Reviving the edges:

Understanding historical wetland extent and lakeshore restoration opportunities for England's lakes

Phil Taylor & Ellie MacKay

UK Centre for Ecology & Hydrology

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Lake wetlands:

Where are they? Where aren't they? Where aren't they where they could be? What do we know about them? What don't we know about them? Why aren't there more of them? Could we have more of them? How? Where?

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Lake Wetlands:
Current & Potential Mapping

Project Outline

1) Literature Review

- Current Wetlands / Case Studies
- Identify stressors

2) Current Lake Wetland Extent

- Collate wetland habitat datasets
- QA the data
- Define lake wetlands

3) Potential Lake Wetland Extent

- Approach 1: National scale
- Approach 2: Lake / catchment scale

Literature Review

LAKE WETLAND	COUNTY	CONSERVATION DESIGNATED SITE	TYPE OF FRINGING
Barton Broad	Norfolk	Part of Ant Broads & Marshes SSSI (Site of Special Scientific Interest) and NNR (National Nature Reserve), Ant Marshes National Conservation Review (NCR) site, Broadland Ramsar wetland site of international importance & Special Protection Area (SPA), and Broads Special Area of Conservation (SAC). In Broads National Park.	Reed swamp.
		Bassenthwaite Lake is designated a NNR, a SSSI	Reed swamp (+ oth and alder woodlanc

Literature Review

Important Factors:

- Slope
- Water depth
- Fetch

Few numbers

Stressors:

- Eutrophication
- Land use
  e.g. over-grazing, shoreline development, encroaching plants
- Water level management

Wetland Loss Case Studies (32 Sites):

Current Lake Wetlands

Datasets:

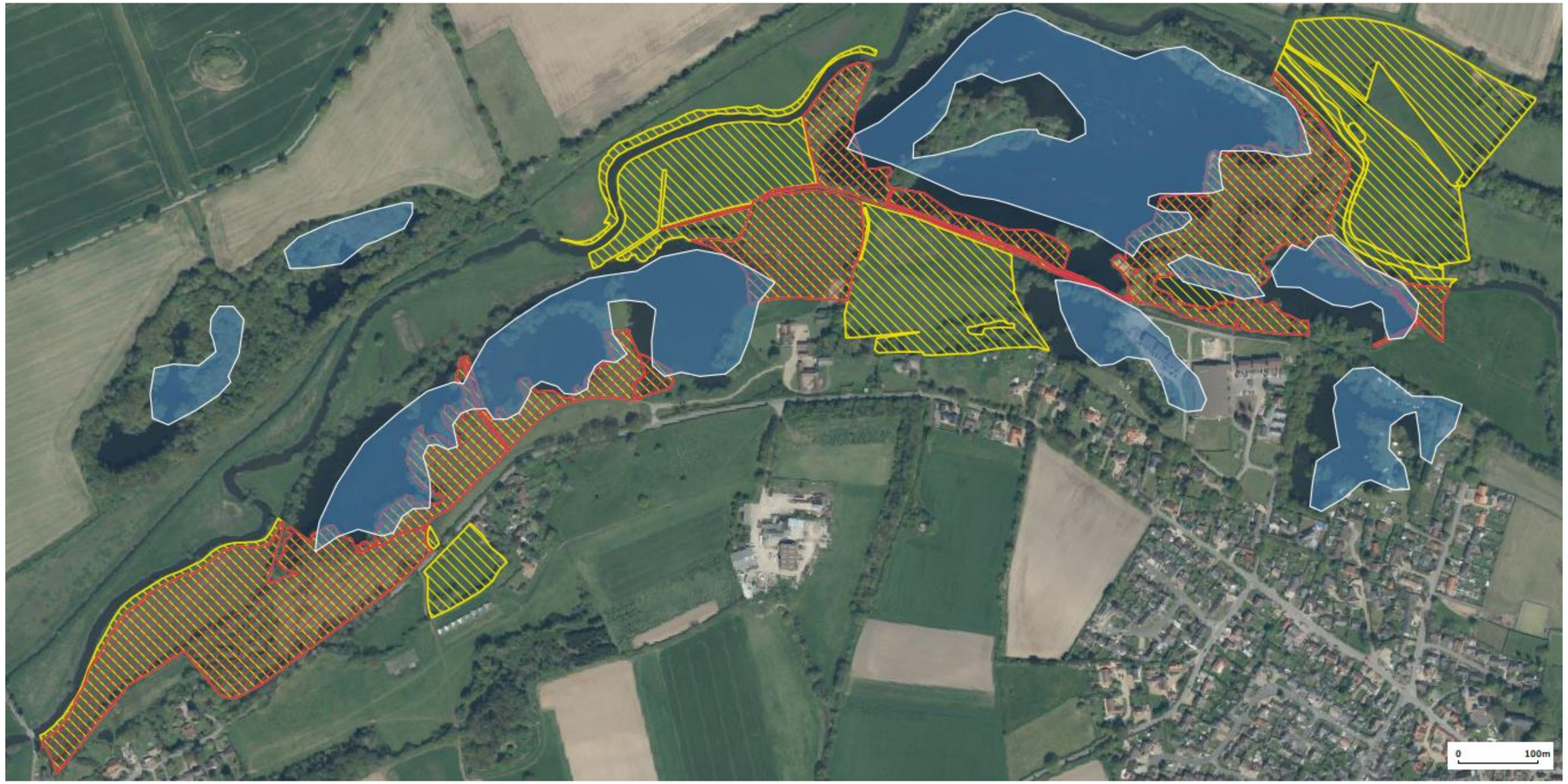
- Priority Habitat Inventory (PHI)
- Annex 1 Habitats

Habitats:

Lowland fens
Lowland raised bog
Purple moor grass and rush pastures
Reedbeds
Upland flushes, fens and swamps
‘No main habitat’

Blanket bog?
Coastal and floodplain grazing marsh?

Current Lake Wetlands - QA



Current Lake Wetlands - QA

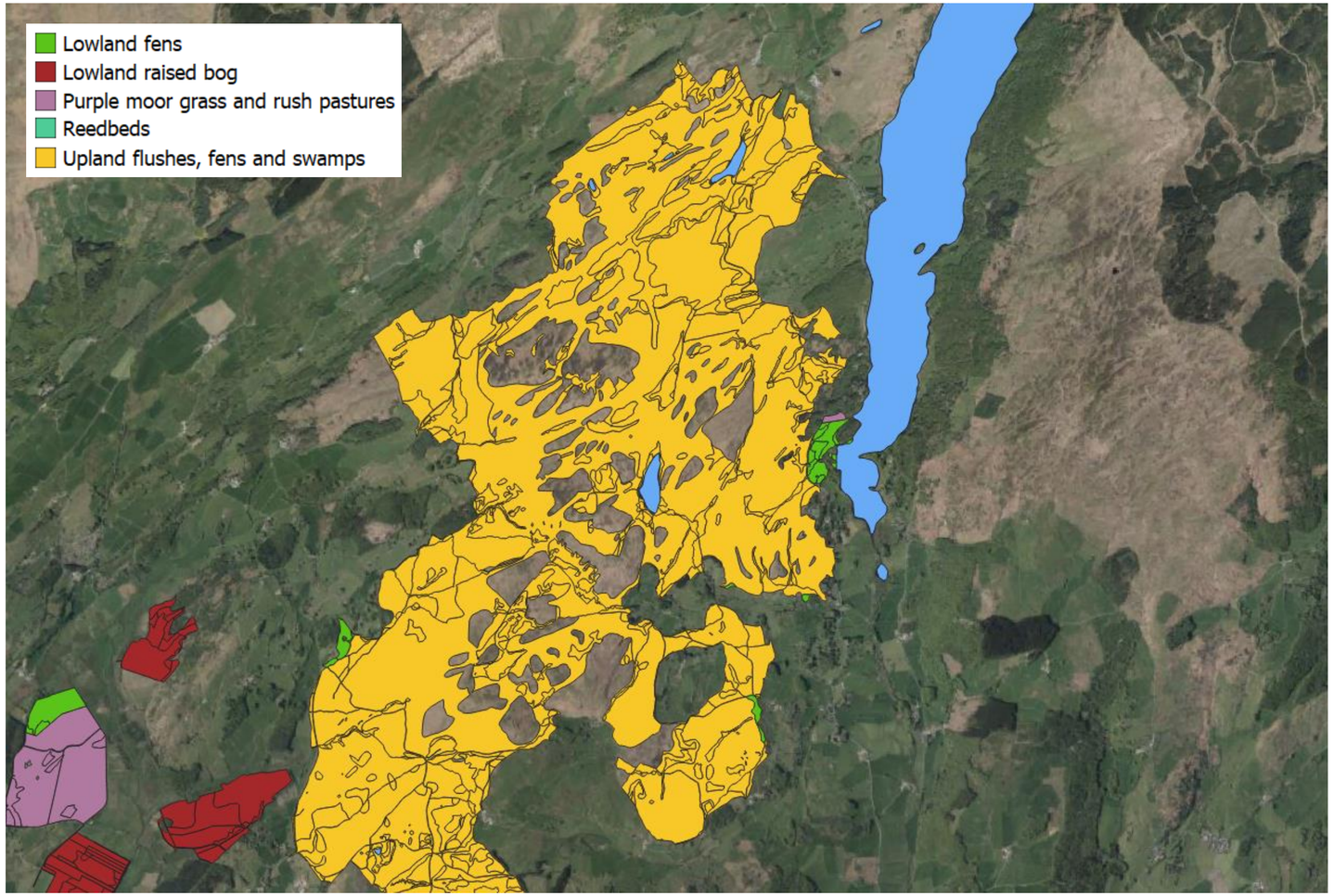
Current Lake Wetlands - QA

‘No main habitat’

