

Sailing Uncharted Waters: Science and the Integration of Grassland and Water Management in England & Wales

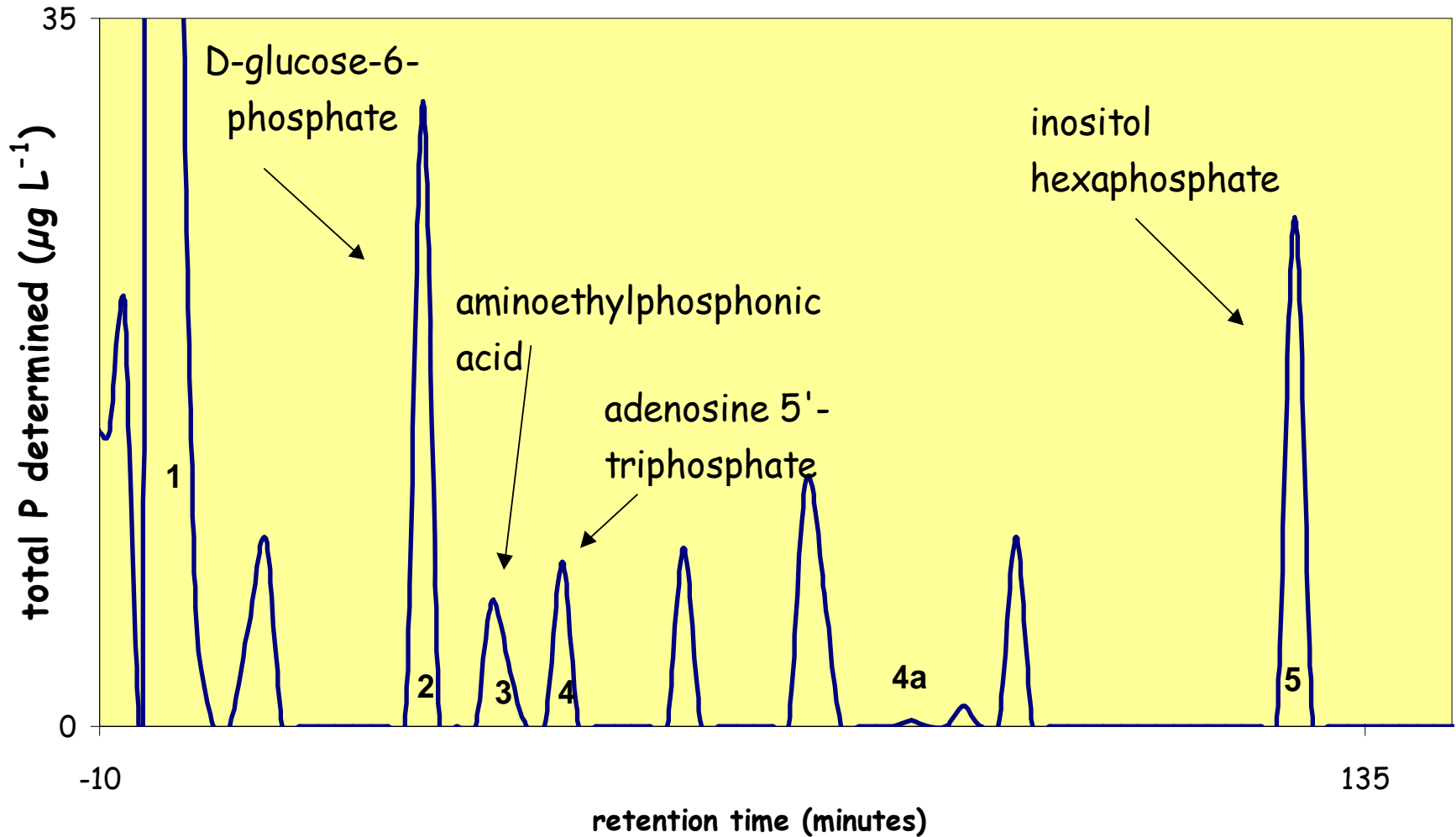
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Lancaster Environment Centre
Lancaster University*





