An Introduction to Natural Flood Management and River Restoration

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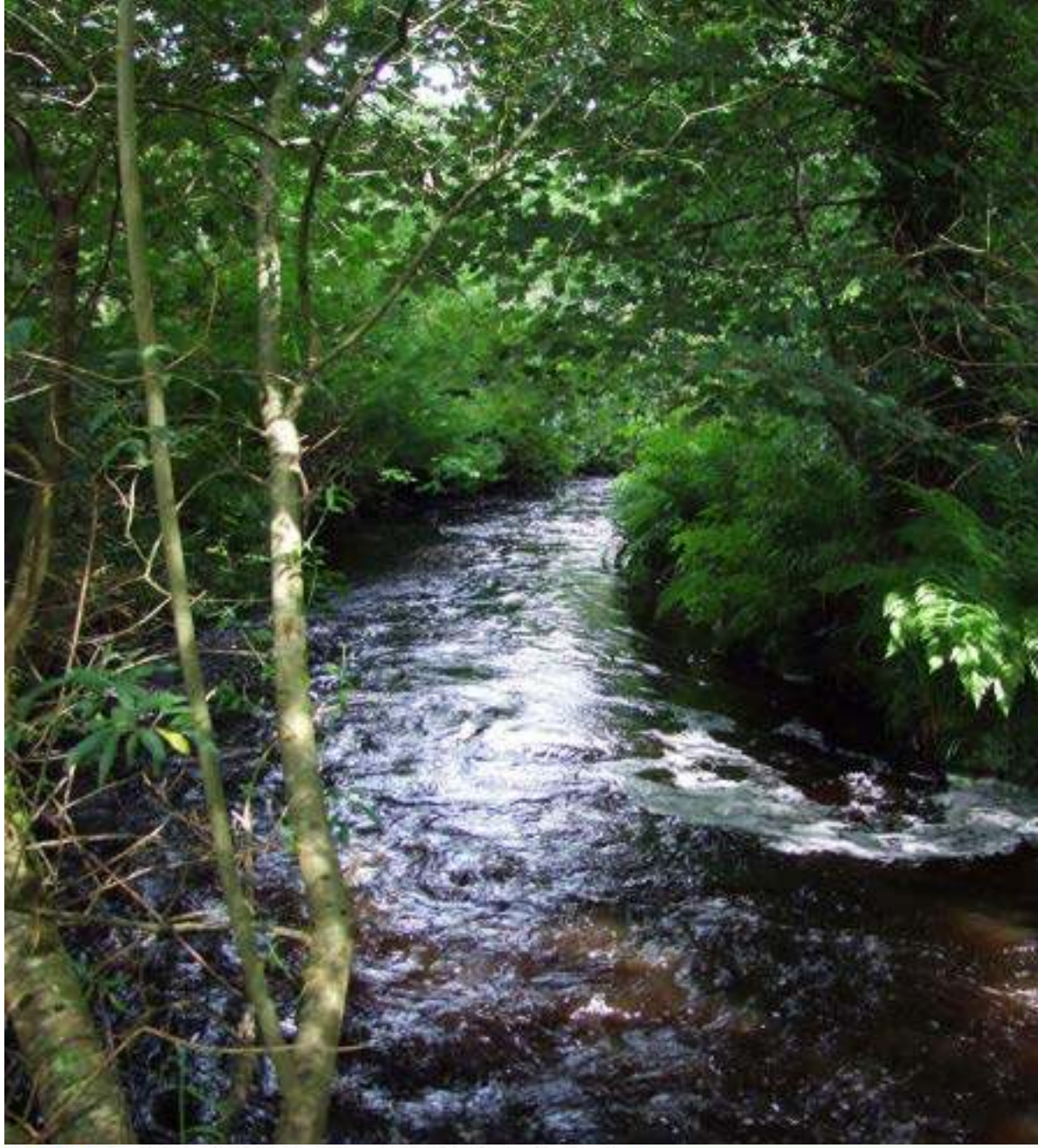
Overview

- **Hydrology**
- **Hydromorphology**
- **Natural Flood Management**
- **River Restoration**
- **Costs**
- **Ecology**
- **Discussion**