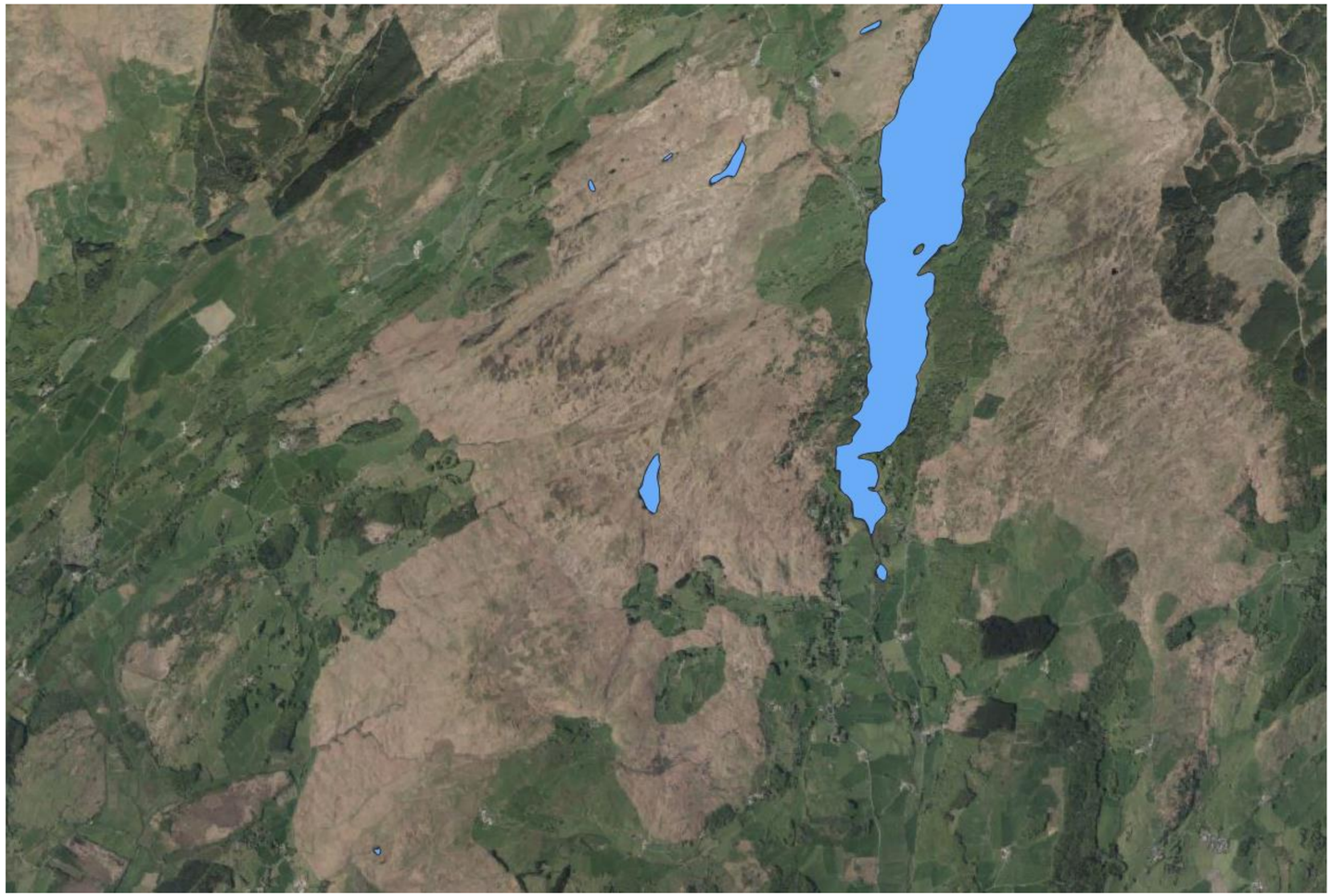
MasterMap conflict?

