



Planning and delivering river restoration at multiple scales for the Water Framework Directive

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The River Restoration Centre (RRC)

Vision and objectives

‘Naturally functioning, wildlife-rich systems, valued by people’

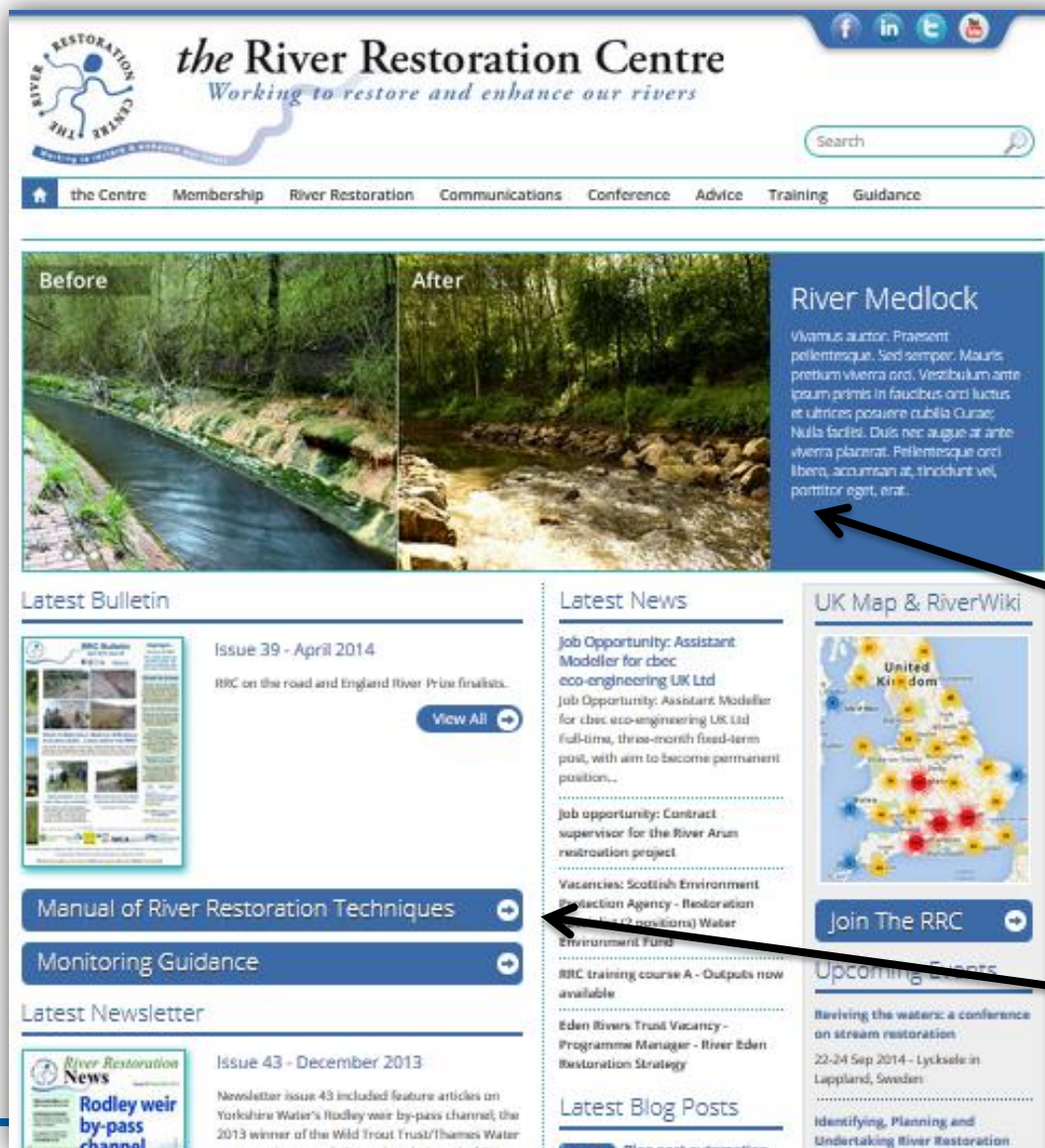
- To actively **promote** the re-establishment of **natural processes**, features, habitats and biodiversity of a river system
- To **support others** to achieve this by **collating knowledge**, information and evidence to **share best practice** throughout the river and catchment management community.

Delivering practitioner-focused knowledge and capacity building





Knowledge Exchange



- Information

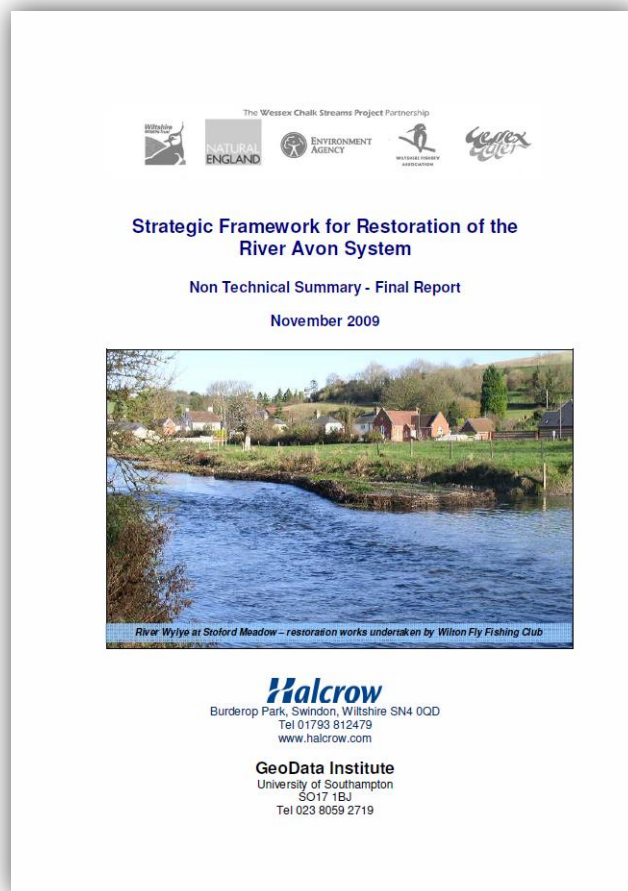
- Website, Bulletin, RRC Inventory, River Wiki

Photo and video gallery

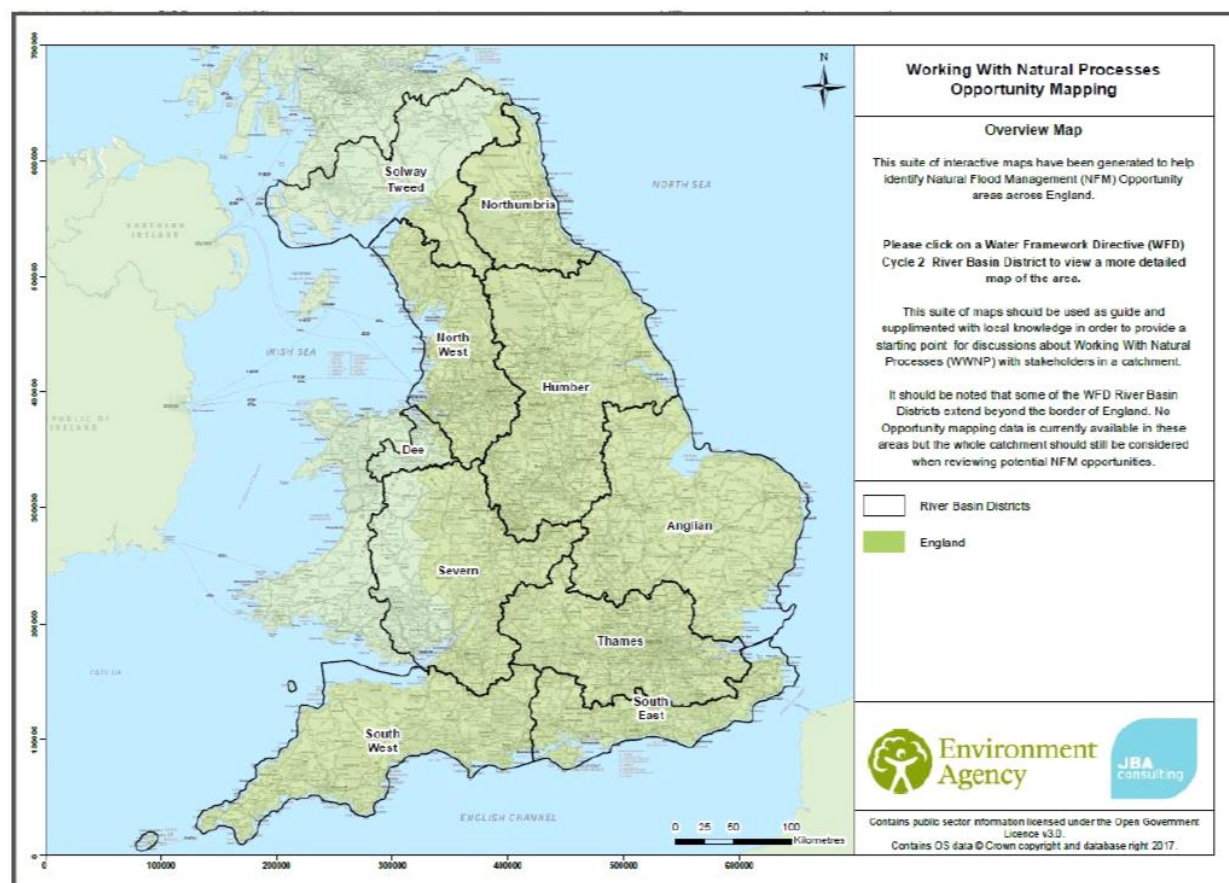
Manual of River Restoration Techniques and the Monitoring Guide

