Natural Capital Evidence Compendium for Norfolk and Suffolk

November 2020

Norfolk County Council

Suffolk County Council

UEA University of East Anglia | SCHOOL OF ENVIRONMENTAL SCIENCES

Photos: Trudie Dockerty UEA unless otherwise stated.

NATURAL CAPITAL EVIDENCE COMPENDIUM ORGANISATION

INTRODUCTION

About:
About this compendium
About this research

What:
What are 'natural assets' & 'ecosystem services'?
What are 'pressures' & 'risks'?

How?
How do we implement a natural capital approach?

REGIONAL CONTEXT

Environmental change:
Climate change
Sea level rise

Social change:
Population growth projection
Population age structure

Economic change:
Economic activity
Housing need
Offshore activity

NATURAL ASSET INVENTORY

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Food producing land
Productive woodland
Land under conservation management
Recreational use of land
Carbon density in vegetation

Soil & Sub-surface:
Soil types
Soil physical properties
Biological health
Chemical/nutrient status
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Peat
Minerals

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Extent/condition of SSSIs
Habitat connectivity
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Lowland heath & grasslands
Saltmarsh & coastal habitats
Wetlands & grazing marsh
Priority/iconic species

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Surface water quality
Groundwater quality
Water availability
Flood risk
Chalk rivers
Recreational use of waterways

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Fish stocks
Shellfish stocks
Marine mammals
Seabirds & migrating birds
Recreational use of coasts

Atmosphere:
Particulates
GHG Emissions
Point source emissions

RISKS

Land: | Soil & Sub-surface: | Habitats & Species: | Freshwater: | Coast & Marine: | Atmosphere:

Synthesis

IMPLICATIONS

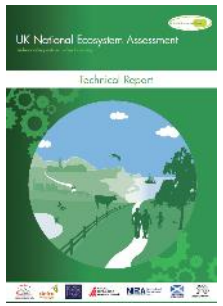
State:
Nationally important assets
Locally significant assets

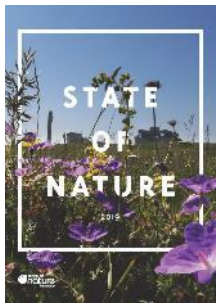
Impact:
Vulnerable ecosystem services and benefits

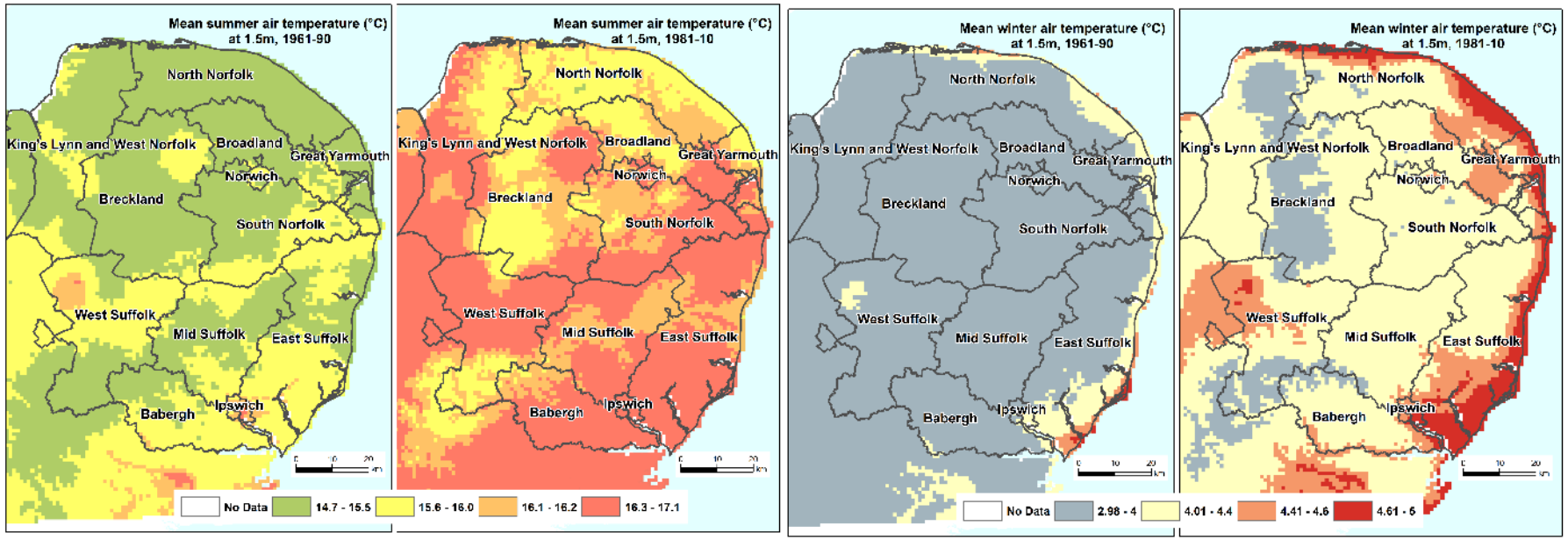
Response:
Identified needs
Priorities and next steps

Drivers and pressures – a changing climate

Drivers and pressures at the national scale
It is widely recognised that human influences have been responsible for a decline in both extent and condition of many natural assets in the UK. This is reflected in the findings of the UK National Ecosystem Assessment and the State of Nature reviews.







Source of observed climate data - HadUK-Grid https://www.metoffice.gov.uk/climate/uk/data/haduk-grid/haduk-grid

