THEME 6: WATER RESOURCES

INTRODUCTION

WATER RESOURCES AND GREEN INFRASTRUCTURE

2.293 The water environment is essential in providing water to drink and for industry, as well as providing a host of biodiversity and amenity benefits. There is also good evidence that the natural environment and green infrastructure can have an effective role in improving the water environment, providing improvements in water quality, quantity, biodiversity, flooding and amenity benefits.

2.294 Agricultural practices frequently produce diffuse pollution, with the water industry spending many millions of pounds removing nitrates and pesticides to make water safe for drinking.[109] Urban and highways runoff also carries a range of pollutants into watercourses and can also be a major contributor to reducing water quality as well as being at risk of surface water flooding due to the extent of impermeable surfaces, plus the blocking of culverts and accumulation of debris.

2.295 In natural environments fluvial flooding occurs as a dynamic process between the river and its floodplain. Un-engineered rivers with vegetated channels can slow flows and channel water to natural floodplains outside of urban areas. Restoring wetlands can also help to prevent diffuse pollution from entering surface waters, with a high cost-benefit ratio.

2.296 Woodlands, in appropriate locations in the catchment, can intercept rainwater and reduce peak run off, as well as helping to reduce pollution,[110] and tree planting in urban areas can be beneficial in slowing otherwise rapid run-off rates. Green roofs are also effective at reducing runoff, particularly for smaller storm events. Urban layout and landscape can be designed to allow the space for water to pass freely and Sustainable Drainage Systems (SuDS) can both intercept flows and pollutants. The design of new green infrastructure, especially in parks and gardens and changed practices in green infrastructure management can reduce water demand for site maintenance.

2.297 Green infrastructure can also benefit groundwater quality and supply, through reducing pollutant loading reaching the aquifers and increasing recharge through land management. A summary of green infrastructure solutions for water resources management is shown in Table 6.

109 2004/5 – 2008/9 water companies in England spent £189m removing nitrates and £92m removing pesticides, NERR057 (Natural England).

110 Forest Research (2011), Woodlands for Water: Woodland Measures for meeting Water Network Directive Objectives.

TABLE 6: SOME GREEN INFRASTRUCTURE SOLUTIONS FOR WATER RESOURCES MANAGEMENT[111]

Water Management Issue		Potential Green Infrastructure Solutions
Water supply regulation (incl. drought mitigation)		Re/afforestation and forest conservation * Reconnecting rivers to floodplains * Wetlands restoration/conservation/ construction * Water harvesting * Green spaces (bio-retention and infiltration) * Permeable pavements
Water quality regulation	**Water purification**	Re/afforestation and forest conservation * Riparian buffers * Reconnecting rivers to floodplains * Wetlands restoration/conservation * Constructing wetlands * Green spaces (bio-retention and infiltration) * Permeable pavements
	Erosion control	Re/afforestation and forest conservation * Riparian buffers * Reconnecting rivers to floodplains * Removal of engineered banks
	Biological control	Re/afforestation and forest conservation * Riparian buffers * Reconnecting rivers to floodplains * Wetland restoration/ conservation/construction
	Water temperature control	Re/afforestation and forest conservation * Riparian buffers * Reconnecting rivers to floodplains * Wetlands restoration/conservation * Constructing wetlands * Green spaces (shading of waterways)
Moderation of extreme events (floods)	**Riverine flood control**	Re/afforestation and forest conservation * Riparian buffers * Reconnecting rivers to floodplains * Wetlands restoration/conservation * Constructing wetlands * Establishing flood bypasses * Removal of engineered banks
	Urban stormwater runoff	Green roofs * Green spaces (bio-retention and infiltration) * Water harvesting * Permeable pavements

WATER NETWORK DIRECTIVE

2.298 The Water Framework Directive (WFD) (2000) introduced a comprehensive river basin management planning system to protect and improve the ecological health of the water environment. The WFD splits the water environment into waterbodies, classified as rivers, lakes, transitional (estuaries), coastal and groundwater.

2.299 The WFD sets out quality objectives, requiring that waterbodies must reach 'good' status by 2021. To achieve 'good' status, both the ecological and chemical status must be 'good' in the case of surface waters and the chemical and quantitative status 'good' for ground waters.

2.300 Heavily modified waterbodies are those which are significantly affected by human activity, the default objective is good ecological potential; the best the waterbody can be without compromising human use. Many estuarine waterbodies are heavily modified.

