NFM features mitigate sediment and nutrient loading in a lowland agricultural catchment in England

John Robotham, Gareth Old, Ponnambalam Rameshwaran, David Sear, Emily Trill, James Bishop, David Gasca-Tucker, Joanne Old, David McKnight

UK Centre for Ecology & Hydrology

University of Southampton

University of Reading

UKRI Natural Environment Research Council

Thames Water

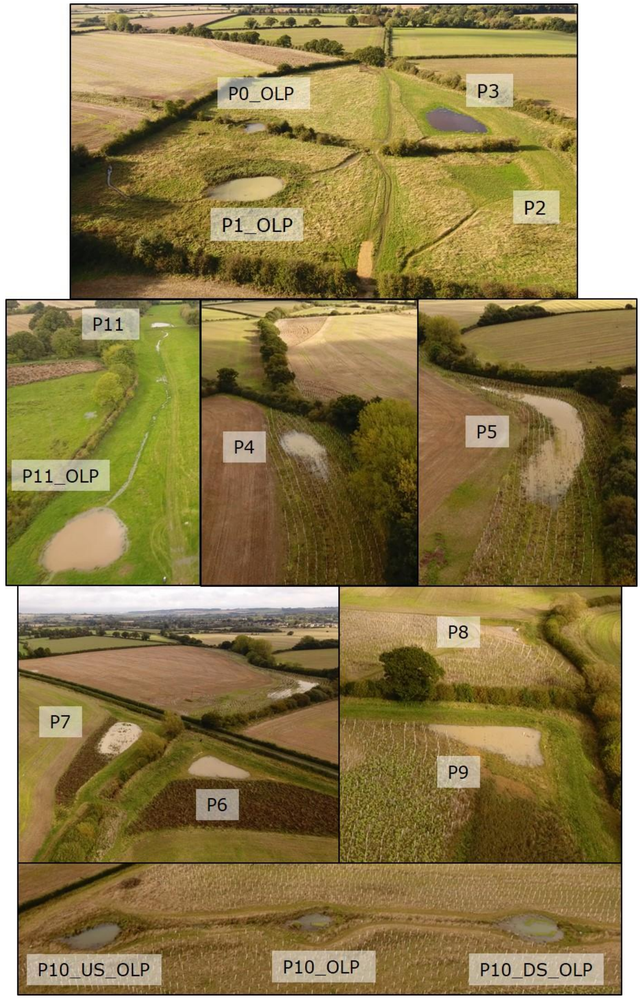
ATKINS
Member of the SNC-Lavalin Group

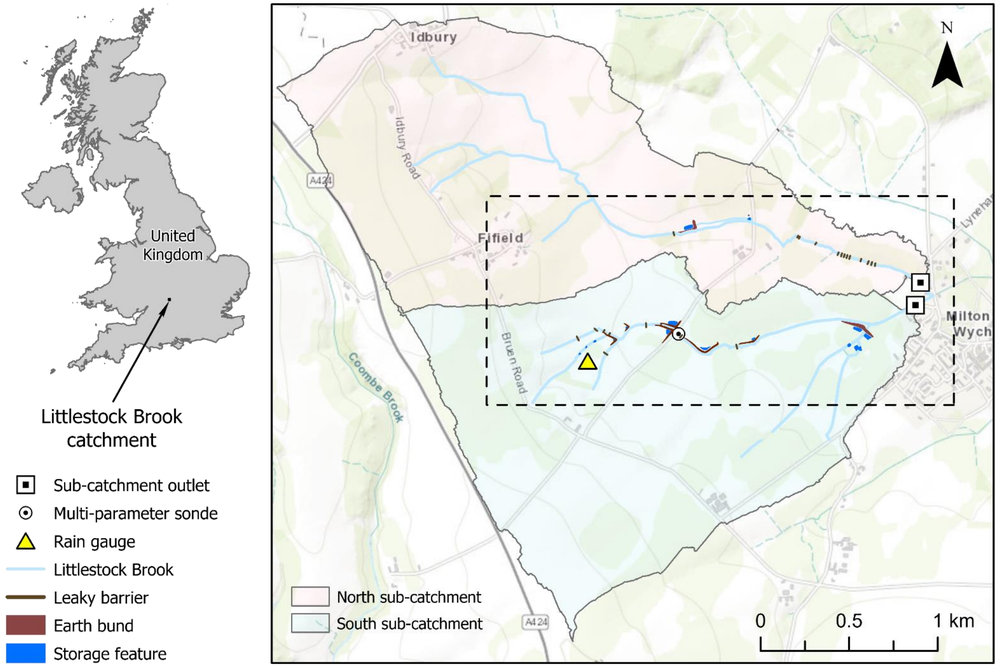
Environment Agency

Wild Oxfordshire

