

Strategic Regional Water Resource Solutions: Annex B5: Wider Benefits Study

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

Date: November 2022



Severn to Thames Transfer

Wider benefits study

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SEVERN THAMES TRANSFER (STT) SOLUTION

Wider Benefits Study

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1. INTRODUCTION

1.1 PURPOSE OF THIS REPORT

The key purpose of this study is to develop a bespoke “blue skies” benefits approach that considers wider benefit opportunities associated with the implementation of the Severn to Thames Transfer (STT) solution, which is being jointly promoted by Severn Trent Water, Thames Water and United Utilities (the STT Partners).

The aim of the STT solution is to enable water to be transferred from the River Severn to the River Thames when needed by water companies in the Southeast of England during periods of drought. The scheme involves the transfer of river water from the River Severn to the River Thames. Due to the risk of concurrent droughts in both river catchments, additional sources of water, apart from those naturally occurring in the River Severn, have been identified to augment the natural flows. These multiple diverse sources of water provide resilience to the system in the provision of raw water flows to the Thames.

The area covered by the STT solution and this Wider Benefits study is outlined in [Figure 1-1](#).

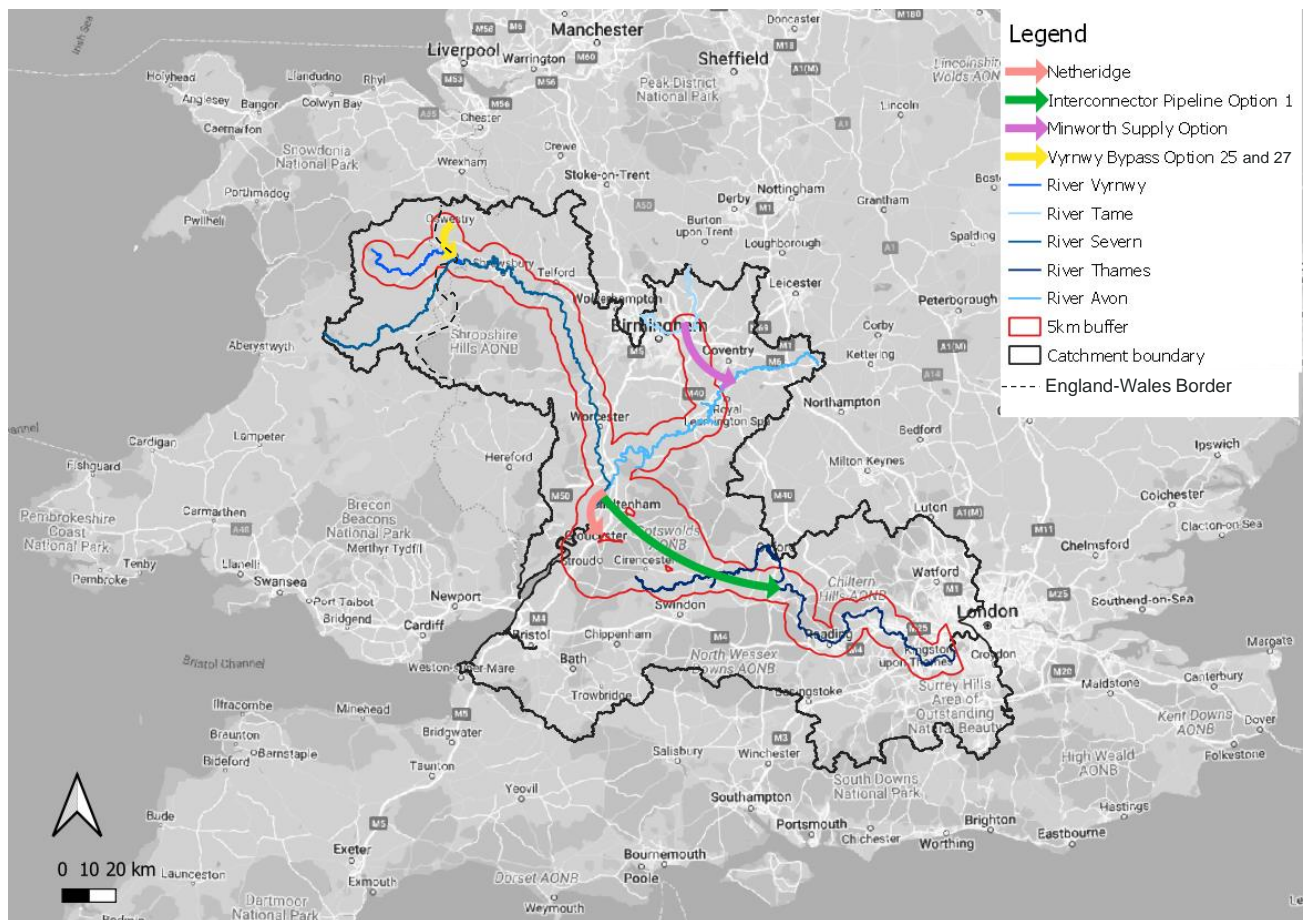


Figure 1-1 The area covered by the STT solution and the study area for this project

The aim of the STT solution is to provide additional raw water resources of 300 to 500MI/d to the Southeast of England during drought, with 500MI/d preferred by the WRSE regional plan public consultation. The water would be provided from excess flows in the River Severn and transferred via an interconnector to the River Thames. For the completion of the Gate 2 assessment, a pipeline “Interconnector” has been selected as the preferred option to transfer water from the River Severn to the River Thames.

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

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

The STT system development and operation may provide a range of opportunities for additional, wider benefits which need to be considered both locally to the sources, receiving waters, and interconnectors, and more widely across the catchment. It should be noted that the STT solution is a potential long-term solution (potentially in the order of 40 years in the future) and there will be many years of planning required ahead of construction.

The purpose of this study is to identify these wider opportunities for environmental enhancement such as improving greenspace accessibility, peatland restoration and reducing runoff risk. The benefits of those opportunities are evaluated using a Six Capitals / Sustainable Management of Natural Resources (SMNR) approach.

As the STT solution covers both Wales and England, it is necessary to develop a bespoke benefits approach that reflects the legislative and policy context of both countries. The approach needs to ensure it accounts for both the SMNR¹ in Wales and associated Wellbeing Goals, and the Six Capitals approach which is accepted for use in England².

Natural capital assets are the stocks of renewable and non-renewable natural capital and the natural processes that underpin them. The benefits we obtain from these natural capital assets are referred to as ecosystem services³. Examples of ecosystem services include products such as food and water, regulation of floods, soil erosion, and recreational benefits in natural areas. Ecosystem services help demonstrate the value of biodiversity as a source of multiple societal benefits, and therefore the importance of the maintenance or enhancement of ecosystems for securing future wellbeing.

The output of this Wider Benefits Study is the development of an interactive geospatial mapping and data assessment approach that accounts for both the SMNR and the Six Capitals, by addressing key questions. The key questions are related to key ecosystem services (water quality, climate regulation, flood management, biodiversity and access to nature) identified by reviewing ecosystem services of most relevance to water companies using the Environment Agency WINEP guidelines and the ACWG Design Principles.

¹ [Introducing Sustainable Management of Natural Resources](#)

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

³ Water resources planning guideline supplementary guidance – Environment and society in decision-making

This work has been developed as “blue skies” geospatial opportunity mapping.

It has been developed based mainly on open-source data at this stage but can accommodate a much larger range of data sets as and when these become available, or following detailed discussion with wider stakeholders.

It is designed to work in parallel with, and add additional benefit to, the work being completed as part of the regulatory Natural Capital and biodiversity net gain work for the STT solution.

As such, this work does not specifically include biodiversity net gain but rather is an approach that identifies areas that can provide the widest range of benefits. The separate Biodiversity Net Gain (BNG) assessment can subsequently be mapped onto this approach.

1.2 REPORT STRUCTURE

This report sets out the work undertaken in the following sections:

- [Section 2](#) sets out the approach adopted in identifying “blue skies” possibilities with regard to wider benefits, incorporating the SMNR associated Wellbeing Goals and the Six Capitals approach, the derivation of key focus areas and heat mapping of opportunity areas;
- [Section 3](#) outlines the data collection undertaken, including stakeholder engagement;
- [Section 4](#) presents key outputs;
- [Section 5](#) presents the Engagement Plan; and
- [Section 6](#) presents conclusions and recommendations for further work.

2. APPROACH

2.1 INTRODUCTION

This wider benefits assessment aims to encompass the Six Capitals approach (**Section 2.2.1**) which is accepted for use in England, and the SMNR and Wellbeing Goals which relate to Wales (**Section 2.2.2**).

Our approach comprises the following aspects, which are set out in more detail below:

- Developing a bespoke benefits approach to account for both Wales and England;
- Data collection;
- Mapping opportunities; and
- Current and future engagement with stakeholders.

The approach is based on “blue skies” thinking at a large spatial scale. As such, it demonstrates the opportunities at the STT solution scale, which crosses the Welsh and English borders. It references guidance from Wales and England, set out in **Section 2.2**, and the All Company Working Group (ACWG) design principles.

The approach outlined below aims to identify potential multiple environmental and societal benefits across the whole of the STT area.

It does not:

- Take the place of the regulatory BNG and Natural Capital Assessment for the STT solution which focus on the requirements for BNG/biodiversity resilience related to specific on-site and off-site opportunities related directly to the STT solution delivery (construction and operation).

It can:

- Support wider catchment benefit thinking.
- Provide a benefits tool that can be used at a range of scales.
- Provide a platform and mapping outputs that can be discussed with wider stakeholders beyond this work into Gate 3.
- Enable blue-skies thinking about what can be considered in the wider catchment and within an agreed buffer zone to support future thinking of where opportunities can be considered on-the-ground to provide other benefits.

It has been developed to be able to:

- Support longer term strategic thinking noting that much of the current work that is being completed by wider stakeholders is to assist current and shorter-term ambitions, whereas for the STT solution, there are many years of pre-planning required ahead of construction.
- Be applied and refined through the gated process at different spatial scales.
- Allow for the inclusion of additional data and information to be added as it become available.
- Account for monetised benefits in the future when there is a more detailed agreement of opportunity areas; currently no monetisation has been applied as it would not be meaningful at this scale (there needs to be agreement of focus areas as part of future work).

2.2 BESPOKE BENEFITS APPROACH FOR ENGLAND AND WALES

2.2.1 Applying the Six Capitals: Accounting for England

The six capitals approach is to explain to financial capital providers how an organisation creates value over time. The capitals are stocks of value that are impacted by the activities and outputs of an organisation. The Six Capitals method that has been developed for the purposes of this study involves initially applying a Natural Capital approach. Natural capital is one of the six identified capitals that is accepted for use in England.

From this foundation, the remaining 5 capitals were then considered as additional components, based on the definitions used in the 2013 report by the International Integrated Reporting Council (IIRC)⁴. The IIRC definitions have been used for consistency with the work of other water companies who have also used the IIRC definitions when incorporating the Six Capital approach.

The remaining 5 capitals based on the IIRC definitions are:

- Financial – the pool of funds that is available to an organisation and obtained through financing;
- Manufactured – manufactured physical objects that are available to an organisation for use in the production of goods or provision of services (e.g., buildings, equipment, infrastructure, such as roads);
- Human - people’s competencies, capabilities and experience, and their motivations to innovate;
- Intellectual - organisational, knowledge-based intangibles; and
- Social - the institutions and the relationships within and between communities, groups of stakeholders and other networks, and the ability to share information to enhance individual and collective well-being.

Further details for each of the capitals are provided in the sections below.

The approach developed does not use the methodology used in the BNG metric⁵ because the purpose of this study is to identify all the opportunities that are available for the scheme in enhancing multiple ecosystem services as well as the remaining 5 capitals.

Overall, the Six Capitals approach broadly aligns with the classification of capital goods in the *Dasgupta Review: The Economics of Biodiversity*⁶; **Figure 2-1** shows the interactions among produced, human, and natural capital. Produced capital refers to all capital that is tangible and intangible and whose ownership can be transferable (alienable) for example roads and public knowledge. Human capital refers to intangible and assets whose ownership can’t be transferred (non-alienable) for example education and skills. Economists have developed methods for measuring the value individuals place on natural resources, so we now have a third category of capital goods: natural capital which includes for example plants (tangible and alienable), pollinators (tangible and often non-alienable), the view from one’s sea-front home (intangible and alienable) and the global climate (intangible and non-alienable).

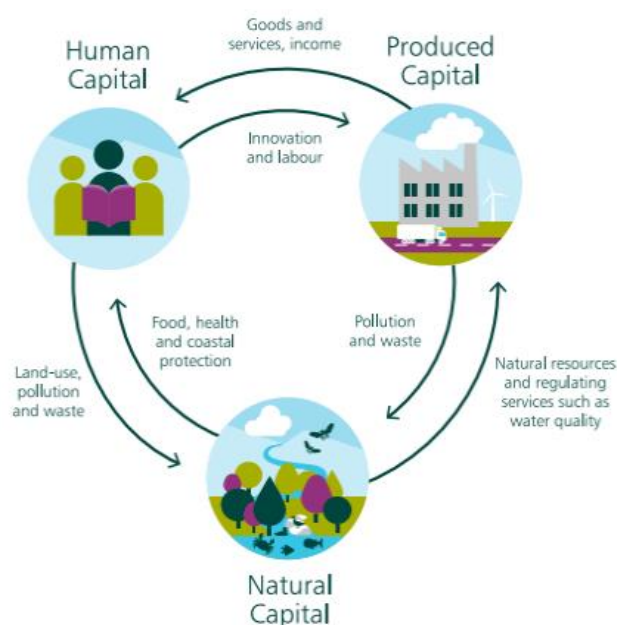


Figure 2-1 The interactions among produced, human, and natural capital

Source: Dasgupta, 2021⁷

⁴ [13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf \(integratedreporting.org\)](https://www.integratedreporting.org/publications/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf)

⁵ <http://publications.naturalengland.org.uk/publication/6049804846366720>

⁶ [Final Report - The Economics of Biodiversity: The Dasgupta Review - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/604980/4846366720.pdf)

2.2.1.1 *Natural capital*

A Natural Capital approach was taken using Natural England's Natural Capital Evidence Handbook⁷ and Natural Capital indicators⁸ to define natural capital opportunities with which to identify potential opportunity areas and subsequent benefits offered from the provision of ecosystem services.

The Natural Capital Indicators identify key components of the environment which are essential for the long-term provision of benefits on which society relies. The Indicators also provide a comprehensive list that identifies what attributes of natural capital are required to sustain multiple ecosystem services.

To target the ecosystem services that are most likely to be influenced by the STT solution and which are of most relevance to water companies, the Environment Agency Water Industry National Environment Programme (WINEP) Natural Capital spreadsheet was examined, which highlighted biodiversity, water quality, climate regulation, and access to nature and flood regulation as key ecosystem services to measure. WINEP is identified as one of the measures that should be included in the Water Resources Planning guidelines.

The ACWG design principles for strategic resource options and projects⁹ were also considered. This guidance clearly states that design principles should be tailored to consider climate, people, place, and value using a combination of the Six Capitals. These principles are embedded in the multiple benefits approaches developed in this study, using both the Six Capitals approach for England, and SMNR and Wellbeing approaches for Wales (see **Section 2.2.2** for the latter). For example, climate mitigation is captured through areas of carbon sequestration as opportunity areas; people and place are accounted via access to nature as well as highlighting the areas with the highest deprivation; whilst value relating to achieve multiple benefits links across the whole study.

In addition, the Outcome Delivery Incentives (ODIs) of the relevant water companies were reviewed to help ensure that the ecosystem assessment outputs would also have direct linked-ODI benefits for the water companies.

2.2.1.2 *Intellectual capital*

Intellectual capital is a key element in an organisation's future earning potential, with a tight link and contingency between investment in R&D, innovation, human resources, and external relationships, which can determine the organisation's competitive advantage.

The geospatial analysis method that has been developed and explained in **Section 2.3** allows for the inclusion of such data and exploration of this capital when information is available.

Through the planning and delivery of the STT solution, knowledge networks can be created and will link stakeholders together; this will contribute, in part, to intellectual capital. Formalising this network, its role, and remit will be to provide an opportunity to measure the impact, outcomes, and contribution to intellectual capital.

2.2.1.3 *Social capital*

Indices of Multiple Deprivation will be used to capture benefits related to social capital such as health, employment, income and social inequality. There are two different Indices of Multiple Deprivation calculated for both Wales and England. Therefore, if areas between Wales and England are being reviewed, then it is important to only use those indices which can be compared, namely, the income and employment domains.

The income deprivation domain measures the proportion of the population experiencing deprivation relating to low income. The definition of low income includes both people that are out-of-work, and those that are in work but who have low earnings (and who satisfy the respective means tests).

The employment deprivation domain measures the proportion of the working-age population in an area involuntarily excluded from the labour market. This includes people who would like to work but are unable to do so due to unemployment, sickness or disability, or caring responsibilities.

The other domains included for England are:

⁷ [Natural Capital Evidence Handbook: to support place-based planning and decision-making - NERR092 \(naturalengland.org.uk\)](https://www.naturalengland.org.uk/natural-capital/evidence-handbook)

⁸ [Natural Capital Indicators: for defining and measuring change in natural capital - NERR076 \(naturalengland.org.uk\)](https://www.naturalengland.org.uk/natural-capital/indicators)

⁹ All Company Working Group (ACWG) Design Principles, Process and Gate two Interim Guidance <https://www.ofwat.gov.uk/publication/strategic-regional-water-resource-solutions-guidance-for-gate-two/>

- **Education:** measures the lack of attainment and skills in the local population; and
- **Health:** measures the risk of premature death and the impairment of quality of life through poor physical or mental health.

The other domains for Wales are:

- **Health:** measures lack of good health by looking at a range of health indicators such as premature death (rate per 100,000) and limiting long-term illness (rate per 100); and
- **Education:** captures the extent of deprivation relating to education, training, and skills.

A full list of the indicators used to measure the Welsh domains can be found on the Welsh Government website under Welsh Indices of Multiple Deprivation¹⁰, and on the GOV.UK¹¹ website for England.

Both the England and Welsh Indices can be used to:

- Compare small areas across England and Wales. As mentioned previously, only the income and employment domains can be compared across countries;
- Identify the most deprived small areas;
- Explore the domains (or types) of deprivation;
- Compare larger administrative areas e.g., local authorities; and
- Look at changes in relative deprivation between iteration (i.e., change in ranks).

They cannot be used to:

- Quantify how deprived a small area is;
- Identify deprived people;
- Say how affluent a place is;
- Compare with small areas in other UK countries; or
- Measure absolute change in deprivation over time.

2.2.1.4 Human capital

Using the definition in the IIRC report¹², human capital is “*generally understood to consist of the individual’s capabilities, and the knowledge, skills and experience of the company’s employees and managers, as they are relevant to the task at hand, as well as the capacity to add to this reservoir of knowledge, skills, and experience through individual learning*”.

It should be noted that the intellectual and human capitals do not have any datasets available at the scale that is required for this study, and therefore have not been scrutinised, although some aspects of human capital have been explored through targeting areas with low employment and health (as defined by the Indices of Multiple of Deprivation for both Wales and England). Further, improving the educational opportunities in an area could improve the local population’s capabilities and knowledge.

Should these capitals be included in the future development of this work, further discussion with stakeholders is needed to assess whether there are opportunities. The geospatial analysis that has been developed (see **Section 2.3**) will allow for the inclusion of such data and exploration of these capitals when information is available.

2.2.1.5 Manufactured capital and financial capital

Manufactured capital looks at the impacts on, for example, a water companies’ pipes, treatment works, offices and IT. Manufactured capital can also look at the benefits that the existing infrastructure has on the natural environment and human health. Financial capital measures the financial health and efficiency of the company.

In terms of measuring the benefits for manufactured capital, it is possible to look at how improvements in ecosystem services e.g., water quality and flood protection, can lead to a reduction in risk to the operation of the water companies’ infrastructure e.g., water treatment works, and undertake a comparison of this. For example, restoring a wetland nearby to a treatment works could lead to a reduction in costs of maintaining the treatment assets due to the wetland potentially reducing the risk

¹⁰ [Welsh Index of Multiple Deprivation: index guidance | GOV.WALES](#)

¹¹ [English indices of deprivation 2019 - GOV.UK \(www.gov.uk\)](#)

¹² <https://www.integratedreporting.org/wp-content/uploads/2013/03/IR-Background-Paper-Capitals.pdf>

of damage via natural flood protection. This can then be compared to how much was originally spent on maintaining the treatment works (the baseline cost).

To support our understanding of potential opportunities as discussed in the paragraph above the wastewater treatment works discharge points have been mapped for this study which also provides a baseline of current related manufactured capital/assets. Any wider environmental and health opportunities that might be accrued from these assets has not yet been fully quantified since this requires greater clarity over project delivery time frames and land access; only then it will become possible to specify habitat opportunities and resulting expected benefits associated with the wastewater treatment works. This will need to be considered as part of Gate 3.

For this study, the current benefits of the water companies' manufactured capital in terms of improving the natural environment or human health were not included. This approach was taken to avoid any issue of double counting but should be considered in the future if valuing the benefits of water companies' manufactured capital is required.

Financial capital refers to the source of financing and funding flows that ensure the operation of manufactured capital and the organisation overall. Impacts to financial capital can be examined in this case through a proxy metric that concerns investor sentiment. This proxy metric involves examining financial losses as a result of reputational impacts through instances such as failure to provide adequate water quality.

Overlapping the financial and social capital are customer bills, and the impact that changes may have upon them. The overall STT solution will affect the financial capital of water companies and therefore has a link to customer bills and affordability. The specific impacts can be considered when more detailed information related to scheme costs and opportunities/benefits are available.

2.2.2 The Sustainable Management of Natural Resources and Wellbeing Goals: accounting for Wales

For each of the principles in the SMNR and the Wellbeing Goals in Wales, potential datasets that could be used to measure the potential benefits for each of the principles were researched and investigated. A full list of the datasets included can be found in [Section 3](#). The SMNR is defined in the Environment (Wales) Act 2016 as: "using natural resources in a way and at a rate that maintains and enhances the resilience of ecosystems and the benefits they provide. In doing so, meeting the needs of present generations of people without compromising the ability of future generations to meet their needs, and contributing to the achievement of the well-being goals in the Well-being of Future Generations (Wales) Act 2015." The definitions of each of the principles and Wellbeing Goals can be found in this [document](#).

Where possible, published area statements were also reviewed in order to take into account the priorities for those areas in the geospatial approach, as well as opportunities to improve social, economic, environmental and well-being across the whole of Wales. Each area statement outlines the key challenges facing that particular locality, what can be done to meet those challenges, and how natural resources can be managed for the benefit of future generations¹³.

The datasets used in the GIS analysis can be measured over time which is particularly important when measuring environmental benefits. This also helps to meet the Environment (Wales) Act requirements of building resilience into Welsh ecosystems and recognising the benefits as the datasets allow for benefits to be measured over time.

For the **Welsh SMNR and Wellbeing Goals** (see also [Figure 2-2](#) for the latter) the habitats within the catchments of the STT solution have been mapped to capture the multiple benefits that these could provide if managed appropriately. [Table 2.1](#) provides a summary of SMNR principles and Wellbeing Goals that have been considered in the analysis. It should be noted that, at this stage, the benefits identified are at a high level across the STT solution in Wales. Furthermore, as discussed in more detail in [Section 3.4](#), it is recognised that before some of the principles outlined in [Table 2.1](#) can be fully applied, it is essential that the design and planning of the STT solution is at a stage where the exact detail of the route has been agreed. For example, to measure the impact on 'a prosperous Wales' or 'a Wales of vibrant culture and thriving Welsh language' we need know the route to understand the impact. It is essential to bear in mind the time lag between the planning, construction, and implementation of

¹³ [Natural Resources Wales / Area Statements](#)

this scheme, which may be in the order of 40 years in the future. Therefore, many of these goals will need to be considered in detail at Gate 3 as noted in [Table 2.1](#).

Table 2.1 A summary of the Welsh SMNR principles and Wellbeing Goals that have been considered in the analysis

SMNR principles and Wellbeing Goals	How the analysis has considered SMNR/well-being priorities	Current limitations
Adaptive management	The data sets used can be monitored and reviewed over time. This will allow for a baseline against which any future appropriate management can be implemented.	The geospatial approach can be further developed as new or revised datasets are available and fit to different queries.
Scale	The geospatial approach includes datasets to allow the identification of benefits at different spatial scales.	The current aim of this project is to provide a high level, “blue skies” approach to opportunities across the whole of the STT area. The approach can be used at different spatial scales throughout Gate 3 and assist the detailed planning process.
Collaboration and engagement	The analysis results can be used to promote collaboration and engagement across a number of stakeholders.	Currently this is focused on key stakeholders (Environment Agency, Natural England, and Natural Resources Wales). However, the method allows for further collaboration and engagement with relevant stakeholders if required. At the moment, due to the scale of the project, the geospatial analysis is at a high level, however if required the data can be more closely scrutinised for different areas. It is recommended that further analysis continues into Gate 3.
Public participation	This is not feasible at this stage, but the approach developed uses open-source data which provides a platform for future participation.	Public participation is more appropriate at Gate 3 once there is a confirmed detailed design for the solution. This does not preclude discussion around opportunities, however. Participation will be required for multiple years, given the future programme of work associated with the planning and construction of the solution.
Evidence	The geospatial approach has incorporated relevant available datasets to capture benefits at the project scale. The datasets are all publicly available and are published by credible bodies.	This work uses the best data available at this scale. The approach developed allows for other data/updates to be added when available so that all evidence is in one place.
Multiple benefits	The geospatial analysis captures multiple benefits that cover benefits from ecosystem services and benefits to the public.	This is currently at a high-level scale, and based on available open-source data. The approach provides a platform for discussing benefits as part of the planning process in Gate 3.
Long term	The approach uses data that can be updated over time and be used as an ongoing tool.	Many of the datasets used are updated frequently meaning comparison over time could be undertaken.
Preventative action	This is currently something that cannot be addressed in the geospatial approach as more detailed local data would be required in order to understand the pressures and drivers of change on the ecosystem services.	Data collection at the local scale would be needed to understand this.
Building resilience	The geospatial approach looks at the importance of the quality of the environment and not just the extent by including data where possible that measures the quality for example, water quality is measured by the WFD status.	When datasets on the state and condition of the natural environment become available they can be integrated into the approach.
A globally responsible Wales	The geospatial outputs highlight the areas with the greatest opportunities in terms of climate regulation/carbon sequestration. They also include river biodiversity maps.	The approach can be further developed when more data becomes available that indicate the quality or condition of the natural environment.

SMNR principles and Wellbeing Goals	How the analysis has considered SMNR/well-being priorities	Current limitations
A prosperous Wales	The geospatial analysis uses data from the Welsh Indices of Multiple Deprivation which are explained in Section 2.2.1.3 Social capital. The STT solution is likely to boost employment, through construction works or the creation of woodland, as well as skills and knowledge. This in turn boosts the local economy.	To determine potential learning and development opportunities, engagement is needed with water company stakeholders on whether planned innovation and research and development will likely contribute to improvements in skills, and whether there are opportunities for local supply chain and local employment. This cannot be completed for this high level study but the approach provides a platform for starting these conversations at Gate 3.
A Wales of vibrant culture and thriving Welsh language	How the STT solution will benefit the Welsh language and the culture is not possible to capture in our geospatial approach.	Currently, we are not able to measure this as the actions to improve certain areas aren't currently known so we can't estimate the impact on Welsh language and culture. However, in Gate 3 once we understand the actions to be put in place in the opportunity areas there will be an opportunity to look at the potential impact on Welsh language and culture.
A Wales of cohesive communities	The geospatial approach uses data from the Welsh Indices of Multiple Deprivation which are explained in Section 2.2.1.3 Social capital.	This high-level study provides some indication of areas of focus. It may be possible during Gate 3 and beyond to give focus to opportunities for local group engagement (volunteers) and options to increase cohesive communities such as providing access linkages etc.
A more equal Wales	The geospatial approach uses data from the Welsh Indices of Multiple Deprivation which are explained in Section 2.2.1.3 Social capital.	As above for cohesive communities.
A healthier Wales	Opportunity areas for improving access to greenspace have been mapped using the Green Infrastructure standards. These standards include the need for at least 0.5ha of greenspace within 200 m; local natural green spaces of at least 2ha within 300 m; and neighbourhood natural green spaces of at least 10 ha within 1 km; and all within a 15-minute walk zone from home. Mapping these areas enables the identification of locations within Wales where opportunities exist to improve physical activity.	The approach provides a high-level assessment of areas that currently are not close to green spaces. It is recommended that this is explored in more detail at Gate 3, taking account of the ambitions stated in the Area Statements.

Figure 2-2 shows an example of how ecosystem services have been mapped to the Natural Resource Wales Wellbeing Goals. As mentioned in the Introduction (Section 2.1), to focus on the ecosystem services that were of most relevance to water companies, **biodiversity, water quality, climate regulation, access to nature and flood regulation** have been selected as the key ecosystem services.

A dashboard mapping ecosystem services to the SMNR principles and the Welsh Wellbeing Goals has been created in Section 4.4. The effects (possibly negative to high benefit) were determined by expert judgement and using the final heat maps.

It is recognised that tourism is also an important ecosystem service for Wales, although there is not a dataset at the scale and granularity required that could be analysed to understand the impact of the STT solution in terms of tourism that could be effected by creating or improving the quality of habitats. There is data at the national level for habitats¹⁴ published by the Office for National Statistics but not at the spatial level needed for this project.

Ecosystem themes and Welsh Government Priorities					
	Water purification	Biodiversity (resilience)	Flood regulation	Climate regulation	Recreation and tourism
	Nature emergency for Wales		Climate emergency for Wales		Priorities for the visitor economy 2020-2025
Well-being goals	A globally responsible Wales	✓	✓	✓	✓
	A prosperous Wales		✓	✓	✓
	A resilient Wales	✓	✓	✓	✓
	A healthier Wales	✓	✓	✓	✓
	A more equal Wales			✓	✓
	A Wales of cohesive communities				✓
	A Wales of vibrant culture and thriving Welsh language				✓

Figure 2-2 Generic example of the approach to mapping ecosystem services to Natural Resources Wales’ Wellbeing Goals

2.3 MAPPING OPPORTUNITIES

The geospatial approach developed for this project was created following internal discussions and workshops attended by Ricardo’s economic, ecological, geospatial, and planning experts. The approach has been further discussed within workshops with key stakeholders including the STT project management board, the regulators (Natural England (NE), the Environment Agency (EA), and Natural Resources Wales (NRW)) and Atkins. Feedback and suggestions from these workshops regarding the approach have been addressed within the overall methodology. The geospatial approach is outlined in Figure 2-3.

This mapping of opportunities is underpinned by a large data collection exercise from a range of spatial open-source data, and other information that required interpolation before use. See Section 3 for full details related to data collection.

¹⁴ [Tourism and outdoor leisure accounts, natural capital, UK - Office for National Statistics \(ons.gov.uk\)](https://ons.gov.uk)

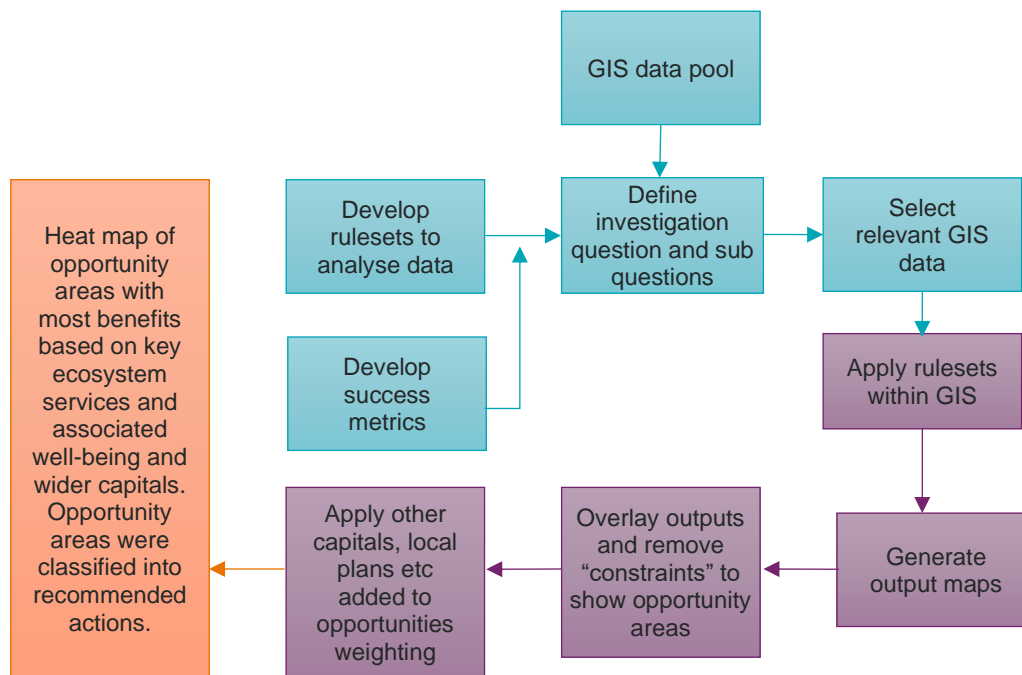


Figure 2-3 A flow chart showing the geospatial approach to map “blue skies” opportunities

2.3.1 Key focus areas

2.3.1.1 Introduction

Key focus areas were identified by reviewing ecosystem services of most relevance to water companies using the Environment Agency WINEP guidelines and the ACWG Design Principles. A question-based approach was used to consider a range of benefits derived by:

- Identifying relevant GIS datasets selected from the GIS data pool (which is outlined in Section 2.2);
- Listing the most important issues for each focus area (e.g., diffuse pollution etc); and then
- Developing rulesets and success metrics that could highlight opportunity areas.

The questions are outlined below and broadly reflect the key ecosystem services that are considered the most important within the regulatory methodology outlined by the ACWG, namely water quality, climate regulation, access to nature (noting wellbeing is derived through local social deprivation indicators), flood management and river biodiversity. More details on the methodology can be found in **Section 2.3.2**.

Due to the scale of the project, it was not feasible to place any monetary valuations on the ecosystem services at this stage for England. Furthermore, many of the benefits captured cannot be monetised as they would unfairly skew the results for this high-level cross-country level assessment. In the future, specific areas could be assessed in more detail following stakeholder engagement and, at that stage, monetisation could be completed where/if required.

The STT solution and this Wider Benefits study area for all of the key focus areas (apart from ‘Access to nature’) was the catchments around the River Severn up to Teddington. For the key focus area, ‘Access to nature’, a 5 km buffer around the proposed scheme route was used as it was deemed that most of the significant changes in landscape from the project would occur in this region.

Various spatial analyses were undertaken, using the software package QGIS, to generate maps to answer each sub question (see below). Outputs of the key focus areas were overlaid, given scores from 0-10 based on their importance (scoring details can be found in **Section 2.3.2**), and rasterised accordingly. The opportunity area rasters were added together and weighted by a number of actors including: the social capital overall map (most deprived areas), synergies with local plans¹⁵ (e.g., proposed local nature reserves), and land owned by various organisations (e.g., United Utilities, Royal Society for the Protection of Birds (RSPB) etc.). Constraints

¹⁵ The term ‘local plans’ used in the report refers to local plans in England and local development plans in Wales.