LINKS TO ECOSYSTEM SERVICES

2.301 Water is an essential component of ecosystem services and performs a supporting (the water cycle), regulating and provisioning role and, in some cases fulfils a cultural role as well. The National Ecosystem Assessment reports that the main long-term driver of changes in water

111 Source: UNEP (2014), Green Infrastructure Guide for Water Management

quantity is human activity, alongside changes in climate which will vary precipitation patterns.[112]

DESCRIPTION OF THE NETWORK AREA AND ANALYSIS

2.302 The majority of the Network area is with the South East River Basin District (RBD). Part of northern East Hampshire district fall within the Thames RBD.

RIVER CATCHMENTS

2.303 There are five catchments which fall within the South East RBD; Test and Itchen, East Hampshire, Rother, Arun, Adur, Ouse and Cuckmere with the Wey catchment within the Thames RBD, see Plan 34.

2.304 Each of these catchments have Catchment Partnerships, listed in Table 7. Other active initiatives include:

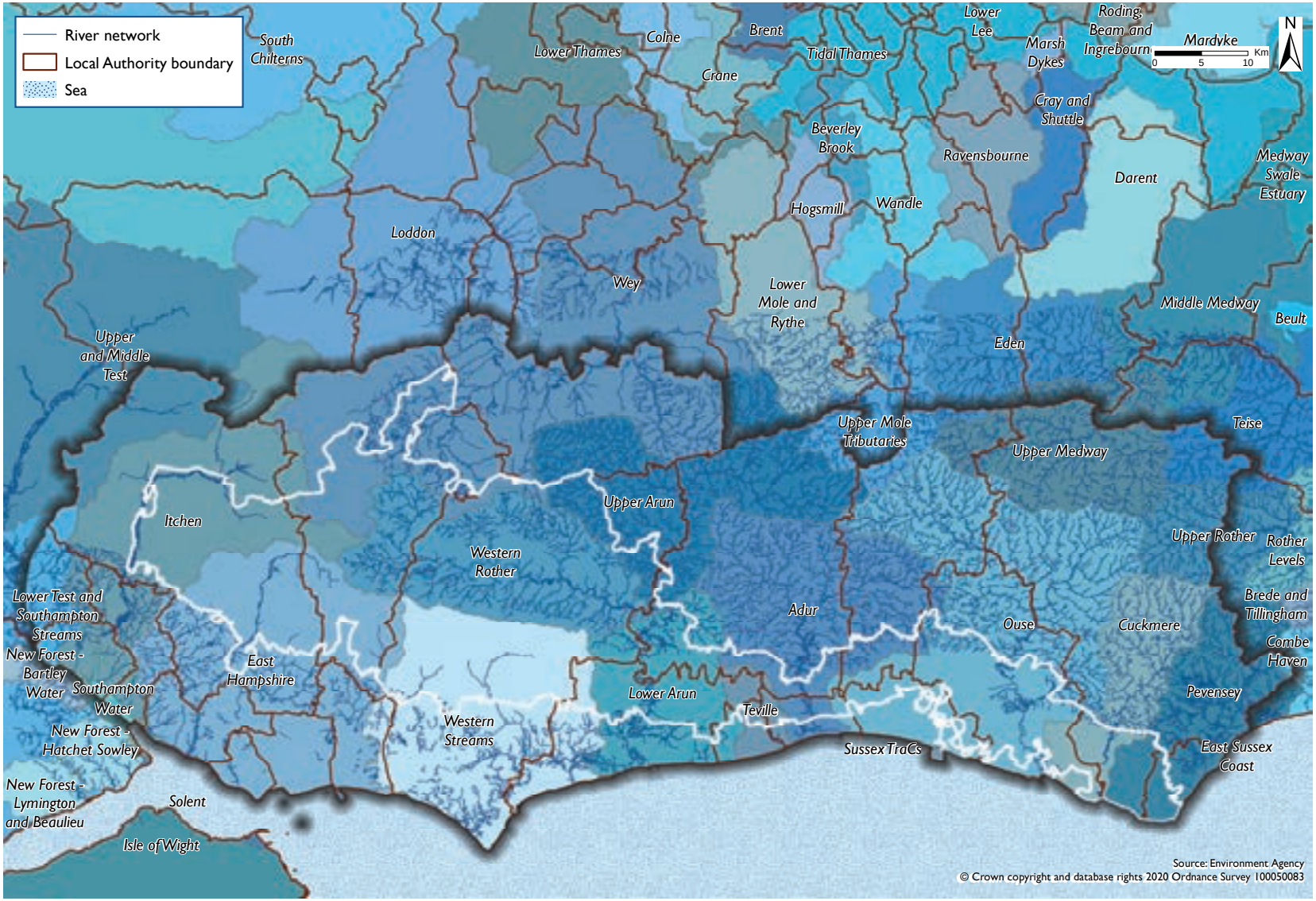
- Downs and Harbours Clean Water Partnership;
- SMART (Sediment Pressures and Mitigation Options for the River Rother – now finished but being followed up through the Channel Payments for Ecosystem Services (CPES) project and work with the farm cluster);
- Catchment sensitive farming initiatives, e.g. following the 'Up Stream Thinking' model;[113]
- Some areas are within target areas for the Catchment Sensitive Farming Capital Grant Scheme – River Rother, parts of East Hampshire catchment around Horndean, areas of River Itchen catchment and Hailsham to the Pevensey Levels.
- Chalk Streams and Springs Initiative, Sussex Flow Initiative