HPLC separation of organic P in leachate: Espinosa et al., *JEQ*, 1999



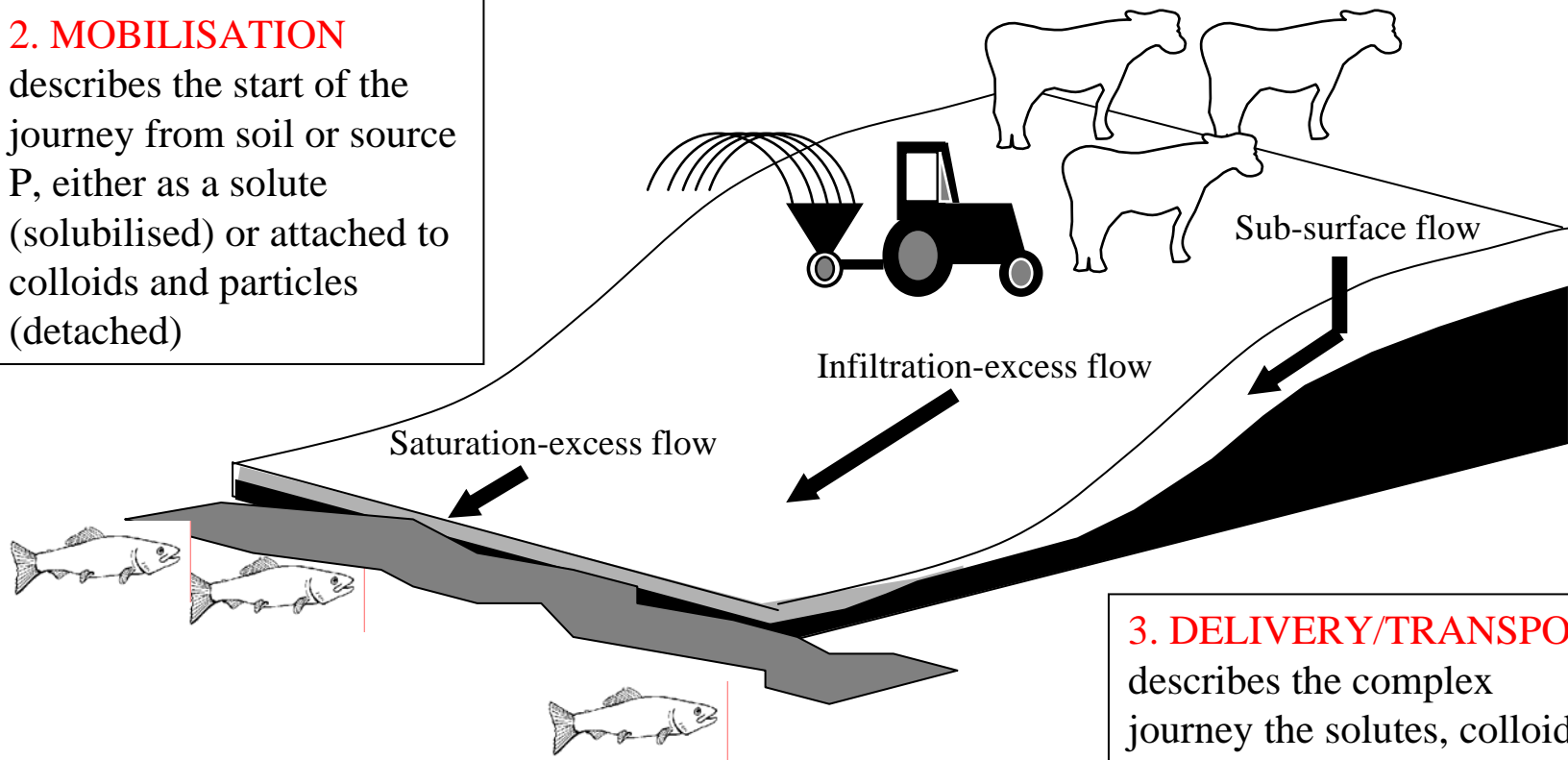
A framework – the ‘transfer continuum’

Haygarth *et al* (*Sci Tot Env* 2005)

