

## Evaluating storm period in situ high resolution phosphorus data from the North Wyke Farm Platform

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### Introduction

Phosphorus (P) is an essential macro-nutrient for plants and as such, is essential for modern agricultural production. However, on many farms, a P surplus now exists such that more P is contained within the soil than is required by crops, leading to an elevated risk of P loss to watercourses. Increases in P in watercourses can have serious deleterious effects and, for this reason, it is essential we understand better the dynamics of P losses from land to water.

Long-term routine, but infrequent, water quality sampling is used widely in monitoring programmes to provide insight into longer-term trends. Such sampling, however, fails to capture the high resolution data necessary for elucidating hydrological and biogeochemical processes and responses e.g. to hydroclimatic and/or management drivers. Technological advances in environmental monitoring mean, however, that it is now possible to collect high resolution measurements for a wide range of water quality parameters, including P. Here, in situ wet chemistry analysers now provide a means of capturing greater ranges in nutrient concentrations, high resolution hysteresis patterns and both storm and non-storm dependent transfers.

Despite the attractions of using on-the-bank analysers there remains, nevertheless, the fundamental need to evaluate the quality of the data generated. Accordingly, some work has been undertaken to evaluate the P data collected by the PHOSPAX machines on the North Wyke Farm Platform (Fig.1).



Figure 1. Map of North Wyke Farm Platform and photo of PHOSPAX machine.

### The experiment

The evaluation of the PHOSPAX data involved the three machines serving the three treatments being compared in the North Wyke Farm Platform experiment (flumes 2, 5, 8; see Fig. 1). Data for this preliminary exercise, were collected during storm events on 17/02/2016 and 9/03/2016. An autosampler at each site was used to sample the discharge automatically to generate paired (PHOSPAX and autosampler) results for TRP and TP for each of the three flumes. The autosamples were analysed in the laboratory within 48 hours of collection.

In the case of the in situ analyses, TRP and TP are measured by a sample collected from the sump at the monitoring station by a separate device (SIGMATAX 2) which homogenises the sample using ultra-sound before passing it to the PHOSPAX photometer which analyses ortho-phosphate colourimetrically using standard molybdenum blue chemistry. Unfiltered autosamples were analysed in the laboratory for both TRP and TP thus giving equivalent data to those generated from the in situ analysers. Samples requiring TP analysis were initially subject to an oxidation reaction using acidified potassium persulphate thus converting all P forms to RP. Both digested and undigested samples were then analysed for RP colorimetrically on an Aquachem 250 analyser using a molybdenum blue reaction.

### Example results

Table 1 presents an example comparison of the P data generated using the in situ analyser and laboratory analysis of conventional autosamples from flume 2. In this case, the average absolute difference between the TRP laboratory and in situ data was  $4 \mu\text{g L}^{-1}$  with a standard error of difference of  $1 \mu\text{g L}^{-1}$ . For TP, the corresponding average absolute difference between the laboratory and in situ data was  $34 \mu\text{g L}^{-1}$  with a standard error of difference of  $4 \mu\text{g L}^{-1}$ . These results are contributing to ongoing evaluation of the in situ P data recorded on the North Wyke Farm Platform.

Date / Time	PHOSPAX TRP $\mu\text{g L}^{-1}$	Lab TRP $\mu\text{g L}^{-1}$	PHOSPAX TP $\mu\text{g L}^{-1}$	Lab TP $\mu\text{g L}^{-1}$
17/02/2016 13:06	5	16	150	92
17/02/2016 13:20	10	14	135	85
17/02/2016 13:50	10	13	115	82
17/02/2016 14:22	10	13	105	61
17/02/2016 14:52	15	14	95	57
17/02/2016 15:24	20	12	90	56
17/02/2016 15:40	15	12	90	55
17/02/2016 15:56	10	12	90	110
17/02/2016 16:26	10	11	80	51
17/02/2016 16:58	10	12	80	61
17/02/2016 17:30	20	11	70	54

Table 1: Summary of the TRP and TP values for flume 2 during a storm event on 17/02/2016 using the in situ PHOSPAX and laboratory analysis of autosamples.