ecp

Study Site





Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Methods & Monitoring

Sharing is encouraged

Sediment core sampling
- Bulk Density
- Total Phosphorus
- Organic Matter/Carbon
- Particle size distribution

Sediment depth surveying

Spatial interpolation (natural neighbour)
- Sediment volume estimation

$BD \times Volume = Mass$

Sediment

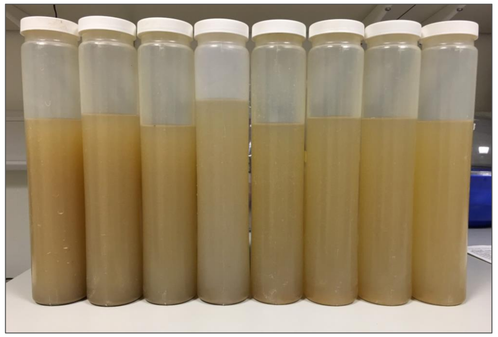
Total Phosphorus

Accumulation Rates

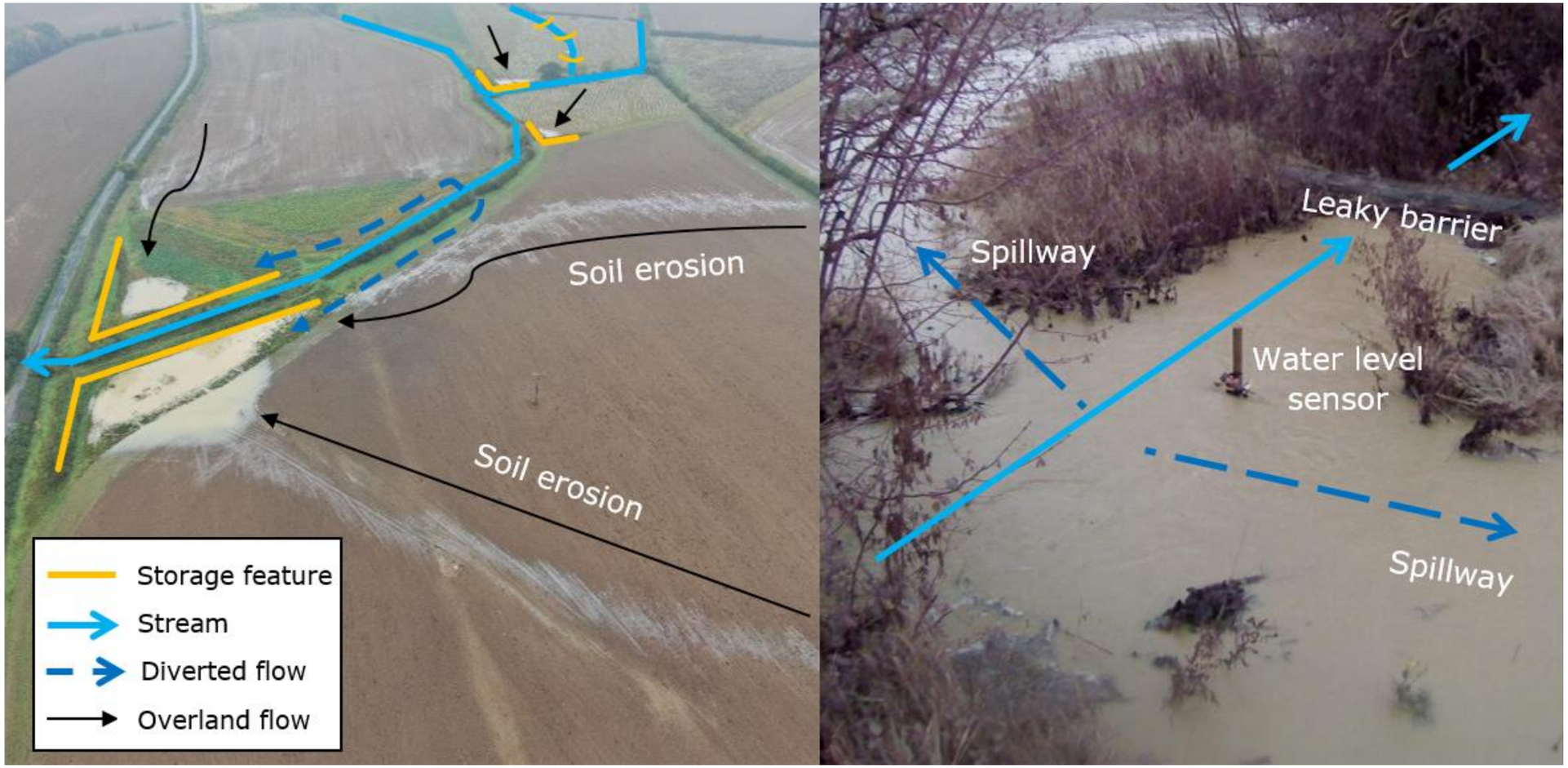
Turbidity & Discharge monitoring at catchment outflow