1. SOURCES include fertilizer applications, defecation from grazing animals, spreading of manure on soils

2. MOBILISATION

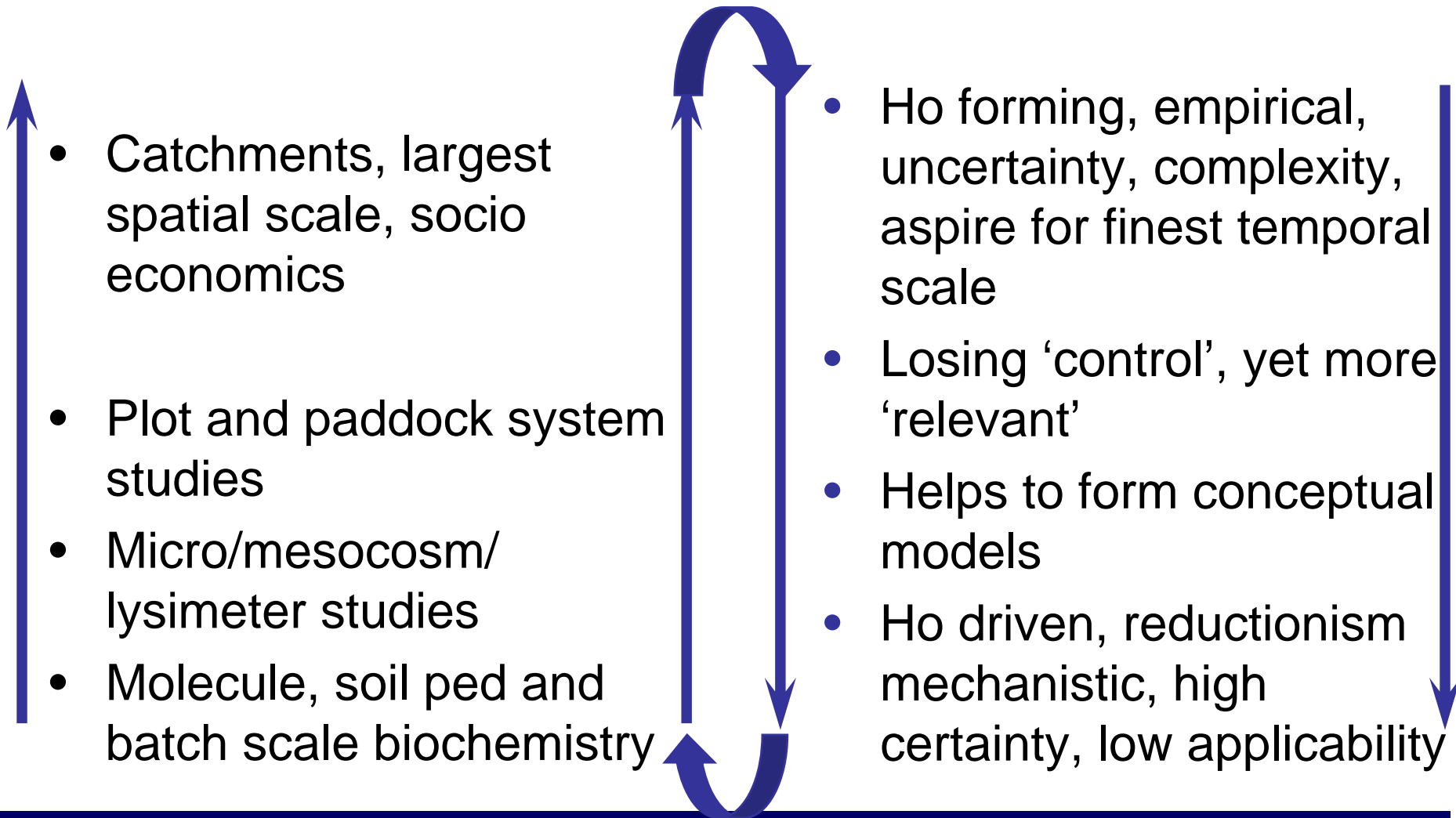
describes the start of the journey from soil or source P, either as a solute (solubilised) or attached to colloids and particles (detached)



