



Monitoring of Natural Flood Management in a range of UK Catchments

Guglielmo Sonnino Sorisio¹, Daniel Jones¹, Mike Adams², Catherine
A.M.E. Wilson¹

¹ - Cardiff School of Engineering
² - Environment Agency

SonninoSorisioG@cardiff.ac.uk



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Project Groundwater
Are you flood resilient?



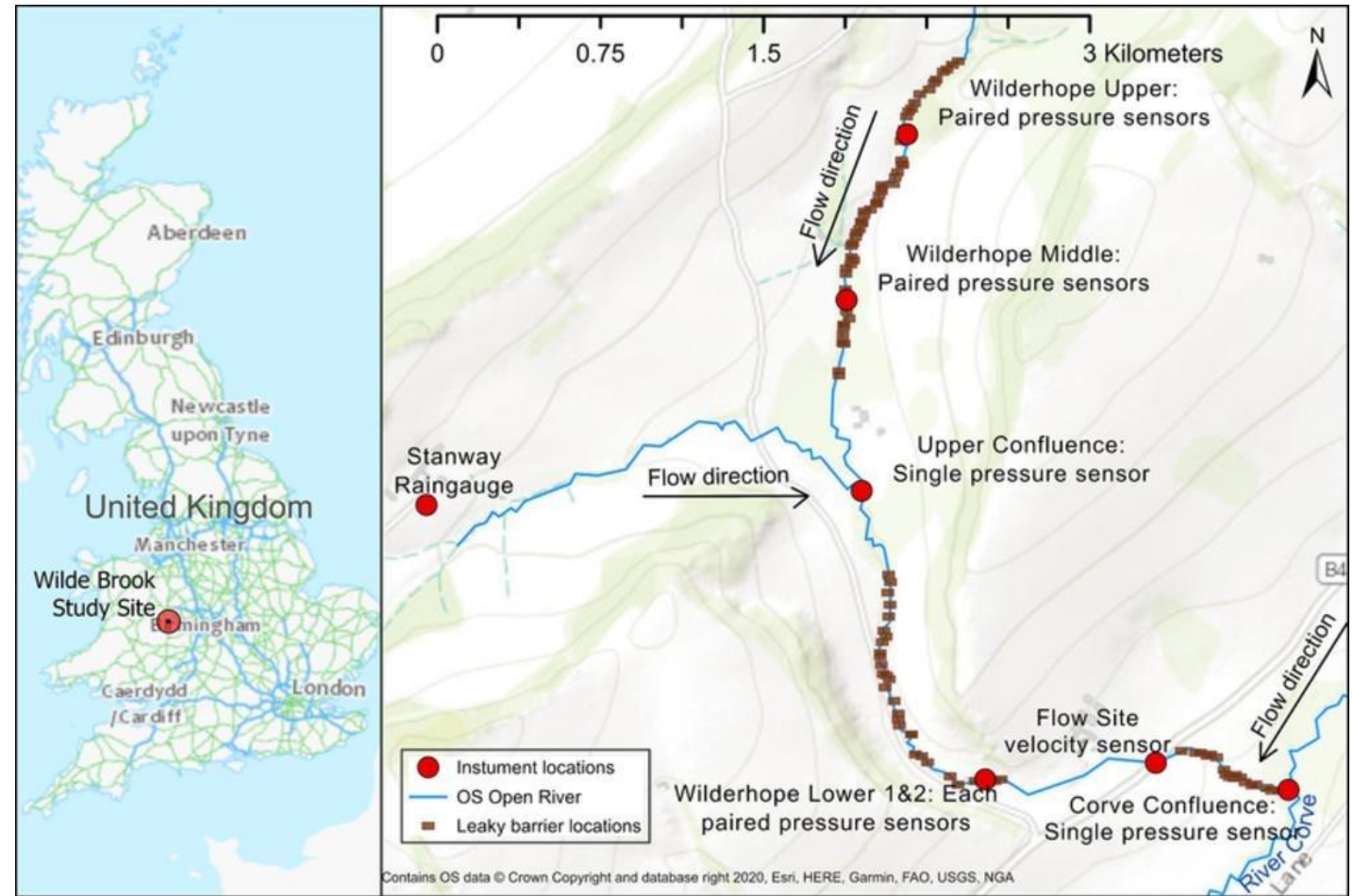
**Environment
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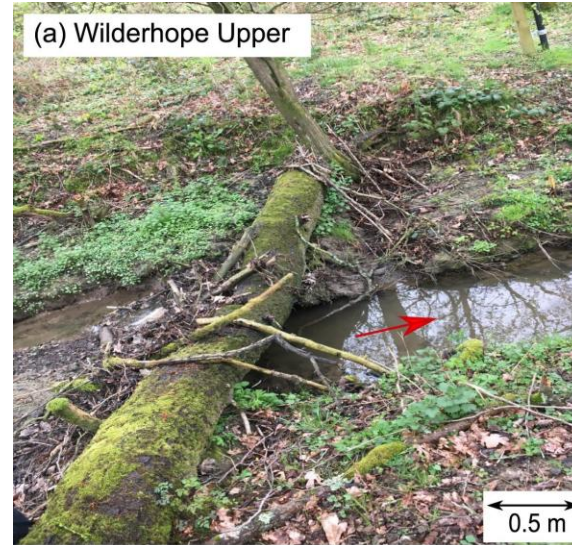
Long Term Monitoring Site

- Long term monitoring is rare in NFM, mostly due to existing schemes being relatively young
- Leaky barrier effectiveness has not been studied for the entire lifespan of a barrier yet
- Wilde brook in Shropshire, England is part of the Corve catchment
- 105 leaky barriers along 5.36 km
- Monitored for 7 years