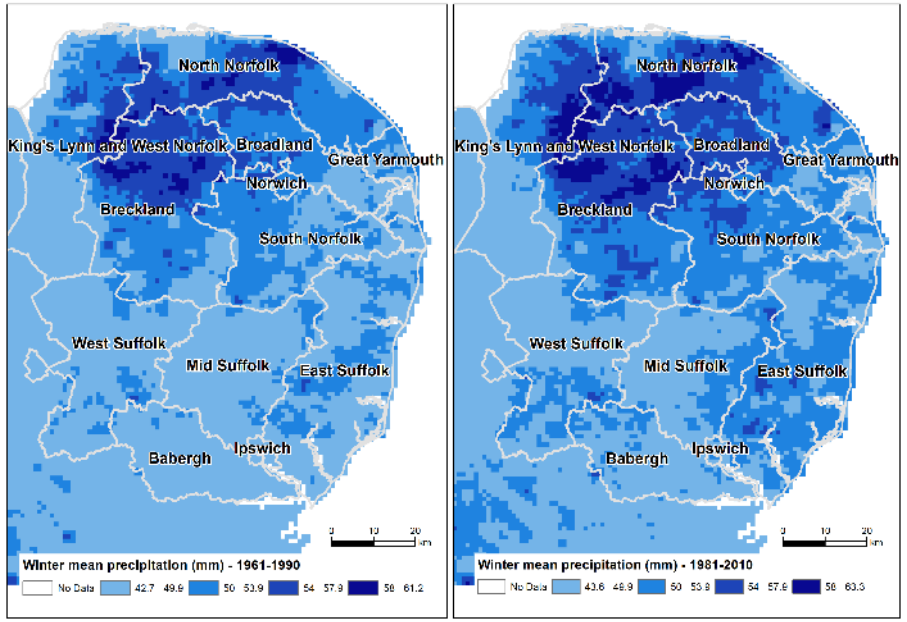
Indirect drivers include changes in population, culture and personal behaviours, economic growth and technological advances. These have influenced more direct pressures, such as alterations in land use, pollution of air, land and water, intensified agricultural land management, overexploitation of resources, and introductions of alien species, as well as changes in climate.

The regional situation The remainder of this section outlines environmental and socio-economic characteristics that represent important drivers of change at the regional level. **Climate change** represents a major societal challenge from the global to local scales and information from UK Climate Projections (UKCP18) is now sufficiently detailed to allow an assessment for Norfolk and Suffolk. The four maps above show the ***observed*** increase in mean Summer and mean Winter temperatures in East Anglia between 1961-90 and 1981-2010. As can be seen from the maps, mean temperatures have increased over time. Climate change projections suggest a further 1.2-1.6°C rise in mean summer temperature and a further 1-1.3°C rise in mean winter temperature by the 2040s.

Next: Precipitation and sea level rise

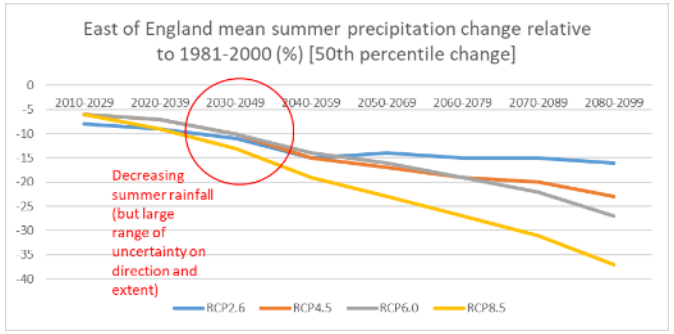
Environmental change – precipitation and sea level rise

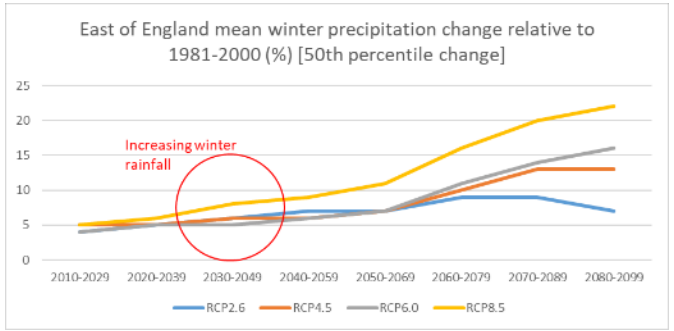
Precipitation Norfolk and Suffolk are amongst the driest counties in England. Differences in mean precipitation between 1961-90 and 1981-2010 were less pronounced than those for temperature, though the maps below show that winter averages increased more in the north and east compared to further inland.



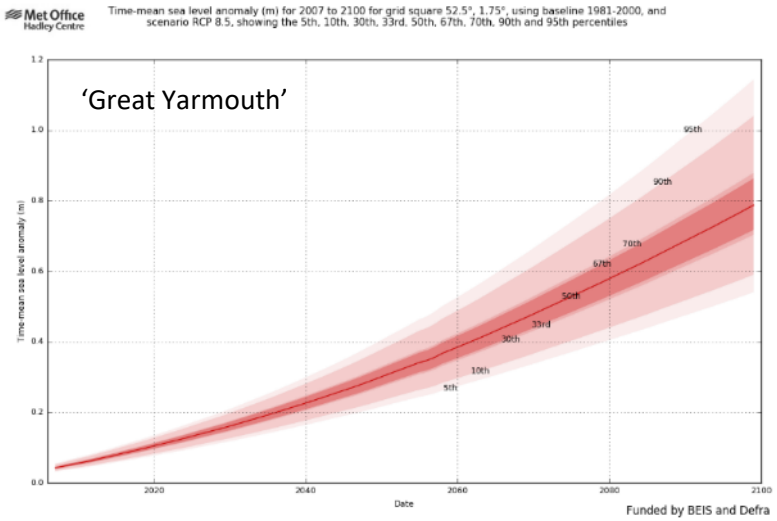
[Source for data download: https://catalogue.ceda.ac.uk/]

Future projections suggest a decrease in mean summer precipitation of 1% to 13% and an increase in mean winter precipitation of 5% to 8% by the 2040s. However, there is a considerable range of uncertainty around these mid-point estimates. Intensity of precipitation (e.g. concentration in several consecutive days) is also expected to increase and this will have implications for runoff and greater risk of surface water flooding.





Sea level rise Local sea level rise projections 2007 – 2100 relative to 1981-2000 baseline. E.g. Projections for 'Great Yarmouth' indicate 0.2-0.4m rise by mid-century and potentially 0.6-1m+ by 2100 (grid-ref approximation to nearest town). This is under UKCP18 RCP8.5 scenario climate change scenario which is the most extreme.



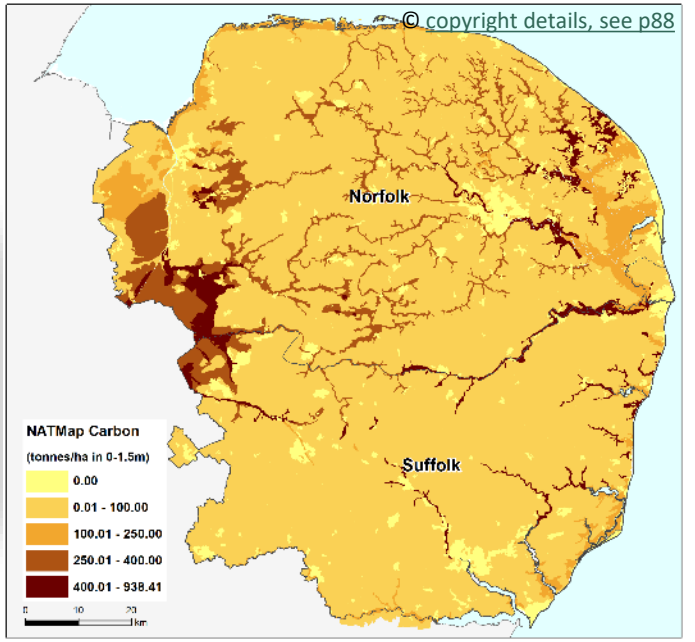
Next: Social change

Soil biological health

Soil organic matter is another important indicator of long-term soil health, important for soil structure, resilience and water retention and as a vital store of carbon (Environment Agency, 2019). Increasing rates of organic matter decomposition and leaching due to climate change is a threat to soil formation (UKNEA, 2011).

