ITRC mistral

multi-scale infrastructure systems analytics

Green infrastructure

Mapping natural capital and ecosystem services

Alison Smith, University of Oxford

EPSRC
Engineering and Physical Sciences Research Council

Natural capital underpins the delivery of essential ecosystem services

Cultural services

Recreation

Aesthetic value

Education and knowledge

Interaction with nature

Sense of place

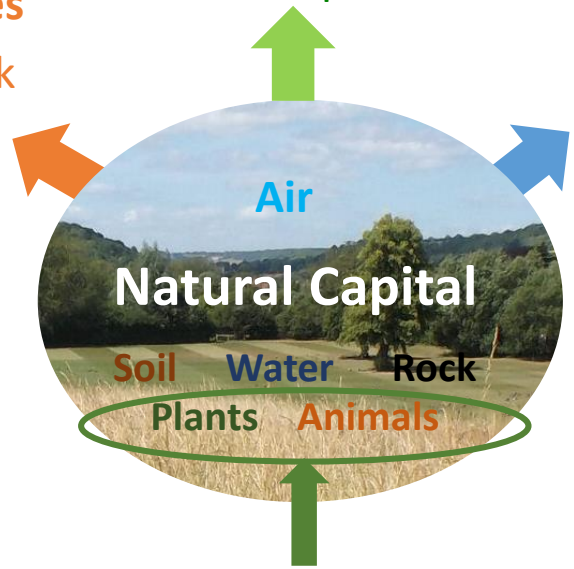
Provisioning services

Food crops, livestock

Wood

Fish

Fresh water supply



Regulating services

Flood control

Erosion control

Water quality

Carbon storage

Air quality

Cooling and shading

Noise regulation

Pollination

Pest control

Biodiversity

Embedding a natural capital approach in the Arc

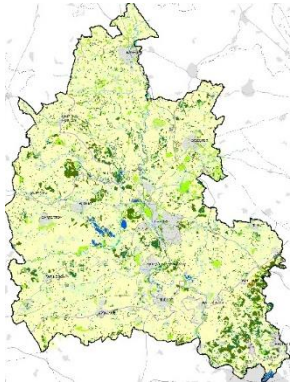
To develop a 'Green Arc' vision we need to know:

- Where are our high value natural capital assets?
- Where do we need to restore or enhance natural capital to deliver the services that people need?
- What are the impacts of different development patterns on natural capital?
- Where do we need to create green corridors that link habitats for wildlife into a connected network?

Natural capital mapping method

1. Matrix of scores from 0 to 10 for the ability of each habitat / land use type to deliver each of the 18 services
2. Apply the scores to a habitat and land use map -> maps for each of the 18 services
3. Extra multipliers to reflect habitat condition or location – e.g. agricultural land use class (for food provision) and public access (for recreation)

Habitat and land use maps



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Matrix of scores for each habitat and land-use type

Habitat	Food	Wood	Fish	WaterProv	Flood	Erosion	WaterQual	Carbon
Broadleaved, mixed and yew semi-natural woodland	1	6	0	3	9	10	10	10
Broadleaved, mixed and yew plantation	0	8	0	2	9	8	8	9
Native pine woodlands	0	0	0	3	9	8	6	7
Coniferous plantation	0	10	0	1	10	6	5	8
Wood pasture and parkland with scattered trees	5	2	0	7	6	8	6	5
Traditional orchards	5	1	0	7	8	8	5	5
Dense scrub	1	2	0	4	6	8	5	6
Hedgerows	1	1	0	4	6	8	5	5
Felled woodland	0	0	0	4	1	0	1	2
Tall herb and fern	1	0	0	8	5	8	5	4
Bracken	1	0	0	8	5	8	5	4
Semi-natural grassland	6	0	0	9	4	8	4	4