>50% in lake included

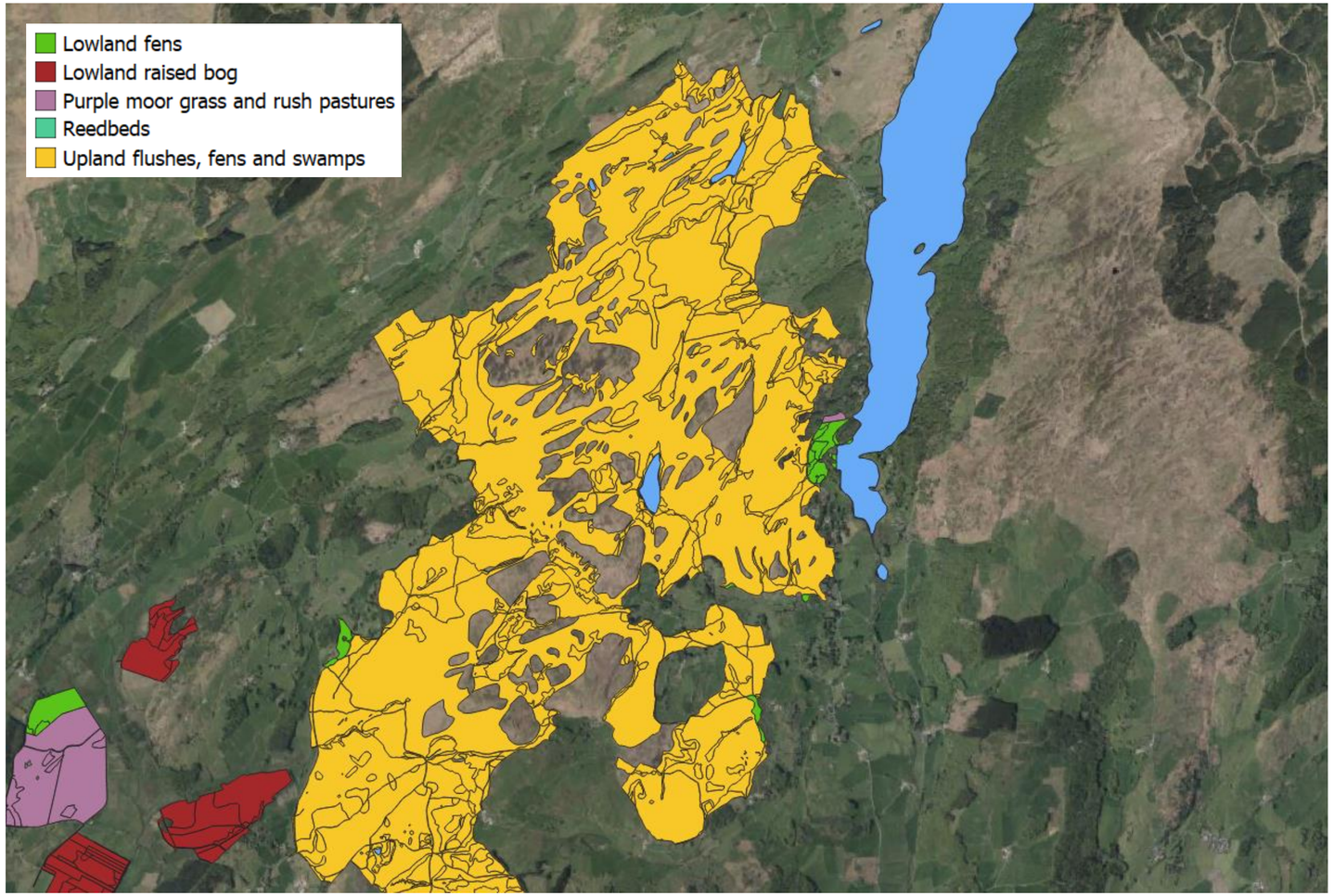
Current Lake Wetlands - QA



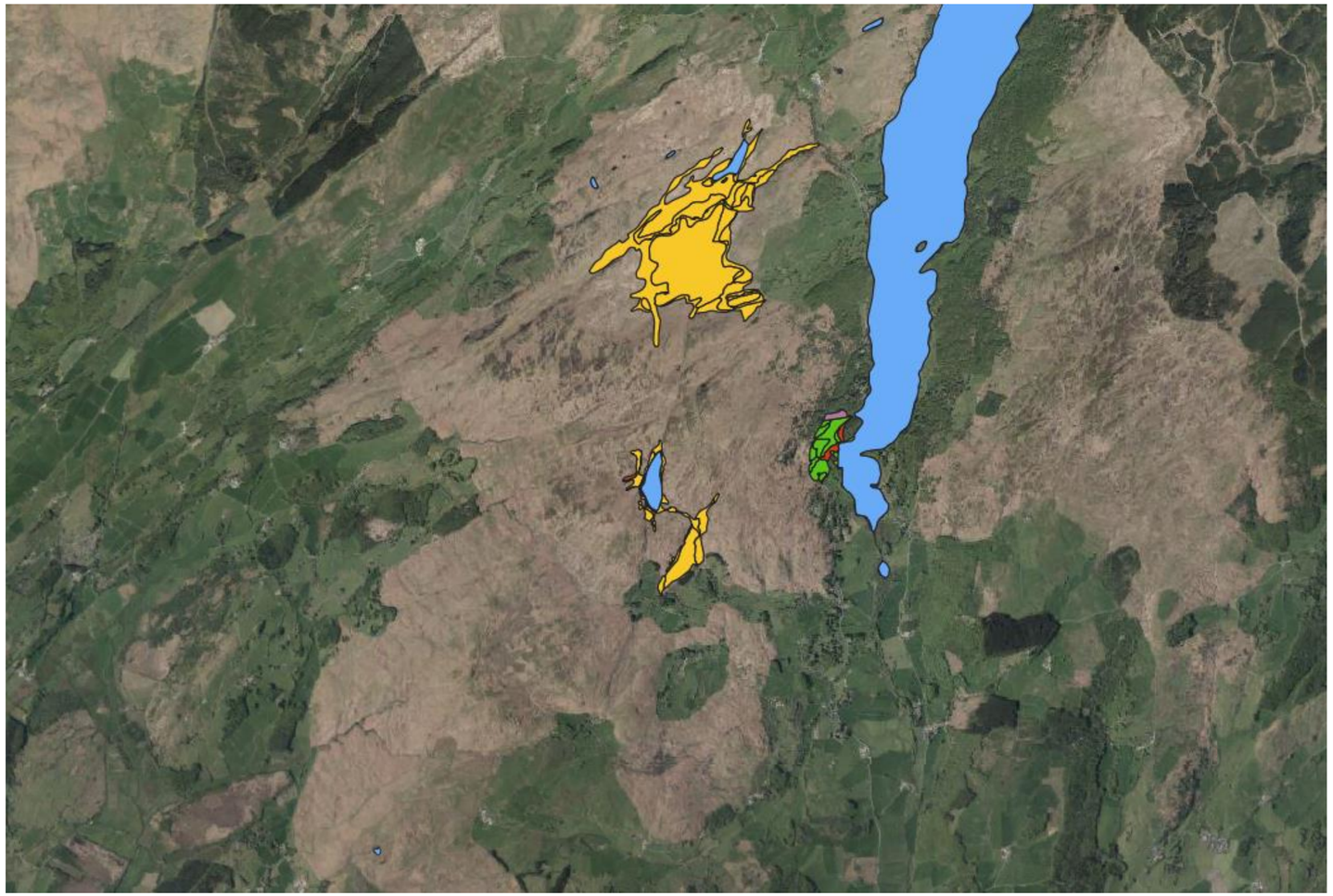
Current Lake Wetlands - QA



Current Lake Wetlands - QA



Current Lake Wetlands - QA



- Mean slope < 10°

- Variable polygons

Current Lake Wetlands

Potential Lake Wetlands

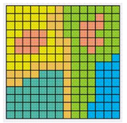
Approach 1:

- National Scale
- Datasets:
  - BGS Geology
  - DTM > Slope
  - NE Peat Layer

Approach 2:

- Lake / catchment Scale
- Datasets:
  - UKLakes Alkalinity
  - UKLakes Lake Area
  - UKLakes Lake Depth
  - UKLakes Fetch

95th percentile of current wetlands



50m Grid

Documentation

- R Version / Packages
- Data Collation
- Likely Wetlands
- Land Cover Data
- Analysing Wetland Slopes
- NE Peat Layer Intersect
- Bedrock Geology Types
- OSM Drainage - Length
- Amber Barriers - Count
- Potential Wetlands - 1
- Potential Wetlands - 2
- Potential Stressed - 1 & 2
- Likely wetlands - Stats
- Potential wetlands - Stats
- WFD Status
- Main Outputs
- Wetland Stressors - Stats

Natural England - Lake Wetlands

Code

UK Centre for Ecology & Hydrology

This document details the technical process in creating outputs for the Natural England - Lake Wetlands project. R code is shown by default, but can be shown / hidden using the buttons above code snippets or at the top-right of the page.

NB Most of the scripts below require those before them to have been run first.

R Version / Packages

The following R code was run on R 4.0.3 (64 bit / 32 bit for RODBC), with the following packages / version numbers used within the different scripts:

- basicTrendline 2.0.5
- dplyr 1.0.2
- exactextractr 0.7.2
- ncdf4 1.17
- raster 3.3.13
- readxl 1.3.1