Data on topsoil carbon density (0-15cm depth) are available from the Centre for Ecology and Hydrology (CEH) and data on carbon down to 150cm is available from the National Soil Resources Institute, Cranfield University (map, right). The peaty soils of heaths, freshwater margins and under woodland provide the highest carbon densities per hectare in the top 15cm of soil, and freshwater margins and grassland is significant for deep carbon (0-150cm) (see Table, below right).

Photo: Worm survey, Wensum DTC (S.Dugdale)



Map (right): Soils Data © Cranfield University (NSRI) and for the Controller of HMSO [2020].

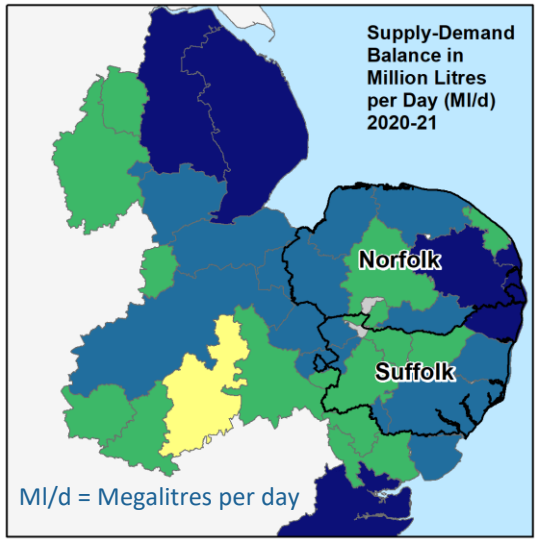
Soil Biota

Soil bacteria and invertebrates are additional key indicators of soil biological health. Mean estimates of bacterial and invertebrate diversity in topsoil per 1km^2 have been extrapolated from sets of sample locations by CEH (Henrys et al, 2014; 2012a). Bacterial diversity tends to be higher in lowland areas with agriculturally associated flora, less acidic soils and milder climate. In Norfolk & Suffolk diversity values are relatively uniform across natural habitats and cultivated land (Shannon-Weiner Index 3.65 – 3.83; [Index range 0-5 where 5 = high]). Topsoil invertebrates (0-8cm depth), on the other hand, tend to be in higher densities in semi-natural less-managed habitats and in lower quantities in more intensively managed habitats such as arable, improved and neutral grassland (Henrys et al 2012a). Invertebrate abundance values from the CEH data for Norfolk and Suffolk by habitat are shown right. A map of this data on a national scale is included as a soil quality indicator in the National Natural Capital Atlas (NE, 2020).

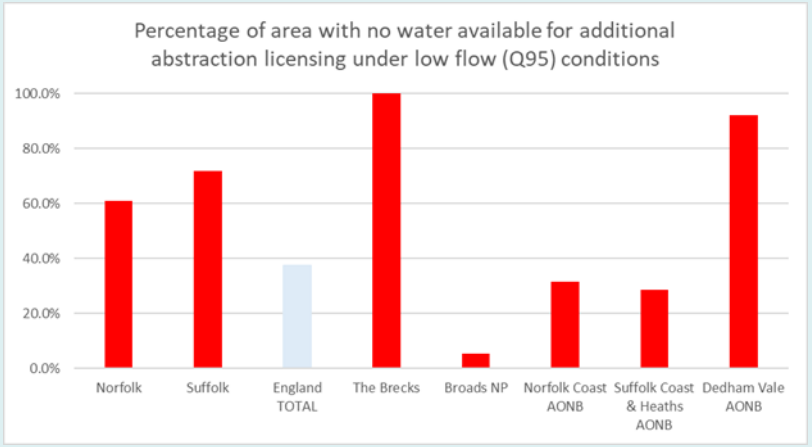
Mean Abundance of Invertebrates in Topsoil	CEH Topsoil Carbon Density in 0-15cm in Norfolk & Suffolk				NATMAP Carbon C Tonnes 0-150cm			Topsoil Carbon	Deep Carbon
	Habitat Group	Hectares	C Tonnes	t/ha	Hectares	C Tonnes	t/ha	Rank t/ha	Rank t/ha
60.51	Arable Crops & Fruit	656,851	31,985,573	48.7	660,972	115,775,515	175.2	7	6
47.87	Pastures & Natural Grassland	110,761	6,418,449	57.9	112,884	35,102,163	311.0	4	**2**
66.81	Heaths (Mountains, Moors & Heaths)	2,435	165,108	67.8	2,825	413,639	146.4	**1**	7
61.82	Woodlands	55,565	3,469,037	62.4	56,218	13,652,085	242.8	3	4
61.38	Freshwaters (margins)	8,972	593,579	66.2	9,702	6,753,722	696.2	**2**	**1**
43.13	Coastal Margins	1,567	92,873	59.3	4,479	1,042,676	232.8	4	5
46.25	Urban and Human Activities	41,999	2,383,441	56.8	67,901	5,636,247	253.7	6	3
		878,151	45,108,060		914,981	178,376,046			
	Unclassified (CEH -mostly urban)	40,029			3,199				
	Norfolk & Suffolk Total	918,180			918,180				

Water availability

Water Resources East (WRE) is the organisation tasked under the National Framework for Water Resources (EA, 2020) with producing an integrated water resource plan for eastern England. The WRE initial position statement (2020) includes an assessment of the current and future supply-demand balance based on water company Water Resource Management Plans, taking into consideration climate change impacts, abstraction reductions in environmentally-sensitive areas, and demand considerations based on forecasted economic growth and development. The maps on the right show the current supply-demand status and projections out to 2040. Across the whole region there is a **net projected deficit of around -200 Ml/d by 2050** (WRE, 2020).



