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# GGGP Resilient Ecological Network Mapper: Technical Report

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# Executive Summary

This report has been produced for the Gwent Green Grid partnership as part of a project to map resilient ecological networks to support and enhance biodiversity in the region. It is intended a technical document to support the online mapping tool created by Environment Systems. This report outlines the development, intended users, applications and future steps for the Gwent Resilient Ecological Network Mapper. Maps for four habitat networks (woodland, grassland, wetland and heathland) are presented on the interactive online mapper. The mapper includes the both the current extent of ecological networks, and opportunities to enhance these networks using Nature Based Solutions (NBS).

This information facilitates evidence-driven decisions to maintain and enhance the biodiversity of the aera by enabling users to explore the spatial data and assess opportunities for habitat restoration, management and creation.

The project has provided:

- A complete coverage comprehensive habitat map, by modelling together the best existing data.
- Ecological network modelling and maps which utilised Environment System's SENCE (Spatial Evidence for Natural Capital Evaluation) toolkit, creating data showing for four habitat types—grassland, heathland, wetland, and woodland.
- Opportunity mapping of potential areas for habitat restoration or enhancement prioritised based on ecological, geographic and management constraints.
- The geographic information created as part of the project is shared publicly through a bespoke online mapper, built by our project partners Beyond Zero[1], using ESRI experience builder. Static versions of all of the layers on the mapper can be found in Appendix 0.
- A series of workshops which were held to incorporate user feedback, and ensure stakeholder engagement was at the heart of the project. Responses have been constructive and the reaction very positive.

[1] https://beyondzero.ag/

# Contents



# 1. Introduction

This report has been produced for the Gwent Green Grid Partnership (GGGP) as part of a project to map resilient ecological networks to support and enhance biodiversity in the region. It is intended as a technical document to support the online mapping tool created by Environment Systems.

## 1.1 Context

Wales is facing twin crisis of climate change and biodiversity loss. This is being driven by habitat loss, due to factors such as intensification of agricultural production, fragmentation by developments, and climate change. To counter these adverse trends, a coordinated approach is essential to protect, restore, and link crucial natural habitats and the corridors that facilitate wildlife movement. Gwent Green Grid has come together as a partnership to work across landscape, at a scale, to ensure the maximum benefit is gained from any habitat enhancement or creation through NBS.

In 2010, the independent review led by Professor Sir John Lawton[2] highlighted the need to enhance and integrate our protected wildlife sites through making them bigger, better and more joined up. The development of Resilient Ecological Networks[3] (RENs) within this project involved mapping existing habitats to identify species-rich and native areas that are in close proximity to one another. This mapping allows for the identification of potential ecological corridors and networks. By analysing the intervening land use between these areas, the project pinpoints the best opportunities for habitat expansion and improvement. The goal of the Gwent Green Grid is to link habitats through existing natural and high-biodiversity areas, creating corridors that allow for the movement of genetic resources, such as insects and pollen, between sites. This facilitation of species movement helps build up genetic diversity, which in turn stabilizes and grows native populations. Ultimately, this approach enhances the resilience of our ecosystems.

The focus of the RENs is on pinpointing key areas where habitat restoration and protection can yield maximum benefit. By identifying both existing natural resources and areas for potential enhancement, a strategic plan will be crafted by the members of the Gwent Green Grid to bolster environmental resilience across the whole area.

Community needs and well-being are also integral to the aims of the project. By involving local stakeholders—ranging from governmental bodies to residents—the initiative ensures that recovery efforts are inclusive and mutually beneficial. This collaborative approach aims to deepen the connection between the Gwent community and their natural environment, promoting sustainable interaction with and appreciation of our natural heritage.

## 1.2 Project Aims

The project aimed to provide the most up-to-date and compressive RENS data for the GGGP area. These maps and models are presented on a web browser to let any stakeholder understand how action they are taking enhances environmental resilience.

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[2] Lawton, J., 2010. *Making space for nature: A review of England's wildlife sites and ecological networks*. Defra.
[3] Garrett HM, and Ayling SC. 2021.Terrestrial and freshwater Resilient Ecological Networks: a guide for practitioners in Wales. 43 pp. NRW Report No. 483 Natural Resources Wales. Dolgellau.

## 1.3 Project outputs

- Creation of a comprehensive habitat map: More than 50 individual datasets were used across the analysis and modelling, with 41 being conflated to form the habitat map. All the geographic information produced during the project was open data that is freely available or which has been contributed free of charge to the project. This means that all data can be displayed on the web browser without any licences costs and so can be freely shared with all stakeholders in the project.
- Ecological Network Modelling: Ecological networks were mapped for four broad habitat types: grassland, heathland, wetland and woodland. The extent and connectivity of the networks was modelled using a cost-distance approach which meets best practice recommended by NRW in their all-Wales scale suite of national ecological network layers produced by NRW[4]. Having an up-to-date, detailed habitat map, incorporating new field work surveys, allowed the RENs produced here to be at a finer spatial scale. There is a single network map for each habitat, giving an insight that is easy to understand than the national maps for non-expert users.
- Opportunity Mapping: "Opportunities" here refers to areas with habitats which could be enhanced through new management or restored to a more species rich and natural state or re-created. For example, trees will grow almost anywhere, but for a native species rich woodland ecosystem to develop, the trees will need to be 'in the right place' on suitable soil with a nutrient load that mirrors the natural communities, amongst other factors. Being near existing woodland sites helps bring existing species into the newly planted wood helping develop the site further.

  These opportunity layers are a key output in themselves, but they also form the basis of a series of 'prioritisation' maps which focus on regional priorities as defined in the South East Wales Landscape Profile statements published by the Gwent Wildlife Trust[5]. For example, agricultural run-off mitigation is a priority in several Landscape Profile areas, therefore we provide a subset of the woodland and grassland opportunities, identifying areas with potential for riparian planting on the edge of waterways.
- Online Web Mapper: The geographic information created as part of the project is shared publicly through a bespoke online mapper created by our partner Beyond Zero[6] using ESRI experience builder. The resulting mapper allows users to explore interactive maps, zoom in on specific areas of interest, and view detailed spatial information that supports decision-making and planning. It provides access to data layers including, a habitat map, ecological networks and network enhancement opportunity maps as well as supplementary layers from Landmap and NRW's dark sky maps to provide context and evidence.
- Stakeholder Engagement: Two workshops were held to incorporate user feedback, and ongoing updates continue to improve model accuracy and functionality. The primary focus was on engaging stakeholders and fostering collaboration with partners, and relevant agencies to ensure the mapper met their needs and supported their decision-making processes. During the first workshop of the project discussion focussed on the data outputs, while in the second the emphasis shifted to the mapper, its text and the messaging used to communicate with user.

  Key points from stakeholder feedback include:

  - Users found the tool easy to use and appropriate for their aims.

[4] J. Latham, J. Sherry & J. Rothwell, 2013, Ecological Connectivity and Biodiversity Prioritisation in the Terrestrial Environment of Wales, CCW Staff Science Report No. 13/3/3
[5] https://www.gwentwildlife.org/landscape-profiles
[6] https://beyondzero.ag/

- NRW staff felt the network modelling was at a suitable scale for implementing local projects and complimented the existing NRW networks well.
- All regarded the tool as a very useful mechanism for identifying and prioritising site of nature-based activities.
- Additional data provided by stakeholders following workshop one improved the precision of network modelling.
- Feedback during workshop two helped refine the language of the mapper to ensure that it was accessible to non-expert users and the general public.

The final phase of stakeholder engagement is a wider, open to the public, training session, which will provide hands-on guidance for new users, promote best practices for utilising the mapper, and facilitate a broader understanding of its potential applications in the GGGP. This is scheduled to occur following completion of the mapper to showcase all the results, including this report.

# 2. Analysis Approach

The mapping of ecosystem networks and opportunities was undertaken using SENCE (Spatial Evidence for Natural Capital Evaluation); an established natural capital tool developed by Environment Systems Ltd and used in over 100 projects in the UK and overseas. It is a modelling process that provides geographic information on natural capital as well as opportunities to enhance this including calculation of RENs.

The SENCE tool uses a scientific expert rule base, backed by information from over 500 scientific references. It maps and combines various environmental factors that affect natural ecosystems in an additive raster model. SENCE considers key elements that affect the location and health of natural habitats and the natural capital benefits / ecosystem services they provide. These elements include:

- Habitat type: What kind of environment is present, like forests, wetlands, or grasslands.
- Habitat management and condition: How well these areas are cared for and their current state of health.
- Soil type and geology: The types of soil and rock, which affect what can grow and live in an area.
- Landform: The shape of the land, such as hills, valleys, or flat plains.
- Hydrology: The movement and presence of water

### 2.1.1 Habitat Map

The habitat map provides the baseline of our understanding of local habitat ecology and how areas interact to form a network. The habitat map created to underpin the project is a bespoke product, created using the most up-to-date spatial habitat data available, the result is a continuous habitat map, at a 5-metre resolution, across the Gwent region. As well as information on landcover, it retains metadata detailing the source of the habitat information, this allows users to vary modelling rules based on the provenance of the data.

The input datasets are individually processed to fit a standard raster grid of 5m pixels. These ‘layers’ are then conflated, with precedent given to data that is more up-to-date and/or more reliable (Appendix 1). The datasets presented first in the table sit on top overwriting any information on other layers that might lie below them in a conflation.

### 2.1.2 Modelling Networks

Ecological networks describe how well individual habitat patches are connected across the landscape. The closer patches of habitats are together, the better they are able to share resources and facilitate genetic flow. The intervening habitat also has an effect, where there is a big change in land use for example a ploughed field or big road, this can stop resources moving from one area to another. Where habitats are close enough for these exchanges to take place, an ecological network is formed. These networks are significant as they increase the resilience of the habitats within them. Habitat patches, and the populations they support, which are isolated, are often more vulnerable to pressures and disturbances (e.g. pollution, hunting, storm damage, invasive non-native species (INNS), drought, flooding).

Here, ecological networks were mapped for four broad habitat types: grassland, heathland, wetland and woodland. Connectivity was modelled using a cost-distance approach complementary to that developed by Latham et al.[7].

In this cost-distance approach, 'Core' and 'Stepping Stone' habitats were first identified. 'Core' habitat types are natural or semi-natural habitats identified from the habitat map classes; these were then filtered by area to divide the patches into larger (Core) areas and smaller (Stepping Stone) areas. Core habitats are defined as blocks that are large enough to sustain viable populations of a generic species ('pseudospecies') of the broad network type (grassland, heathland, wetland or woodland). Stepping stones are not necessarily large enough to support viable populations in their own right, but still provide an important source of resources and facilitate movement onwards to other core areas. The size thresholds used to differentiate between core and stepping stone patches are listed in Table 1.

Table 1. Thresholds used to define core and stepping stone patches in the four ecological networks

| Ecological network | Patch type | Size threshold (Ha) |
|---|---|---|
| Grassland | Core | >= 0.25 ha |
| | Stepping Stone | < 0.25 ha |
| Woodland | Core | >= 2.0 ha |
| | Stepping Stone | < 2.0 ha |
| Wetland | Core | >= 0.2 ha |
| | Stepping Stone | < 0.2 ha |
| Heathland | Core | >= 0.25 ha |
| | Stepping Stone | < 0.25 ha |

Once the core and stepping stone habitats had been assigned for each network type, the whole of the habitat map was assessed in terms of its landscape permeability. For each network type, all habitat classes in the habitat map were considered in terms of how easy or difficult it would be for a typical grassland / heathland / wetland / woodland species to move through and forage within; on this basis each habitat type was assigned a movement cost value. Core habitats were assigned a movement cost of 0, meaning that the associated species can freely move in these patches. Higher cost values were assigned to habitats judged to be more difficult for species to traverse, with intensively managed agricultural land and urban areas normally having the highest cost values. In these habitats, conditions generally allow predators to easily find their prey species, the soil conditions are so different from the

[7] J. Latham, J. Sherry & J. Rothwell, 2013, Ecological Connectivity and Biodiversity Prioritisation in the Terrestrial Environment of Wales, CCW Staff Science Report No. 13/3/3

native vegetation that fungal networks and soil fauna do not transfer between them well, and the microclimate (generally hotter and drier) are such that insect species are less likely to traverse them.