River restoration at catchment scale: the story so far

Strategic frameworks

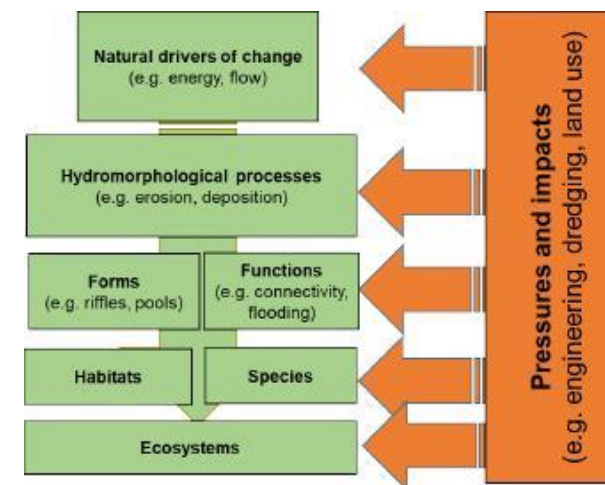
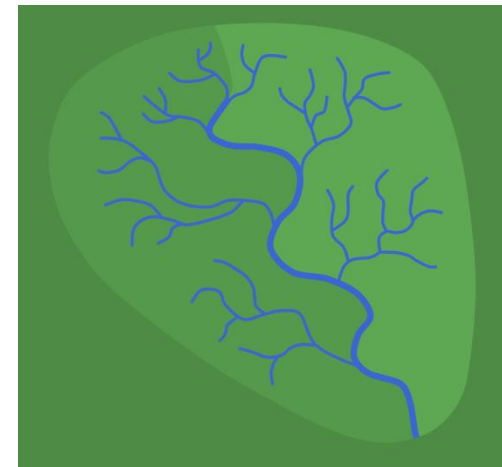


Opportunity-driven initiatives



What are we looking to create?

- A restoration plan that works at **catchment scale** through the identification of **pressures and impacts** on **catchment and river processes**.
- A plan that identifies a set of **restoration options** that will contribute to improving catchment processes.
- A plan that delivers **SMART** aims and objectives.
- Tools and techniques that can be used by **a wide community of practitioners**





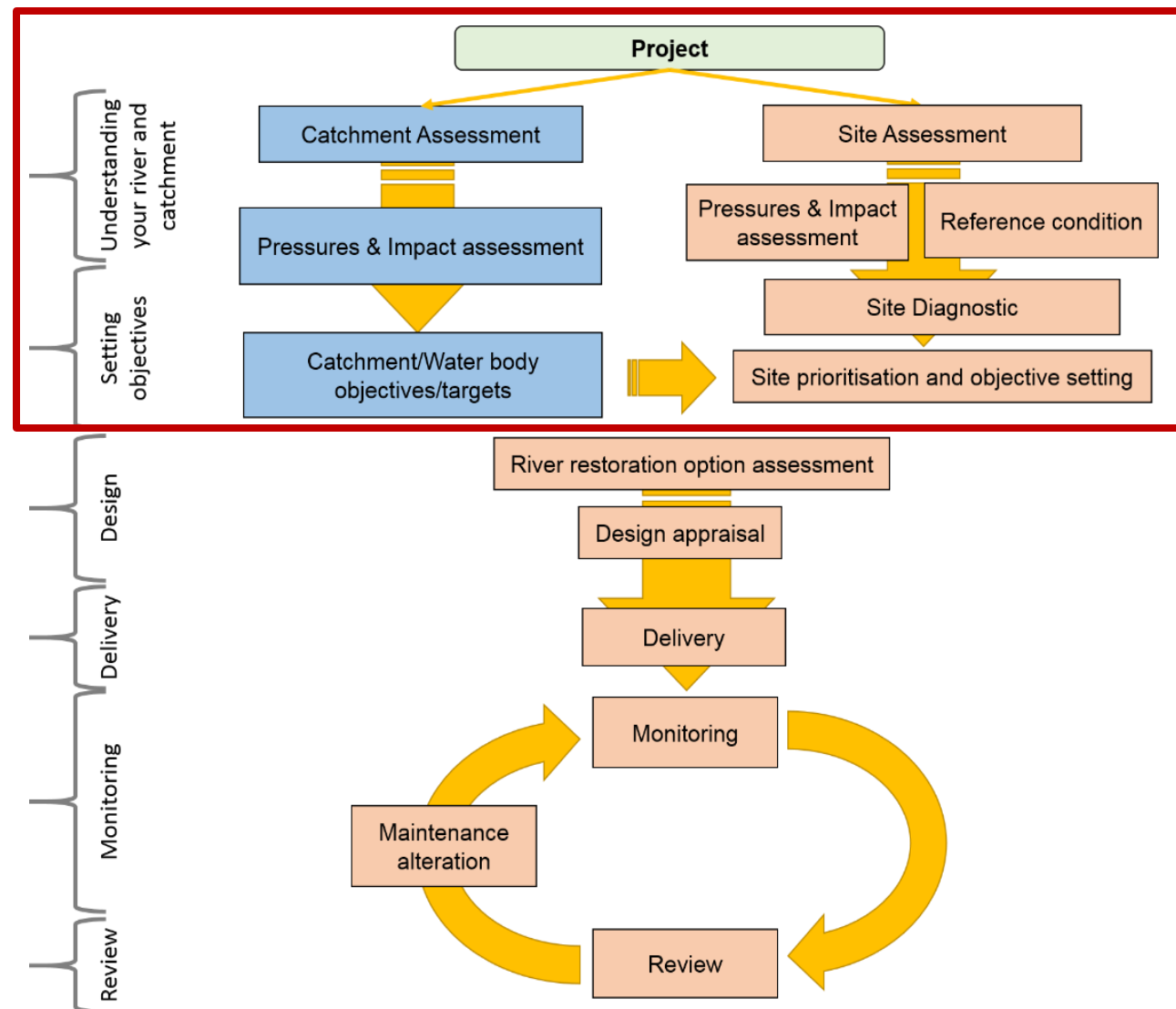
Catchment-centred restoration

What do we need?

- An **analytical framework**,
- A **process**, and
- A **set of methods** that are:
 - **Simple** enough to be used by specialists and non-specialists
 - Use **cheap**/free tools and software
 - **Flexible**
 - Can involve volunteers

The river restoration process

1. Understand your river and catchment
2. Setting objectives
3. Design
4. Delivery
5. Monitoring
6. Review



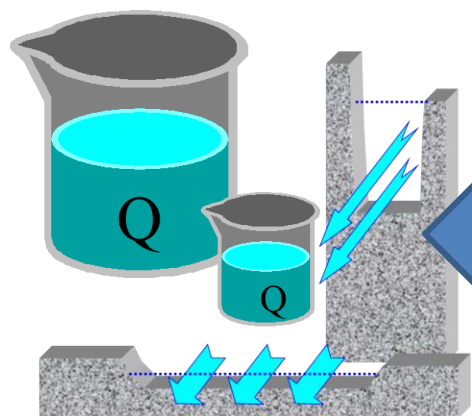


Assessing hydromorphology

Hydromorphology can be defined as the study of **'the physical habitat constituted by the flow regime (hydrology and hydraulics) and the physical template (fluvial geomorphology)'** (Orr et al 2008)



Hydromorphological Framework



Natural drivers of change
(e.g. energy, flow)

Hydromorphological processes
(e.g. erosion, deposition, runoff)

Forms
(e.g. riffles, pools)

Functions
(i.e. connectivity, flooding)

Habitats

Species

Ecosystems

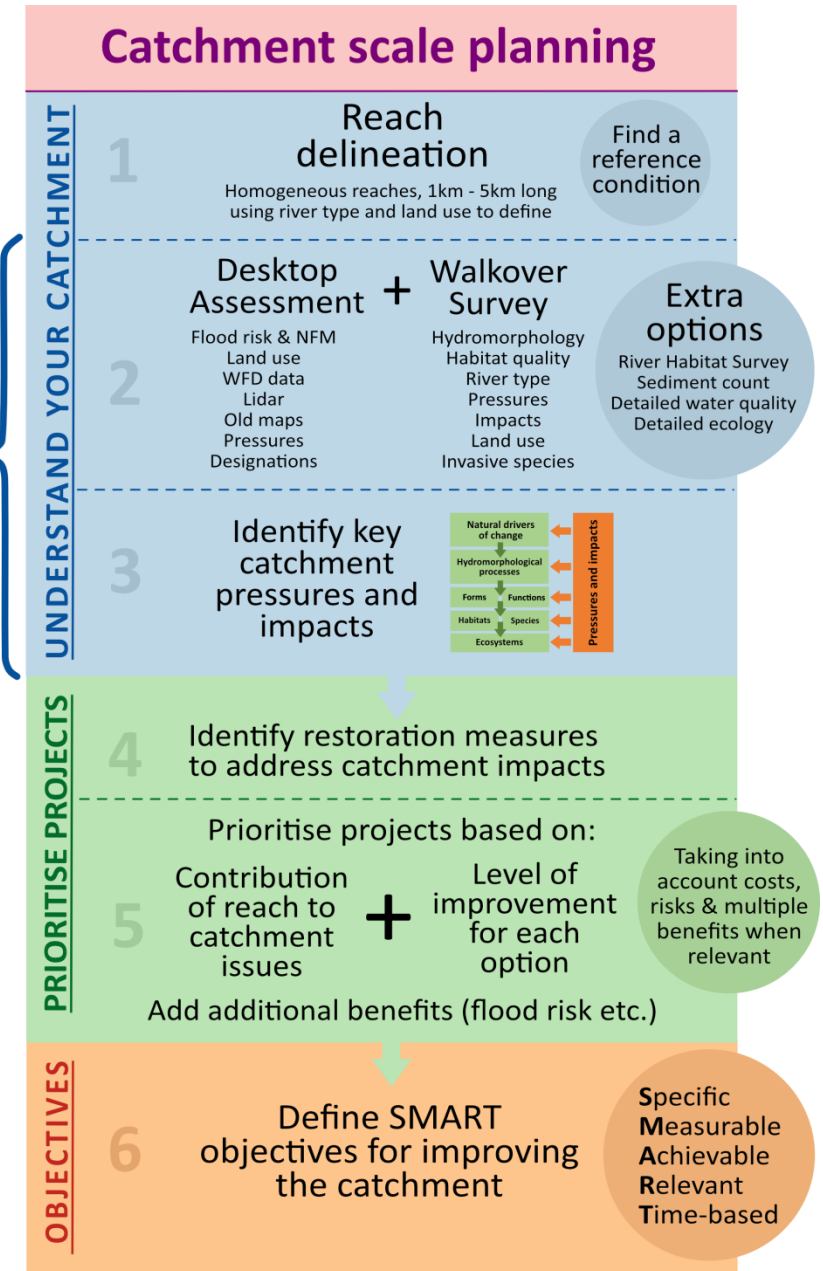
Pressures and impacts
(e.g. engineering, dredging, land use)