Current Lake Wetlands

Potential Lake Wetlands

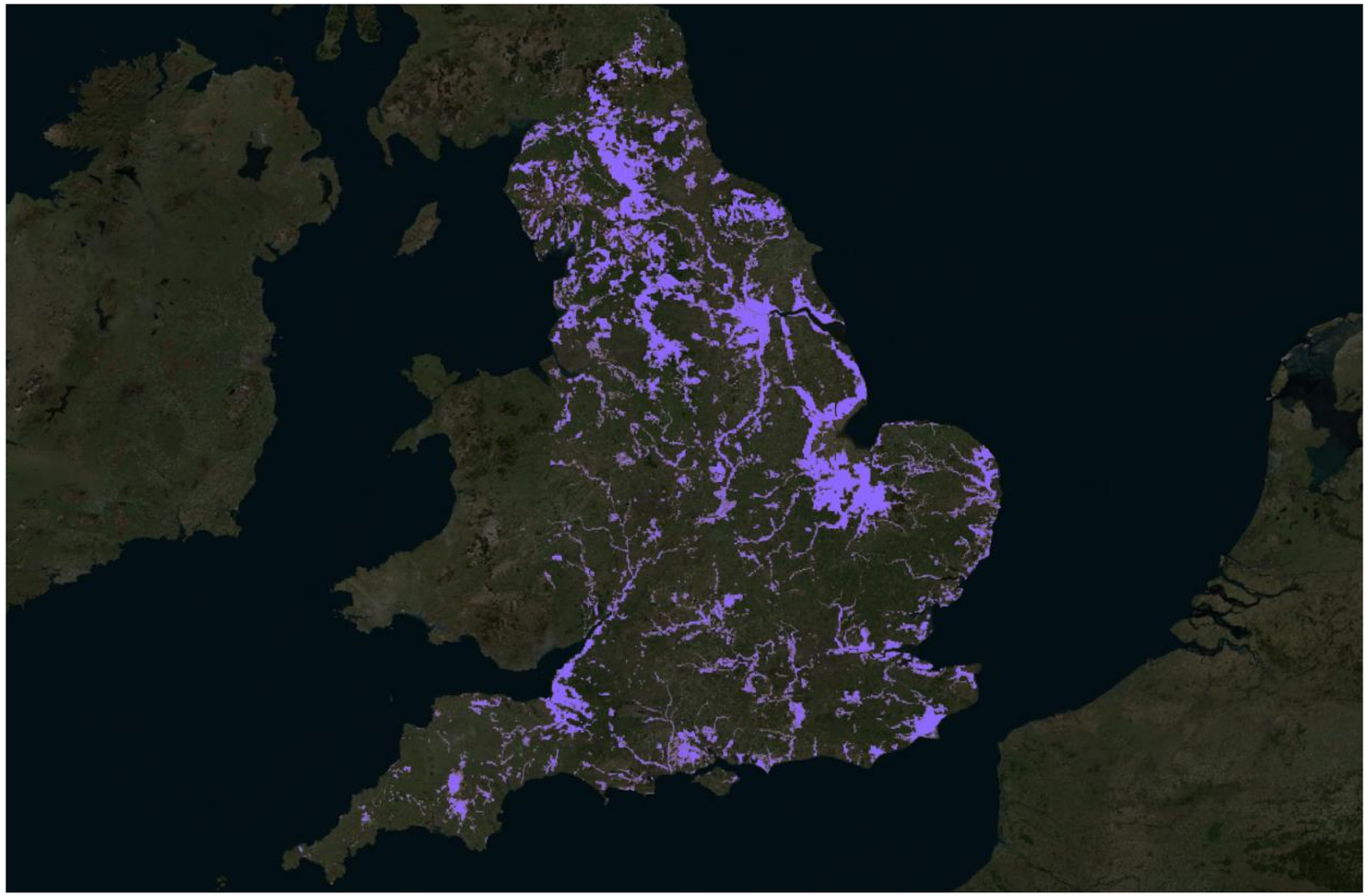
Likely: 4958 hectares

Potential: 353854 hectares

Potential Lake Wetlands

Potential Lake Wetlands

Potential Lake Wetlands



Wetland Vision

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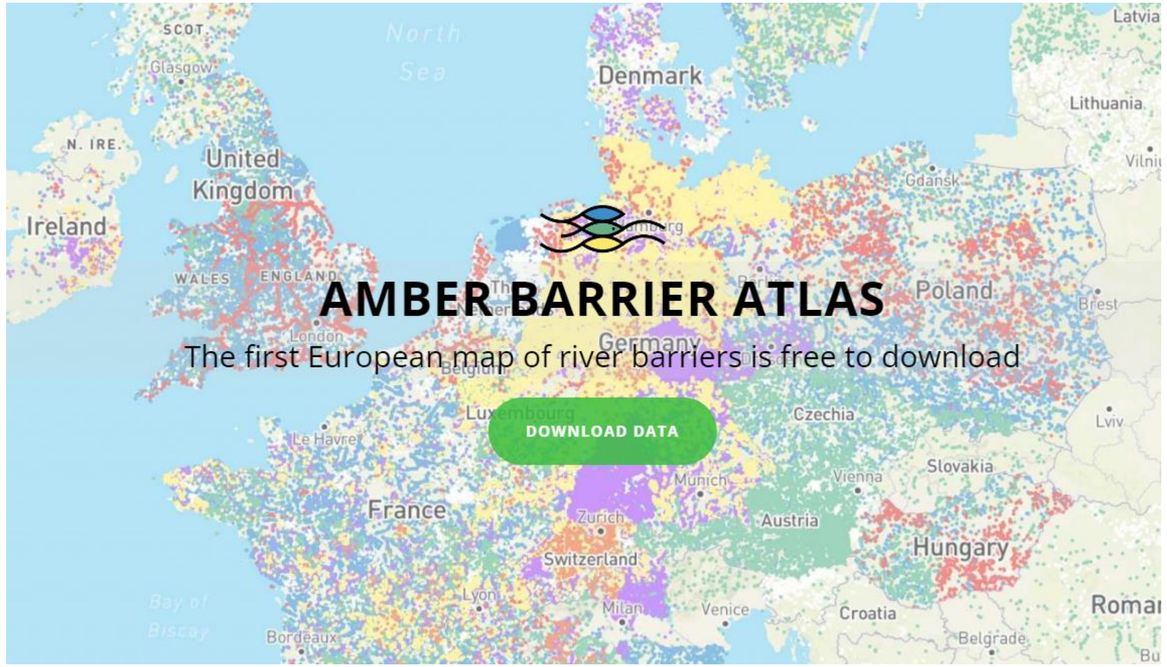
https://data.catchmentbasedapproach.org/datasets/theriverstrust::wetland-vision-future-potential-wetlands-1/about

Stressors

Datasets:

- Amber Barrier
- OSM drainage features
- WFD TP / TN status
- UKCEH Land Cover Map



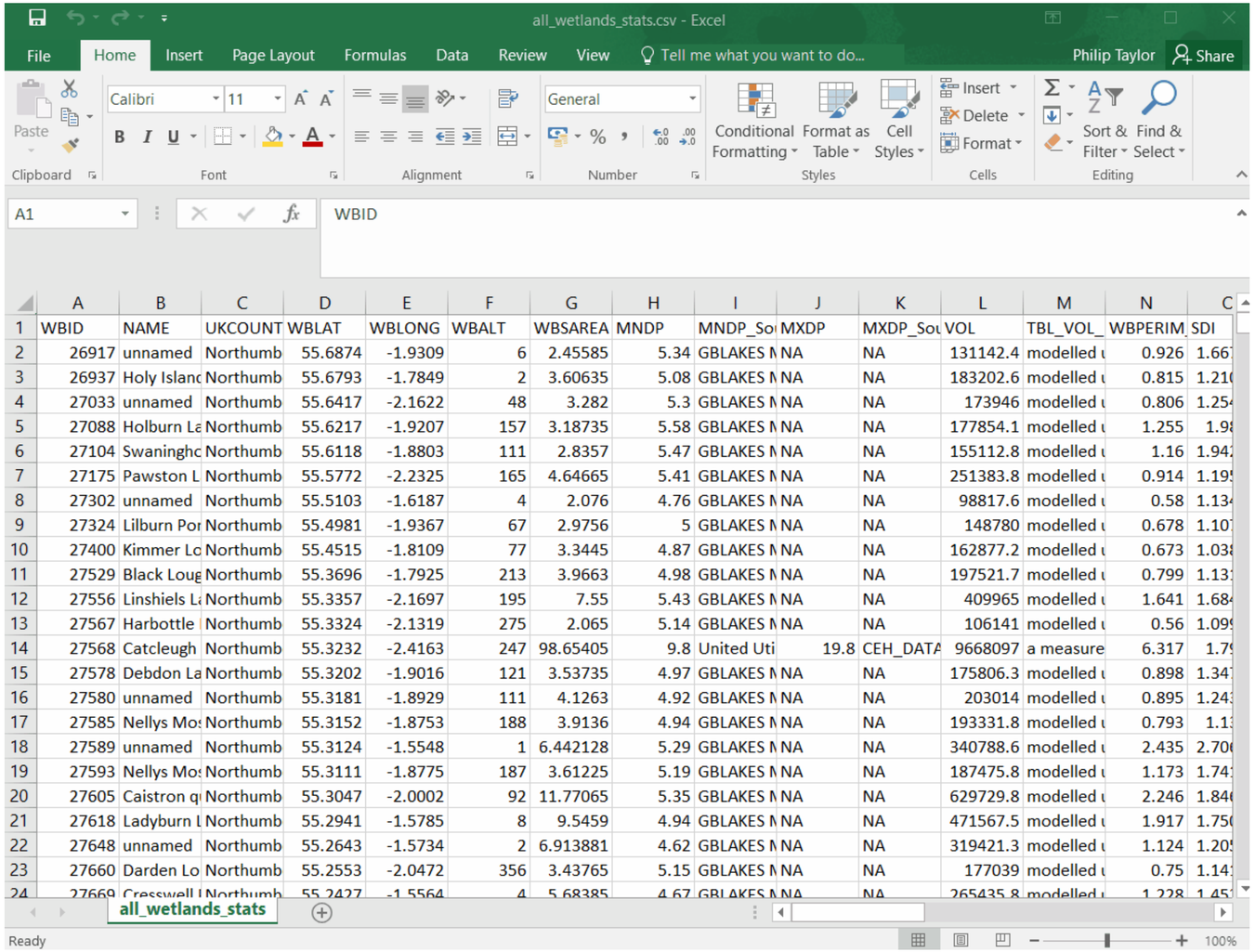
Final Analysis

- lakes > 2ha
- 100m buffer

Final Analysis

- lakes > 2ha
- 100m buffer
- 50m resolution / polygons
- Data:
  - Lake info / data
  - Current wetlands
  - Potential wetlands
  - Stressors