Water Use: (Baseline 2020/21): "On an average day, in a dry year, the total consumptive demand for water in the WRE region is equivalent to 2,311 million litres (megalitres) per day. Most of this water **(85%) is used for public water supply** . Most of the rest is used for **spray irrigation (8%), power generation (3%)** and in the **manufacturing, food and drink sectors (2%)**. (WRE, 2020 p.9)



Water Resource Availability and Abstraction Reliability Cycle 2 data (EA, 2019), indicates the current demand stress on water for irrigation. Norfolk and Suffolk both have a greater area of land where additional water is not available for abstraction than the average for England. This is most critical for The Brecks and Dedham Vale AONB.

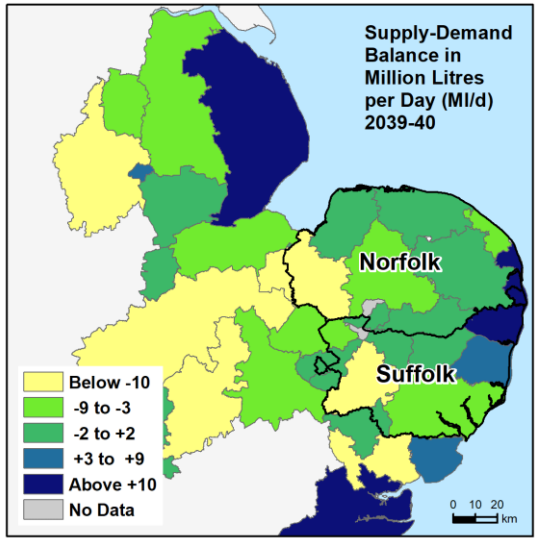
Pressures

- Driest region in the UK
- Highest forecast growth outside London
- Internationally important natural habitats
- Leading agricultural producer
- Tension between water needed for the environment, public supply and irrigation
- Little surplus water currently available

Source: WRE (2020)

Responses

- Increase efficiency of all water users
- Promote need for additional water storage within the landscape through opportunities to link water scarcity with flood risk management solutions
- Transfer water from areas of surplus to areas of deficit, increasing connectivity and maximising open water channels
- Explore other technologies, e.g. water transfers, desalination and water re-use.

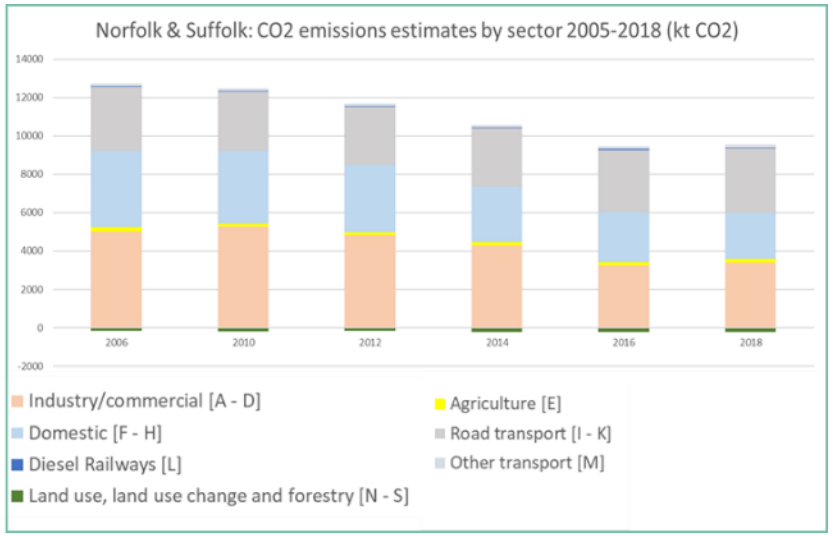


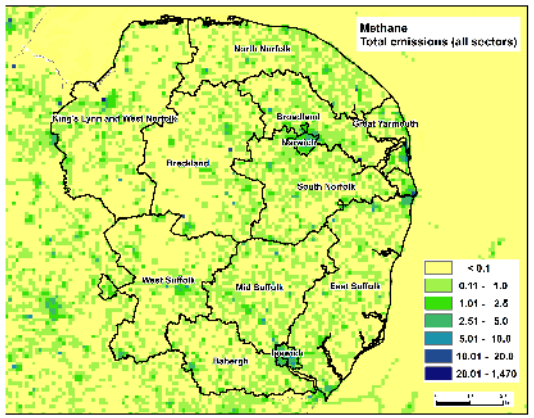
Greenhouse gas emissions

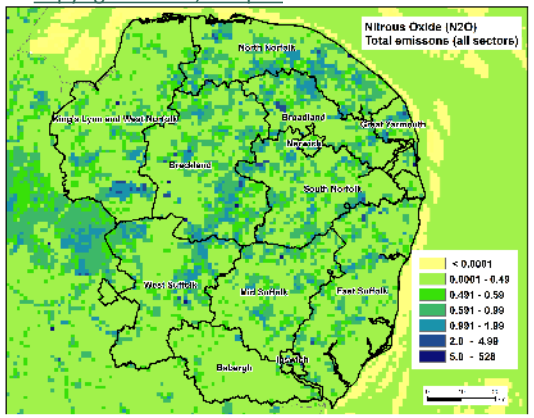
It is widely accepted that global warming, due to greenhouse gas emissions from human activity, is leading to climate change, and that this is one of the greatest challenges for governments and communities to address at this time. The Inter-govermental Panel on Climate Change (IPCC) states -

