

# Strategic Regional Water Resource Solutions: Annex B3.8: Natural Capital and Biodiversity Net Gain (England) Assessment

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

Date: November 2022



# Severn to Thames Transfer

## Natural Capital & Biodiversity Net Gain (England) Assessment

STT-G2-S3-118

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

## Natural Capital & Net Gain Assessment Report

Ricardo ref. ED15323

Issue: 005

10/10/2022

# CONTENTS

---

<b>1. Introduction</b>	<b>1</b>
1.1 Background and description of the STT scheme	1
1.1.1 The River Severn to River Thames Transfer Description	1
1.1.2 Gate 2	1
1.2 Study area	2
1.3 Summary of the Solution components and operation	3
1.4 Scope of this report	6
1.4.1 Link with other Reports	7
1.5 Structure of this Report	7
<b>2. Assessment approach</b>	<b>8</b>
2.1 Summary of the approach	8
2.2 Biodiversity Net Gain	9
2.2.1 Net Gain calculations (terrestrial habitats)	10
2.2.2 Potential Biodiversity Opportunities– terrestrial habitats	12
2.2.3 Net Gain Calculations – rivers and streams	13
2.2.4 Biodiversity Opportunity Areas – rivers	18
2.3 Natural Capital Assessment	18
2.3.1 Data sources, gaps, and assessment	19
2.3.2 Natural Capital stocks	19
2.3.3 Climate Regulation (carbon sequestration)	20
2.3.4 Natural Hazard Regulation	20
2.3.5 Water Purification	21
2.3.6 Water Regulation	22
2.3.7 Air Quality	22
2.3.8 Recreation and Tourism	22
2.3.9 Agriculture	22
2.4 Stakeholder Engagement	24
2.4.1 Introduction	24
2.4.2 Workshops	24
<b>3. Assessment Results</b>	<b>26</b>
3.1 BNG – Full Scheme Temporary Impacts	26
3.2 BNG – Habitat Enhancements required to achieve 10% net gain for temporary habitat loss	27
3.3 BNG – Full scheme permanent Impacts	27
3.4 BNG – Habitat Enhancements required to achieve 10% net gain for permanent habitat loss	28
3.4.1 Potential Biodiversity Opportunities – Full scheme	28
3.5 BNG – Gloucestershire Permanent Impacts	28
3.5.1 BNG – habitat enhancements required to achieve 10% net gain for permanent habitat loss	28
3.6 BNG – Gloucestershire Temporary Impacts	30
3.6.1 BNG – habitat enhancements required to achieve 10% net gain	30
3.6.2 Potential Biodiversity Opportunities – Gloucestershire	31
3.7 BNG – Oxfordshire Permanent Impacts	36
3.7.1 BNG – habitat enhancements required to achieve 10% net gain for permanent habitat loss	36
3.8 BNG – Oxfordshire Temporary Impacts	36
3.8.1 BNG – habitat enhancements required to achieve 10% net gain	37
3.8.2 Potential Biodiversity Opportunities – Oxfordshire	37
3.9 BNG – Shropshire Permanent Impacts	44

3.9.1	BNG – habitat enhancements required to achieve 10% net gain for permanent habitat loss	44
3.10	BNG – Shropshire Temporary Impacts	44
3.10.1	BNG – habitat enhancements required to achieve 10% net gain	45
3.10.2	Potential Biodiversity Opportunities – Shropshire	45
3.11	BNG Tables – Rivers – Full Scheme	51
3.11.1	BNG - rivers and streams – temporary construction impacts	51
3.11.2	BNG - rivers and streams – permanent construction impacts	52
3.11.3	BNG - rivers and streams – operational impacts	53
3.12	Biodiversity OPPORTUNITIES– Rivers	55
3.12.1	Wider benefits assessment outputs for river PBOs	55
3.12.2	River enhancement – temporary construction	55
3.12.3	River enhancement – permanent construction	57
<b>4.</b>	<b>Natural Capital</b>	<b>58</b>
4.1	Biodiversity and Habitat	58
4.2	Climate regulation	58
4.2.1	Natural Hazard Regulation	58
4.3	Water Purification	59
4.4	Water Regulation	59
4.5	Tourism and Recreation	59
4.6	Agriculture	60
4.7	Summary of natural capital impact	60
<b>5.</b>	<b>Engagement plan</b>	<b>62</b>
<b>6.</b>	<b>Conclusions</b>	<b>67</b>
6.1	Summary of the findings	67
6.1.1	BNG terrestrial	67
6.1.2	BNG rivers	67
6.1.3	Natural Capital	67
6.2	Uncertainty, confidence data gaps	67
6.3	Recommendations for Gate 3	68
<b>Annexes</b>		<b>69</b>

## Figures

Figure 1.1	Flow chart showing the scope of investigations for STT Gate 2 and their interactions	2
Figure 1.2	Map showing the study area and associated catchments	4
Figure 1.3	Schematic representing flow changes (accounting for losses) of STT Solution	6
Figure 2.1	Flow diagram of PBO method	13
Figure 3.1	Biodiversity Opportunity Areas scoring and heatmap outputs– full scheme	29
Figure 3.2	Heat map showing all the scoring for all PBOs in Gloucestershire within 5 km of the STT scheme	33
Figure 3.3	Map 1 of 2 showing the 15 highest scoring PBOs within Gloucestershire (northern sites)	34
Figure 3.4	Map 2 of 2 showing the 15 highest scoring PBOs within Gloucestershire (southern sites)	35
Figure 3.5	Heat map showing all the PBOs in Oxfordshire within 5 km of the STT scheme	39
Figure 3.6	Map 1 of 4 showing the 15 highest scoring PBOs within Oxfordshire	40
Figure 3.7	Map 2 of 3 showing the 15 highest scoring PBOs within Oxfordshire	41
Figure 3.8	Map 3 of 4 showing the 15 highest scoring PBOs within Oxfordshire	42
Figure 3.9	Map 4 of 4 showing the 15 highest scoring PBOs within Oxfordshire	43
Figure 3.10	Heat map showing all the PBOs in Shropshire within 5 km of the STT scheme	47
Figure 3.11	Map 1 of 3 showing the 15 highest scoring PBOs within Shropshire	48

Figure 3.12 Map 2 of 3 showing the 15 highest scoring PBOs within Shropshire	49
Figure 3.13 Map 3 of 3 showing the 15 highest scoring PBOs within Shropshire	50
Figure 3.14 River biodiversity opportunity heat map	55
Figure 3.15 Temporary construction River Biodiversity Opportunity Areas (labelled with WFD name) identified within 1km of the proposed STT pipeline	56
Figure 3.16 Permanent construction River Biodiversity Opportunity Areas (labelled with WFD name) identified within 1km of the proposed outfall	57
Figure 4.1 Ecosystems Services NPV	61

## Tables

Table 1.1 Components of Early Phase and Full STT Operation	5
Table 1.2 River Severn at Deerhurst: HoF conditions	6
Table 2.1 Approach to the Gate 2 BNG, NCA and SMNR assessments	8
Table 2.2 Woodland and Pasture UKHab classification and condition assumptions	11
Table 2.3 Off-site habitat enhancement rules used to calculate habitat area required to achieve 10% net gain*	12
Table 2.4 Potential Biodiversity Opportunities scoring criteria	13
Table 2.5 Condition weightings for rivers and streams	14
Table 2.6 Distinctiveness categories	15
Table 2.7 Description of riparian zone encroachment bands	15
Table 2.8 Description of in-watercourse encroachment bands	16
Table 2.9 Strategic significance categories	16
Table 2.10 Spatial risk multipliers for rivers and streams	16
Table 2.11 Conversion from land cover classification data to broad habitat types	19
Table 2.12 Carbon sequestration of land use from EA WRPG Supplementary Guidance	20
Table 2.13 Benefit Transfer Values: Natural Hazard Regulation	21
Table 2.14 Benefit transfer values: provisioning services supporting agriculture	23
Table 2.15 Components included within the adapted farm income method	23
Table 2.16 Stakeholder recommendations identified through STT Gate 2 workshops	24
Table 3.1 STT full scheme temporary habitat loss during construction	26
Table 3.2 STT full scheme temporary hedgerow loss during construction	26
Table 3.3 STT Full Scheme construction temporary loss BNG summary pre mitigation	26
Table 3.4 STT full scheme off-site mitigation required to achieve a 10% net gain for temporary habitat loss	27
Table 3.5 STT full scheme off-site mitigation required to achieve a 10% net gain for temporary hedgerow loss	27
Table 3.6 STT full scheme permanent loss during construction	27
Table 3.7 STT Full Scheme construction permanent loss BNG summary pre mitigation	27
Table 3.8 STT full scheme off-site mitigation to achieve a 10% net gain for permanent habitat loss	28
Table 3.9 STT Gloucestershire permanent loss during construction	28
Table 3.10 STT Gloucestershire construction permanent loss BNG summary pre mitigation	28
Table 3.11 STT Gloucestershire off-site mitigation to achieve a 10% net gain for permanent habitat loss	28
Table 3.12 Temporary Habitat Loss Gloucestershire	30
Table 3.13 STT Gloucestershire construction temporary loss BNG summary pre and post mitigation	30
Table 3.14 BNG – habitat enhancements required to achieve 10% net gain within Gloucestershire	30
Table 3.15 The 15 highest scoring PBOs identified within 5km of the proposed STT scheme in Gloucestershire	32
Table 3.16 STT Oxfordshire permanent loss during construction	36
Table 3.17 STT Oxfordshire construction permanent loss BNG summary pre mitigation	36
Table 3.18 STT Oxfordshire off-site mitigation to achieve a 10% net gain for permanent habitat loss	36
Table 3.19 STT Oxfordshire temporary habitat loss during construction	36

Table 3.20 STT Oxfordshire construction temporary loss BNG summary pre and post mitigation	37
Table 3.21 STT Oxfordshire off-site mitigation to achieve a 10% net gain for temporary losses	37
Table 3.22 The 15 highest scoring PBOs identified within 5km of the proposed STT scheme in Oxfordshire	38
Table 3.23 STT Shropshire permanent loss during construction	44
Table 3.24 STT Shropshire construction permanent loss BNG summary pre mitigation	44
Table 3.25 STT Shropshire off-site mitigation to achieve a 10% net gain for permanent habitat loss	44
Table 3.26 Shropshire temporary loss during construction	45
Table 3.27 STT Shropshire construction temporary loss BNG summary pre mitigation	45
Table 3.28 BNG – offsetting required to achieve 10% net gain within Shropshire	45
Table 3.29 The 15 highest scoring PBOs identified within 5km of the proposed STT scheme in Shropshire	46
Table 3.30 STT Solution full scheme temporary loss of river units during construction.	51
Table 3.31 Construction of STT Solution (excluding Minworth and Netheridge) and temporary loss of BNG river units pre mitigation.	52
Table 3.32 STT Solution full scheme temporary loss of river units during construction.	52
Table 3.33 Construction of STT Solution (excluding Minworth and Netheridge) and permanent loss of BNG river units pre mitigation.	52
Table 3.34 MoRPh survey locations	53
Table 3.35 Assessed changes in river condition indicators during the operation of STT Solution at STT 08 and 26	54
Table 3.36 Waterbodies identified for potential enhancement, in order to achieve 10% BNG from temporary construction losses.	56
Table 3.37 Waterbodies identified for potential enhancement, in order to achieve 10% BNG from permanent construction losses.	57
Table 4.1 Summary of non-traded carbon sequestration values	58
Table 4.2 Summary of natural hazard regulation impacts	59
Table 4.3 Summary of baseline and potential change to water purification service provision	59
Table 4.4 ORVal outputs: Welfare values and estimated visits for affected recreation sites*	60
Table 4.5 Baseline assessment of agriculture ecosystem service provision	60
Table 5.1 Stakeholder organisations engaged in Gate 2 workshops	62
Table 5.2 Stakeholder organisations to be included in future activities	64

# 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 (subject to consultation in the context of WRMP24 and the consenting process) 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 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.

### 1.1.2 Gate 2

RAPID issued a guidance document<sup>1</sup> in April 2022 to describe the Gate 2 process and set out the expectations for solutions at standard Gate 2.

---

<sup>1</sup> RAPID (2022) Strategic regional water resource solutions guidance for gate two

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) guidance<sup>2</sup> and the Environment Agency Invasive Non-native Species risk assessment tool.

Figure 1.1 shows the investigations being undertaken for STT Gate 2 and their interactions, in order to show the full scope of work across both environmental and engineering disciplines. Reporting for the environmental investigations has been undertaken in a phased way to account for, and incorporate all previous assessments, data collection and feedback: (i) the evidence reports were produced first, and set out the data and evidence to be used in the assessments; (ii) assessment reports were then produced using the evidence to determine the potential effect of the STT solution on the physical environment, water quality and ecological receptors (dark blue box in in Figure 1.1); (iii) based on the evidence and assessments, the informal statutory reports, and assessments required to meet the RAPID and regulatory expectations for solutions at Gate 2 were produced.

This report presents an assessment of the effect of the solution on the physical environment. It informs other assessments, including the statutory assessments.

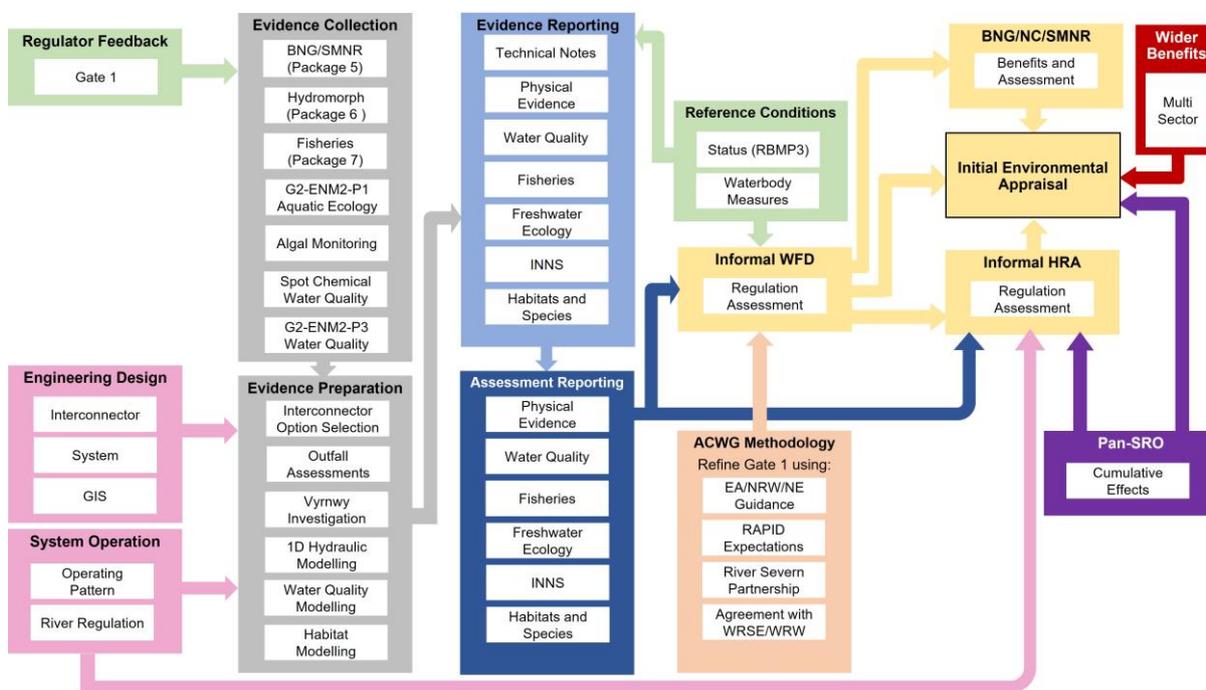


Figure 1.1 Flow chart showing the scope of investigations for STT Gate 2 and their interactions

## 1.2 STUDY AREA

The study area for the STT solution for 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).

<sup>2</sup> All Companies Working Group (2020) WRMP environmental assessment guidance and applicability with SROs

It should be noted that the consideration of impacts in the River Tame and Trent, from the transfer of treated discharge from Minworth Wastewater Treatment Works (WwTW) to the River Avon, is included in Severn Trent Water's Minworth Strategic Resource Solution and therefore excluded from the STT solution assessment.

Similarly, the STT solution assessment accounts for the effects from the relevant solutions related to the supply of water into the STT system (United Utilities Sources, and Severn Trent Sources). It therefore includes a range of environmental assessments to determine the potential effects of the water arising from the outfalls from the transfers (Minworth and Netheridge). It does not cover the effects arising from infrastructure construction as this is included in Severn Trent Water's Minworth and Sources Solution assessments.

### 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<sup>3</sup>. 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 1.1.1**), 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**.

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 unsupported<sup>4</sup>. 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 modelling<sup>5</sup> 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 **Figure 1.3**.

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 series<sup>6</sup> 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 **Section 2.2.3** of the **Physical Environment Assessment Report** with the derived representation of dates with the full STT in operation (for water resources purposes) used in environmental assessment. 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 Solutions (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.

<sup>3</sup> STT-G2-S3-359-STT Gate 2 Design Principles

<sup>4</sup> Email from Caroline Howells (Environment Agency Environment Planning Officer) to Peter Blair (Thames Water, Water Resources Modelling Specialist) 27 February 2020.

<sup>5</sup> Email from Alison Williams (Environment Agency Senior Water Resources Officer) to Helen Gavin (Ricardo) and Valerie Howden (HRW) on 10 February 2022.

<sup>6</sup> 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,

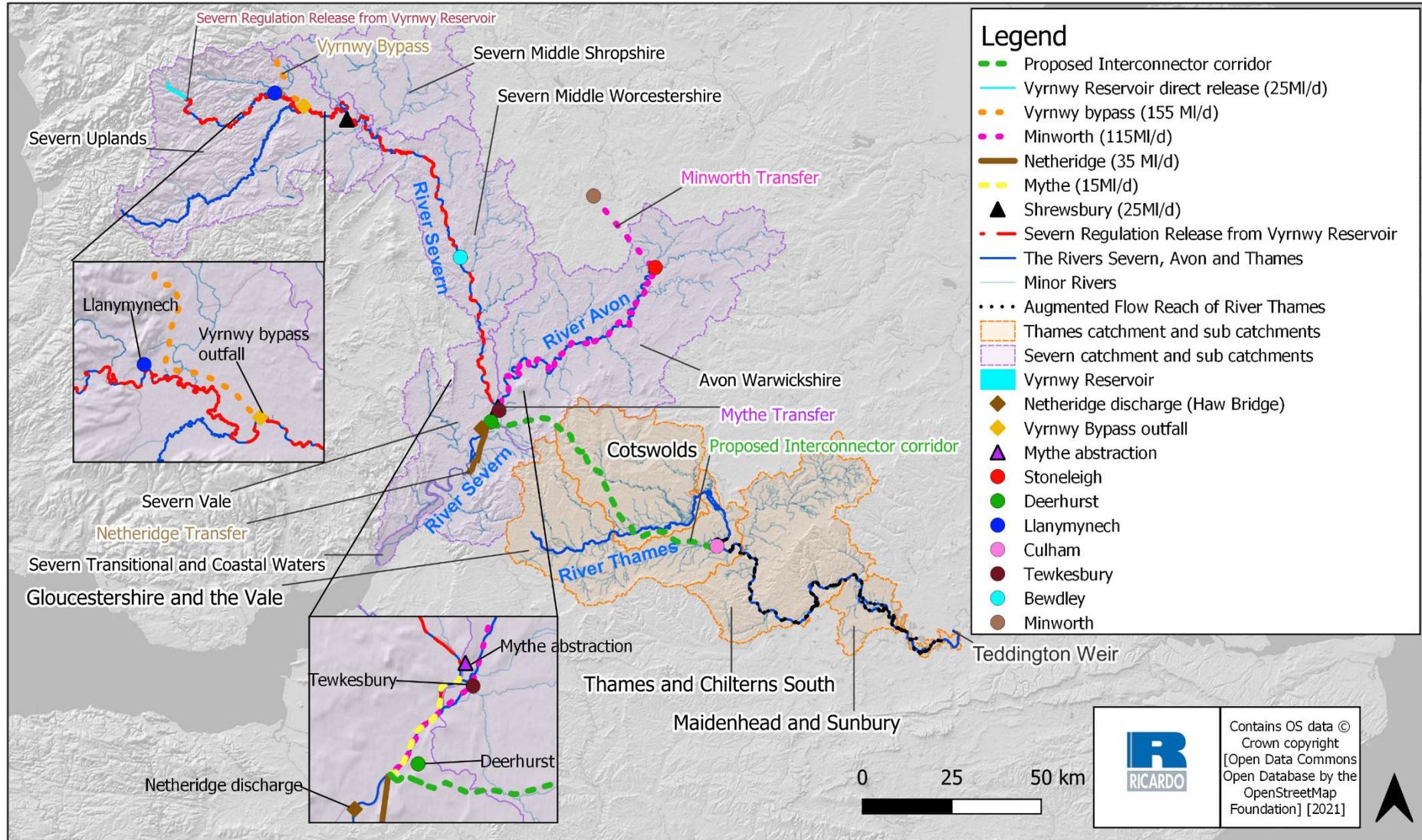
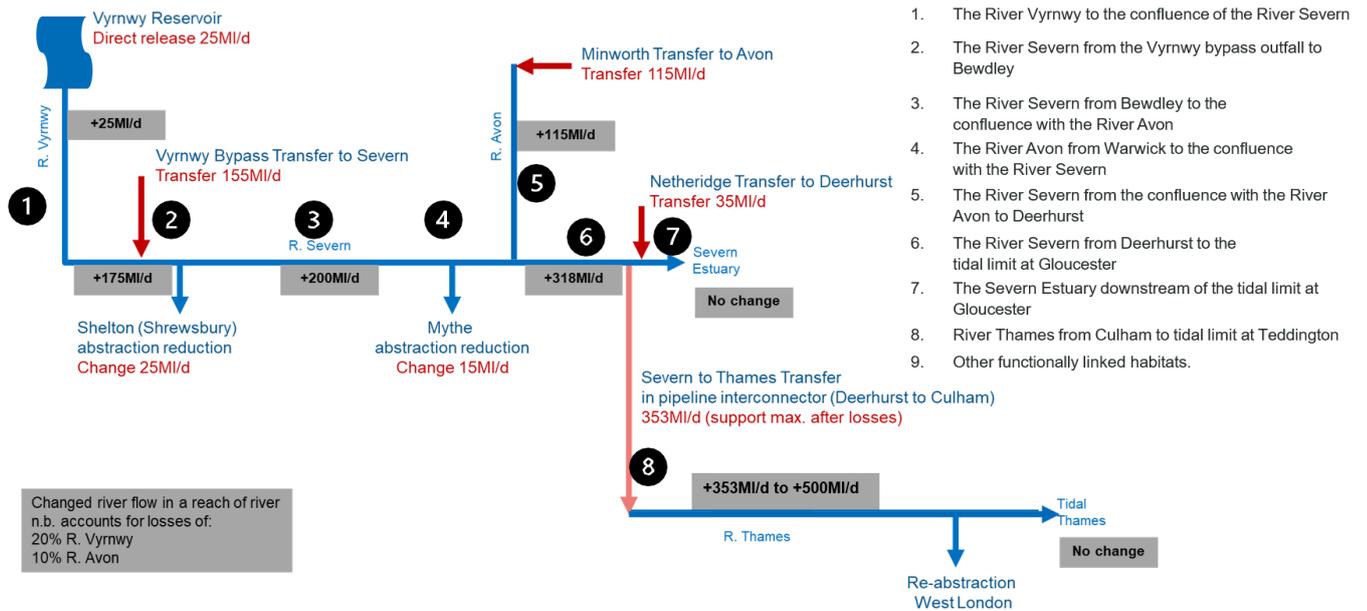


Figure 1.2 Map showing the proposed interconnector corridor

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
<p>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.</p> <p>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.</p>	<p>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):</p> <ol style="list-style-type: none"> <li>1. <b>Vyrnwy Reservoir:</b> Release of 25MI/d water licensed to UU from Lake Vyrnwy directly into the River Vyrnwy;</li> <li>2. <b>Vyrnwy Reservoir:</b> Utilisation of 155MI/d water licensed to UU from Lake Vyrnwy and transferred via a bypass pipeline (“Vyrnwy Bypass”) to the River Severn;</li> <li>3. <b>Shrewsbury:</b> 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;</li> <li>4. <b>Mythe:</b> 15MI/d of the Severn Trent Water licensed abstraction at Mythe remaining in the River Severn for abstraction at Deerhurst;</li> <li>5. <b>Minworth:</b> 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</li> <li>6. <b>Netheridge:</b> 35MI/d of the Severn Trent Water licensed abstraction piped to the River Severn for abstraction at Deerhurst.</li> </ol>
<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"> <li>• Either unsupported abstraction when not limited by hands-off flow conditions; or</li> <li>• Supported abstraction by flow volume matching from Netheridge Transfer</li> </ul>	<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"> <li>• Either unsupported abstraction when not limited by hands-off flow conditions; or</li> <li>• Supported abstraction by flow volume matching from Netheridge Transfer</li> </ul>



**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

### 1.4 SCOPE OF THIS REPORT

The purpose of this report is to provide a Biodiversity Net Gain (BNG) and Natural Capital (NC) assessment of the STT solution as outlined in Section 1 of this report. This is to provide information related to a preliminary assessment of BNG and NC losses and benefits. This report also includes an assessment of opportunity mapping using Ricardo’s in-house Priority Biodiversity Opportunity (BPO) tool.