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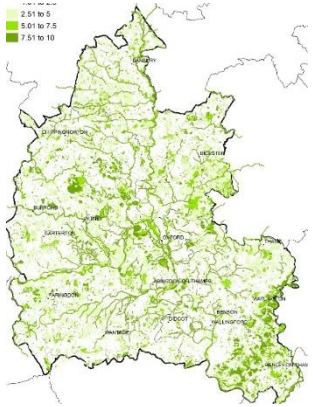
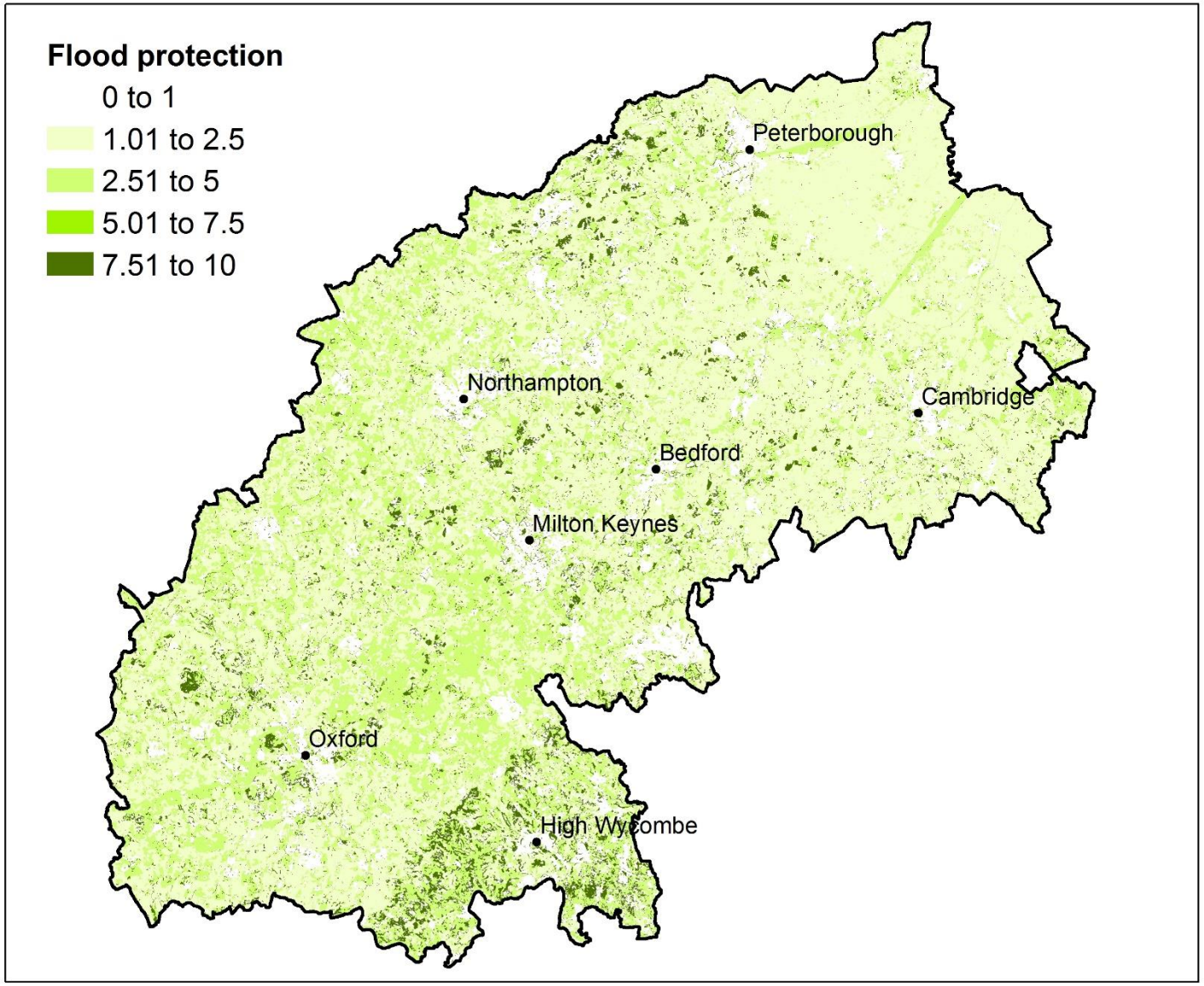
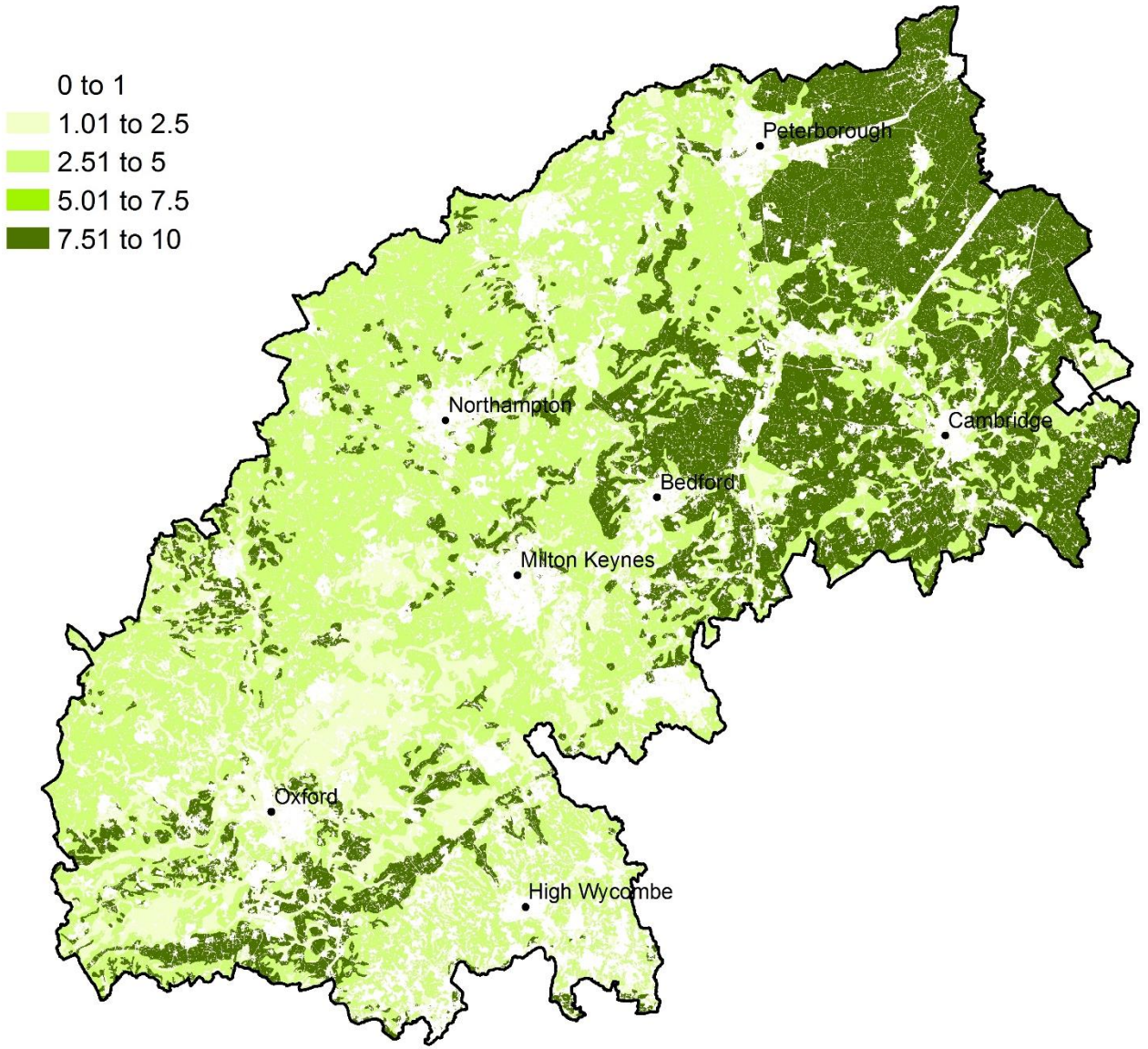
Ecosystem service maps