Final Analysis



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	C
1	WBID	NAME	UKCOUNT	WBLAT	WBLONG	WBALT	WBSAREA	MNDP	MNDP_So	MXDP	MXDP_So	VOL	TBL_VOL_	WBPERIM	SDI
2	26917	unnamed	Northumb	55.6874	-1.9309	6	2.45585	5.34	GBLAKES M	NA	NA	131142.4	modelled u	0.926	1.66
3	26937	Holy Islanc	Northumb	55.6793	-1.7849	2	3.60635	5.08	GBLAKES M	NA	NA	183202.6	modelled u	0.815	1.21
4	27033	unnamed	Northumb	55.6417	-2.1622	48	3.282	5.3	GBLAKES M	NA	NA	173946	modelled u	0.806	1.25
5	27088	Holburn La	Northumb	55.6217	-1.9207	157	3.18735	5.58	GBLAKES M	NA	NA	177854.1	modelled u	1.255	1.9
6	27104	Swaninghc	Northumb	55.6118	-1.8803	111	2.8357	5.47	GBLAKES M	NA	NA	155112.8	modelled u	1.16	1.94
7	27175	Pawston L	Northumb	55.5772	-2.2325	165	4.64665	5.41	GBLAKES M	NA	NA	251383.8	modelled u	0.914	1.19
8	27302	unnamed	Northumb	55.5103	-1.6187	4	2.076	4.76	GBLAKES M	NA	NA	98817.6	modelled u	0.58	1.13
9	27324	Lilburn Por	Northumb	55.4981	-1.9367	67	2.9756	5	GBLAKES M	NA	NA	148780	modelled u	0.678	1.10
10	27400	Kimmer Lc	Northumb	55.4515	-1.8109	77	3.3445	4.87	GBLAKES M	NA	NA	162877.2	modelled u	0.673	1.03
11	27529	Black Loug	Northumb	55.3696	-1.7925	213	3.9663	4.98	GBLAKES M	NA	NA	197521.7	modelled u	0.799	1.13
12	27556	Linshiels L	Northumb	55.3357	-2.1697	195	7.55	5.43	GBLAKES M	NA	NA	409965	modelled u	1.641	1.68
13	27567	Harbottle	Northumb	55.3324	-2.1319	275	2.065	5.14	GBLAKES M	NA	NA	106141	modelled u	0.56	1.09
14	27568	Catcleugh	Northumb	55.3232	-2.4163	247	98.65405	9.8	United Uti	19.8	CEH_DATA	9668097	a measure	6.317	1.7
15	27578	Debdon La	Northumb	55.3202	-1.9016	121	3.53735	4.97	GBLAKES M	NA	NA	175806.3	modelled u	0.898	1.34
16	27580	unnamed	Northumb	55.3181	-1.8929	111	4.1263	4.92	GBLAKES M	NA	NA	203014	modelled u	0.895	1.24
17	27585	Nellys Mo	Northumb	55.3152	-1.8753	188	3.9136	4.94	GBLAKES M	NA	NA	193331.8	modelled u	0.793	1.1
18	27589	unnamed	Northumb	55.3124	-1.5548	1	6.442128	5.29	GBLAKES M	NA	NA	340788.6	modelled u	2.435	2.70
19	27593	Nellys Mo	Northumb	55.3111	-1.8775	187	3.61225	5.19	GBLAKES M	NA	NA	187475.8	modelled u	1.173	1.74
20	27605	Caistron q	Northumb	55.3047	-2.0002	92	11.77065	5.35	GBLAKES M	NA	NA	629729.8	modelled u	2.246	1.84
21	27618	Ladyburn L	Northumb	55.2941	-1.5785	8	9.5459	4.94	GBLAKES M	NA	NA	471567.5	modelled u	1.917	1.75
22	27648	unnamed	Northumb	55.2643	-1.5734	2	6.913881	4.62	GBLAKES M	NA	NA	319421.3	modelled u	1.124	1.20
23	27660	Darden Lo	Northumb	55.2553	-2.0472	356	3.43765	5.15	GBLAKES M	NA	NA	177039	modelled u	0.75	1.14
24	27669	Cresswell I	Northumb	55.2427	-1.5564	4	5.68385	4.67	GBLAKES M	NA	NA	265435.8	modelled u	1.228	1.45

Wetland Statistics

Good current wetlands (52 sites):
Mean LCM farming %: 0.61
Mean LCM woodland %: 0.92
Mean barrier count per km2: 1.78
Mean drainage count per km2: 0.14
Mean WFD TN score (1=bad, 5=high): 3.42
Mean WFD TP score (1=bad, 5=high): 3

(lakes with no unused potential wetland)

Good potential wetlands (2076 sites):
Mean LCM farming %: 9.03
Mean LCM woodland %: 13.12
Mean barrier count per km2: 2.04
Mean drainage count per km2: 1.59
Mean WFD TN score (1=bad, 5=high): 3.34
Mean WFD TP score (1=bad, 5=high): 2.78

100m lake buffers

lakes

(lakes with all unused potential wetland)

Case study wetlands - Eutrophication (21 sites):
Mean LCM farming %: 22.6
Mean LCM woodland %: 8.45
Mean barrier count per km2: 0
Mean drainage count per km2: 0
Mean WFD TN score (1=bad, 5=high): 2.8
Mean WFD TP score (1=bad, 5=high): 2.43

Case study wetlands - Land Use (15 sites):
Mean LCM farming %: 19.81
Mean LCM woodland %: 14.42
Mean barrier count per km2: 0.27
Mean drainage count per km2: 0
Mean WFD TN score (1=bad, 5=high): 2.88
Mean WFD TP score (1=bad, 5=high): 2.45

Case study wetlands - Water Level (14 sites):
Mean LCM farming %: 12.31
Mean LCM woodland %: 5.9
Mean barrier count per km2: 0.07
Mean drainage count per km2: 0.44
Mean WFD TN score (1=bad, 5=high): 3.36
Mean WFD TP score (1=bad, 5=high): 2.85

