River Ems
Restoration Plan 2024 - 2034

Photo: Mill Meadows, John Barker

Western Sussex Rivers Trust

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DISCLAIMER:

This report has been prepared by the Western Sussex Rivers Trust (WSRT – previously known as the Arun and Rother Rivers Trust) working in collaboration with the Friends of the Ems (FotE), local experts, regulators, community members and other stakeholders. The report was funded by Portsmouth Water. This report was prepared with all reasonable care and diligence within the terms of the contract of engagement with Portsmouth Water Limited, and taking into account the resources and information made available at the time.

PHOTOS:

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1 River Ems 10 Year Restoration Plan

In answer to the call for Flagship Chalk Stream projects, and to help inform other work they were undertaking around flow and ecology on the Ems, Portsmouth Water commissioned the Western Sussex Rivers Trust (previously known as the Arun and Rother Rivers Trust) to develop a 10 year plan to help the Ems, working with the local community, landowners and others to develop short and long term actions to improve elements vital for chalk stream health.

1.1 Plan Objectives

This plan has a number of key objectives:

- Understand the current and historic state of the River Ems, and provide baselines and targets relating to - Water Quality, Water Quantity and Physical Habitat.
- To work with the community and landowners to develop and inform the plan.
- Understand the pressures, drivers and opportunities to help achieve Good Ecological Status under the Water Framework Directive.
- Help progress delivery of targets set in the Chalk Stream Strategy.
- Create an outline adaptive plan for the Ems waterbody, with reach-by-reach restoration measures, a timeline of actions and potential funders.

This was undertaken in a series of stages (see schematic below).

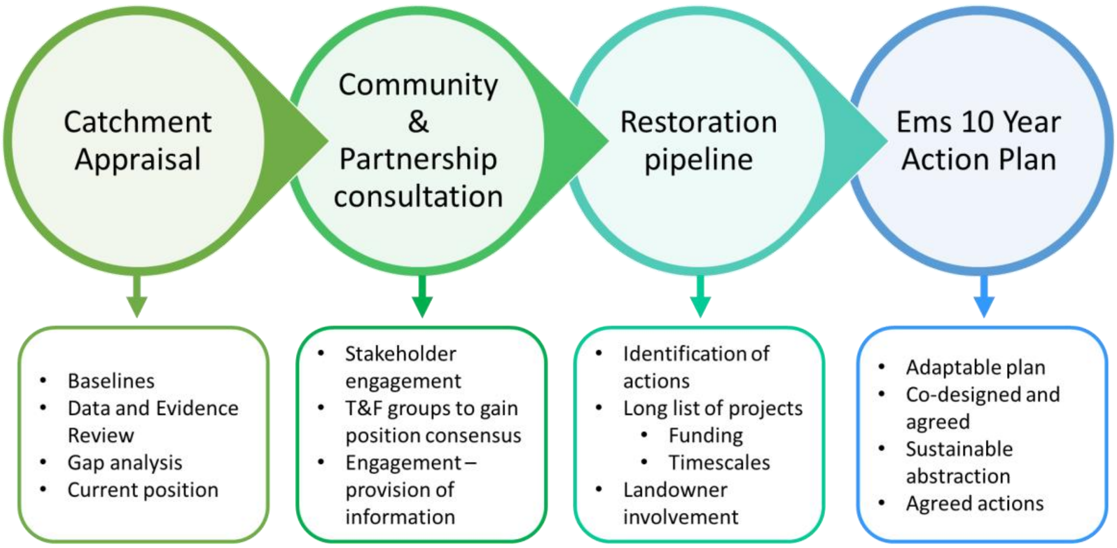

Figure 1. Schematic showing development of the Ems 10-year plan

1.2 Catchment Appraisal

The River Ems Catchment Appraisal (available from WSRT) provides an overview of the catchment, outlining its characteristics and issues. It incorporates information from a wide range of sources, including past, current and future views, and is being used to help guide and inform future work. We also hope that it can provide a baseline of current conditions.

1.3 Community Engagement

To inform the development of the Restoration Plan we published a questionnaire about the River Ems, how people use the river, what they value and things of note. We received 207 responses including members from 35 different local groups. The data captured through the questionnaire has been used to inform the plan. A summary report can be provided on request from WSRT.

We held a number of Task & Finish group meetings with local experts, regulators and local groups to discuss and understand the characteristics of the Ems and available evidence. Meetings were held virtually and focused on the trinity of ecological health – water quality, water quantity and physical habitat.

In the spring of 2023 and using our developing Restoration Pipeline of issues and opportunities in the catchment, we held a workshop for 30 farmers and landowners. This provided further detail for the plan and developed important local links – not just for the plan, but also linking neighbours and riverside landowners up and down the river.

1.4 Restoration Plan (and Pipeline)

The data and evidence we have gathered, is assessed later in this report, outlining issues and providing practical mitigation and recommendations.

Throughout the development of the plan, we have also been capturing geographic data about locations where issues persist, or opportunities for enhancement exist, creating a live spreadsheet to help target and plan.

1.5 River Ems Condition Assessment (2022)

Alongside work to develop the plan we also secured funding from Portsmouth Water's 'Biodiversity Fund' to undertake a River Ems walkover survey, to provide a supporting and up-to-date assessment of the evidence relating to the current state of the Ems. This included:

- Condition Assessment – standardised river health assessment based on naturalness.
- Biodiversity Net Gain assessment – providing guidance on how and where to achieve maximum uplift.
- Presence of invasive species, tree disease, ad hoc notable or rare species.
- Macrophyte assessment.
- Mapping of issues and opportunities.
- Landowner engagement.

This survey utilised Holmes' (2007) four defined reaches of the Ems, which were found to still be valid in delineating these river sections relative to their characteristics. Results of this survey have been incorporated into this report and restoration plans. See Section 2 of this report.

1.6 Arun & Western Streams Catchment Partnership (AWSCP)

The Catchment Based Approach (CaBA) group supports a national network of Catchment Partnerships. Focused on water at a catchment scale, partnerships are made up of organisations from the local water sector including NGOs, regulators such as the Environment Agency (EA), water companies and other interest groups working in the area. The Ems sits within the Arun & Western Streams catchment, in the southwest of the catchment area.

Catchment Partnerships aim to deliver more at a larger scale and in partnership with other organisations. They aim to reduce overlap of efforts and mobilise work in areas of co-interest.

The partnership has already delivered work on the Ems via a WSRT led river habitat restoration project along the river Ems in 2015/16, utilising Environment Agency funding.

The AWSCP is currently working on a new Catchment Management Plan using digital mapping to highlight issues and help focus and target future partnership projects. Outputs from the CMP have been used to inform the plan where relevant. The River Ems Restoration plan (and related data and documents) will be housed by the AWS Catchment Partnership and presented to members to deliver work collaboratively to drive action.

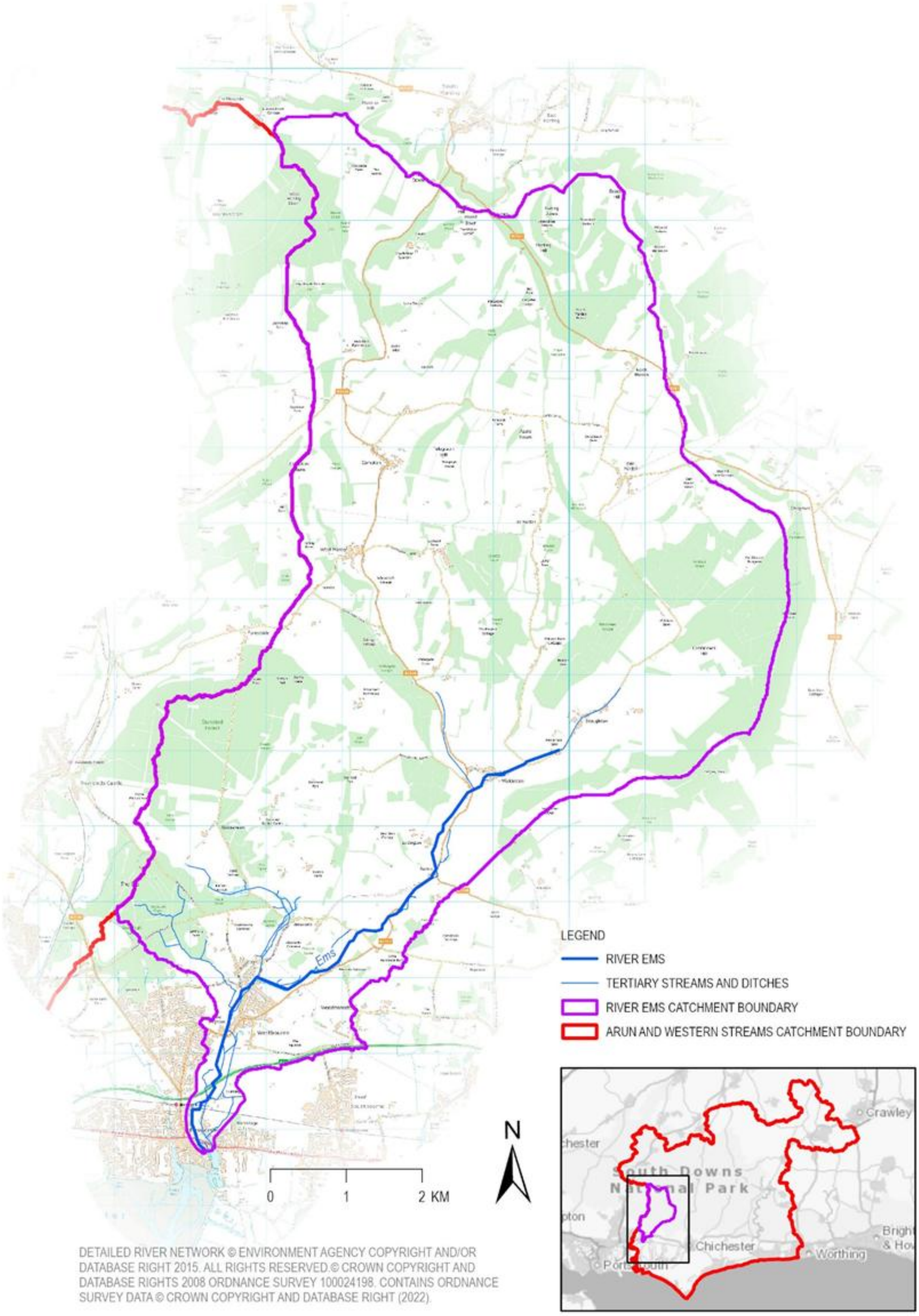

Figure 2. Map showing South East with AWSCP area / Ems Catchment.

2 River Ems Condition Assessment (2022)

In 2022 WSRT were awarded funding from the Portsmouth Water 'Biodiversity Grant Fund' to undertake a walkover survey of the Ems. This survey included:

- River Condition Assessment (inc. Modular River Survey – MoRPH).
- Biodiversity Net Gain assessment (BNG)
- Floodplain land use
- Opportunities for enhancement
- Mapping pipes, culverts and in-river structures.
- Presence of Invasive Non-Native Species
- Presence of trees and riverside buffers.
- Mapping and analysis.
- Pressures and recommendations.

2.1 Methods

The River Condition Assessment, MoRPH and Biodiversity Net Gain survey methodologies follow nationally agreed approaches and are designed specifically to assess river health and status. More details of the components of this assessment can be found in Appendix 7.

2.1.2 River Condition Assessment (RCA)

A River Condition Assessment (RCA) was used to evaluate the physical habitat and geomorphological condition of the River Ems. This approach uses the field- and desk-based components of the Modular River Physical (MoRPH) Survey. This information is used to assign a provisional numerical condition score for each subreach based on 32 condition indicators (19 positive & 13 negative). These characterise the condition of different aspects of bank tops, bank faces, channel edge – water margin, and channel bed and can be used to direct enhancement works.

2.1.3 Walkover Survey

Walkover surveys were undertaken on each landholding which included one or more of the MoRPH5 sub-reaches and collected information on the following:

- Extent of bank side trees and evidence of disease.
- Land use along the river corridor.
- Wetland features present in the floodplain.
- Presence of macrophyte and other notable species.
- Location and extent of river modifications (e.g. weirs, reinforcements, re-sectioning, outfall pipes).
- Location and extent of invasive non-native plants.
- Locations of any sediment or pollution pathways.

2.1.4 Habitat Modification Score

Data relating to river modifications recorded in the survey were exported and used to derive Habitat Modification Scores following the River Habitat Survey 2018 revised scoring system. Final scores were translated into five modification classes (pristine/semi-natural: 0-16, predominantly unmodified: 17-199, obviously modified: 200-499, significantly modified: 500-1399, severely modified: >1400).
All data were collected using ESRIs Survey 123 and translated to GIS files.