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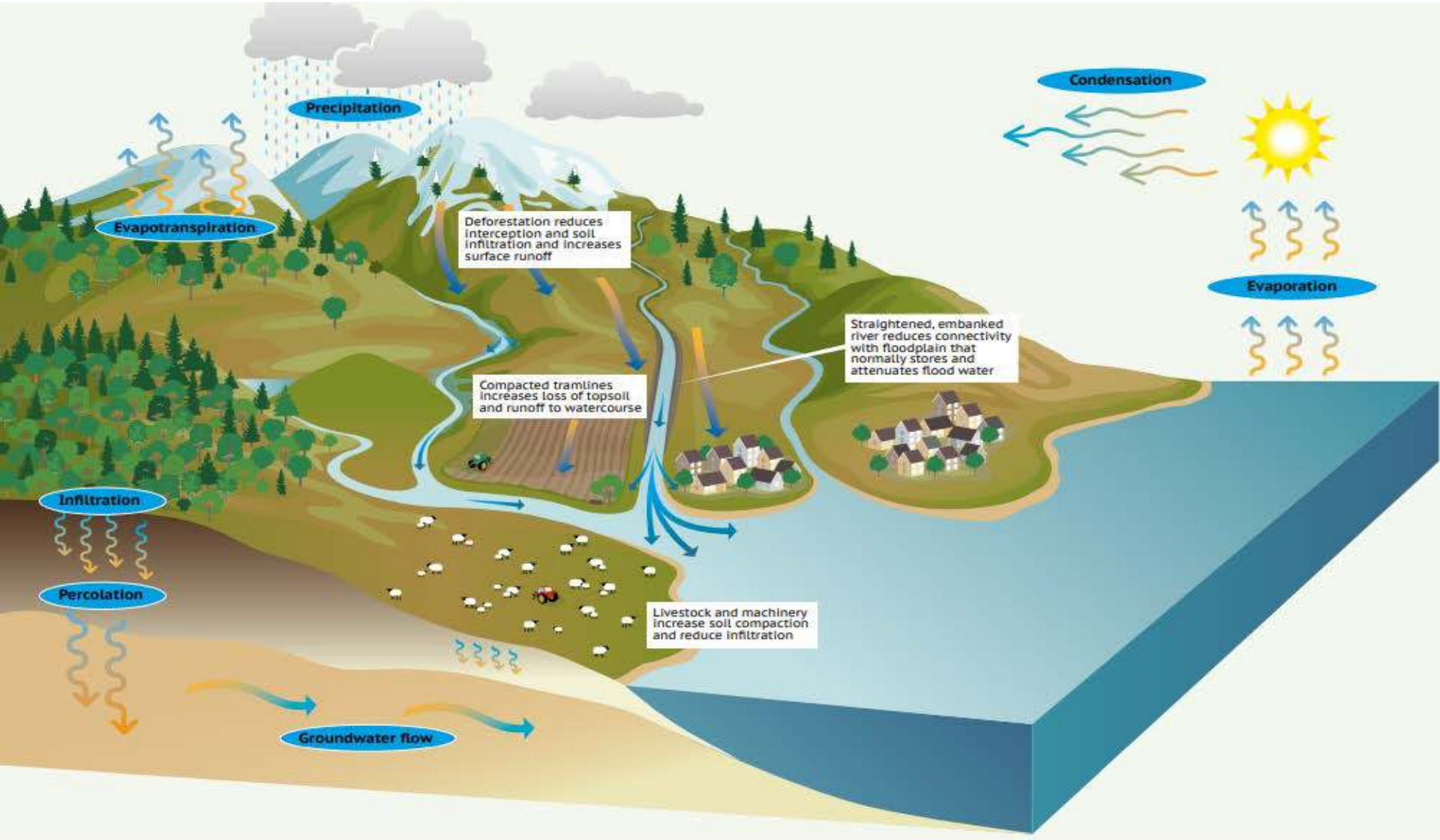
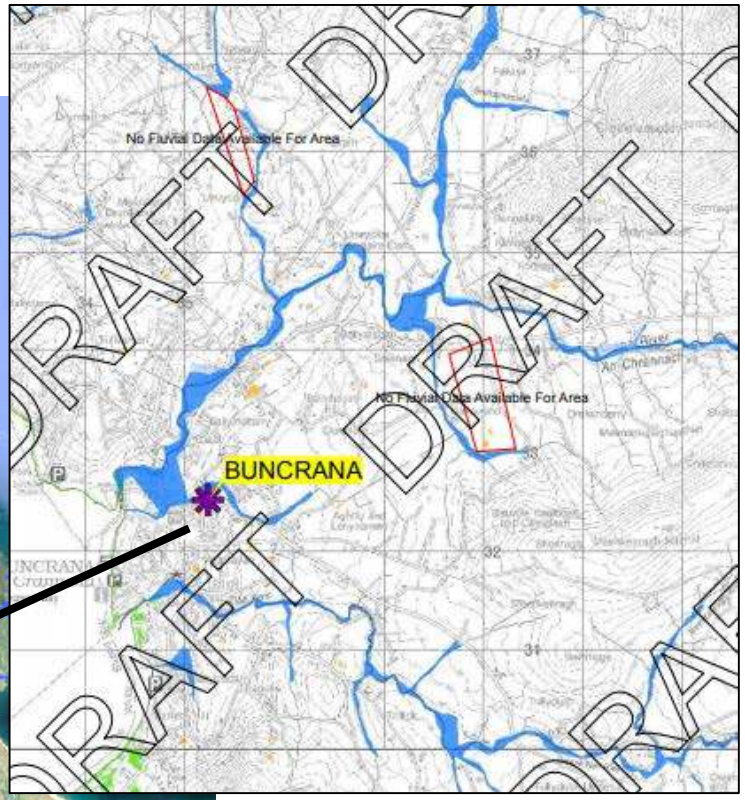
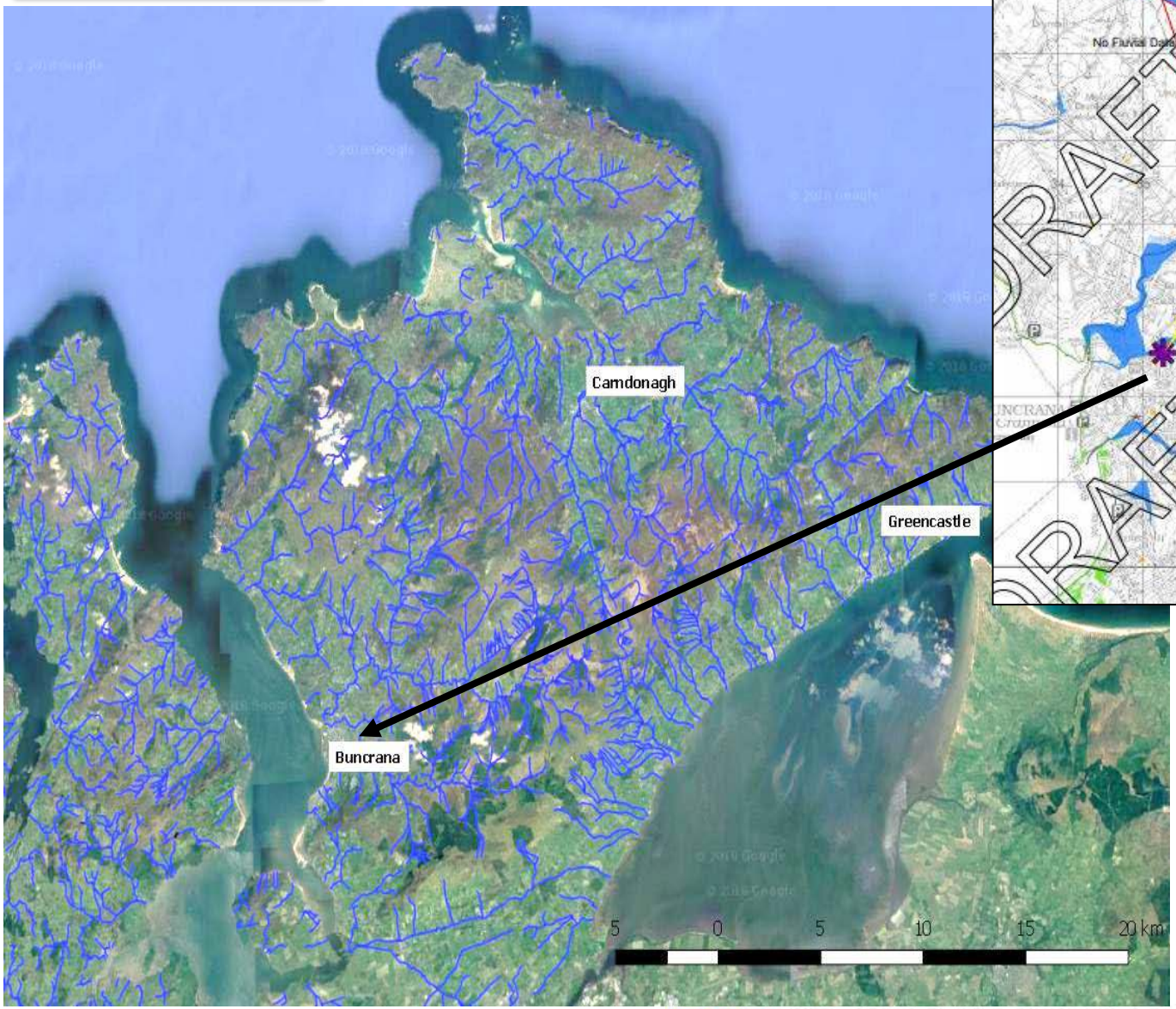
Hydrological cycle



Hydrology





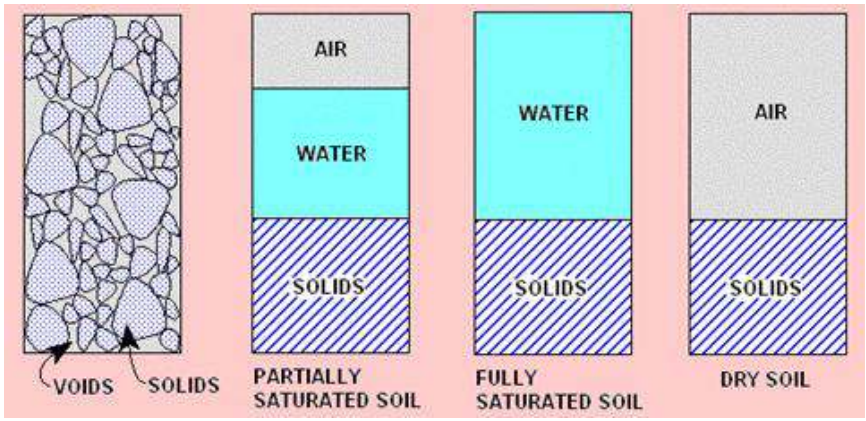
Fluvial - Indicative 1% AEP (100-yr) Event

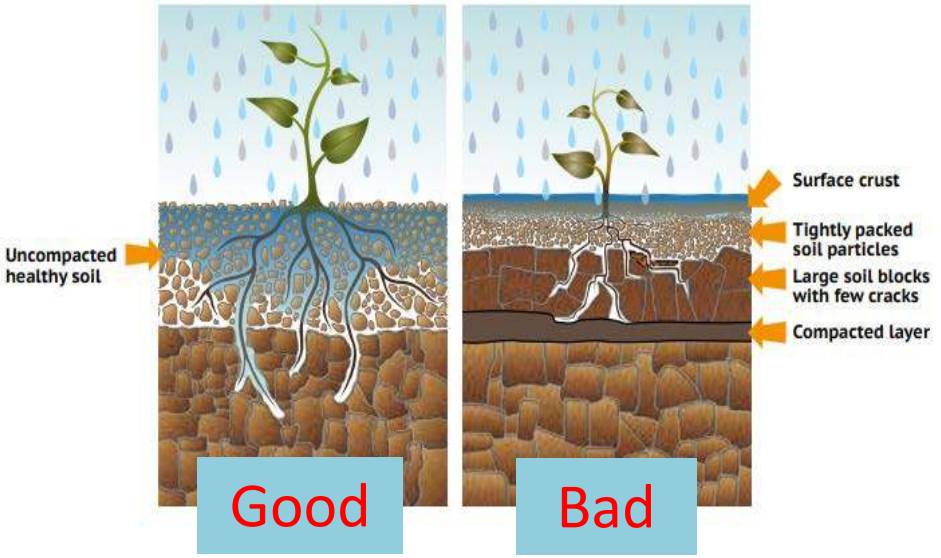
Office of Public Works
Jonathon Swift Street
Trim
Co Meath
Ireland

