# Designed riparian buffers to improve functions and uptake

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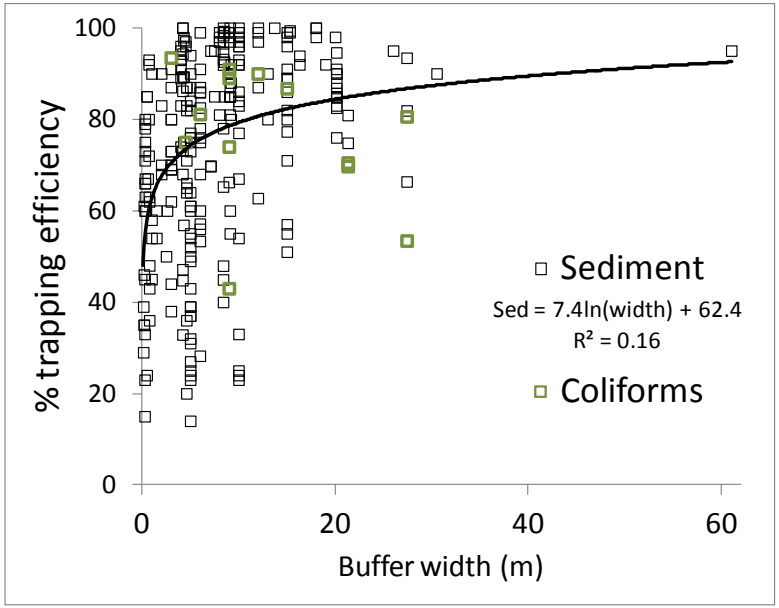
# Reasons for rethinking watercourse buffers

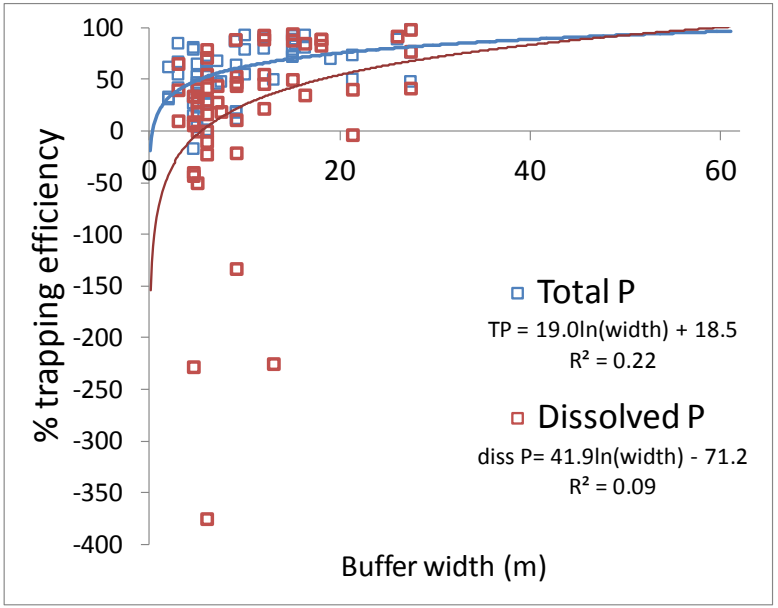
- Innovative use of designed structures in watercourse margins increases wider benefits to:
  - provide more certainty in functions;
  - lead to more space or effort in their adoption;
  - align funding and add leverage for uptake

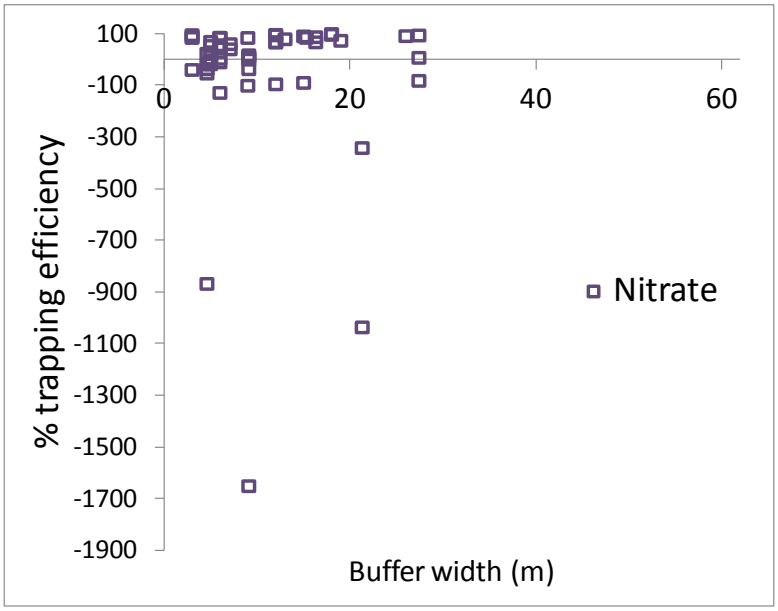
Current riparian margins are poorly performing in many cases……