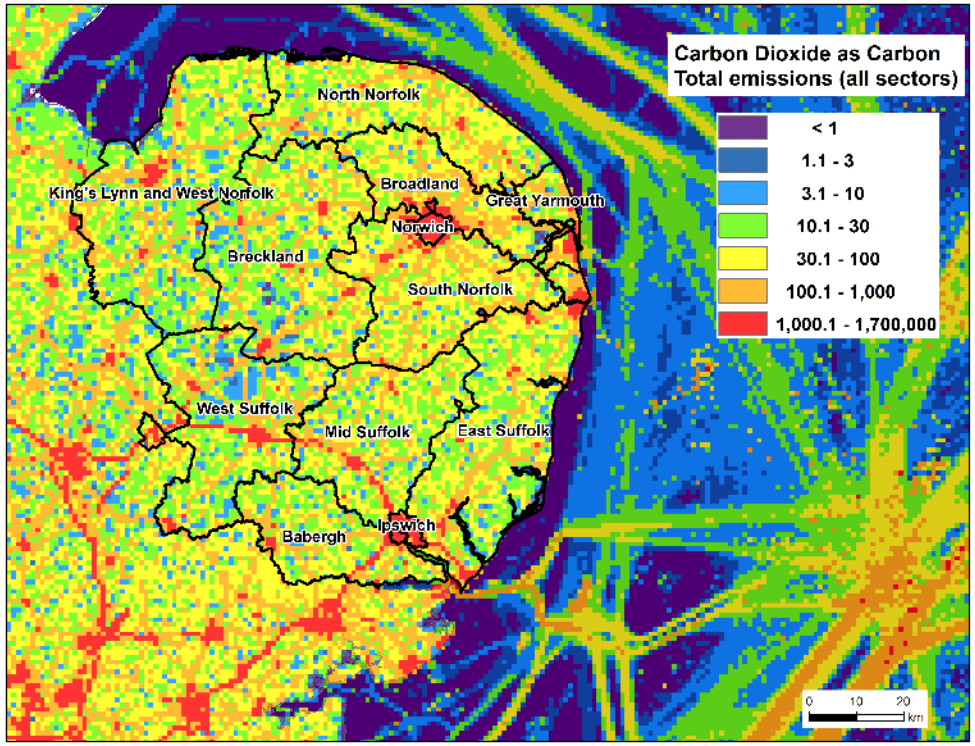
"Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems." IPCC's Fifth Assessment Report (AR5). A 6th Assessment report is due in 2022.

Maps showing emissions of carbon dioxide, plus the more potent gases, methane and nitrous oxide are shown on the right. Although National Atmospheric Emissions Inventory statistics show an overall downward trend in total GHG emissions for Norfolk and Suffolk, emissions from road transport remain reasonably static, making up an increasing proportion of the overall total (see graph below).









Per capita emissions

Progress has been made on reducing emissions but both counties now have higher per capita emissions than the England average (see table right). Per capita emissions need to reduce to -0.4 – 1.7 tonnes/per person /per year to meet the Paris Agreement and limit global mean temperature rise to below 1.5°C.

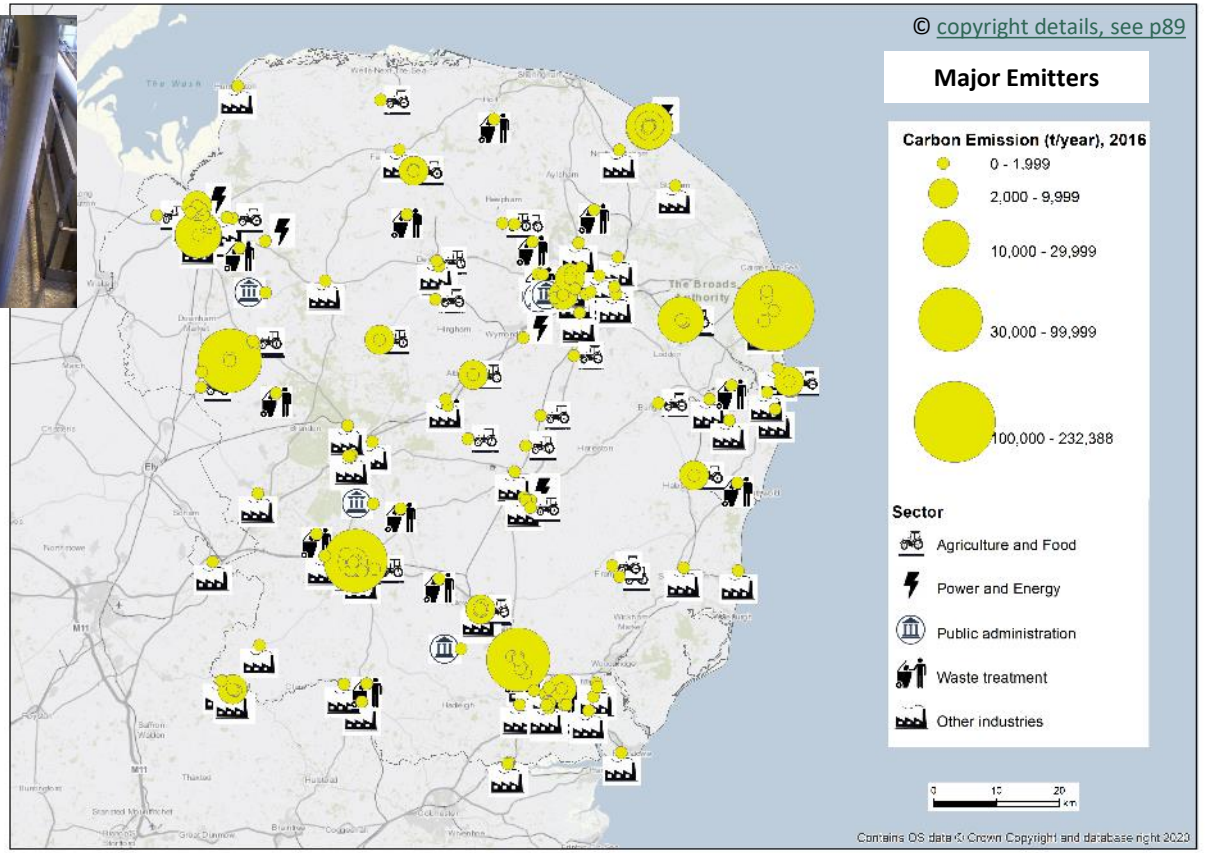
Per Capita (tonnes, CO2 pp/year)			
Year	England	Norfolk	Suffolk
2005	8.5	8.3	8.1
2018	5.0	5.6	5.6

Point source emissions

Data from the National Atmospheric Emissions inventory shows that point-source emitters produce approximately one quarter of CO_2 emissions in Norfolk & Suffolk (map, right). Each point-source on the map is represented by a circle for the amount of emissions and a symbol for the sector involved. There are 37 sources in total, the largest four being the Great Yarmouth power station, the British Sugar factories at Bury St Edmunds and Wissington, and the Suez recycling plant near Ipswich.

The emissions data are reported as tonnes of carbon rather than CO_2 but the total 568,019 tonnes of carbon (in 2016) is equivalent to 2,088,303 tonnes of CO_2. The BEIS emission estimates total 9,232,700 tonnes of CO_2 for Norfolk and Suffolk in 2016 so the 37 point sources account for 22.6% of total CO_2 emissions.