The resulting ecological networks reflect that species will be able to travel further distances from the core habitats in places where the core habitats are surrounded by permeable, low-cost habitat types. In places where the core habitats are surrounded by more impermeable habitat types, species will not be able to travel as far.

### 2.1.3 Modelling Opportunities

"Opportunities" here refers to areas of land that could contribute to an effective REN, *if* they were improved through habitat *management*, *restoration* or *creation.*

For each broad habitat type used in the ecological network mapping, the habitat map classes were assessed to determine which were a RENs opportunity. For example, areas of bracken may be an opportunity for restoration to species rich grassland, or in the right circumstances, it may also be an opportunity for conversion to a woodland.

Habitat classes that were identified as core habitat were automatically excluded from being considered as opportunities; this prevented areas of existing important habitat being identified as opportunities for another habitat type. This resulted in the production of opportunity datasets for grassland, heathland, wetland and woodland. Some opportunity areas overlapped, meaning that there were multiple options for habitat creation in these locations.

These base opportunity results are then constrained to reflect the management and ecological limitations that a given opportunity would be subject to, for example, for a suggested wetland opportunity, hydrology and geology must be considered, as well as the designation status of the land. See Table 2 for a summary of the constraints applied.

Table 2: Summary of constraints applied to network enhancement opportunities

| Woodland | Grassland | Wetland | Heathland |
|---|---|---|---|
| Cadw SAM | Cadw SAM | Cadw SAM | Cadw SAM |
| ALC 1, 2 and 3a | ALC 1, 2 and 3a | ALC 1, 2 and 3a | ALC 1, 2 and 3a |
| SSSI (excluding Gwent Levels) | SSSI (excluding Gwent Levels) | SSSI (excluding Gwent Levels) | SSSI (excluding Gwent Levels) |
| SPA/SAC | SPA/SAC | SPA/SAC | SPA/SAC |
| NNR | NNR | NNR | NNR |
| LNR | LNR | LNR | LNR |
| Peatlands of wales | | Within Gwent Levels SSSI: Wetland and grassland opps' were limited to 20m buffered reens. | >500m from a core habitat |
| Steep slopes (>45deg) | | Slope (<2°) and high hydrological connectivity | |
| | | Unsuitable drift or bedrock in British Geological Survey | |

We also identify 'Opportunities outside of the existing network', which may have the potential to expand, or even create, a network, however due to their isolation the ecological success of projects at these sites should be considered as more uncertain.

### 2.1.4 Prioritisation

The guidelines for RENs practitioners in Wales highlight the importance of considering current national and local area priorities when identifying opportunities[8].

The scale of these considerations should reflect the requirements of the project, in this case the model covers the region of Gwent and the Gwent Levels, an area of roughly 200,000 hectares. Recent work towards the South East Wales Area Statement provides a valuable framework for this assessment, dividing the region into six Landscape Profiles (Gwent Levels, Central Monmouthshire, Newport, Brecon Beacons & Black Mountains, Wye Valley & Wentwood and Eastern Valleys). The Landscape Profile statements published by the Gwent Wildlife Trust[9] allow one to find common priorities across the area and to distinguish key regional concerns at an appropriate granularity.

Following a review of these statements, landscape profile priorities were built into the opportunity modelling. In Central Monmouthshire, NRW priority habitat Parkland was identified as 1st class opportunity for grassland enhancements and in the Eastern Valleys, acid grasslands were flagged as opportunities for heathland and woodland. In addition, the following datasets were produced as separate layers for the full study area having been identified as common priorities across the region.

#### Opportunities - Riparian Grassland and Woodland

Implementing riparian grasslands and woodlands can significantly reduce surface runoff, thereby improving water quality, this is a key priority across several SE Landscape Profiles. The layers are produced by intersecting the initial grassland and woodland opportunities with the results of a hydrological flow model (HFM). The HFM considers topography, rainfall and the erodibility of the land cover, as defined by the habitat map. The results provide a modelled channel network, through which water is predicted to travel across the landscape. These channels are buffered by 20m each side, providing a buffer strip within which the planting of riparian species have the potential to provide agricultural and/or urban run-off mitigation.

#### Opportunities - Floodplain Woodland, Wetland, and Grassland

The establishment of floodplain woodlands, wetlands, and grasslands, including wet woodlands and wet meadows, offers substantial opportunities for improving water quality within key river corridors. These ecosystems naturally filter pollutants and enhance the ecological health of rivers. Additionally, there is potential for Natural Flood Management (NFM) benefits, such as reducing downstream flood risks through increased water retention. However, it should be noted that a comprehensive modelling of these NFM advantages is beyond the current scope of the project.

The layers are created using an analogous approach to that for riparian opportunities, however, in place of a buffered channel network, we use 'NRW Flood Map for Planning: River Flood Zones'. The suggested woodland and grassland opportunities are then further constrained, (the initial wetland opportunities are similarly constrained as standard), using modelled topographic slope. This limits suggestions to flat or depressed areas which could provide viable wetland habitats.

#### Opportunities to enhance protected habitat

Where possible, the classification considers the condition of existing protected habitat and highlights areas where management intervention may strengthen the network as a whole. This information is derived from NRW's Protected sites baseline assessment 2020[10]. Where a SSSI or SAC has been classified as Unfavourable or Unknown, the land is included as an enhancement opportunity. This

[8] Garrett HM, and Ayling SC. 2021.Terrestrial and freshwater Resilient Ecological Networks: a guide for practitioners in Wales. 43 pp. NRW Report No. 483 Natural Resources Wales. Dolgellau.
[9] https://www.gwentwildlife.org/landscape-profiles
[10] https://naturalresources.wales/evidence-and-data/research-and-reports/protected-sites-baseline-assessment-2020/?lang=en

information is provided as separate layer, 'Opportunities to enhance protected habitat', with enhancement opportunities tagged with the current habitat of land according to a simplified version of the habitat map.

### Social Benefit Index

The Social Benefit Index informed by The Welsh Index of Multiple Deprivation (WIMD) 2019[11] is crucial for targeting interventions where they can have the greatest social impact, namely, in areas with low access to greenspace and high levels of mental health issues. It ensures that resources are allocated effectively, addressing social and environmental inequalities to enhance community well-being.

The indicator presents information at the scale of community wards and scores run from 0 to 5, high scores have low access to greenspace and high levels of mental health issues.

### Opportunities - Multi-habitat

The objective of this indicator is to identify potential sites that can support biodiversity-rich mosaic habitats, which consist of a mix of different habitat types. These areas can also be prioritized based on their potential to align with local conservation goals and priorities. By focusing on these multi-habitat sites, there is an opportunity to enhance biodiversity, create ecological corridors, and address various local environmental and community needs simultaneously.

The output is produced by combining all of the initial opportunity layers, into one summary layer. Scored from 0-4, it states the number of potential ecological network enhancements identified at any given location.

## 3. How the project will be used

The results of this project will be used by the GGGP as evidence in the definition of Nature Networks in Gwent[12], helping to target the delivery of almost £1million of National Lottery Heritage Funding for enhancement of green corridors, tree planting and habitat management across the region. The mapper also serves a wide range of stakeholders who are committed to ecological conservation and community well-being in Gwent:

- Local Nature Partnerships

  Local Nature Partnerships (LNPs) play a vital role in tackling the nature crisis across Wales. With an LNP coordinator active in every region, these partnerships offer expert guidance on biodiversity, optimize funding opportunities and collaborative efforts, and empower community groups to take meaningful action. By leveraging their expertise and that of their partners, LNPs effectively target community engagement initiatives. They work with volunteer groups across Wales, from big charitable organisations such as the National Trust, RSPB and the Wildlife Trusts, to smaller community groups. They serve as essential contacts, actively identifying opportunities and advocating for nature within local communities. LNPs

- County Ecologists

  Local Authority Ecologists in Wales are key to safeguarding biodiversity by integrating ecological expertise into local planning and land management. They assess development impacts on wildlife, guide mitigation efforts, and contribute to Local Biodiversity Action Plans that align with broader conservation goals. Collaborating with agencies like NRW and Local Nature Partnerships, these ecologists advocate for nature-friendly practices and engage with

[11] https://datamap.gov.wales/layers/geonode:GWC21_Social_Benefits_Dissolve_Score
[12] https://www.monmouthshire.gov.uk/2023/07/funding-awarded-for-gwents-nature-network/

communities to raise ecological awareness, supporting resilient ecosystems that benefit both people and wildlife.

- Planners

  Local Authority Planners play a vital role in shaping sustainable communities by overseeing policy, development and land use to balance growth with environmental protection. They ensure that planning applications comply with ecological regulations, considering impacts on natural habitats and biodiversity. The mapper integrates a Social Benefit Index informed by the Welsh Index of Multiple Deprivation 2019 to address areas with limited greenspace and high mental health needs, guiding habitat restoration to support social and environmental equity.

- Developers

  Private developers are essential partners in the creation and preservation of sustainable ecological networks. They are responsible for the creation of new construction projects that meet economic and housing needs while respecting environmental regulations and biodiversity. With access to the mapper, developers can identify ecologically sensitive areas early in the planning process, helping them design projects that minimize impact on habitats and align with conservation goals.

The mapper provides these users with detailed maps of habitat connectivity across different ecosystems. This helps them assess how well-connected habitats are within their region and identify gaps or isolated areas where restoration efforts could enhance connectivity. This may be at site specific, local level, or county wide and strategic. With information on habitat types, ecological networks, and priority areas, the mapper allows people to design conservation plans that target the highest-impact areas.

Using this information users can be more confident in the positive effect that their plans will have on the broader ecological landscape and it enables them to build stronger cases for funding applications. In addition, the mapper's accessible format allows it to be used to share actionable insights with non-expert users. This supports us in educating communities about local ecosystems and biodiversity hotspots which can inspire more public involvement and a stronger local commitment to protecting natural spaces.

## 4. Conclusions

This tool is an important resource for the GGGP that aligns with Wales' biodiversity and social well-being goals, directly supporting the commitment to ecological restoration, habitat protection, and sustainable land use. It offers a practical means for translating policy goals into on-the-ground actions. The GGGP mapper represents a major step forward in supporting ecological network resilience in Gwent. By harnessing complex data modelling and sophisticated mapping processes, this project delivers an interactive, user-friendly tool designed to meet the needs of conservation, planning, and community engagement.

The mapper empowers local organisations by providing an accessible platform for setting conservation priorities, and effectively advocating for resources and policy support. With this tool, conservation groups can more easily pinpoint critical habitats, understand local ecological challenges, and communicate their needs to decision-makers and the public. This enables conservation actions that are both strategic and impactful.

A key strength of the project has been the engagement of a diverse group of stakeholders, whose collaboration has shaped the mapper to be both functional and relevant to community needs. Input from conservation groups, local authorities and technical experts has ensured that the tool meets the practical requirements of its users, from policy alignment to usability in the field. This stakeholder involvement has enhanced the mapper's ability to serve as a unifying resource for targeting RENs actions in Gwent.

Finally, the mapper can be used to increase public awareness by offering community members essential information about their local ecological landscape. By making ecological data accessible, it fosters a deeper connection between residents and their environment, encouraging greater community involvement in conservation activities. This enhanced public engagement is vital for long-term ecological resilience, as it strengthens collective responsibility and support for biodiversity preservation.