Photos: S Langan, M Stutter, B Kronvang

# Pollution retention is highly site (study)-specific……

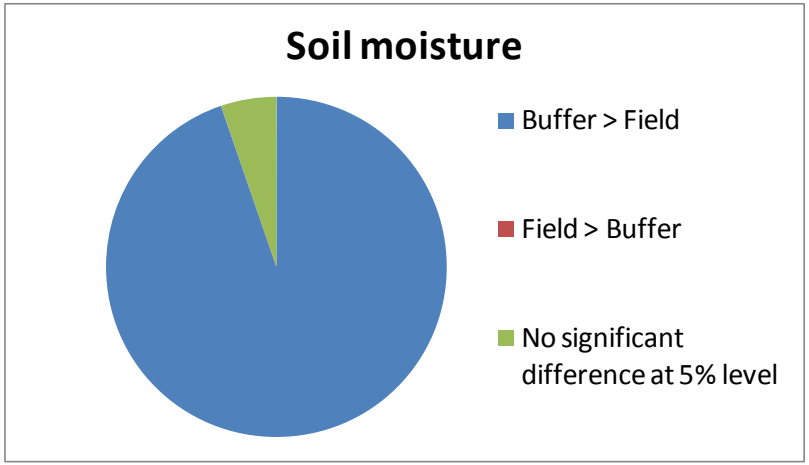


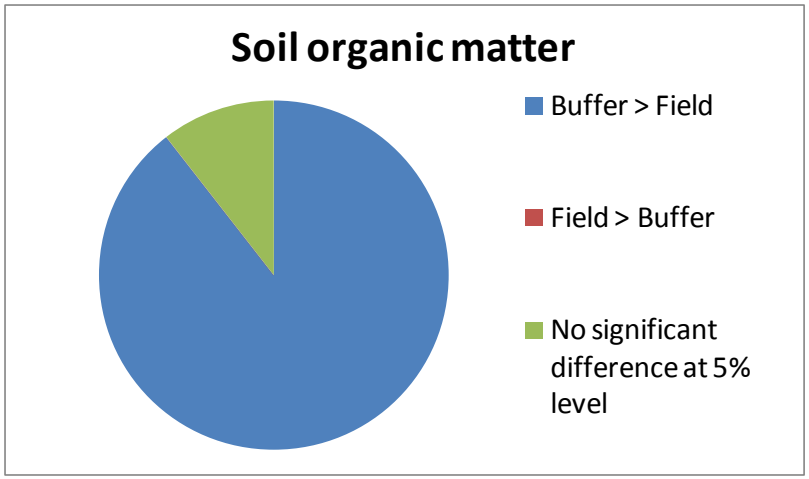




| | Model *p* | Trapping efficiency (Mean ± 95% C.I.) | |
|---|---|---|---|
| | | 2 m width | 10 m width |
| Sediment | <0.001 | 67 (62 to 73) | 79 (71 to 88) |
| Total P | <0.001 | 32 (6 to 60) | 62 (22 to 103) |
| Diss P | 0.03 | -42 (-148 to 64) | 25 (-139 to 190) |

