Where is water for peatland restoration and environmental benefits going to come from?

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10%
UK total land area that is peatland (~3 million ha)

16%
UK total peat area in the lowlands (~465,000 ha)

90%
Lowland peat area drained for agriculture

3%
UK reported GHG emissions are from drained agricultural lowland peat

Greenhouse gas emissions from peat soils are proportional to water table depth

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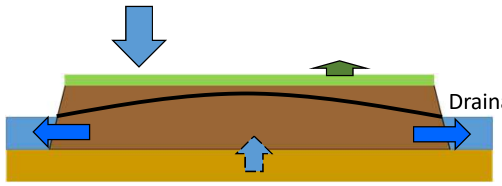
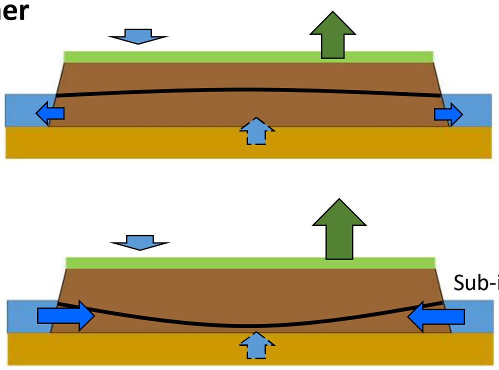
Basics of drainage

Watertable depth in LAP is a function of drainage regime, water inflows and water outflows

Winter



Summer



Key WT controls
- Drain / ditch spacing
- Freeboard (surface water vs land level)
- Weather

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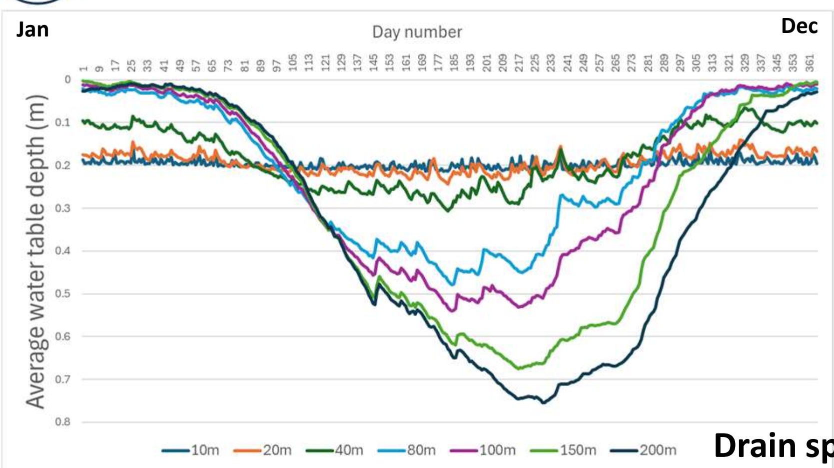
The importance of drain spacing



Drain water level

Drain spacing

- High drain water levels ≠ high watertable
- Smaller drain spacing = Lower water table variability

Lowland Peat 3

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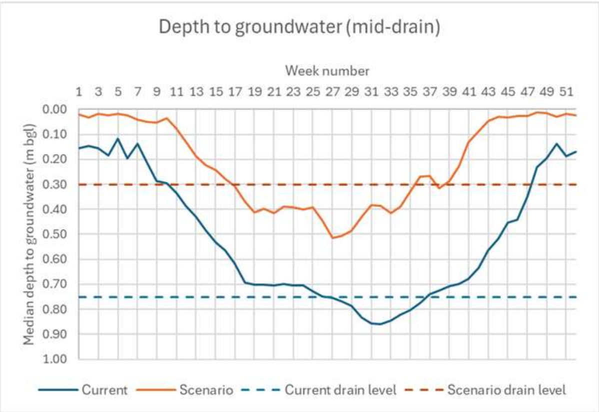
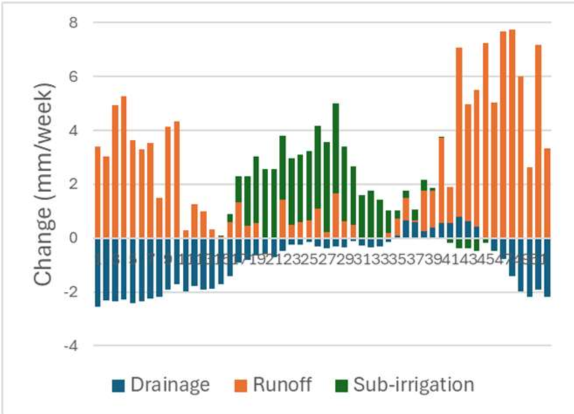
Consequences of raising water levels (and water table) (example)





- Water table rises throughout year
  - Winter: near surface
  - Summer: below ditch water level
- Winter: less drainage; more runoff
- Summer: more sub-irrigation from drains
  - **How can that water be supplied?**