Berms and shallows creation – River Rother © V Craddock

112 National Ecosystem Assessment (2011), Chapter 13 Supporting Services.

113 **upstreamthinking.org**

PLAN 34: CATCHMENTS AND RIVER NETWORK



GROUNDWATER

2.305 The Brighton Chalk aquifer provides public water supplies to 365,000 people as well as base flow to rivers. The aquifer is vulnerable to diffuse urban and rural pollution and its status is at risk due to rising nitrate levels, as well as quantity issues due to high abstraction, principally for public water supply. The Brighton Chalk Integrated Catchment Management Partnership aims to identify and implement measures to reduce nitrate concentration and reduce urban and rural pollution reaching the aquifer.

2.306 Other chalk aquifers, the East Hants. Chalk and River Itchen Chalk aquifers, are also at risk due to varying degrees of pollution, nitrate and low flows.

2.307 The Lower Greensand and the Littlehampton Anticlines East and West aquifers are currently at good status but increased abstraction is a pressure.

ECOSERVEWATER PURIFICATION SERVICE MODEL

2.308 Water purification services are provided by areas where the natural environment and habitats purify water through slowing run off, increasing infiltration, filtering particles and pollutants, encouraging nutrient take up by plants. Vegetation and woodland cover help trap sediment and slow water run-off in locations where pollutants are likely to be mobilised. The capacity of the natural environment for water purification is mapped by calculating surface resistance based on land cover and slope gradient. The demand is calculated on the basis of erosion risk and the proportion of the watershed covered by agricultural or urban land uses that can act as sources of pollution. This model works best at a local scale so has not been included in this document.

CATCHMENT PRESSURES AND OPPORTUNITIES FOR GREEN INFRASTRUCTURE

2.309 Much of the Network area is failing under the WFD. The ecological status of the waterbodies is shown in Plan 35.

2.310 Many of the Catchment Partnerships have produced or are in the process of producing Catchment Management Plans, which detail the pressures on the water environment. The work of the Catchment Partnerships will offer further detail on priority areas for intervention, for joint working and for the development of multifunctional green infrastructure approaches through this Network. The specific actions or green infrastructure approach requires evaluation on a case by case basis using the extensive evidence base available. Some potential overarching areas which provide links with green infrastructure from these management plans are listed in Table 7.

2.311 While the specific issues for each catchment differ, some common themes emerge which have relevance to future green infrastructure projects:

- Barriers to fish passage;
- Pollution from urban areas (e.g. surface water flow, highway drainage);
- Physical modifications, canalisation, culverting etc.;
- Aims to re-naturalise water channels for habitat;
- Aims to re-naturalise water channels for flood storage;
- For some rivers, water temperature;
- Riparian tree planting;
- Reconnecting communities with water environment through engagement and access.