# What's different about margin soils?

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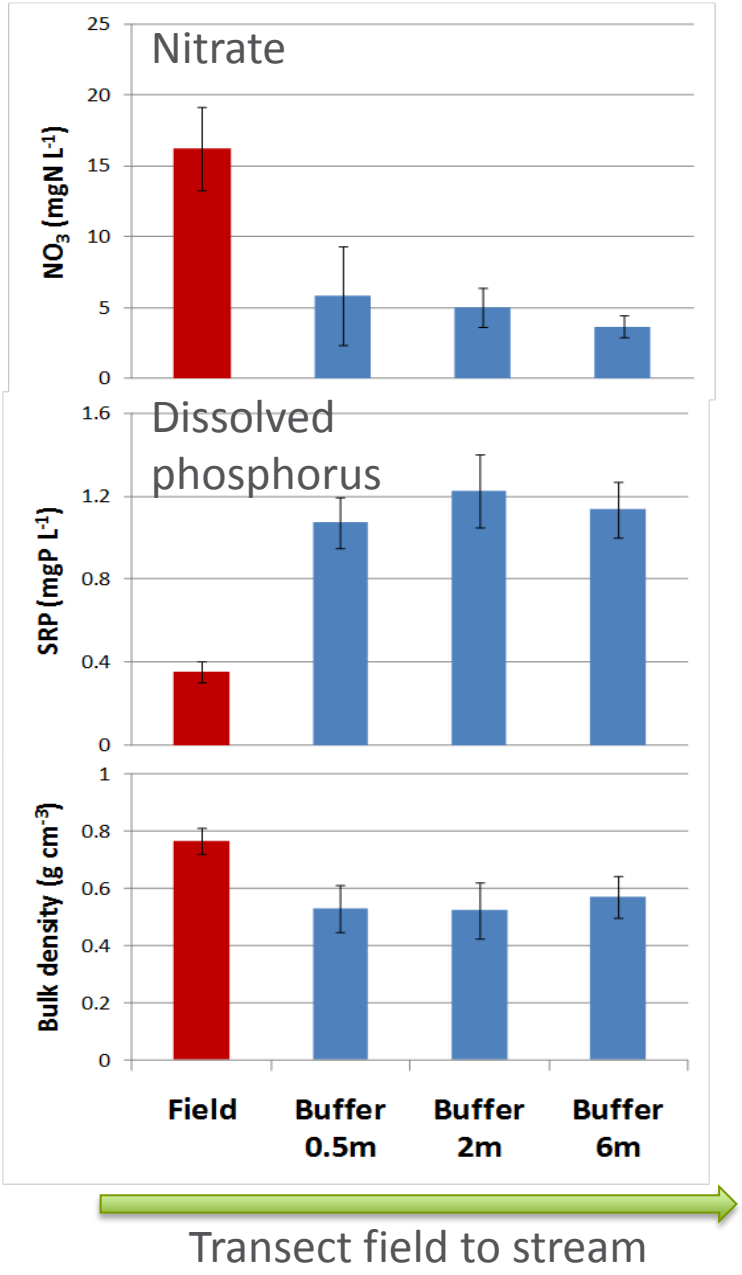


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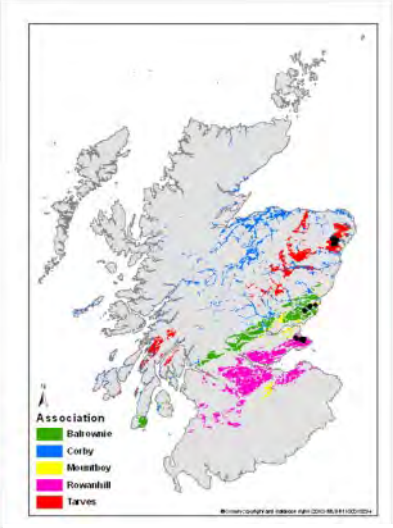