Shoreline Restoration

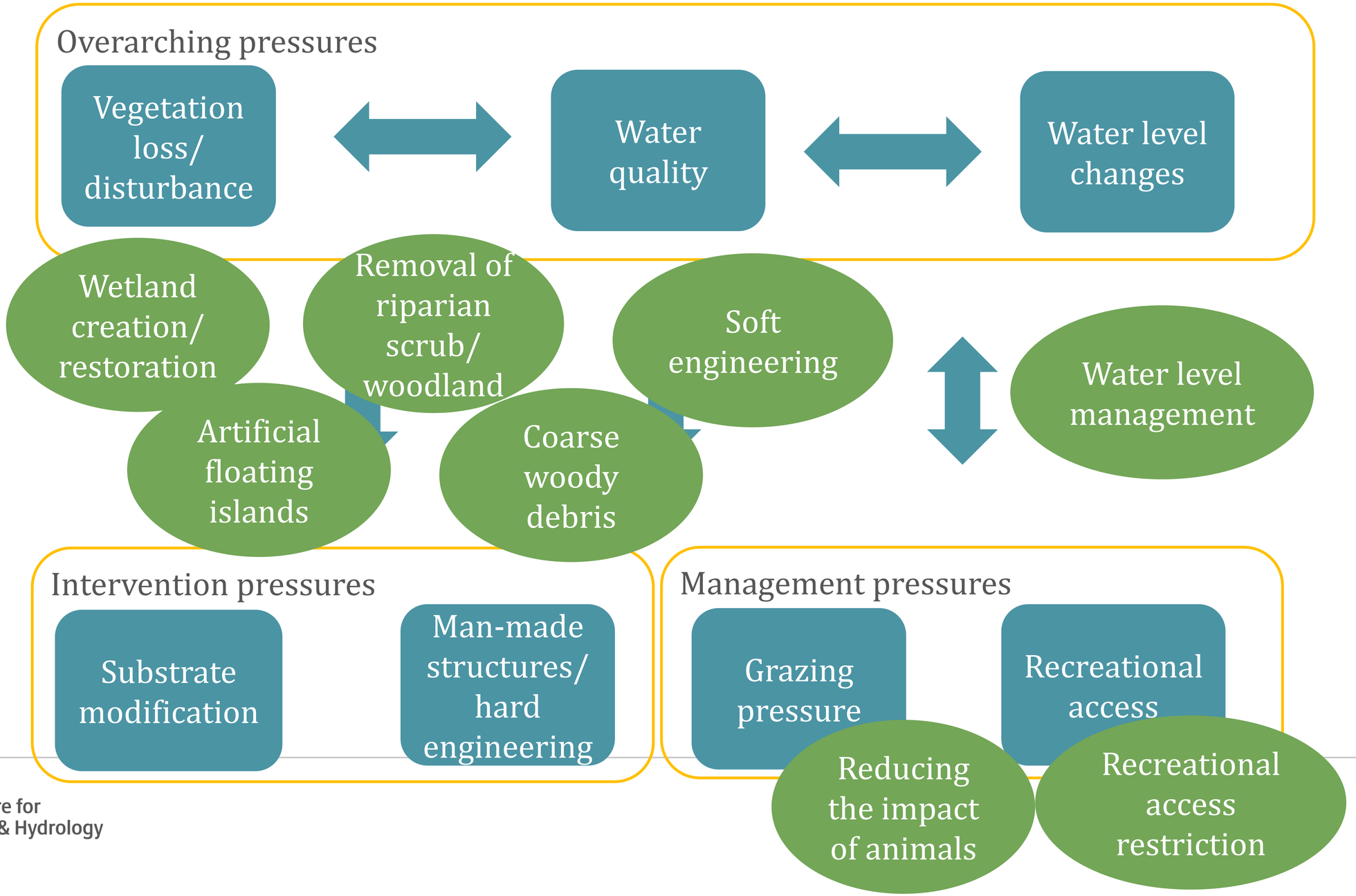
What we did

- Literature review of published and unpublished literature
- Online survey
- Structured interviews with restoration experts and practitioners

Notes from report

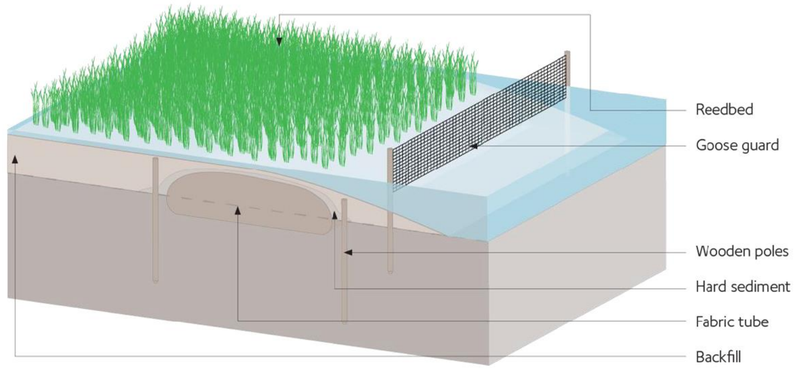
- Pressures on lake shorelines
- Restoration techniques
  - Reedbed, swamp and fen creation/ restoration
  - Removal of riparian scrub/ woodland
  - Water level management
  - Artificial floating islands
  - Soft engineering
  - Coarse woody debris
  - Recreational access restriction
  - Reducing the impact of animals – fencing
  - Reducing the impact of animals – population controls
- Monitoring/ evaluating effectiveness
- Conclusions – range of techniques, importance of good design, access to information, knowledge gaps

Shoreline pressures and restoration techniques



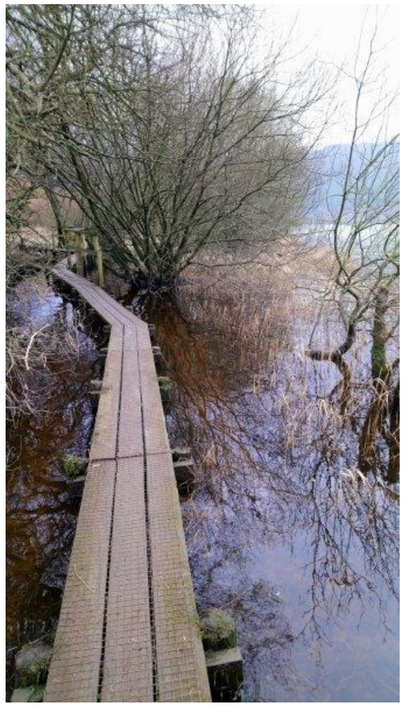
Examples of techniques – changing shorelines

- Interventions to address specific issues:
- Reprofiling, coir rolls and planting to reduce erosion and improve water vole habitat
- Large scale wetland restoration – soft engineered wave protection and planting using natural materials to combinations of harder engineering and planting



Examples of techniques – improved management

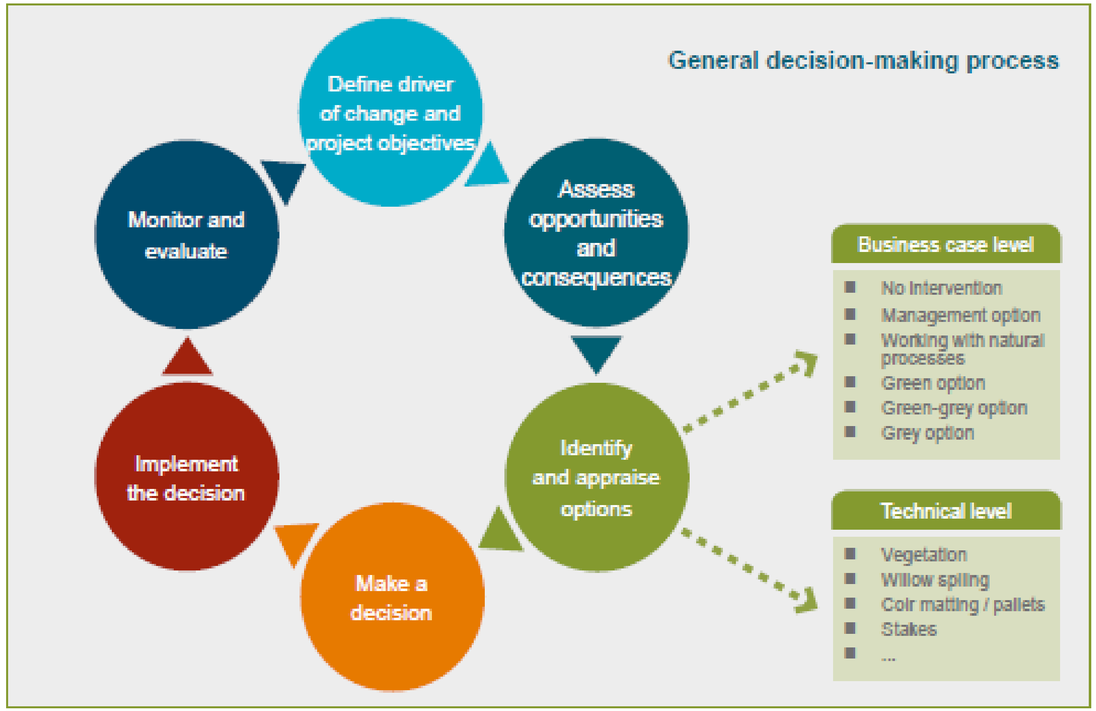
- Grazing exclosure for livestock and wild vertebrates (birds, deer etc.) to allow habitat recovery
- Appropriate grazing – stock, density, seasonality to maximise biodiversity benefits
- Do we have adequate data on this in the context of shorelines?



- Understanding visitor pressure
- Relocating amenities
- Controlling desire lines
- Enforcing restrictions
- Signage to explain activity
- Reduce impacts at sensitive locations
- But can be politically tricky!