## 5. Next Steps

As the enhancement, restoration and re-creation activities are delivered it would be very beneficial if this information could be integrated into the mapper in future. The easiest way would be for the GGGP to gather spatial data as each project is developed, and then the sites could be updated in the habitat map, the networks could then show enhancement every year. This would provide an excellent way of monitoring progress.

Data on condition of existing sites, restoration and re-created is key to many initiatives in Wales including the biodiversity deep dive and the 30x30 goals that have come out of this. Making sure that data on all NBS activities are co-ordinated and held in an accessible way that can be passed to other initiatives will also be able to highlight the GGGP area in the context of the wilder Wales environment.

We suggest the following actions could help develop the project further:

- Designing near real time monitoring

With all the actions which are planned within the GGGP partnership the platform could provide a way of showing how the actions are developing. To further enhance its value, the mapper could integrate additional data sources, including real-time environmental data, habitat quality assessments, land use changes and the location of habitat enhancement projects currently underway. These additions could expand the mapper's capacity to provide a dynamic picture of Gwent's ecological health and the actions being taken to improve it.

Future upgrades could also include further data analysis, such as predictive modelling for habitat restoration, that could allow users to explore and plan for potential ecological outcomes based on a range of conservation and climate change scenarios.

- Enhancing Accessibility and Facilitating Educational Outreach

A critical area of project development is promoting the mapper's usability, particularly for community groups and non-expert users. This will include tutorials, and training resources that make it easy for users of all backgrounds to navigate and apply the data. When the planned training workshop has been run a useful next step would be a review and evaluation of the workshop and any suggestion coming out of it. This could lead to further workshops and to further refinement of the tool.

- Broadening Applications

This tool is innovative in its landscape scale approach, providing an updated habitat map and modelling of opportunities at a wider landscape scale. We suggest that it is presented at a workshop where ecologists from NIP, NGO's and county ecologists could be present to see if this is an approach that benefits them. Possibly a CIEEM Wales webinar would be a good platform for this.

- Strengthening Feedback Loops

As the mapper moves into its next phases, continued engagement we suggest the review of the mapper is kept as an agenda item so that it continues as an up-to-date accurate tool moving forward.

## 6. Project Team and Contributions

This project has benefited from the collaboration and expertise of a wide range of stakeholders. We are grateful to the steering group for their guidance and strategic insight, which ensured that the project aligned with its regional priorities from the outset.

The diverse range of stakeholders involved has been a core strength, bringing together different perspectives and expertise that enriched the development of the mapper tool and website. The steering group's support, and the engagement of staff from the five local authorities, Natural Resources Wales, and conservation bodies such as RSPB helped shape the mapper as a practical, community-focused tool with real-world applications.

Stakeholder involvement was prioritized throughout the project, fostering a tool that reflects local needs, by engaging community members and conservation organisations, the project also encourages local ownership and awareness of environmental resources, supporting community well-being through more informed and inclusive conservation.

# Appendices

## Appendix 1. Datasets used to create the habitat map

| Dataset | Conflation Priority |
|---|---|
| Wye Valley AONB Phase 1 Map - Hedgerows | 1 |
| OSMM Water | 2 |
| OSMM Gardens | 3 |
| OSMM Urban | 4 |
| Gwent Levels Sea Wall Phase 1 Map | 5 |
| Gwent Levels Extra Grasslands | 6 |
| Wye Valley AONB Phase 1 | 7 |
| NRW National Phase 1 (within Designations) | 8 |
| NRW Priority Habitat Parkland | 11 |
| NRW Priority Habitat Upland Heathlands | 12 |
| NRW Priority Habitat Flush, Fen and Swamp | 13 |
| NRW Priority Habitat Upland Calcareous Grassland | 14 |
| Gwent Levels Orchards | 15 |
| NRW Priority Habitat Traditional Orchards | 16 |
| NRW Priority Habitat Raised Blanket Bog | 17 |
| NRW Priority Habitat Purple Moor Grass and Rush Pastures | 18 |
| NRW Priority Habitat Mountain Heaths and Willow Scrub | 19 |
| NRW Priority Habitat Maritime Cliff and Slopes | 20 |
| NRW Priority Habitat Lowland Meadows | 21 |
| NRW Priority Habitat Lowland Heathlands | 22 |
| NRW Priority Habitat Lowland Fens and Reedbeds | 23 |
| NRW Priority Habitat Lowland Dry Acid Grasslands | 24 |
| NRW Priority Habitat Lowland Calcareous Grasslands | 25 |
| NRW Priority Habitat Limestone Pavements | 26 |
| NRW Priority Habitat Inland Rock Outcrop and Scree | 27 |
| NRW Priority Habitat Coastal Saltmarsh | 28 |
| NRW Priority Habitat Calmarinian Grasslands | 29 |
| NRW Priority Habitat Blanket Bog | 30 |
| NRW Priority Habitat N-Sensitive Woodlands | 31 |
| NRW Priority Habitat Coastal Open Mosaic on Previously Developed Land | 32 |
| NRW Supplementary Traditional Orchards | 33 |
| Ancient Woodland Inventory (Selection) | 34 |
| NFI (Selection) | 35 |
| RSPB Gwent Levels Habitat Map 2018 | 36 |
| NRW Priority Habitat Coastal Grazing Marsh and Floodplain Grassland | 37 |
| SINC Sites Grassland Classification | 38 |
| NRW National Phase 1 B1.1 and C1.1 | 39 |
| Living Wales 2022 – Broadleaf Woodland | 40 |
| ESA Worldcover 2021 | 41 |

## Appendix 2. List of layers on mapper

| Mapper Tab | Layer name |
|---|---|
| Habitat | Habitat Map |
| Networks | Nature Network - Grassland |
| | Nature Network - Woodland |
| | Nature Network - Wetland |
| | Nature Network - Heathland |
| | Core / Stepping Stone - Grassland |
| | Core / Stepping Stone - Woodland |
| | Core / Stepping Stone - Wetland |
| | Core / Stepping Stone - Heathland |
| Opportunities | Opportunities - Grassland |
| | Opportunities - Woodland |
| | Opportunities - Wetland |
| | Opportunities - Heathland |
| Priorities | Opportunities - Multi-habitat |
| | Opportunities - Riparian Grassland |
| | Opportunities - Riparian Woodland |
| | Opportunities - Floodplain Wet Woodland |
| | Opportunities - Floodplain Wetland |
| | Opportunities - Floodplain Grassland |
| | Social Benefit Index |
| | Opportunities to enhance protected habitat |
| Landmap & Darksky | NRW LANDMAP - Cultural Landscape Services Classification |
| | NRW LANDMAP - Geological Landscape Classification |
| | NRW LANDMAP - Landscape Habitats Classification |
| | NRW LANDMAP - Historic Landscape Classification |
| | NRW LANDMAP - Visual Sensory Classification |
| | NRW LANDMAP - Geological Landscape Evaluation |
| | NRW LANDMAP - Landscape Habitats Evaluation |
| | NRW LANDMAP - Historic Landscape Evaluation |
| | NRW LANDMAP - Visual Sensory Evaluation |
| | Dark Skies and Light Pollution in Wales |

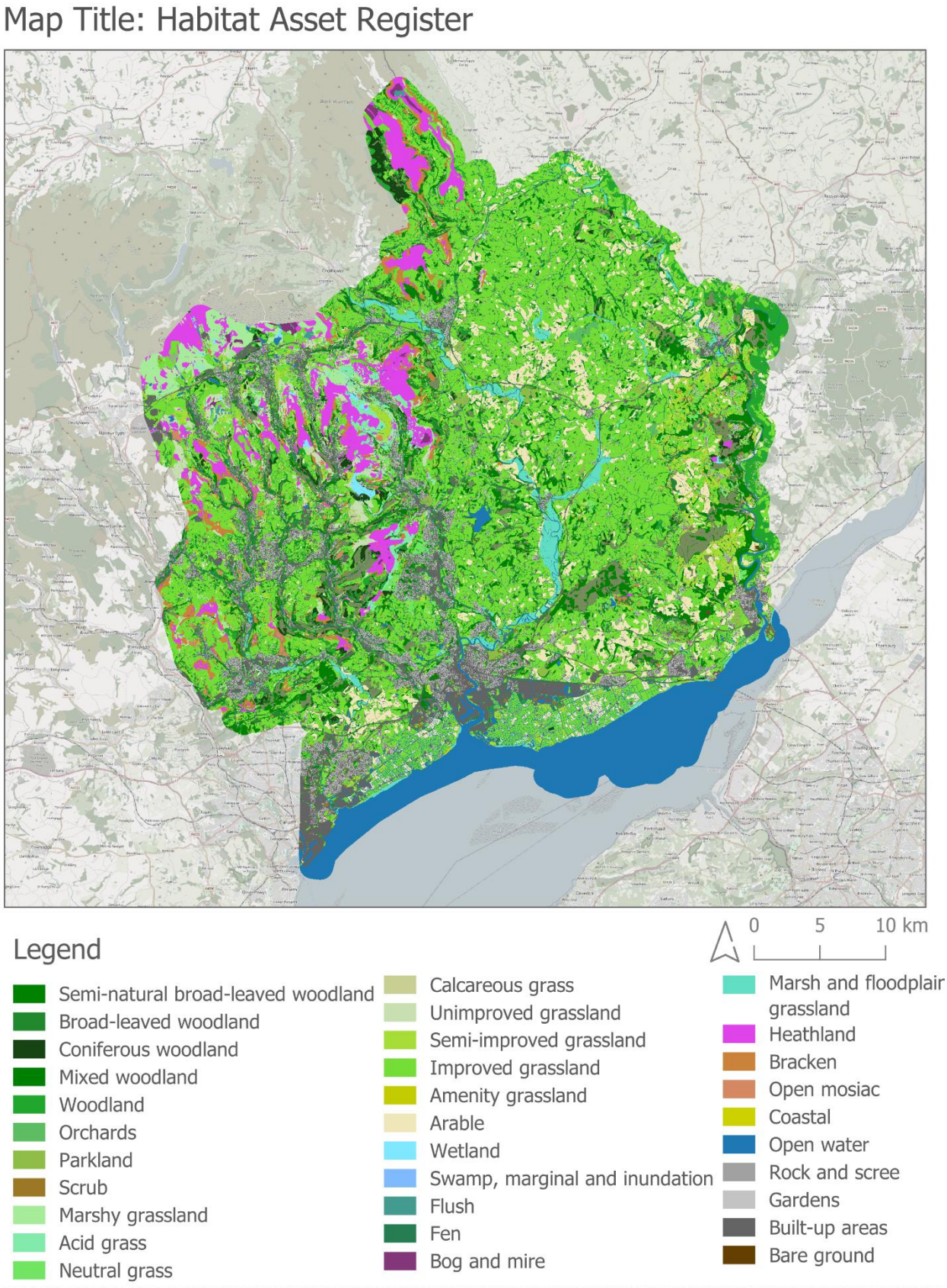



Figure 1. Simplified version of the habitat map used to model ecological networks