This report applies the latest methodologies for BNG and NC assessment as set out in the WRMP24 water-resources supplementary guidance<sup>7</sup> and the All Company Working Group (ACWG) guidance<sup>8</sup> to Solution Environmental Assessment alongside the technical guidance for upcoming DEFRA Metrics (3.1 and 4.0)<sup>9</sup> and the British Standard on implementation of BNG<sup>10</sup>. This report sets out the environmental evidence and data used to inform the natural asset baseline and the results of the BNG and NC assessments.

As part of this assessment we have reviewed the tools outlined in the WRMP24 guidance and where feasible these have been used. Where not used for a specific service this has been justified as requested in the guidance noting that many tools have limitations or need a level of detail not necessarily currently available.

The report also identifies the remaining evidence and data gaps for further consideration in the next stage of development of the Solution.

This report includes an assessment of habitat loss (both temporary and permanent loss), a high-level assessment of habitat reinstatement required on-site and where necessary considers additional offsite mitigation to offset any habitat loss. An assessment of ‘uplift’ necessary to achieve a minimum of 10% net

<sup>7</sup> 2021 03023 RMP24 SG -ES Decision-making- England

<sup>8</sup> Mott MacDonald Limited (2020). All Companies Working Group WRMP environmental assessment guidance and applicability with SROs. Published October 2020

<sup>9</sup> Natural England (2021) Biodiversity Metric 3.1 – Calculation Tool. Available at publications.naturalengland.org.uk

<sup>10</sup> BS 8683: Process for designing and implementing biodiversity net gain – Specification

gain is also included. An associated NC assessment is included that accounts for temporary and permanent losses and additional benefits related to net gain.

### 1.4.1 Link with other Reports

This report has assessed the operational effects and associated hydrologically impacted reaches based on the findings of the hydrological modelling and assessments presented in the **STT Gate 2 Physical Environment Report**<sup>11</sup>. These findings are used by many of the STT Gate 2 Environmental Assessment and Statutory reports which interpret the significance of the changes for their specific feature(s) or topic of interest. The baseline data, scope and detailed assessment methodology used in this report are presented in the STT Gate 2 Biodiversity Evidence report<sup>12</sup>.

## 1.5 STRUCTURE OF THIS REPORT

This report includes the following sections:

Section 1: Introduction;

Section 2: Assessment approach;

Section 3: Assessment results;

Section 4: Engagement Plan; and

Section 5: Conclusions and recommendations for Gate 3.

---

<sup>11</sup> Ricardo Energy and Environment (2022) Severn Thames Transfer SRO. Physical Environment Assessment Report. Report for United Utilities on behalf of the STT Group. May 2022

<sup>12</sup> Ricardo Energy & Environment (2022). Severn to Thames Transfer SRO. Biodiversity Evidence Report. Report for United Utilities on Behalf of the STT Group. February 2022.

## 2. ASSESSMENT APPROACH

### 2.1 SUMMARY OF THE APPROACH

The scope of the BNG, NCA, and Sustainable Management of Natural Resources (SMNR) assessments for the STT Solution required for Gate 2 and the approach to undertaking these assessments are described in **Table 2.1** noting that the Welsh assessment is discussed in a separate report (see note in box below). This table is based on that presented in the STT Biodiversity Evidence Report<sup>13</sup>.

Note: Whilst the overall approach and tasks for Wales and England is highlighted in Table 2.1, it should be noted that there is a separate assessment report for Wales covering the Vyrnwy Reservoir area. A separate report has been requested by the environmental regulators to examine that part of the STT which is located within Wales\*. Table 2.1 provides a summary, and signposts to other assessment reports undertaken at Gate 2 where more detail can be found.

\*Please read the report *STT-G2-S3-119-Ecosystem resilience, wellbeing & SMNR (Wales) Assessment* for an assessment of the STT solution against

Table 2.1 Approach to the Gate 2 BNG, NCA and SMNR assessments

Task item	Scope of assessment	Approach to assessment	Evidence Base for Task
a. BNG (England) and Biodiversity Resilience and Environmental Ambitions (Wales)	<ul style="list-style-type: none"> <li>Desk review of data sources to refine the baseline and identify strategic opportunities</li> </ul>	<ul style="list-style-type: none"> <li>Use data to update the baseline assessment of habitats for the BNG/Biodiversity Resilience assessment, which underpins the NC/SNMR assessment.</li> </ul>	<ul style="list-style-type: none"> <li>Data sources as listed in the supporting Excel workbook “<i>STT_G2_BiodiversityEnvAmbitionEvidenceWorkbook</i>” in the tab ‘GIS data review sources’.</li> <li>Mapped outputs.</li> </ul>
	<ul style="list-style-type: none"> <li>Habitat and river morphology surveys to refine the baseline and identify strategic opportunities</li> </ul>	<ul style="list-style-type: none"> <li>Undertake targeted surveys to refine the identification of habitat type and condition along the proposed pipeline routes and impacted reaches of watercourses using standard survey methodologies.</li> </ul>	<ul style="list-style-type: none"> <li>Survey locations as listed in the supporting Excel workbook in the tabs ‘Transect survey details’ and ‘River MoRPh survey locations’.</li> <li>The results of the priority habitat surveys are presented in a separate report ‘<i>STT_G2 Evidence Report_Priority habitats</i>’ and summarised in the <i>Excel workbook</i>, tabs ‘Summary report’, ‘UKHab and condition’, ‘Condition tables’ and ‘River MoRPh - results’.</li> </ul>
	<ul style="list-style-type: none"> <li>Stakeholder workshops: three workshops held with stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Hold workshops to discuss the information requirements for Gate 2 and gather information on opportunities through a structured questionnaire and follow-up workshop to discuss the results in more detail. Hold a third workshop to discuss the findings and identify the locations of greatest opportunity.</li> </ul>	<ul style="list-style-type: none"> <li>Data provided to support the workshops included maps of a 5km buffer along the pipeline routes and impacted river reaches.</li> <li>Responses from the questionnaires</li> <li>The key discussion points from Workshop 2</li> <li>Recordings and transcripts from the workshop sessions</li> </ul>
	<ul style="list-style-type: none"> <li>Review of relevant IEA/HRA/Protected Habitats and Species and Hydro-ecology data</li> </ul>	<ul style="list-style-type: none"> <li>Review the ancillary environmental assessment reports for relevant information with which to refine the</li> </ul>	<ul style="list-style-type: none"> <li>The ancillary environmental assessment and associated reports (Protected Habitats, Protected Species, Water Quality, Physical Environment,</li> </ul>

<sup>13</sup> STT-G2-S3-110-Biodiversity and Environmental Ambition Evidence

Task item	Scope of assessment	Approach to assessment	Evidence Base for Task
		baseline assessment of habitat/river condition and identify opportunities to deliver cross benefits.	Macroinvertebrates, Invasive Non-native Species and Fisheries, IEA, HRA and WFD)
	<ul style="list-style-type: none"> <li>Update Gate1 BNG calculations for each scheme component and</li> </ul>	<ul style="list-style-type: none"> <li>Recalculate the BNG score for each scheme component and/or option in order to include updated data following the UKHab, MoRPh, and associated condition assessments surveys, and baseline data from the desk study.</li> <li>Undertake further assessment of Biodiversity Resilience (Wales)</li> </ul>	<ul style="list-style-type: none"> <li>Above data sources on the baseline habitats from the desk study</li> <li>Analysis using the Defra metric 3.0<sup>14</sup> (England)</li> <li>SMNR principles for Building Resilience<sup>15</sup></li> </ul>
b. Natural Capital Assessment (England)	<ul style="list-style-type: none"> <li>Update baseline data, monetised and non-monetised assessments to include the survey results</li> <li>Update Gate1 monetised and non-monetised assessments for each scheme component</li> <li>Quantitative and qualitative assessments of mitigation and enhancement opportunities</li> </ul>	<ul style="list-style-type: none"> <li>Recalculate the monetised and non-monetised Ecosystem Service assessments related to the updated BNG assessment for each scheme component and / or option to include the updated data sources based on the results of the UKHab, MoRPh, and associated condition assessments surveys.</li> <li>Hold workshops to discuss the information requirements for Gate 2, to (1) gather information on opportunities through a structured questionnaire; (2) follow-up to discuss answers; and (3) discuss the findings and identify the locations of greatest opportunity.</li> </ul>	<ul style="list-style-type: none"> <li>Data sources as listed in the supporting Excel workbook "STT_G2_BiodiversityEnvAmbiti onEvidenceWorkbook" in the tab 'GIS data review sources'.</li> </ul>

## 2.2 BIODIVERSITY NET GAIN

The mandatory requirement is to achieve at least a 10% BNG increase from the pre-development biodiversity value. The requirement is framed as a pre- commencement condition, meaning that the biodiversity gain condition must be discharged before development can begin. It is underpinned by the Environment Act that offers new powers to set new binding targets, including for water and biodiversity.

BNG is the concept of going beyond the mitigation of development impacts on the environment and putting in a conscious effort to initiate positive ecological change. It requires an understanding of the habitats that will be lost both temporarily and permanently through construction, and provides a means to calculate how to mitigate the damage caused. This is accomplished through the use of the Biodiversity Metric 3.0 tool<sup>16</sup> which, through consideration of habitat type and condition, converts areas of habitats into Biodiversity Units. Once a value of habitat units lost has been calculated, a target for how many should be achieved to produce 10% BNG is also calculated. The metric tool then allows for plans to be made for habitat creation or enhancement in order to increase the net Biodiversity Units of the project until the target 10% gain is reached. The 10% gain was

<sup>14</sup> <http://publications.naturalengland.org.uk/publication/6049804846366720>

<sup>15</sup> Natural Resources Wales (undated) Introducing Sustainable Management of Natural Resources. Available from: [Introducing Sustainable Management of Natural Resources https://naturalresources.wales/media/678317/introducing-smnr-booklet-english.pdf](https://naturalresources.wales/media/678317/introducing-smnr-booklet-english.pdf)

<sup>16</sup> Natural England (2021) Biodiversity Metric 3.0 – Calculation Tool. Available at [publications.naturalengland.org.uk](https://publications.naturalengland.org.uk)

calculated for the whole scheme boundary (scheme route plus working width buffer). A newer version of the tool, 3.1, has been released but 3.0 was used for these assessments to provide consistency across multiple SROs.

### 2.2.1 Net Gain calculations (terrestrial habitats)

The calculation of net loss/gain within the Biodiversity Metric 3.0 considers both direct impacts resulting in habitat loss (whether permanent or temporary) and changes in habitat condition. The areas required to achieve 10% for each option have been identified based on the baseline habitats present within the working width and following the requirement of the Biodiversity Metric 3.0, this included requirements such as same habitat required (high distinctiveness) or replacement of same habitat type or higher distinctiveness (low distinctiveness).

The off-site mitigation required used in the assessment was intended to provide an indicative area off site habitat required to achieve 10% net gain for the full scheme and within each local authority. Habitats, where possible, were used in the same proportions as the baseline habitats excluding habitats which do not provide BNG Units and are not possible to enhance within the metric (e.g., urban-sealed surface). Moderate to very high distinctiveness habitats were mitigated through off site enhancement e.g., poor to moderate or moderate to good. It is not possible to enhance cropland in the Biodiversity Metric so consequently modified grassland was used for off-site mitigation to offset impacts to crop land using a change in habitat type from poor condition modified grassland to moderate condition neutral grassland. Examples are shown in **Table 2.3**.

Due to the high-level nature of the Gate 2 assessment and the paucity of detailed design information, several assumptions have been made to allow the calculation of BNG requirements. The key assumptions are summarised below.

#### 2.2.1.1 Statutory and non-statutory designated sites

The baseline dataset is a habitat assessment based on identifying risks to terrestrial Priority Habitats. Risks to European designated sites from construction and operation are covered in the STT Gate 2 Habitats Regulations Assessment Report<sup>17</sup>. Impacts to water dependent priority habitats and designated sites from the operation of the STT scheme are included in other reports<sup>18</sup>. Operational impacts to watercourses have been assessed for the Rivers and Stream BNG Metric; the methodology is outlined below.

#### 2.2.1.2 Baseline habitat area and condition

The data sources used to inform the baseline habitats within the scheme footprint are outlined in **Table 2.1** and provided in full in the STT Gate 2 Biodiversity Evidence Report<sup>13</sup>.

Areas of habitats were calculated through the use of the geographical information system software QGIS. The areas of permanent and temporary loss were mapped over the habitat data, then run through a model which identified habitats which fell within the construction polygons. This model prioritises the habitat layers that have high resolution, importance and validity. This ensured that the most accurate and important data was not missed due to overlapping data of lower resolution. Areas identified as being river were removed from the metric as these were assessed separately in the BNG Rivers part of the assessment (see **Section 3.11**).

The STT Solution's pipeline elements cross various minor roads, for which it has been assumed that open cut construction methods will be used. Roads are classified as 'Urban - built linear features', which scores 0 units and therefore they are excluded from the assessment.

Normally, the condition of each habitat type is assessed against specific requirements listed within the guidance documents from field survey data. These requirements are specific to each habitat type and relate to physical characteristics, structural attributes, typical species present, and positive and negative indicators, such as the presence of invasive species.

Sampling surveys were undertaken by Ricardo in 2021 where UKHab and river MoRPH surveys were undertaken at various locations along the scheme<sup>19</sup>. The results of the UKHab surveys were used to refine the assumptions of habitat losses based on type of habitat present and condition for woodland and grassland. **Table 2.2** shows the conversion of woodland or pasture into respective UKHab categories and the split in condition, based on results from the sampling surveys.

<sup>17</sup> STT-G2-S3-121-Informal Habitats Regulation Assessment (HRA)

<sup>18</sup> See: STT-G2-S3-117-Protected Habitats Assessment and STT-G2-S3-118-Protected Species Evidence

<sup>19</sup> Biodiversity Net Gain and Natural Capital Survey Assessment, Ricardo 2022

The metric calculates hedgerows differently to most other habitats in that it bases its calculations on lengths of hedgerow rather than areas. Areas identified in the UK Habitat Classification (UKHab) data as hedgerows therefore had to be converted into two-dimensional lengths before they could be entered into the metric. Rather than creating Habitat units, the metric outputs Hedge Units instead. Separate mitigation calculations were then made in a similar method to other terrestrial habitats, whereby mitigation comes from increasing the condition of other hedgerows from 'Poor' to 'Moderate', or 'Moderate' to 'Good'. The lengths of enhanced hedgerows required to achieve 10% net gain in hedge units could then be calculated.

Table 2.2 Woodland and Pasture UKHab classification and condition assumptions

Desk based habitat output	UKHab conversion	Condition
Woodland	Broadleaved woodland (79%)	Moderate (88%)
		Good (12%)
	Built linear features (9%)	N/A
	Cereal crops (6%)	N/A
Pasture	Neutral grassland (6%)	Poor (39%)
		Moderate (61%)
	Cereal crops (10%)	N/A
	Neutral grassland (41%)	Poor (39%)
		Moderate (61%)
Pasture	Modified grassland (49%)	Poor (57%)
		Moderate (42%)
		Good (1%)

### 2.2.1.3 Strategic significance

Strategic significance is measured at a landscape scale, taking into consideration local plans for green infrastructure and biodiversity, national character areas, and national objectives. This category gives value to habitats that are situated within optimal locations, and which could enable biodiversity objectives to be met. The assignment of strategic significance was informed by a review of the data sources outlined in **Table 2.1** and the Gate 2 Biodiversity Evidence Report<sup>13</sup>.

### 2.2.1.4 Habitat loss

All habitats within the construction easement are assumed to be lost and re-instated with the existing baseline habitat type and restored to the same condition. There is no information at this stage on whether some of the habitat along the STT Scheme overall route will be retained but degraded from vehicle access and restored (temporary degradation).

Priority habitat layers for hedgerows are not open-source information. However, hedgerow intersections have been identified through analysis of aerial photography. An estimate made of habitat loss was calculated using a working easement of 20m (i.e. zone of operation influence). Hedgerows were entered into the Metric Tool.

Construction methods are unknown for small watercourses (<2m) and an assumption was made of open cut methods, with a 20m easement corridor that will be subject to habitat loss. It has been assumed for the calculations that there will be 15m loss of habitat along riverbanks for all outfall structures.

### 2.2.1.5 Calculation of net gains/ losses (terrestrial habitats)

The calculation of net loss/gain within the Biodiversity Metric 3.0 only considers direct impacts resulting in habitat loss, whether permanent or temporary. The areas required to achieve 10% for each option have been identified based on the baseline habitats present within the working width and following the requirement of the BNG Metric 3.0 Tool – such as the same habitat required (high distinctiveness) or replacement of same habitat type or higher distinctiveness (low distinctiveness). The habitat creation and enhancements required were based on proportions of the baseline habitat on-site. Restoration of habitats is assumed to be undertaken within 2 years of initial impact.

The calculation of off-site mitigation required provides an indicative area of the off-site habitat required to achieve 10% net gain for the full scheme, which can be broken down to the area within each local authority. Where possible, the same habitat was identified in the same proportions as the baseline habitat (excluding those which do not provide BNG units and which are not possible to enhance within the metric (e.g. urban-sealed surface). Habitats assessed as having moderate to very high distinctiveness were mitigated through off-site enhancement e.g. poor to moderate or moderate to good. It is not possible to enhance cropland in the

BNG metric; consequently, modified grassland was used for off-site mitigation to offset impacts to crop land, using enhancement from poor condition modified grassland to moderate condition neutral grassland. Examples are shown in **Table 2.3**. Off-site mitigation is required as on-site mitigation for temporary losses will be through creation of lost habitats.

The number of units required to achieve a 10% can be significantly higher than the number of units lost due to the number of units gained from mitigation needing to be equal to the number of units lost plus 10% of the total baseline to achieve a 10% net gain. The number of units required from mitigation relative to the number of units lost varies depending on the proportion of the total baseline affected by the proposed activities.

**Table 2.3 Off-site habitat enhancement rules used to calculate habitat area required to achieve 10% net gain\***

On site baseline habitat	Off-site habitat Pre-mitigation		Off-site habitat post- mitigation	
	Habitat	Condition	Habitat	Condition
Cropland	Modified grassland	Poor	Neutral grassland	Moderate
Modified grassland	Modified grassland	Moderate	Neutral grassland	Moderate
Neutral grassland	Neutral grassland	Moderate	Neutral grassland	Good
Woodland (Broad leaved)	Modified grassland	Moderate	Other; Broadleaved woodland	Moderate
Woodland (mixed)	Modified grassland	Moderate	Other; Mixed woodland	Moderate
Traditional Orchards	Modified grassland	Moderate	Traditional Orchards	Moderate
Floodplain Wetland Mosaic (CFGM)	Modified grassland	Moderate	Floodplain Wetland Mosaic (CFGM)	Moderate
Lowland Calcareous Grassland	Lowland Calcareous Grassland	Moderate	Lowland Calcareous Grassland	Good

*Note: The above is based on open source information plus some data from areas that have been surveyed. As set out in Section 6.3, it is recommended that further surveys are undertaken at Gate 3 to increase the accuracy of the assumptions, and ensure it is possible to create the desired habitats.*

### 2.2.2 Potential Biodiversity Opportunities– terrestrial habitats

Gate 1 focused on identifying landscape scale plans and policies (nature recovery partnerships). At Gate 2 the process was refined to identify sites within 5km from the option locations based on a scoring system (as shown in Table 2.4). A bespoke model was developed as outlined in **Figure 2.1**. It pooled together over 20 datasets (see **Table 2.4**) to identify Potential Biodiversity Opportunities (PBOs), assign scores to them so they could be prioritised and identify the most suitable PBOs<sup>20</sup> for habitat restoration or creation. The scoring system was largely based on the Lawton principals<sup>21</sup>, whereby effort should be made for new/enhanced habitats to be actively part of a healthy ecological network including landscape corridors, buffer zones, sustainable use areas, etc., rather than isolated reservoirs. In addition to the, the system also took into account variables from the Biodiversity Metric.

GIS processes such as buffering were carried out on each dataset (where applicable), scores were assigned, and the modified datasets were then rasterised at a 5m resolution (for computational efficiency). These rasters were added together and constraints such as building, railways, roads and planned developments were removed. This dataset was then polygonised, then the areas of each polygon and associated scores (based on the criteria) were calculated and areas less than 0.5 ha were removed. The overall score was calculated, and the dataset assigned IDs and exported into shapefile and excel spreadsheet formats indicating PBA sites prioritised based on an overall score.

Sites were then linked to the outputs from the BNG calculations based on requirement for habitat type and location.

<sup>20</sup> Identification of PBOs also takes into account Natural England’s Biodiversity Opportunity Areas

<sup>21</sup> Prof. J. Lawton (2010), Making Space for Nature. Report for the UK Government

Table 2.4 Potential Biodiversity Opportunities scoring criteria

Scoring criteria	Dataset/source	Score			
		3	2	1	0
Distance to pipeline	Pipeline options	<1 km	1-3 km	3-5 km	>5 km
Within same LPA as scheme/option – county boundaries	Pipeline options	Yes	-	-	No
Non-statutory designation	Ordnance Survey GB Counties	Yes	-	-	No
Proximity to statutory sites	Local wildlife sites, nature reserves, proposed country parks, ecosites	Yes	-	-	No
	National Nature Reserves, Ramsar sites, Special Areas of Conservation, Special Protection Areas, SSSI sites	Within 2 km	Within 5 km	-	No
Strategic significance designation	Canal conservation and restoration, green networks, local greenspace, special landscape, sites for green infrastructure	Yes	-	-	No
	Ancient Woodland England and Wales	0.3 km	1 km	-	No
Proximity to ancient woodland	Information provided by relevant water company	Yes	-	-	No
Owned/operated or managed by the relevant water company/companies	Common Land England	-	-	No	Yes
Identified as common land	Calculated using QGIS	>5 ha	1-5 ha	<1 ha	-
Size					

\*For full list of data sources see the STT Biodiversity Evidence Report<sup>22</sup>

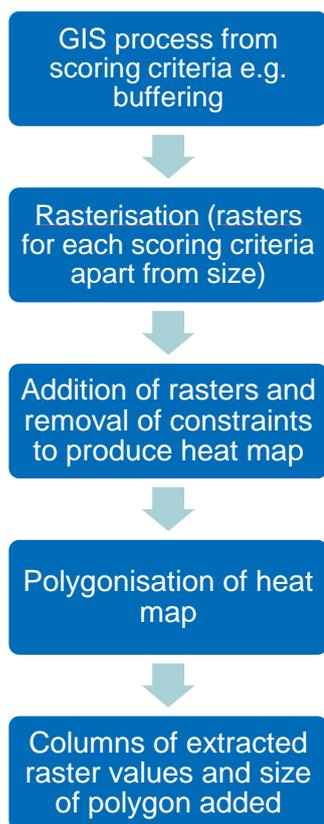


Figure 2.1 Flow diagram of PBO method

### 2.2.3 Net Gain Calculations – rivers and streams

The Biodiversity Metric requires the assessment of the following characteristics of rivers/streams and canals:

- River type and distinctiveness;

<sup>22</sup> Ricardo Energy & Environment (2022). Severn to Thames Transfer SRO. Biodiversity Evidence Report. Report for United Utilities on Behalf of the STT Group. February 2022

- Condition;
- Riparian zone encroachment;
- In-watercourse encroachment;
- Strategic significance; and
- Dealing with risk: difficulty of creation and enhancement/ restoration, time to target condition and spatial risk.

