Eco-metric Approach

Growing natural capital benefits for people and places through biodiversity net gain

CIEEM Conference: Biodiversity Net Gain from policy to practice

27 March 2019

Department for Environment Food & Rural Affairs

NATURAL ENGLAND

Ecosystems Knowledge Network

Environment Agency

Balfour Beatty

ceep Consultancy for Environmental Economics & Policy

wsp

Northumbria University NEWCASTLE

CEH

Environmental *Change* Institute

eci

UNIVERSITY OF OXFORD

Spring Statement

‘Following consultation, the government will use the forthcoming Environment Bill to mandate biodiversity net gain for development in England, ensuring that the delivery of much-needed infrastructure and housing is not at the expense of vital biodiversity.’

25 Year Environment Plan

Refers to..

expanding the net gain approaches used for biodiversity to include wider natural capital benefits

Sets out the ambition of …

embedding and environmental net gain (ENG) principle in development, including housing and infrastructure

Eco-metric

- Eco-metric is about measuring wider **natural capital benefits for people and places** from biodiversity net gain.

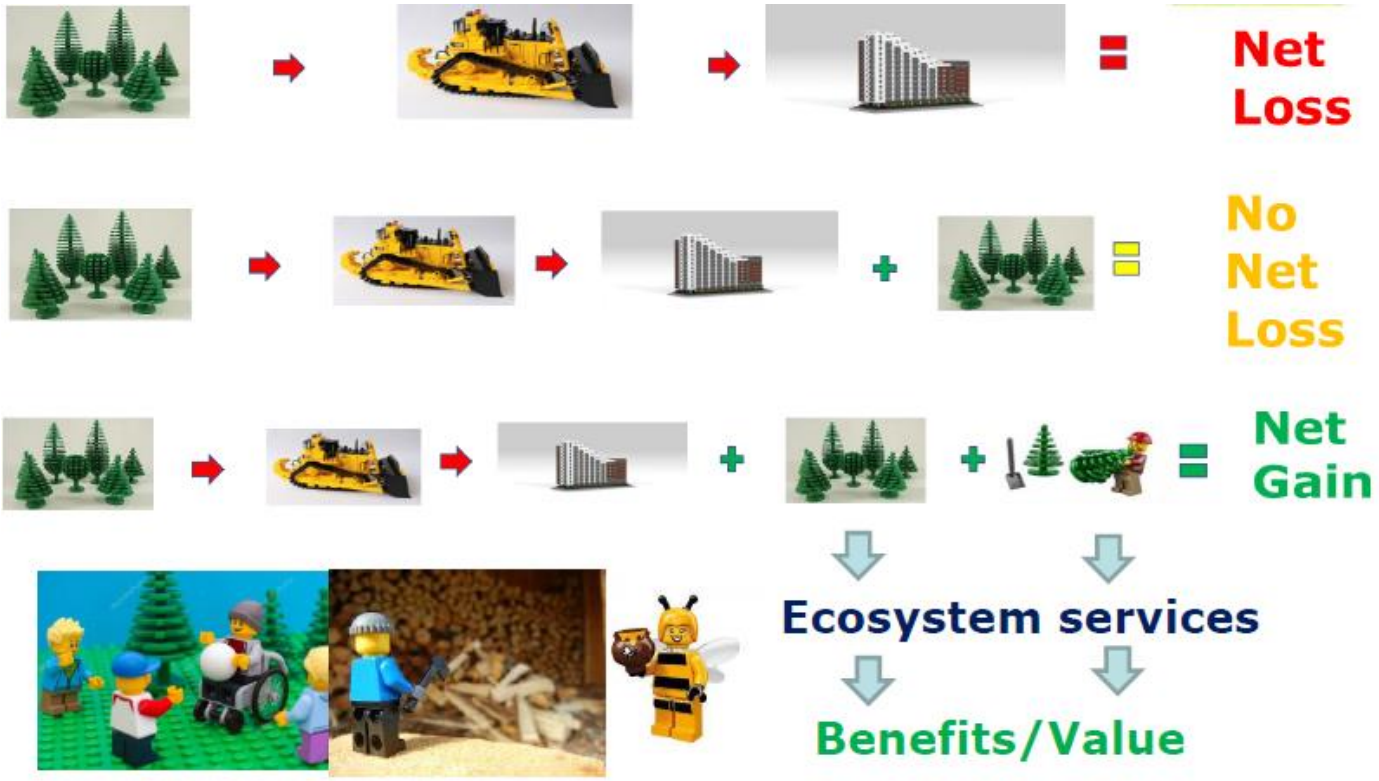
- Deliberately **biodiversity-led approach..**

  …expanded to measure **net gains and losses in natural capital, specifically ecosystem services,** in land use change/development context.

- Bigger bang for our biodiversity buck!

- **Habitats-based metric** for quantifying 18 ecosystem services based on a scoring matrix, adjusted for condition and spatial factors, with post land use change taking account of time to target condition for each ecosystem service and delivery risk.

Unit of measurement



Unit of Measurement
Defra Biodiversity Metric 2.0 measures 'biodiversity units'
Eco-metric - measures ecosystem services from biodiversity net gain

Principles

- **Biodiversity net gain is a pre-requisite.** The eco-metric can be used to enhance delivery of ecosystem services once biodiversity net gain is achieved.

- **Use within the mitigation hierarchy** (avoid - minimise - restore - compensate)

- The eco-metric is an **initial scoping assessment** to be used alongside or in advance of detailed impact assessments such as an EIA.

- **Scores for individual ecosystem services should not be added together,** because they are not directly comparable.