2.2 Survey Area

As previously indicated the survey used the Holmes (2007) defined four reaches, based on contrasting hydrological characteristics, which were further delineated into 23 sub-reaches based on the morphology, sediments, physical features and vegetation structure of the river channel and margins within 10m of the bank top.

Location of surveys was dictated in part by landowner permission, with some desirable stretches being unassessed. The survey incorporated 7.88km of the main River Ems (as defined by EA) which can be described as follows:

- **Reach no .1.** Upper Ems: very dry currently winterbourne reach from Stoughton to Broadwash.
- **Reach no. 2.** Middle Ems: currently winterbourne/perennial reach from Broadwash to Watersmeet.
- **Reach no. 3.** Aldsworth Stream: north-west tributary of the Ems including perennial stream and Brickkiln and Aldsworth Ponds.
- **Reach no. 4.** Watersmeet to Dolphin Lakes: Perennial, modified multi-thread reach.

2.3. Summary of Results

Results agree with the Holmes 2007 survey, indicating that many of the issues facing the River Ems can be attributed to historical modification and contemporary management degrading the natural processes typical of chalk streams. The wide, straightened, or canalised channel shape, particularly in the lower reaches, is limiting catchment resilience to low flow conditions, reducing habitat diversity, and disrupting natural sediment transfer and settlement patterns, and over-deepening and embanking has reduced lateral connectivity with the floodplain. A high abundance of structures, reinforcements and artificial features are restricting natural flow further disrupting sediment transfer. Unsympathetic management of marginal, bank face and riparian habitat is increasing the risk of sediment entering the river, allowing the establishment of non-native species, enabling extensive overshading, and reducing the complex habitat required to slow flows and retain water during drought conditions.

This study identified a number of pressures affecting the Ems:

- Channel straightening and over deepening
- Impoundments (i.e. weirs)
- Artificial features and reinforcements
- Non-native Invasive Plants
- Loss of characteristic riparian habitat (e.g. wet woodland and marsh)
- Low flows and resulting loss of physical and morphological diversity.

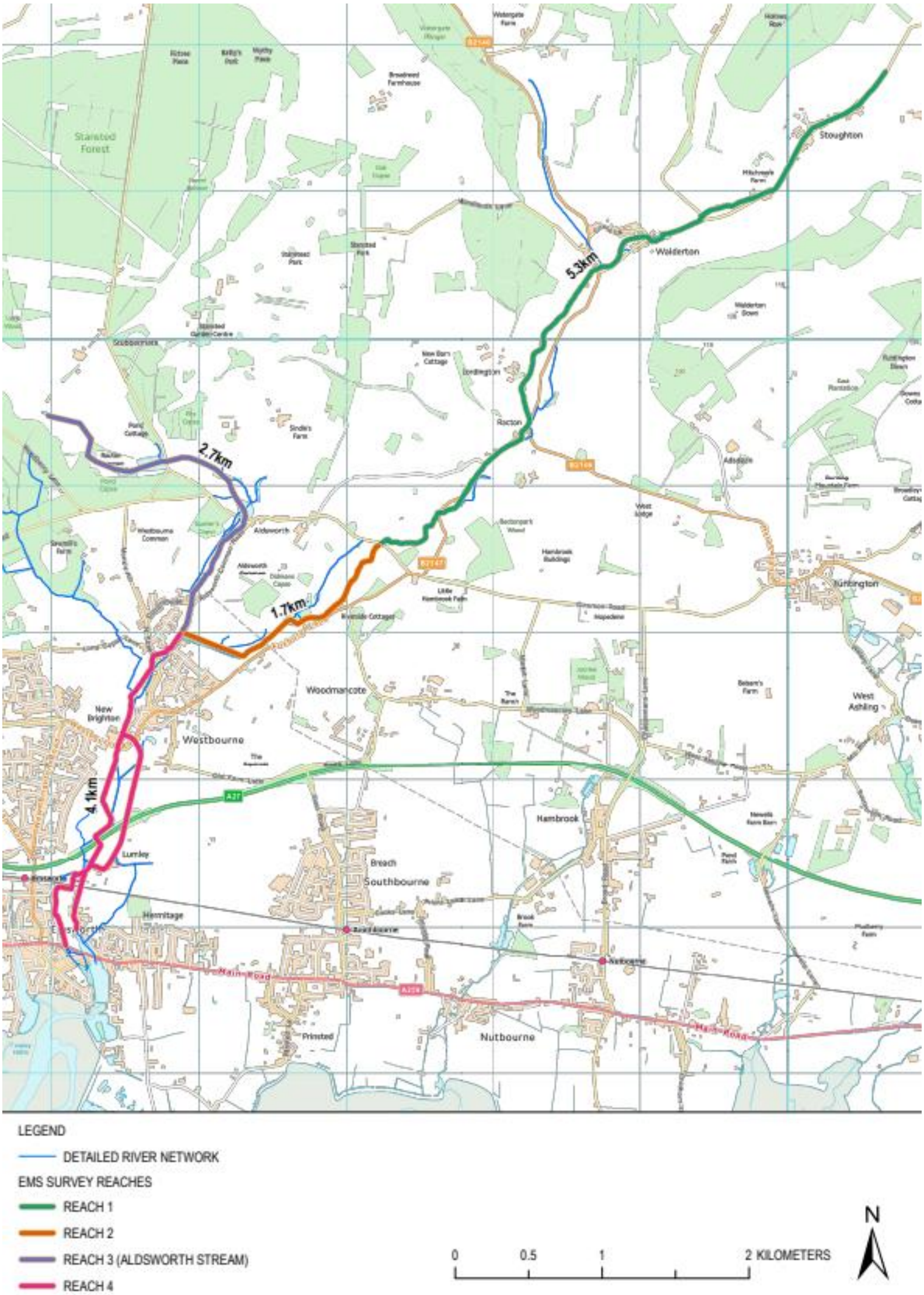

Figure 3. River Ems Reach Map.

Figure 4. River Ems River Condition Assessment Score by sub-reach.

Recommendations to mitigate these impacts are presented in the report under five categories:

1. Weirs, sluices and culverts
2. Reducing the extent and severity of artificial features
3. Non-native invasive plants
4. Re-naturalising the river corridor
5. Enhancements to the channel

Condition indicators have then been reassessed to provide future condition scores for each sub-reach, based on the delivery of improvements, which can be used as a focal point for monitoring of condition following any future project delivery.

3 Future Ems Landscape Perspectives

According to the 2023 State of Nature report, the UK is suggested to be one of the most nature depleted countries in the world – sitting in the bottom 10% for biodiversity.

We are now at a crisis point for biodiversity. Records already show a loss not just in the number of species and habitats in our landscapes and rivers, but also the range. This can be attributed to a number of causes including industrialisation of farming, increasing population and urbanisation, landscape change and development, pollutants and disease, and the threat and progress of Climate Change.

The Ems, in common with many of our coastal rifes and streams, is at the forefront of the impacts of biodiversity loss and the effects of Climate Change. Situated in one of the most populated areas in the UK, and located on the groundwater dominated coastal plain, predicted sea level rise will cause freshwater streams and habitats to be pushed further upstream, and increase flooding. An increasing demand for water from a growing population will further burden the water sources, and our rivers and streams.

3.1 Climate Change

Climate change is the most defining crisis of our time and taking action to adapt and build resilience now and in the future will be an ongoing challenge. In the UK, we are already experiencing a climate that is an average 1°C warmer than pre-industrial levels. The top ten warmest years since 1884 have occurred in the last 20 years, and in 2022, we saw the warmest year on record with temperatures exceeding 40°C for the first time. We are also starting to see a rising trend in the amount and intensity of seasonal rainfall and around our coast sea levels have risen an average of 16.5cm since that start of the 20th century. Further change is inevitable and the most recent climate projections for the UK (UKCP18) suggest that we are likely to see a shift to warmer, wetter winters and hotter, drier summers along with an increase in the frequency and intensity of weather extremes.

3.1.1 How could climate change impact the Ems?

Fresh waters are considered to be among the most sensitive of all ecosystems to the effects of climate change since they rely on the larger water cycle for their flow. Figure 5. illustrates how climate change may impact the water cycle over the next century. This shows that there are many ways in which the

River Ems and the wider catchment could be impacted by changes to our climate and water cycle, and these are discussed in detail below.

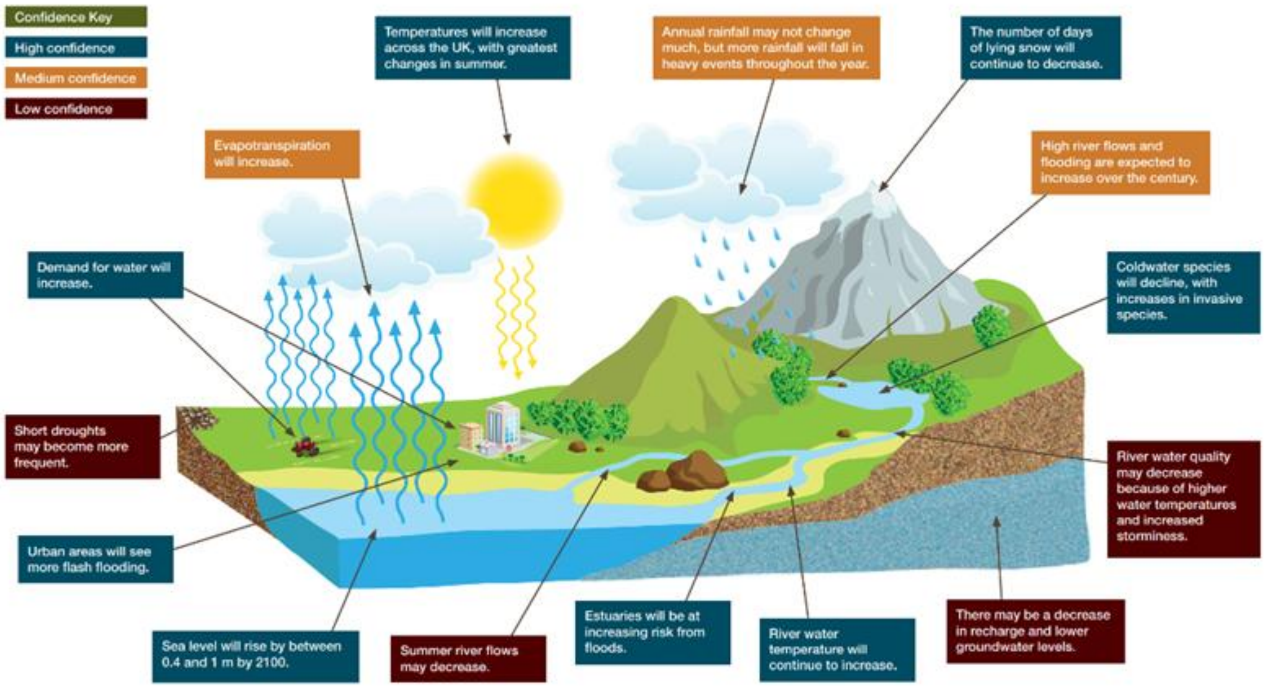

Figure 5. Illustration of the potential impacts of climate change on water, taken from Living With Environmental Change (LWEC) Water Report Card and adapted from an original by Vasily Merkushe

3.1.1.1 River flow

The majority of (natural) flow for the River Ems is derived from groundwater and changes to the amount and duration in which water infiltrates into our aquifers will directly impact river flows. Using the central estimates for rainfall for a low climate mitigation scenario (RCP 6.0), the River Ems may see winter rainfall increase by 10.7% by 2069 and 20% by the end of the century[1]. In contrast, summer rainfall is predicted to reduce by 19% and 29.7% over the same time periods, suggesting that we could see a reduction in the overall annual infiltration to groundwater, resulting in a reduction in base flow and potential disappearance of spring lines. Groundwater levels may also be impacted if rainfall intensity increases, as heavy rain tends to run off the land as surface water and is less likely to infiltrate into our groundwater. Certain methods of agricultural management and growing settlements will exacerbate this effect. This is relevant to large areas of the Ems catchment.

Reduced summer rainfall combined with higher temperatures will add further pressure as decreased soil moisture will impact agricultural production and further increase runoff during rainfall events, reducing infiltration to the groundwater. Hot summers will also likely see increased public demand putting pressure on the potable supply network, potentially leading to increased levels of groundwater or surface water abstraction during periods of highest stress on the water environment.