# What buffer space exists to build upon?

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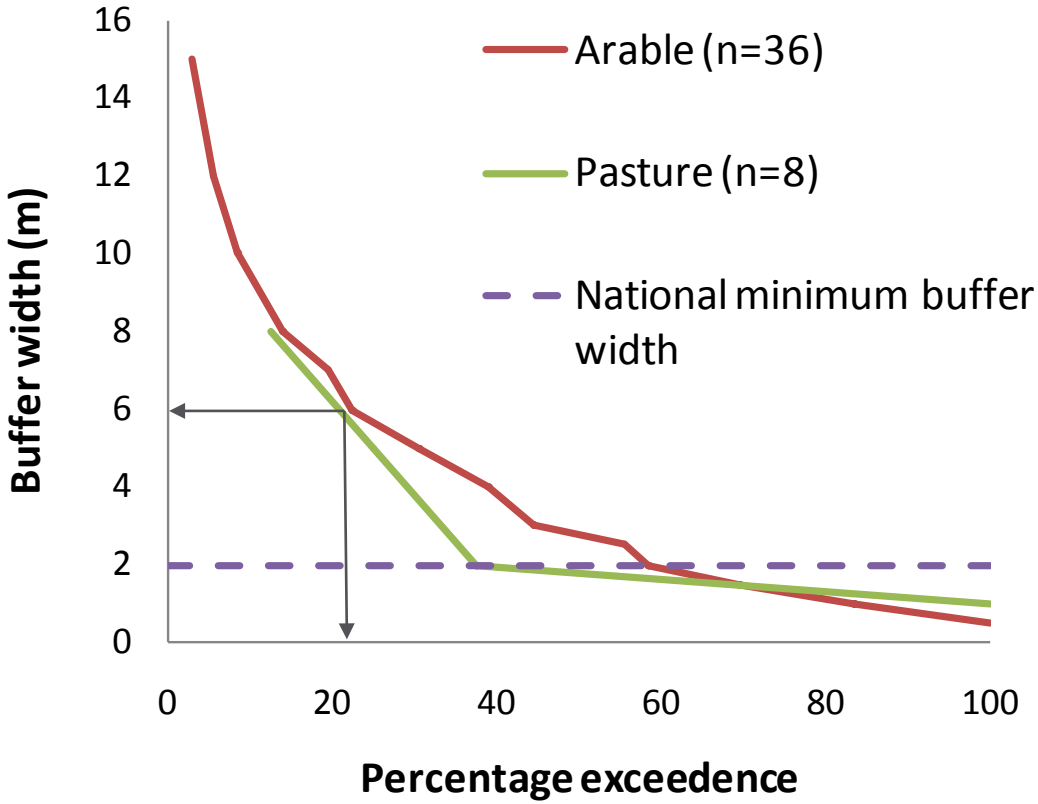
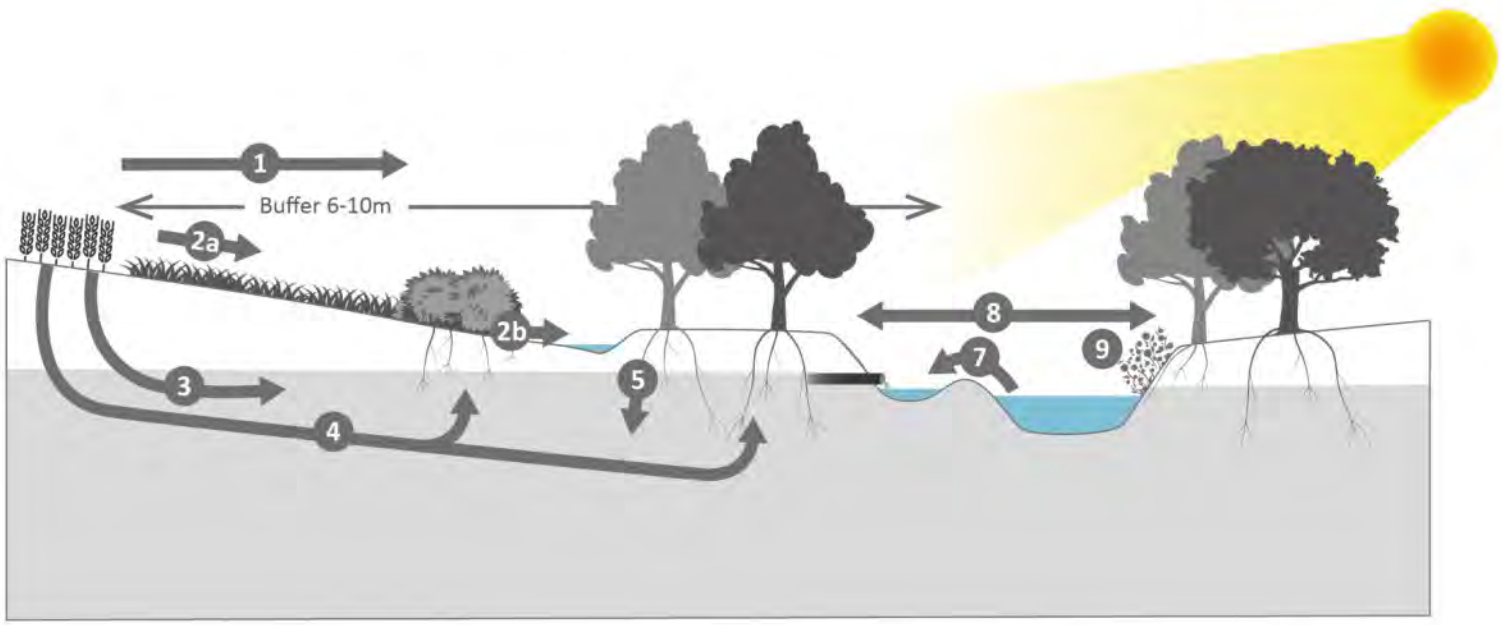