Cultural services

Recreation

Aesthetic value

Education and knowledge

Interaction with nature

Sense of place

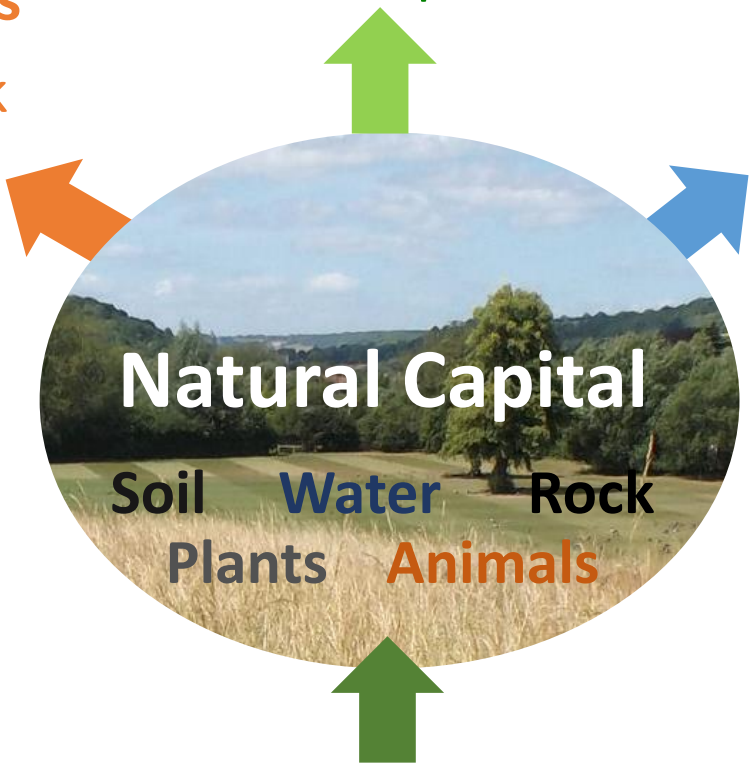
Provisioning services

Food crops, livestock

Wood

Fish

Fresh water supply



Regulating services

Flood control

Erosion control

Water quality

Carbon storage

Air quality

Cooling and shading

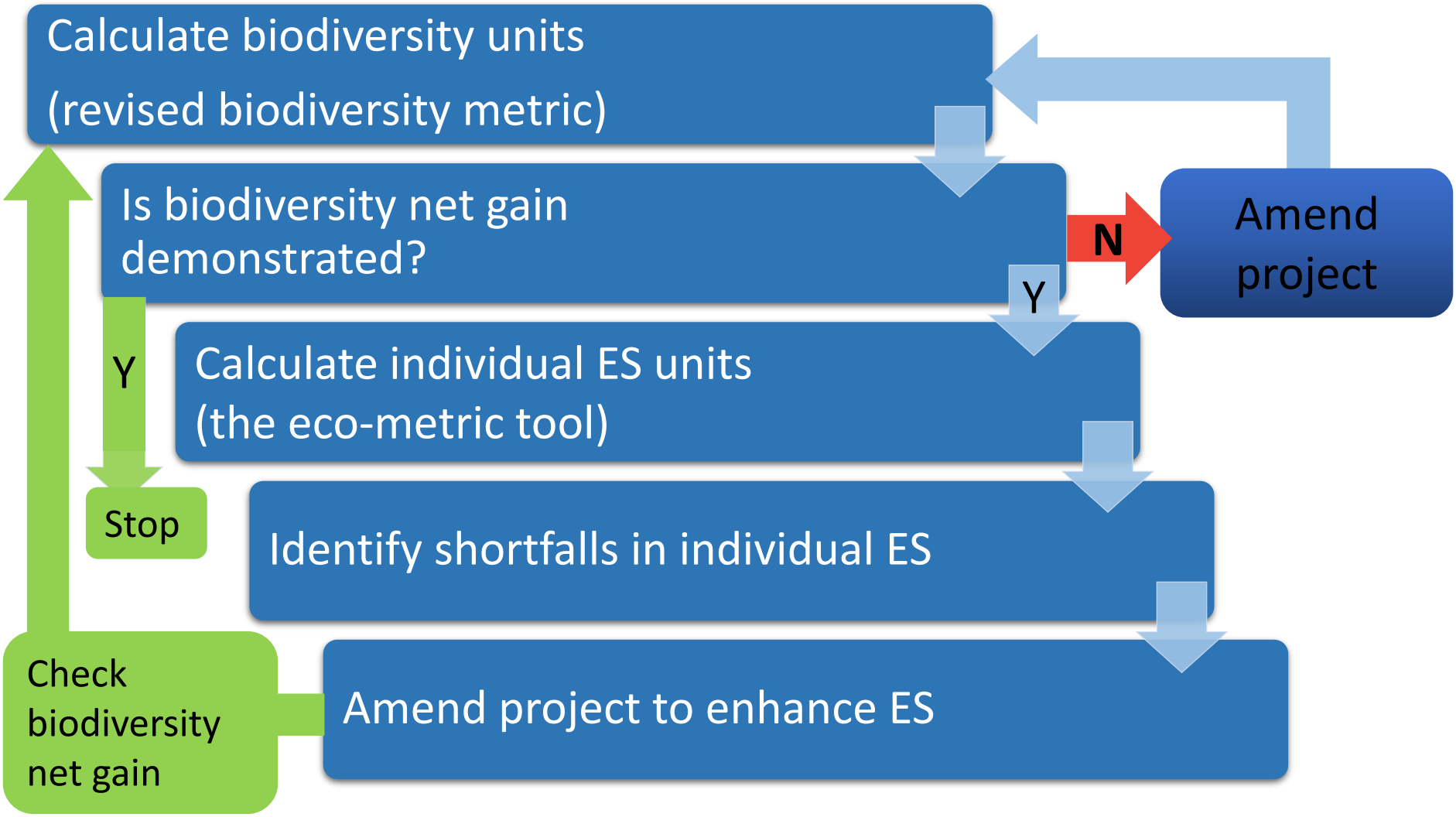
Noise regulation

Pollination

Pest control

Biodiversity net gain

The overall process



Eco-metric calculation

The biodiversity metric

BD = Area x Distinctiveness x Condition x Spatial x Time x Delivery

The eco-metric

ES1 = Area x Score x Condition x Spatial x Time x Delivery
ES2 = Area x Score x Condition x Spatial x Time x Delivery
ES3 = Area x Score x Condition x Spatial x Time x Delivery
ES4 = Area x Score x Condition x Spatial x Time x Delivery
…

Part of draft scoring matrix – scores are still being refined

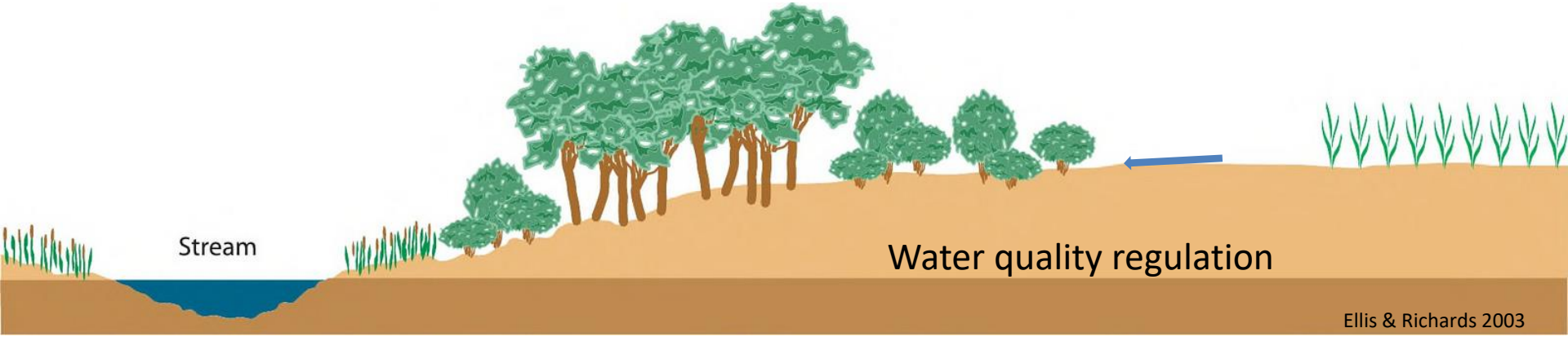
	Food production	Wood production	Fish production	Water supply	Flood regulation	Erosion protection	Water quality regulation	Carbon storage	Air quality regulation	Local climate	Noise regulation	Pollination	Pest control	Recreation	Aesthetic value	Education/science	Interaction with wildlife	Sense of place
Broad-leaved, mixed and yew semi-natural woodland	1	6	0	3	10	10	10	10	6	10	8	8	8	10	10	10	10	10
Broad-leaved, mixed and yew plantation	0	8	0	2	9	8	8	9	6	10	8	6	6	8	10	6	7	8
Parkland / pasture with scattered trees	5	2	0	7	6	8	6	5	3	6	6	8	8	10	10	6	6	10
Coniferous plantation	0	10	0	1	10	6	5	7	10	10	10	2	6	8	6	6	4	6
Native pine woods	0	0	0	2	10	8	6	8	8	10	10	6	8	10	10	10	10	10
Dense scrub	1	2	0	4	6	8	5	5	7	6	6	8	10	8	8	6	8	6
Traditional orchard	5	1	0	7	8	8	5	5	4	8	6	8	8	8	10	8	7	10
Hedgerows	1	1	0	4	6	8	5	5	8	6	6	8	10	8	10	8	10	10
Tall herb and fern	1	0	0	8	5	8	5	4	1	2	1	8	10	8	10	6	8	4
Bracken	1	0	0	8	5	8	5	4	1	2	1	6	8	8	6	4	6	2
Semi-natural grassland	6	0	0	9	4	8	4	2	1	2	1	8	8	10	10	10	10	10
Acidic grassland	6	0	0	9	4	8	4	3	1	2	1	6	8	10	10	10	10	10
Calcareous grassland	6	0	0	9	4	8	4	2	1	2	1	10	8	10	10	10	10	10
Neutral grassland	6	0	0	9	4	8	4	2	1	2	1	8	8	10	10	8	10	10
Improved grassland	10	0	0	7	3	4	1	3	1	2	1	2	3	4	4	2	2	4
Arable fields	10	0	0	7	2	0	0	2	1	2	1	2	2	2	2	2	1	2
Arable field margins	0	0	0	8	4	6	5	2	1	2	1	8	8	4	8	6	6	4
Horticulture	10	0	0	7	2	0	0	1	1	2	1	2	2	2	2	2	1	2
Woody biofuel crops	0	10	0	3	4	2	1	3	1	2	1	2	4	2	2	2	1	2
Intensive orchards	10	0	0	3	8	6	1	5	4	8	6	6	4	2	8	2	1	2