3.1.1.2 Water Quality

Climate induced alterations to river hydraulics will likely lead to changes in the dilution of nutrients and contaminants within river channels and increase their mobility across the surrounding landscape. More frequent and intense storm events increase the risk of pollutants being transported from land into the river whilst higher temperature extremes and increased UV radiation owing to shallower water during summer can enhance the potential for algal blooms. The River Ems is also littered with structures that impound water and reduce dissolved oxygen content making some areas even more susceptible to eutrophication, a process which chalk streams are prone to due to their naturally low level inputs of nitrogen and phosphate.

3.1.1.3 River Ecology

The potential impacts of climate on river ecology is extensive and complex. Whilst chalk streams may be slightly more resilient to increases in water temperature due to being fed by groundwater, their associated high biomass and species diversity is threatened by the combination of the indirect impacts of water quality and rapid hydraulic changes from low (drought) to peak (flood) flow, and the direct impacts of increasing surface water temperature and evapotranspiration from still waters, and the associated depletion of oxygen.

Many fish species are particularly susceptible to changes in water temperatures with brown trout growth occurring between 3.5°C and 19.5°C and maximum water temperature tolerances of 25°C for seven days. Egg incubation nears total mortality at temperatures over 16°C for both trout and salmon. These impacts are further exacerbated by low, slow moving flow enabling warmer water temperature and with warmer water holding less oxygen. These impacts are not restricted to salmonid fish with many coarse fish species experiencing disrupted reproduction at water temperatures over 18°C for prolonged periods.

Alongside temperature, fish populations may be impacted by increased sediment input from runoff during storm events which smothers spawning substrates or incubating eggs. Excess sediment can also reduce the growth of characteristic plants species which provide food, habitat and breeding grounds for fish and freshwater invertebrates. This, alongside changes in flow rate and nutrient levels, may lead to a shift in invertebrate community composition. The “flashy” nature of winterbourne streams such as the River Ems will become more unpredictable through the impacts of climate change with increasingly rapid rate of change and sudden peaks in flow rates exerting pressure on specialist winterbourne biotic species.

The short length of the River Ems and high abundance of weirs and other barriers makes riverine species such as fish more vulnerable to climate extremes due to the inaccessibility of the diverse range of habitats which would be required to mitigate the impacts of warming water temperatures and rapid changes in flow.

Many invasive non-native species (INNS) are likely to favour a warmer climate through extended growing or breeding seasons providing competitive advantages over native species. High intensity rainfall events leading to increased occurrence and extent of flooding will likely increase the dispersal and distribution of INNS across catchment areas. Other INNS not known to be present across the landscape may be dormant within the existing seedbank, awaiting climatic conditions appropriate for their emergence and dispersal.

Whilst the River Ems currently benefits from areas of extensive bankside tree cover, warmer winters increase the overwinter success of pathogens whilst drought makes tree species more predisposed to pathogen attack due to moisture deficits.

3.1.1.4 Impacts on the estuary

The River Ems flows into Chichester Harbour which is home to some of our most valuable and internationally rare habitats such as saline lagoons, mudflats and saltmarsh. This means that any reduction in water quality resulting from climate change will have a knock-on effect on the estuary. Increased nutrients flowing from the Ems into the estuary, for example, can lead to growth of macroalgal weeds. These weeds can smother saltmarsh habitats, reduce oxygen levels in the mud which kills invertebrates that many of the birds feed upon and can prevent birds from accessing their food. The continued rise in sea levels will result in the loss of our intertidal habitats which are currently unable to migrate inland due to the presence of hard defences along our coast.

3.1.1.5 Impacts on the community

Many people living in the Ems catchment will experience climate change through its effect on water. Warmer, wetter winters and increased rainfall intensity places homes, business, and infrastructure at increased risk of flooding from both groundwater and surface water. The community at Emsworth and critical infrastructure (e.g. road, sewage network) along our coastline are at greater risk of flooding, damage and erosion due to rising sea level. Hotter, drier summers are likely to increase the demand for water by people, industry and agriculture putting additional pressure on groundwater resources. The supply of public water and other assets and infrastructure may also be disrupted due to damage resulting from extreme weather events.

[1] The UK Climate Projections (UKCP18) provides the most up-to-date assessment of how the climate of the UK may change over the 21st century. Using the latest observed climate data and most recent generation of international climate models the projections provide the relative probabilities of specific outcomes based on a range of future emission scenarios known as Representative Concentration Pathways (RCPs). Each pathway results in a different range of global mean temperature increases over the 21st century and can be met by a combination of different socioeconomic assumptions (e.g. population growth, land use change, switch to greener technology). The RCP pathways attempt to capture a broad range of potential futures and climate outcomes, however, the UKCP18 does not capture all possible future outcomes. The “central estimates” referred to herein are those that have a 50% cumulative probability and have the most support based on evidence from models and climate observations.

4 Summary of Findings

4.1. Historic Ems

Our historic assessment indicates that the Ems was a landscape with water at its heart, from water mills to water meadows, and place names which give an indication of the presence of species no longer seen. The presence of a mill at Lordington is significant in that they would not have invested in such without sufficient water to run this.

Local people also report a decline in water quantity, quality and local species and habitats over time.

The impacts of Shifting Baseline Syndrome means we need to build future plans with a view of past conditions. It also needs a pragmatic approach, and given pressures from climate change and increasing water demand we may never be able to recreate our historic level of biodiversity, however aspirations should be set as high as possible.

4.2 Habitats and Species

Baselines are vitally important to show the diversity of species in any area in both a present and past context. The assemblage and abundance of species can reveal a great deal about the conditions, health, history and potential of any area, and enables people to understand its value and ultimately help to prevent further decline in biodiversity.

4.2.1 Habitats

Our desk study gathered more than 65,000 species records from the catchment, and more than 20 designated sites including of international, national and local importance and covering 400ha (approx. 7% of the total catchment area).

These important wildlife sites provide stepping stones across the catchment, acting as a green blue corridor from Chichester Harbour to the South Downs. There are however great opportunities to increase and connect these patches. There are a number of sites which could be enhanced, and by supporting community groups there are further opportunities to increase practical interventions with a sound ecological basis.

Woodland cover in the Ems waterbody area is more than twice the national average. This woodland provides a useful service in slowing rainfall and increasing groundwater infiltration in the upper catchment. Improving connectivity between these woodlands through hedge restoration or allowing development of new woodland would help to expand the range of existing species, increase corridors for migration, and allow movement to withstand climate change – particularly in the lower catchment.

Although it is an internationally rare chalk stream the River Ems has no statutory protection. Local chalk streams (such as the Itchen) which do have formal designation (i.e. SAC status) are better protected against abstraction and development pressures. There should be equal consideration and protection given to all chalk streams given their rarity and sensitivity. Some groups (such as Chalk Stream First) are pushing for greater protection, and this could be the most rapid route to reducing abstraction pressures.

River restoration undertaken in 2016 by WSRT (previously known as ARRT) and EA proved successful in reviving some river sections, however the ecological improvements achieved via this work risk being limited by the impacts of abstraction.

4.2.2 Species

All species mentioned in the report are rare or locally / nationally notable. This shows a wealth of interesting species and diversity – however surveys are needed to fully understand their current presence and abundance. There are some large gaps in records, and even common species (e.g. red fox) are scant in number, with few data points for comparison.

A high proportion of respondents to our community questionnaire highlighted a reduction in both species diversity and abundance over even short timespans. Given what we know about patchy species recording and shifting baselines these comments warrant further investigation.

Some species records such as otter and badger are kept confidential. Locals report otter on the Ems in several areas in recent years. Otter are an indicator of good habitat quality, and are important in driving predator / prey dynamics, helping to increase biodiversity.

Rare and protected Water vole are still present in reduced numbers and are largely located in the most downstream reach.

Whilst the number of fish species are within the expected range for coastal chalk streams, available records are intermittent, and difficult to interpret in terms of trends. Uncovering more historic fish catch data would help to give greater insight.

The presence of Blind cave shrimp at locations on the Ems highlights connectivity between ground and surface water and could be a useful metric to assess these connections in a local context.

A number of rare and interesting plant and lower plant species are present, including the very rare algae *Audouinella pygmaea*, and the chalk stream specialist red algae *Hildenbrandia rivularis*. The latter appears to have increased in area and distribution since the 1980s, perhaps supported by good water quality.

Invertebrate assemblages recorded via WFD assessment and other ad hoc surveys reveal a chalk stream that has high diversity suggested to rival larger chalk streams such as the Meon. Additional and comparative surveys are needed to understand long term trends, and continued presence.

4.3 Water Quantity

The most critical and challenged element of the Ems 'Trinity of Health' is water quantity. WFD and other assessments provide clear evidence of the extent to which water abstraction is impacting on natural flow, length of perennial stream and river ecology and species.

Under all scenarios a major reduction in licensed abstraction will be needed, specifically for drinking water (which is by far the largest proportion of current abstraction). Portsmouth Water and the Environment Agency agree that a reduction is needed, however there is a great deal of work which must be done to achieve this. The first of these tasks is to understand and agree what sustainable abstraction is for the Ems. Using standard methods for assessing sustainable abstraction (see River Ems Catchment Appraisal), and under all scenarios, we can see that this reduction will be considerable. It will take some time to find an alternative source of water, and enact this scale of reduction, however incremental changes should be made as soon as possible. This unsustainable abstraction combined with climate change and increased urban development, increases the need to act.

The hydrogeology of the Ems is complex, and not fully understood. The chalk aquifer straddles other drainage catchment areas, and also water company supply areas. Models such as the EHCC may help to account for this, and work via the Water Resources South East group all help to align and plan for future water resource issues. There should not be a choice between protecting one chalk stream or another – even those without formal protection are internationally rare and severely threatened.

In terms of perennial vs ephemeral reaches, surveys show clearly that Reach 2 (Westbourne to Broadwash Bridge) should be perennial, having all the features of a flowing stream. This survey suggested that the headwaters at Reach 1 showed less river features, this also supported Holmes' findings. Historic landscape features (namely Lordington Mill) along with local testimonies do support more water year-round in lower sections of Reach 1 however, and given the length of time since abstraction commenced it could be reasonably expected that over time areas of Reach 1 have lost river features associated with flow.

The East Hampshire Chichester Chalk (EHCC) model was commissioned by the EA in 2013 to help predict the status of the underlying aquifer that supports drinking water abstraction and surface river flows of many chalk streams and rivers located across the southern coastal area of England. The EHCC model suggested that abstraction is pushing the perennial head of the river downstream by about 1500m, moving from Lordington to Broadwash. See the River Ems Ctachment Appraisal (available from WSRT) for further discussion.

It should be noted that the EHCC model is currently being updated but should allow additional scenarios to be run. Regardless acceptance that the perennial head would historically have been in the downstream section of Reach 1, somewhere between Woodmancote and Walderton around Lordington would help set an expectation of natural conditions. It should be noted that there are other variables aside from abstraction which may affect the potential for perennial flow here, and that it is realistic to expect that some level of abstraction will continue. Agreeing where the perennial flow should commence (accounting for varying up and downstream location depending on annual conditions) is vital for setting environmental flow targets.

More qualitative research is needed to look at historic records, and as many historic memories of the river Ems and its wider landscape as possible before they are lost.

Currently the augmentation scheme is enacted once the river drops below a certain level, and monitored via the Westbourne gauge. The distance between the augmentation discharge point (2023 location) and the Environment Agency gauging station is approximately 1900m, and only really accounts for flow between these points. As we have seen in many places on the Ems, flow drops into groundwater during low flow times, with river sections downstream of Westbourne gauge running dry on occasion. Additional gauging – both downstream and upstream of Westbourne is critical in ensuring that augmented flow is supporting lower reaches (e.g. through Brook meadow). The telemetry network introduced through the Atkins work, and supported by Friends of the Ems should continue, with wider community participation and more frequent gauging or monitoring sites, both in the ephemeral and perennial reaches.

4.4 Water Quality

From a water quality perspective, the Ems is fortunate not to suffer impacts of large Sewage Treatment Works, however the additional (treated) flow from such would increase water provision. It does have a smaller pumping station operated by Southern Water at Lumley. In terms of licensed discharges, the greatest number are attributed to Small Sewage Treatment Works, and whilst current water quality appears to be good, ensuring owners of these works understand their maintenance obligations would help to ensure these systems do not cause future issues.

There is one site on the Ems reported on the Category 1 & 2 Environmental Pollution Incidents, at which there were six recorded category 2 incidents. Information provided does not give an indication of the likelihood for recurrence, and discussions should be developed with the Environment Agency to understand future risk.