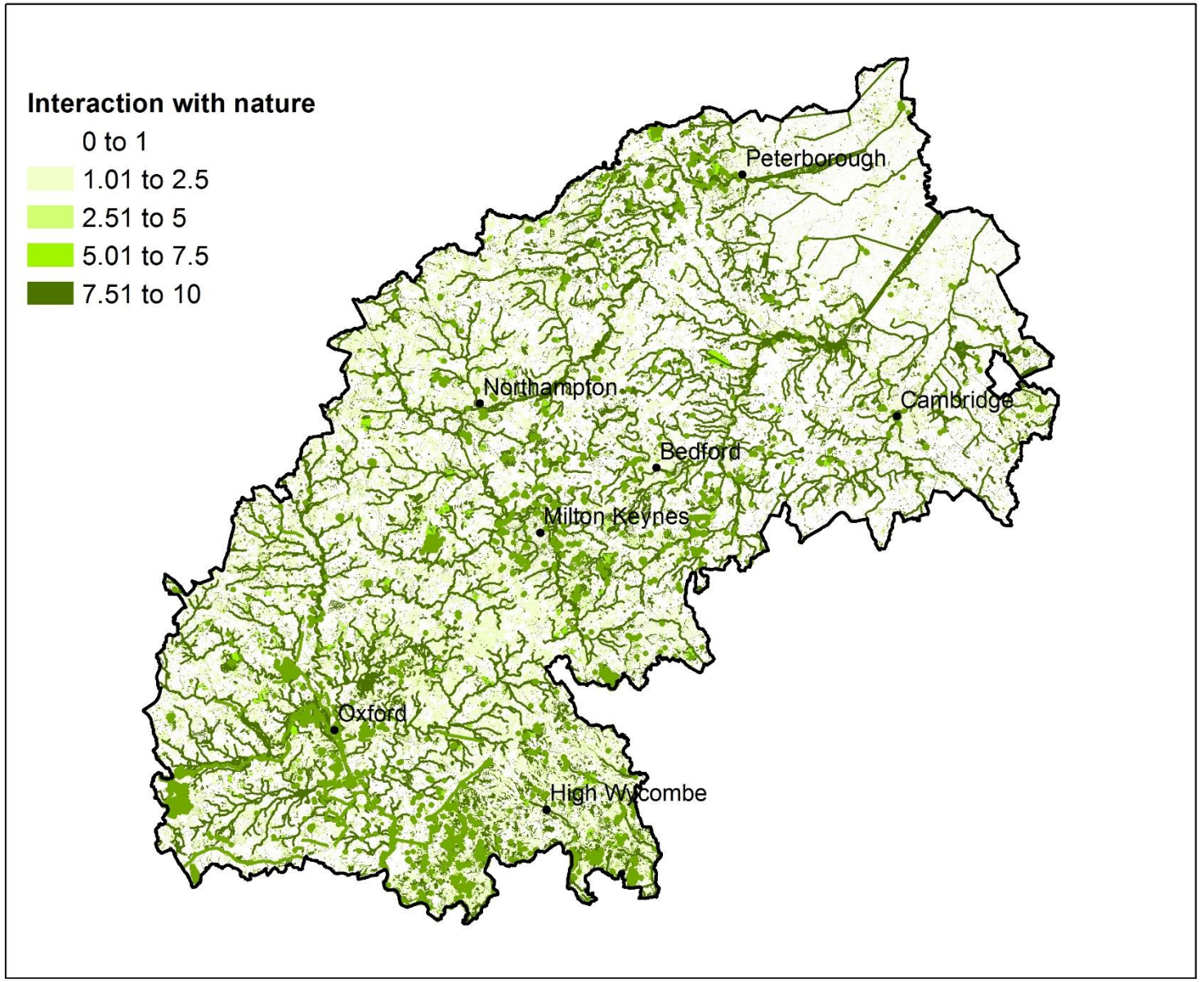
Flood protection by ecosystems



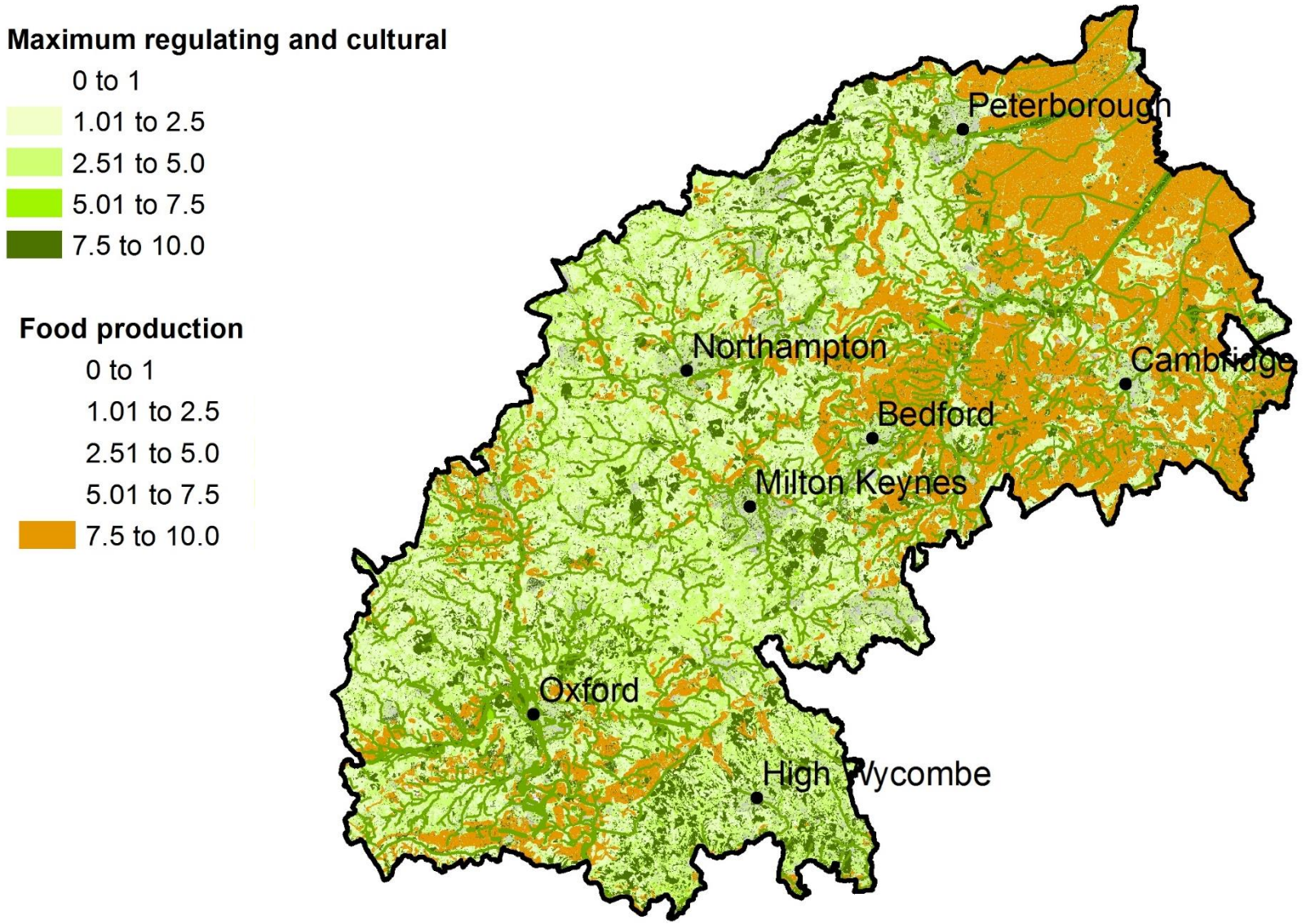
Food production (with ALC grade multiplier)