Condition factors for ES


James Petts, Flickr

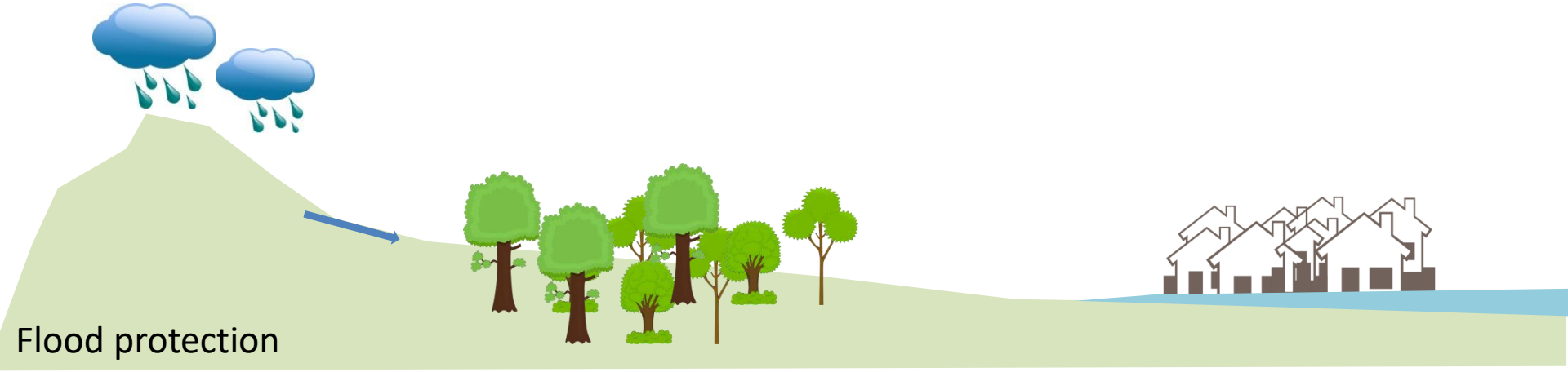

Steve, Flickr

Spatial factors for ES



Water quality regulation

Ellis & Richards 2003



Flood protection

Air quality and noise regulation

Data requirements and sources

BASIC	Generally from freely available online maps. Do not vary much, if at all, across the site.
STANDARD	May require a site survey or collection of local information, or simple GIS analysis. May vary across the site.
ADVANCED	Typically require a site survey or complex GIS analysis. May vary for every habitat parcel.

Online data sources

1	Agricultural Land Class (ALC)	MAGIC
2	Surface water availability	Environment Agency Water resource availability and abstraction reliability cycle 2
3	Groundwater availability	Environment Agency Catchment Data Explorer website
4	Catchment Flood Management Plan policy	Catchment Flood Management Plans
5	Flood risk priority	MAGIC
6	Woodland for flood risk	MAGIC
7	Woodland for water priority catchments	MAGIC
8	WWNP target zone?	Working with Natural Processes ArcGIS webmap
9	Water quality: WFD status	Environment Agency Catchment Data Explorer website
10	Water quality management area?	MAGIC
12	Soil drainage	LANDIS soilscapes
14	Soil erodibility	LANDIS soilscapes
26	Population density	CAVAT
29	Designated for nature?	MAGIC
30	Ancient habitat?	MAGIC
31	Cultural or historic importance?	MAGIC
33	Special recreational value?	MAGIC
38	Slope	UK Soil Observatory
39	Rainfall	Met Office

Survey data: indicators

5	Vegetation	Tree size	Largest class (saplings, poles, etc)
20		Ground cover (%)	Under 30%, 30-70%, over 70%
21		Tall or tussocky grasses	Under 5%, 5-33%, over 33%
22		Shrub layer	Under 5%, 5-33%, over 33%
23		Flowering plants	H/M/L (compared to expected)
24		Invertebrate nesting sites	H/M/L (dead wood, old trees etc)
44		Resources for local species	H/M/L (need local info)
13	Soil	Peat quality	Active / degraded
36		Soil compaction	Heavily, locally / slightly, not
11	Position and configuration	Position for water quality regulation	Y/partial/N
40		Position for erosion prevention	Y/partial/N
17		Air pollution barrier	Y/partial/N
18		Shading ability	Y/partial/N
19		Noise barrier	Y/partial/N
45	Rivers and lakes	Fish barriers	Height, length, slope
46		Water body naturalness	Presence of meanders etc.

Local knowledge, aerial photos or site plans

16	**Canopy cover**	Aerial photos	Estimate or quadrat analysis of a grid of points overlaid on aerial photos/ Google Earth.
25	**Public access**	Local authority	Public rights of way data
27	**Landscape diversity**	Site plans	Number of different habitat groups on the site, from the list of 19 categories in the user guide.
28	**Educational use?**	Local authority	Special educational value, e.g. use by school groups, use for scientific research, or an information centre?
31	**Cultural or historic importance?**	Online map and local authority	Ask Local Authorities for archaeological constraint areas
32	**Managed for nature?**	Local knowledge	Is the site managed to preserve or enhance nature?
34	**Soil depth disturbed**	Site knowledge	Not yet implemented - fill in all cells as not applicable. What depth of soil is to be removed or disturbed?
35	**Special value to the local community?**	LA/ local knowledge	Local landscape character assessment on Local Authority webpage. If time and resources permit, community consultation can feed in here.
37	**Soil management**	Local knowledge	Are soil erosion management practices used (e.g. cover crops, crop residue, contour ploughing, no-till)?

Habitat translation

Habitats before change (baseline)

Select classification system for drop-down:

Defra biodiversity metric 2.0

Eco-metric
Defra biodiversity metric 2.0
UK Hab
Phase 1
User-defined

106 Total area before change (ha)

						Help	Help	Help	Help
						1	2	3	4
	appropriate eco-metric habitat provided that it is listed on the habitat translation sheet. This includes Phase 1, UK Hab and Defra metric habitats.	Length, m	Width, m	Area, ha	Calculated area, ha	Eco-metric habitat	Agricultural Land Classification	Surface water availability	Groundwater availability	Catchment Flood Management Plan policy
ID	Input_habitat	Length	Width	Area_in	Area_before	Eco-metric habitat	ALC_before	Surface_water	Groundwater_	Flood_policy_
1	Cropland - Cereal crops			40	40	Arable fields, horticulture and te	2	Restri	Restri	Policy
2	Cropland - Arable field margins	3000	3		0.9	Arable field margins	Not ap	Restri	Restri	Policy
3	Grassland - Modified grassland			20	20	Improved grassland	2	Restri	Restri	Policy
4	Native Species Rich Hedgerow with trees -	1000	5		0.5	Hedgerows	Not ap	Restri	Restri	Policy
5	Native Species Rich Hedgerow	1000	3		0.3	Hedgerows	Not ap	Restri	Restri	Policy
6	Native Hedgerow	1000	3		0.3	Hedgerows	Not ap	Restri	Restri	Policy
7	Woodland and forest - Other woodland; broadleaved			5	5	Broadleaved, mixed and yew plar	Not ap	Restri	Restri	Policy
8	Rivers and lakes - Other rivers and streams	2000	10		2	Running water	Not ap	Restri	Restri	Policy
9	Grassland - Lowland meadows			5	5	Neutral grassland	Not ap	Restri	Restri	Policy
10	Grassland - Lowland calcareous grassland			2	2	Calcareous grassland	Not ap	Restri	Restri	Policy
11	Cropland - Cereal crops			10	10	Arable fields, horticulture and te	2	Restri	Restri	Policy
12	Cropland - Temporary grass and clover leys			20	20	Arable fields, horticulture and te	3	Restri	Restri	Policy

Welcome | Map | Data sources | Project data | Habitat_before | Habitat_after | Results | Score before | ...

