

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



© David Dixon, Geograph

Literature Review

LAKE WETLAND	COUNTY	CONSERVATION DESIGNATED SITE	TYPE OF FRINGING
Barton Broad	Norfolk	Part of Ant Broad & 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 Broad Special Area of Conservation (SAC). In Broad National Park.	Reed swamp.
		Bassenthwaite Lake is designated a NNR, a SSSI	Reed swamp (+ oth and alder woodland

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

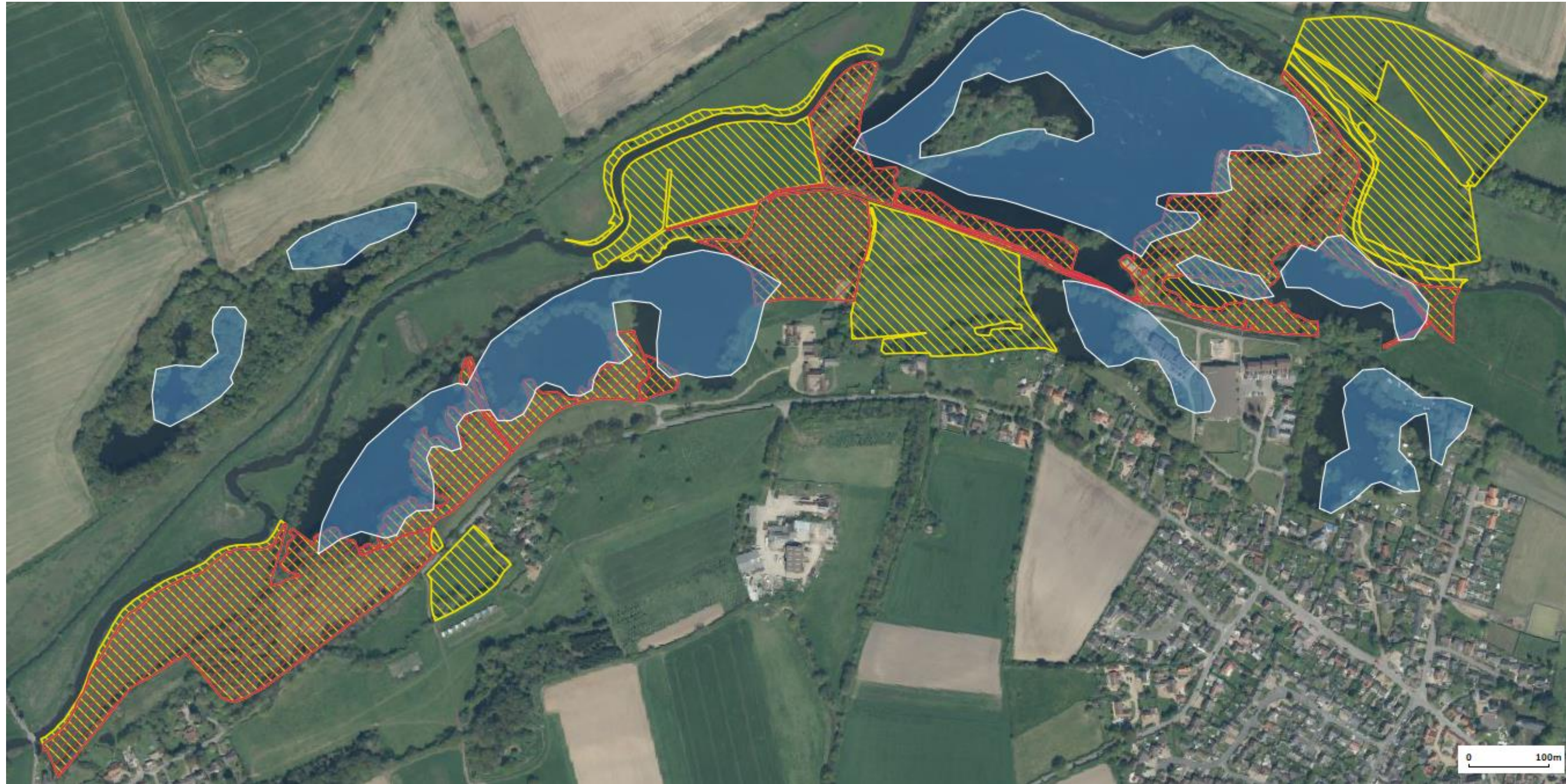
'No main habitat'

Blanket bog?

Coastal and floodplain grazing marsh?