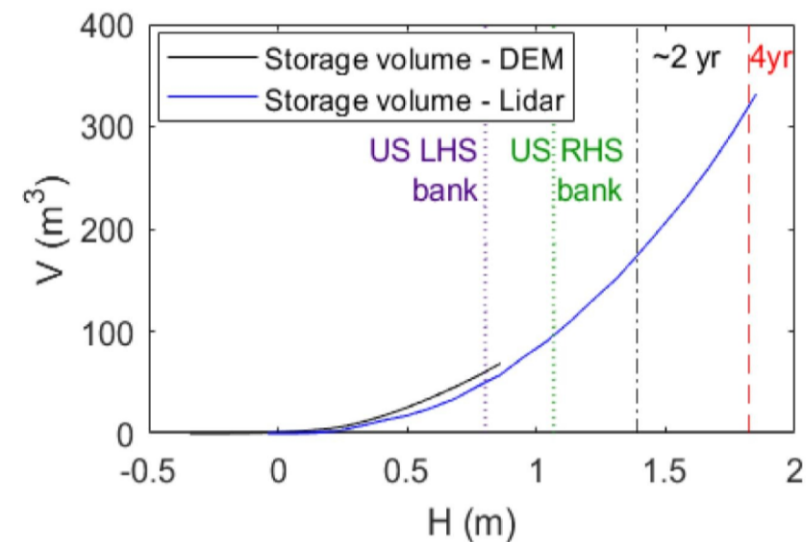
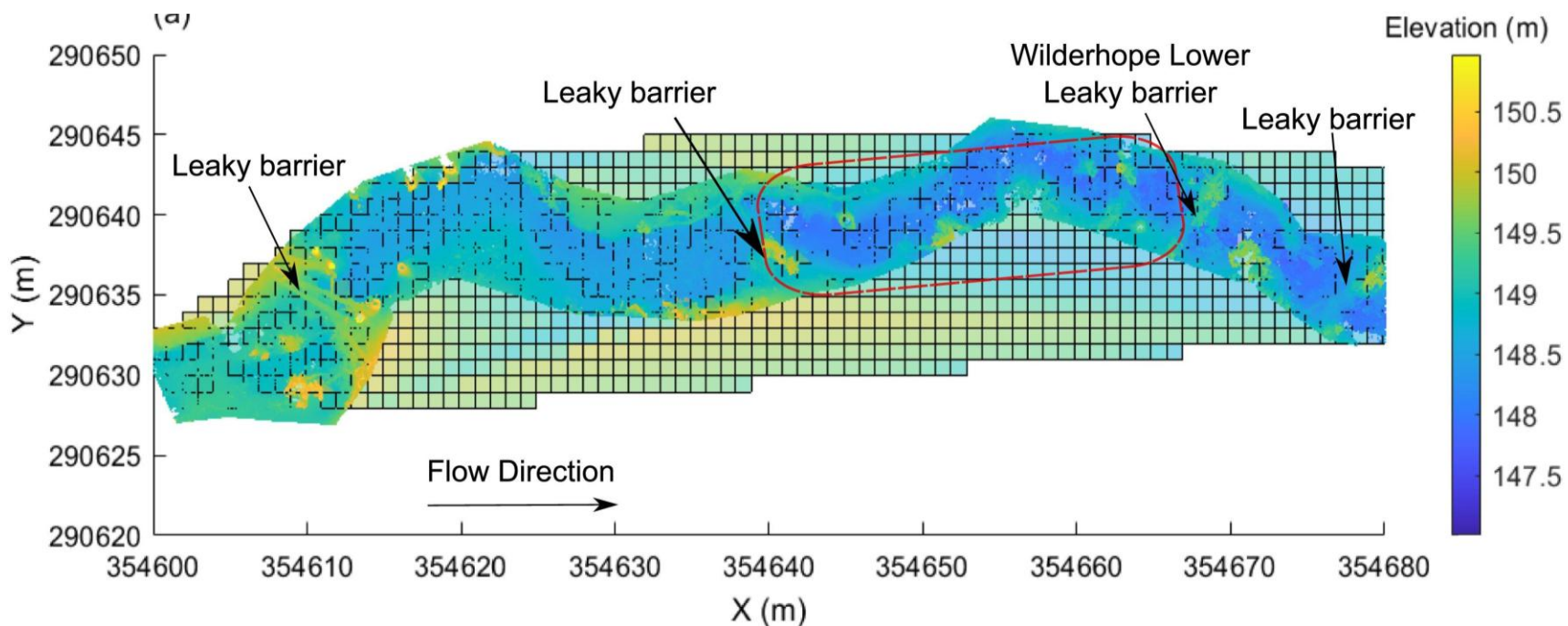
Muhawenimana, V., Follett, E., Maddock, I., & Wilson, C. A. M. E. (2023). Field-based monitoring of instream leaky barrier backwater and storage during storm events. *Journal of Hydrology*, 622. <https://doi.org/10.1016/j.jhydrol.2023.129744>

- Four leaky barriers along the reach are fully instrumented with:
- Two pressure transducers (upstream and downstream)
- Two wildlife cameras capturing the barrier from different angles and recording pictures every 15 minutes
- A rain gauge and a flow velocity sensor are also present on the reach



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- The volume behind the Lower Barrier was evaluated through photogrammetry to estimate storage during flood events.