TABLE 7: CATCHMENTS AND POTENTIAL GREEN INFRASTRUCTURE ACTIONS

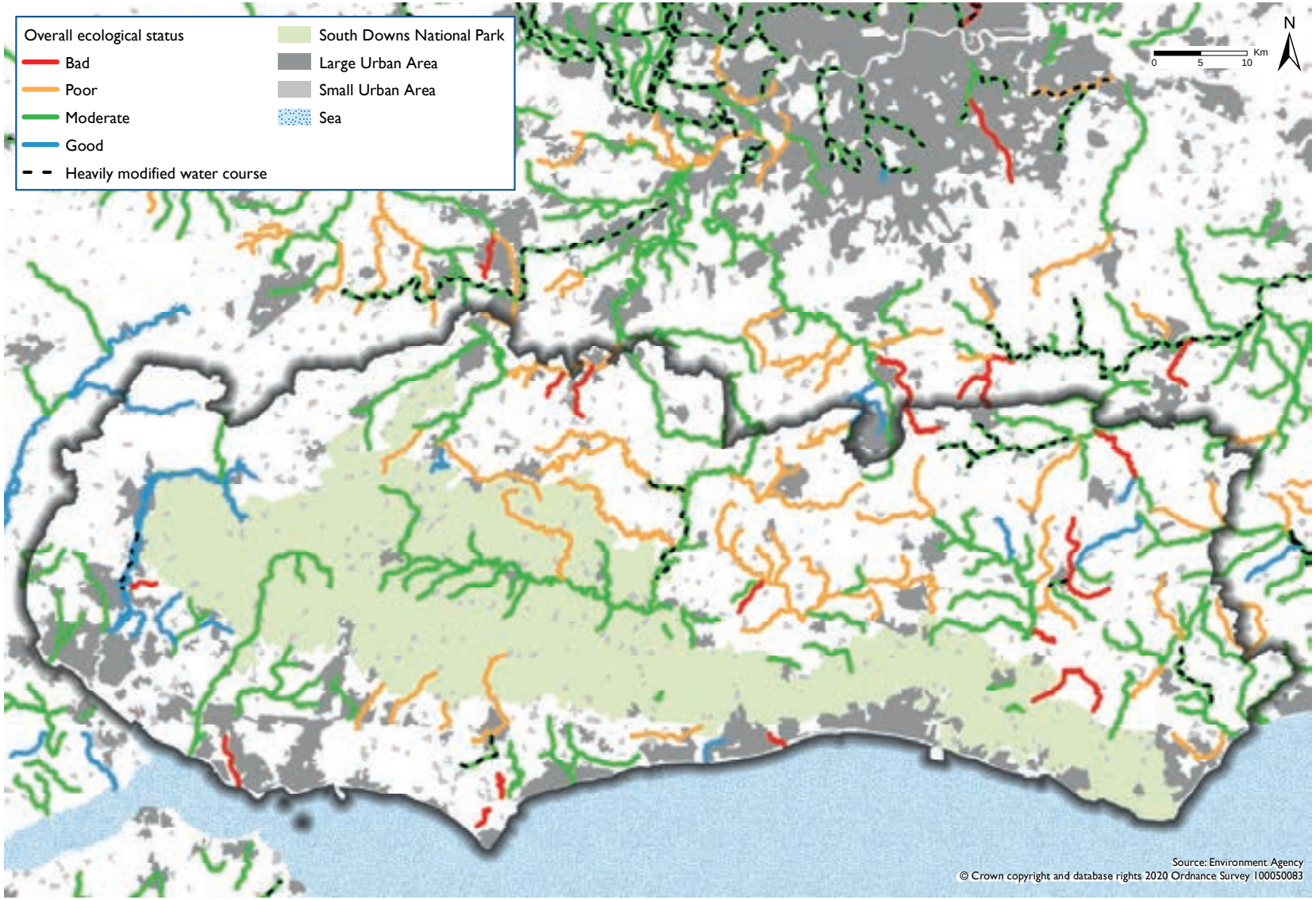
	Description	Issues Relevant to Potential Green Infrastructure Actions	Catchment Partnership
Test and Itchen Catchment	The Itchen is within the Network area and the River Test flows out of the Network area in north Winchester district. A predominantly rural catchment containing two rivers popularly regarded as two of the finest chalk streams, fed from chalk groundwater. The River Itchen is a Special Area of Conservation (SAC). Chalk streams have been historically modified for agriculture and industry, leading to rivers being over-widened, impounded and disconnected from the floodplain.	■ SSSI, SAC and condition and WFD status; ■ Barriers to fish passage; ■ Physical modifications; ■ Natural flood management, increase water attenuation with strategic woodland and wetland creation – 'multifunctional wetland'; ■ 'Keeping Rivers Cool' programme.[114] ■ Major impacts on the Itchen due to over abstraction. Watercress and Winterbournes HLF project.[115]	Hosted by the Wessex Chalk Streams and Rivers Trust and the Hampshire and Isle of Wight Wildlife Trust.
East Hampshire Catchment	This catchment includes the Meon, Hamble, Hermitage, Wallington and Lavant. Also Wessex Chalk Streams and Rivers Trust and Meon Valley Partnership active in the catchment. Havant Thicket Winter Storage Reservoir	■ High urban impact, adjacent to PfSH area, ■ New storage reservoir to provide strategic GI between Havant and SDNP ■ Naturalise watercourses, remove barriers to fish ■ Urban and rural pollution; ■ Create blue-green corridor links to the PfSH area.	Hosted by Groundwork South (Solent).
Arun and Western Streams Catchment	Two main rivers in this catchment, the Arun and the River Rother. The Arun flows from Horsham to Pulborough, where it is joined by the Rother which originates in Hampshire. Both rivers flow through the South Downs to the coast at Littlehampton. Arun and Rother Connections is an active wetland restoration and reconnection project. The Arun and Western Streams Catchment incorporates Lower Arun floodplain that has been subject to periodic extensive flooding most recently over winter 2014.	■ Barriers to fish passage, especially on River Rother; ■ Habitat restoration on both rivers, reconnect habitats, floodplain grazing marsh and other wetland projects; ■ Improvements to 'access for all' at Pulborough Brooks; ■ Wet woodland creation; ■ Sustainable urban and rural land management to reduce pollutants reaching groundwaters; ■ Urban and rural pollution; ■ Some local demand to restore as navigable river. ■ Restoration work and habitat creation on river Ems.	Hosted by Arun and Rother Rivers Trust (ARRT).