Getting the conditions right

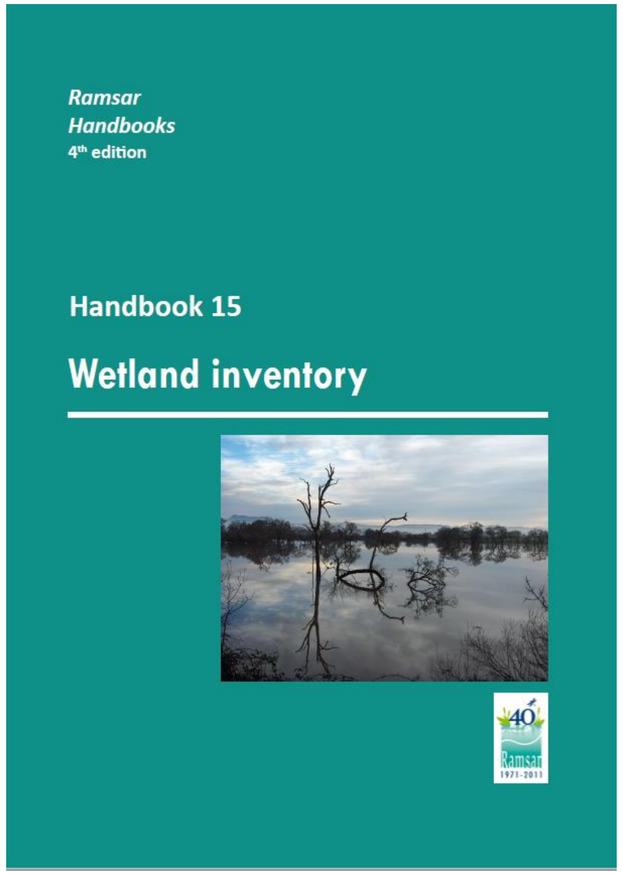
- Site-specific understanding of the interacting pressures
  - Littoral zone
  - Riparian zone
- Critical to understand and control the underlying drivers of change across lake and catchment
- Importance of good design and to engage with relevant stakeholders and create a vision for what a more naturally functioning shoreline will look like



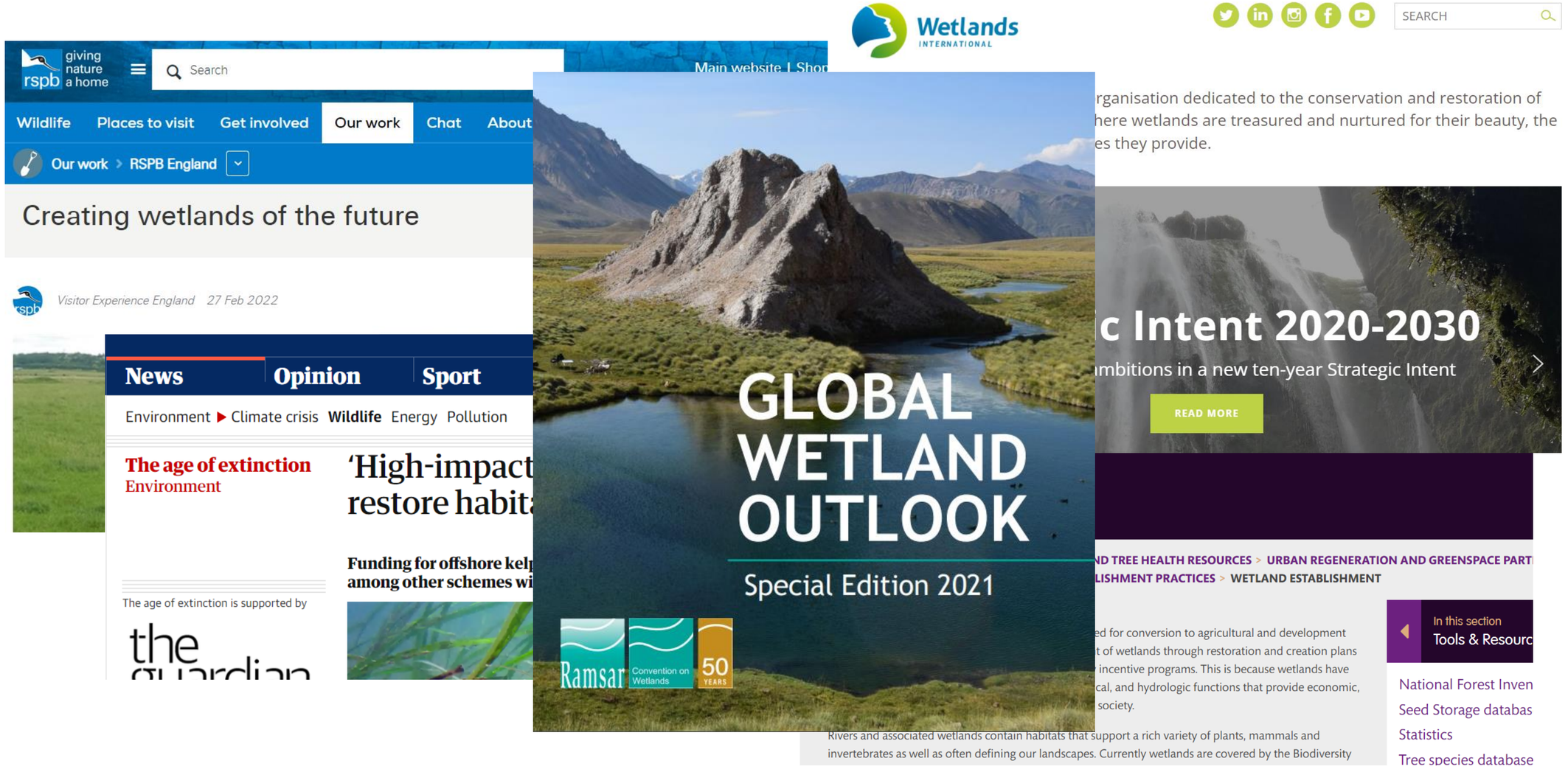
Roca, M., Escaramela, M., Gimeno, O., de Vilder, L., Simm, J., Horton B. and Thorne, C. (2017), *Green approaches in river engineering: Supporting implementation of Green Infrastructure*. HR Wallingford Ltd. https://eprints.hrwallingford.com/1250/

The Bigger Picture

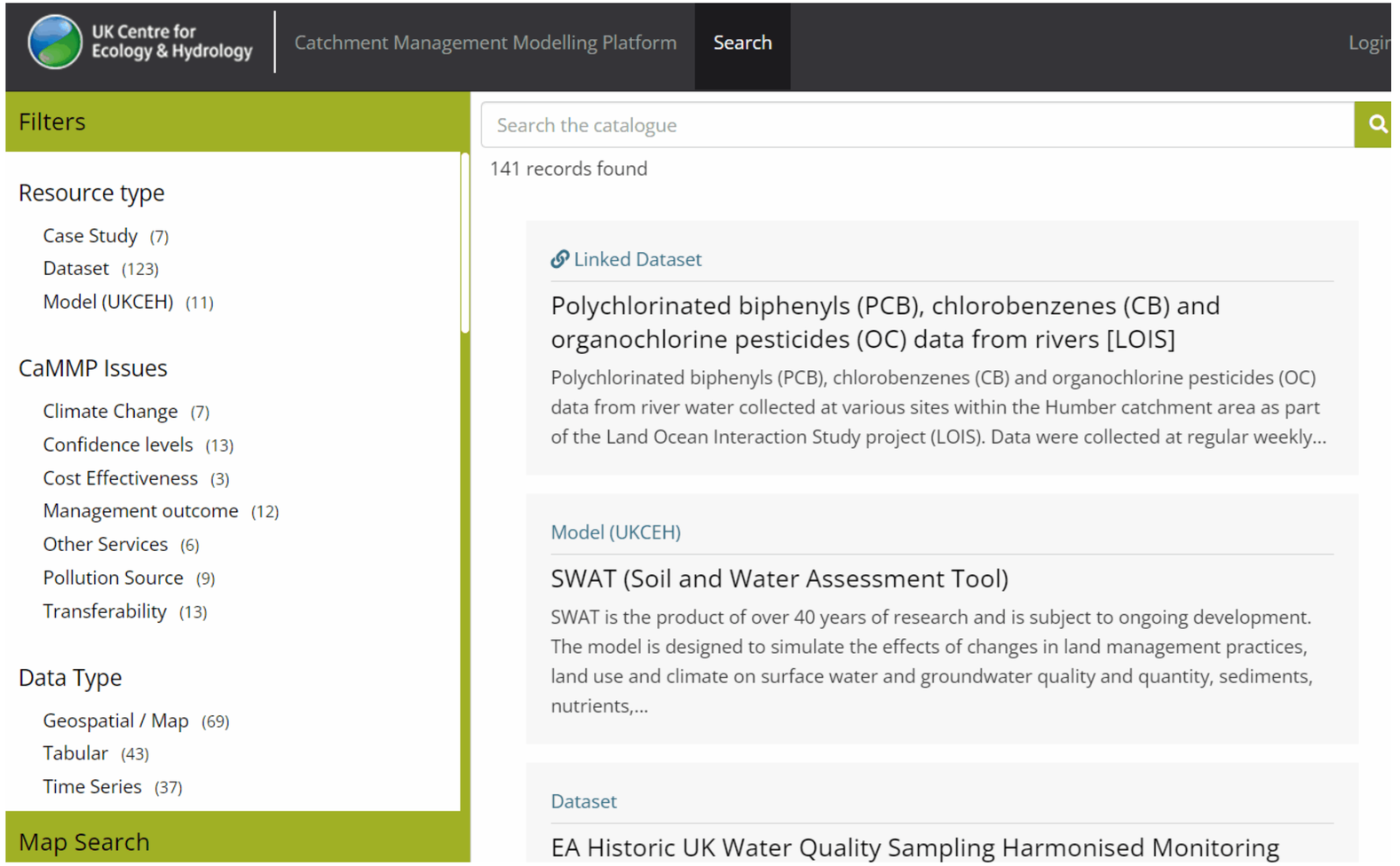
UK Wetlands Directory?