- Local effects on sediment distribution

February 2019

Wilderhope Middle barrier

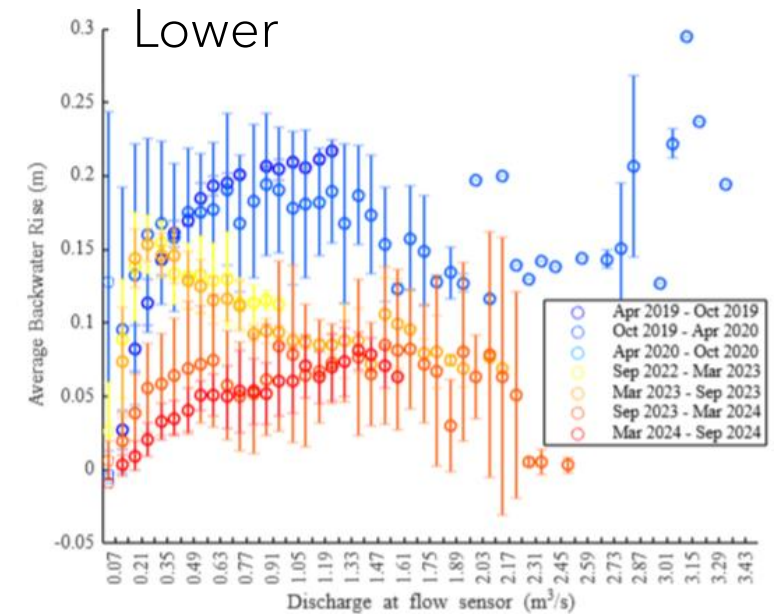
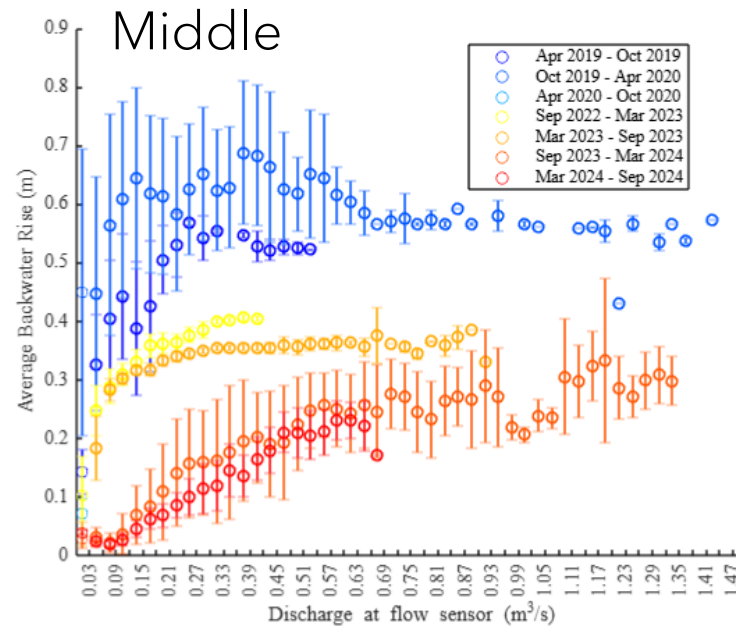
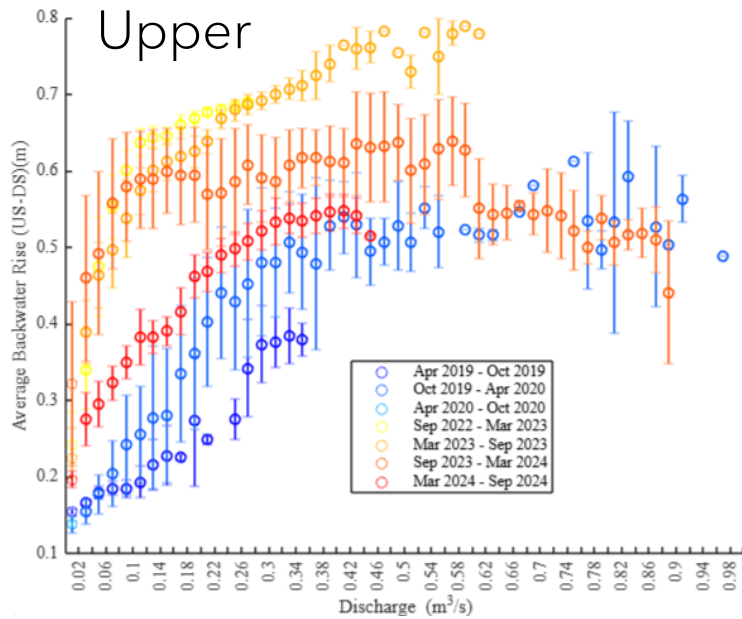