(areas allocated to housing or employment, industrial units, and continuous urban fabric) were erased from this raster. The raster was rescaled from 0-10 for visualisation purposes and mapped. Scores less than two standard deviations above the mean were removed in order to isolate the most important areas which give the most benefits and would therefore be most cost-effective. Based on the sorts of opportunities that overlapped, the areas were then categorised into recommended actions (e.g., peatland restoration).

2.3.1.2 *Water quality questions*

- **Key Question(s)** – *What are the opportunities for improving water quality?*
- **Sub-question(s)** – *Where are the potential locations for solutions which can be implemented to improve water quality? Where are the greatest point and diffuse sources of pollution?*
- **Outputs** – Locations of watercourses and catchments with overall poor or bad Water Framework Directive (WFD) status, and with point and diffuse pollution sources. Locations of specific activities, e.g., poor livestock management, contributing to diffuse pollution. Locations of wastewater treatment discharge points, disused mines, and farm site equipment likely to be responsible for point pollution.

WFD data on ecological, morphological, chemical, and overall status were mapped to highlight rivers that have poor and bad water quality status. The point and diffuse pollution cause of the poor or bad river status were then mapped. The corresponding catchments were mapped for the diffuse polluted rivers. The locations of nearby wastewater discharge points were mapped to indicate rivers affected by wastewater treatment works. Possible locations of rivers affected by disused mines and farm site infrastructure, were mapped using satellite imagery.

2.3.1.3 *Climate regulation questions*

- **Key Question(s)** – *Where are the opportunities to enhance carbon sequestration and storage?*
- **Sub-questions(s)** – *What is the general level of carbon sequestration and storage of the land cover within the catchment, and how does this correlate with degraded land cover and peat soils (leading to higher emissions)?*
- **Outputs** – Land cover carbon sequestration map based on habitat type. Locations of peat which are suitable for restoration based on if the habitat is natural or not (i.e. agricultural land on deep peat is not natural). Carbon flux map based on habitat type and underlying soil type.

Carbon flux coefficients and carbon storage (of soil, vegetation, and total stock) were estimated for all possible combinations of landcover and soil type (mineral soil, deep peat, shallow peat, and mineral soil with peaty pockets) using data from Natural England’s Carbon storage and sequestration by habitat report¹⁶. Habitats on shallow and deep peat soils were assumed to have identical carbon flux coefficients; peaty pockets were assumed to have carbon fluxes of half the value of the other two soil types. Peaty soil types were mapped and overlaid with urban areas to indicate their suitability for restoration. Carbon sequestration and carbon storage capacity maps were also produced.

2.3.1.4 *Access to nature questions*

- **Key Question(s)** – *How can access to nature be improved within the 5 km buffer area?*
- **Sub Question(s)** – *Which terrestrial habitats are closest to urban areas and could benefit from footpath access, or closest to access to nature areas and could gain additional access to nature benefit?*
- **Outputs** – Location of Built-Up Areas (BUAs) not within Accessible Natural Greenspace standards. Opportunity areas to provide green space for access to nature based on closeness to urban areas, and accessibility of these areas based on the Accessible Natural Green Space Standards.

Terrestrial habitats (selected from Priority Habitat Inventory (PHI)¹⁷, National Forest Inventory (NFI)¹⁸, and Wales Phase 1 habitat¹⁹) within the 5 km buffer around the route options that did not intersect with Public Rights of Way were mapped. The natural habitats (within the 5 km buffer around the route options) that lie closest to recreational greenspaces were also mapped. Finally, built-up areas that fell outside of the Accessible Natural Greenspace Standard²⁰ (ANGSt) buffers were mapped (see **Table 2.2**). It is worth noting that there is

¹⁶ [Carbon Storage and Sequestration by Habitat 2021 - NERR094 \(naturalengland.org.uk\)](https://naturalengland.org.uk/nerr094)

¹⁷ [Priority Habitat Inventory \(England\) - data.gov.uk](https://data.gov.uk)

¹⁸ [National Forest Inventory - Forest Research](https://forestresearch.gov.wales)

¹⁹ [Lle - Terrestrial Phase 1 Habitat Survey \(gov.wales\)](https://gov.wales)

²⁰ [Accessible natural greenspace in towns and cities: a review of appropriate size and distance criteria - ENRR153 \(naturalengland.org.uk\)](https://naturalengland.org.uk/enrr153)

a potential negative impact on the increased use of habitat by people. This was not quantified in the study but should be considered when specific opportunity areas are being reviewed, for example by investigating the potential for trampling; the potential adverse impact on vulnerable species caused by disturbance, and other factors.

Table 2.2 Accessible Natural Greenspace standards

Accessible Natural Greenspace standards
300 m from at least 2 ha greenspace
2 km from at least 20 ha
5 km from at least 100 ha
10 km from at least 500 ha
Outside of these buffers

2.3.1.5 Flood management questions

- **Key Question(s)** – *Where are the opportunities to reduce flood risk?*
- **Sub-question(s)** – *Where in the catchments do the highest levels of potential runoff occur, and how do these correlate with land cover? How far downstream could these enhancements be seen?*
- **Outputs** – Locations of greatest runoff risk and greatest flood risk within the scheme catchment which indicate opportunity areas for remediation.

Flood risk maps were compiled using available planning data on flood zones 2 and 3 which indicated medium and high flood risk (respectively) from surface water, small watercourses, rivers, and the sea. Open data for surface water risk in England is only available on a 1 km square basis, whereas the Welsh surface water flood risk is at a finer resolution. Historic flooding extents were also mapped. Following this, a proxy for runoff risk was modelled (using the Whitebox package in R) by assigning Manning's roughness coefficients to landcover, slope produced from DTM 50 m data, annual rainfall average from 2011-2020 and distance from watercourse. The output of the model comprises the areas with the greatest runoff.

2.3.1.6 River biodiversity questions

- **Key Question(s)** – *Which rivers could be enhanced to improve biodiversity?*
- **Sub-question(s)** – *Where are the greatest barriers to fish and eel migration? Which rivers have the lowest WFD fish status? Which rivers have invasive species, have undergone physical modifications or have undergone changes to the natural flow and levels of water?*
- **Outputs** – Locations and lengths of rivers with poor or bad fish status. Location and heights of priority barriers. Locations of specific activities, e.g., non-native invasive species, contributing to poor or bad overall WFD status.

WFD fish status watercourses were mapped throughout the scheme catchment, and the location of poor or bad status were extracted. Priority fish barriers were mapped and categorised according to their height. The barriers greater than 1.4 m were extracted as this height has been shown to act as a barrier to Atlantic Salmon migration²¹. Watercourses with an overall WFD status of bad or poor were mapped according to the given activity or reason for this status. Three aspects were considered as being related to biodiversity: (1) physical modifications; (2) non-native invasive species; and (3) changes to natural flow and levels.

2.3.1.7 Social capital questions

- **Key Question(s)** – *Which ecosystem services could be enhanced for societal benefits?*
- **Sub-question(s)** – *Where are the most deprived areas in terms of health, employment, education, and income?*
- **Outputs** – Mapped deprivation indices

Deprivation indices namely health, employment, education, and income were mapped using the English and Welsh Indices of Multiple Deprivation to provide an understanding of the interlinks between ecosystem service and societal benefits.

²¹ [The impact of a small-scale riverine obstacle on the upstream migration of Atlantic Salmon \(springer.com\)](https://www.springer.com)

2.3.2 “Heat map” opportunity mapping

This section gives the method for the “heat map” opportunity mapping process.

2.3.2.1 Water quality heat map

The catchments producing diffuse pollution (and segments of river in the case of in-river or riparian causes), and locations responsible for point pollution of rivers (including segments of river where specific locations could not be identified) were assigned a score of 2 for bad status and a score of 1 for poor status. The scored catchments, river segments, and point locations were combined in a final heat map to show opportunities to enhance river biodiversity. These opportunities are complementary to Natural Resource Wales’ Plan of Action for Salmon and Sea Trout²².

2.3.2.2 Climate regulation heat map

A heat map was created from the positive carbon flux values (habitats with carbon emissions) and data on soil type. Scores were assigned as shown in **Table 2.3** with higher scores indicating more benefit.

Table 2.3 Climate regulation heat map scoring

Soil type	Flux	Score
Deep peat	≥ 30	10
Shallow peat	≥ 30	9
Deep peat	$20 \leq \text{Flux} < 30$	8
Shallow peat	$20 \leq \text{Flux} < 30$	7
Deep peat	$10 \leq \text{Flux} < 20$	6
Shallow peat	$10 \leq \text{Flux} < 20$	5
Deep peat	$0 < \text{Flux} < 10$	4
Shallow peat	$0 < \text{Flux} < 10$	3
Peaty pockets	> 0	2
Mineral soil	> 0	1
	< 0	0

2.3.2.3 Access to nature heat map

Terrestrial habitats with no public rights of way, and natural habitats which are closest to green spaces, were each given scores according to Accessible Natural Greenspace Standard (ANGSt) buffers from urban areas which did not have access to greenspace according to the ANGSt methodology (**Table 2.4**). The two layers were then rasterised and added together to give the access to nature opportunity heat map with higher scores indicating more benefits.

Table 2.4 Access to nature heat map scoring using the Accessible Natural Greenspace standards

Areas to be assigned score	Buffer	Score
Natural habitats with no public rights of way or natural habitats which are closest to green spaces	300 m	5
	2 km	4
	5 km	3
	10 km	2
	Outside of these buffers	1

2.3.2.4 Flood management heat map

Areas with a greater than average runoff risk were overlaid with the flood zone areas and given scores according to **Table 2.5**. The scores were mapped in a heat map showing the relative importance of the flood regulation opportunity areas within the STT solution and Wider Benefits study area.

²² [Natural Resources Wales / Salmon and sea trout plan of action 2020](#)

Table 2.5 Heat map flood management opportunity scoring method

Condition 1	Condition 2	Score
Greater than the average runoff risk score	High flood risk (flood zone 3)	3
Greater than the average runoff risk score	Medium flood risk (flood zone 2)	2
Greater than the average runoff risk score	No flood risk assigned	1
Less than the average runoff risk score	No flood risk assigned	0

2.3.2.5 River biodiversity heat map

Rivers with poor or bad ecological, fish, and overall status (due to invasive species, changes to natural flow/water levels and physical modifications) were assigned scores of 1 and 2 respectively. Barriers greater than 1.4 m were given a score of 2. These layers were combined to give the river biodiversity heat map.

2.3.2.6 Social capital heat map

Deprivation indices namely health, employment, education, and income were mapped to provide an understanding of interlinks between ecosystem service and societal benefits. The cumulative deprivation was mapped showing the potential for the largest societal benefit. This map was used to weight the final heat map by multiplying factors (see [Table 2.6](#) in [Section 2.3.2.7](#)).

2.3.2.7 The Final Heat Map

To identify the final opportunity areas, the heat map rasters were added together and weighted with the datasets shown in [Table 2.6](#). Scores of 0 were given to the constraints to remove them (when multiplied); a score of 1 was given to medium importance; and 2 was given for higher importance. This enabled the creation of a final heat map where the scores indicate the priority of the opportunity area. Scores that fell two standard deviations above the mean score were isolated in order to highlight the most important areas which give the most benefits and would be most cost effective. These areas were then categorised into appropriate actions according to [Table 2.7](#).

The final heat map also displayed river biodiversity opportunities to improve bad status, river barriers greater than 1.4 m and possible wastewater treatment plant discharge points causing bad river status. The final heat map identified the opportunity areas where the greatest potential benefits can be realised.

Table 2.6 Datasets used in weighting for the final heat map

	Dataset	Multiplying factors
Synergies	Social capital heat map	1-2
	National Trust, RSPB, Crown Estate and United Utilities ownership	2
	Proposed green infrastructure, local nature reserves or areas undergoing nature improvement	2
Constraints	Employment, housing, and transport development areas	0
	Continuous urban fabric (CORINE)	0
	Industrial units (CORINE)	0

Table 2.7 The recommended actions associated with the most important opportunity areas and the criteria used to categorise them

Recommended actions	Criteria
Peatland restoration	Climate regulation score > 2
Reducing surface runoff	High flood management score with no other priorities
Greenspace – improving accessibility and planting	High scores for access to nature and flood management
Reducing urban diffuse pollution	High score for diffuse pollution, and overlap with other activities
Reducing transport diffuse pollution	
Reducing livestock diffuse pollution	

Reducing nutrient diffuse pollution	
Reducing soil erosion	

3. DATA COLLECTION

3.1 INTRODUCTION

The Ricardo team has amassed data and information through its work on other aspects for the STT solution, ranging from data sets, stakeholder engagement and other activities. To supplement this information, further data was gathered and assessed for this Wider Benefits Study relating to the area immediately around the STT solution's working corridor and potential Net Gain/resilience areas.

3.2 DATA

Table 3.1 details the GIS data sources used, the publisher, link, and region of the STT solution covered by each. **Table 3.2** details the data sources which were derived from local or neighbourhood plans. These data sources were either downloaded as GIS files or digitally georeferenced and traced to produce GIS files.

Table 3.1 Data sources used in the key focus areas

Data name	Published by	Source link	Region of STT scheme
CORINE landcover 2018	European Environment Agency	https://land.copernicus.eu/pan-european/corine-land-cover/clc2018	England and Wales
HadUK-Grid Gridded Climate Observations on a 1 km grid annual rainfall from 2010 to 2020	Met Office	https://catalogue.ceda.ac.uk/uuid/4dc8450d889a491ebb20e724debe2dfb	England and Wales
Priority barriers – combined coarse and salmonid	Environment Agency	https://data.catchmentbasedapproach.org/datasets/therivertrust::priority-barriers-combined-coarse-and-salmonid-rank/about	England and Wales
WFD River Waterbody Catchments Cycle 2	Environment Agency	https://ckan.publishing.service.gov.uk/dataset/wfd-river-waterbody-catchments-cycle-2	England and Wales
WFD River Canal Surface Water Transfer Cycle 2	Environment Agency	https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/WFDRiverCanalAndSWTWat erBodiesCycle2&Mode=spatial	England and Wales
Indices of Multiple Deprivation (England)	Ministry of Housing, Communities and Local Government	https://www.gov.uk/guidance/english-indices-of-deprivation-2019-mapping-resources	England
Welsh Indices of Multiple Deprivation	Welsh Government	https://datamap.gov.wales/layergroups/inspire-wg:WelshIndexOfMultipleDeprivationWIMD2019	Wales
Flood Map for Planning (Rivers and Sea) Flood Zone 2	Environment Agency	https://data.gov.uk/dataset/cf494c44-05cd-4060-a029-35937970c9c6/flood-map-for-planning-rivers-and-sea-flood-zone-2	England
Flood Map for Planning (Rivers and Sea) Flood Zone 3	Environment Agency	https://data.gov.uk/dataset/bed63fc1-dd26-4685-b143-2941088923b3/flood-map-for-planning-rivers-and-sea-flood-zone-3	England
Historic Flood Map	Environment Agency	https://data.gov.uk/dataset/76292bec-7d8b-43e8-9c98-02734fd89c81/historic-flood-map	England
Recorded Flood Extents	Natural Resource Wales	http://lle.gov.wales/catalogue/item/HistoricFl/?lang=en	Wales
Wales Flood Map for Planning Flood zones 2 and 3	Natural Resource Wales	https://datamap.gov.wales/layergroups/inspire-nrw:FloodMapforPlanningFloodZones2and3	Wales
Terrestrial Phase 1 Habitat Survey (Wales)	Natural Resources Wales	https://lle.gov.wales/catalogue/item/TerrestrialPhase1HabitatSurvey/?lang=en	Wales
Priority Habitat Inventory (England)	Natural England	https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcd6/priority-habitat-inventory-england	England
National Forest Inventory	Forestry Commission	https://data-forestry.opendata.arcgis.com/	England and Wales

Data name	Published by	Source link	Region of STT scheme
National Trust land ownership	National Trust	https://open-data-national-trust.hub.arcgis.com/datasets/national-trust-open-data-land-always-open/explore?location=53.373930%2C-1.994053%2C10.76	England and Wales
RSPB Reserves	RSPB	https://opendata-rspb.opendata.arcgis.com/datasets/rspb-reserves/explore?location=55.360271%2C-3.252746%2C6.16	England and Wales
Public Rights of Way	Various Local Authorities within the scheme boundaries	https://www.rowmaps.com/	England and Wales
Greenspace	Ordnance Survey	https://www.ordnancesurvey.co.uk/business-government/products/open-map-greenspace	England and Wales
Built Up Areas (BUA)	Office for National Statistics	https://data.gov.uk/dataset/15e3be7f-66ed-416c-b0f2-241e87668642/built-up-areas-december-2011-boundaries-v2?msckid=30524d87af8011ec92e662ac29ce7d5b	England and Wales
Flood risk	Environment Agency	https://data.gov.uk/dataset/95ea1c96-f3dd-4f92-b41f-ef21603a2802/risk-of-flooding-from-surface-water-extent-3-3-percent-annual-chance	England and Wales
OS Terrain 50	Ordnance Survey	https://osdatahub.os.uk/downloads/open/Terrain50?ga=2.220781976.1451334156.1648630429-1910969130.1648630429	England and Wales
Wastewater treatment discharge points	European Environment Agency	https://www.eea.europa.eu/data-and-maps/data/waterbase-uwvtd-urban-waste-water-treatment-directive-7	England and Wales
Peaty Soils Location	Natural England	https://data.gov.uk/dataset/c9eb1cd9-c254-4128-a18d-d368f6e6acf0/peaty-soils-location	England
Unified peat map for Wales	Environmental Information Data Centre	https://data.gov.uk/dataset/d8fde265-42bc-4474-a305-ffaef14afd8/unified-peat-map-for-wales	Wales

Table 3.2 Data derived from local or neighbourhood plans

Local / Neighbourhood Plan name	Published by	Source link	Region of STT solution
Stratford-on-Avon Development Plan	Stratford-on-Avon District Council	https://www.stratford.gov.uk/planning-building/policies-maps.cfm	Stratford-on-Avon (England)
South Worcestershire Development Plan	Malvern Hills District, Worcester City and Wychavon District Councils	http://swdp.addresscafe.com/app/exploreit/default2.aspx	South Worcestershire (England)
Wyre Forest Development Plan	Wyre Forest District Council	https://www.wyreforestdc.gov.uk/planningpolicy	Wyre Forest (England)
Shropshire Local Plan	Shropshire Council	https://www.arcgis.com/apps/webappviewer/index.html?id=d6ab15037ca741589b262f27170843c1	Shropshire (England)
Tewkesbury Borough Plan	Tewkesbury Borough Plan	https://www.tewkesbury.gov.uk/local-plan#tewkesbury-borough-plan	Tewkesbury (England)
Cotswold District Local Plan	Cotswold District Council	https://cotswold.maps.arcgis.com/apps/MapSeries/index.html?appid=885eb94398bf4819b17bd66d64275e59	Cotswold (England)
Gloucester City Plan	Gloucester City Council	https://www.gloucester.gov.uk/planning-development/planning-policy/gloucester-city-plan/	Gloucester (England)
Birmingham Development Plan	Birmingham City Council	http://www.planvu.co.uk/bcc/index.php	Birmingham (England)
North Warwickshire Local Plan	North Warwickshire Borough Council	https://www.northwarks.gov.uk/downloads/file/8947/policy_map_whole_area_with_hyperlinks	North Warwickshire (England)

Local / Neighbourhood Plan name	Published by	Source link	Region of STT solution
Warwick District Local Plans	Warwick District Council	https://www.warwickdc.gov.uk/downloads/download/971/adopted_local_plan_maps	Warwick (England)
Solihull Local Plan	Solihull Council	https://www.solihull.gov.uk/sites/default/files/migrated/Planning_LDF_Local_Plan_Final.pdf	Solihull (England)
West Oxfordshire Local Plan	West Oxfordshire District Council	https://westoxfordshire.maps.arcgis.com/apps/MapJournal/index.html?appid=e1c98b708d3f45feaec1cca13833cdac	West Oxfordshire (England)
Vale of White Horse District Local Plan	Vale of White Horse District Council	https://www.whitehorsedc.gov.uk/vale-of-white-horse-district-council/planning-and-development/local-plan-and-planning-policies/local-plan-2031/	Vale of White Horse (England)
Stroud District Local Plan	Stroud District Council	https://www.stroud.gov.uk/environment/planning-and-building-control/planning-strategy/stroud-district-local-plan	Stroud (England)
Wiltshire Development Plan	Wiltshire Council	https://www.wiltshire.gov.uk/planning-policy	Wiltshire (England)
Swindon Local Plan	Swindon Borough Council	https://maps.swindon.gov.uk/sbc_soloexpanded.htm	Swindon (England)
Powys Local Development Plan	Powys County Council	https://en.powys.gov.uk/article/4898/Adopted-LDP-2018	Powys (Wales)
Telford & Wrekin Local Plan	Telford & Wrekin Co-operative Council	https://telford-gis.maps.arcgis.com/apps/webappviewer/index.html?id=b16fe1e5d68f4127a12e68bce1aa21a7	Telford & Wrekin (England)
Churchdown & Innsworth Neighbourhood Plan	Tewkesbury Borough Council	https://www.tewkesbury.gov.uk/neighbourhood-development-plans/churchdown-and-innsworth-neighbourhood-plan	Churchdown & Innsworth (England)
Down Hatherley, Norton & Twigworth Neighbourhood Plan	Tewkesbury Borough Council	https://tewkesbury.squarespace.com/neighbourhood-development-plans/down-hatherley-norton-and-twigworth-neighbourhood-plan	Down Hatherley, Norton & Twigworth (England)
Highnam Neighbourhood Plan	Tewkesbury Borough Council	https://www.tewkesbury.gov.uk/neighbourhood-development-plans/highnam-neighbourhood-plan	Highnam (England)
Twynning Neighbourhood Plan	Tewkesbury Borough Council	https://www.tewkesbury.gov.uk/neighbourhood-development-plans/twynning-neighbourhood-plan	Twynning (England)
Gotherington Neighbourhood Plan	Tewkesbury Borough Council	https://www.tewkesbury.gov.uk/neighbourhood-development-plans/gotherington-neighbourhood-plan	Gotherington (England)
Winchcombe and Sudeley Neighbourhood Plan	Tewkesbury Borough Council	https://www.tewkesbury.gov.uk/neighbourhood-development-plans/winchcombe-and-sudeley-neighbourhood-plan	Winchcombe and Sudeley (England)
Faringdon Neighbourhood Plan	Vale of White Horse District Council	https://www.whitehorsedc.gov.uk/vale-of-white-horse-district-council/planning-and-development/local-plan-and-planning-policies/neighbourhood-plans/emerging-neighbourhood-plans/faringdon-neighbourhood-plan/	Faringdon (England)
Drayton Neighbourhood Plan	Vale of White Horse District Council	https://www.whitehorsedc.gov.uk/vale-of-white-horse-district-council/planning-and-development/local-plan-and-planning-policies/neighbourhood-plans/emerging-neighbourhood-plans/drayton-neighbourhood-plan/	Drayton (England)
Eastington Neighbourhood Plan	Eastington Parish Council	https://www.stroud.gov.uk/media/2227/eastington-basic-conditions-statement-plus-sea-screening.pdf	Eastington (England)
Madeley Neighbourhood Plan	Telford & Wrekin Co-operative Council	https://www.telford.gov.uk/info/20683/completed_neighbourhood_development_plans/547/madeley_neighbourhood_plan	Madeley (England)
Reading Borough Council Plan	Reading Borough Council	https://images.reading.gov.uk/2019/12/Local_Plan_Adopted_November_2019.pdf	Reading (England)
West Berkshire District Local Plan	West Berkshire Council	https://info.westberks.gov.uk/localplan	West Berkshire (England)
Woking Borough Local Development Plan	Woking Borough Council	https://www.woking2027.info/developmentplan	Woking (England)
Windsor and Maidenhead Borough Local Plan	Royal Borough of Windsor & Maidenhead	https://www.rbwm.gov.uk/home/planning-and-building-control/planning-policy/development-plan/adopted-local-plan	Windsor & Maidenhead (England)
Wycombe District Local Plan	Buckinghamshire Council	https://buckinghamshire-gov.uk.s3.amazonaws.com/documents/Wycombe-	Wycombe (England)

Local / Neighbourhood Plan name	Published by	Source link	Region of STT solution
Chiltern and South Bucks. Local Plan	Buckinghamshire Council	District-Local-Plan-Adopted-August-2019-accessible.pdf https://www.buckinghamshire.gov.uk/planning-and-building-control/local-development-plans-info/local-development-scheme/neighbourhood-development-plans/	Chiltern and South Buckinghamshire (England)
Buckinghamshire Local Plan	Buckinghamshire Council	https://www.buckinghamshire.gov.uk/planning-and-building-control/local-development-plans-info/local-development-scheme/our-current-plans-and-documents/#:~:text=Extant%20Local%20Plan%20documents%20for%20Chiltern%20are%20the,adopted%202019%2C%20applies%20to%20the%20whole%20council%20area.	Buckinghamshire (England)
Runnymede Local Plan	Runnymede Borough Council	https://www.runnymede.gov.uk/localplan	Runnymede (England)
Spelthorne Local Plan	Spelthorne Borough Council	https://www.spelthorne.gov.uk/article/17620/Development-Plan-2009	Spelthorne (England)
Elmbridge Development Management Plan	Elmbridge Borough Council	https://www.elmbridge.gov.uk/planning/local-plan/strategic-planning/development-management-policies-and-advice-notes/	Elmbridge (England)
The London Plan	Greater London Authority	https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/london-plan-2021	London (England)

3.2.1 Linking data to the Key Questions

The open-source data collected within **Table 3.1** was used to answer the key questions and sub questions within each natural capital focus area. Not all the datasets were used concurrently; for each question specific datasets were picked which were used for the analysis. **Table 3.3** shows the specific datasets used to answer each question. The data in **Table 3.2** from the local plans was used to create layers indicating the synergies with and constraints of the opportunity areas. This included assessing the practicality of delivering the benefit by identifying land owned by large organisations such as National Trust and RSPB which would potentially have less delivery constraints than private land.

Table 3.3 Data sources used for each key question

Focus area	Data sources used
Water quality	Wastewater treatment discharge points, river paths, WFD waterbodies and status, Google Satellite Imagery.
Climate regulation	CORINE, carbon flux and storage values (Natural England Carbon storage and sequestration by habitat 2021), Unified Peat Map for Wales, Peaty Soils Location (Natural England)
Access to nature	CORINE, Public rights of way, Accessible Natural Green Space Standards, Priority habitat inventory, National Forest Inventory, Terrestrial Phase 1 Habitat Survey (Wales), Built up area (England and Wales)
Flood management	OS Terrain 50, HadUK-Grid Gridded Climate Observations on a 1 km grid annual rainfall from 2010 to 2020, CORINE, Flood Map for Planning (Rivers and Sea) Flood Zone 2 and Flood Zone 3, Wales Flood Map for Planning Flood zones 2 and 3, Recorded Flood Extents

3.2.2 Assessment of local plans and opportunities

Alongside the open-source datasets, a review of local plans mostly within a 5 km buffer of the STT solution was undertaken in England and Wales (see **Table 3.2**). The local plans which are publicly available were reviewed to identify key ambitions that link to the overall STT solution area. These ambitions varied per local authority but were in the form of either written policies or specific mapped opportunity areas. This has included an assessment of opportunities for coordination or contribution to other regional and national strategic priorities – for example local neighbourhood plans, wider planning ambitions, natural recovery networks and SMNR priorities. The review included relevant plans and programmes such as local government development strategies and plans, WFD River Basin Management Plans (RBMPs), Area Statements and local/regional flood

risk management strategies. A list of the reviewed documentation and a summary of relevant plans and policies is provided in **Annex 1**.

Together with the review of policies and mapped opportunity areas, areas of land that local authorities have afforded a designation in Local Plans within 5 km of the STT solution were identified. This included housing allocations, residential allocations, and mineral safeguarding areas. GIS layers were manually created from PDF maps within Local Plan documentation. The purpose of mapping these designated areas was to remove the parcels of land from the opportunity mapping due to already having an allocated use (i.e. employment, housing, and transport development areas). In addition, certain areas could be synergistic with the opportunity areas. This includes proposed green infrastructure, local nature reserves or areas undergoing nature improvement (see **Table 2.6**).

3.2.2.1 Summary of landownership

Figure 3-1 shows that the National Trust land is widespread across the catchment with small areas mainly in the southeast of the study area and one larger area in the north west (Carding Mill Valley and the Long Mynd) (shown in green). There are much fewer RSPB reserves although there is a very large reserve in Wales (Lake Vyrnwy) (shown in pink). Only one Crown Estate owned parcel of land was identified (although there may be more).

Figure 3-1 shows the location and extent of land owned by the Crown Estate, RSPB, National Trust and United Utilities. National Trust owned land is scattered frequently in small areas throughout the scheme catchment boundary. The large RSPB reserve located at the north-western boundary of the STT solution catchment is Lake Vyrnwy. A single parcel of land is owned by the Crown Estate, and this is located within the centre of the STT solution catchment boundary. Only very small areas of land within the catchment are owned by United Utilities. Land ownership data for other water companies was not available. The relative areas of each of these land ownership categories are present in **Table 3.4**.

Table 3.4 Areas and percentage of landownership

Landowner	Area (ha) within STT solution catchment	Percentage (%) of known mappable landownership	Percentage (%) of the whole catchment boundary
RSPB	10,931.4	51	0.4
Crown Estate	514.7	2	0.02
National Trust	10,058.5	47	0.4
United Utilities	70.6	0.3	0.003

Figure 3-2 shows there are large areas for mineral safeguarding (pale blue areas) particularly in the north west of the study area. There is a large aerodrome safeguarding area in the south east (in yellow) and large areas with development constraints including conservation areas and areas with special landscape status in the east near Gloucester and the Cotswolds (in dark blue). Potential constraints to the opportunity areas in the study area are the development areas (housing, employment, and transport) which are particularly prevalent in the south east, centre, west and north east of the study area (in burgundy). The burgundy line in the east shows the High Speed 2 (HS2) development. Possible synergies with the opportunity areas are with the proposed green infrastructure, areas undergoing nature improvement and proposed local nature reserves (in pink) which are mainly in the centre and north of the study area.

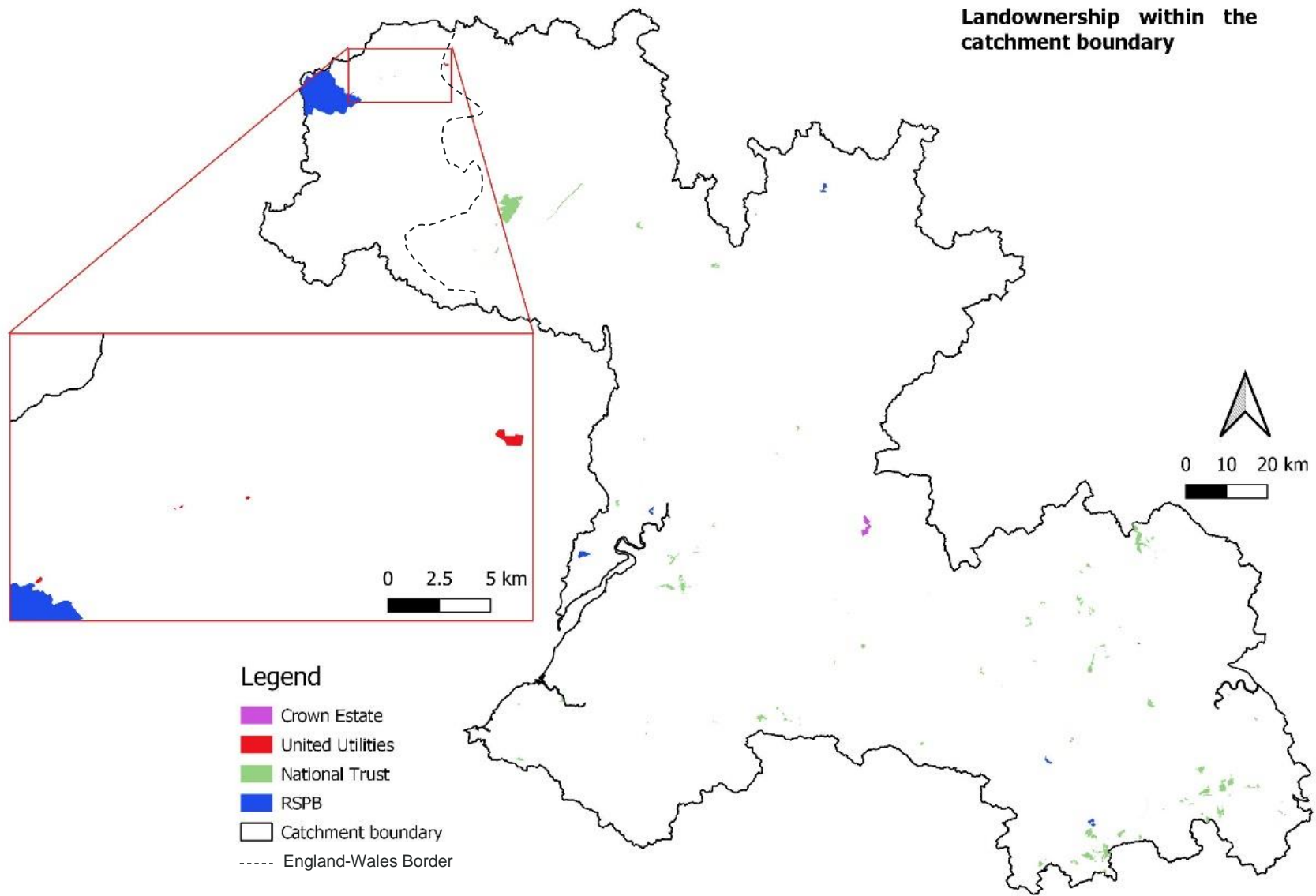


Figure 3-1 Land ownership within the STT solution catchment

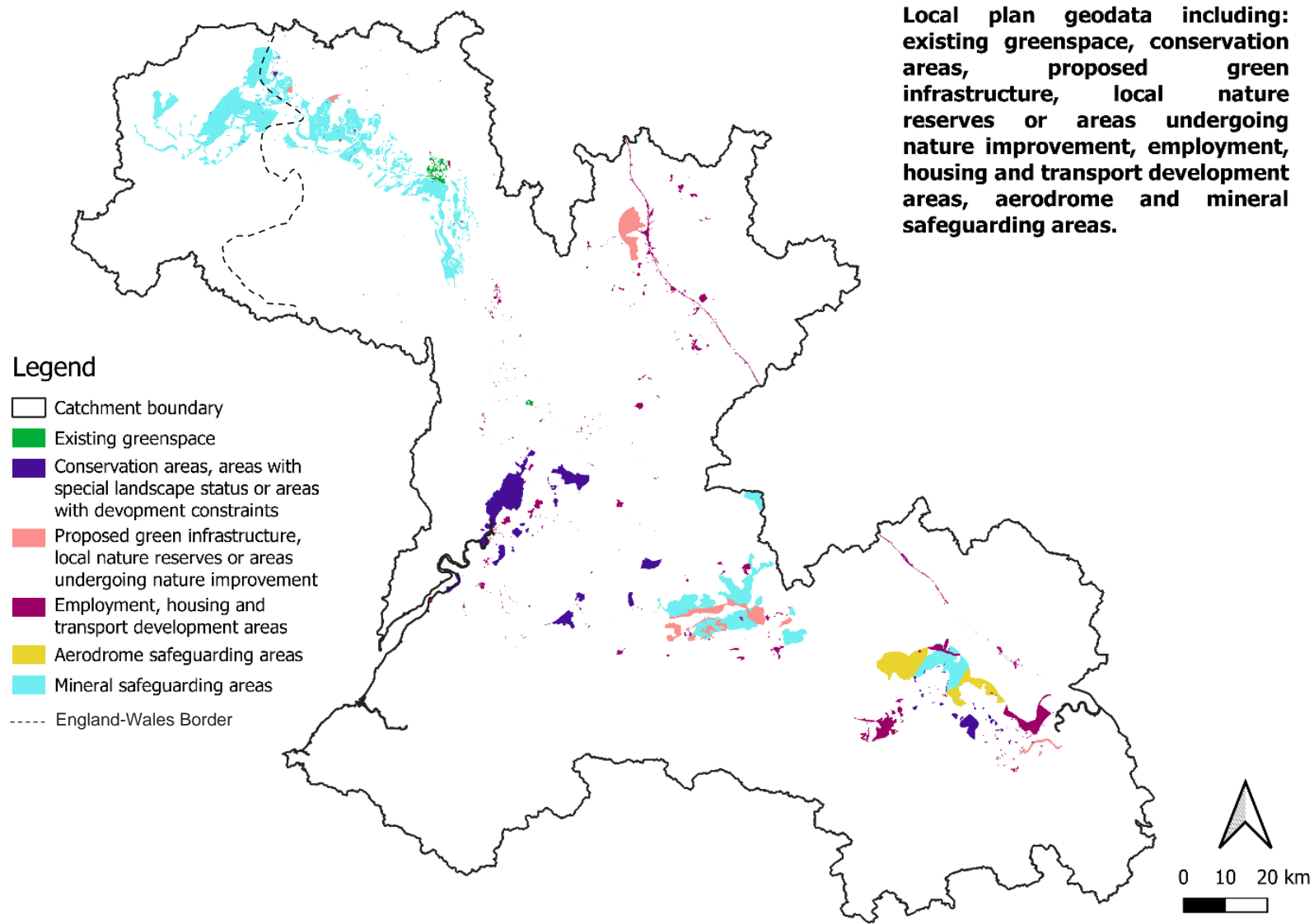


Figure 3-2 Data extracted from local and neighbourhood plans mainly within 5 km of the STT solution route, categorised according to land allocation

3.3 STAKEHOLDER ENGAGEMENT

3.3.1 Introduction

As part of the work for the Gate 2 BNG and Natural Capital assessment, Ricardo has engaged with stakeholders via a number of workshops to explore potential opportunities and the findings from those have underpinned this study and the development of the approach.