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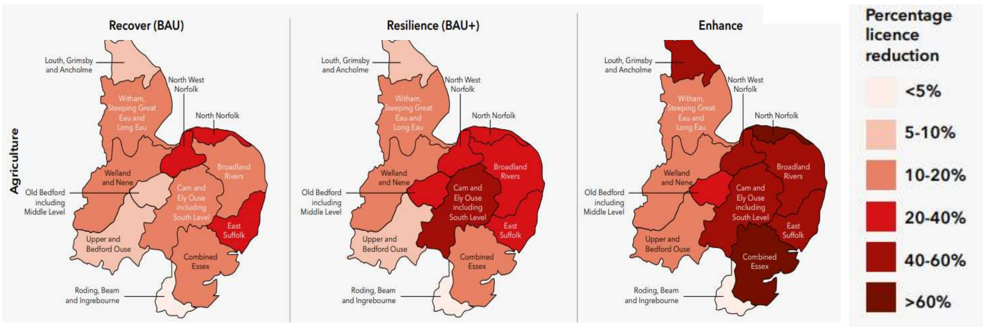
Enabling access to more water



(Water Resources East, 2023)

- Maintaining higher peat water tables requires more water in summer
- Environmental Destinations suggest future reduced water availability
- Demand-availability calculations reductions don’t allow for peatlands
- Need to enable (processes; financing etc) more on-farm storage

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Where is the water for peatland restoration going to come from?

Lowland Agricultural Peat Water Discovery Pilot 'Patchy Peat Solutions Project' (Phase 1).

Julia Casperd, Scott Kirby, Simon Jeffery, Karl Behrendt, Iona Huang, Wyn Morgan, Jackie Symmons and Anthony Millington.

Rigare Ltd. Rob Low & Laura King.

Harper Adams University

Environment Agency

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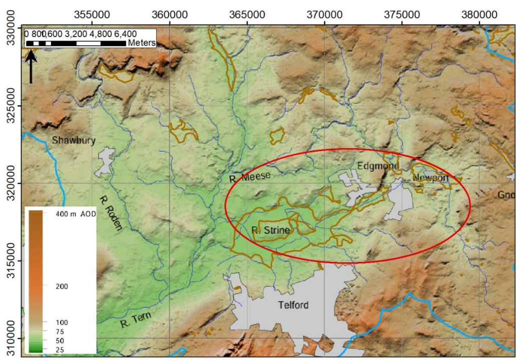
Farm holdings – Shropshire/Staffordshire

- Diverse farm businesses (1875 ha)
- Lonco, Strine & Aqualate catchments



Feasibility project to explore sustainable farm business opportunities on rewetted lowland agricultural peat.

- Paludiculture
- Natural capital
- Other innovative opportunities, e.g. photovoltaics

How could this be achieved?
How much water would be required?
Where would it come from?

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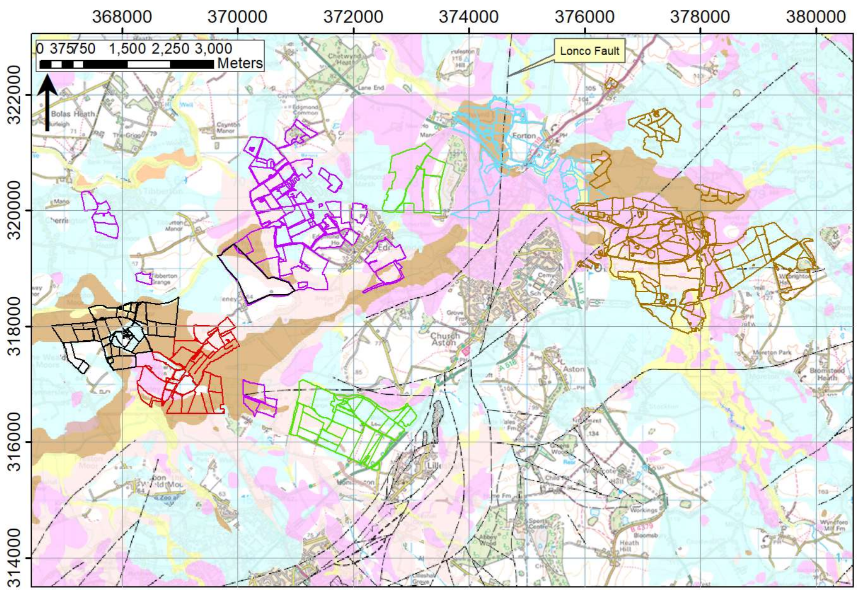
Patchy Peat



Key

- Sky Blue = Glacial Till
- Bright Pink = Glacio-fluvial Deposits Dusky
- Pink = Glacio-lacustrine Deposits
- Yellow = Alluvium
- Brown = Peat