July 2021



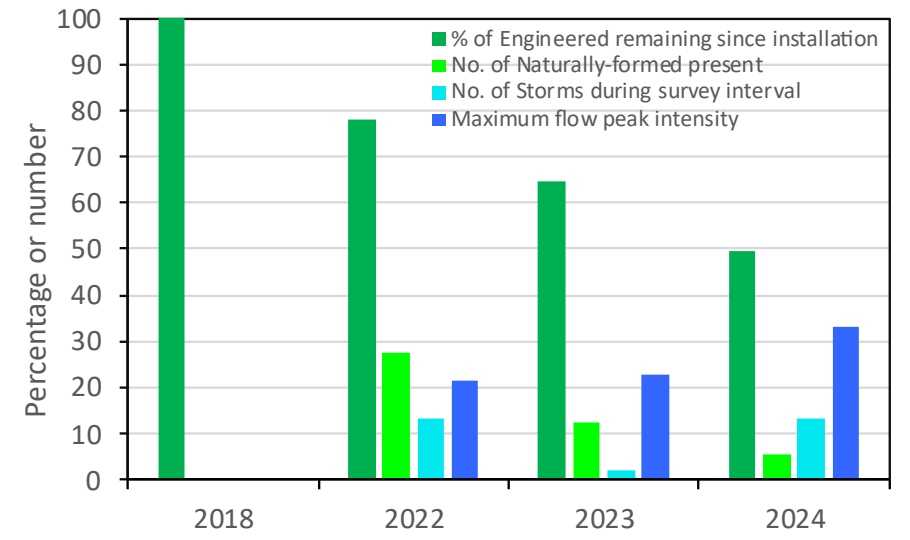
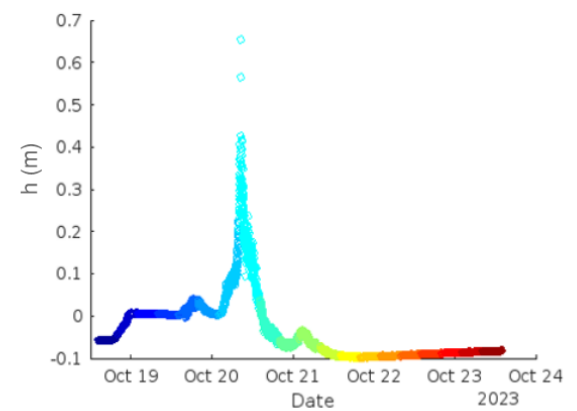
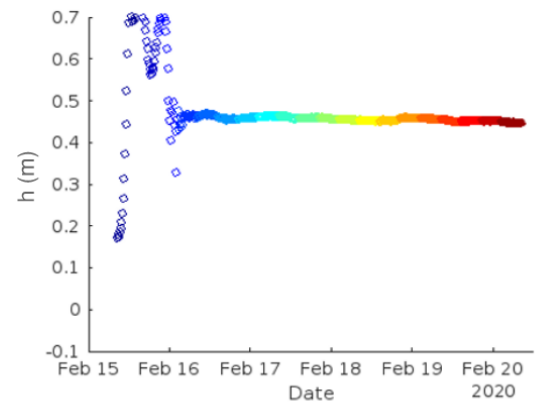
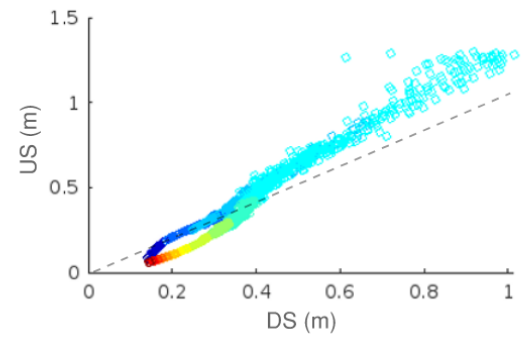
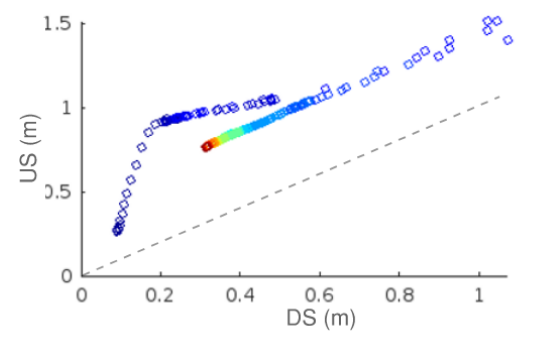
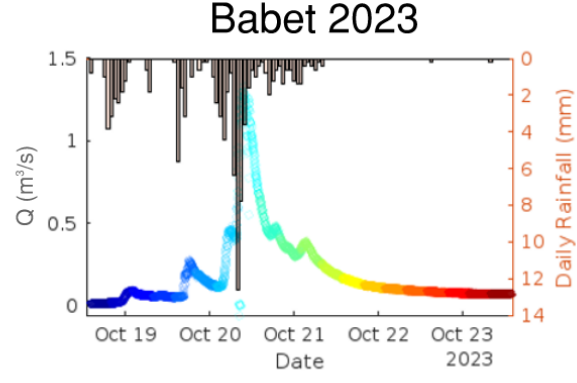
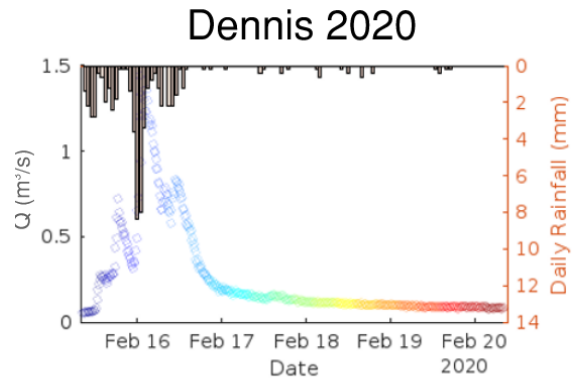
Long Term Monitoring Shows Barrier Performance Over Time

- Generally, barrier performance decreased over time, the middle barrier failed almost completely in September 2023
- The upper barrier had increased effectiveness over time, peaking in 2022