Recognising that this project overlaps with the Gate 2 BNG and Natural Capital assessment but is a separate study, further engagement has been sought with stakeholders in the form of additional workshops. The purpose of these was to set out the approach, show our findings, and gain feedback from the environmental regulators plus other stakeholders with expertise in this area.

3.3.2 Workshops

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

Two wider benefits specific workshops were held in April 2022 with attendees from the regulators, STT Water Companies and consultants from Atkins and Wood (as peer reviewers). The first workshop objectives were to introduce the study and the context for the work in relation with the STT environmental assessment Gate 2 submission, outlining how both Welsh and English requirements are accounted for in our approach. The workshop outlined the geospatial approach developed to examine potential wider benefits and showcase how potential benefits have been explored using available data sets. The second workshop objectives were to discuss the final results and show key areas identified where multiple benefits and opportunities lie.

The Gate 2 workstream is in parallel to this study, and a regulatory requirement but there is overlap between data sources and stakeholders. Where those links are appropriate, approaches have been aligned and feedback received to date has been utilised.

3.3.3 Outputs

The first wider benefits workshop was held on the 1st of April 2022 and attendees included Natural Resources Wales, Severn Trent Water, United Utilities, Thames Water, Wood, Atkins and Ricardo. A recording of the workshop was made and minutes sent to the Environment Agency for comment.

The key issues raised during the wider benefits study workshop included:

- ACWG design principles: the wider benefits study is cognisant of the design principles. The principles of people, place, carbon, and value maps very well onto the approach taken for this study in terms of wellbeing, sustainable management, and the Six Capitals approach.
- Detail of study: the study takes a high level, and “blue-skies” perspective. This is necessary due to the scale of the scheme, covering both England and Wales, and the temporal scale, as the scheme may not be constructed for many years to come. At this stage, only those datasets that are available can be applied. However, it is recognised that there are various benefits linked to capitals which are extremely important, and which are beneficial for different organisations. At present, some of the capitals cannot be expressed fully until further work is undertaken to identify discrete opportunities on the ground, and these include the manufacturing, financial capitals, and intellectual capitals.

The second workshop was held on the 25th of April 2022 and attendees included Natural Resources Wales, the Environment Agency, Atkins, United Utilities and Ricardo. A recording of the session was made available to Thames Water, Severn Trent Water, and Natural England.

The key issues raised included:

- Updating the data sets to included additional available datasets;
- The relationship between the wider benefits and BNG; and
- The relationship between wider benefits opportunities and 3rd Party organisations.

The key related points arising from the Gate 2 workshops included:

- **Timescales:** There is much (on the ground) work currently being delivered that will be completed ahead of the STT solution delivery timeframes. It should, therefore, be noted that there is a degree of uncertainty about currently identified opportunities, which may be delivered under different programmes ahead of the implementation of the STT solution;
- **Other workstreams:** It was identified at the workshop that there are several other workstreams and initiatives outside the STT that are also collating data to ascertain opportunities within the study area. Examples of initiatives that cover the study area, include the nature recovery projects where full data sets will not be available for a number of years. This information will need to be collated and considered at Gate 3 and beyond for wider benefits identification at the time of STT solution delivery; and
- **HS2:** It was identified that large areas of land in the Minworth area are already identified or earmarked for net gain in relation to that programme, so wider opportunities will need to be sought in relation to the STT solution.

Throughout the development of the approach, feedback was sought from stakeholders and an internal log of comments and feedback recorded to shape and refine the ongoing development of the approach. A draft version of the report was made available for regulator comment.

3.4 DATA LIMITATIONS AND GAPS

A key aspect to consider is the uncertainty related to the future delivery timeframe of the STT solution. There are a number of Development Consent Order applications, programmes and initiatives being delivered or planned for delivery between now and the STT solution implementation. It is therefore critical that this evolving position is kept under review, for appropriate benefits and opportunities to be identified at the time of programme delivery.

Local plans are regularly updated with new policies, some of which, in the future, may provide more detail with regards to benefit mapping. Land allocated for housing and employment will also be updated approximately every five years which would change the availability of land between this assessment and delivery. Local and neighbourhood plan analysis focussed mainly within the 5 km buffer of the STT solution routes as it was deemed that most of the significant changes in landscape from the project would occur in this region. In future versions of this study, it would be useful to extend the analysis to the edge of the scheme catchment boundary in order to capture information about potential opportunities which are wider in the catchment as was undertaken for other key focus areas.

Overall, WFD water quality data in Wales did not include the cause or reasoning for the overall status. This information is useful in determining potential benefits and is therefore missing from the Welsh watercourses. Furthermore, the locations of wastewater treatment discharge points shown on the maps were specifically extracted due to being the closest to rivers where wastewater pollution is a named source on the WFD status. The actual wastewater pollution source is not defined in the WFD status dataset and therefore these locations may not be representative. Several watercourses with wastewater pollution listed as a reason for poor or bad status were not assigned an associated wastewater treatment works location due to the discharge point not being obvious within the dataset, e.g. several potential discharge points possible or potential discharge points located at a much greater distance. It is possible that other sources of wastewater pollution, e.g. private sources, are not included in the dataset used. The most recent WFD status information is from 2019 and this analysis assumes no change since that time. It is possible that the source of pollution or other reasons for WFD status has since altered.

Whilst the aim was to meet all the Welsh SMNR principles and Wellbeing Goals, this has not been possible due to availability of data, as explained in [Section 2.2.2](#). For example, there was no data available that could be used to explore the impacts on 'A Wales of vibrant culture and thriving Welsh language'. However, the geospatial approach has been designed such that if datasets for these priorities become available, they can be included in the analysis.

CORINE landcover data was used for the habitat mapping due to being large scale and covering both England and Wales uniformly, however, this dataset is not accurate at a finer scale. The higher resolution and more accurate Phase 1 habitat mapping present for Wales is not available for England. For future studies of this scale, the recently released Living England dataset²³, which maps habitats using satellites at a finer scale than

²³ [Living England Habitat Map \(Phase 4\) | Natural England Open Data Geoportal \(arcgis.com\)](#) [online – accessed 08/04/2022]

CORINE, would be more useful and may produce more accurate opportunity areas in England which are comparable to the Welsh Phase 1 habitat map.

Peat data from Wales did not distinguish between different depths of peat (i.e., whether shallow, deep, or peaty pockets), unlike the England dataset. This information is useful when determining and assigning carbon flux.

Flood risk data for surface water in England is limited in resolution to 1 km squares, whereas the Welsh surface water flood risk is at a finer resolution.

For river biodiversity, the Priority barriers – combined coarse and salmonid dataset is incomplete and not up to date for Wales which could impact the outputs.

4. OUTPUTS

4.1 THE KEY FOCUS AREAS

As outlined in the previous sections, the outputs for this “blue-skies” work are underpinned by extensive data sets that collectively provide the opportunity to create final heat maps.

In order to identify key opportunity areas that can potentially deliver the widest range of benefits, it is necessary to first answer a series of key questions related to water quality ([Section 4.1.1](#)), climate regulation ([Section 4.1.3](#)), flood management ([Section 4.1.7](#)) and river biodiversity ([Section 4.1.9](#)). In addition, access to nature ([Section 4.1.5](#)) was considered based on how accessible greenspaces are (distance from public footpaths and to where people live) and whether people can access natural areas (the proximity of recreational areas to natural areas).

The following sections provide the mapped workings for each question together with outputs of heat maps related to each of those questions. The final heat maps for each question have then been used to create the overall benefits heat maps for the STT solution (see [Section 4.3](#)) and an associated dashboard of benefits ([Section 4.4](#)).

4.1.1 Water quality mapping

It is generally acknowledged that a range of solutions such as river and floodplain restoration, buffer strips, drain-blocking, and the production or improvement of wetlands can improve water quality. Improvements to water quality can, in addition, improve the biodiversity of riparian and aquatic habitats particularly for species which are sensitive to high water quality.

In addition, such solutions can provide multiple other ecosystem and health and well-being opportunities including reducing flood risk, increased carbon sequestration, potential recreational improvements for angling (due to increase fish populations) or wild swimming.

To identify key opportunity areas across the STT solution, the key and sub-questions for water quality (see [Section 2.3.1.2](#) for further details) were first reviewed namely:

- **Key Question(s)** – Where are the opportunities for improving water quality?
- **Sub-question(s)** - Where are the greatest point and diffuse sources of pollution? Where are the potential locations for solutions which can be implemented to improve water?

To address these questions the following data sets were used and maps provided as outlined in [Table 4.1](#).

Table 4.1 Data sets used in the water quality analyses, key answers, and links to the maps

Data set	Key answers it provides	Map
WFD waterbodies and status, river paths	Overall WFD river status highlighting rivers that had poor or bad status	Figure 4-1
WFD waterbodies and status, river paths	Ecological WFD status highlighting rivers with poor or bad ecological status possibly due to poor water quality	Figure 4-2
WFD waterbodies and status, river paths	Chemical WFD status highlighting rivers with poor or bad chemical status	Figure 4-3
WFD waterbodies and status, river paths	Morphological WFD status highlighting rivers with poor or bad status	Figure 4-4
WFD waterbodies and status, river paths	Catchments (or possible catchments in the case of Wales) with poor or bad river status due to diffuse pollution. This highlights the diffuse pollution causes of low water quality.	Figure 4-5
WFD waterbodies and status, river paths, Google Satellite Imagery, Wastewater treatment discharge points	Rivers with poor or bad river status caused by point source pollution (or possibly caused by this for Wales). This indicates the point pollution causes of low water quality.	Figure 4-6
All of the above	Key opportunity areas to enhance water quality (including catchments, wastewater treatment plant discharge points, disuse mines)	Figure 4-7

Figure 4-1 indicates that only 377 km of river has good overall status which are mostly in Wales. Most of the rivers in the study area have moderate, poor, and bad overall WFD status (6901 km, 2183 km and 224 km respectively).

Figure 4-2 shows a similar picture for ecological status with 1173 km of river which has good overall status, mostly in Wales. Most of the rivers have moderate, poor, and bad overall WFD status (6105 km, 2183 km, and 224 km respectively). **Figure 4-3** shows that most of the rivers have bad chemical status (8909 km) while rivers in Wales tend to have a higher status.

In contrast, **Figure 4-4**, shows that rivers in Wales do not have good morphological status in contrast with rivers in England which have good status.

Figure 4-5 shows the rivers with poor or bad WFD overall status as well as the catchments and activities that are responsible for the diffuse pollution. **Table 4.1** indicates that poor livestock management causes the most diffuse pollution in terms of river reach length (376.8 km). Poor nutrient management is the second largest contributing activity to diffuse pollution in terms of river reach (290.1 km). The causes for diffuse pollution in Wales are mostly unclassified whereas in England the causes are classified into various activities laid out in **Table 4.2**.

Table 4.2 Activity responsible for diffuse pollution and length of river reach with poor or bad WFD overall status as a result of the activity

Activity	Length (km)	Percentage (%)
Poor Livestock Management	377	44
Poor nutrient management	290	34
Poor soil management	48	6
Riparian/in-river activities (incl. bankside erosion)	20	2
Transport Drainage	36	4
Urbanisation - urban development	86	10

Figure 4-6 shows the rivers with poor or bad WFD overall status as well as the catchments and activities that are responsible for the point source pollution. **Table 4.3** indicates that pollution from wastewater causes the most pollution from point source pollution in terms of river reach length (678 km). Physical modifications are the second largest contributing activity to point source pollution in terms of river reach (477 km).

Table 4.3 Activity responsible for point source pollution and length of river reach with poor or bad overall WFD status as a result of the activity

Activity	Length (km)	Percentage (%)
Pollution from abandoned mines	23	3
Pollution from rural areas	11	1
Pollution from towns, cities, and transport	34	5
Pollution from wastewater	678	91

4.1.2 Water Quality collective heat map

The water quality collective heat map was created by assigning catchments (diffuse sources of pollution) and point sources with scores of 2 if the river had bad status and scores of 1 if the river had poor status. **Figure 4-7** shows the opportunity heat map relating to water quality, with the yellow areas representing greater opportunities than purple areas.

Specifically, this shows which watercourses, and watercourse catchments, are responsible for watercourses of bad WFD overall status (yellow; with the most improvements to be made) and watercourses of poor WFD overall status (purple; with some improvements to be made). The point pollutions shown for high opportunity areas (i.e., yellow on the map) all refer to wastewater treatment discharge points. Additional point pollution sources are present within the lower opportunity areas (i.e., purple on the map). There is a higher number and area of the greatest opportunities for water quality within the north of the STT solution catchment boundary, within the region of Shrewsbury, Telford, and Birmingham.

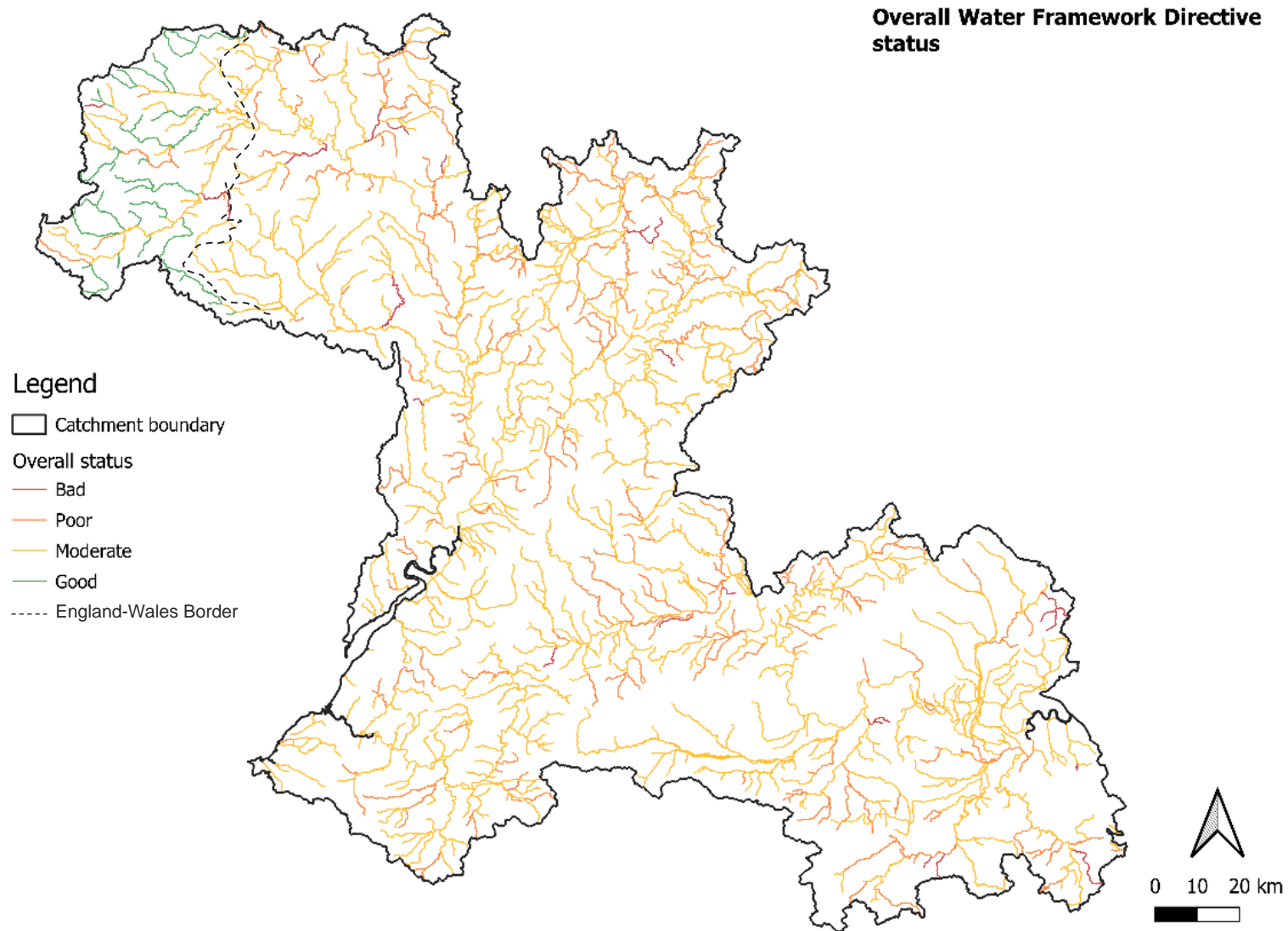


Figure 4-1 Overall Water Framework Directive status

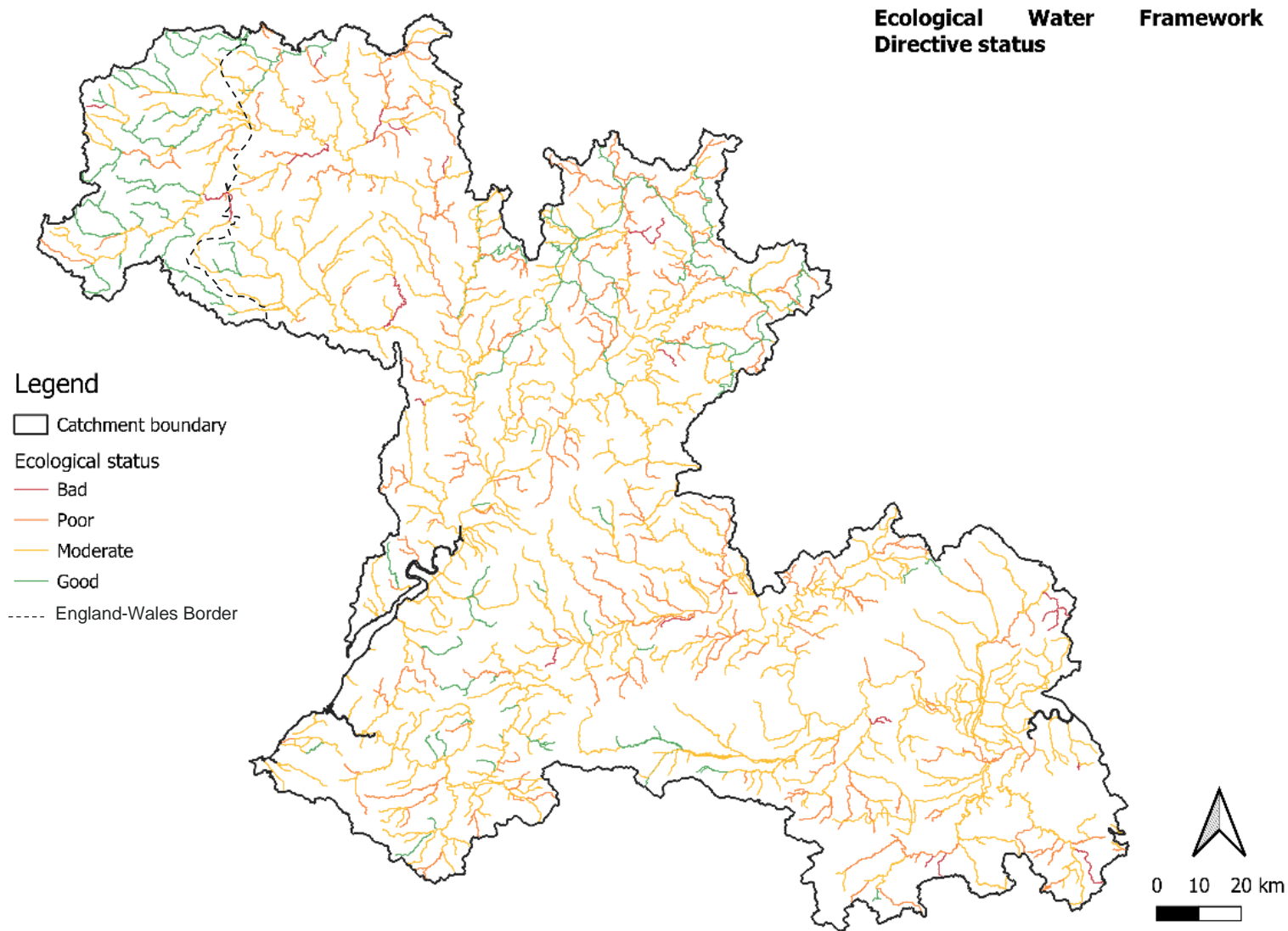


Figure 4-2 Ecological Water Framework Directive status

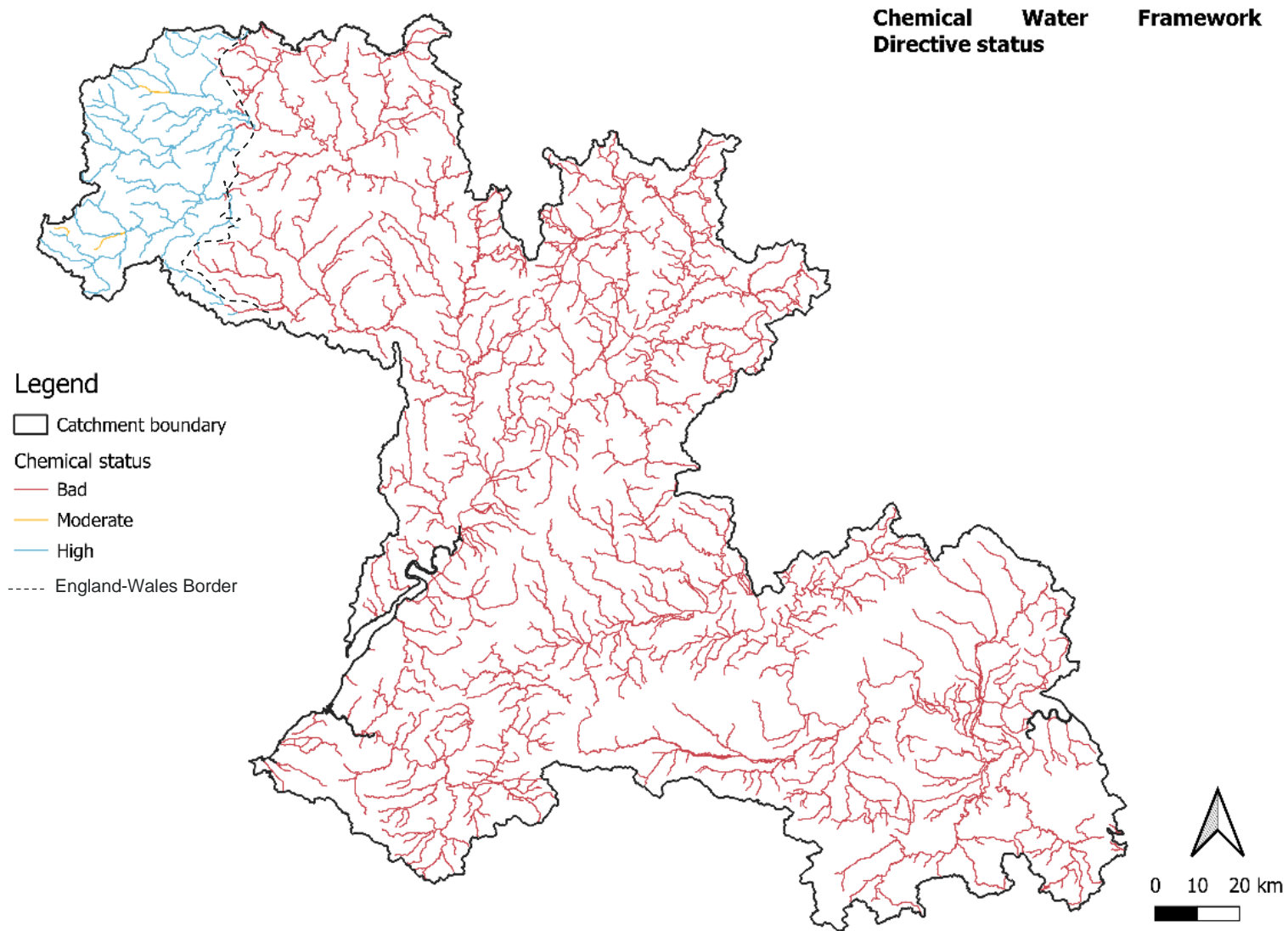


Figure 4-3 Chemical Water Framework Directive status

Morphological Water Framework Directive status

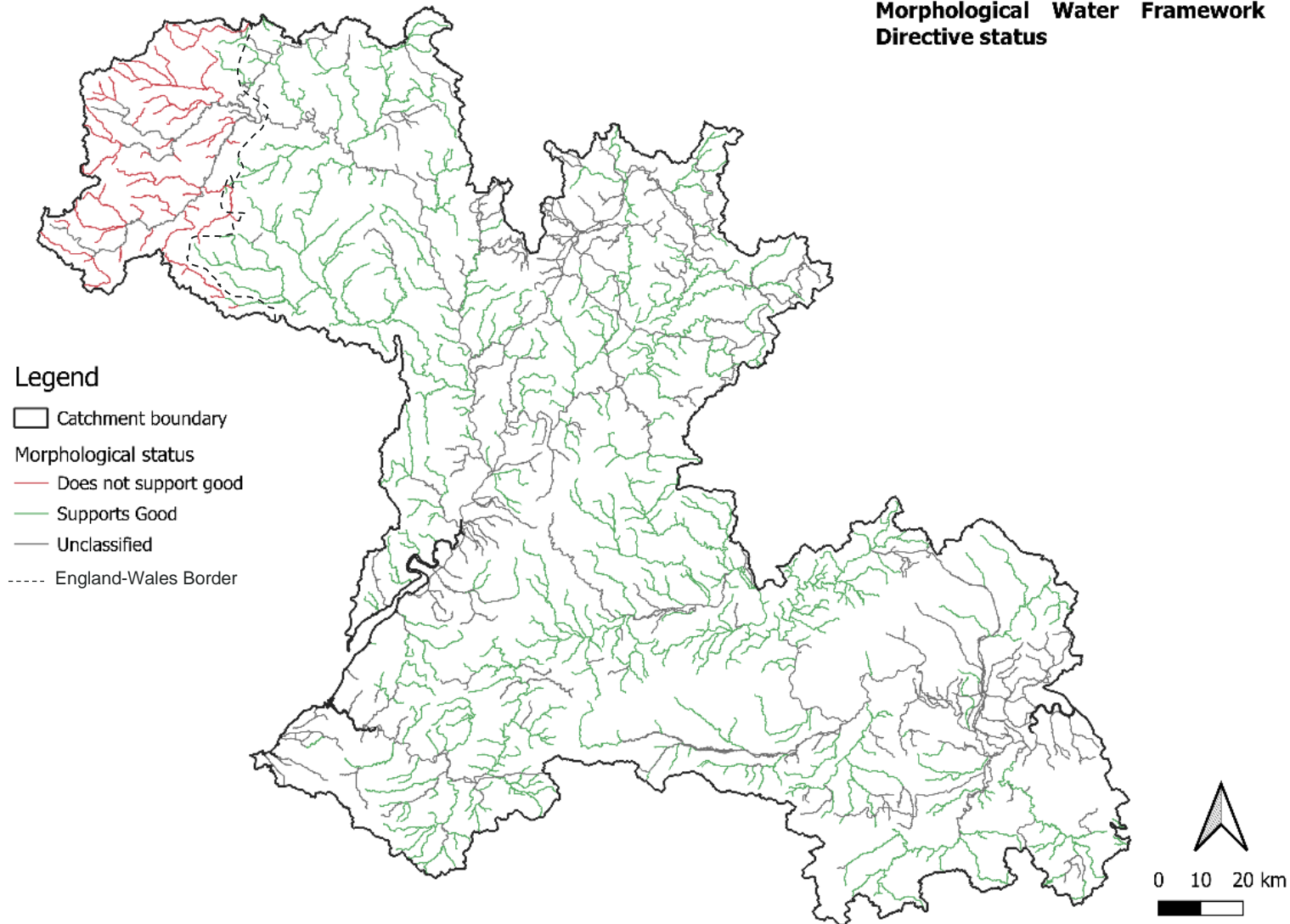


Figure 4-4 Morphological Water Framework Directive status

Rivers with poor or bad Water Framework Directive overall status and the catchments and activities responsible for the diffuse pollution. The catchments in grey have poor status but the causes are unknown.