GHG Emissions in Norfolk & Suffolk - major emitters						
NAEI Emissions from Point Sources, (as carbon) tonnes / % share, 2016						
Greenhouse gas	Human-related sources	Agriculture, forestry & fishing	Food, drink & tobacco industry	Power / energy producers	Others	TOTAL CO2e (tonnes)
Carbon dioxide	Fossil fuel combustion/use. Land use changes. Industrial processes.	3,309	302,853	303,248	59,610	568,019
		1%	36%	53%	10%	
Methane	Fossil fuel production, distribution and use. Livestock farming. Landfills and waste. Biomass burning. Rice agriculture.	0.2	24.2	2,348.1	6.2	2,379
		0%	1%	99%	0%	
Nitrous oxide	Agriculture, fossil fuel combustion, industrial processes	0.02	3.18	41.52	0.43	45
		0%	7%	92%	1%	
TOTAL CO2e						570,443



Source: National Atmospheric Emissions Inventory http://naei.beis.gov.uk/data/map-large-source

Assisting businesses that are large point-source emitters (particularly in food processing) transition to a low carbon economy could be an important consideration in a 25 year environment plan for the region.

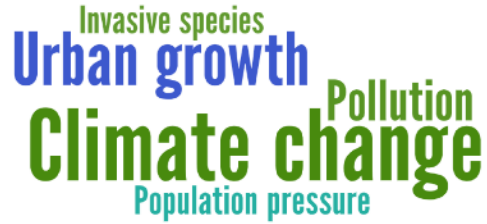
Risks: Local insights

Stakeholder workshops

Stakeholder workshops were held in Diss and Lowestoft in November 2019 as part of this project, to gain expert insights from representatives of a range of local organisations who have an interest in feeding in to the development of the 25 year Environment Plan. Discussion focussed on the four natural asset categories shown below. A number of specific pressures, and risk to particular assets were indicated, along with the additional cross-cutting pressures of climate change, population growth and urban expansion and development. Highlighted ecosystem services most thought at risk were food, water, wildlife and flood alleviation.

Pressures on natural assets identified by local experts (shown as word clouds where the size of the word or phrase indicates relative importance)

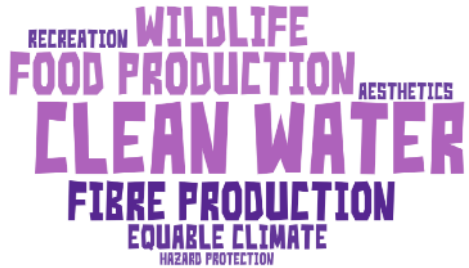
Land



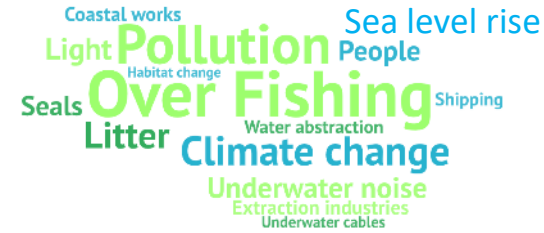
ES benefits at risk

Habitats & species

Freshwater



Coast & Marine



Source: Local expert opinion from workshops held in November 2019.

Risk review: Key findings

Risks at a glance: The literature and expert opinions from the workshops have been synthesised to identify the most vulnerable indicators within the natural asset groups using a 'traffic light' system to identify high risk, medium or growing risk or low risk to the assets.

Pressures and risks:

There are a number of key issues that have a bearing on all asset categories:

- Climate change (the stand-out pressure across all asset categories)
- Population growth / Urban expansion

(See Regional Context section).

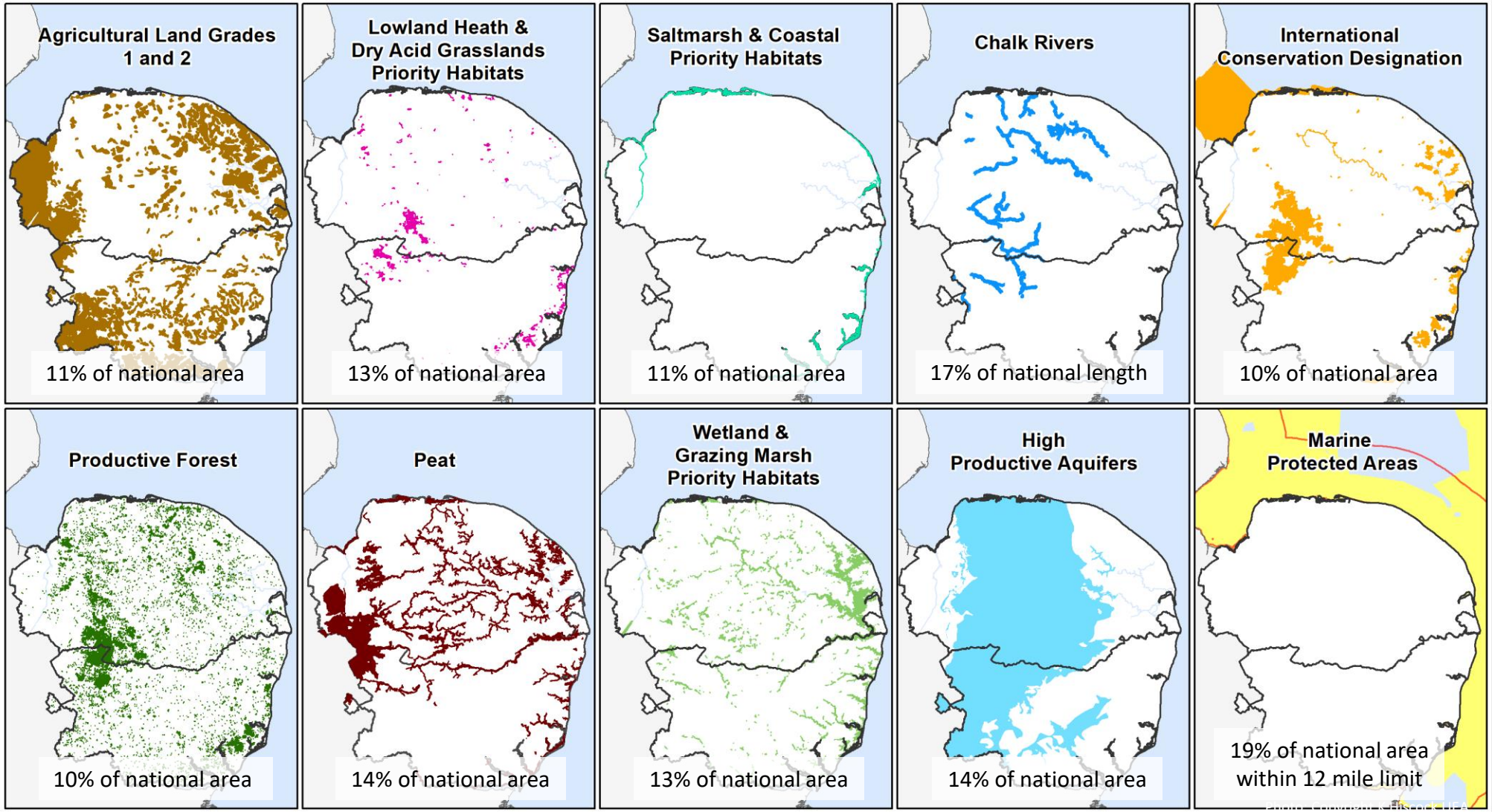
The risks resulting from these (e.g. loss of land to other uses, impact on quality of assets) are included in the risk review.