The data sources, and their use in the assessment are described in the sections below. The baseline data for distinctiveness, condition and strategic significance is provided for each element in Annex 1 Excel spreadsheet 'Gate 2 A1 BNG Rivers Data'.

### 2.2.3.1 Condition

The rivers and streams condition assessment is based on the extent and diversity of observed physical features in the river channel and riparian zone (including the physical structure of vegetation) as well as the extent and types of any human modifications. The rivers and streams condition assessment, called the River Metric Survey, is based on geomorphic principles and comprises a largely desk-based reach-scale assessment, which indicates the current hydro-geomorphological river type, and a sub-reach scale field survey to inform the river type and assess its baseline condition (the Monitoring of River Physical habitat (MoRPh) survey).

River MoRPh surveys were undertaken at 15 sites across potentially impacted reaches of the River Severn, Avon and Thames. The sites were identified based on the presence of potentially sensitive habitats to hydrological changes caused by the STT Solution. Gate 2 River MoRPh surveys were not conducted along rivers and streams potentially affected from the construction of STT Solution. Therefore, WFD ecological status has been used as an alternative to MoRPh data for the baseline river condition for those watercourses. For the purposes of this assessment, WFD bad and poor ecological status were assumed to equate to the same condition score (i.e., poor) in the Metric Tool<sup>23</sup>.

Table 2.5 Condition weightings for rivers and streams

Classification	Weighting
Good	3
Fairly good	2.5
Moderate	2
Fairly poor	1.5
Poor	1

### 2.2.3.2 River Type and Distinctiveness

River type is based on the Priority Habitats classification, as defined under section 41 of the Natural Environmental and Rural Communities Act 2006. Priority River Habitats include the following types:

- Riverine water bodies of high hydro-morphological/ ecological status;
- Chalk rivers;
- Watercourses with water crowfoot assemblages (Habitats Directive Annex I habitat H3260); and
- Active shingle rivers.

The distinctiveness assessment is desk-based. In contrast to the Biodiversity Metric 2.0 used at Gate 1, the Biodiversity Metric 3.0<sup>23</sup> determines a distinctiveness score via entering the following river type categories into the tool: Priority River Habitats, rivers and streams (other), canal, ditch and culvert (see **Table 2.6** for more information).

<sup>23</sup> Natural England (2021) Biodiversity Metric 3.0 User Guide <http://nepubprod.appspot.com/publication/5850908674228224>

Table 2.6 Distinctiveness categories

Category	Weighting	River type
Very High	8	On Priority River Habitat Map Priority River Habitat and streams of high hydro-morphological and ecological status
High	6	Rivers and streams (other) All other rivers and streams that are not classified as Priority River Habitat
Medium	4	Canal Ditch – artificially created linear water-conveyancing features that are <5 m wide and likely to retain water for more than 4 months per annum.
Low	2	Culvert A covered channel or pipe designed to prevent the obstruction of a watercourse or drainage path by an artificial construction.

### 2.2.3.3 Riparian zone encroachment

The riparian zone is defined as a 10 m zone from the bank top: urban development within the riparian zone is termed ‘riparian encroachment’. This multiplier has been added to the Biodiversity Metric 3.0 and therefore was not included in the STT Gate 1 assessments (as these used the previous version of the Tool). Riparian zone encroachment is considered as either no encroachment, minor, moderate or major considering distance of the development from the river channel or area (calculated as %) of encroachment within the 10 m riparian zone (see **Table 2.7**).

Table 2.7 Description of riparian zone encroachment bands

Riparian zone encroachment band	Multiplier	Description
No encroachment	1.00	“No development within 10 m of bank top”
Minor	0.95	“Any development 8 – 10 m from bank top (up to 100% of area)** or “where development footprint occupies 0 – 10% of the riparian zone area 4 – 10 m from bank top.”
Moderate	0.85	“Any development where footprint occupies between 10 – 25% of the riparian zone area 4 – 10 m from bank top.”
Major	0.75	“Any development 0 – 4 m from bank top** or “where development footprint occupies >25% of the total riparian zone area. “

\*These rules were not used to determine riparian zone encroachment band. Due to the lengths covered by the watercourse reaches, which have been defined by WFD waterbody ID, using these rules to determine the riparian encroachment band means for example the entire stretch of watercourse could be classified as major with just one development within 0 to 4 m of the bank top.

The riparian encroachment band was estimated using open-source GIS data. The CORINE 2018 landcover dataset<sup>24</sup> was used to determine areas of urban development. CORINE landcover layers assessed to fall under urban development included continuous urban fabric, discontinuous urban fabric, industrial or commercial units, port areas, airports, mineral extraction sites, dump sites, construction sites and sports and leisure facilities. Ordnance Survey Open Map vector GIS layer<sup>25</sup> for surface water was used as the baseline watercourse width, using the Water Framework Directive (WFD) River Canal Surface Water Transfer Cycle 2 GIS layer<sup>26</sup> overlaid to assign the WFD watercourse ID. The total area of urban development within two riparian zones (0 – 4 m and 4 – 10 m buffered from the watercourse) were calculated as percentages. The percentages were then applied to the descriptions in the above table to give the final encroachment band.

### 2.2.3.4 In-watercourse encroachment

In-watercourse encroachment refers to any development within the riverbank (bank face) or river channel. This multiplier has been added to Biodiversity Metric 3.0<sup>23</sup> and therefore was not included in the Gate 1 assessments. In-watercourse encroachment is considered in the metric as minor or major based on how far the development has encroached into the river channel (% width) or along the bank (% length) (see **Table 2.8**).

<sup>24</sup> European Environment Agency (2018) <https://land.copernicus.eu/pan-european/corine-land-cover/clc2018>

<sup>25</sup> Ordnance Survey (2022) <https://osdatahub.os.uk/downloads/open>

<sup>26</sup> Environment Agency (2022) <https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/WFDRiverCanalAndSWTWaterBodiesCycle2&Mode=spatial>

Table 2.8 Description of in-watercourse encroachment bands

In-watercourse encroachment band	Multiplier	Description
No encroachment	1.0	<5% bank length comprising an engineered bank revetment and no encroachment into channel
Minor	0.8	5 – 20% bank length comprising engineered bank revetment or encroachment up to 10% channel width (i.e., small headwalls, jetties and pontoons).
Major	0.5	>20% bank length comprising an engineered bank revetment or encroachment >10% of the channel width (i.e., weirs, barrage, bank revetment and large headwalls).

The definitions of in-watercourse encroachment detailed above were not used for this assessment due to lack of data coverage, i.e., the presence of engineered banks or other encroachments are not known along the entire lengths of each impacted watercourse. Therefore, rivers and streams with major in-watercourse encroachment were identified using the heavily modified waterbody dataset<sup>27</sup>. All other WFD waterbodies not designated as heavily modified within the River Severn, Avon and Thames were considered to have minor in-watercourse encroachment.

#### 2.2.3.5 Strategic significance

The strategic significance<sup>23</sup> of each river, stream or canal within the zone of influence indicates whether it is present within local and catchment plans, Catchment Planning Systems, River Basin Management Plans and Priority Habitats for Restoration. This category gives value to watercourses that are identified for action, which could enable biodiversity objectives to be met (see **Table 2.9**). A review was undertaken of these plans for each watercourse within the zone of influence and the data sources provided for each element in the Excel spreadsheet 'Gate 2 A1 BNG Rivers Data' in column I of the 'Classifications' tab.

Table 2.9 Strategic significance categories

Category	Multiplier	Point applied to calculation	
		Pre-impact	Post-impact
<b>High strategic significance</b> Within local and catchment plans, Catchment Planning Systems, River Basin Management Plans and Priority Habitats for Restoration	1.15	Yes	Yes
<b>Low strategic significance</b> Low environmental potential and not formally identified in any local plan	1	Yes	Yes

#### 2.2.3.6 Risk multipliers

The Biodiversity Metric<sup>23</sup> for rivers includes risk multipliers to take account of uncertainty and difficulty of restoration/ enhancement and creation of offsets, plus spatial risk.

The assessment of spatial risk uses WFD waterbody and catchment boundaries to determine the spatial risk created by delivering offsets in different locations. This multiplier is demonstrated in **Table 2.10**.

Table 2.10 Spatial risk multipliers for rivers and streams

Description	Spatial risk multiplier
Within waterbody	1.0
Outside waterbody	0.75
Outside catchment	0.5

#### 2.2.3.7 Calculation of net gains / losses

##### 2.2.3.7.1 Construction

Construction impacts consider both permanent and temporary construction associated with the STT solution in relation to impacted rivers and streams. For the purposes of this assessment, permanent construction is

<sup>27</sup> Environment Agency (2020). <https://data.gov.uk/dataset/39c5484d-90ea-41fe-8119-ea699b08689a/water-framework-directive-cycle-2-heavily-modified-water-body-use-and-physical-modification>

defined as abstraction and outfall infrastructure; temporary construction is defined as intersections of the proposed pipeline route with watercourses <2m wide, where it is assumed that open cut methods will be used.

The calculation of net loss/ gain within the Biodiversity Metric 3.0 only considers direct impacts resulting in river loss. The baseline river scores are then adjusted for the associated impacts (gains or losses) related to construction. This is assessed following construction, and prior to river re-instatement, and assumes typical good practice construction methods and mitigation will be used, such that potential for downstream effects of construction will be fully mitigated, i.e., there will be no change in river condition. Changes to riparian encroachment were included in the assessment to reflect the presence of bankside structures associated with the crossing of a river or stream. This part of the assessment identifies high risk areas where the proposals will result in a significant loss of biodiversity and offsetting will be more onerous or may identify an 'irreplaceable habitat' that should be avoided, such as certain priority habitats.

The number of units required to achieve a 10% can be significantly higher than the number of units lost due to the number of units gained from mitigation needing to be equal to the number of units lost plus 10% of the total baseline to achieve a 10% net gain. The number of units required from mitigation relative to the number of units lost varies depending on the proportion of the total baseline affected by the proposed activities.

The following assumptions have been made when assessing the impact of construction on rivers and streams:

- Intersections of the proposed pipeline route with watercourses <2 m wide will affect a 20 m length of the watercourse;
- Permanent discharge and outfall infrastructure will result in a direct loss of 15 m of the bank face; and
- If the baseline river was assessed as 'no encroachment' for riparian encroachment, the category was changed to 'minor'.

The gains and losses are calculated assuming all river habitat within the zone of influence from construction impacts (see **Section 2.2.1.4**) will be lost and reinstated with the same river habitat. This is assessed as on-site river habitat loss and on-site river habitat creation within the Biodiversity Metric. Due to the risk factors in habitat creation, such as time lags and difficulty in creation, the habitat units for reinstatement will not equally compensate for the units lost. This provides the potential loss of River Biodiversity Units (RBU) which will require offsetting/ net gain, and identifies how many units are required for net gain. Using river Potential Biodiversity Opportunities (PBO), see **Section 2.2.1.4**, the off-site river baseline, and off-site river enhancement, values are calculated to provide an example scenario of how to achieve a minimum 10% net gain for rivers. Off-site enhancement scenarios assume an increase of river condition by one category, e.g., from poor to moderate condition, and the length of river is then manipulated to determine the minimum length required for 10% net gain.

#### 2.2.3.7.2 Operation

The Biodiversity Metric tool is not specifically developed for assessing long-term habitat degradation, such as that which may occur through operation of the STT Solution. The scheme may affect flow, geomorphology, water level, water depth and geomorphology of reaches downstream of abstractions and releases. This in turn has the potential to alter habitat structure and function, and the associated aquatic ecological communities. Therefore, using the principles of the Biodiversity Metric, an approach was developed to assess operational impacts to rivers. The operational impact is a change in habitat condition and the net loss/ gain is the difference in habitat condition. This is reflected as a change in the RBU score between the river baseline and the modelled operational output score. This provides the potential loss of RBU required for offsetting/ net gain. Although operational impacts are not required to be assessed under the Environment Act the assessment is based on the predevelopment biodiversity value of a site compared to the post development biodiversity value.

The physical environment modelling outputs and ecological assessments undertaken at Gate 2 identified the rivers and streams where the risk of impact pathways that could impact on river condition are likely. For those rivers and streams only, the baseline condition assessment (determined via River MoRPH surveys conducted for Gate 2) were reviewed and amended to reflect potential alterations in positive and negative indicators as a result of the operation of STT Solution.

This approach has been further developed (using the data collected from the River MoRPH surveys) from the Gate 1 assessments where only incremental alterations to the hydrological regime (significant changes in flow) were assumed to provide incremental ecological change in the baseline.

The output is the Biodiversity Metric 3.0 tool spreadsheet which provides an output of RBU for offsetting and identifies how many units are required for net gain. Using river PBOs, the off-site river baseline and off-site river enhancement values are then calculated to provide an example scenario of how to achieve a minimum 10% net gain for rivers. Off-site enhancement scenarios assume an increase of river condition by one category, e.g., from poor to moderate condition, and the length of river is then manipulated to determine the minimum

length required for 10% net gain. As identified above for construction losses, the number of units required to achieve a 10% net gain is the number of units lost plus 10% of the total baseline units. The number of units required from mitigation relative to the number of units lost varies depending on the proportion of the total baseline affected by the proposed activities.

#### 2.2.4 Biodiversity Opportunity Areas – rivers

To ensure no net loss, and at least 10% net gain of riverine habitat, enhancements were considered. Rivers that could potentially be enhanced to offset net losses and achieve at least 10% net gain were identified using outputs from the STT Wider Benefits Study<sup>28</sup>. The Study considered opportunities within the STT scheme which encompassed the six capitals<sup>29</sup> approach for use in England, and the Sustainable Management of Natural Resources (SMNR) and Wellbeing goals relating to Wales. A key focus area of this study was ‘river biodiversity’ which was applied to this assessment to determine river PBOs. This identified all rivers within the catchment boundary of the STT scheme which had either bad or poor WFD ecological status, bad or poor WFD fish status, and bad or poor WFD overall status due to either 1) invasive species, 2) changes to natural water flow / water levels or 3) physical modifications. These rivers were then used to identify potential enhancement rivers with the STT scheme. Potential enhancement rivers were identified within 1 km of infrastructure that could cause temporary (pipeline) or permanent (abstraction or discharge locations) riverine habitat loss, or within 1 km of reaches potentially impacted via the operation of the STT Solution.

### 2.3 NATURAL CAPITAL ASSESSMENT

A Natural Capital Assessment has been carried out to identify the potential environmental benefits of the Gate 2 scheme and develop understanding of its overall viability. The socio-economic aspects of affected features have also been considered to provide a more holistic view of the consequences of the Gate 2 scheme. The socio-economic aspects of impacted features have also been considered to provide a more holistic view of the consequences of STT Solution component implementation. This highlights the relationships between people and the affected environments and identifies how these relationships could change as a result of the options.

The EA’s WRPG Supplementary Guidance states that Natural Capital Assessments in England should include as a minimum the following five ecosystem services:

- Biodiversity;
- Climate Regulation (carbon sequestration);
- Water Purification;
- Water Regulation; and
- Natural Hazard Regulation.

In addition to those services required as a minimum, a **food production** ecosystem service metric has also been considered. The assessment of social benefits is advocated by the RAPID, therefore additional ecosystem services of **recreation and tourism** and **air quality** have been included to support this requirement (where the latter is related to urban and Air Quality Management Areas).

The NC Assessment is based on the BNG Metric 3.0 data for permanent loss, temporary loss and mitigation required to meet the 10% net gain. The habitats are categorised into broad habitats which is used as the NC baseline data required for the qualitative, quantitative and monetisation of ecosystem services. The GIS and BNG assumptions followed through into the NC assessment. The following section summarises the NC approach, assumptions and limitations for each ecosystem service.

<sup>28</sup> Ricardo (2022). *Severn Thames Transfer SRO. Wider Benefits Study*. Ricardo ref: ED16053.

<sup>29</sup> [13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf \(integratedreporting.org\)](#)

### 2.3.1 Data sources, gaps, and assessment

The NCA has been completed using the following data sources, as recommended by the All Company Working Group (ACWG) environmental assessment guidance for Solution<sup>30</sup> and the EA<sup>31</sup> Water Resources Planning Guideline (WRPG) WRMP24 Supplementary Guidance on Environment and Society in Decision-Making. The required focus of this report is to provide a Natural Capital baseline. The assessment has therefore focused on construction related losses, and potential gain related to mitigation, including 10% BNG uplift based on open-source data. The operational impact on rivers is considered in the context of water purification.

### 2.3.2 Natural Capital stocks

The ACWG Guidance for a Natural Capital Approach advises that land use should be used as a proxy for habitats, from which ecosystem services and benefits to society can be attributed and then monetised. The assessment for the Natural Capital approach is based on available open-source data. Habitat types were converted into the UKHab classifications using the conversation table within the Technical Data tab in the BNG Metric. The area (ha) of each habitat type within a variable buffer was measured in GIS. The UKHab Classifications were then converted into eight broad habitat types to give the total area of each broad habitat. The conversion from the detailed habitat layers to broad habitat was undertaken and is outlined in **Table 2.11**.

Groups were determined following the broad groups identified for calculation of carbon sequestration by land use from the EA's Supplementary Guidance<sup>31</sup> (see **Table 2.12** below). Modified grassland has been classified as arable land and not grassland, as per advice from the Office for National Statistics (ONS) in developing a semi-natural grassland ecosystems account<sup>32</sup>. The UK NEA differentiates semi natural grassland from improved and amenity grassland as semi natural grassland has a much higher species-richness<sup>33</sup>. Where a land cover class could belong in multiple broad habitat groups it was placed within the one that had a lower carbon sequestration rate to give a more conservative estimate of benefits. Where either no habitat or an unclear habitat type was identified, such as Natural Environment, the area was put into the urban land cover class, so as not overestimate benefits.

Table 2.11 Conversion from land cover classification data to broad habitat types

Land Cover Classification	Broad habitat type
Cropland – Cereal crops	Arable
Modified grassland	Semi natural grassland
Heathland and shrub	Heathland and shrub
Lowland mixed deciduous woodland	Deciduous woodland
Neutral grassland	Semi natural grassland
Lakes – pond	Freshwater
Other coniferous woodland	Coniferous woodland
Purple moor grassland	Freshwater
No habitat	Urban
Broadleaved woodland	Deciduous woodland
Poor semi-improved grassland	Semi natural grassland
Other rivers and streams	Freshwater
Eutrophic standing waters	Freshwater
Other coniferous woodland	Coniferous woodland
River and streams	Freshwater
Sparsely vegetated land	Sparsely vegetated land
Lowland heathland	Heathland and shrub
Other woodland mixed	Deciduous woodland
Traditional orchards	Semi natural grassland
Lowland meadows	Semi natural grassland
Floodplain wetland mosaic	Semi natural grassland
Traditional orchards	Semi natural grassland

<sup>30</sup> All Company Working Group (2020). WRMP environment assessment guidance and applicability with SROs

<sup>31</sup> Environment Agency (2020) Water resources planning guideline 2024 supplementary guidance- Environment and society in decision-making (England).

<sup>32</sup> [Office for National statistics \(2018\) Developing semi-natural grassland ecosystem accounts](#)

<sup>33</sup> UK Habitat Classification Working Group (2018). *UK Habitat Classification - Habitat Definitions V1.1* at <https://ukhab.org/>

### 2.3.3 Climate Regulation (carbon sequestration)

The carbon sequestration rates for Natural Capital stocks have been taken from the EA WRPG Supplementary Guidance<sup>34</sup> as shown in **Table 2.12**. Carbon sequestration rates of the relevant Natural Capital assets have been converted into monetary values using the Department for Business, Energy, and Industrial Strategy (BEIS) Carbon Values<sup>35</sup>. As the prices published by BEIS are in £2020, GDP deflators<sup>36</sup> were used to adjust them to the £2022 base year of modelling.

It is not currently possible to quantify the non-spatial changes in biodiversity and habitat ecosystem services arising from habitat condition improvement. This is because only planned habitat creation is deciduous woodland and there is significant uncertainty in terms of current condition of woodland due to lack of on-site data. So that the beneficial impact of the change in non-traded carbon sequestration values are not overestimated following BNG habitat creation / reinstatement, this value has been calculated by summing the change in non-traded carbon sequestration value during construction (the temporary loss), the permanent loss and creation.

The NPV value assumes that the benefit changes based on the price of carbon 2020; post 2050, a 1.5% real growth rate is assumed.

Table 2.12 Carbon sequestration of land use from EA WRPG Supplementary Guidance

Land use type	Carbon sequestration rate (t/CO <sub>2</sub> e/ha/yr)
Woodland (deciduous)	4.97
Woodland (coniferous)	12.66
Arable land	0.10
Pastoral land	0.39
Grassland	0.39
Heathland & shrub	0.7
Urban	0

### 2.3.4 Natural Hazard Regulation

For the purposes of this assessment, flooding was determined to be the most significant natural hazard risk. A high-level qualitative assessment has been undertaken based on the EA flood risk zones<sup>37</sup> and the habitats impacted within the buffer area accounting for both temporary and permanent loss of grassland and woodland relative to natural hazard potential risks. A drought risk has been considered related to Catchment Abstraction Management Strategy (CAMS) data with the impact to groundwater and surface water impact reviewed at a high level. However, as the London effluent schemes are water recycling, no impact to water sources is expected. Further assessment will be undertaken at Gate 3 to assess the physical changes to natural capital stocks which potentially impact the capacity of habitats to slow the flow of flood water year-round. This is because although the options are likely to be operational during drought periods only, the physical changes to Natural Capital stocks may impact the capacity of habitats to slow the flow of flood water year-round. Monetary values were sourced per broad habitat type from existing studies conducted in the UK. Values for woodland and wetlands/ floodplains broad habitat types were identified using the ENCA Services Databook<sup>38</sup> where the associated studies were evaluated to ensure their suitability for benefit transfer. A value for semi-natural grasslands was not available. Additional studies were identified, and the final best estimate for semi-natural grasslands derived from a benefit function in an existing ecosystem services assessment (Christie et al, 2011<sup>39</sup>) noting that these values are mainly applicable to lowland meadows (Holzinger & Haysom, 2017<sup>40</sup>) and that some uncertainty is recognised.

An annual monetary value was only derived for the flood regulating services of woodland, semi-natural grassland, and wetland/ floodplain assets (see **Table 2.13**). Robust monetary values for the urban and

<sup>34</sup> Table 7 of the EA Supplementary Guidance: Environment and Society in Decision-Making (2020).

<sup>35</sup> HM Treasury (2020). Table 3 of the Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal.

<sup>36</sup> GDP deflators used throughout the assessment to adjust monetary values to £2022 are those published by HM Treasury based on calendar year market prices. <https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-march-2021-budget>

<sup>37</sup> <https://flood-map-for-planning.service.gov.uk/location>

<sup>38</sup> <https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca#enca-services-databook>

<sup>39</sup> Christie, Mike, Tony Hyde, Rob Cooper, Ioan Fazey, Petter Dennis, John Warren, Sergio Colombo, and Nick Hanley. 2011. Economic Valuation of the Benefits of Ecosystem Services delivered by the UK Biodiversity Action Plan. Report to Defra: Aberystwyth University.