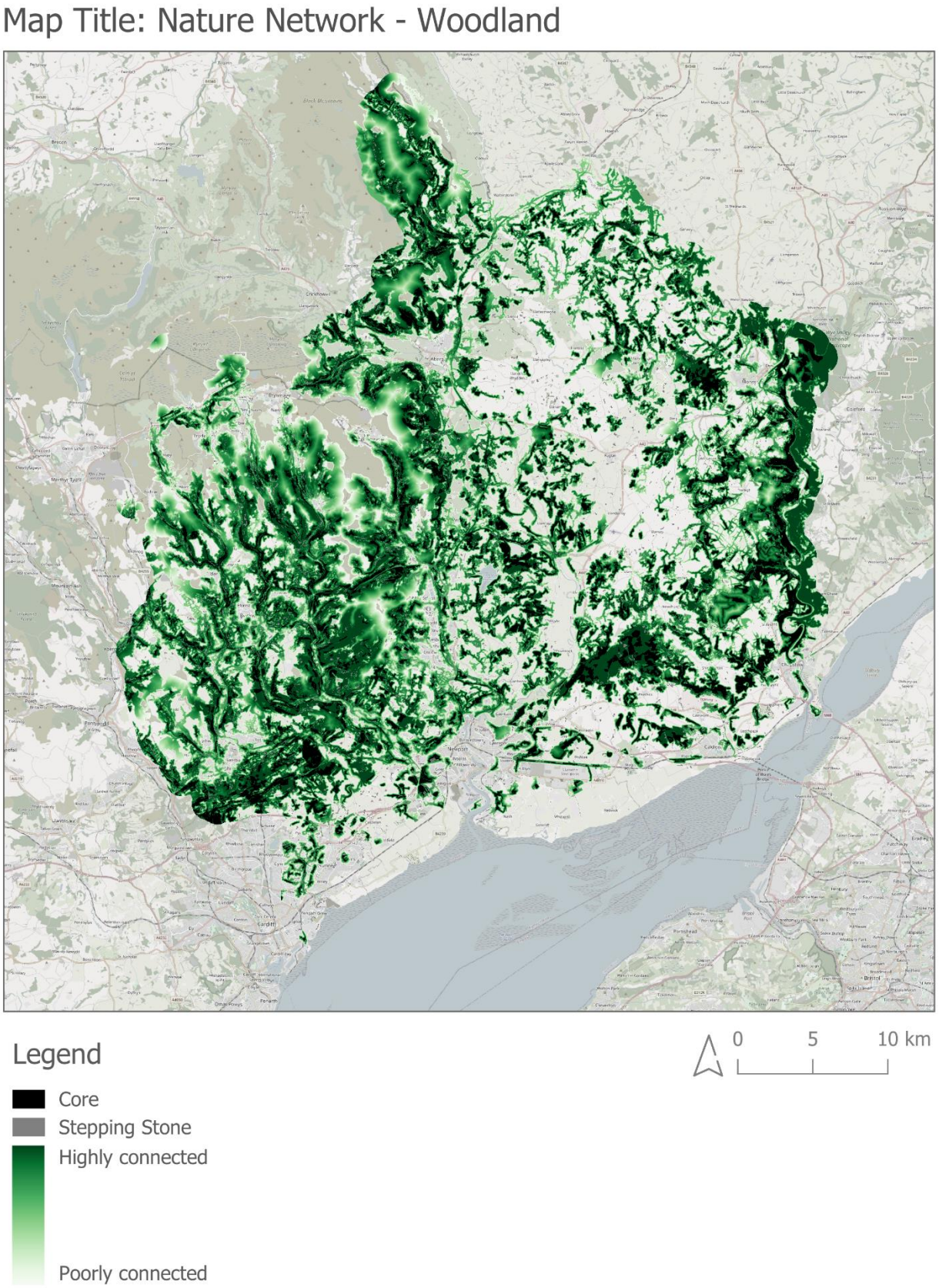



Figure 2. Network connectivity of woodlands

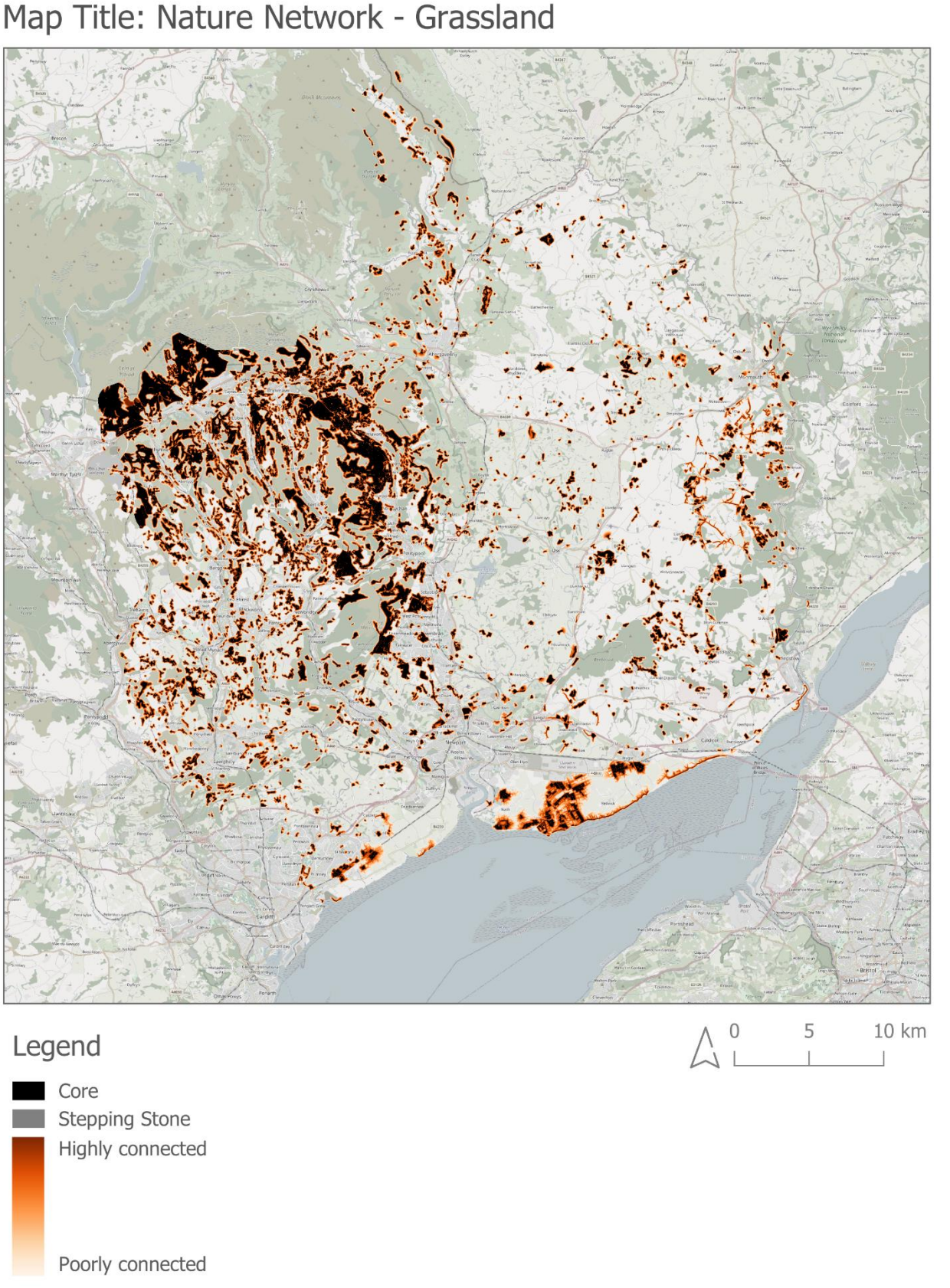



Figure 3. Network connectivity of grasslands

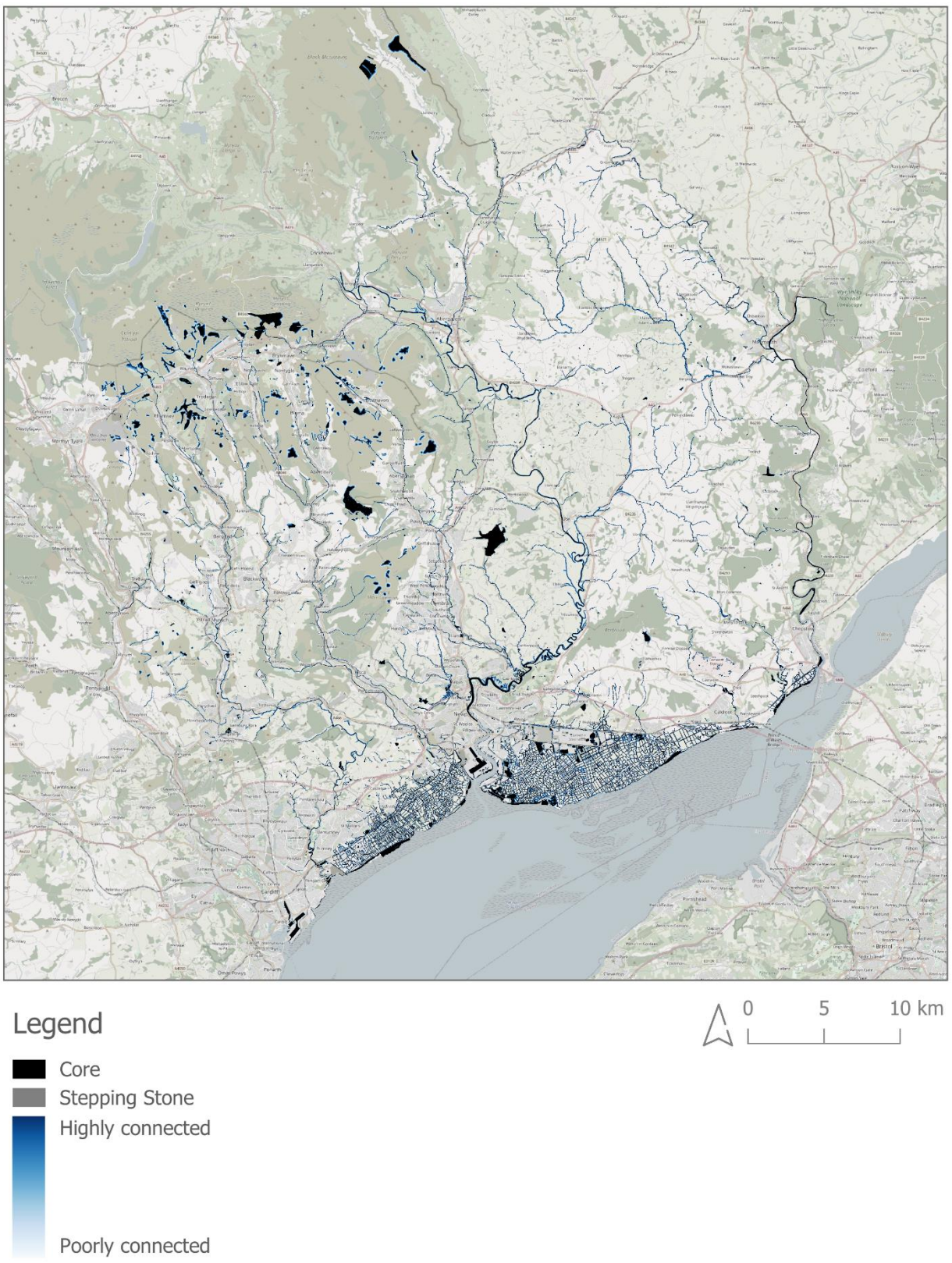



Figure 4. Network connectivity of wetlands

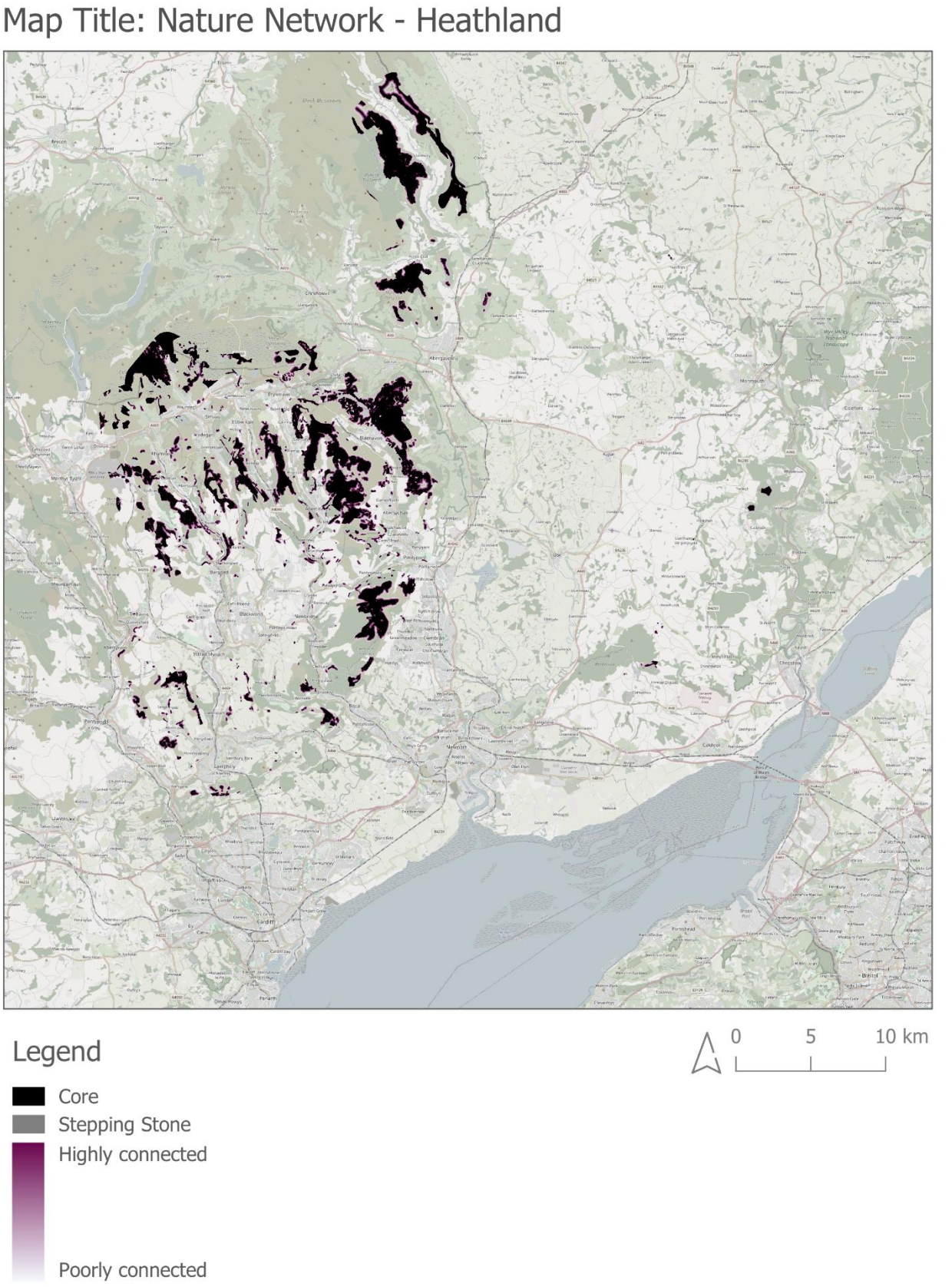
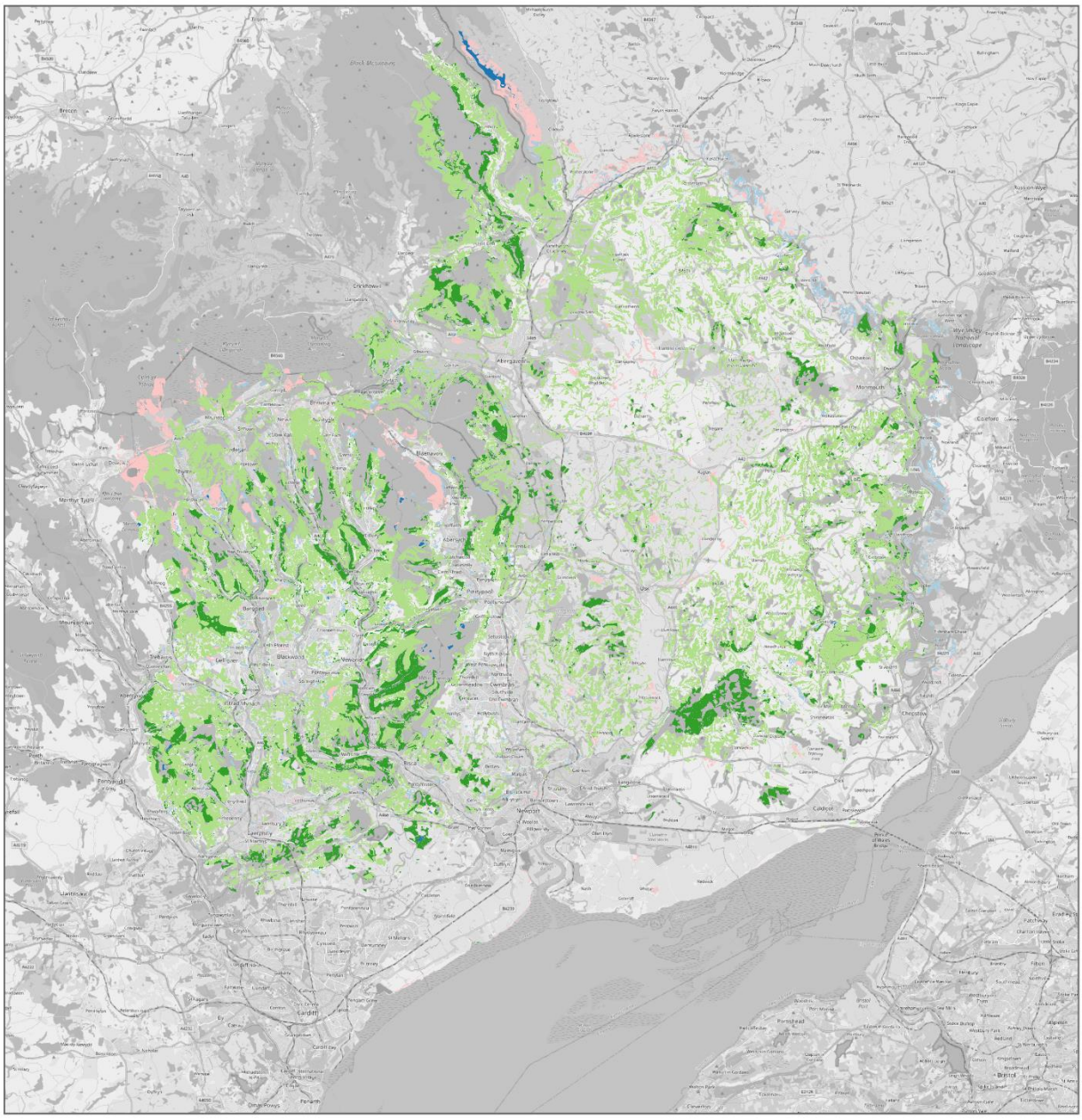



Figure 5. Network connectivity of heathlands

Map Title: Woodland Ecological Network Opportunity



Legend

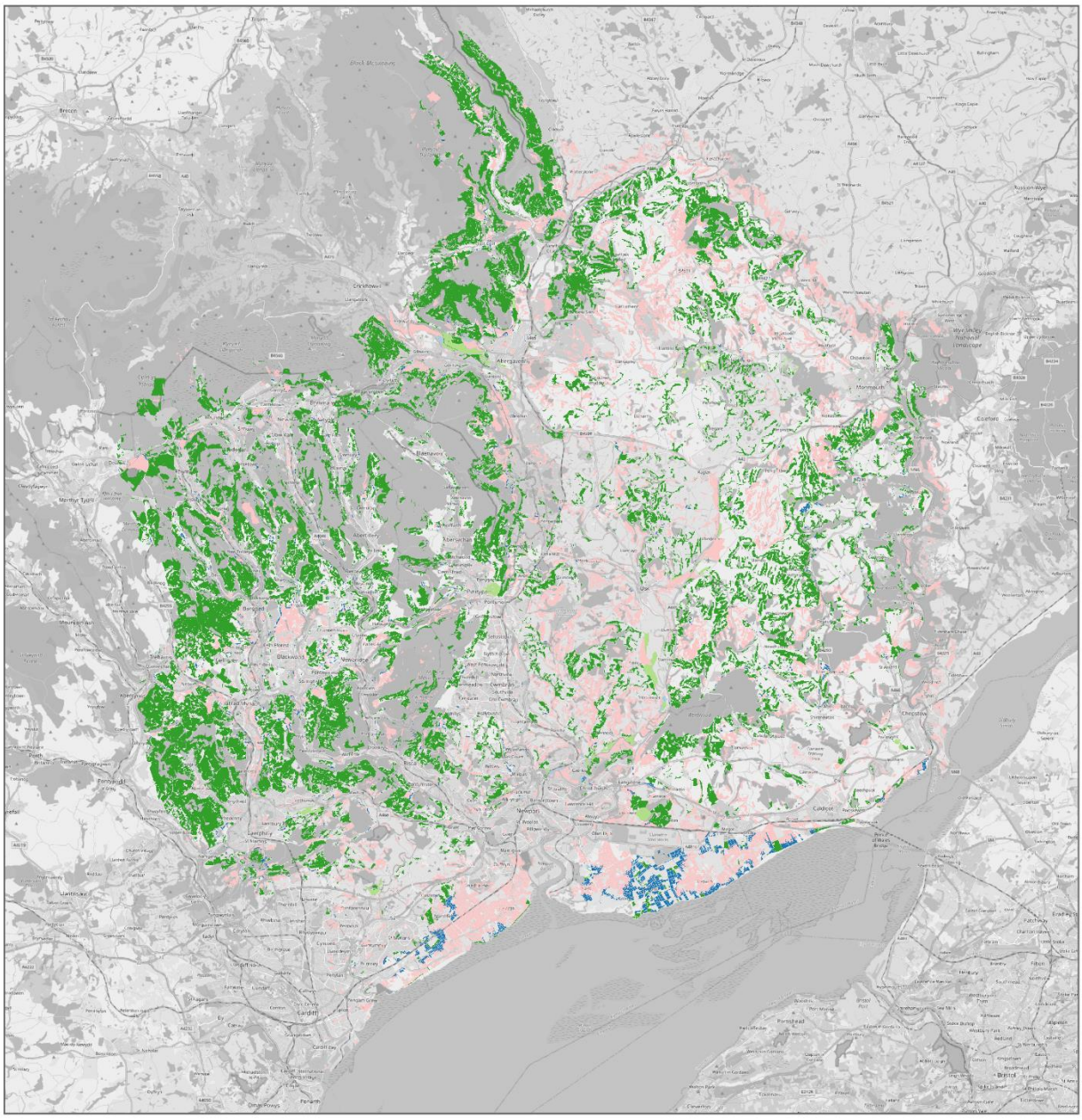
- Best opportunities to increase extent
- Some opportunities to increase extent
- Best opportunities to increase connectivity
- Some opportunities to increase connectivity
- Other opportunities (outside the existing network)

0 5 10 km



Figure 6. Opportunities to increase the resilience of the woodland network

Map Title: Grassland Ecological Network Opportunity



Legend

- Best opportunities to increase extent
- Some opportunities to increase extent
- Best opportunities to increase connectivity
- Some opportunities to increase connectivity
- Other opportunities (outside the existing network)