Habitats after change

Habitats after change

16	*Number of parcels, of which not known:*	*0*	*0*	*0*	*0*

Areas match (within 0.1 ha)

106	*Total area before change (ha)*
106	*Total area after change (ha)*

Select classification system for drop-down:
Defra biodiversity metric 2.0

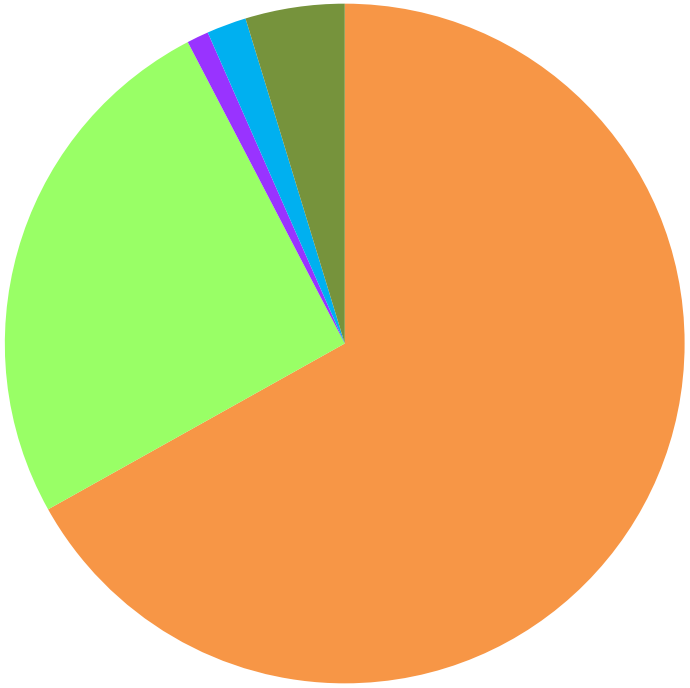
	Onsite / offsite?	Habitat type The input habitat will be translated to the appropriate eco-metric habitat provided that it is listed on the habitat translation sheet. This includes Phase 1, UK Hab and Defra metric habitats.	Length, m	Width, m	Area, ha	Calculated area, ha	Eco-metric habitat	Type of change	Agricultural Land Class	Surface water availability	Groundwater availability	Catchment Flood Management Plan
									Online Help	Online Help	Online Help	Online Help
									1	2	3	4
ID		Input_habitat	Length	Width	Area_in	Area_after	Eco-metric habitat	Change	ALC_after	Surface_water	Groundwater_	Flood_policy
1	On s	Urban - Suburban/ mosaic of developed/ natural surface			40	40	Suburban/ mosaic of developed/ nat	Create	Not ap	stri	Mode	Polic
2	On s	Grassland - Lowland meadows	3000	3		0.9	Neutral grassland	Create	Not ap	Restri	Mode	Polic
3	On s	Urban - Suburban/ mosaic of developed/ natural surface			16.2	16.2	Suburban/ mosaic of developed/ nat	Create	Not ap	Restri	Mode	Polic
4	On s	Native Species Rich Hedgerow with trees - /	1000	5		0.5	Hedgerows	Retain	Not ap	Restri	Mode	Polic
5	On s	Native Species Rich Hedgerow	1000	3		0.3	Hedgerows	Enhance	Not ap	Restri	Mode	Polic
6	On s	Native Species Rich Hedgerow	1000	3		0.3	Hedgerows	Enhance	Not ap	Restri	Mode	Polic
7	On s	Woodland and forest - Lowland beech and yew woodlan			5	5	Broadleaved, mixed and yew semi-r	Enhance	Not ap	Restri	Mode	Polic
8	On s	Rivers and lakes - Rivers (priority habitat)	2000	10		2	Running water	Enhance	Not ap	Restri	Mode	Polic
9	On s	Grassland - Lowland meadows			5	5	Neutral grassland	Enhance	Not fa	Restri	Mode	Polic
10	On s	Grassland - Lowland calcareous grassland			2	2	Calcareous grassland	Enhance	Not ap	Restri	Mode	Polic
11	On s	Urban - Brown roof			1	1	Brown roof or extensive green roof	Create	Not ap	Restri	Mode	Polic
12	On s	Urban - Intensive green roof			1	1	Intensive green roof	Create	Not ap	Restri	Mode	Polic

Welcome | Map | Data sources | Project data | Habitat_before | Habitat_after | Results | Detailed results | Score be ...

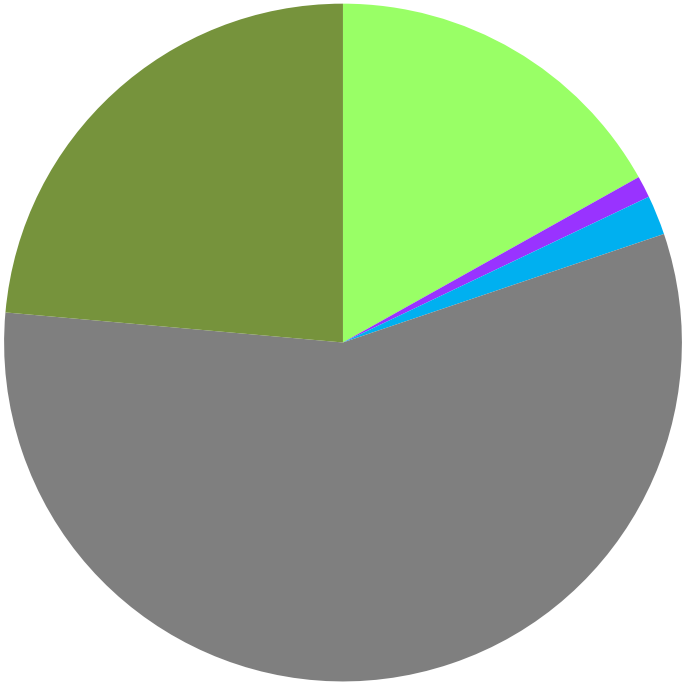
Output test case: Habitat areas

Development on farmland; designed for on-site biodiversity net gain

Habitat areas before



Habitat areas after



- Cropland
- Grassland
- Heathland and shrub
- Rivers and lakes
- Sparsely vegetated land
- Urban
- Wetland
- Woodland and forest

Outputs

	Before	After	Change
Food production	656	38	-618
Wood production	41	29	-13
Fish production	14	25	12
Water supply	471	241	-230
Flood regulation	119	105	-14
Erosion protection	64	133	69
Water quality regulation	53	144	90
Carbon storage	67	101	34
Air quality regulation	103	73	-30
Cooling and shading	154	95	-59
Noise regulation	98	101	3
Pollination	120	155	35
Pest control	214	180	-34
Recreation	0	109	109
Aesthetic value	111	117	6
Education	0	19	19
Interaction with nature	0	35	35
Sense of place	21	30	9

