Peat restoration reduces stormflow from headwater catchments:

Results from the MS4W Peak District demonstration catchments

Tim Allott[1], Martin Evans[1], Clive Agnew[1], Jon Gorham[1], Jane Mellor[1], Dave Milledge[2], Mike Pilkington[3], Rachael Maskill[3]

+ Many other helpers!!

University of Manchester [1], University of Durham[2]

and Moors for the Future[3]

Landscape-scale degradation, Landscape-scale restoration

Key Messages

- Peat restoration slows delivery of water from the headwaters
  - lag times increased by c.20 minutes (100%)
  - c.30% reductions in peak discharge of large storms
- Pronounced benefit from re-vegetation of bare peat, additional benefit from gully blocking
- Restoration can contribute to downstream flood risk reduction
  - Issue now is scale of the contribution

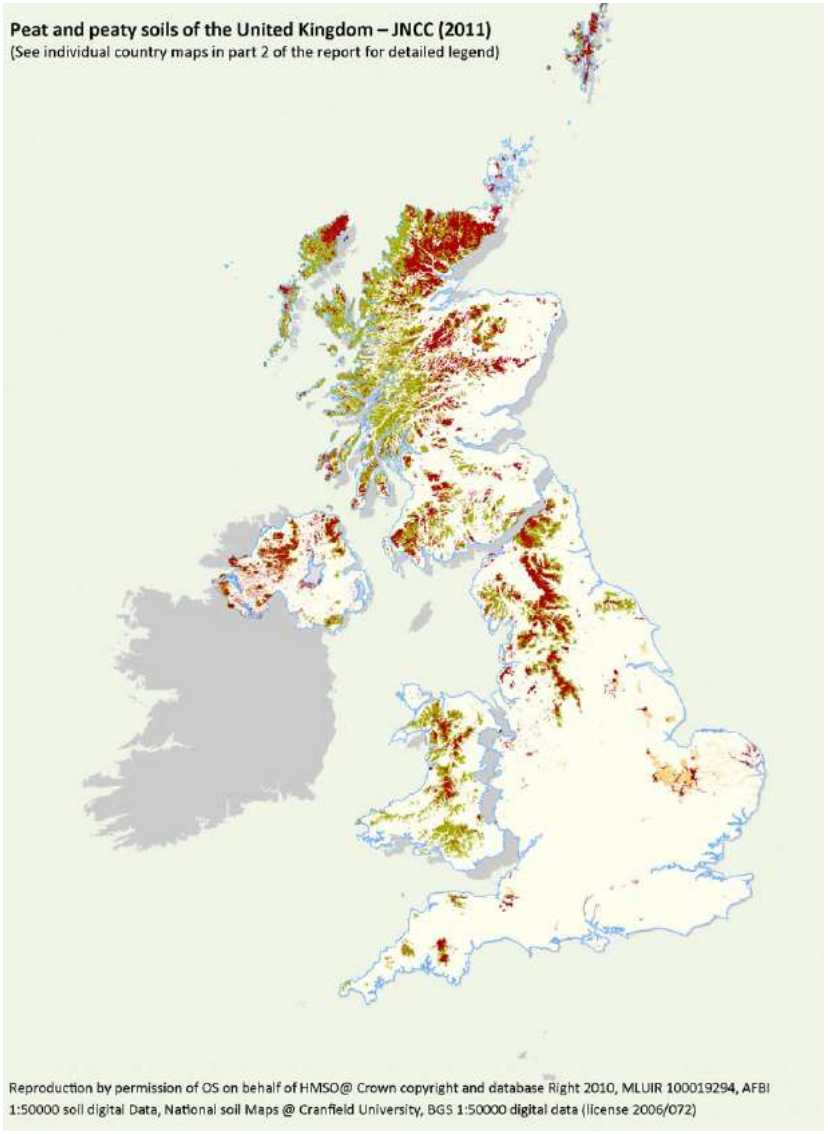

The Queens
30 7 2002

Glossop and the Pennine Hills

The headwaters are dominated by peatlands (blanket bogs)

Peat Erosion in the Peak District

UK Upland Blanket Peats and Erosion



Shetlands (© The Shetland Times)

Abergwesyn, Wales (© National Trust)

Peat erosion and rapid stormflow runoff

Landscape-scale erosion and restoration

Restoration by Re-vegetation

Restoration by Gully blocking

The Peak District Making Space for Water Demonstration Project

Will peat restoration slow the release of water from the hills and reduce downstream flood risk?

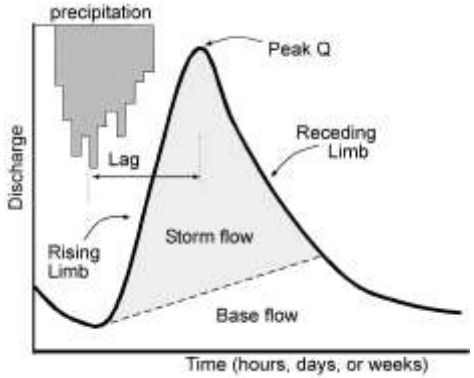
Our Initial Question

Can we detect reduced stormflow from ***headwater catchments*** following restoration?