4.4.1 Low Flow

Reduction in water levels in late summer / autumn can increase stress on the river, and reduce water quality via reduced oxygen levels, increased temperature, and lack of dilution for polluting inputs. Gravel beds can become silted without sufficient flow to wash silt through the system, reducing spawning ground for fish and growth of macrophytes.

4.4.2 Forever Chemicals

There is increasing recognition that a range of chemicals are present in the environment which are not possible to remove, with implications for the health of people and wildlife. Many of these substances are now banned, and it is expected that over time they will be diluted. We are only starting to understand the full impacts and implications of these substances, and there is still potential for this to become a greater issue in the future.

4.4.3 Future Ems

The impacts of climate change are already being felt, and the Ems is in one of the most climate vulnerable areas of the South East. Water will be at the forefront of this change, with more intense rainfall leading to flooding along with an overall reduction in annual rainfall. Droughts and extended periods of dry weather will increase and exacerbate the impacts of low flows. Without a reduction in abstraction the Ems will not survive these challenges, leading to a reduction in biodiversity and the extent and health of existing habitats.

Whilst there is considerable uncertainty about how and if the global community will reduce our carbon emissions, we know that changes to our climate will continue to increase pressure on the catchment and river. An increasing population means water will be more in demand (particularly on the South East coastal plain), with a vulnerable and shrinking resource. An increase in drought conditions means that overstretched water demand is having a disproportionate impact on river ecology.

Making the Ems catchment and communities more resilient to climate change will demand a wide range of approaches to reduce impacts, and also societal change in the way we use water and other resources.

5 Key Pressures

Investigations including our walkover surveys, local knowledge, data and reports reveal a number of specific pressures which are resulting in biodiversity decline with a reduction in species presence and abundance and impacting the river health of the Ems catchment.

5.1 Catchment Wide

- **Connectivity.** Lack of connecting and stepping stone habitats between wildlife sites and habitats including woodland, rivers, freshwater and coast.
- **Flooding**. Increased flood risk due to high rainfall events, infrastructure pressure, climate change.
- **Freshwater Habitats.** Reduction in number of freshwater habitats such as ponds for wading birds and other aquatic wildlife.
- **Invasive Non-Native Species**. Increasing number and spread of invasive species.
- **Climate Change.** Increase in temperature both in river, landscape and urban areas. Increase in droughts and extreme weather events.

5.2 River Corridor

A number of overarching pressures can be seen across the whole river, and others are more influential at a 'reach level'.

- **River / Floodplain Connectivity.** Over-deepened / straightened channels are not well connected to their natural floodplain (urban development limits opportunities for improvement in some areas).
- **River impoundments.** Weirs or other in-river structures limiting flow and habitat, acting as barriers to fish passage.
- **River Buffers.** Lack of unmanaged marginal river buffers, such as rough grassland or scrub.
- **Riparian habitats.** Loss of characteristic riparian habitat (e.g. wetlands, wet woodland and marsh).

5.2.1 Lower Ems (Reach 4)

- Channel straightening and over deepening
- Floodplain disconnection
- Artificial features and reinforcements (e.g. artificial banks)
- Impoundments to flow and fish passage (e.g. weirs, sluices etc)
- Urban litter and surface water run off (e.g. road drains, pipes, culverts)
- Invasive Non-Native Species
- Channel management (e.g. unsympathetic ad hoc river / stream management)
- Sediment and pollution
- Channel shading

5.2.2 Middle Ems (Reach 2 & 3)

- Abstraction / low flows

- Impoundments to flow and fish passage (e.g. weirs, sluices etc)
- Artificial features and reinforcements (e.g. artificial banks)
- Floodplain disconnection
- Channel shading
- Channel straightening and over deepening
- Low flows and resulting loss of physical and morphological diversity
- Invasive Non-Native Species (particularly *Crassula helmsi* at Aldsworth ponds)
- Sediment and pollution

5.2.3 Upper Ems (Reach 1)

- Abstraction / low flows and resulting loss of physical and morphological diversity (e.g. flow does not support ecology)
- Artificial features and reinforcements (e.g. artificial banks)
- Invasive Non-Native Species
- Lack of shade
- Tree disease
- Sediment and pollution

6 Restoration Actions

The Ems is under pressure from a range of local factors including urban areas, farming, abstraction, and in-river obstructions. The combination of these factors and more, means that there is an urgent need to help build the resilience and sustainability of local habitats and species, but also to extend the range and number of places for nature, and for water.

There are great range of actions, both investigative and ground based, which can answer some of the pressures and issues we have identified in the River Ems Catchment. Some can be rapidly delivered, whilst others may take years to get plans, permissions and funding in place.

The whole river would benefit from more water, and reducing abstraction pressures would lead to an increase in perennial river sections. Until perennial flow is restored to Reach 2, and perhaps up as far as Lordington Mill in Reach 1, some restoration plans will not be effective.

Evidence – both desk-based and gained via our walkover survey – reveal a number of measures that are suited and needed. This is not an exhaustive list, but outlines some recommended approaches and actions. Later in this section we also highlight other projects and groups who are working locally, and provide a ten year timeline based on priorities, current opportunities and factors in time needed to develop plans.

WSRT have developed a working spreadsheet of actions and priorities, with specific sites and funding opportunities – a redacted version (to comply with GDPR rules) is available on request.

6.1 Ems Community

The Ems is fortunate to have a many local groups and people championing its cause and care. Their local knowledge and passion is critical in ensuring the long-term protection and support for the river and its wider landscape. Our community questionnaire revealed a range of opportunities for further engagement and collaboration (see below).

6.2 Nature Based Solutions (NBS)

Environmental conservation approaches increasingly move towards utilising nature process to drive sustainable restoration. By working with nature rather than against it wider benefits are achieved, with restoration providing space for species and habitats to thrive. These benefits include carbon sequestration, biodiversity, human health and ecosystem support and restoration.

Consideration of use of NBS is now prioritised by the Environment Agency, as outlined in their Flood Risk Strategy (2020):

> *Nature based solutions have an important contribution to play in achieving climate resilient places particularly at a community led, river catchment scale. They can support flood and coastal resilience, improve water supply and quality as well as contribute to wider climate change and sustainable development objectives. In doing so, nature based solutions help to achieve the ambitions of the government's 25 Year Environment Plan.*

NBS including a suite of tested and evidenced methods which can be utilised to remedy pressures on the Ems. They can be tailored to a site, be adaptive to change, and align with local management practices. Some measures have a range of funding available.

In some places, especially in urban areas and when dealing with in-river structures, there are occasions where NBS are not well suited, and hard engineering approaches are more appropriate. This may be the case with some of the in-river structures on the Ems which have historic or structural implications.

1. In stream structures for example woody debris.
2. Blocking of moorland drainage channels
3. Woodland planting
4. Land and soil management practices, cover crops, hedgerows, suitable crops
5. River morphology and floodplain restoration for example removal of embankments and re-meandering)
6. Inland storage ponds and wetlands
7. Protecting riverbanks for example stock fencing
8. Sustainable urban drainage systems for example swales, wetlands in urban areas, green roofs, permeable pavements, detention ponds, filter strips
9. Saltmarsh restoration
10. Coastal managed realignment
11. Coastal change management

Figure 6. Nature Based Solutions (NBS). From EA National Flood and Coastal Erosion Risk Management Strategy for England (2020).

6.3 Restoration Actions: Catchment Wide

6.3.1 Water Quantity

6.3.1.1 Assessing Sustainable Abstraction

Groundwater influenced chalk streams, such as the River Ems, are highly susceptible to impacts of abstraction. All the evidence, including from the Environment Agency, WRSE, Portsmouth Water and other local groups shows that abstraction is having a negative effect on river flow and related habitats and species, and is not compliant with the Environmental Flow Indicator. The perennial sections of river have reduced, meaning that lengths of river that should be expected to run year-round (with some movement associated with weather events) are frequently dry.

CaBA and the Chalk Stream Restoration group highlight the need for substantial reductions, and to agree methods and targets to meet ecological flow. They also highlight how current metrics fail to fully account for chalk stream flow and ecology and offer some alternative methods to understand what Sustainable Abstraction means at a local river level.

Clearly there is a need to urgently reduce the licensed volumes of water taken from the Ems, predominantly by Portsmouth Water for potable supply. This means that there needs to be an agreement on how much water is needed to support ecology and perennial reaches and agree levels of 'Sustainable Abstraction'.

There are a range of different methods used to assess Sustainable Abstraction, summarised in the section. There are also a range of other approaches which could be utilised to reduce pressure on the river immediately. Portsmouth Water have commissioned Atkins to undertaken investigations into sustainable abstraction over the coming months, towards an agreed and time-lined route to reduced abstraction.

Alongside this there needs to be work to identify other sources of drinking water to support a growing population.

6.3.1.1.1 Suspension of Abstraction to Allow Recharge

Groundwater recharge is increased during wet weather periods, however the extent of recharge is affected by the level of abstraction. Turning off the abstraction for some periods of time to allow groundwater to fully recharge could help provide better base flow to support the lower flow or drought periods. This suspension should be undertaken during the high rainfall periods over the winter / early Spring when recharge potential is highest. Such a change would need to be agreed by the Environment Agency, and given a sufficient window of time to enact this and be adaptable to account for stochastic variation. The CaBA Chalk Stream Restoration Group discuss this further in their 2020 strategy and outline some difficulties with such. Some concern has been expressed by local hydrologists about the Ems potential to retain water due to its complex hydrogeology and situation on the coastal plain. This needs more evidence to consider more fully, but should this be the case recharge rates are likely to be below expected levels, and water losses greater than predicted, further increasing water resource pressures.

6.3.1.1.2 Water Usage

Portsmouth Water and other water companies are already doing a range of work to help customers reduce their water footprint and have plans for greater interventions such as water meters. These measures will help reduce by an estimated 9-15% from current levels. However, given that water demand will increase with population expansion, and that Climate Change predictions suggest a potential reduction and changes in rainfall, it is unlikely that these water savings will relate to a direct reduction in abstraction.

6.3.1.1.3 Relocation of Abstraction Point

The Ems abstraction point at Walderton is on the upper section of the river, which means it takes water from near the source, and will therefore influence all of the river downstream of this point. Moving the abstraction point further downstream could protect flow in the upper reaches. However, the Ems is groundwater dominated, and its hydrology is intricately connected. It is also bounded by the sea. Subsequently moving the abstraction point at current levels would still influence groundwater levels, and therefore river flow. In the lower section of the Ems near the sea, ensuring the abstraction point is not affected by salt water ingress may be difficult to achieve. Also the lower catchment is widely developed, with little space for related infrastructure. Portsmouth Water have no current plans to relocate the abstraction point, however, in their long-term water resources management plan Options Appraisal they will be reviewing their abstraction sites.

6.3.1.1.4 Methods for Assessing Sustainable Abstraction

There are a number of methods for assessing what level of flow is needed to support ecology, and how much could safely be abstracted.

6.3.1.1.4.1 EFI at the Perennial Head (point X)

Under the EFI methodology there is recognition that the assessment may not adequately account for low flow impacts on the headwater sections of the river.

A suggested change to the EFI method attempts to account for headwater flow by using the perennial head of the river (point X) as the baseline for the assessment (as opposed to outflow further downstream as is currently used). This would help to ensure that the upper reaches are suitably considered. In order to use this method there needs to be an agreement about where the perennial head of the river would naturally be situated (with agreement of some annual variation). This report attempts to provide more evidence about perennial river sections to help with future assessment.

6.3.1.1.4.2 Annual % Recharge (A%R)

This method assesses the groundwater abstraction against the amount of annual recharge through rainfall. It does not account for groundwater sources which straddle catchment boundary, instead focussing on rainfall in the catchment area.

Augmentation investigations help highlight the complex nature of Ems hydrogeology even over a short range. Our surveys of the Ems also identified sections of river which were dry with upstream and downstream sections running. An improved Ems hydrology model is currently awaited from EA, and this will provide further detail.

Discussions with local hydrologists from regulatory bodies and other experts indicate that it is still unclear how and if the Ems catchment retains water, with further suggestion that water from the aquifer flowing underground and appearing as springs under Chichester Harbour.

If this is the case, and the Ems is losing water from the system through Karst geology, it would suggest that the threshold of 10% APR may not sufficiently account for this additional loss.

6.3.1.2 Flooding and Groundwater Recharge

6.3.1.2.1 Wetland Creation

Wetlands have largely been lost from our landscape for many reasons including land drainage, lack of management and disconnection between the river and its natural floodplain. Wetlands are extremely important to ecosystem functioning, and also climate change, water provision and flooding. Allowing the river to flood naturally onto surrounding land, creating wet scrapes or ponds, breaking field drains and other measures can rapidly increase biodiversity, carbon storage and river health. Work to increase wetlands should prioritise finding and restoring lost ponds and restoring or creating wetlands in key places to provide stepping stone habitats (helping to increase connectivity between Chichester Harbour and the South Downs). We have identified more than twenty locations where ponds could be restored or created, six areas with potential for wetland creation and more than five wet meadows for further investigation.

