Referees comments are in italics, reply from author is in plain text

This manuscript reports the detailed information on N and P concentrations collected from three DTC catchments in England using on-site monitoring equipment, during the high flows in late April 2012 that followed an extended period of drought conditions. The data collected are of high quality and demonstrate a number of interesting features of the catchment responses. However, having read the ms I was left uncertain as to the main purpose of the manuscript and whether the data presented merited publication in a high level inter-national journal in its current form. My primary concerns are listed below:

We thank the reviewer for this comment and we are pleased that you think the data are of high quality which demonstrates interesting features of catchment responses.

(1)The introduction contains a lot of superfluous information on the background to the DTC catchments. I would see this as being of limited relevance to the main thrust of the study. The key point would seem to be the existence of three catchments instrumented with similar equipment and representative of rather different landscape types.

This information has been substantially reduced.

(2)The modelling of nationwide rainfall patterns for the study period would seem to be of limited value/relevance. Representative rainfall records from each of the catchments would seem to be all that is required. By focussing on a short period as distinct from a longer time-series, the rainfall data presented obscure the important difference in antecedent conditions between the Wensum and the other 2 catchments (see below). I would like to see rainfall records covering a longer antecedent period.

The modelled rainfall section has been removed. We have now, in response to this comment and comments elsewhere, included time-series data from all three catchments for rainfall, discharge, nitrate and TP concentrations for the hydrological year 2011-2012 (Figure 2). We have also plotted up on the same graph Antecedent Precipitation Index (API) values for each catchment throughout the year as an indication of antecedent catchment 'wetness' throughout the water year, including a discussion of the API values before the storm. We feel this helps the reader understand how antecedent conditions effect the hydrological and hydrochemical response to rainfall throughout the entire year and not just for the storm period discussed in detail. This information can be found in sections 3.1, 3.2 and 4.1.

(3)The reason why attention focussed on the nutrient response of the catchments at the end of a drought period and the importance of the findings is not made clear. Is there a suggestion that such events are critical in terms of ecological impact or that changing weather patterns in the UK could make such conditions more common and that an improved understanding is therefore required?

Although antecedent conditions are not 'equal' in all three catchments before this event, it is interesting because the conditions were similar due to the wider-scale national drought conditions. Given the nature of the storm that proceeded, an evaluation of behaviour across catchments over a

wide geographical area was afforded because of the high frequency monitoring infrastructure in place, so although this cannot be considered a replicate controlled event it did, however, have some desirable characteristics to allow an evaluation of responses. We agree that such transition periods from drought to flood conditions may become more frequent in the future given climate predictions and have added some text to this affect in the conclusions (page 23 line 14 – 23). However, the main thrust of the paper is that these unusual conditions allowed for an analysis of the three catchment responses acting under relatively similar conditions, the variety of responses detected indicating the scale of the challenge to environmental managers in tackling nitrogen and phosphorus pollution in rural catchments.

(4)The basis for the comparison presented is not entirely convincing. The absence of N data for the Eden would seem to be a major problem, if the intention is to compare the response of different landscape types. It is important to know how the N concentrations in the Eden catchment responded to complete the story. This gap represents a large hole in the study.

Because of the nature of the bankside monitoring there are down periods for various instruments – it is certainly a challenge to maintain the equipment. The authors chose to study this particular storm because we felt the transition from dry to wet conditions (albeit with different antecedent conditions) was an interesting basis for comparison across the three catchments, but unfortunately there was no nitrate data for the Eden and no TRP data for the Avon at this time. However, the inclusion of the new Figure 2 show the more continuous nitrate data record for the Eden which is actually complete for the remainder of the year. We have included in the discussion the general hydrological and hydrochemical trends revealed by the high frequency data (sections 3.1 and 4.1) which we believe complete the understanding for the three catchments even though there are some gaps for the storm period.

I was also not convinced that the antecedent conditions in the three catchments were very similar. Fig. 4 indicates that the antecedent flows for the Wensum were flows equalled or exceeded <10% of the time, whereas the equivalent values for the Eden and Avon were 60% and 80% respectively. This latter discrepancy makes the comparison dubious.

The authors agree that some of the more general sentences about the drought condition across the country give the impression that the catchments were all experiencing identical antecedent conditions before the storm event. These sentences have been removed. As mentioned before, the addition of the API values to the time-series in Figure 2 and further discussion of API values right before the storm acknowledges the fact that the antecedent conditions were different (section 3.2), which is then used to further interpret the storm responses. For example, the Wensum had experienced wetter conditions in the run up to the storm and had also experienced a large event in March which we have pointed out as a possible explanation for the quick phosphorus exhaustion in the storm event studied in detail here. Reference to antecedent conditions affecting storm response can be found: page 15 line 30 –page 16 line 2, page 17 line 3- page 18 line 1 for the Avon; page 16 line 28 -33, page 18 line 12-16 for the Wensum; page19 line 21-24 for the Eden.