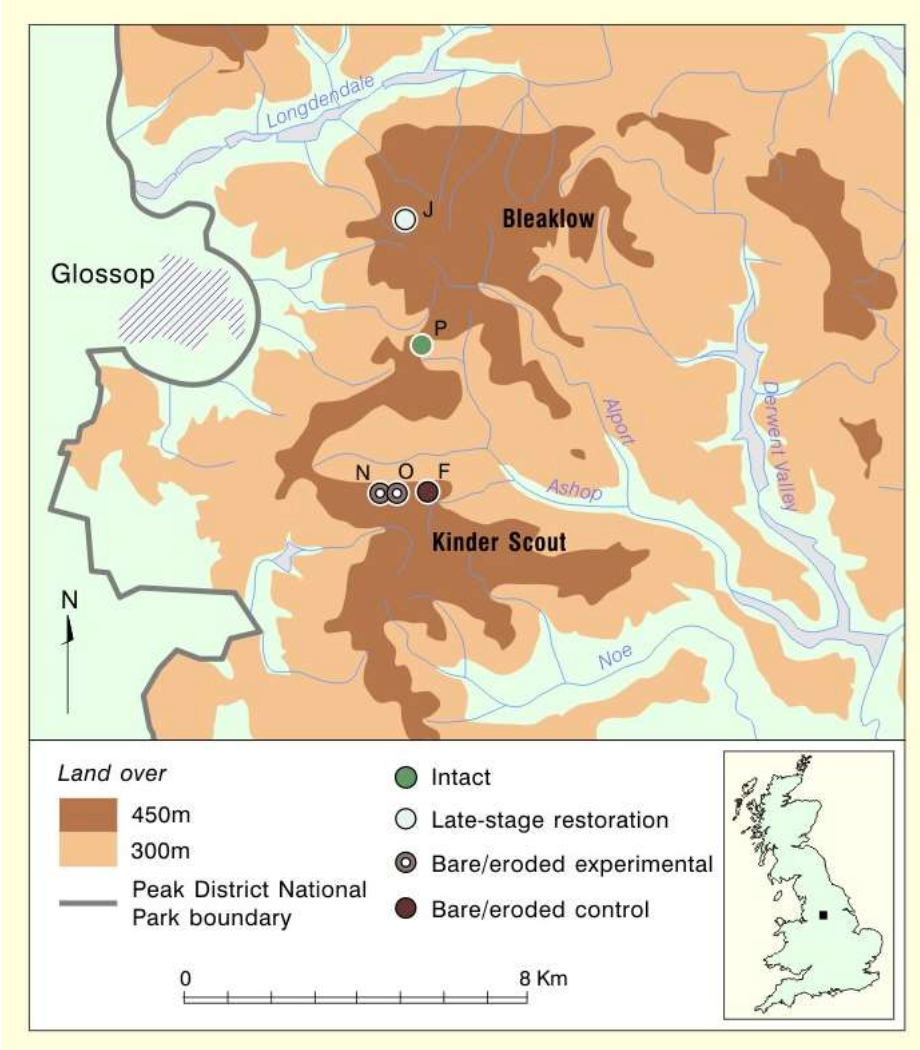
- Reductions in stormflow peaks
- Increases in lag times
- Hydrograph attenuation

Bare peat

Early stage restoration



'*Making Space for Water*' Peak District demonstration project (2010-2015)



- Hectare-scale study catchments
- Monitoring rainfall-runoff, with additional overland flow and water table data
- **Space-for-time** comparison of runoff characteristics of intact, eroded and restored (re-vegetated) catchments
- **Before-after-control-intervention** (BACI) study of restored eroded catchments
  - Control
  - Intervention = re-vegetation only
  - Intervention = re-vegetation and gully blocking