Biodiversity metric results

Results

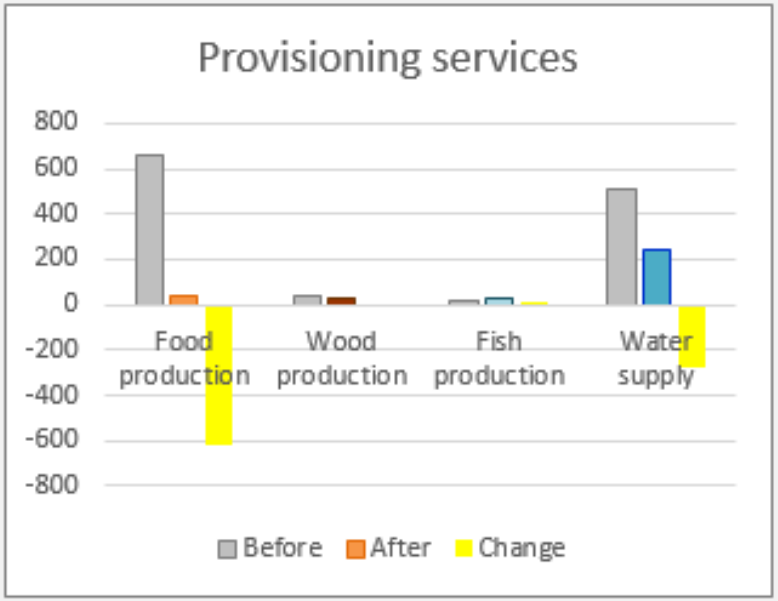
The eco-metric units indicate the direction and magnitude of change of each of the 18 ecosystem services. Biodiversity net gain is a pre-requisite. Wher
gain assessment, please enter the results of the external biodiversity metric calculation below.

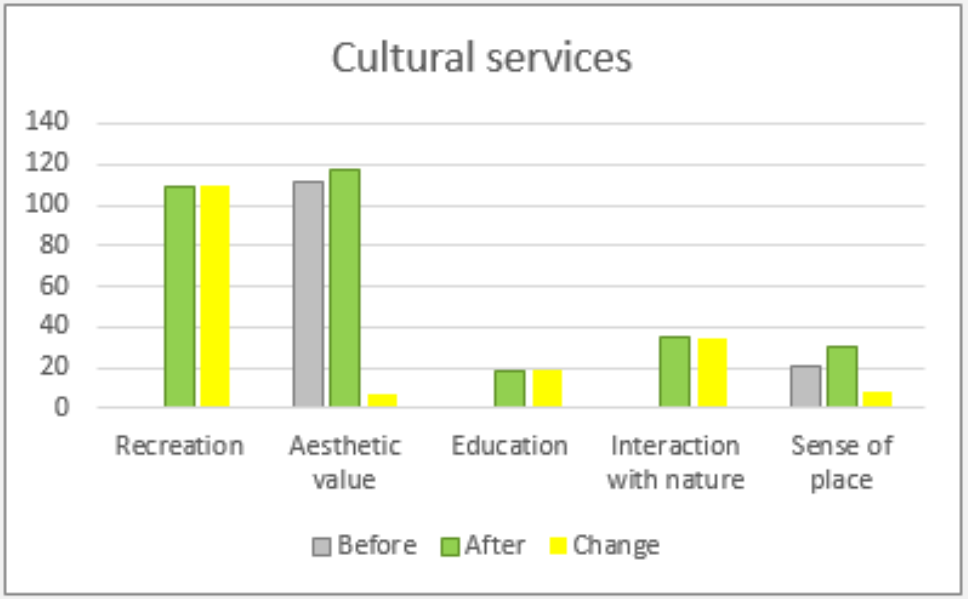
	Before (baseline)			After (delivered)			Change
	Onsite	Offsite	Total	Onsite	Offsite	Total	
Biodiversity units	305.0	60.0	365.0	248.2	129.2	377.4	12.4
Hedgerow units	36.7	0.0	36.7	45.2	0.0	45.2	8.5

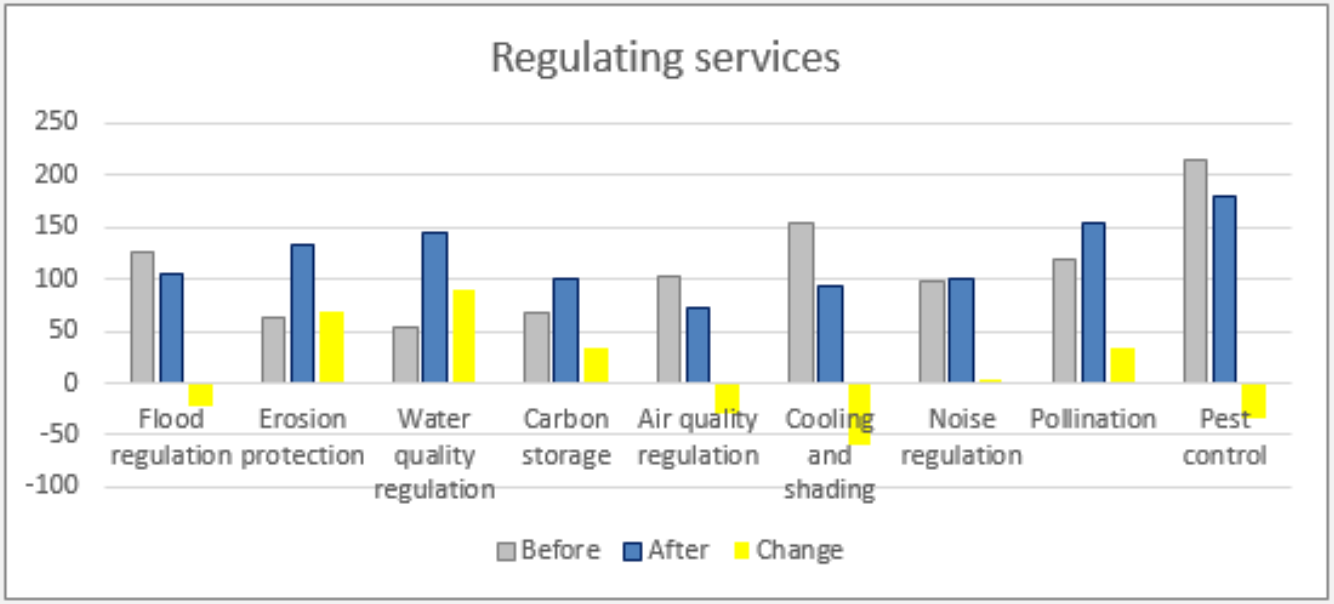
		Normalised score			Normalised score per ha			Raw score		
	Maximum score	Before	After	Change	Before	After	Change	Before	After	Change
Food production	*30.33*	656	38	-618	6.3	0.4	-5.9	1990	115	-1875
Wood production	*10.00*	41	52	11	0.4	0.5	0.1	41	52	11
Fish production	*14.40*	25	34	9	0.2	0.3	0.1	36	50	13
Water supply	*12.00*	609	252	-357	5.8	2.4	-3.4	731	302	-428
Flood regulation	*15.25*	225	167	-58	2.1	1.6	-0.6	343	255	-89
Erosion protection	*19.33*	104	200	96	1.0	1.9	0.9	202	387	185
Water quality regulation	*15.84*	87	224	137	0.8	2.1	1.3	138	355	217
Carbon storage	*20.00*	134	79	-55	1.3	0.8	-0.5	268	158	-110
Air quality regulation	*12.00*	108	76	-32	1.0	0.7	-0.3	129	91	-38
Cooling and shading	*12.00*	200	124	-77	1.9	1.2	-0.7	240	148	-92
Noise reduction	*10.00*	98	103	5	0.9	1.0	0.0	98	103	5
Pollination	*13.31*	205	163	-42	2.0	1.5	-0.4	273	216	-56
Pest control	*12.10*	251	178	-72	2.4	1.7	-0.7	303	216	-87
Recreation	*14.40*	0	407	407	0.0	3.9	3.9	0	587	587
Aesthetic value	*14.64*	255	246	-9	2.4	2.3	-0.1	374	360	-14
Education	*17.42*	0	208	208	0.0	2.0	2.0	0	362	362