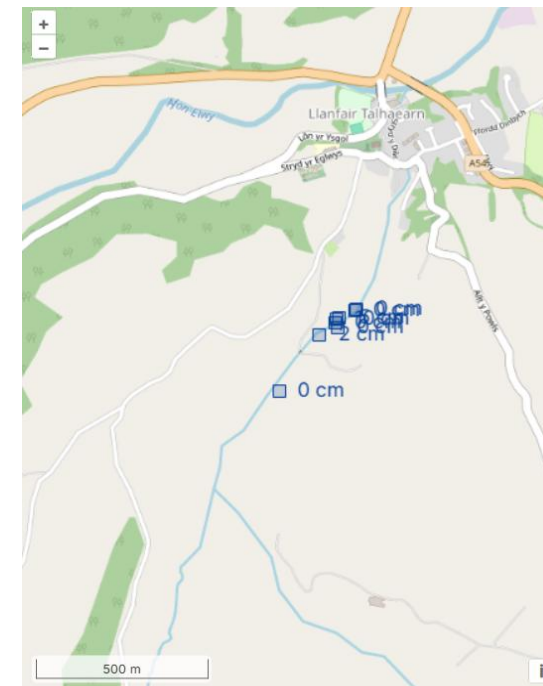
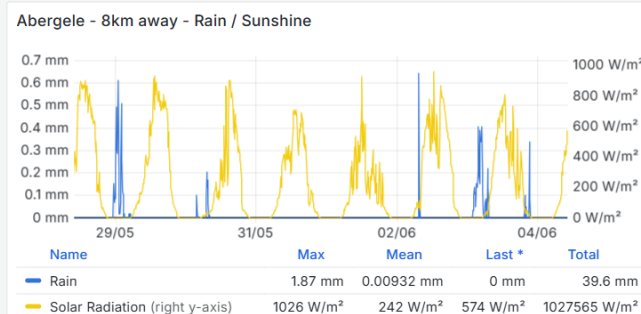
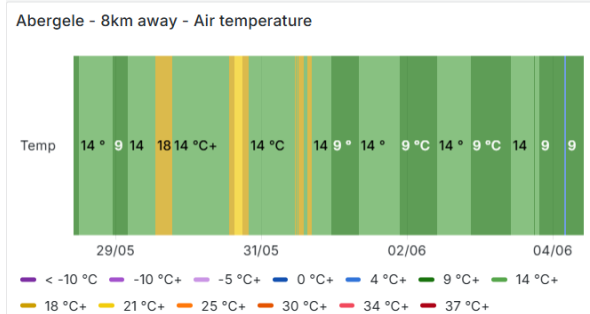
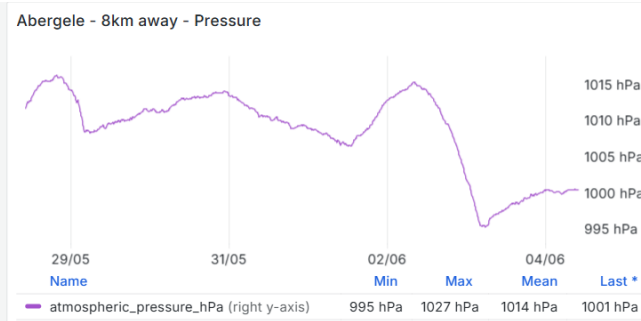
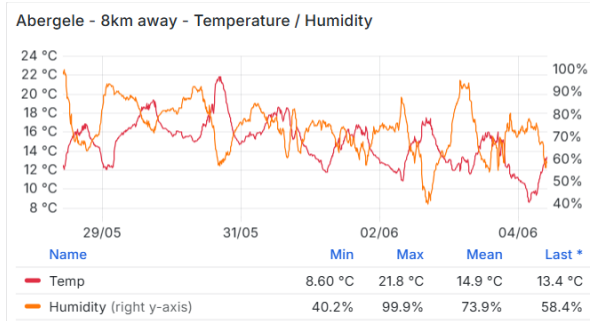
Long Term Performance and Survival Rates

- Similar storms from 2020 and 2023 shows the decreased effectiveness of the middle barrier
- Around 50% of barriers are still in place and other have been moved by flow or naturally occurred
- Conservative estimates for barrier lifespan are 5 years.



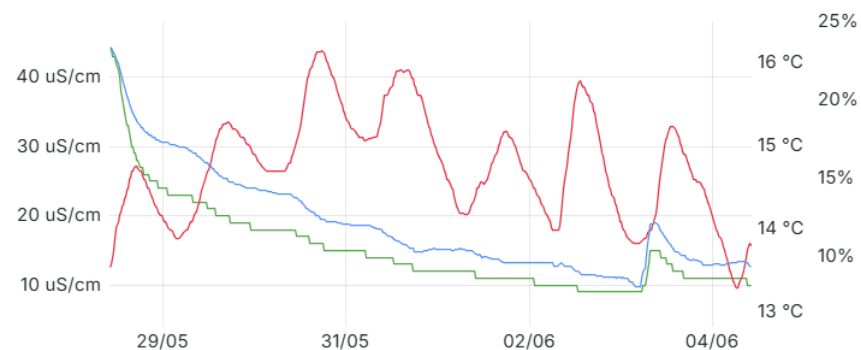
Monitoring Steep Rural Catchments

- Large scale flooding in Llanfair TH in 2020 following Storm Ciara
- The surrounding area is also susceptible to flooding
- The Nant Barrog upstream of the town features high hillslopes and bedslopes
- Local weather data and live sensor data integrated into dashboard.



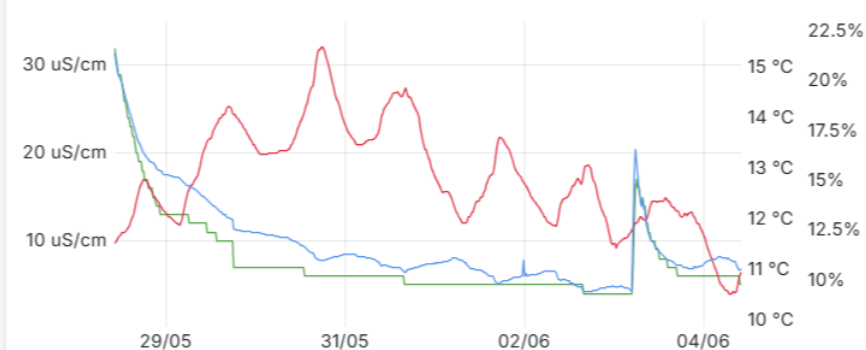
Monitoring Steep Rural Catchments

LlanfairTH, NantBarrog, Soil Moisture, Top of Field, 65421



Name	First *	Min	Mean	Max	Range
conduct_SOIL	44 uS/cm	9 uS/cm	15.2 uS/cm	44 uS/cm	35 uS/cm
temp_SOIL (right y-axis)	13.5 °C	13.3 °C	14.8 °C	16.2 °C	2.87 °C
water_SOIL (right y-axis)	23.4%	8.11%	12.1%	23.4%	15.3%