Current Lake Wetlands - QA



Current Lake Wetlands - QA



Current Lake Wetlands - QA

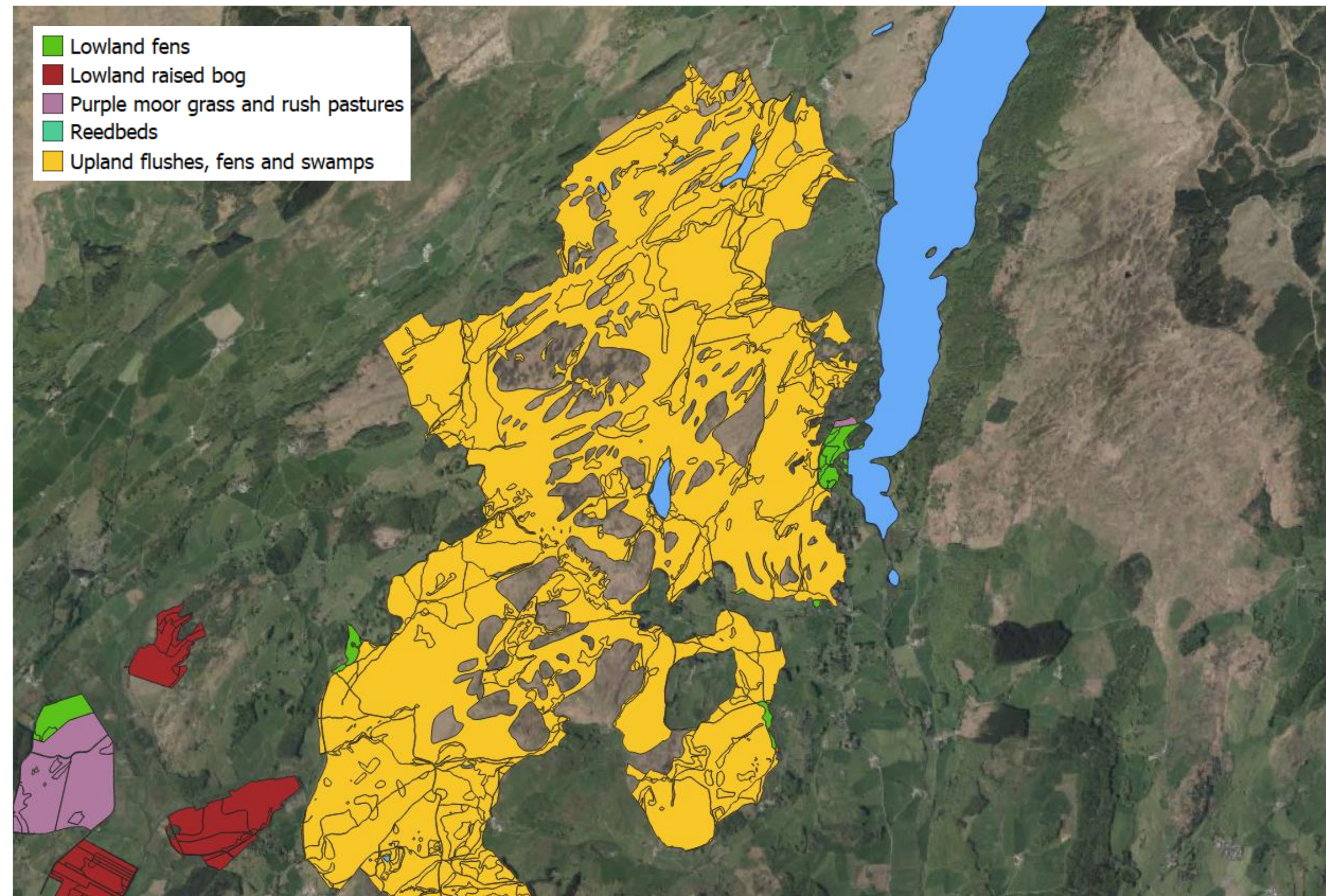


‘No main habitat’

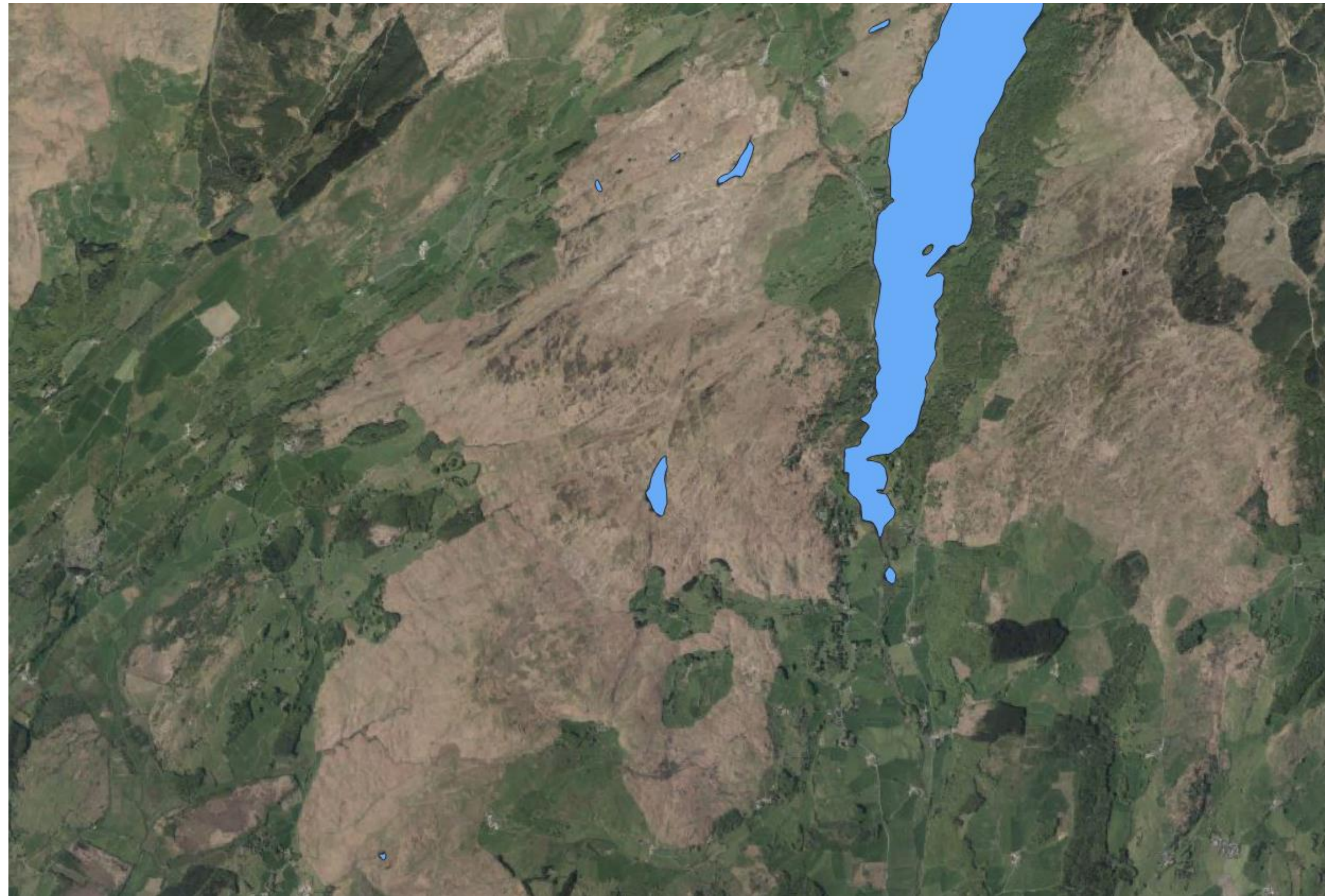
MasterMap conflict?