Site Setup

The ‘Space for Time’ Study

Past conditions → Degraded peats → Future conditions

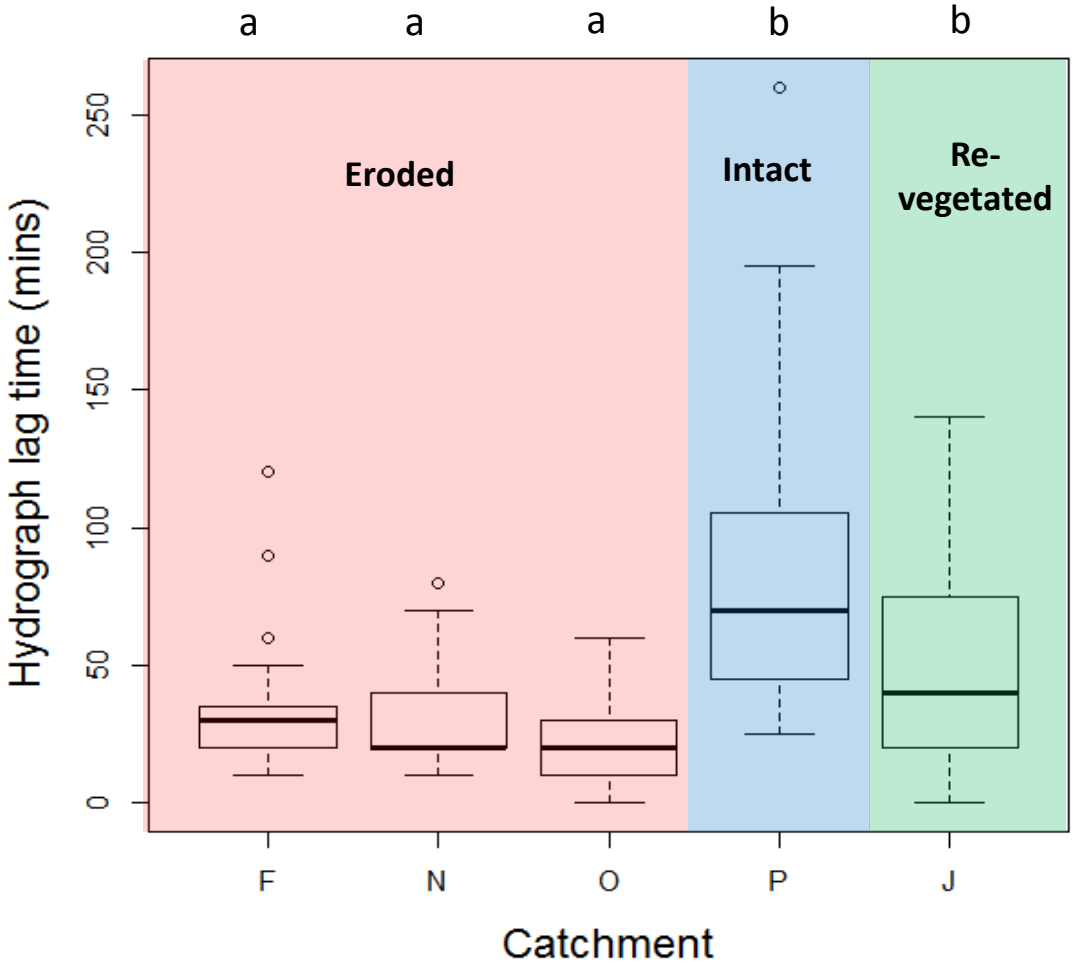
Intact blanket peat catchment

Bare/eroded peat catchments

Restored catchment (was bare/eroded, but re-vegetated in 2003)

MS4W Peak District catchments:

Comparison of stormflow lag times in the **space-for-time** study (2010-11 data)



MS4W Peak District catchments:

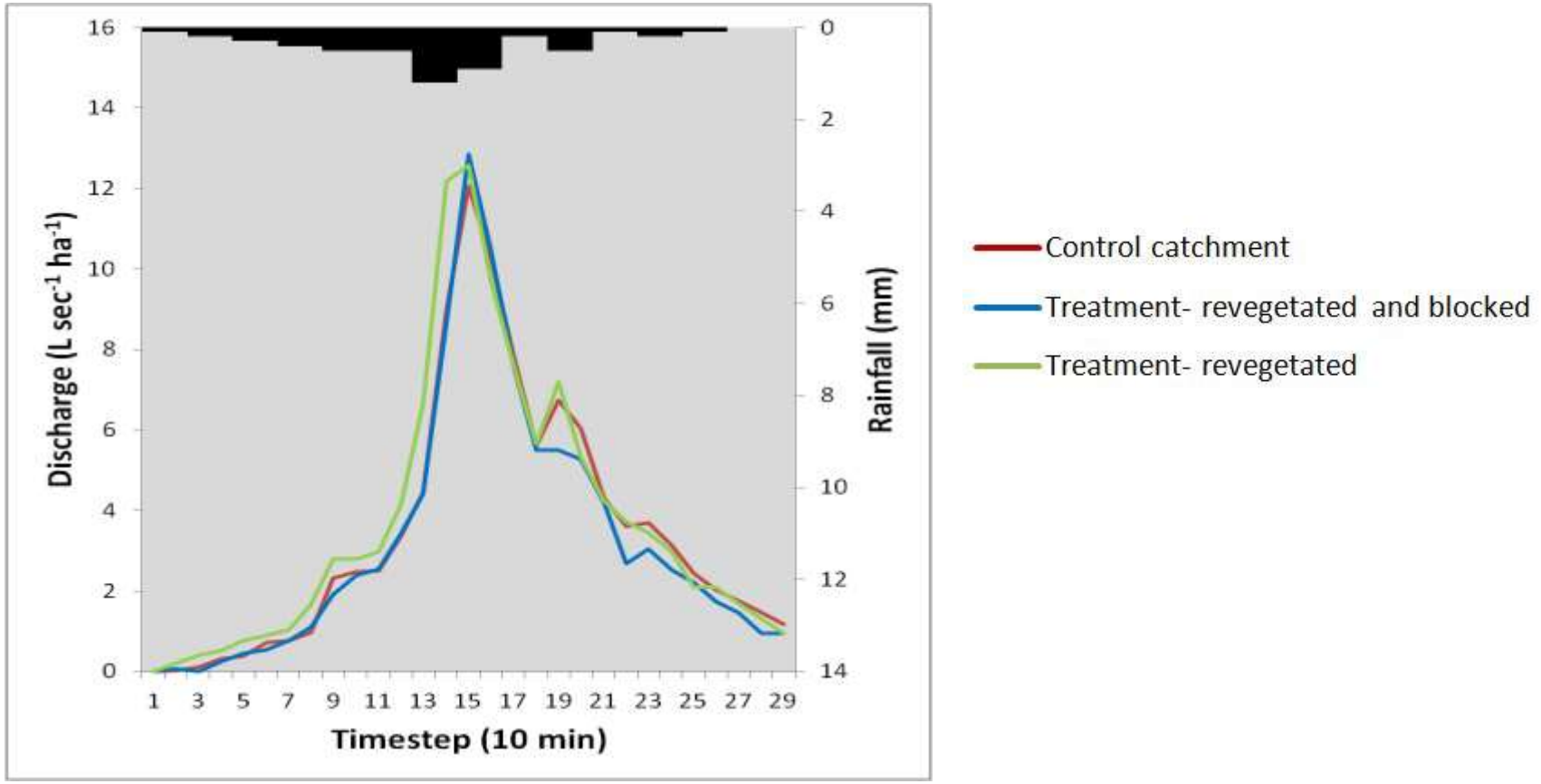
Before-After-Control-Intervention Study

Example of storm hydrograph responses before restoration

Before Treatment

4/11/2010

Storm rainfall = 10.4 mm



MS4W Peak District catchments:

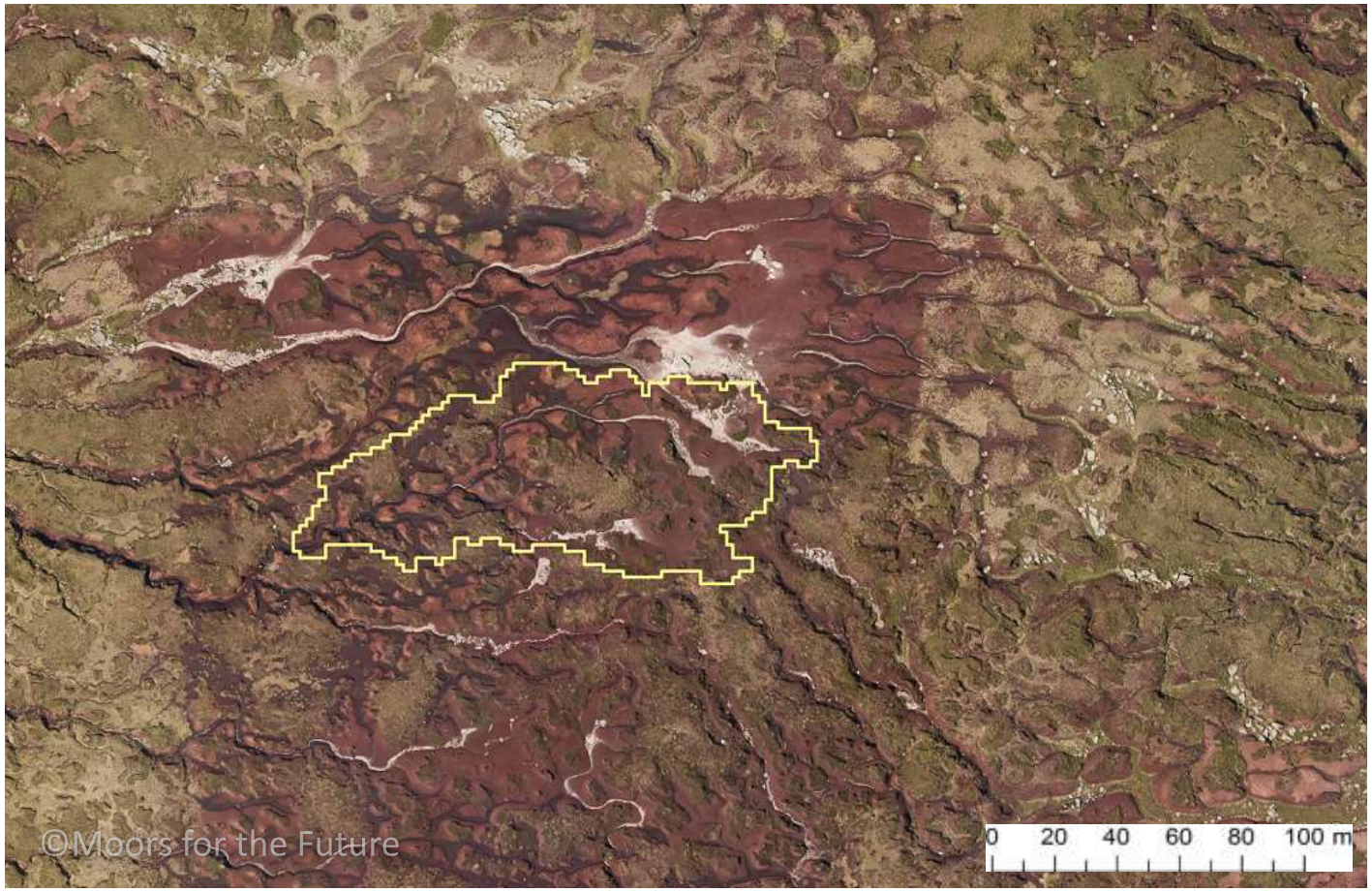
Before-After-Control-Intervention study

2010/11

2013/14

Control area and catchment

June 2013, 2 years after restoration of surrounding peatland
(seed-lime-fertilizer and gully blocks)

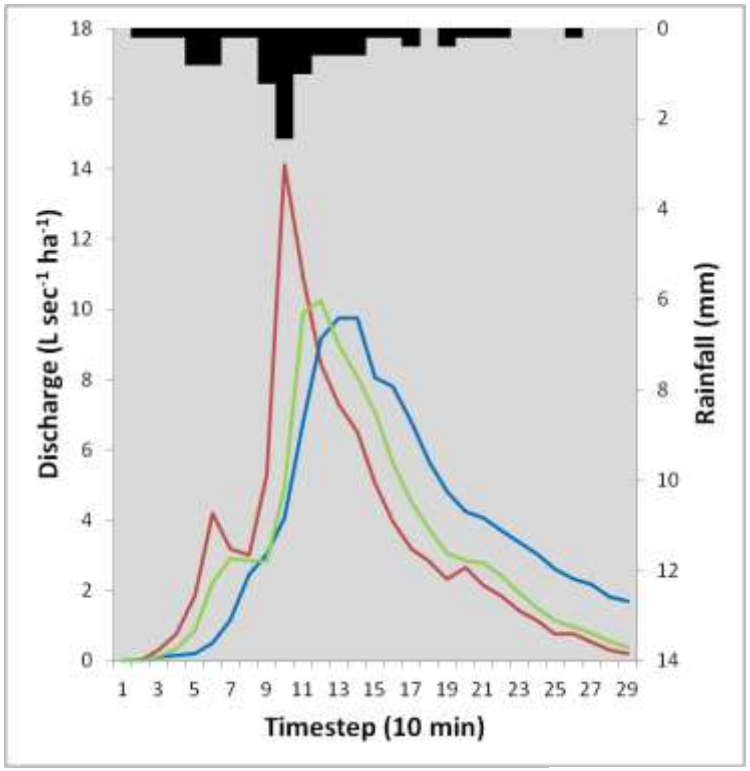


MS4W Peak District catchments:

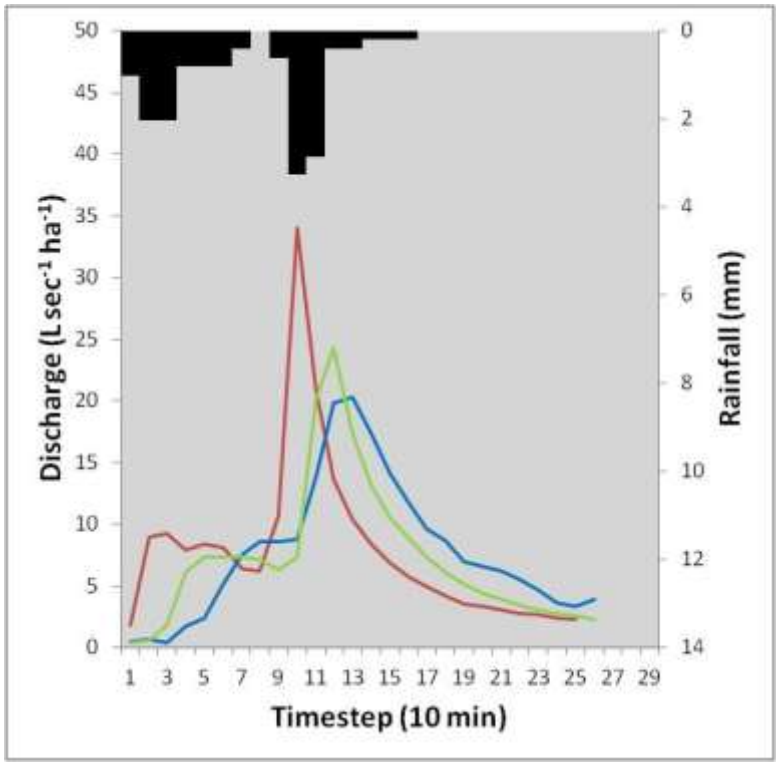
Before-After-Control-Intervention Study

Examples of storm hydrograph responses after restoration

After Treatment
19/7/2012
Storm rainfall = 11.2 mm



After Treatment
16/12/2013
Storm rainfall = 15.1 mm



Control catchment

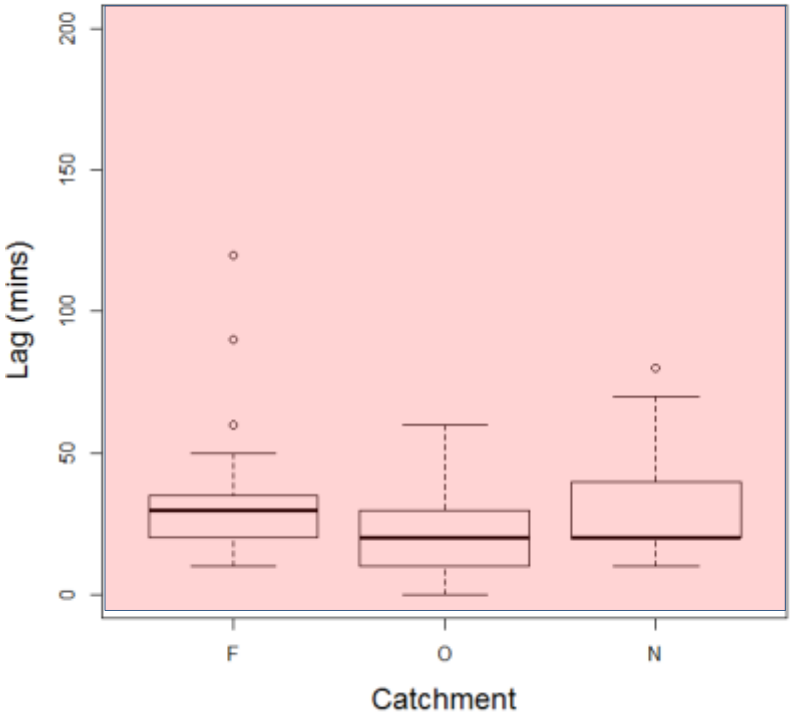
Treatment- revegetated and blocked

Treatment- revegetated

MS4W Peak District catchments:

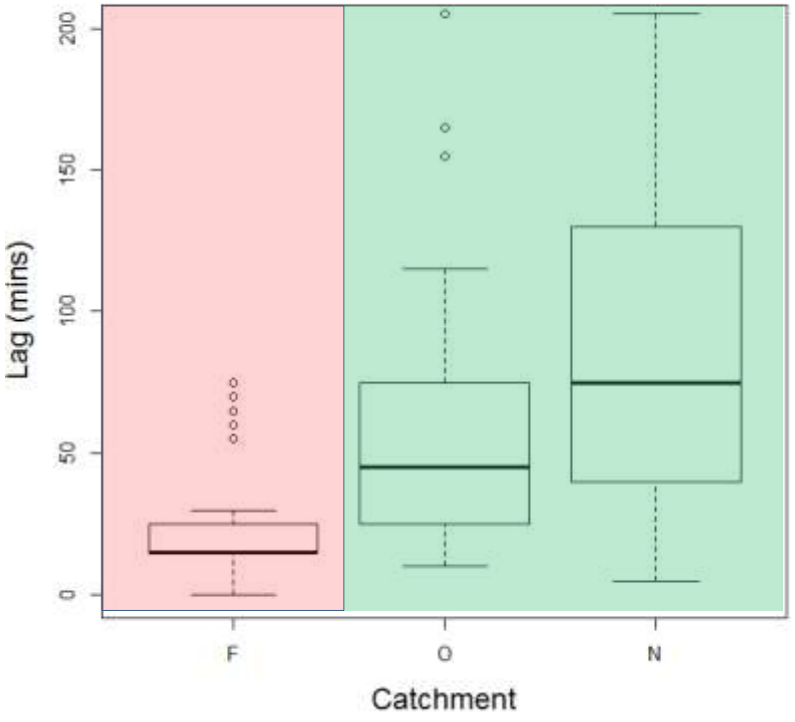
Comparison of **stormflow lag times** in the before-after-control-intervention study