Hydrology - surface runoff

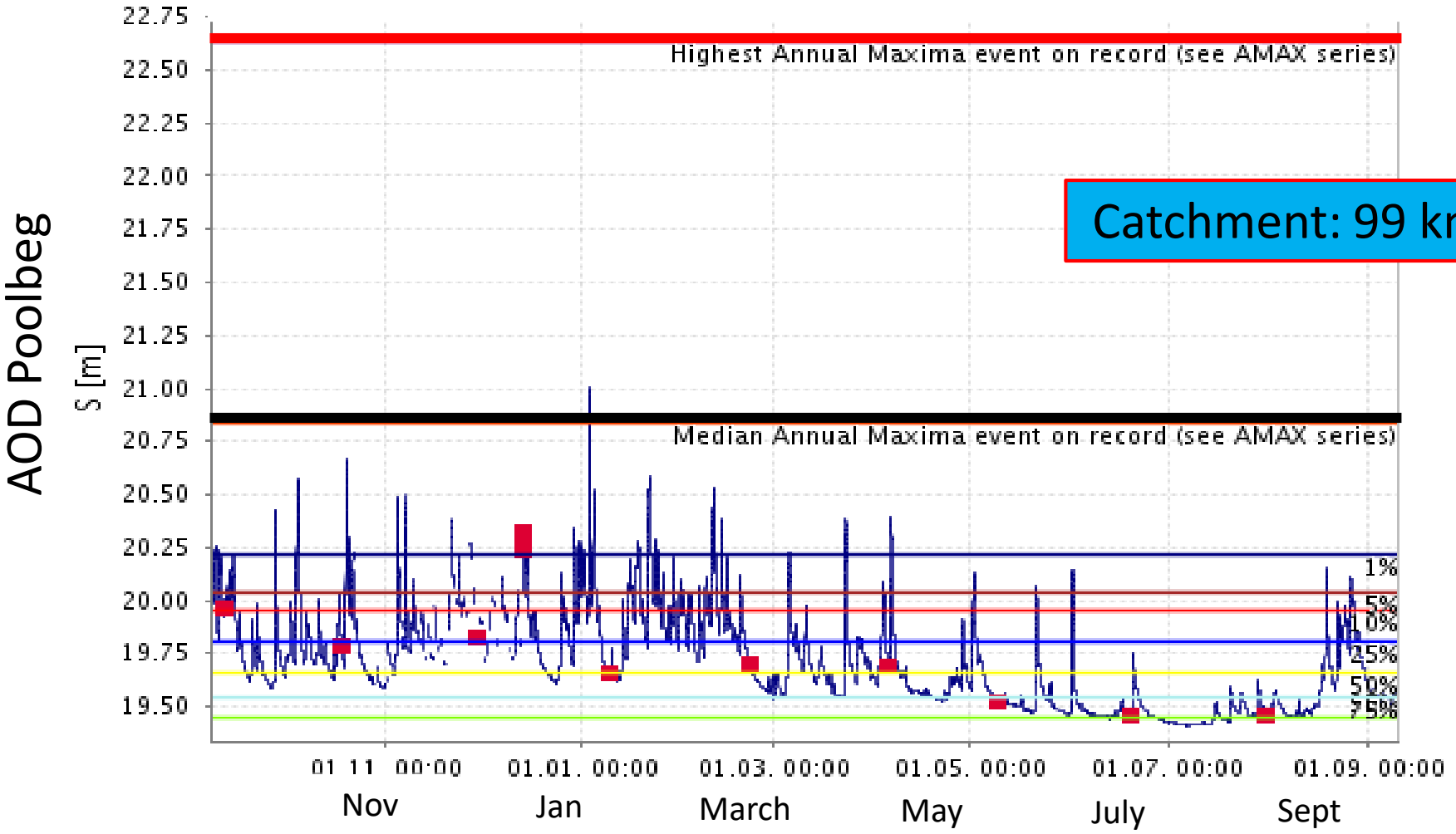
Saturation excess overland flow

Hortonian overflow





Hydrology - Tullyarvan annual water level



Catchment: 99 km^2

63 mm fell in 6 hour period (22/8/2017)

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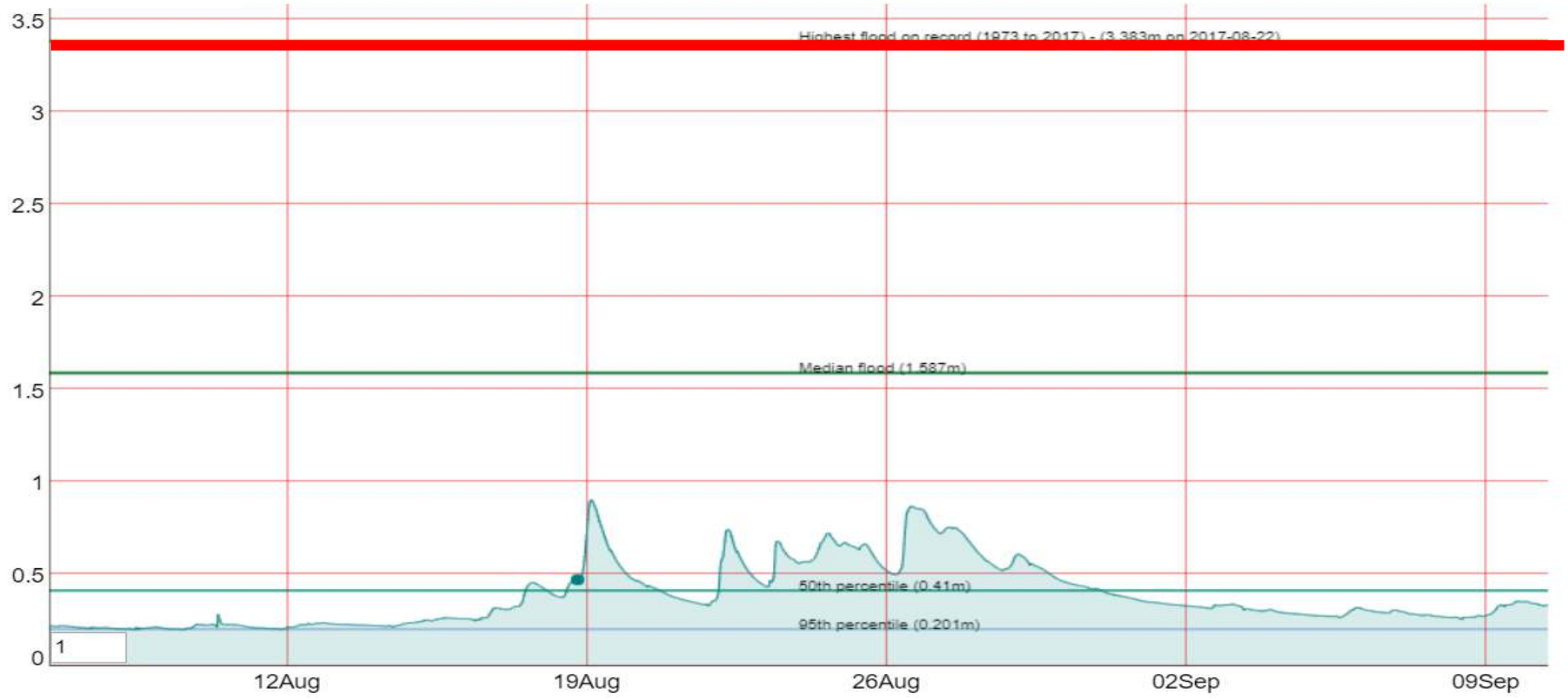
Hydrology – characterization



95%ile: 0.223m^3/s

1%ile: 21.34m^3/s

Hydro Year	S.G reading (m)
1985	2.00
1984	2.02
1981	2.24
1980	2.27
1987	2.83
2016	3.38

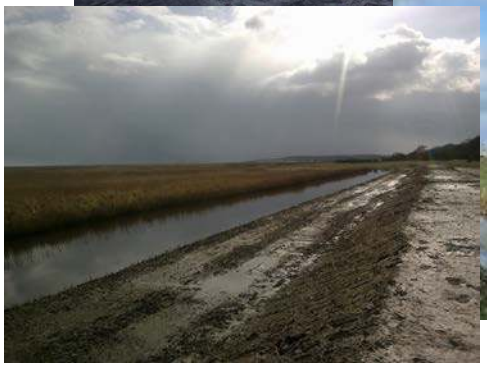
Hydromorphological modification

Inishowen rivers are flashy PRG sequences.

Significant alteration since 1800s, WW1 & WW2

UK: 1970s rate of drainage approximately 100,000 ha year^{-1}.

UK: Nearly 1 million hectares were drained between 1971 and 1980.