>50% in lake included

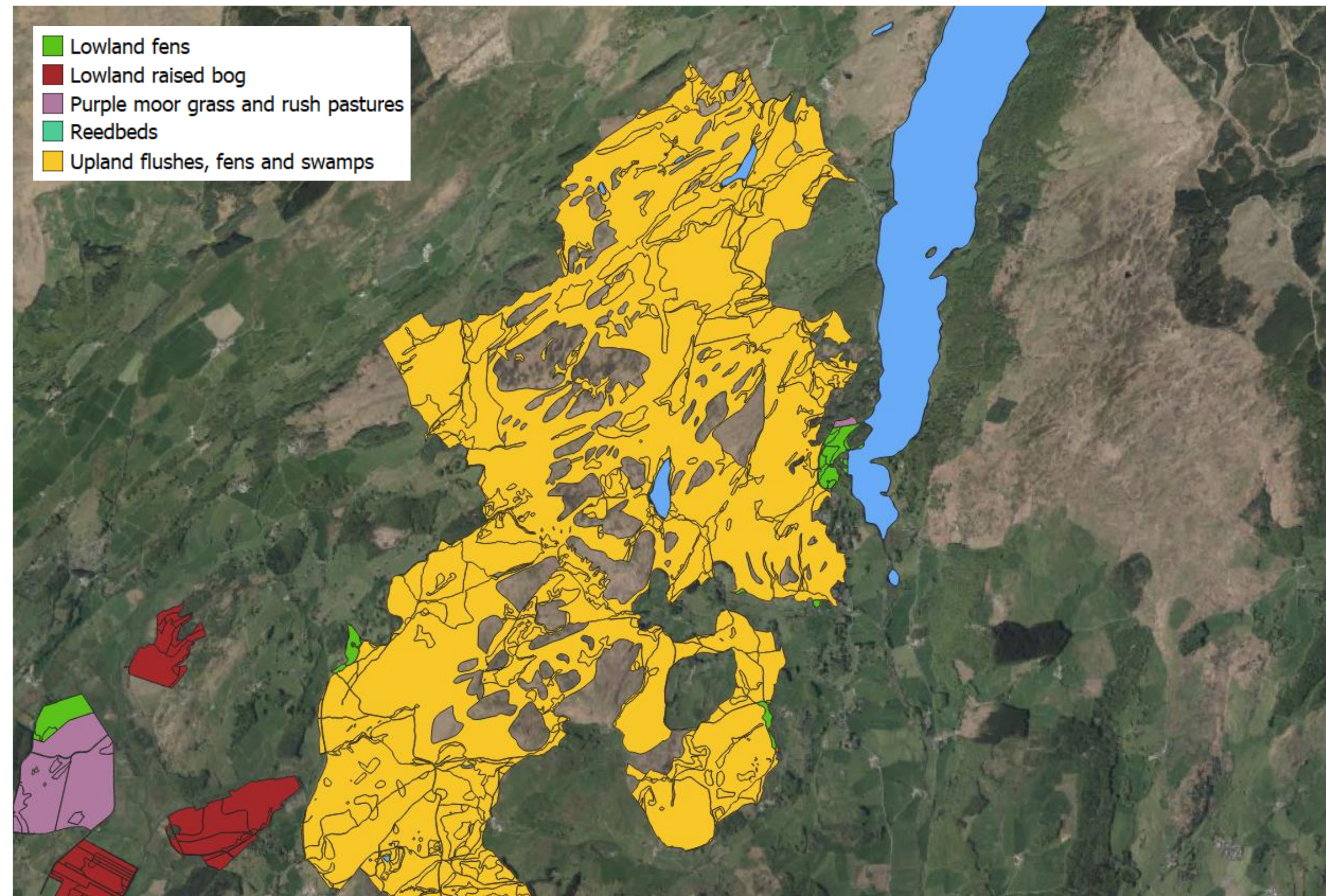
Current Lake Wetlands - QA



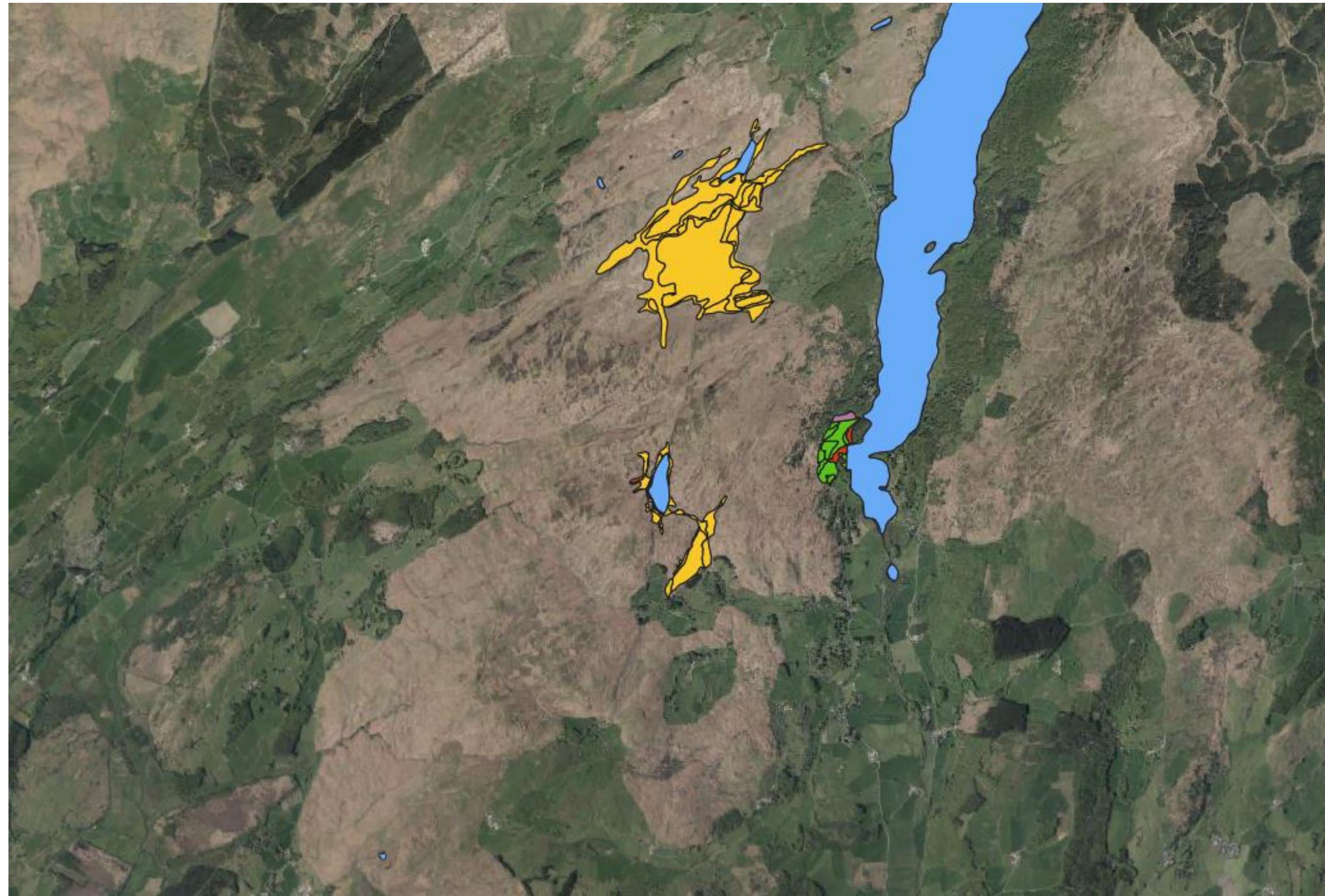
Current Lake Wetlands - QA



Current Lake Wetlands - QA



Current Lake Wetlands - QA



- Mean slope < 10°
- Variable polygons

Current Lake Wetlands



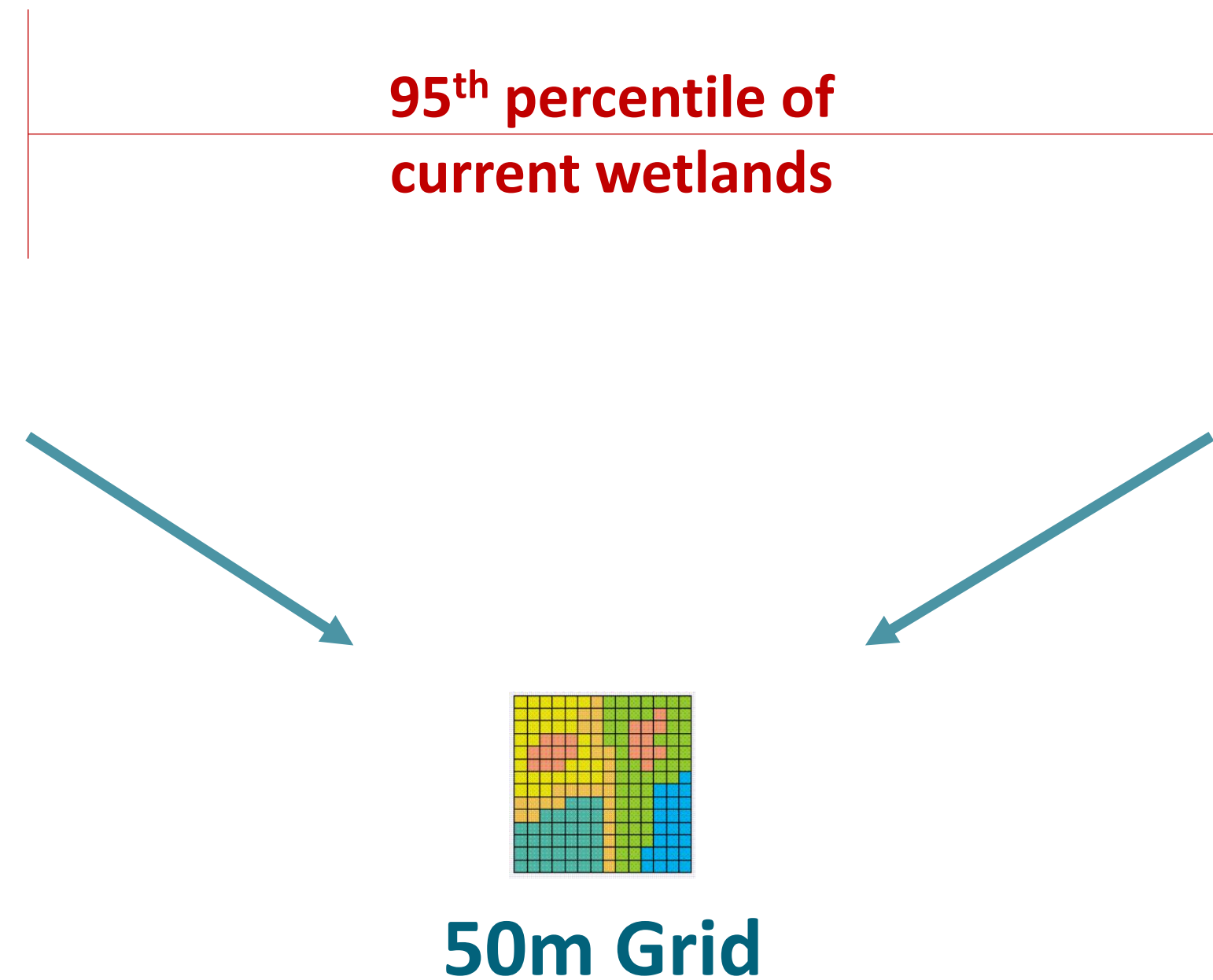
Potential Lake Wetlands

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



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 ▾



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

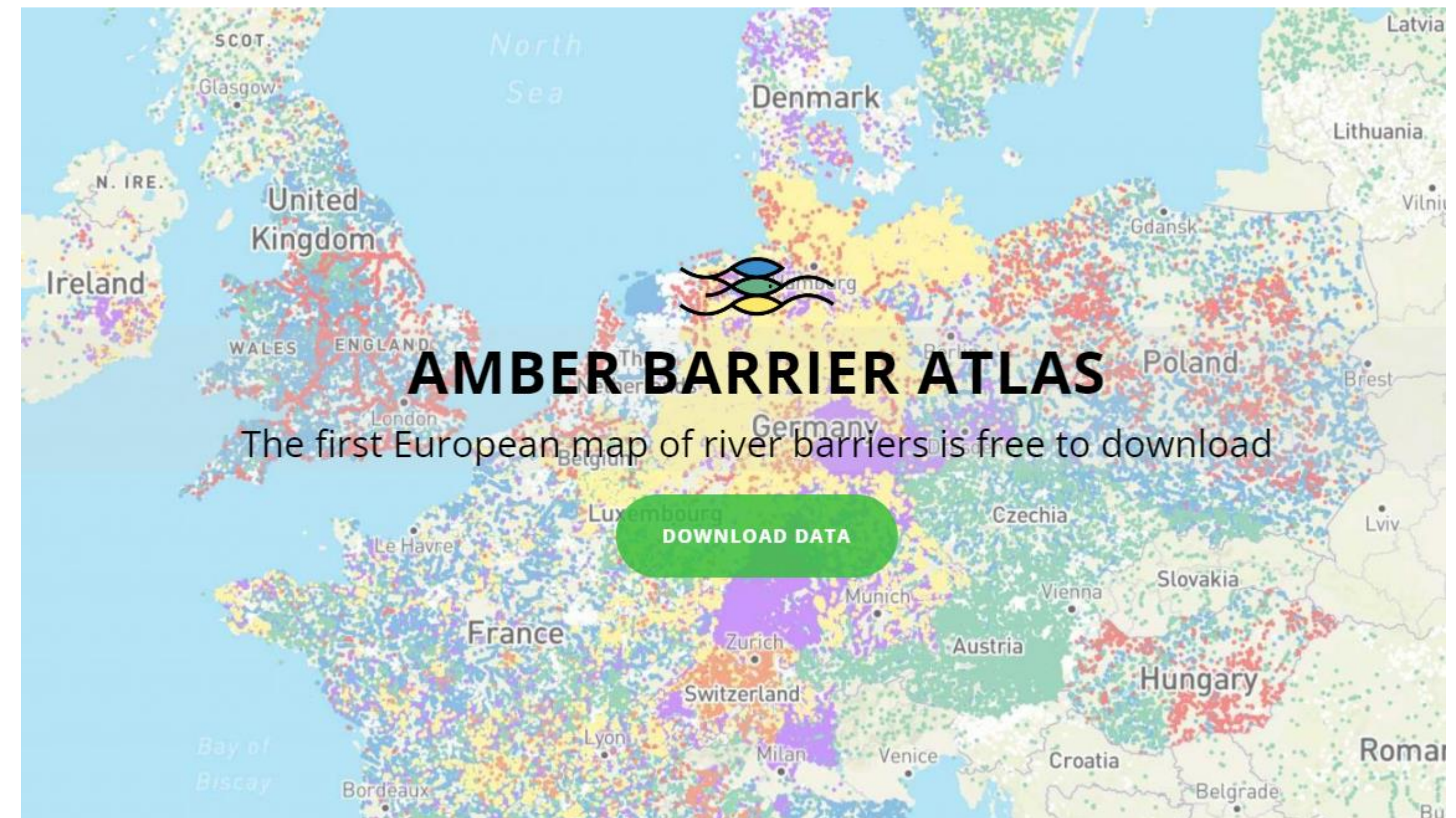


Wetland Vision

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

all_wetlands_stats.csv - Excel

Philip Taylor

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
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	NA	NA	131142.4	modelled	0.926	1.66
3	26937	Holy Island	Northumb	55.6793	-1.7849	2	3.60635	5.08	GBLAKES	NA	NA	183202.6	modelled	0.815	1.210
4	27033	unnamed	Northumb	55.6417	-2.1622	48	3.282	5.3	GBLAKES	NA	NA	173946	modelled	0.806	1.254
