

## ***Interactive comment on “From existing in situ, high-resolution measurement technologies to lab-on-a-chip – the future of water quality monitoring?” by A. J. Wade et al.***

### **Anonymous Referee #1**

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Wade et al.

From existing in situ, high-resolution measurement technologies to lab-on-a-chip – the future of water quality monitoring?

Major remarks The majority of this paper offers good insights into the use of high frequency chemical monitoring technology in rivers and is a good example of use in lowland river settings. The paper is well written and generally well presented.

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I enjoyed reading the paper and seeing how the technology has been deployed and critically assessed and data interpreted with regard to process understanding and phosphorus load estimation.

However, the title promises more. After reading, it's clear that the reference to lab-on-a-chip technology is not part of the comparison and the material in section 5.5 is speculation rather than based on comparative deployment results. I think it detracts from the paper and reads a little like a grant application. The title could therefore be changed (and the hanging question mark removed) to reflect what the paper is about. This is an appraisal of in-situ high-resolution monitoring technologies and data insights in lowland rivers.

Lab-on-a-chip technologies are still open to question as is the use of extensive deployments of passive samplers. This will require much more research and development and it will be good to see critical comparisons, in ambient river systems, in the literature. Specifically, questions related to limits of detection, biofouling (if the mains powered and large Filtrax system was prone to biofouling here then I suspect that miniaturised ion-chromatography methods will be challenged) and deployment time should be compared against those methods that show a robust, accurate and sustained data run in complex and challenging river systems. I agree with some of the points on sustainability of bankside wet chemistry methods and that research to provide alternatives is a good objective. The whole of section 5.5 should therefore be condensed to a few referenced lines, and possibly with references to passive samplers, suggesting these (l-o-a-c and passive samplers) as a possible low cost, extensive monitoring solution but which will require testing across gradients of river systems alongside the wet chemistry platforms reported as an example in the manuscript. The manuscript is long anyway and this condensing will not affect the main messages.

Other comments Abstract The last three sentences of the abstract are irrelevant really – last section saying 'justified' is not...justified. Claims of issues related to electricity supply and elsewhere with data processing are surprising – installation/deinstallation

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costs of new supplies, even in rural areas, are not generally prohibitive and water information systems are well able to cope with hydrometric time series at high resolution. Here and elsewhere, reference to daily sampling for annual load estimates is useful but consideration should also be given, here and where relevant, that the sub-daily sampling (here noted as 7hour potentials) will also pick up diurnal changes – not picked up by daily sampling.

Page 6461 line 18 Delete “the”

Page 6462 line2 References should include (Fealy et al., 2011; Wall et al., 2011; Jordan et al. 2012; Mellander et al., 2012; Melland et al. – in press; Mellander et al. - in press). It will be necessary, therefore, to change “of assessing streamwater quality has been limited to a handful of studies” to “of assessing streamwater P and N quality has been reported in a growing number of studies”.

Page 6462 line 9 Should read “field-based spectrophotometric equipment similar in scope to that reported elsewhere (e.g. Wall et al., 2011)”.

Page 6462 lines 16-19 Delete.

Page 6462 line 24 “good” can mean many things here. Do you mean “complete, weekly” ?

Page 6463 line 27 What did the study show?

Page 6468 line 14 I believe the Sigmatax delivers sample to the ultra-sound chamber via positive pressure rather than by a vacuum.

Page 6469 line 7 As the operational filter is 0.45  $\mu\text{m}$ , need to mention at least this and why 0.15  $\mu\text{m}$  was used.

Page 6472 line 20 Delete this sentence. You report on issues rather than justify the use of miniaturisation – which you don’t use in this study.

Page 6473 line 5 Consider a different word to ‘gleaned’ Delete last line of paragraph

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Page 6474 line 10 To end of sentence consider adding, “similar to findings for rural point source discharges reported in Northern Ireland rural streams by Jordan et al. (2007).”

Page 6474 line 14 and 16 Does the p value in the equation relate to 99% CI?

Page 6474 line 20 etc. Is it likely that combined storm overflows were part of high flow nutrient transfers? These need to be mentioned somewhere.