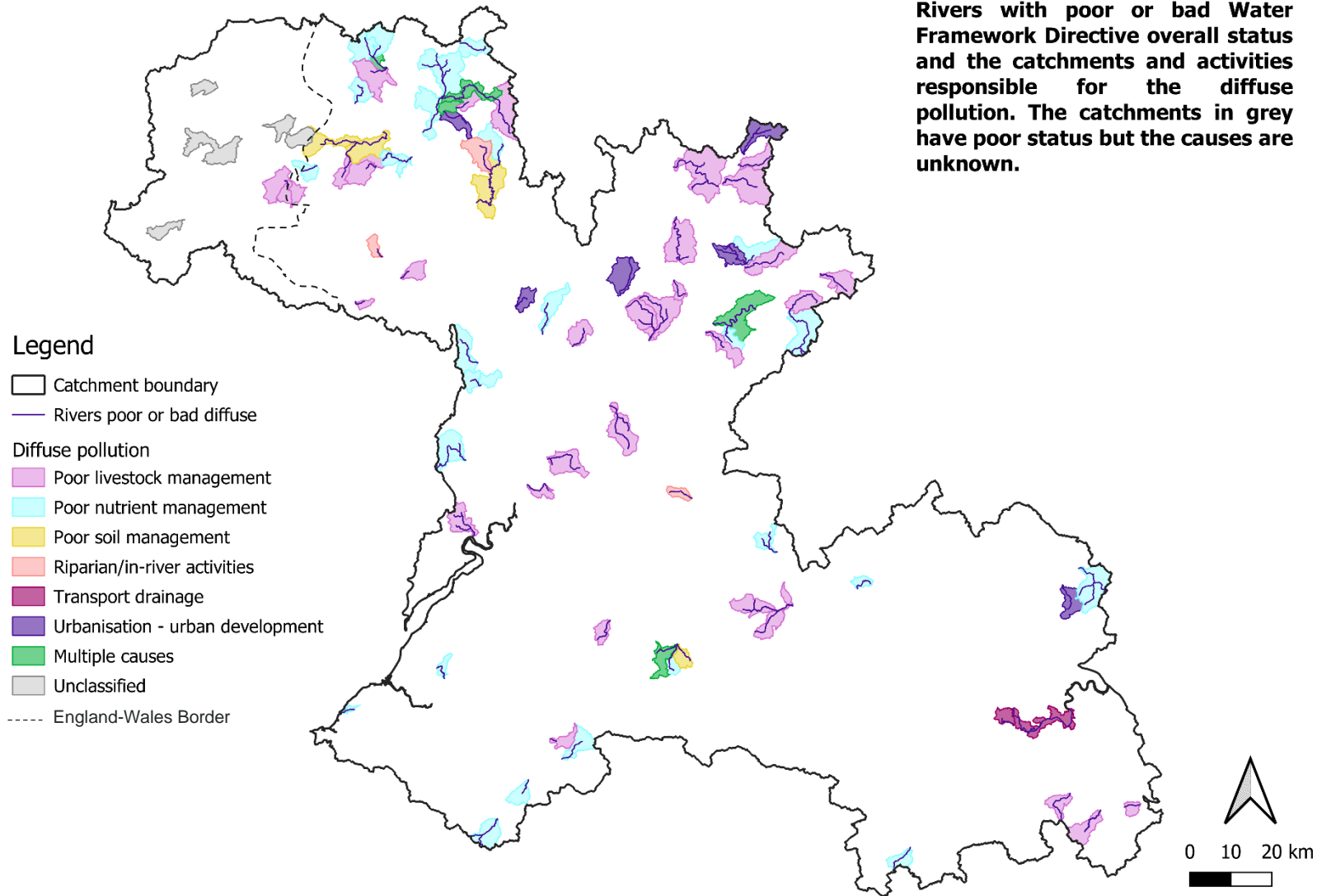


Figure 4-5 Rivers with poor or bad Water Framework Directive overall status and the catchments and activities responsible for diffuse pollution

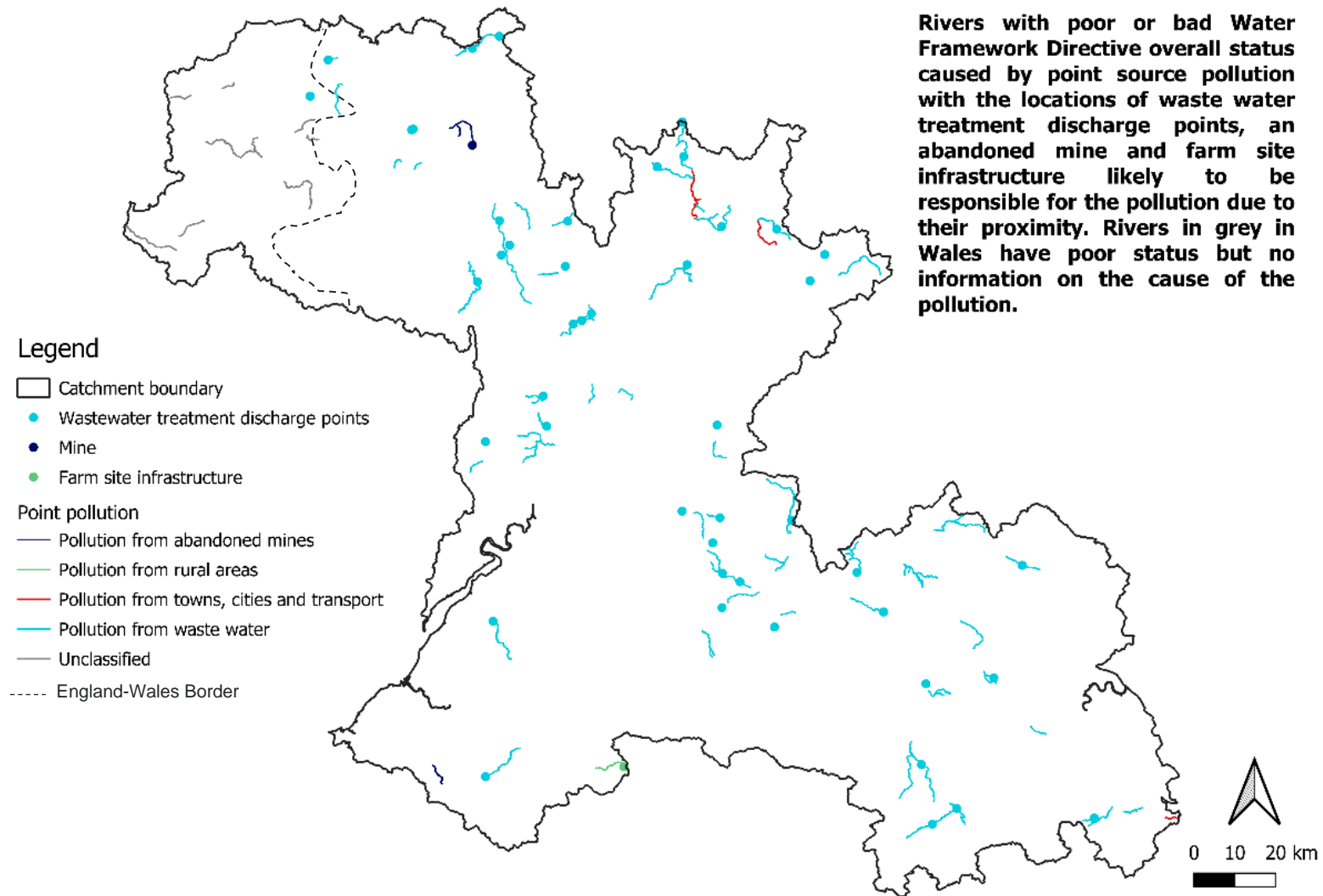


Figure 4-6 Rivers with poor or bad Water Framework Directive overall status caused by point source pollution with the locations of WWT discharge points, disused mines and farm site infrastructure

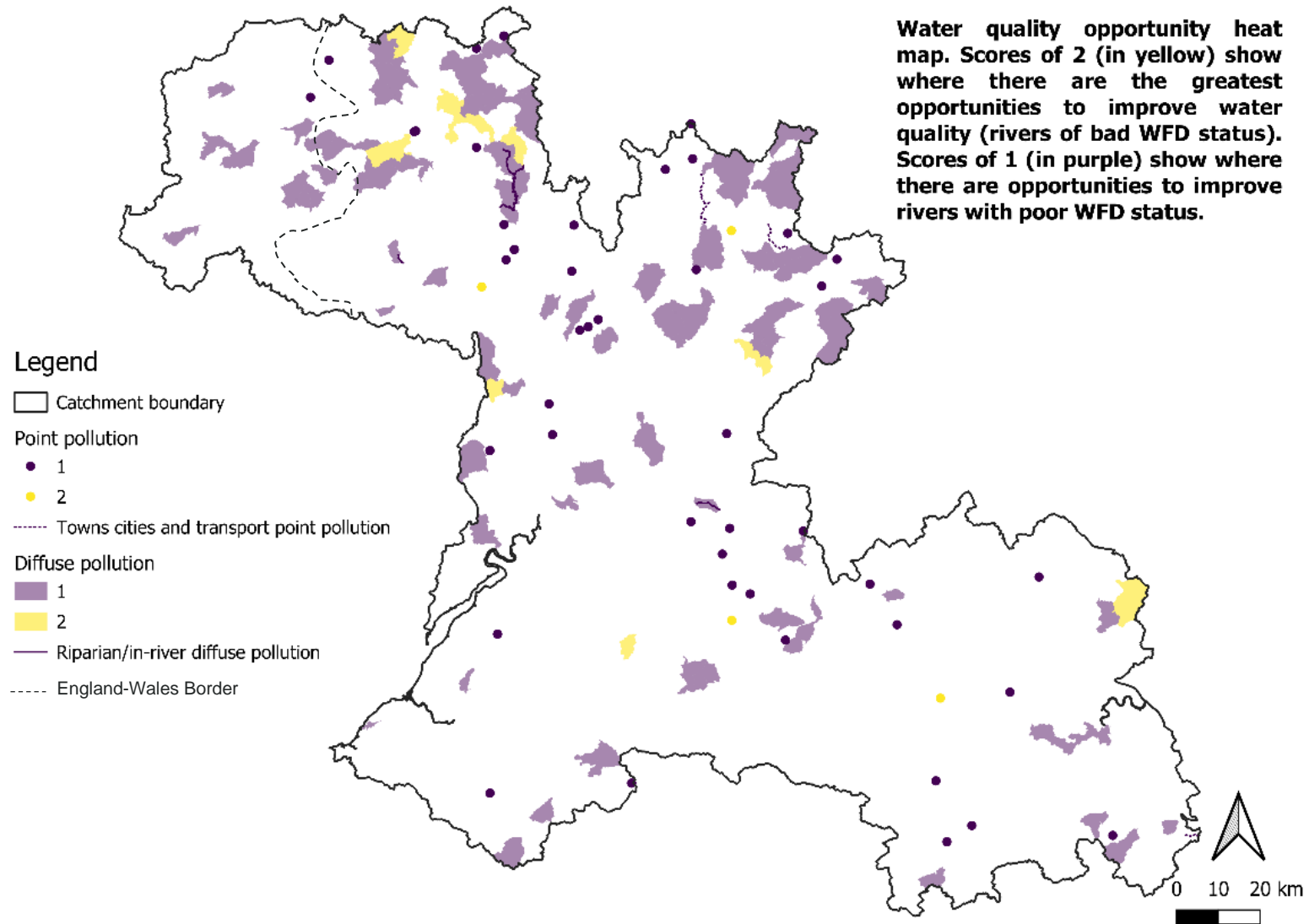


Figure 4-7 Water quality opportunity heat map

4.1.3 Climate regulation / carbon sequestration mapping

Peatlands are ecosystems which are among the most carbon rich on Earth. Healthy peatlands capture carbon dioxide by photosynthesis of plants and because these plants do not fully decompose under wet conditions, they do not release carbon dioxide to the atmosphere²⁴. Climate regulation improvements can have additional benefits via reducing downstream flood risk due to an enhancement of wetlands and peatlands (i.e., flood hazard regulation). The restoration or improvements to carbon sequestering habitats could also improve biodiversity via increasing habitat diversity and subsequently individual species diversity. Habitat restoration or improvements could also increase the water quality via water purification by the habitats, and water supply.

To identify key opportunity areas across the STT solution, the key and sub-questions for climate regulation (see [Section 2.3.1.3](#) for further details) were first reviewed namely:

- **Key Question(s)** - *Where are opportunities to enhance carbon sequestration and storage?*
- **Sub Question(s)** - *What is the general level of carbon sequestration and storage of the land cover within the catchment, and how does this correlate with degraded land cover and peat soils (leading to higher emissions)?*

To address these questions the following data sets were used and maps provided as outlined in [Table 4.4](#).

Table 4.4 Data sets used in the climate regulation analyses, key answers, and the links to the maps

Data set	Key answers it provides	Map
Peaty Soils Location Unified peat map for Wales	Types of peat soils	Figure 4-8
Peaty Soils Location Unified peat map for Wales CORINE	Carbon sequestration	Figure 4-9
Peaty Soils Location Unified peat map for Wales CORINE	Carbon storage	Figure 4-10
Peaty Soils Location Unified peat map for Wales	Opportunity areas for enhancing climate regulation	Figure 4-11

The types of peat soil are shown in [Figure 4-8](#). Soils with peaty pockets tend to occur in the south, and south east of the study area, while deep peat and shallow peat tend to be in the north west. It should be noted that the deep peat soils in Wales could be shallower but the depth information was not available.

Carbon flux coefficients were estimated for landcover and soil type combinations from Natural England's Carbon storage and sequestration by habitat 2021. Habitats on shallow and deep peat soils were assumed to have identical carbon flux coefficients and peaty pockets were assumed to have carbon fluxes of half the value of the other two soil types. [Figure 4-9](#) shows the greatest emissions were found to come from arable land on shallow and deep peat soils (yellow areas) with slightly lower emissions from arable land on soils with peaty pockets (green areas). The lowest emissions came from the agricultural land on mineral soil and other habitats on peat soils seeing that 80% of peatland in the UK is degraded²⁵ (green-blue areas). The woodland, scrub and other natural habitats on mineral soil sequester carbon (purple areas). There are also large areas that do not sequester carbon (shown in white).

[Figure 4-10](#) shows carbon storage is low across most of the study area (yellow areas). It is highest on the deep peat soils (purple areas) and moderate on the other peaty soil types and on the woodland habitat types on all soil types (blue and green areas). Carbon storage was set at zero on urban landcover (white areas).

4.1.4 Climate regulation / carbon sequestration collective heat map

[Figure 4-11](#) shows the greatest climate regulation opportunities are on deep (and shallow) peat soils with high carbon emissions. They are mainly in the north west of the study area (in purple) but also in the south west and south east (in purple and blue). There are some opportunities with medium priority in the south and particularly southeast (in green) where there are soils with peaty pockets. The land in yellow indicates where there are mineral soils and agricultural carbon emissions and there are opportunities to reduce these emissions through more sustainable agricultural practices (such as conservation tillage) or opportunities to sequester carbon through planting trees and hedges.

²⁴ <https://www.ceh.ac.uk/sites/default/files/Peatland%20factsheet.pdf>

²⁵ <https://www.iucn-uk-peatlandprogramme.org/about-peatlands/peatland-damage>

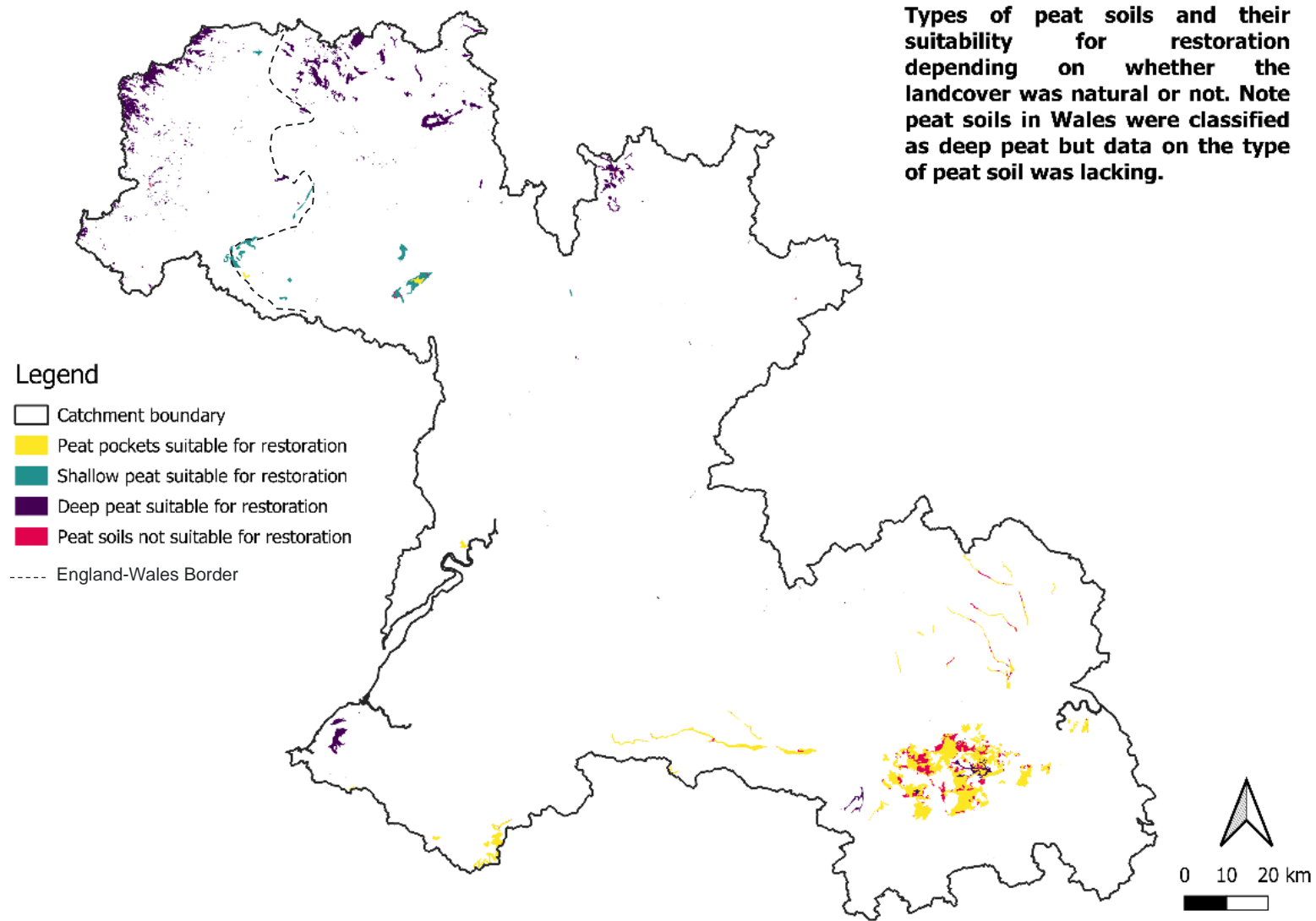


Figure 4-8 Types of peat soils and their suitability for restoration depending related to naturalness of landcover

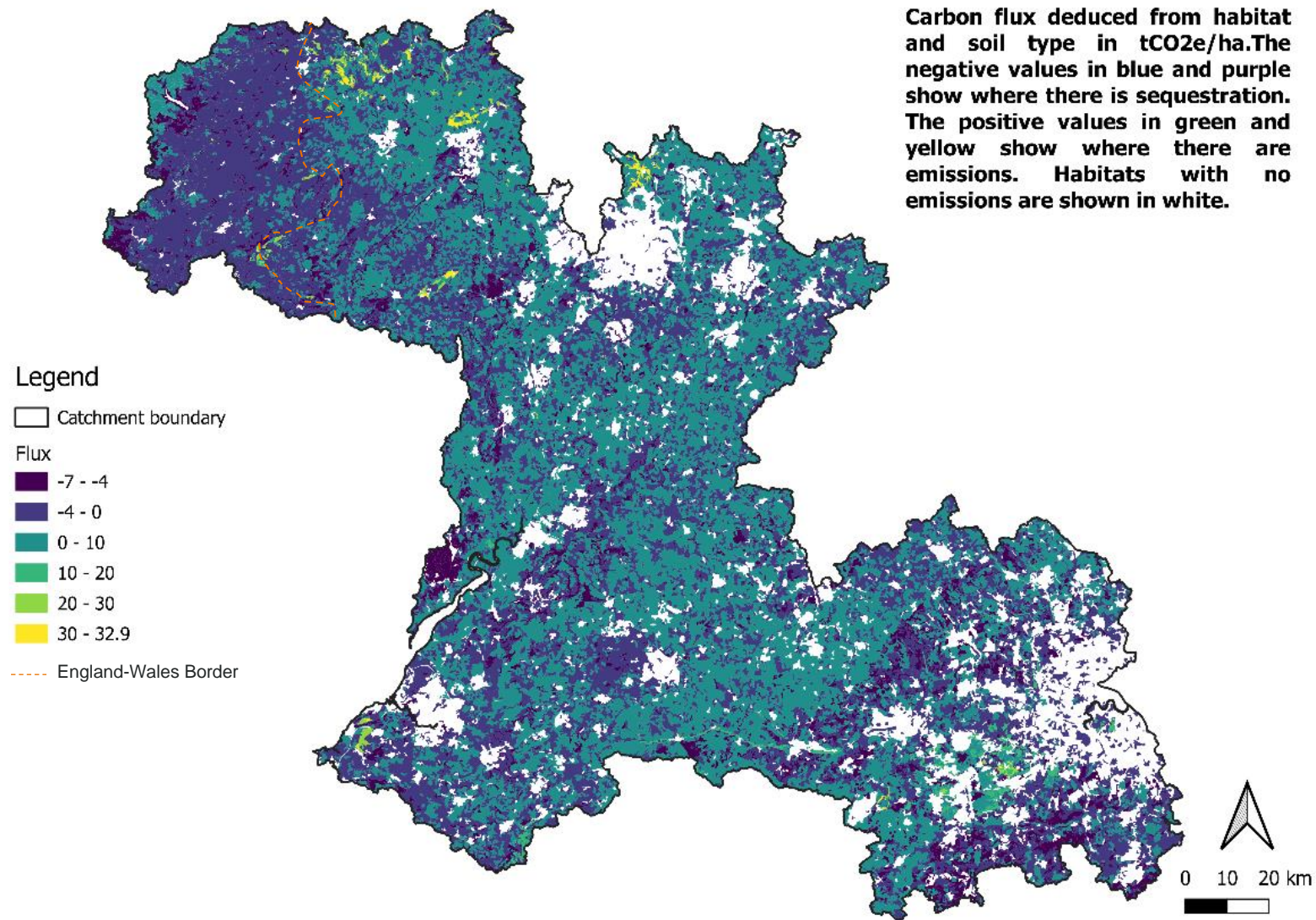


Figure 4-9 Carbon flux deduced from habitat and soil in tCO₂e/ha.

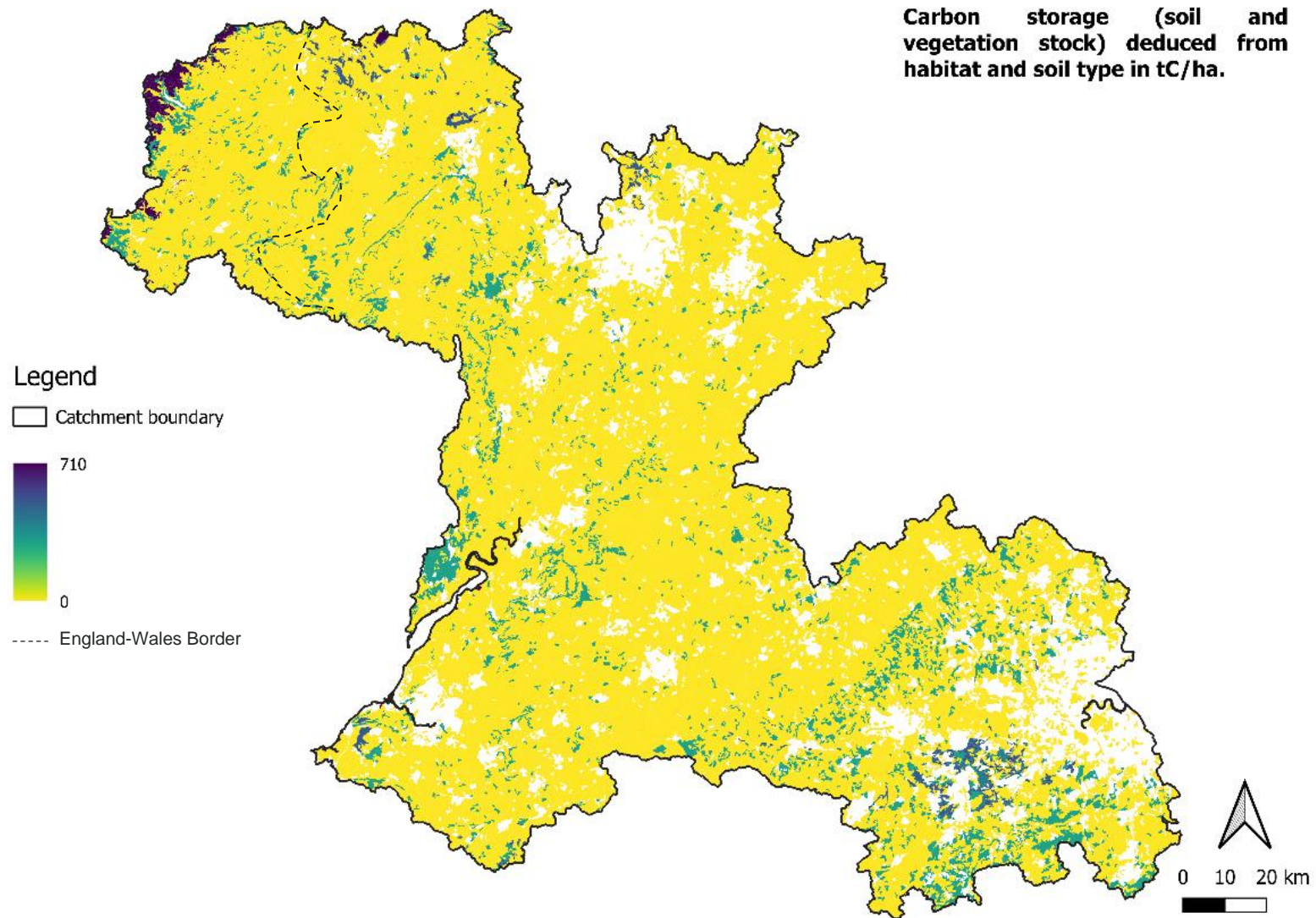


Figure 4-10 Carbon storage (soil and vegetation stock) deduced from habitat soil type in tC/ha.

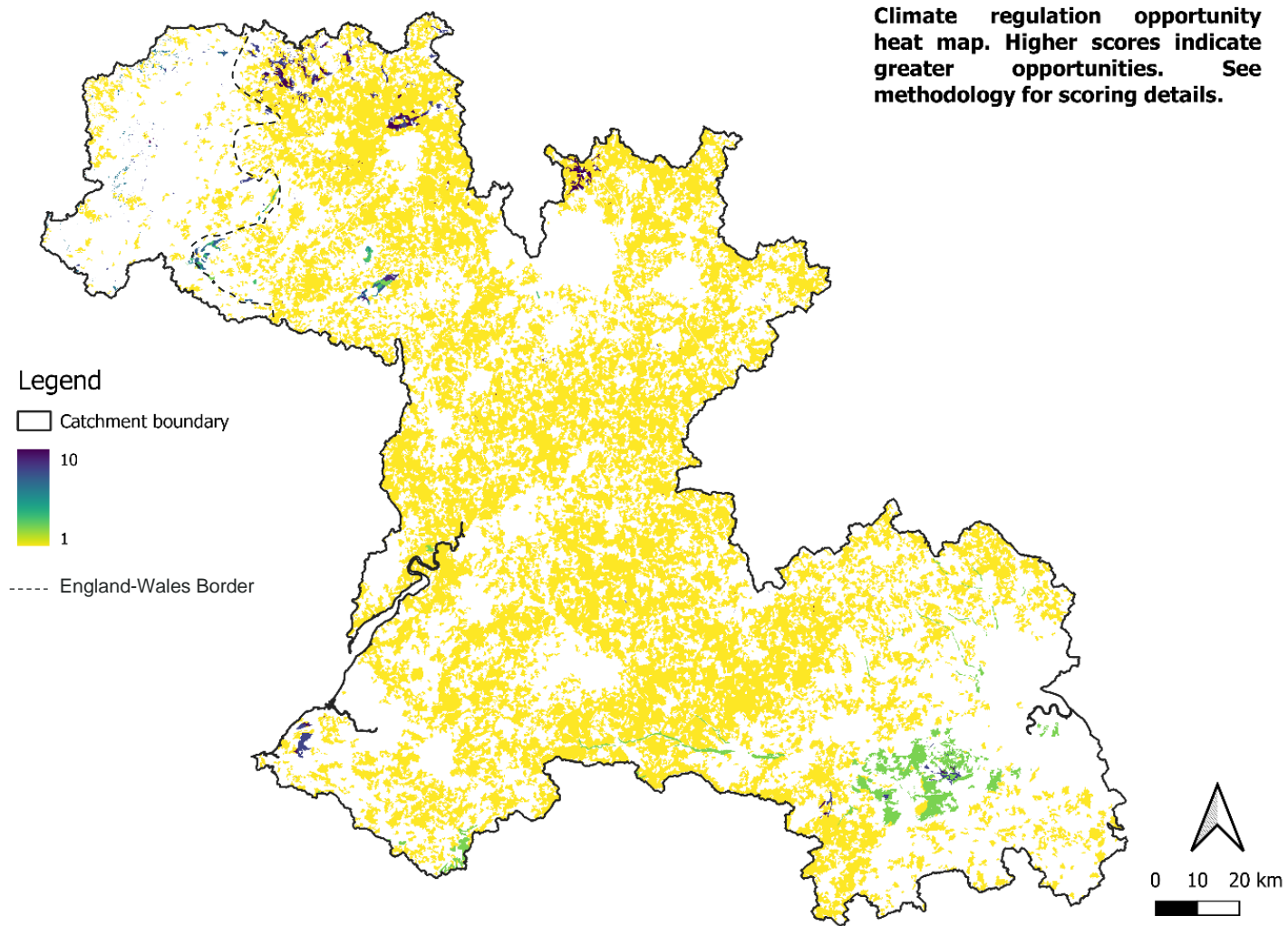


Figure 4-11 Climate regulation opportunity heat map

4.1.5 Access to nature mapping

Access to nature improvements can have additional opportunities for improvements in health and fitness (health and wellbeing). The restoration of habitats for the purpose of access to nature can also have improvements for education and biodiversity if done thoughtfully, for example, setting up outdoor educational spaces within the recreational areas and installing a higher diversity of habitats within an area which was once a uniform habitat. It should be noted that some habitats are sensitive, and it would not be appropriate to introduce public rights of way.

To identify key opportunity areas across the STT solution, the key and sub-questions for access to nature (see [Section 2.3.1.4](#) for further details) were first reviewed namely:

- **Key Question(s)** – How can access to nature be improved within the 5 km buffer?
- **Sub Question(s)** - *Which terrestrial habitats are closest to urban areas and could benefit from footpath access, or closest to recreational areas and could gain additional access to nature benefit?*

To address these questions the following data sets were used and maps provided as outlined in [Table 4.5](#).

Table 4.5 Data sets used in the access to nature focus area analyses, key answers, and maps

Data set	Key answers it provides	Map
Priority Habitat Inventory, National Forest Inventory, Phase 1 habitat Wales, PRow	Terrestrial habitats near urban areas that could benefit from footpath access	Figure 4-12
Priority Habitat Inventory, National Forest Inventory, Phase 1 habitat Wales	Terrestrial habitats near recreational greenspaces	Figure 4-13
Built Up Areas	Urban areas that are in need of access to nature	Figure 4-14
All of the above	Opportunity areas for accessible greenspace to provide access to nature benefits	Figure 4-15

Figure 4-12 identifies the terrestrial habitats within the 5 km buffer around the route options that are close to urban areas that could benefit from having footpath access to greenspaces. The selected terrestrial habitats (from Priority Habitat Inventory (PHI), National Forest Inventory (NFI) and Phase 1 habitat (Wales)) that do not have associated Public Right of Way (PRow) are displayed respectively.

Figure 4-13 identifies the terrestrial habitats within the 5 km buffer around the route options that lie closest to recreational greenspaces. Overall, there are more opportunities in Wales because of the greater proportion of terrestrial habitats.

Figure 4-14 identifies urban areas (built up areas - BUA) within the 5 km buffer around the route options that do not meet the Accessible Natural Greenspace Standards. These standards outline that no person should live more than 300 m from their nearest area of natural greenspace; there should be at least one accessible 20 ha site within 2 km from home; there should be one accessible 100 ha site within 5 km and there should be one accessible 500 ha site within 10 km. The majority of the urban areas in Wales within the study area meet the Accessible Natural Greenspace Standards, providing little benefit for access to nature opportunities. There is greater demand in parts of England including near Birmingham and London.

4.1.6 Access to nature collective heat map

Figure 4-15 shows the opportunity areas for accessible green space within 5 km of the STT solution route. Higher scores indicate areas closer to urban areas which do not have access to greenspace, in accordance with the Access to Natural Greenspace Standard methodology. Excluded from this figure are areas with peaty soils as development would lead to increased carbon emissions. Areas of greatest access to nature opportunities are scattered throughout the 5 km buffer, with concentrations identified close to some major towns and cities such as Telford, Kidderminster, Abingdon, Reading, Slough, and Woking.

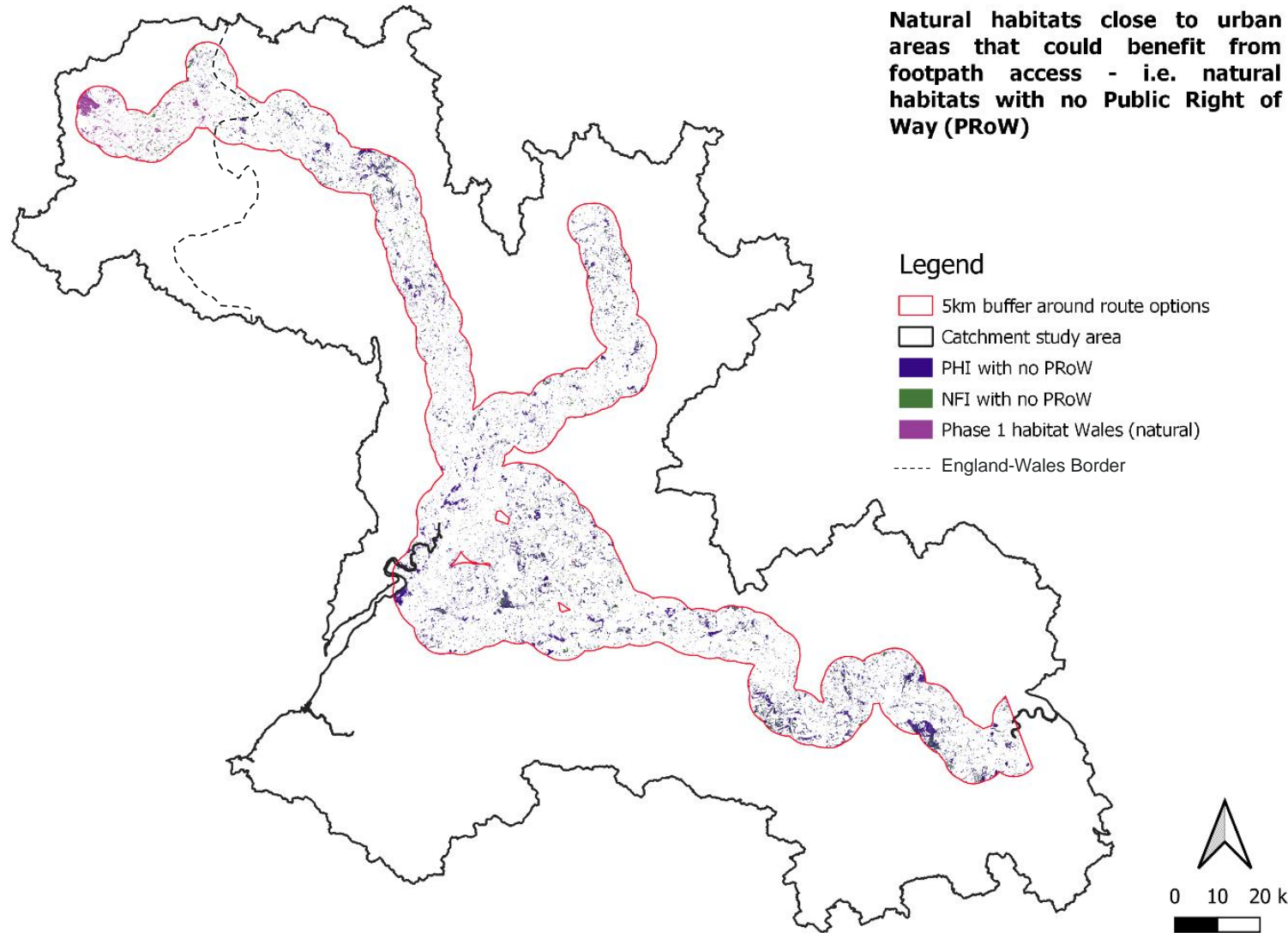


Figure 4-12 Natural habitats close to urban areas that could benefit from footpath access