Pre-Treatment Storms (2010-11)



n= 32 n= 37 n= 34

Post-Treatment Storms (2012-13)

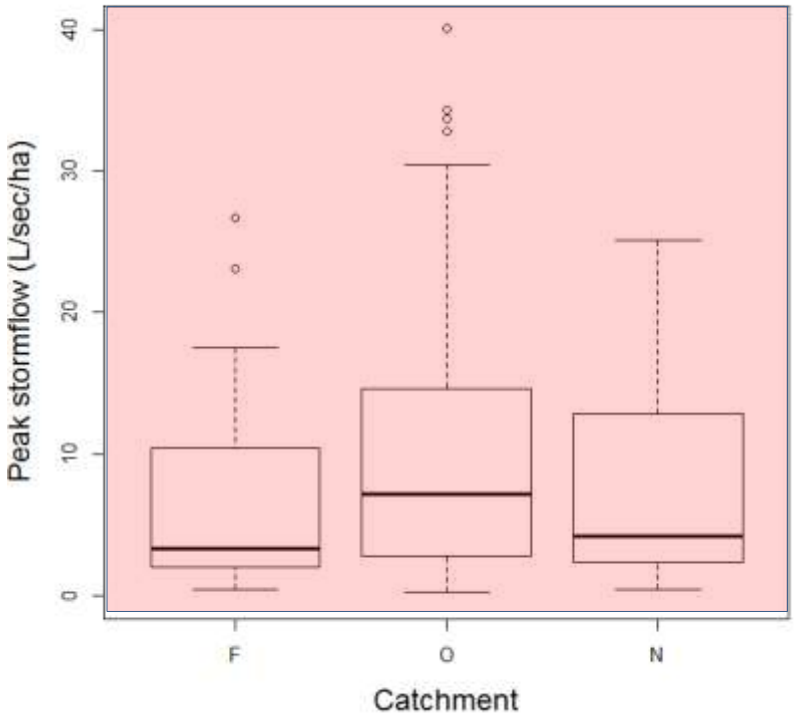


n= 36 n= 42 n= 46

MS4W Peak District catchments:

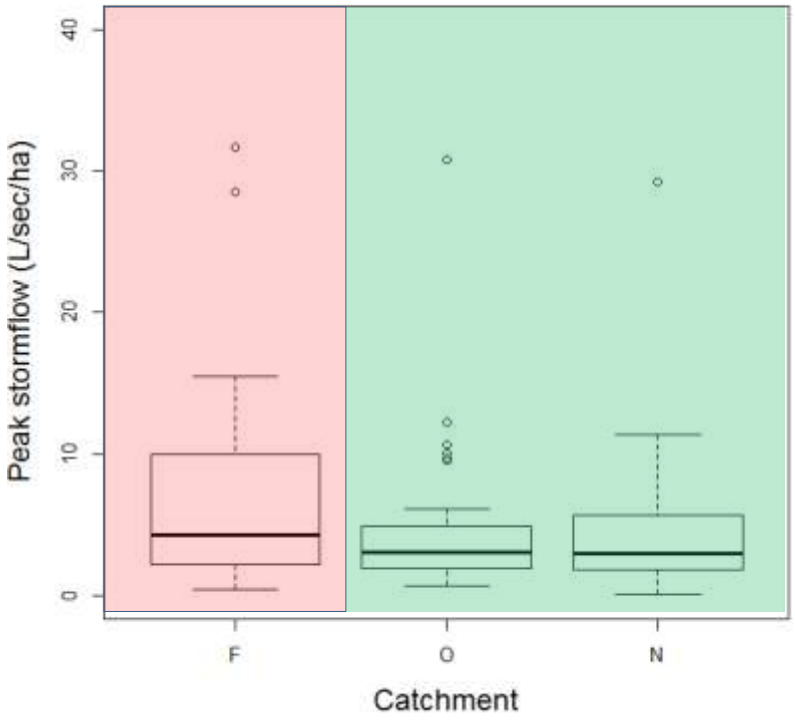
Comparison of **peak stormflows** in the before-after-control-intervention study

Pre-Treatment Storms (2010-11)



n= 32 n= 37 n= 34

Post-Treatment Storms (2012-13)



n= 36 n= 42 n= 46

MS4W Peak District catchments:

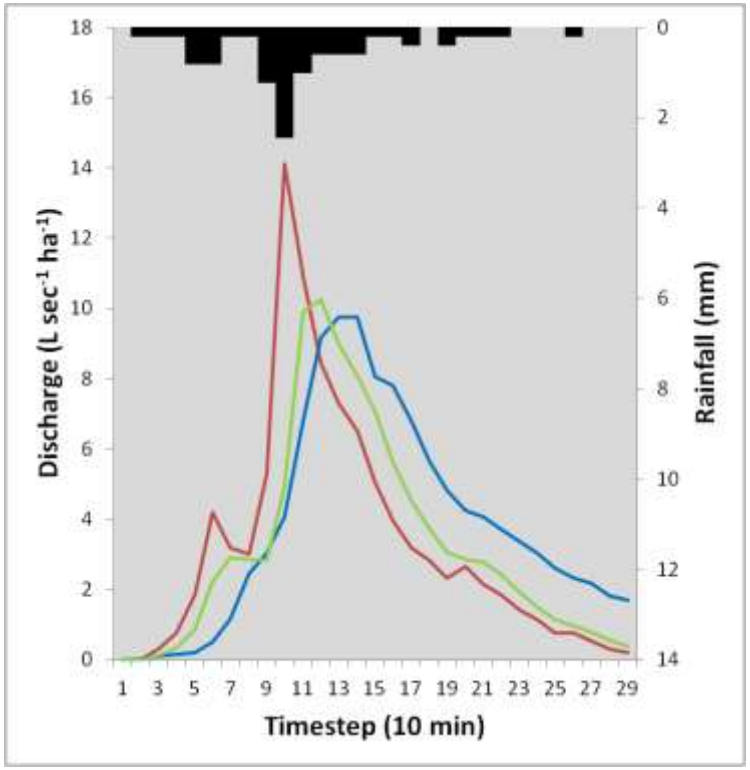
But does this still hold for the really big events??

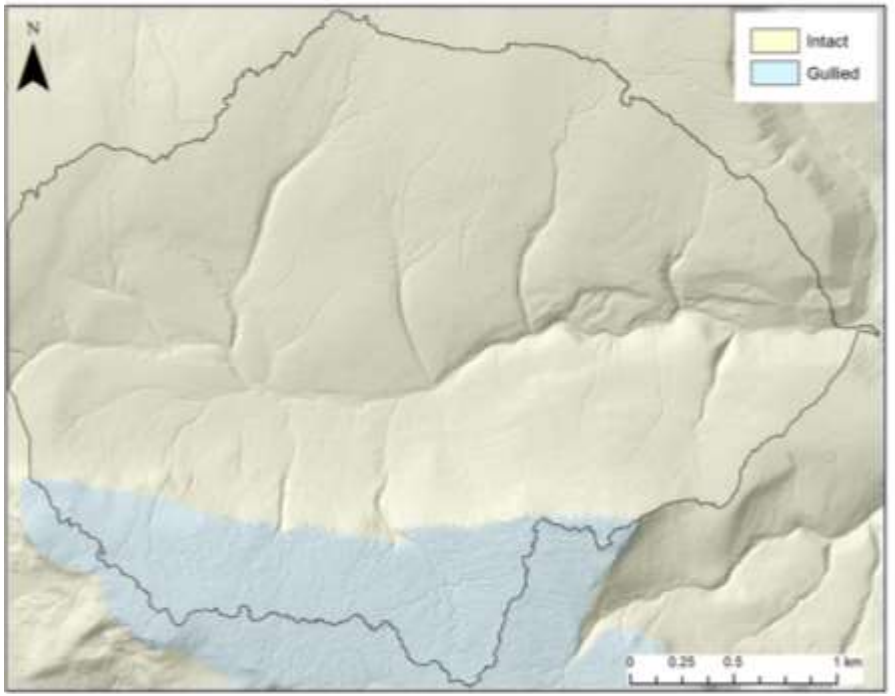
Catchment		Mean peak stormflow discharge Full dataset (36-46 storms)	Mean peak stormflow discharge Largest 10 storms only
Control	L sec^{-1} ha^{-1}	6.83	12.4
Treatment – re-vegetated	L sec^{-1} ha^{-1}	4.54	8.84
	% Reduction	34%	29%
Treatment – re-vegetated and blocked	L sec^{-1} ha^{-1}	4.52	9.01
	% Reduction	**34%**	**28%**

So far… YES! Peak flow reduced c.30% in the larger storms

MS4W Peak District catchments:
Evaluating contribution to *downstream* hydrographs and flood risk reduction

Upscaling through modelling – TALK 2
(Dave Milledge)





MS4W Peak District catchments:
Some remaining work needed to confirm the cause/s of change in storm behaviour

Oct 2010

March 2014

Slope overland flow retardation (*sensu* Holden *et al* 2008)
and/or
Channel roughness and storage effects

Summary

- Peat restoration slows delivery of water from the headwaters
  - lag times increased by c.20 minutes (100%)
  - c.30% reductions in peak discharge of large storms
- Pronounced benefit from re-vegetation of bare peat, additional benefit from gully blocking
- Restoration can contribute to downstream flood risk reduction
  - Issue now is scale of the contribution
- Final stages of the current project will evaluate:
  - Relative importance of overland vs channel flow effects
  - Impacts of the headwater changes at the larger catchment scale