River Deben at Woodbridge
Photo: Gerry Balding (CC2.0)

East Suffolk Catchment Partnership

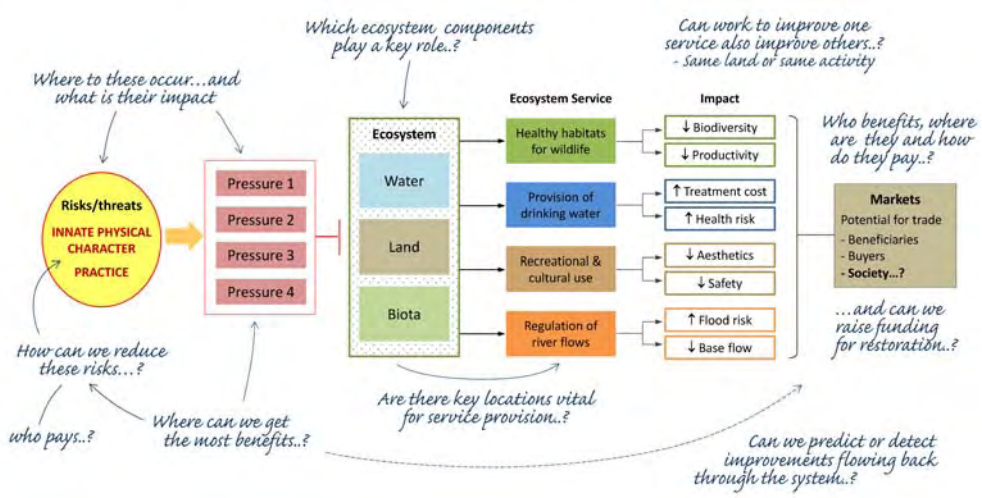
Environmental Services Evidence Review

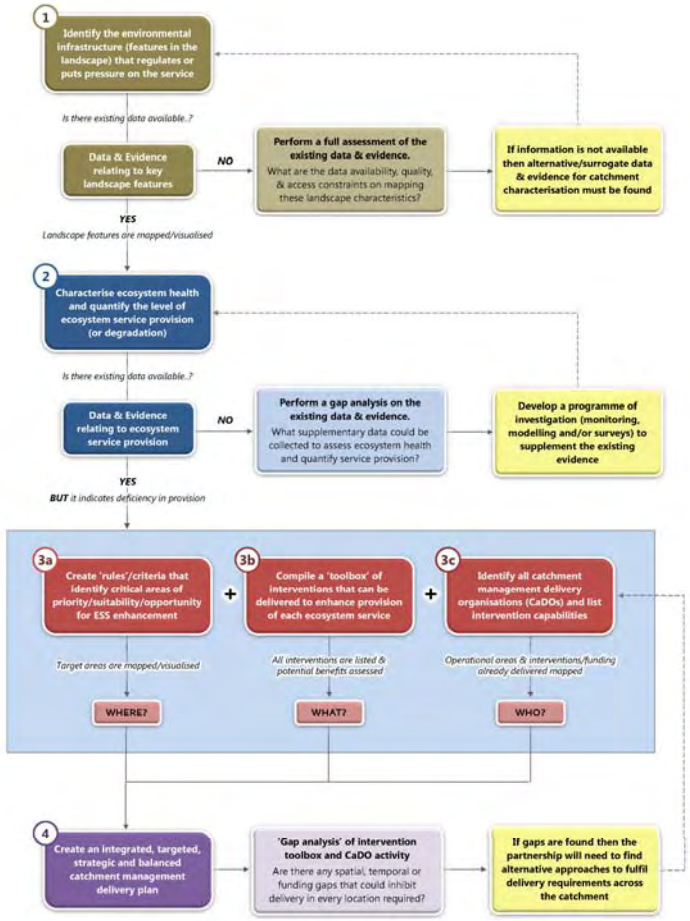
Participatory Ecosystem Services Visualisation

A method for undertaking stakeholder-led spatial visualisation of ecosystem services provisioning areas across a catchment landscape has been developed. During this participatory process, stakeholders (1º, 2º and 3º) and technical specialists work with a broker/facilitator to collate and scruitinise all of the data and evidence relating to environmental infrastructure and ecosystem services provision for their area of interest.

Once the evidence has been evaluated, the partnership then works to develop a series of conceptual models or 'rules' that can be used to define areas of the catchment most likely to play a critical role in the provision of the different ecosystem services singly or in combination. These priority areas are locations where a programme of measures may realise the greatest enhancement in the provision of multiple ecosystem services.

Fundamentally this is a data visualisation and evidence exploration process that facilitates the development of a shared vision and language in a catchment group.





The process...

1. For each service it is first important to identify and map all of the **priority areas**, **drivers** and **receiving features** affected by the provision or non-provision of the service. This sets out where the beneficiaries (or 'dis-beneficiaries') of a service are and where there are drivers (statutory, social or economic) for the restoration and/or enhancement of the service.

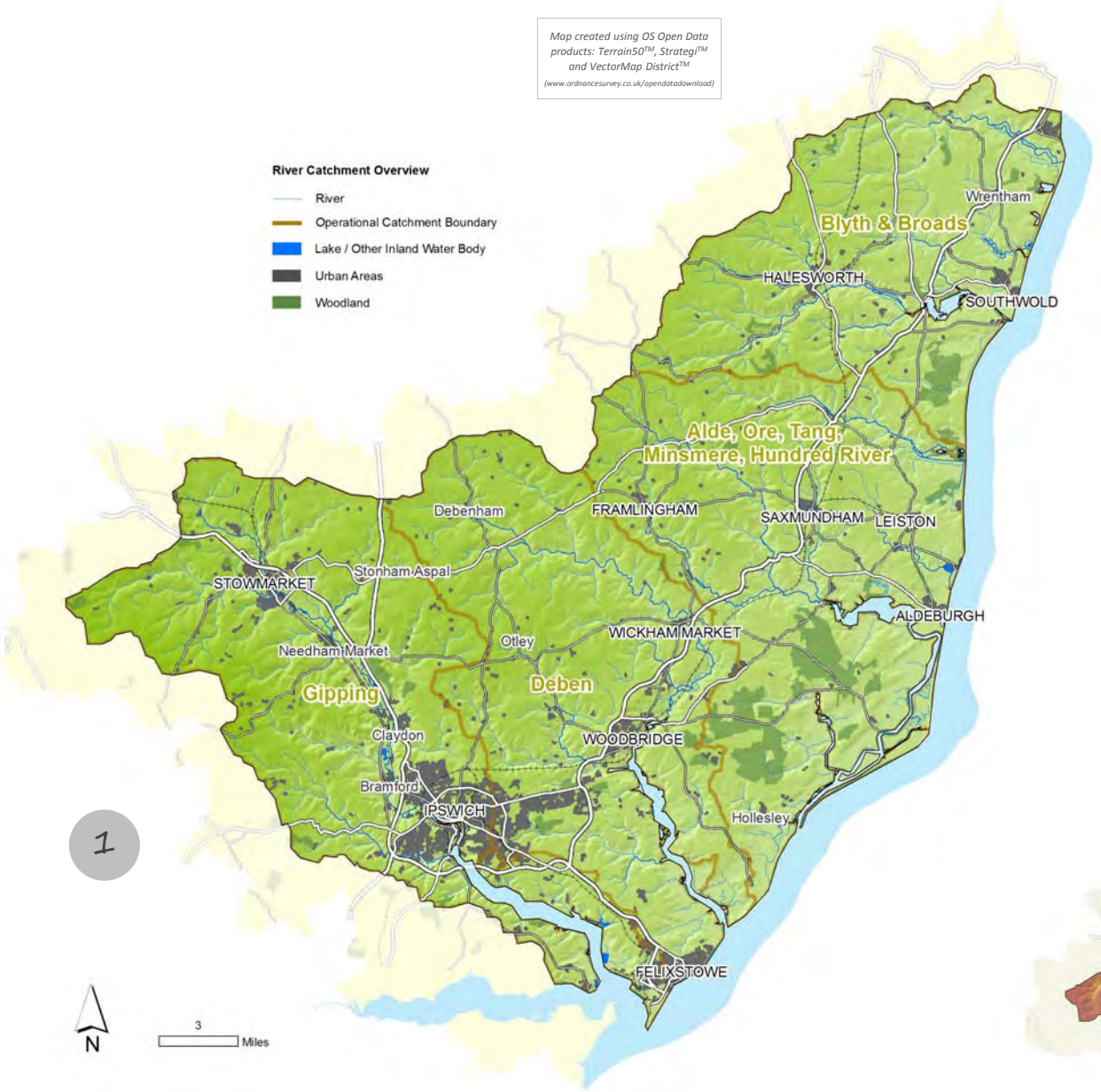
2. The second stage is to undertake a comprehensive **audit of the environmental infrastructure** (identifiable features in the landscape) that is responsible for the provision of each service. It is not possible to develop a strategic programme of measures if the current environmental infrastructure provision has not been characterised. This also allows the group to characterise a 'toolbox' of interventions that can be used to enhance service provision when delivered in a suitable location.

3. Following on from this audit, all of the available data and evidence should then be used to **assess the current condition of the ecosystem** and to determine its ability to provide the service in question. Through detailed evaluation of the scientific evidence and discussion with catchment stakeholders a partnership must first decide whether something needs to be done to enhance the provision of a particular service – this gives them a mandate to act.

4. If the accumulated evidence indicates that the provision of the service is below that required (and that in some areas there are potential beneficiaries who are not receiving sufficient service provision), criteria are then developed and mapped which **define areas of priority, suitability and/or opportunity** for the delivery of catchment management interventions designed to enhance that provision.

5. Once the individual opportunity maps have been created they are overlaid to identify areas of the catchment which have the **potential to regulate the provision of multiple services**. These priority areas are, conceptually, areas where delivering interventions for one reason could actually enhance the provision of multiple services and where the cost-benefit ratio of delivery could therefore be significantly more advantageous.

6. The final component is to collate and **map the activities and funding previously undertaken or delivered** by the various Catchment Area Delivery Organisations (CADOs) in the catchment. This allows the partnership to assess the level of intervention already being delivered in the catchment and therefore allows areas of (1) opportunity (i.e. through collaboration, synergy or integration), (2) redundancy (i.e. where organisations are working in parallel) and (3) spatial or temporal inactivity (where no interventions are being undertaken) to be identified.

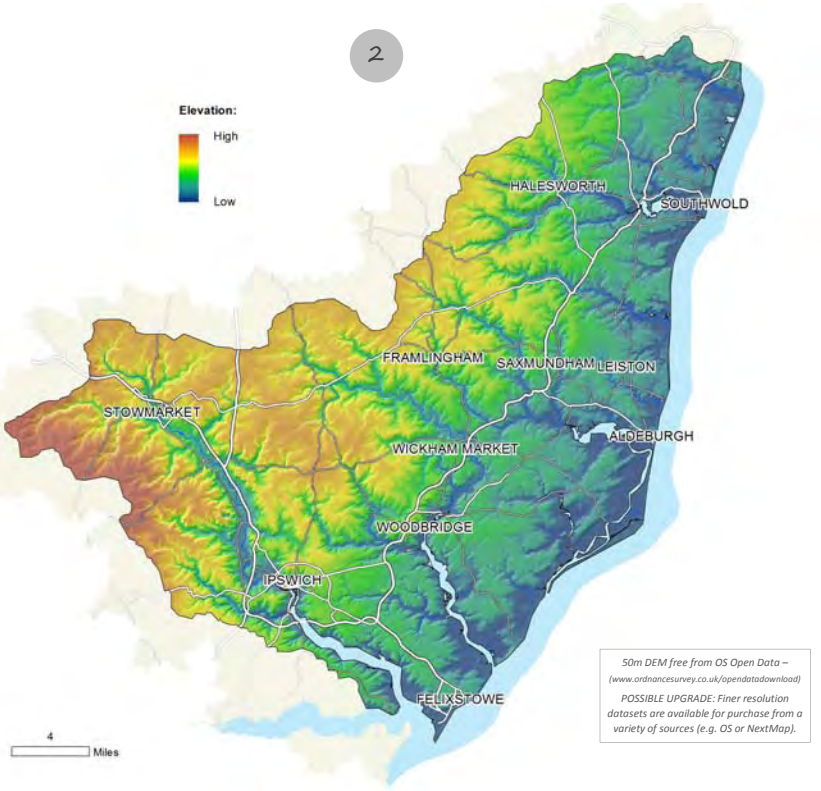


Principal catchment features

Covering nine river catchments, including; the Gipping, Deben, Alde-Ore and Blyth, and extending along the east coast from Felixstowe in the south to Kessingland in the north, the East Suffolk Catchment covers an area of 1,595 sq km in the southern half of East Anglia.

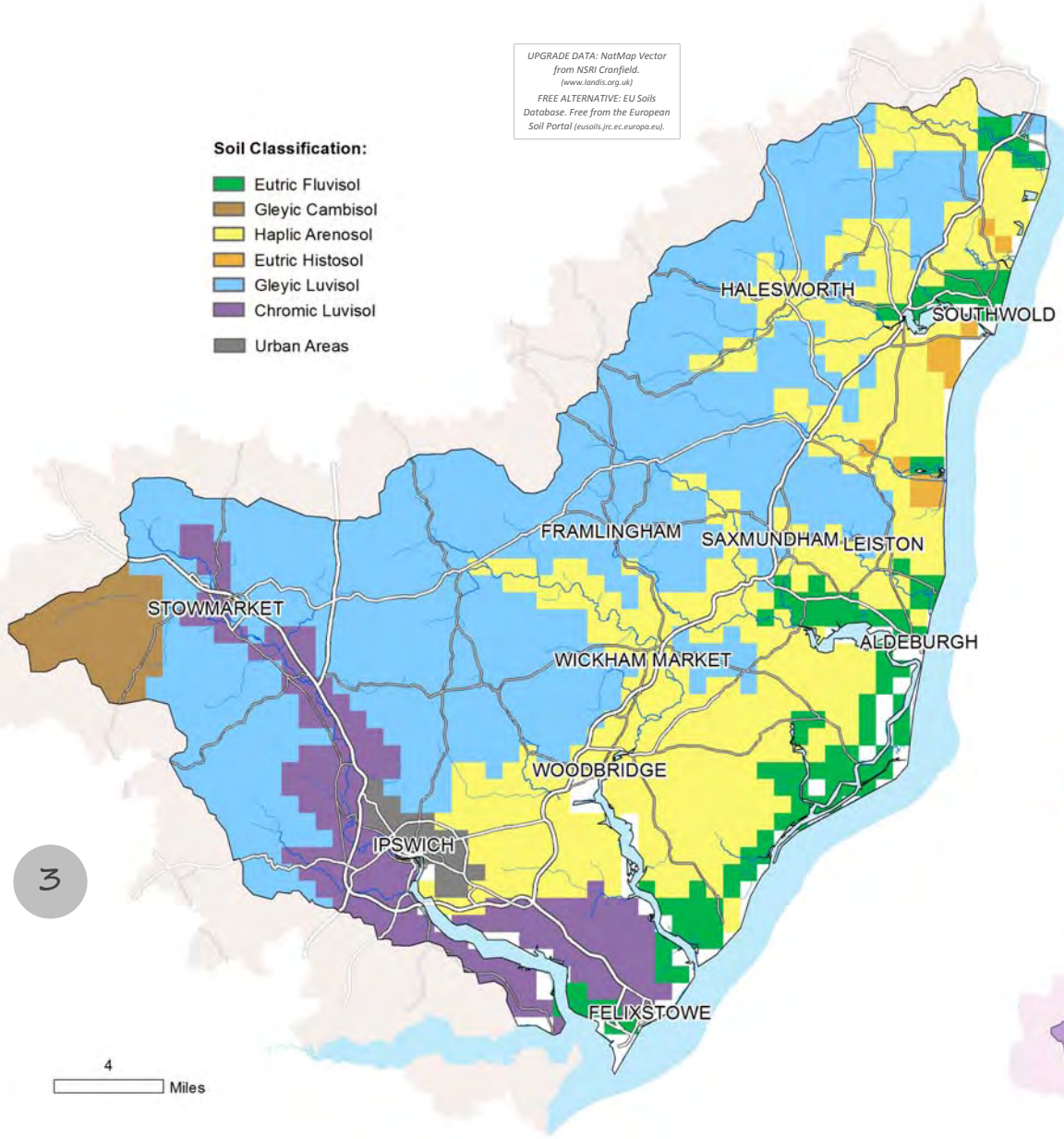
The East Suffolk Catchment landscape is primarily rural with agricultural land making up ~90% of the total land area, but the catchment does have a population of around ~650,000 which is largely focused in the towns of Ipswich, Stowmarket, Needham Market, Felixstowe, Aldeburgh, Debenham and Southwold.

The landscape of the catchment varies considerably, with headwaters of the rivers located on higher and more steeply sloping ground to the west (dominated by chalk geology), while the land nearer the coast is largely flat and characterised by slow flowing rivers and wetland habitats (dominated by marine-derived sands and gravels.. ⇦



Morphology

Digital terrain data is very useful for visualisation of landform, while detailed accurate data representing rivers, streams and other watercourses is also a vital component of any catchment mapping process. ⇨



3

Soil typology

Soil is the medium in which plants grow and is a vital habitat that supports a huge diversity of animal species and micro-organisms.

Fertile soil is critical for the production of food, timber and fibre, and it is therefore essential for our survival and economic prosperity.

Soils also influence the character of our local landscapes and play a key role in the regulation of environmental services such as nutrient cycling, water quality, water flow regulation and carbon storage. ⇦

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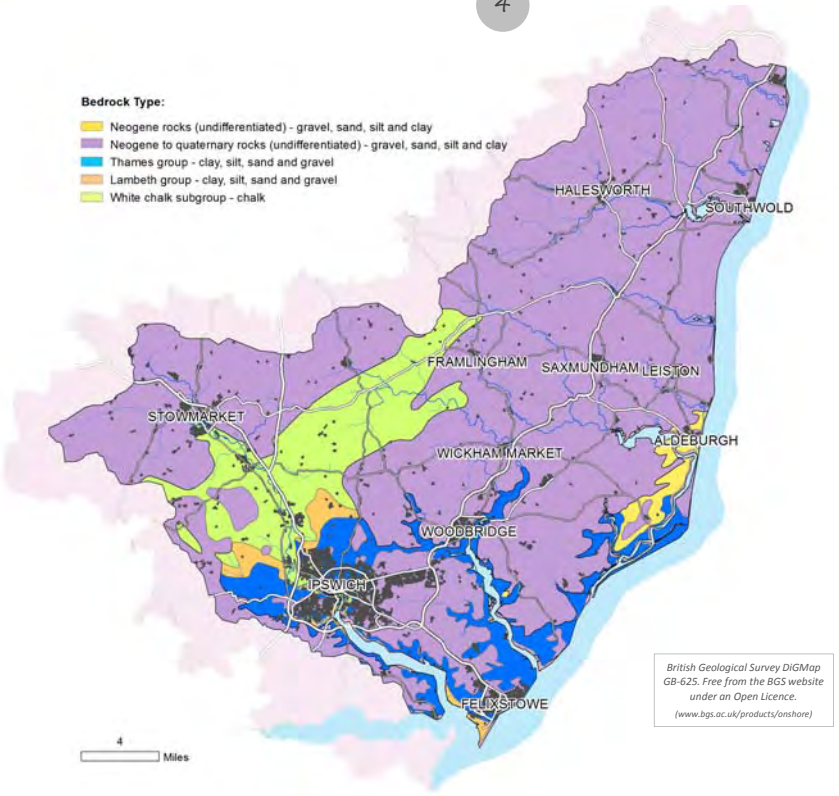
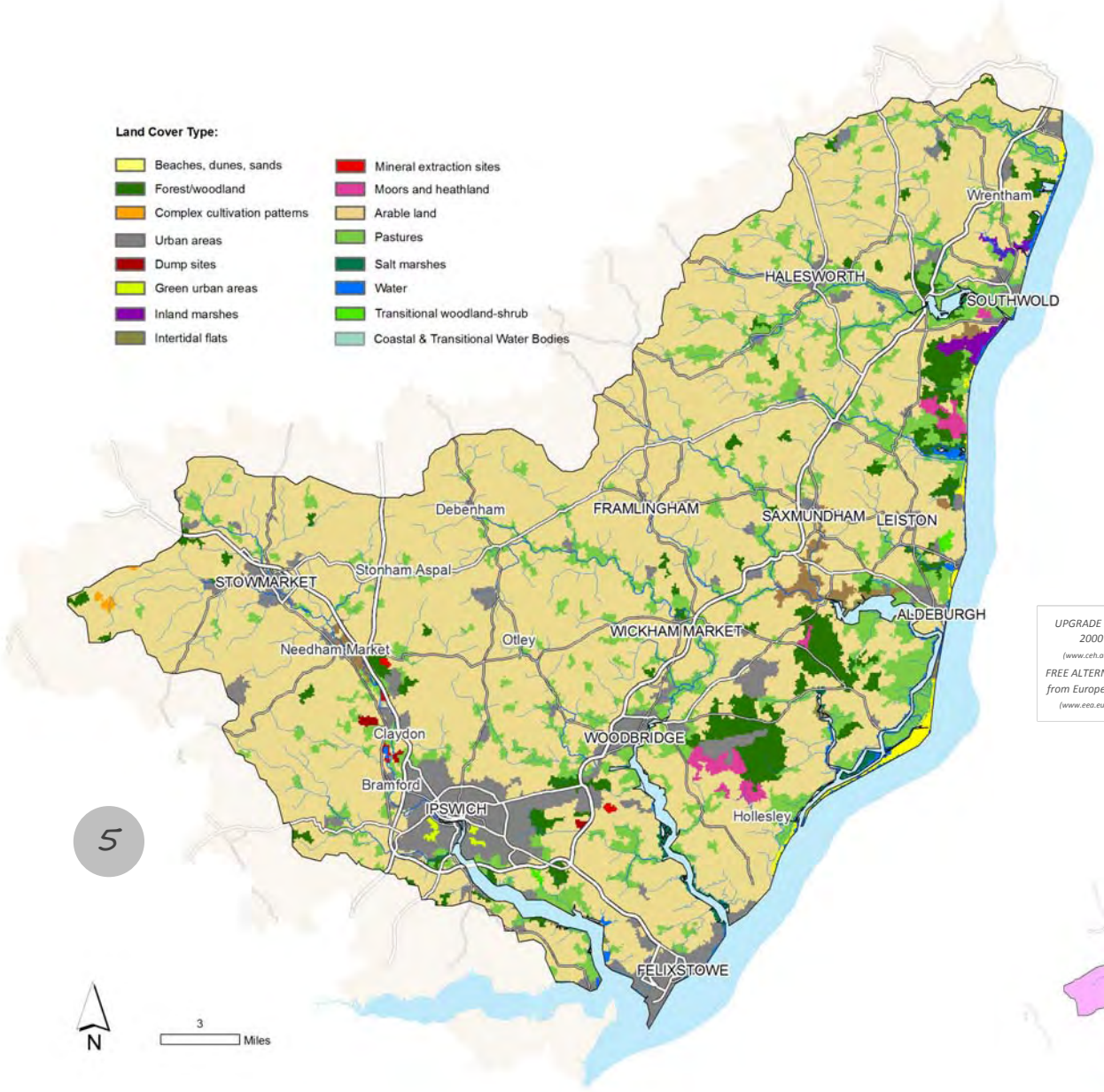


British Geological Survey DiGMap GB-625. Free from the BGS website under an Open Licence. (www.bgs.ac.uk/products/onshore)

Bedrock Geology

Geological maps are of potential use to a wide range of people with both interests in planning and development, oil and gas (including shale gas) reserves, water and mineral resources (especially groundwater), waste disposal sites, utilities, transport, geo-hazards and property insurance; as well as academic interests such as the Earth's geological history, its fossils, and its landscape development. ⇨



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Landcover typology

Land cover is the physical material on the surface of the Earth, including artificial materials, such as roads and buildings in urban areas, but also natural and managed vegetated surfaces and inland water.

Land cover information has multiple uses, such as the management of natural resources, urban planning, carbon accounting and flood risk modelling.

Land cover information also gives us an insight into how the land in a catchment is being used (or was being used previously) and this can be a very useful indicator of ecosystem health/condition and therefore its ability to provide different ecosystem services.