5	27088	Holburn La	Northumb	55.6217	-1.9207	157	3.18735	5.58	GBLAKES	NA	NA	177854.1	modelled	1.255	1.98
6	27104	Swaningho	Northumb	55.6118	-1.8803	111	2.8357	5.47	GBLAKES	NA	NA	155112.8	modelled	1.16	1.942
7	27175	Pawston L	Northumb	55.5772	-2.2325	165	4.64665	5.41	GBLAKES	NA	NA	251383.8	modelled	0.914	1.195
8	27302	unnamed	Northumb	55.5103	-1.6187	4	2.076	4.76	GBLAKES	NA	NA	98817.6	modelled	0.58	1.134
9	27324	Lilburn Por	Northumb	55.4981	-1.9367	67	2.9756	5	GBLAKES	NA	NA	148780	modelled	0.678	1.107
10	27400	Kimmer Lo	Northumb	55.4515	-1.8109	77	3.3445	4.87	GBLAKES	NA	NA	162877.2	modelled	0.673	1.038
11	27529	Black Loug	Northumb	55.3696	-1.7925	213	3.9663	4.98	GBLAKES	NA	NA	197521.7	modelled	0.799	1.131
12	27556	Linshiels L	Northumb	55.3357	-2.1697	195	7.55	5.43	GBLAKES	NA	NA	409965	modelled	1.641	1.684
13	27567	Harbottle	Northumb	55.3324	-2.1319	275	2.065	5.14	GBLAKES	NA	NA	106141	modelled	0.56	1.099
14	27568	Catcleugh	Northumb	55.3232	-2.4163	247	98.65405	9.8	United Uti	19.8	CEH_DATA	9668097	a measure	6.317	1.79
15	27578	Debdon La	Northumb	55.3202	-1.9016	121	3.53735	4.97	GBLAKES	NA	NA	175806.3	modelled	0.898	1.347