Natural habitats that lie closest to recreational greenspace areas

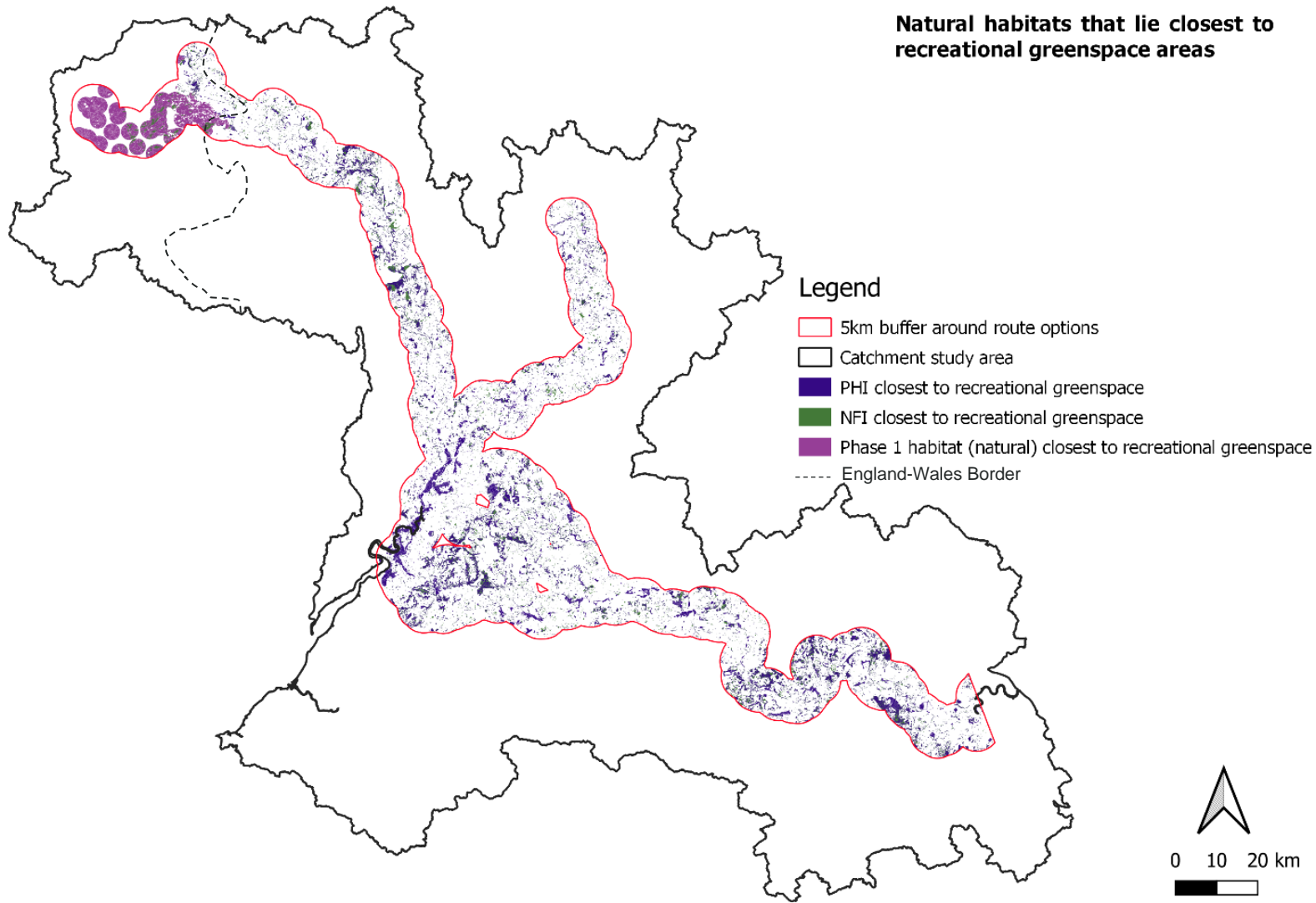


Figure 4-13 Natural habitats that lie closest to greenspace areas

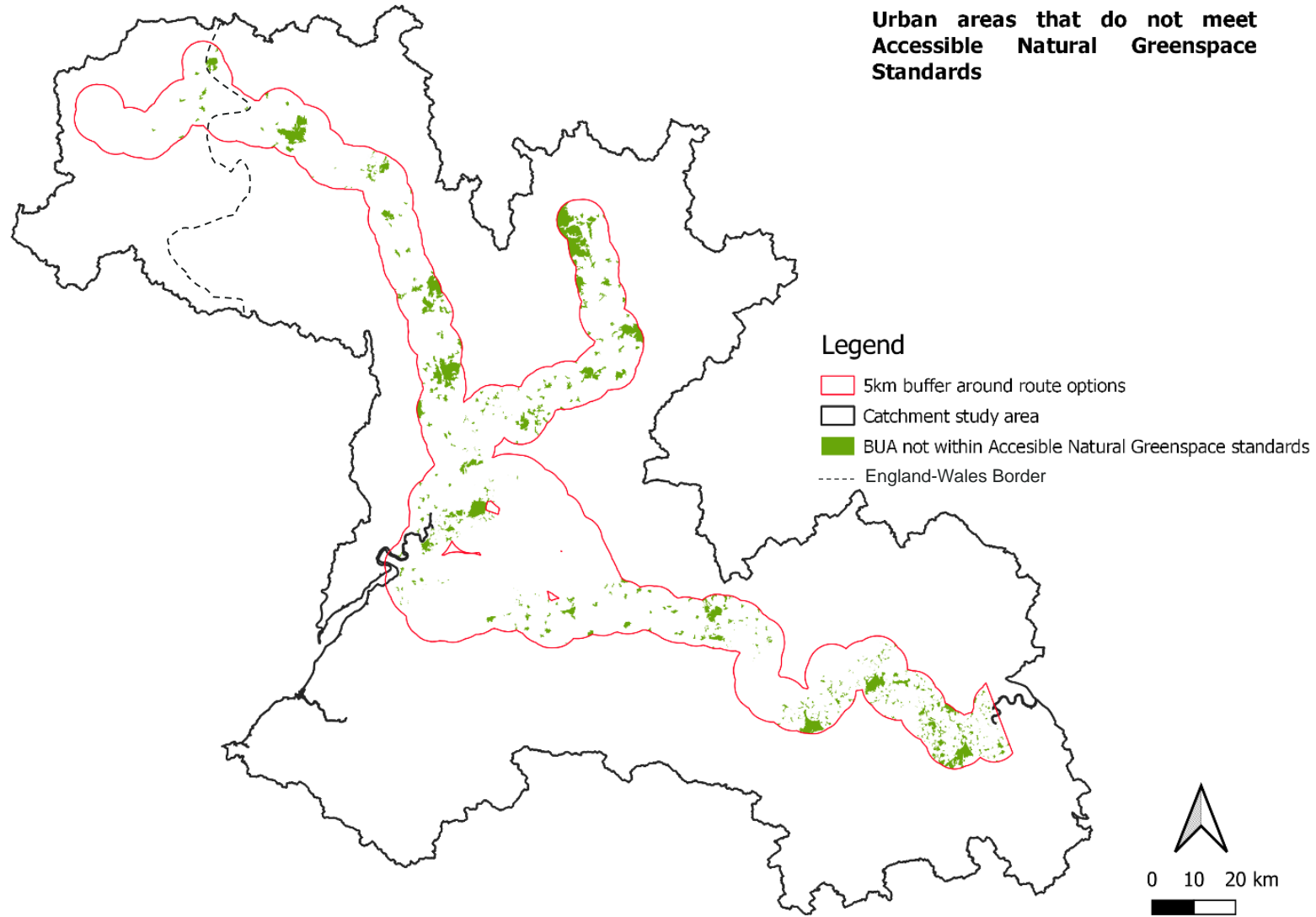


Figure 4-14 Urban areas that do not meet Accessible Natural Greenspace Standards

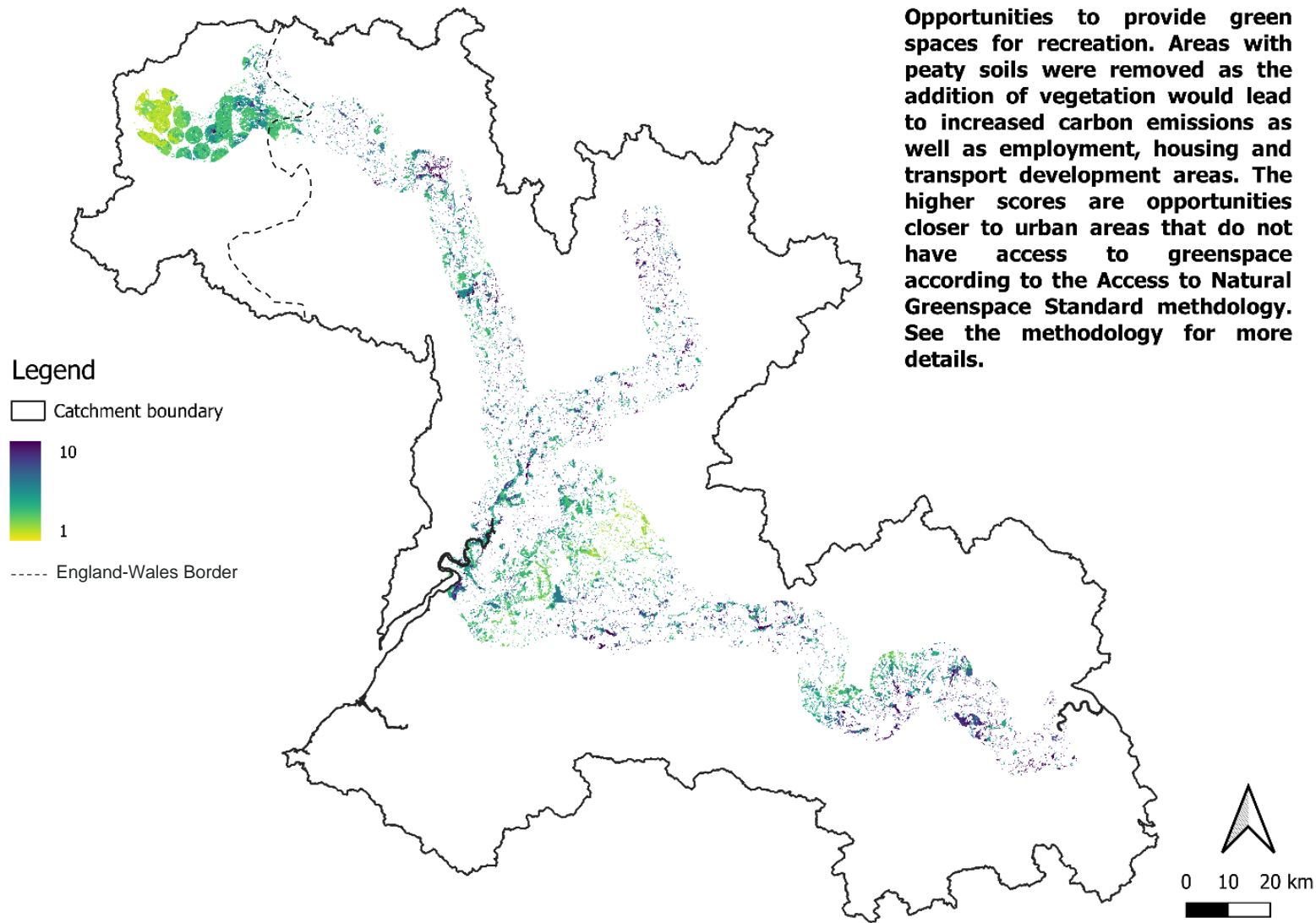


Figure 4-15 Access to nature opportunities within the 5 km buffer scored from 1-10 where higher scores indicate greater potential benefit.

4.1.7 Flood management mapping

Flood management improvements can have far reaching impacts to downstream urban areas which are within the flood zone. Woodland and other publicly accessible habitat creation can also have access to nature benefits. Additional links to water supply and quality may be present via the identification of downstream sewage treatment works which are in the floodplain and hence could benefit from increased flood management protection, and therefore improved resilience of water assets. Improving other habitats for flood amelioration could improve biodiversity, for example, wetlands and planting trees such as oaks (which are associated with the largest number of associated species than any other native trees in England²⁶). A reduction in flooding will also improve carbon sequestration via the installation of carbon sequestering habitats and decreased greenhouse gas emissions produced during and after flood events.

To identify key opportunity areas across the STT solution, the key and sub-questions for flood management (see **Section 2.3.1.5** for further details) were first reviewed namely:

- **Key Question(s)** – *Where are the opportunities to reduce flood risk?*
- **Sub-question(s)** – *Where in the catchments are the highest levels of potential runoff and how do these correlate with land cover and degraded habitats? Where are the areas of high flood risk and how do these correlate with areas of high potential run-off?*

To address these questions the following data sets were used and maps provided as outlined in **Table 4.6**.

Table 4.6 Data sets used in the flood management focus area analyses, key answers, and maps

Data set	Key answers it provides	Map
Flood Map for Planning (Rivers and Sea) Flood Zone 2 Flood Map for Planning (Rivers and Sea) Flood Zone 3 Historic Flood Map Recorded Flood Extents Wales Flood Map for Planning Flood zones 2 and 3	A picture of flood risk across the catchment boundary	Figure 4-16
HadUK-Grid Gridded Climate Observations on a 1 km grid annual rainfall from 2010 to 2020	Average annual rainfall (which contributes to increased flood risk)	Figure 4-17
	Average annual rainfall average per catchment	Figure 4-18
OS Terrain 50	Slope (which contributes to increased runoff risk)	Figure 4-19
	Slope average per catchment	Figure 4-20
CORINE	Manning's roughness score	Figure 4-21
HadUK-Grid Gridded Climate Observations on a 1 km grid annual rainfall from 2010 to 2020 OS Terrain 50 CORINE	Runoff risk	Figure 4-22
All of the above	Flood management opportunity areas to reduce runoff risk.	Figure 4-23

Figure 4-16 shows Flood Zone 2 which refers to medium risk from flooding, and Zone 3 which refers to high (and medium) risk from flooding. There is significant flood risk along various rivers such as the River Severn in the southwest and northwest of the study area, River Thames in the centre and southeast, the River Kennet in the south and the River Tame in the north. There is also some risk slightly further away from the main rivers in London and in the north (although these areas are represented by 1 km grid squares as a finer resolution was not available).

Figure 4-17 shows the mean annual rainfall from 2010 to 2020, produced using HadUK datasets to 1 km grid squares. Mean annual rainfall from 2010 to 2020 was highest in Wales (up to 2827 mm, purple areas). There were also some areas of high rainfall in England particularly in the south and west of the study area (blue and green areas) within the Shropshire Hills, Cotswolds hills, North Wessex Downs, Chiltern Hills, and Surrey Hills. Mean annual rainfall was calculated for each catchment (WFD River Waterbody Catchments Cycle 2) and is shown in **Figure 4-18**. It indicates that most of Wales within the study area received over 1m of annual rainfall

²⁶ <https://catalogue.ceh.ac.uk/documents/22b3d41e-7c35-4c51-9e55-0f47bb845202>

as well as certain catchments in the south and west (purple areas). Catchments in the southwest, south and northwest received 800 mm to 1m of annual rainfall (blue areas).

The locations of higher mean rainfall coincide with the locations of high slope angles, as shown in **Figure 4-19**. Mean slope angle per WFD River Waterbody Catchments Cycle 2 was also calculated and is shown in **Figure 4-20**.

CORINE landcover habitat categories were assigned a Manning roughness score, the resulting map is shown in **Figure 4-21**. Roughness scores range from 0.03 to 0.6 across the scheme catchment boundary. There is a concentration of the lowest roughness score category (yellow, 0.03) within Wales at the eastern edge of Snowdonia and the habitat the corresponds to is pastures. The adjacent high roughness scores in Wales are comprised of woodland and peat bog habitats. Concentrations of lower roughness (green, 0.05) are clearly around the major towns and cities such as London, Bristol, Birmingham, and Telford. These habitats are urban or industrial. The small areas of scattered high roughness (deep purple, 0.6) generally comprise pockets of broadleaved woodland.

Figure 4-22 shows the runoff risk across the catchment boundary. Runoff risk is highest where there are slopes with a steep gradient particularly in Snowdonia and also in urban areas where there is low roughness such as London, Birmingham, Bristol, and other small towns (blue areas).

4.1.8 Flood management collective heat map

Figure 4-23 shows the opportunities to reduce surface runoff. Most of the opportunities have the lowest priority (in purple) outside of flood risk zones with high runoff risk. These are concentrated in Snowdonia where there is high annual rainfall but also in the south of the Cotswold hills, north of the South Downs, the Forest of Dean area and in the Shropshire Hills. There are some opportunities in green and yellow in the flood risk zones.