The steps...

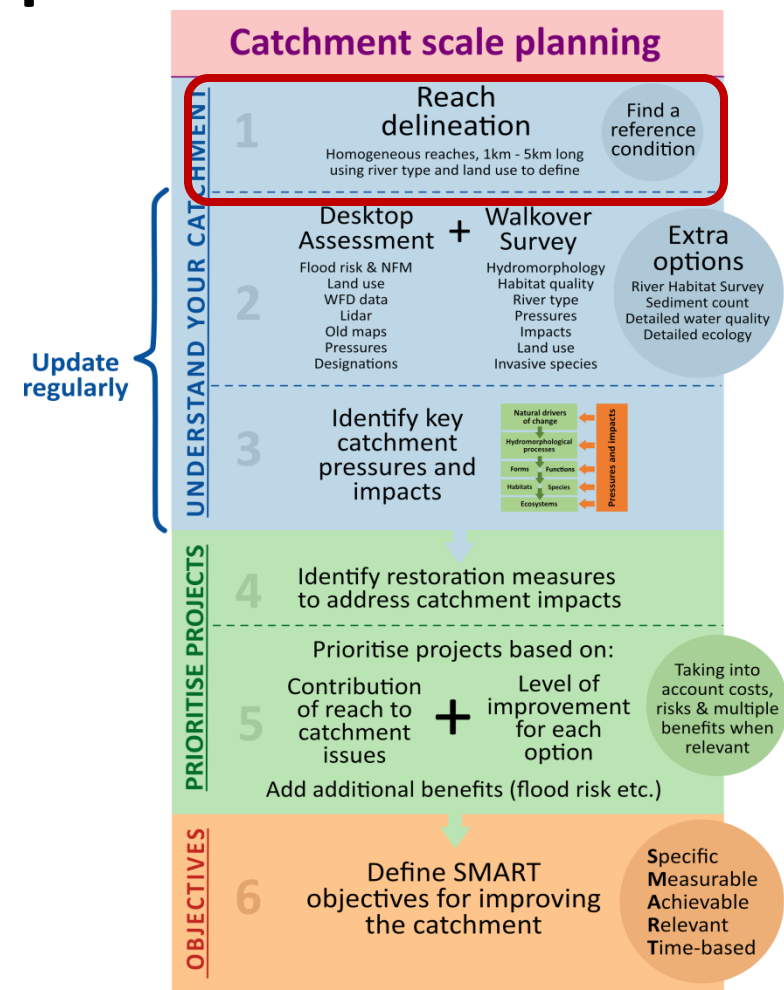
- Understand your catchment
 - Reach delineation
 - Desktop assessment & walkover
 - Identify **catchment pressures and impacts**
- Identify **reach contribution to catchment impacts**
- Identify restoration options + **influence on catchment impacts**
- **Prioritise** projects based on targets, costs, benefits
- Define **objectives**

Update regularly

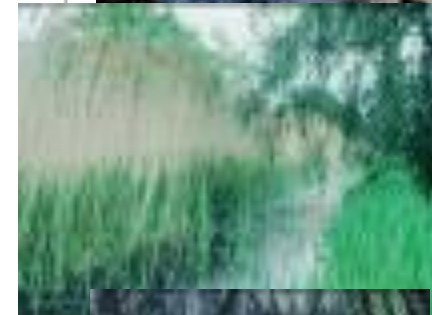
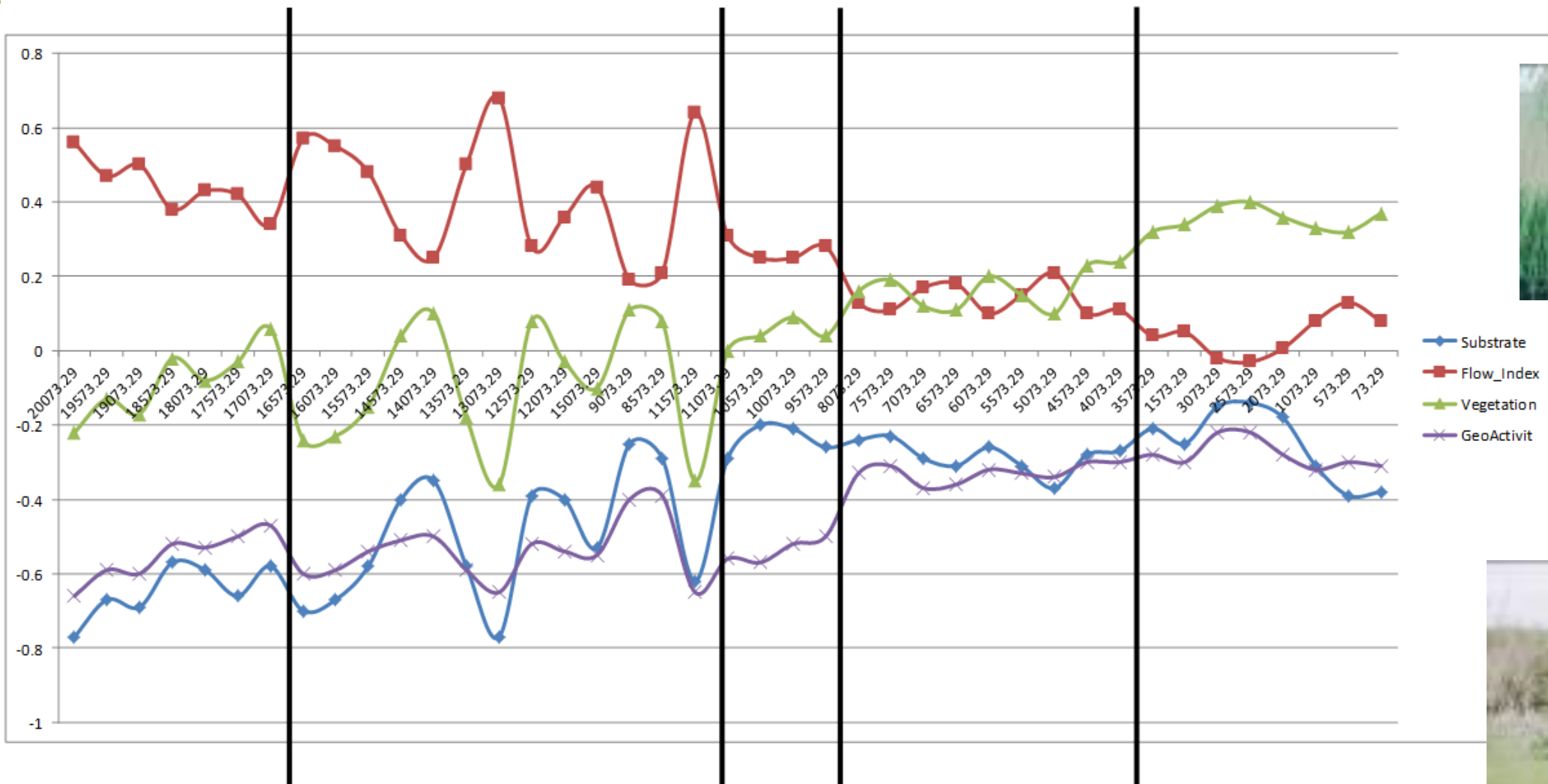


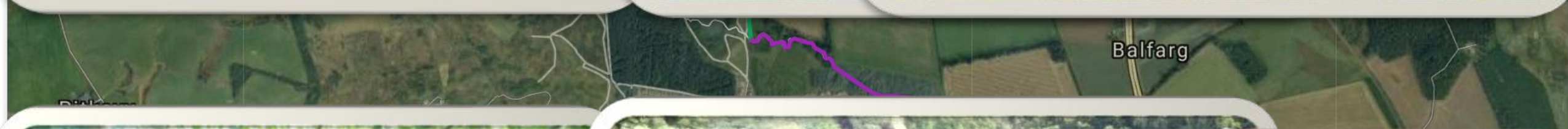
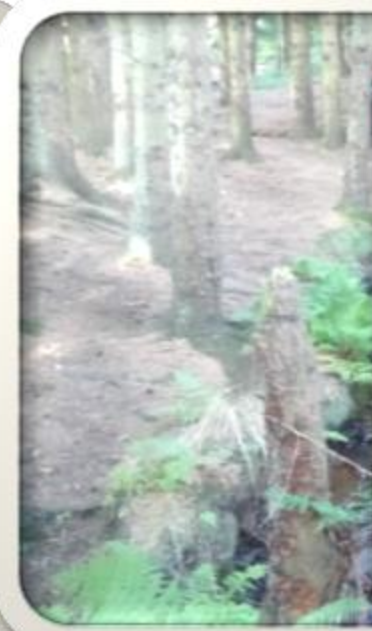
1 - Reach delineation