16	27580	unnamed	Northumb	55.3181	-1.8929	111	4.1263	4.92	GBLAKES	NA	NA	203014	modelled	0.895	1.243
17	27585	Nellys Mos	Northumb	55.3152	-1.8753	188	3.9136	4.94	GBLAKES	NA	NA	193331.8	modelled	0.793	1.13
18	27589	unnamed	Northumb	55.3124	-1.5548	1	6.442128	5.29	GBLAKES	NA	NA	340788.6	modelled	2.435	2.706
19	27593	Nellys Mos	Northumb	55.3111	-1.8775	187	3.61225	5.19	GBLAKES	NA	NA	187475.8	modelled	1.173	1.745
20	27605	Castron q	Northumb	55.3047	-2.0002	92	11.77065	5.35	GBLAKES	NA	NA	629729.8	modelled	2.246	1.846
21	27618	Ladyburn L	Northumb	55.2941	-1.5785	8	9.5459	4.94	GBLAKES	NA	NA	471567.5	modelled	1.917	1.750
22	27648	unnamed	Northumb	55.2643	-1.5734	2	6.913881	4.62	GBLAKES	NA	NA	319421.3	modelled	1.124	1.205
23	27660	Darden Lo	Northumb	55.2553	-2.0472	356	3.43765	5.15	GBLAKES	NA	NA	177039	modelled	0.75	1.145
24	27669	Cresswell I	Northumb	55.2427	-1.5564	4	5.68385	4.67	GBLAKES	NA	NA	265435.8	modelled	1.228	1.451

all_wetlands_stats

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

(lakes with all unused potential wetland)