114 Projects listed in the Test and Itchen Catchment Management Plan.

115 **hiwwt.org.uk/watercress-and-winterbournes**

	Description	Issues Relevant to Potential Green Infrastructure Actions	Catchment Partnership
Adur and Ouse Catchment	This catchment includes the Adur and the Ouse rivers flowing over chalk and sand bedrock through inland towns including Lewes, Haywards Heath and Burgess Hill and through the South Downs to the coast at Brighton and Hove and Newhaven. Water quality of both river systems is compromised by a range of pressures, including point-source and diffuse pollution, nutrification and water demand. River channels affected by navigation, canalisation, culverts and hard engineering.	▪ Urban and rural pollution – sustainable urban and rural land management to reduce pollutants reaching groundwaters; ▪ Barriers to fish passage; ▪ Restoring natural river courses; ▪ Riparian planting and supporting delivery of Trees on the River Uck Project; ▪ Re-naturalisation of the rivers, e.g. supporting projects such as MORPH to continue.	Hosted by the Ouse and Adur Rivers Trust.
Cuckmere and Pevensey Levels Catchment	The northern extent of the catchment is in the rural High and Low Weald, flowing south to the internationally designated Pevensey Levels to the east of Eastbourne, a large area of wetland and grazing marsh. The River Cuckmere rises near Heathfield and Hailsham, flowing south through the South Downs at Cuckmere Haven, to the Heritage Coast of the Seven Sisters. The Lower Cuckmere has a coastal management regime of no active intervention and experiences periodic over-topping of the river defences particularly during autumn storms.	▪ Barriers to fish passage; ▪ Improvement of habitat; ▪ Urban and rural pollution – sustainable urban and rural land management to reduce pollutants reaching groundwaters; ▪ Re-naturalisation projects. ▪ Periodic damage to the sea defences for which there is no longer resources allocated to maintain. ▪ Riverfly monitoring	Hosted by the Sussex Wildlife Trust and the South East Rivers Trust.
Wey Catchment	The River Wey has two sources in the Network area; the Northern Wey from a chalk spring near Alton and the Southern Wey from near Liphook. The river flows north east through the Thames basin, joining the Thames at Weybridge. Native brown trout in headwaters. Opportunities to improve for wildlife and people in this densely populated area.	▪ Barriers to fish passage; ▪ Improvement of habitat; ▪ Urban and rural pollution – sustainable urban and rural land management to reduce pollutants reaching groundwaters; ▪ Re-naturalisation projects; ▪ Alton river restoration; ▪ Improvements as element of Whitehill & Bordon; ▪ Local Trust with aim of restoration of navigable link between Wey and Arun.	Hosted by the Surrey Wildlife Trust on behalf of the Wey Landscape Partnership.

PLAN 35: ECOLOGICAL STATUS, 2014 (CYCLE 2) AND HEAVILY MODIFIED WATERBODIES



CLIMATE CHANGE

2.312 Climate change over the next 30-40 years has already been determined by historic emissions and inertia in the climate system. The requirement of some adaptation is therefore unavoidable.