0 5 10 km



Figure 7. Opportunities to increase the resilience of the grassland network

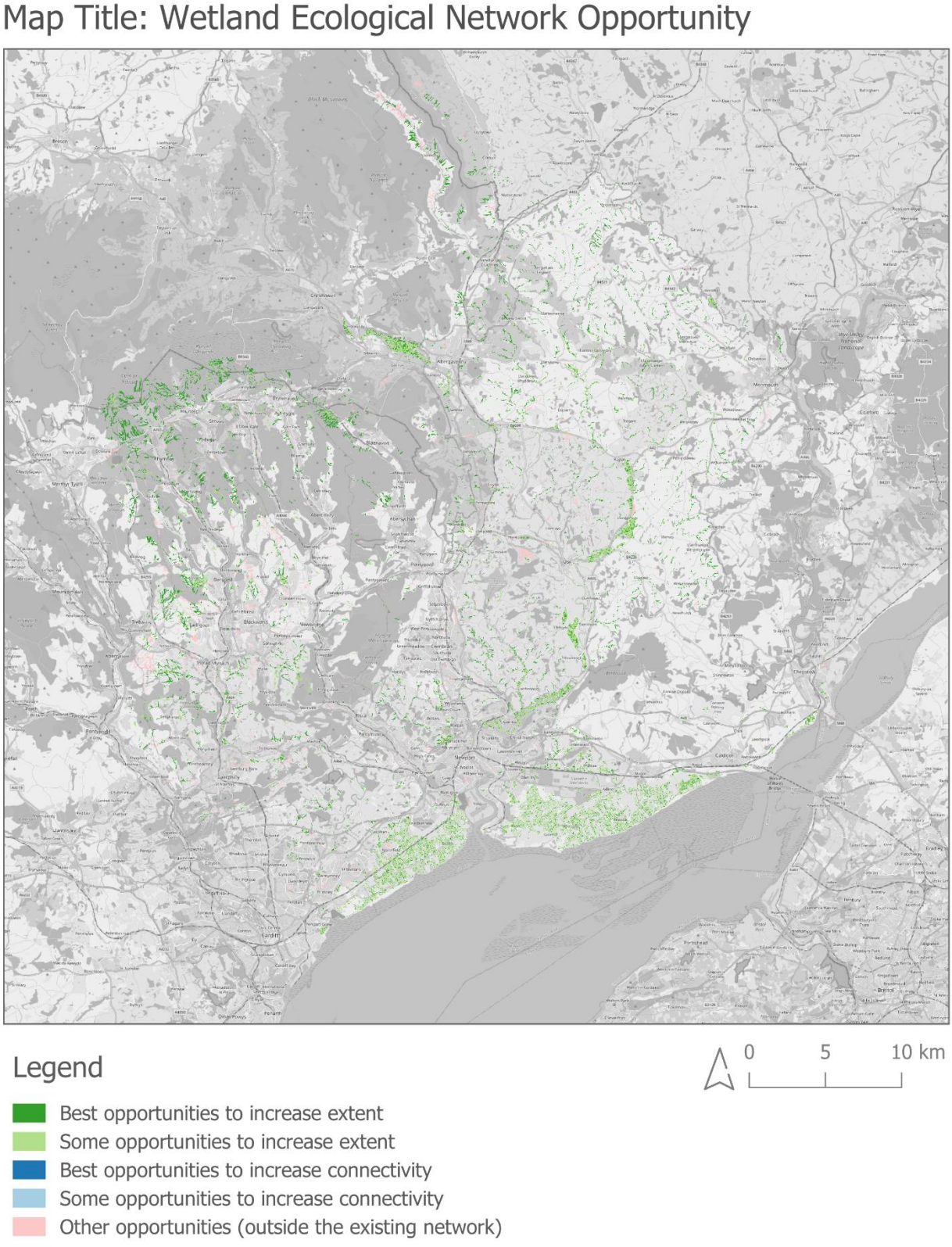
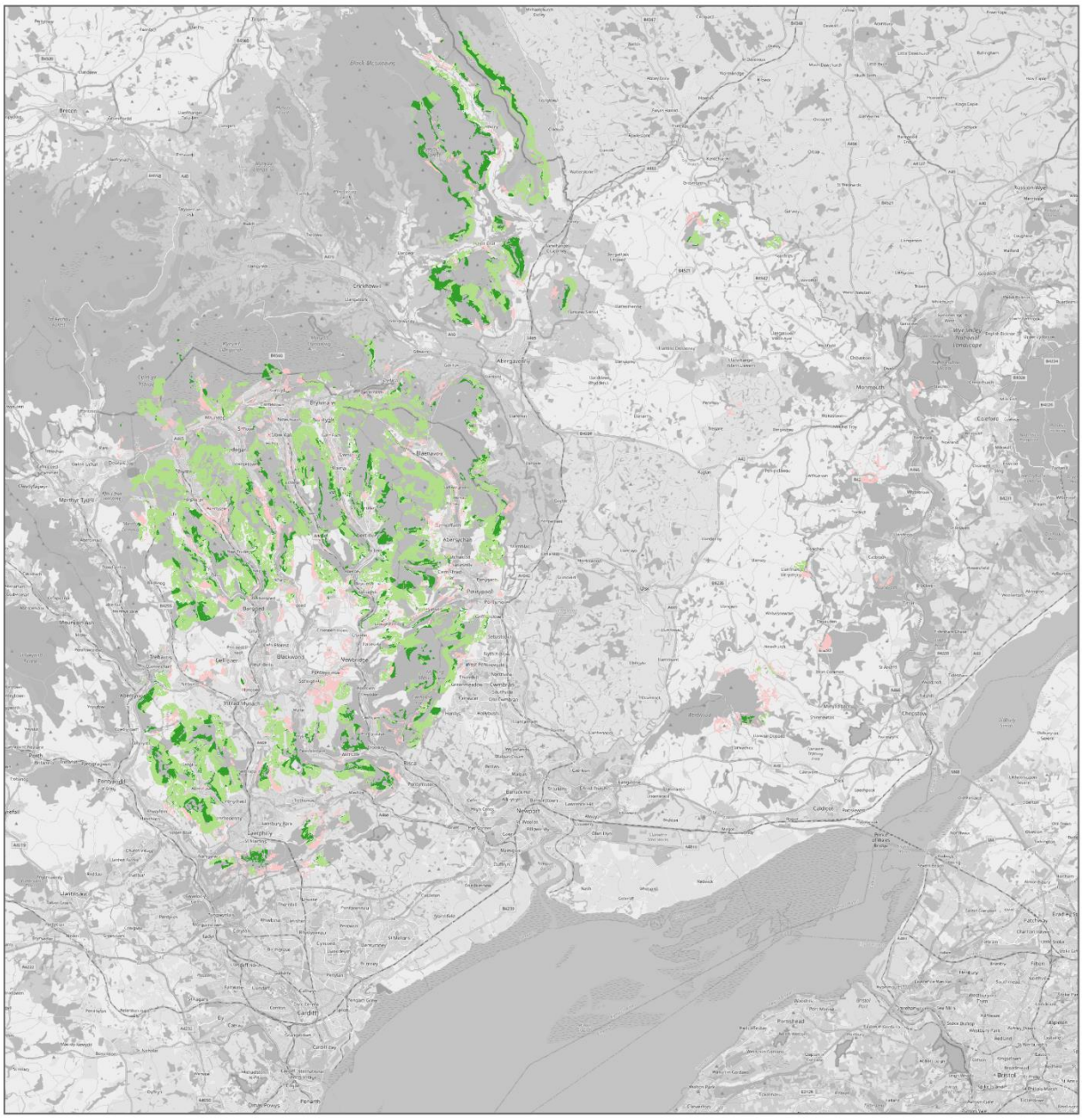



Figure 8. Opportunities to increase the resilience of the wetland network

Map Title: Heathland Ecological Network Opportunity



Legend

- Best opportunities to increase extent
- Some opportunities to increase extent
- Best opportunities to increase connectivity
- Some opportunities to increase connectivity
- Other opportunities (outside the existing network)

0 5 10 km



Figure 9. Opportunities to increase the resilience of the heathland network

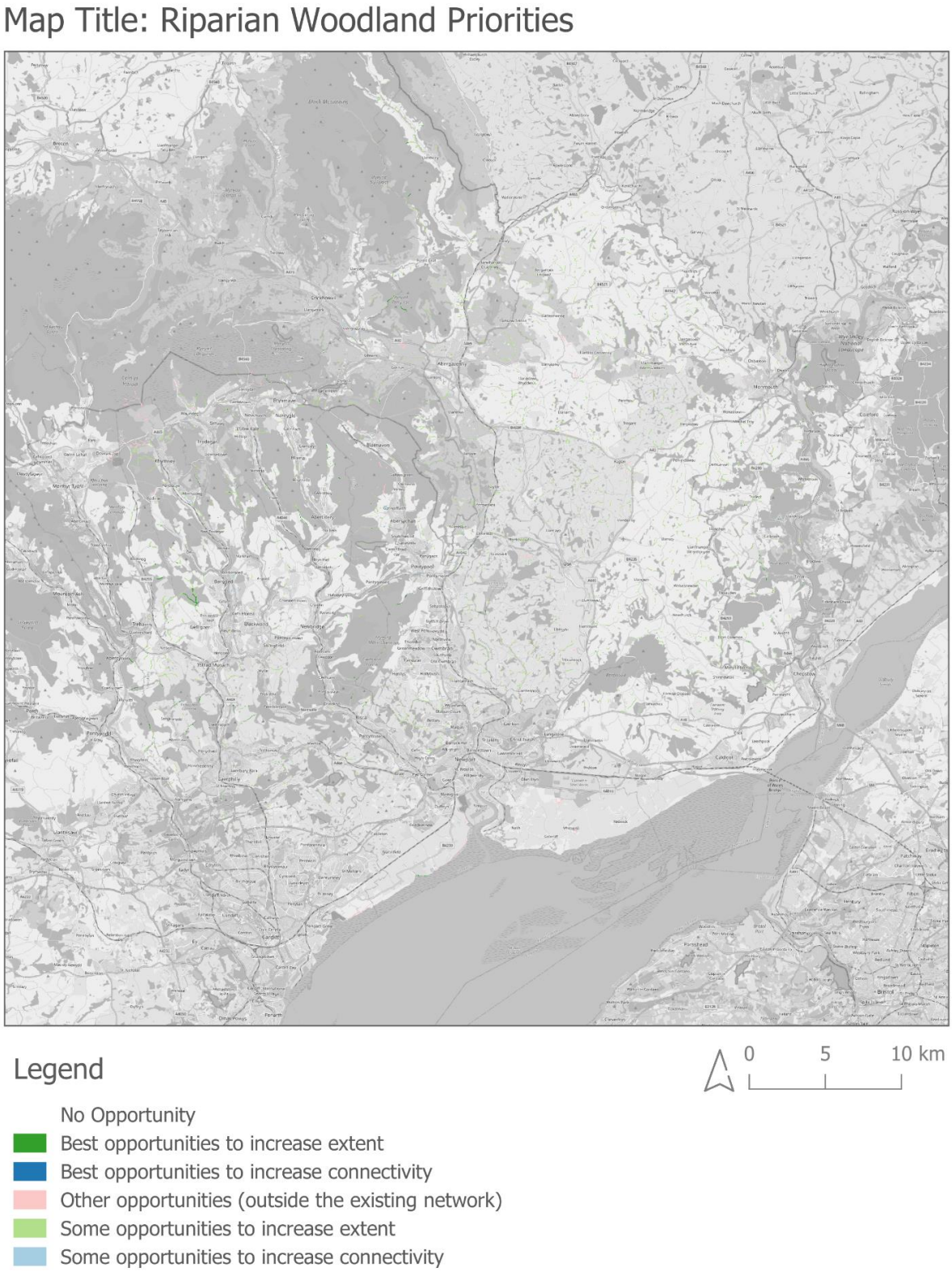
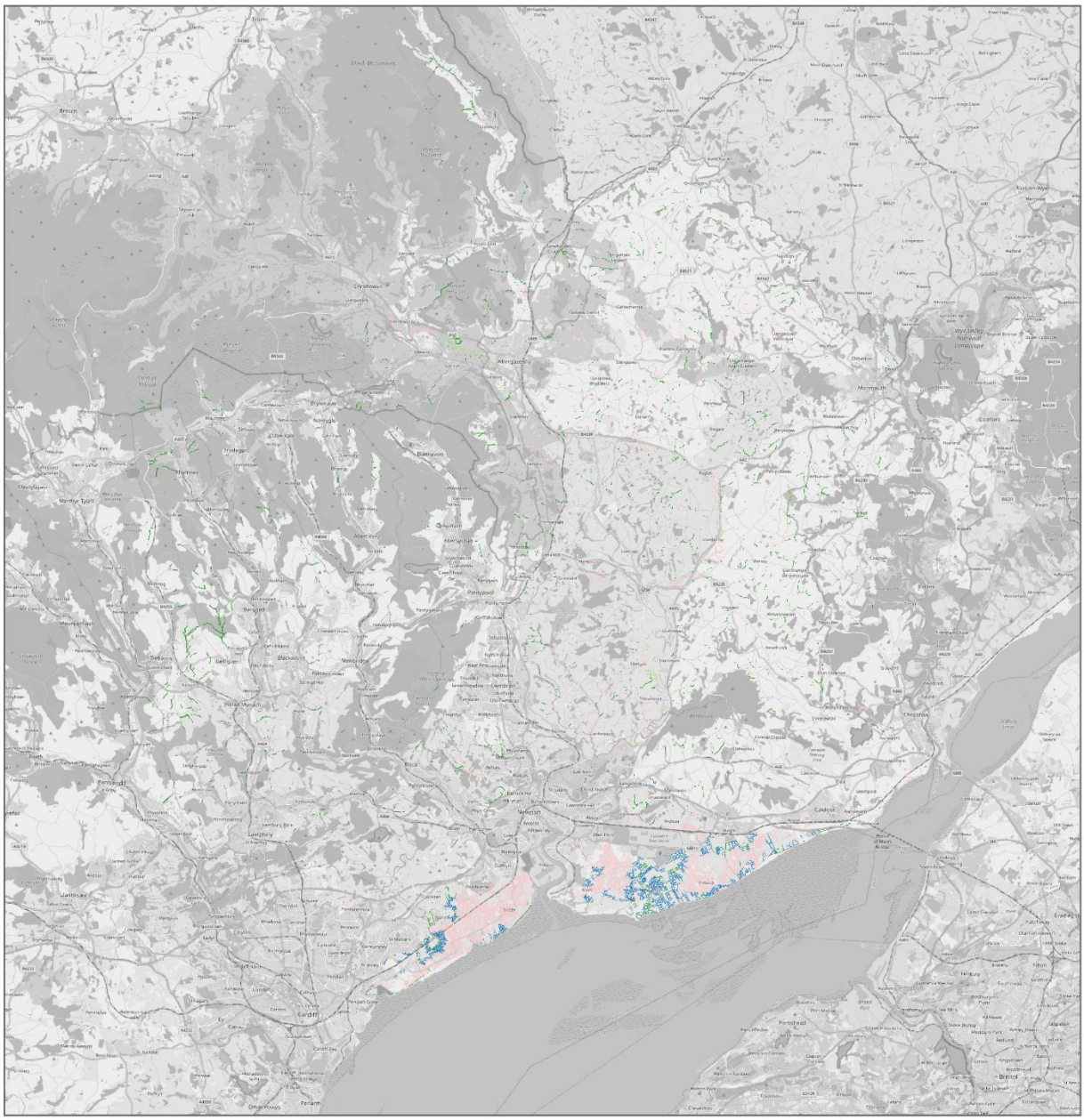