(5)If the purpose of the study was to provide an improved understanding of post drought catchment response, there would seem to be a need to compare this response with the more standard storm

period response at different times of the year. Looking at the post drought period essentially in isolation would seem to be of limited value. I would also like to see detailed records of flow and nutrient concentration for the entire 2012 year presented in order to demonstrate precisely how the post drought response fitted into the longer term response. The 'duration curve' data are of limited value in this context. How does the hysteretic behaviour of the post-drought periods compare with that at other times of the year? The three catchments would seem to offer far more scope for comparison than that attempted in the study reported.

We thank the reviewer for this constructive comment, which, as already mentioned, was part of the motivation for including Figure 2 and wider discussion around how the post drought response fitted into the longer term response. We felt that it was unnecessary to include hysteresis analysis for other periods as we were using the hysteresis as a tool to explore the different catchment responses to this particular storm period and that the time-series data provide a wealth of information for the wider functioning of the catchments at other times of the year.

(6)The relevance of the analysis of hysteretic behaviour to the overall purpose of the study is not entirely clear and needs to be explicitly stated. If it is going to be included, there would appear to be a need to relate the post-drought behaviour to the hysteretic behaviour at other times.

See comment above.

(7)Towards the end of the ms attention shifts to emphasising the value of the detailed data provided by the onsite monitoring equipment. This introduces a different topic which needs to be treated more fully if it is important. Is the equipment uses really so novel? Details of its calibration and the accuracy and precision of the measurements and the data recovery success need to be reported. The lack of N data for the Eden during the events under consideration could suggest that there were large gaps elsewhere in the record.

In response to this comment and the other reviewer's feedback we have now included a paragraph on the QA/QC procedures to validate the bankside analysis with more standard analysis of grab samples in the laboratory, which show good agreement. We believe that this type of monitoring is advanced as there are only a handful of other research groups which have bankside analysis of nitrate, TP and TRP, particularly at three distinctly different catchment typologies. As mentioned, the lack of nitrate data for the Eden during this storm is unfortunate but the time-series data for the remainder of the hydrological data show that this is a good data set. We appreciate that this was not necessarily obvious to the reader before the inclusion of the time-series.

(8)There is a great deal of rather vague inference regarding flow paths etc and comparisons between the different catchments. This is based primarily on analysis of the hysteretic behaviour and it is well known that such analysis is far from definitive. More rigorous analysis is required to confirm the interpretations presented. To be meaningful such inferences ideally need to be confirmed by analysis of the behaviour of other geochemical parameters and particularly isotopic tracers capable of distinguishing old and new water etc.

Hysteresis concentration-discharge plots have been used many times in the literature to infer flow pathways, including several highly regarded papers in this journal. We have now included a section in the introduction (page 3 line 23 – page 4 line 9) reviewing some of those papers whilst also making reference to the Chanat et al. 2002 paper suggested by the reviewer to make it clear that hysteresis interpretation is not powerful enough to distinguish absolute pathways for pollutants during storm events. We have also toned down some of the language to make it clear that we are inferring pathways as well as including information on concentrations of end members where applicable, such as groundwater and tile drain concentrations, to back up our interpretation of hysteresis plots (see page 9 lines 8-9; page 13 lines 29 – page 14 line1; page 17 lines 5-6). The hysteresis loops produced as a result of the storm event studied in the three catchments were so different that the authors believe it is possible to infer the controlling pathways which can then be investigated further with tracers and mixing models. All three catchments are engaging in this type of analysis but this was deemed beyond the scope of this paper the main purpose was to highlight the benefits of bankside monitoring which provides a wealth of data for understanding catchment processes.

This raises issues of the purpose of the DTCs. If they aim to quantify the effectiveness of mitigation measures in terms of % change etc the instrumentation installed should provide useful results, but if the aim is to understand the response of the different catchments a more comprehensive monitoring strategy is arguably required.

The reviewer noted earlier that there was superfluous information on the DTC project in the introduction and they are correct that this paper is not aimed at explaining the entire purpose of the wider DTC project. We haven't outlined how we intend to detect improvements in water quality in response to mitigation measures as it is beyond the scope of this paper. We therefore find no reason to respond to this comment further.

(9)As indicated above, there is much subjective inference regarding contrasts in the response of the different catchments to the post-drought wetting. It was far from clear how the suggestion that the TP response of the Eden catchment was transport controlled was justified. If much of the P was PP derived from surface sources it would seem almost certain that this would be supply limited rather than transport limited. Lack of exhaustion is not in itself evidence of lack of a supply limitation.

These unclear sentences have been removed.

(10)I was expecting some discussion of the extent to which the results presented conformed to other studies or existing understanding and thus their wider importance/ significance.

This has now been done.

(11)I am not familiar with the geology of the study catchments, but I found the reference to a clay layer underlying the Chalk and Greensand unclear. Are you referring to these rocks being underlain by clay strata or simply the existence of a clay layer at their base? More generally, I would see a need for a fuller description of the three catchments so that readers can link the results to the catchment characteritics more fully.

The geology of the Avon catchment has been clarified in the manuscript (section 2.1). A more detailed description of each catchment has been added including soil information in Table 1. Figure 2 also shows the more general hydrological and hydrochemical regimes for each of the catchments which should help the reader make distinctions between the three catchments.