2.313 With regard to the water environment, despite some uncertainties over the precise effects and future emissions scenarios, climate change is likely to lead to increases in the amount of winter rain which falls in heavy downpours, along with a decrease in summer rainfall and higher temperatures. Rising temperature in rural areas may threaten valuable biodiversity, such as trout, for which river shading has been shown to be effective.[116] Demand for water is likely to increase, in the South East RBD 24% of river and 81% of groundwater is at/probably at risk from abstraction and flow regulation.[117]

2.314 The key pressures which will be affected by climate change for which the green infrastructure measures listed can play a role are:[118]

- Abstraction (very high);
- Nitrogen and phosphorus loads (high);
- Physical modification (high);
- Biological (low/medium);
- Temperature (low).

RISING SEA-LEVELS

2.315 Sea levels are projected to rise by up to 1m by the end of this century and along with the potential for increased storminess there is a threat to both coastal communities and the coastal plain. Some of the communities likely to be at increased risk are the deprived ones along the South Coast. The risks to coastal infrastructure and communities is one of the most urgent risk identified in the UK Climate Change Risk Assessment Evidence Report.[119]

BLUE-GREEN TOWNS AND VILLAGES

2.316 The rivers are central to the life of the Network, many originating from their position on the rivers for water, industry and trade, with the river networks linking the towns and villages of the Network area.

2.317 Urban areas produce effects such as increased surface flow and input of pollutants, as well as issues of engineered watercourses, as previously detailed. Water quality and failure under the WFD are key issues across the entire Network area. Whilst the reasons for this are complex and not all related to the urban environment, there are several significant issues which can be addressed. The issues relevant to each town vary, but an ambition within the Network area should be to re-establish the water environment as central to towns and villages of the Network area, not only to improve WFD issues, but to reconnect people with the water environment. Green infrastructure planning in these 'blue-green' towns and villages should include the water environment as a central element.

2.318 There are many towns and villages which are situated on rivers, for which improving and reconnecting with the water environment should be furthered, to name a few:

- Petersfield and Liss
- Alton
- Winchester
- Lewes
- Midhurst
- Arundel

2.319 As a principle, new development should not contribute to a deterioration of the water

116 eg. in New Forest, Environment Agency (2011), Keeping Rivers Cool, referenced in NERR057 (Natural England publication).

117 Environment Agency (2009), South East River Basin Management Plan, Annex H: Adapting to Climate Change.

118 Ibid.

119 ASC (2016) UK Climate Change Risk Assessment 2017 Synthesis Report: priorities for the next five years

environment, but with greater ambition, more enhancements can be gained to support the natural water cycle and provide measures to manage flooding, improve water quality, biodiversity and amenity value. (eg. Eastleigh BC request three stages of filtration into groundwater and watercourses.)

2.320 Potential green infrastructure approaches could include:

- Surface water lagoons and staged reedbeds to capture and filter highways drainage
- Work to identify pollutant sources posing greatest risk of polluting surface and groundwaters and target these areas;
- Target drainage from industrial and commercial and roads;
- The re-naturalisation of channels and water courses;
- Associated amenity improvements and access to watercourses;
- Reduction in demand – championing low water input parks and gardens;
- Naturalised SuDS schemes;
- Green roofs.

NATURAL RIVERS – NATURAL SOLUTIONS

2.321 A range of green infrastructure measures can help to relieve flooding, as well as improving biodiversity and amenity, as previously outlined. The 'Trees on the River Uck Project', for example, has implemented riparian planting to help relieve flash flooding in Uckfield.

2.322 There are other parts of the Network area which could benefit from a range of catchment based green infrastructure approaches, many of which have been captured or are being researched through catchment based work, especially in areas highlighted as falling under Policy 6 in the Catchment Flood Management Plans, see Plan 36.

2.323 Policy 6: Areas of moderate flood risk where the Environment Agency will take action with others to store water or manage run- off in locations that provide overall flood risk reduction or environmental benefits.