3. DELIVERY/TRANSPORT

describes the complex journey the solutes, colloids or particles take after mobilisation to connect to the stream

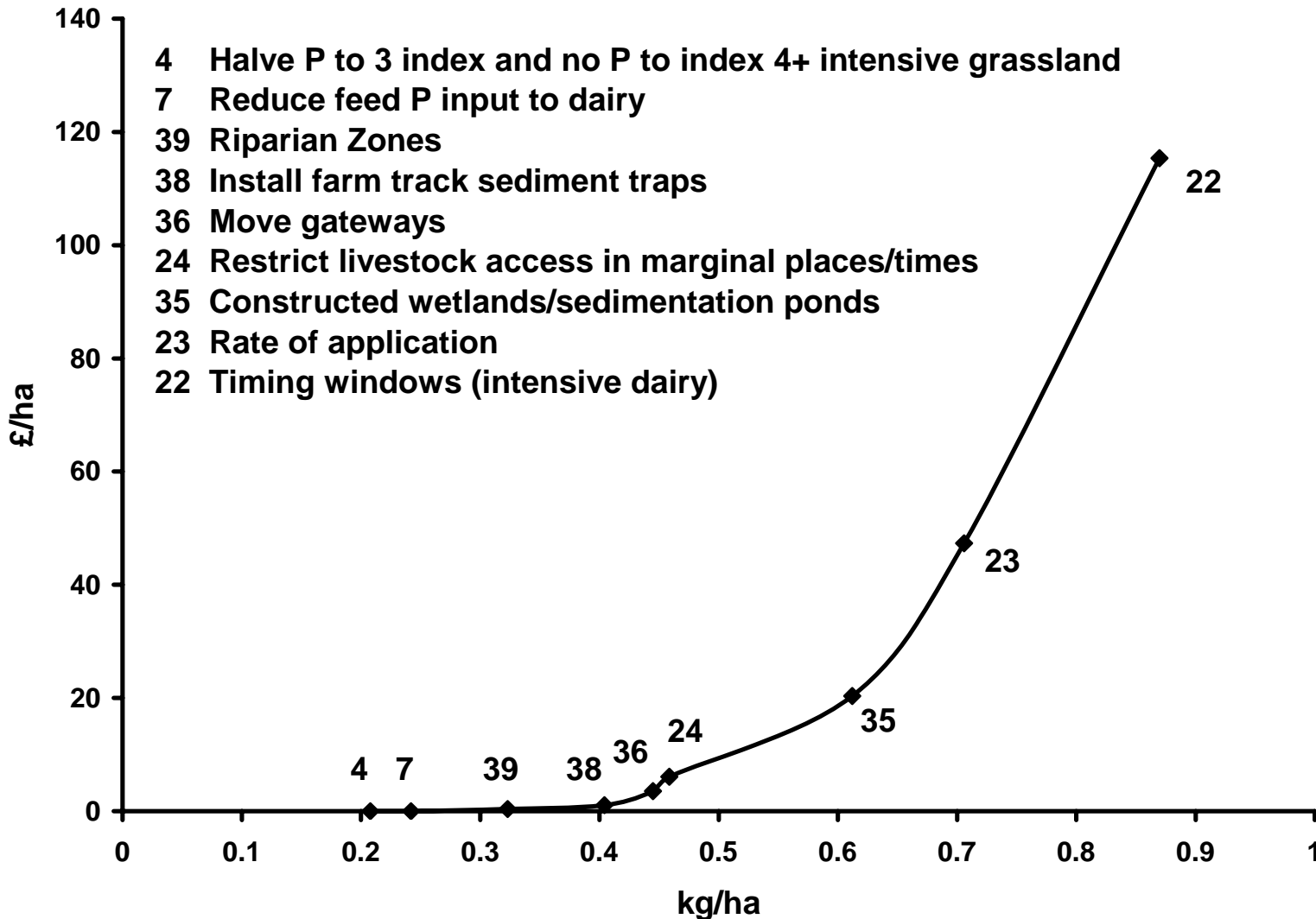
Soil and water biogeochemistry; *The transfer continuum*