Interaction with nature



High value natural capital assets: Maximum score out of all 18 services



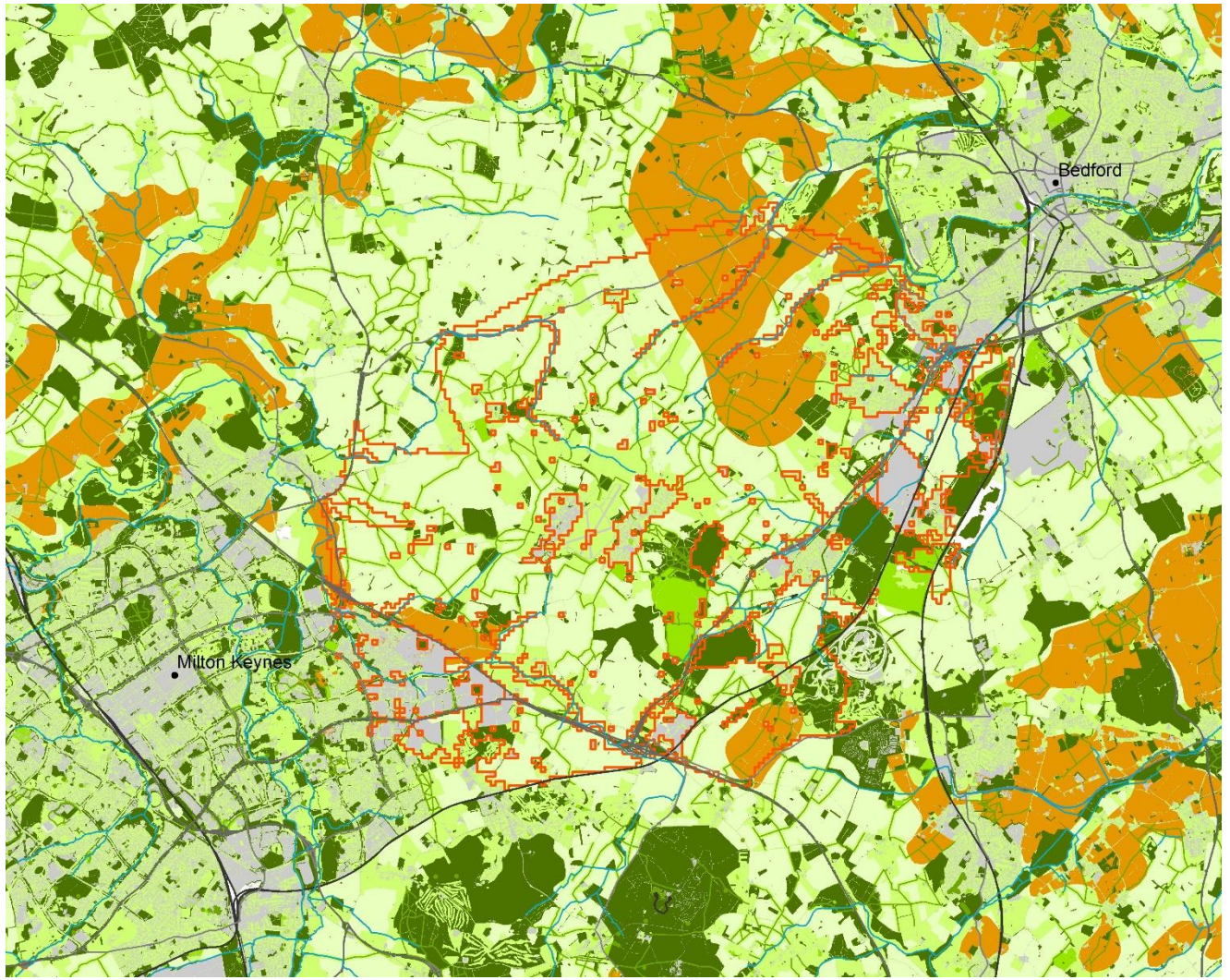
Impact of the new settlement scenario

Maximum regulating and cultural

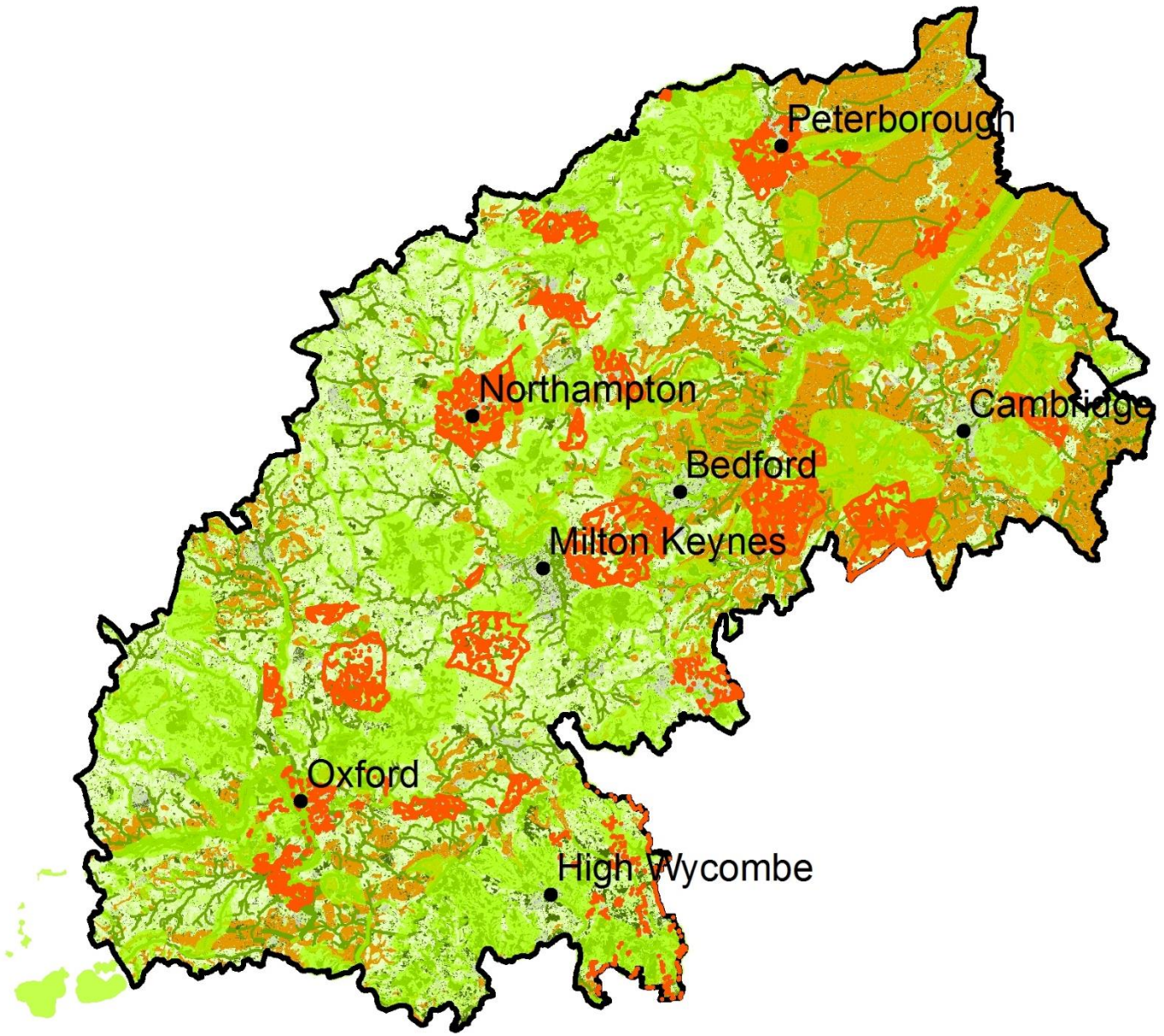
- 0 to 1
- 1.01 to 2.5
- 2.51 to 5.0
- 5.01 to 7.5
- 7.5 to 10.0

Food production

- 0 to 1
- 1.01 to 2.5
- 2.51 to 5.0
- 5.01 to 7.5
- 7.5 to 10.0



New settlements (red) with habitat networks (bright green) and high value natural capital



Key results

- Intensive farmland dominates – high scores for food production
- Low scores for many regulating and cultural services because semi-natural habitats are sparse and fragmented
- Almost all unsealed land has natural capital value – even low grade farmland can store carbon in soil, soak up floodwater and allow groundwater recharge.
