Gate 2 modelling.

Table 2-1 Evidence and approach to the Gate 2 assessment of fish communities

Item	Scope of assessment	Approach to assessment	Evidence Base for Task
<p>a. Fish (WFD/NERC) Freshwater and Estuarine</p>	<p>Build upon the Gate 1 assessment using additional baseline data collected during Gate 1 and Gate 2 and the updated physical environment and water quality assessments (including modelling outputs)</p>	<ul style="list-style-type: none"> • Update the assessment to consider additional species/community data collected during Gate 1 and Gate 2 • Update assessment in consideration of the 1D hydraulic model outputs, including water and flow at key locations to consider the risk of changes in velocities, depth and wetted margins that may result in changes in community structure, loss of preferred habitat, etc. under a range of scenarios • Update assessment in consideration of the interpretation of the fluvial modelling of abstraction/outfall locations and the 2/3D habitat model at selected sites • Include relevant monitoring programme survey data such as Acoustic Doppler Current Profiler (ADCP), habitat walkovers and River MoRPh survey⁴ outputs and additional habitat modelling at key locations • Update assessment in consideration of the interpretation of the water quality assessment and model outputs to consider the potential for water quality changes to drive changes in community structure • Suggest further mitigation measures (where required) for the scheme design/engineering • Review additional data collected on barrier passability in the River Avon 	<ul style="list-style-type: none"> • The physical environment and water quality assessments of the hydraulic and water quality model outputs. • Habitat assessment results based on the hydraulic and water quality model outputs. • EA Ecology & Fish Data Explorer data (2000-present) throughout the study area⁵. • NRW data for the River Vyrnwy and wider catchment obtained through data request.⁶ • Targeted electrofishing surveys completed since 2020 at freshwater sites within the project area by the STT group. • eDNA results from INNS surveys undertaken by the STT Group which included a wide range of groups/species. • Salmonid redd counts completed by the STT Group. • Targeted walkovers, mapping and surveys for lamprey species completed by the STT Group. • Targeted walkovers and mapping of shad habitat completed by the STT Group. • Barrier assessment on the River Avon completed by the STT Group. • Location of barriers on the associated waterbodies from open-source data, including the EA river obstruction database⁷ and the Catchment Based approach datahub⁸. • EA eel manual to determine compliance. • Guidance from The Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) for temperature standards for marine and freshwater environments⁹ to understand risk associated with operation. • Monitoring completed during trial releases to support the assessment of physical losses from the Vyrnwy Reservoir¹⁰.

⁴ [Modular River Survey](#)

⁵ <https://environment.data.gov.uk/ecology/explorer/>

⁶ Obtained via data request: AT122731a

⁷ <https://data.gov.uk/dataset/cda61957-f48b-4b75-b855-a18060302ed1/potential-sites-of-hydropower-opportunity>

⁸ <https://data.catchmentbasedapproach.org/datasets/all-barriers/explore?location=30.720208%2C135.924750%2C2.96>

⁹ Water Framework Directive - United Kingdom Technical Advisory Group (WFD-UKTAG). (2008) UK Environmental Standards and Conditions. (Phase 2)

¹⁰ Ricardo Energy & Environment (2021). Seven to Thames Transfer SRO River Vyrnwy Test Releases – Initial Ecological Findings. Report for United Utilities on behalf of the STT Group. November 2021

Item	Scope of assessment	Approach to assessment	Evidence Base for Task
b. Olfactory cues	<ul style="list-style-type: none"> • Update the Gate 1 assessment using the desktop review of available information on olfactory cues • Assess the potential for the masking of migratory salmonid olfactory cues 	<ul style="list-style-type: none"> • Update assessment in consideration of the outputs of the hydraulic and water quality model, including the flow series at key locations and extent of mixing zones • Update the assessment in terms of the risk to olfactory cues using data as required on the ratio of treated effluent to river water under baseline conditions and modelled under various scenarios 	<ul style="list-style-type: none"> • Evidence and literature collated as part of the initial gap analysis of the STT which includes information on fish passes on the River Severn ¹¹. • Fish pass design and operational requirements as provided by the EA. • Outputs from the hydraulic and water quality model. • Review of olfactory cues of migratory fish¹². • Flow, velocity, water quality data (spot samples and continuous sondes). • Assessment of WFD and EQSD chemical quality throughout the study area for the range of reference conditions and scenarios with STT Solution.