Mitigating according to cost and efficiency

Haygarth et al. (in press) *J. Env. Qual.*

Mitigation Options:



**An Inventory of Methods to Control
Diffuse Water Pollution from
Agriculture (DWPA)**

USER MANUAL

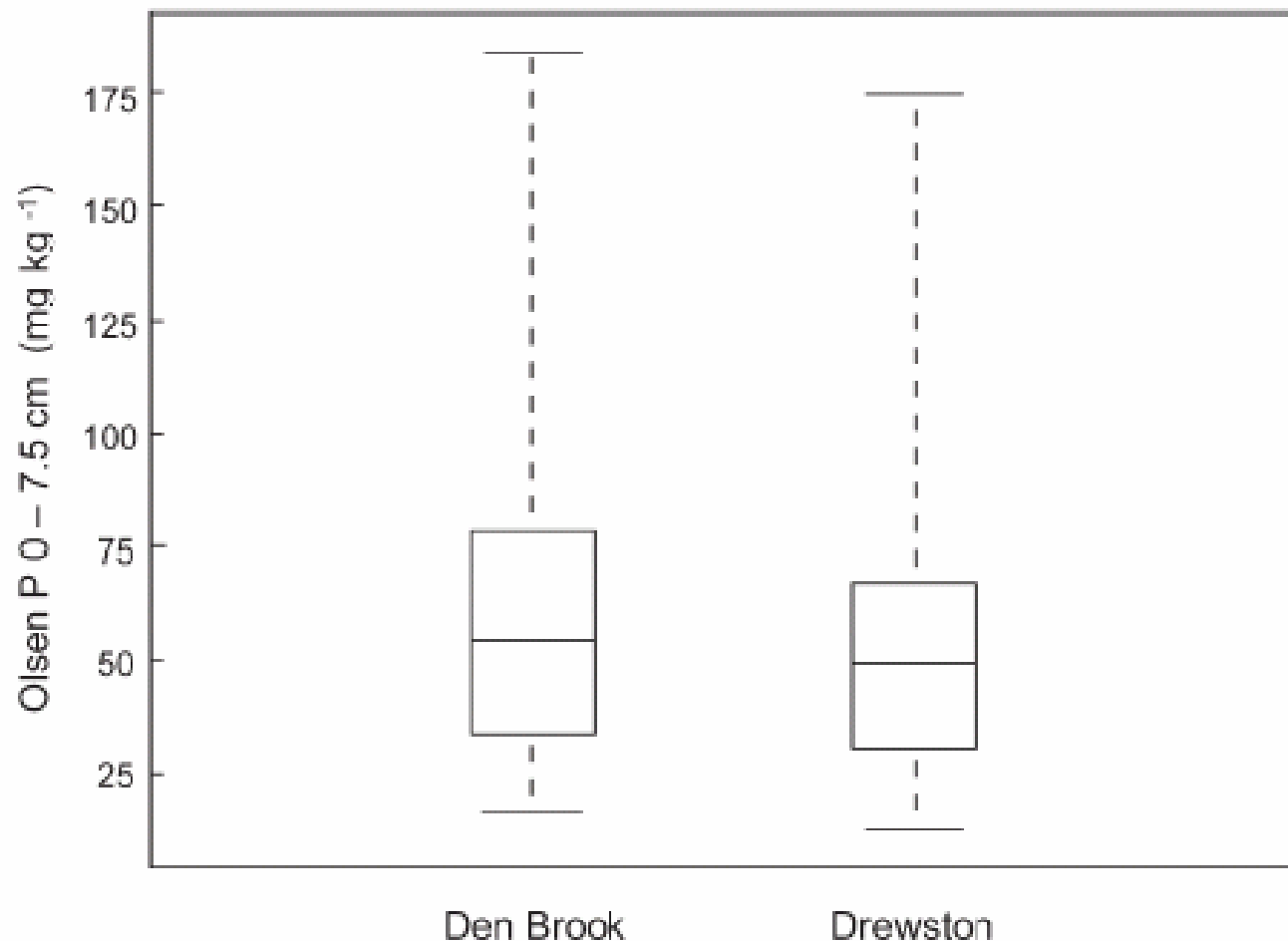
**S.P. Cuttle, C.J.A. Macleod, D.R. Chadwick,
D. Scholefield & P. M. Haygarth (IGER)**

