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title: **Investigation of diffuse groundwater chemical impacts on groundwater-dependent terrestrial ecosystems in England and Wales: Implications for WFD significant damage assessments**

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INTRODUCTION

Procedures for risk screening and assessment of significant damage to groundwater-dependent terrestrial ecosystems (GWDTEs) for EU Water Framework Directive (WFD) implementation have been developed by the Environment Agency for England and Wales (Hulme et al., 2007; Brooks et al., 2009; Whiteman et al., 2009; Whiteman et al., in press).

FIELD INVESTIGATIONS

Field investigations have been undertaken at a small number of wetlands to test the procedures, and to improve our ability to detect significant damage and help us to prevent further deterioration in groundwater status. This paper reports the results of these investigations, which focus on diffuse groundwater chemical impacts, and their implications for significant damage assessments, research needs and policy implementation through groundwater status assessments in the second cycle of WFD river basin planning.

Investigations have been based on a source-pathway-receptor approach, quantifying these linkages at each site. Multiple sources and pathways of nitrates have been demonstrated by a combination of techniques, including high resolution logging of multilevel piezometers, combined with hydrochemical and nitrogen isotope sampling, geophysical and hydro-ecological surveys and ecological mapping. At each stage of the investigation, the eco-hydrological conceptual model has been reviewed and updated by a multidisciplinary team of ecologists and hydrogeologists.

It has also been important to consider the timing of impacts and lag time in the ecological response, as some GWDTEs may still be responding to historic chemical pressures rather than current pressures.

DISCUSSION & CONCLUSIONS

The results suggest that desk-based risk screening procedures are inadequate on their own to confidently predict the likelihood of significant damage. A combination of risk screening methods and targeted site-based data analysis will be required to ensure good status of WFD groundwater bodies in future river basin cycles. Site specific chemical data are required, along with knowledge of hydrological and chemical thresholds to trigger detailed assessment of significant damage. Existing groundwater monitoring networks do not provide this site-specific data.

The implications of the investigations for WFD Programmes of Measures, groundwater quality sustainability and effective management of the GWDTEs will be discussed in the paper.

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