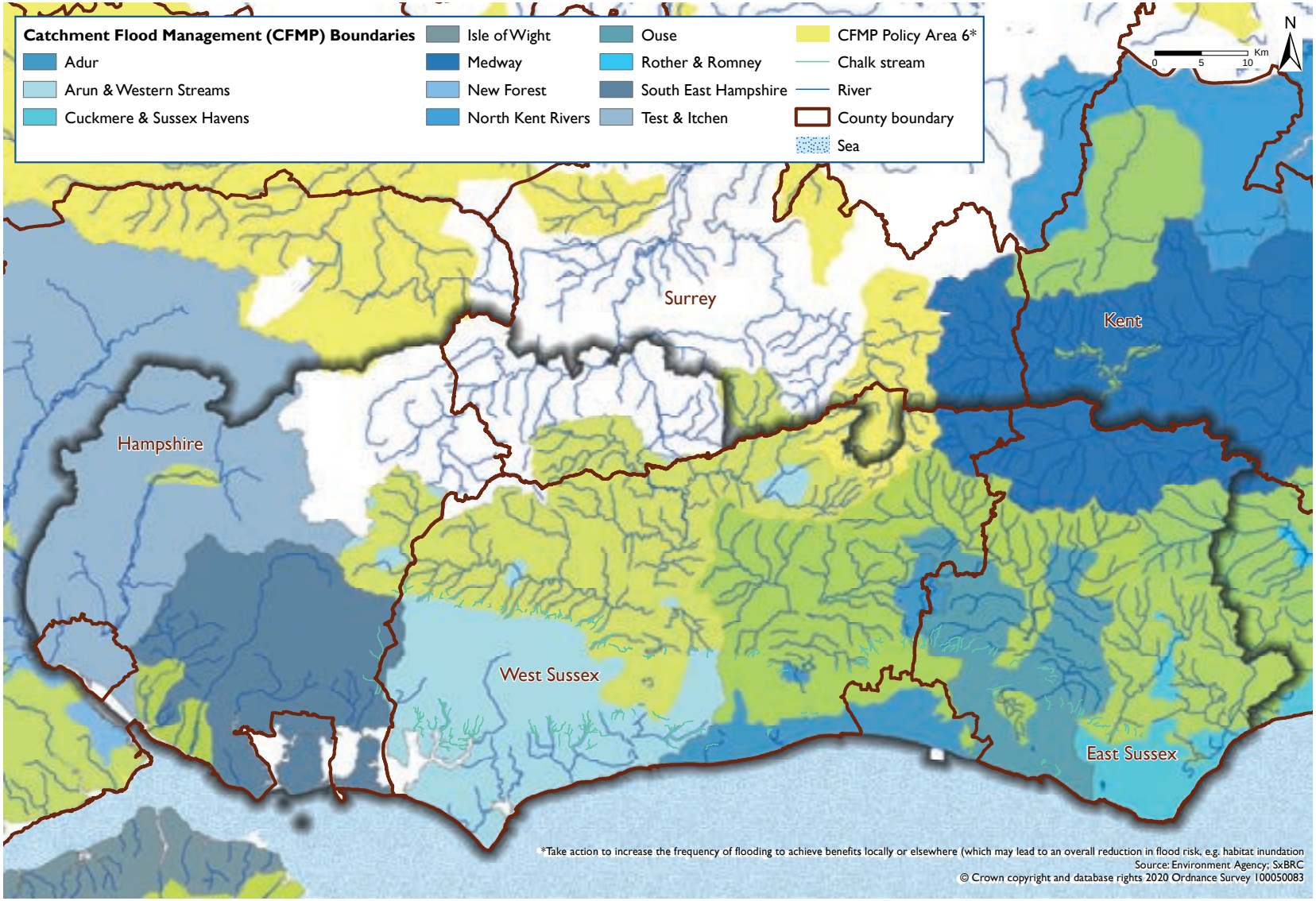
BLUE-GREEN CONNECTIONS

2.324 All of the river corridors provide connections not only for the water environment but for biodiversity and amenity, as outlined in other sections of this report.

