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The hyporheic zone: pollutant attenuation zone or ecologically critical habitat?

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The hyporheic zone (HZ) is located at the interface between groundwater and surface waters. It exhibits dynamic chemical and temperature gradients and is often conceptualised as a dynamic ecotone at the interface of aquifer and river systems. New environmental legislation, such as the EU Water Framework Directive, requires regulatory organisations to take a more holistic approach to environmental management, including integrated management of surface water groundwater bodies. Understanding processes at the interface of these environmental compartments, which have traditionally been managed separately, has become a high priority.

The HZ has the potential to enhance certain pollutant degradation and retardation processes, which are collectively termed natural attenuation. The HZ is also a unique and little studied hypogean habitat. The geochemical conditions conducive to natural attenuation of certain priority pollutants, such as nitrate and halogenated ethenes (chemically reducing conditions) are the opposite of those that typically enhance the biodiversity and ecological status of river systems (aerobic conditions). The HZ can provide either ecological service, but rarely both.

Assessors need to consider which ecological services are most valuable in a given catchment or river reach. In urban and other contaminated areas the benefits provided by reductive natural attenuation processes in hyporheic sediments may be large. In other ‘pristine’ catchments the benefits provided by a diverse and healthy hyporheic invertebrate community might support fisheries and other higher faunal communities, while the benefits of reductive microbial processes may be minimal. As river restoration proceeds the relative benefit accrued by each ecological service may change, and

river managers may need to consider this in long-term environmental restoration plans.

This paper will review the environmental objectives of recent legislation with respect to the groundwater – surface water interface. It will consider policy issues regarding the ecological benefits required of the HZ, and will describe potential environmental management strategies for the HZ. Current risk assessment and management protocols in the UK and elsewhere rarely consider processes occurring within the HZ, or its role as a pathway or receptor within a source-pathway-receptor risk analysis. Examples from a range of UK rivers will be used to illustrate the different environmental objectives that might be applied to the HZ.