<sup>40</sup> Holzinger, Oliver, and Karen Haysom. 2017. Chimney Meadows Ecosystem Services Assessment: An Assessment of how the new management of Chimney Meadows Nature Reserve by Bers, Bucks and Oxon Wildlife Trust impacts on the value of ecosystem services. Oxford: Berks, Bucks and Oxon Wildlife Trust.

enclosed farmland broad habitat types are not currently available and hence it has not been possible to provide a monetised estimate of these services.

Estimates for enclosed farmland (71.4 EUR/ha) and urban (0.42 EUR/ha) habitats regarding their contribution to natural hazard regulation were identified (Vallecillo et al., 2020<sup>41</sup>) however, these were only applicable at EU level and therefore not considered specific enough for application to the context of this study.

Estimates were also derived from Vallecillo et al. (2020) for broad habitat types other than agriculture but these were not comparable with the estimates employed within this study for semi-natural grasslands, woodlands, and freshwater. For example, the natural hazard benefits provided per hectare of woodland were estimated to be approximately £60 (in £2019) in comparison to the approximate £117 value (in £2019) used within this study. In the case of Vallecillo et al. (2020) the estimates were derived following the approach outlined in the United Nations System of Environmental-Economic Accounting- Experimental Ecosystem Accounts (SEEA EEA)<sup>42</sup> with monetisation following a damage cost approach. Vallecillo (2020) goes on to note that damage functions are specific to each country and therefore these estimates may not reflect the UK context. As a result, the overall value of the NCA is likely to be understated at this stage. Hence the NPV for Natural Hazard Regulation assumes no change in annual benefits over 30- and 80-year period.

Table 2.13 Benefit Transfer Values: Natural Hazard Regulation

Broad habitat type	Annual Value	Reference	Additional Comments
Woodland	115 (£2018/ha)	Forest Research (2018) <sup>43</sup> & ENCA Services Databook	These results are experimental noting no semi-grassland value is included in this paper.
Semi-natural grasslands	197 (£2015/ha)	Christie et al (2011) <sup>39</sup> & Holzinger & Haysom (2017) <sup>44</sup>	Appears applicable to lowland meadow only. Based on an ecosystem services assessment of Chimney Meadows Reserve (UK)
Freshwater (Open waters/ wetlands/ floodplains)	407 (£2011/ha)	Morris & Camino (2011) <sup>45</sup> & ENCA Services Databook	

### 2.3.5 Water Purification

The WRP<sup>31</sup> does not require the monetisation of Water Purification Services, as these services are highly dependent on local factors and there are limited tools available to provide accurate monetised assessment. Thus, at this stage, only a qualitative assessment rather than a monetised assessment of this service has been undertaken. This qualitative assessment is based on habitat data and WFD status information from the EA's Catchment Explorer <sup>46</sup>. A baseline quantitative assessment for water purification was discounted using the Natural Environment Valuation Online (NEVO)<sup>47</sup> due to the uncertainties flagged within this assessment approach ( i.e. very high level). Furthermore, the WFD report<sup>48</sup> assesses water quality, therefore, to avoid double counting water quality that is related to water purification further assessment has been discounted at this stage as the WFD report provides more detail.

Baseline provision of water purification services is dependent on the following:

- Land cover (habitat);
- Proximity to receptor (i.e., a water body); and
- Current water quality of receptors (based on WFD status).

<sup>41</sup> Vallecillo et al. (2020), Accounting for changes in flood control delivered by ecosystems at the EU level. *Ecosystem Services* (44), 1-16.

<sup>42</sup> UN, 2017. Technical Recommendations in support of the System of Environmental Economic Accounting 2012 – Experimental Ecosystem Accounting. Available at: [https://seea.un.org/sites/seea.un.org/files/technical\\_recommendations\\_in\\_support\\_of\\_the\\_seea\\_eea\\_final\\_white\\_cover.pdf](https://seea.un.org/sites/seea.un.org/files/technical_recommendations_in_support_of_the_seea_eea_final_white_cover.pdf)

<sup>43</sup> Forest Research (2018). Valuing flood regulation services of existing forest cover to inform natural capital accounts.

<sup>44</sup> Holzinger, Oliver, and Karen Haysom. 2017. Chimney Meadows Ecosystem Services Assessment: An Assessment of how the new management of Chimney Meadows Nature Reserve by Bers, Bucks and Oxon Wildlife Trust impacts on the value of ecosystem services. Oxford: Berks, Bucks and Oxon Wildlife Trust.

<sup>45</sup> Morris & Camino (2011) UK National Ecosystem Assessment Economic Analysis Report, School of Applied Sciences, Cranfield University.

<sup>46</sup> <https://environment.data.gov.uk/catchment-planning/>

<sup>47</sup> <https://sweep.ac.uk/portfolios/natural-environment-valuation-online-tool-nevo/>

<sup>48</sup> Ricardo (2022) London Effluent Reuse SRO, Gate 2 Water Framework Directive Report. Report For: Thames Water Utilities Ltd

### 2.3.6 Water Regulation

The WRPG<sup>31</sup> does not require the monetisation of Water Regulation Services. The main benefit of the STT Solution is the deployable output from the transfer. As the scheme will involve increased water flow along rivers and canals to achieve this output, there are likely to be some impacts related to water regulation of the waterbodies involved (e.g., increased flow along the River Vyrnwy during releases from Vyrnwy Reservoir). A high-level assessment based on the WFD status and Catchment Abstraction Management Strategy (CAMS) assessing water resource availability, identifying water bodies status and potential deterioration due to the scheme has been undertaken. Resource rent value has not been calculated at this stage as there is no data for £2022 to be consistent with other ecosystem services. This will be calculated in Gate 3.

### 2.3.7 Air Quality

Airborne pollutants represent a serious threat to human health and wellbeing: assessment of air quality regulation services is therefore also relevant to the well-being goals set out by the UK Government. Natural habitats can reduce these harmful effects by absorbing air pollution providing ecosystem service benefit to society. The STT Solution does not fall within an Air Quality Management Area, and due to the temporary nature of the habitat impacts during construction, air quality has been screened out of the assessment.

### 2.3.8 Recreation and Tourism

The Outdoor Recreation Valuation Tool (ORVal)<sup>49</sup> was used to estimate recreation demand from existing footpaths and greenspaces that could be impacted by the construction of STT and hence as a proxy for recreation value. The values derived from the ORVal tool are estimated using a Random Utility Model of travel cost estimates<sup>50</sup>. The values represent the total welfare lost if the site in question were to be removed. The ORVal tool data is based on the £2016 values, therefore these values have been adjusted to £2022 values.

For the assessment, the following rules apply:

- If the construction is located on the periphery of a recreation site and is judged not to impact any key attributes of a recreation site that would significantly impact visitor numbers, then the per ha average value of the recreation site to the area of construction can be applied.
- A conditional percentage has been applied to the footpath values depending on the number of footpath intersections (and therefore alternative routes) present. For example:
  - If there are no intersections, and therefore no alternative routes, then 100% of the footpath value is taken;
  - If there are 1-2 intersections present, then 50% of the value is taken;
  - If there are 3-4 intersections present, then 25% of the value is taken; and
  - And if there are 5+ intersections present, then 10% of the value is taken.

The use of the ORVal tool has uncertainties surrounding the ‘true’ impact that the construction may have on recreation and tourism, with ORVal potentially giving an overstated account of the impact. This uncertainty has been reduced by using a developed conditional multipliers approach as outlined above. Additionally, this uncertainty has been reduced by stating that the impact to recreation and tourism will be a temporary impact of one year of closure. At this stage of assessment and when using the ORVal tool it is not currently possible to specify if some pathways and parks would be required to be closed for the whole year, or longer than a year. In a more refined assessment this is something that could be considered. However, at this level of assessment, ORVal remains the recommended and most informative data set to use.

### 2.3.9 Agriculture

This assessment adopts the same principles to ecosystem services associated with agriculture as outlined in the UK Natural Capital Accounts. Namely, the distinction between what is considered natural capital, and therefore what is included in the estimation of provisioning services, and what is produced capital is defined as the “*point at which vegetable biomass is extracted*”<sup>51</sup>. For the purposes of this assessment, to estimate the annual value per ha of ecosystem services relevant to agricultural production, an adaptation of the whole-farm

<sup>49</sup> <https://www.leep.exeter.ac.uk/orval/>

<sup>50</sup> Day & Smith (2017) The ORVal Recreation Demand Model: Extension Project. Accessed via: [https://www.leep.exeter.ac.uk/orval/pdf-reports/ORVall\\_Modelling\\_Report.pdf](https://www.leep.exeter.ac.uk/orval/pdf-reports/ORVall_Modelling_Report.pdf)

<sup>51</sup> ONS (2017) Principles of Natural Capital Accounting. Accessible via: <https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/principlesofnaturalcapitalaccounting>

income method outlined by the UK Office of National Statistics Natural Capital Accounts was used<sup>52</sup>. This approach was used as opposed to the industry residual value method adopted for the 2020 ONS Natural Capital Accounts as this method allows for differentiation between the provisioning services associated with different farm types - in this case arable and pasture- and were therefore considered more appropriate for this assessment. The marginal values estimated per hectare derived from this method (presented in **Table 2.14** below) remain comparable to the estimated industry residual value per hectare reported by the ONS for their 2020 accounts (£241.80/ ha in 2018)<sup>53</sup>.

**Table 2.14 Benefit transfer values: provisioning services supporting agriculture**

Farm type	Estimated average £2019 /ha	
	England	Southwest
All farm types	293.63	284.29
Arable (cropping)	237.14	326.99
Pasture (grazing livestock)	227.74	268.30

These values represent the average farm output level estimate of the industry residual value for farms in the STT SRO related area. Data was obtained from the Farm Business Survey (England)<sup>54</sup> and was subject to the following high-level calculation.

$$\frac{\text{Average output from agriculture} - \text{Average costs for agriculture}}{\text{Average total farm area (ha)}}$$

Given that this methodology is not included in the ACWG guidance, a short summary of the approach is included here, noting that the methodology used is based on that developed by the ONS (2019). It has subsequently been adapted based on calculations for the STT SRO related areas. This specific data resulted in a negative residual value per hectare for both arable and pasture. This implies that the provisioning services of these natural assets have no inherent value and that they do not contribute to agricultural production. It is concluded in the literature that a probable explanation of negative resource rents is that they reflect market distortions such as subsidies<sup>55</sup>. The original method outlined by the ONS excludes subsidies and agri-environment payments and activities from their calculation, however the adapted method adopted for this assessment includes these factors. An overview of what is included is outlined in **Table 2.15**.

The total annual benefit values calculated for this assessment makes use of the estimated averages calculated for each of the variables and component for each of the high-level farm types associated with this assessment (arable and pasture). The average used is defined as the average for all farms in that region for one year. The Farm Business Survey publishes annual average data so this assessment will be refined at Gate 3.

**Table 2.15 Components included within the adapted farm income method**

Variable	Components included
Output from agriculture	<ul style="list-style-type: none"> <li>• Output from agriculture (excl. subsidies and agri-environment payments)</li> <li>• Subsidies and payments to agriculture (excl. agri-environment payments)</li> <li>• Agri-environment and related payments (incl. HFA)</li> <li>• Basic Farm payment</li> <li>• Output from diversification</li> </ul>
Costs for agriculture	<ul style="list-style-type: none"> <li>• Costs for agriculture (excluding agri-environment activities)</li> <li>• Costs for agri-environment work</li> <li>• Costs of diversification out of agriculture</li> <li>• Costs associated with Basic Payment Scheme</li> </ul>

<sup>52</sup> Office for National Statistics (ONS), 2019. *UK natural capital accounts methodology guide: October 2019*, s.l.: ONS

<sup>53</sup> This was calculated by dividing the aggregate industry residual value reported by utilised agricultural area in the UK in 2018.

<sup>54</sup> <https://farmbusinesssurvey.co.uk/>

<sup>55</sup> Obst, C., Hein, L., & Edens, B., (2016). National Accounting and the Valuation of Ecosystem Assets and their Services, *Environ Resource Econ* 64, pp 1-23.

## 2.4 STAKEHOLDER ENGAGEMENT

### 2.4.1 Introduction

As part of the work for the Gate 2 Biodiversity and Natural Capital assessment, Ricardo engaged with stakeholders via a number of workshops to set out the approach, show our findings, and gain feedback from the environmental regulators plus others with expertise in this area. The workshops included representative from the following organisations:

- Natural England
- Natural Resources Wales
- Environment Agency

### 2.4.2 Workshops

Three Gate 2 workshops were held with stakeholders in December 2021, and January and May 2022. The objective of the workshops was to obtain data, evidence and knowledge of the local ambitions, and sought to gain feedback on the biodiversity resilience and net gain opportunities approach for Gate 2 from Regulators across England and Wales. The workshop participants include representatives from a number of technical disciplines, catchment co-ordinators and national teams.

A questionnaire was sent to the regulators to outline information required for further assessments after the first (December) workshop and the responses received were presented in the second (January) workshop. The workshops gathered other information from the stakeholders with which to refine the Gate 2 assessments.

The workshops have identified key data sets, stakeholder views and opportunity areas. The key points arising were:

- **Timescales:** There is a lot of on-the-ground work that is being completed currently, focused on specific areas and on a short time scale. This is different to the STT scheme which is a longer term and strategic programme of work. It should be noted that what has been identified as current opportunities may already be completed by the time of detailed planning or implementation of this strategic scheme;
- **Other workstreams:** There are many workstreams that are also collating data to ascertain opportunities. The workshops identified some which will need to be pulled together as part of Gate 3 once there is more focus on key opportunity areas. It was also flagged that there is a lot of other work taking place within the study area related to strategic ambitions (e.g., nature recovery areas and local planning). Such data will not be available for 1-2 years in full. This information will need to be reviewed as part of Gate 3;
- **Data gaps:** There was agreed amongst the workshop participants that a very comprehensive data set associated with this programme of work has been developed, with only a few data gaps identified;
- **HS2:** A lot of the area around Minworth falls coincidentally in the same area of opportunity as that associated with the HS2 programme. Much of the land in this area is already earmarked for net gain and hence wider opportunities will need to be sought; and
- **Opportunities:** There are key groups working up catchment ambitions, for example local nature recovery network initiatives and groups delivering catchment scale river restoration : liaison is required with these different groups.

The final workshop held in May 2022 provided an update on the assessment and focused on the high-level opportunity area outputs from the mapping approach. Stakeholder recommendations identified through the workshops are listed in **Table 2.16**.

Table 2.16 Stakeholder recommendations identified through STT Gate 2 workshops

Key points from Stakeholders	How we are addressing this in Gate 2
Opportunities are too numerous at this scale to identify and contact the right stakeholders.	Used desk-based information to identify 'strategic hotspots' to focus efforts on, using GIS mapping. At Gate 3, we can be more targeted in the locations of the opportunities we are seeking.

Key points from Stakeholders	How we are addressing this in Gate 2
There may be competition with large infrastructure projects.	Excluded urban areas, local plan housing allocation sites, industrial land. HS2 safeguarding zone will also be considered. Developed a tool to allow incorporation of allocated sites when relevant (Gate 3 and beyond).
Talking to partners and catchment coordinators is important to define what the opportunities are in the areas.	Due to the scale of the assessment, engagement will continue through Gate 3, as the locations for opportunities become more specific.
Given the timescales of this assessment and implementation, current projects may have passed and no-longer be relevant.	Focused on a higher-level assessment using strategic data rather than specific current opportunity examples.
There may be u/s opportunities (beyond the 5km buffer that benefits the d/s sections within the buffer. Can a catchment scale be considered?	PBOs for rivers have been assessed on a catchment scale. Terrestrial is a 5km buffer.
Look at areas that provide interconnectivity could be a good way to go forward in thinking strategically.	Our analysis scores opportunity areas on proximity to statutory sites, PHI, non-designated sites and ancient woodland, as well as using (in England) the Habitat Network.
WFD layers and habitat layers are critical to underpinning any assessment.	WFD layers have been used to assess the opportunities (benefits) for aquatic PBOs. The data sets for habitats will be presented (see later table).
Non-statutory sites and functionally linked sites could be an effective route for delivery.	We've considered non-statutory sites and suitability in terms of proximity.
STT and WRW need to comply with the Biodiversity Duty under Section 6 of the Environment (Wales) Act 2016.	This is addressed in the separate report: STT-G2-S3-119-Ecosystem resilience, wellbeing & SMNR (Wales) Assessment.
In a few years, we're likely to have spatial priority mapping through the Nature Recovery Network, where c. 30% of the LNRs areas may be identified for nature recovery. However, this information is not currently available.	Would need to feed in at Gate 3 and beyond as the data becomes available.
We need to be mindful that net gain delivery in the future may be more expensive to deliver because of land take. Those with land are aware of the financial opportunities so land values for net gain may inflate.	This will be taken into consideration at a later part of the process. More mechanisms are coming forward to finance the delivery of environmental benefits, e.g. ELMS (land management approach).
Grant based schemes have already been identified as a good way to deliver habitats. This is an opportunity to consider in the future too and identify areas where local communities are keen to see habitat and associated recreational benefits.	We have included access to nature (footpaths etc) within our assessment, to identify opportunities, which link with local plans.
CABA approach for considering landownership.	This will be addressed at Gate 3, when more specific opportunities are identified. PBOs and Conservation Target Areas (CTAs) are based on existing habitat and connectivity and are not landownership-based, which is more appropriate for Gate 2.
Environmental Land Management Schemes (ELMs) could link into opportunity areas.	Will be considered at Gate 3, when more specific locations are identified i.e. if agricultural land is a suitable mechanism for delivery.
Local Wildlife Site projects can help engage landowners with PBOs and CTA's.	LWS have been considered within our assessment at Gate 2. More specific projects will be considered at Gate 3.
Impacts on riparian habitat should seek to compensate in an equivalent riparian location local to the site of impact – any compensation should be driven by spatially local opportunities as this is what the Defra metric rewards.	Catchment level approach.

### 3. ASSESSMENT RESULTS

#### 3.1 BNG – FULL SCHEME TEMPORARY IMPACTS

The baseline habitats identified within the temporary construction corridor for the full STT scheme (see scheme description, and **Figure 1.2**, in **Section 1**) are summarised in **Table 3.1**.

The full scheme construction corridor was dominated by non-cereal crops (agricultural – 57% of total area), moderate condition modified grassland (34% of total area) and which combined comprise 92% of the impacted habitat area. The next most common habitats present across the scheme were moderate condition neutral grassland (2.40% of the total area) and poor condition modified grassland (just over 2% of the total area). The total temporary loss of hedgerows was calculated at approximately 8km.

The temporary habitat loss from the construction across the full STT scheme would result in the loss of approximately 391 ha of baseline habitats. Reinstatement of baseline habitats, in the absence of additional off-site mitigation, would result in a net change of -12.14% BNG units pre- mitigation. The net loss in biodiversity units, after temporary loss habitats are reinstated, is due to the unit scores per habitat being higher for on-site habitat loss than for on-site creation due to the time lag required for habitats to function again after creation.

Table 3.1 STT full scheme temporary habitat loss during construction

Habitat	Area (ha)	Habitat condition
Cereal crops	3.2	N/A -Agricultural
Intensive orchards	0.01	N/A -Agricultural
Non-cereal crops	223.55	N/A -Agricultural
Floodplain Wetland Mosaic (CFGM)	3.27	Moderate
Lowland calcareous grassland	0.22	Moderate
Modified grassland	0.15	Good
Modified grassland	135.17	Moderate
Modified grassland	8.82	Poor
Other neutral grassland	9.4	Moderate
Other neutral grassland	5.07	Poor
Traditional orchards	0.1	Moderate
Ruderal/Ephemeral	0.38	Moderate
Artificial unvegetated, unsealed surface	0.28	N/A - Other
Built linear features	0.06	N/A - Other
Developed land; sealed surface	0.23	N/A - Other
Felled	0.1	Good
Other coniferous woodland	0.03	Moderate
Other woodland; broadleaved	0.06	Good
Other woodland; broadleaved	1.03	Moderate
Other woodland; mixed	0.09	Moderate
<b>Total Area</b>		<b>391.21 ha</b>

Table 3.2 STT full scheme temporary hedgerow loss during construction

Habitat	Length (km)	Condition
Native species rich hedgerow	8.12	Moderate

Table 3.3 STT Full Scheme construction temporary loss BNG summary pre mitigation<sup>56</sup>

Total net unit change (onsite habitat retention, creation and enhancement)	<i>Habitat units</i>	<b>-155.50</b>
	<i>Hedgerow units</i>	<b>-11.66</b>
Total on-site net% change (onsite habitat retention, creation and enhancement)	<i>Habitat units</i>	<b>-12.14%</b>
	<i>Hedgerow units</i>	<b>-16.32%</b>

<sup>56</sup> River metric units are assessed in Section 3.2

### 3.2 BNG – HABITAT ENHANCEMENTS REQUIRED TO ACHIEVE 10% NET GAIN FOR TEMPORARY HABITAT LOSS

The tables below show the area required to achieve 10% net gain for temporary habitat loss for the full scheme.

Table 3.4 STT full scheme off-site mitigation required to achieve a 10% net gain for temporary habitat loss

Off-site Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Modified grassland	Moderate	2	Traditional orchard	Moderate	14.58
Modified grassland	Moderate	4	Floodplain Wetland Mosaic (CFGM)	Moderate	34.12
Lowland calcareous grassland	Moderate	2	Lowland calcareous grassland	Good	29.45
Neutral grassland	Moderate	30	Neutral grassland	Good	356.44
Modified grassland	Moderate	10	Woodland (Broad leaved)	Moderate	69.78
Modified grassland	Moderate	40	Neutral grassland	Moderate	299.25
Modified grassland	Moderate	10	Woodland (mixed)	Moderate	69.78
<b>TOTAL</b>		<b>98</b>			<b>873.4</b>

Table 3.5 STT full scheme off-site mitigation required to achieve a 10% net gain for temporary hedgerow loss

Baseline Hedgerow	Baseline Condition	Kilometres	Proposed Hedgerow	Proposed Condition	Hedge Units Delivered
Native Hedgerow	Moderate	5.2	Native species rich hedgerow	Moderate	42.03

### 3.3 BNG – FULL SCHEME PERMANENT IMPACTS

The baseline habitats identified within the areas of permanent habitat loss for the full STT scheme (see scheme description and **Figure 1.2** in **Section 1**) are summarised in **Table 3.6**

The full scheme permanent habitat loss (see **Table 3.1**) comprised moderate condition modified grassland with a total area of permanent loss of 9.05 ha. Permanent loss comprises of intake/outfall structures and permanent site compounds. Where specific details of exact locations of site compounds was not available an assumption was made that the habitat type lost would be modified grassland.

**Table 3.6** shows that the permanent habitat loss from the construction across the full STT scheme would result in the loss of 9.05ha of baseline habitats in the absence of additional off-site mitigation. This would result in a net change of -100% BNG units pre- mitigation.

Table 3.6 STT full scheme permanent loss during construction

Habitat	Area (ha)	Habitat condition
Modified Grassland	9.05	Moderate
<b>Total Area</b>	<b>9.05</b>	

Table 3.7 STT Full Scheme construction permanent loss BNG summary pre mitigation

Total net unit change (onsite habitat retention, creation and enhancement)	Habitat units	-39.80
	Hedgerow units	0.00
	River units	0.00
Total on-site net% change (onsite habitat retention, creation and enhancement)	Habitat units	-100%
	Hedgerow units	0.00%
	River units	0.00%

### 3.4 BNG – HABITAT ENHANCEMENTS REQUIRED TO ACHIEVE 10% NET GAIN FOR PERMANENT HABITAT LOSS

The table below shows the area required to achieve 10% net gain for permanent habitat loss for the full scheme.