- Unplanned and unconstrained development -> further depletion and fragmentation of natural capital assets and risk to quality of life for current and future residents

What does this mean for planning in the Arc?

- Need to protect existing assets from further loss to:
  - Safeguard quality of life for residents
  - Exploit cost-effective opportunities to enhance flood protection, carbon storage, active travel routes, health and wellbeing
  - Meet nature recovery targets

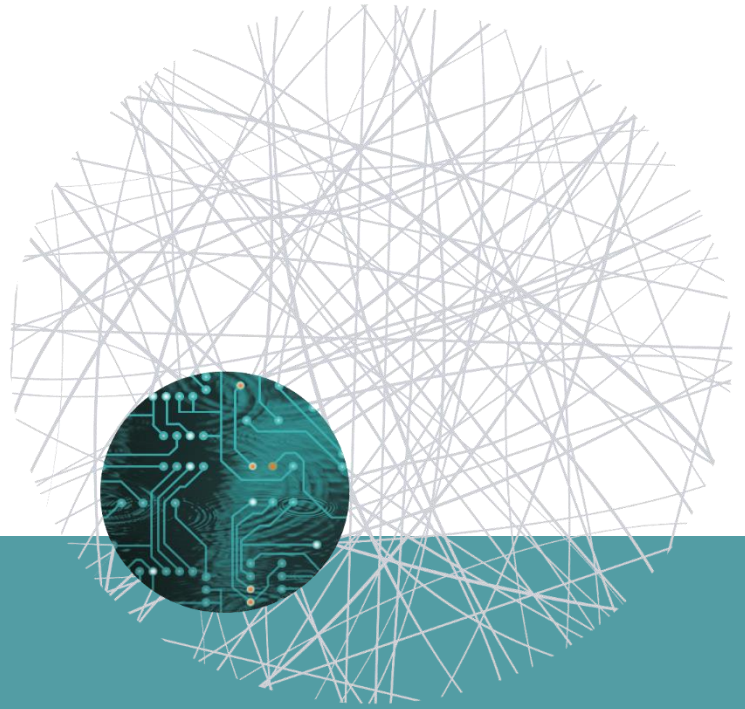
- Can test scenarios for future development, including ‘Green Arc’ vision with multifunctional green space and green corridors for wildlife and people (next steps)

- Highlight areas of low natural capital value -> align with opportunities to restore habitats to create nature recovery networks.