LlanfairTH, NantBarrog, Soil Moisture, Bottom of field, 65422



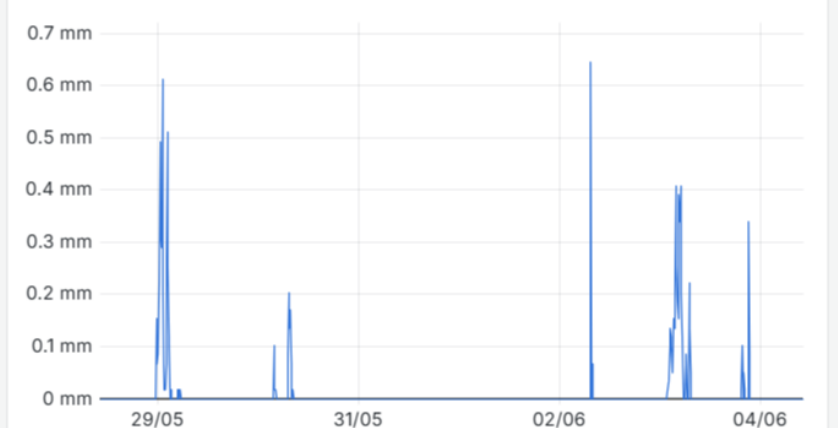
Name	First *	Min	Mean	Max	Range
conduct_SOIL	32 uS/cm	4 uS/cm	7.75 uS/cm	32 uS/cm	28 uS/cm
temp_SOIL (right y-axis)	11.5 °C	10.5 °C	12.8 °C	15.4 °C	4.89 °C
water_SOIL (right y-axis)	21.4%	9.41%	11.8%	21.4%	12.0%

Panel Title



Name	First *	Last *	Min	Max	Mean	Range
Water_deep_cm	5.31 cm	2.44 cm	1.94 cm	5.31 cm	2.81 cm	3.38 cm

Abergele - 8km away - Rainfall



Name	Max	Mean	Last *	Total
Rain	1.87 mm	0.00932 mm	0 mm	39.6 mm

Monitoring Steep Rural Catchments

- Leaky barriers have been constructed upstream of Llansannan
- 393 barriers across multiple sites.

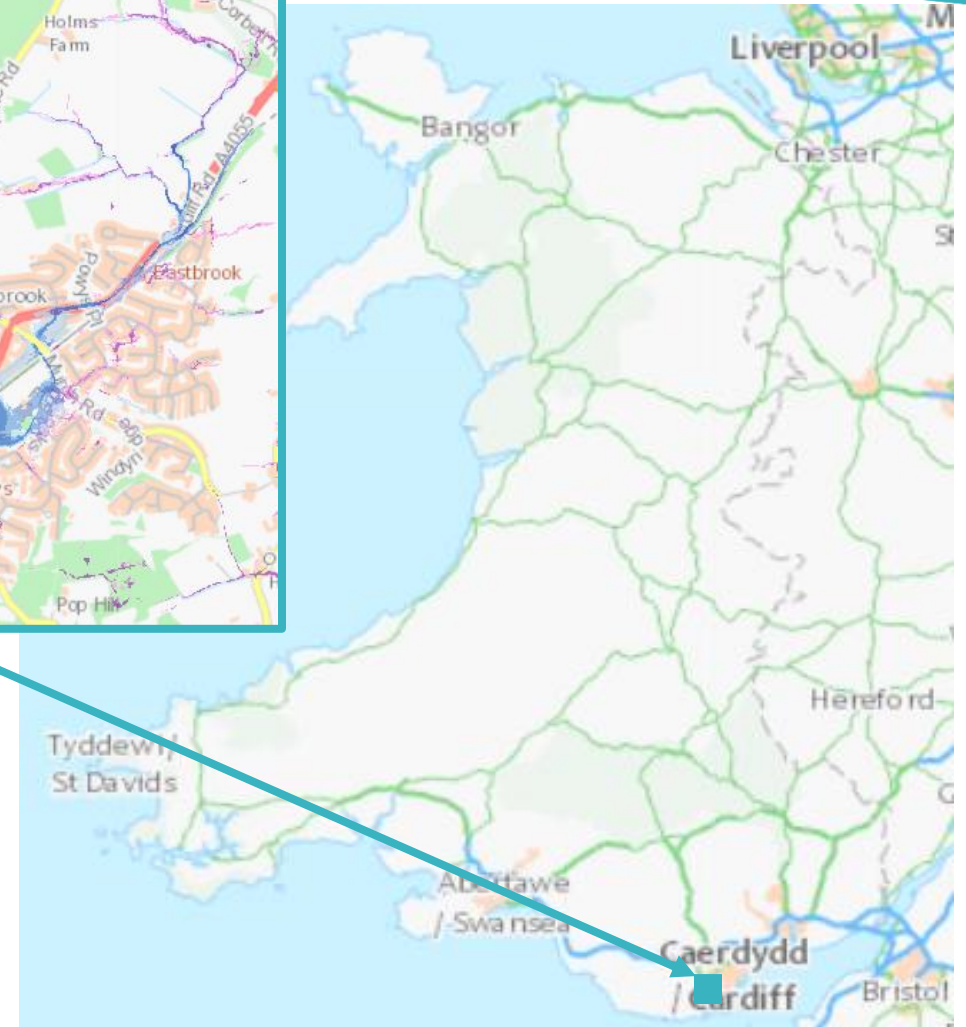
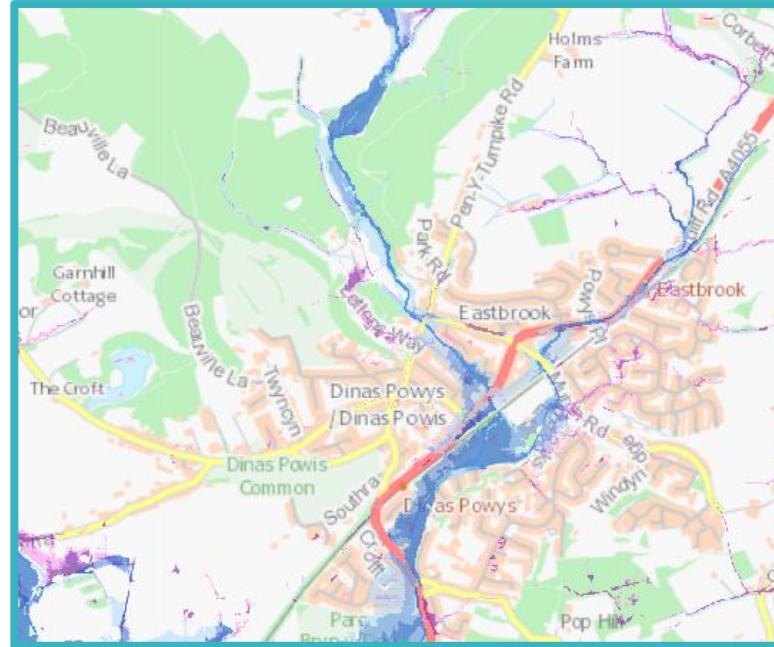