- Hydromorphological **homogenous** reaches
- One observed and reference condition



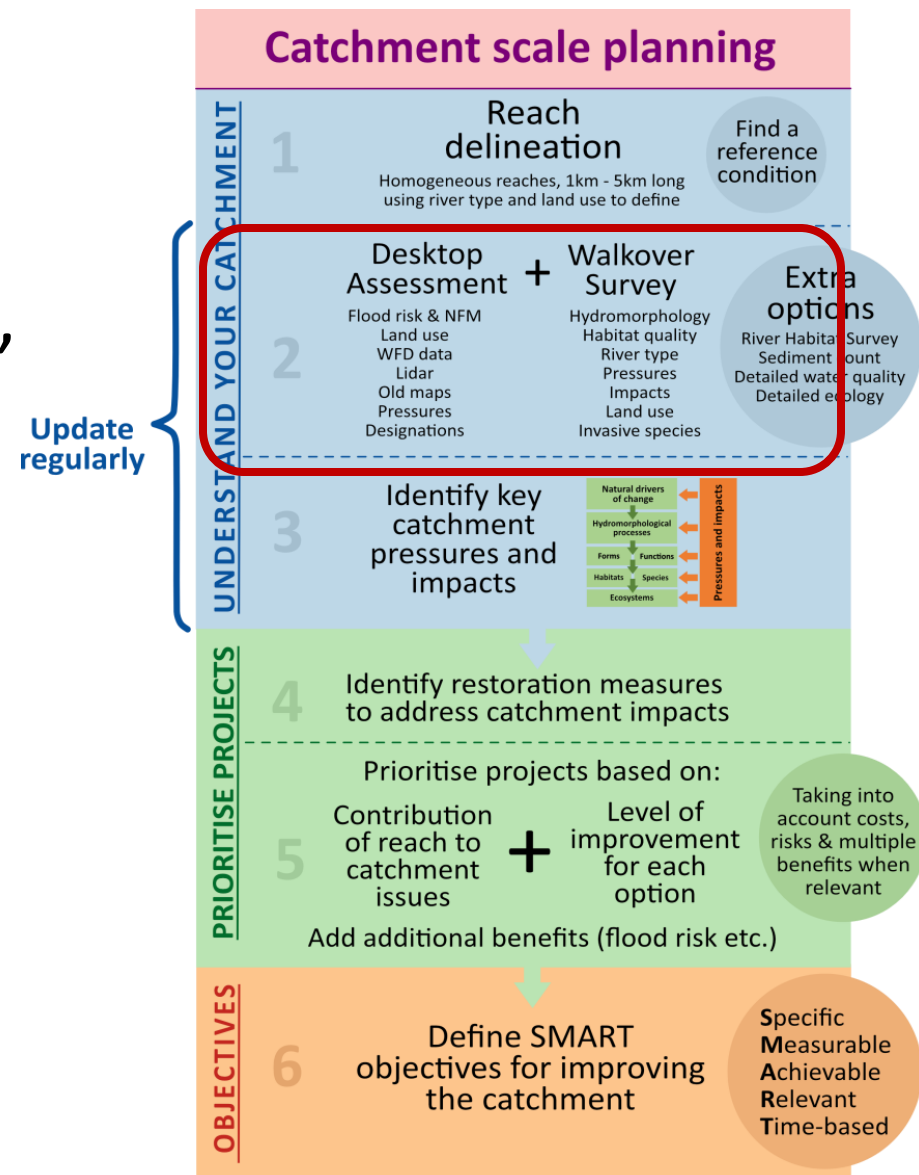
1 - Reach Delineation: Hydromorphological indices available for GB



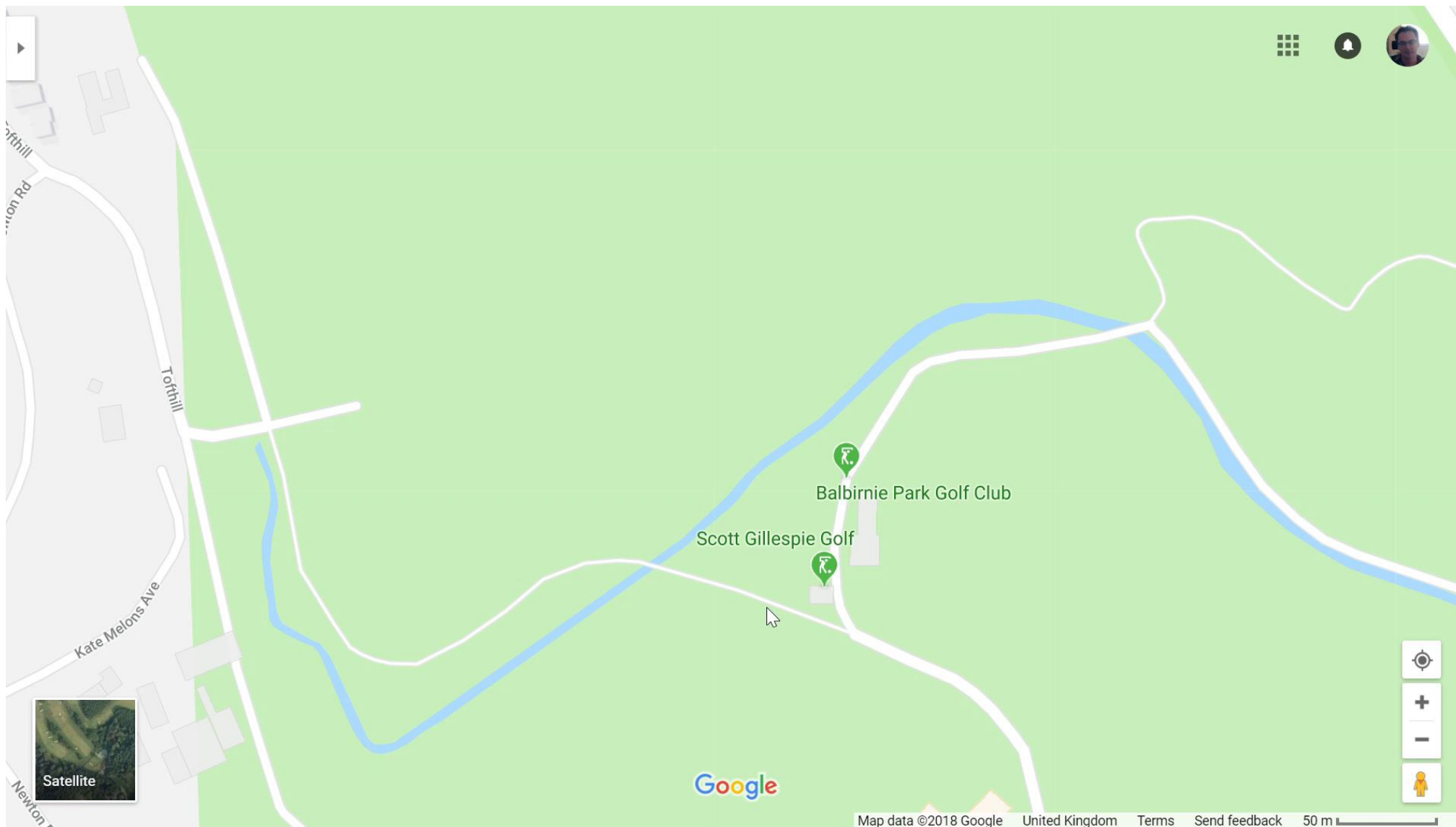


2 – Desktop assessment and walkover survey

- Overview data: RRC walkover survey, 360 photos
- Semi-quantitative data: RHS, RHAT, MIMAS, Mesohabitat mapping...