**P. Newell-Price, D. Harris, M.A. Shepherd,
B.J. Chambers & R. Humphrey (ADAS)**

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Spatial Variability of Soil Phosphorus in Relation to the Topographic Index and Critical Source Areas: Sampling for Assessing Risk to Water Quality

Trevor Page, Philip M. Haygarth,* Keith J. Beven, Adrian Joynes, Trisha Butler, Chris Keeler, Jim Freer, Philip N. Owens, and Gavin A. Wood

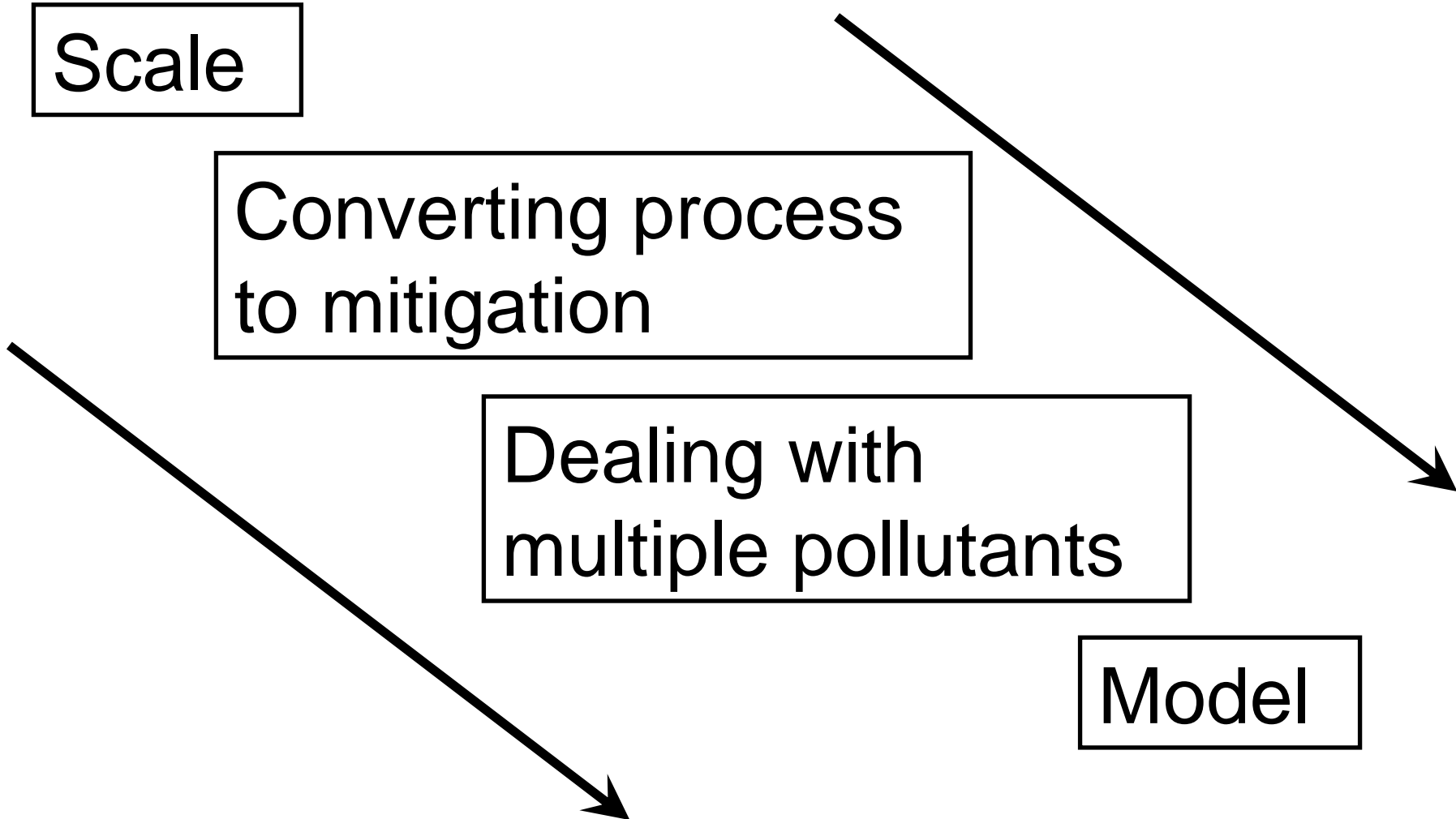
Compound uncertainties in catchment biogeochemistry