Site	Total number of installations
Llansannan S1	85
Llansannan S2	67
Llansannan S3	144
Dolwyddelan	93
Llansannan donor	4
Total	393



Monitoring Urban Catchments

- History of large-scale flooding in Dinas Powys
- Most recently flooded in 2020 with 98 properties flooded internally
- Initial plans for flood risk reduction were rejected by the community because of associated loss of woodland and trees nearby
- Natural Flood Management was chosen as an alternative to deliver flood risk reduction.



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Natural Resources Wales

Management Knowledge Transfer Partnership with NRW

"Transform Natural Resources Wales' organisational capability from traditional engineering to nature-based flood management through management innovation, economic frameworks, and experimental implementation, enabling cost-effective flood protection while delivering ecosystem benefits, supporting Welsh communities' climate resilience through public sector transformation and adaptive management approaches."



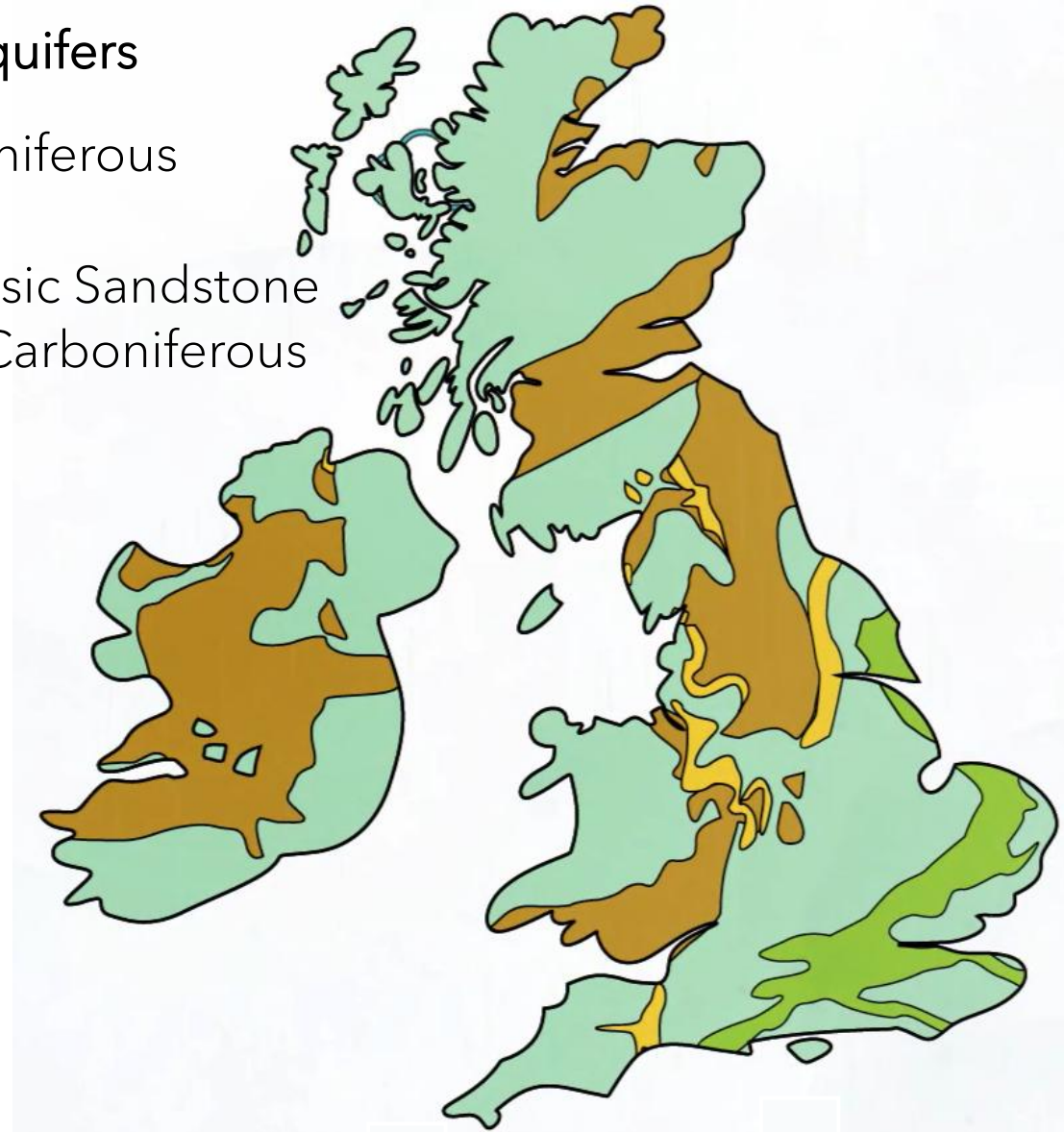
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NbS and Monitoring for Groundwater Dominated Catchments


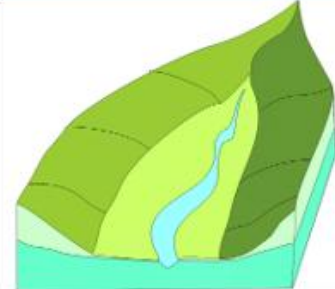
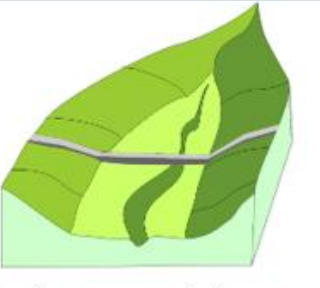