100m lake buffers

lakes

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

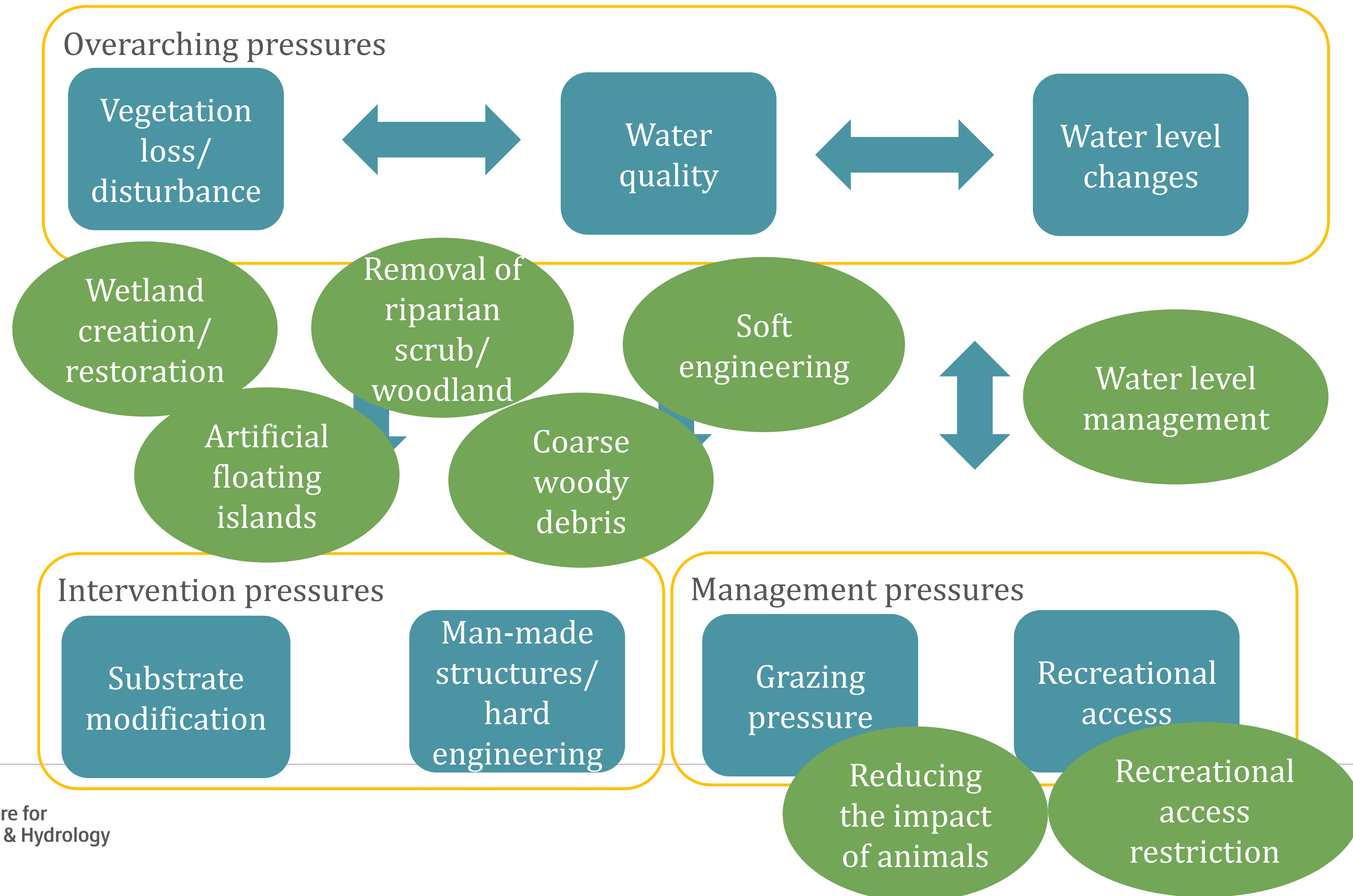
What we did

- 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

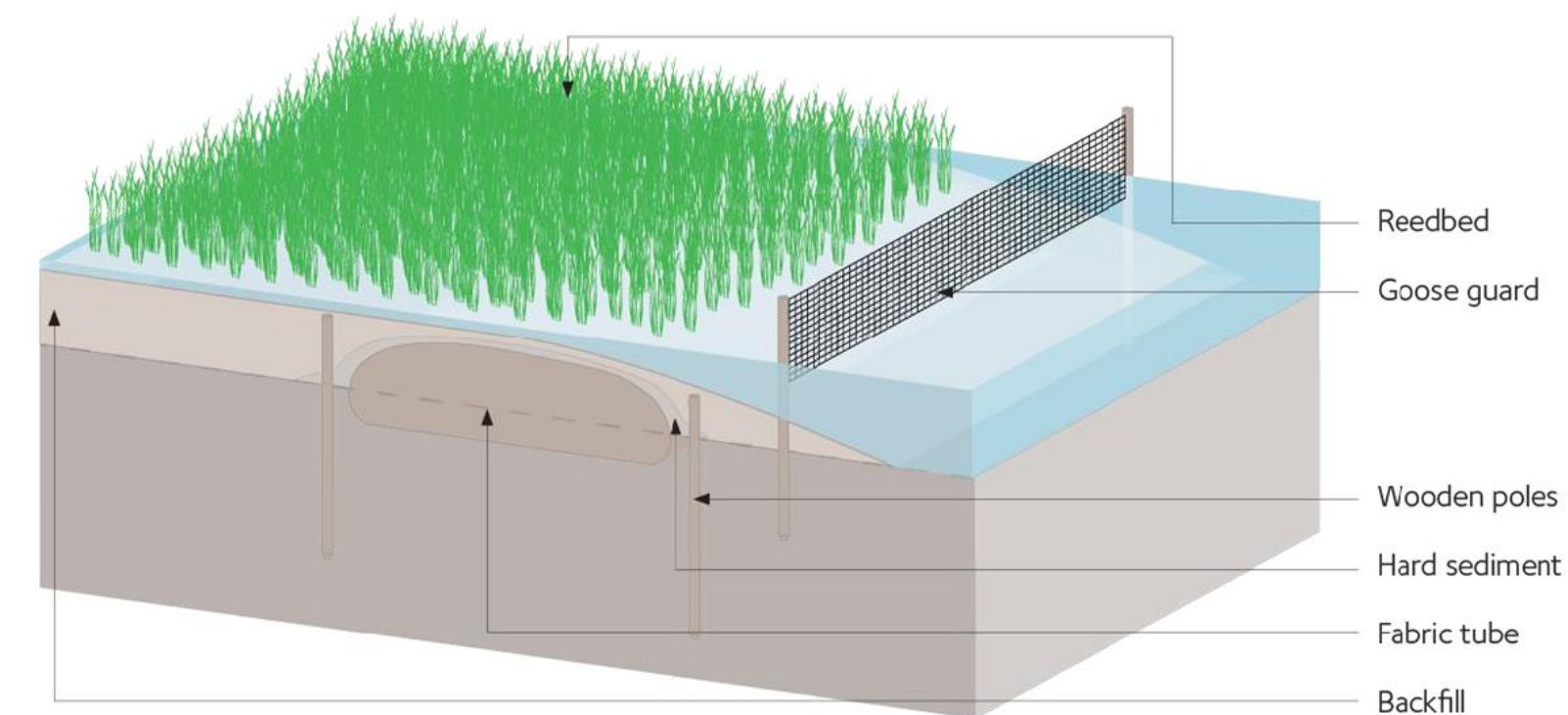
Shoreline pressures and restoration techniques



Examples of techniques – changing shorelines



- Interventions to address specific issues:
- Reprofilng, 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 enclosure 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?