Scale

Converting process
to mitigation

Dealing with
multiple pollutants

Model





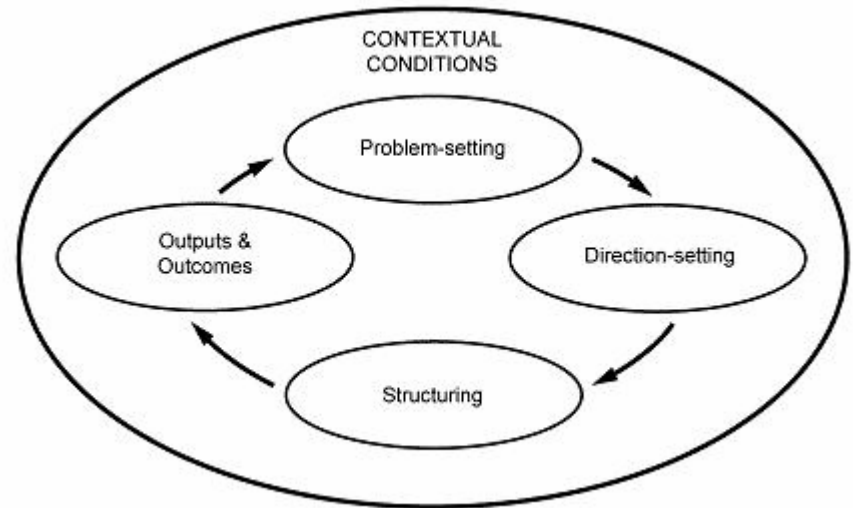
Integrated Catchment Management

Different forms of ICM practiced in England & Wales for a long time

Largely remained a plan-based, state-led & water-centric process

Fundamental *institutional reforms* needed to achieve WFD targets

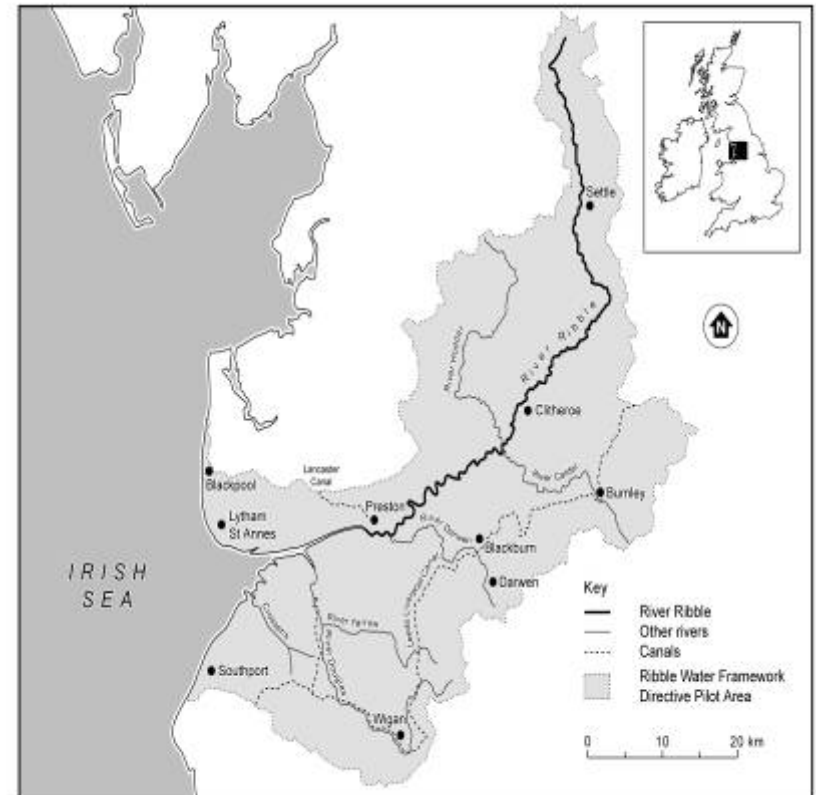
Developing 'collaborative capital' for ICM