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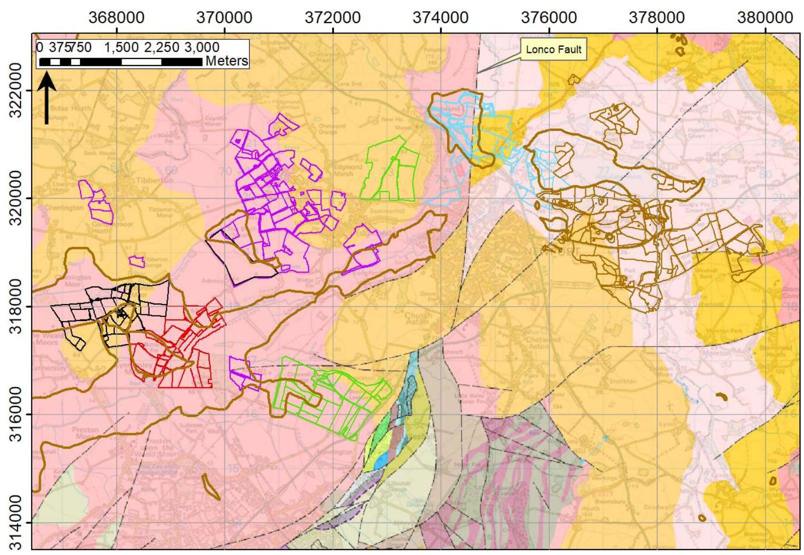
Permo-Triassic Sandstones



Key

Dark Pink = Bridgnorth Sandstone Formation

Dull Gold = Chester Formation

Light Pink = Wildmoor Sandstone Formation

Vivid Gold = Helsby Sandstone Formation.

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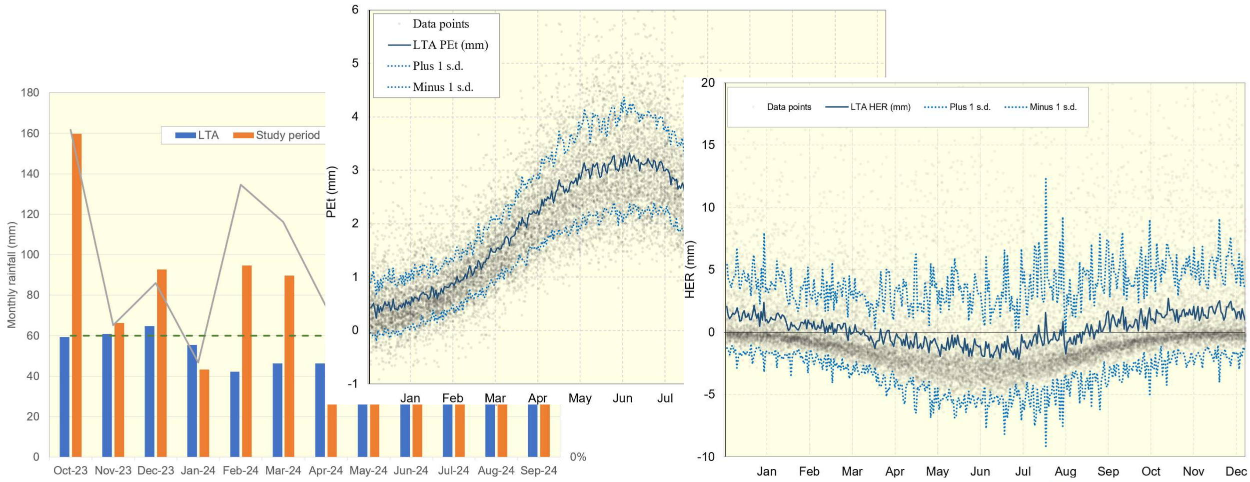
Where is the water going to come from? Hydrological characterisation (March to November 2024)



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River flow gauging stations within or close to LAPWDP area

Station	NGR	Location	Catchment area (km²)	Mean flow (m³/s)	BFI
Strine (Crudgington)	SJ 640 175	Immediately west of PPSP	95.7	0.673	67%
Coley Brook (Coley Mill)	SJ 779 192	Immediately upstream of Aqualate Mere	37.3	0.406	62%
River Meese (Tibberton)	SJ 680 204	North of PPSP area	167.8	1.167	79%

Key

NGR: Grid Reference, BFI: Base Flow Index; PPSP: Patchy Peat Solutions Project.

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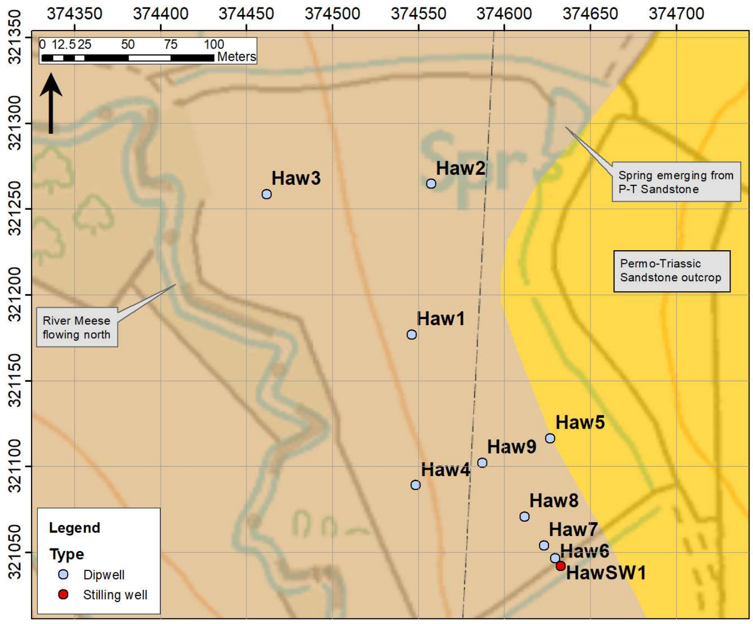