Figure 10. Opportunities for riparian woodland creation[13]

[13] Please zoom-in to view opportunity areas

Map Title: Riparian Grassland Priorities



Legend

No Opportunity
Best opportunities to increase extent
Best opportunities to increase connectivity
Other opportunities (outside the existing network)
Some opportunities to increase extent
Some opportunities to increase connectivity

0 5 10 km



Figure 11. Opportunities for riparian grassland creation

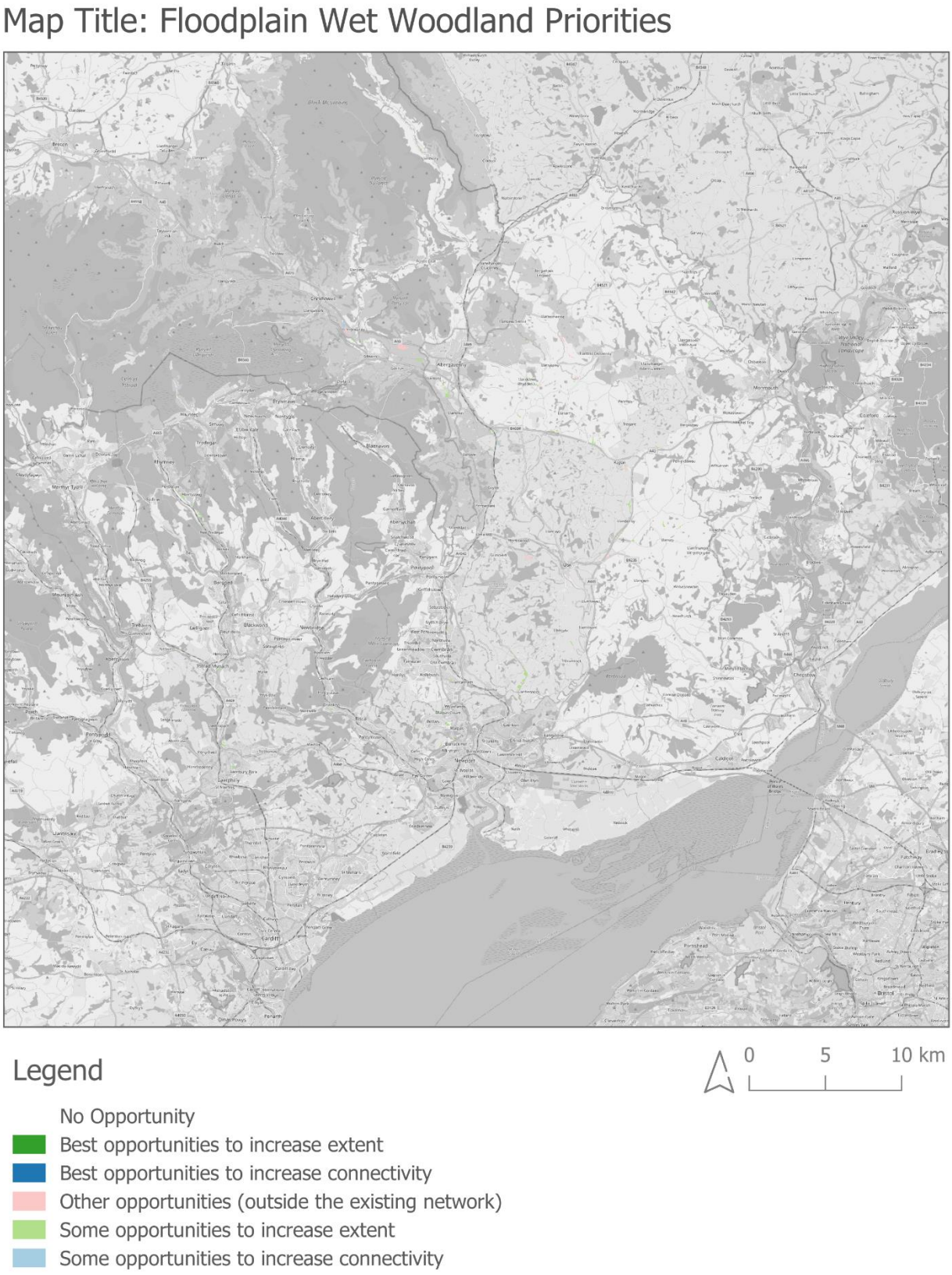