6.3.1.2.2 Natural Water Retention Measures (NWRM) / Natural Flood Management (NFM)

Increasing the number of wet areas where water can be held or slowed during times of high rainfall helps not only to reduce downstream flood peak, but also increases groundwater infiltration. Allowing more time for water to linger on the ground helps to disperse water across the land increasing time for it to percolate into the ground. When confined to the river channel, or where surface water flows over impermeable surfaces such as roads, runoff and river flow is faster, reducing opportunities for water capture and increasing the magnitude and velocity of flooding. NFM / NWRM can include a range of approaches, tailored to the location and designed to work with nature including tree planting, reconnecting the floodplain to the river, ditch blocking and urban rainfall systems (see Sustainable Drainage Systems/SuDS section 7.3.1.2.3).

Measures have different effects in different locations, and depending on the location of each rainfall event.

The upper headwaters of the Ems are situated on highly permeable chalk with representative dry valleys, and the extensive woodland network here is already providing an important role in slowing rainfall. There are also areas of pasture, steep slopes and road and ditch networks which offer opportunities for intervention.

NFM / NWRM can be effective at increasing groundwater resources, however care should be taken to ensure this does not increase pollutants entering groundwater, for example via road runoff or agricultural inputs. Guidelines for protection zones should also be considered.

As part of the AWSCP Catchment Management Plan an assessment of high-level opportunities for Natural Flood Management (NFM) was undertaken. This used a digital mapping (GIS) model called SCIMAP to assess and grade locations. This incorporates a wide range of relevant environmental data.

The opportunity maps for NFM interventions for the Ems River catchment are presented in Figure 18 on the AWSCP Catchment Management Plan (page 41). This shows opportunities are present on the steeper slopes in the upper part of the catchment, and in the middle part of the catchment at the source of the River Ems at Stoughton and at West Marden.

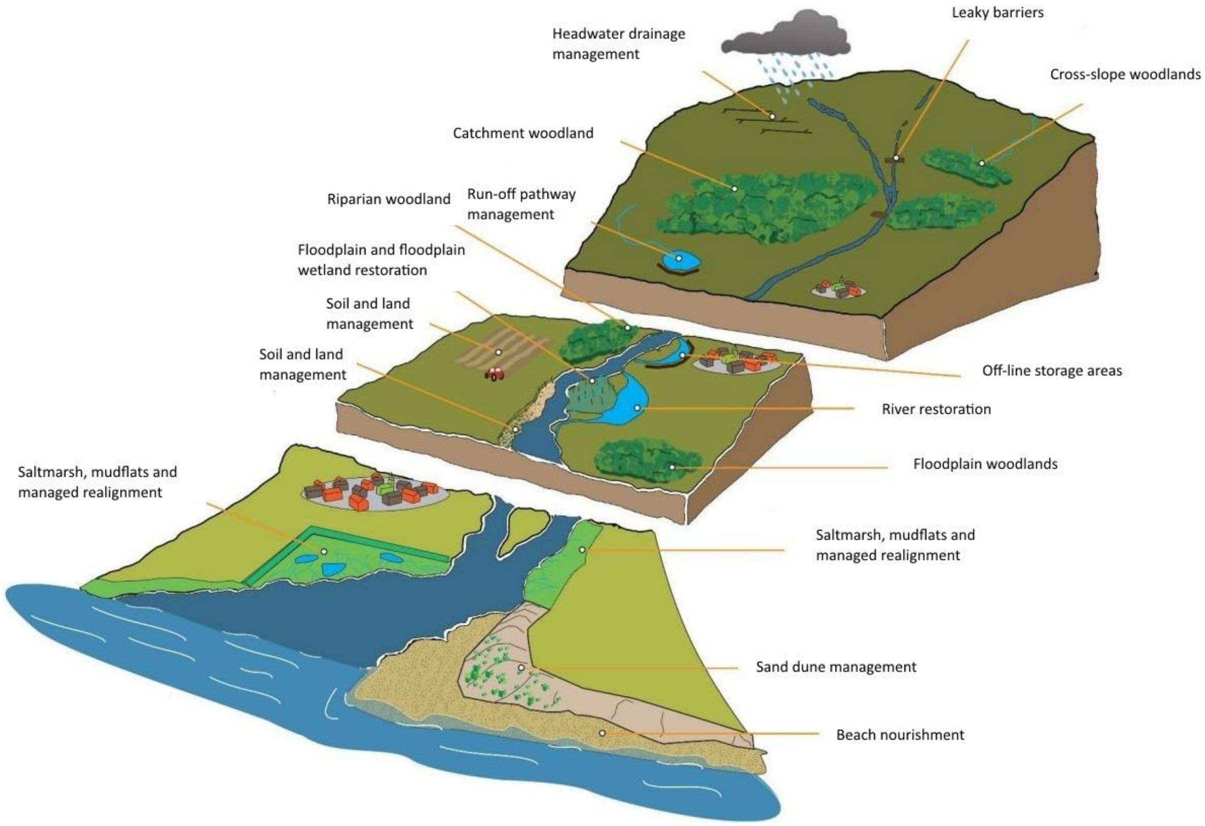

Figure 7. Natural Flood Management catchment examples (CaBA)

6.3.1.2.3 Sustainable Drainage Systems (SuDS)

SuDS are designed to work in urban areas to slow and store water during times of high rainfall. Hard paved areas, roofs and road design can all increase the speed that rainfall reaches the drain network and ultimately the river, and increasing local surface water and river flooding. They can help to increase groundwater infiltration and recharge and reduce pressure on our burgeoning drainage systems.

SuDs use natural processes with soft engineering to provide places for water, and can include rainscapes – designed for flood mitigation and nature including planters positioned under down pipes, or sumps and storage areas in road verges.

SuDS can also have wider benefits for climate change, reducing local temperatures in towns and increasing biodiversity. They also help make important space for water in urban areas, helping to create stepping stone habitats for species dispersal.

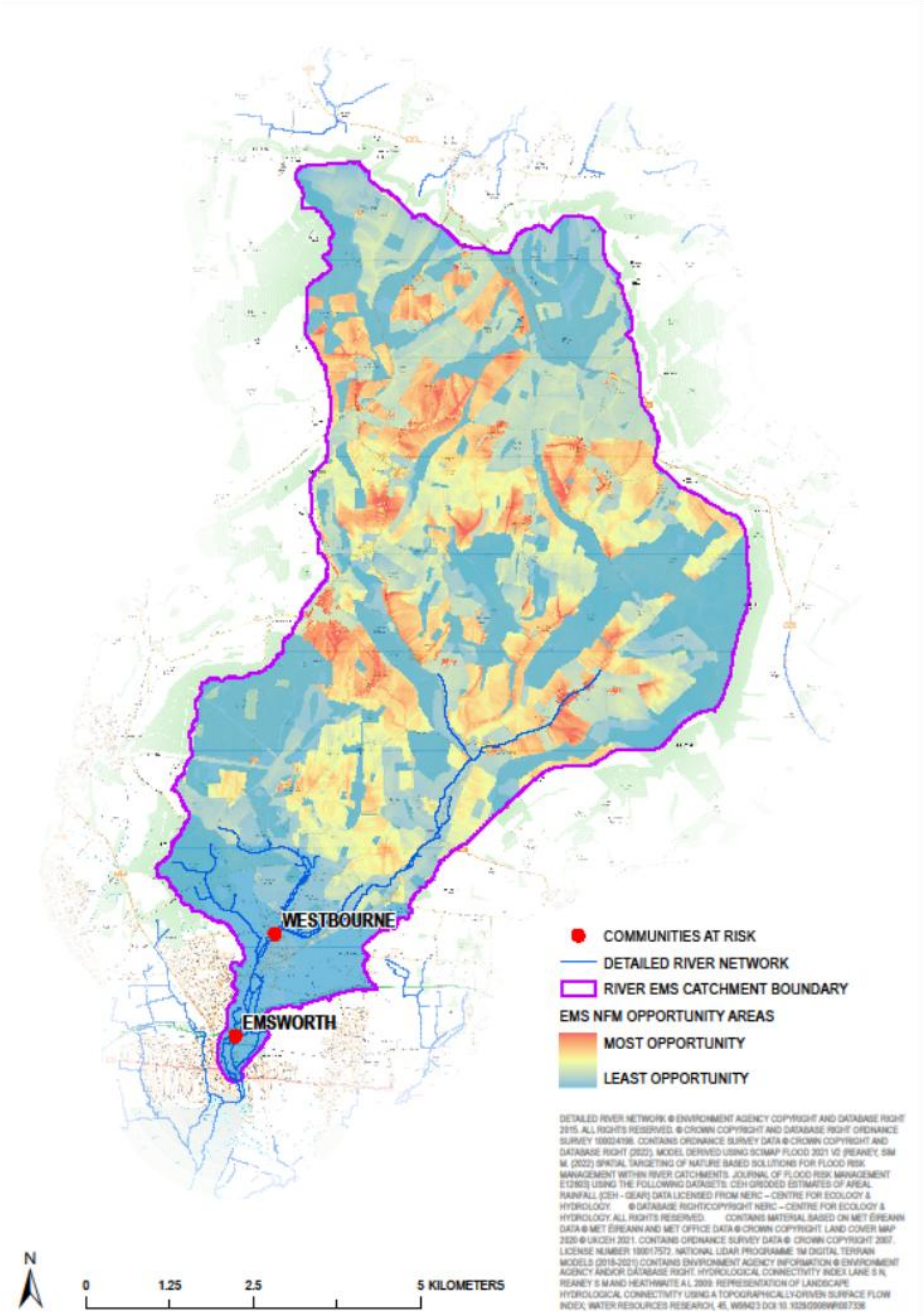

Figure 8. River Ems Catchment Natural Flood Management Opportunity Map (WSRT, 2022).

6.3.2 Improving Connectivity

The Arun and Westerns Streams Catchment Partnership have recently assessed river and landscape connectivity using a digital mapping model. This utilises a range of data including existing habitats, designated sites and other landscape variables, with outputs highlighting locations where Ecological Connectivity can be improved in both a riparian and landscape context.

6.3.2.1 Landscape Connectivity

In terms of ecology, connectivity describes how linked up habitat patches and natural spaces are across a river or landscape. In order for species to thrive they must be able to move freely, not only to access all they need for different life stages, but also for population dispersal and health, and to provide migratory routes and climate change buffers. Some species may have a large range and move across the landscape easily, where others may only be weakly mobile with a small range.

Stepping stone habitats (e.g. ponds or patches of woodland), linking habitats and corridors (e.g. hedgerows or rivers) can be used to provide interlinking patches to increase connectivity and help species move across the landscape. Figure 9 highlights levels of connectivity between habitat patches in the Ems catchment.