Farm E, Area E1

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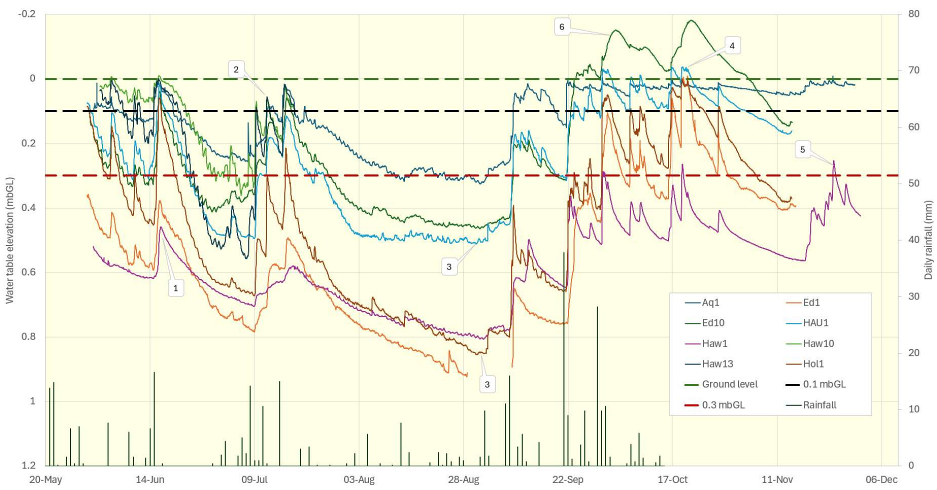

Centre-field dipwells; water level hydrograph, mbGL

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Rigare Ltd. conceptual model

Simulated Water Table Elevations (WTE) compared to those monitored on the 6 farms during the project.

Mechanisms of managing water for rewetting

- **Retaining water**
  Excess water retained during the colder-month period to buffer against excess evapotranspiration during the warmer-month period using bunds.

- **Sub-surface irrigation**
  Flow from field-side ditches which are held at an appropriately high level during the warmer-month period – water moves under gravity.

- **Irrigation from above**
  Pumping water and distributing it across fields.

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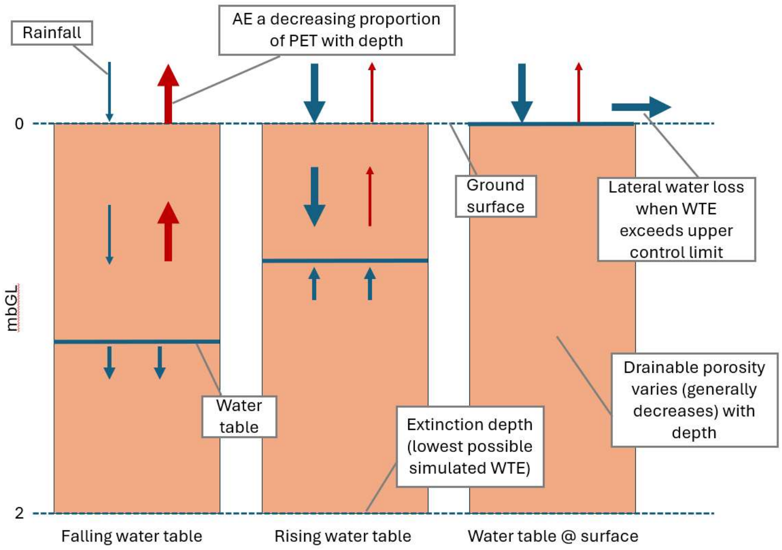
Simple spreadsheet model to estimate water demand



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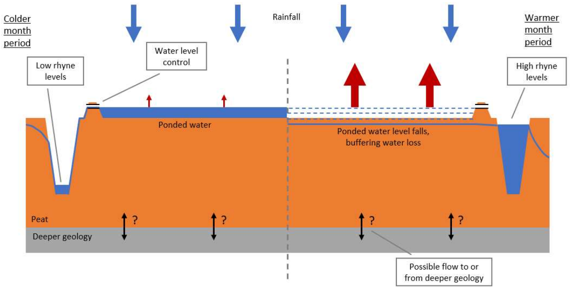
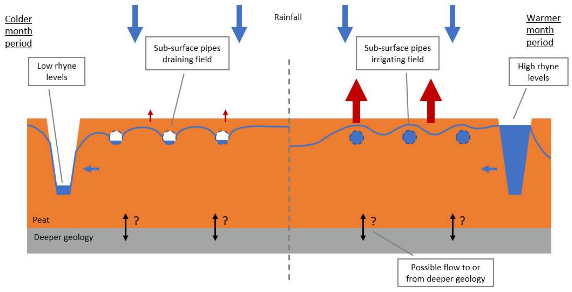
Higher-level options for restoration





On-field or on-site storage of winter-excess rainfall, reduces water requirement during summer

Sub-surface (pipes) or surface irrigation; significant water requirement during summer

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Model estimation of water demand for peatland restoration

- Run over 60 years (1961-2021), daily timestep
- Daily rainfall data from CEH GEAR
- Daily PET from EA
- Control scenarios…..