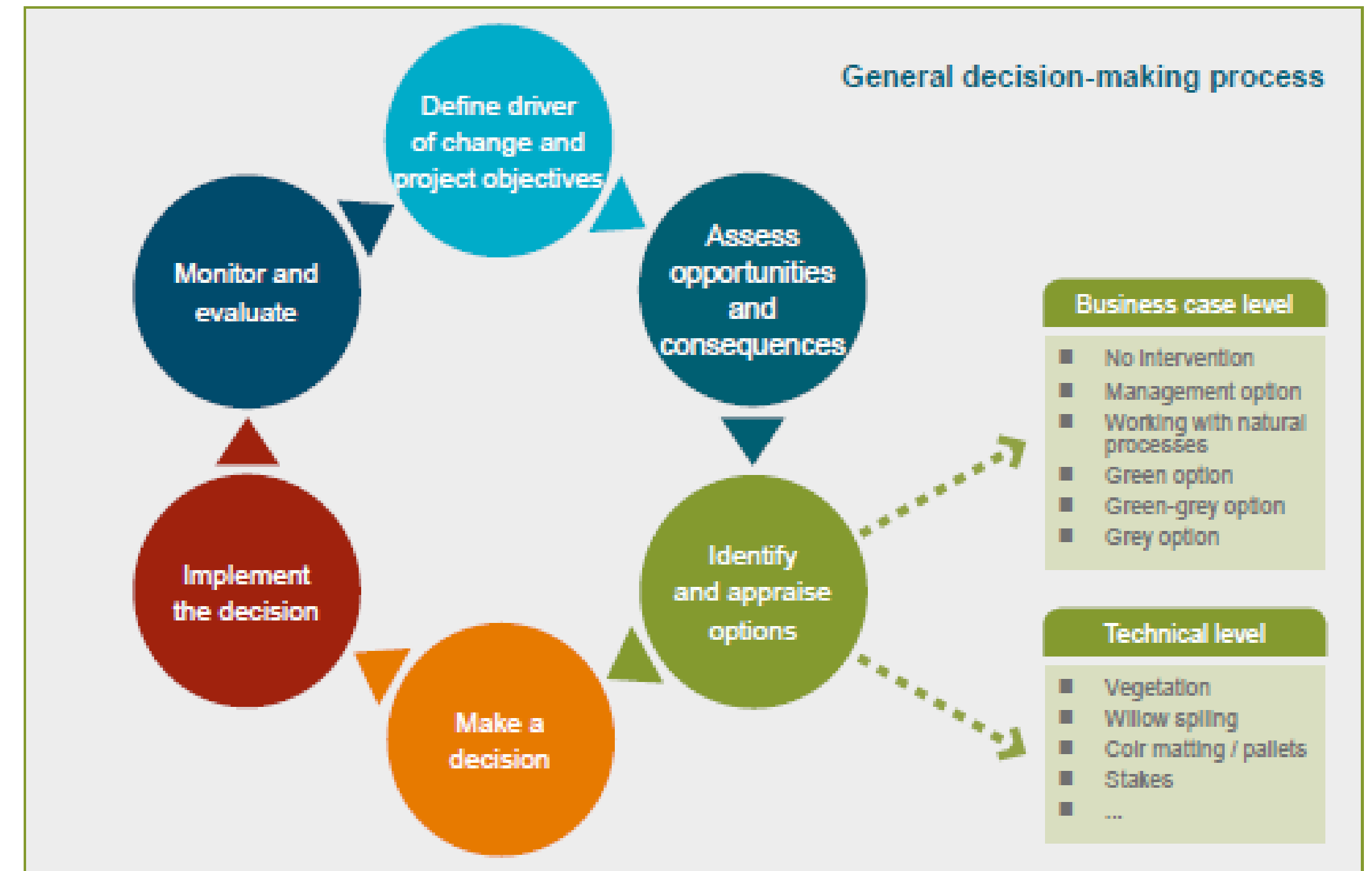


- Understanding visitor pressure
- Relocating amenities
- Controlling desire lines
- Enforcing restrictions
- Signage to explain activity
- Reduce impacts at sensitive locations
- But can be politically tricky!



Getting the conditions right

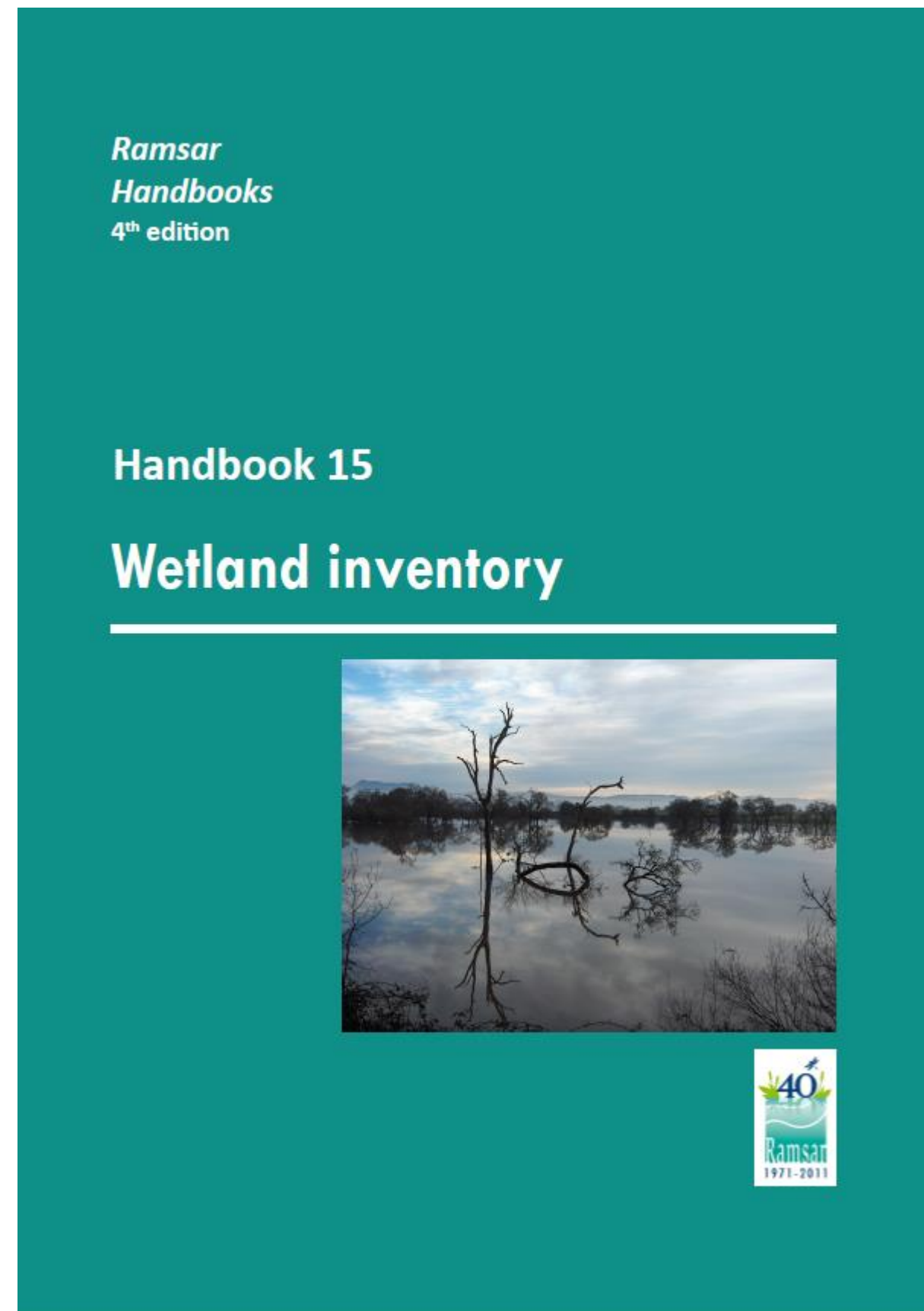
- Site-specific understanding of the interacting pressures
 - Littoral zone
 - Riparian zone
- Critical to understand and control the underlying drivers of change across lake and catchment
- Importance of good design and to engage with relevant stakeholders and create a vision for what a more naturally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



SEARCH

organisation dedicated to the conservation and restoration of where wetlands are treasured and nurtured for their beauty, the es they provide.

c Intent 2020-2030

ambitions in a new ten-year Strategic Intent

READ MORE

ND TREE HEALTH RESOURCES > URBAN REGENERATION AND GREENSPACE PART
LISHMENT PRACTICES > WETLAND ESTABLISHMENT

ed for conversion to agricultural and development
t of wetlands through restoration and creation plans
incentive programs. This is because wetlands have
cal, and hydrologic functions that provide economic,
society.