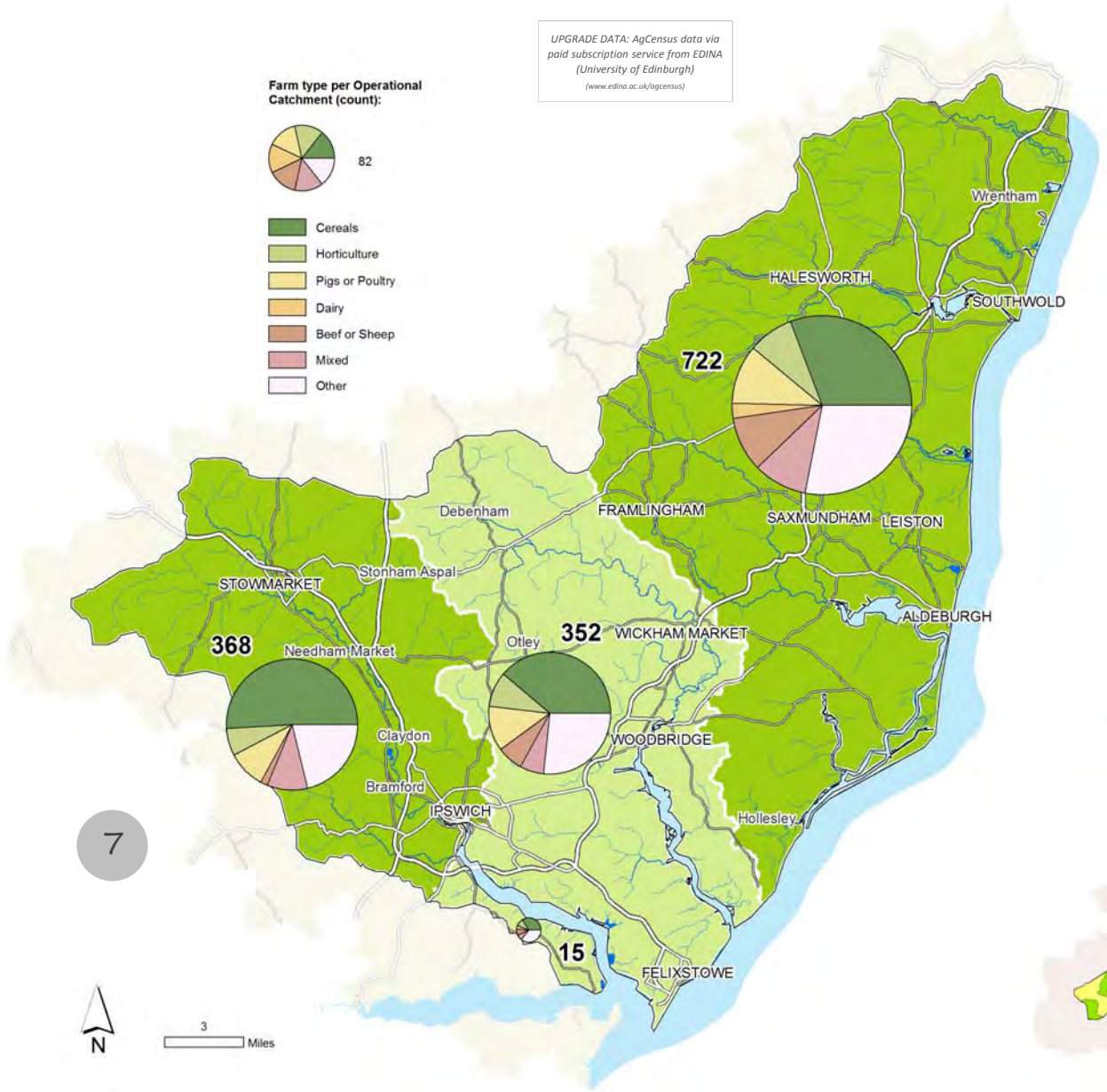
Landcover data can be obtained from a variety of sources, but its most important use is to give a broad overview of the catchment landscape character (also see below). ⇦

UPGRADE DATA: Land Cover Map 2000 or 2007 from CEH
(www.ceh.ac.uk/landcovermapping.html)
FREE ALTERNATIVE: Corine Landcover from European Environment Agency.
(www.eea.europa.eu/data-and-maps/data)

6

Landscape Character Areas

A Landscape Character Area is defined as "*a distinct, recognisable and consistent pattern of elements, be it natural (soil, landform) and/or human (for example settlement and development) in the landscape that makes one landscape different from another, rather than better or worse*". The Landscape Character Assessment (LCA) helps us to understand what components give England's landscapes their unique character. ⇨



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Agricultural practices

The agricultural activities undertaken in a catchment often define the character of the rural landscape and can have a significant impact on the environment and its ability to provide the services we need.

An indication of the types and intensity of farming practice undertaken across the catchment landscape can be gained by looking at Agricultural Census data.

The AgCensus includes information on farm type (up until 2000) and the overall statistics for livestock or arable farming practices can also be sub-divided into all of the individual types of activity undertaken to determine where certain farming activities are occurring and to what intensity across the landscape. ⇦

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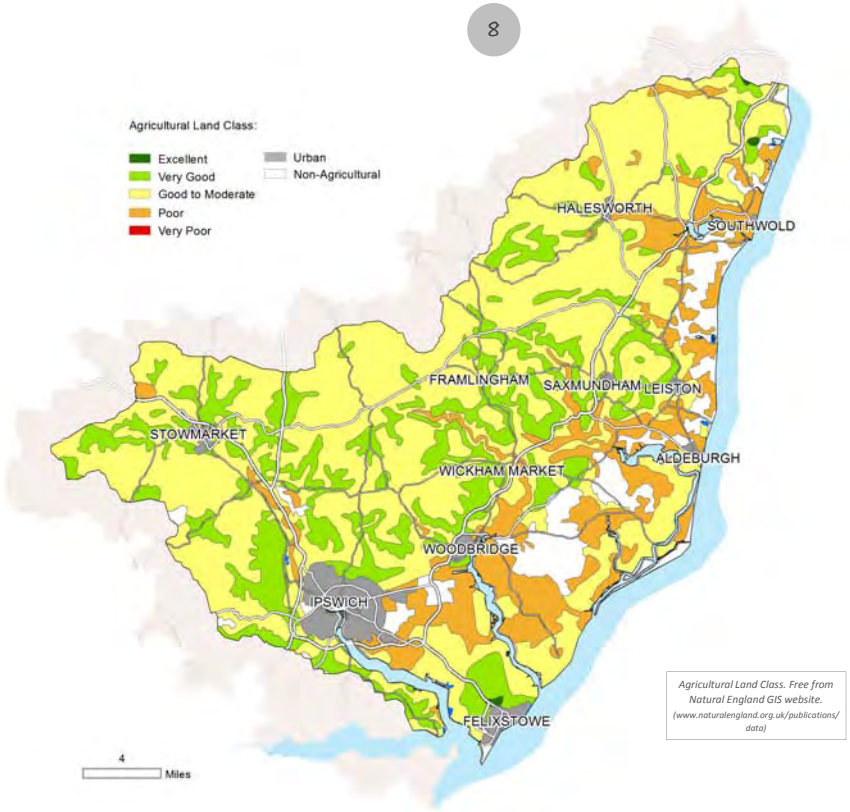


Agricultural Land Class. Free from Natural England GIS website. (www.naturalengland.org.uk/publications/data)

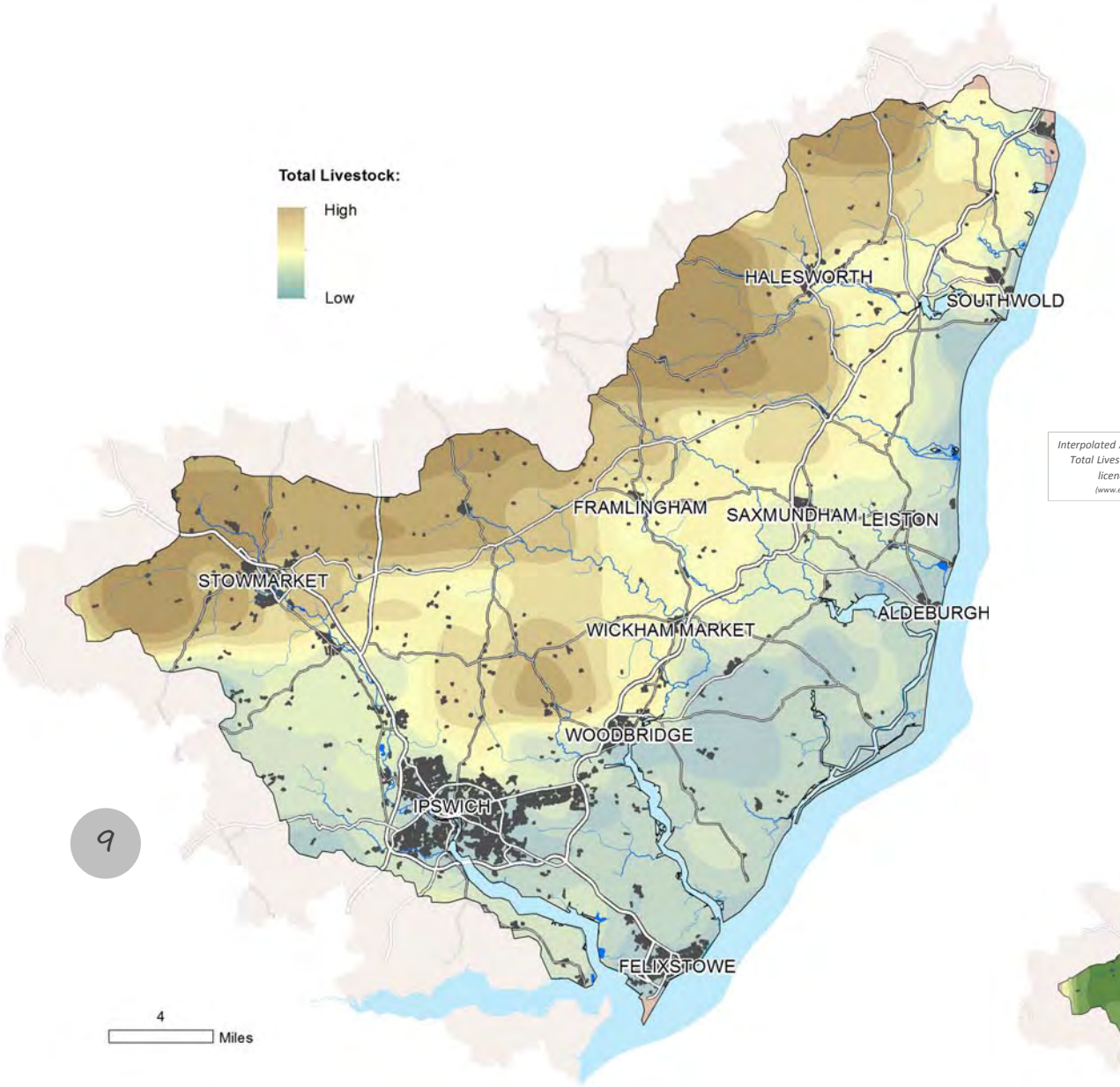
Agricultural Land Class

Agricultural Land Classification (ALC) is a method for assessing the quality of farmland to enable informed choices to be made about its future use within the planning system (as defined by the National Planning Policy Framework). The ALC system classifies land into five grades: the best and most versatile land is defined as Grades 1, 2 and 3, while Grades 4 and 5 are of poorer quality. ⇨

Livestock farming

Livestock farming is the raising of animals for use (food or work) or enjoyment. Farm types include dairy, mixed livestock, beef & sheep, indoor and outdoor rearing of pigs or poultry.

The Agricultural Census includes estimated total number of livestock and can be divided into many types, including; cattle, pigs, sheep, horses, and poultry for meat or eggs. It can also be further sub-divided into the various sub-groups of these individual categories. ⇦



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Interpolated AgCensus 2010 data for Total Livestock. Obtained under licence from EDINA.
(www.edina.ac.uk/agcensus)

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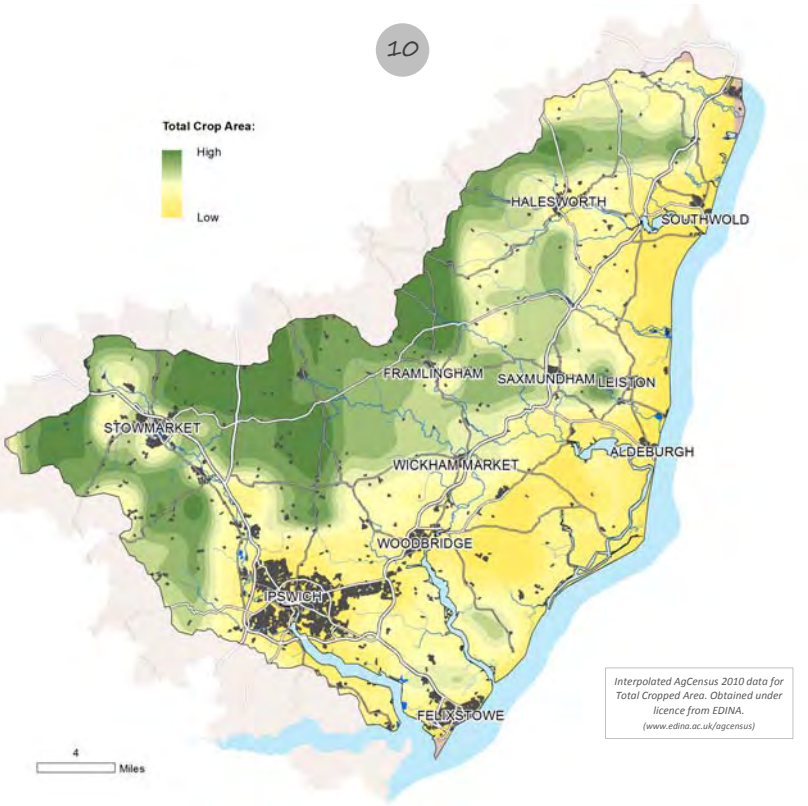
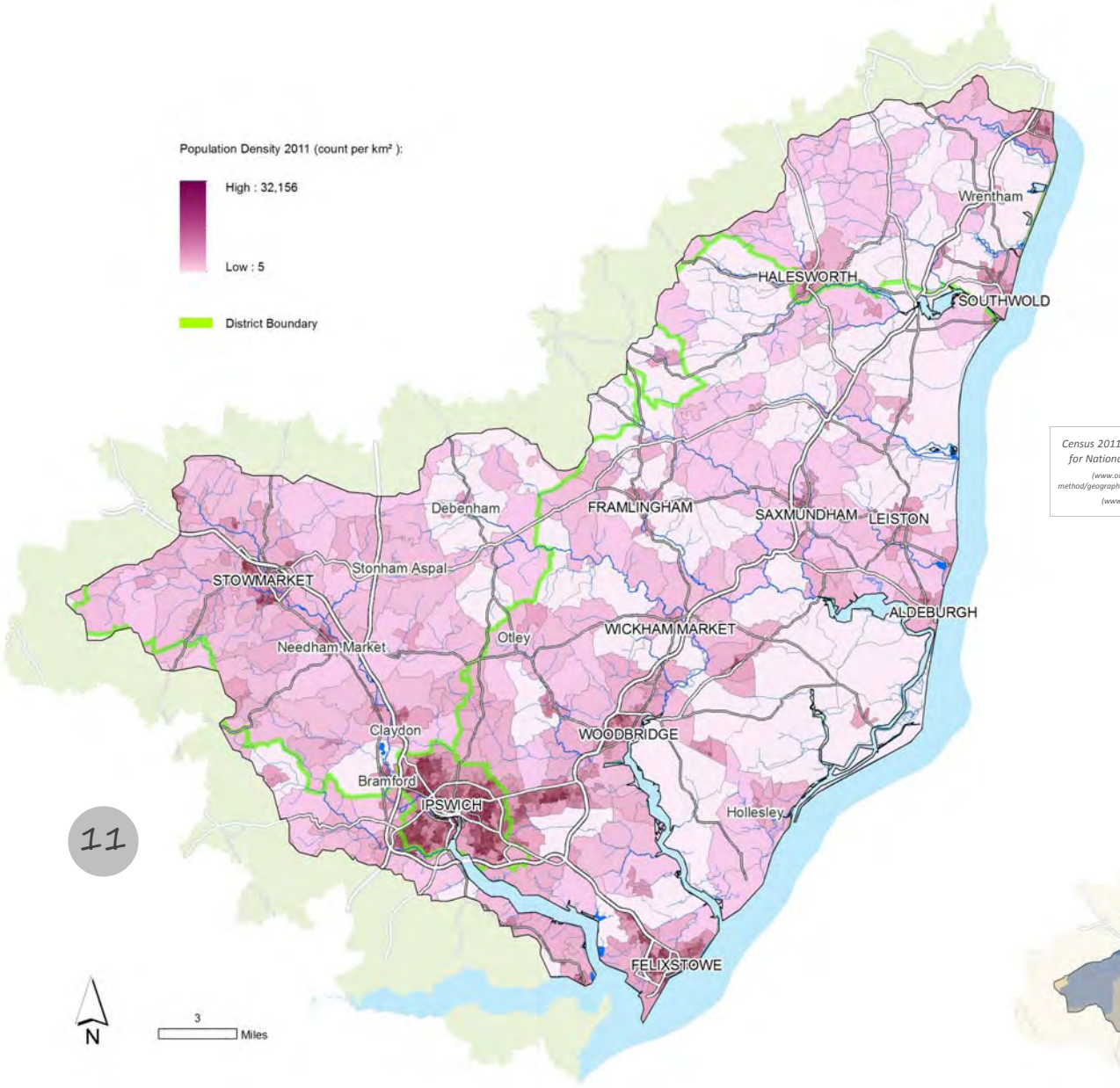


Interpolated AgCensus 2010 data for Total Cropped Area. Obtained under licence from EDINA.
(www.edina.ac.uk/agcensus)

Arable farming

Arable land is land used to grow crops that are sown and harvested within the same agricultural year. The Agricultural Census allows us to visualise, at a catchment-scale, the area of land being used for the production of crops (i.e. under arable cultivation). This data can be broken down into different crop types, such as maize, different types of cereal, oil seed rape, fruit and vegetables, etc.. ⇨



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Population

The Census 2011 statistics from the Office for National Statistics help paint a picture of the British population and how they live their lives.

The information the census provides allows central and local government, health authorities and many other organisations to target their resources more effectively and to plan housing, education, health and transport services for years to come. ⇦

Census 2011. Free from the Office for National Statistics (Nomis).
(www.ons.gov.uk/ons/guide-method/geography/products/digital-boundaries)
(www.nomisweb.co.uk)

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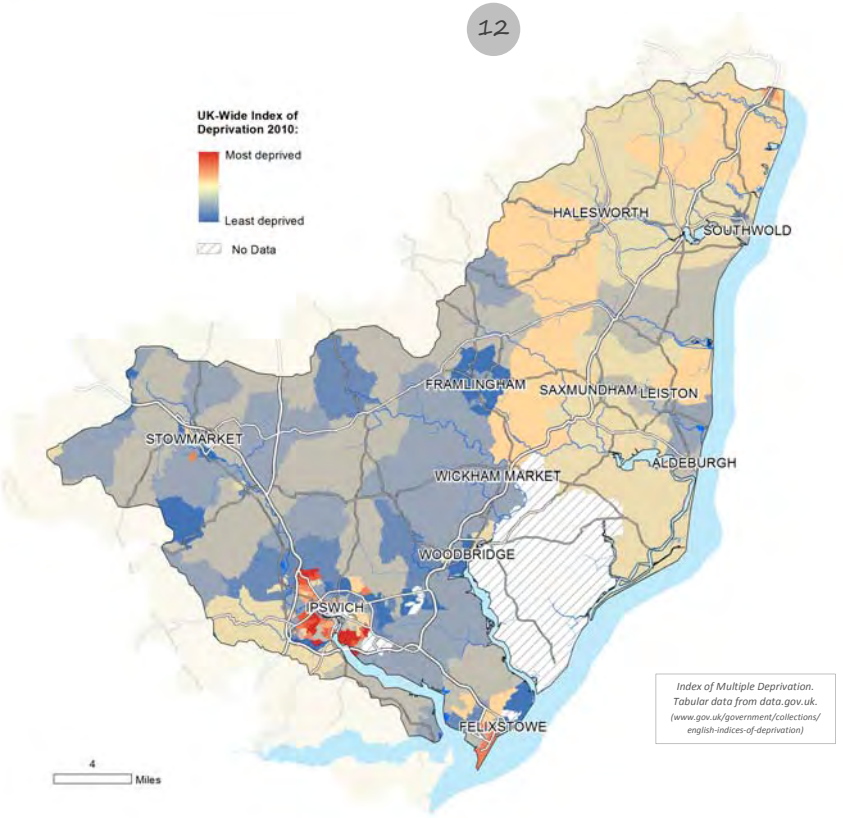


Index of Multiple Deprivation. Tabular data from data.gov.uk. (www.gov.uk/government/collections/english-indices-of-deprivation)

Social deprivation

The English Indices of Deprivation (IMD) 2010 provide a relative measure of deprivation at small area level across England. Areas are ranked from the least deprived to most deprived across the country according to seven different dimensions of social deprivation (income, employment, health, education, housing, living environment and crime) and an overall composite measure of multiple deprivation. ⇨

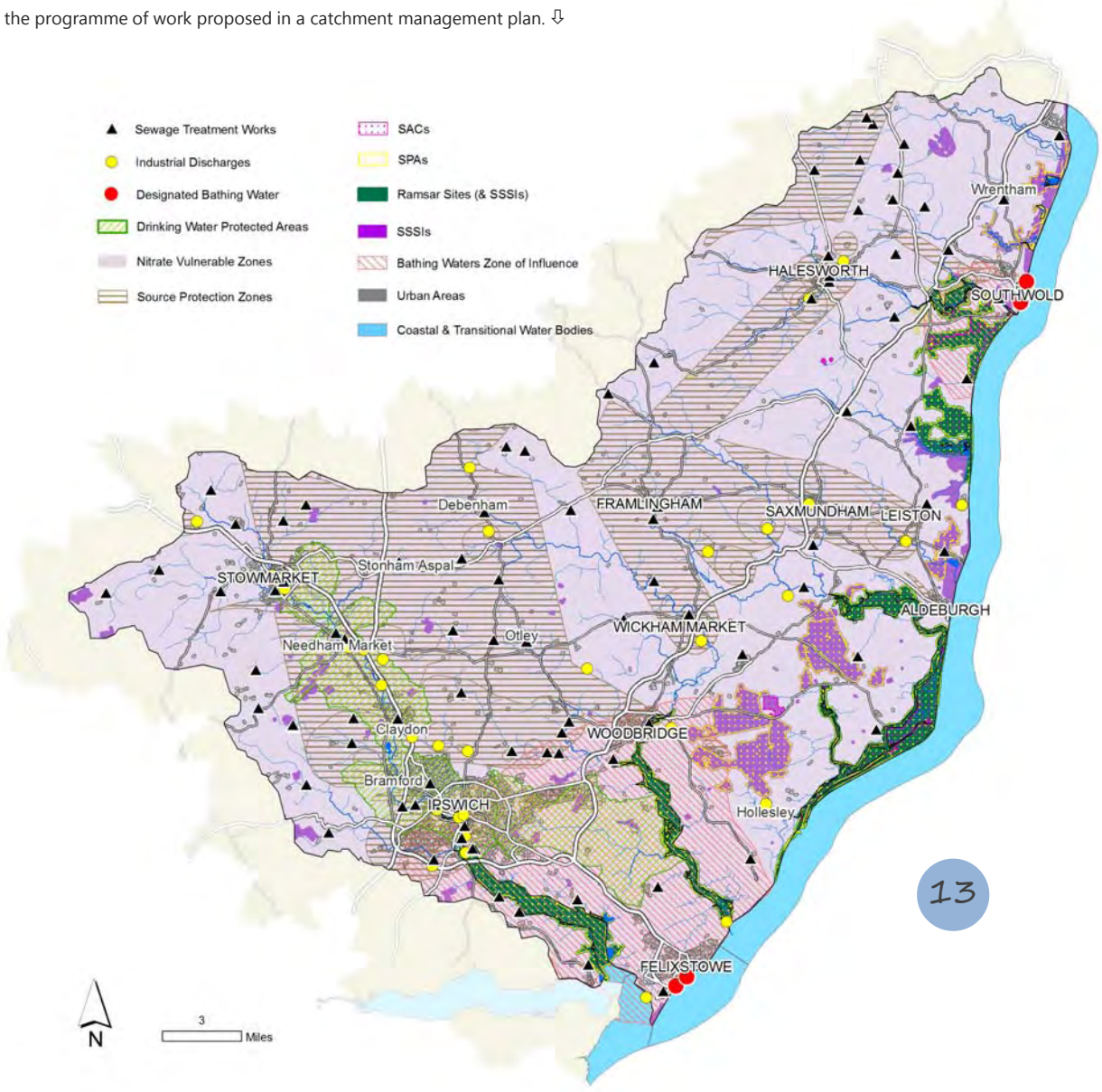
Water Quality

Priority Areas for Water Quality

There are three principal locations where degradation of the water quality in our rivers and streams can result in the loss of ecosystem service provision and the subsequent deprivation of those who would normally benefit from this provision:

1) within the aquatic ecosystems themselves,
2) at downstream locations in the river system, and
3) where water is abstracted from rivers and reservoirs for provision as drinking water.