#	Upper	Lower	Rationale
1	0	300	To assess the amount of water which would be required if the water table could be 'micro-managed' to not fall below 0.3 mbGL. No surface inundation.
2	0	200	To assess the amount of water required if, in practice, the average lowest WTE was 0.2 mbGL. No surface inundation.
3	0	100	To assess the amount of water required if, in practice, the average lowest WTE was 0.1 mbGL. No surface inundation.
4	-100	200	To assess the amount of water required if surface inundation was allowed to 0.1 m depth. A lower control depth of 0.2 mbGL used as a reference.
5	-200	200	To assess the amount of water required if surface inundation was allowed to 0.2 m depth. A lower control depth of 0.2 mbGL used as a reference.

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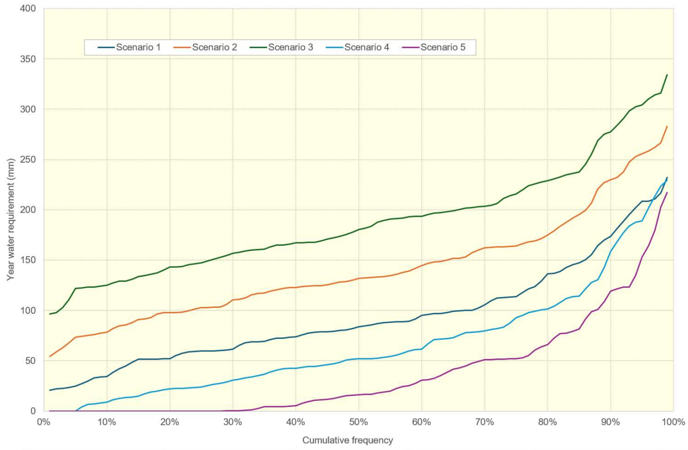
Model estimation of water demand for peatland restoration



Depth of water (mm) required to fulfil demand for x% of years

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
50% of years	83	132	180	52	16
90% of years	174	230	277	159	119

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Patchy Peat Solutions Project - future work

- Measure BFI - water coming from springs and watercourses & monitor ditches.
- Determine effectiveness of existing drainage, weirs, & water pumps.
- Establish the nature of vertical hydraulic gradients by installing deeper piezometers.
- Assess level of abstraction from Permo-Triassic Sandstone.
- Impact - establish hydrological inter-dependencies between farms/land holdings (including ditches).

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Farm specific water retention & management strategies

	Individual farm re-hydration strategy										
	TB-R	**TB-GWD**	**DW**	**DD**	**PS**	**PD**	**PR**	**DF**	**BB**	**Opportunities**	**Finance mechanism**
Farm A	■		■	■						Farming @ higher WTE & wetland creation/restoration	Gov't & private finance
Farm B	■				■	■		■	■	Farming @higher WTE (grazing) & wetland creation	Gov't & private finance
Farm C										N/A	N/A
Farm D	■	■	■				■	■		Farming @higher WTE (grazing) & wetland creation	Gov't & private finance
Farm E	■	■						■		Farming @ higher WTE (cricket bat willow, grazing &	Gov't & private finance
Farm F				■				■		Farming @ higher WTE (Miscanthus)	N/A

Key

TB-R: Trench Bunds - inundation from Rainfall; **TB-GWD**: Trend Bunds – retaining Ground Water Discharge; **DW**: Dams in Watercourses; **DD**: Dams in Ditches; **PW**: Pumped water from Watercourses; **PD**: Pumped water from Ditches; **PR**: Pumped water from Reservoirs; **DF**: Disable Field drains; **BB**: Breach Banks to allow flooding in low lying fields during high flows.

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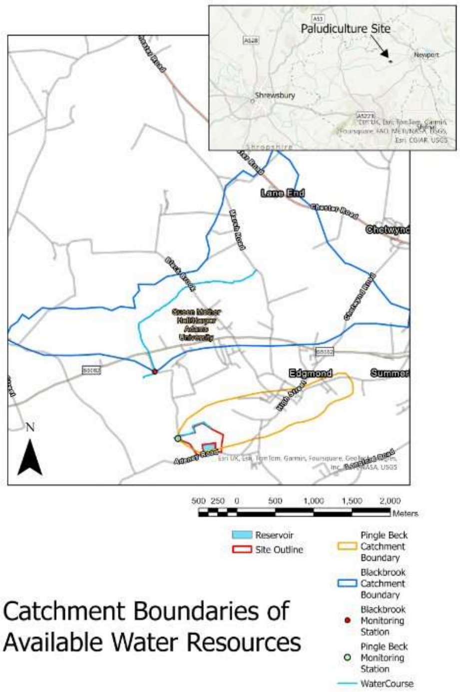
Paludiculture Innovation Project – Adeney Yard.