Hydromorphology - channelization

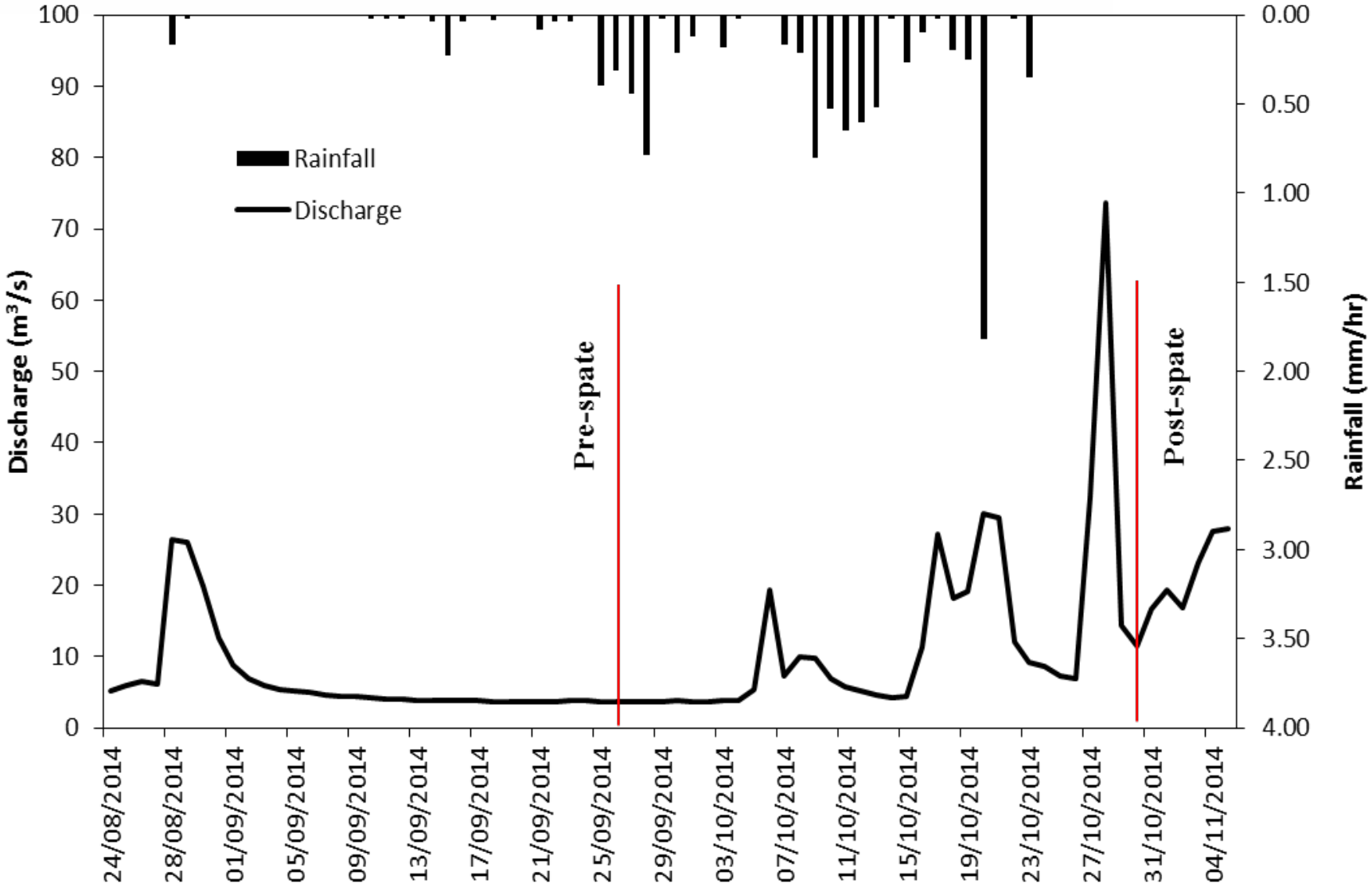
Channelization

Straightening

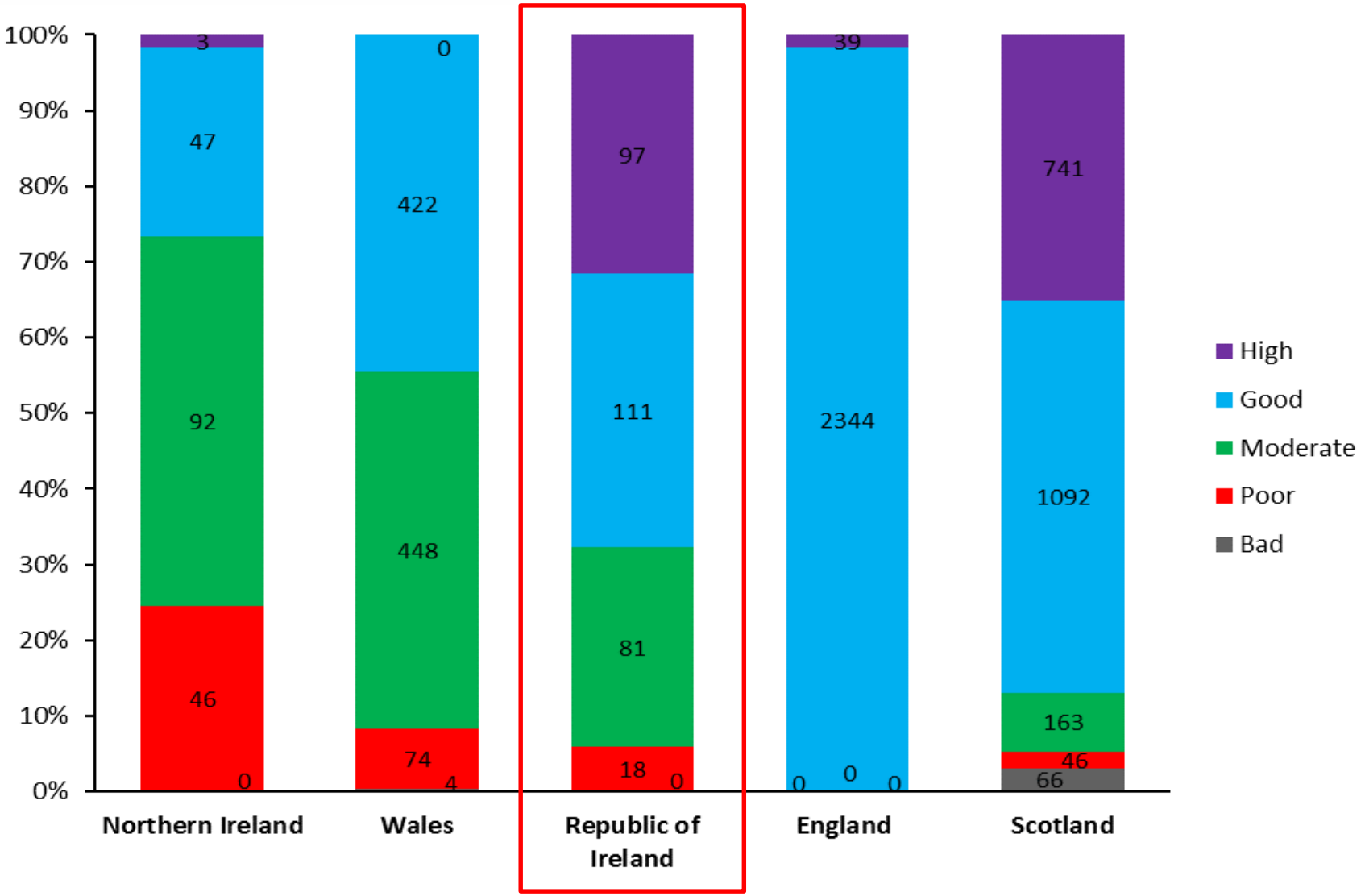
Culverts & bridges

Dredging…….?

Hydromorphological - channelized hydrology



Hydromorphology - status



Natural flood management

SuDS measures involve infiltration or storage, or a combination

Swales - Broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey or store runoff (or both), and can infiltrate the water into the ground.

Re-use - storage and re-use of surface water.