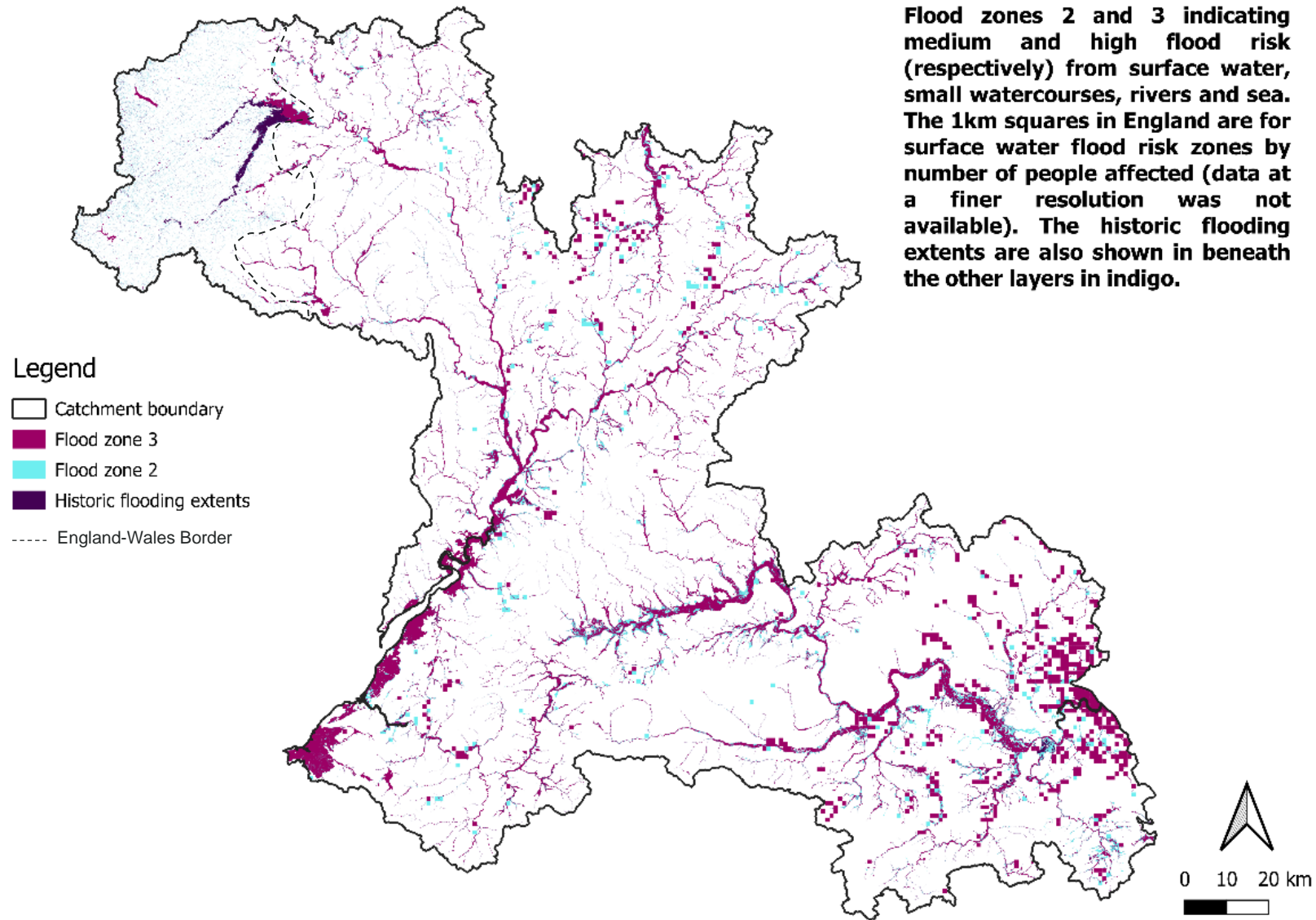


Figure 4-16 Flood Zones 2 and 3 and historic flooding extents

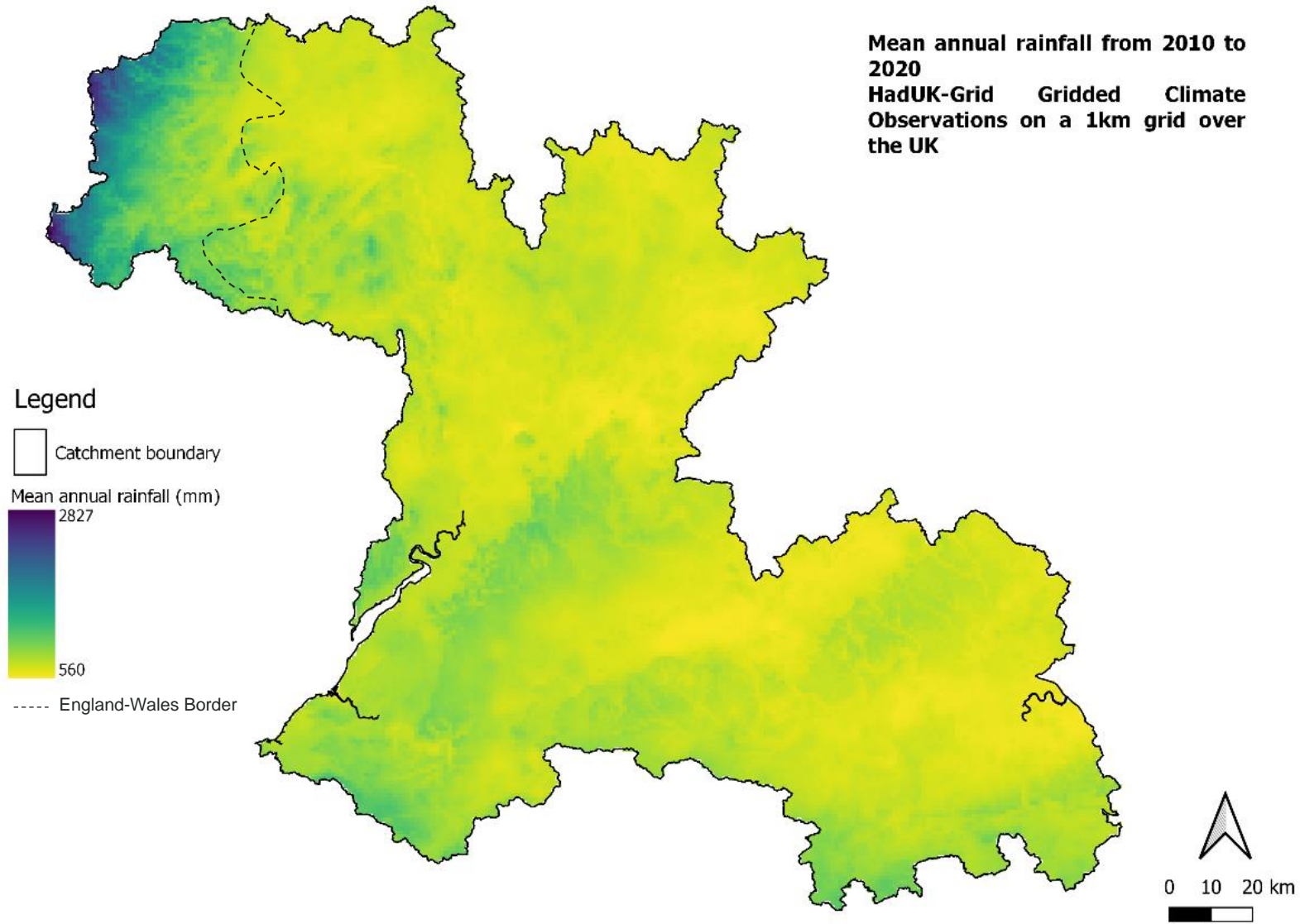


Figure 4-17 Mean annual rainfall from 2010 to 2020

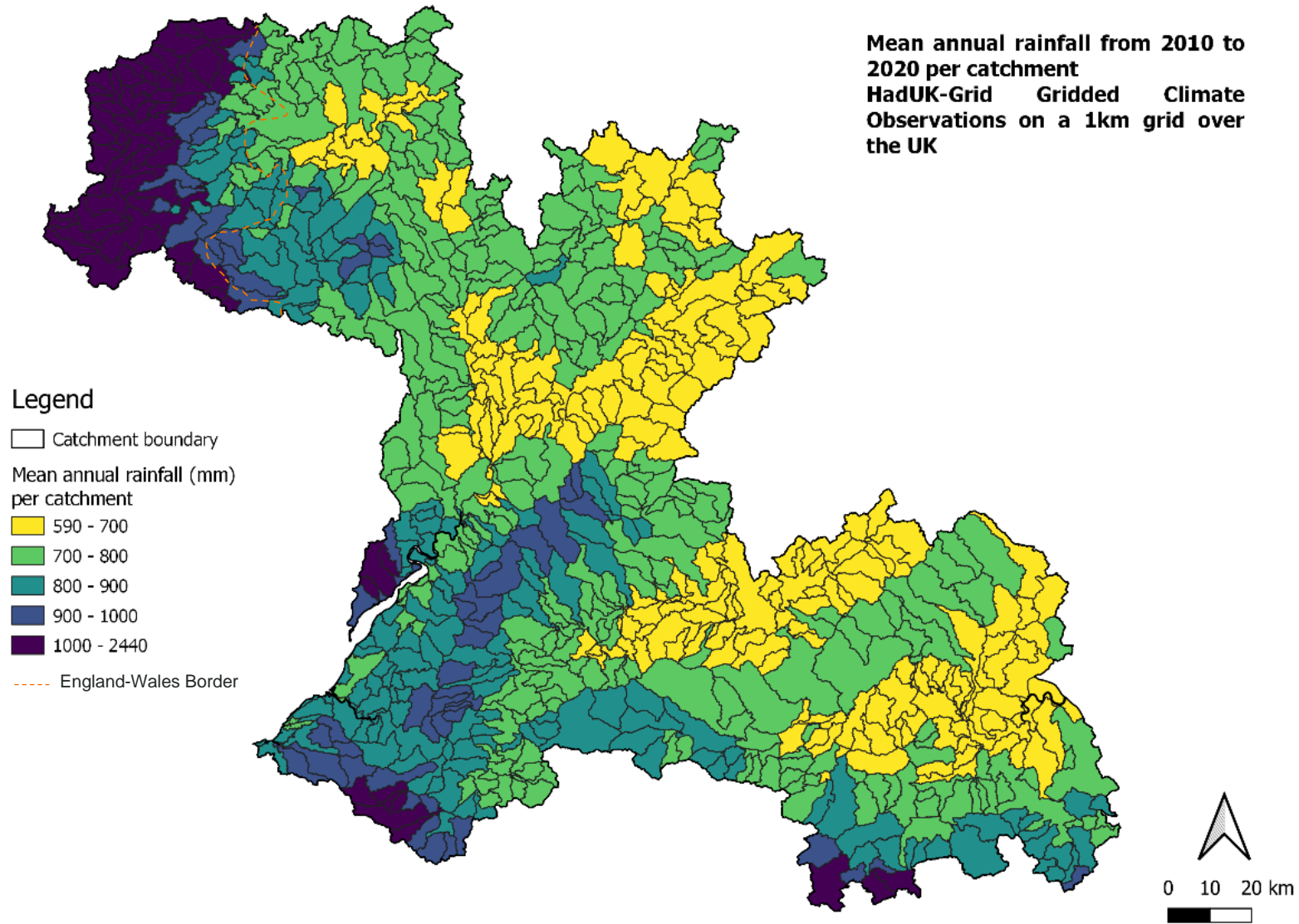


Figure 4-18 Mean annual rainfall from 2010 to 2020 per catchment

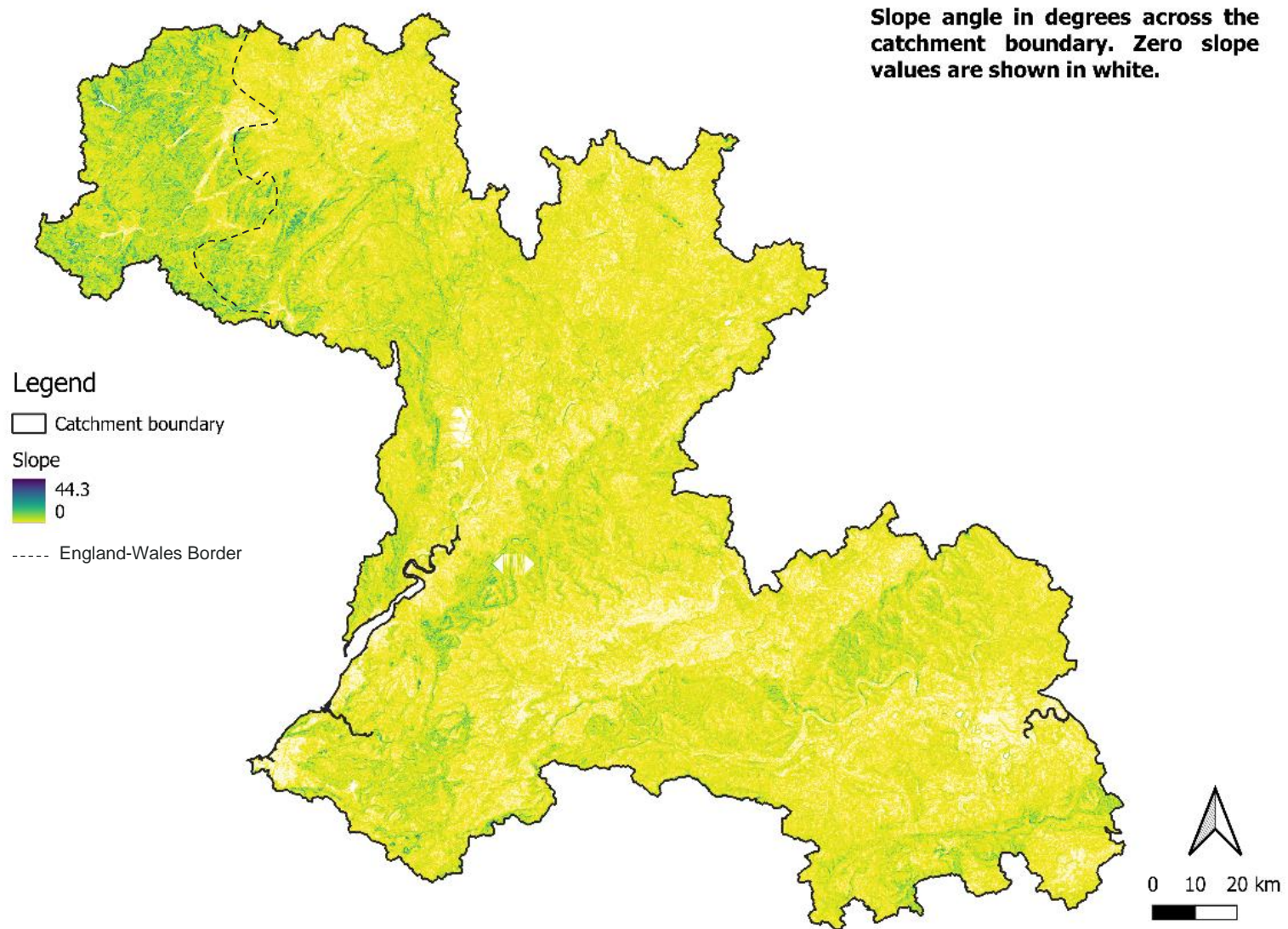


Figure 4-19 Slope angle in degrees across the catchment boundary

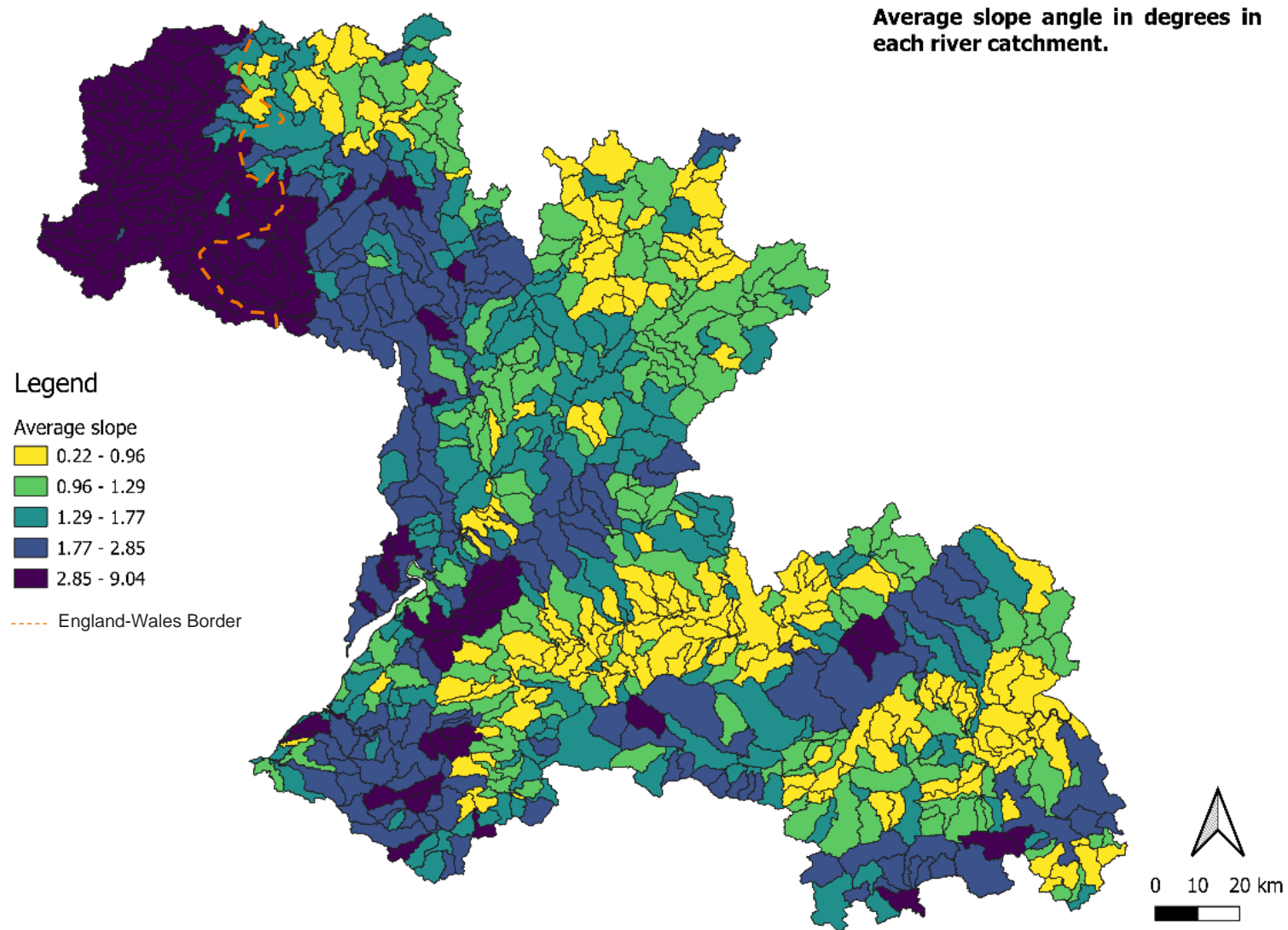


Figure 4-20 Average slope angle in degrees in each river catchment

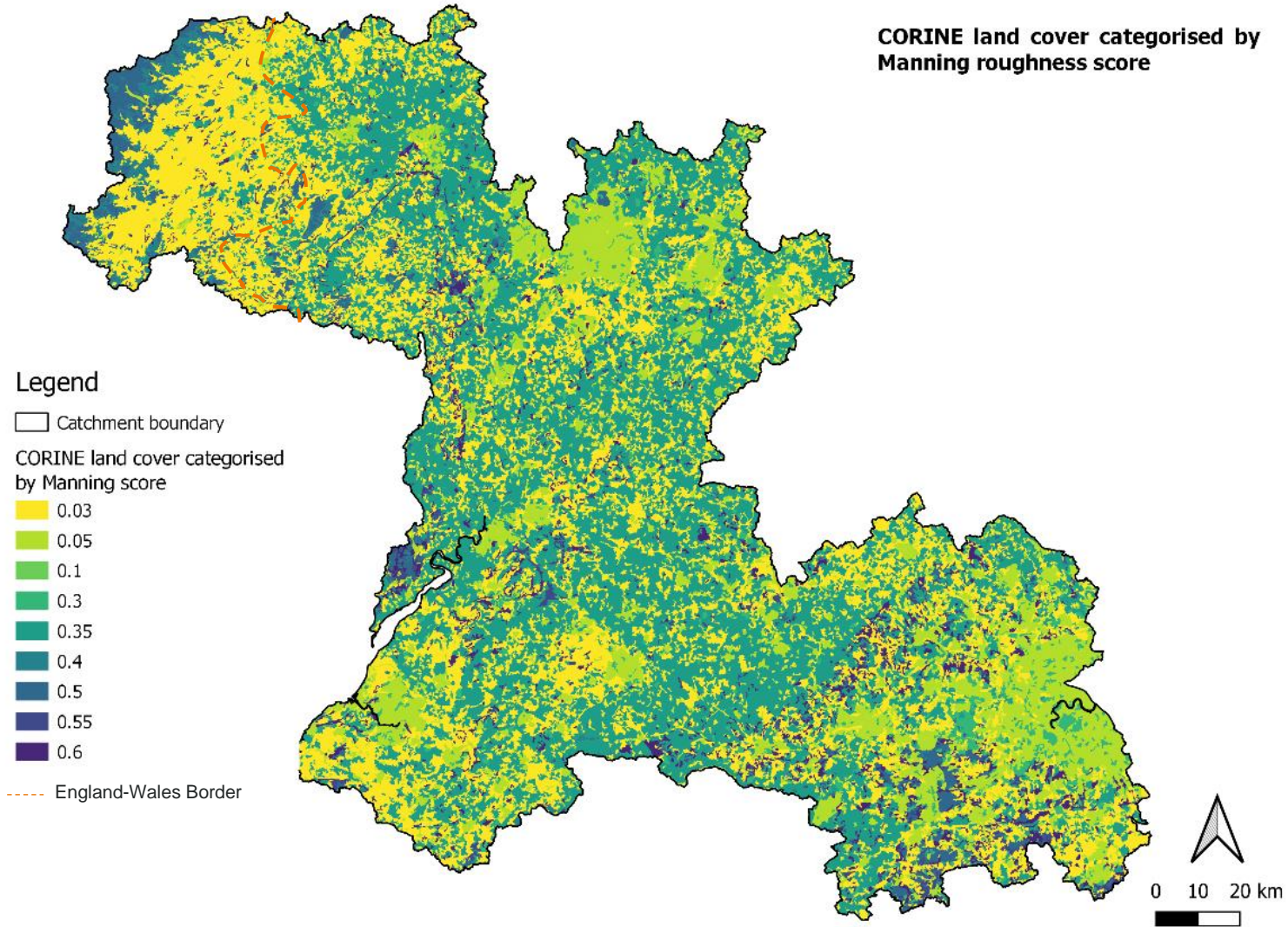


Figure 4-21 CORINE land cover categorised by Manning roughness score

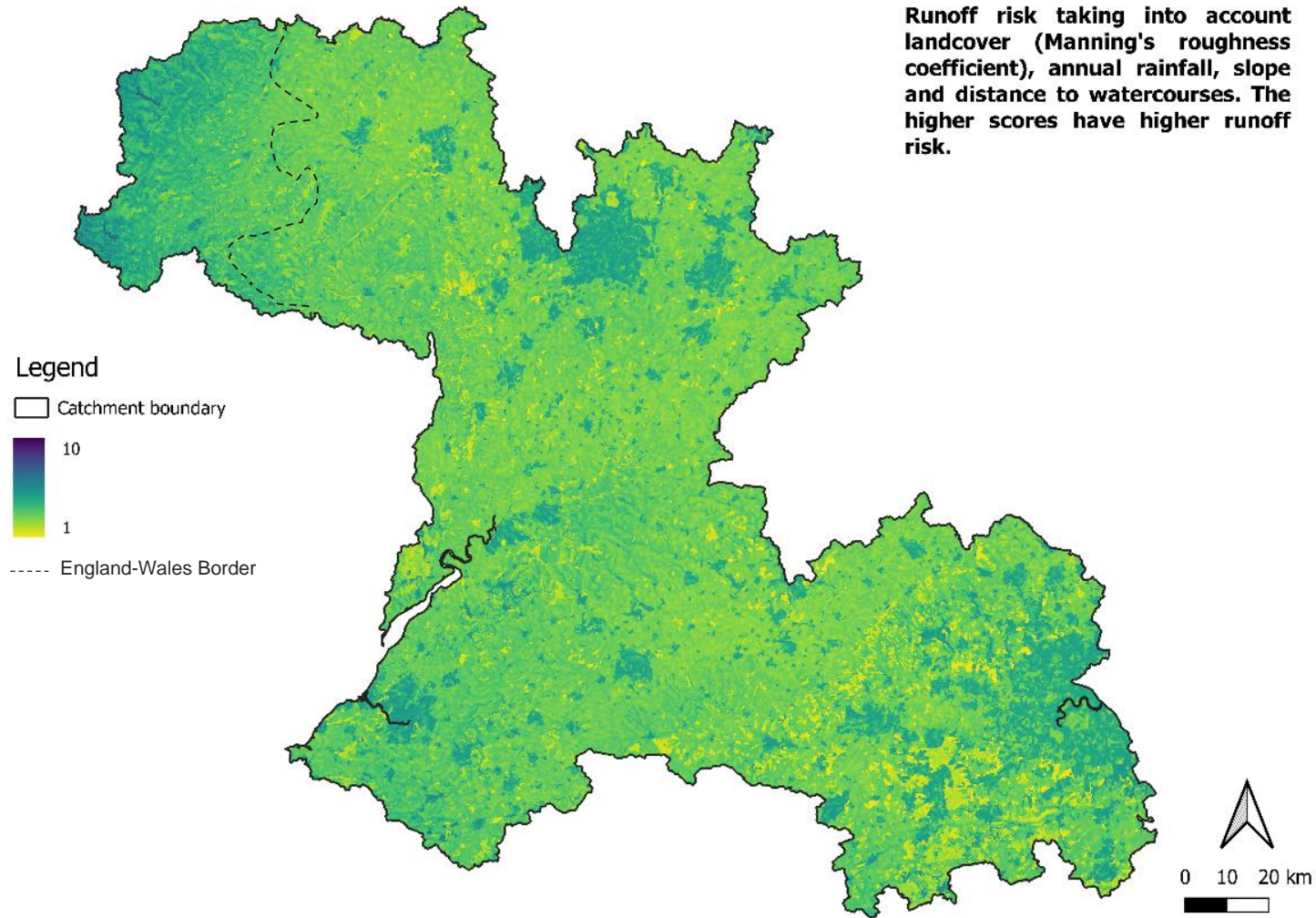


Figure 4-22 Runoff risk

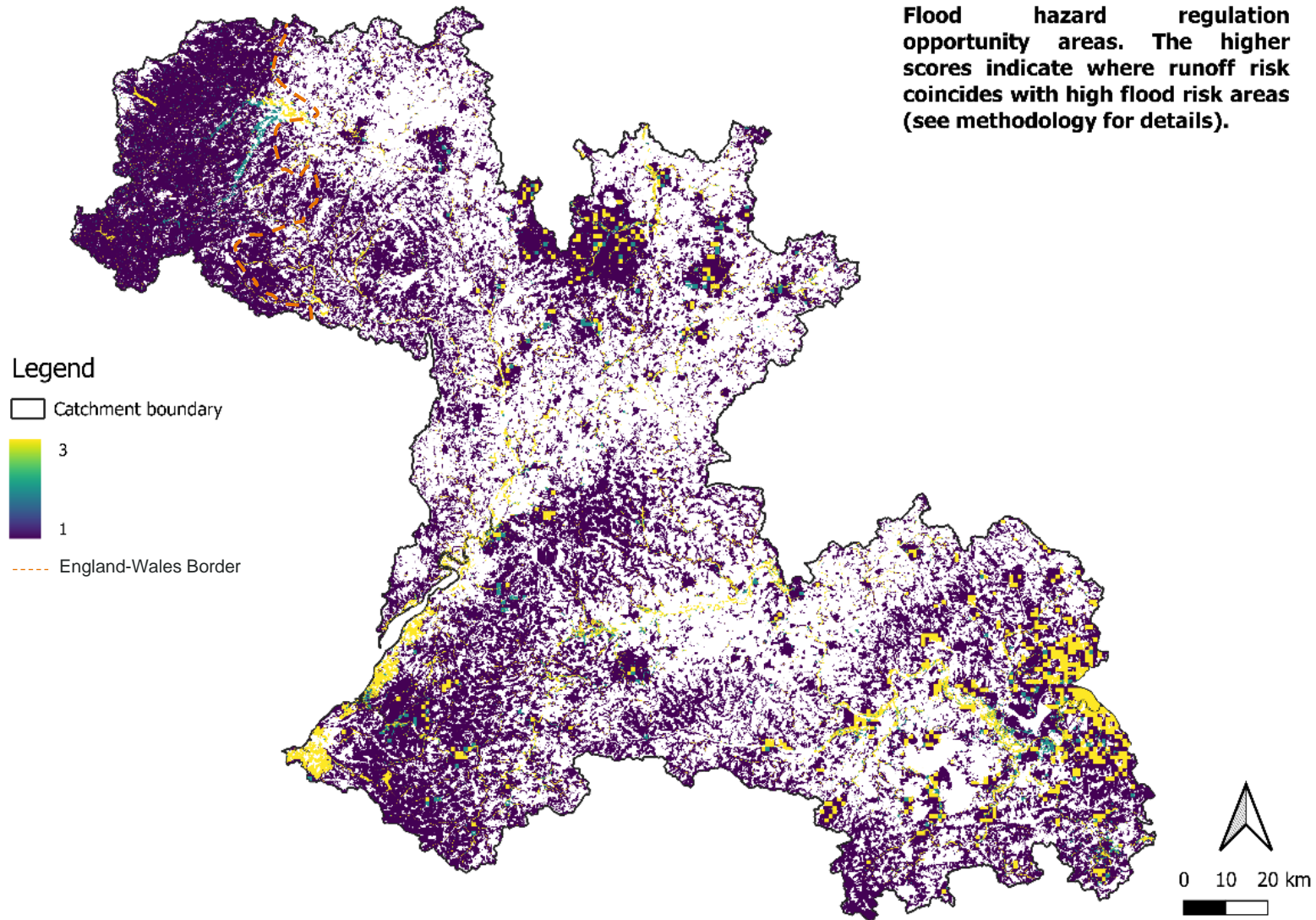


Figure 4-23 Heat map showing opportunities to reduce surface run off to prevent flooding

4.1.9 River biodiversity mapping

Reconnected rivers and WFD water bodies in proximity to footpaths and urban areas can offer access to nature and angling opportunities (access to nature and health and wellbeing). Removal of existing barriers within fluvial or riparian SSSIs can help enhance biodiversity through improvement in water quality and supply. Reduction in non-native species can also improve habitat and species diversity.

To identify key opportunity areas across the STT solution, the key and sub-questions for river biodiversity (see [Section 2.3.1.6](#) for further details) were first reviewed namely:

- **Key Question(s)** – *Which rivers could be enhanced to improve biodiversity?*
- **Sub-questions** – *Where are the greatest barriers to fish and eel migration? Which rivers have the lowest WFD fish status? Which rivers have the greatest pressures impacting biodiversity (e.g., invasive species)?*

To address these questions the following data sets were used and maps provided as outlined in [Table 4.7](#)²⁷:

Table 4.7 Data sets used in the river biodiversity analyses, key answers, and maps

Data set	Key answers it provides	Map
WFD waterbodies and status, river paths	An indication of the pressures on river biodiversity	Figure 4-24
WFD waterbodies and status, river paths	Fish status	Figure 4-25
Priority barriers – combined coarse and salmonid	Height of barriers	Figure 4-26
All of the above	Opportunities to enhance river biodiversity and their relative importance	Figure 4-27

[Figure 4-24](#) shows the locations of rivers with ‘poor’ or ‘bad’ overall WFD status which is caused by point source pollution or other activities (except diffuse pollution), along with the related activities contributing to the status. The most common activity responsible was physical modifications, as detailed in [Table 4.8](#). The watercourses in Wales did not include reasoned activities for the poor or bad WFD overall status.

Table 4.8 Activity responsible for poor or bad WFD overall status and length of river reach

Activity	Length (km)	Percentage of total river length (%)
Changes to the natural flow and levels of water	69.6	11.4
Non-native invasive species	65.6	10.7
Physical modifications	477.1	77.9

There are 795 watercourses with a total combined length of approximately 9680 km within the STT solution catchment which are derived from the WFD RBMP2. The locations of these are shown in [Figure 4-25](#) with symbology showing the six classifications of fish status (bad, poor, moderate, good, high, and unclassified). There are a total of 3927 priority barriers (salmonid and coarse) within the scheme catchment. These are shown in [Figure 4-26](#) and are classified according to the recorded height of the barrier. The barriers range in height from 2 cm to 459 cm. The locations of the barriers show opportunity areas for barrier removal, fish pass construction and the replacement of existing fish passes that are inefficient or could be improved.

In order to determine the watercourses which were the most critical and would potentially benefit the most from interventions or improvements relating to fish, the watercourses with ‘bad’ and ‘poor’ fish status were extracted from the RBMP2 dataset, as shown in [Figure 4-27](#). This accounted for 119 watercourses with a total combined length of 1467 km. The distribution of ‘bad’ and ‘poor’ fish status watercourses is scattered throughout the scheme catchment boundary, with a slight concentration in the south-east within the Thames River basin such as Wey and tributaries, Loddon and tributaries and Mole surface water management catchments. There is also

²⁷ Ricardo is aware that there are other data sets available but at this stage open-source data was focussed on to provide the “blue skies” proof of concept. Additional more local data sets such as more detailed fisheries data in Wales, as an example, can be added at the more detailed planning stage.

a slight concentration of 'bad' and 'poor' fish status watercourses at the centre of the scheme boundary within the Tame Anker and Mease surface water management catchments.

Barriers ≥ 1.4 m have been shown to act as a barrier to Atlantic Salmon migration and therefore these barrier locations were extracted from the dataset²⁸, as shown in **Figure 4-27**. These accounted for 219 barriers and showed a clear concentration (184 out of 219, approximately 84%) within the Severn River basin. Within the Thames River basin there are 22 barriers ≥ 1.4 m and these are concentrated at the edges of the Thames River basin catchment boundary.

4.1.10 River biodiversity collective heat map

Figure 4-27 shows the locations of opportunities relating to river biodiversity. This includes the location of 'bad' and 'poor' fish status watercourses, priority barriers ≥ 1.4 m, watercourses with 'invasive species', 'changes to natural flow/water levels' and 'physical modifications' listed as reasons for overall WFD status, and 'poor' and 'bad' WFD ecological status. The locations of 'bad' and 'poor' fish status watercourses, and locations of barrier heights ≥ 1.4 m are shown to be largely exclusive of each other, i.e., not all watercourses with 'bad' or 'poor' fish status also have barriers ≥ 1.4 m, and vice versa. However, it should be noted that not all watercourses have been classified for the fish status. The areas with a concentration of higher opportunity areas (i.e., yellow on the figure) are in the north west of the STT solution catchment boundary, specifically around Shropshire and the Wales-England border. There is also a small concentration of greatest opportunities to the west of London.

²⁸ [The impact of a small-scale riverine obstacle on the upstream migration of Atlantic Salmon \(springer.com\)](#)

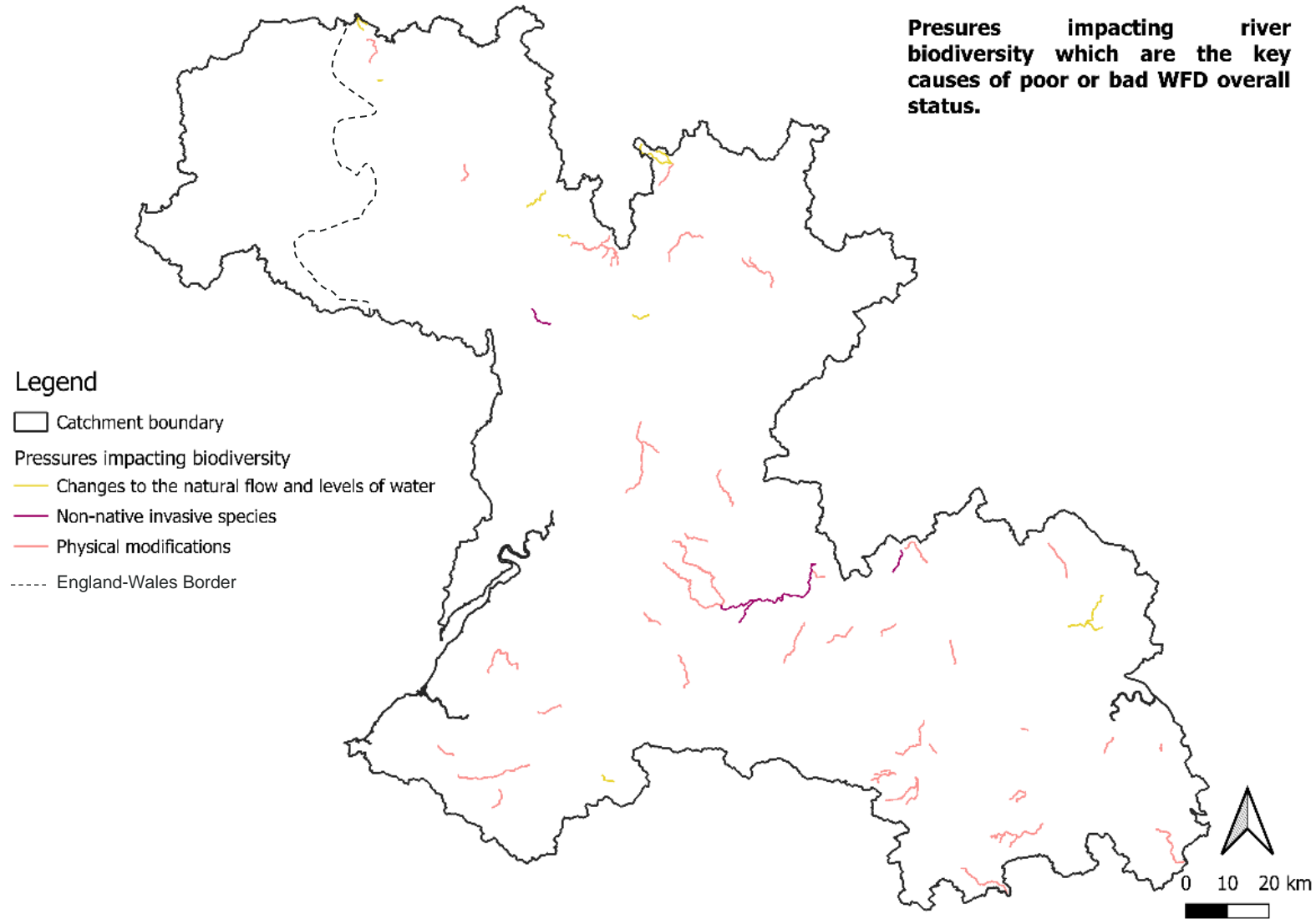


Figure 4-24 Rivers with poor or bad Water Framework Directive overall status caused by activities that have a negative impact on biodiversity

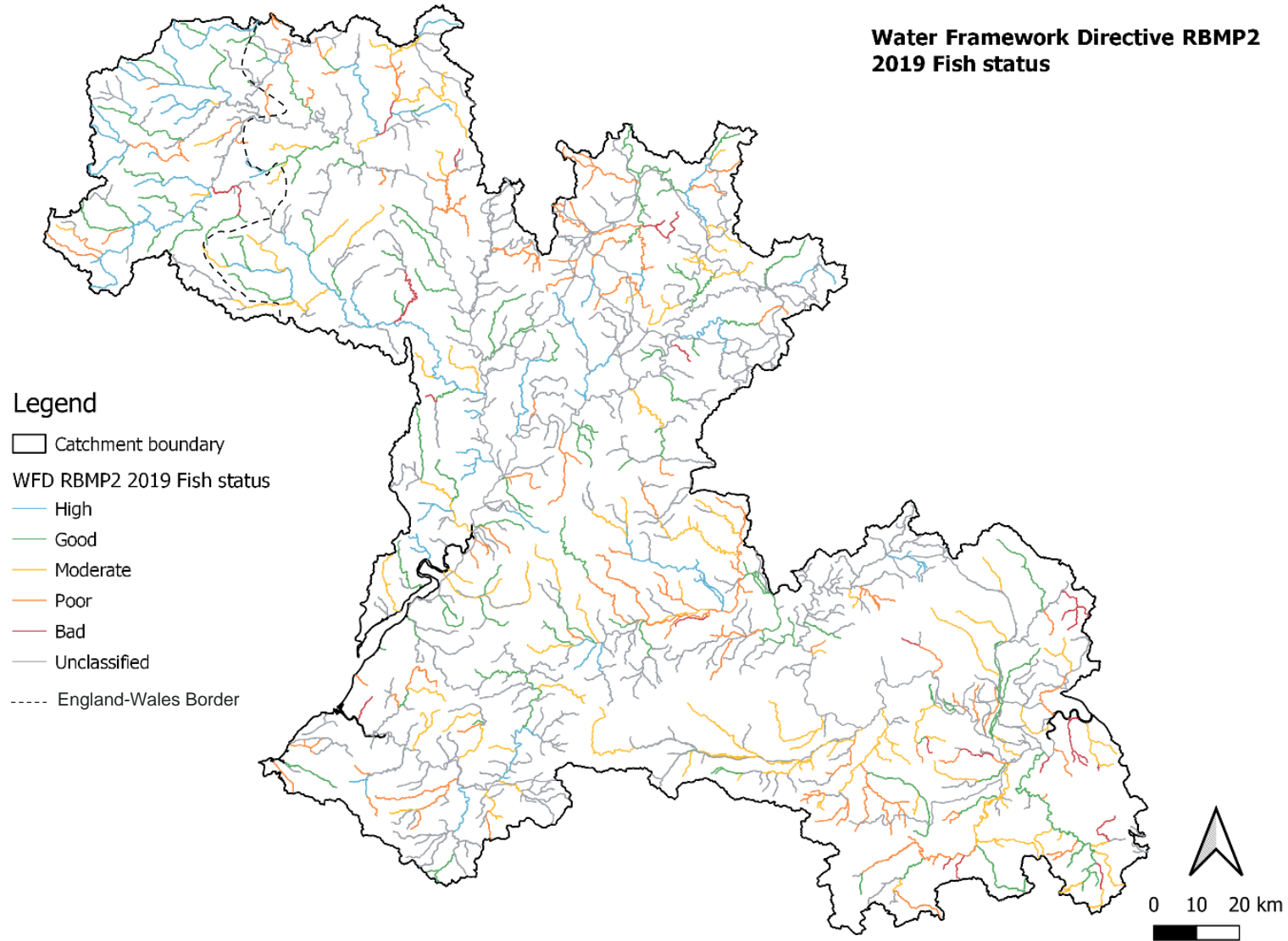


Figure 4-25 Water Framework Directive RBMP2 2019 Fish status

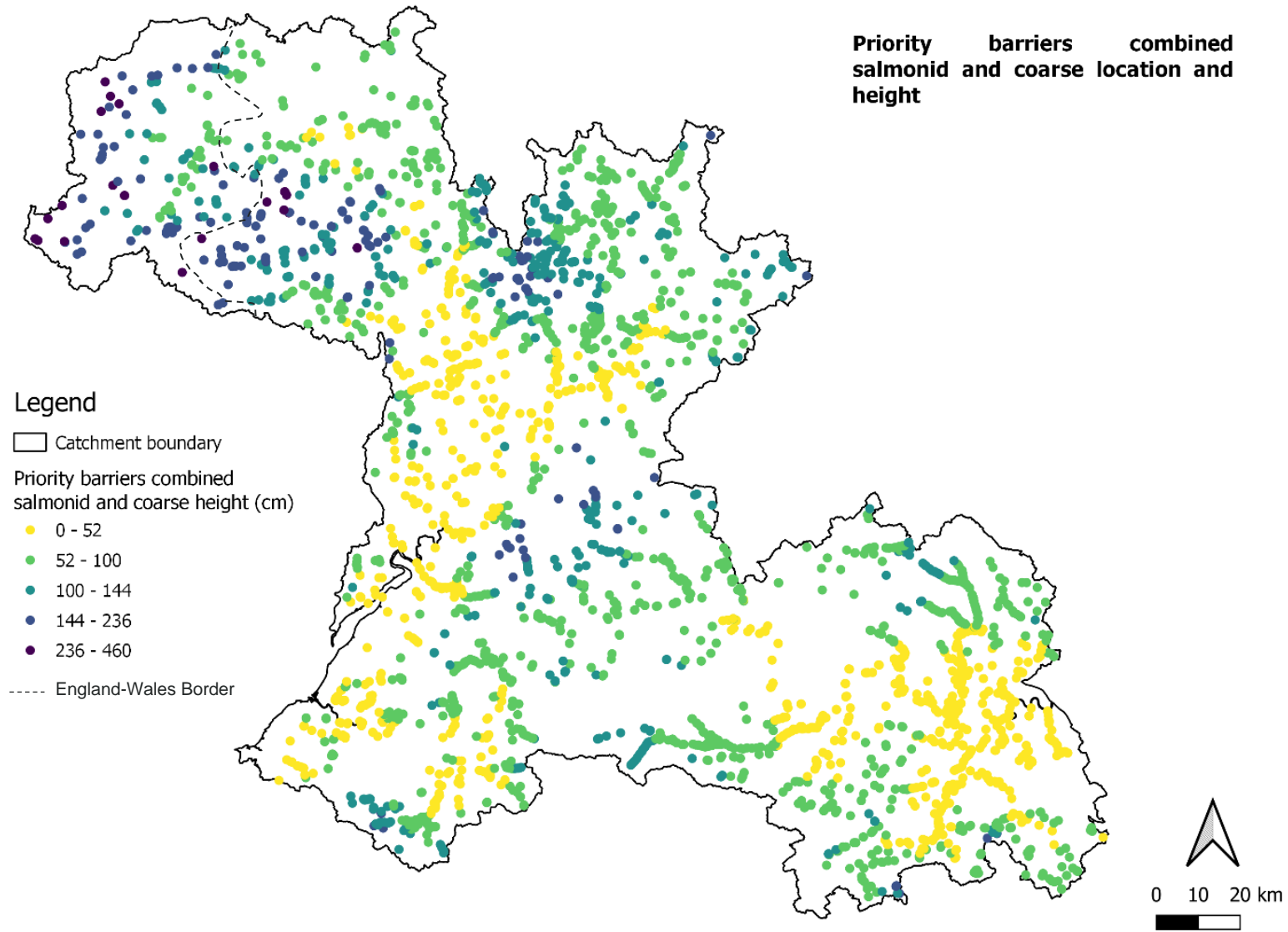


Figure 4-26 Priority barriers combined salmonid and coarse location and height

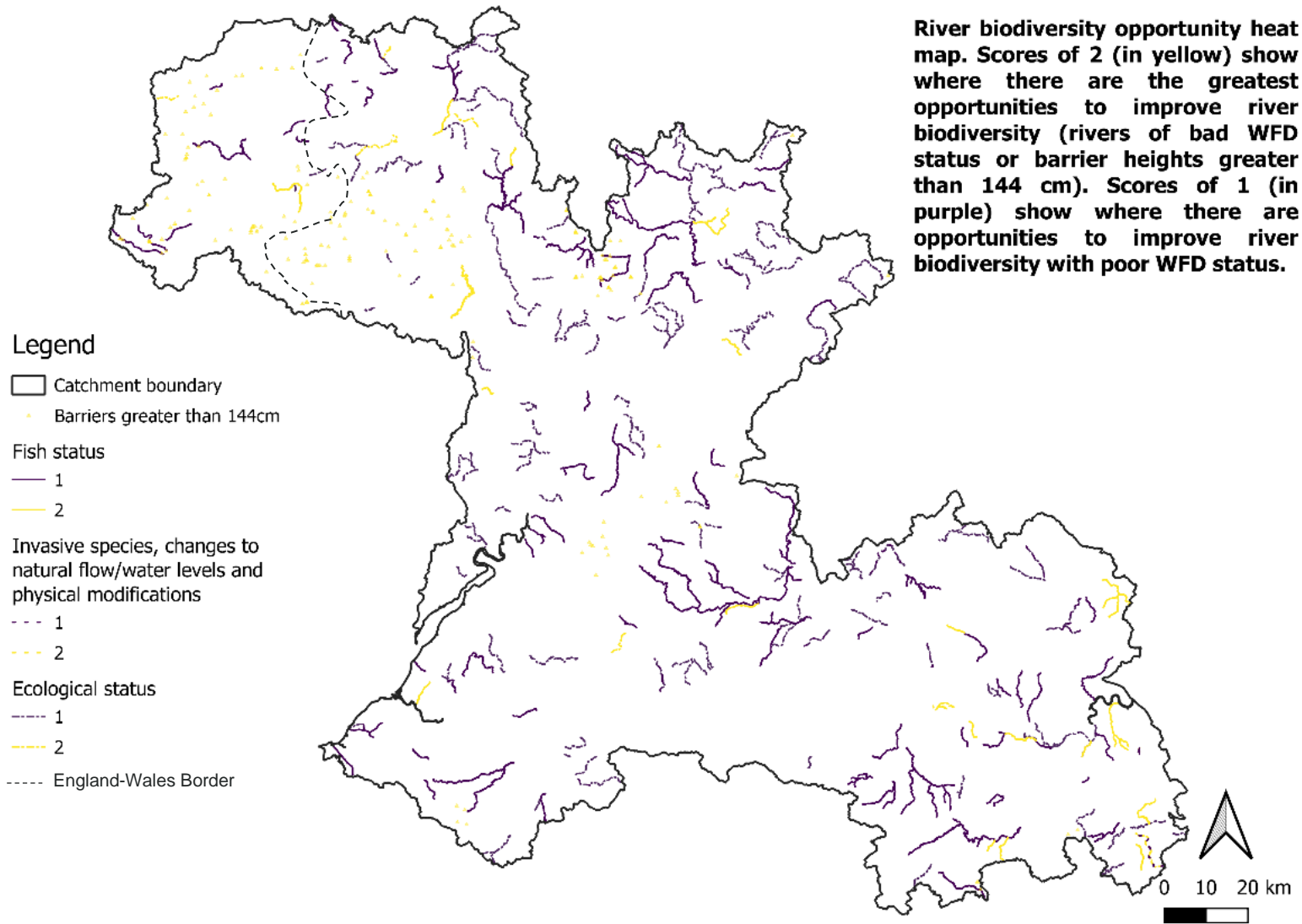


Figure 4-27 Locations of priority barriers over 1.4 m and WFD RBMP2 2019 Fish poor and bad status

4.2 SOCIAL CAPITAL MAPS

In addition to the key questions and maps outlined above in **Section 4.1**, deprivation indices namely health, employment, education, and income were mapped to provide an understanding of interlinks between ecosystem service and societal benefits. **Figures 4-28 to 4-31** map the individual key deprivation indices, whilst **Figure 4-32** provides the cumulative deprivation and hence maps potential for the largest societal benefit.

Figure 4-28 shows that health deprivation is highest in Birmingham and in the towns and rural areas around Birmingham such as in Bromsgrove (to the south), Telford (to the west) and Coventry (to the east) as well as in Bristol, Gloucester, and Swindon to a lesser extent. Health deprivation is low in the rest of the catchment.

Figure 4-29 shows employment deprivation is highest in Birmingham. There is also significant deprivation in Coventry, Telford, and Bristol as well as in rural areas such as the Forest of Dean, to the south of Bracknell, Wyre Forest, and Wychavon.

Figure 4-30 shows education deprivation is highest in Birmingham and its satellite towns and Bristol. There is also some deprivation in Swindon, Reading, Welshpool, the Forest of Dean and scattered across the southeast of the catchment boundary. Education deprivation is generally much lower in Wales.

Figure 4-31 shows income deprivation is highest in Birmingham, its satellite towns and to a lesser extent in Bristol. There is also some income deprivation in London.

Figure 4-32 presents the cumulative benefits for social capital opportunity within the STT solution catchment, showing that the largest benefits (most significant deprivation) are predominantly located around Birmingham and the surrounding area and to a lesser extent in Bristol. There is also a cluster of opportunities around London.