ITRC-MISTRAL Infrastructure Analysis: OxCam Arc

Wed, 20 November 2019

Institution of Civil Engineering, London



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UKRI Engineering and Physical Sciences Research Council

EPSRC Engineering and Physical Sciences Research Council

Protecting and enhancing the environment in the Oxford Cambridge Arc

Professor Paul Leinster CBE

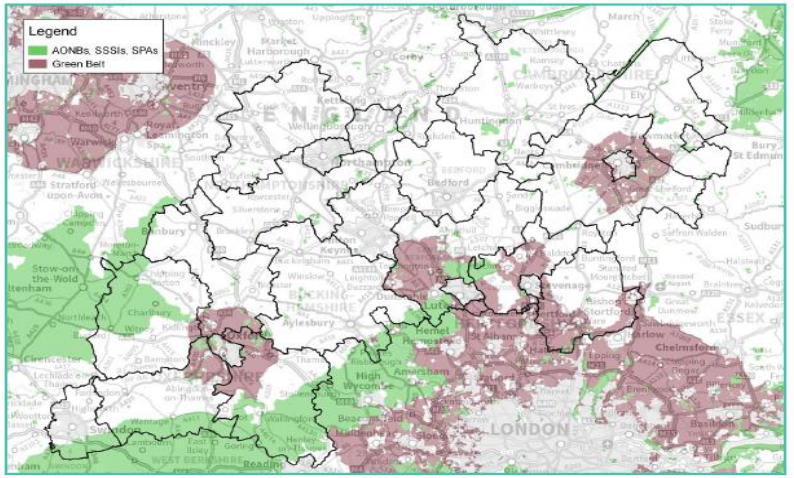
November 2019

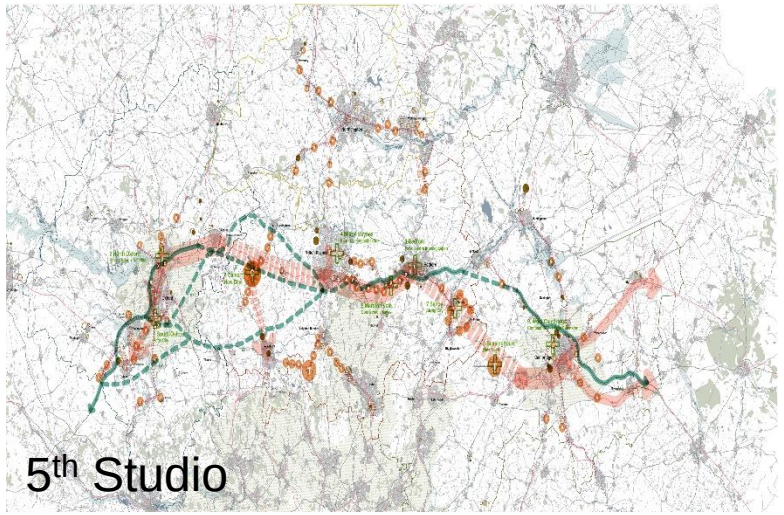
Oxford Cambridge Arc: the challenge

Major economic growth area of worldwide significance

- House building rates need to double - delivering up to 1,000,000 new homes by 2050
- Large new settlements; major urban extensions; development in and around existing towns and cities
- Current population 3.3 million to increase by between 1.4 and 1.9 million
- East west rail
- East west expressway

Figure 5: Environment and planning constraints across the corridor





Oxford to Cambridge 66 miles

Overarching context

The first generation to leave the natural environment of England in a better state than that in which we found it

Goals and policy intents:

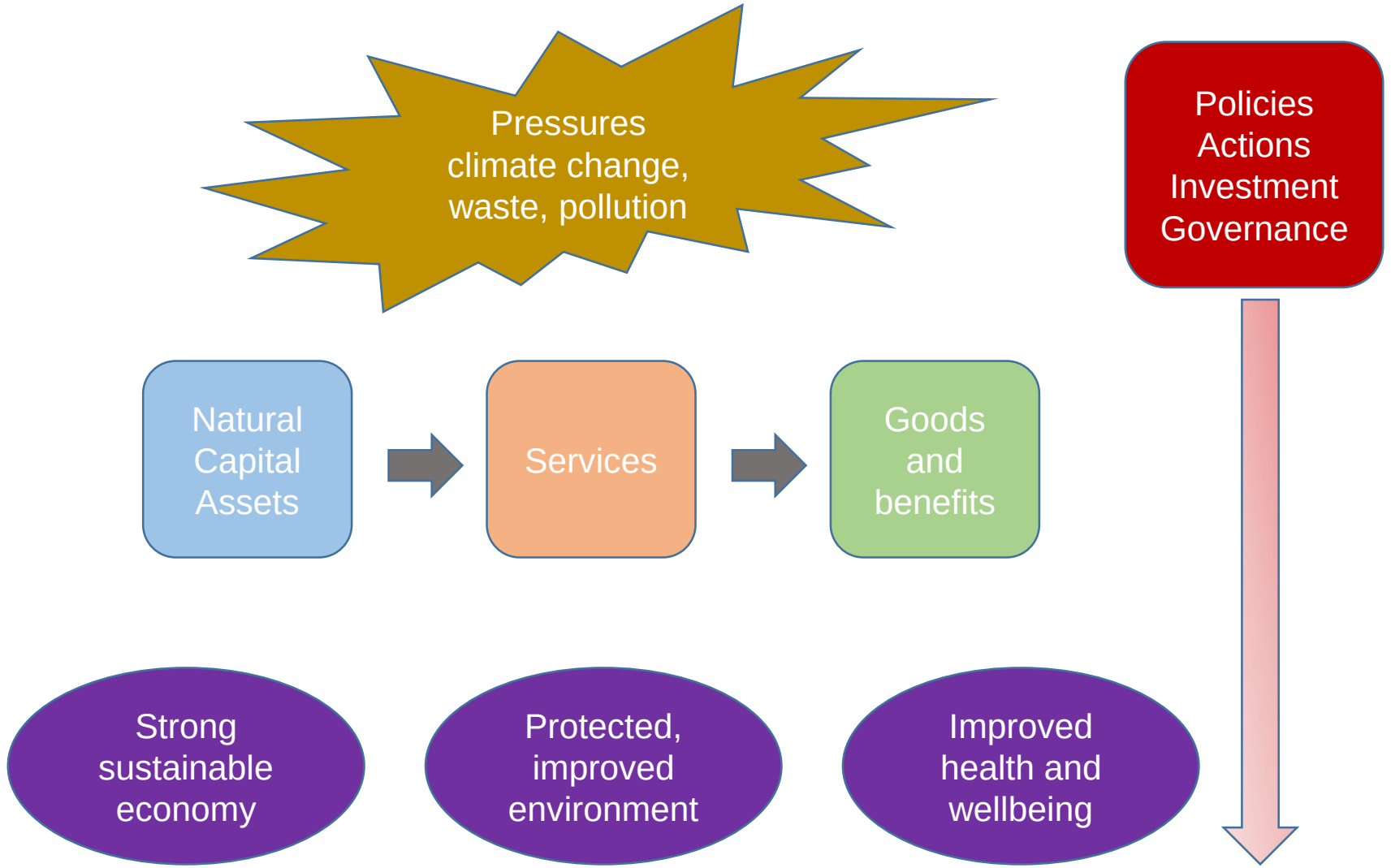
- Public goods for public money
- Net biodiversity gain
- Net environment gain
- Nature recovery strategies
- Local natural capital plans