Table 3.8 STT full scheme off-site mitigation to achieve a 10% net gain for permanent habitat loss

Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Modified grassland	Moderate	14.5	Neutral grassland	Moderate	108.48

#### 3.4.1 Potential Biodiversity Opportunities – Full scheme

An overview of the results of the terrestrial habitat biodiversity opportunity areas heat mapping exercise for the full STT Solution scheme are presented in **Figure 3.1**. A total of 28879 opportunity areas were identified within 5km of the full STT scheme, with a combined area of 183,382ha. The location of terrestrial opportunity areas to mitigate both permanent and temporary losses were calculated based on the impact within each Local Authority (Gloucester, Oxfordshire, and Shropshire). These areas are assessed in detail below.

### 3.5 BNG – GLOUCESTERSHIRE PERMANENT IMPACTS

This section summarises the habitat loss, temporary and permanent within Gloucestershire. **Table 3.9** and **3.12** assess specific habitat loss and the hectarage impacted, with subsequent summaries of the off-site habitat requirements needed to achieve at 10% net gain.

The permanent habitat loss from the construction across the full STT scheme would result in the loss of 8.64ha of baseline habitats in the absence of additional off-site mitigation (see **Table 3.10**). This would result in a net change of -100% BNG units pre- mitigation.

Table 3.9 STT Gloucestershire permanent loss during construction

Habitat	Area (ha)	Habitat condition
Modified Grassland	8.64	Moderate
<b>Total Area</b>	<b>8.64</b>	

Table 3.10 STT Gloucestershire construction permanent loss BNG summary pre mitigation

Total net unit change (onsite habitat retention, creation and enhancement)	Habitat units	-38.02
	Hedgerow units	0.00
Total on-site net% change (onsite habitat retention, creation and enhancement)	Habitat units	-100%
	Hedgerow units	0.00%

#### 3.5.1 BNG – habitat enhancements required to achieve 10% net gain for permanent habitat loss

The table below shows the area required to achieve 10% net gain for permanent habitat loss for the full scheme.

Table 3.11 STT Gloucestershire off-site mitigation to achieve a 10% net gain for permanent habitat loss

Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Modified grassland	Moderate	13.6	Neutral grassland	Moderate	101.74

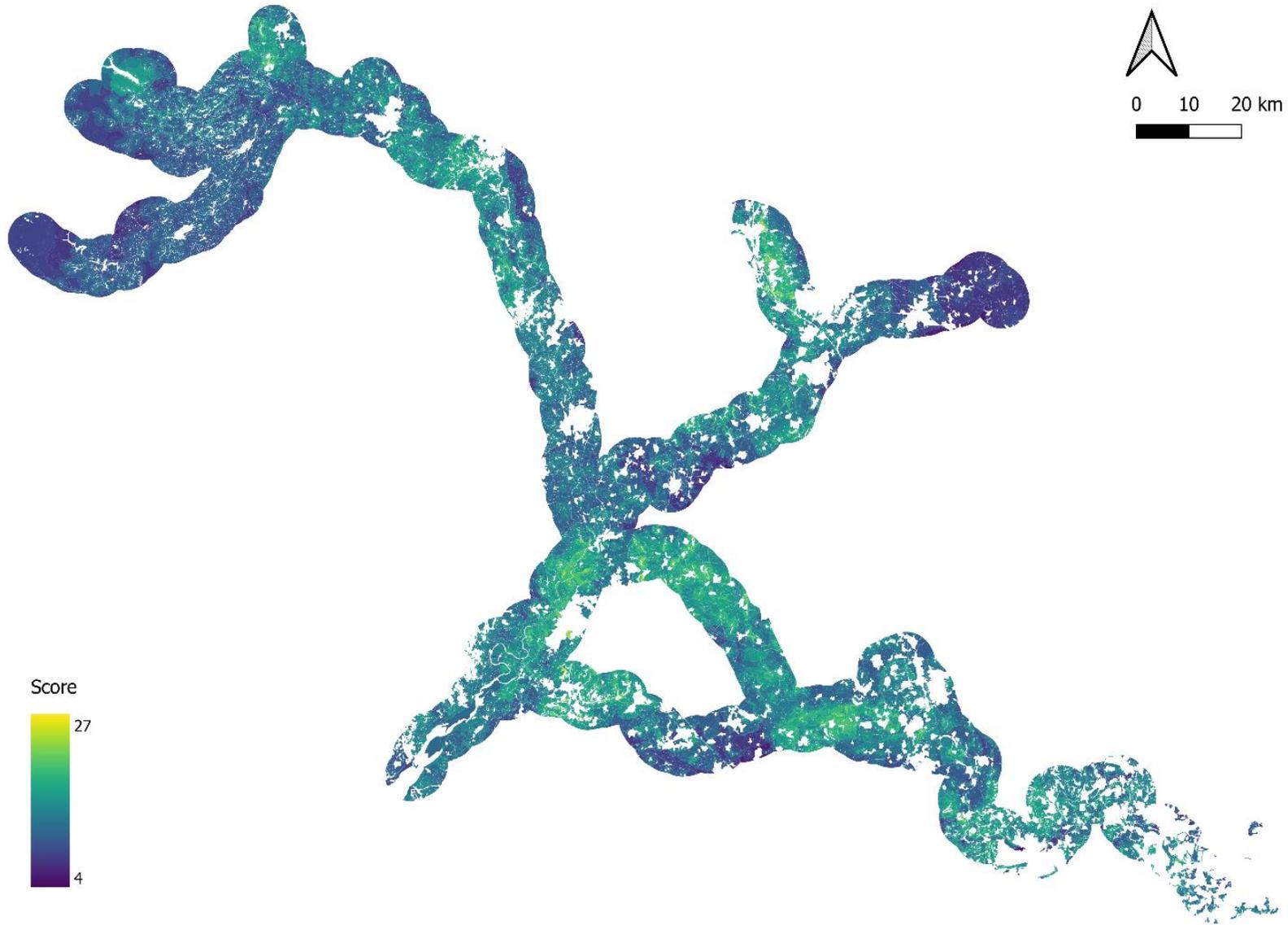


Figure 3.1 Biodiversity Opportunity Areas scoring and heatmap outputs– full scheme

### 3.6 BNG – GLOUCESTERSHIRE TEMPORARY IMPACTS

The table below shows the area of temporary habitat loss in Gloucestershire.

Table 3.12 Temporary Habitat Loss Gloucestershire

Habitat	Area (ha)	Habitat condition
Cereal crops	1.1015	N/A -Agricultural
Intensive orchards	0.0084	N/A -Agricultural
Non-cereal crops	100.6284	N/A -Agricultural
Floodplain Wetland Mosaic (CFGM)	0.9373	Moderate
Lowland calcareous grassland	0.2181	Moderate
Modified grassland	0.0523	Good
Modified grassland	73.0774	Moderate
Modified grassland	2.9826	Poor
Other neutral grassland	4.169	Moderate
Other neutral grassland	1.7206	Poor
Traditional orchards	0.1023	Moderate
Ponds (non-priority habitat)	0.2835	Moderate
Ruderal/Ephemeral	0.0394	Moderate
Artificial unvegetated, unsealed surface	0.1866	N/A - Other
Built linear features	0.0504	N/A - Other
Developed land; sealed surface	0.2265	N/A - Other
Other coniferous woodland	0.033	Moderate
Other woodland; broadleaved	0.053	Good
Other woodland; broadleaved	0.5187	Moderate
Other woodland; mixed	0.0418	Moderate
<b>Total Area</b>		<b>186.15</b>

Table 3.13 STT Gloucestershire construction temporary loss BNG summary pre and post mitigation

Total net unit change (onsite habitat retention, creation and enhancement)	Habitat units	-72.49
	Hedgerow units	0.00
Total on-site net% change (onsite habitat retention, creation and enhancement)	Habitat units	-11.71%
	Hedgerow units	0.00%

#### 3.6.1 BNG – habitat enhancements required to achieve 10% net gain

A total of 396.04 habitat units from off-site mitigation are required to achieve a 10% net gain for temporary habitat loss from the proposed works within Gloucestershire. To meet the BNG offsetting requirements and gain enhancements to the relevant habitats affected within the scheme footprint this would require a total of 45 hectares of off-site habitat. The off-site habitats required to achieve a 10% net gain for temporary habitat loss in Gloucestershire are shown in **Table 3.14**.

Table 3.14 BNG – habitat enhancements required to achieve 10% net gain within Gloucestershire

Off-site Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Modified grassland	Moderate	1	Traditional orchards	Moderate	7.29
Modified grassland	Moderate	2	Floodplain Wetland Mosaic (CFGM)	Moderate	17.06
Lowland calcareous grassland	Moderate	2	Lowland calcareous grassland	Good	29.45
Other neutral grassland	Moderate	10	Other neutral grassland	Good	118.81
Modified grassland	Moderate	1	Other woodland; broadleaved	Moderate	6.98
Modified grassland	Moderate	1	Other woodland; mixed	Moderate	6.98
Modified grassland	Moderate	28	Other neutral grassland	Moderate	209.47
<b>Total</b>		<b>45 ha</b>			<b>396.04</b>

### 3.6.2 Potential Biodiversity Opportunities – Gloucestershire

The results of the terrestrial habitat biodiversity opportunity areas heat mapping exercise for the section of STT Solution scheme within Gloucestershire are presented in **Figure 3.2**

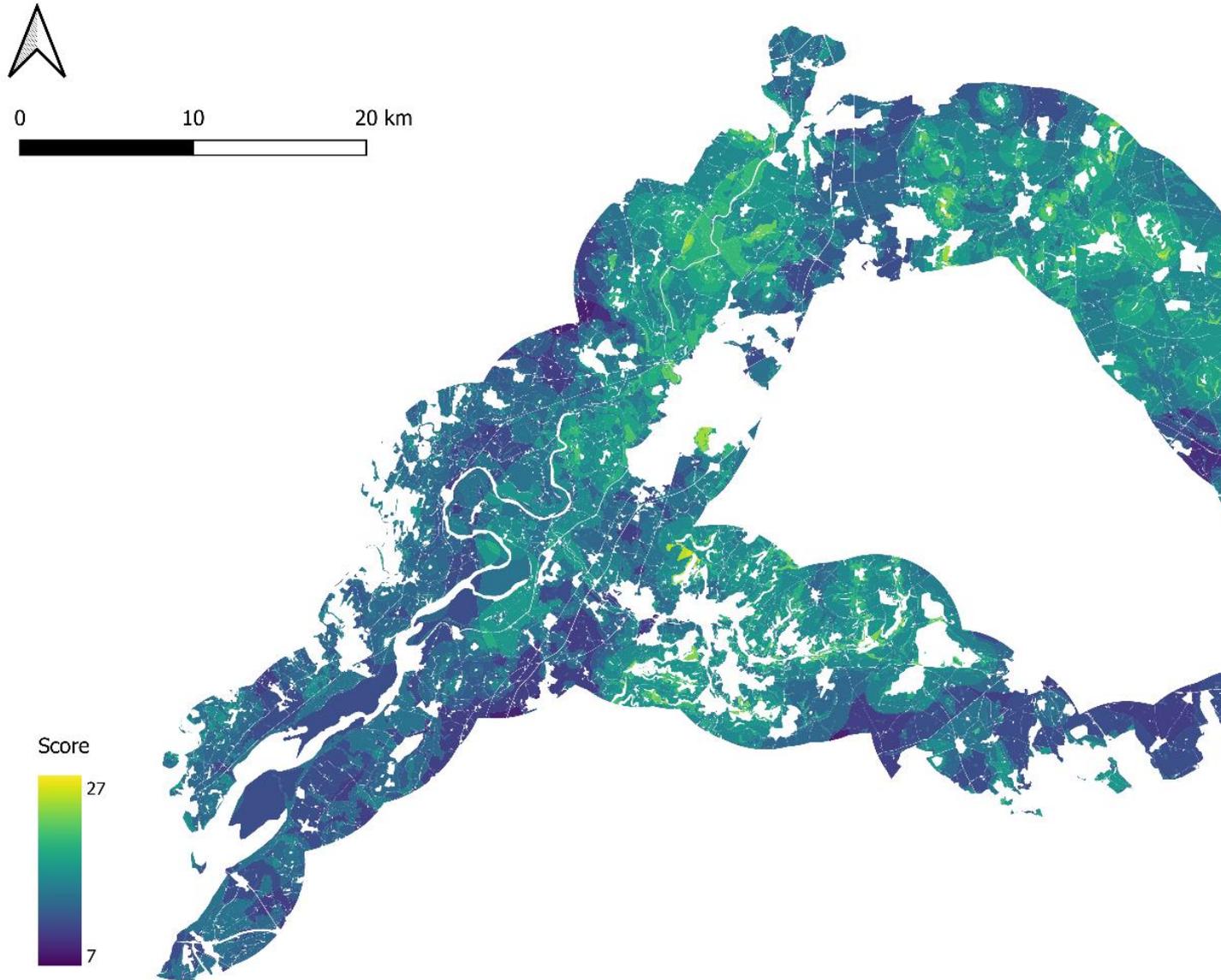


Figure 3.2. As identified above a total of 58.6 ha of offsite habitat enhancement are required achieve a 10% net gain for both permanent and temporary terrestrial habitat loss within Gloucestershire.

The 15 highest scoring PBOs identified are summarised in **Table 3.15** with the location of each PBO shown on **Figure 3.3** and **Figure 3.4**. The full results of the PBO scoring are presented in Annex 2. The 15 highest scoring PBOs identified had a total area of 142.61 ha. The required off-site mitigation would require the top 10 highest scoring PBOs shown in **Table 3.15** (which would provide 63.71 ha) to provide sufficient area to achieve 10% net gain based on the enhancements shown in **Table 3.11** and **Table 3.14**.

Table 3.15 The 15 highest scoring PBOs identified within 5km of the proposed STT scheme in Gloucestershire

NB The locations are shown on **Figure 3.3** and **Figure 3.4**.

ID	Total score	Area (ha)	Distance to scheme	Within pipeline county	Common land	Statutory site proximity	Ancient woodland proximity	Strategic significance designation	Non statutory designation	Water company owned	Priority habitat	Area score
27276	23	7.20	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27288	23	5.21	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27294	23	5.17	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27295	23	9.18	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27296	23	5.13	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27300	23	7.26	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27309	23	7.01	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27311	23	5.09	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27315	23	12.46	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27326	23	11.93	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27327	23	29.35	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27336	23	5.29	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27345	23	7.46	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27351	23	14.54	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3
27353	23	10.30	<1 km	Yes	No	<2 km	< 300m	Yes	Yes	No	Yes	3

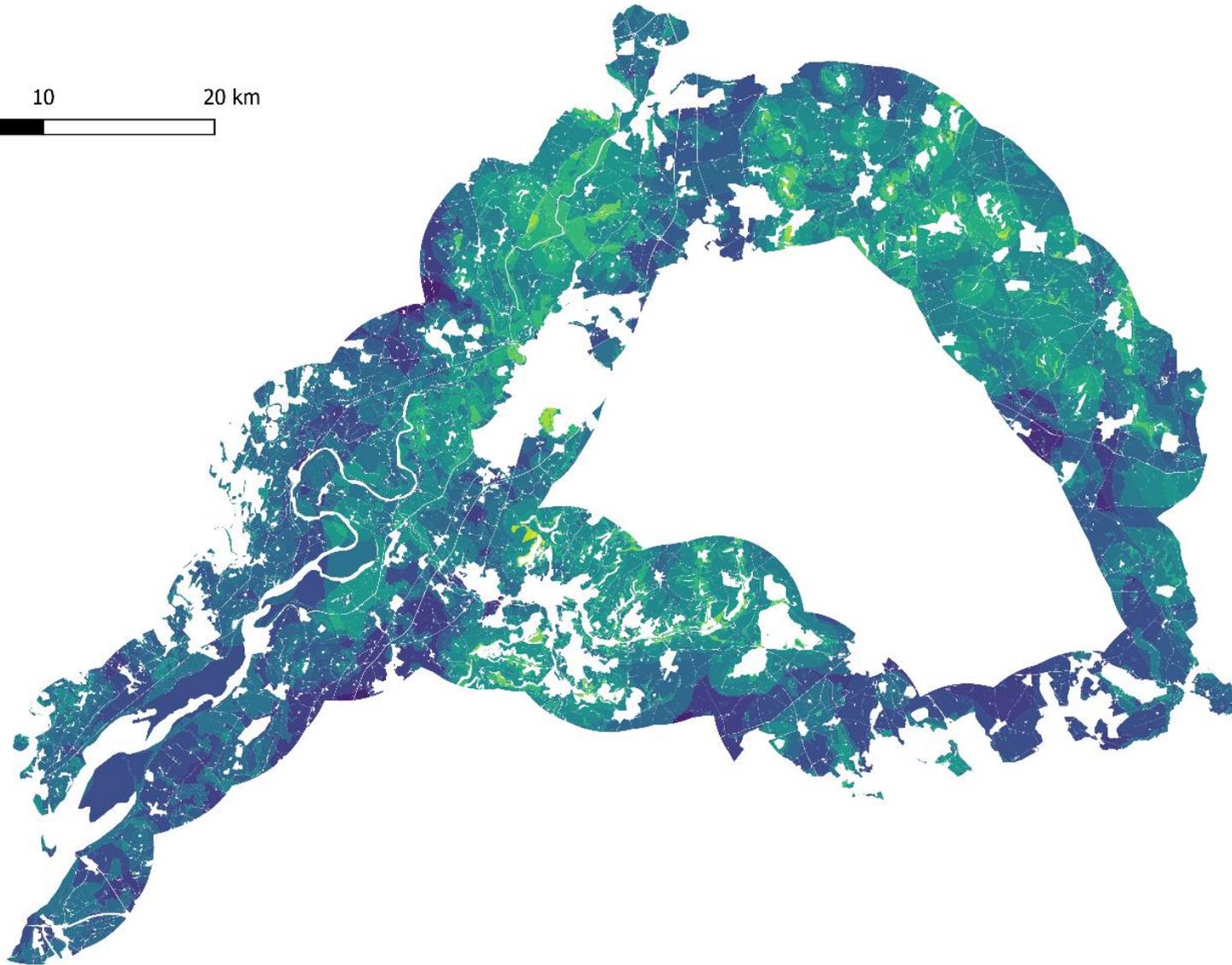
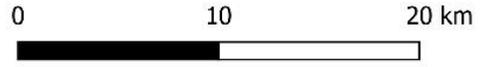


Figure 3.2 Heat map showing all the scoring for all PBOs in Gloucestershire within 5 km of the STT scheme



Figure 3.3 Map 1 of 2 showing the 15 highest scoring PBOs within Gloucestershire (northern sites)

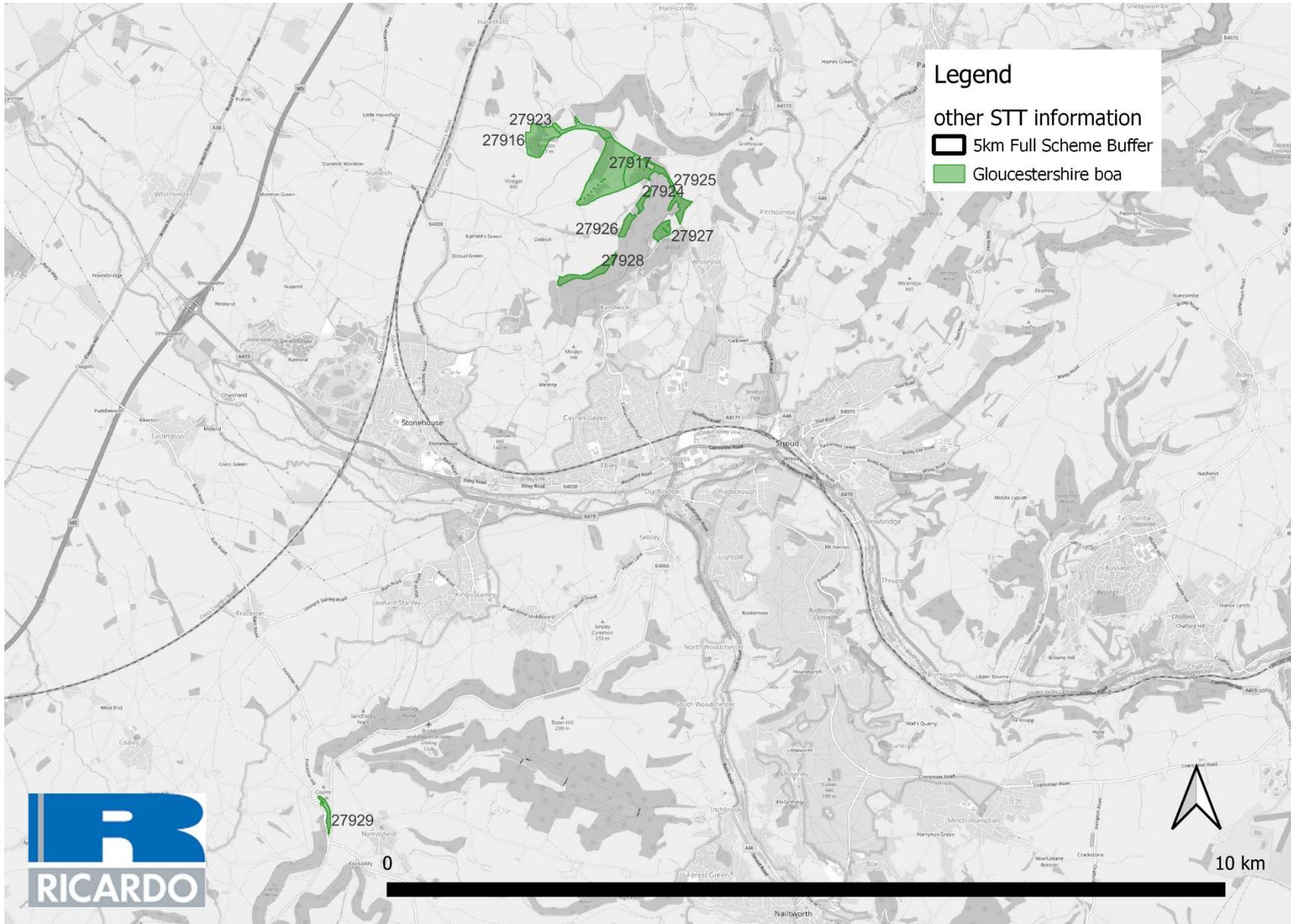


Figure 3.4 Map 2 of 2 showing the 15 highest scoring PBOs within Gloucestershire (southern sites)

### 3.7 BNG – OXFORDSHIRE PERMANENT IMPACTS

The tables below summarises the permanent habitat loss within Oxfordshire.

Table 3.16 STT Oxfordshire permanent loss during construction

Habitat	Area (ha)	Habitat condition
Modified Grassland	0.075	Moderate
<b>Total Area</b>	0.075	

Table 3.17 STT Oxfordshire construction permanent loss BNG summary pre mitigation

Total net unit change (onsite habitat retention, creation and enhancement)	Habitat units	-0.33
	Hedgerow units	0.00
Total on-site net% change (onsite habitat retention, creation and enhancement)	Habitat units	-100%
	Hedgerow units	0.00%

#### 3.7.1 BNG – habitat enhancements required to achieve 10% net gain for permanent habitat loss

The table below sets out the off-site mitigation required to achieve a 10% net gain for permanent habitat loss.

Table 3.18 STT Oxfordshire off-site mitigation to achieve a 10% net gain for permanent habitat loss

Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Modified grassland	Moderate	0.12	Neutral grassland	Moderate	0.90

### 3.8 BNG – OXFORDSHIRE TEMPORARY IMPACTS

The tables below show the area of temporary habitat loss in Oxfordshire.

