

Interactive comment on “Sources and fate of nitrate in groundwater at agricultural operations overlying glacial sediments” by Sarah A. Bourke et al.

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Dear authors,

Thank you for this interesting manuscript, in a challenging environment no doubts. I have a few suggestions to make for you to consider. First, I think providing a summary of N transport and transformations (including dissolved organic nitrogen and NH_4^+) would have been useful. I note that data on NH_4^+ and DON (DON = TKN - NH_4^+) is presented in Supplementary Material, but a summary in the main text is warranted. To receiving environments, whether the N is DON, NH_4^+ or NO_3^- matters little.

C1

There is also limited information presented on the redox conditions in the three 'biogeochemical environments' present (waste piles/vadose zone/groundwater). Do these differ? This matters because the best conditions for N attenuation will be when we have alternating aerobic and anaerobic environments during transport. Is this the case here? Is there an effect of a shallower vadose zone at one of the sites (less nitrification)?

I would also suggest to de-emphasise 'denitrification' as a removal mechanism for nitrate unless you have additional measurements to back this up. In what seems like an heterogeneous environment, a range of processes could remove NH_4^+ and NO_3^- (anammox, NH_3 volatilisation, dissimilatory NO_3^- reduction to NH_4^+ ...). It would be more prudent perhaps to talk about 'nitrate removal' instead of denitrification? The large variations in the stable isotope of nitrate data argues for a more complicated story than just nitrification-denitrification.

I hope this is helpful.

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C2