# Improving functions through designed elements

# Elements of ‘designed’ structure




1 Interception of spray drift

2 Surface runoff control

3 Within-soil processing

4 Nutrient uptake into biomass

5 Increasing soil organic matter

6 Interception of soil artificial drainage waters

7 Altered bank profiles

8 Interactions between terrestrial and aquatic ecosystems

9 Bank stabilisation

10 Riparian shading

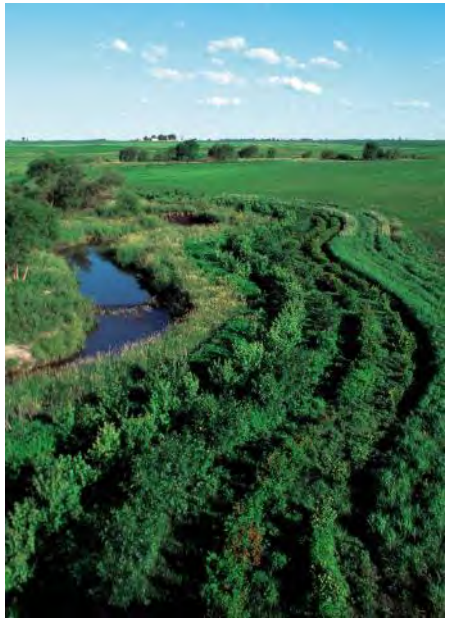
# Tree planting

- Mainly native broadleaved trees

  Can use fast-growing biomass species

- Needs design, establishment time and management

Riparian alder for stream shade, NE Scotland



Riparian wooded buffer, U.S.: USDA, Environmental Quality Incentives Program (EQIP)

Willow riparian SRC systems in Canada: https://cfs.nrcan.gc.ca/projects/134/2

# Raised ground features

- Simple earth bunds retain water, sediment and contaminants

- Small ponded infiltration areas across the slope base
  *e.g. created by a tiled-ridger furrows*

- Scope to work alongside NFM actions

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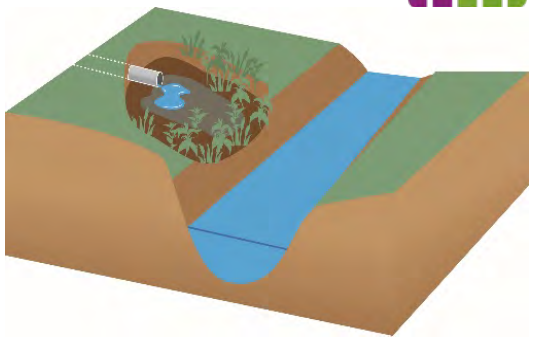
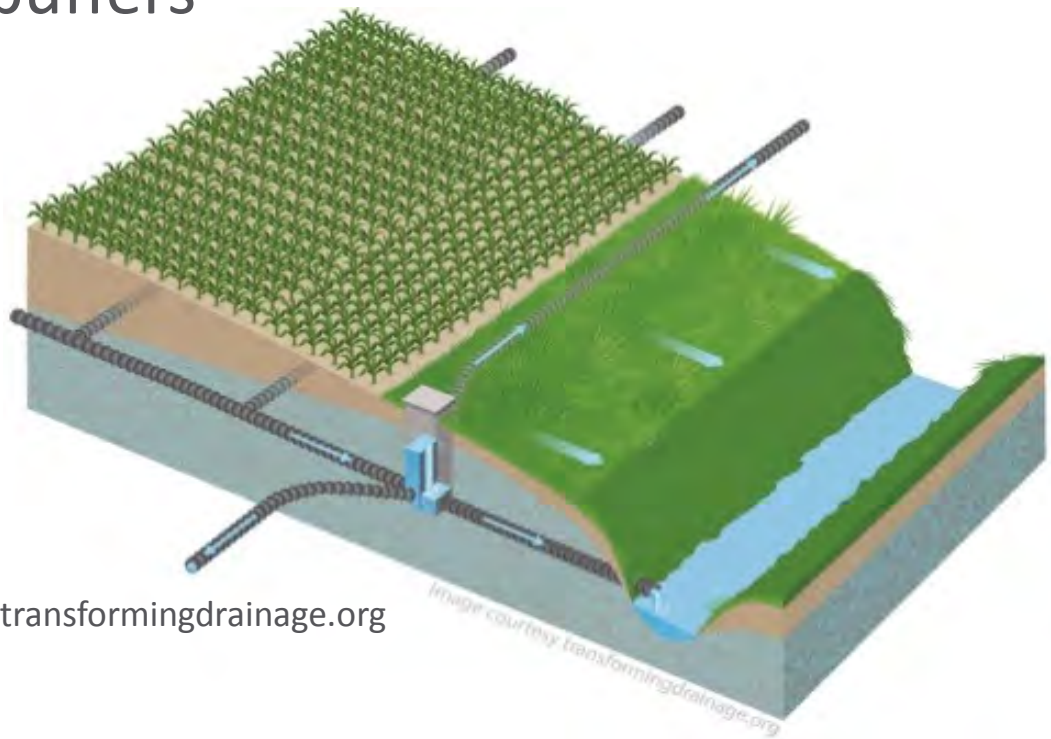
# Reducing pollution via artificial soil drainage using saturated buffers