The distribution of these features across the catchment are shown in the map and listed in the table (right). These features are critical in targeting the programme of work proposed in a catchment management plan. ⇩



Designated sites important for water quality

Data / information	Notes
Nitrate Vulnerable Zones (NVZs) *DEFRA dataset from MAGIC www.magic.gov.uk*	An NVZ is designated where land drains and contributes to the nitrate found in "polluted" waters.
Drinking Water Protected Areas (DrWPAs) *EA dataset from Geostore www.geostore.com/environment-agency*	WFD waterbodies where drinking water for public supply occurs are designated Drinking Water Protected Areas.
Source Protection Zones *EA dataset from Geostore www.geostore.com/environment-agency*	SPZs are defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.
Designated Bathing Waters *EA dataset from Geostore www.geostore.com/environment-agency*	A bathing water is one where a large number of people (~100 people) are expected to bathe at any one time.
Transitional and Coastal (TraC) Waterbodies *EA dataset from Geostore www.geostore.com/environment-agency*	Much of the water and pollution from catchments ends up in transitional (e.g. estuaries) and coastal waterbodies which have their condition assessed under WFD
Natura 2000 Designated Sites *NE dataset from NE GIS data website www.naturalengland.org.uk/publications/data*	Internationally important sites including Special Protection Areas (SPAs), Special Areas for Conservation (SACs) and Ramsar Sites.
Sites of Special Scientific Interest (SSSIs) *NE dataset from NE GIS data website www.naturalengland.org.uk/publications/data*	Nationally designated sites across the UK.
Local Wildlife Sites *Typically obtained from Local Biological/ Environmental Record Centre. Not included as not currently available.*	Non-statutory designated sites for wildlife.

Other receiving infrastructure

Data / information	Notes
Human population *Census 2011. Free from the Office for National Statistics (Nomis). www.ons.gov.uk/ons/guide-method/geography/products/digital-boundaries www.nomisweb.co.uk*	Resident and visitor population using the environment can be susceptible to the effects of poor water quality.
Waste Water Treatment Infrastructure (STWs) *EA dataset from Geostore www.geostore.com/environment-agency*	Water quality in a river has a direct bearing on the effluent volumes and concentrations that can be discharged from point sources of pollution.
Industrial discharges *EA dataset from Geostore www.geostore.com/environment-agency*	As above.
Private water supplies *Should be recorded by Local Authorities, but not included as not currently available.*	These low volume abstractions (<20m³/day), where treatment is often minimal, can be severely impacted by poor raw water quality.

Infrastructure that regulates the service

The land areas that play a key role in the regulation of water quality as it moves through the landscape can be identified by mapping a series of key indicators of inherent water quality risk.

By documenting where these features occur and where they coincide we can identify areas of land that play a greater role in the regulation of water quality and where there is a correspondingly greater risk of water quality being degraded in the catchment. This then allows us to target these areas for protection or interventions that mitigate this threat. *

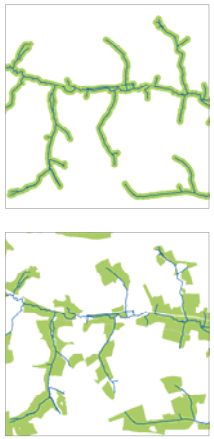
Proximity to watercourse

Areas in the 'riparian corridor' are considered to pose an elevated risk to water quality because they have direct connectivity to the watercourse (no pathway present = no opportunity to disconnect mobilised pollutants)

The simplest way to identify areas in the riparian corridor and in close association with the rivers/watercourses is to create a buffer around a river dataset.

Detailed River Network (EA) and VectorMap Inland Water (OS Open Data) should be used as the template for this analysis, but other river datasets can be used.

POSSIBLE UPGRADE: A good further analysis is to also identify agricultural fields with direct river frontage. Fields can be selected using the MasterMap 'general surface – natural' polygons or the agricultural landuse polygons from Landcover Map 2007. Not included at this stage.



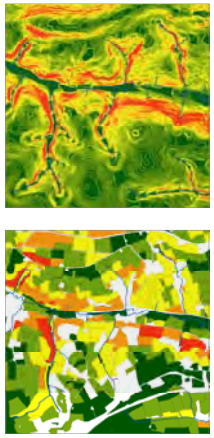
Slope

There are numerous sources of literature that cite slope as a critical risk factor that poses a threat to water quality.

Slope is calculated from a Digital Elevation Model (this can be effective at any resolution of DEM, but data processing can become more challenging at finer resolutions).

50m DEM freely available from OS Open Data, while finer resolution datasets are available for purchase from a variety of sources.

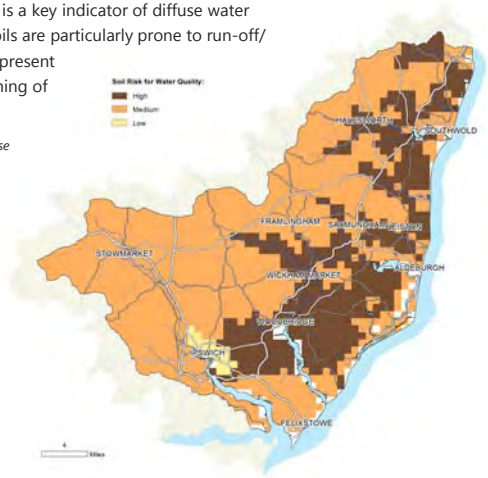
POSSIBLE UPGRADE: There is some advantage to be gained by using zonal statistics function in GIS to calculate average slope on a field-by-field basis. This is technically quite difficult to achieve and cannot be done without some form of field boundary dataset. Not included at this stage.



Soil typology & hydrology

Soil typology/character is a key indicator of diffuse water pollution risk – some soils are particularly prone to run-off/ erosion, while others represent a risk due to rapid leaching of pollutants in solution.

Soil data from EU Soils Database – see map 4

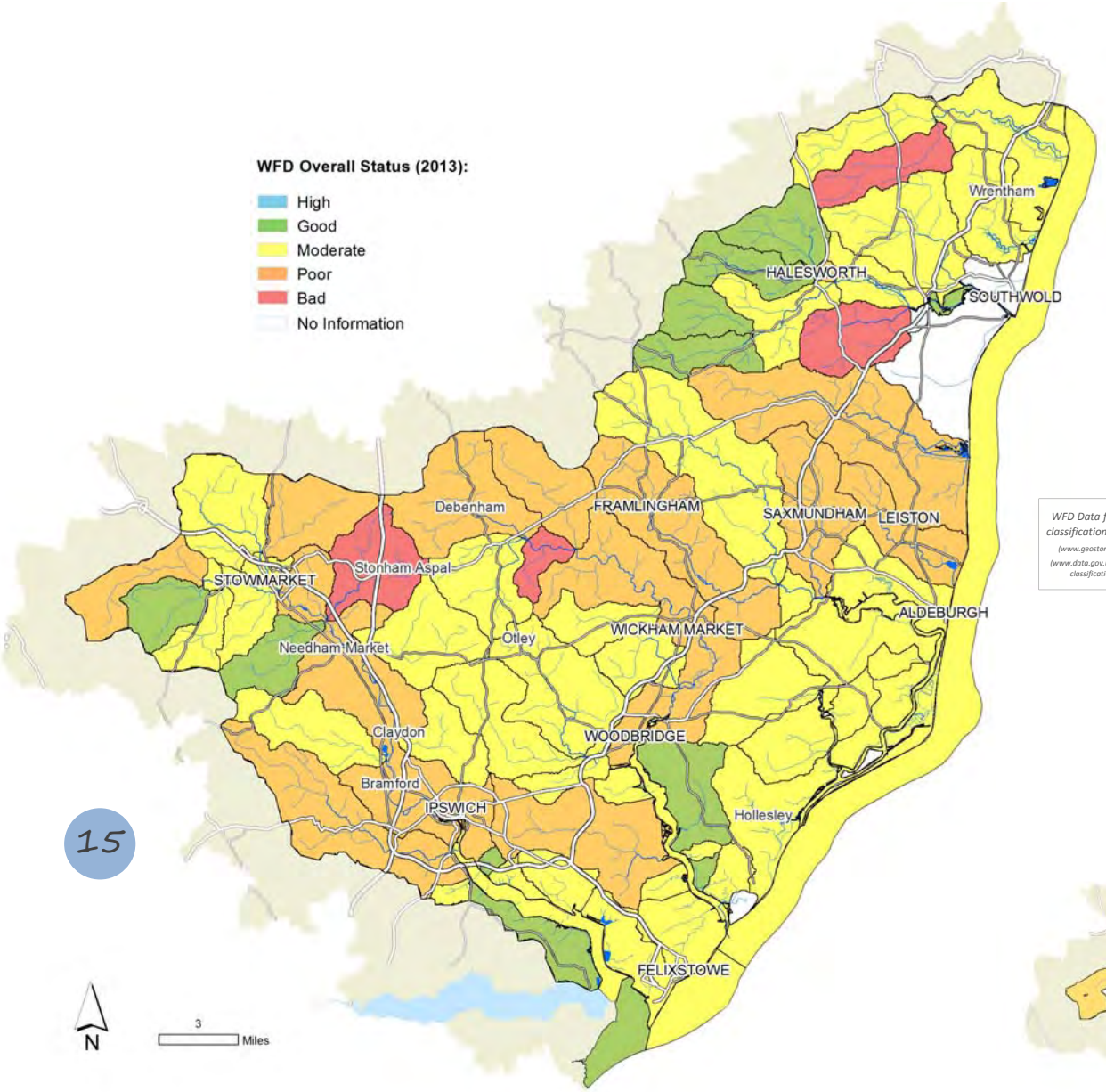


Hydrological connectivity

In some locations water has a greater propensity to run over the surface and collect due to the shape of the land and the size of the upstream catchment area. These areas are of critical importance to the regulation of water quality as moving water has the greatest chance of becoming contaminated and/or they are where contaminated water may be moving along a pathway. ⇨

Hydrological connectivity mapped using the modified 'wetness index' used to create the Surface Flow Index/Network Index in the SCIMAP modelling framework. This can be run on DEM data at a variety of resolutions with varying effects in the outputs.

* NB. These individual criteria are not combined together at this stage – this synthesis is created later during the opportunity mapping process.



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WFD classification

We need to collate and assess all of the data and evidence that indicates whether the catchment ecosystem is delivering a service.

The principal set of evidence that we can use to assess the water quality in a catchment is the WFD classification of the waterbodies. The ecological status of a waterbody is primarily measured using a series of biological parameters and is recorded on the scale high, good, moderate, poor and bad (with moderate or worse being regarded as a failure).

The different status classes used represent different degrees of disturbance to the various indicators of ecological health being measured. ⇦

WFD Data from EA Geostore with classification data from EA website.
(www.geostore.com/environment-agency)
(www.data.gov.uk/dataset/wfd-surface-water-classification-status-and-objectives)

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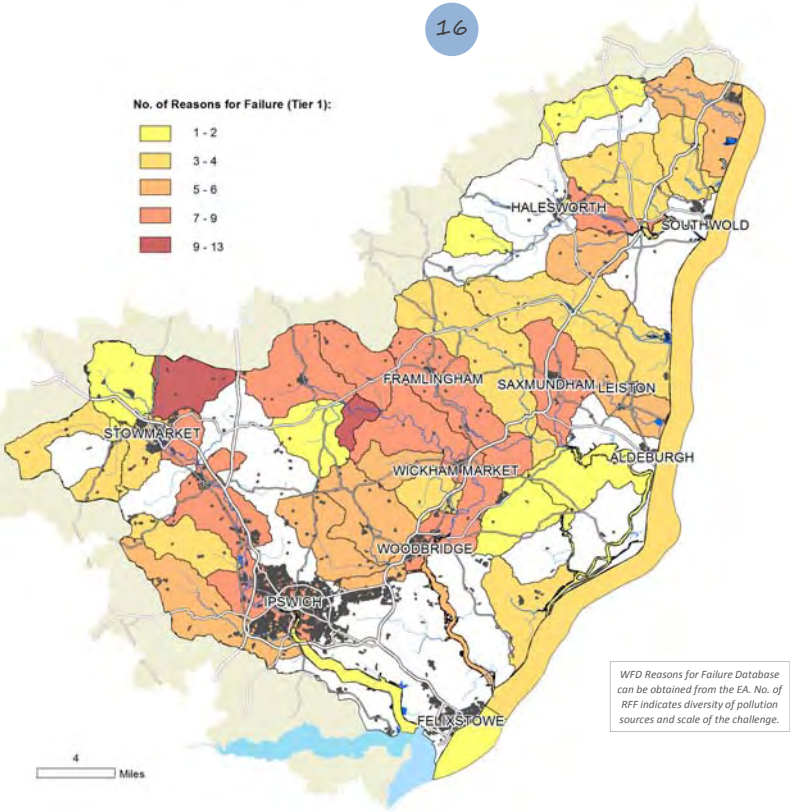
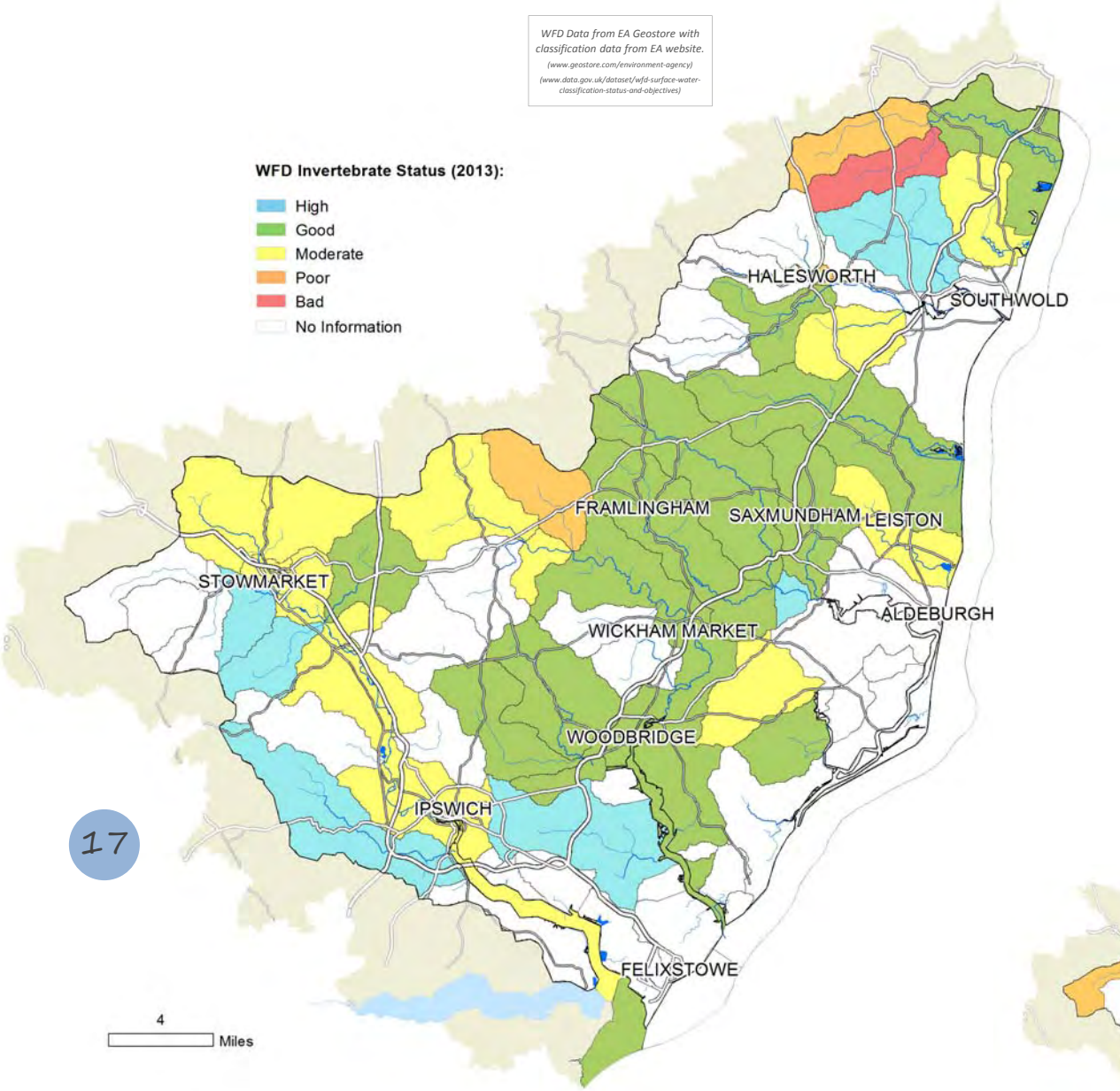


WFD Reasons for Failure Database can be obtained from the EA. No. of RFF indicates diversity of pollution sources and scale of the challenge.

WFD Reasons for Failure

The Environment Agency's WFD Reason for Failure database identifies the causes of a waterbody being determined to be at less than Good Status (activity, source, sector). The cause is recorded using a defined set of reasons for failure and pressures. ⇨



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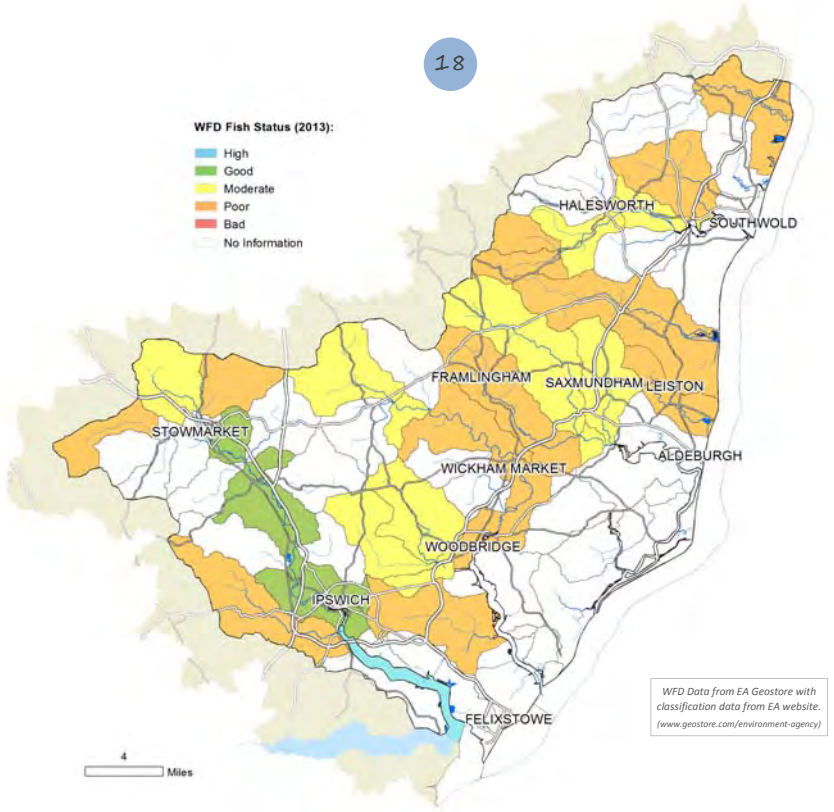
WFD Biological Assessments

For surface waters, such as rivers and lakes, the 'overall status' of a waterbody is comprised of an ecological and a chemical component. The ecological status of a waterbody is primarily measured using a series of biological parameters and the different status classes are used to demonstrate different degrees of disturbance to the various indicators of ecological health being measured.

WFD Invertebrate Status

The evaluation of invertebrate assemblages in a river is a good method for assessing the impacts of environmental stress. Invertebrate samples collected using standardised methods are identified to the level of taxonomic family or species and their approximate abundance in the sample recorded. This data is then used to calculate biotic indices which are used to draw conclusions about the condition of the river and to make comparisons between sites on the same or different rivers. ⇦



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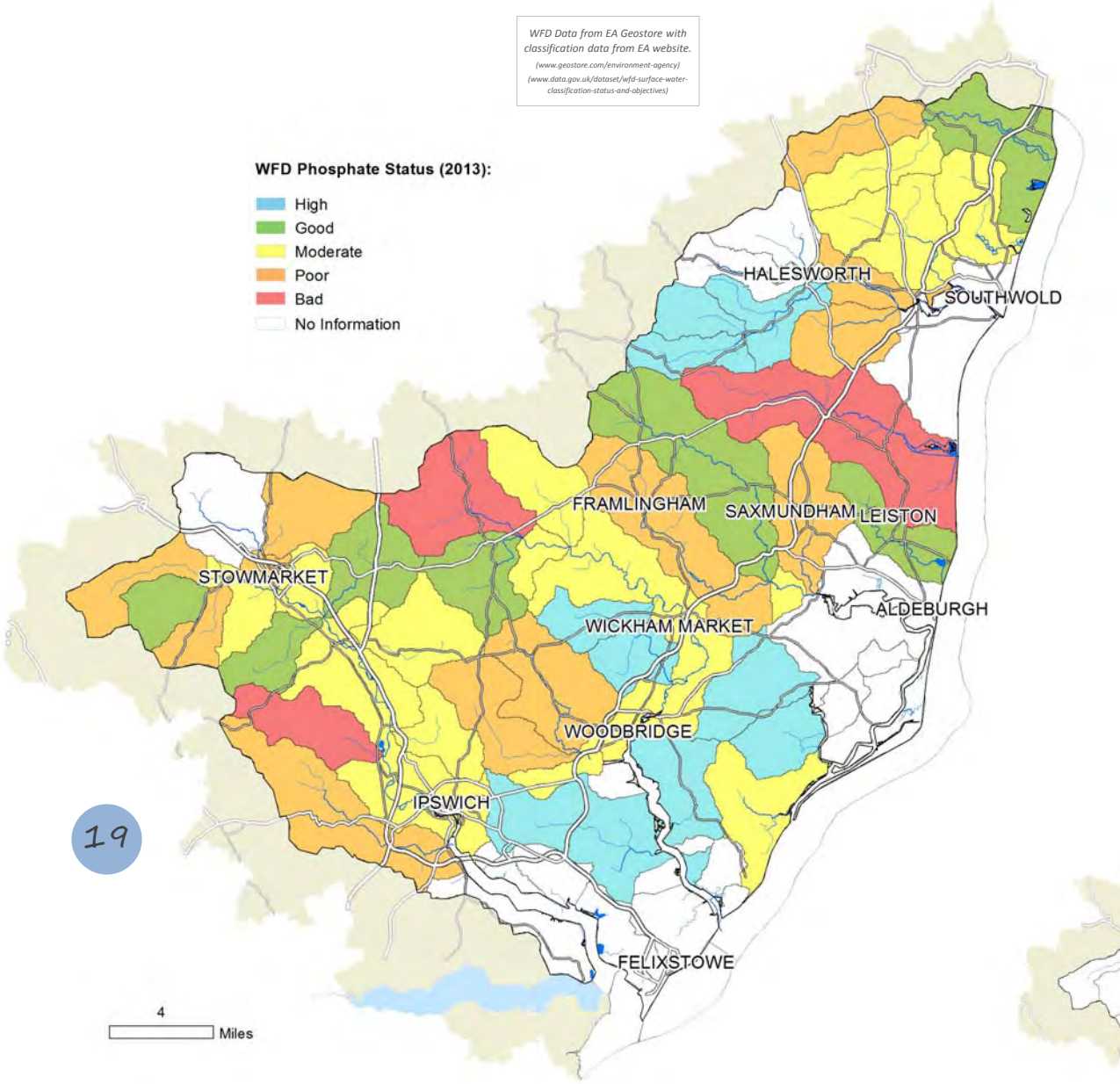
WFD Fish Status

Fish populations, especially of salmonid species, are widely accepted to be good biotic indicators of river ecosystem health. The WFD assessment method for fish uses a non-parametric geo-statistical model called the Fisheries Classification Scheme 2 (FCS2) to predict the abundance of different fish species that should be found in a particular river based on a number of recorded environmental variables and the geographic location of the site. ⇨



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WFD Diatom Status

Diatom indices are a well-established method for assessing water quality. It is widely accepted that a detailed evaluation of the structure and function of phytobenthic (diatom) communities in a river can provide robust evidence for assessing its ecological condition. Diatom community composition is particularly affected by changes in the pH and nutrient levels in the water and can be used to identify rivers impacted by these types of pollution. ⇨

WFD Nutrient Assessments

Nitrogen and phosphorus containing compounds (often termed nutrients) are natural and vital components of healthy aquatic ecosystems. They play a critical role in supporting the growth of aquatic plants and algae, which, in turn, produce oxygen and provide habitats that support the growth and reproduction of other aquatic organisms.

Unfortunately, when nutrients accumulate in aquatic ecosystems they can drive the uncontrolled and unbalanced growth of aquatic plants and algae in a process called eutrophication which can cause severe problems for other aquatic organisms, the ecological health of the waterbody and for the humans who also depend on the water.

Communities of phytobenthic algae (known as diatoms) that live in a river are very sensitive to nutrient enrichment and are therefore good indicators of degraded ecological health.