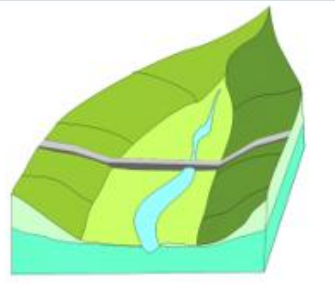
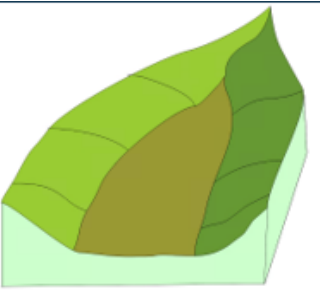
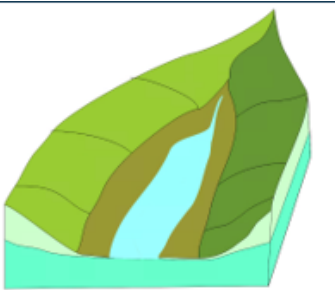
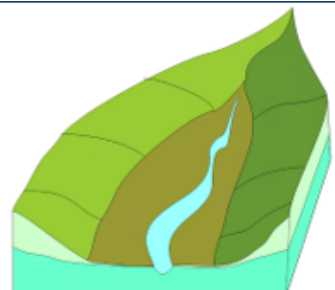
- Chalk geology creates largely groundwater driven catchments
- During winters and periods of prolonged rain, groundwater levels rise and cause long lasting flooding
- This type of flooding cannot be remediated with most NFM techniques aimed at surface flows
- NFM for groundwater flooding remains a challenge

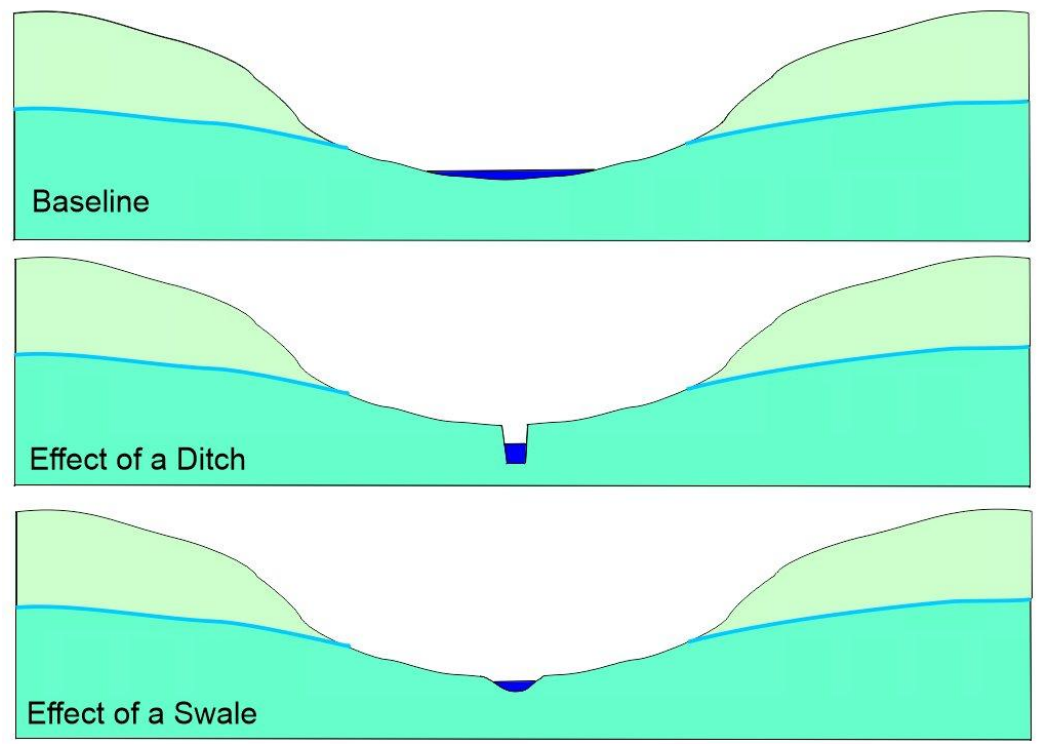
Types of UK aquifers

- Post-Carboniferous
- Chalk
- Permo-Triassic Sandstone
- Devonian/Carboniferous Old Cover



NbS and Monitoring for Groundwater Dominated Catchments

	Typical Conditions	Flood	Adaption to Flood
Natural	 Nature Valley with minimal human interventions	 Winterbourne activities in winter	No adaption needed
Impounding Trackways	 Track on causeway built across a dry valley	 Causeway impounds water	 Ford or culvert installed through causeway to allow winterbourne to flow
Arable Land infill	 Conversion of valley floors to arable can cause winterbourne channel to be ploughed in	 Without the winter channel water spreads over a wider area	 Winterbourne channels can be re-established through the creation of swales within buffer strips



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Are you flood resilient?

NbS and Monitoring for Groundwater Dominated Catchments

- Winterbournes are ephemeral streams that flow when groundwater levels are high
- Many of these have been destroyed and built over
- Winterbourne restoration and management could help reduce local flood risk.



NbS and Monitoring for Groundwater Dominated Catchments

Monitoring of the winterbourne will be carried out in two phases: pre-monitoring will gather baseline data before the winterbourne is restored, post-implementation monitoring will show benefits of changes post-restoration.

Hydrology

- Shallow groundwater level
- Soil moisture
- Rain data
- Estimation of water storage from new features
- Wetland flow
- Surface water level

Biodiversity

- Changes in habitat
- Changes in wildlife population

Water quality

- Sediment load reduction
- pH
- Salinity
- Various pollutants
- Microplastics





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Natural Resources Wales



Thank You

SonninoSorisoG@cardiff.ac.uk



Shropshire
Wildlife Trust



Department
for Environment
Food & Rural Affairs



Environment
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Project Groundwater
Are you flood resilient?