- Breaking/ending drains into small wetlands and ponds

- Raising and irrigating onto saturated buffers




www.transformingdrainage.org

Bottom photo: Fortier et al. Forests 2016, 7(2), 37

# Increasing the range of public goods in farmed landscapes

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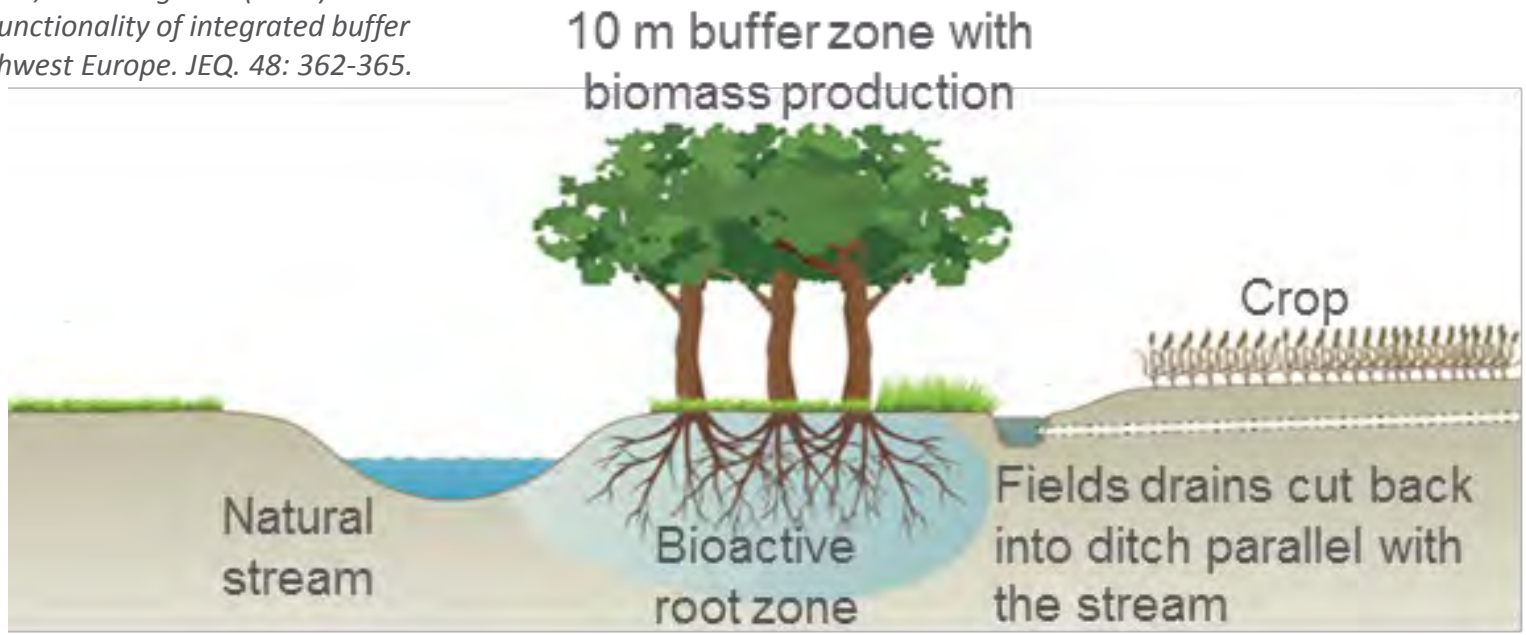
- Public access: footpaths
- Enhancement of visual amenity
- Increased abundance of pollinators
- Stream shading and river temperature regulation
- Alternative harvests

# Integrated buffer designs

*See: Zak, Stutter, Kronvang et al (2019) A review of the multi-functionality of integrated buffer zones in Northwest Europe. JEQ. 48: 362-365.*