360 photos and Streetview



River Habitat Survey

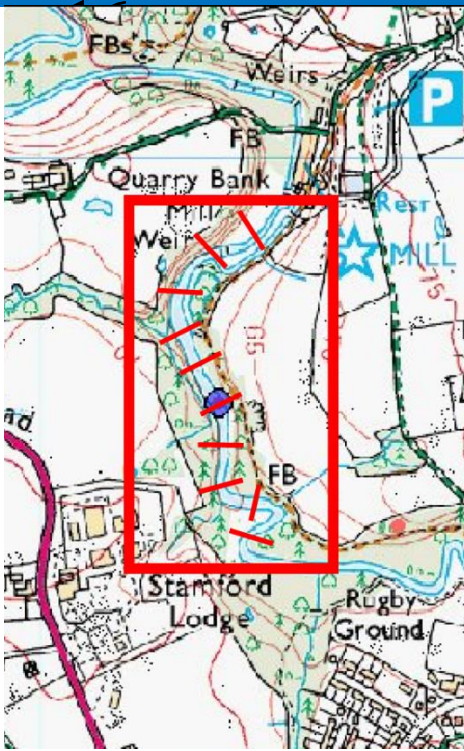
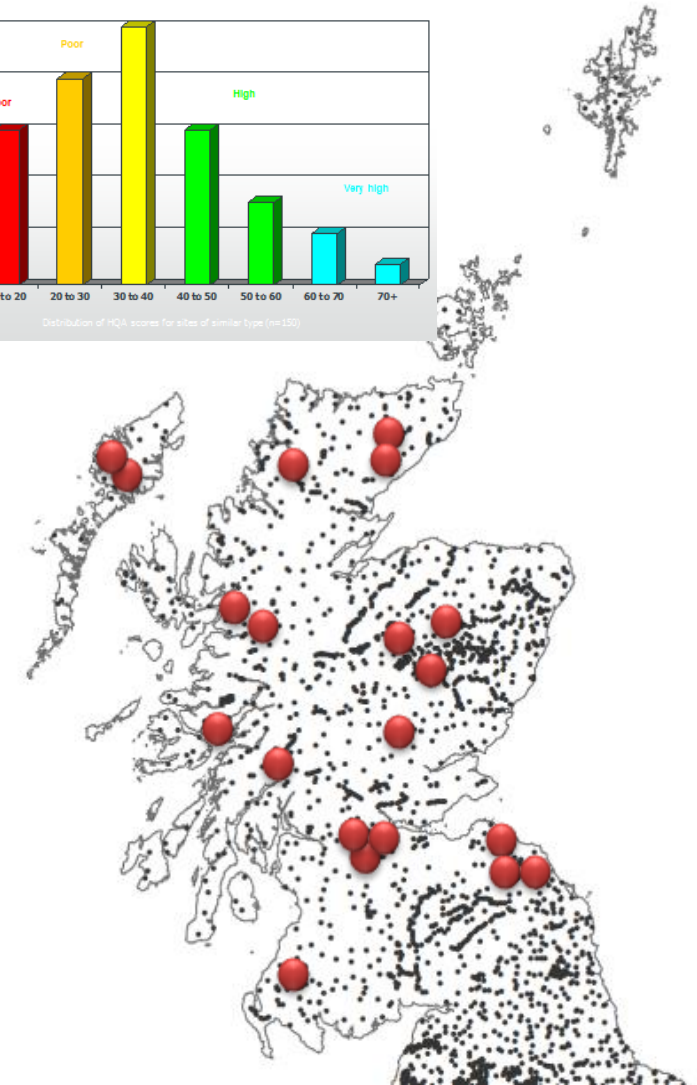
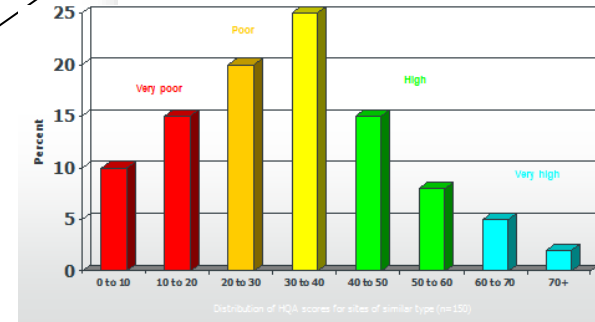
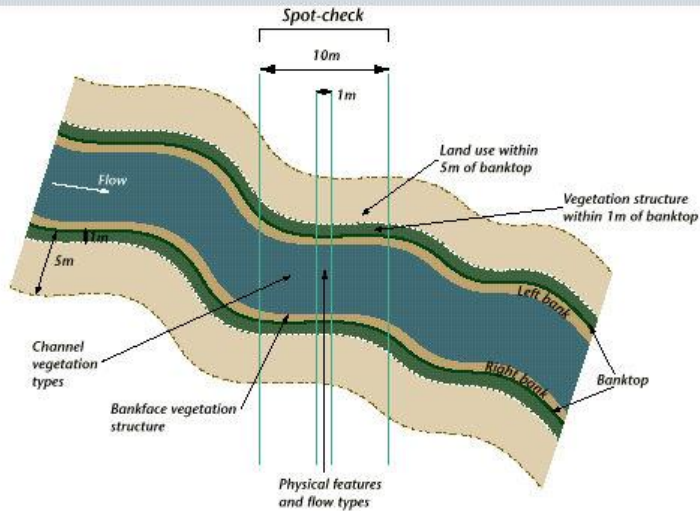


Figure 2 Features recorded at RHS spot-checks.



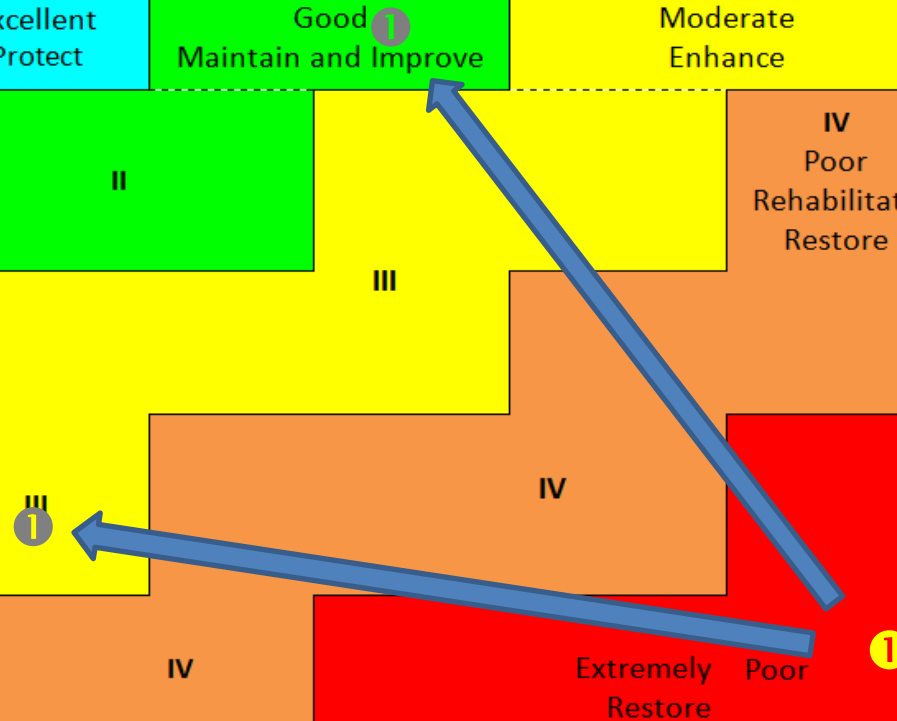


River Habitat Quality (RHQ)

Habitat Quality (diversity)

		Habitat Quality Assessment Score Categories				
		Top 20%	Top 40%	40%-60%	Bottom 40%	Bottom 20%
Habitat Modification Score Categories	Semi-natural (HMS 0-16)	I Excellent Protect	II Good Maintain and Improve		III Moderate Enhance	
	Predominantly unmodified (HMS 17-199)	II		III		IV Poor Rehabilitate Restore
	Obviously modified (HMS 200-499)	III		IV		
	Significantly modified (HMS 500-1399)	III	IV			
	Severely modified (HMS 1400+)	IV		Extremely Poor Restore		

Engineering structures





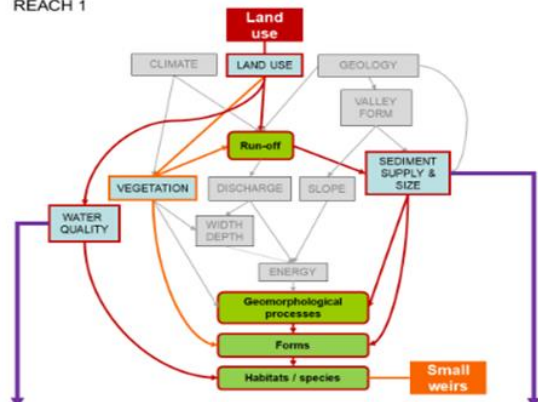
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	Obviously modified (HMS 200-499)	1		III		IV
	Significantly modified (HMS 500-1399)	III		IV		IV
	Severely modified (HMS 1400+)	IV		3	V Extremely Restore	Poor 2 4 5 6 7

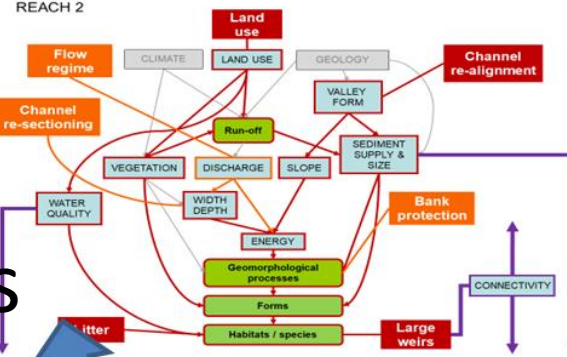
3 - Pressures and impacts

RESTORA-

REACH 1



REACH 2



REACH 3

Catchment scale planning

1 Reach delineation

Homogeneous reaches, 1km - 5km long using river type and land use to define

Find a reference condition

2 Desktop Assessment + Walkover Survey

Flood risk & NFM
Land use
WFD data
Lidar
Old maps
Pressures
Designations

Hydromorphology
Habitat quality
River type
Pressures
Impacts
Land use
Invasive species

Extra options

River Habitat Survey
Sediment count
Detailed water quality
Detailed ecology

3 Identify key catchment pressures and impacts



4 Identify restoration measures to address catchment impacts

Prioritise projects based on:

Contribution of reach to catchment issues

Level of improvement for each option

Taking into account costs, risks & multiple benefits when relevant

Add additional benefits (flood risk etc.)