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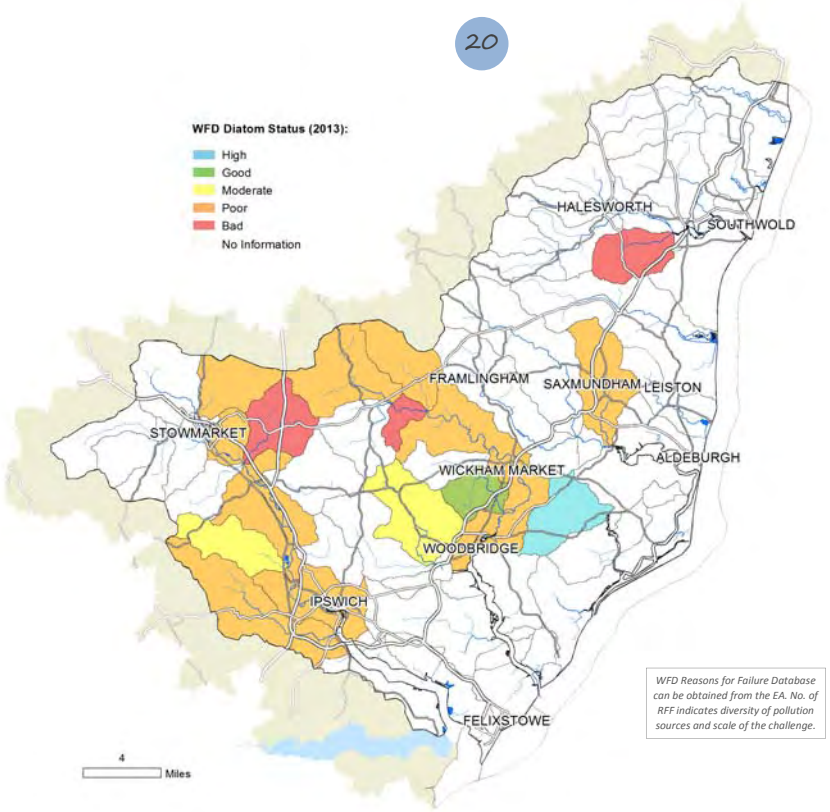
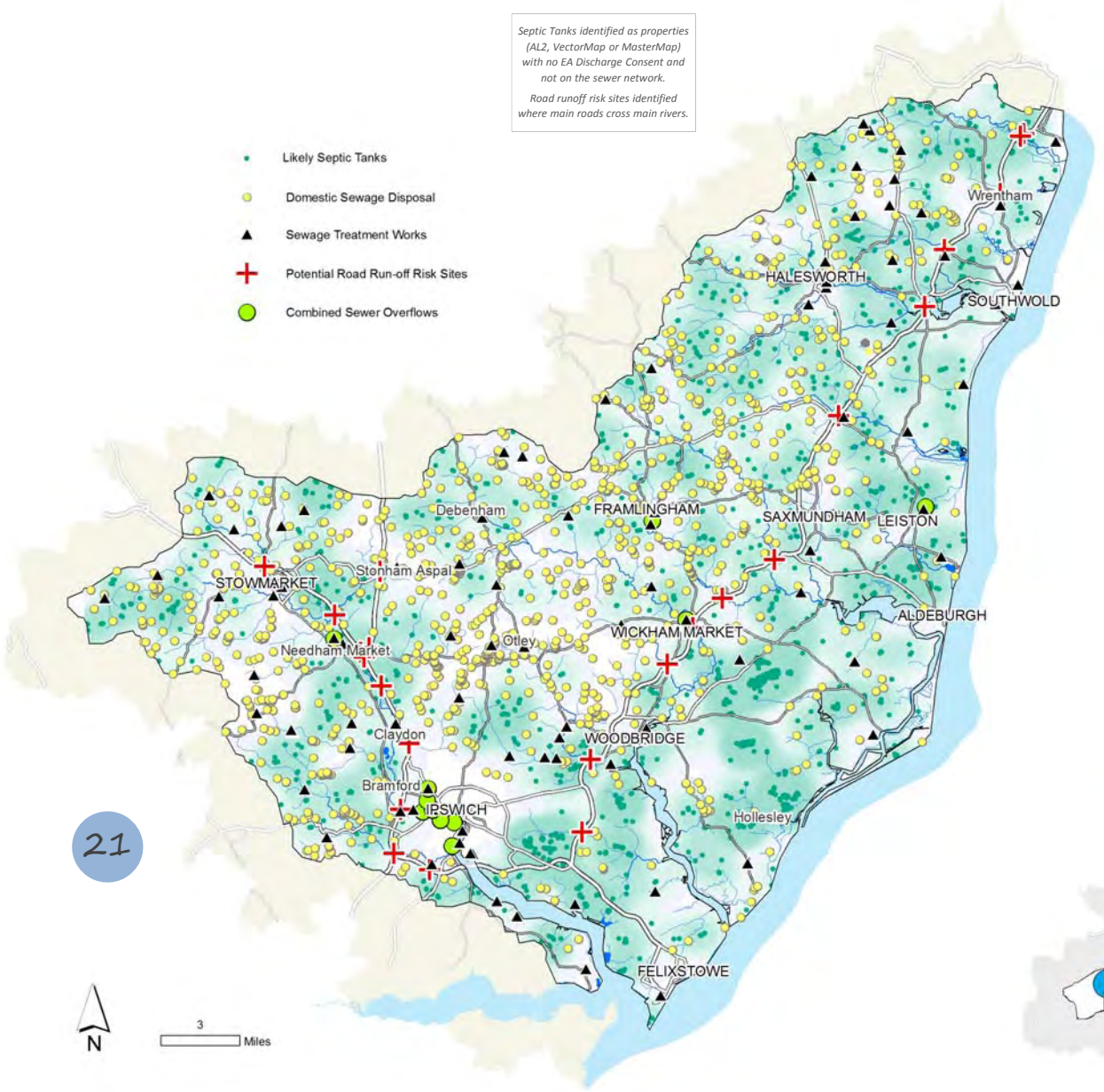


WFD Reasons for Failure Database can be obtained from the EA. No. of RFF indicates diversity of pollution sources and scale of the challenge.

Point sources of pollution

Given that the contamination in a catchment can be caused by a wide array or different pollutants in different locations, and that these pollutants can each be derived from a number of different sources, it is vital to explore the contribution that different sources of contamination make to the pollution load in different sections of the catchment.

There are a huge number of pollutants that can be derived from so-called point sources (outfalls, discharges, drains, mis-connections, etc..) and it is important to consider the location and contribution of these alongside examination of the different diffuse sources when making an assessment of the water quality problem in a catchment and designing a programme of interventions to correct it. ⇦



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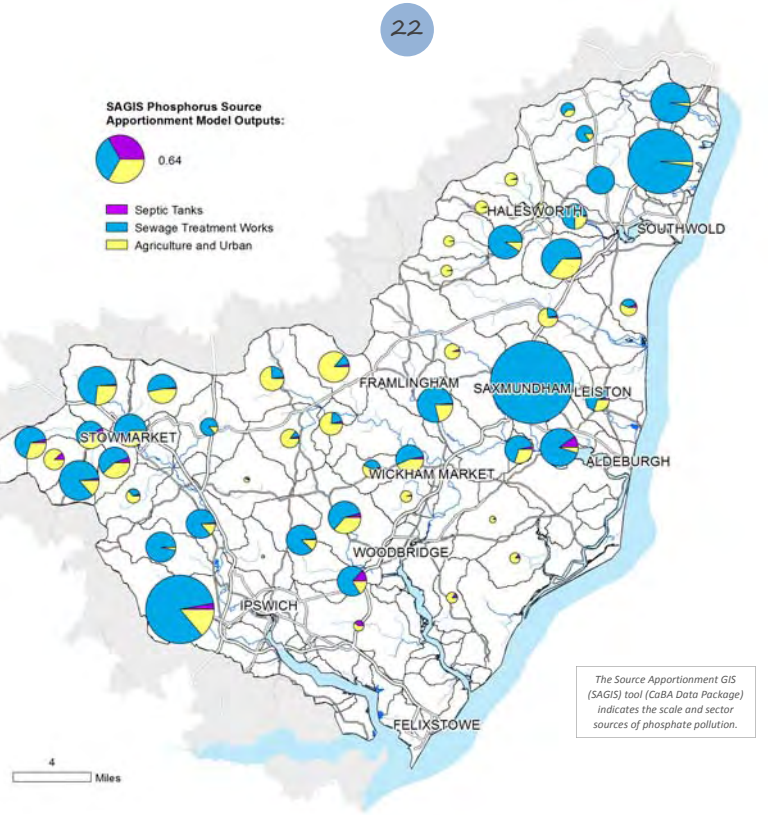

The Source Apportionment GIS (SAGIS) tool (CaBA Data Package) indicates the scale and sector sources of phosphate pollution.

Pollution source apportionment

The sources of different pollutants occurring in a catchment can be estimated a variety of data, water quality monitoring and modelling techniques. The Source Apportionment GIS (SAGIS) is one of these tools, which estimates the load, concentration and sources of nutrient pollution in waterbodies across an entire catchment area. ⇨

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Landuse/landcover Risk

Landuse is a key indicator of diffuse pollution risk as there are some practices/landuses which inherently pose more of a threat to water quality. For example (notwithstanding that any landuse can become a source of pollution if its condition deteriorates) arable, temporary grassland/ rotational crops, permanent pasture and natural habitats have inherently reducing risk of generating pollution. ⇨

Opportunities for enhancement

The priority areas for water quality protection/enhancement are defined as areas of increased risk/importance for water quality regulation (as defined above) with additional information about landuse and condition superimposed on the top. The highest scoring opportunity areas for water quality enhancement are identified by superimposing additional information about activity or land condition onto the map of infrastructure that regulates water quality. ⇦

Other optional measures to be considered

Data / information	Notes
Farming practice/intensity *AgCensus 2010 from EDINA AgCensus. Not included. (www.edina.ac.uk/agcensus)*	An indication of the intensity of farming practice can be gained using AgCensus data.
Soil condition assessment *Commercial product of NSRI (Cranfield University) or local soil surveyors. Not included as very patchy and expensive.*	Soil condition assessments are available from fine scale soil data, detailed local soil surveys or studies conducted using remote sensing techniques.
Land drainage *Dataset from the EU soils database. Not currently included.*	Areas likely to have land drainage. Remains un-proven – it may show where the risk is reduced for run-off, but not sure whether the impact on leaching has been considered.

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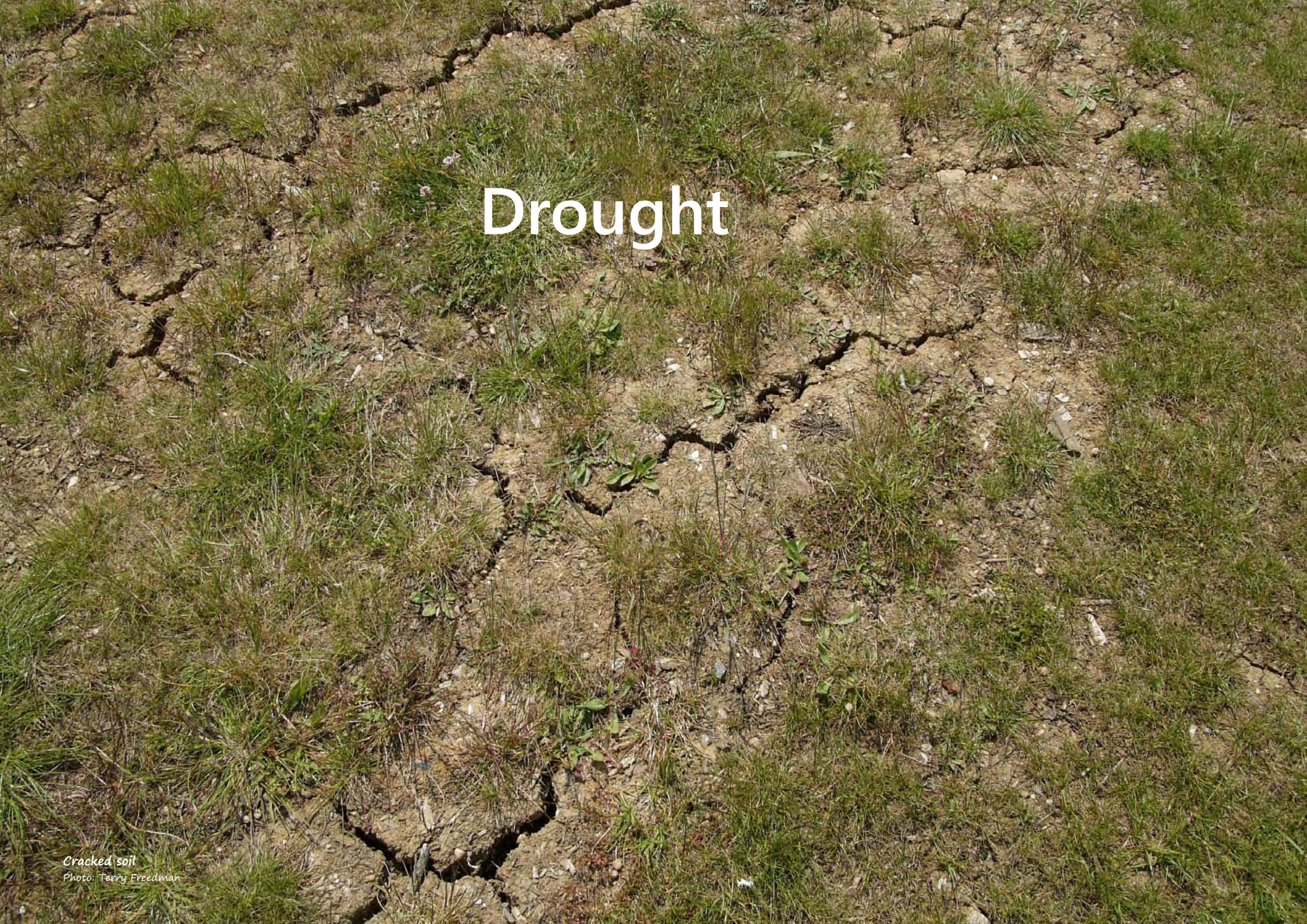
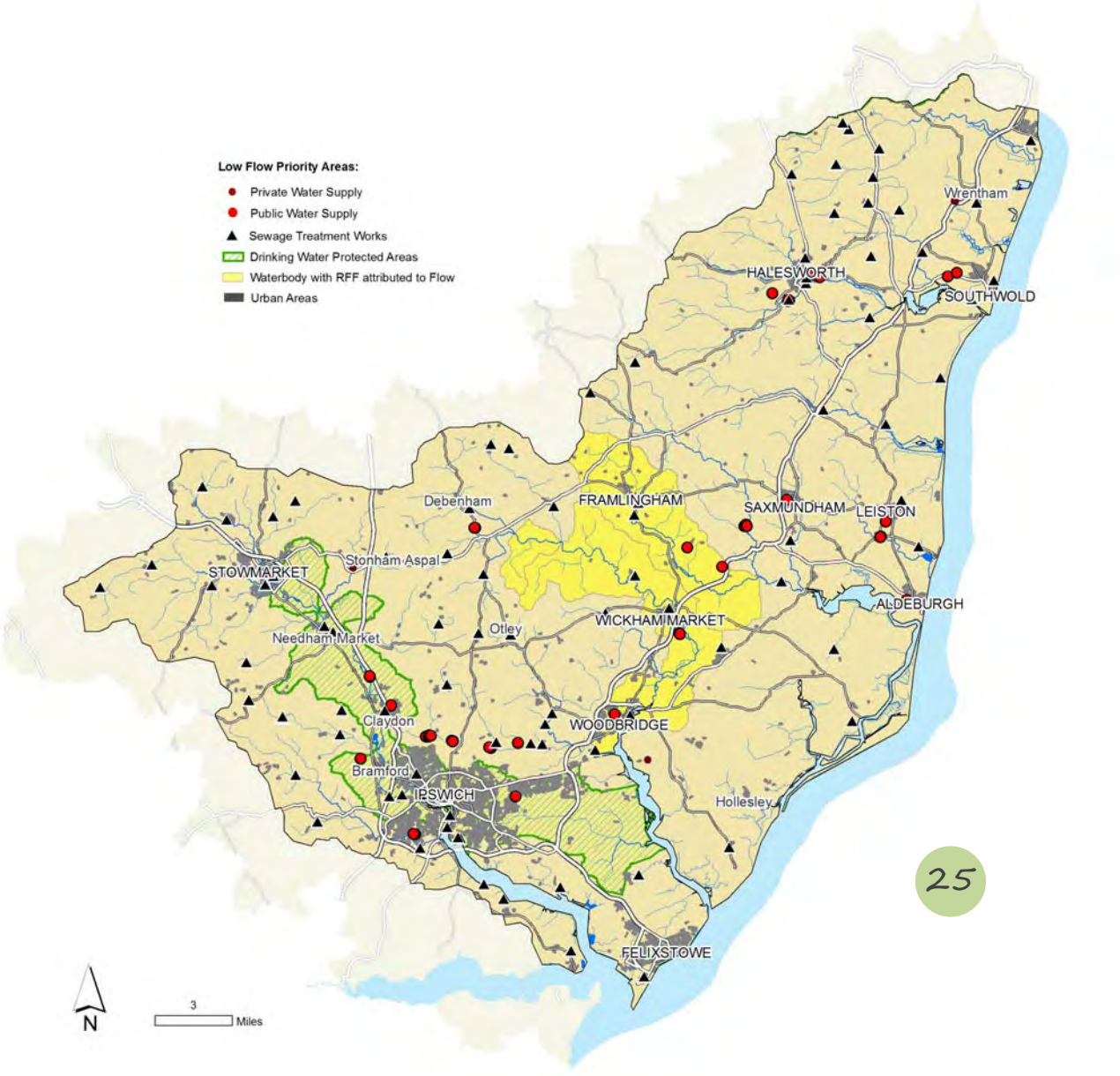
Drought



Cracked soil
Photo: Terry Freedman



Priority areas for drought alleviation

There are a number of locations in a catchment landscape where a reduced ability for an ecosystem to maintain base flows in rivers during periods of low rainfall will exert a negative impact.

Water quantity in a river has a direct bearing on the effluent volumes and concentrations that can be discharged from point sources of pollution. Sufficient flows are required to ensure that effluent is diluted appropriately downstream.

Where abstraction intake licences exist for drinking water supply there is a clear need for baseflows to be maintained. Rivers also require sufficient flow during dry periods to remain in good ecological condition. ⇦

Rivers – Ecological Health	
Data / information	**Notes**
Flow for ecological health of rivers *WFD Reasons for Failure Database can be obtained from the EA.*	Waterbodies where flow may be driving degradation in ecological health can be identified from the EA's Reason for Failure database

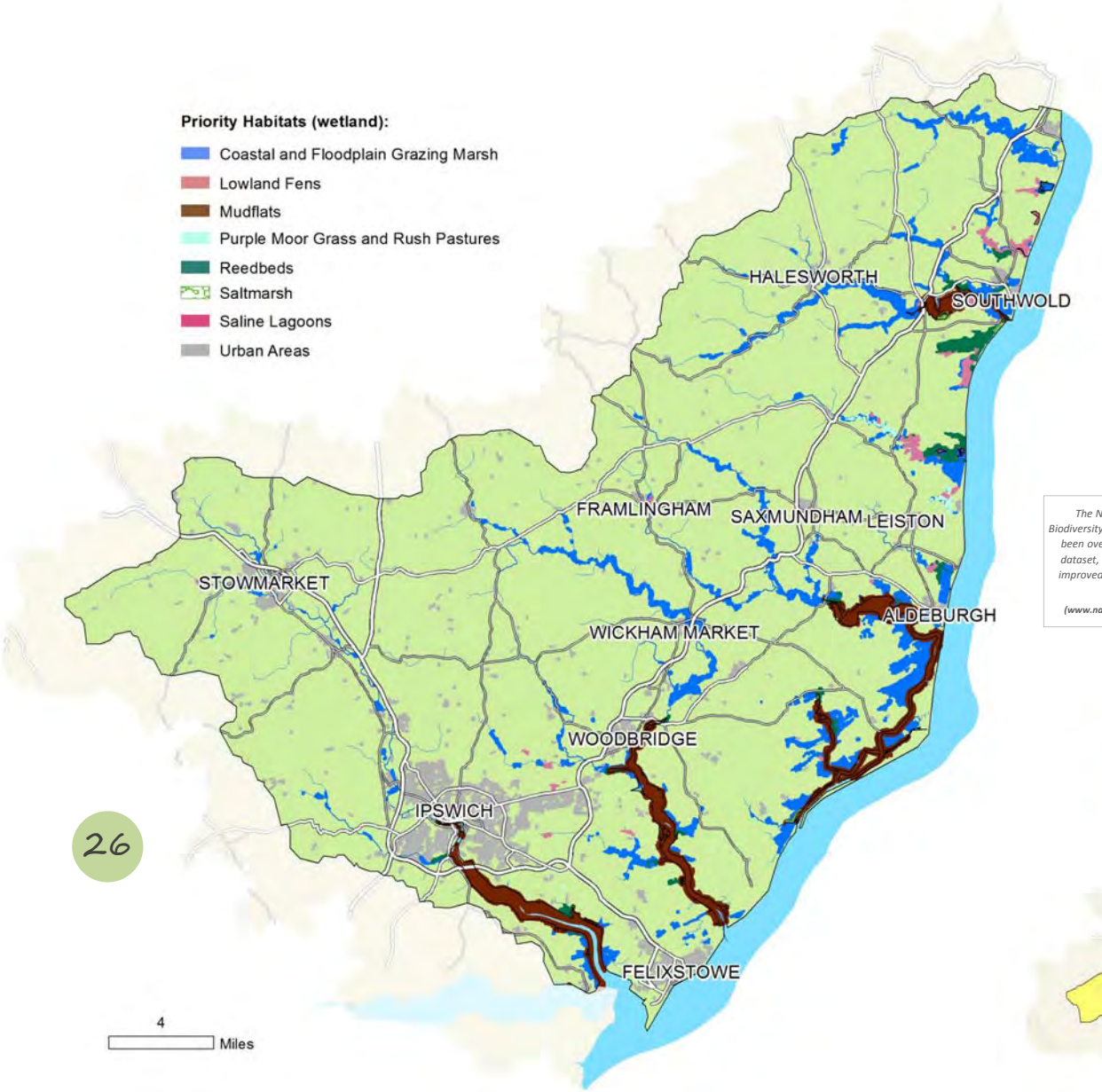
Sewage effluent dilution – Sewage Treatment Works	
Data / information	**Notes**
Sewage Treatment Works (STWs) *EA dataset from Geostore www.geostore.com/environment-agency*	STWs can have a significant impact on water quality - STWs can be mapped using the EA Discharge Consents dataset (optionally in comparison or supplemented with water company data).

Drinking Water Abstractions	
Data / information	**Notes**
Drinking Water Protected Areas (DrWPAs) *EA dataset from Geostore www.geostore.com/environment-agency*	WFD waterbodies where drinking water for public supply occurs are designated Drinking Water Protected Areas (DrWPAs) – these can be mapped from the EA WFD Classification data.
Abstraction Locations *EA dataset from Geostore www.geostore.com/environment-agency Not currently included as not obtained yet.*	Abstraction locations are obtained in the EA's NALD Abstraction Licences dataset. Permitted details for these abstractions are not included in the data, but can be obtained from the EA or water company locally.
Private water supplies *Should be recorded by Local Authorities, but not included as not currently available.*	These low volume abstractions (<20m3/day), where treatment is often minimal, can be severely impacted by degraded raw water quality. Have been mapped by some Local Authorities, who took responsibility for their regulation in 2011, but this would require local investigation

Infrastructure regulating service

The principal land-based interventions that can delay the release of water from a catchment are: good management practices that maintain the healthy structure of soil, the cessation of land drainage in areas with a propensity to accumulate water (i.e. that are naturally wet), and the creation/restoration of upland and floodplain wetland habitats.

