TESTING WOODCHIP DENITRIFICATION WALL TECHNOLOGY IN A SHALLOW GRAVEL AQUIFER

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Alluvial gravel aquifers represent the most important groundwater systems in New Zealand. They are particularly vulnerable to nitrate contamination from land-use impacts because they tend to be overlain by thin soils prone to nitrogen leaching. Furthermore, being unconfined and largely aerobic systems that lack electron donors to fuel redox reactions, gravel aquifers themselves have little capacity to attenuate nitrate (Burbery *et al*., 2013). As part of a research programme examining the feasibility of a variety of 'end-of-pipe' nitrate mitigation tools for the NZ agricultural landscape, we are piloting a woodchip denitrification wall (also known as a denitrifying permeable reactive barrier (PRB)) in an alluvial gravel aquifer that is impacted with nitrate. Whilst existing examples of denitrifying PRBs can be found for sandy aquifers (e.g. Schipper et al., 2000; Schmidt and Clark, 2012), our work represents the first case of a woodchip PRB trialled in a gravel aquifer setting.

In November 2018 we installed an experimental denitrifying PRB in the Silverstream catchment, North Canterbury, at a site where the water table rests within 0.5 m of ground level and groundwater nitrate concentrations are consistently 6-7 mg/L NO_3-N. We employed the hydrogeophysical method of electrical resistivity tomography to determine the important design parameters of groundwater flow direction and nitrate flux, in the shallow alluvial gravel aquifer. The PRB measures 25 m long and 5 m wide. It was constructed using a binary mixture of 50/50 (v/v) woodchip and gravel (Burbery *et al.*, 2014) that was emplaced in a dewatered trench excavated to 3 m below ground level. The particle sizes of both materials were over 20 mm nominal diameter.

So far, as of January 2019, the denitrification wall appears to be working effectively in so much that a plume of nitrate-free groundwater can be traced down-gradient from the PRB. Nitrite and ammonium concentrations within the plume are negligible, leading us to assume at this stage that the observed N-losses are primarily from heterotrophic denitrification. As we predicted, the PRB has led to mobilisation of arsenic, iron and manganese from the greywacke aquifer sediments in the anoxic area immediately down-gradient of the PRB.

Editor's Note: An extended manuscript has not been submitted for this presentation.