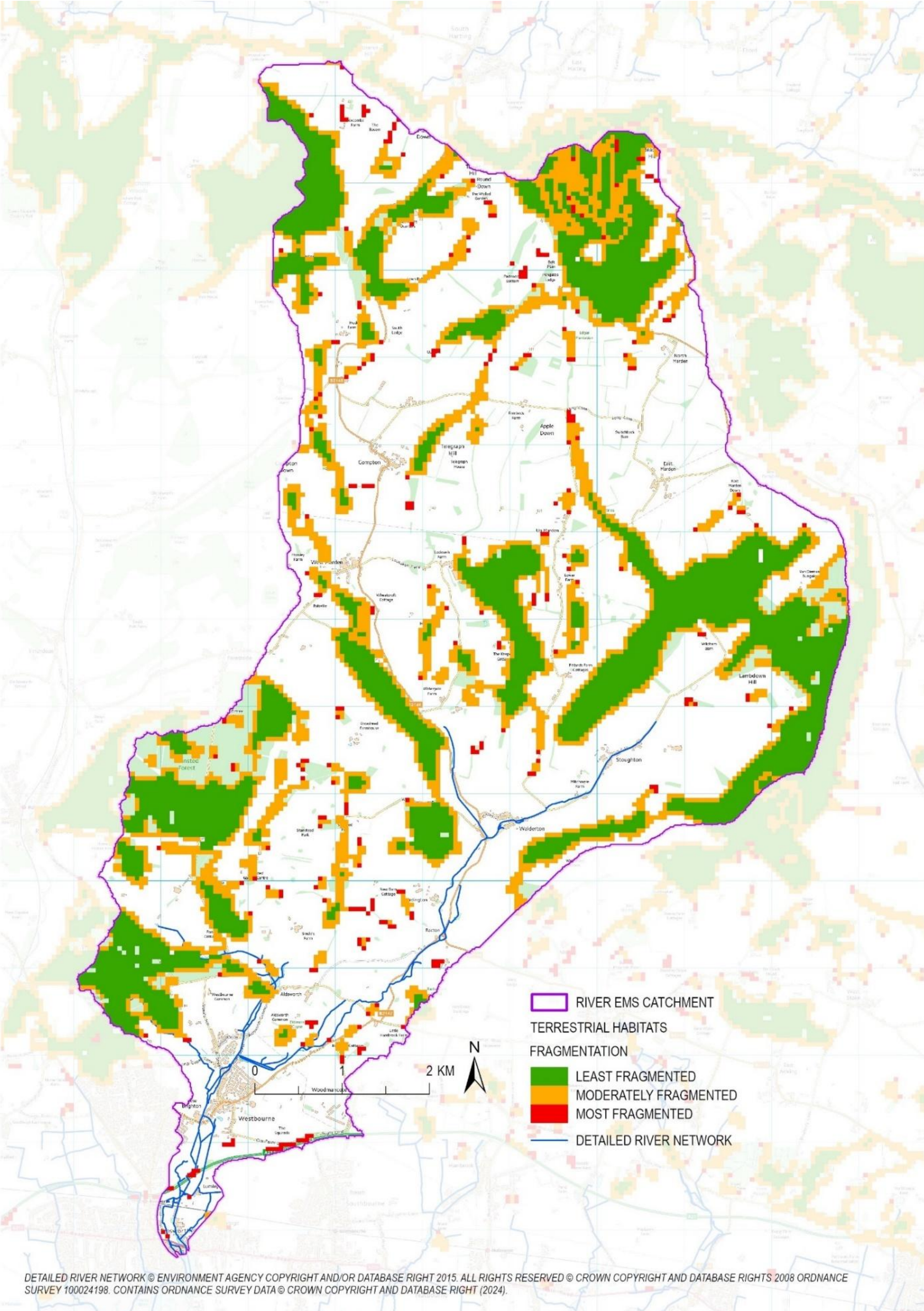

Figure 9. Ems Catchment Landscape Connectivity Opportunities map

6.3.2.2 River Connectivity

As we have outlined, weirs, sluices, and culverts assert a negative influence on the hydraulics of rivers, altering flow and sediment regimes, and restricting river habitats and the free passage of fish species, the majority of which require some level of migration throughout their life stages.

In some sections of the river modifications and management have lowered bed levels further exacerbating issues. In other places sediment accumulation is raising bed levels, increasing local flood issues. Culverts and other pinch points have accumulated debris and sediment, causing flooding to infrastructure.

Our 2022 Ems Walkover survey assessed 11 weirs/sluices (out of a total of 19 along the River Ems and tributaries), some of which appear to serve no function, and 20 culverts which impact the function of the River Ems.

Structures which no longer serve a purpose should be entirely removed from the channel. Where full removal of weirs/sluices is technically infeasible, alterations to their operation, fitting of fish passes, or creation of bypass channels should be investigated.

Culverts identified as potential barriers to fish should be subject to the further investigation with view to implement an appropriate fish passage solution.

Figure 10 highlights places where connectivity is good and should be maintained, and locations where it needs to be improved. This can act as additional evidence for what to do where, and which areas to prioritise.

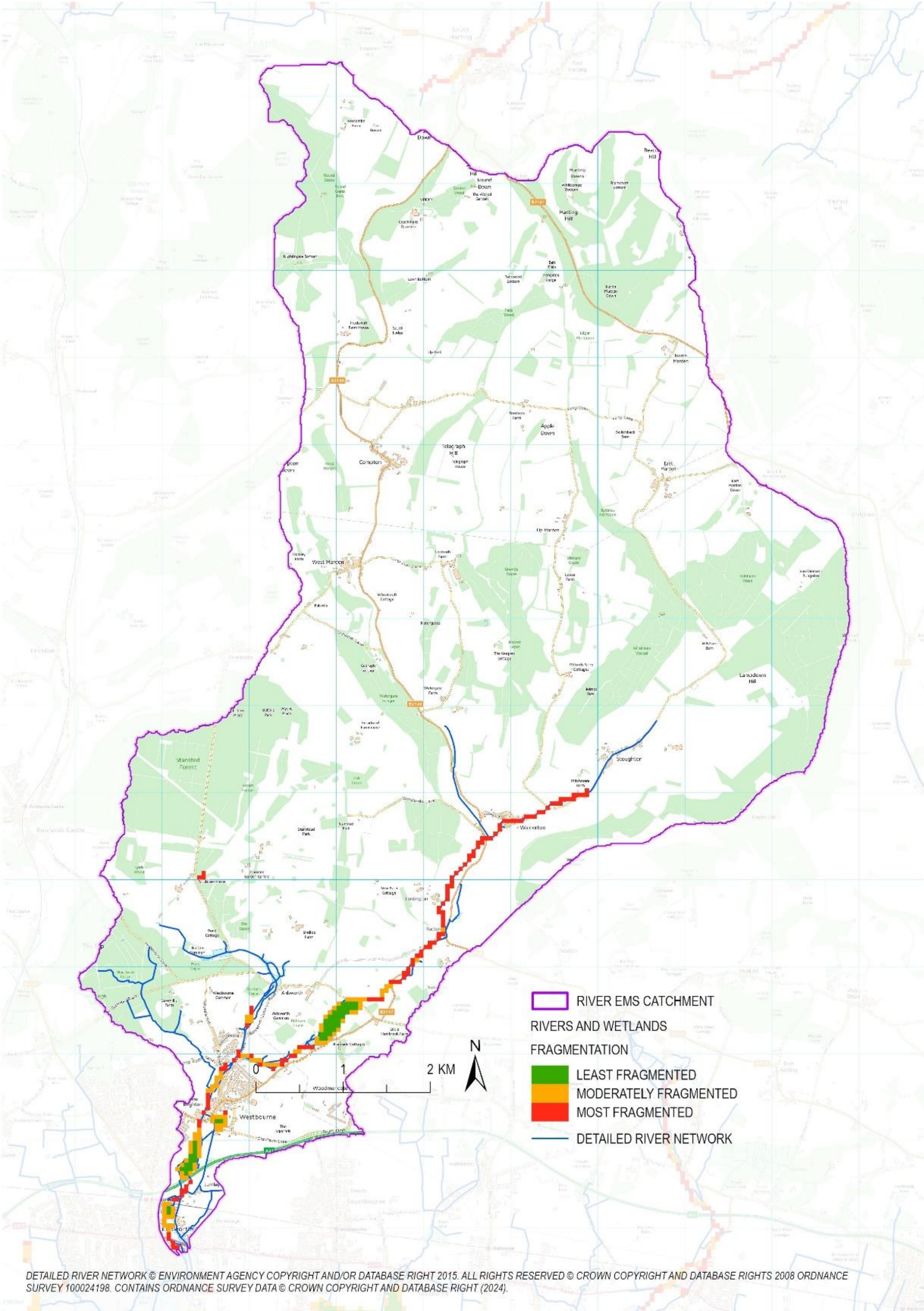

Figure 10. Ems Catchment River Connectivity Opportunity Map (AWSCP)

6.3.3 Education and Engagement

We have identified a number of opportunities for engagement and education which would have a direct benefit for the river.

6.3.3.1 River Education

A number of subjects and issues have been identified which could help to improve the river via engagement with the local community, including:

- Animals and water – impacts on general river ecology
- Impacts of dog flea treatment on river invertebrates
- Riparian ownership responsibilities and management
- Pond and river management
- Investigate potential river school locations and possible funding for equipment etc.

The opportunity to work with local schools, perhaps via the 'River Schools' model, would also allow us to inspire the next generation about the rare chalk stream habitats on their doorstep.

6.3.3.2 Water Usage

Helping people understand where their water comes from and how demand affects ecology is vital in engendering long term and meaningful reduction in water usage. Using drinking water to wash cars, and flush toilets is not sustainable, particularly in view of options for grey water recycling and other water capture technologies. The local community needs education, support and funding to make these changes.

Portsmouth Water are planning further water metering with an expectation that this will reduce demand.

6.3.3.3 Climate Change

Currently there is little direction or agreed action for members of the public to make changes to help reduce, mitigate or reverse the impacts of Climate Change. Practical advice should be developed to help local people make meaningful adjustments and preparations now. Links should be consistently made to how future water demand, extreme weather, temperature and sea level rise will impact the river and local community.

Many of the Nature-Based Solutions/NbS approaches outlined derive benefits for mitigating Climate Change.

6.3.3.4 Landowner / Land manager engagement

Many landowners and managers are sympathetic to nature and water friendly farming. They should be encouraged to access good, free advice, and made aware of specific legislation or funding opportunities.

More than 30 landholders have been engaged with the development of this report, and present future opportunities for delivery – many of which have been captured in our Restoration Pipeline.

Providing greater links with neighbours and locals across the catchment is vital in developing actions towards new grant schemes which aim to deliver landscape scale benefits.

There are already a number of groups with focus on the farming sector locally, including Catchment Sensitive Farming, South Downs National Park rangers, Portsmouth and Southern Water and others. Links should be established to assess gaps in coverage or overlapping messages.

Portsmouth Water, South Downs National Park Authority, Chichester District Council and others have a number of schemes and work with focus on land and water management to reduce water pollution. Collaboration with others working in the area, and collation of offers and advice would ensure work is targeted and messages are coordinated and shared.

6.3.4 Monitoring and Surveys

6.3.4.1 Citizen Science Monitoring

Given the reduction in Environment Agency monitoring and need for more data monitoring points, the community could be mobilised to fill gaps through Citizen Science monitoring. There are a number of schemes, methods and more novel approaches which could provide more evidence and support community action.

6.3.4.2 Water Quality & Quantity

Outfall Safari

Whilst the Ems doesn't have inputs of sewage treatment works to the same degree as some other rivers, there are still a number of pipes and drains which can impact water quality. Outfall Safari is a national Citizen Science scheme which assesses outfall pipes for contamination or issues. WSRT have secured funding to commence a trial of this approach in the Western Streams from 2023.

Groundwater

Due to the complex nature of the hydrogeology of the Ems, and need to reduce abstraction, FotE have been working with Portsmouth Water to assess springs and flow. This could be widened to provide more data from local people about when and where the stream is flowing and facilitated via a mobile phone app or similar.

Flow monitoring

Springwatch development / expansion. As the main gauge is situated in Westbourne this does not provide a clear picture of surface river flow in the upper headwaters. FotE have developed a monitoring network of springs and wells. Ensuring this continues (either utilising citizen scientists or others) is vital in providing a consistent and hopefully long-term dataset. This work could be supported and expanded to include more locations, and more local people (e.g. Springwatch mobile app to record when and where water is flowing throughout the year).

6.3.4.3 Species monitoring

Supporting and encouraging more species recording and monitoring, particularly of rare or threatened species such as *Hildenbrandia rivularis*, will help to build a more detailed baseline to understand current and historic biodiversity and habitat quality, and trends. Blind cave shrimp *Niphargus aquilex* could also provide an interesting dataset about groundwater / surface water interaction.

6.3.4.3.1 Invasive Species

A number of INNS have been recorded in the Ems waterbody area. Eradicating the most virulent and invasive species should be a priority of future plans. Continued work to control the New Zealand Pygmyweed *Crassula helmsii* at Aldsworth pond will be vital in ensuring this patch does not spread more widely. In addition publicising problem INNS and eradication methods could help build community knowledge and assess wider presence, and aid in eradication.

6.3.4.3.2 Invertebrates

A good indicator of river health, and useful in understanding trends and issues in water quality, invertebrate monitoring is an extremely useful tool. To this end WSRT has trained local people to undertake Riverfly surveys (a national river invertebrate monitoring scheme) which includes a monthly survey (when water is safe to enter) to assess key groups of invertebrates. Alongside this Friends of the Ems/FotE have been working with Chichester District Council/CDC and Wildfish to commence SMARTriver monitoring – a twice yearly and more detailed survey including invertebrate identification to species level. A long term and consistent dataset is needed to understand trends in data, and schemes will need future support and funding to continue.

6.4 Restoration Actions: River Focus

6.4.1 Biodiversity Net Gain Walkover Survey

Through our walkover survey opportunities for enhancement and improvement were noted, alongside the quality of the river and its habitats. Subsequently an assessment was undertaken to predict how enhancements could increase the quality and functioning of the river. Results suggest that increasing river margins would confer the most uplift in the condition scores.