Wetland habitats, whether on upland peat-based soils or on the floodplain, have been shown by many studies to play a key role in the regulation of the hydrological cycle in river catchments and one of their principal actions is to act as water storage that releases water to rivers during periods of low rainfall and to contribute to the maintenance of base-flows. ⇦



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The Natural England Priority (formerly Biodiversity Action Plan) Habitat Inventories have been overhauled and combined into a single dataset, which is perceived by many to be of improved quality. Data available from NE GIS data website –

(www.naturalengland.org.uk/publications/data)

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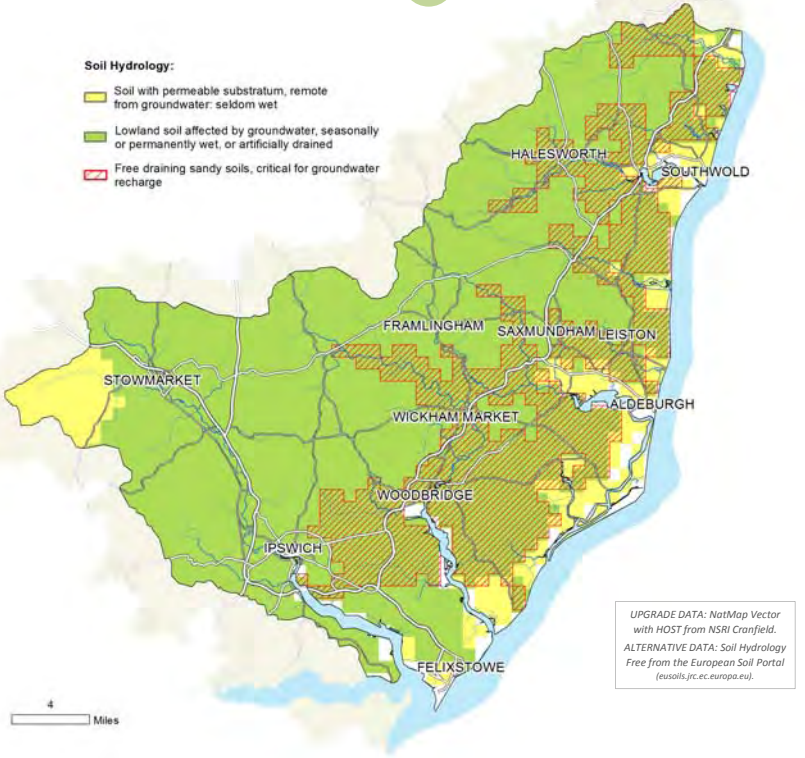


UPGRADE DATA: NatMap Vector with HOST from NSRI Cranfield.

ALTERNATIVE DATA: Soil Hydrology Free from the European Soil Portal (eusoils.jrc.ec.europa.eu).

Soil hydrology

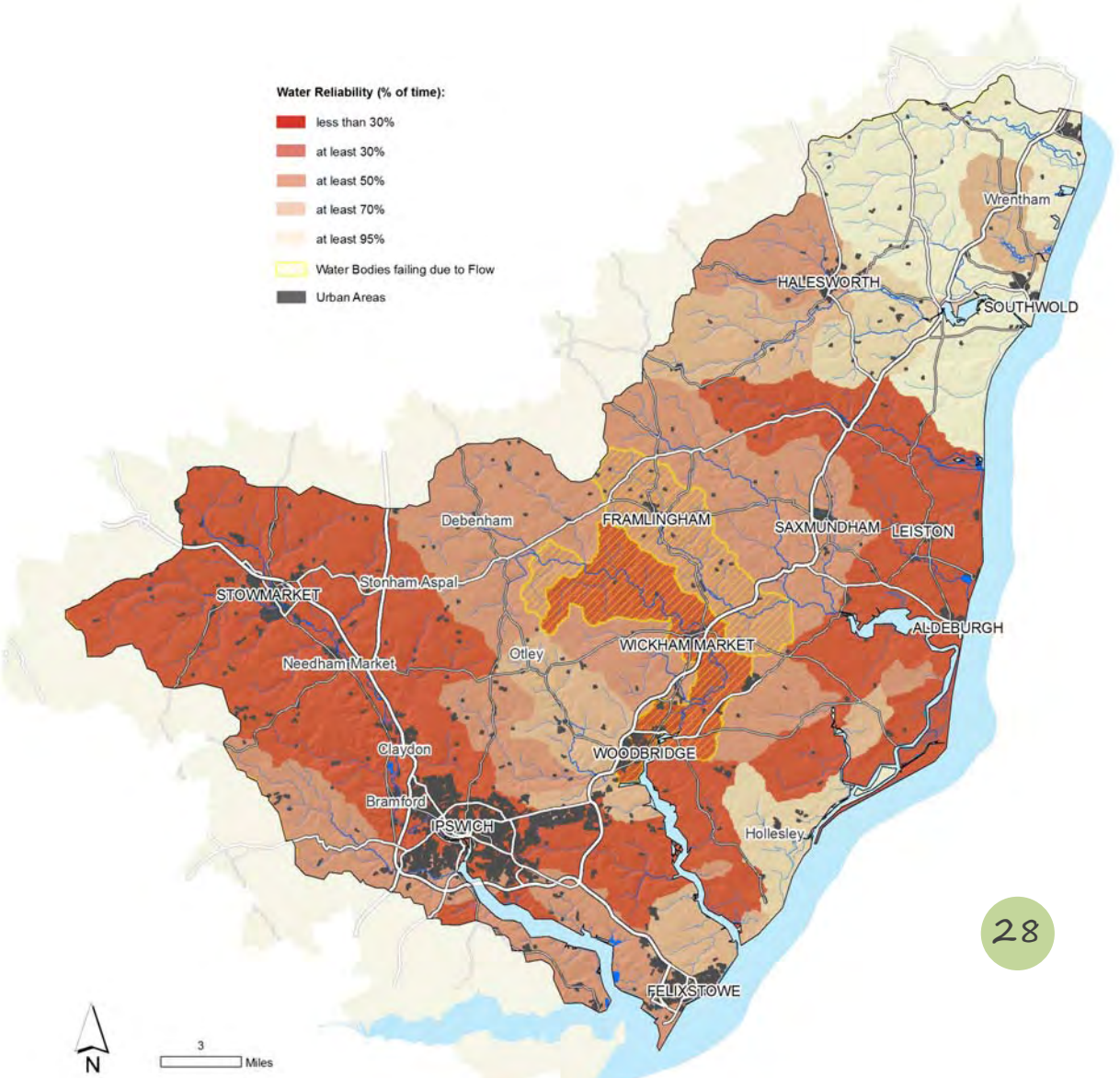
Soil hydrology is a key factor when examining an areas ability to hold water for longer and release it slowly to maintain base flows. Soils with a natural propensity to be water-logged are likely to play a greater role in regulating the flow of water through a landscape via surface waters, while free-draining soils (especially sandy soils) play a key role in transferring water into groundwater stores (see map right). ⇨

Water resources assessments

In order to assess the scale of any problems or deficiencies in ecosystem service provision from a catchment, we need to collate and assess all of the data and evidence linked to the assessment of water quantity for the maintenance of base flows. When considering the provision of an ecosystem service, such as the regulation of water flow, it is important to consider the time at which the greatest demands are placed on the service and to look into the future to assess whether greater demands will be placed on the service in the future.

The Environment Agency is responsible for managing water resources in England and they use the catchment abstraction management strategy (CAMS) process and abstraction licensing strategies to do this. They also identify where reduced flow may be causing rivers to be ecologically degraded through the WFD Classification and the Reasons for Failure Database. ⇩

Designated sites important for water quality	
Data / information	Notes
Catchment Abstraction Management Plans *CAMS and other water resources documents are available for download from EA website and local water company websites* *GIS dataset from Geostore www.geostore.com/environment-agency*	The Catchment Abstraction Management Strategies (CAMS) approach sets out how the EA will manage water resources within a catchment area. These plans are supplemented by a wide array of governmental and water company water resources management strategies and plans.
Reasons for failure *WFD Reasons for Failure Database can be obtained from the EA.* *Not yet included*	The EA Reasons for Failure database identifies the cause of less than Good classifications under WFD (activity, source, and sector). The cause is recorded using a defined set of pressures and reasons for failure. This data can be used to identify where low flow is causing ecological degradation.
Hydrometric data *Hydrometry data can be obtained from the EA through a data request.* *Not yet included*	In river flows are measured across a network of gauging stations. This data will require significant collation, pre-processing and analysis to get useful information out. Could alternatively get some of the very extensive CEH hydrological data, but this is commercial data.
Hydromorphological assessments *Hydromorphological survey data collected as part of the River Habitat Survey (RHS) can be obtained from the EA through a data request. Other local organisations may also have this type of data.* *Not yet included*	There are a number of walkover survey methodologies (such as the WFD River Habitat Survey and the recently developed Rivers Trust Fluvial Audit) and biological sampling methods (such as the LIFE Invertebrate Index), which can be used to identify where lack of flow may be impacting the ecological health of a watercourse. This data may be challenging to obtain and is very difficult to analyse without assistance.



Soil hydrology

Soil hydrology is a key factor when examining an areas ability to hold water for longer and release it slowly to maintain base flows. Soils with a natural propensity to be water-logged are likely to play a greater role in regulating the flow of water through a landscape.

Soil Hydrology dataset is free to download from the European Soil Portal (eusoils.jrc.ec.europa.eu). The EU Soils Database this has a hydrology of soils layer as a 1km x 1km grid – see map 26.

POSSIBLE UPGRADE: NatMap Vector with Hydrology of Soil Type (HOST) classification from NSRI Cranfield.

European Soil Hydrology data reclassified according to its potential to support wetland habitat.
SUITABLE SOIL = 2pts
UNSUITABLE SOIL = 0pt

Propensity to be inundated

Wetland restoration or creation is most successfully achieved on land with a high natural propensity to be seasonally or permanently wet or water-logged either through groundwater efflux or surface water inundation.

In many strategic mapping approaches this land is primarily identified as being on the floodplain.

EA Flood Zones are the best indicator of flood plain extent (although functional flood plain may be available from Local Authority through their Strategic Flood Management Plan – SFMP). Need to exclude Areas Benefiting from Flood Defences.

EA dataset from Geostore - www.geostore.com/environment-agency

EA Flood Zone 2 reclassified to indicate locations that are on the flood plain.
ON FLOOD PLAIN= 2pts
NOT ON FLOOD PLAIN = 0pt

Hydrological Connectivity

In some locations water has a greater propensity to run over the surface and collect due to the shape of the land and the accumulation of water over an upstream catchment area. These areas are of critical importance to the regulation of water flow as this is where moving water has the greatest chance of being slowed as it moves through the landscape.

Surface Flow Index is modelled from topographic data using the Durham University Network Index tool in the open source SAGA 2.0 GIS package. Once calculated the 'wettest' 5 or 10% of the land surface can be identified as the most hydrologically connected.

Surface Flow Index reclassified to show the wettest 5 and 10% of land areas.
WETTEST 5% = 2pts
WETTEST 5-10% = 1pt
NOT WET = 0pt

Areas to be excluded

There are a number of factors that make it less likely that wetland creation could be undertaken in a particular location. These factors can be excluded from the opportunity identification process.

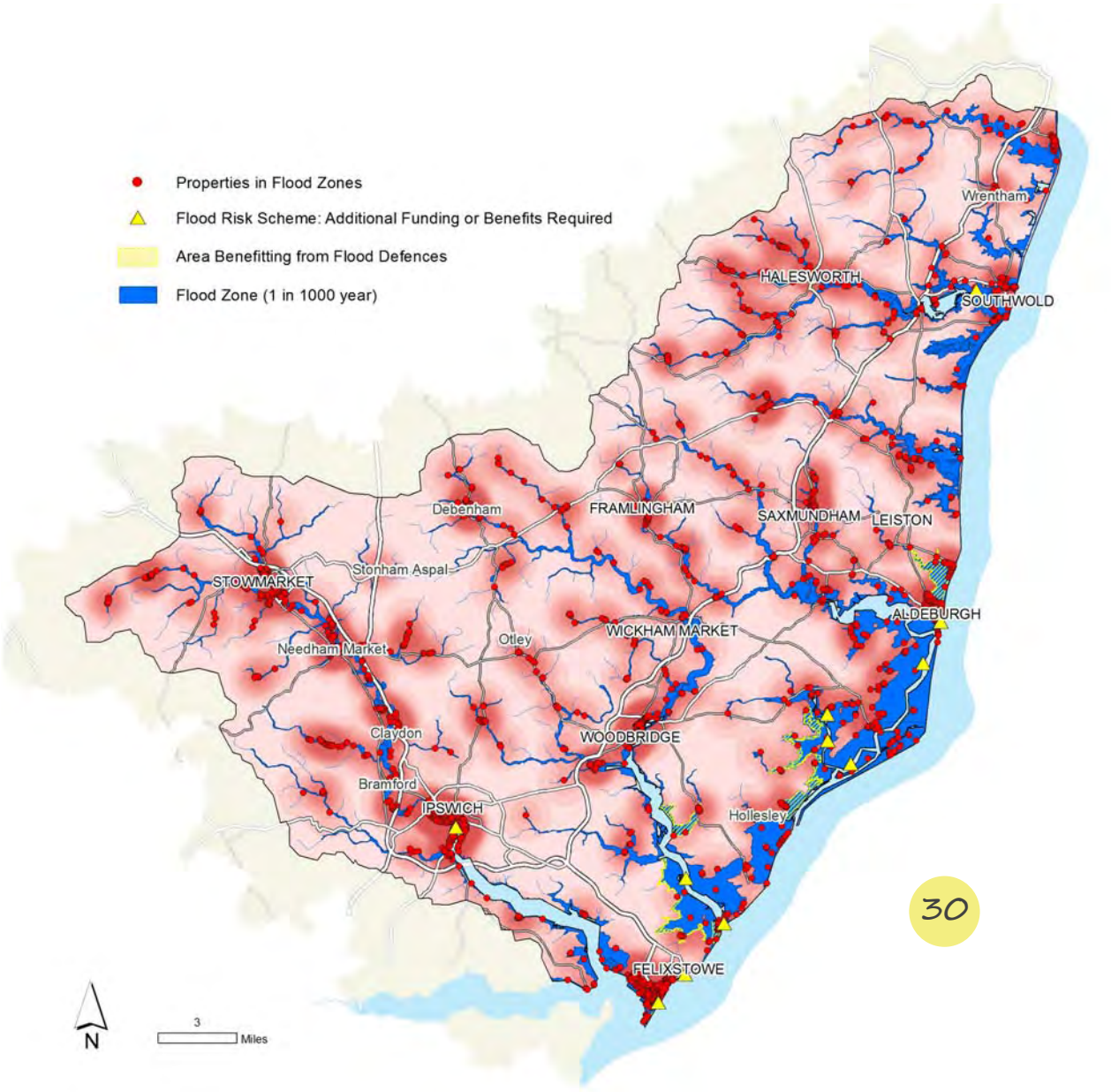
Datasets include urban areas (OS Open Data), existing natural habitats (NE Priority habitats), existing designated sites (NE Designated Sites), important historical features (EH Scheduled Ancient Monuments), contaminated land (EA) or highly productive agricultural land (NE ALC) occurring on a particular site.

Opportunities for enhancement

It is widely accepted that there are two main methods for the enhancement of water quantity regulation for drought alleviation (i.e. holding water in a catchment landscape for longer and releasing it more slowly after cessation of rainfall): 1) restore/maintain good soil condition everywhere, and 2) restore/create wetland habitats. The former of these should be undertaken everywhere as a minimum requirement of good land management practice and every attempt should be made to identify soil in poor condition and restore its structure. Opportunities for the second can be identified using a wetland creation/restoration suitability mapping exercise similar to that adopted in the Wetland Vision and EA Habitat Creation Strategy Projects. ⇩

Flooding

Southwold Flood in 2007
Photo: Claire Guppy (CC2.0)



Properties at Risk of Flooding

Properties and infrastructure at risk of flooding have been determined using the EA Flood Zones and data representing buildings of properties. This is shown as a density map to represent priority/ hotspots at a catchment scale. ⇧

Properties at risk of flooding can be mapped using a number of freely available or commercial products including: OS Address Layer 2, VectorMap/MasterMap Buildings or (worst case scenario) Urban Areas from OS Strategi.

Priority flood risk areas

There are often many locations in a catchment where the unregulated release of water from the land and into our rivers can pose a threat to people living in the catchment and cause community disruption. In addition to residential properties there may also be locations where important buildings and other critical infrastructure are at risk of flooding.

The properties and infrastructure at risk of being flooded can be mapped and cross-referenced against the flood risk zones and the surface water flood risk areas to identify where there is a risk of flooding and damage to property or threatening human health and safety. ⇦

Infrastructure regulating service

Hydrological Connectivity – see Map 14

There are some locations in the landscape where water has a greater propensity to run over the surface and collect due to the shape of the land and the accumulation of water over an upstream contributing area. These areas are of critical importance to the regulation of water flow as this is where moving water has the greatest chance of being slowed as it moves through the landscape.

Data / information	Notes
Surface Flow Index – modified wetness *Digital elevation data is available from a variety of sources. 50m data is freely available from OS Open Data (Terrain50), while 5-10m data can be purchased from OS or Nextmap.*	We can identify areas of high hydrological connectivity using the modified 'wetness index' used to create the Surface Flow Index/Network Index in the SCIMAP modelling framework. This can be run on DEM data at a variety of resolutions with varying effects in the outputs. This can be quite a technically difficult analysis, but will show areas with a propensity to accumulate water by surface or sub-surface flow.

Propensity to be inundated

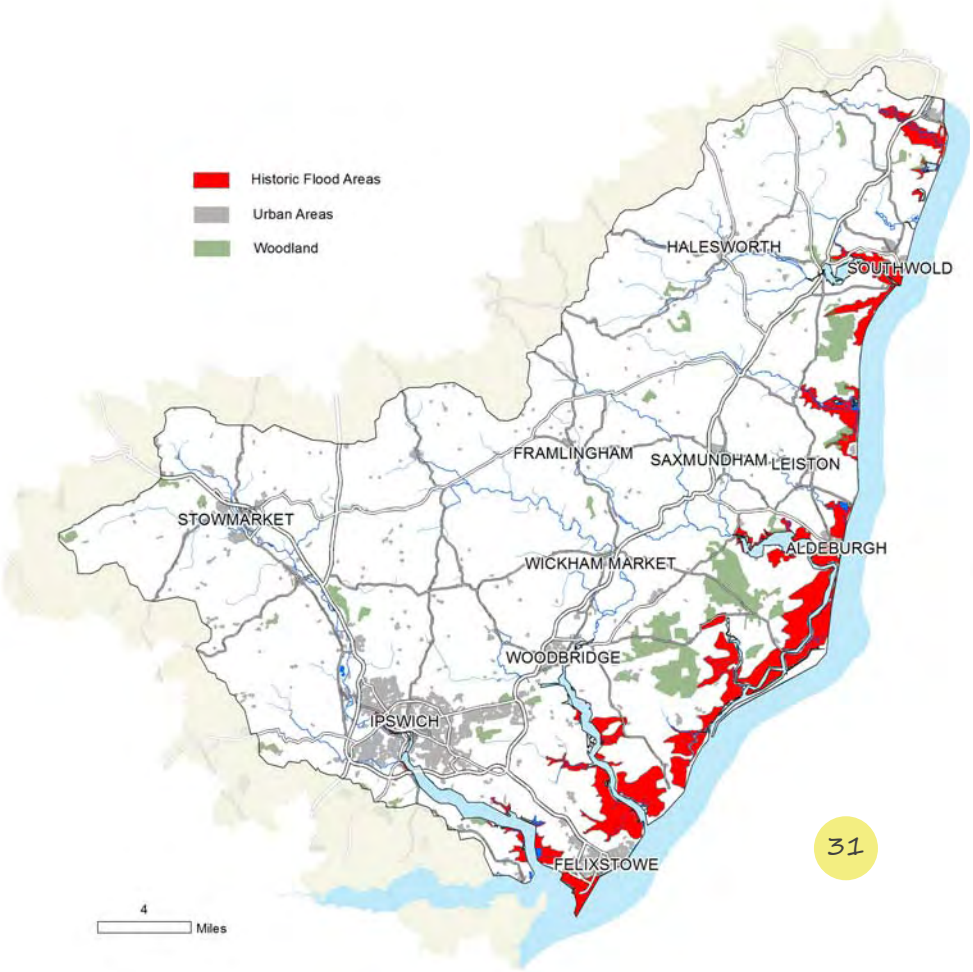
A functioning flood plain will deliver natural peak flow attenuation, which acts to change the shape of the flood hydrograph (reducing the flood peak and increasing flood duration) due to a combination of storage capacity and increased resistance to over-land flow of water.

Data / information	Notes
Flood Plain *Flood Zones are an EA dataset available from the Geostore - www.geostore.com/environment-agency*	EA Flood Zones are the best indicator of flood plain extent (although functional flood plain may be available from Local Authority through their Strategic Flood Management Plan – SFMP). Need to exclude Areas Benefiting from Flood Defences (part of the Flood Map Package).

Assessing the provision of the service

There is a large body of evidence than can be used to indicate whether high flows have caused a problem in a catchment and to therefore quantify the provision of this ecosystem service. Much of this information is captured in the Environment Agency's Catchment flood management plans (CFMPs) which consider all types of inland flooding, from rivers, ground water, surface water and tidal flooding.

Historic Flood Outlines is the maximum extent of all recorded individual Historic Flood Events Outlines from river the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England & Wales, while the National Flood Risk Assessment predicts the cost of flooding across the catchment. ⇩



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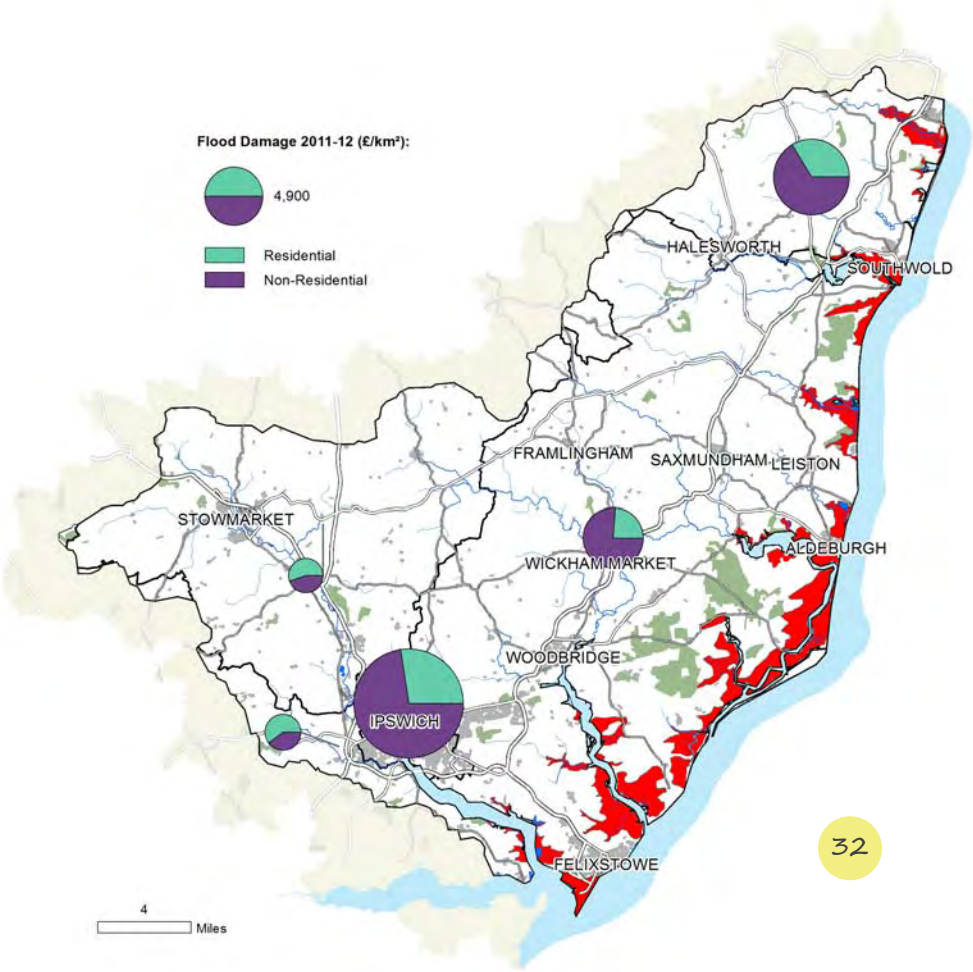

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Historic flood map

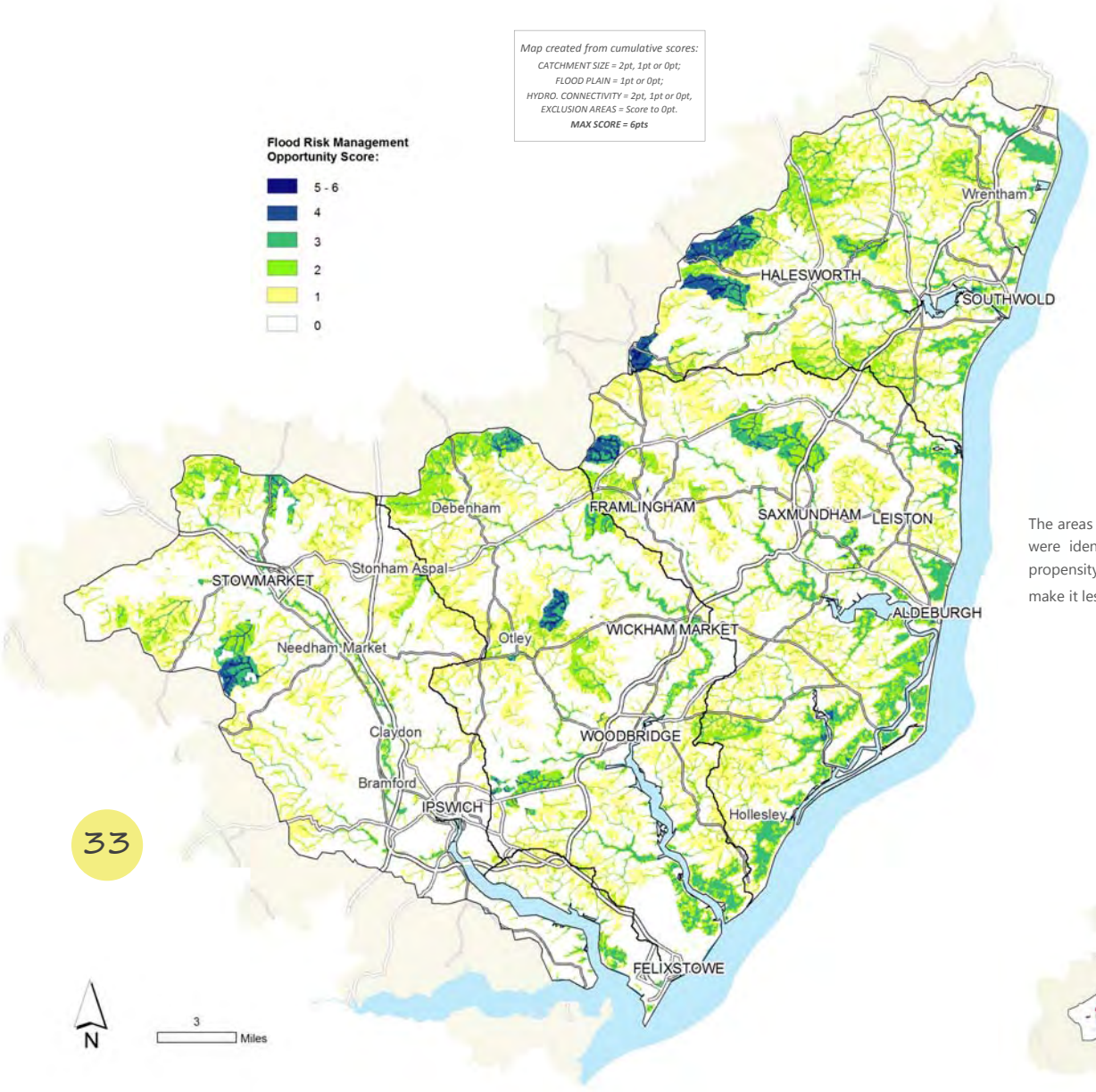
Historic Flood Map is the maximum extent of all recorded individual Historic Flood Events Outlines from river, the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England & Wales.