In addition, for each asset type there may be more specific associated threats (e.g. invasive species, sea level rise). These are also included in the review.

	Land	Soil & Sub-Surface	Habitats & Species	Freshwater	Coast & Marine	Atmosphere
High risk *Mentions/ suggestion of 'high risk' from the literature or workshops*		Aquifers Peat	Saltmarsh & coastal habitats Wetlands & grazing marsh Priority/iconic species Priority habitats	Water availability Surface water quality		Greenhouse gas emissions Point source emissions
Growing or medium risk *Mentions/ suggestion of 'medium risk' or 'growing risk' from the literature or workshops*	Food producing land Productive woodland Carbon density in vegetation Land under conservation management Land types	Soil physical properties Soil biological properties	Habitat connectivity Natural woodlands Extent & condition of SSSIs Lowland heath & dry acid grasslands	Groundwater quality Chalk rivers Flood risk Recreational use of waterways	Marine habitats & protected areas Seabirds & migrating birds Fish stocks Shellfish stocks Recreational use of coasts	Air quality: particulates
Low or reducing risk *Mentions/ suggestion of 'low risk', 'no risk' or 'reducing risk' from the literature or workshops*	Recreational use of land	Soil chemical/ nutrient status Minerals			Marine mammals	

State: Nationally important assets

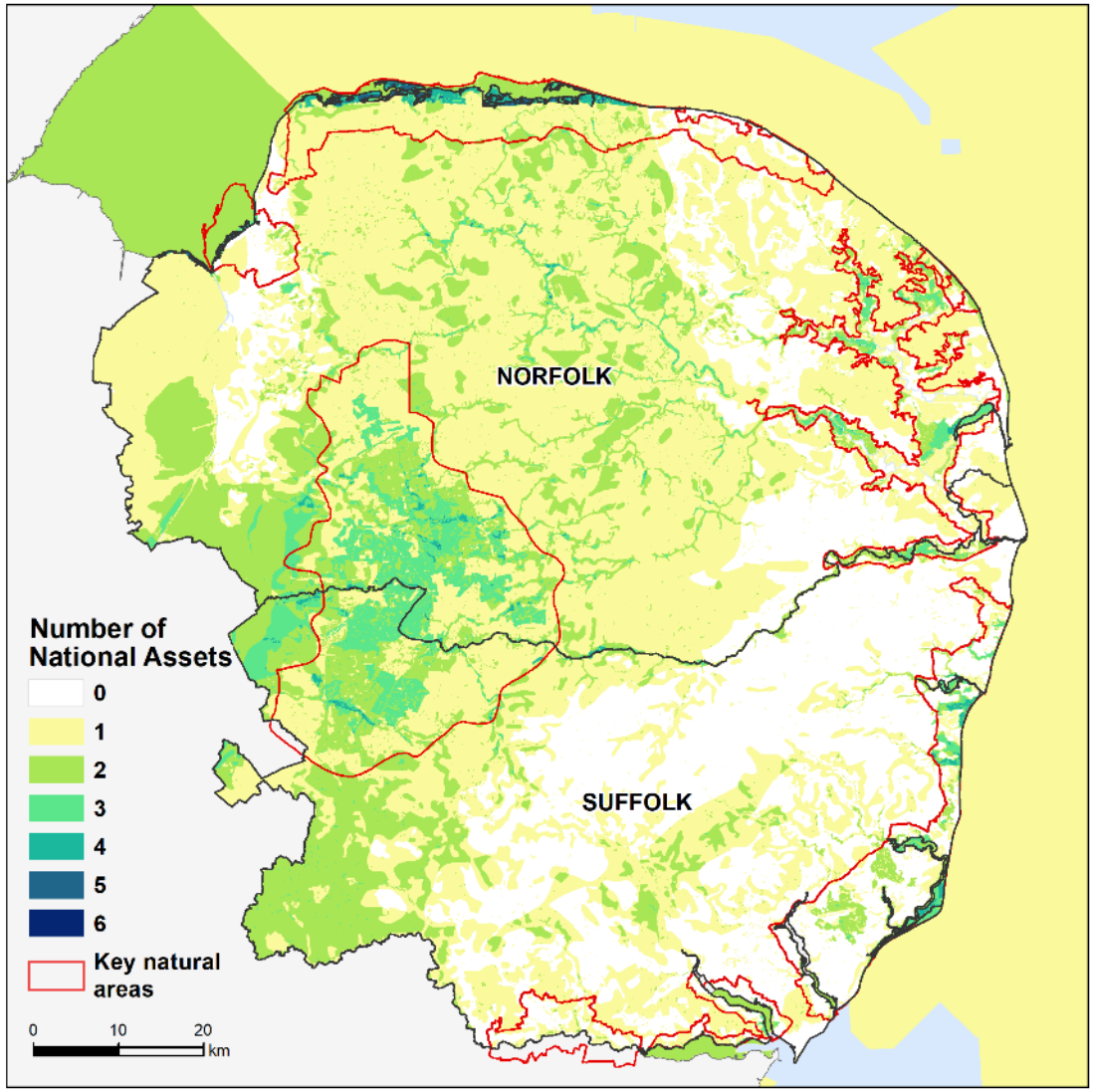
Norfolk and Suffolk constitute 7% of the land area of England and in 2018, supported 3% of its population. As the maps to the right show, the counties include over 10% of a variety of natural assets and protected areas. These examples span provisioning, regulating and cultural ecosystem services, as well as aspects of biodiversity and terrestrial and marine designations. The land, coast and sea of Norfolk and Suffolk therefore make a substantial contribution to the total stock of England's natural assets.