This gives a clear case for the benefits of taking action and the ultimate potential condition of the river and can act as a guide for future work. This is summarised on a reach level in Figure 11.

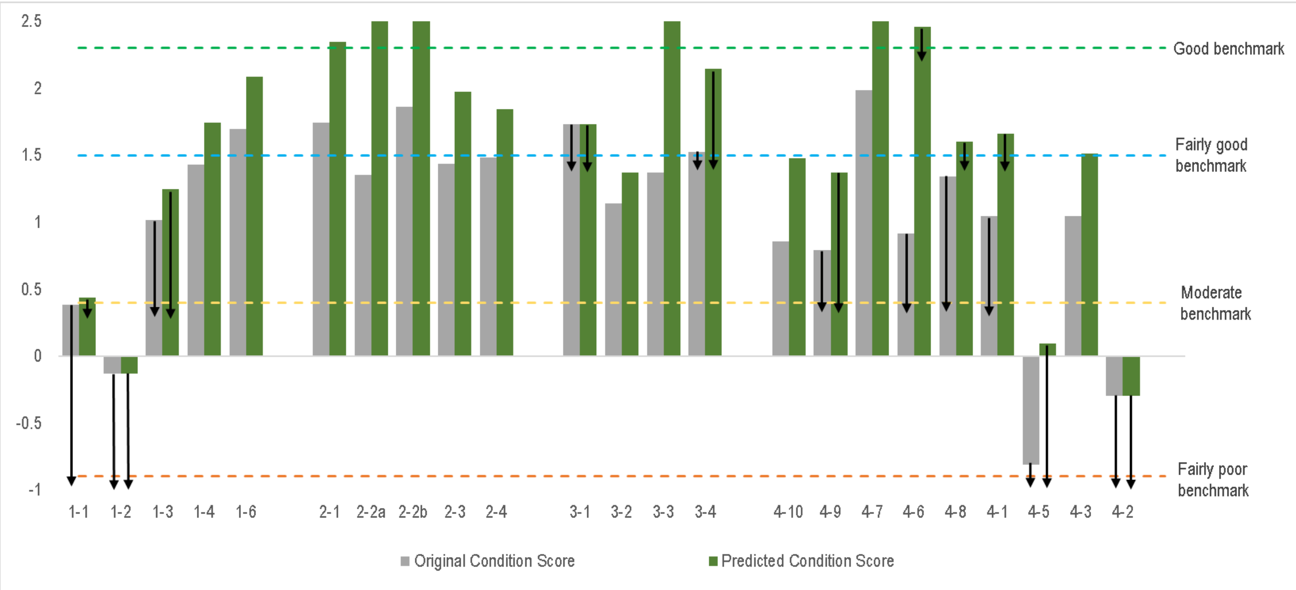

Figure 11: Chart showing original and predicted numerical condition scores and benchmark scores for each condition class. Arrows denote the reduction of one condition class due to over deep channels (from River Ems Walkover Survey 2022, Dr Row Baker).

6.4.2 Reducing Modifications & Artificial Features

A wide range of artificial features are present along the River Ems including concrete bank and bed reinforcement, fencing, trash (rubbish), and deflectors. These alterations are detrimental to naturally functioning rivers, restricting the recharge and settlement of coarse material and natural debris, increasing downstream erosion, creating eddies, and polluting watercourses. Recommended restoration actions include:

- Concrete/brick/wood bank reinforcement is replaced with bristly brash which will absorb high flows and collect sediment.
- Concrete bed reinforcements are removed in conjunction with associated structures.
- Fencing across/through the river channel is removed
- Community river clean ups remove urban debris and trash

Historic alterations to the channel course and creation of, and subsequent modification to, side channels is exacerbating the impact of low flows and reducing physical and fluvial diversity that provides habitat and refuge for fish and other organisms. Actions to enhance re-sectioned, over deepened and canalised subreaches include:

- Channel narrowing through creation of marginal bars/benches, gravel installation or planting
- Hinging trees to create natural deflectors to encourage scour, sediment deposition and diversify flow
- Creation of backwaters (marginal dead water) to provide refuge habitat and diversify flow
- Modify management of bankside and in-channel vegetation (weed cutting)
- Conserve woody features within the channel

6.4.3 Floodplain Buffers

The WSRT Ems Condition Assessment and Walkover Survey clearly highlighted the benefits of an increase in buffer strips along the river for increasing Biodiversity Net Gain. Buffers can include rough grassland, scrub or trees, and preferably left unmanaged or with sympathetic light management.

6.4.4 River Shade

Shade provided by trees is increasingly important to keep rivers cool, increase bank stability, and provide important habitat features for fish, particularly under temperature rise associated with climate change. It is suggested that the optimal cover being around 30% of the river.

On some sections of river overshading may lead to reduction in macrophyte growth and reduce habitat value.

Recent surveys have highlighted a number of areas where shade could be increased or carefully decreased to improve river habitats and optimal shade.

6.4.4.1 Bank side and floodplain tree planting.

Increasing bank side and floodplain trees can have help provide shade for the river, helping to keep rivers cool, however they also help to slow rainfall, increase bank stability and help retain water in the soil. In many places along the Ems diseased Alder (*Alnus glutinosa*) are present. These should be coppiced or replaced to provide some consistent tree cover over the coming years.

6.4.5 Re-naturalising the River Corridor

Characteristic habitats of chalk streams include a mixture of marsh habitat with open groundwater pools, wet woodland, and open woodland with dominance of herbaceous plants due to high floodplain water tables. Whilst examples of these can be found along Reach 2, the majority of habitat along the bank top is managed or is residential or urbanised. As such, there is considerable scope to increase the condition and resilience of the River Ems by re-naturalising the river corridor. Options include:

- Establishing riparian buffer strips with increased habitat complexity (e.g. trees and scrub)
- Installing fencing to reduce poaching pressures
- Using large wood features to block run-off pathways
- Creating wetland features that store groundwater or capture surface/flood water
- Removing or setting back embankments to increase lateral connectivity
- Reduce shading from trees and scrub
- Reduce management (e.g. bank mowing)

6.4.6 Junction Ponds

Our coastal rifes and streams are lined with ditches and man-made channels. In locations like the Ems, well-managed ditches can provide high biodiversity of plants and other species. Water voles, birds and other wildlife utilise ditches. Where two ditches meet widening the area around the junction to form a wider ‘Junction Pond’ can help to provide more varied habitats and more space for these species to flourish, and more space for water.

6.5 Restoration Actions: Reach Focus

Our walkover survey identified a number of specific actions. Figures 12-16 show opportunities by reach, identified via walkover surveys. The survey did not cover the whole river network and further opportunities will exist. In addition, we have captured a range of other opportunities and issues for further work and investigation, detailed on our Restoration Pipeline working spreadsheet.

WSRT to contact all riparian landowners who provided access for the walkover surveys to gain their feedback, input and consent for any proposed actions.

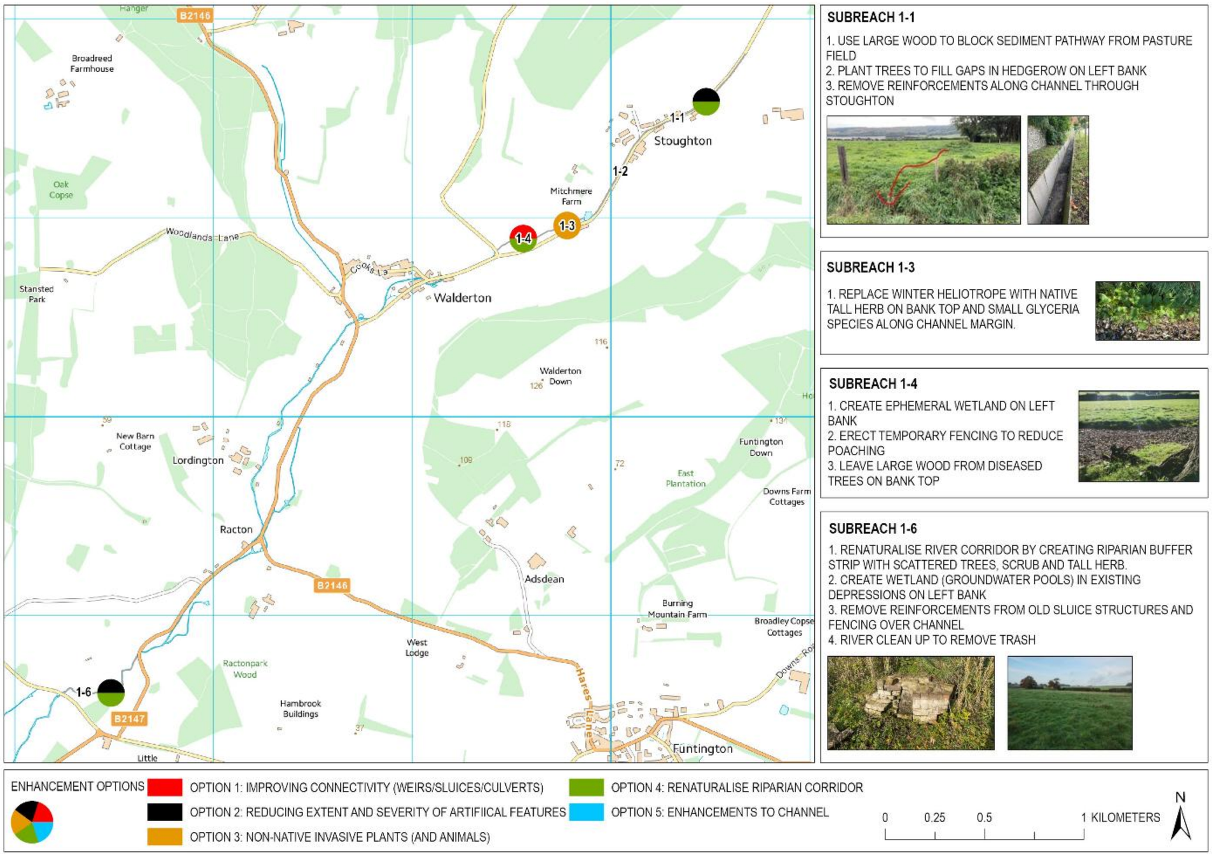

Figure 12. Restoration Actions for River Ems Reach 1 – Broadwash bridge to Stoughton

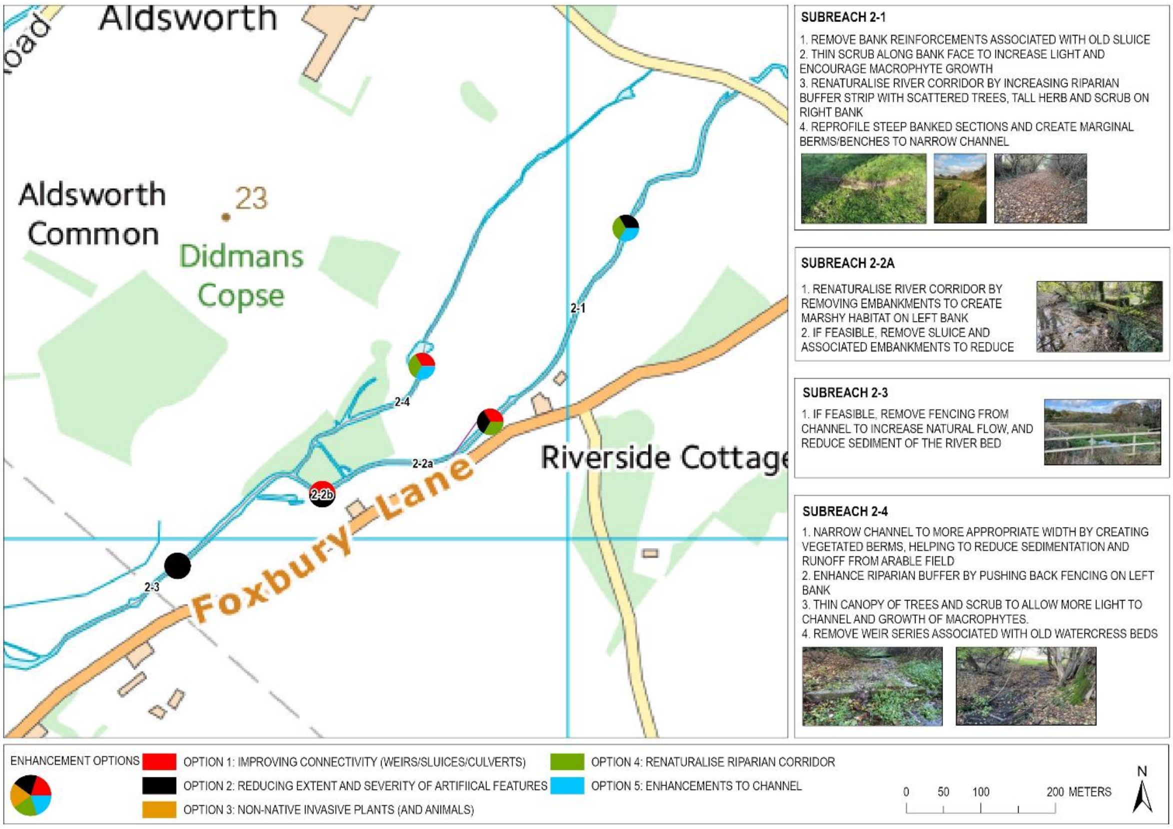

Figure 13. Restoration Actions for River Ems Reach 2. Westbourne to Broadwash Bridge.