The historic flood extents are part of the EA Flood Map data package that is available from the EA Geostore - www.geostore.com/environment-agency

Critical Infrastructure/Cost of Damages

The Environment Agency's National Flood Risk Assessment (NaFRA) provides an indication of flood risk at a national level. The data has been created by calculating the likelihood of flooding to areas of land within the flood plain of an extreme flood (1 in 1000 chance in any year). The method considers the probability that the flood defences will overtop or breach. It also predicts the cost of flood damage that could be incurred.

For more information about NaFRA see – www.tinyurl.com/nxxvc8x



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Opportunity areas with small upstream catchments

In light of the evidence that land-based interventions are likely to deliver the most cost-effective and demonstrable flood risk benefit in smaller catchments, the flood risk management opportunity mapping process first identifies properties at risk of flooding with small upstream catchments (less than 5 sq km = max opportunity, 5-10 sq km = high opportunity). ⇨

Opportunities for enhancement

The principle 'soft-engineering' or land management methods used to mitigate flood risk involve the prolonged storage of water on the land (in a pond or on the flood plain) either before it enters a watercourse or by removing it from the watercourse in specific locations and delaying its progress down through the river network.

Most importantly, it has been extensively demonstrated that interventions of this nature can only be delivered at a level that achieves measurable attenuation of peak flows in small catchments below a certain size. Once a catchment exceeds this size the volume of accumulated flow reaches a point where it is not possible to store enough water to have a noticeable effect on the flood peak.

The areas of greatest opportunity for achieving demonstrable flood risk mitigation using land-based approaches were identified by combining the small upstream catchments of properties at risk with the areas with a propensity to be inundated, areas with high hydrological connectivity and then removing areas with features that make it less likely that mitigation measures could be undertaken in a particular location. ⇦

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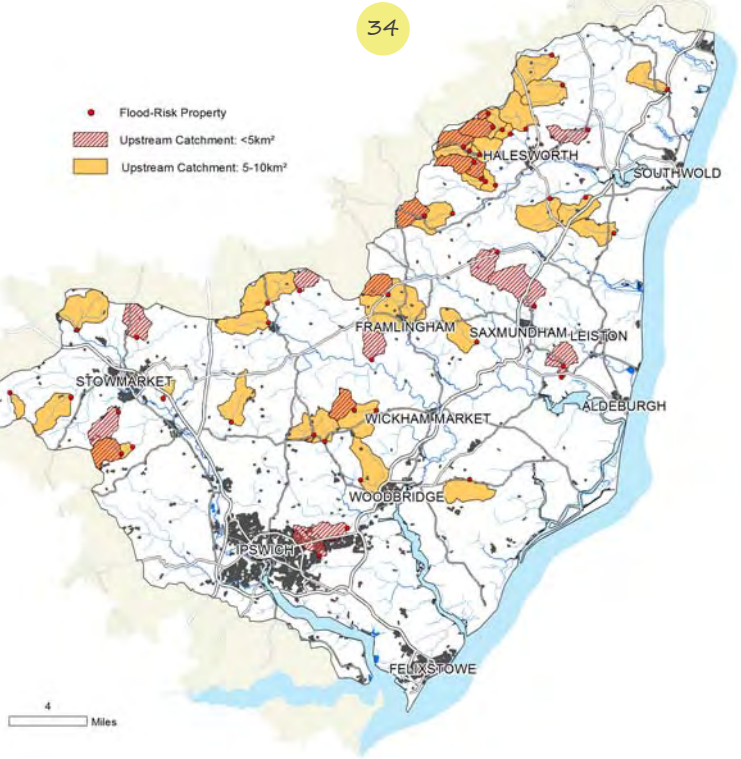

A Red-backed Shrike at Boyton Marsh

Photo: Rabs Pics (CC 2.0)

Habitats for Wildlife

Priority areas for habitats

The conservation of wildlife and biodiversity in the UK has traditionally focused on three principal approaches: (1) the protection of important species and habitats through designation and protection of high quality habitats supporting priority species, (2) the creation and management of wildlife habitats on farmland through agri-environmental schemes (the so-called 'pillar 2' of the EU's Common Agricultural Policy), and (3) the protection or creation of natural spaces in urban areas (greenspaces) through local planning processes.

In addition, numerous strategic mapping exercises have been undertaken to identify priority areas where habitat creation and/or restoration work should or could best be undertaken to enhance the provision of functional ecological networks at a landscape-scale. These studies have included the mapping of biodiversity opportunity areas (various regional Biodiversity Forums), Strategic Nature Areas (SW Biodiversity Forum), Wetland Vision (various conservation groups), Regional Habitat Creation Strategies (Environment Agency) and the England Habitat Network (Natural England; below). ⇩

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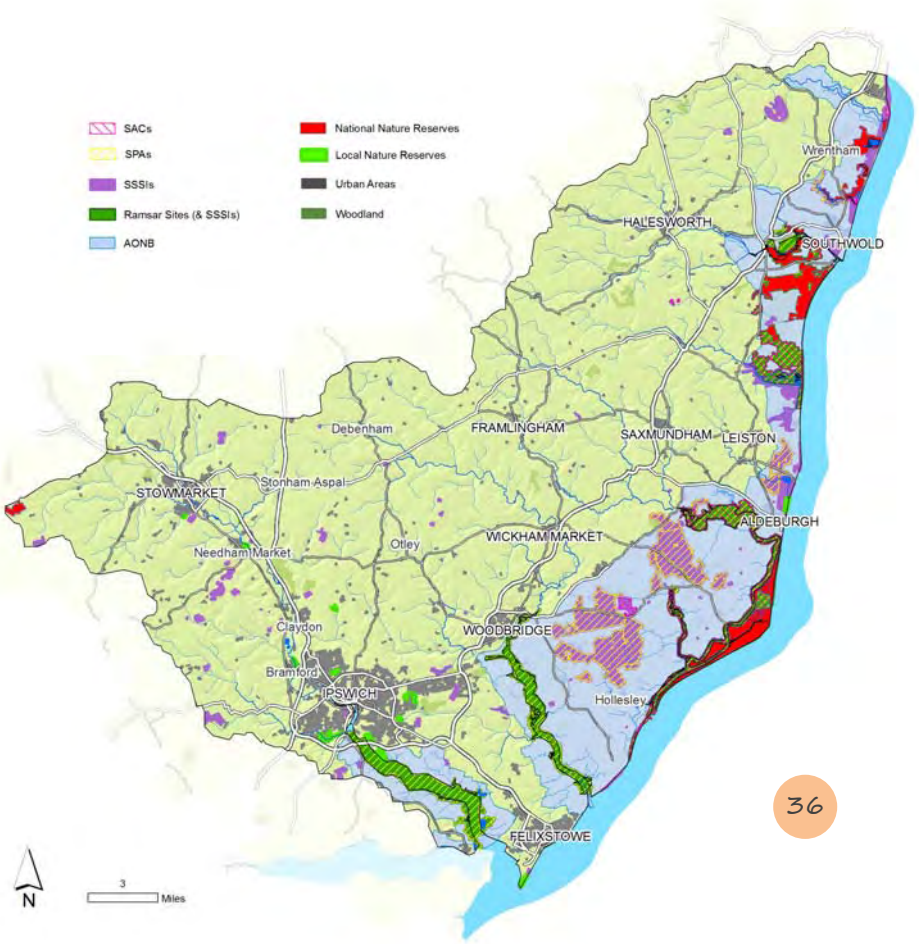

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England Habitat Network

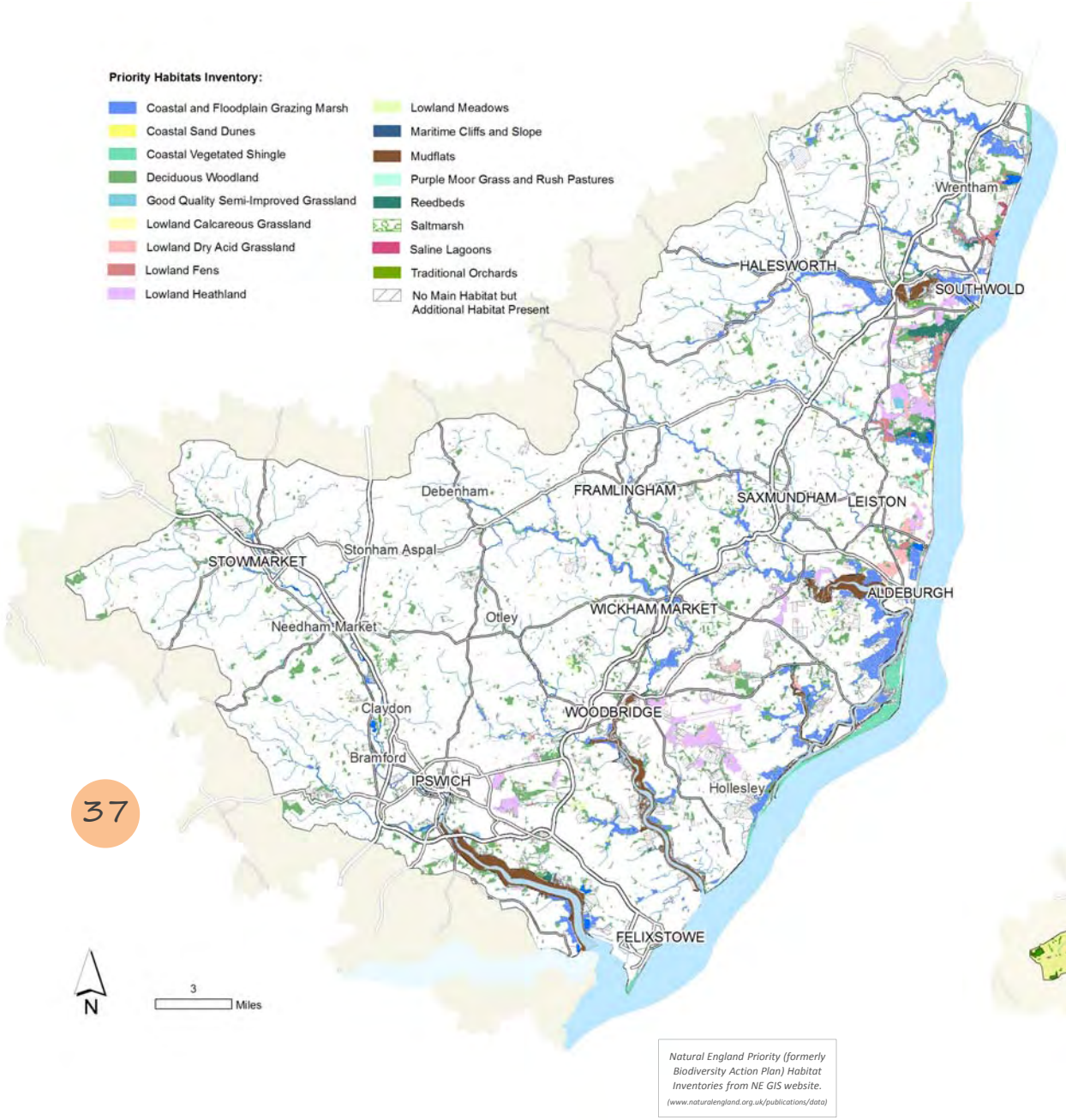
The England Habitat Network (EHN) was developed by English Nature (2005) in an attempt to systematically evaluate the impact of fragmentation and land use intensification on areas of conservation value, at a national scale. A series of data layers were subsequently published, at the end of 2006, which defined areas of landscape where clusters of sites might be functioning as 'ecological networks' – i.e. linked by the frequent exchange of propagules and/or individuals.

England Habitat Network data free to download from Natural England GIS website -www.naturalengland.org.uk/publications/data

Designated Sites Network

There are a number of statutory designations protecting England's terrestrial and aquatic natural environment under both national (Sites of Special Scientific Interest - SSSIs, Ancient Woodlands, National Parks, AONBs) and international law (Ramsar Wetlands, Special Conservation Areas - SPAs, Special Areas for Conservation - SACs). These designated sites represent critical infrastructure in the conservation of biodiversity in the UK and should be prioritised for protection.

Designated Sites data free to download from Natural England GIS website -www.naturalengland.org.uk/publications/data

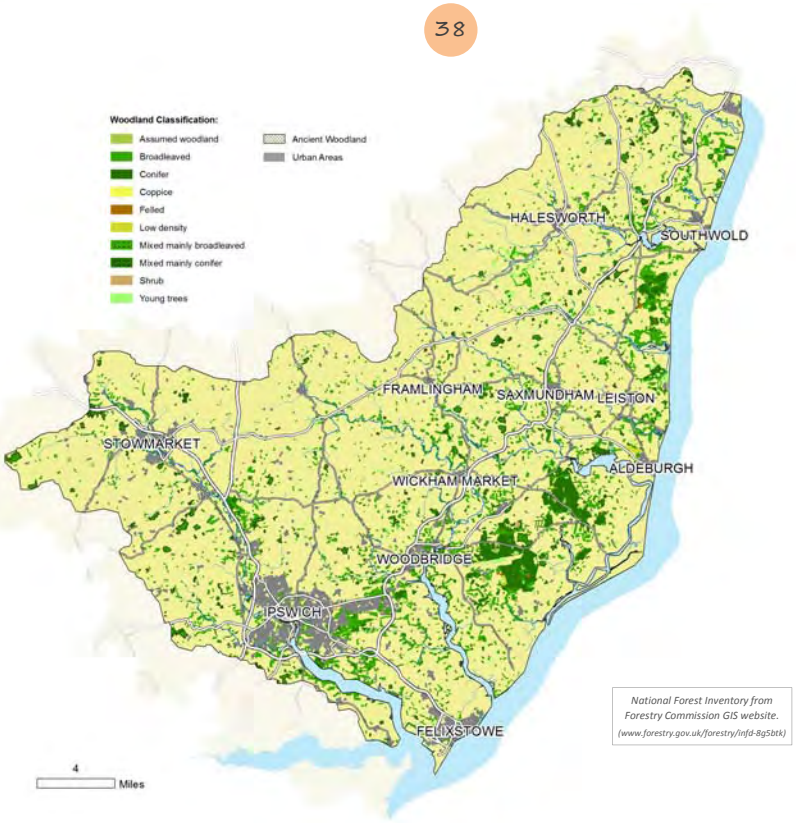


Natural England Priority (formerly Biodiversity Action Plan) Habitat Inventories from NE GIS website.
(www.naturalengland.org.uk/publications/data)

Infrastructure regulating service

The species and biodiversity that occur in a catchment landscape are supported by the network of natural habitats and greenspaces that currently exist in the catchment landscape. Ecological theory suggests that the habitat patches must be of a particular extent and have sufficient connectivity between them in order for the landscape to have a functional ecological network and for the assemblage of species to be supported at the correct level.

Before any work is done it is vital that he habitat components of the landscape are mapped and that work is undertaken to protect and enhance them – there is no point working to add to the ecological network in a landscape if the current infrastructure in the landscape is being degraded or damaged at the same time.



National Forest Inventory from Forestry Commission GIS website.
(www.forestry.gov.uk/forestry/infd-8g5btk)

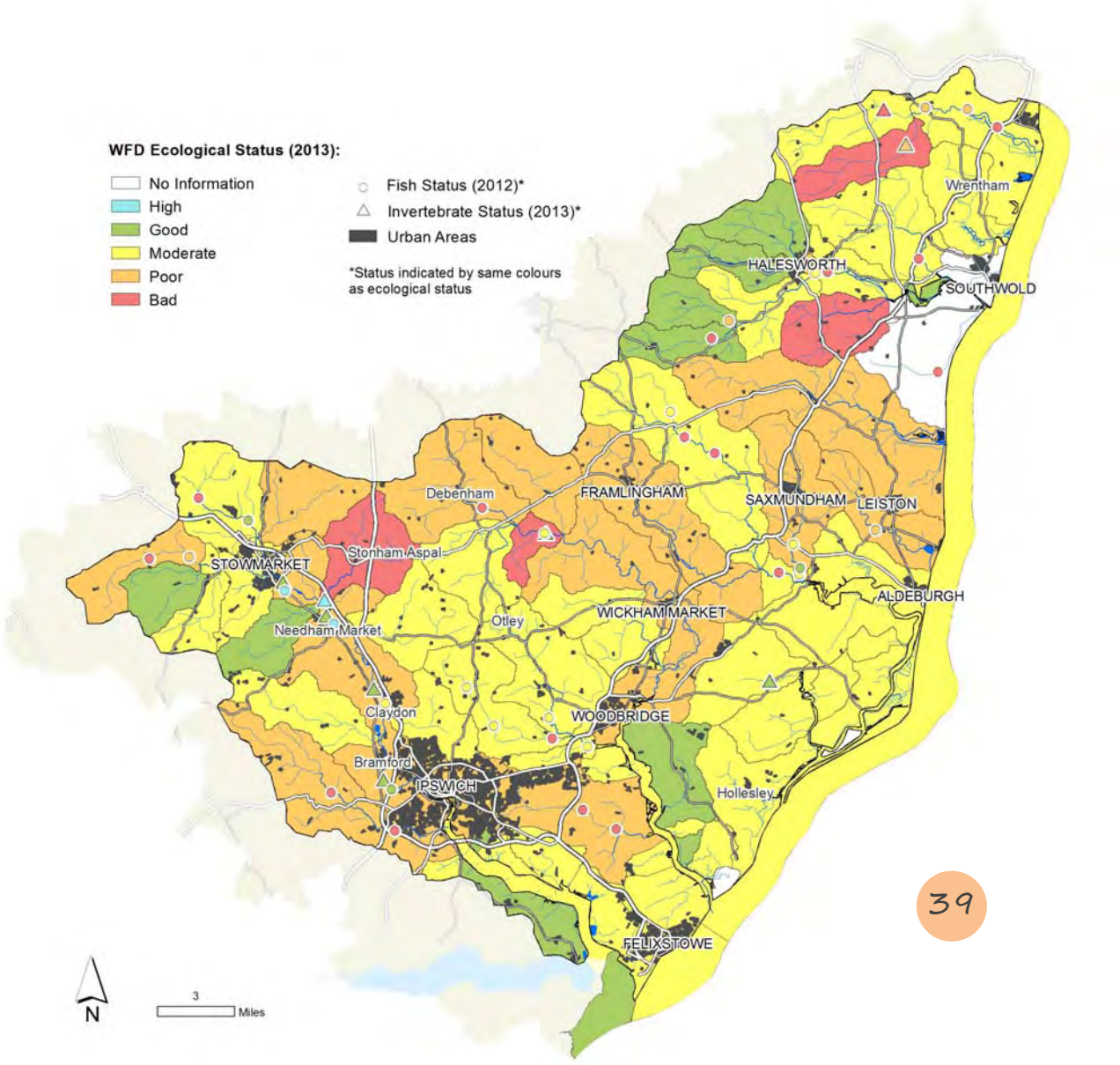
Assessing the provision of the service

There are numerous data and evidence available for the assessment of ecological health/biological richness/wildlife across a catchment landscape. Designated sites are classified according to their condition and rivers and other aquatic ecosystems are assessed via a number of metrics, including the WFD ecological assessments made each year.

In addition to these assessments there are also data on the long-term abundance of several key indicator species (mammals, farmland and woodland birds, breeding birds, plants etc), which can be used to indicate whether the biodiversity/wildlife in a landscape is declining or increasing. Finally, there are number of analytical methods which can be used to determine whether habitats present represent a functional ecological network (e.g. Fragstats).

Assessing the provision of habitats for wildlife & biodiversity

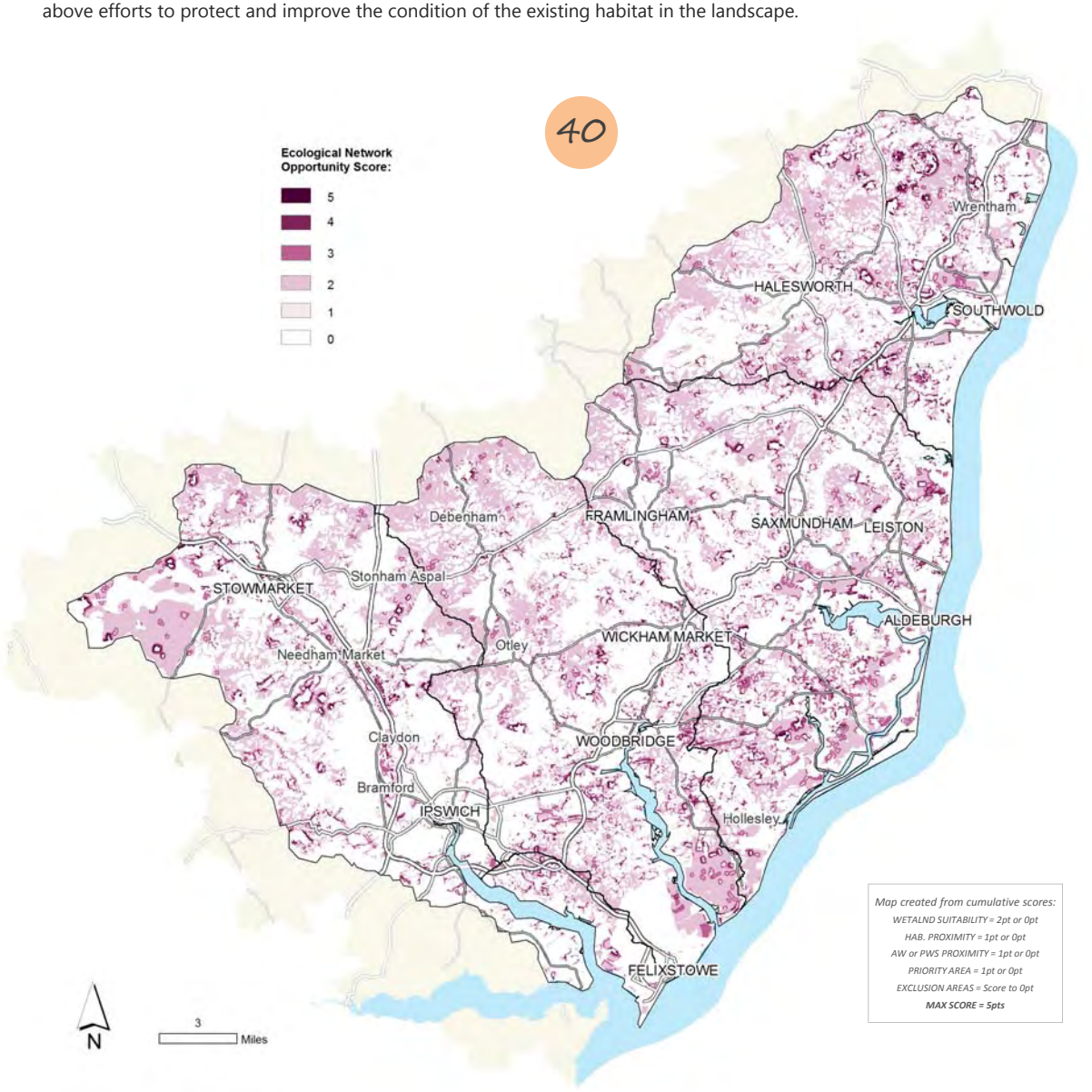
Data / information	Notes
Designated Site Condition Assessments *NE dataset from NE GIS data website www.naturalengland.org.uk/publications/data*	Natural England assesses the condition of all SSSIs as part of a six year cycle. These condition assessments are carried out on all the SSSIs in England and will continue to be carried out on a regular basis to help them monitor the health of these sites over the long-term.
WFD Ecological Status *EA dataset from Geostore www.geostore.com/environment-agency*	WFD classification assesses the biological quality (fish, benthic invertebrates, aquatic flora) of our aquatic ecosystems.
Local Record Centre Species & Invasive Species data *Typically obtained from Local Biological/ Environmental Record Centre.* *Not included as not currently available.*	Local Environmental Record Centres hold the best quality species data, including data on invasive species.it is important to note that species records are not a true indication of species distribution and ecological health – they are just record of occurrence.
Indicator species data *Typically obtained from Local Biological/ Environmental Record Centre or other specialist recorders (e.g. BTO, RSPB, Mammal Society etc).* *Not included as not currently available.*	Long-term monitoring datasets exist for a number of species including woodland and agricultural birds – the BTO Breeding Bird Survey and the RSPB Garden Birdwatch are comprehensive and systematic in their sampling and could be used to indicate wildlife populations present.
Ecological Network Analysis *Not included as analysis still underway.*	FRAGSTATS is a spatial pattern analysis program for quantifying the structure (i.e., composition and configuration) of landscapes. The landscape subject to analysis is user-defined and can represent any spatial phenomenon. FRAGSTATS simply quantifies the spatial heterogeneity of the landscape as represented in either a categorical map (i.e., landscape mosaic) or continuous surface (i.e. landscape gradient).