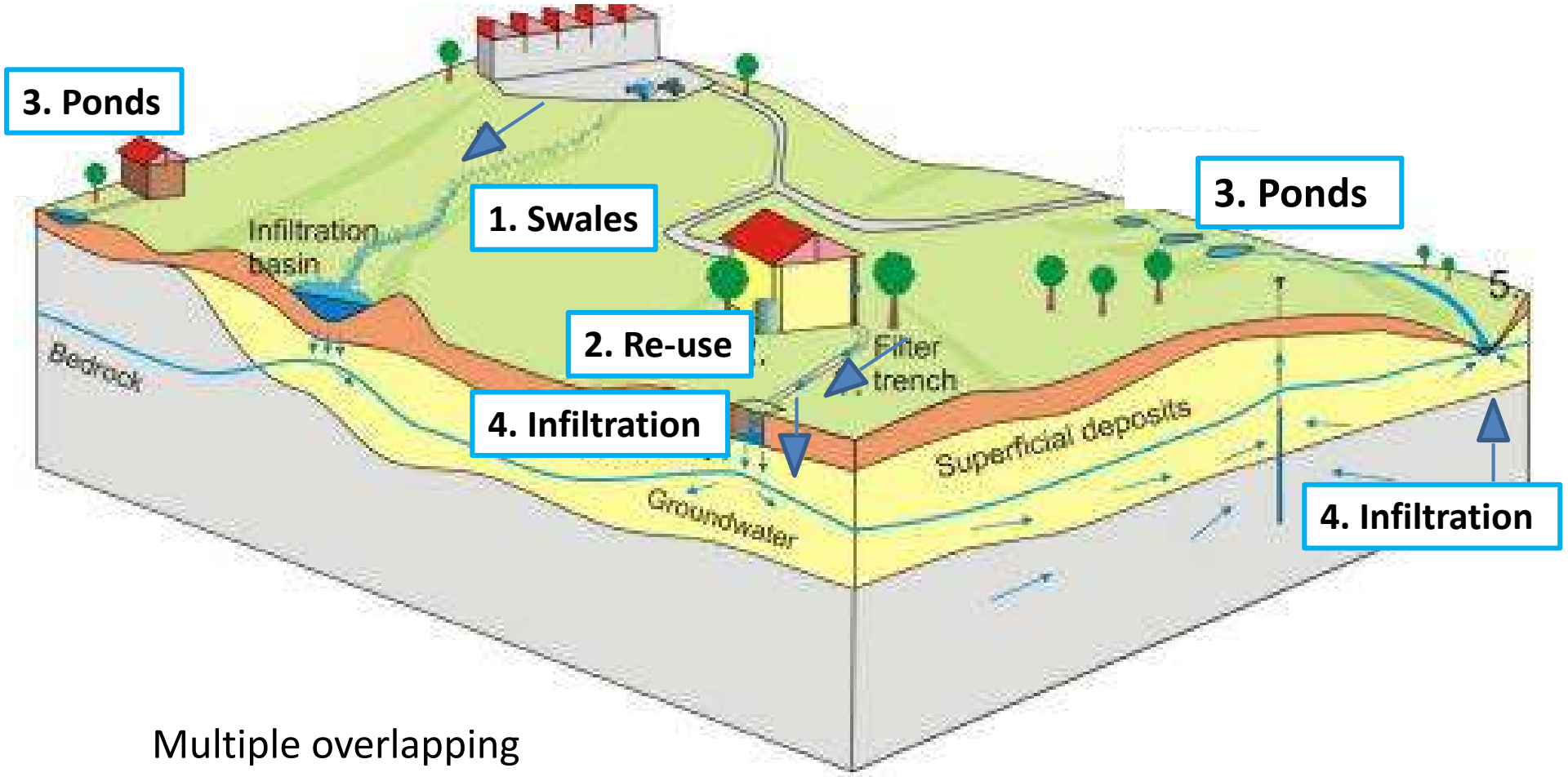
Infiltration basins - Depressions in the surface that are designed to store runoff and infiltrate the water to the ground.

Wet ponds - Basins that have a permanent pool of water that may be designed for treatment to improve water quality. They provide temporary storage for additional storm runoff.

Extended detention basins/offline storage - Normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff..

Constructed wetlands - Ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.

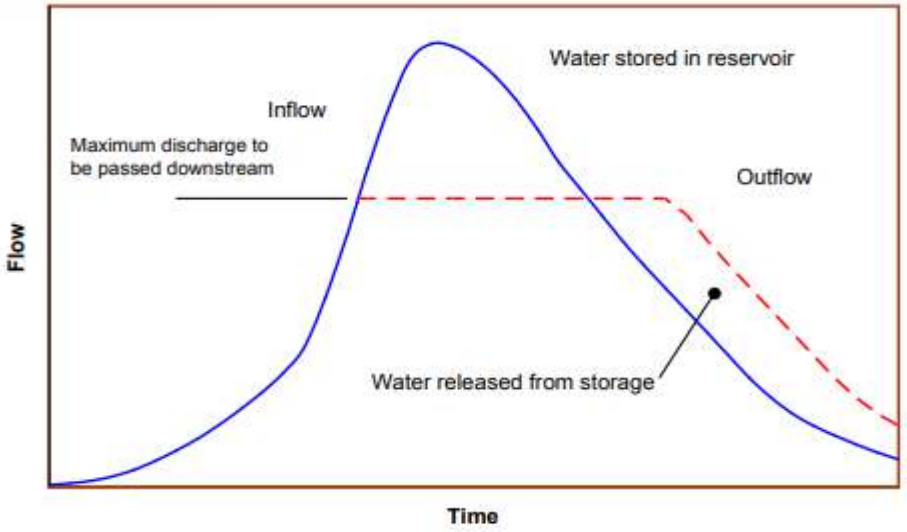
Natural flood management



Multiple overlapping stressors requires a mosaic of components

Natural flood management - SuDS

Features are designed to pass downstream the full flood up to threshold, **storing all the water in excess of the threshold**.



Green roofs

Filter strips and filter drains

Permeable paving

Swales, ponds, wetlands, detention basins

Hydro-Brake®

Natural flood management - working with natural processes

- Flood resilience is like a mosaic, many different pieces need to come together to complete the resilience picture.

- Flood schemes feature a mixture of hard, soft engineering and natural flood management.

- Natural flood management works best when a 'catchment based approach' is taken, to manage the flow from its source to sea.

• River restoration • Floodplain/ wetland restoration • Leaky barriers • Offline storage areas	• Catchment woodland • Cross-slope woodland • Floodplain woodland • Riparian woodland	• Soil and land management • Headwater drainage management • Run-off pathway management	• Saltmarsh and mudflat management • Sand dune management • Beach nourishment

Natural flood management - WWNP

River restoration

Reinstatement of natural physical processes and features in a river

Floodplain restoration

Restoration of the hydrological connection between rivers and floodplains

Leaky/woody barriers

Pieces of wood installed in channel, river corridor or floodplain to manage water

Offline storage areas

Areas of floodplain adapted to retain water in a managed way

Slowing flows

Floodplain storage

Soil water storage

Sedimentation?

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Natural flood management - WWNP

Recently planted riparian woodland

Natural flood management - WWNP

Restoration of blanket bog by blocking small drains

Natural flood management - WWNP

Wooden structures log jams (LWD)