Impact: Vulnerable Ecosystem Services and Benefits

The table below shows the outcome of comparing the ten nationally important assets against the key findings of the Risk Review.

Risk Category	Nationally Important Assets
High	High productive aquifers
	Peat
	Saltmarsh & coastal habitats
	Wetlands & grazing marsh
Medium	Grade 1 & 2 agricultural land
	Productive forest
	Chalk rivers
	Marine Protected Areas
	International conservation designations
Low	Lowland heath & dry acid grasslands



Four assets are in the high category and several of these are also in environments which are important for recreation and nature-motivated tourism. These features therefore clearly require particular attention in any plan to maintain and enhance natural capital. However, it is essential to also recognise that key natural assets are widely dispersed across Norfolk and Suffolk. The map to the right shows the result of overlaying the 10 nationally important assets. Only 28% of the land area in the two counties has no such asset present, 67% has one or two and just 5% three or more. Key natural areas such as Breckland, the Broads and the coastal AONBs all have higher proportions of their area (at least 10%) with three or more assets, but much important natural capital occurs outside them. It is also important to recognise that there are wider functional connections across landscapes (e.g. via water flows in river catchments). As a consequence, initiatives in areas currently without such assets (the 'white space' on the map) might well improve quality further afield and indeed may be places where the greatest benefits could be achieved from investments in the local environment.

Response: Priorities & next steps (1)

Drawing on the information gathered in this work regarding the ***state*** of natural assets and ***risks*** identified, the following **seven priority areas** are suggested for consideration in the development of a local 25 year environment plan.

	Priority	Rationale & Evidence
A	**Develop a policy framework & programmes to safeguard water availability within planning control and other spheres of influence.**	***Rationale:*** *Safeguarding water availability is vital to ensuring protection of natural assets and meeting environmental and economic goals.* ***Evidence:*** *p46, p65, p69*
B	**Support policy and programmes for sustainable land management across whole landscapes to safeguard biodiversity, soil & water quality, food production and access that benefits health and wellbeing.**	***Rationale:*** *Provides the foundation for nature recovery, supports a wide range of ecosystems services and associated benefits.* ***Evidence:*** *p17, p18, p20, p25, p26, p27, p28, p29, p44, p45, p49, p57, p66*
C	**Develop a policy framework & programmes to reduce greenhouse gas emissions though planning control, to ensure energy efficiency & sustainability in new build, support retrofit in older buildings, decarbonise heating prioritising off-gas areas & by working with & targeting support at large point-source emitters.**	***Rationale:*** *Climate change is one of the greatest threats to natural assets and economic goals. Action to reduce GHG emissions is urgent.* ***Evidence:*** *p61, p62, p65, p71*
D	**Develop a policy framework & programmes to support carbon sequestration initiatives (e.g. through peatland restoration & measures to enhance soils & their organic content).**	***Rationale:*** *Carbon sequestration offsets GHG emissions and produces a wide range of benefits to natural assets.* ***Evidence:*** *p21, p26, p29, p65, p66, p67*
E	**Develop policy & programmes for partnership working to increase species richness, abundance and ecological resilience by managing existing habitats, improving habitat connectivity and enabling habitat & species migration (especially in coastal areas).**	***Rationale:*** *Supports nature recovery and mitigates the risks from sea level rise, climate change, pests & diseases and development pressures.* ***Evidence:*** *p19, p33-41, p48, p52-56; p68, p70*
F	**Support policy and programmes to improve biosecurity (e.g. raise awareness of, and provide early alert to, invasive species, pests and diseases).**	***Rationale:*** *Mitigation of risks to ecosystem services such as food production (both on land and sea) and fibre production.* ***Evidence:*** *p18, p33, p37, p39, p41, p66, p69, p70*
G	**Assess natural asset vulnerability & develop contingency planning in preparation for increasing likelihood of extreme climate events e.g. droughts & wildfires, floods, extreme storms and associated amplified coastal erosion.**	***Rationale:*** *Mitigation of risks to new developments, coasts, priority habitats & food producing land from climatic events.* ***Evidence:*** *p47, p61, p65, p71*

Response: Priorities & next steps (2)

The **seven priority areas** identified for Norfolk and Suffolk, map to natural capital elements within the UK 25 Year Environment Plan (DEFRA, 2018; see Box, lower left) and will align with national programmes outlined within it e.g. Nature Recovery Networks (Crick et al., 2020) and the new post-Brexit Environmental Land Management (ELM) scheme. Existing policies and programmes that support natural assets e.g. the Regional Invasive Species Management Plan for the Eastern region (Kenworthy *et al.*, undated); local waste management strategies (UK 25 YP policy area 4, see below) and the East Marine Plan (DEFRA, 2014) (UK 25 YP policy area 5) will also need to be linked to the Norfolk & Suffolk 25 Year Environment Plan, as will the inclusion of better data on locally important indicators and risk appraisal. Additionally, the learning experiences of the recently concluded Suffolk Marine Pioneer project (SMP 2020) regarding approaches to and processes for partnership working, provide a good blueprint for furthering the natural capital approach in the development of the Norfolk & Suffolk 25 Year Plan.

UK 25 Year Environment Plan:
Six key policy areas

1. Using and managing land sustainably [B], [C], [D], [E], [G]
2. Recovering nature and enhancing the beauty of landscapes [A], [B], [E], [F]
3. Connecting people with the environment to improve health & wellbeing [B], [E]
4. Increasing resource efficiency, and reducing pollution and waste [A], [C]
5. Securing clean, productive and biologically diverse seas and oceans [F]
6. Protecting and improving the global environment [C], [G]

(DEFRA, 2018)

Alignment of the **seven priority areas** for Norfolk & Suffolk [in brackets] to the UK 25 year Plan.

Next steps

This Evidence Compendium has highlighted the diversity of natural assets in Norfolk and Suffolk, as well as their importance for multiple benefits at national and regional scales. It is also apparent that there are risks that a number of key assets may decline or deteriorate in future and that, in some cases, gaps exist in the information base needed to enhance their functioning or resilience. Addressing these issues and improving collaboration between local organisations through a Norfolk and Suffolk 25 Year Environment Plan will help improve capacity to respond to the environmental and societal challenges ahead.

Next steps include dissemination of the findings of this work (including creation of an online resource to provide access to digital maps and associated statistics); identification of monitoring needs and more locally-specific or relevant indicators of the state of natural assets in the two counties; creation of new monitoring programmes to address these data gaps, and establishment of a stakeholder driven process to feed into the development of the Norfolk and Suffolk 25 Year Environment Plan.