6 Define SMART objectives for improving the catchment

Specific
Measurable
Achievable
Relevant
Time-based

Issues

Pressures

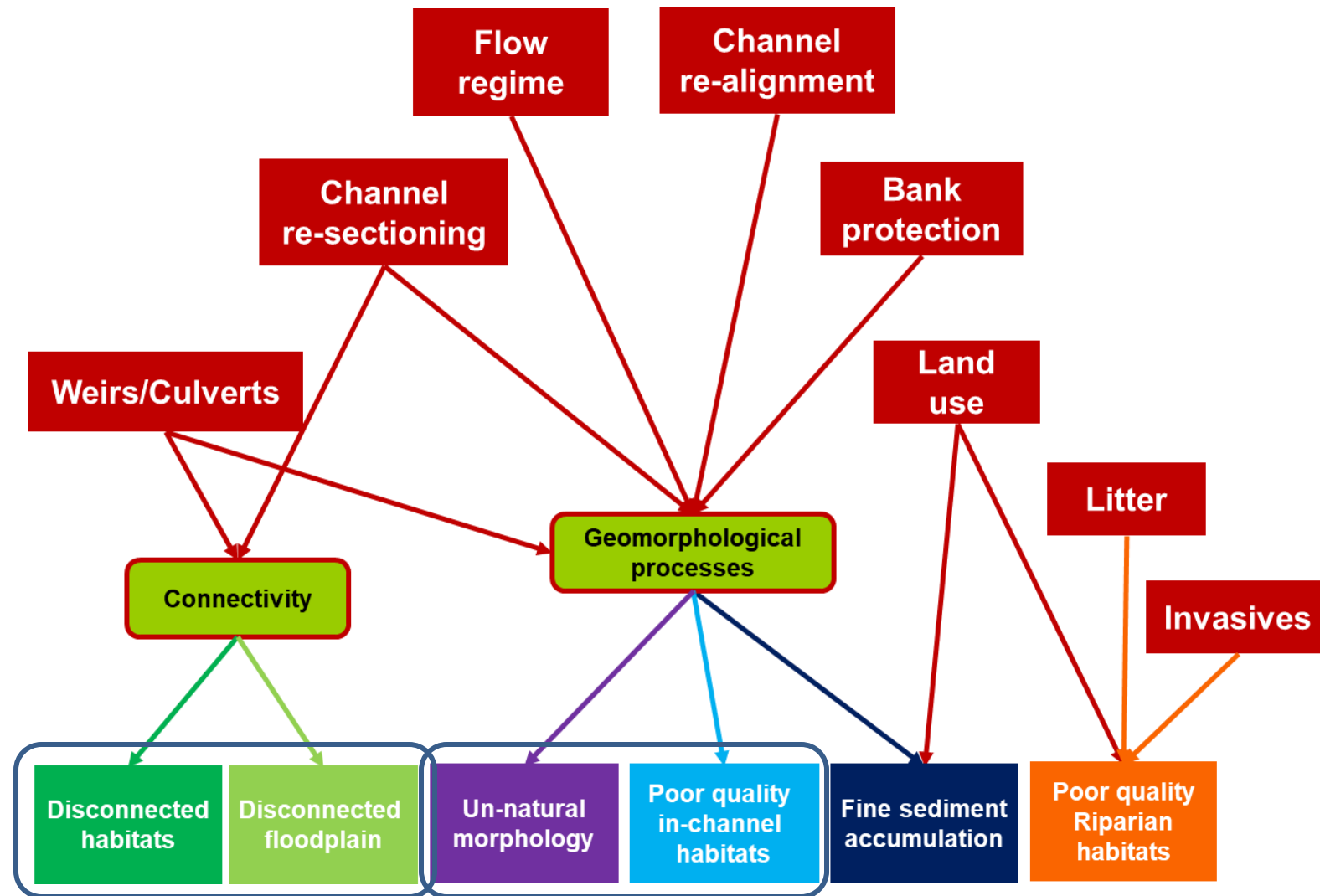
Impacts

Land use
Barriers
Channel modifications
Flood risk management
Fine sediment input
Poor channel habitat
Disconnected habitat
Poor riparian habitat
Un-natural morphology
Poor floodplain habitats

Update regularly



3 - Pressures and impacts



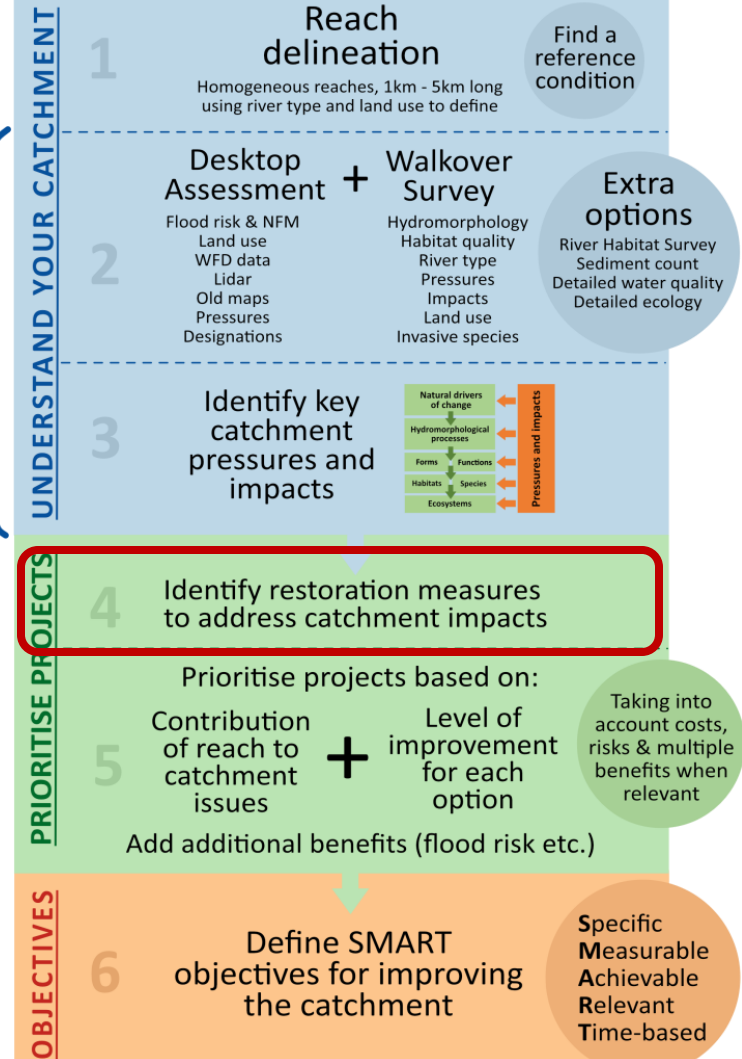


4 – Option identification

Reach contribution to catchment				
	Un-natural morphology	Poor quality in-channel habitats	Fine sediment accumulation	Discouraged
Reach 1	0	0	3	
Reach 2	3	3	3	
Reach 3	2	2	0	
Reach 4	3	3	3	
Reach 5	3	2	2	
Reach 6	2	2	0	
Reach 7	3	3	3	

Update regularly

Catchment scale planning





4 – Option identification

Land use management

Option description	Poor channel habitat quality	Fine sediment accumulation	Poor riparian habitats	Risk	Cost
Increase buffer size	1	2	3	L	££
Land management practice	1	2	0	L	£
Sediment Bund / filter barrier	1	2	0	L	£



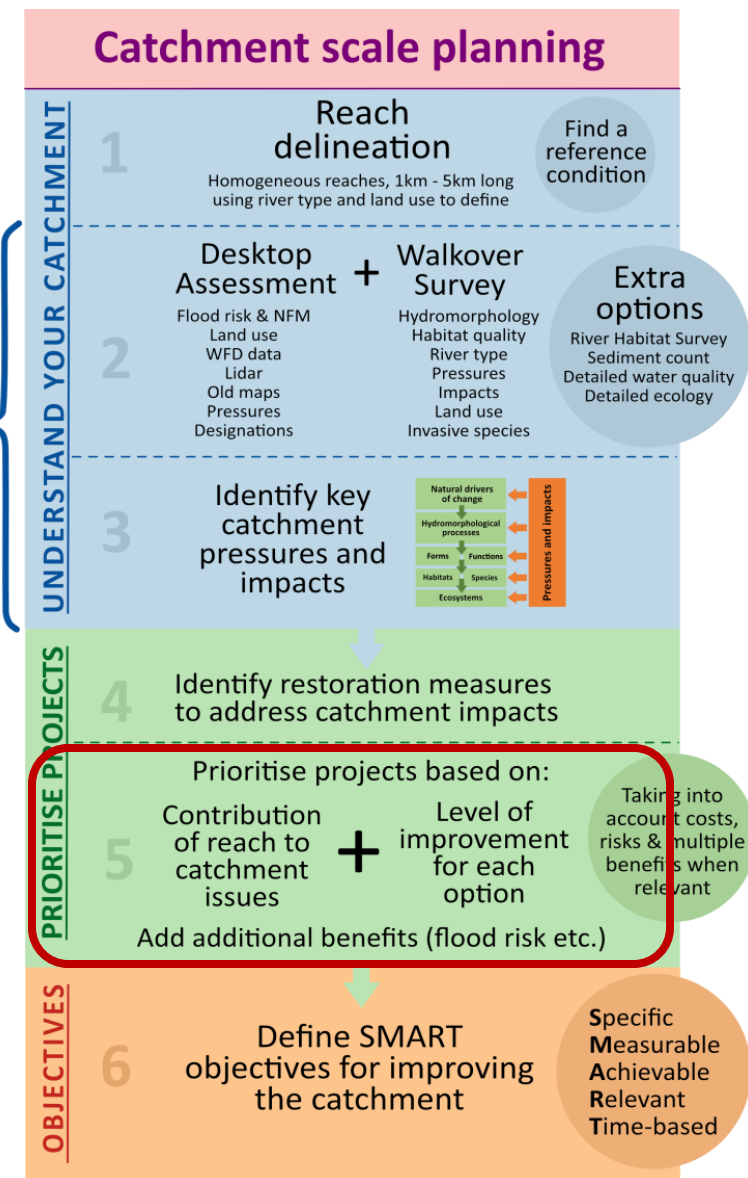
Small weirs

Option description	Poor channel habitat quality	Disconnected habitats	Risk	Cost
Remove weirs	1	1	L	£