Table 3.19 STT Oxfordshire temporary habitat loss during construction

Habitat	Area (ha)	Condition
Cereal crops	0.58	N/A -Agricultural
Non-cereal crops	115.44	N/A -Agricultural
Floodplain Wetland Mosaic (CFGM)	2.33	Moderate
Modified grassland	0.03	Good
Modified grassland	21.38	Moderate
Modified grassland	1.6	Poor
Other neutral grassland	1.44	Moderate
Other neutral grassland	0.92	Poor
Ruderal/Ephemeral	0.34	Moderate
Built linear features	0.01	N/A - Other
Developed land; sealed surface	0	N/A - Other
Felled	0.1	Good
Other woodland; broadleaved	0.01	Good
Other woodland; broadleaved	0.49	Moderate
Other woodland; mixed	0.05	Moderate
<b>Total Area (ha)</b>		<b>144.72 ha</b>

Table 3.20 STT Oxfordshire construction temporary loss BNG summary pre and post mitigation

Total net unit change (onsite habitat retention, creation and enhancement)	<i>Habitat units</i>	-51.83
	<i>Hedgerow units</i>	0.00
Total on-site net% change (onsite habitat retention, creation and enhancement)	<i>Habitat units</i>	-12.68%
	<i>Hedgerow units</i>	0.00%

### 3.8.1 BNG – habitat enhancements required to achieve 10% net gain

The table below sets out the off-site mitigation required to achieve a 10% net gain for temporary habitat loss.

Table 3.21 STT Oxfordshire off-site mitigation to achieve a 10% net gain for temporary losses

Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Modified grassland	Moderate	3	Floodplain Wetland Mosaic (CFGM)	Moderate	25.59
Neutral grassland	Moderate	20	Neutral grassland	Good	237.62
Modified grassland	Moderate	4	Woodland (Broad leaved)	Moderate	27.91
Modified grassland	Moderate	4	Woodland (mixed)	Moderate	27.91
<b>Total</b>		<b>31 ha</b>			<b>319.03</b>

### 3.8.2 Potential Biodiversity Opportunities – Oxfordshire

The results of the terrestrial habitat biodiversity opportunity areas heat mapping exercise for the section of STT Solution within Oxfordshire are presented in **Figure 3.5**. As identified above a total of just over 31 ha of offsite habitat enhancement is required to achieve a 10% net gain for both permanent and temporary terrestrial habitat loss within Oxfordshire.

The 15 highest scoring PBOs identified are summarised in **Table 3.22** with the location of each PBO shown on **Figure 3.6**, **Figure 3.7**, **Figure 3.8**, and **Figure 3.9**; the full results of the PBO scoring are presented in Annex 2. The 15 highest scoring PBOs identified had a total area of 127.04 ha. The required off-site mitigation would require the top 11 highest scoring PBOs shown in **Table 3.22** (which would provide 99.16 ha) to provide sufficient area to achieve 10% net gain based on the enhancements shown in **Table 3.21** and **Table 3.18**.

Table 3.22 The 15 highest scoring PBOs identified within 5km of the proposed STT scheme in Oxfordshire

NB The locations are shown on Figure 3.6 , Figure 3.7 , Figure 3.8, and Figure 3.9.

ID	Total score	Area (ha)	Distance to scheme	Within pipeline county	Common land	Statutory site proximity	Ancient woodland proximity	Strategic significance designation	Non statutory designation	Water company owned	Priority habitat	Area score
27595	24	13.62	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27615	24	10.59	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27619	24	8.35	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27626	24	9.17	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27634	24	6.62	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27638	24	7.79	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27639	24	7.5	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27648	24	5.59	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27654	24	14.75	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27655	24	8.59	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27656	24	6.59	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27659	24	6.22	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27666	24	5.37	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27672	24	5.81	<1 km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3
27683	24	10.5	<1km	Yes	No	<2k m	<300 m	Yes	Yes	No	Yes	3

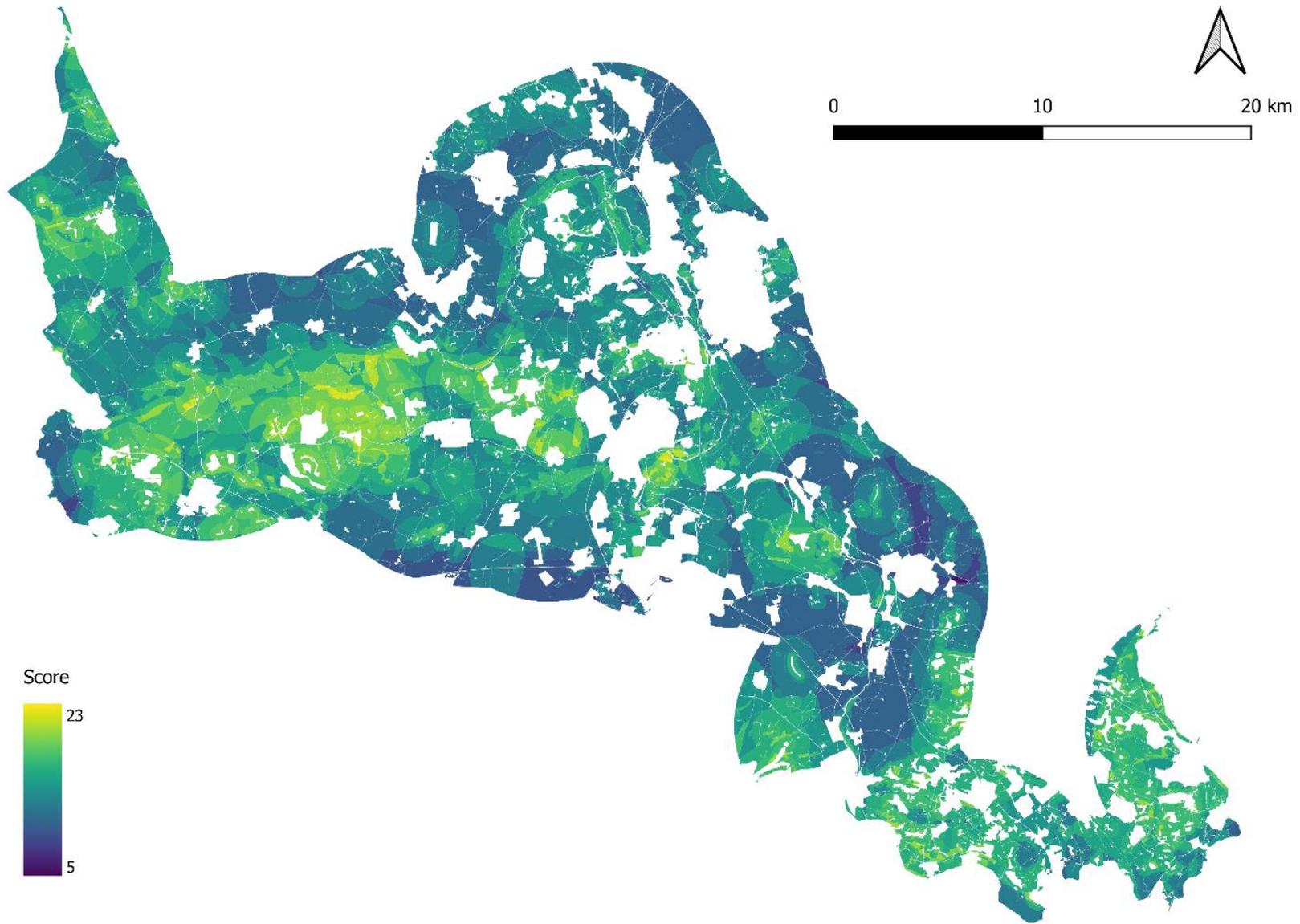


Figure 3.5 Heat map showing all the PBOs in Oxfordshire within 5 km of the STT scheme



Figure 3.6 Map 1 of 4 showing the 15 highest scoring PBOs within Oxfordshire



Figure 3.7 Map 2 of 3 showing the 15 highest scoring PBOs within Oxfordshire



Figure 3.8 Map 3 of 4 showing the 15 highest scoring PBOs within Oxfordshire



Figure 3.9 Map 4 of 4 showing the 15 highest scoring PBOs within Oxfordshire

### 3.9 BNG – SHROPSHIRE PERMANENT IMPACTS

The permanent habitat loss from the construction across the full STT scheme would result in the loss of 0.33ha of baseline habitats (modified grassland) in the absence of additional off-site mitigation (**Table 3.23**). This would result in a net change of -100% BNG units pre- mitigation (**Table 3.24**).

Table 3.23 STT Shropshire permanent loss during construction

Habitat	Area (ha)	Habitat condition
Modified Grassland	0.33	Moderate
<b>Total Area</b>	<b>0.33</b>	

Table 3.24 STT Shropshire construction permanent loss BNG summary pre mitigation

Total net unit change (onsite habitat retention, creation and enhancement)	Habitat units	-1.45
	Hedgerow units	0.00
Total on-site net% change (onsite habitat retention, creation and enhancement)	Habitat units	-100%
	Hedgerow units	0.00%

#### 3.9.1 BNG – habitat enhancements required to achieve 10% net gain for permanent habitat loss

A total of 3.89 habitat units from off-site mitigation are required to achieve a 10% net gain for permanent habitat loss from the proposed works within Shropshire. To meet the BNG offsetting requirements and gain enhancements to the relevant habitats affected within the scheme footprint this would require a total of 0.52 hectares of off-site habitat. The off-site habitats required to achieve a 10% net gain for temporary habitat loss in Shropshire are shown in **Table 3.25**.

Table 3.25 STT Shropshire off-site mitigation to achieve a 10% net gain for permanent habitat loss

Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Modified grassland	Moderate	0.52	Neutral grassland	Moderate	3.89

### 3.10 BNG – SHROPSHIRE TEMPORARY IMPACTS

The temporary habitat loss from the construction across Shropshire would result in the loss of 60.35 ha of baseline habitats in the absence of additional off-site mitigation (**Table 3.26**). This would result in a net change of -12.33% BNG units pre- mitigation (**Table 3.27**). The habitats within the temporary construction corridor within Shropshire were dominated by low distinctiveness habitats including modified grassland (poor, moderate and good condition), cereal crops, and other neutral grassland (poor and moderate condition).

Table 3.26 Shropshire temporary loss during construction

Habitat	Area (ha)	Condition
Cereal crops	1.5179	N/A -Agricultural
Non-cereal crops	7.4753	N/A -Agricultural
Modified grassland	0.0743	Good
Modified grassland	40.7127	Moderate
Modified grassland	4.2354	Poor
Other neutral grassland	3.7935	Moderate
Other neutral grassland	2.4253	Poor
Artificial unvegetated, unsealed surface	0.0961	N/A - Other
Built linear features	0.0022	N/A - Other
Other woodland; broadleaved	0.0023	Good
Other woodland; broadleaved	0.0168	Moderate
<b>Total Area</b>		<b>60.35</b>

Table 3.27 STT Shropshire construction temporary loss BNG summary pre mitigation

Total net unit change (onsite habitat retention, creation and enhancement)	Habitat units	-31.18
	Hedgerow units	0.00
	River units	0.00
Total on-site net% change (onsite habitat retention, creation and enhancement)	Habitat units	-12.33%
	Hedgerow units	0.00%
	River units	0.00%

### 3.10.1 BNG – habitat enhancements required to achieve 10% net gain

A total of 190.6 habitat units from off-site mitigation are required to achieve a 10% net gain for temporary habitat loss from the proposed works within Shropshire. To meet the BNG offsetting requirements and gain enhancements to the relevant habitats affected within the scheme footprint this would require a total of 20 hectares of off-site habitat. The off-site habitats required to achieve a 10% net gain for temporary habitat loss in Shropshire are shown in **Table 3.28**.

Table 3.28 BNG – offsetting required to achieve 10% net gain within Shropshire

Baseline Habitat	Baseline Condition	Hectarage	Proposed Habitat	Proposed Condition	Habitat Units Delivered
Other neutral grassland	Modified	10	Other neutral grassland	Good	118.81
Modified grassland	Modified	6	Other woodland; broadleaved	Moderate	41.87
Modified grassland	Modified	4	Other neutral grassland	Moderate	29.92
<b>Total Habitats Units Delivered</b>					<b>190.60</b>

### 3.10.2 Potential Biodiversity Opportunities – Shropshire

The results of the terrestrial habitat biodiversity opportunity areas heat mapping exercise for the section of STT Solution within Shropshire are presented in **Figure 3.10**. As identified above a total of 20.52 ha of offsite habitat enhancement is required achieve a 10% net gain for both permanent and temporary terrestrial habitat loss within Shropshire.

The 15 highest scoring PBOs identified are summarised in **Table 3.29** with the location of each PBO shown on **Figure 3.11**, **Figure 3.12**; and **Figure 3.13**; the full results of the PBO scoring are presented in Annex 2. The 15 highest scoring PBOs identified had a total area of 96.8 ha. The required off-site mitigation would require the top four highest scoring PBOs shown in **Table 3.29** (which would provide 26.76 ha) or PBO 27327 (area 29.35 ha) would be large enough in one habitat parcel to provide sufficient area to achieve 10% net gain based on the enhancements shown in **Table 3.25** and **Table 3.28**.

Table 3.29 The 15 highest scoring PBOs identified within 5km of the proposed STT scheme in Shropshire

NB The locations are shown on **Figure 3.11**, **Figure 3.12**, and **Figure 3.13**

ID	Total score	Area (ha)	Distance to scheme	Within pipeline county	Common land	Statutory site proximity	Ancient woodland proximity	Strategic significance designation	Non statutory designation	Water company owned	Priority habitat	Area score
27816	25	37.64	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	3
27809	24	10.2	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	3
27810	24	16.27	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	3
27811	24	13.23	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	3
27812	24	1.82	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27813	24	2.14	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27814	24	1.16	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27815	24	1.5	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27817	24	1.15	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27818	24	1.6	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27819	24	1.06	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27822	24	2.09	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27823	24	1.98	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27824	24	3.54	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2
27830	24	1.42	<1 km	Yes	No	<2 km	<300 m	Yes	Yes	Yes	Yes	2

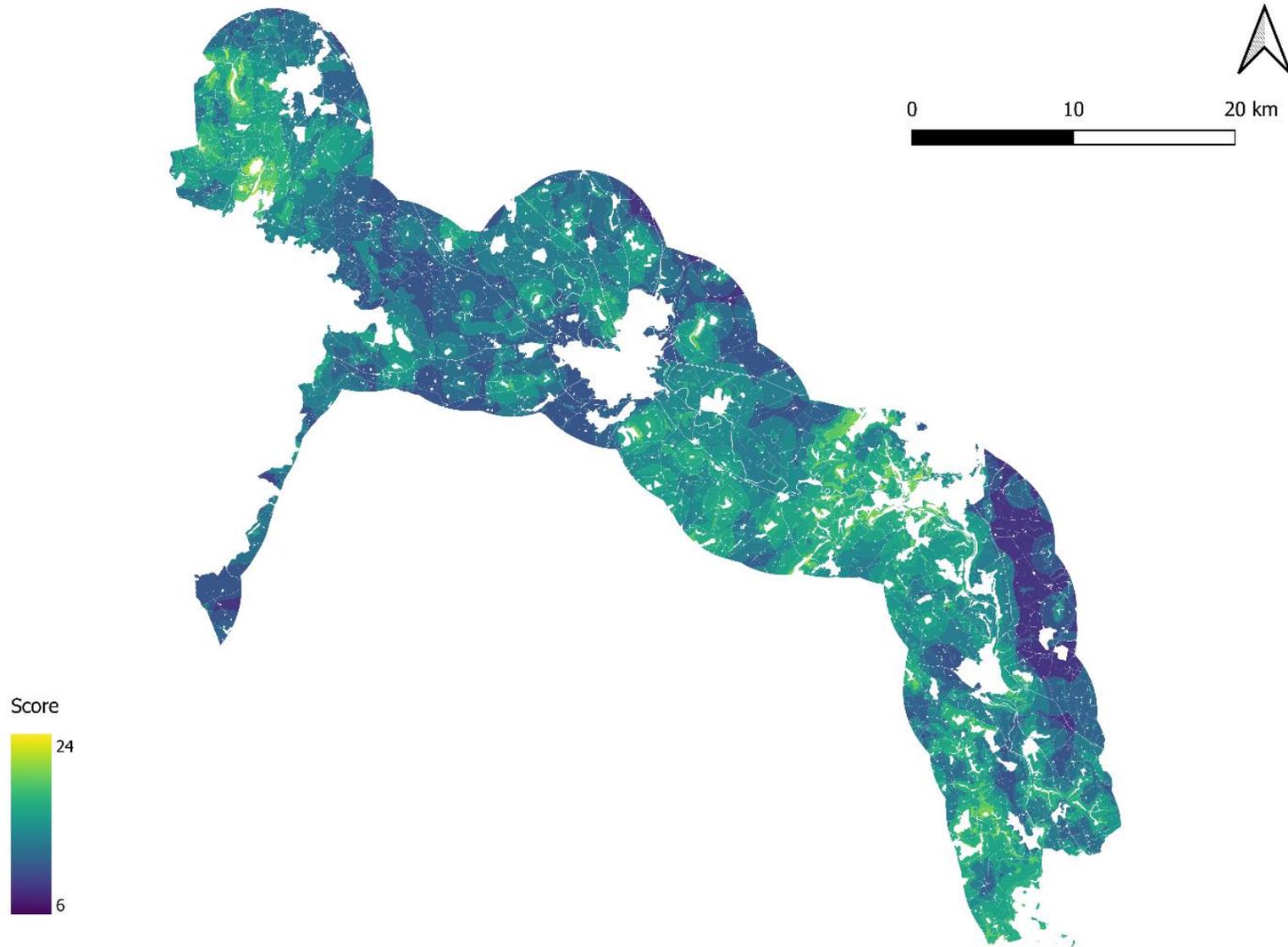


Figure 3.10 Heat map showing all the PBOs in Shropshire within 5 km of the STT scheme



Figure 3.11 Map 1 of 3 showing the 15 highest scoring PBOs within Shropshire

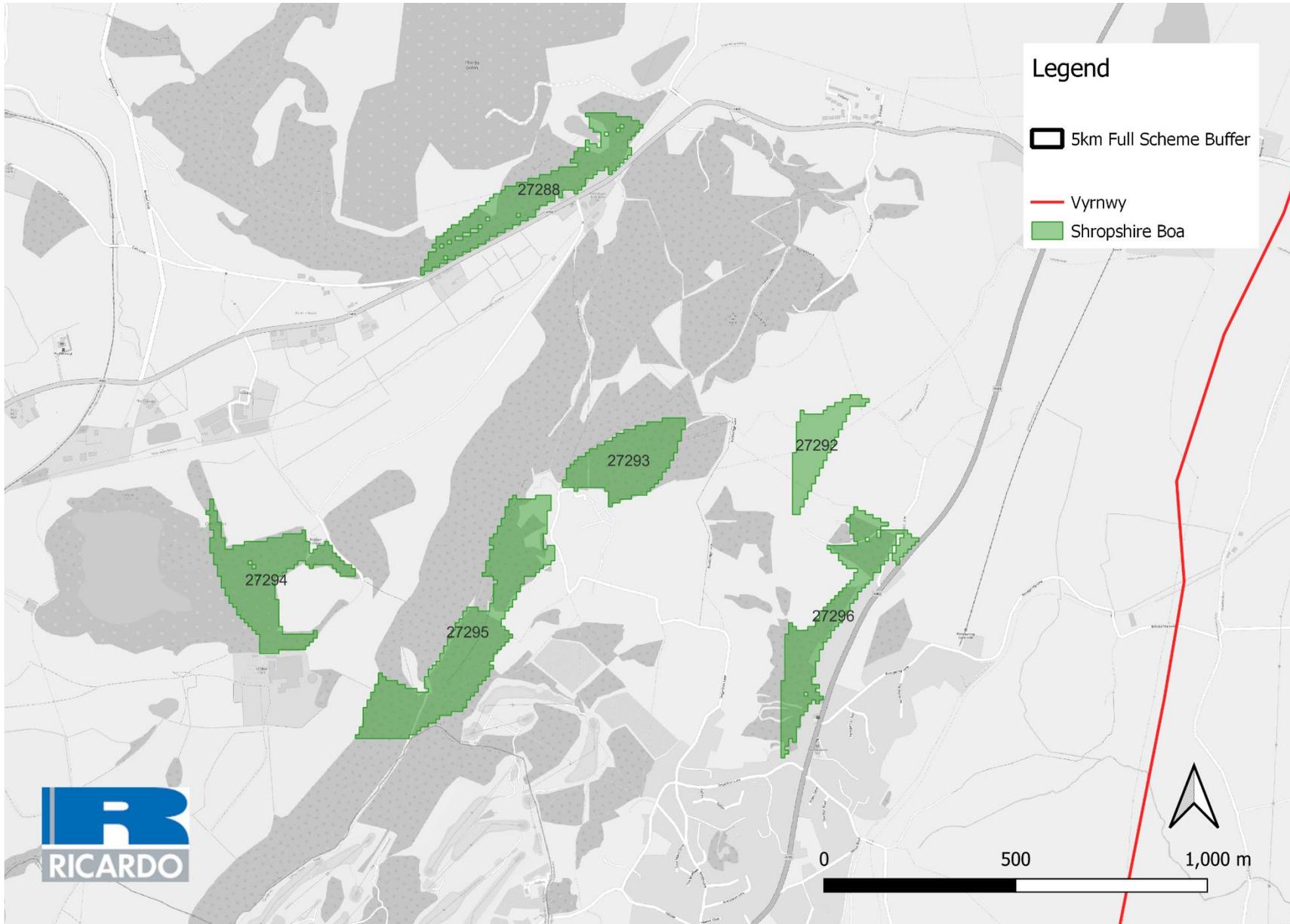


Figure 3.12 Map 2 of 3 showing the 15 highest scoring PBOs within Shropshire



Figure 3.13 Map 3 of 3 showing the 15 highest scoring PBOs within Shropshire

### 3.11 BNG TABLES – RIVERS – FULL SCHEME

#### 3.11.1 BNG - rivers and streams – temporary construction impacts

A total of 28 watercourses were identified within the construction footprint of pipelines associated with STT Solution (excluding construction associated with Minworth and Netheridge). This will result in temporary construction impacts on watercourses intersected by the proposed pipelines. The WFD waterbody, river type, ecological condition, length of reach impacted based on assumptions listed in **Section 2.2.3.7.1** and river units lost are provided below in **Table 3.30**.

The total net unit change and total on-site net% change as a result of temporary construction impacts is provided in **Table 3.31**.

Table 3.30 STT Solution full scheme temporary loss of river units during construction.