Catchment Boundaries of Available Water Resources

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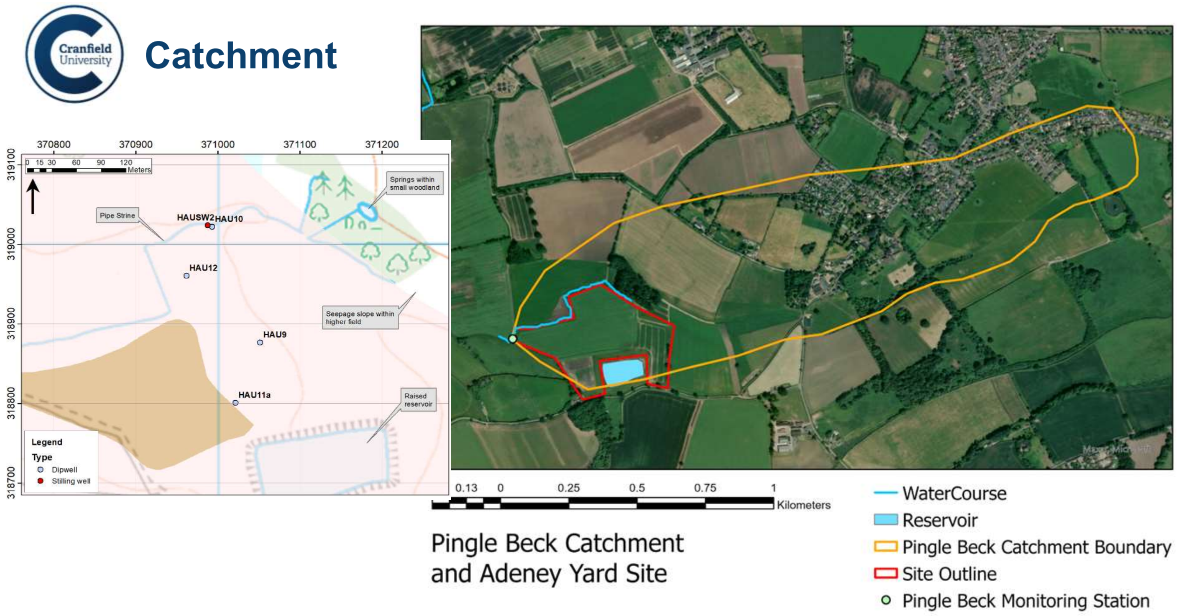
Catchment



Pingle Beck Catchment and Adeney Yard Site

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Site creation

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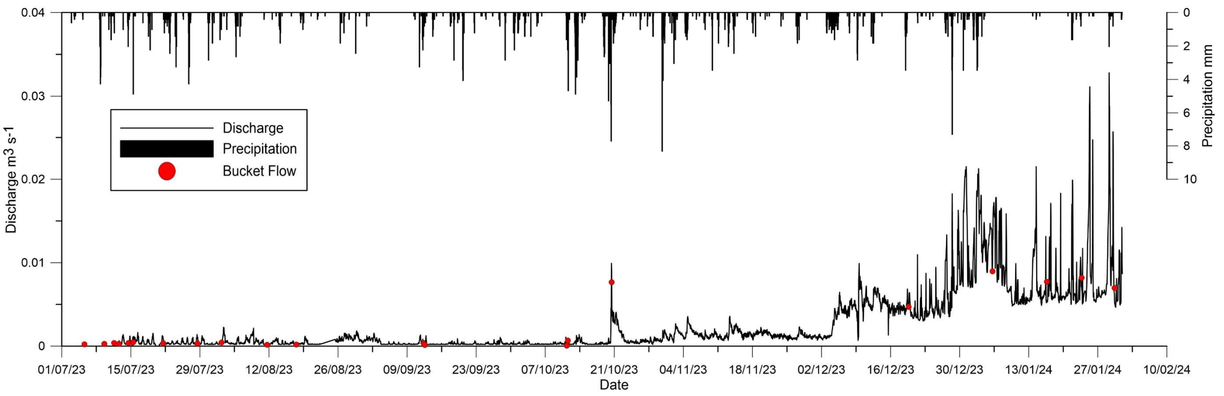
Pingle Beck Flows