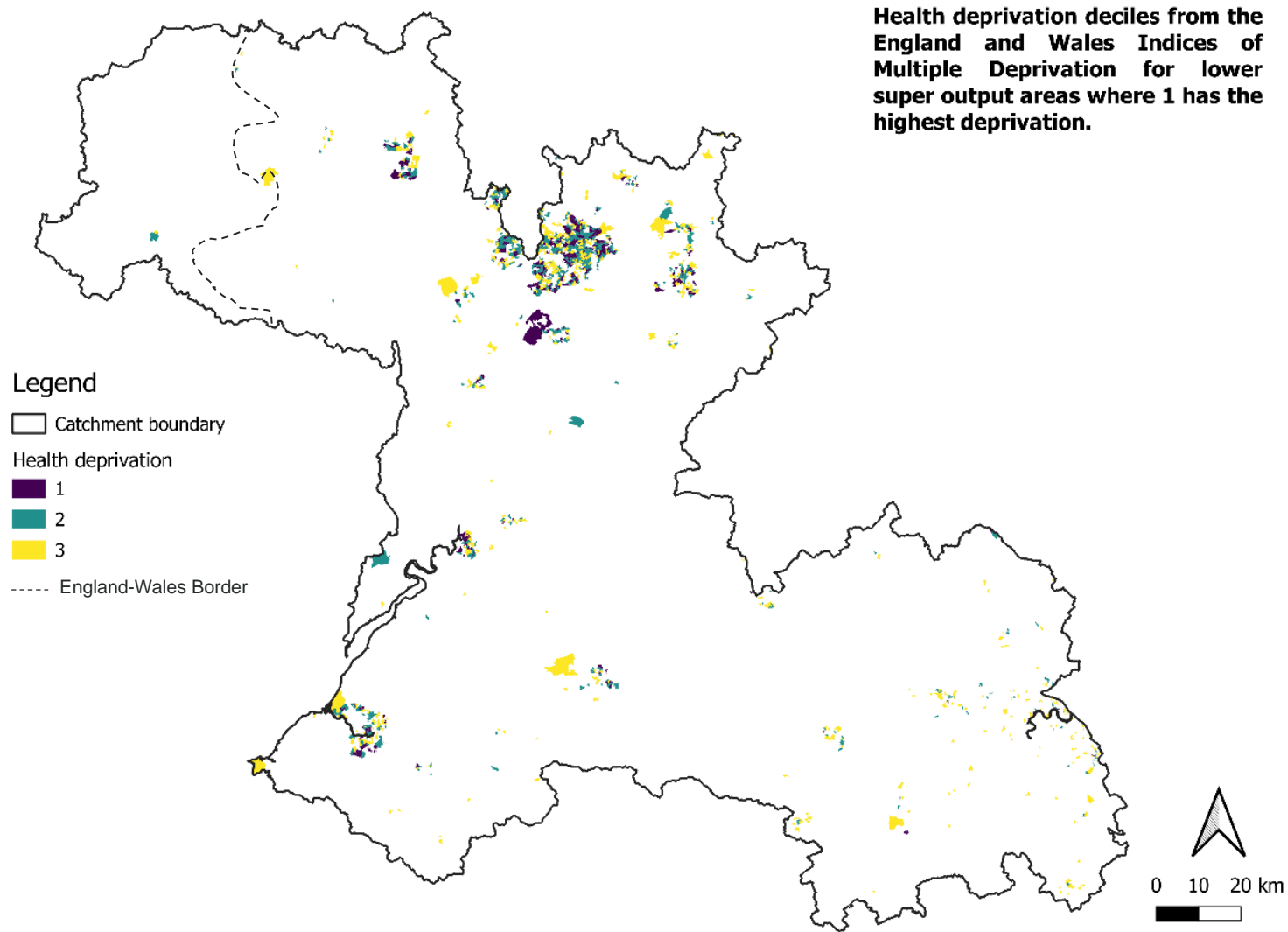


Figure 4-28 Health deprivation scores across the STT solution catchment

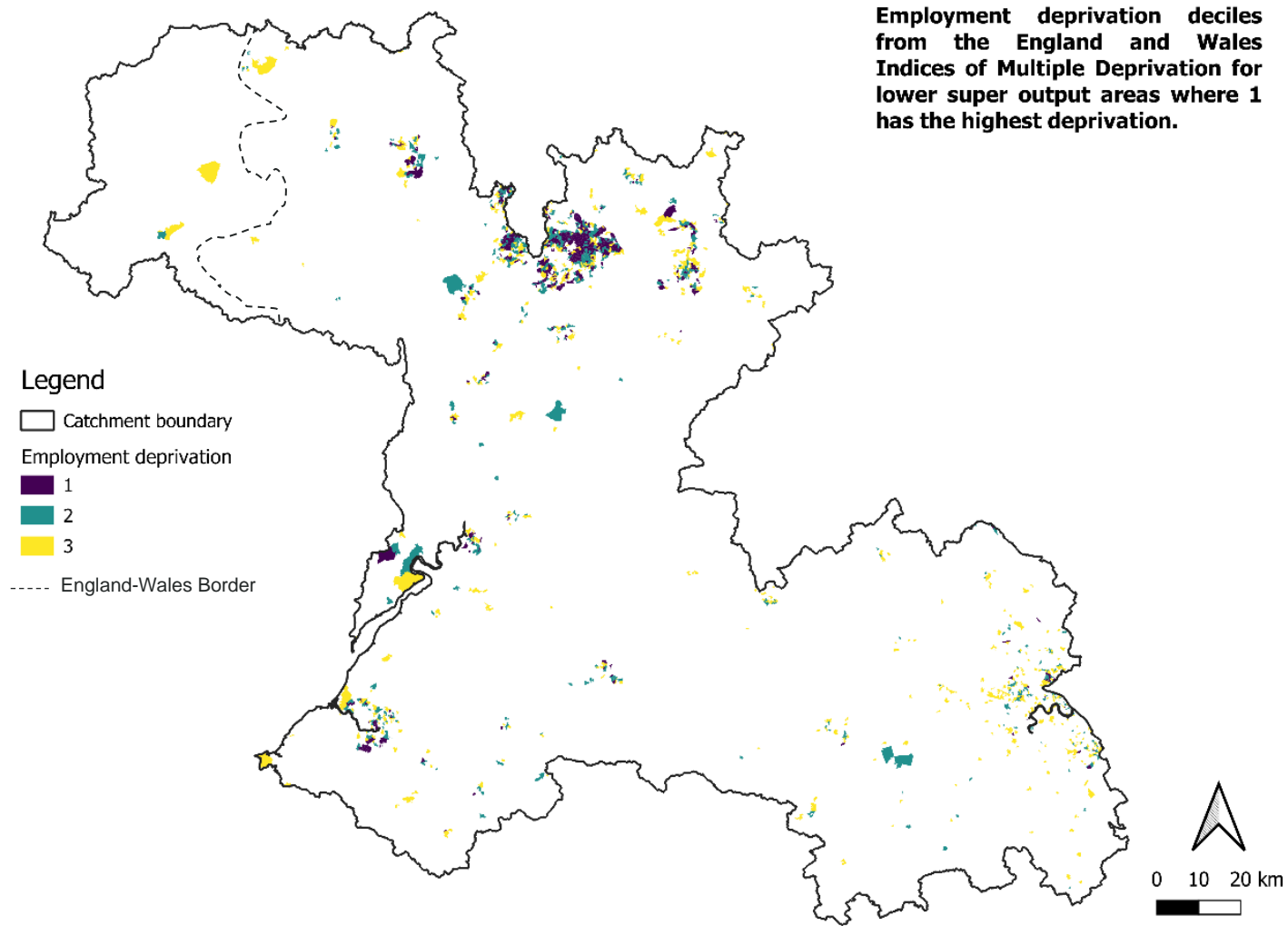


Figure 4-29 Employment deprivation scores across the STT solution catchment

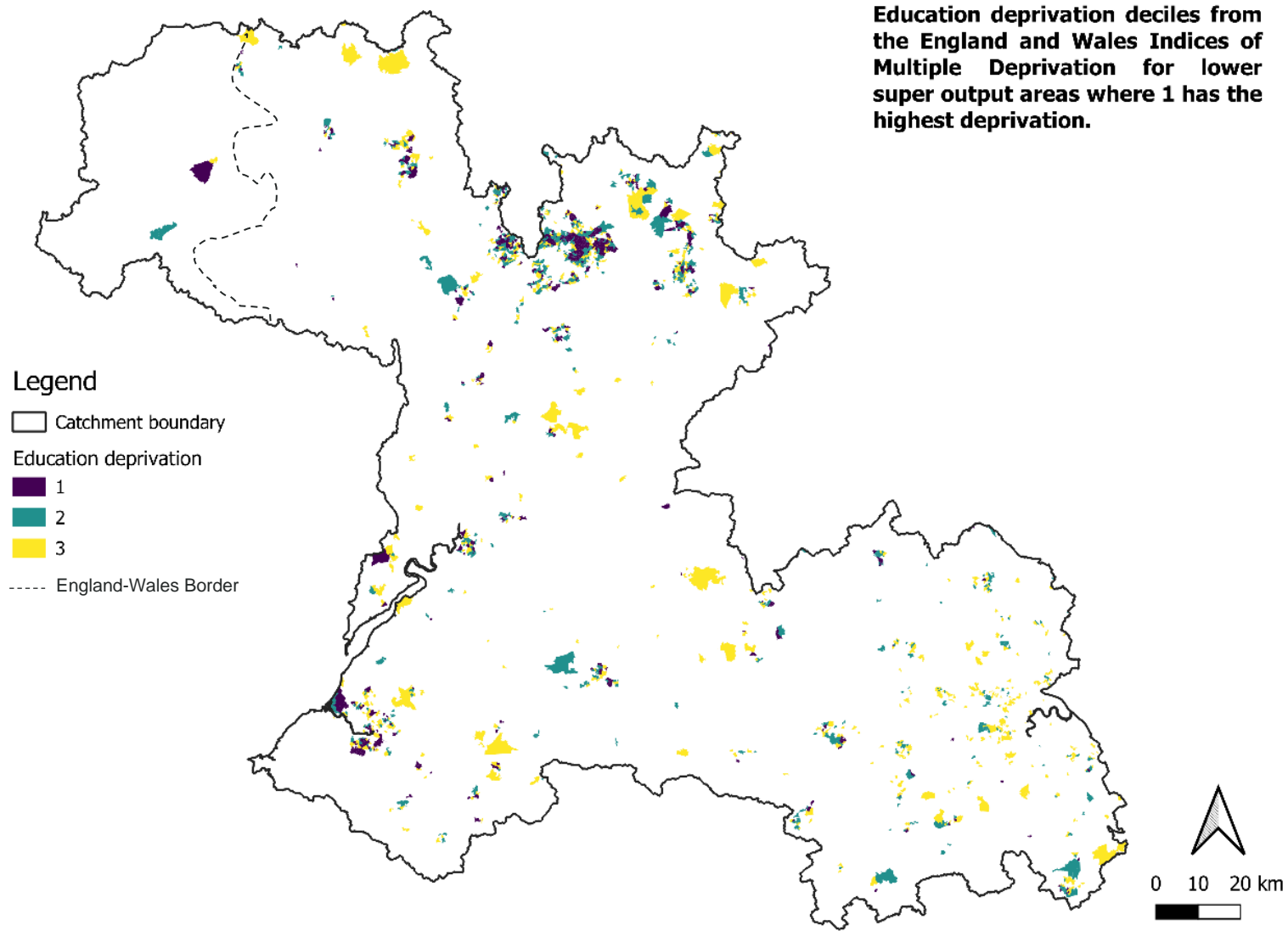


Figure 4-30 Education deprivation scores across the STT solution catchment

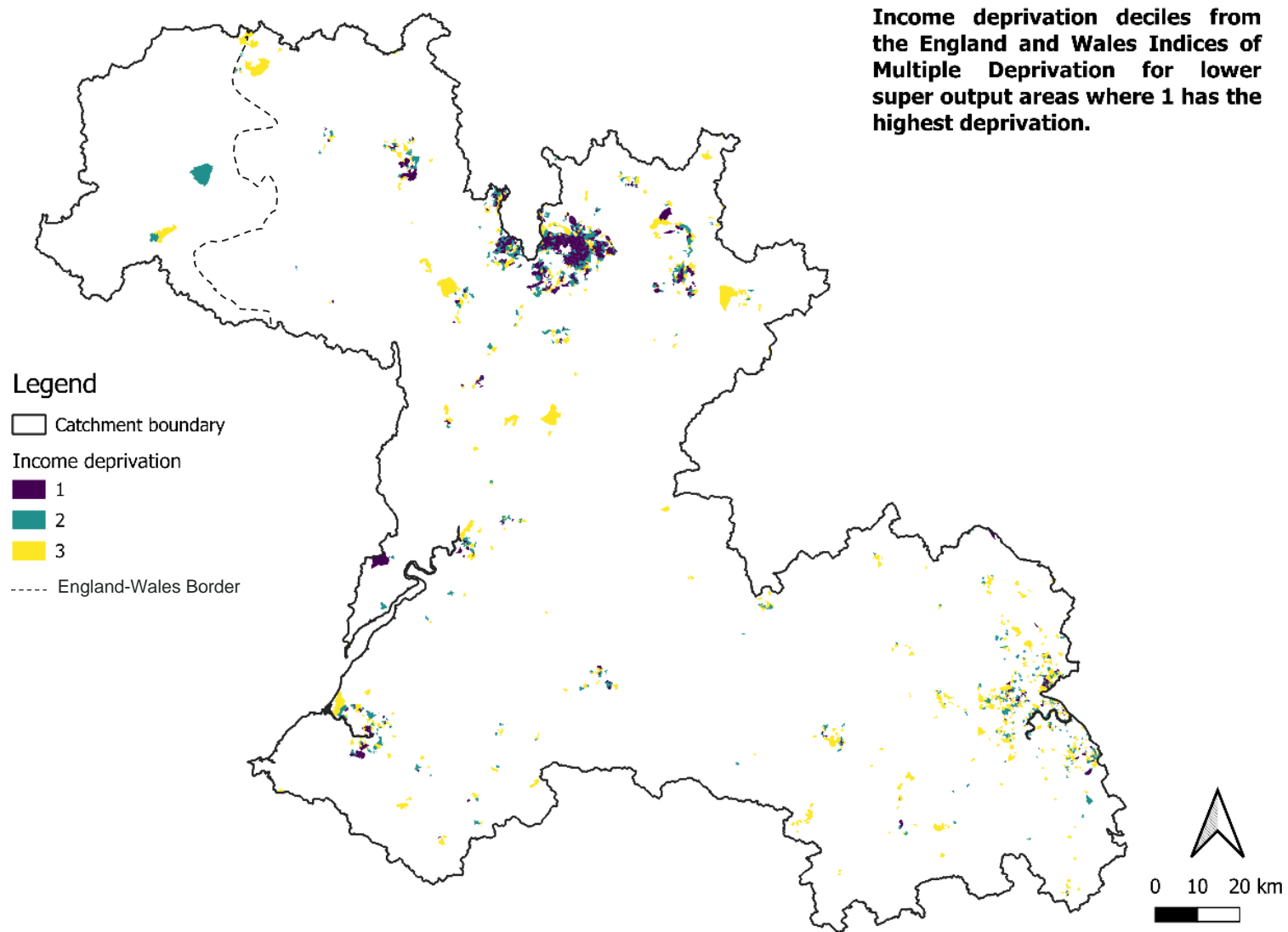


Figure 4-31 Income deprivation scores across the STT solution catchment

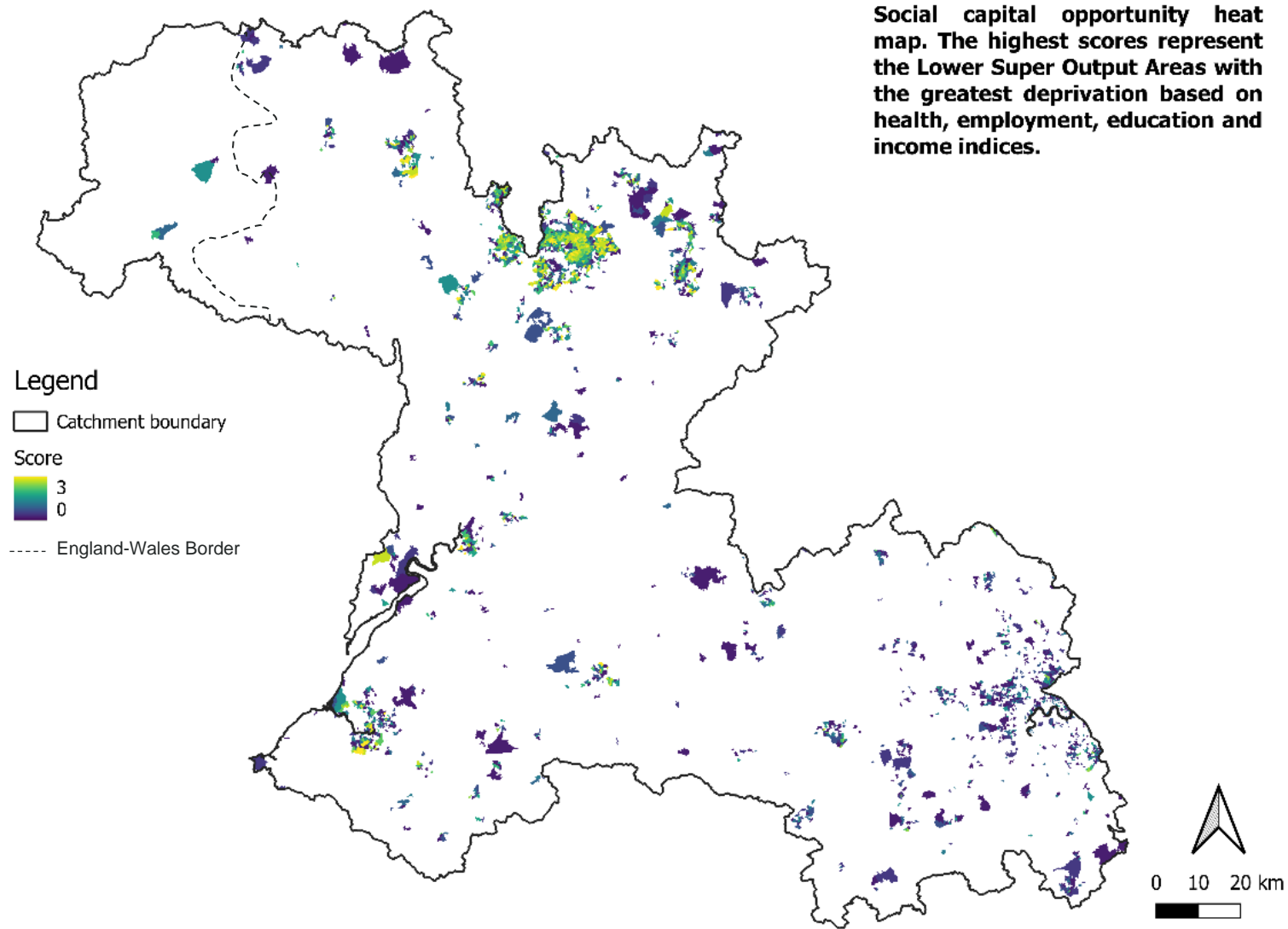


Figure 4-32 Social capital opportunity based on a combination of the previous deprivation scores

4.3 HEAT MAPS OF MAXIMUM OPPORTUNITY AREAS

The final heat map (**Figure 4-33**) was created by rescaling the summation of the scores, weighting them by ownership and local plan information, removing constraints, rescaling and taking the scores that were two standard deviations above the mean (see **Section 2.3.2**). The map shows the most important opportunity areas are around Birmingham due to higher deprivation scores (shown in green). Most of the other opportunity areas have much lower scores (shown in purple). **Figure 4-34** was derived by assigning recommended actions to each opportunity area and the grid used to divide the map into sectors. The rest of the heat maps (**Figure 4-35 to Figure 4-41**) show each sector of **Figure 4-34** in more detail (see **Table 2.7** in **Section 2.3.2**). Although no specific actions were identified from the social capital maps, the weighting they provide show areas that could significantly benefit from enhancing the natural capital through the actions selected. For example, increased accessible nature could tackle health deprivation.

The areas in brown near Lake Vyrnwy and in the north of **Sector A** (**Figure 4-35**, see also **Figure 4-33**) have opportunities for peatland restoration where there is deep (and shallow) peat which have benefits for climate regulation but also for flood management regulation^{29,30}. Given there is high pluvial flood risk in this area, these are important opportunities (as identified in **Figure 4-16**). The areas highlighted in dark green are opportunities for tree, hedge, and scrub planting (while taking account of, and minimising risks to, biodiversity) to reduce runoff risk which is high in this area but also for climate regulation (particularly where there is carbon emitting agricultural land). These areas are on a large area of RSPB owned land (RSPB lake Vyrnwy) which increased the priority score given there is a greater chance of work being carried out. Opportunities in paler green have predominantly access to nature opportunities through enhancing accessibility (within the 5 km buffer). Opportunity areas in purple, yellow and pale blue could be targeted to reduce diffuse pollution from livestock, nutrients, and poor soil management (respectively) for example maintaining buffer strips around fields or creating retention ponds. **Sector A** (**Figure 4-35**, see also **Figure 4-33**) also shows there are opportunities to support fish migration where barriers are currently above 1.4 m (although this data is likely to be less reliable) as well as four opportunities to enhance water quality where there are wastewater treatment plant discharge points likely to be responsible for point pollution.

In **Sector B** (**Figure 4-36**, see also **Figure 4-33**), there are opportunities to reduce diffuse pollution from urban areas (in dark blue) near Telford and Coalville such as planting trees and hedges near roads. There are other diffuse pollution prevention opportunities in the east and west of the Sector from livestock (in purple), poor soil management (in yellow) and nutrient runoff (in light blue near Newport). There are opportunities for access to nature and to reduce runoff to the south of Telford (green areas). There are also opportunities for peatland restoration particularly near Newport (brown areas). There are six opportunities to reduce point pollution from wastewater treatment plants in this Sector - two of which are along the River Tame.

Sector C (**Figure 4-37**, see also **Figure 4-33**) shows there are mostly fish migration opportunities in this area (burgundy triangles) and livestock and nutrient diffuse pollution prevention opportunities particularly near Ludlow and Montgomery. The river near Montgomery has biodiversity opportunities so reducing livestock runoff here could have multiple benefits. There are also some small opportunity areas for peatland restoration in Wales mainly to the north of the River Severn (in brown).

Sector D (**Figure 4-38**, see also **Figure 4-33**) shows some of the largest areas of benefits in Birmingham where there are also opportunities to enhance social capital as deprivation is high. These include making natural habitats and greenspaces more accessible to enhance access to nature, reducing runoff as flood risk is high in west Birmingham and reducing urban diffuse pollution (possibly from domestic misconnections due to the presence of phosphate). There are also opportunities to reduce flood risk and urban and agricultural diffuse pollution in Coventry. These opportunity areas are near the Minworth Supply Option. Other opportunity areas are around Bridgnorth, Rugby, Royal Leamington Spa, Warwick, Stourport-on-Severn, Worcester, Gloucester, and Stroud mainly for access to nature, to reduce diffuse pollution and reduce surface runoff.

Sector E (**Figure 4-39**, see also **Figure 4-33**) has opportunities particularly around Cricklade near the River Thames to reduce livestock diffuse pollution and runoff and for access to nature. There are also opportunities to the south of Swindon to reduce diffuse pollution and flood risk. Other opportunities are near Chippenham, Lacock and Melksham for livestock diffuse pollution, near Frome and Westbury mainly to reduce flood risk and to the west of Bristol for peatland restoration.

²⁹ <https://www.sciencedirect.com/science/article/pii/S2589915518300063>

³⁰ <https://www.sciencedirect.com/science/article/pii/S0009254116301243>

In **Sector F** (Figure 4-40, see also Figure 4-33), there are mostly opportunity areas to reduce urban and nutrient diffuse pollution to the south of Luton. There are also some smaller opportunity areas to reduce flood risk and to restore peatland.

Finally in **Sector G** (Figure 4-41, see also Figure 4-33) there are significant opportunities for access to nature around Egham, Slough, Marlow and Reading within the 5 km buffer. There are urban diffuse pollution opportunities to the north near Watford, livestock diffuse pollution opportunities in the south around the Surrey Hills Area of Outstanding Natural Beauty (AONB) and transport diffuse pollution in London (in pink). There are peatland restoration opportunities, but these are of lower priority than the deep peat soils in the north west of the catchment boundary. There are also runoff prevention opportunities near Bordon in the south west of the Sector.

Overall, livestock diffuse pollution is a significant problem across the catchment boundary and these opportunity areas should be targeted particularly where they coincide with high flood and runoff risk. Peatland restoration should be targeted where there is deep peat soil (particularly in the northwest of the catchment boundary) as well as high flood risk and diffuse pollution as restored peatland offers water flow and purification ecosystem services. Opportunity areas near Birmingham are of particularly high priority due to high deprivation. This region could offer substantial benefits when the Minworth supply option is developed.

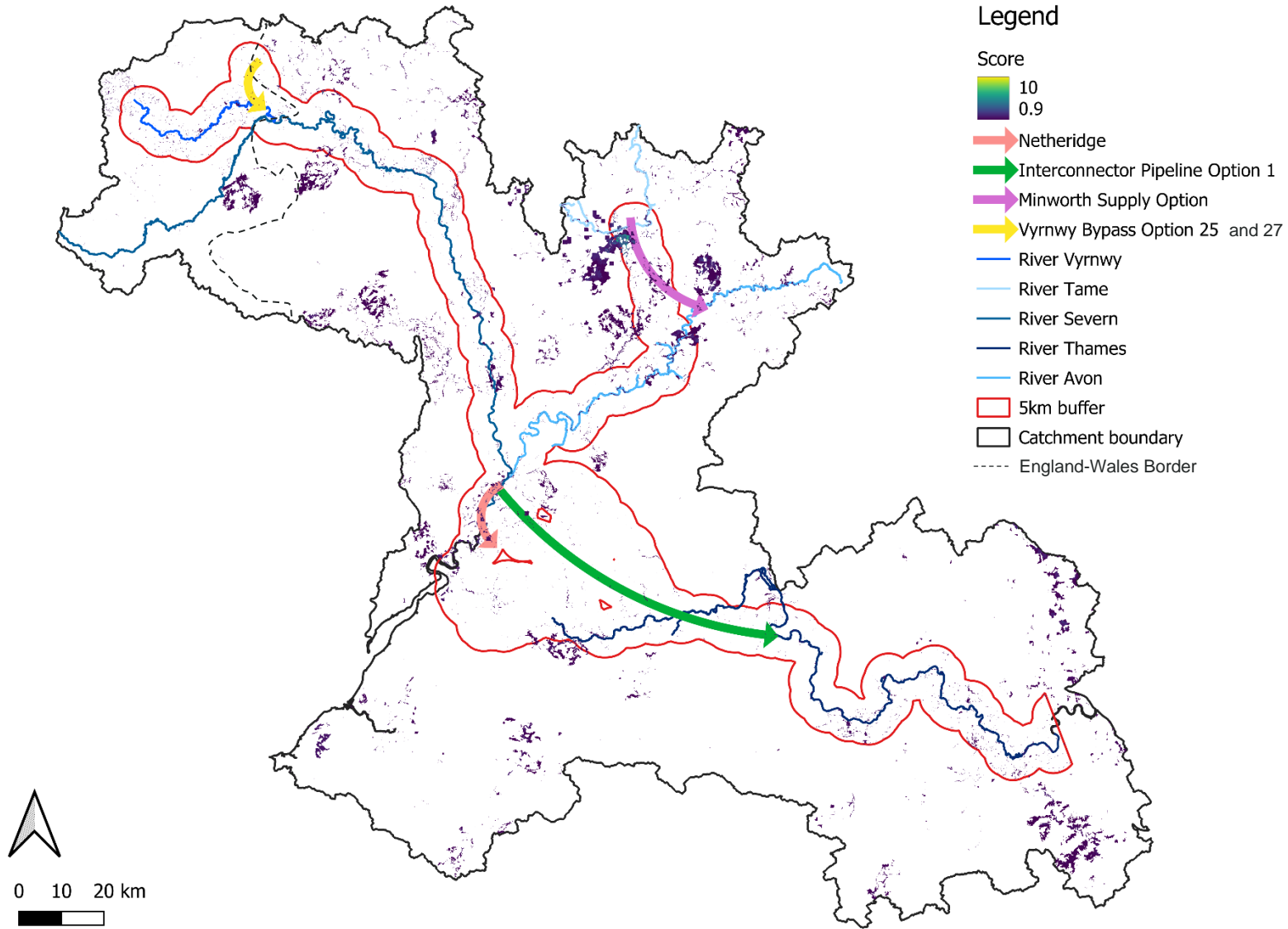


Figure 4-33 Final heat map showing scoring for each opportunity area

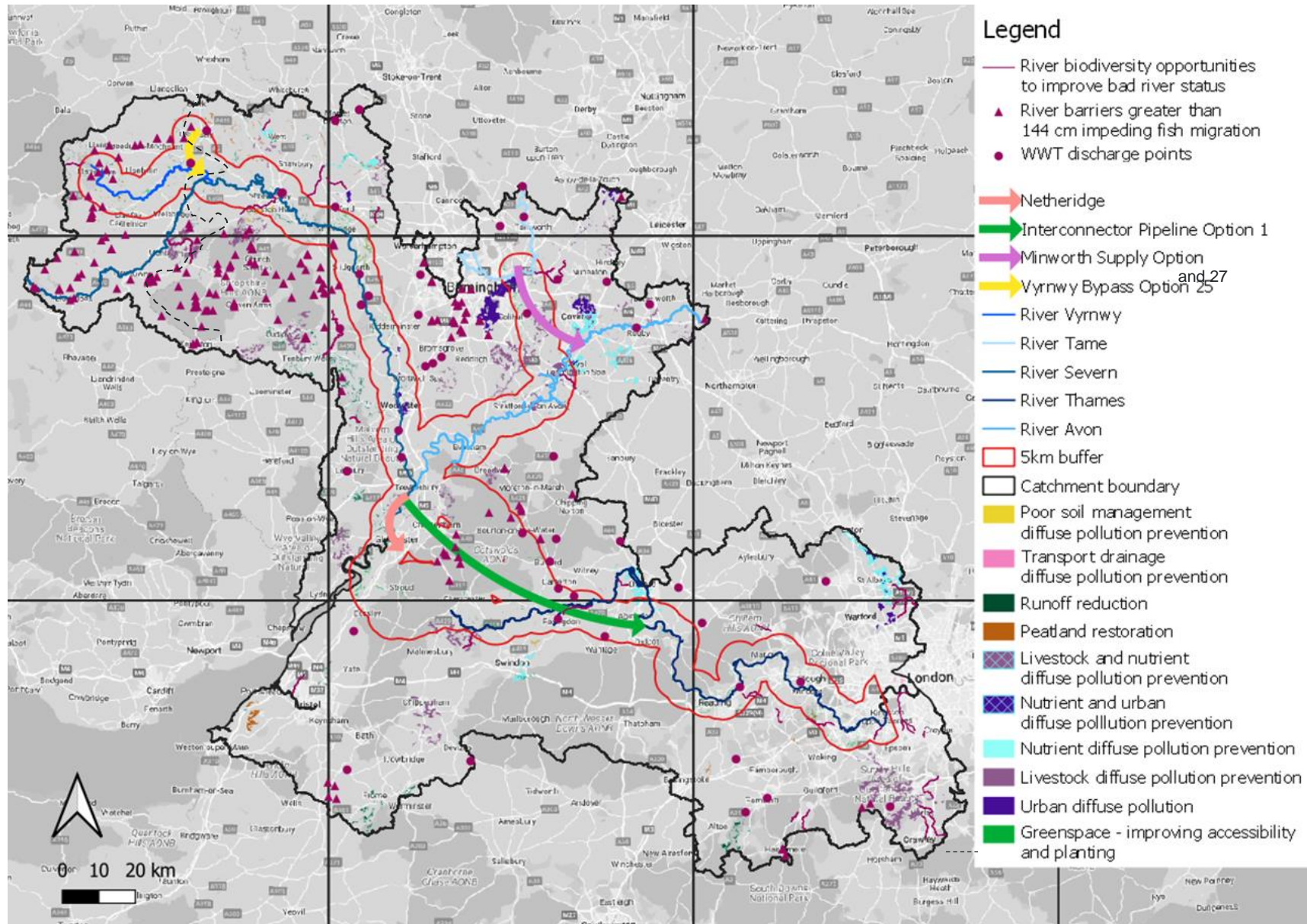


Figure 4-34 Final heat map where opportunity areas have been categorised into recommended actions