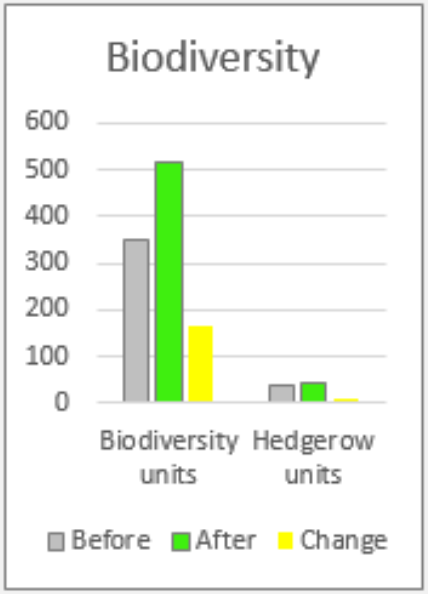
... Detailed results | Charts | Breakdown | Score before | Score after | Scores | Multipliers | Time facto ...

Bar charts: before, after and change

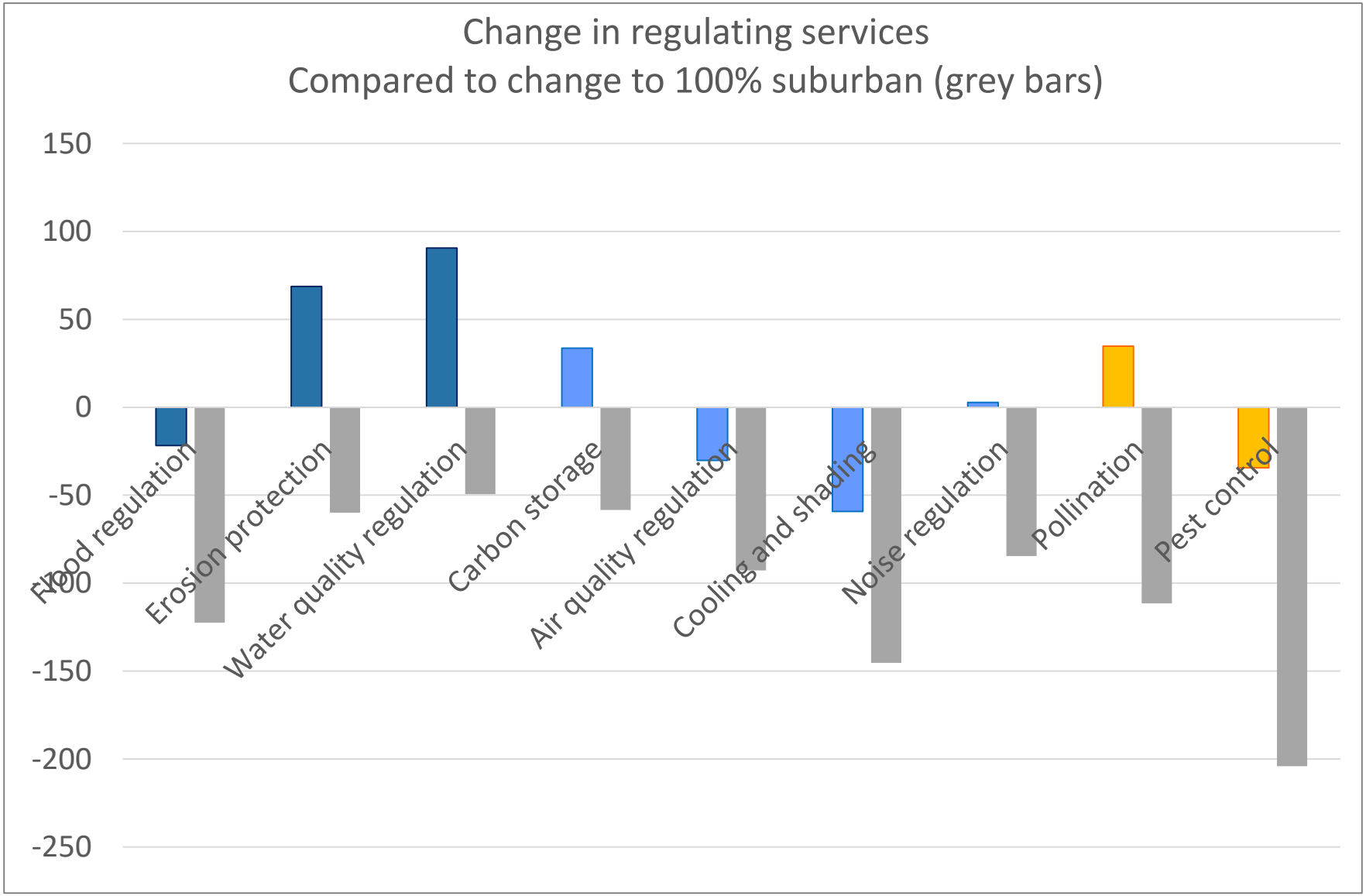




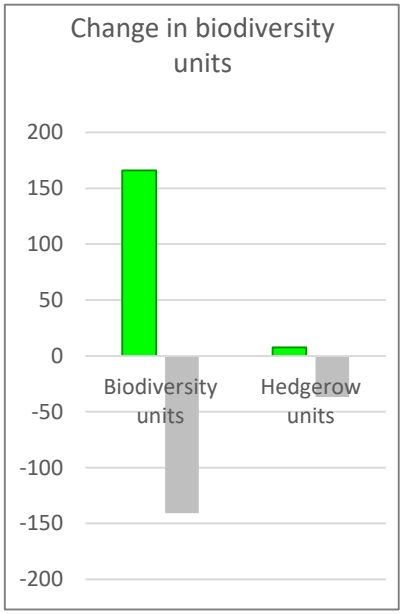


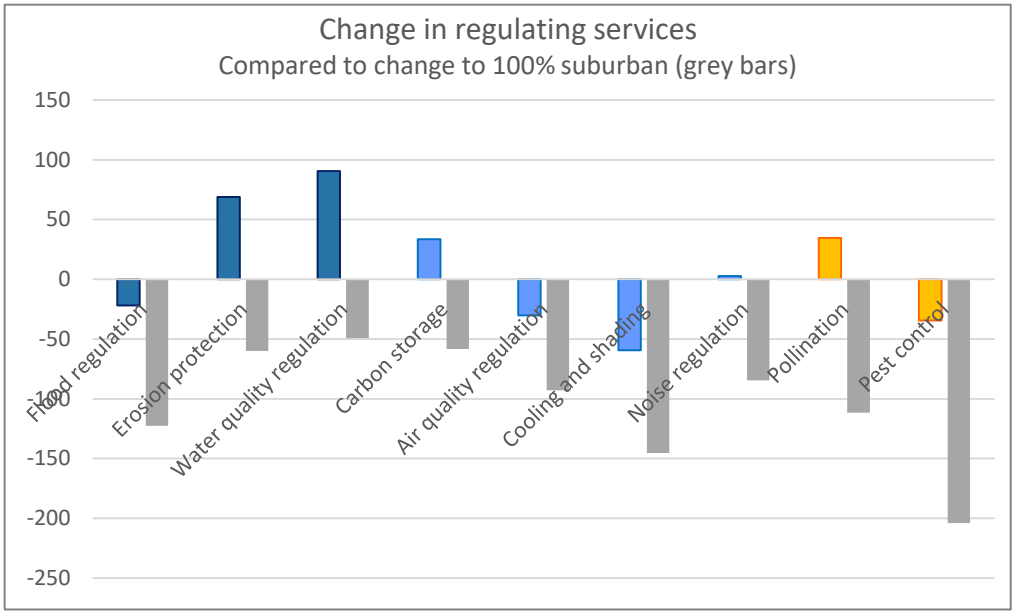


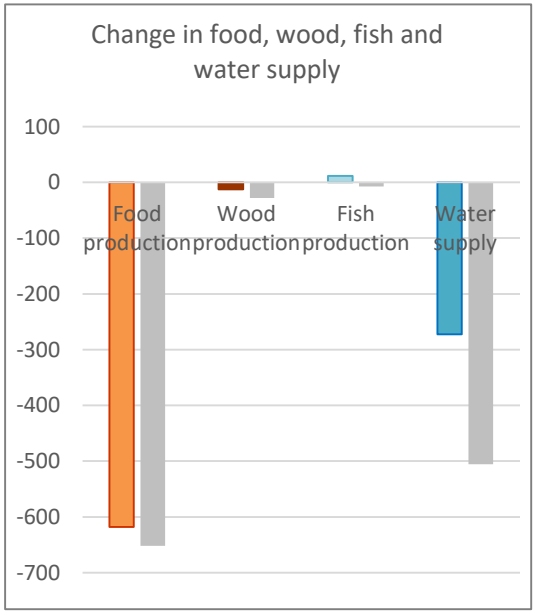
Change compared to ‘worst case’

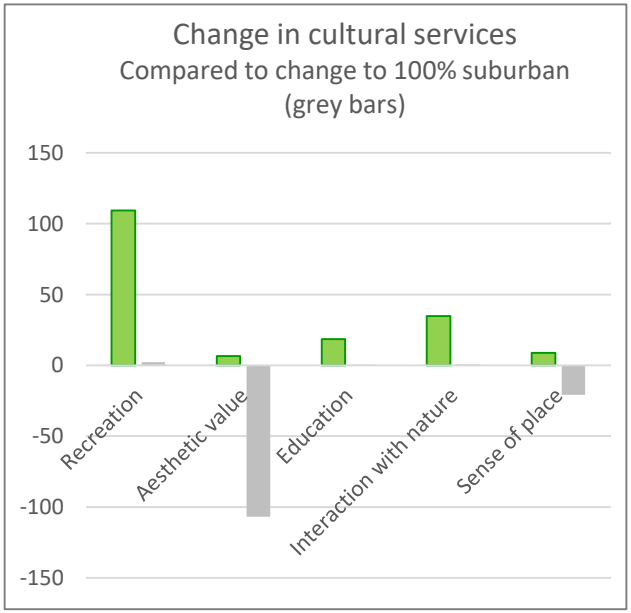


Change compared to ‘worst case’