¹¹ APEM (2020). STT Ecological Literature Review. APEM Scientific Report P00004288. Severn Thames Transfer Partnership, September 2020, v2.0 Final, 480 pp

¹² Ricardo Energy & Environment (2021). Technical Note: Severn Thames Transfer SRO – Impact of determinands on olfaction and fish populations in the Severn Estuary. Report for United Utilities on behalf of the Severn Thames Transfer Programme. 01 December 2021.

2.3 EVIDENCE BASE

The evidence base has been summarised in an Excel workbook supplied separately, named “**STT Fisheries Evidence Workbook**”. These data were also used to inform the extent of any remaining data/evidence gaps that would result in any uncertainty in the assessments of the potential impacts of the STT Solution on the fish communities of the associated waterbodies.

The Excel workbook includes the following:

- A map showing the distribution of Environment Agency monitoring locations providing a long-term dataset;
- A list of survey locations and data obtained from the Environment Agency Ecology & Fish Data Explorer and a summary of the number of surveys and their date range;
 - The list of surveys is limited to those waterbodies associated directly associated (e.g. support releases and abstraction);
 - It is noted that numerous tributaries of the River Severn, River Vyrnwy, River Avon and the Severn Estuary could indirectly be affected by the operation of the STT Solution. As such, maps representing the connectivity of the catchments for migratory fish species have also been produced.
- A map showing the distribution of Natural Resources Wales monitoring locations providing a long-term dataset;
- A list of survey locations and data obtained from Natural Resources Wales and a summary of the number of surveys and their date range;
- A summary of the tolerance of the fish community at each Environment Agency and Natural Resources Wales survey location based on the Fish Classification Scheme 2¹³;
- A list and map of survey locations associated with the STT Group’s targeted monitoring programme;
- A summary of the tolerance of the fish community at the targeted survey location based on the Fish Classification Scheme 2 (it is important to note that the 'tolerance level' used is simply the tolerance (or sensitivity) of the FCS2 model classification to changes in the numbers of the fish caught. It does not represent any form of biological or ecological tolerance to impact;
- Maps and lists showing the location of migratory fish in the wider catchments; and
- 3D maps showing the survey locations used to inform the baseline fish community.

The baseline fish community has been further informed through the detailed literature review completed on behalf of the STT group in 2020¹⁴.

The current evidence base has not considered the baseline data for the fish community associated with the Severn Estuary. It is also recommended that this evidence base is reviewed should hydrological and water quality modelling identify any risk to the Severn estuary in terms of supporting habitat for the wider/resident estuarine fish community (i.e., non-migratory species). This review should consider the availability of recent baseline data on the diversity and abundance of fish species considered to be estuarine residents, and species that may use the estuary for breeding and foraging.

Note: 3D maps have been embedded in the Excel workbook that give a greater visualisation of the data than 2D maps. These can be accessed by selecting “insert” on the Excel ribbon, then “3D Maps”, and then “Open 3D Maps” then click to open the “Tour” that appears in the window.

¹³ Water Framework Directive - United Kingdom Technical Advisory Group (WFD-UKTAG). (2008) UKTAG Rivers Assessment Methods Fish Fauna (Fisheries Classification Scheme 2 (FCS2)). ISBN: 978-1-906934-09-5

¹⁴ APEM (2020). STT Ecological Literature Review. APEM Scientific Report P00004288. Severn Thames Transfer Partnership, September 2020, v2.0 Final, 480 pp

3. CONCLUSIONS

3.1 FISH COMMUNITY

3.1.1 Summary of baseline data, uncertainty and data gaps

The potential impacts of the STT Solution should be considered in the context of the ecological requirements, and lifecycle for each of the species identified in the baseline evidence. The potential impacts will also be considered in terms of the extent to which the required conditions will be altered as a result of the operation of the STT. The requirements (e.g. flow and habitat requirements) of the key fish species are well understood.