SSC & TP sampling to calibrate turbidity

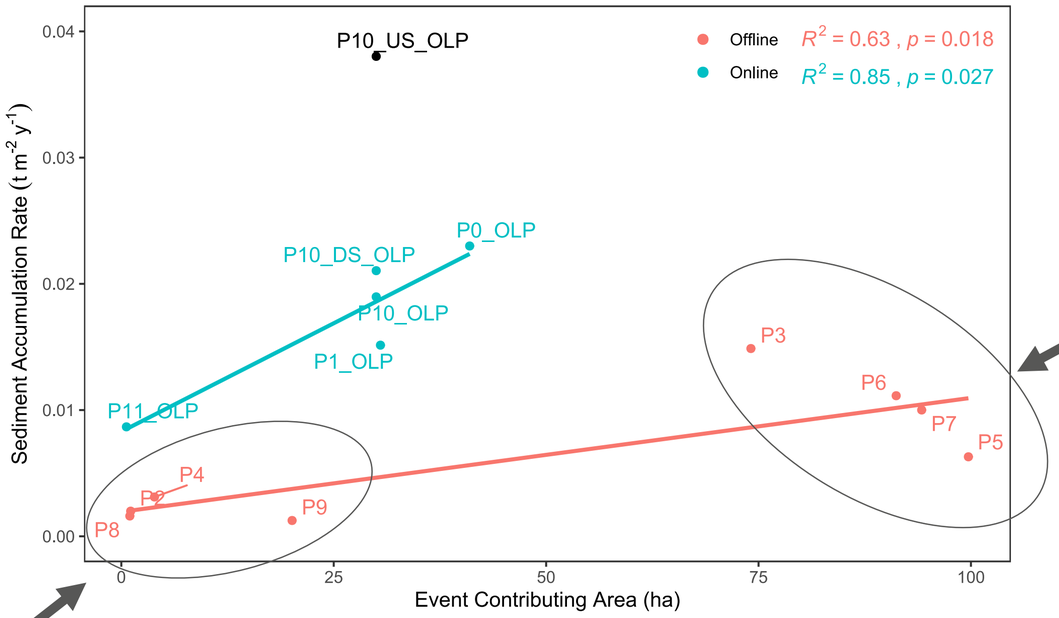
Suspended Sediment & Total Phosphorus fluxes



NFM Design & Function



Key Findings – Accumulation Rates



Filled by run-off and overbank flow

Filled by run-off only

Offline Feature Hydrological Functioning

Benefits & Potential Disbenefits?