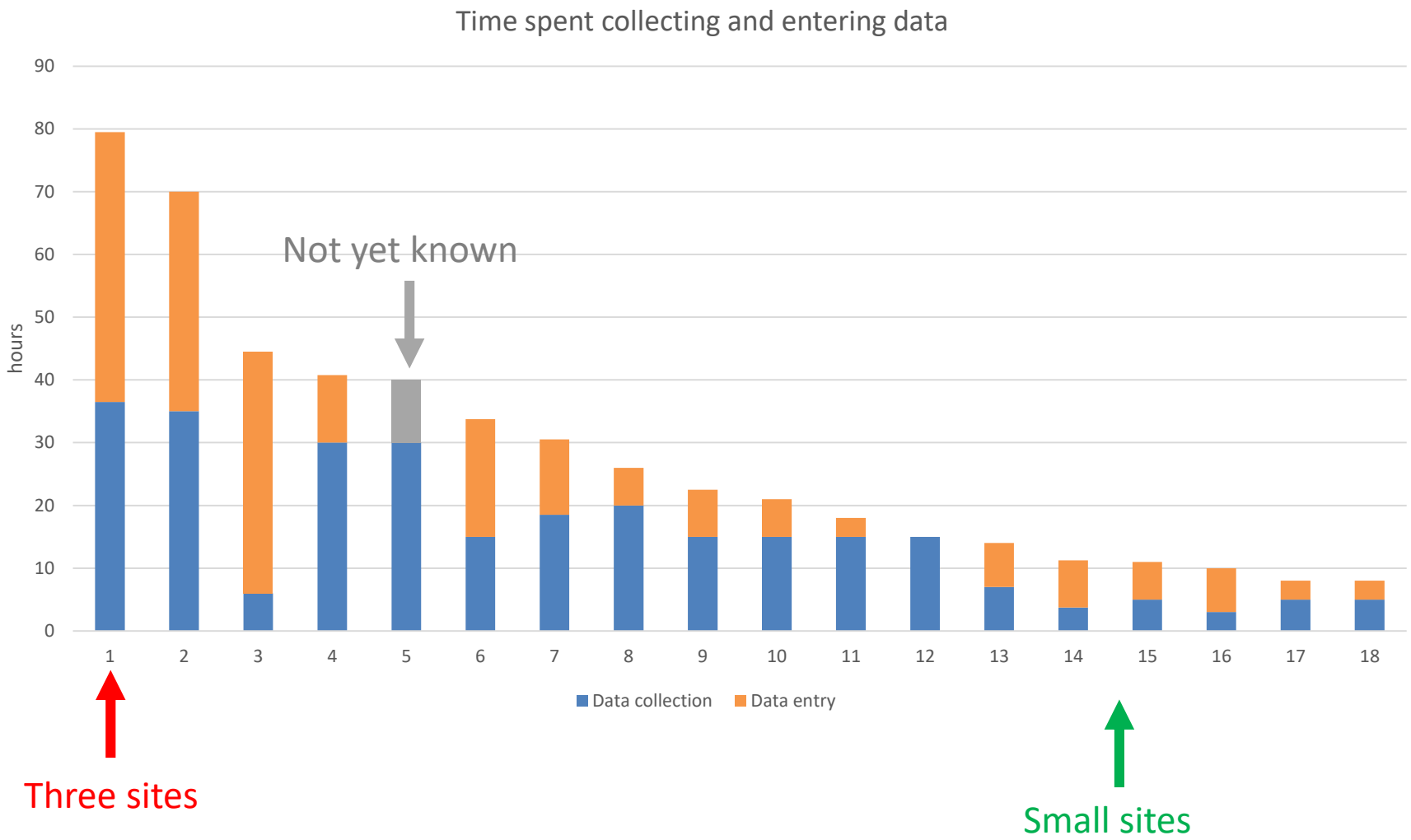








Pilot feedback survey: time spent



Pilot feedback survey

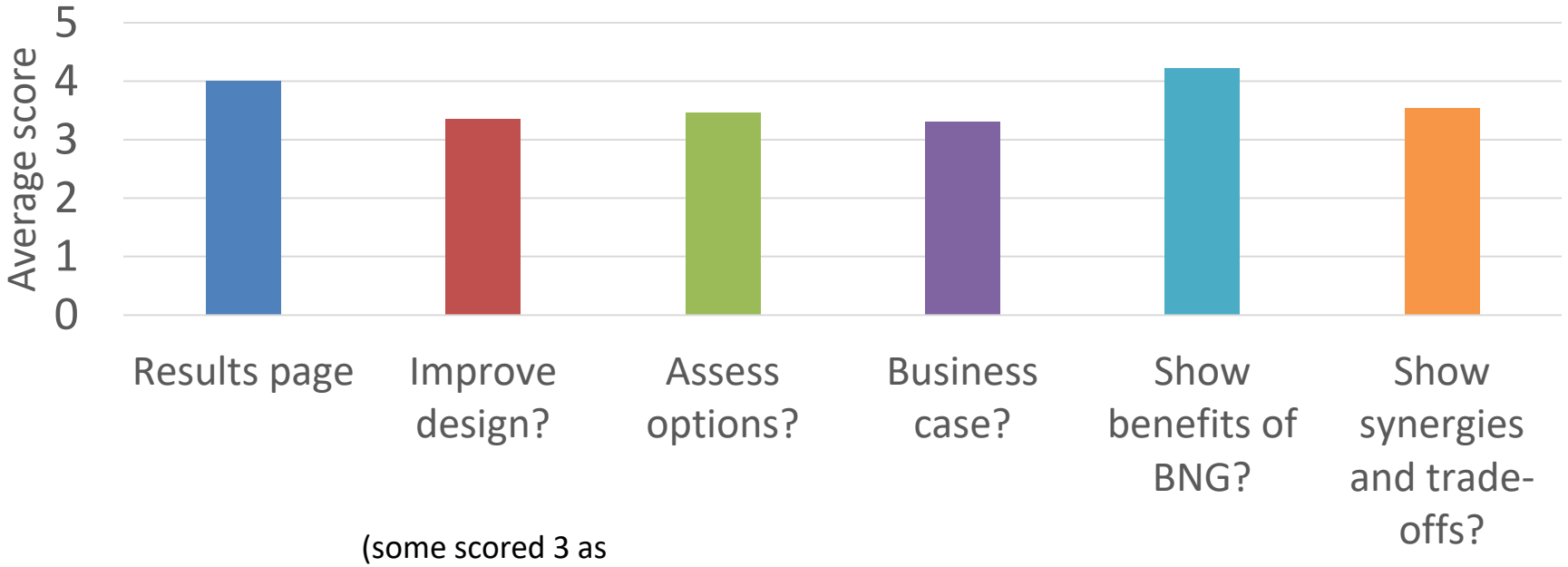
We already had most of the data from Phase 1 and biodiversity net gain survey

Should advise users to parcel up habitats in biodiversity metric to match eco-metric factors

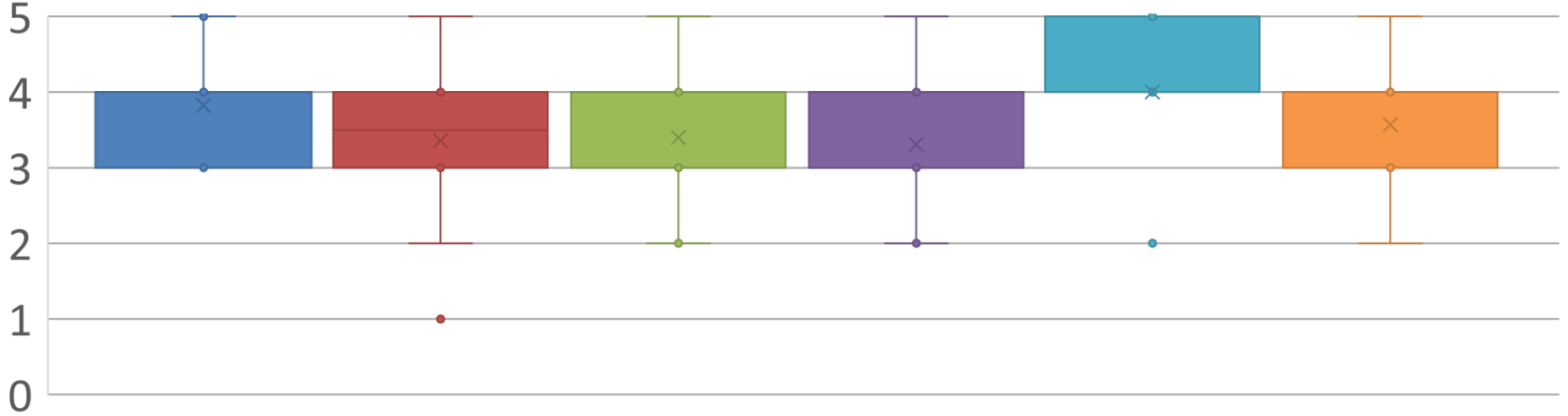
Fine if you know data needs in advance – ask ecologists to gather it as part of scope of works

Would be quicker if automated with GIS

Using the results



(some scored 3 as decisions already taken)



Informing site design

Showed a good potential for our site to improve biodiversity and ES

Will help to inform design of off-site compensation

Shows shortfalls or negative impacts - where to focus resources

Did not capture all the important factors

Could help to locate habitat for air quality, noise, shading

Could encourage retention of woodland

Could tailor to local priorities e.g. flood, air quality, noise

Assessing options

Score per ha helps to compare alternative sites

Should encourage developers to choose sites in poor initial condition

Can use ‘suburban mosaic’ to assess options

Easy to trial different options and compare results

Could be useful for strategic site assessment

Making the business case

Helps to make the case for investment by showing another dimension to the impacts