Baseline data suggests a fish community within the River Severn and associated tributaries consisting of several species that are considered sensitive to changes in water quality, flow and habitat. This includes Atlantic salmon *Salmo salar* (Annex II species), sea/brown trout *Salmo trutta*, allis *Alosa* and twait shad *Alosa fallax* (both Annex II species), river lamprey *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus* and brook lamprey *Lampetra planeri* (all Annex II species); bullhead *Cottus gobio* (Annex II species), and European eel *Anguilla anguilla*. Atlantic salmon, sea/brown trout, bullhead and European eel are also present in low abundances in the associated reaches of the River Thames (from Culham to Teddington). The fish community of the River Thames, the River Avon and the lower reaches of the River Severn appears to be dominated by coarse fish. This includes species with a medium to high tolerance to environmental pressures such as: chub *Squalius cephalus*, perch *Perca fluviatilis*, roach *Rutilus rutilus*, gudgeon *Gobio gobio*, dace *Leuciscus leuciscus* and minnow *Phoxinus phoxinus*.

It is evident that the different reaches of the River Severn, the River Thames, and associated tributaries are important for different life-stages of the fish community. Many of the species listed above are qualifying features of the Severn Estuary protected site (Special Area of Conservation (SAC) and Ramsar site) or are considered protected species. Maintaining the status of the fish community of the Severn Estuary and the functionally linked habitats are also of critical importance for other protected sites which are designated for features that are directly associated with the Severn Estuary or are depended on successful migration of key fish species. This includes the River Usk SAC and River Wye SAC which includes Annex II species that are also associated with the Severn Estuary and the River Clun SAC where the Annex II species, freshwater pearl mussel *Margaritifera margaritifera*, is directly depended on migratory fish (Atlantic salmon) as a host species to complete its lifecycle.

The current evidence base for the fish communities is considered sufficient to complete the Gate 2 assessments. However, it is recommended that recommended that the baseline monitoring programme continues to ensure the provision of a minimum 3 year dataset. The specific survey locations, monitoring that has been completed, and recommend programme going forward is provided in **Table 3-1**.

It is also recommended that this evidence base is reviewed should hydrological and water quality modelling identify any risk to the Severn estuary in terms of supporting habitat for the wider/resident estuarine fish community (i.e., non-migratory species). This review should consider the availability of recent baseline data on the diversity and abundance of fish species considered to be estuarine residents, and species that may use the estuary for breeding and foraging.

Locations associated with the potential canal transfer have not been identified for further monitoring, as the canal transfer option will not be further considered in Gate 2. It is recommended that the survey methodologies applied in the 2020 and 2021 monitoring programme should continue to be used, to ensure consistency.

Table 3-1 Survey locations for the STT Solution monitoring programme for fisheries

Note: Green shaded cells indicate surveys that have been completed. Blue shaded cells indicate surveys which are recommended to be undertaken in order to compile a 3-year baseline). An asterisk * indicates sites that will no longer be considered in the survey programme as the canal transfer will not be selected for Gate 2 assessments.

Site ID	Site Name	Easting	Northing	Survey programme			
				2020	2021	2022	2023
STT-01	River Vyrnwy d/s Reservoir u/s Conwy	302148	317261				
STT-01b	River Vyrnwy u/s SSSI	302930	315316				