# Planning and scaling up to catchment scale protection

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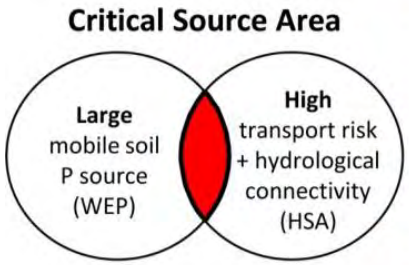
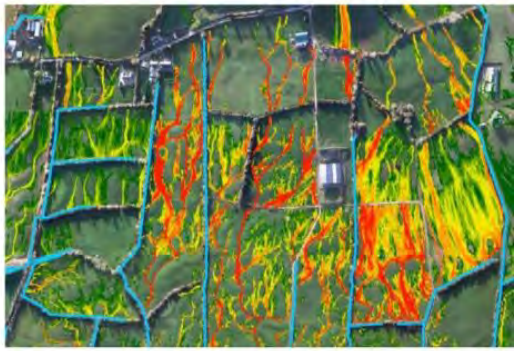
# Planning tools for correct placement…

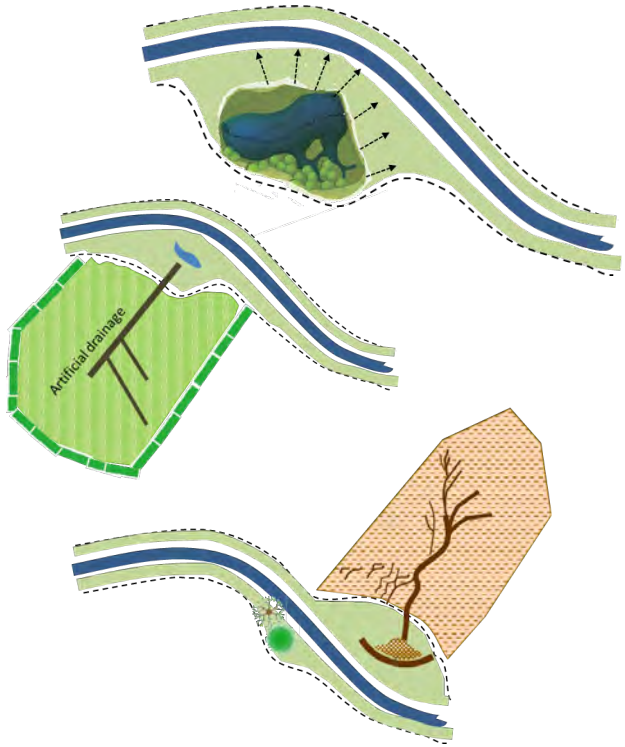
Wilkinson et al.
Error in the margin? *(Thurs)*



e.g. Thomas et al. Agric. Ecosyst. Environ. 233: 238-252 (2016)

## ….means that buffer space can be targeted to critical locations
**(rather than linear fixed widths)**



# Working at catchment scales

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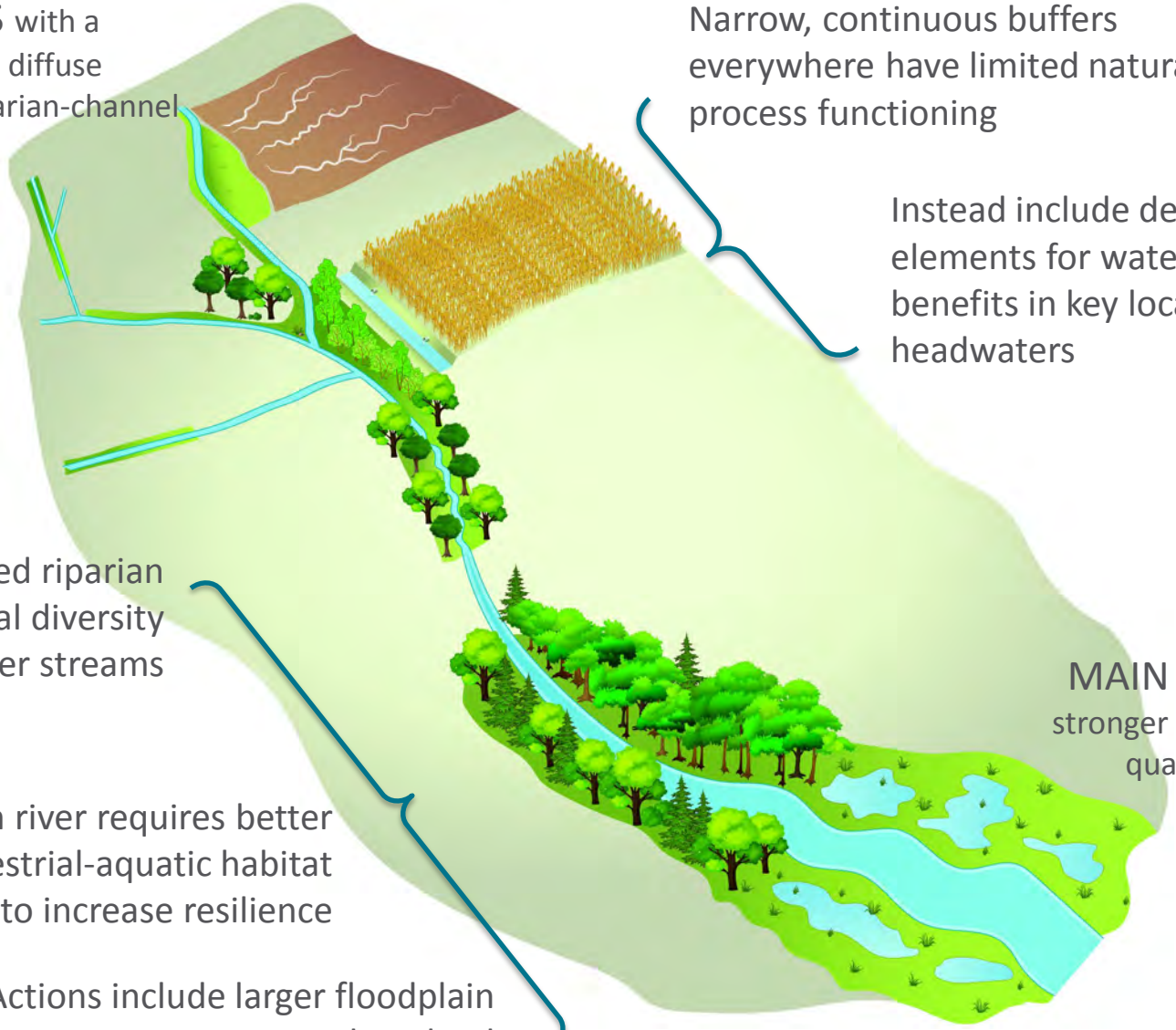
HEADWATERS with a stronger focus on diffuse pollution and riparian-channel physical diversity