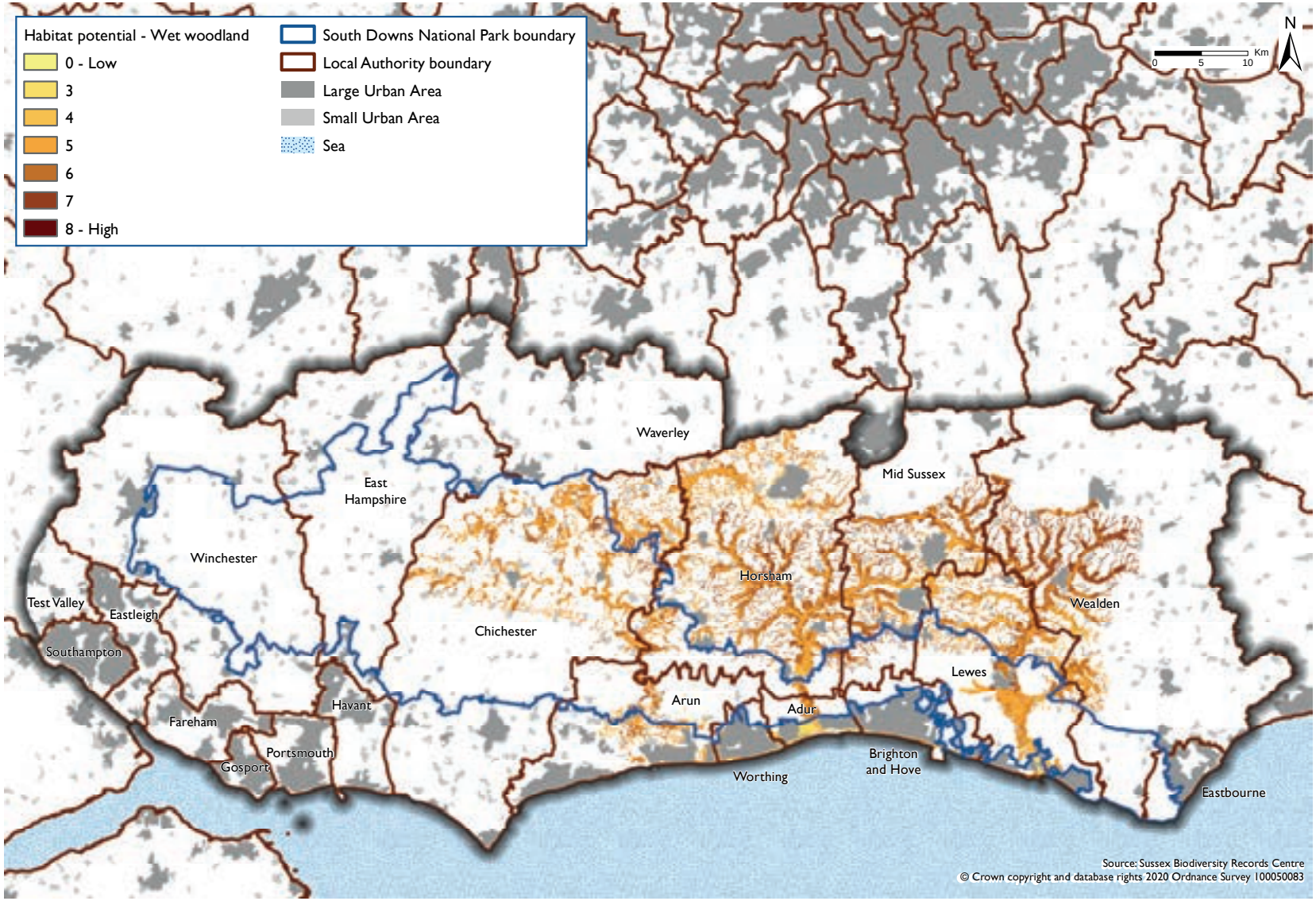
2.325 Mapping of potential habitats has been carried out the Sussex Biodiversity Record Centre for the Arun and Western Streams and Adur and Ouse catchments (Plan 37). This highlights high potential for wet woodland in the upper catchments of the Adur and Ouse catchments, which could have biodiversity as well as water flow regulations benefits, plus the potential to link with the highly wooded High Weald AONB. There is high potential for other habitats; lowland meadow particularly in the Arun and Western Streams catchment and grazing marsh in the lower reaches of both catchments.

Daylighting streams in towns creates wildlife corridors and provides interest and beauty for people. Here in Petersfield the Tilmore Brook runs through a housing development alongside a new cycleway. © V Craddock

PLAN 36: CATCHMENT FLOOD MANAGEMENT PLAN POLICY 6 AREAS



PLAN 37: HABITAT POTENTIAL MAPPING ADUR AND OUSE CATCHMENTS – WET WOODLAND HABITAT



Dew pond at dusk © SDNPA/Andy Flowerday

SOURCES

- Catchment Management Plans: Adur and Ouse Partnership, Arun and Western Stream Partnership, Test and Itchen Catchment Partnership, River Wey Partnership (draft).
- Biodiversity Opportunity Areas: South East England Biodiversity Opportunity Areas (2009), Statements Folio and Mapping, Hampshire and Sussex Biodiversity Opportunity Area Statements.
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- UNEP (2014), *Green Infrastructure Guide for Water Management.*