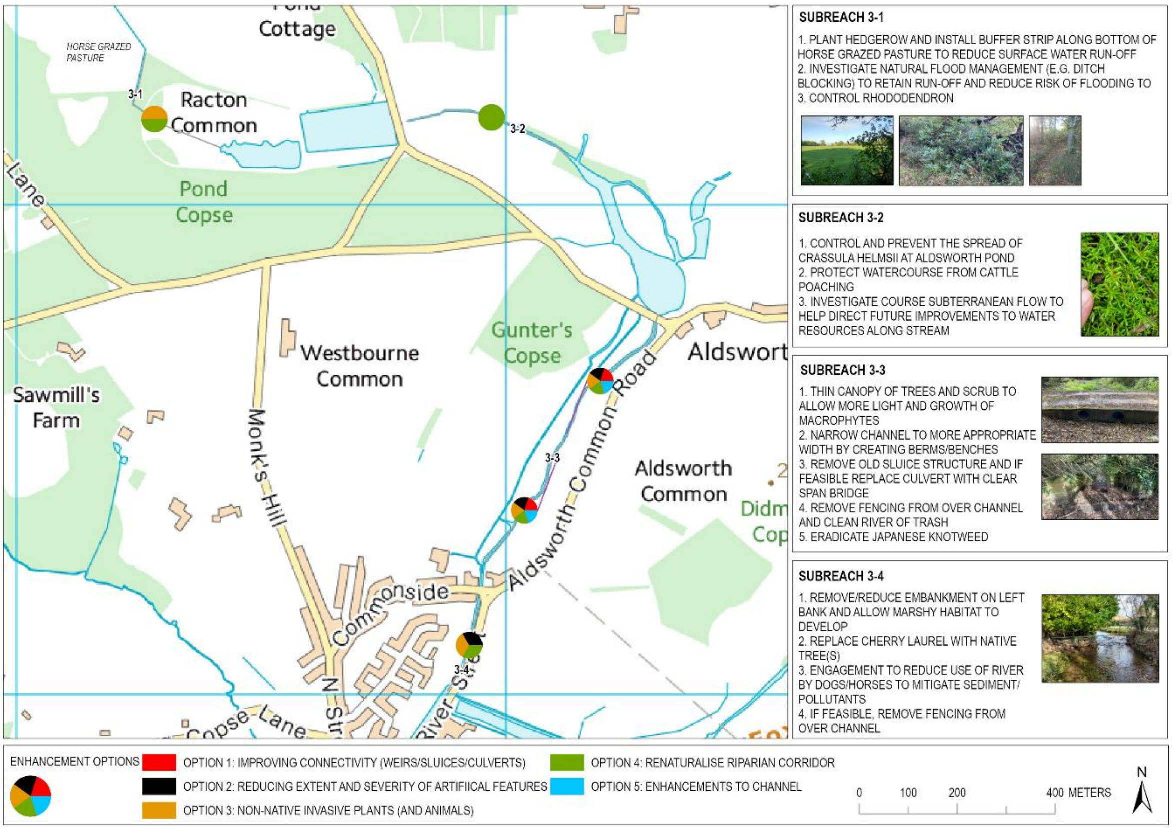

Figure 14. Restoration Actions for River Ems Reach 3. Aldsworth stream.

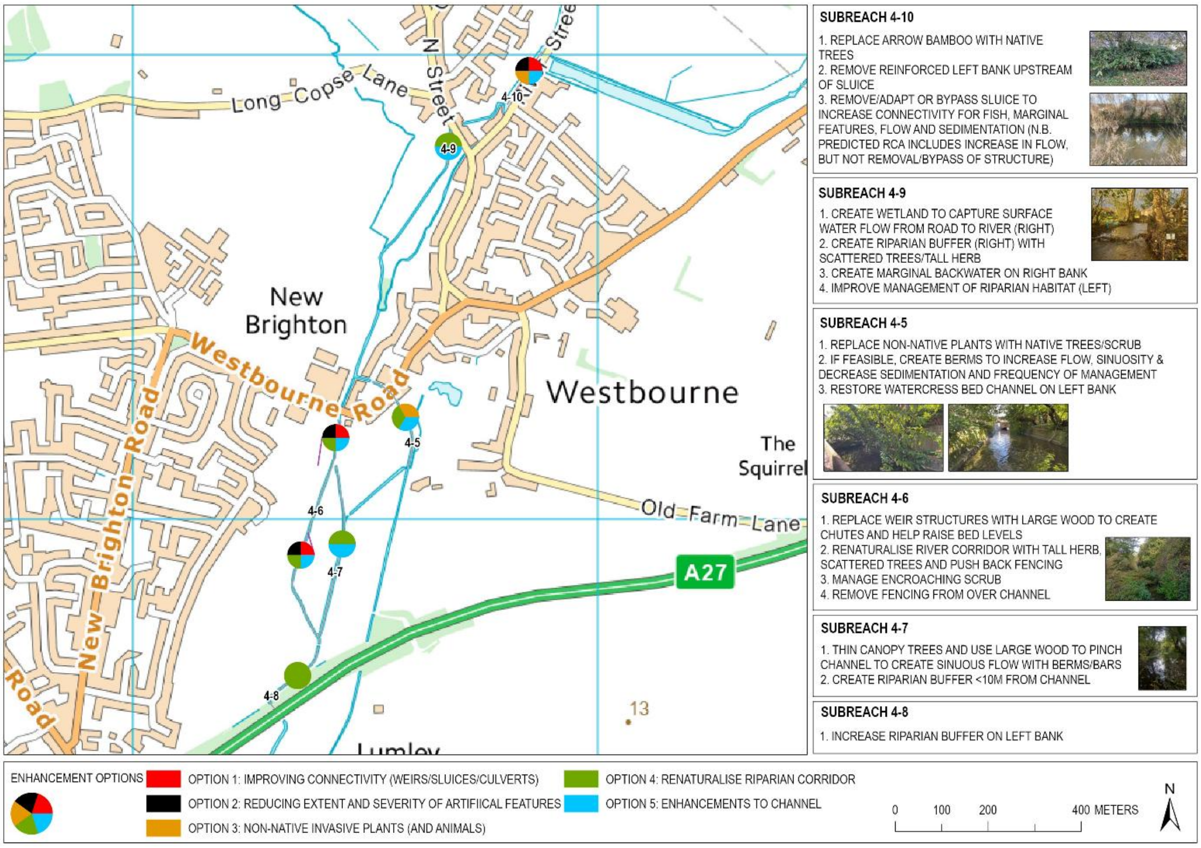

Figure 15. Restoration Actions for River Ems Reach 4 – upstream of A27 – Westbourne.

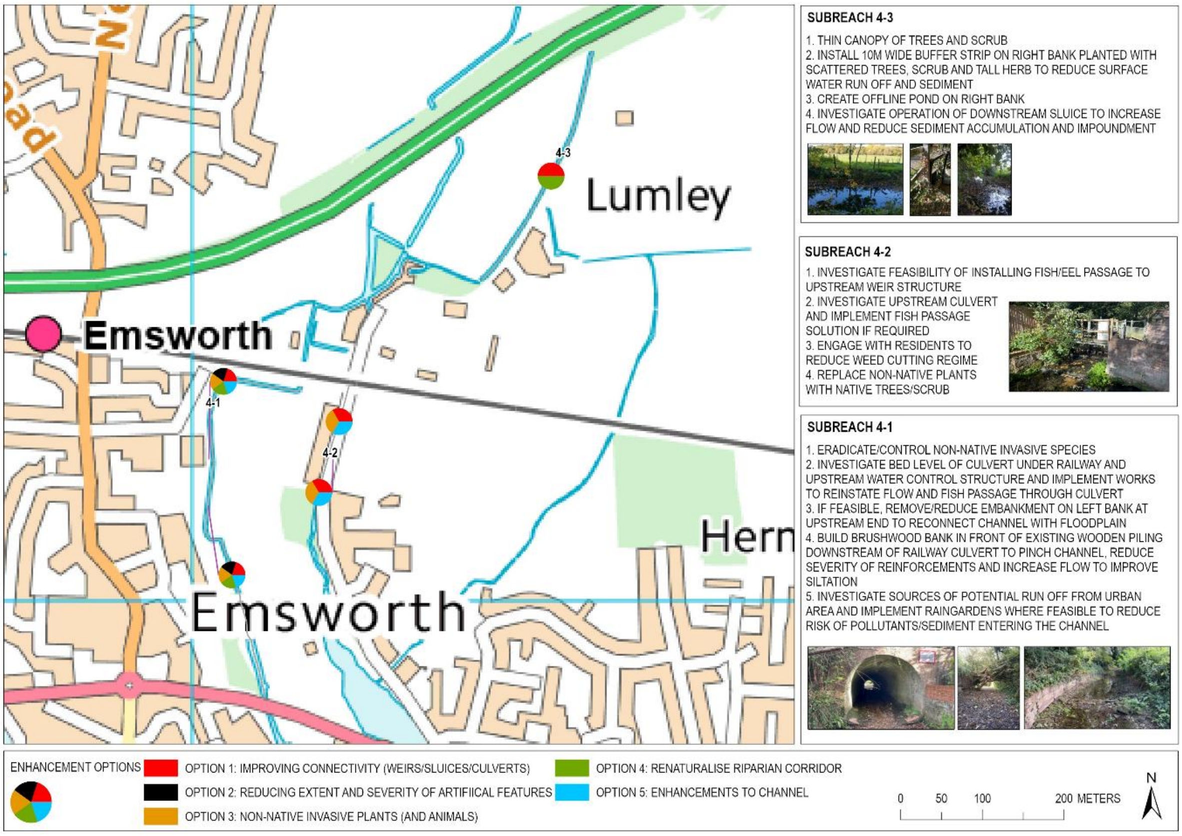

Figure 16. Restoration Actions for River Ems Reach 4 – Emsworth – downstream A27.

6.6 Restoration Pipeline

Through the course of developing the plan we have been capturing all sites where issues need investigating or resolving, where work is needed, or where opportunities exist. This working spreadsheet is being used to help kick start action, and will be shared with the Arun and Western Streams Catchment Partnership (with due consideration to GDPR rules). Although the spreadsheet cannot be shared publicly due to GDPR, details on projects are available from the WSRT Chalk Stream Resilience Officer.

7 Getting involved in the Ems Restoration Plan

There will be many opportunities for the community to get involved in restoring the Ems in the coming years. Follow the Western Sussex Rivers Trust (@westernsussexrivers) on Instagram, Facebook or TikTok and look out for updates on our Chalk Stream Resilience projects, or find our more on our website.

8 References and Biliography

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Appendix 1. River Ems Condition Assessment Walkover Survey – survey components.

MoRPH Field Survey

The MoRPH field survey characterises short sections of river (referred herein as subreaches) based on the morphology, sediments, physical features and vegetation structure of the river channel and margins within 10m of the bank top. Each subreach comprises 5 contiguous survey modules within which the type and abundance of all physical features are recorded.

Data collected were assessed against 32 condition indicators providing a current condition score, and a habitat modification score (based on the River Habitat Survey methodology).

MoRPH Desk Study

The desk-based study determines the (indicative hydromorphological) River Type for an extended river reach. A reach is defined by a stretch of river that has similar planform, sediment and flow regimes and will contain one or more of the surveyed subreach(es). Each river type has an expected range of positive condition indicator scores that represent what the river may display when it is naturally functioning.

River Condition Score

A final condition score is calculated for each subreach by comparing the provisional condition indicator scores with the expected scores. The final scores are then translated into one of five categorical conditions (5-good, 4-fairly good, 3-moderate, 2-fairly poor, 1-poor). If the river is considered over deep (partly or wholly disconnected from the riparian margin/floodplain), the final condition score is reduced by one category (e.g. moderate to fairly poor).