5 - Prioritisation

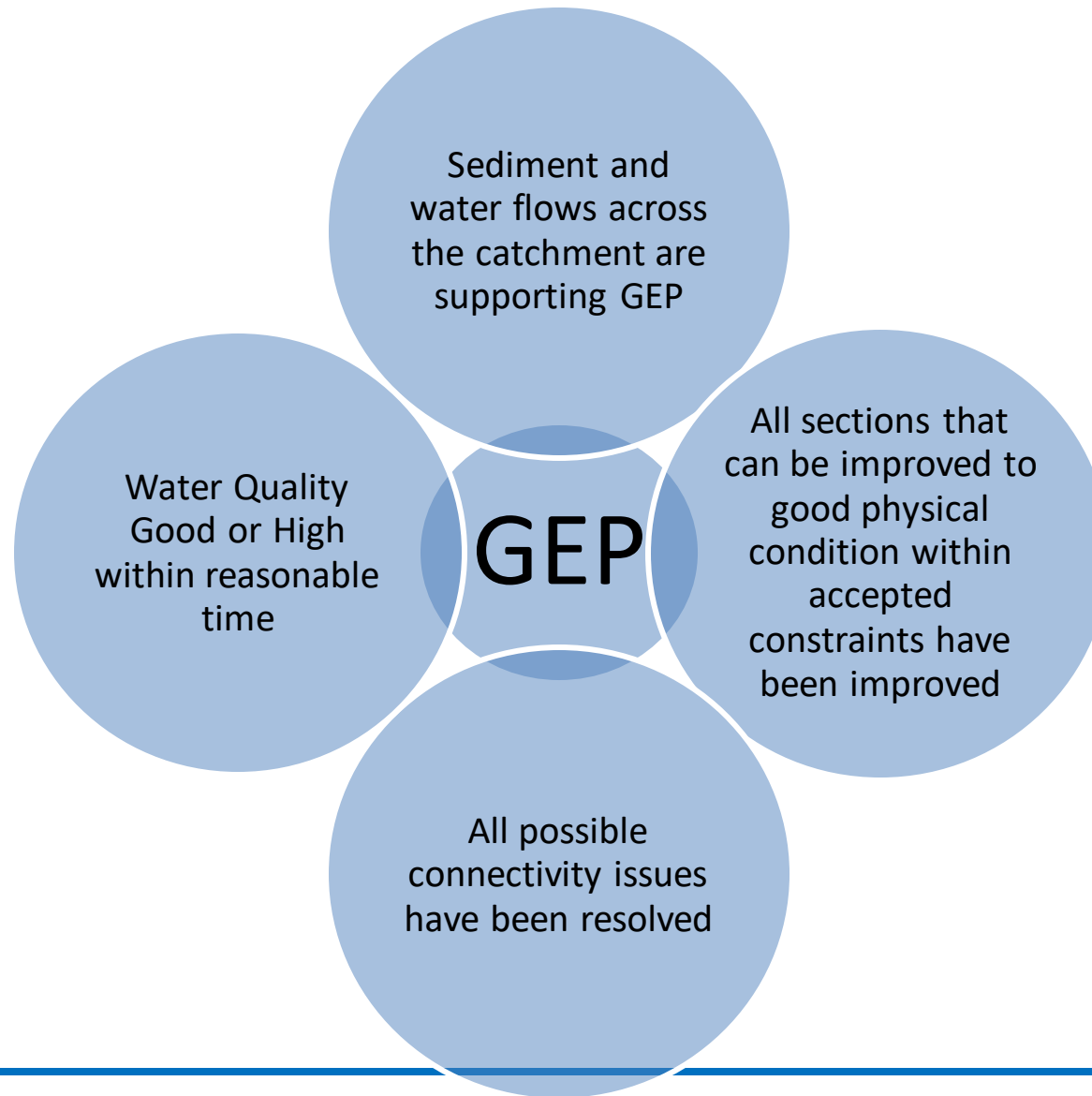
Details					
Reach	Reach pressure	Option	Disconnected habitats	Un-natural morphology and planform	Ph
1	Land use fine sediment pressure	Increase buffer size	0	0	
		Land management practice	0	0	
		Sediment bund	0	0	
	Small weirs	Remove weirs	1	1	
2	Channel re-alignment	Re-connect old channel with step-pool out	2	3	
		Partially re-connect old channel	0	2	
	Weir upstream of Coul Den	Remove weir	1	2	
		Retrofit baffles	1	0	
	Weir in re-aligned channel	Remove weir	1	0	
	Weirs in conifer plantation	Remove weirs	0	1	
	Land use - Conifer plantation	Remove conifers in the riparian zone	0	0	
		Improve conifer land management	0	0	
	Land use fine sediment pressure	Increase buffer size	0	0	
		Land management interventions	0	0	
		Sediment bund	0	0	
	Litter	Litter and barbed wire removal	0	0	

Update regularly





6 Objectives and targets at catchment and reach scale





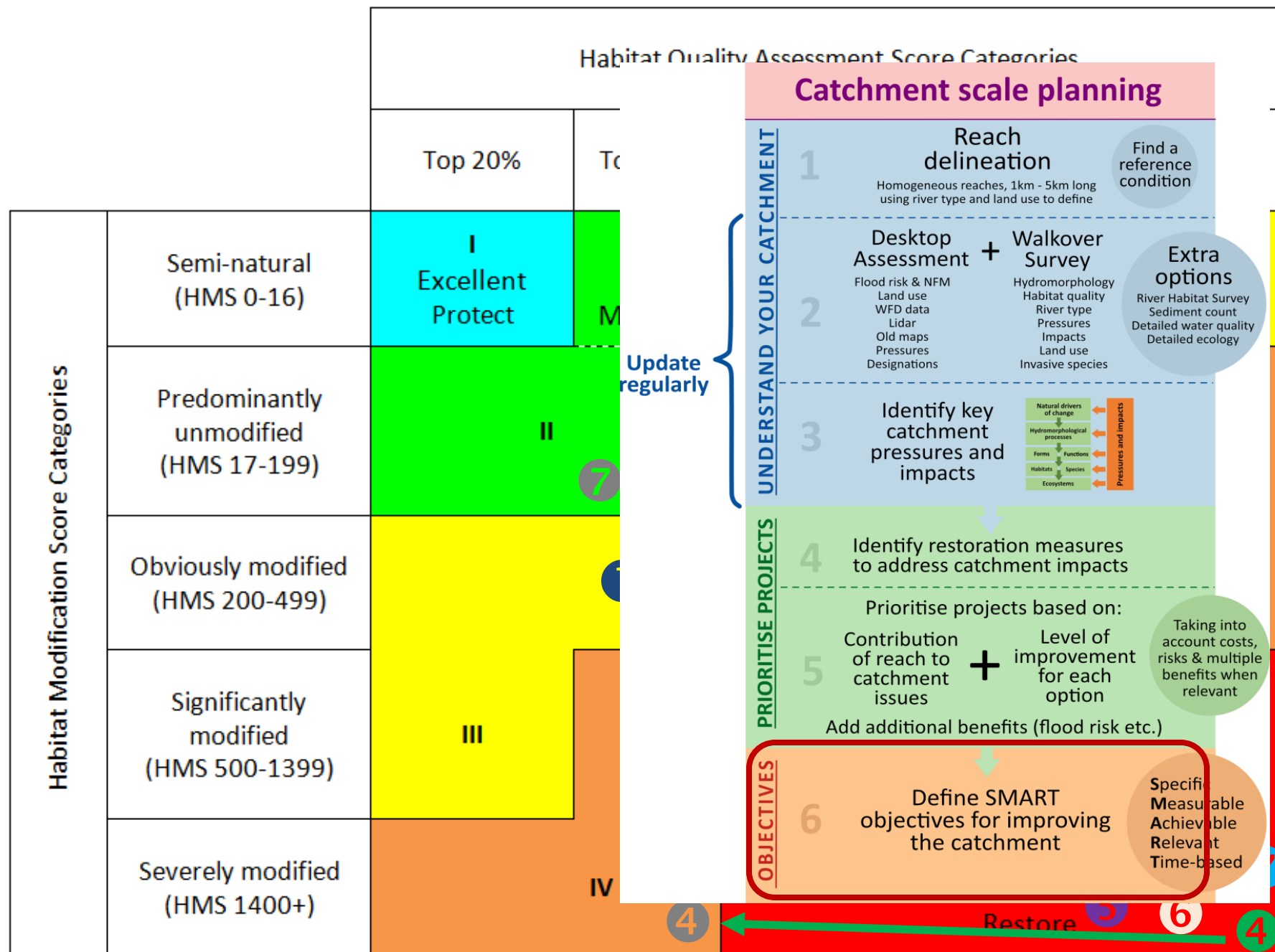
Defining GEP

Reach	Reinforced Bank bed	Resectioned bank bed	Realignment	Weirs dams and sluices	Bridges	Poaching
2	120	2480	400	300	250	10