The Ribble WFD Pilot

A participatory catchment planning exercise conducted by EA in 2004 to 'test' approaches for implementing the WFD

Many uncertainties remain regarding how to practice collaborative & participatory ICM



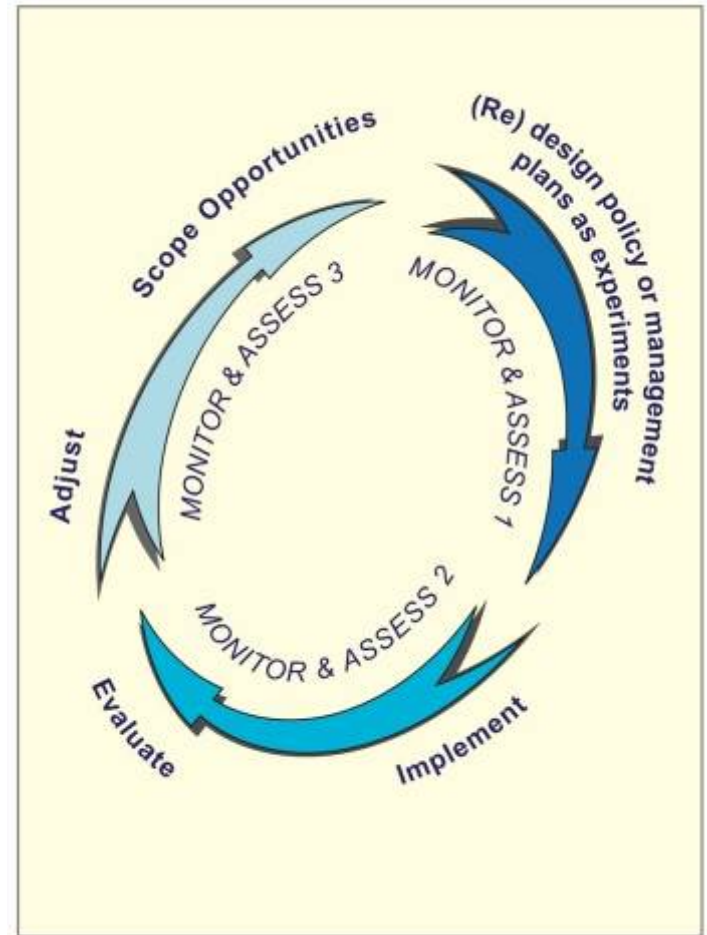
Coping with Uncertainty

- ***Risk*** – key variables and inter-relationships quite well understood at small scales (experimental plot & field scale)
- ***Ignorance and indeterminacy*** – significance of variables and interrelationships unclear at larger scales (catchment & river basin)

Adaptive Environmental Management

“...how to cope with the uncertain, the unexpected, and the unknown.”
(C.S. Holling, 1978)

Increase rates of knowledge acquisition via iterative cycles of trail-and-error policy development and implementation based of scientific hypotheses and models



Understanding and Acting in Loweswater



- **Small lake in LDNP owned by National Trust**
- **13 farms**
- **Controversy surrounding causes, consequences and responsibilities for eutrophication problems**
- **3 year RELU research project**
- **Inter-disciplinary**
- **Est. multi-stakeholder platform (Loweswater Knowledge Collective)**
- **Exploratory/collaborative/deliberative**
- **Adaptive?**

Future science and policy orientations

- Approach uncertainty as an opportunity rather than a barrier
- Use knowledge of diffuse agricultural pollution mitigation to design novel 'experimental' policy measures and packages
- Invest in monitoring and evaluation of implemented policy measures to facilitate more rapid learning and adaptation
- Recognize ICM as a *collaborative* process and establish multi-party institutional arrangements for land and water