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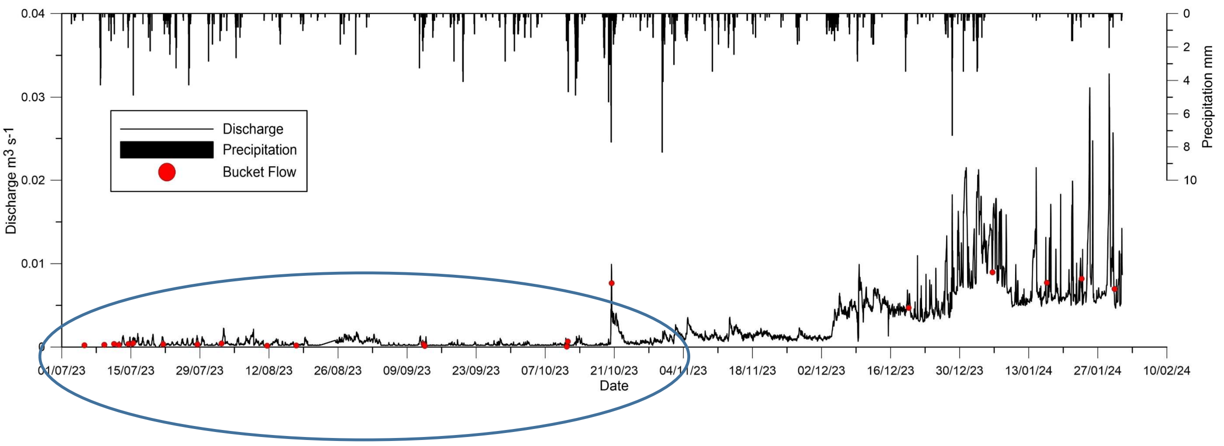
Pingle Beck Flows



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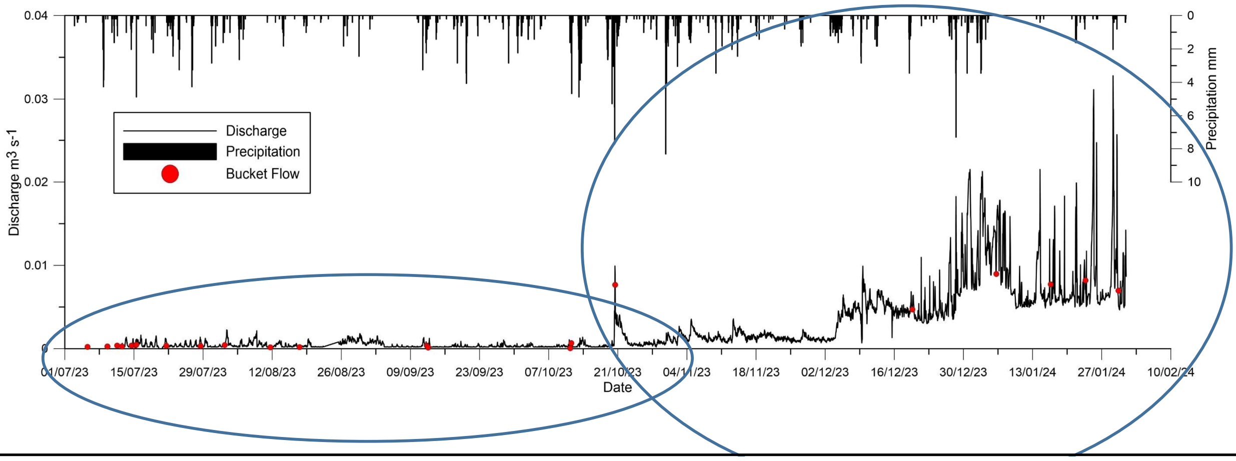
Pingle Beck Flows



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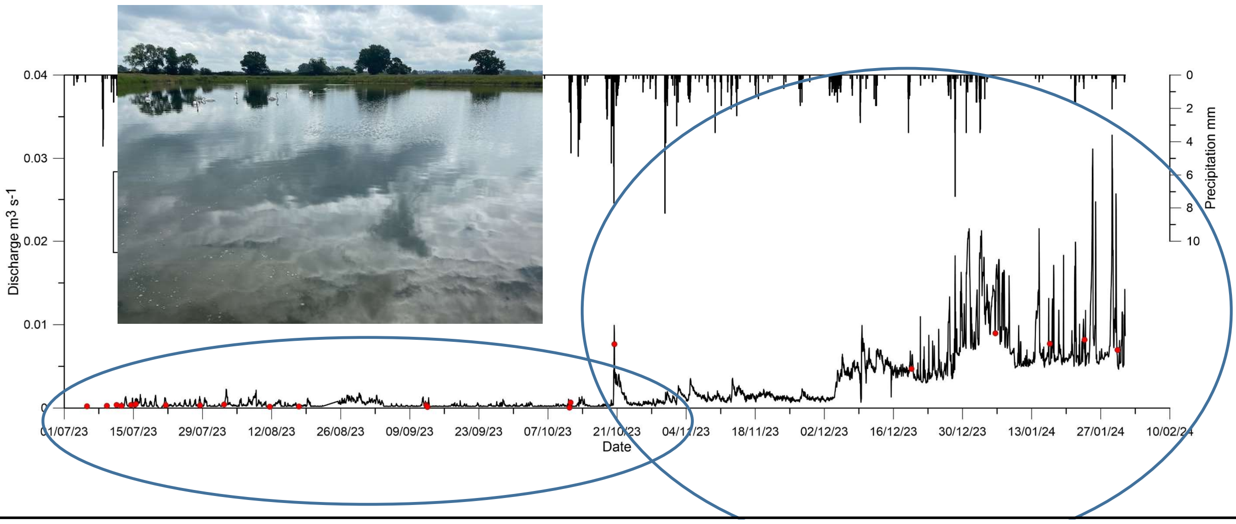
Pingle Beck Flows