Natural flood management - WWNP

Wetlands / sediment traps

Natural flood management - WWNP

Channel re-meandering

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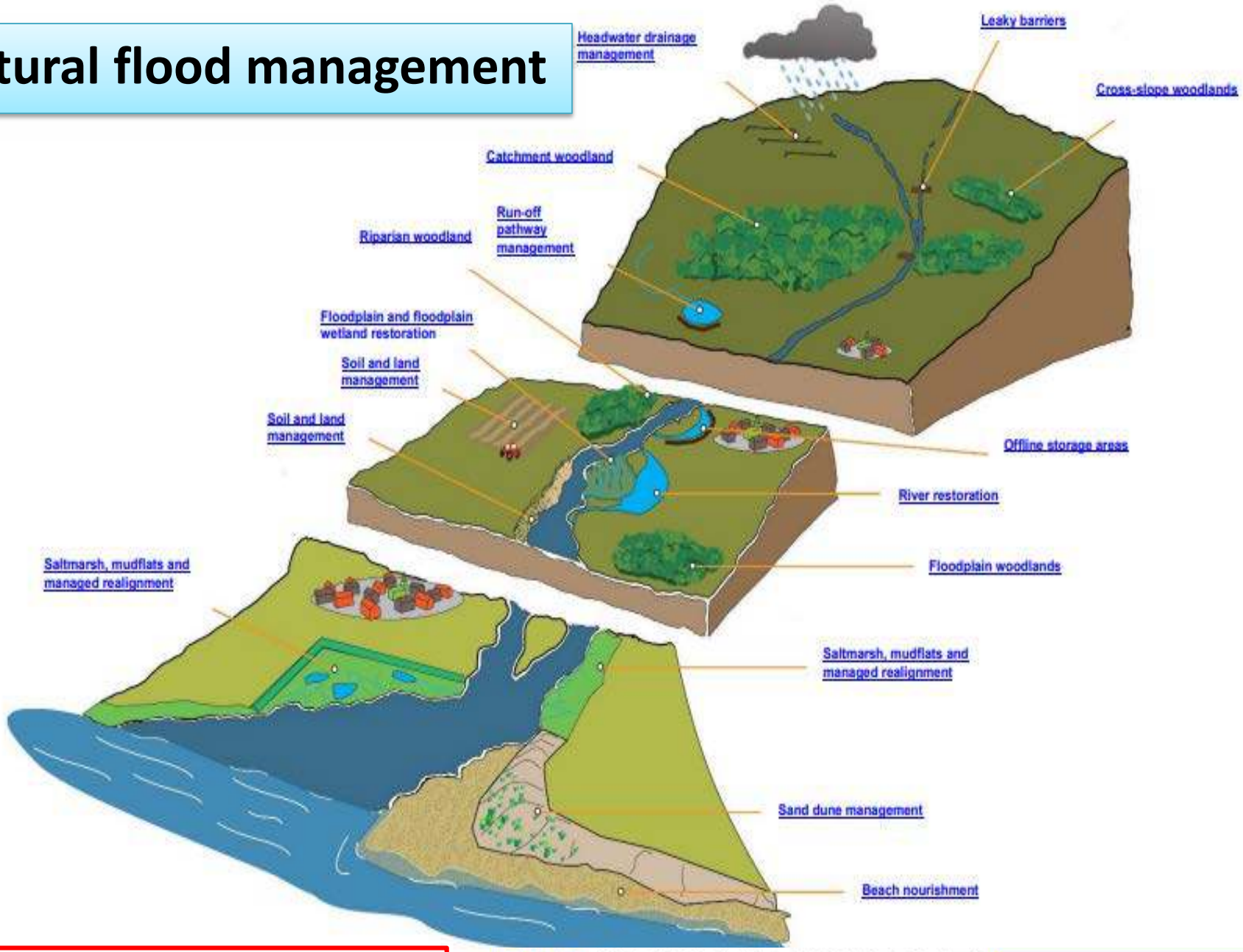
Natural flood management



Solution is catchment specific

Approx. £1 bn is being spent on flood protection in England/yr

Almost €1 bn is 'committed' in Ireland between 2018-2027 (OPW)

River restoration - NFM

Restoring meanders.

Enhancing redundant and straightened channels.

Revetting and support river banks.

Hydromorphological stabilization.

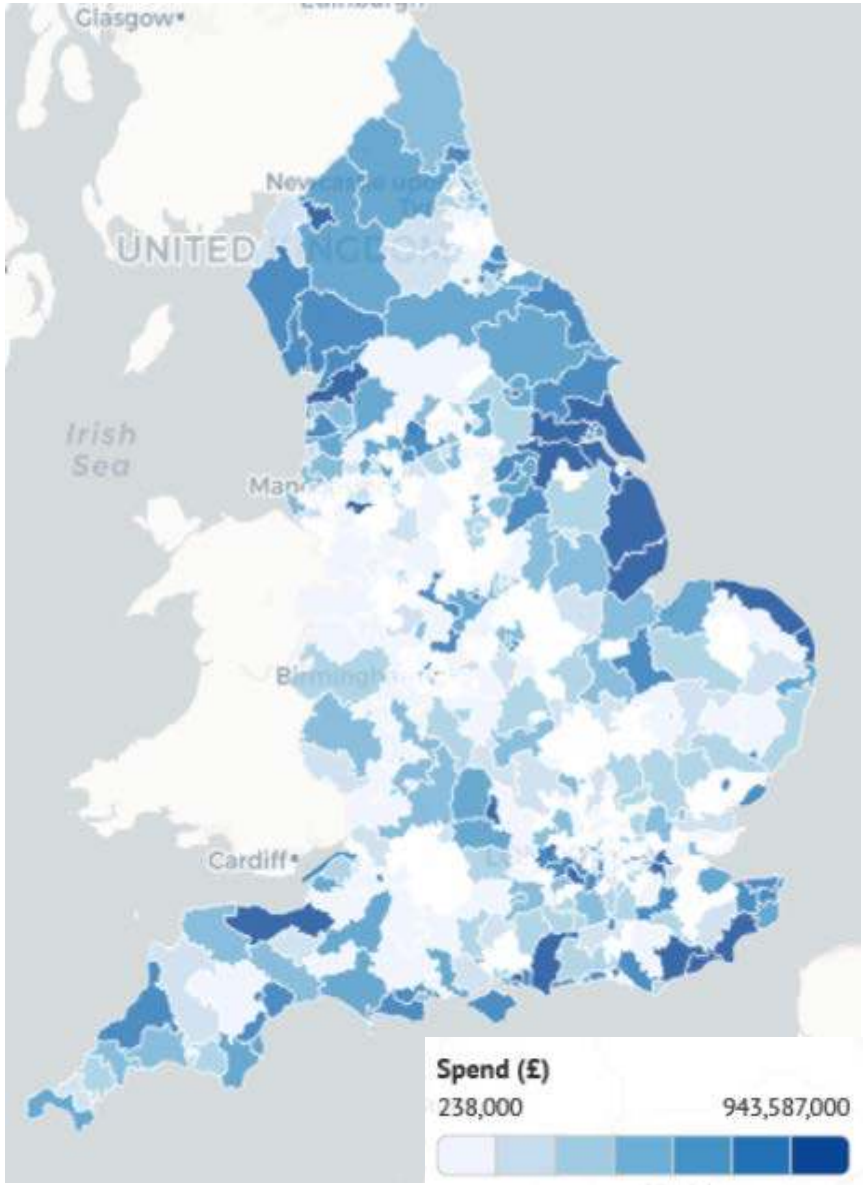
Managing overland floodwaters.

Creating floodplain wetland features.

Enhancing outfalls to waterbodies.

Utilising sediment excavated from rivers.

Removal of riverine barriers.



River restoration - NFM


Restoring meanders


Backwaters


Revetment


Bank protection


Flow deflectors


Refugia

The process

Assessment/planning

Hydrological design

Budget

Permission

Construction

BACI monitoring!

The challenges

Land acquisition / consent

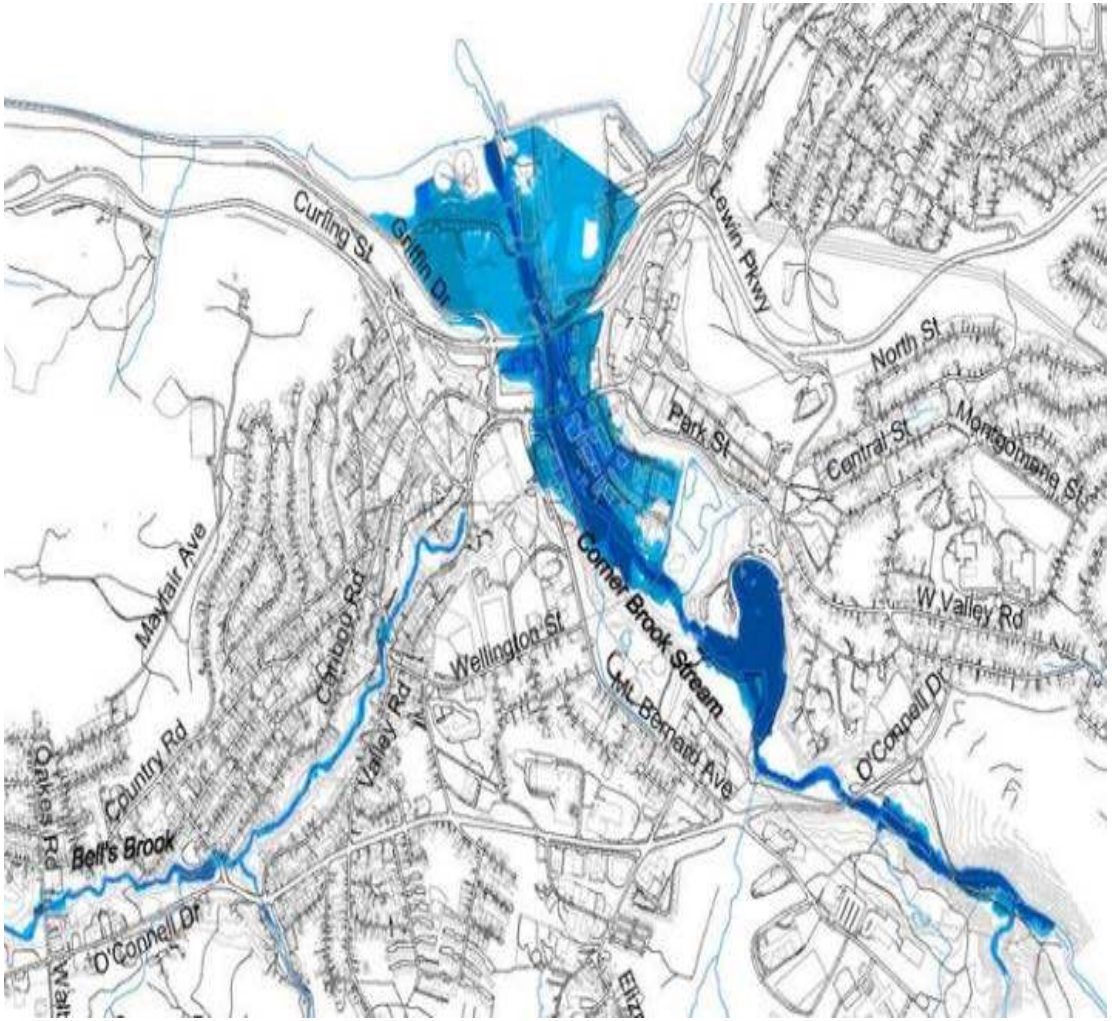
Legislation

Env/Eco impacts

Landscape usage

Hydrological design

Funding!