UK Wetlands Directory?

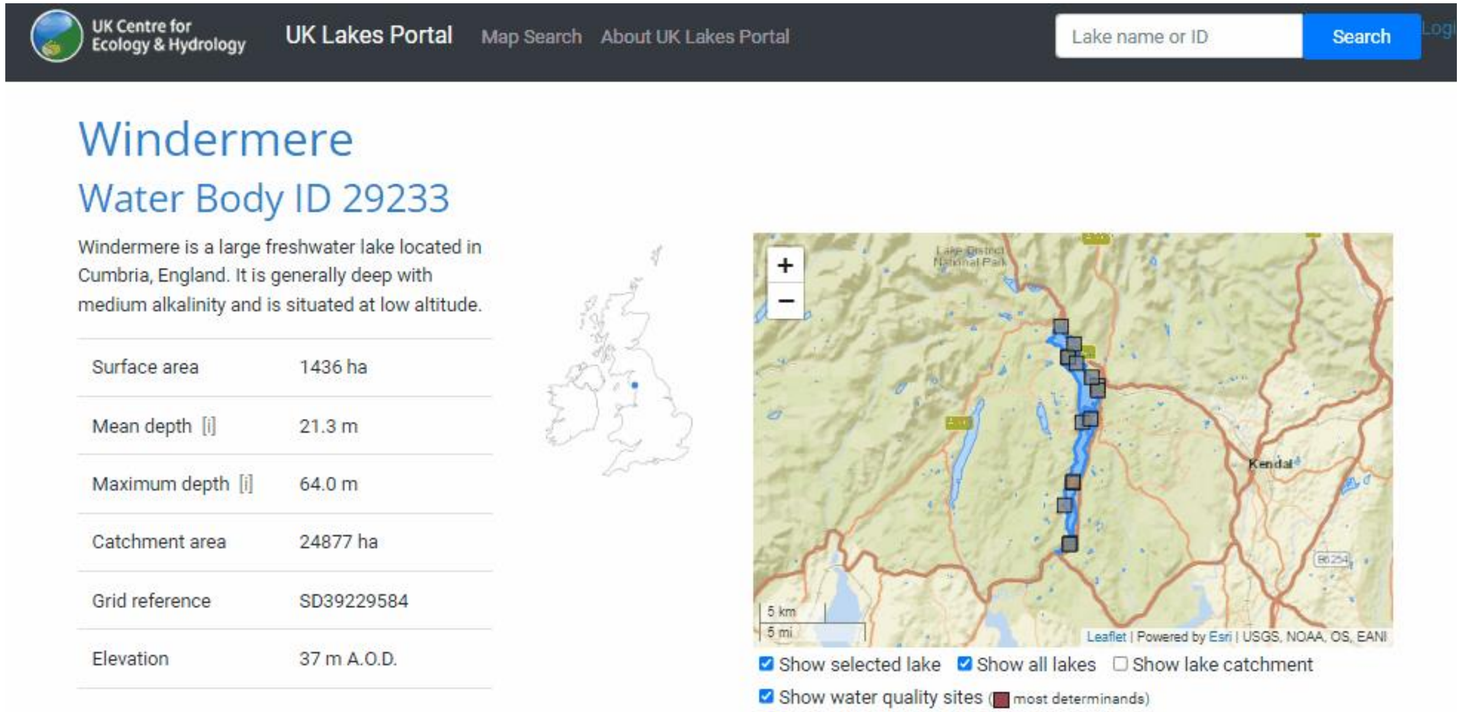


UK Wetlands Directory?



https://catalogue.ceh.ac.uk/cmp/documents

UK Wetlands Directory?



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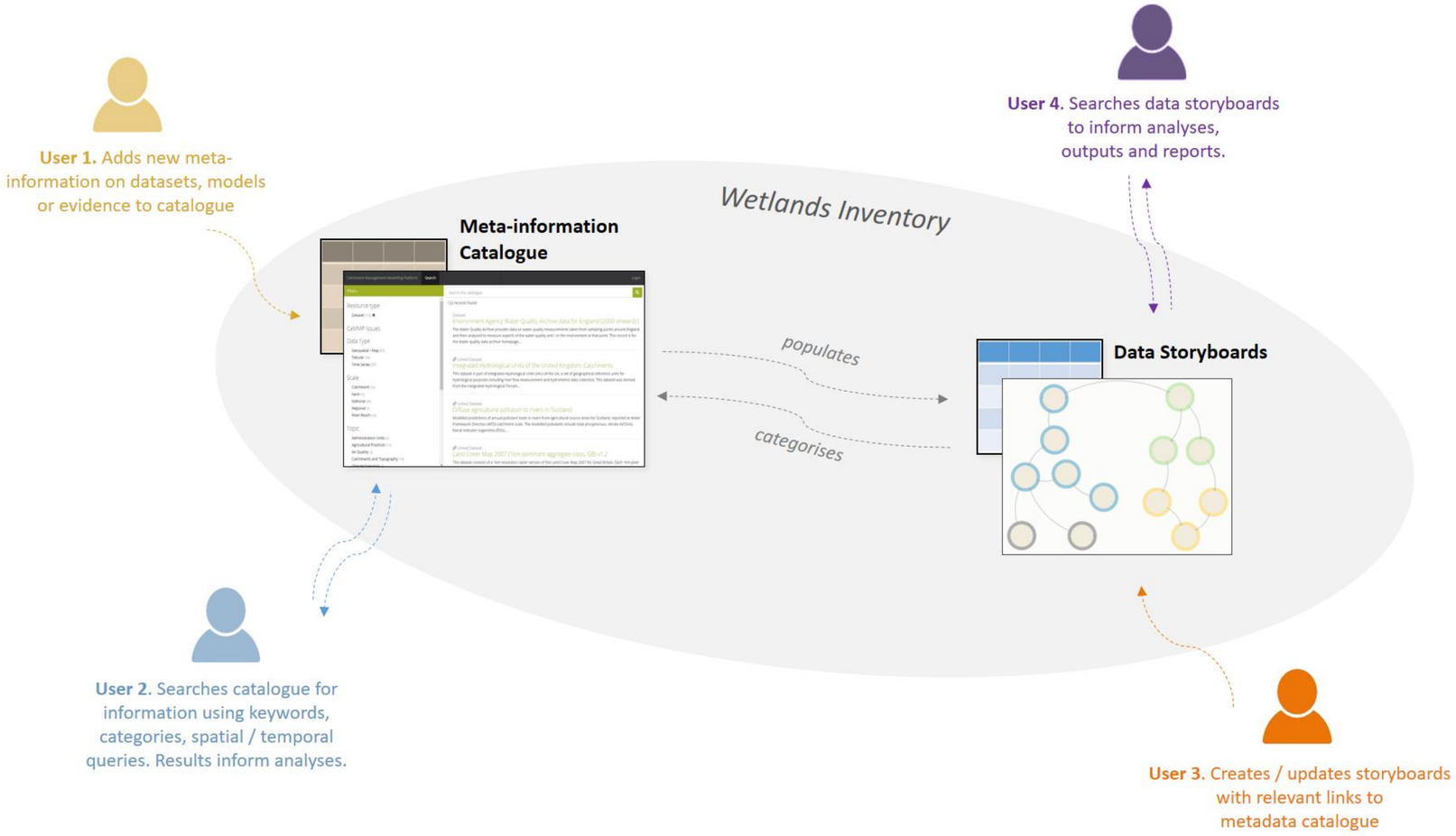
https://eip.ceh.ac.uk/apps/lakes/

UK Wetlands Directory?



Future Work

Lake wetlands:

- *Where are they?*
- *Where aren't they?*
- *Where aren't they where they could be?*
- *What do we know about them?*
- *What don't we know about them?*
- *Why aren't there more of them?#*
- *Could we have more of them?*
- *How?*
- *Where?*

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NATURAL ENGLAND

defra
Department for Environment Food and Rural Affairs

UNIVERSITY OF OXFORD

OXFORDSHIRE TREESCAPE PROJECT

Thank you

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ScienceAndMaps