Narrow, continuous buffers everywhere have limited natural process functioning

Instead include designed elements for water quality benefits in key locations in headwaters



Increased riparian structural diversity benefits larger streams

MAIN RIVERS with a stronger focus on habitat quality and linkages

Down river requires better terrestrial-aquatic habitat connectivity to increase resilience

Actions include larger floodplain measures and wetland reconnection

*Stutter, Kronvang, Ó hUallacháin, Rozemeijer (2019) JEQ 48, 236-247*

# A need for demonstration

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- Tree planting and grass margins are acceptable to land managers
- Features seen as ‘engineered’ can have negative perceptions presently due to unfamiliarity
  - ……these need demonstration
- There’s a negative perception of wet ground on farms
  - ……water quality measures should align with NFM actions

# Summary

- Current narrow or absent buffers are failing for diffuse pollution and wider benefits;  uncertainty in their function leads to a lack of ‘extra effort’

- Incorporating designed elements into a 6-10 m width, where required, imparts a range of beneficial processes

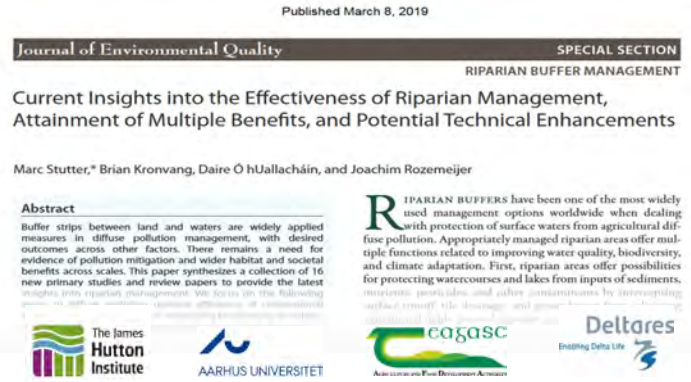
- Specific strategies (ie measures) are needed for problem erosion situations, subsurface nitrate, soluble P accumulation

# Links and resources

- Packages of mitigation options build on earlier work in: Stutter M, Wilkinson M, Vinten A, Nisbet T, Letts J, Dils R, Coath D, Quinn P, Collins A, Stoate C.2019. **Improving the benefits from watercourse field margins using 3D buffers.** Scientific Report (Evidence) to the Environment Agency for England and Wales.

- BufferTECH project (www.buffertech.dk/en)

- Scientific literature synthesis on riparian management in Journal of Environmental Quality 2019.




- Irish EPA-funded Specific Management and Robust Targetting of Riparian Buffer Zones (SmarterBufferZ; 2018-22)