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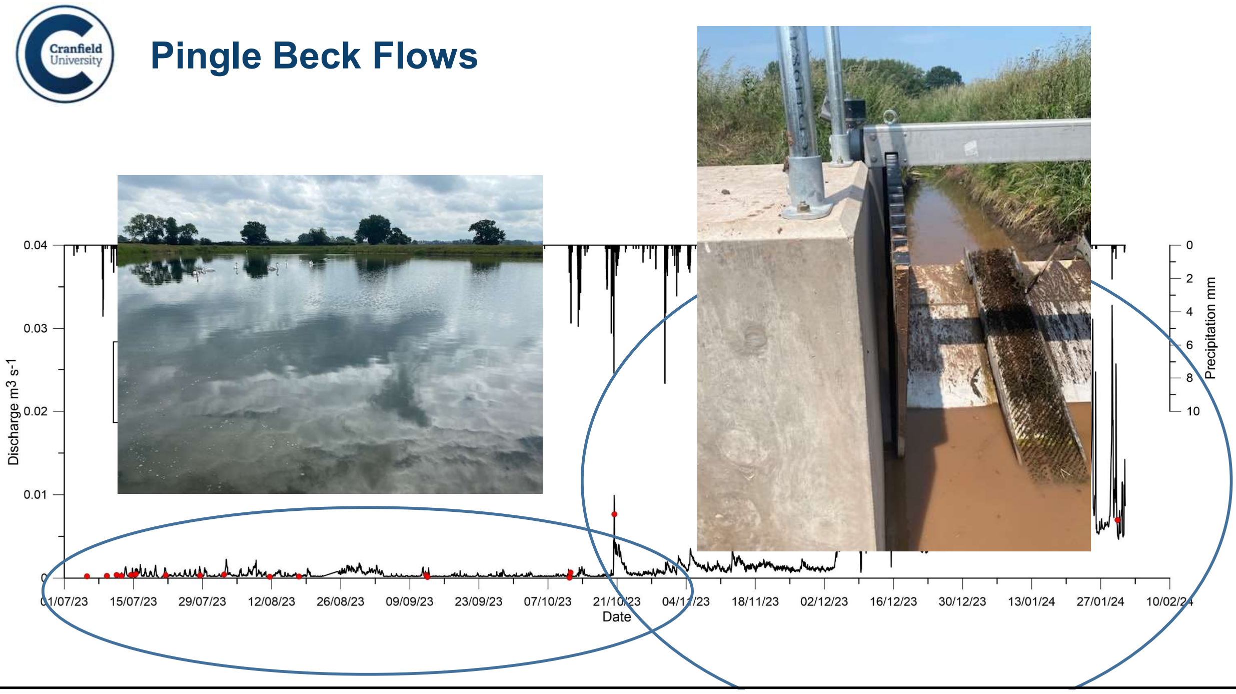
Pingle Beck Flows



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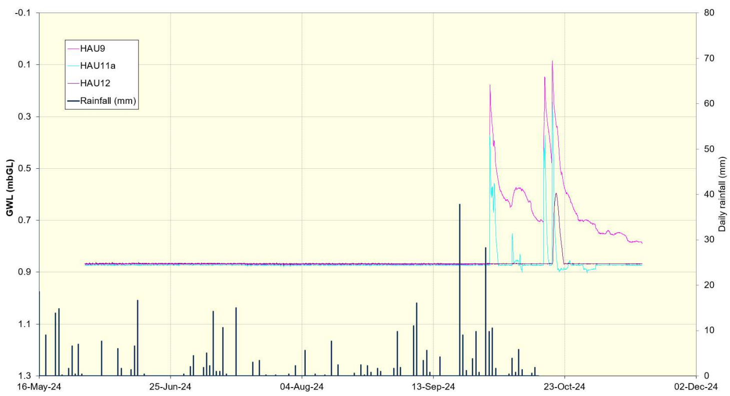
Farm D – impact of abstraction

Hydrograph (mbGL) for dipwells within Farm D, Area D1 (Adeney Yard)



- Rapid post-rainfall falls in Water Table Elevation and the very low WTEs during the majority of the monitoring period demonstrates that the coarse to medium sand acts as an under-drain to the peat.
- This is due to over abstraction of the Permo-Triassic sandstone (aquifer).

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Conclusions

Where is water for lowland agricultural peat restoration going to come from?

What are the priorities for lowland agricultural peat?
- Emission reduction
- Restoration

How will this be achieved?
- On farm storage
- Innovation
- Public & private finance
- Agri-tech solutions
- Policy
- Social & human capital

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Thank you very much to our funders, (Environment Agency) & our Patchy Peat Solutions Project Team of farmers, academics and stakeholders.

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