WFD waterbody	River type	WFD ecological condition	Length impacted (km)	River units lost
Weir Bk - source to conf R Severn	Priority Habitat	Poor	0.02	0.15
Unknown waterbody; Weir Bk - source to conf R Severn	Ditches	Poor	0.02	0.06
Unknown waterbody 2; Weir Bk - source to conf R Severn	Ditches	Poor	0.02	0.06
Unknown waterbody 6; Weir Bk - source to conf R Severn	Ditches	Poor	0.02	0.06
Unknown waterbody 3; Weir Bk - source to conf R Severn	Ditches	Poor	0.02	0.06
Unknown waterbody 4; Weir Bk - source to conf R Severn	Ditches	Poor	0.02	0.07
Swilgate - source to conf R Avon	Other Rivers and Streams	Moderate	0.02	0.17
Isbourne - source conf R Avon	Priority Habitat	Poor	0.02	0.13
Radcot Cut	Other Rivers and Streams	Moderate	0.02	0.14
Thames (Leach to Evenlode)	Other Rivers and Streams	Poor	0.02	0.07
Unknown watercourse - trib to Thames (Leach to Evenlode)	Ditches	Poor	0.04	0.13
Unknown watercourse 2 - trib to Thames (Leach to Evenlode)	Ditches	Poor	0.02	0.06
Unknown watercourse 3 - trib to Thames (Leach to Evenlode)	Ditches	Poor	0.02	0.06
Unknown watercourse - trib to Wadley Stream (Source to Thames at Duxford)	Other Rivers and Streams	Poor	0.02	0.10
Unknown watercourse - trib of Cow Common Brook and Portobello Ditch	Other Rivers and Streams	Poor	0.02	0.09
Mere Dike - trib of Cow Common Brook and Portobello Ditch	Other Rivers and Streams	Poor	0.02	0.10
Unknown watercourse 2 - trib of Cow Common Brook and Portobello Ditch	Other Rivers and Streams	Poor	0.02	0.09
Wadley Stream (Source to Thames at Duxford)	Other Rivers and Streams	Poor	0.02	0.11
Unknown watercourse - trib of Ock and tributaries (Land Brook confluences to Thames)	Other Rivers and Streams	Poor	0.02	0.07
Ock and tributaries (Land Brook confluences to Thames)	Priority Habitat	Poor	0.02	0.08
Childrey Brook and Norbrook at Common Barn	Other Rivers and Streams	Poor	0.02	0.11
Slade Barn Stream (Source to Windrush)	Priority Habitat	Moderate	0.04	0.59
Sherborne Brook	Priority Habitat	Poor	0.02	0.11
Tirle Brook - source to the conf River Swilgate Water body	Priority Habitat	Poor	0.02	0.11

WFD waterbody	River type	WFD ecological condition	Length impacted (km)	River units lost
Unknown watercourse - trib to Tirlle Brook - source to conf River Swilgate	Other Rivers and Streams	Poor	0.02	0.07
Unknown watercourse 2 - trib to Windrush (Slade Barn Stream to Dikler)	Other Rivers and Streams	Moderate	0.02	0.16
Unknown watercourse - trib to Windrush (Slade Barn Stream to Dikler)	Other Rivers and Streams	Moderate	0.02	0.16
Cow Common Brook and Portobello Ditch	Other Rivers and Streams	Poor	0.02	0.10

Table 3.31 Construction of STT Solution (excluding Minworth and Netheridge) and temporary loss of BNG river units pre mitigation.

Results	Unit or Percentage
Total net unit change (including all on-site river loss & creation)	-1.95
Total on-site net% change plus off-site surplus (including all on-site river loss & creation)	-58.60 %

### 3.11.2 BNG - rivers and streams – permanent construction impacts

A total of three watercourses were identified within the construction footprint of abstraction and discharge infrastructure associated with STT Solution (excluding construction associated with Minworth and Netheridge). This will result in permanent loss of riverine habitat. The WFD waterbody, river type, ecological condition, length of reach impacted based on assumptions listed in **Section 2.2.3.7.1** and river units lost are provided below in **Table 3.32** STT Solution full scheme temporary loss of river units during construction.

The total net unit change and total on-site net% change as a result of permanent infrastructure and associated riverine habitat loss is provided in **Table 3.33**.

Table 3.32 STT Solution full scheme temporary loss of river units during construction.

WFD waterbody	River type	WFD ecological condition	Length impacted (km)	River units lost
Severn - conf Bele Bk to conf Sundorne Bk	Other rivers and streams	Moderate	0.015	0.14
Severn - conf R Avon to conf Upper Parting	Other rivers and streams	Moderate	0.015	0.08
Thames (Evenlode to Thame)	Other rivers and streams	Moderate	0.015	0.12

Table 3.33 Construction of STT Solution (excluding Minworth and Netheridge) and permanent loss of BNG river units pre mitigation.

Results	Unit type	Unit or Percentage
Total net unit change (including all on-site river loss & creation)	River units	-0.25
Total on-site net% change plus off-site surplus (including all on-site river loss & creation)	River units	-72.38 %

### 3.11.3 BNG - rivers and streams – operational impacts

Based on outputs from the Physical Environment and Ecology Assessment Reports, the ecological condition of waterbodies present upstream of Alveston to the outfall location at Stoneleigh (associated with Minworth) could be impacted by changes in velocity and depth. Within this reach of the River Avon, two WFD waterbodies have been identified: 'Avon (Warks) – conf R Sowe to conf R Leam' and 'Avon (Wark) conf R Leam to Tramway Br, Stratford'. At Gate 2, MoRPh5 surveys were conducted at each waterbody; the MoRPh survey reference and Ordnance Survey National Grid Reference (OS NGR) of the MoRPh modules 1 and 5 provided in **Table 3.34**.

Table 3.34 MoRPh survey locations

WFD Waterbody name	Waterbody ID	WFD ecological condition	MoRPh survey reference	MoRPh5 (Module 1 and 5 OS NGR)	Length potentially impacted (km)
Avon (Wark) conf R Leam to Tramway Br, Stratford	GB109054044402	Moderate	STT 08	SP 03363 43143 SP 26579 61047	14.48
Avon (Warks) – conf R Sowe to conf R Leam	GB109054043840	Moderate	STT 26	SP 31457 71620 SP 26579 61047	14.90

Upstream of Alveston to the outfall location at Stoneleigh an increase in velocity of 0.02 m/s, an increase in depth of the river channel of 4 cm and a decrease in nutrient concentrations is anticipated<sup>57</sup>. This could result in partial inundation of unvegetated/ vegetated side bars, islands, exposed bedrock and emergent vegetation, plus minor changes in bank face profile via change in water depth. The decrease in nutrient conditions may cause a decrease in presence of filamentous algae on the surface and bank water margin. No impacts are anticipated on the water surface flow patterns or bed sediment size due to the minor increase in velocity.

The baseline MoRPh condition data for waterbodies upstream of Alveston to the outfall location at Stoneleigh were reviewed and amended based on the impact pathways identified above, to provide an indication of the potential change in condition caused by the operation of STT Solution. The results of this assessment are provided in **Table 3.35**.

WFD waterbodies present upstream of Alveston to the outfall location of Stoneleigh were assessed as in moderate ecological condition via the MoRPh5 surveys conducted. It is estimated that during the operation of STT Solution that one negative and five positive indicators will be impacted by the scheme. These include bank face natural bank profile extent, bank face natural bank profile richness, bank face reinforcement material severity, channel margin aquatic morphotype richness, channel margin physical feature richness and channel bed aquatic morphotype richness. The alterations resulted in an increase in preliminary condition score where MoRPh5 surveys were conducted and no overall change in condition category was recorded. STT 08 slightly increased in preliminary condition score due to assessed changes in bank face reinforcement material severity; this indicator was assessed as less negative in the operational scenario. STT 26 slightly increased in preliminary condition score due to assessed changes in bank face natural bank profile extent and bank face natural bank profile richness, these indicators were assessed as more positive in the operational scenario. Indicator changes were not the same for STT 08 and STT 26 due to the differences in the baseline MoRPh surveys.

Based on criteria input into BNG metric (see Excel spreadsheet 'Gate 2 A1 BNG Rivers Data') no temporary or permanent loss of BNG river units was calculated pre mitigation. Therefore, the impacts of the operation of the STT Solution in relation to BNG will not be further assessed.

<sup>57</sup> Ricardo Energy and Environment (2022). Severn to Thames Transfer SRO, Physical Environment Assessment Report. Report for United Utilities on behalf of the STT Group.

Table 3.35 Assessed changes in river condition indicators during the operation of STT Solution at STT 08 and 26

Note: MoRPh surveys conducted at Gate 2. White rows show changes in the indicator score of the operational scenario comparison to baseline.

Code	Indicator name	Positive / Negative type	STT 08 baseline	STT 08 operational	STT 26 baseline	STT 26 operational
B1	Bank top vegetation structure	Positive	2	2	2	2
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	-3	-3	-2	-2
B5	Bank top managed ground cover	Negative	-4	-4	-2	-2
C1	Bank face riparian vegetation structure	Positive	3	3	2	2
C2	Bank face tree feature richness	Positive	2	2	2	2
C3	Bank face natural bank profile extent	Positive	3	3	2	3
C4	Bank face natural bank profile richness	Positive	4	4	2	4
C5	Bank face natural bank material richness	Positive	1	1	1	1
C6	Bank face bare sediment extent	Positive	2	2	0	0
C7	Bank face artificial bank profile extent	Negative	0	0	0	0
C8	Bank face reinforcement extent	Negative	-2	-2	0	0
C9	Bank face reinforcement material severity	Negative	-3	-2	0	0
C10	Bank face NNIPS cover	Negative	-3	-3	-1	-1
D1	Channel margin aquatic vegetation extent	Positive	3	3	1	1
D2	Channel margin aquatic morphotype richness	Positive	3	3	1	0
D3	Channel margin physical feature extent	Positive	3	3	3	3
D4	Channel margin physical feature richness	Positive	4	3	1	1
D5	Channel margin artificial features	Negative	-1	-1	0	0
E1	Channel bed aquatic morphotype richness	Positive	4	4	3	2
E2	Channel bed tree features richness	Positive	2	2	1	1
E3	Channel bed hydraulic features richness	Positive	3	3	0	0
E4	Channel bed natural features extent	Positive	3	3	2	2
E5	Channel bed natural features richness	Positive	2	2	1	1
E6	Channel bed material richness	Positive	3	3	1	1
E7	Channel bed siltation	Negative	-2	-2	-2	-2
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	0	0
E11	Channel bed NNIPS extent	Negative	-3	-3	0	0
E12	Channel bed filamentous algae extent	Negative	0	0	0	0
<b>Preliminary condition score:</b>			<b>0.62753</b>	<b>0.651822</b>	<b>0.935223</b>	<b>0.987854</b>
<b>River condition category:</b>			<b>Moderate</b>	<b>Moderate</b>	<b>Moderate</b>	<b>Moderate</b>

### 3.12 BIODIVERSITY OPPORTUNITIES– RIVERS

#### 3.12.1 Wider benefits assessment outputs for river PBOs

The wider benefits study<sup>58</sup> considered opportunities within the STT scheme which encompassed the six capitals<sup>59</sup> approach for use in England, and the Sustainable Management of Natural Resources<sup>60</sup> (SMNR) and Wellbeing goals relating to Wales. Key focus areas of this study included river biodiversity (which considers ecological, fish and biodiversity status), which can be applied to this assessment to determine river PBOs. The key output opportunity heat map relating to river biodiversity is shown at a catchment scale in **Figure 3.14**. At this stage land ownership was not fully assessed but can be added in the PBO assessment at Gate 3 as more data becomes available given that landownership is of key importance to determine on the ground opportunities.

The outputs shown in **Figure 3.14** were then reviewed along with a 1 km buffer from the temporary construction and permanent construction impacts. The resulting river opportunity areas (i.e., those considered for enhancement as mitigation for the assessed net gain losses) are discussed in **Sections 0** and **0** and shown in **Figure 3.15** and **Figure 3.16**

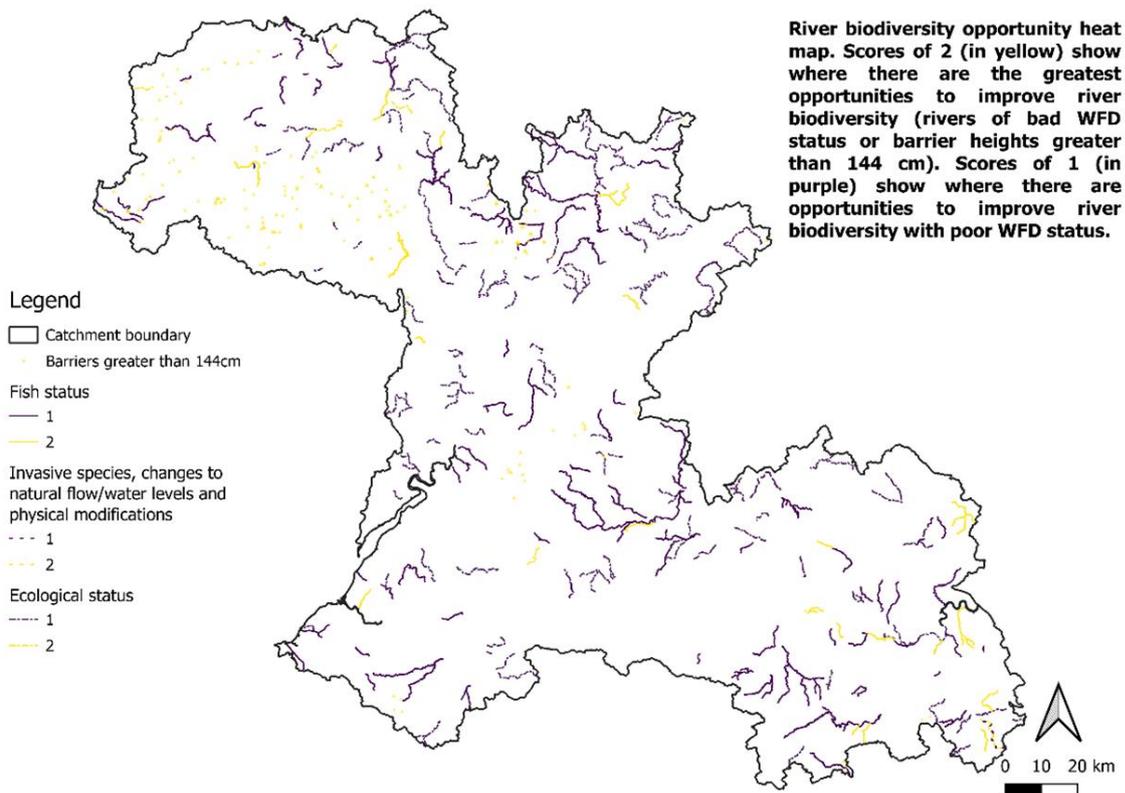


Figure 3.14 River biodiversity opportunity heat map

#### 3.12.2 River enhancement – temporary construction

A total of 10 river PBOs were identified within 1 km of the proposed pipeline route for Deerhurst to Culham and Vyrnwy Bypass (option 27). Based on river unit losses of -1.95, an 0.18 km length of each river PBO listed in

<sup>58</sup> Ricardo (2022). *Severn Thames Transfer SRO. Wider Benefits Study*. Ricardo ref: ED16053.

<sup>59</sup> [13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf \(integratedreporting.org\)](#)

<sup>60</sup> [Introducing Sustainable Management of Natural Resources](#)

**Table 3.36** would require enhancement, from poor to fairly poor condition to achieve a 10.85% net gain. The location of the river PBOs in relation to the Deerhurst to Culham pipeline are shown in **Figure 3.15**.

Note that Ock and Tributaries (Land Brook confluences to Thames) is a priority river habitat targeted for physical river restoration, and Weir Bk (source to conf R Severn) is a priority river habitat targeted for hydrological river restoration.

Table 3.36 Waterbodies identified for potential enhancement, in order to achieve 10% BNG from temporary construction losses.

WFD waterbody	Condition	Length enhanced (km)	Post intervention condition	River units delivered
Tirle Brook - source to the conf River Swilgate	Poor	0.18	Fairly poor	1.15
Isbourne - source to conf R Avon	Poor	0.18	Fairly poor	1.48
Sherbourne Brook	Poor	0.18	Fairly poor	1.30
Thames (Leach to Evenlode)	Poor	0.18	Fairly poor	0.81
Wadley Stream (Source to Thames at Duxford)	Poor	0.18	Fairly poor	1.30
Ock and tributaries (Land Brook confluence to Thames)	Poor	0.18	Fairly poor	1.30
Childrey Brook and Norbrook at Common Barn	Poor	0.18	Fairly poor	1.30
Cow Common Brook and Portobello Ditch	Poor	0.18	Fairly poor	1.24
Weir Bk - source to conf R Severn	Poor	0.18	Fairly poor	1.74
Leach (Source to Thames)	Poor	0.18	Fairly poor	0.62

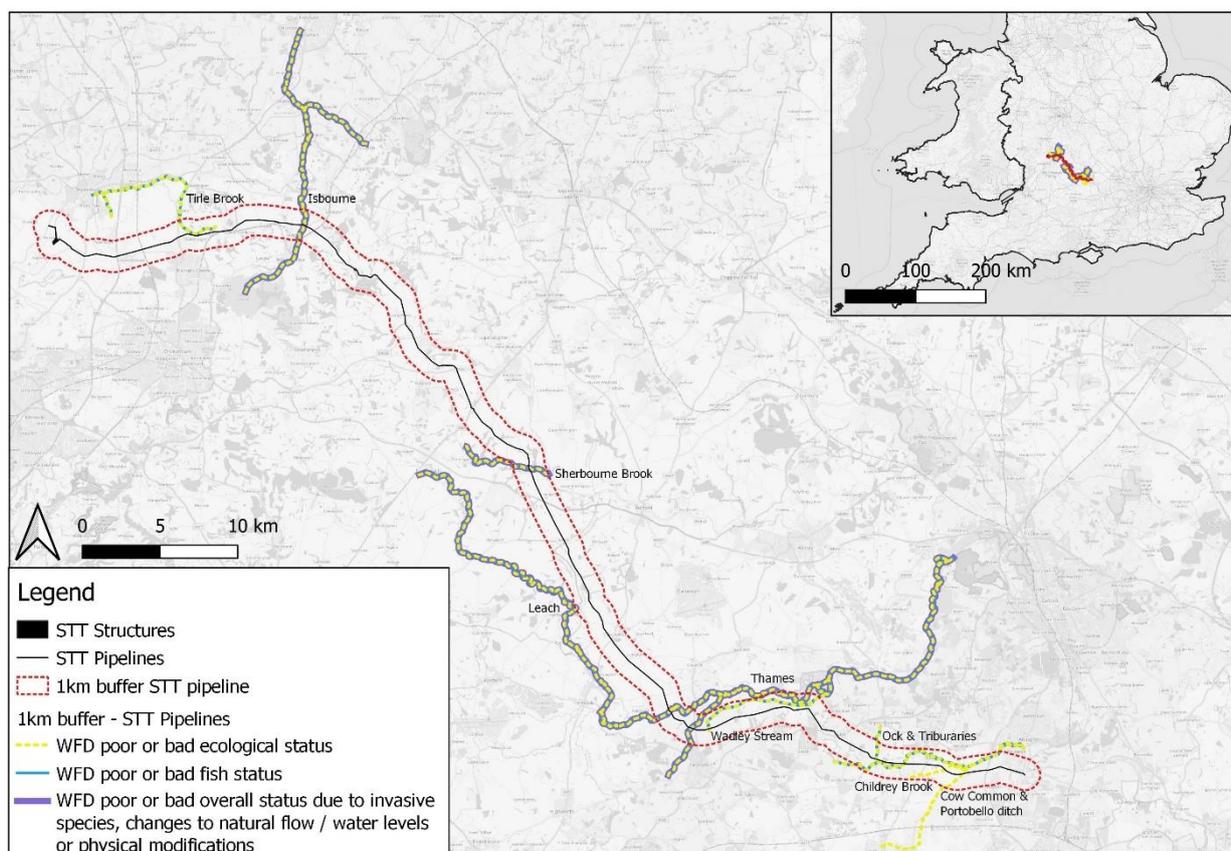


Figure 3.15 Temporary construction River Biodiversity Opportunity Areas (labelled with WFD name) identified within 1km of the proposed STT pipeline

### 3.12.3 River enhancement – permanent construction

One river PBO was identified within 1 km of the proposed outfall of Vyrnwy Bypass (option 27). No PBOs were identified within 1 km of proposed permanent infrastructure associated with the Deerhurst to Culham pipeline. This included pumping stations and abstraction and discharge locations. Based on river unit losses of -0.25, an 0.25 km length of the river PBO listed in **Table 3.36** would require enhancement from poor to fairly poor condition to achieve a 10.14% net gain. The location of the river PBO in relation to the Vyrnwy Bypass pipeline (option 27) is shown in **Figure 3.16**.

Note that Weir Bk (source to conf R Severn) is a priority river habitat targeted for hydrological river restoration.

Table 3.37 Waterbodies identified for potential enhancement, in order to achieve 10% BNG from permanent construction losses.

WFD waterbody	Condition	Length enhanced (km)	Post intervention condition	River units delivered
Weir Bk - source to conf R Severn	Poor	0.25	Fairly poor	2.12

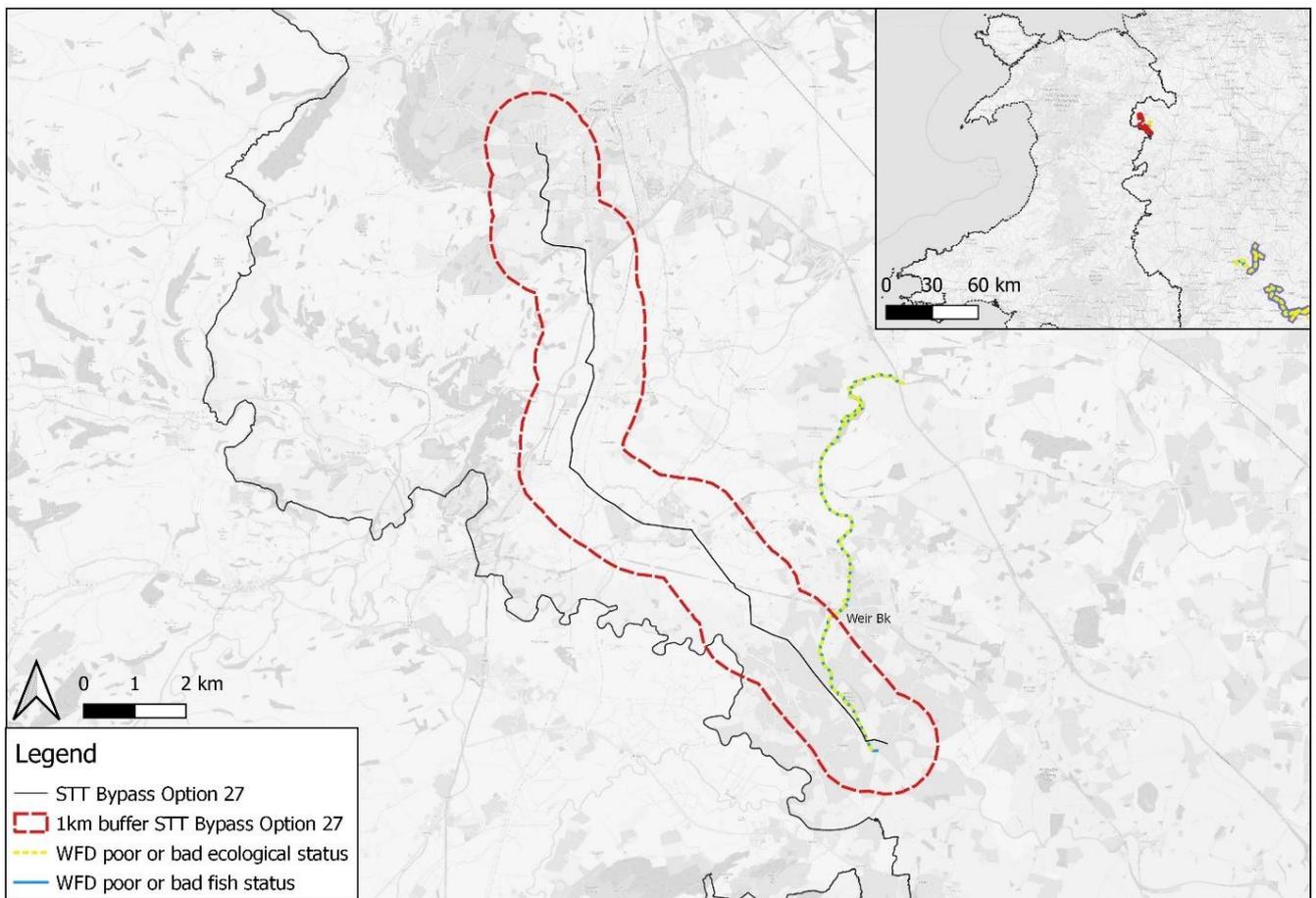


Figure 3.16 Permanent construction River Biodiversity Opportunity Areas (labelled with WFD name) identified within 1km of the proposed outfall

## 4. NATURAL CAPITAL

### 4.1 BIODIVERSITY AND HABITAT

The habitats affected by the STT Solution, and used for the natural capital assessments, are set out in **Section 3.1**. It is assumed for the purpose of this assessment that all habitat falling within the zone of influence will be temporarily lost during the construction period (with the exception of any areas of permanent loss within the area), and replaced following construction. Therefore, the loss of associated ecosystem services will occur only for the period of construction and habitat reinstatement.