In this section
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Seed Storage databas
Statistics
Tree species database

giving nature a home

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Creating wetlands of the future

Visitor Experience England 27 Feb 2022

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The age of extinction
Environment

'High-impact
restore habit

Funding for offshore kelp
among other schemes wi

The age of extinction is supported by

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GLOBAL
WETLAND
OUTLOOK

Special Edition 2021

Ramsar Convention on Wetlands 50 YEARS

Rivers and associated wetlands contain habitats that support a rich variety of plants, mammals and invertebrates as well as often defining our landscapes. Currently wetlands are covered by the Biodiversity

UK Wetlands Directory?

 UK Centre for Ecology & Hydrology

Catchment Management Modelling Platform

Search

Login

Filters

Resource type

Case Study (7)

Dataset (123)

Model (UKCEH) (11)

CaMMP Issues

Climate Change (7)

Confidence levels (13)

Cost Effectiveness (3)

Management outcome (12)

Other Services (6)

Pollution Source (9)

Transferability (13)

Data Type

Geospatial / Map (69)

Tabular (43)

Time Series (37)

Map Search

Search the catalogue

141 records found

Linked Dataset

Polychlorinated biphenyls (PCB), chlorobenzenes (CB) and organochlorine pesticides (OC) data from rivers [LOIS]

Polychlorinated biphenyls (PCB), chlorobenzenes (CB) and organochlorine pesticides (OC) data from river water collected at various sites within the Humber catchment area as part of the Land Ocean Interaction Study project (LOIS). Data were collected at regular weekly...

Model (UKCEH)


SWAT (Soil and Water Assessment Tool)

SWAT is the product of over 40 years of research and is subject to ongoing development. The model is designed to simulate the effects of changes in land management practices, land use and climate on surface water and groundwater quality and quantity, sediments, nutrients,...

Dataset

EA Historic UK Water Quality Sampling Harmonised Monitoring

UK Wetlands Directory?



UK Centre for Ecology & Hydrology

UK Lakes Portal

Map Search

About UK Lakes Portal

Lake name or ID

Search


Log


Windermere

Water Body ID 29233

Windermere is a large freshwater lake located in Cumbria, England. It is generally deep with medium alkalinity and is situated at low altitude.

Surface area	1436 ha
Mean depth [i]	21.3 m
Maximum depth [i]	64.0 m
Catchment area	24877 ha
Grid reference	SD39229584
Elevation	37 m A.O.D.





☒ Show selected lake ☒ Show all lakes ☐ Show lake catchment
☒ Show water quality sites (most determinands)

Parameters

Typology

Chemistry

Land cover (2007)

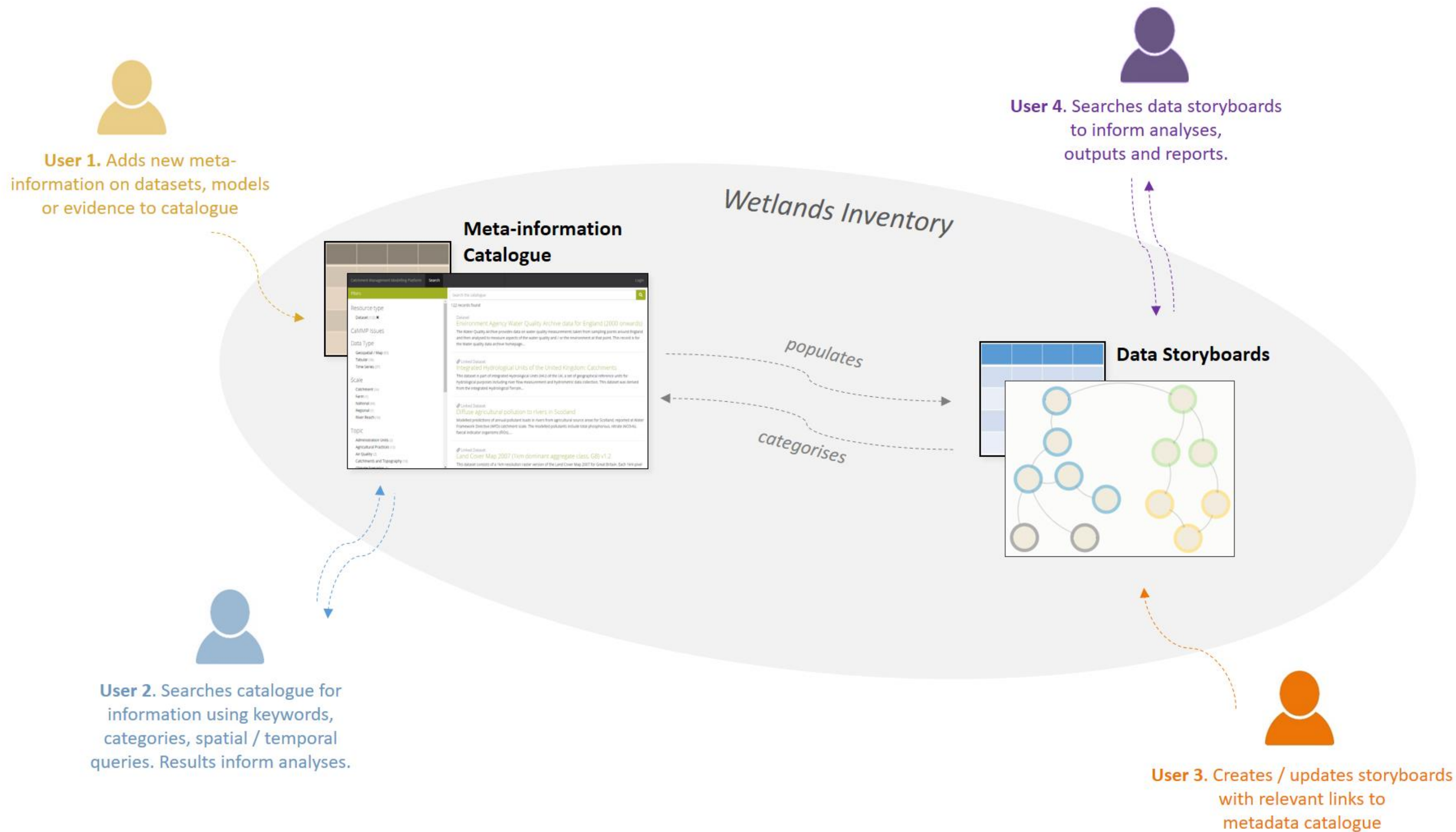
Biology

Connectivity

Water quality

Perimeter length	52 km
Shoreline development index [?]	2.88

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?*



OXFORDSHIRE
TREESCAPE PROJECT

Thank you

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 ScienceAndMaps

