An Improved Understanding of Phosphorus Origin, Fate and Transport within Groundwater and the Significance for Associated Receptors

Project Code: WFD85

Who this research is intended for: environmental regulators

Objectives of the project

The purpose of this study was to develop an improved understanding of the origin (natural and anthropogenic), fate and transport of phosphorus as it moves through the soil, unsaturated zone and saturated zone to discharge in rivers, lakes or wetlands. The report aimed to answer a number of key questions:

1. Are observed phosphorus concentrations in groundwater a cause for concern in the context of achieving the status objectives for receiving surface waters and groundwater dependent terrestrial ecosystems?
2. Is there evidence that observed phosphorus concentrations in groundwater are elevated above concentrations which would be expected to occur naturally?
3. Where groundwater P concentrations are elevated, is there sufficient certainty in our understanding to justify restoration measures?
4. What further research or monitoring are likely to be appropriate to develop the necessary understanding for delivery of WFD objectives?

Background

Prior to human influences, the only significant source of phosphorus (P) was weathering of primary phosphate minerals in rocks and soils on land. However, the global P cycle has been extensively modified by human activities (agricultural, urban and industrial). The principal cause is the extraction of P from mineral deposits, followed by its widespread use in fertilisers and detergents.

The limitations in our knowledge of groundwater P impinges upon the ability of the environmental regulators in the United Kingdom and Republic of Ireland to design and implement appropriate measures to manage anthropogenic phosphorous in a defensible manner. An improved understanding of phosphorus in groundwater is, therefore, required to enable ongoing refinement of risk assessments as well as informing threshold-value-setting, monitoring requirements and the appropriateness of programmes of measures.
The rationale for this study was, therefore, to synthesise current understanding of the spatial and temporal distribution of P concentrations in groundwater and the origin (natural and anthropogenic), fate and transport of phosphorus as it moves through the soil, unsaturated zone, saturated zone and hyporheic zone to discharge in rivers, lakes or wetlands.

Key Findings and Recommendations

It is very apparent that our understanding of P movement through groundwater is in its infancy, particularly compared with the major efforts which have been invested to try to understand P movement to surface waters in runoff and drain flow.

However, combined with an understanding of the high risk settings for groundwater P to impact surface water receptors, the potential risk of groundwater P contributing to a failure to achieve good status in some receptors has been identified.

In developing an improved understanding of phosphorus fate and transport within groundwater and the significance for associated surface water receptors, a number of limitations have become apparent in the underlying knowledge base. These will require further research, data collation and monitoring.

Next Steps

- Additional monitoring is required.
- A programme of work to identify natural background P levels in groundwater is required.

Further Information

Copies of the research outputs are available for free download from [www.sniffer.org.uk](http://www.sniffer.org.uk) (search on ‘SNIFFER Code’ WFD85)

Contact: info@sniffer.org.uk

Partners

[Environmental Protection Agency](http://www.epa.gov)

[Scottish Environment Protection Agency](http://www.sepa.org.uk)

[Environment & Heritage Service](http://www.ehsn.gov.uk)

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Date produced: September 2008
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