**Section 3.1** also presents the permanent habitat loss, the area proposed for habitat creation, and the area proposed for habitat improvement. It also set out the required mitigation for BNG which has been used in the natural capital assessments.

### 4.2 CLIMATE REGULATION

**Table 4.1** summarises the monetary value of the climate regulation ecosystem services provided. It also presents the change in carbon sequestration including consideration of required mitigation for BNG. The results show a loss of carbon sequestration for some options, even with BNG mitigation in place.

The monetisation is based on the BNG calculation (i.e. size of the area, whether the loss is temporary or permanent, and the biodiversity value of the habitats affected). As a result, calculations are based on the carbon sequestration value related to derived biodiversity units, noting that habitat with a higher biodiversity value are typically more difficult to recreate following completion of the construction phase. Hence the loss and reinstatement of these habitats will result in a greater impact relative to lower value habitats such as arable fields or modified grassland.

The 30- and 80-year NPV covers the period 2022-2051 and 2022-2100 respectively. A five-year planning stage followed by five years of construction has been used so annual benefits are assumed to be zero until 2032. The discount rates used are 3.5% for the first 30 years (from 2022), 3% for years 31-75 and 2.5% for years 76-80 following the HMT Green Book Discount Rate. Carbon prices are only used to adjust future annual benefits from climate mitigation.

It is not possible to quantify the non-spatial changes in biodiversity and habitat ecosystem services arising from habitat condition improvement. To avoid overestimating the beneficial impact of the change in non-traded carbon sequestration following BNG habitat creation or reinstatement, the value has been calculated by summing the change in non-traded carbon sequestration value during construction (the temporary loss), the permanent loss, and habitat creation.

Table 4.1 Summary of non-traded carbon sequestration values

	Climate Regulation Values (£2022 / year)			30-year NPV	80-year NPV
	Temporary loss	Permanent loss	Net Gain (includes value of created habitats)		
STT Solution	-£13,309	-£237	£28,722	£340,752	£833,233

#### 4.2.1 Natural Hazard Regulation

There is a potential risk to flooding as the proposed sites affect some areas within Flood Zone 2 and 3. The magnitude of this risk will be small considering the scale of the project. The largest habitat types to be affected are agricultural land and modified grassland, neither of which offer any value to natural hazard regulation. The areas of woodland, semi-natural grassland and freshwater that are lost within flood zones are still likely to have an impact. The monetised baseline assessment of natural hazard regulation net impact is presented in Table 4.2. A benefit transfer value has not been identified at this stage for agricultural land, therefore this has not been accounted for in the baseline assessment. Detailed NC calculations summarised in the sections below are shown in Appendix 1.

The CAMS data for STT scheme shows the water availability at pre-drought conditions (Q70) is unavailable for the majority of affected catchments, with equal minorities still being available for water abstraction or being

at risk. At drought conditions (Q95) the same proportion of water catchments are unavailable but a larger proportion of other catchments will have availability. The highest risk caused through the implementation of the scheme will be in the Severn downstream from the abstraction point, however increased flow within the waterbodies associated with the scheme may provide a small benefit to their catchments during drought conditions.

**Table 4.2** presents the baseline assessment of natural hazard regulation.

Table 4.2 Summary of natural hazard regulation impacts

	Climate Regulation Values (£2022 / year)			30-year NPV	80-year NPV
	Temporary loss	Permanent loss	Net Gain (includes value of created habitats)		
STT Solution	-£4,223	£0	£23,276	£242,724	£462,594

### 4.3 WATER PURIFICATION

A brief summary of the baseline and potential change is included below in **Table 4.3**.

Table 4.3 Summary of baseline and potential change to water purification service provision

	Water purification ecosystem service provision assessment	RAG rating
SST Solution	<p>Services are currently provided by greenfield and woodland habitats. Water will be extracted from the River Severn, the WFD waterbody is currently achieving a moderate status. In additional water is also transferred from the River Avon and Severn which influences water quality. Potential opportunities for restoration have been highlighted in the accompanying STT-G2-S3-125-Wider Benefits Study.</p> <p>The construction of an intake will temporarily change the land cover and therefore have the potential to reduce water quality. These temporary associated water quality impacts will be mitigated via standard engineering and mitigation construction approaches in line with the requirements set out within the Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG5: Works and maintenance in or near water). However there is also an opportunity to consider the ability for land to regulate water quality by reducing runoff etc to support water purification for habitat requirements. This will need to be discussed more at Gate 3 but is also discussed in the Wider Benefits Study as habitat restoration opportunities.</p> <p>The pipeline construction may have a temporary negligible impact on water purification but will be mitigated via standard engineering and mitigation construction approaches. Additional purification services can be gained from the suite of Net Gain opportunities.</p>	No change

### 4.4 WATER REGULATION

The maximum deployable output from the scheme will be 500MI/d to the southeast of England during drought conditions. A large portion of the 3,423,800 houses identified in London by the 2021 census are likely to benefit from the scheme, with a further 3,807,900 identified in the Southeast of England which will also stand to benefit. Wider stakeholder engagement has not been carried out at this stage. Therefore, assessment of current abstractors, water left for other existing and future users will be reviewed during stakeholder engagement and will be considered at Gate 3.

### 4.5 TOURISM AND RECREATION

**Table 4.4** depicts the baseline welfare value for the recreation assets affected by the STT scheme.

It has not been possible to monetise the recreation and tourism benefits of the component with BNG uplift as the details of the habitat creation opportunities have not been agreed, therefore these cannot be assessed

using the ORVal tool. It is unknown whether new habitat creation sites will provide additional recreation facilities, as public access is currently unknown.

Table 4.4 ORVal outputs: Welfare values and estimated visits for affected recreation sites\*

	Recreation value (£2022 / year)	
	Temporary loss	Visitor numbers
STT Solution	-£1,028,907	-118,886

\*Note that is only NPV values for Agriculture, Carbon and Natural hazard, since these 3 have associated mitigation. For tourism and recreation all is only currently for temporary loss and would need to be refined at Gate 3 when precise location of all sites have been identified.

## 4.6 AGRICULTURE

**Table 4.5** depicts the baseline agriculture value for the STT scheme. The values below represent the annual value of provisioning services that support agricultural production for the estimated area of each component. For pipeline routes, it is assumed that this value will be lost during the construction period only as agricultural land will be reinstated.

Table 4.5 Baseline assessment of agriculture ecosystem service provision

	Agriculture Values (£2022 / year)				
	Temporary loss	Permanent loss	Net permanent impact	30-year NPV	80-year NPV
STT Solution	-£121,186	-£2,955	-£2,955	-£30,819	-£58,736

## 4.7 SUMMARY OF NATURAL CAPITAL IMPACT

The overall environmental benefits in relation to climate regulation, natural hazard regulation and agriculture ecosystem services are shown in **Figure 4.1**. The Natural Capital methodology doesn't take into account the monetary cost of land acquisition and management for the required mitigation. The larger schemes will require more land and it is assumed that this will incur associated higher management costs.

As all schemes are required to provide 10% BNG, larger schemes do provide a larger net gain after mitigation. When this mitigation, through habitat succession or creation, is converted into possible ecosystem services, it is possible that the larger schemes look more favourable in terms of monetary gain, even if the impacts are greater initially.

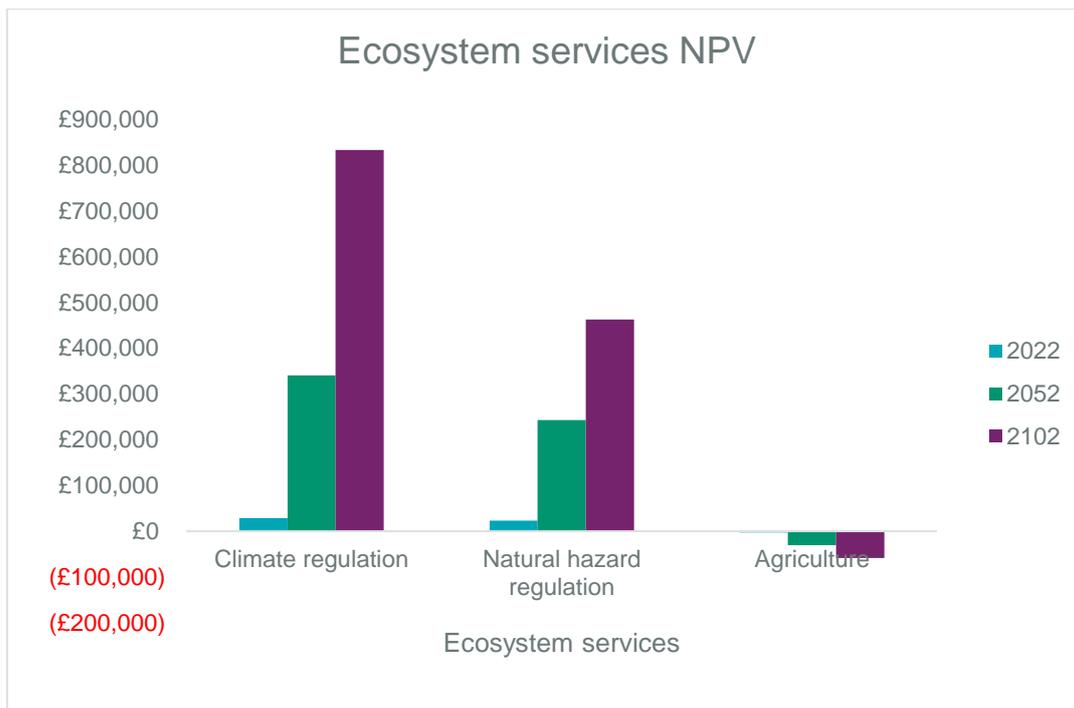


Figure 4.1 Ecosystems Services NPV

## 5. ENGAGEMENT PLAN

The outputs of this study have identified areas of opportunities. The opportunity areas will require further ground-truthing at a local level. The STT group will need to co-ordinate stakeholder engagement activities to work with the network of stakeholders in the area, to deliver and co-ordinate community and environmentally linked benefits across the STT project area. A co-ordinated group would allow multiple organisations to come together to deliver benefits linked to the STT and would become key to identifying further opportunities at a local level. Building on the results and mapping undertaken and informing the engagement plan.

There are several organisations working within the STT Solution project area which are currently delivering environmental improvements. Land within the STT catchment is also being allocated for environmental mitigation activities linked to other infrastructure projects and ongoing local development. The timeframe for the STT solution delivery is not confirmed at present and further changes will continue on the ground which will need to be incorporated into the engagement plan. It is for these reasons that an actual engagement plan of action is not presented here. Nevertheless, the steps that have been taken to date, the organisations that have been engaged, and those that could be included in the future development of the scheme are described below.

The engagement plan will be further developed as part of the Gate 3 requirements, when there will be increased confidence in the Solution’s planning horizons and delivery timescales, along with greater clarity of the organisations who are delivering current and planned projects within the opportunity areas of the STT solution footprint.

The key stakeholders that have been identified through the Gate 2 workshops and questionnaire responses for the STT solution area, are set out in **Table 5.1**. The local level stakeholder network will provide valuable knowledge and data to further refine the six capitals and sustainable management of natural resources approaches. To date two specific BNG and Natural Capital workshops have been held with the organisations listed in **Table 5.1**.

**Table 5.1 Stakeholder organisations engaged in Gate 2 workshops**

Organisations included in Gate 2 engagement workshops	Nature of organisation
Nature Resources Wales	Environmental Regulator
Natural England	Environmental Regulator
Environment Agency	Environmental Regulator
Severn Trent Water	Solution core water company
Thames Water	Solution core water company
United Utilities	Solution core water company

The water companies and key stakeholders, including landowners (example stakeholder organisations identified in **Table 5.2**) could identify opportunities within their own landholdings or opportunities to partner with large landowners to provide wider benefits. This will help to identify land constraints, and opportunities. In parallel, other initiatives can be identified that may be delivered before the STT solution. This may include habitat improvements delivered from local nature recovery networks for example, helping to narrow down the potential land available to deliver the benefits. Given this scheme is to be delivered in the future, the time period between current conditions (as reflected in available data) and information that will be available in the future when the scheme is to be delivered, needs to be borne in mind when implementing a suitable engagement plan in support of the benefits, utilising the best available data. Further information on BNG (and if appropriate natural capital) can be provided in the context of the consenting process, where needed.

Partnership working with stakeholders and key organisations will enable the development and delivery of the engagement plan. Aligned to the STT solution delivery timescales, the engagement plan may include the development and delivery of timely and continued regular communication via multiple channels with stakeholders. Including (where appropriate) linking with local charities, schools, or educational organisations for specific and defined aspects of the engagement plan. Establishing connections between community groups and individuals to enable wide- and far-reaching local engagement to be co-ordinated consistently across the greater STT solution geographical area.

Community workshops and forums could be held to engage local communities and share information about the planned project delivery and timescales, management expectations, and link community and special

interest groups. This could be supported by the development of technical or geographic specific groups co-ordinating special interest engagement activities and opportunities identification.

Utilising a co-ordinated stakeholder engagement approach, the specific plan formation would be developed in collaboration with STT partners and stakeholder organisations. Workstreams including special interest groups, could be established, related to the heat and opportunities mapping work presented in this report.

The identification of additional social and environmental value benefit opportunities following confirmation (in the future) of land available for use for the STT solution also aligns to the aims of the Six Capitals approach, (in addition to the land required for offsetting or BNG mitigation).

Through the co-ordination of activities, one key aspect will be the identification of data gaps and monitoring requirements/ responsibilities to ensure that opportunities are monitored, and benefits realisation can be tracked. The specific details related to data gaps and monitoring will need to be established when wider stakeholders are confirmed. Due to the large geographic area covered by the STT solution, use could be made of a digital platform to co-ordinate localised and special interest groups to maintain consistency.

The core stakeholder group should be aligned to the scheme delivery timeframe, however, there should be flexibility in the plan to include other stakeholders as the solution develops. Therefore, the engagement plan would need to be dynamic to adapt to changes available in land, data and timescales.

It should be noted that the stakeholders included in **Table 5.2** are not exhaustive and there may be other organisations to include in the stakeholder engagement as the project progresses. Different groups of stakeholders will need to be engaged and involved at different times, depending on their role, with some involved throughout the project life cycle.

Future engagement can be linked to the gated process timeline, which will influence when different stakeholders may be engaged. The timing of engagement activities will vary by stakeholder, so will be different, for example, for Regulators and local special interest groups who may only be involved with engagement activities on a particular focused issue.

Table 5.2 Stakeholder organisations to be included in future activities

Stakeholder	Type of stakeholder	Purpose of engagement	Types of engagement activities / communication channels	Level of engagement	When to engage
Nature Resources Wales	Regulator	Statutory	Mixed engagement activities including workshops, meetings, formal feedback on reports, using mixed communication channels	High	Throughout
Natural England	Regulator	Statutory	Mixed engagement activities including workshops, meetings, formal feedback on reports, using mixed communication channels	High	Throughout
Environment Agency	Regulator	Statutory	Mixed engagement activities including workshops, meetings, formal feedback on reports, using mixed communication channels	High	Throughout
Severn Trent Water	Water company	STT solution partner	Mixed engagement activities including workshops, meetings, formal feedback on reports, using mixed communication channels	High	Throughout
Thames Water	Water Company	STT solution partner	Mixed engagement activities including workshops, meetings, formal feedback on reports, using mixed communication channels	High	Throughout
United Utilities	Water Company	STT solution partner	Mixed engagement activities including workshops, meetings, formal feedback on reports, using mixed communication channels	High	Throughout
Wildlife Trusts	Special interest Group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	Before Gate 3 and then ongoing
Canals and Rivers Trust	Key stakeholder	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed
The River Trusts	Key stakeholder	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed
RSPB	Special interest Group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed
CaBA catchment co-ordinators	Key stakeholder	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed
Local Nature Recovery Strategy groups	Special interest Group	Environmental / Community / Planning	Mixed engagement activities, using mixed communication channels	Issue Specific	Before Gate 3 and then ongoing
OxCam Arc	Special interest Group	Environmental / Community / Planning	Mixed engagement activities, using mixed communication channels	Issue Specific	Before Gate 3 and then ongoing
Angling organisations	Local group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed
River Severn Partnership	Key stakeholder	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	Before Gate 3 and then ongoing
Local Councils	Key stakeholder	Environmental / Community / Planning/ Statutory	Mixed engagement activities, using mixed communication channels	High	Before Gate 3 and then ongoing
Recreational River users	Local group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	Before Gate 3 and then ongoing
Local Wellbeing organisations	Special interest Group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed

Stakeholder	Type of stakeholder	Purpose of engagement	Types of engagement activities / communication channels	Level of engagement	When to engage
Local schools and educational organisations	Local group	Educational/ Community / Environmental.	Mixed engagement activities, using mixed communication channels	Issues Specific	To be confirmed
Local Landowners	Special interest Group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed
The National trust	Special interest Group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed
The Crown Estate	Special interest Group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed.
Local Nature Reserves	Special interest Group	Environmental / Community	Mixed engagement activities, using mixed communication channels	Issue Specific	To be confirmed.



## 6. CONCLUSIONS

---

### 6.1 SUMMARY OF THE FINDINGS

#### 6.1.1 BNG terrestrial

A total of 391.21 ha of temporary habitat loss was calculated for the whole STT scheme due to pipelines and construction compounds. In the absence of off-site mitigation this would result in a net change of -12.14% BNG units. A total of 9.05 ha of permanent habitat loss calculated for the whole STT scheme, in the absence of off-site mitigation, would result in a net change of -100% BNG units. The mitigation required to achieve a minimum of 10% BNG was calculated per county where habitat loss occurred, namely Shropshire, Oxfordshire and Gloucestershire. Approximately 98 ha of land will be required to mitigate the temporary impacts from the STT scheme and achieve a 10% net gain in biodiversity. Approximately 9.05 ha of land will be required to mitigate the permanent impacts from the STT scheme and achieve at 10% net gain in biodiversity. Areas of land which may be suitable for mitigation have been identified in each county using scoring criteria with the highest scoring sites potentially offering more effective, functioning mitigation.

#### 6.1.2 BNG rivers

A total of -1.95 river unit losses were estimated for the temporary construction of the pipeline routes and -0.25 river unit losses were estimated for the installation of permanent infrastructure such as pumping stations and abstraction and outfall locations associated with the STT Solution (excluding Minworth and Netheridge construction). In order to achieve a minimum of 10% BNG on the river unit losses caused by temporary and permanent construction, a total of 10 river PBOs were identified for enhancement from poor to fairly poor ecological condition. The required length for enhancement is 0.18 km for the 10 temporary construction mitigation rivers, and 0.25 km for the one permanent construction mitigation river. The rivers for enhancement are all located within 1 km of the potentially affected river.

No river unit losses were identified for the operation of STT Solution and therefore no river enhancement scenarios were modelled within the metric.

#### 6.1.3 Natural Capital

The overall environmental benefits in relation to climate regulation, natural hazard regulation and agriculture ecosystem services over the 80 year lifespan of the scheme is £1,237,091. The Natural Capital methodology doesn't take into account is the monetary cost of land acquisition and management for the required mitigation. The larger schemes will require more land and associated management costs. The current Zol for the assessed components extends to just the assumed construction zones. Whilst acceptable for a high-level approach, greater detail will need to be collected following stakeholder engagement, agreed engineering specification etc. as part of further scheme development.

In summary, the key additional points that will need to be considered include:

- Carry out stakeholder engagement to understand what other abstractors may be planning to use water that could have an impact on water regulation status.
- Refine benefits related to agriculture based on more detailed farm business surveys. This will provide a more detailed assessment of the values of different agricultural natural capital related assets.
- Identify land holding in more detail that relates to the associated water companies and key other land owners to identify key opportunity areas.
- Review any natural hazard regulation assessment based on the above assessments.
- Following more detail re planning and identification of net gain sites it will be possible to use the Forest research data and local data to better ascertain flood regulation opportunities and assessment related to woodland ( related to canopy interception, soil storage and roughness).

### 6.2 UNCERTAINTY, CONFIDENCE DATA GAPS

There are a range of known additional data but these are mostly at the local scale and require detailed local stakeholder engagement to pull this important, but focused information together, This will need to be assessed

as part of Gate 3 and beyond. Additionally, there is a large uncertainty related to land ownership at the STT scale. To date, no data has been provided regarding access to all STT-related water company land assets or knowledge of individual water company's BNG ambitions on their land holdings. This has been identified as a gap in knowledge and will need to be addressed in order to support opportunities areas in the future.

River MoRPh surveys at Gate 2 were only undertaken at sites potentially affected by the operation of STT Solution. Modelling outputs at Gate 2 have further defined river reaches potentially impacted by STT Solution. This includes identification of river reaches upstream of Alveston to Stoneleigh that will be affected by changes in velocity, channel depth and nutrient concentrations. No River MoRPh surveys were conducted at watercourses potentially impacted by construction of STT Solution.

### 6.3 RECOMMENDATIONS FOR GATE 3

The following recommendations are made for work beyond Gate 2 in order to further bolster the BNG and NC assessments and to provide this with a more robust empirical framework (this should be consistent with what is required from a consenting perspective):

- UKHab survey and BNG habitat condition surveys of the full construction corridors to provide a complete baseline data set to inform the BNG metric calculations and reduce the assumptions required to determine the impacts and off-site mitigation requirements.
- Additional River MoRPh surveys covering at least 20% of the impacted reach due to the operation of STT Solution from Alveston to Stoneleigh on the River Avon. Construction may need to be considered where there is a new outfall or intake infrastructure area.
- Further engagement related to the potential opportunity areas for biodiversity sites identified in this report to form a final site selection. Additional surveys will be required on sites to confirm specific habitat types present and then updated within the BNG Metric. This approach will help to support understanding and determination of most effective places to carryout biodiversity habitat enhancement and linkages. Once this is completed it will be feasible to update the Natural Capital assessment and associated benefits together with an assessment of wider capitals using the 6 capitals approach.
- **Section 5** of this report provides a high-level **stakeholder engagement** plan to support the development of benefits and opportunities. It is recommended that this stakeholder engagement is started between Gate 2 and 3 to ensure synergy of ideas, additional data collection and mapping. At that stage the engagement plan should be further refined through discussion. This, together with the points above, will allow for more development of the STT Wider Benefits Study<sup>61</sup> that has been completed for Gate 2.
- Consideration needs to be given to the identification of additional social and environmental value following confirmation, in the future at Gate 3, of land available for use that could be delivered related to STT solution aligned to the aims of the Six Capitals approach, in addition to the land required for offsetting or BNG mitigation.
- At Gate 2, only NPV values for Agriculture, Carbon and Natural Hazards have been provided since these 3 have associated mitigation. For tourism and recreation all is only currently for temporary loss and would need to be refined at Gate 3 when precise location of all sites have been identified.
- This work has drawn on the Wider Benefits Study. Following stakeholder engagement this benefits work should be refined to account for local opportunities including land management to understand more details of benefits opportunities. This requires more information related to land ownership which will be necessary at Gate 3.

---

<sup>61</sup> STT-G2-S3-125-Wider Benefits Study

## ANNEXES

---

### **Annex 1**

Annex 1 comprises an accompanying workbook to this report which contains information pertaining to the biodiversity assessment of the characteristics of rivers/streams and canals: distinctiveness, condition and strategic significance, as referenced in **Section 2**.

The workbook is called “STT-G2-S3-123-Annex\_1”.

### **Annex 2**

Annex 2 comprises an accompanying workbook to this report which contains a table that sets out the full results of the PBO scoring approach, as referenced in **Section 3**.

The workbook is called “STT-G2-S3-123-Annex\_2”.



T: +44 (0) 1235 75 3000

E: [enquiry@ricardo.com](mailto:enquiry@ricardo.com)

W: [ee.ricardo.com](http://ee.ricardo.com)