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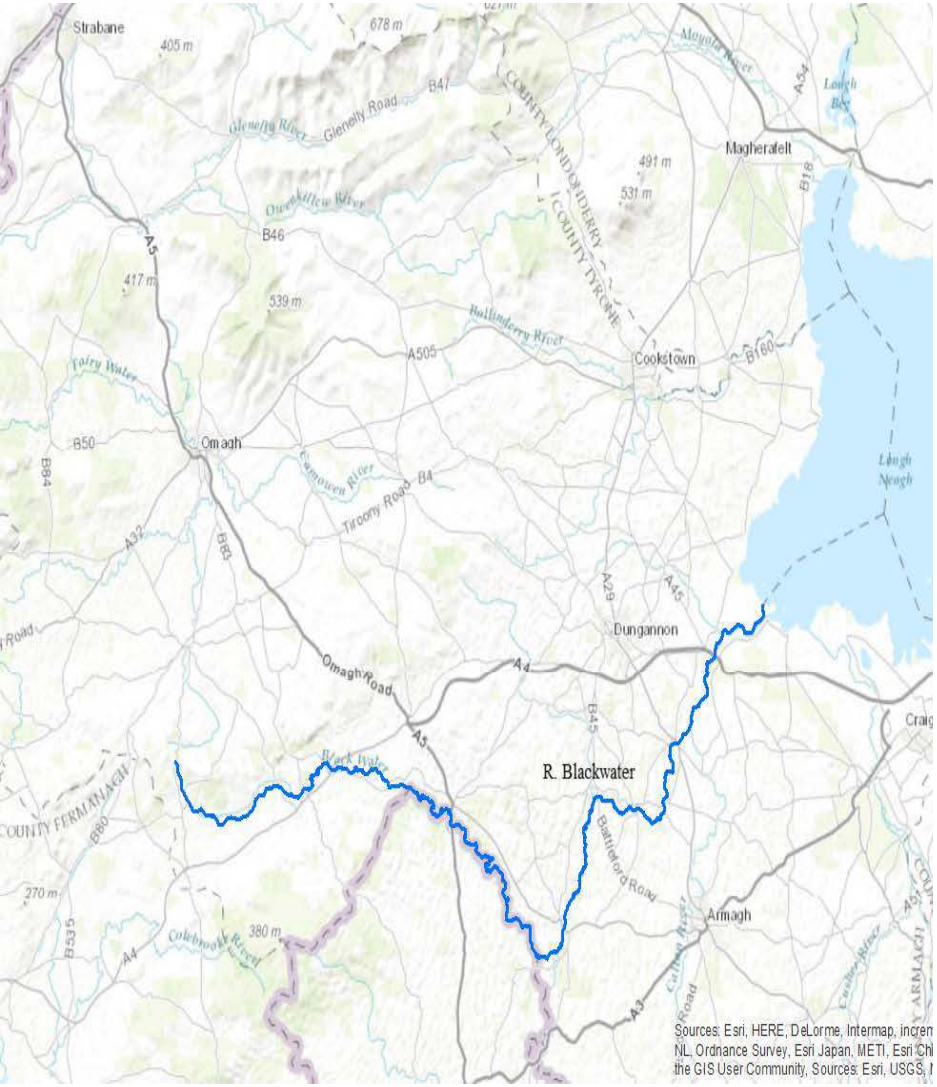
What will this cost? – Scottish EPA

Restoration activity	Rural cost £ Per m^2	Urban Cost £ Per m^2
Green bank reinforcement and bank re-profiling	50	400
Grey bank reinforcement	50	400
Croys, groynes and other flow deflectors	500	5,000
Embankments and floodwalls (no bank Reinforcement)	100	600
Low impact channel realignment	15	400
Embankments and floodwalls (with bank reinforcement)	100	600
Impoundments	50	50
High impact channel realignment	151	1,215
Set back embankments and floodwalls	100	600
Boat slips	50	400
Sediment management	10	15
	per unit	**per unit**
Fish passage (install fish pass)	220	220
Fish passage (remove small weir)	2,000	10,000
Fish passage (remove large weir)	100,000	450,000

What can it cost? - Local

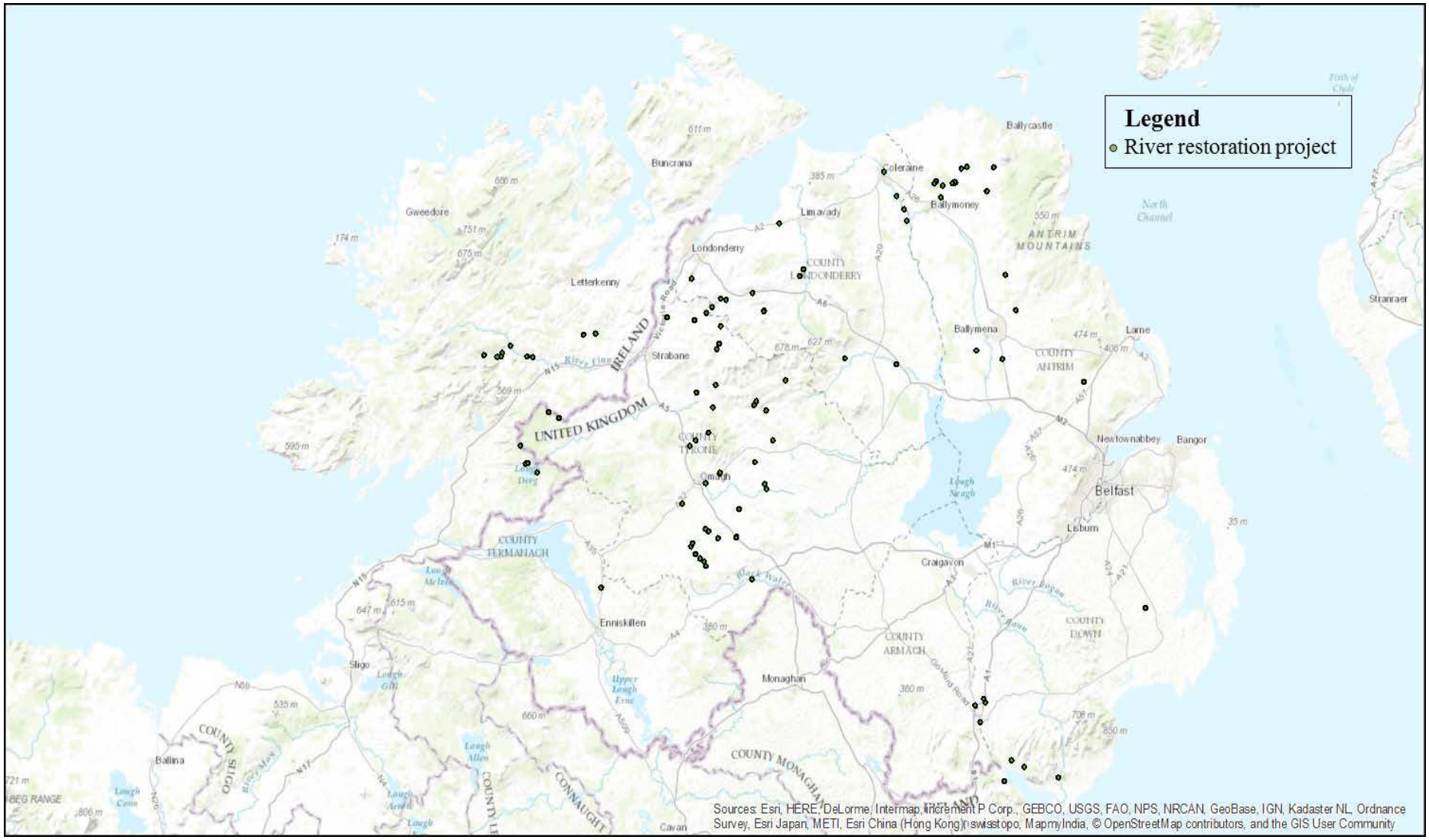
Component	Rate	Average Cost (£)	Minimum (£)	Maximum (£)
Cattle fencing				
Materials	190 (£/100)			
Labour	200 (£/100)	410 (per 100m)	390 (per 100m)	429 (per 100m)
Sheep fencing				
Materials	280 (£/100)			
Labour	200 (£/100)	528 (per 100m)	480 (per 100m)	576 (per 100m)
Pasture pump				
Pump	200 each			
Concrete base	50			
Fitting	50	330 each	300 each	360 each
Bank stabilization				
Rock revetment plus geotextile liner		330 (per 100m)	300 (per 100m)	360 (per 100m)
Nursery enhancement				
Concrete based plus AquaMats ®		110 (per 100m)	100 (per 100m)	120 (per 100m)