STT-02	River Vyrnwy at Dolanog, d/s Falls (fish survey site only)	306922	312784				
STT-04	River Vyrnwy at Pontrobert	310925	312666				
STT-05	River Vyrnwy d/s Meifod	315718	312912				
STT-05a	River Vyrnwy u/s Llanymynech	325410	319636				
STT-05b	River Vyrnwy near Meverley Green	331976	317389				
STT-06	River Severn d/s Vyrnwy Confluence	333223	316529				
STT-06a	River Vyrnwy u/s Severn confluence	335090	317329				
STT-07	Discharge location on River Avon u/s Warwick for Minworth support	430881	270136				
STT-08	Discharge location on River Avon for Minworth support option	427399	262452				
STT-08a	River Avon at Abbot's Salford	407971	249927				
STT-08b	River Avon d/s Evesham	403151	244409				
STT-08c	River Avon near Twyning	390558	236630				
STT-09	Abstraction location on River Severn for transfer pipeline Deerhurst	385941	229233				
STT-12*	Abstraction location on River Severn for Cotswold Canal transfer (Gloucester Dock)	382673	218300				
STT-12a*	Discharge location in Gloucester and Sharpness canal	382432	218278				
STT-13*	Discharge location on River Severn for Netheridge support d/s Gloucester Docks	375734	209389				
STT-14*	Abstraction location in Gloucester and Sharpness canal at Saul Junction	375786	208993				
STT-15*	Discharge location on River Frome for Cotswold Canal transfer at Saul Junction	385470	204629				
STT-16*	Abstraction location on River Frome for Cotswold Canal transfer at Stroud	421285	199381				

The available evidence and data are **considered sufficient** to inform the ecological requirements of the fish communities of the waterbodies associated with the STT Solution for Gate 2. Furthermore, the additional evidence collected by the STT group will help to reduce the uncertainty in the conclusion of the Gate 1 assessments by identifying/confirming the extent of supporting habitat for the Severn Estuary Special Area of Conservation (SAC) and Ramsar site.

The baseline evidence is **considered sufficient** to describe the ecological requirements that should be considered in the assessment.

There is **uncertainty regarding the potential magnitude of the risks/impacts** associated with the STT Solution. These uncertainties relate specifically to:

- The magnitude of changes in freshwater and sediment inputs into the Severn Estuary as a result of the unsupported scheme, and the subsequent risk to supporting habitats and water quality in the Severn Estuary;
- The magnitude of the changes in water quality as a result of the discharge of tertiary treated water into the River Avon from the Minworth Wastewater Treatment Works, and the subsequent risk to olfaction cues and reproduction of the fish community of the River Severn and the Severn Estuary; and
- The overall magnitude of the risk associated with the supported scheme and the subsequent changes in flows, habitat (velocity, depth, width, connectivity, etc) and water quality in the associated reaches in the wider Severn Catchment (e.g. the River Vyrnwy).
- The overall magnitude of the risk associated with the supported scheme and the subsequent changes in weir pool habitat within the River Avon and the River Thames.

As noted in the physical environment and water quality assessments that will inform the assessment upon the fish community, the in-river environmental modelling results will be used to reduce this uncertainty. The modelling will consider a range of different scenarios to assess the potential impacts on the fish communities. The scenarios, baseline considerations and purpose of the modelling work is summarised in **Table 3-2**.

Should the modelling results identify significant changes in terms of the freshwater inflows and water quality entering the Severn Estuary, the study area will be updated in Gate 3 to include an assessment of impact. Any

update in the extent of the study area will necessitate an extension of the evidence base and data collection to reflect the revised area under focus.

Table 3-2 Scenarios that will be modelled for the Gate 2 assessments

Note: all scenarios modelled as a pair: without STT operation (reference condition) and separately with the STT operation.

Scenario		Flow (baseline without Solution)	Water quality (baseline without Solution)	Purpose
1	Moderate-low flow (1:5-1:10 return period)	Represents current meteorological patterns, current demands and abstractions, current sewage returns and representative Severn Regulation pattern (to be determined using the agreed water resources modelling conditions)	Based on the last 5 years measured data and also AMP7 sewage improvements	Central to Gate 2 environmental assessments, WFD etc
2	Very low flow (1:20 return period)			Central to Gate 2 environmental assessments, WFD etc
3	Extremely low flow (1:50-1:100 return period)			Assists resilience understanding
4	Future (2070s) version of “very low flow”	Represents a selected version of 2070s meteorological patterns, abstraction reductions in line with Environmental Destination; future forecast sewage returns and representative Severn Regulation pattern	As Scenario 2	Assists resilience understanding
5	Future (2070s) version of “extremely low flow”		As Scenario 3	Assists resilience understanding
6	Natural version of “Moderate-low flow”	Represents current meteorological patterns, without abstractions or discharges	As Scenario 2	Assists discussions of environmental significance with regulators