Not good for new trees, due to 'time to target condition' factor

Useful for communicating with non-specialists

Shows that our initial plans fall short of net gain

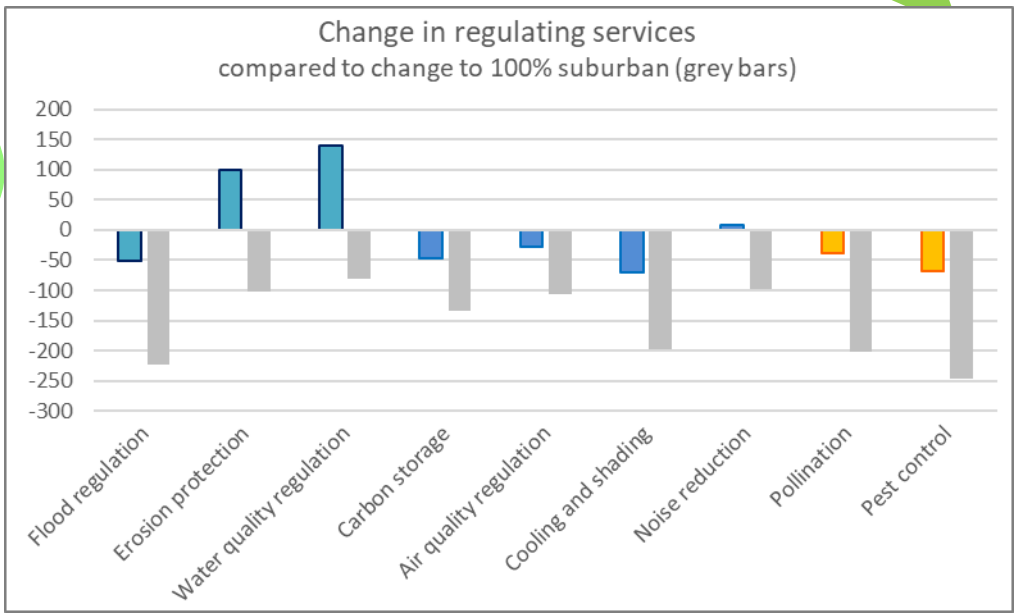
Strong selling point

Showing benefits of biodiversity net gain?

Definitely – great way of showing the benefits for people

Can't always use alongside biodiversity net gain, e.g. if using at site allocation stage before site survey

We had only a small BNG and lots of ES losses



Synergies and trade-offs

Makes positive and negative impacts more transparent

Yes – particularly for food production

Yes – a good conversation to be had based on the outcomes!

Caution, because not in comparable units (apples and pears)

Limitations and caveats

Does not capture impacts on wider landscape, e.g. views, local environment

Need to think what habitats are appropriate for the site – trees not always suitable; scrub can be good

- Use alongside detailed assessments: flood risk, landscape, biodiversity etc.
- Can flag areas where more detailed assessments are needed

Improvements needed

- GIS interface:
  - compile datasets in one place
  - auto-populate where possible
- **Application of ‘time to target condition’, especially for woodland**
- Guidance on how to interpret results – what has caused declines
- New habitats – e.g. line of trees, hedgerow trees
- And more…

Thank you!