Costs - R. Blackwater



Bankside	Rate	Cost
100km of rural bank	2 banks of 50km	2,000,000
40km of urban bank	2 banks of 20km	1,200,000
Fencing 140km of both		560,000
Management of bankside		
Alien species for 5 years	£5000 per km	350,000
Bankside planting (willow or other)	4 ha. @ £2500 per ha	10,000
Structural		
Removal of 8 major weirs		3,600,000
Removal of 12 crossings and bridge construction	£150,000 each	1,800,000
Floodplain reconnection activities		750,000
Flood prevention activities		750,000
Re-meandering		800,000
Bank protection/stabilization and devices	5km at 750,000 per km	3,750,000
Excavation & materials	20km @ £5000 per km	100000
Habitat improvement	20km @ £5,000 per km	100000
Water pumps	50 No. @ £375 ea.	18000
Remedial action	10km @ 50,000 per km	500,000
Admin		
Surveys		20,000
Planning costs		75,000
Archaeological surveys		10,000
Land acquisition /recompensation	at £7,500 per acre	825,000
Miscellaneous		250,000
Total		**17,469,000**

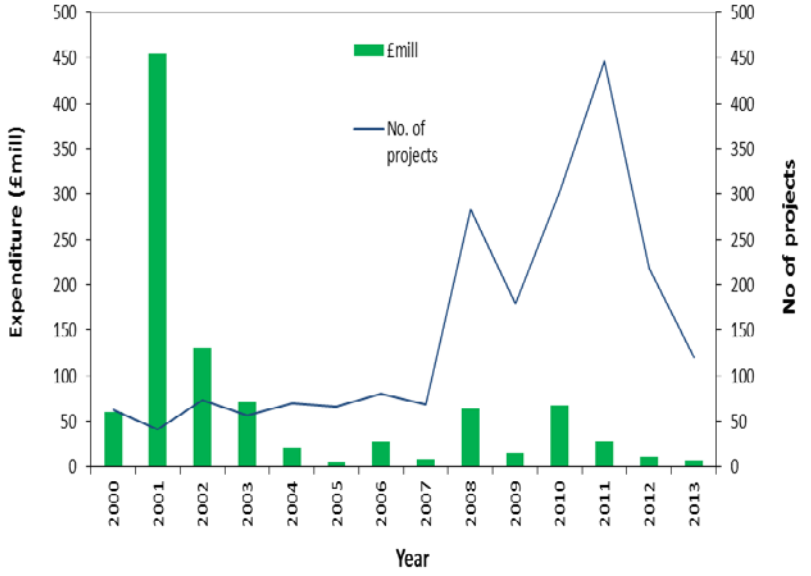
River restoration projects in Northern Ireland and Donegal



Costs - current status

Country	HMWBs & substandard waterbodies	Restoration costs (£)	Timescale (years)
England	2027	35,472,500,000	511.13
Wales	759	13,282,500,000	191.39
Northern Ireland	192	3,360,000,000	48.41
Scotland	545	9,537,500,000	137.43
Republic of Ireland	106	1,855,000,000	26.73
Total	**3629**	**63,507,500,000**	**915**

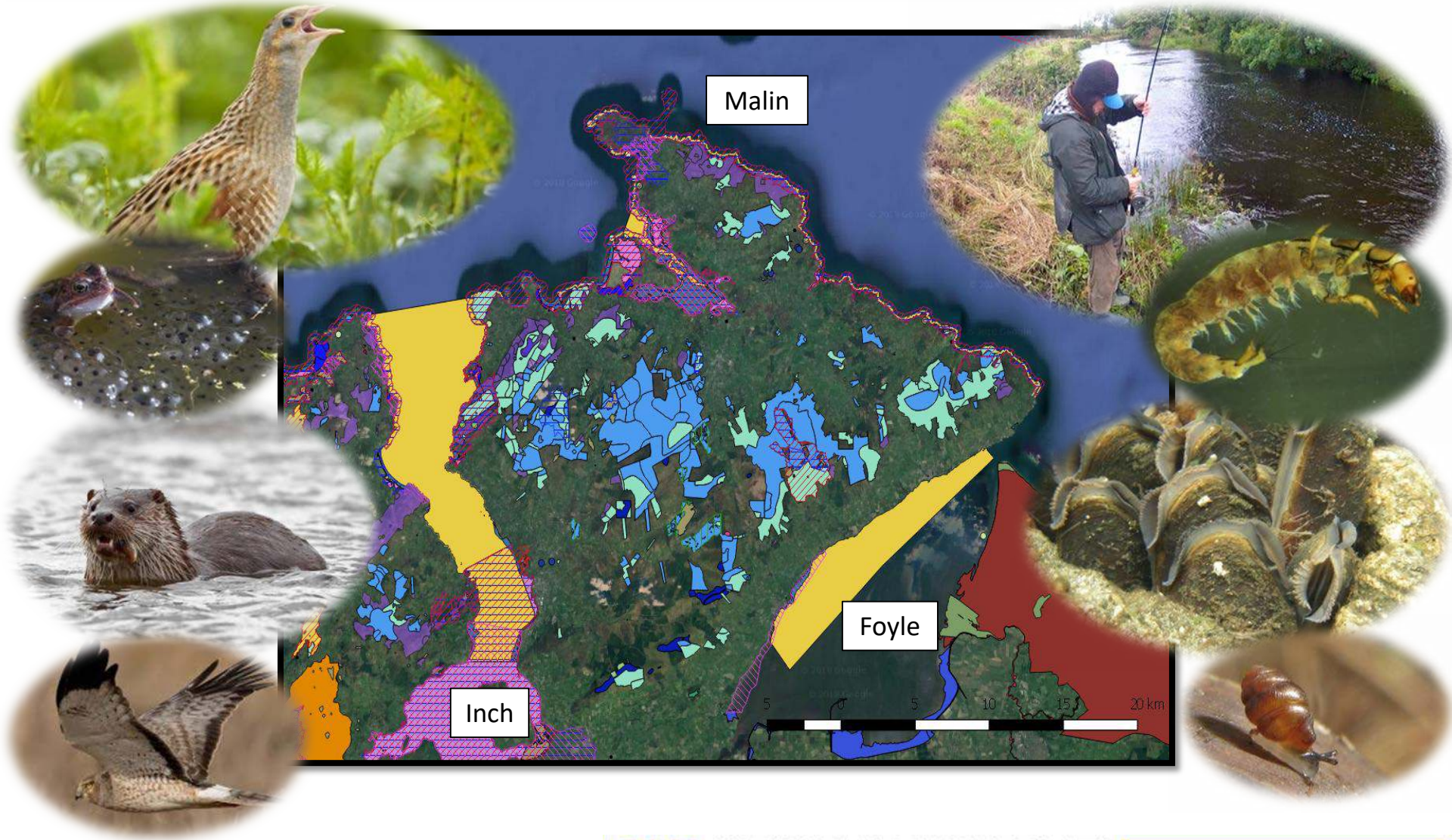
No. of projects



Hydromorphology only - cost does not cover flood protection!

Ecological success? <3%

Ecology? – Annex I & II, Natura 2000 & designated sites



Finish

- Hydrology
- Hydromorphology
- Natural Flood Management
- River Restoration
- Costs
- Ecology
- Discussion

Questions ?