Page 6475 line 1 You infer that septic tank systems are a storm dependent transfer. Some reference to these as point sources also needs to be made.

Line 6476 line 5 You need to complete this comparison by indicating that yours was made on higher resolution data and reasoning.

Section 5.1.3 Some validation data of the Nitratex probe would be important for the readership (see Macintosh et al. 2011 which shows a calibration curve specific to two sites).

Page 6477 line 19 “the lower Thames”.

Page 6478 line 10 “that the photosynthetic”

Page 6479 line 28, 29 I thought that describing storm dynamics as nuanced was interesting. Maybe there are dissimilarities with other catchments in terms of storm transfers but it is important to note that use of high resolution, in-situ equipment elsewhere has been used in the recognition that this was the major process, and that point source signals were nuanced.

Page 6480 line 28 Jordan et al., (2007) only suggested that the data could be used to constrain models.

Page 6481 lines 2 and 3 I wasn’t sure how you differentiated 24h from daily sampling. Also, while it is useful to show how the daily sampling appeared adequate to be integrated into annual loads, to be balanced, some discussion is needed here or elsewhere

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to contextualise to other systems - i.e. is there a take home message on general resolution or are you implying that sample resolution for load will depend on system? How will this be determined, etc. See also previous comment on pattern recognition with sub-daily samples.

Page 6481 line 18 sentence structure suggest, “in the field for P and also for NO<sub>3</sub>,...”

Page 6483 line 4 Change “done” to “undertaken”

Page 6483 line 5 Change to: “provide a temperature controlled environment”

Page 6484 line 7 Do these issues also refer to Nitratax? Again, some comparison and performance data would be useful.

Section 5.5 See above. Reduce to a few referenced lines and incorporate. Not only is the section unjustified, it appears as an annex to the main thrust of the paper – which is really interesting.

Therefore, amend last sentence of conclusion.

Figure 1 It wasn't clear on my print-out where the Kennet catchment was

Figure 6 The discharge and TRP charts need to have the same axes and start from zero for clarity and comparison.

Suggested refs: Mellander, P.-E., Jordan, P., Wall, D.P., Melland, A.R., Meehan, R., Kelly, C. and Shortle, G. (2012) Delivery and impact bypass in a karst aquifer with high phosphorus source and pathway potential. *Water Research*, 46 (7). pp. 2225 - 2236.

Jordan, P., Melland, A.R., Mellander, P.-E., Shortle, G. and Wall, D. (2012) The seasonality of phosphorus transfers from land to water: Implications for trophic impacts and policy evaluation. *Science of The Total Environment*, doi: 10.1016/j.scitotenv.2011.12.070.

Wall, D., Jordan, P., Melland, A. R., Mellander, P. -E., Buckley, C., Reaney, S. M. and

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Shortle, G. (2011) Using the nutrient transfer continuum concept to evaluate the European Union Nitrates Directive National Action Programme. *Environmental Science & Policy*, 14 (6). pp. 664-674.

Fealy, R. M., Buckley, C., Mechan, S., Melland, A., Mellander, P. E., Shortle, G., Wall, D. and Jordan, P. (2010) The Irish Agricultural Catchments Programme: catchment selection using spatial multi-criteria decision analysis. *Soil Use & Management*, 26 (3). pp. 225-236.

Melland, A.R., Mellander, P.-E., Murphy, P.N.C., Wall, D.P., Mechan, S., Shine, O., Shortle, G., Jordan, P. Stream water quality in intensive cereal cropping catchments with regulated nutrient management. *Environmental Science & Policy*, doi.10.1016/j.envsci.2012.06.006 – in press.

Mellander, P.-E., Melland, A.R., Jordan, P., Wall, D.P., Murphy P. and Shortle, G. Quantifying phosphorus and nitrogen transfer pathways in agricultural catchments using high time resolution data. *Environmental Science & Policy*, 10.1016/j.envsci.2012.06.004 – in press.

Macintosh, K., Cassidy, R., Jordan, P., Arnscheidt, J., McCarthy, V., Jordan, S. and Linnane, S. (2011). *Testing a new technology for monitoring nutrients in rivers*. EPA, Wexford, ISBN 978-1-84095-404-3, 67p.

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