		Habitat Quality Assessment Score Categories				
		Top 20%	Top 40%	40%-60%	Bottom 40%	Bottom 20%
Habitat Modification Score Categories	Semi-natural (HMS 0-16)	I Excellent Protect	II Good Maintain and Improve	III Moderate Enhance		
	Predominantly unmodified (HMS 17-199)	GEP and HEP zone for physical condition for site 1		III		IV Poor Rehabilitate Restore
	Obviously modified (HMS 200-499)	III		IV		
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6

Objectives and targets at catchment and reach scale

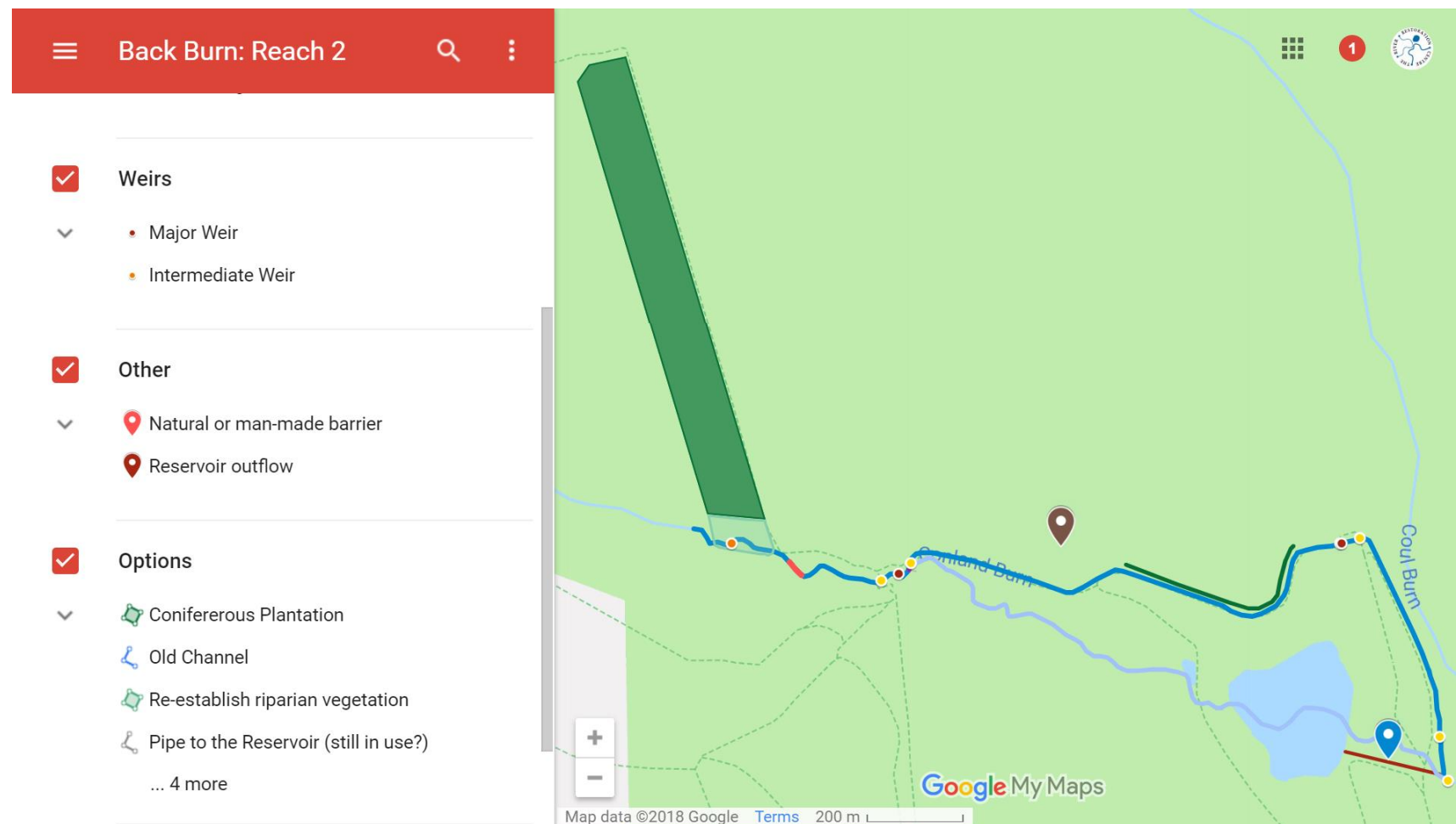


6 Objectives and targets

	River Restoration Proposal Details (RRC)						SUMMARY OF PROPOSALS	
Details			Failing GEP criteria met?					
Reach	Reach pressure	Option	Connectivity	Physical quality	Water quality	Sediment and water flow	TOTAL COST (River Restoration and Biodiversity Improvements)	
1	Land use fine sediment pressure	Increase buffer size	-	No	-	Entirely	£	7,000
		Land management practice	-	No	-	Partially	£	5,000
		Sediment bund	-	No	-	Partially	£	5,000
	Small weirs	Remove weirs	-	Entirely	-	No	£	1,000
2	Channel re-alignment	Re-connect old channel with step-pool outflow	Partially	Entirely	-	No	£	203,000
		Partially re-connect old channel	Partially	Partially	-	No	£	33,000
	Weir upstream of Coul Den	Remove weir	Partially	No	-	No	£	40,000
		Retrofit baffles	Partially	No	-	No	£	15,000
	Weir in re-aligned channel	Remove weir	Partially	No	-	No	£	40,000
	Weirs in conifer plantation	Remove weirs	Partially	Partially	-	No	£	1,000
	Land use - Conifer plantation	Remove conifers in the riparian zone	No	No	-	Partially	£	11,500
		Investigate conifer land management	No	No	-	Partially	£	2,000
	Land use fine sediment pressure	Increase buffer size	No	No	-	Entirely	£	1,000
		Land management interventions	No	No	-	Partially	£	5,000
		Sediment bund	No	No	-	Partially	£	5,000
	Litter	Litter and barbed wire removal	No	Entirely	-	No	£	2,000



Communicating outputs using google maps



Report less

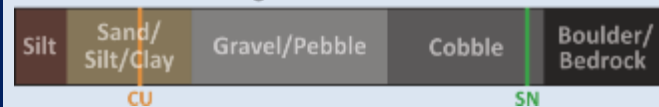
River Name: Conland Burn

Length: 1.05km

Dimensions: W = 3.50m D = 1.20m

Specific Stream Power: 72 w/m²

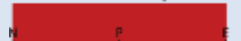
Average channel substrate



5m Land use pressure



50m Land use pressure



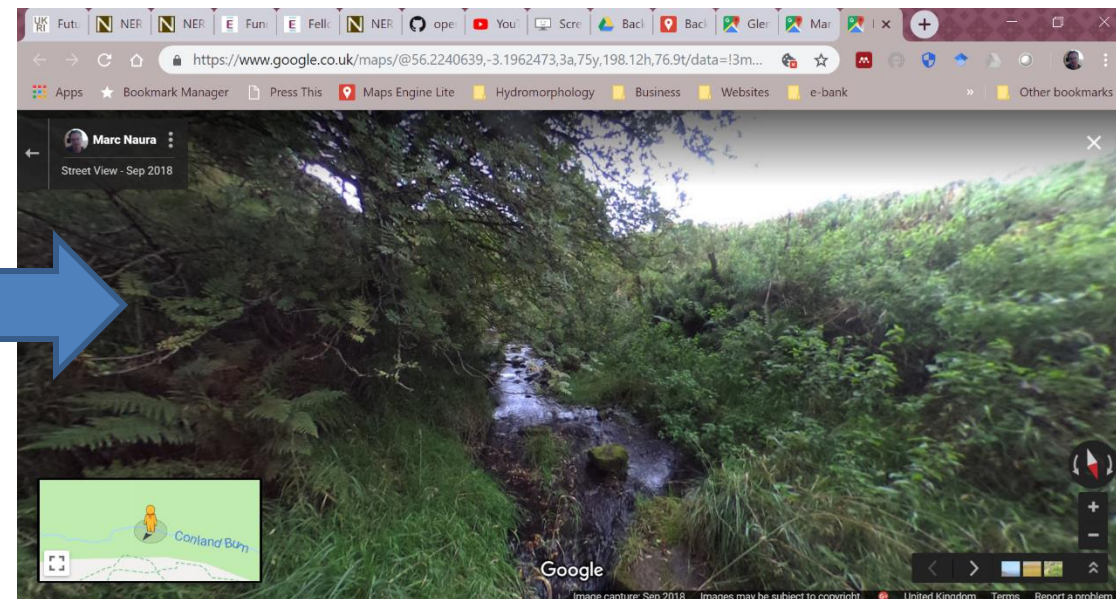
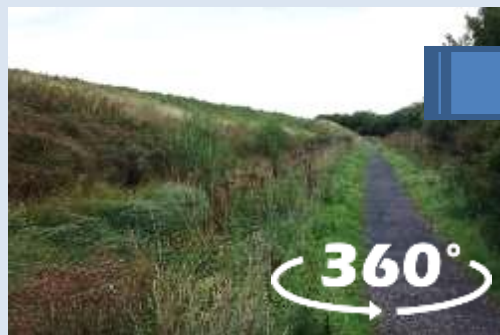
Connectivity pressure



Channel modifications



Artificial bank profiles



Summary

- **Structured process** for delivering catchment-centered river restoration
- Use of **simple data and methods**
- Use of **Google map and street view** (360 photos)
- **Flexible** and can involve non-specialists

Lessons learnt:

- Involve stakeholders from the beginning
- Share tasks amongst groups to reduce costs