Opportunities for enhancement

In order to identify areas of land where there is the greatest opportunity for the restoration or creation of natural habitats to achieve an enhancement of the ecological network in the catchment. We can combine a series of criteria that each indicate some level of suitability or opportunity. One of the key criteria included in this process to create an opportunity map is the wetland suitability map created previously (map 27), which is combined with a number of other criteria (shown right).

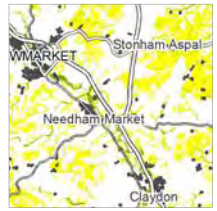
It is important to remember that these opportunity areas for enhancement of the ecological network are to be targeted over and above efforts to protect and improve the condition of the existing habitat in the landscape.



Wetland Opportunity Map

The greatest opportunity for analyses of this type are for targeting wetland restoration or creation because this is most successfully achieved on land with a high natural propensity to be seasonally or permanently wet or water-logged either through groundwater efflux or surface water inundation.

The method for targeting wetland habitat creation or restoration previously described in the baseflow enhancement section (based on floodplain location, propensity for wetness or water-logging due to hydrology and/or the characteristics of its soil) can be applied in this section.



Wetland habitat suitability map reclassified to identify areas of highest suitability

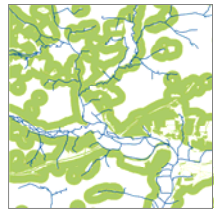
SUITABLE FOR WETLANDS = 2pts
NOT SUITABLE = 0pt

Proximity to existing habitat

It is widely accepted that, while the creation of any natural habitat in isolation is likely to have some ecological benefit, the extension of pre-existing habitats is likely to be far more beneficial for the enhancement of an ecological network at a landscape scale (the so-called 'big is best' approach to conservation).

A ~100m buffer on existing woodland and other natural habitats, but excluding existing natural habitats, urban areas and critical infrastructure. This can be restricted to agricultural land as this is the main opportunity area.

Ancient Woodlands/PAWS could be given higher weighting in this analysis. Not included in this analysis.



Land adjacent to existing habitats (<100m) identified and scored for their elevated opportunity.

ADJACENT <100m = 1pt
NOT ADJACENT = 0pt

Strategic or Priority Areas

The Natural England Habitat Network identifies areas in the landscape where a relatively low level of intervention could potentially, by elevating the provision above a threshold level, yield disproportionately higher ecological benefits than would be realised in other areas.

It is generally accepted that 'biodiversity opportunity areas' of this type, however identified, should receive particular focus in the strategic targeting of measures as they do represent areas where greater improvements may be achievable.

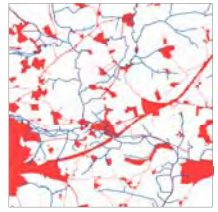
England Habitat Network data free to download from Natural England GIS website - www.naturalengland.org.uk/publications/data

Strategic conservation areas identified and given extra priority scores.

IN NE HABITAT NETWORK = 1pt
NOT IN PRIORITY AREA = 0pt

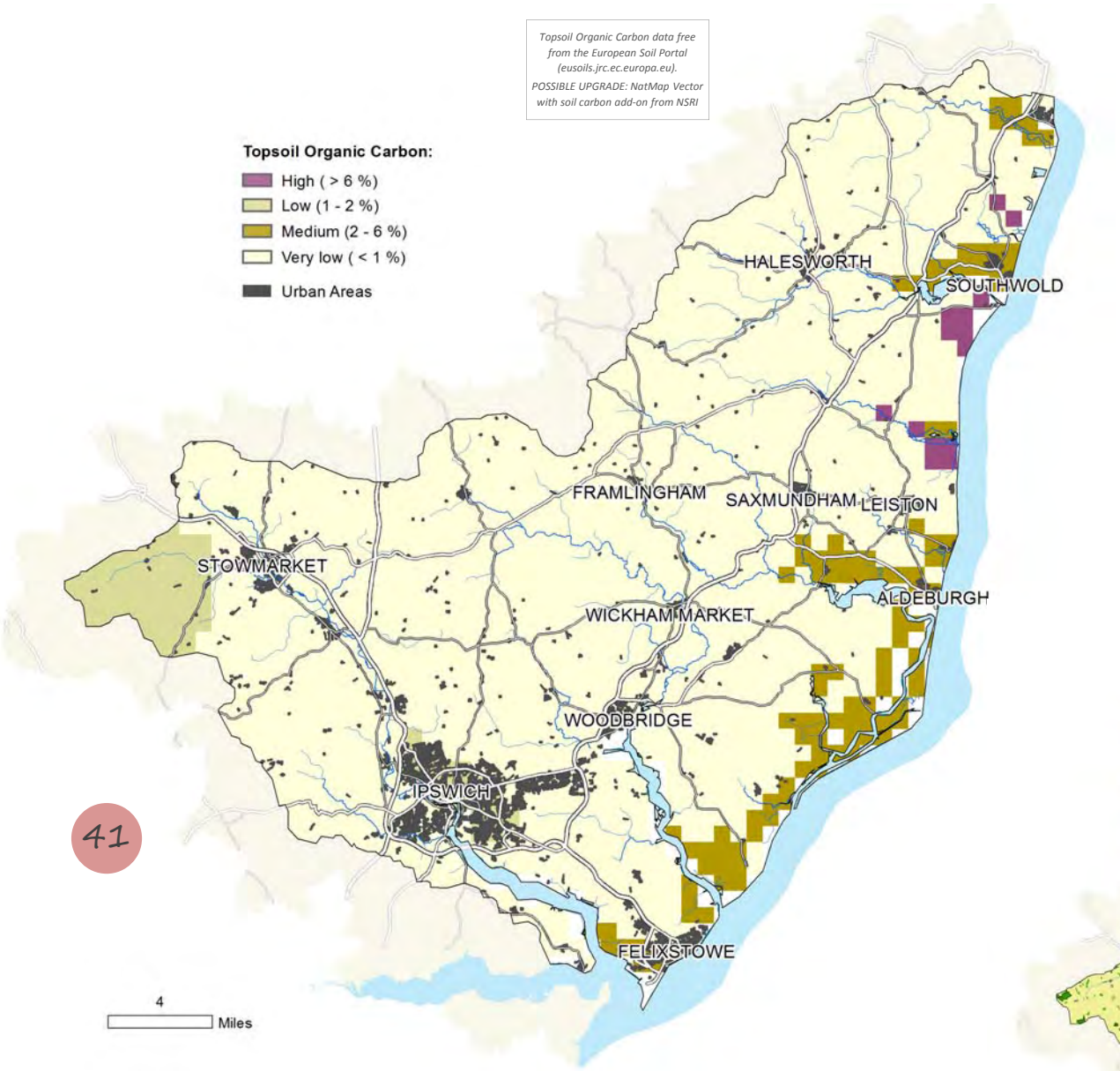
Areas to be excluded

There are a number of factors that make it less likely that wetland creation could be undertaken in a particular location. These factors, which can be excluded from the opportunity identification process, include the presence of development, existing natural habitats, existing designated sites, important historical features, contaminated land or highly productive agricultural land occurring on a particular site.



Carbon Regulation

Leaf Litter
Photo: Nick Paling



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Soil carbon

Soil is a key feature when assessing the current stocks of carbon sequestered in the landscape. Some soils (e.g. peat) contain very high levels of organic material while others (e.g. sandy soils) have very little. ⇧

Biomass – especially woodland

The biomass of the plants that form a woodland represent a significant proportion of the current carbon stores sequestered in our landscape. ⇨

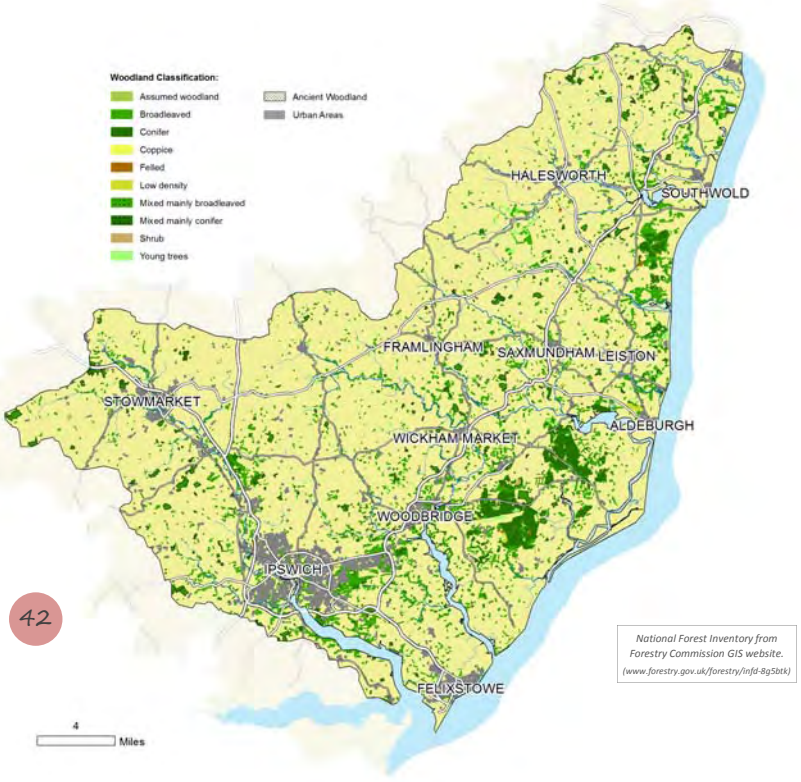
Priority areas for carbon regulation

There are no statutory areas for targeting the benefits of carbon sequestration or greenhouse gas regulation, although the emissions from farmland and farming activities do receive a great deal of attention due to the potential for carbon to be sequestered in farmland soils.

There is also significant focus on the major carbon stores (peatland and woodlands) and the drive to ensure that they continue to hold the carbon that contain and do not become carbon emitting sources of greenhouse gases. Everyone is a beneficiary of carbon sequestration and storage as it plays a key role in the regulation of the climate.

Infrastructure regulating service

It is vital initially that we undertake a broad assessment of where greenhouse gases / carbon are currently sequestered in our catchment landscape. These areas must be restored and/or protected to ensure that they do not become degraded and that their reserves of carbon/GHGs are not emitted into the atmosphere.



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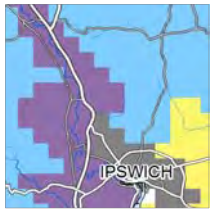
National Forest Inventory from Forestry Commission GIS website. (www.forestry.gov.uk/forestry/infd-8g5btk)

Soil sequestration capacity

Some soils have a higher natural capacity to sequester carbon than others. While any soil can sequester carbon, clay-based soils have a greater capacity to lock up organic material, while lighter sandy or loamy soils have lower capacity for increased sequestration.

Soils will reach maximum capacity for sequestration and a healthy peat-based soil may have limited potential for further sequestration as it is at its maximum capacity. Clay soils have the highest capacity to sequester carbon, while peat is already close to saturation and cannot hold large amounts of additional carbon.



Soil type reclassified according to its sequestration capacity and rate.
GLEYS = 2pt
BROWN EARTH/LOAMS = 1pt
SANDY/PEAT = 0pt

Potential for landuse change

Changing land management/farming practices have been shown to achieve small, often transient, step-change improvements in GHG/carbon emissions/sequestration, but significant step-change improvements are only achieved through permanent landuse change along an *arable* > *rotational cropping* > *temporary grassland* > *permanent pasture* > *woodland* > *wetland* continuum. Tilled land has no sequestered carbon and carbon sequestration begins after around 5 years after cessation of tillage and continuing for 20-30 years depending on the soil type.

CORINE Landcover is free from the European Environment Agency - www.eea.europa.eu/data-and-maps/data. POSSIBLE UPGRADE: Land Cover Map 2000/7 from CEH

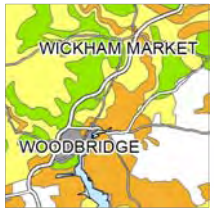
Landuse scored according the number of step-changes that can be achieved.
ARABLE = 3pt
TEMP GRASS = 2pt
PERM GRASS = 1pt
WOODLAND = 0pt

Agricultural Land Class

Agricultural Land Grade is designed to indicate areas of high and low productivity farmland.

Many farmers have indicated that carbon sequestration rewards may be insufficient on land where productivity is high and recommend that measures to enhance sequestration should be undertaken only on 'low grade land'.

Agricultural Land Classification is free from Natural England GIS website - www.naturalengland.org.uk/publications/data



Land scored according to agricultural land grade.
GRADES 4-5 = 1pt
GRADE 3 = 0pt
GRADES 1-2 = -1pt

Re-wetting potential

The other intervention that can produce a step-change increase in carbon sequestration is extensification accompanied by re-wetting of land by manipulating the water-table (e.g. through blocking land drains). We can identify areas of high suitability for wetland creation (based on soil hydrology and hydrological connectivity) and this model can also be used to identify these areas of potential for carbon sequestration as well.

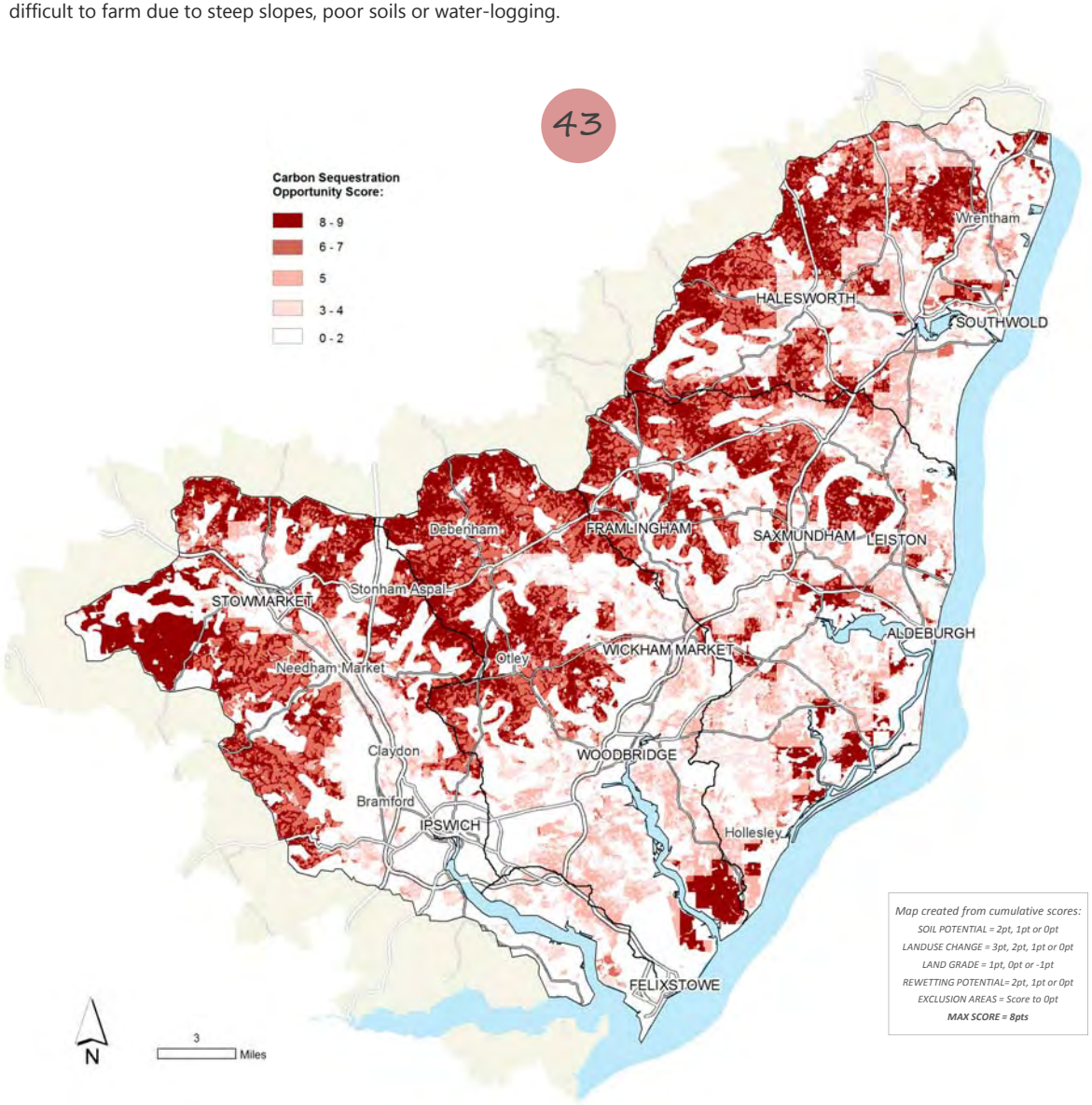
Surface Flow Index is modelled from topographic data. Once calculated the 'wettest' 5 or 10% of the land surface can be identified as the most hydrologically connected.

Surface Flow Index reclassified to show the wettest 5 and 10% of land areas.
WETTEST 5% = 2pts
WETTEST 5-10% = 1pt
NOT WET = 0pt

Opportunities for enhancement

We have developed a series of simple rules (based on the latest research into carbon sequestration) that allow us to identify areas of land where there is the greatest opportunity for reduced GHG/carbon emissions or increased GHG/carbon sequestration.

These criteria also include areas where the required interventions are most feasible/not feasible for cost-benefit or practical reasons – farmers particularly relate to the concept of Agricultural Land Grade as a way of identifying areas of land which are difficult to farm due to steep slopes, poor soils or water-logging.



Map created from cumulative scores:
SOIL POTENTIAL = 2pt, 1pt or 0pt
LANDUSE CHANGE = 3pt, 2pt, 1pt or 0pt
LAND GRADE = 1pt, 0pt or -1pt
REWETTING POTENTIAL= 2pt, 1pt or 0pt
EXCLUSION AREAS = Score to 0pt
MAX SCORE = 8pts

Areas to be excluded

There are a number of factors that make it less likely that carbon sequestration measures could be undertaken in a particular location. These have been described previously – see Map **40**.

Recreation & Leisure

Aldeburgh Beach
Photo: Manolo Blanco (CC SA 2.0)

Priority areas for recreation

Open and green spaces (often referred to as 'green infrastructure') have an extremely important role in maintaining the health, well-being and quality of life of the population. They provide somewhere for people to engage in recreation and social activity, provide access to natural environments and can play a central role in the ecological, economic and social regeneration of our towns and cities. The key beneficiaries of recreational resource provision in a landscape are the residential and visitor population of the area (either permanently or transiently) and the economic prosperity that this brings with it (shown below as the number of people employed in the recreation and tourism industries).

Assessing service provision

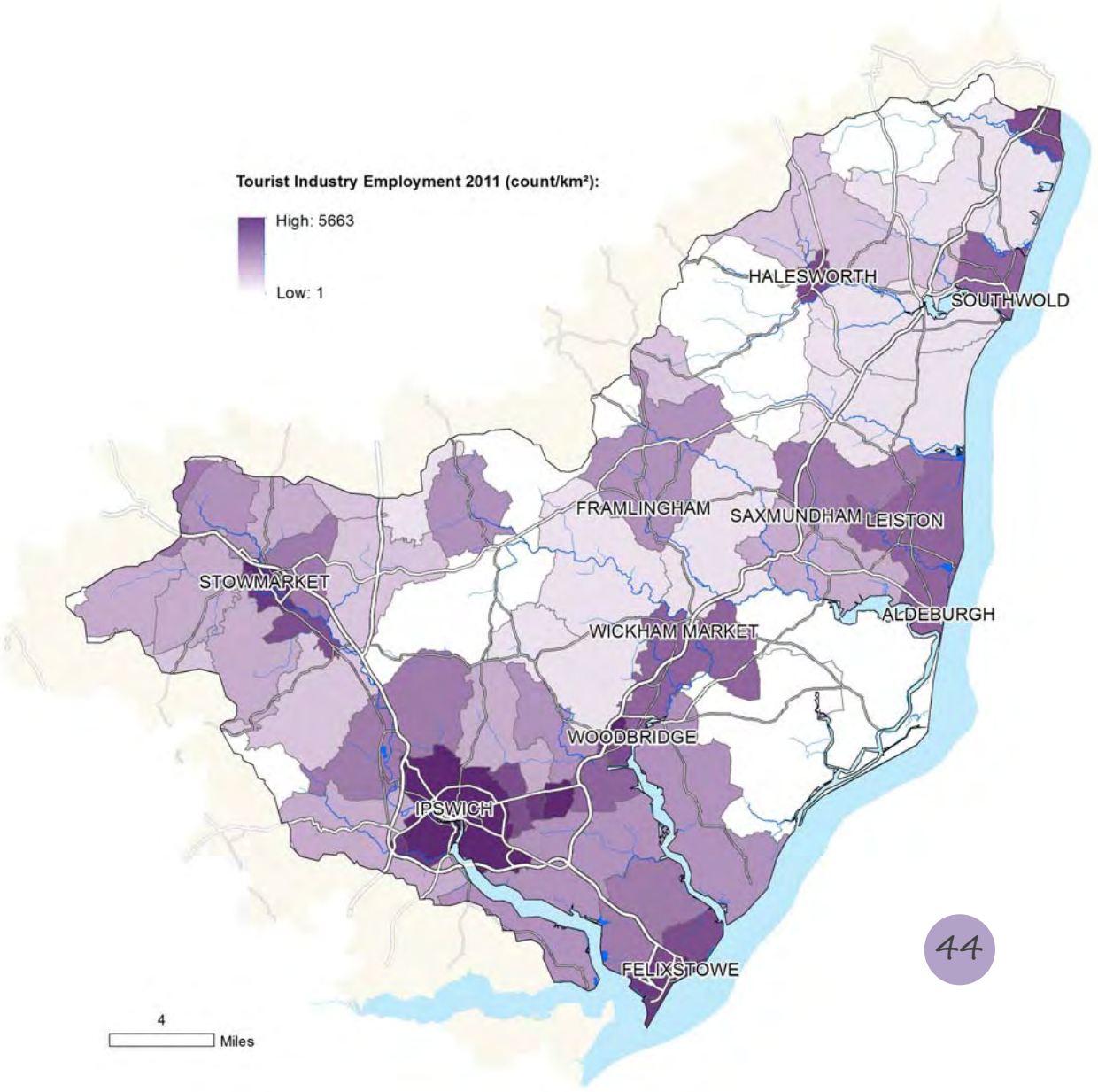
Once all of these elements are mapped it is then possible to identify (using visual inspection or modelling approaches) where there may be a deficiency in provision or an opportunity to enhance provision using one of the methods described above. This information can be further supplemented with data on visitor numbers, financial considerations or visitor experiences reported when using the resources.