The Ox Cam Arc: an opportunity to put the 25 year environment plan into action and embed natural capital in growth plans?

HM Government

A Green Future: Our 25 Year Plan to Improve the Environment

Overall approach



Natural capital principles

- Importance of stocks not just flows
- Place and area based
- Many natural capital assets
  - are spatially and context specific
  - operate at a number of scales
  - are often not linked to biodiversity ‘habitat’ types
- Need to understand:
  - assets and their ownership
  - whether renewable or non-renewable
  - the extent and condition
  - if stock is increasing or decreasing
  - if at risk and from what
  - proximity to any tipping points
  - the cost of enhancement and maintenance
- Manage natural capital so it can continue to meet the needs of people and the economy,
- And don’t forget the biodiversity

How to do it manual

- Setting out the vision: identify the high-level objectives, including benefits to focus on
- Understanding the starting point: determine the boundary of the assessment
  - geographic area; people involved; existing work programmes and activities
- Building the evidence base: identify on a prioritised basis, the natural capital assets that underpin the services delivering the benefits
  - natural capital asset register – extent and condition; natural capital risk register; natural capital accounts; maintenance
- Identifying and weighing up options for future activities: opportunity mapping
- Implementation and evaluation:
  - practical, implementable and prioritised action plan with the necessary funding identified
  - integrated action and pooled resources
  - effective governance, accountability and reporting

Asset assessment

Asset register	natural capital assets, extent and condition – including international, national and local importance
Physical flow of benefits	determine physical flow of benefits
Value of benefits	calculate value of benefits
Asset risk register	is the asset condition and extent at risk and if yes from what?
Restoration cost	calculate costs of restoring assets
Maintenance cost	calculate costs of maintaining assets
Natural capital balance sheet	is value increasing or decreasing year on year?

Thoughts on environmental net gain

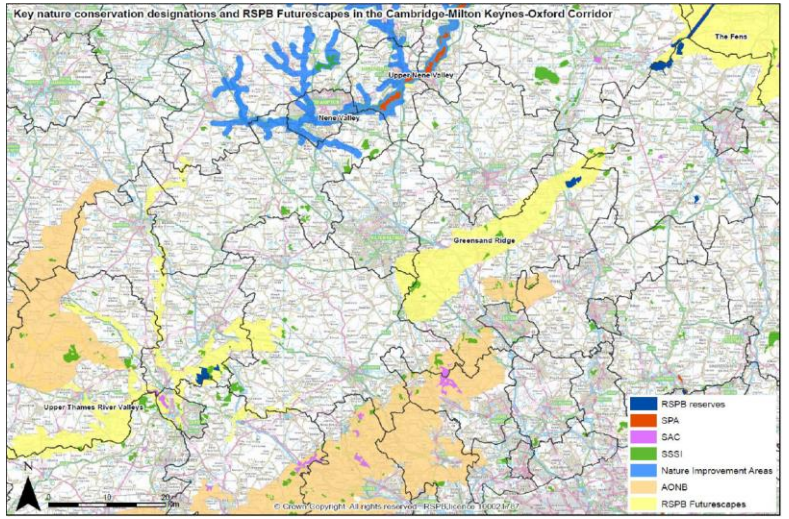
- Decision support tool
- Need agreed methodology including so called insignificant impacts
- Need agreed data sets for a baseline assessment
- Maps and datasets should be made freely and widely available (not withstanding current IP issues)
- A demonstrable increase in natural capital assets - beware of non natural capital trade offs
- Should apply to local and national planning regimes
- Net environmental gain = net biodiversity gain plus
- Restore and maintain existing natural capital
- Incorporate avoid, minimise, remediate, compensate, invest and maintain aspects