Figure 12. Opportunities for floodplain wet-woodland creation

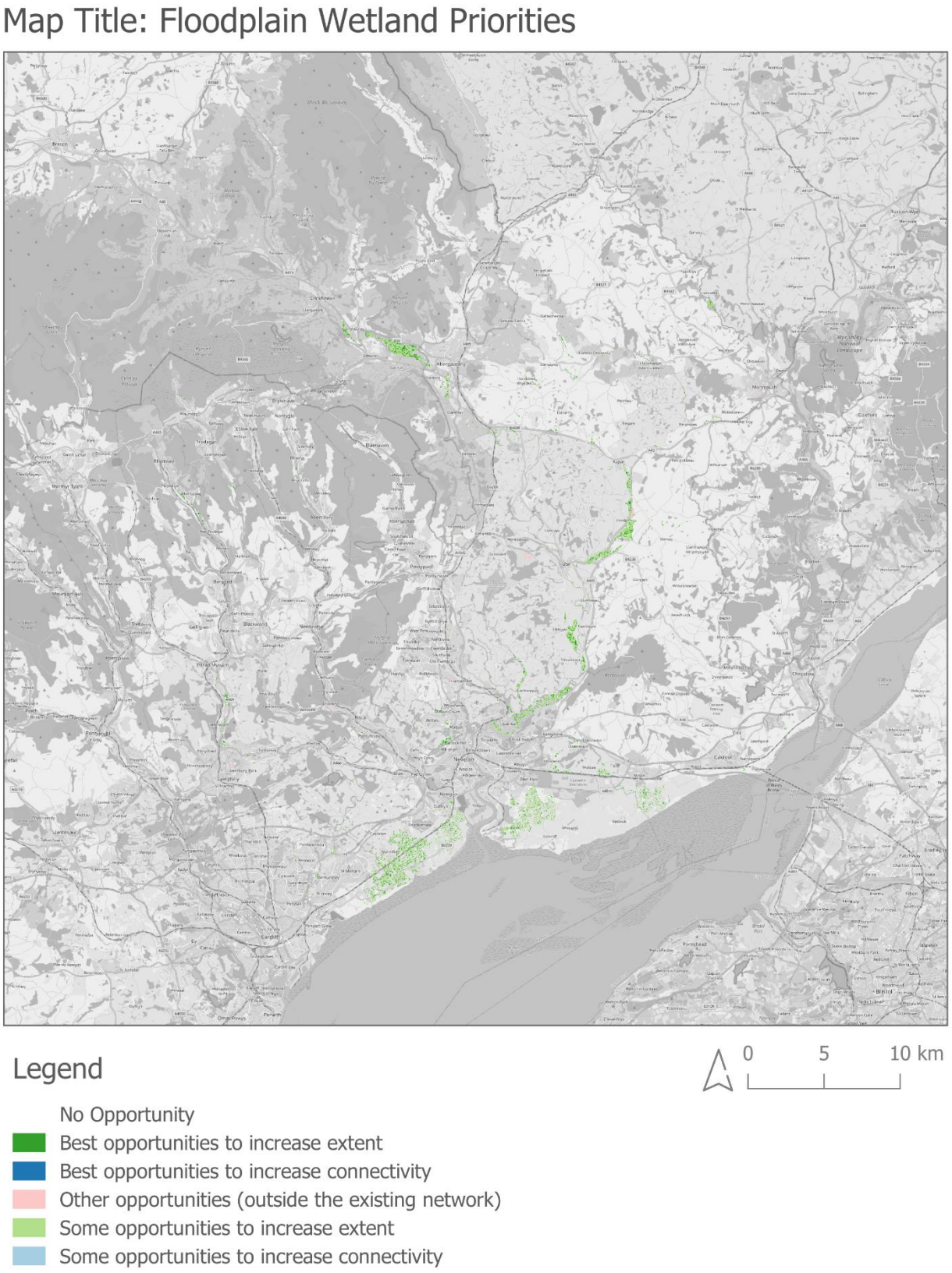



Figure 13. Opportunities for floodplain wetland creation

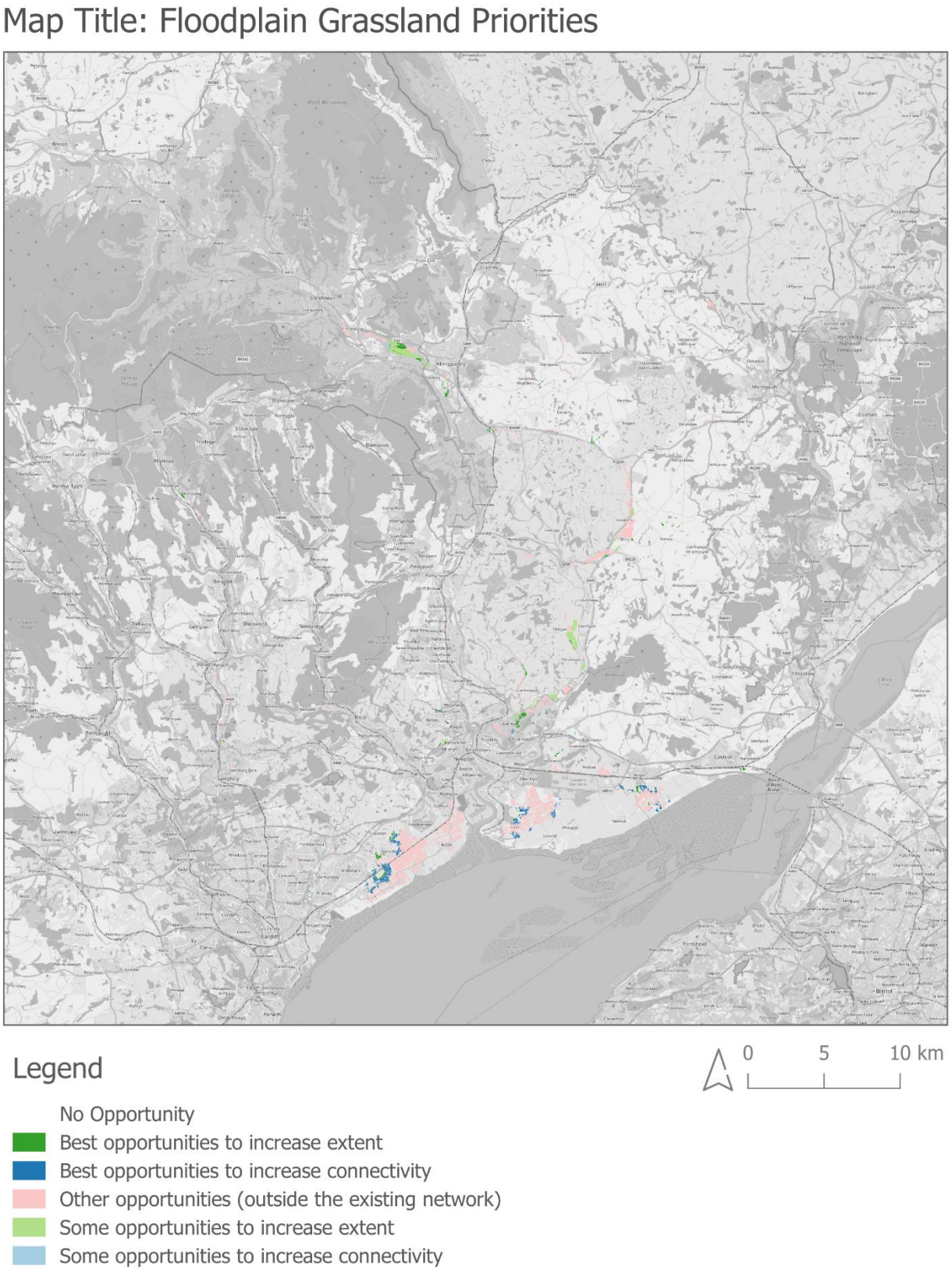



Figure 14. Opportunities for floodplain grassland creation

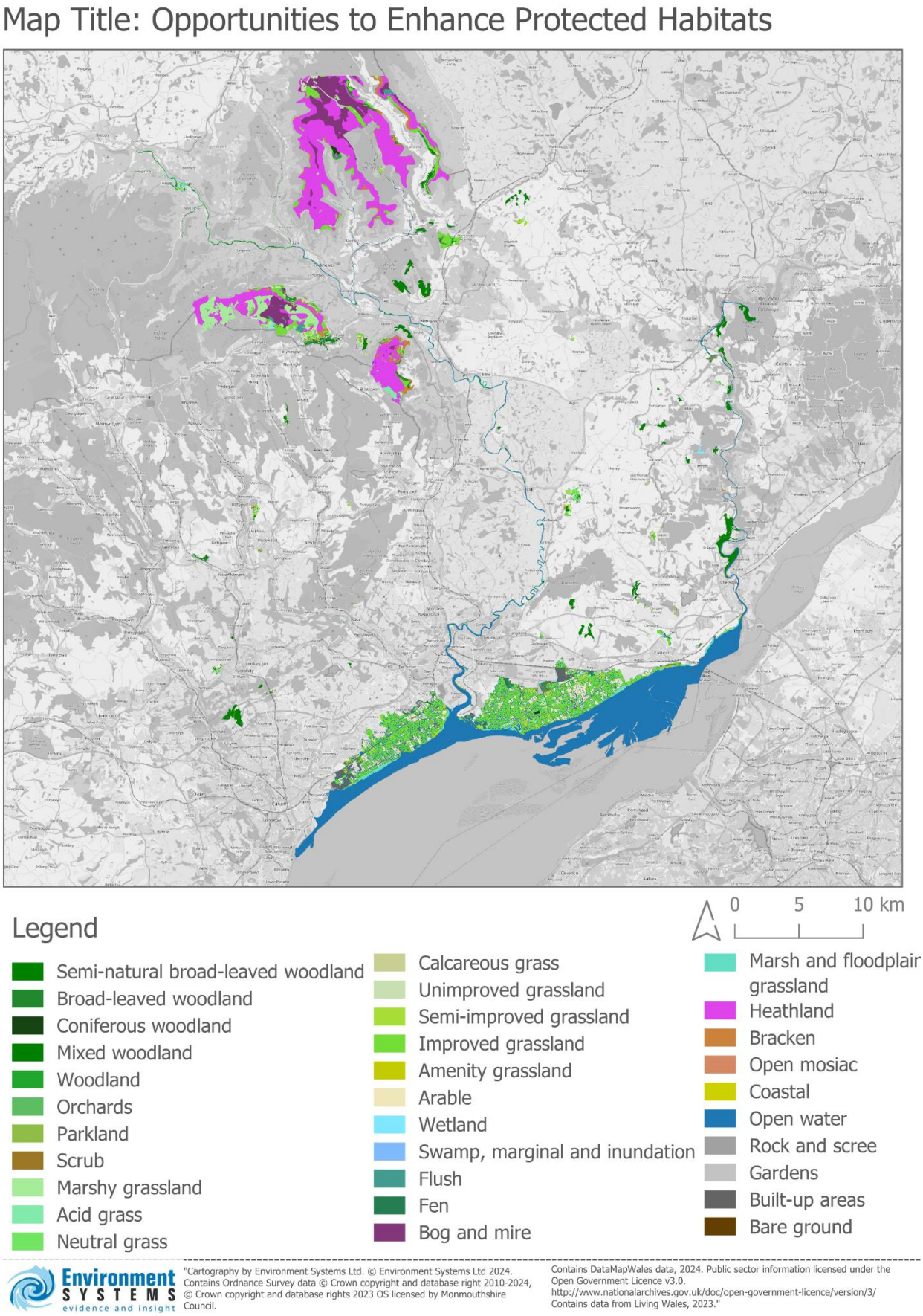



Figure 15. Opportunities to enhance habitats within designated sites

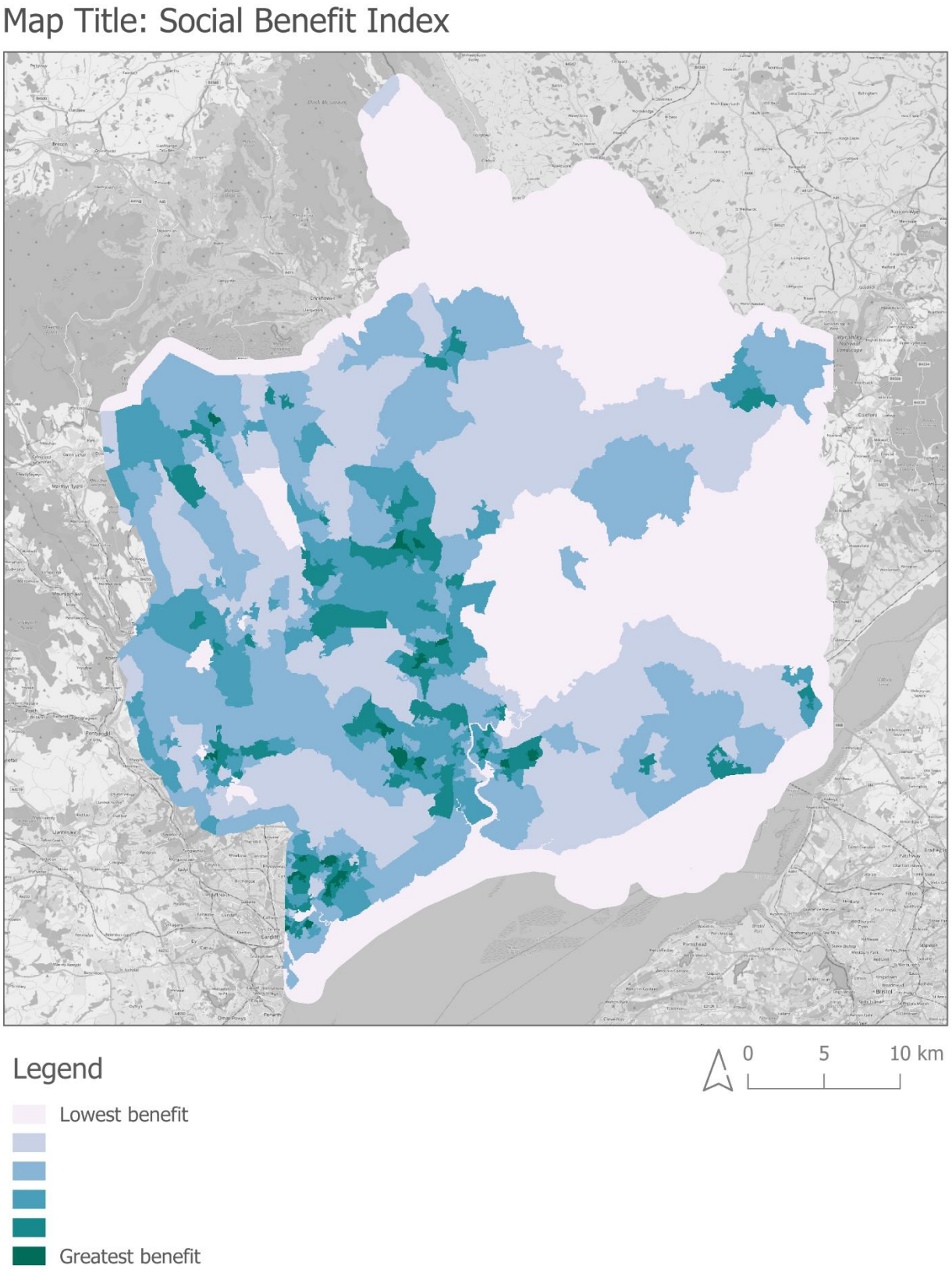



Figure 16. Social benefit index, as per the Welsh Index of Multiple Deprivation 2019