Sharing is encouraged

Baseflow: nutrient attenuation

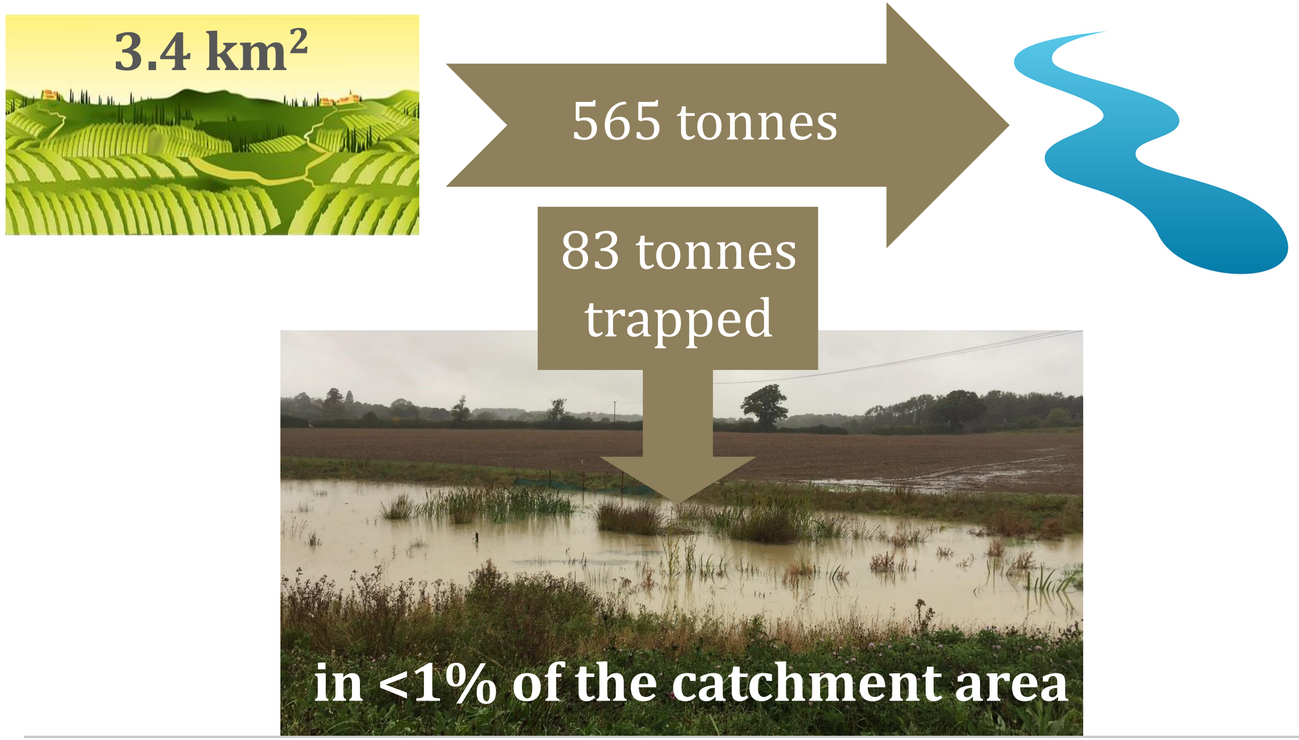
Nitrate
5%
mean reduction

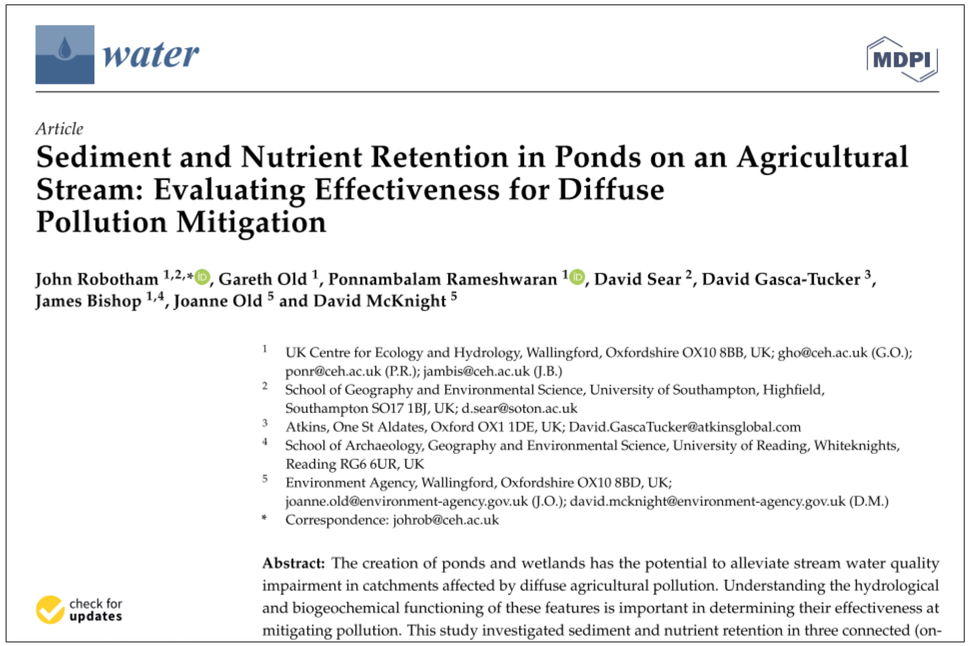
SRP
29%
mean reduction

Sediment remobilisation

In Summary…

- NFM ponds and flood storage areas can trap significant masses of sediment and P
  - 83 t sediment and 122 kg P stored (equivalent to ~25% and ~14% of catchment fluxes)
- Design of features and hydrological connectivity influences trapping rate





water

MDPI

Article

Sediment and Nutrient Retention in Ponds on an Agricultural Stream: Evaluating Effectiveness for Diffuse Pollution Mitigation

John Robotham [1,2,*], Gareth Old [1], Ponnambalam Rameshwaran [1], David Sear [2], David Gasca-Tucker [3], James Bishop [1,4], Joanne Old [5] and David McKnight [5]

1 UK Centre for Ecology and Hydrology, Wallingford, Oxfordshire OX10 8BB, UK; gho@ceh.ac.uk (G.O.); ponr@ceh.ac.uk (P.R.); jambis@ceh.ac.uk (J.B.)
2 School of Geography and Environmental Science, University of Southampton, Highfield, Southampton SO17 1BJ, UK; d.sear@soton.ac.uk
3 Atkins, One St Aldates, Oxford OX1 1DE, UK; David.GascaTucker@atkinsglobal.com
4 School of Archaeology, Geography and Environmental Science, University of Reading, Whiteknights, Reading RG6 6UR, UK
5 Environment Agency, Wallingford, Oxfordshire OX10 8BD, UK; joanne.old@environment-agency.gov.uk (J.O.); david.mcknight@environment-agency.gov.uk (D.M.)
* Correspondence: johrob@ceh.ac.uk

Abstract: The creation of ponds and wetlands has the potential to alleviate stream water quality impairment in catchments affected by diffuse agricultural pollution. Understanding the hydrological and biogeochemical functioning of these features is important in determining their effectiveness at mitigating pollution. This study investigated sediment and nutrient retention in three connected (on-

check for updates

https://doi.org/10.3390/w13121640

Thank you

johrob@ceh.ac.uk

@JohnLovesRivers