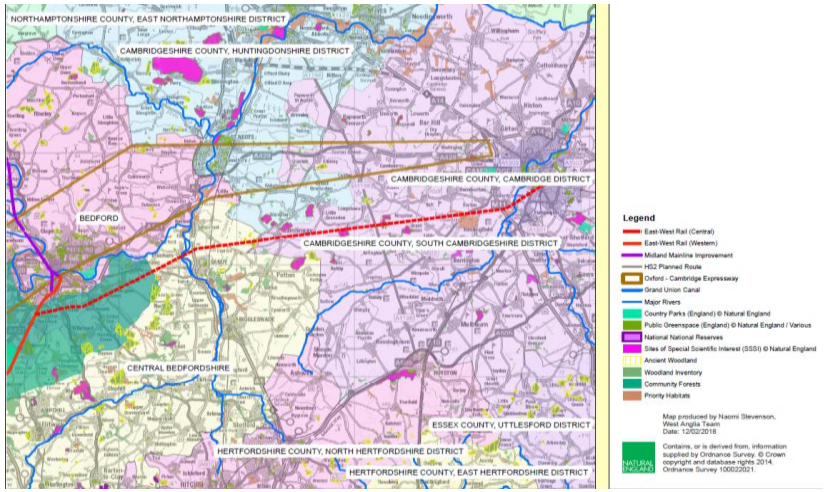
Thoughts on environmental net gain

- Use costs and benefits approach to inform investment in new natural capital
- Don’t net off benefits and impacts
- Remediation activities should be as local as possible to the development
- Provide new assets on at least a 1 for 1 basis
- Gain aspects can be located elsewhere based on costs and benefits approaches
- Net environmental gain of 20%?
- Account for time taken to establish new assets
- Natural capital opportunity maps should be drawn up
- Perverse incentive to allow land to degrade must be addressed
- Need for a clear verification framework

Ox Cam Arc: Local Natural Capital Plan

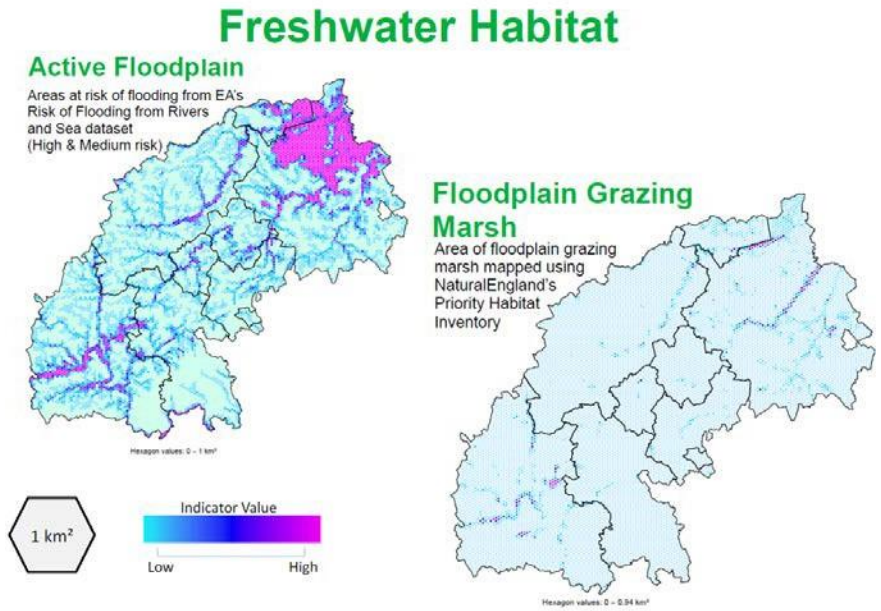
- Shareable and agreed baseline data (maps) based on common standards
  - natural capital assets
  - ecosystem services
  - constraints and risks
  - opportunities
- Natural capital account
- Investment toolkit
- Agreed net biodiversity approach
- Agreed net environment gain approach
- Lessons identified and recommendations report

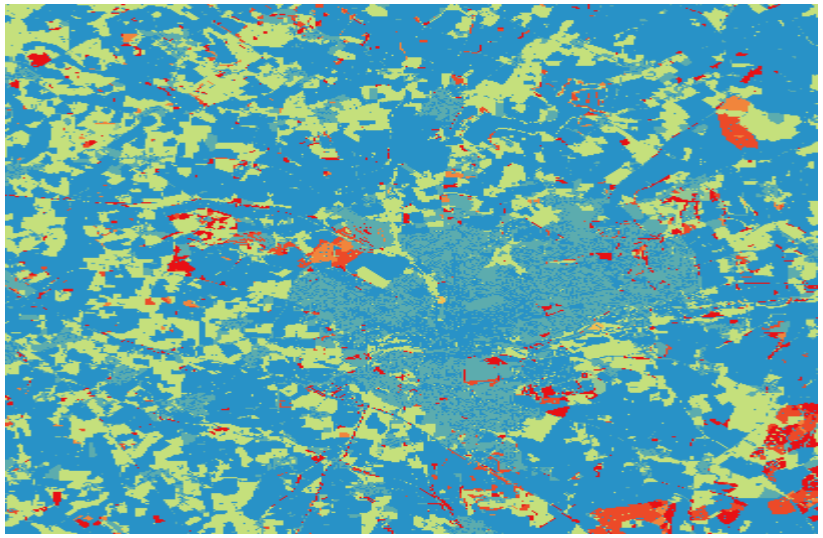




Ox Cam Arc work in progress

- Natural Capital indicator maps
- Based on national data
  - replicates Natural England approach
- Ecosystem services maps
- Jacobs is reviewing natural capital and ecosystem services approaches and tools
- What scale of mapping for what purpose?





Northants County Council, carbon storage capacity

Ox Cam Arc Local Nature Partnerships asks

Connecting people and the environment

- A bold strategic plan to protect and improve the environment, natural capital and biodiversity
  - with same status as the productivity, connectivity and place strategies
  - effective environmental governance at all levels within the Arc
  - building on the ambitions of the 25 year plan for the environment
- Clear and measurable net gain targets for natural capital and biodiversity both Arc wide and within housing and infrastructure projects
- Environmental, natural capital and biodiversity considerations to inform site and route selection and the design of developments
- Protect and improve the resilience and connectivity of habitats
- Local authorities to cooperate effectively across boundaries

- Natural Cambridgeshire doubling nature target: 8.5 to 17% rich wildlife habitats and greenspace

High level findings

- It takes time and effort to build confidence and common purpose in multi-stakeholder groups
- Any new approaches need to find ways of building on existing work
- The identification and weighing of natural capital investment options was complex
- Existing environmental protections do not mitigate the cumulative impacts of new development
- Natural capital based approaches enable an integrated and systems led approach to the protection and improvement of the environment

thank you

questions and discussion