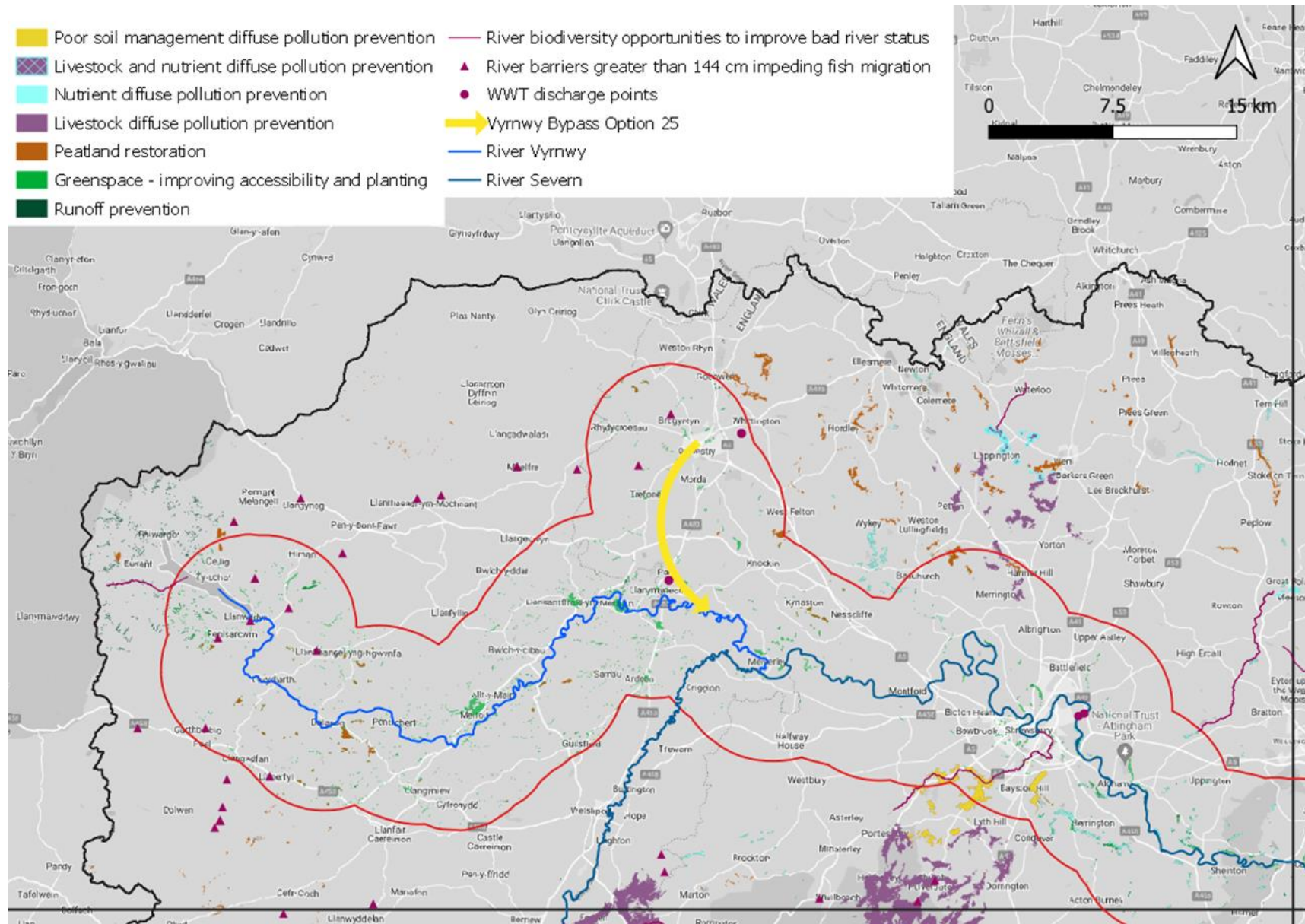


Figure 4-35 Final heat map - Sector A

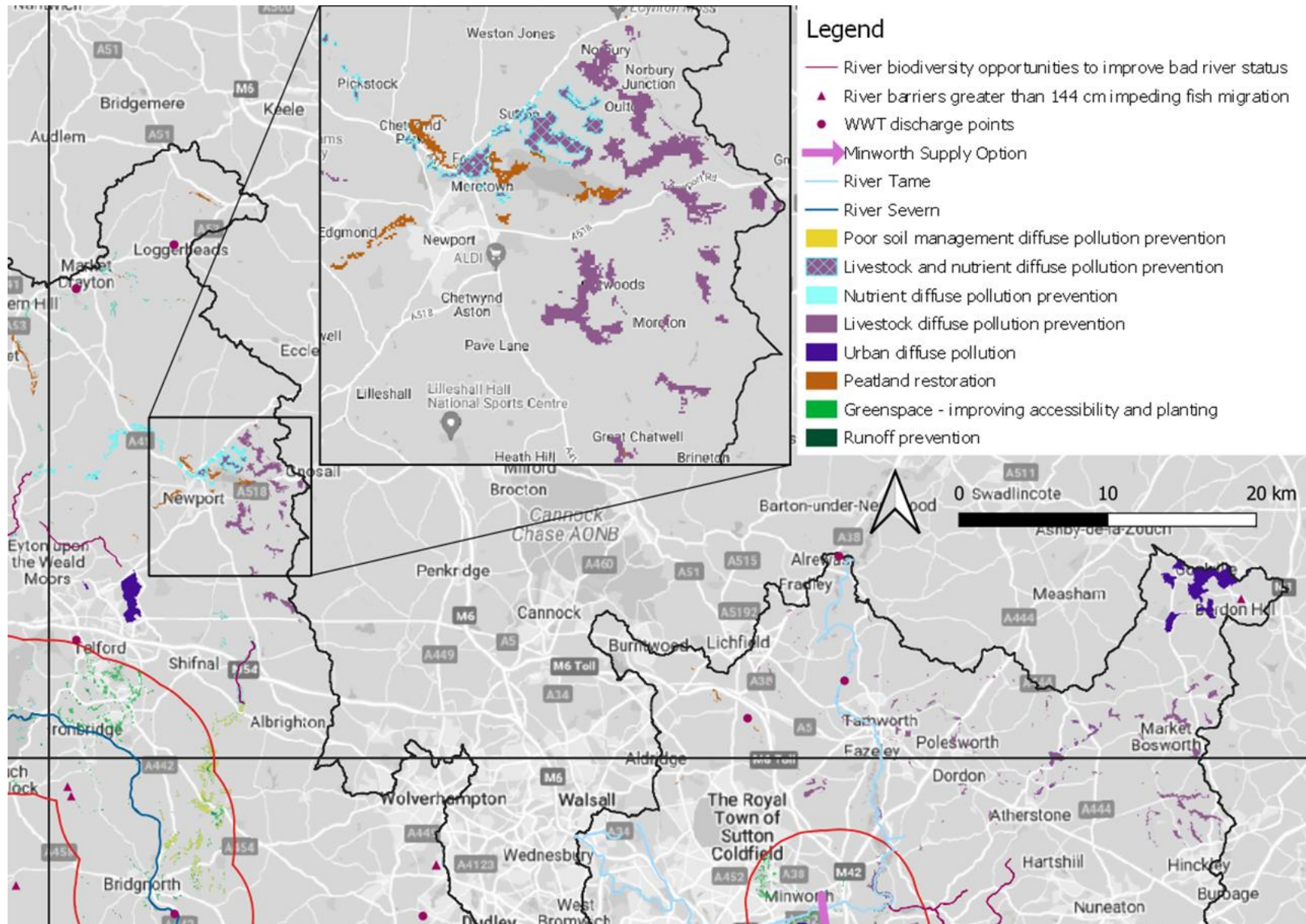


Figure 4-36 Final heat map - Sector B

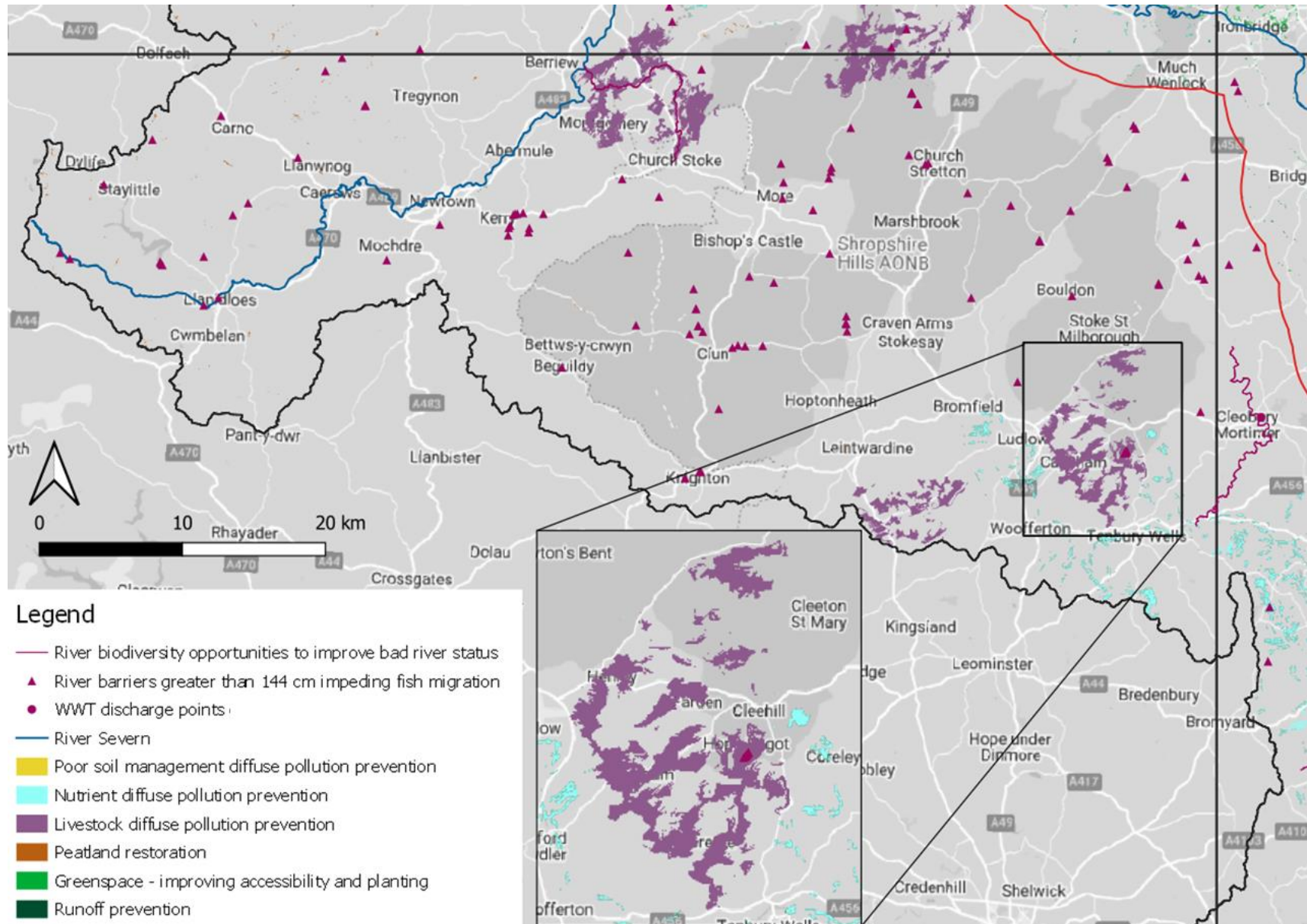


Figure 4-37 Final heat map - Sector C

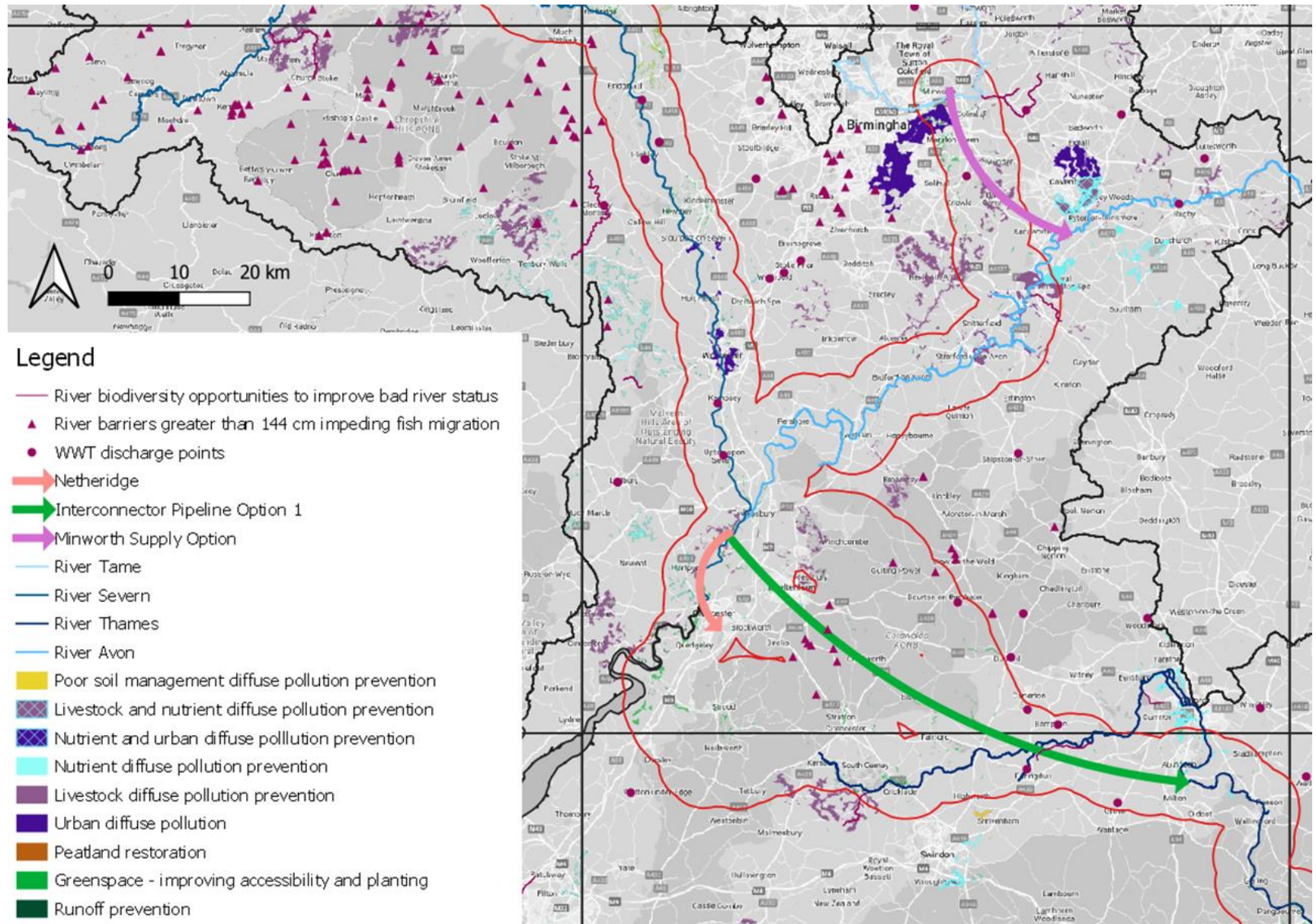


Figure 4-38 Final heat map - Sector D

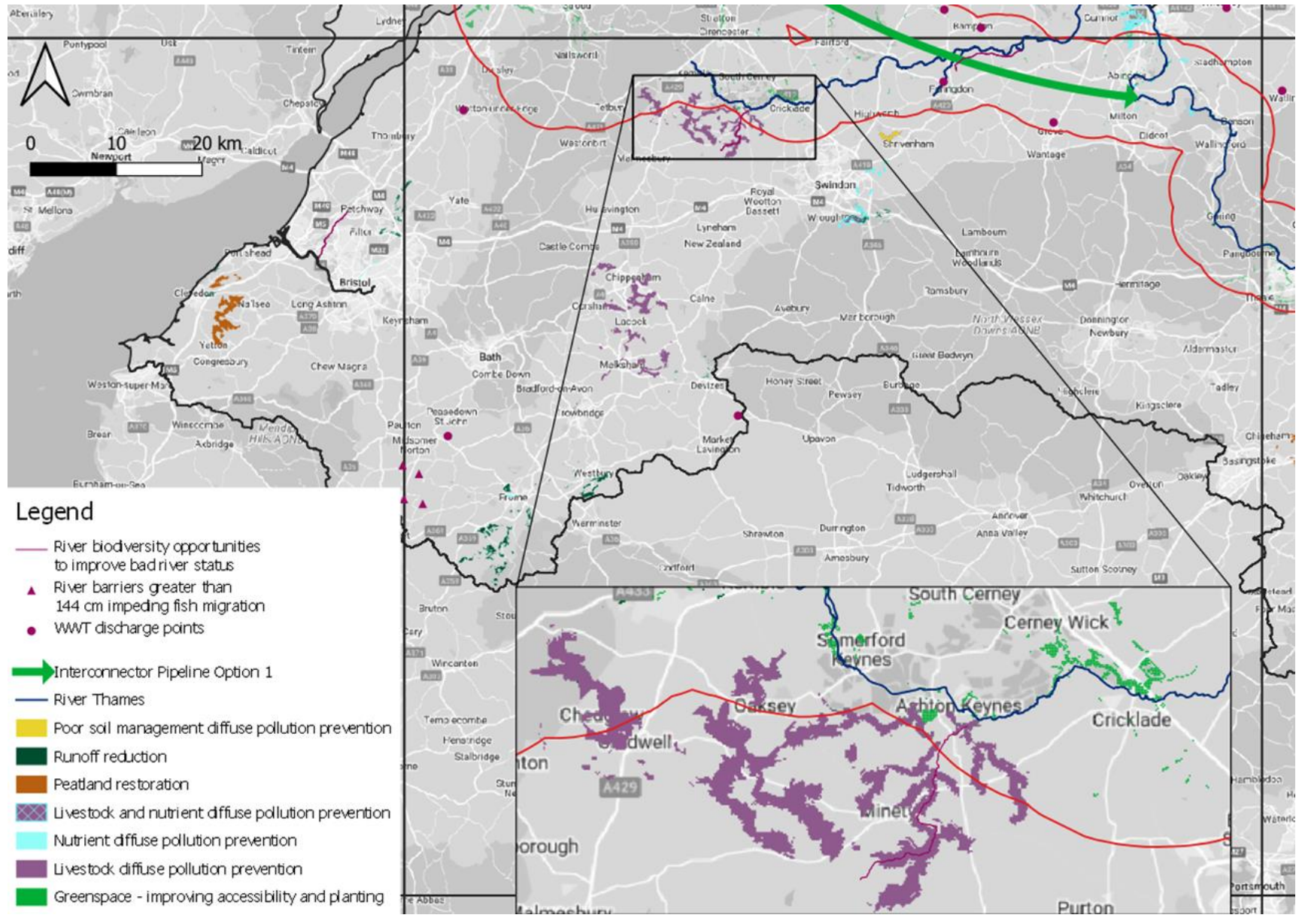


Figure 4-39 Final heat map - Sector E

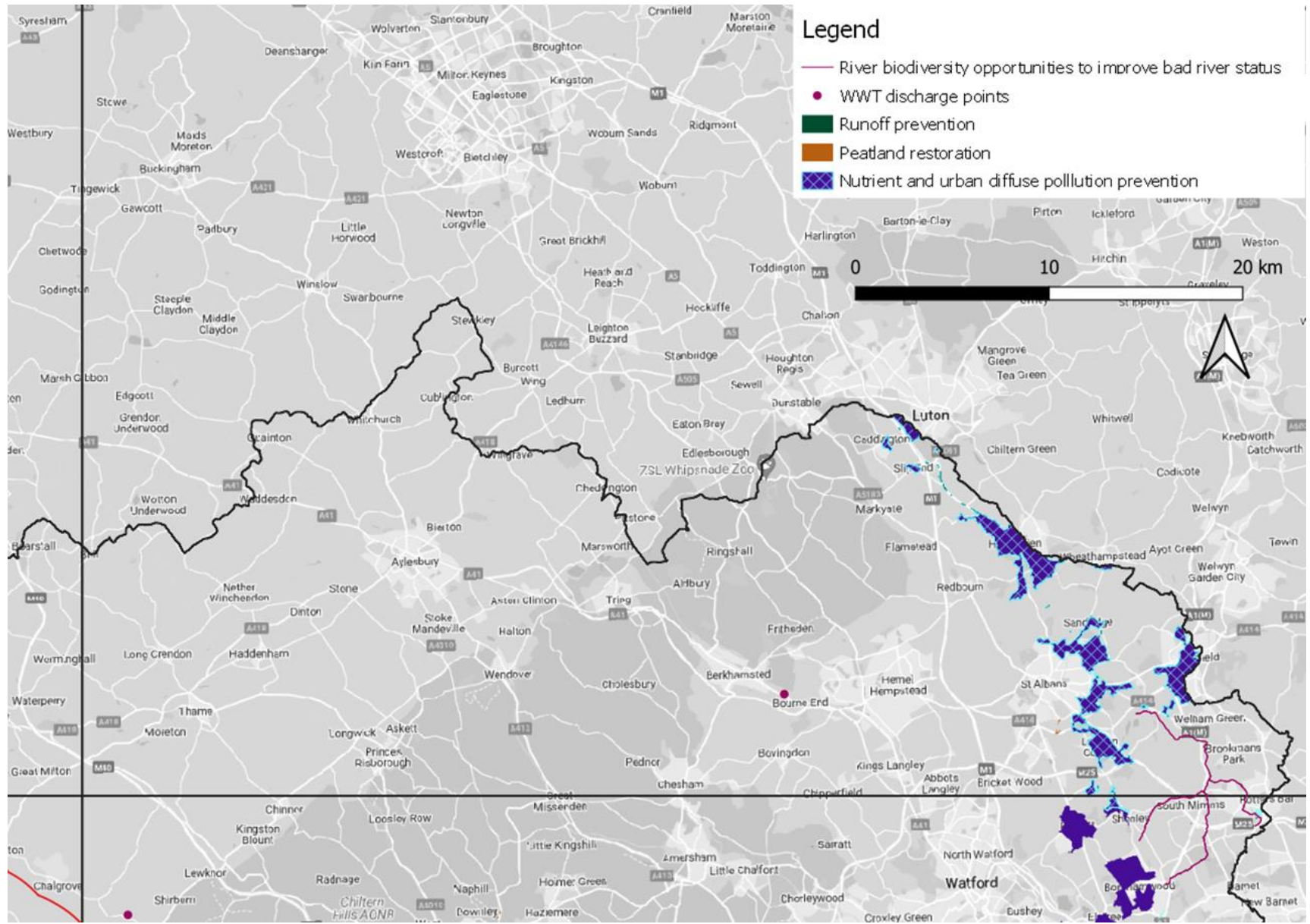


Figure 4-40 Final heat map – Sector F

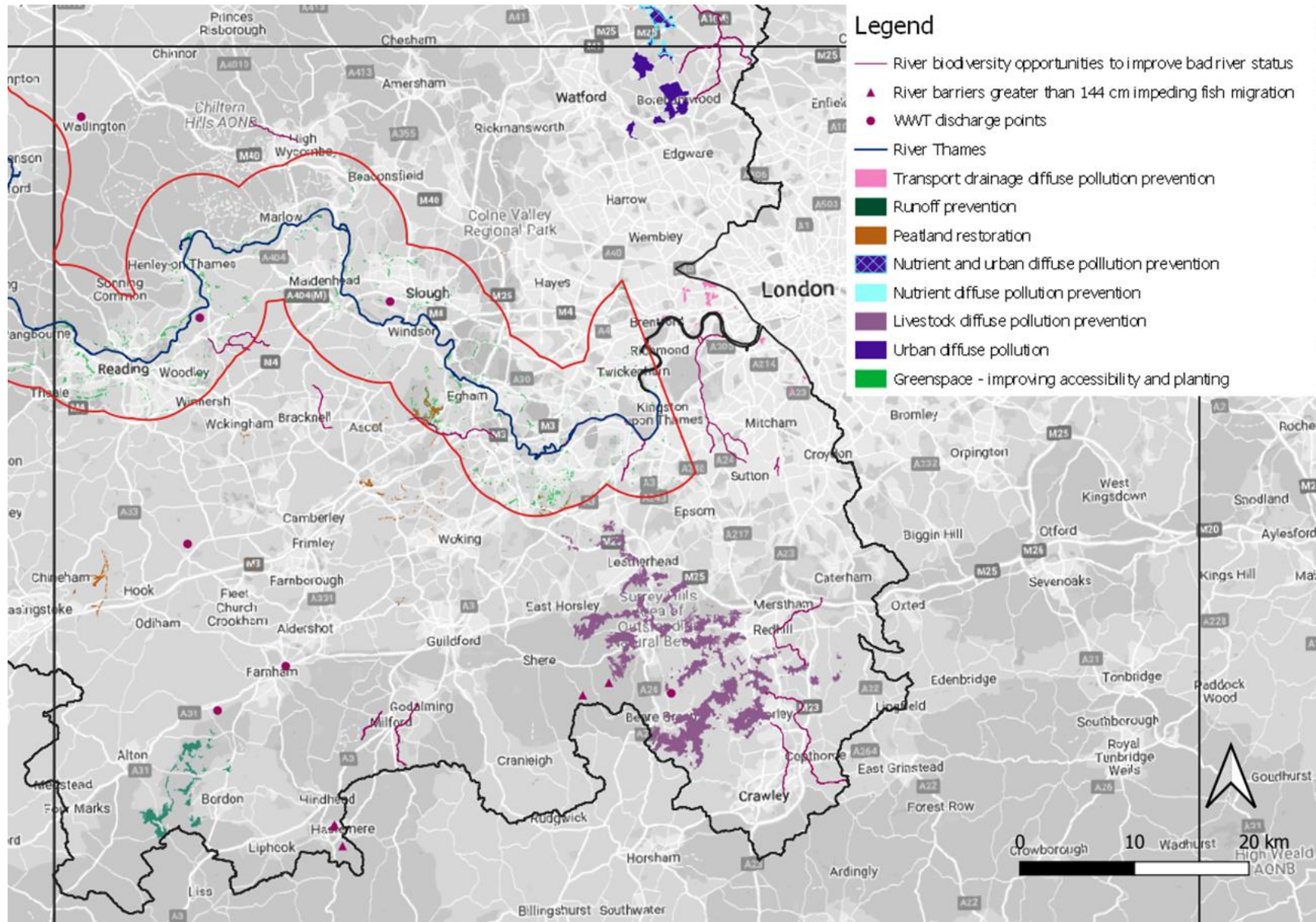


Figure 4-41 Final heat map - Sector G

4.4 DASHBOARD OF BENEFITS

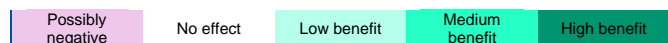
The dashboard below shows the actions, synergies, and trade-offs with three capitals (social capital, manufacturing capital and natural capital and its focus areas), the SMNR principles building resilience goals and the Welsh Wellbeing Goals. The effects (possibly negative to high benefit) were determined by expert judgement and using the final heat maps. For example, reducing livestock diffuse pollution offered significant benefits because this form of pollution was particularly widespread. In addition, peatland restoration offered significant benefits because of synergies across the natural focus areas.

Table 4.9 Dashboard of actions, synergies and trade-offs with three capitals, the SMNR building resilience goals, and the Welsh Wellbeing Goals

Action	Natural capital focus areas				Social capital	Manufacturing capital	SMNR – building resilience					Welsh Wellbeing Goals					
	Water quality	Climate regulation	Access to nature	River biodiversity			Diversity between and within ecosystems	Connections between and within ecosystems	Scale of ecosystems	Condition of ecosystems	Adaptability of ecosystems	Globally responsible	Prosperous	Resilient	Healthier	More equal	Cohesive communities
Peatland restoration	High benefit	High benefit	Low benefit	Medium benefit	Low benefit	High benefit	Medium benefit	High benefit	High benefit	High benefit	High benefit	High benefit	High benefit	High benefit	Low benefit	Low benefit	High benefit
Reducing surface runoff	Medium benefit	Low benefit	Low benefit	Medium benefit	High benefit	High benefit	Low benefit	Low benefit	Low benefit	High benefit	High benefit	No effect	High benefit	High benefit	Low benefit	Low benefit	Low benefit
Adding public rights of way	No effect	No effect	High benefit	No effect	High benefit	No effect	Possibly negative	Possibly negative	Possibly negative	Possibly negative	Possibly negative	High benefit	No effect	High benefit	High benefit	High benefit	High benefit
Enlarging greenspaces	No effect	No effect	High benefit	Low benefit	High benefit	No effect	Possibly negative	Possibly negative	Possibly negative	Possibly negative	Possibly negative	High benefit	No effect	High benefit	High benefit	High benefit	High benefit
Improving river connectivity	No effect	No effect	Low benefit	High benefit	Low benefit	No effect	Medium benefit	High benefit	High benefit	Low benefit	High benefit	Low benefit	High benefit	No effect	No effect	Low benefit	High benefit
Reducing urban diffuse pollution*	High benefit	No effect	Low benefit	Medium benefit	Low benefit	High benefit	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Reducing transport diffuse pollution*	Low benefit	No effect	Low benefit	Medium benefit	Low benefit	High benefit	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Reducing livestock diffuse pollution*	High benefit	Low benefit	Low benefit	High benefit	Low benefit	High benefit	High benefit	Low benefit	High benefit	High benefit	Low benefit	Low benefit	Low benefit	Low benefit	Low benefit	Low benefit	Low benefit
Reducing nutrient diffuse pollution*	High benefit	Low benefit	Low benefit	High benefit	Low benefit	High benefit	High benefit	Low benefit	High benefit	High benefit	Low benefit	Low benefit	Low benefit	Low benefit	Low benefit	Low benefit	Low benefit
Reducing soil erosion*	High benefit	High benefit	Low benefit	Medium benefit	Low benefit	High benefit	High benefit	Low benefit	High benefit	High benefit	High benefit	Low benefit	High benefit	Low benefit	Low benefit	Low benefit	Low benefit

* No data for Wales

Legend:



5. ENGAGEMENT PLAN

The outputs of this study have identified areas of wider opportunities. The opportunity areas will require further ground-truthing at a local level. It is recommended that the STT group considers creating an ‘anchor organisation’ or network to work with key stakeholders in the area, to deliver and co-ordinate community and environmentally linked benefits across the STT project area. The anchor organisation or network would allow multiple organisations to come together to deliver benefits linked to the STT and would become key to refining the study and identifying further opportunities at a local level, building on the results and mapping undertaken and informing the engagement plan.

There are a number of organisations working within the STT solution catchment area which are currently delivering environmental improvements such as Wildlife Trusts and voluntary organisations. 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. In addition, outline steps are recommended for the future when greater clarity and certainty about the scheme develop through the gated process.

It is recommended that the engagement plan 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.

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	SRO core water company
Thames Water	SRO core water company
United Utilities	SRO core water company

The water companies and key stakeholders, including landowners (example stakeholder organisations identified in [Table 5.2](#)) could identify 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 many include habitat improvements delivered from local nature recovery networks for example, helping to narrow down the potential land available to deliver the wider 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 wider benefits, utilising the best available data.

Partnership working with stakeholders and key organisations will enable the development and delivery of the engagement plan. Aligned to the specific STT solution delivery timescales, the engagement plan may include the development and delivery of early and continued regular communication via multiple channels with stakeholders. Thought could be given to linking with local charities, schools, or educational organisations for

specific and defined aspects of the engagement plan. Establishing connections between community groups and individuals may 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.

Via the proposed anchor organisation approach, the specific engagement 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.

Consideration could be given to the identification of additional social and environmental value following confirmation, in future, 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.

Through the formation of linked organisations and co-ordinated 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 formed ahead of the confirmation of the scheme delivery, however as things will change, 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 both in land and available data.

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. **Figure 5-1** outlines the gated process timeline which will influence when different stakeholders may be engaged.

Future engagement can be linked to the gated process timeline outlined in **Figure 5-1**. 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

Stakeholder	Type of stakeholder	Purpose of engagement	Types of engagement activities / communication channels	Level of engagement	When to engage
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
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.

Gated process for potential strategic regional water resource solutions

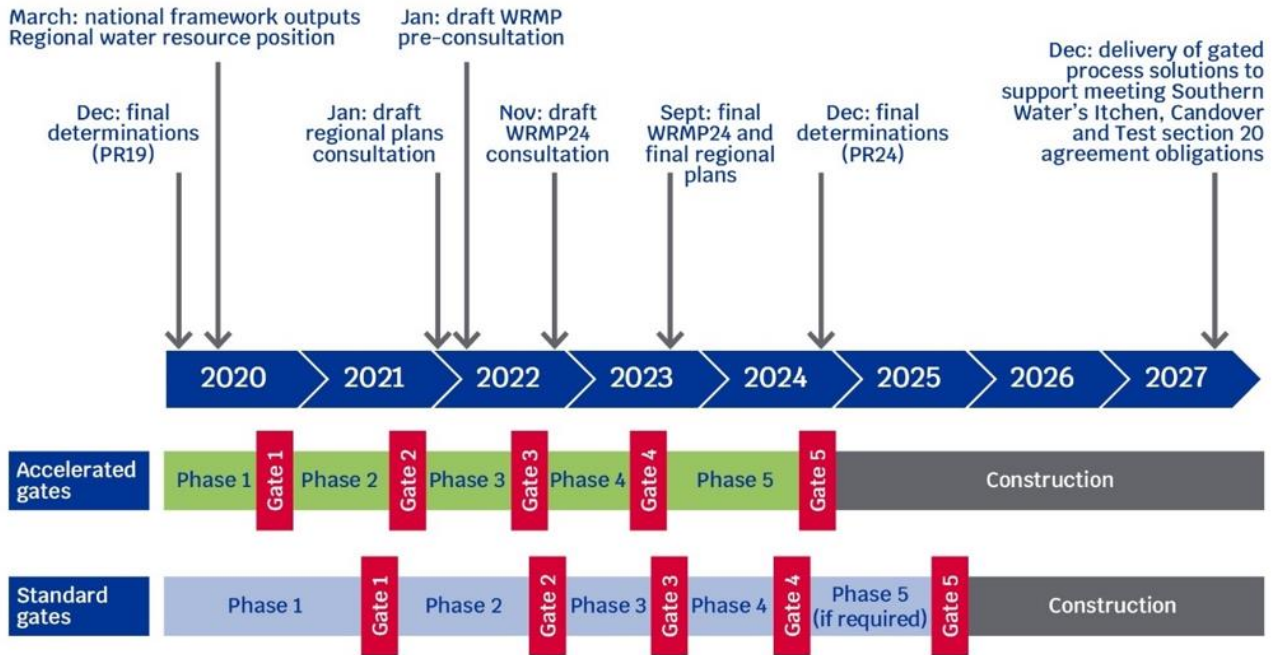


Figure 5-1 Timeline of the gated process

Source: Ofwat 2022³¹

³¹ [The RAPID gated process - Ofwat](#)

6. CONCLUSIONS

6.1 OVERVIEW AND FINDINGS OF THIS WIDER BENEFITS STUDY

The purpose of this assessment is to identify opportunities for environmental enhancement associated with the STT solution. As the STT solution covers both England and Wales, the benefits of those opportunities have been evaluated using a Six Capitals / Sustainable Management of Natural Resources (SMNR) approach.

The aim of this work has been to provide a “blue skies” approach to assessing multiple benefit opportunity areas. This geospatial approach has been created using a large open-source data set. By pulling this data together and applying metrics to each ecosystem service, areas across the STT solution catchment area have been identified that collectively could provide the most benefits for people and the environment. The resultant heat maps and dashboard show, based on current data, clear areas that could become the focus of attention for achieving the widest set of benefits. The most important areas were near Birmingham because of high deprivation in this area as well as high runoff risk and demand for accessible nature. The most common recommended actions were reducing livestock or nutrient diffuse pollution or peatland restoration.

The geospatial approach has been developed to allow for the inclusion of other data sets at different scales at a later date throughout Gate 3 and beyond, which enable the STT solution to focus on benefits areas for a range of targets, offering flexibility as new or updated data become available.

The outputs provide a platform for discussion with wider stakeholders about wider benefits that could be achieved, noting that it is critical to be aware that many plans and projects being currently developed are working at different time scales to the STT programme. As such, care will need to be taken regarding ‘the here and now’ opportunities which may not be directly applicable to demonstrate benefits for the STT solution *per se*.

Furthermore, this study provides a supplementary piece of work to the regulatory requirements for assessing natural capital impacts related to construction and the associated biodiversity net gain (BNG) requirements. Those outcomes plus this wider benefits work, together with any further local data, can be used to focus on more local areas of opportunities in the future.

The power and adaptability of the geospatial approach developed in this project has been demonstrated, going beyond accounting for ‘just’ natural capital and covering other capitals, principles and drivers. At the scale of the STT solution, until detailed planning and design has been provided, the detailed inclusion of all Six Capitals metrics was not feasible as this required additional local information and decision making that was not available. Where possible, however, social capital information gained from the national deprivation indices was included. At Gate 3 and beyond, when precise locations of opportunities have been identified and shortlisted, data can be added, and opportunity areas refined. Only then can a meaningful monetised account of the Six Capitals’ related opportunities be provided.

6.2 UNCERTAINTY, CONFIDENCE DATA GAPS

To provide consistency across the STT solution catchment area, the geospatial approach has used open-source data based on the best available sources. These data have not been ground-truthed or discussed with wider stakeholders beyond regulators and the STT water companies to date.

As such there are known gaps in data but these are mostly at the local scale and it is recommended that these data gaps are addressed as part of the work for Gate 3, and beyond.

A large uncertainty, however, is related to land ownership at the STT solution catchment scale. For this project, it was not possible to collate information on land ownership from all STT partner water companies, nor the BNG ambitions on their land holdings. This has been identified as a knowledge gap to be filled in order to have more insight on potential opportunity areas.

6.3 RECOMMENDATIONS FOR FURTHER WORK

Throughout this study, there are a number of areas that will require further development as more data and evidence is collected through the gated process, and as certainty increases on the final STT solution design. The key aspects are as follows:

- Section 5 of this report provides a high-level **stakeholder engagement** plan to support development of wider benefits and opportunities. It is recommended that this stakeholder engagement is started between Gates 2 and 3 to build upon existing engagement to date,

promote knowledge exchange and synergy of ideas, additional data collection, and mapping. This will allow the engagement plan to be further refined through discussion between STT partners and stakeholders.

- **Data collection:** a range of data gaps have been identified. In addition, there are a range of ongoing programmes of work by numerous organisations that could be linked to an overall benefits assessment project (e.g., mapping of natural flood mapping, local fisheries, detailed data on wastewater treatment works, mapping of Nationally Significant Infrastructure Projects and associated mitigation etc). Identifying and mapping these data sets could be linked to the wider stakeholder engagement to ensure that all relevant information is included as much as possible. Furthermore, during the process of this work, new, more up to date data sets on land use have very recently emerged (i.e., Living England dataset³²), which could provide more detailed local information.
- **Local plans** are in the process of being updated and therefore new data will be available between Gate 2 and Gate 3 and beyond. Existing local plan knowledge should be updated to understand the most up to date local aims, objectives, and ambitions.
- **Wastewater treatment works** - additional details regarding future improvements and impacts on the environment could be obtained from Gate 3 onwards during the detailed planning stage. This will provide more details on the key benefits of interventions relative to wastewater treatment works.
- From Gate 3 onwards, specific areas of **BNG opportunities** will be provided by the solution. The collective data can then be used to provide a **monetised Six Capitals account for England**.
- **SMNR and Wellbeing Goals** are very locally specific, especially with regards to the scale, collaboration, and public engagement. Ascertaining the full detail of benefits through engagement can only be provided once the detailed planning details are provided.
- The STT solution is not the only large infrastructure scheme being developed in the catchment area. As such, there will be competing interests for land on which to implement BNG and wider benefits. An **assessment of other schemes will need to be completed to avoid identification of the same land parcels** as opportunity area and to add to a wider benefits assessment of opportunity areas.
- Actions will be identified at Gate 3 to **enhance social capital** specifically.

³² [Living England Habitat Map \(Phase 4\) | Natural England Open Data Geoportal \(arcgis.com\)](#) [online – accessed 08/04/2022]

ANNEX 1

Annex 1 contains the detailed notes made from the review of a large number of local plans and policies. The review extracted relevant information that was used in the Wider Benefits Study project.

Due to the large amount of information generated and compiled in a spreadsheet for ease of navigation and review, it has proven difficult to integrate the information into the written report in a useful way.

Therefore the decision was made to present the information separately, in a workbook: “*STT-G2-S3-125-Wider Benefits Study_Annex1*”.