It should be noted that environmental health may affect the quality the recreational experiences of visitors to an area, but it is the provision of recreational/leisure spaces to enhance the health, wellbeing and quality of life of the resident population of an area that is assessed in this way.

There are some well-established standards that can be used to assess the level of provision of recreational open/green spaces for recreational/leisure use and their capacity to accommodate/cater for additional population. These can be assessed using connectivity analysis.

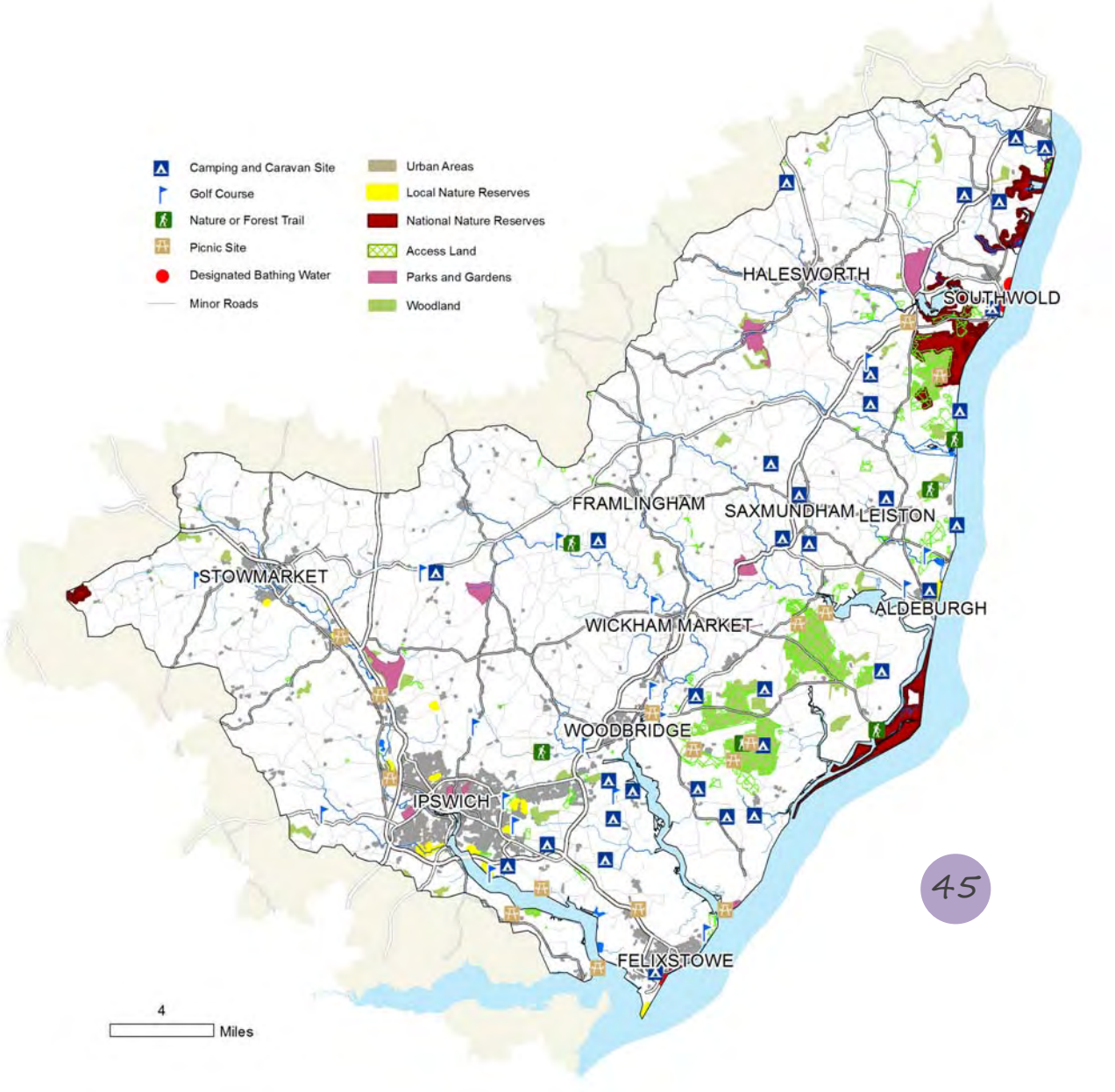
Natural England has developed a nationally consistent standard for the provision of open space called the **Accessible Natural Green Space Standard** (**ANGSt**). ANGSt is a useful measure for determining the provision of open space in the wider landscape, as its standards apply specifically to natural greenspace, but it is widely accepted that it is not easily applied to dense urban environments where open space is more likely to be provided via parks and playing fields rather than high quality natural greenspace. Most importantly, this driver for recreational resources is entirely located where there are people to use them.

ANALYSIS COMING SOON...



Employment in the recreation industry

It is also possible to look at the importance of recreation and leisure to the local economy as an indication of where the key areas of provision occur. This can be achieved using Census 2011 data from the Nomis website combined with Census Output Areas. ⇧



Infrastructure regulating service

The biggest challenge in assessing the provision of resources and accessible land for recreation and cultural activities is mapping the current provision of those opportunities across the landscape catchment and to examine the way that these opportunities were accessed and managed.

Only when this assessment has been made can the level of provision be assessed and compared to the level that I required by the residential and business communities.

The data presented here gives flavour of the infrastructure that exists – public rights of way remain to be mapped, but will allow the levels of access to greenspace/open spaces to be assessed in more detail.

Open spaces, green spaces and blue spaces

Data / information	Notes
Nature reserves *NE dataset from NE GIS data website www.naturalengland.org.uk/publications/data*	National Nature Reserves (NNR) and Local Nature Reserves (LNR) are the best sites in England for seeing wildlife.
Access Land *NE dataset from NE GIS data website www.naturalengland.org.uk/publications/data*	People can access 'open access land' across Britain without using Public Rights of Way
Publically accessible woodlands *Should be obtained from the Forestry Commission or Woodland Trust*	Woodlands with public access can be mapped using data from the Forestry Commission.
Public open spaces (parks & gardens) & other visitor attractions (open farms, leisure parks) *English heritage GIS website www.services.english-heritage.org.uk/NMRDataDownload/*	The English Heritage 'Register of Historic Parks and Gardens of special historic interest in England' currently identifies over 1,600 sites assessed to be of national importance.
Lakes & reservoirs *OS Open Data - Strategi*	Larger waterbodies are popular recreational resources (blue spaces) for people wanting to do water sports, angling, swimming etc.
Designated Bathing Waters *EA dataset from Geostore www.geostore.com/environment-agency*	A bathing water is one where a large number of people ~100 people) are expected to bathe at any one time.
Accessible heritage sites *English heritage GIS website www.services.english-heritage.org.uk/NMRDataDownload/*	Many World Heritage Sites/Landscapes and Scheduled Ancient Monuments (SAMs) have public access.
Urban areas *OS Open Data - Strategi*	Urban areas themselves are key recreational spaces.

Other point attractions

Data / information
Car parks – *OS Open Data - Strategi*
Accommodation locations
Heritage/historical interest attractions

Linear features

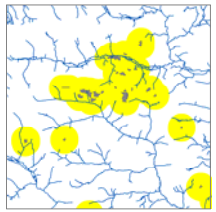
Data / information	Notes
Public Rights of Way (PROW)	Includes footpaths, permissive paths, bridleways
Cycle & long distance routes	Important recreational infrastructure
Minor roads, tracks and paths	Important recreational infrastructure

Increasing permeability

There is a need to increase the permeability of the rural or urban landscape to the resident population.

To identify priority areas for creating recreational infrastructure we can place a 2,000m buffer around human population centres identifies areas where access/ recreation should be considered. This can be done with a cost weighted distance analysis or Euclidean distance buffers.

Population centres can be identified using a variety of datasets. The OS Open Data Strategi product includes urban areas data as does the OS Open Data VectorMap District. Either can be used to create a 2,000m buffer.

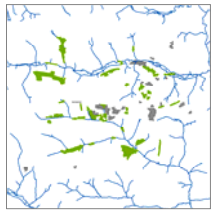


Areas within 2km of an urban area (>50 households) of greater importance.
<2km FROM URBAN AREA = 1pt
>2km FROM Urban AREA = 0pt

Increasing access to existing infrastructure

Access to open/green spaces can be achieved by opening up access to existing greenspaces or by creating more in areas close to human population. Existing or proposed green infrastructure within 500m of human population centres may have greater potential for increased access.

Natural England recommend that people should have an accessible greenspace of under 2 Ha <300m from where they live (Accessible Natural Greenspace Standard: ANGSt). The Woodland Trust has developed the Woodland Access Standard (WASt), which recommends that no person should live >500m from at least one area of accessible woodland of at least 2Ha in size.



Natural habitats <500m from urban centres identified as important.
<500m FROM URBAN AREA = 1pt
>500m FROM Urban AREA = 0pt

Other priority or project areas

A number of organisations and institutions have undertaken strategic exercises to identify and map priority areas for the improvement of recreational access and these priority areas should be recognised when catchment management interventions are being considered in those areas.

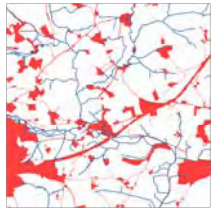
These areas, where they overlap represent an elevated probability of synergies forming between initiatives and for interventions to be delivered and funded.

This should include Local Authority green infrastructure and recreation priority areas and landscape-scale designations such as National Parks, Areas of Outstanding Natural Beauty and World Heritage Sites.

Project or priority areas identified and receive extra weighting.
PRIOR PROJECT AREA = 1pt
NOT PRIOR PROJECT AREA = 0pt

Areas to be excluded

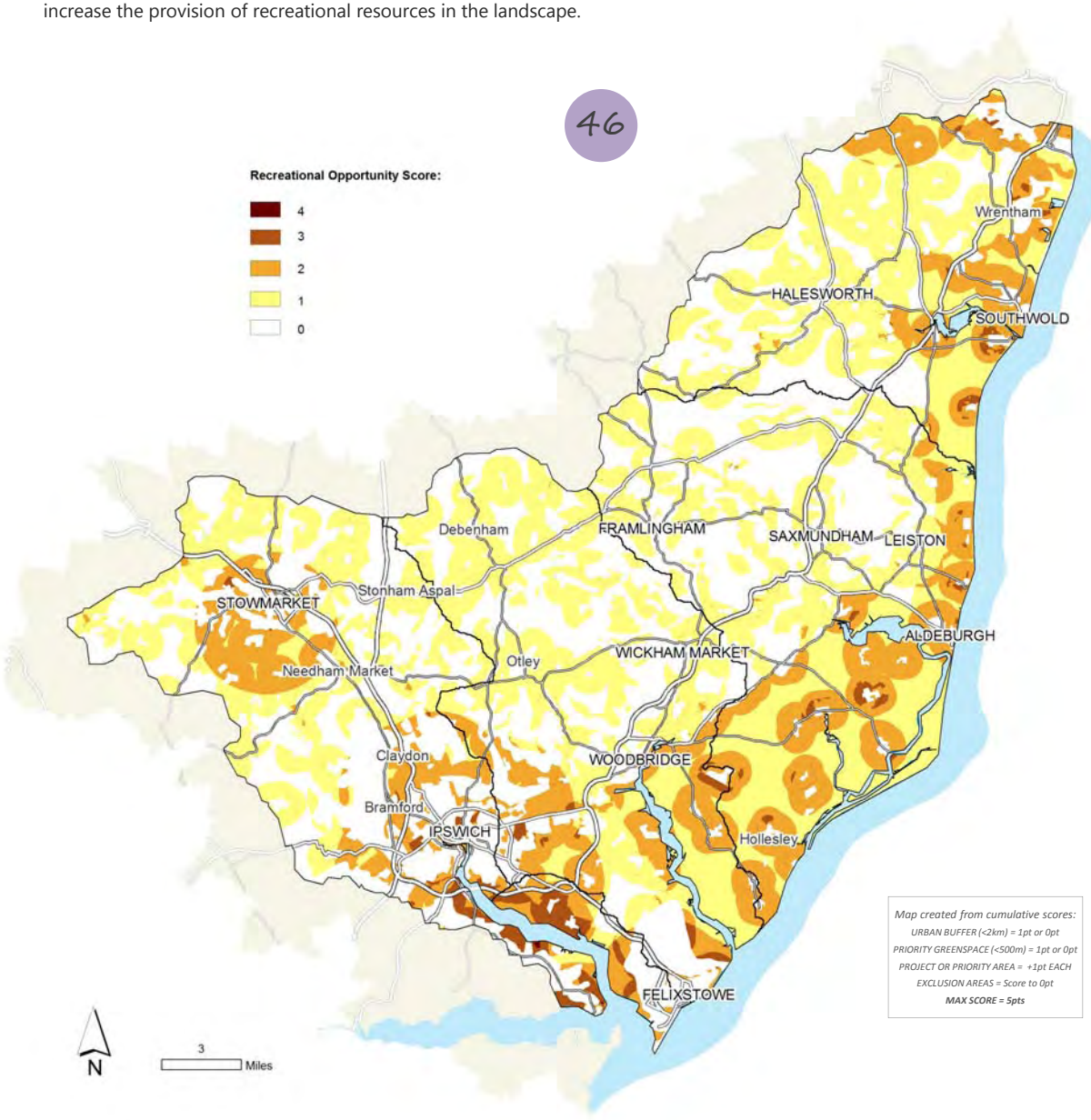
There are a number of factors that make it less likely that wetland creation could be undertaken in a particular location. These factors, which can be excluded from the opportunity identification process, include the presence of development, existing natural habitats, existing designated sites, important historical features, contaminated land or highly productive agricultural land occurring on a particular site.



Opportunities for enhancement

Only when the entire recreational infrastructure in the landscape has been mapped and the levels of provision assessed, can areas where there may be an opportunity and/or priority for enhancing provision be identified.

The first step in enhancing the provision of recreational resources in a landscape is to improve the quality and increase the capacity of the resources already in place – i.e. existing resources receive priority. Then it is necessary to look for opportunities to increase the provision of recreational resources in the landscape.



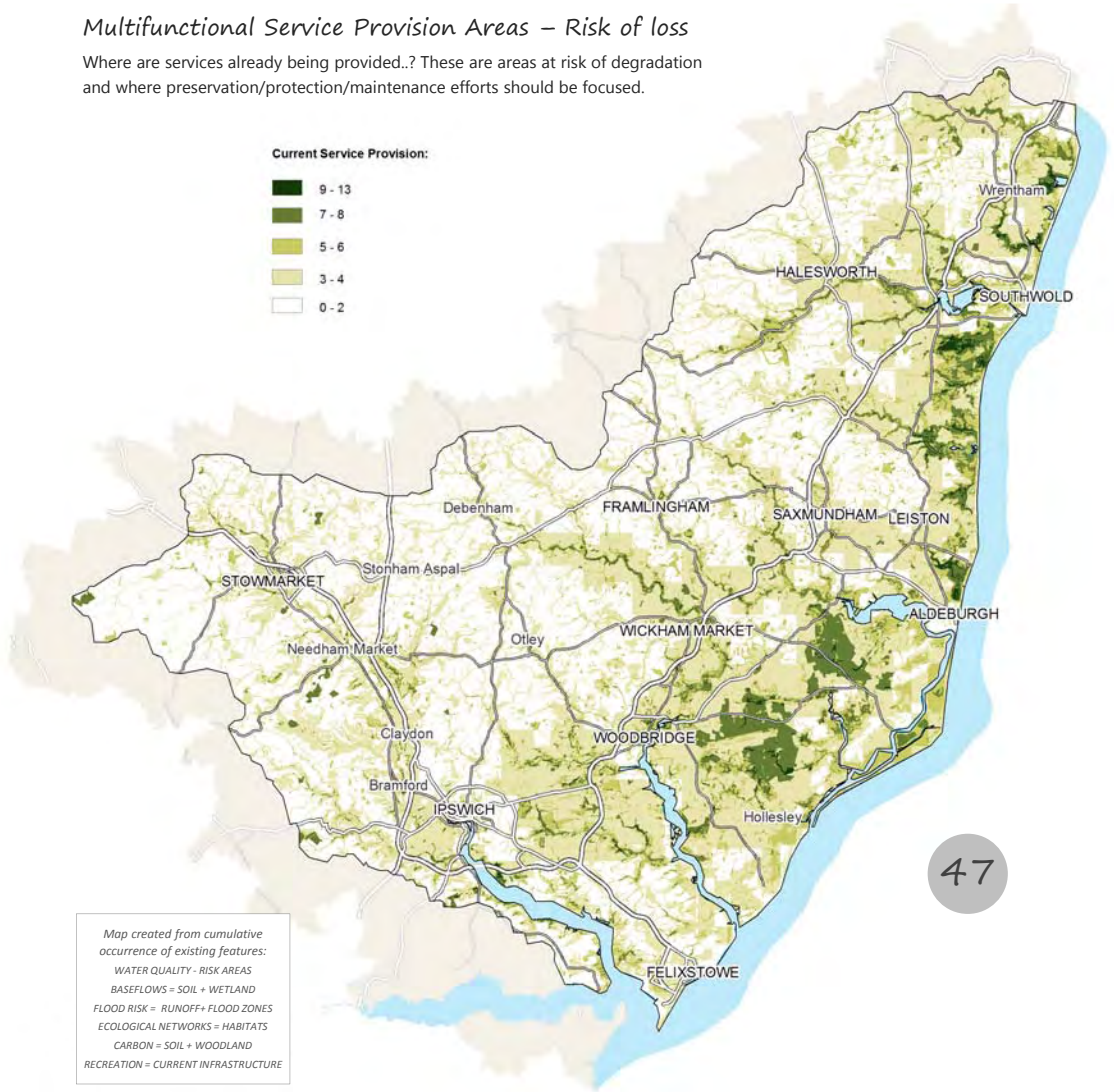
Multifunctional Ecosystem Services Regulating Areas

The final synthesis of these conceptual models/data exploration exercises is to combine them together to identify areas important for the provision of multiple ecosystem services.

- In each of the ESS sections each Y/N or H/M/L question that identify areas either already providing/regulating the service or which represent opportunities for the enhancement of that ecosystem service should be allocated scores of 0, 1, 2 or 3. These individual layers can then be combined to give an overall semi-quantitative prioritisation or opportunity map for that service.
- Locations where areas of high importance/risk or opportunity in the individual services coincide can be considered to be important targets for measures to enhance the provision of multiple ecosystem services.

Multifunctional Service Provision Areas – Risk of loss

Where are services already being provided..? These are areas at risk of degradation and where preservation/protection/maintenance efforts should be focused.



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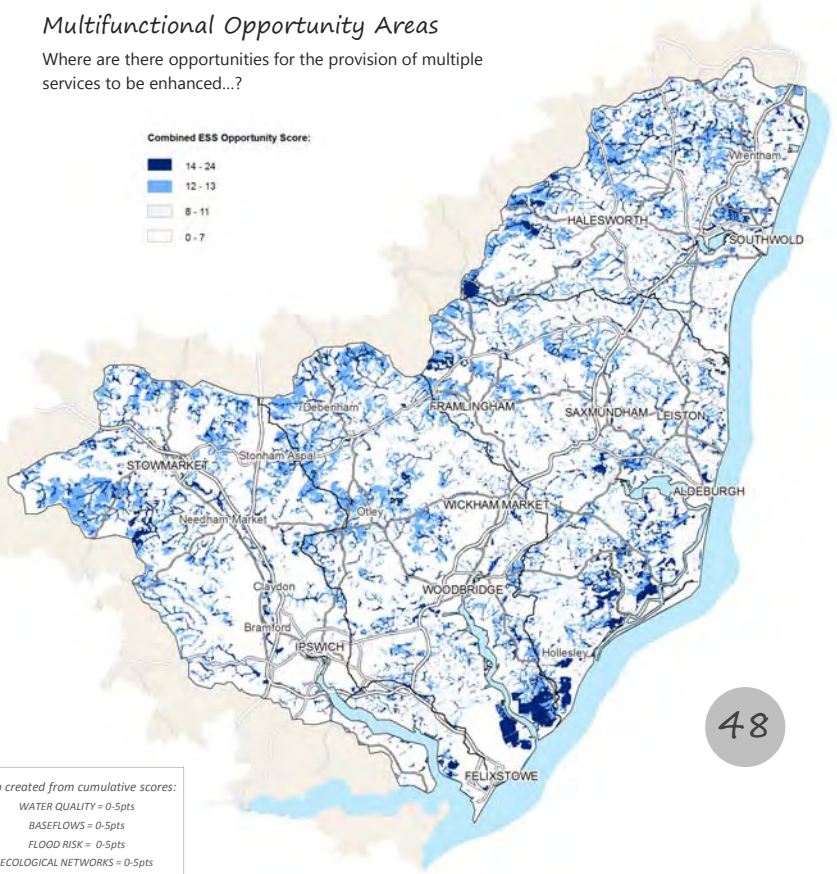
Map created from cumulative occurrence of existing features:
WATER QUALITY - RISK AREAS
BASEFLOWS = SOIL + WETLAND
FLOOD RISK = RUNOFF+ FLOOD ZONES
ECOLOGICAL NETWORKS = HABITATS
CARBON = SOIL + WOODLAND
RECREATION = CURRENT INFRASTRUCTURE

Multifunctional Opportunity Areas

Where are there opportunities for the provision of multiple services to be enhanced...?



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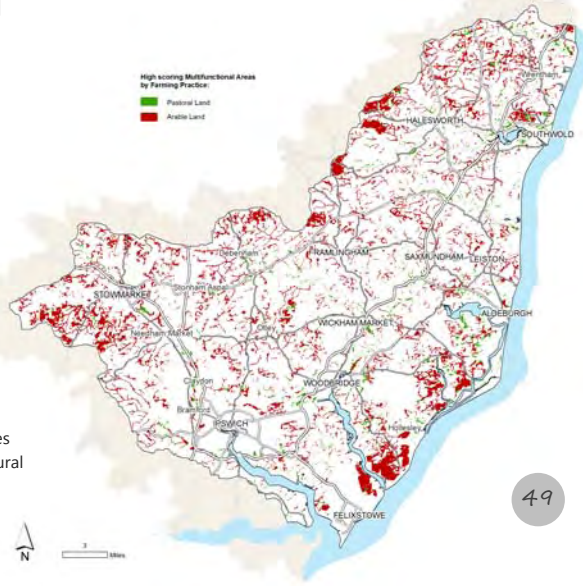
Map created from cumulative scores:
WATER QUALITY = 0-5pts
BASEFLOWS = 0-5pts
FLOOD RISK = 0-5pts
ECOLOGICAL NETWORKS = 0-5pts
CARBON SEQUESTRATION = 0-5pts
RECREATION = 0-5pts
MAX SCORE = 30pts

Conflict Areas

Where do the opportunities for the provision of multiple services come into conflict with agricultural activity...?



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East Suffolk Catchments Partnership

Formed in December 2013 the East Suffolk Catchments Partnership covers the river catchments of the Gipping, Deben, Alde, Thorpeness Hundred, Yox, Blyth and Lothingland Hundred.

The Partnership is a new group building on the successful work and approach pioneered by the Rivers Trust movement across the UK. We hope it will become a wide partnership drawing together a group of engaged organisations and individuals far beyond the 'usual suspects' around the issues of; Urban development and its impacts on the catchment; water availability; diffuse pollution from rural and urban sources; physical modifications and all the Significant Water Management Issues currently identified by the EA and others for the Water Framework Directive.

The Partnership has the potential to provide a source of inspiration to spread the catchment management agenda into the wider public arena through its members and demonstrations of good practice, thus helping embed WFD aims into plans and processes of business, organisations and statutory bodies.

It could also seek to assess the current classifications and data underpinning the River Basin Management Planning (RBMP) process, whilst also identifying valuable additional sources of evidence and information. In this way the Partnership could foster and support growth of local initiatives for delivery, these could be both projects and local action groups.

It is likely that the Partnership will be continually looking for new members who are interested in how their actions impact on the river catchments.

Aims of the Partnership

The broad aims of the East Suffolk Catchments Partnership are:

- To produce Catchment Plans for the river catchments within the East Suffolk area.
- To seek to engage with existing organisations, groups and projects in whatever way is felt to be mutually most beneficial and to avoid unnecessary duplication of effort.
- To develop collaborative projects to improve environmental conditions, and raise funds to deliver them.
- To support activities and projects which meet the aims of the Partnership being carried out in the area through promotion, funding and expertise.
- To be wide and open and to reach out to organisations, individuals and groups including those not historically included in 'catchment management' work.
- To embed a catchment management ethos into the operations of our own businesses and plans as well as advocate the take up of catchment management actions by others.
- To be willing to go beyond the requirements of the Water Framework Directive (WFD) but to retain the WFD as a core objective in our work.
- To pursue a twin-track approach – delivering Water Framework Directive aims in the short-term, but seeking to deliver more widely on environmental improvements wherever possible, including themes such as 'Paid Ecosystem Services' mapping.

River Deben at Woodbridge
Photo: Gerry Balding (CC2.0)