Hampshire Avon DTC, River Wylye Water Quality: 2011-2013

The River Wylye, a sub-catchment of the Hampshire Avon DTC, is underlain by chalk and drains through a lowland landscape dominated by grazing livestock including dairy and specialist pig, along with cereal crops. Water quality in the sub-catchment is of particular importance due to abstraction by Wessex Water for domestic use downstream.

Hampshire Avon
Demonstration Test Catchment

The hydro-chemistry in the Wylye sub-catchment was monitored in two locations, upstream and downstream of a groundwater borehole discharge point, between 2011-2013, providing the baseline assessment of current water quality (figure 1). Rainfall and runoff over the monitored period are shown in figure 2. Key features of river flow during this period include:

- Drought conditions during late 2011 and early 2012 resulted in low flows, below 0.3 m^3 s^{-1} until May 2012 (figure 2).
- Wet conditions through late 2012 cause flows to peak at 2 m^3 s^{-1}, before reducing steadily after March 2013 until present where flows remain below 0.1 m^3 s^{-1}.
- The chalk geology results in slow changes to stream flows in response to rainfall events; therefore the system took time to recover from drought conditions.

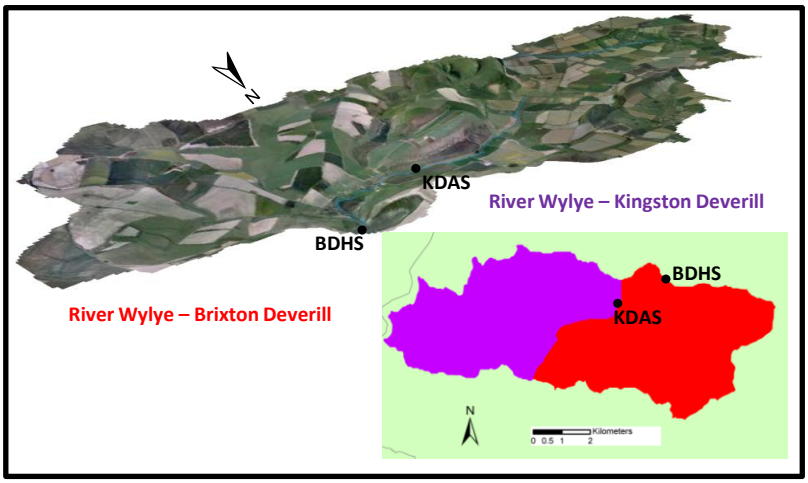


Figure 1: Location of the Wylye DTC sub-catchments. Black dots show sampling stations.

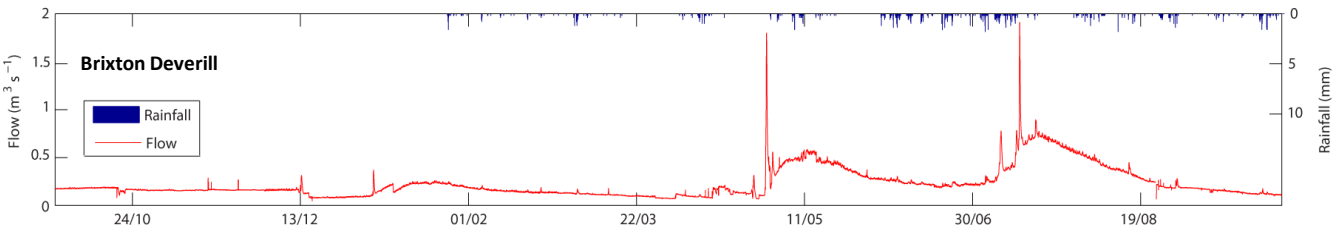


Figure 2: Plots showing example rainfall and discharge data for the Brixton Deverill field site during the Water Year 2011-2012 (Oct 2011 – Sept 2012).

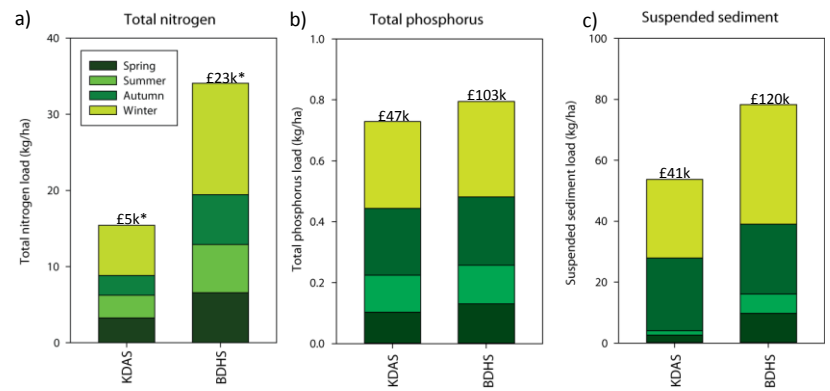
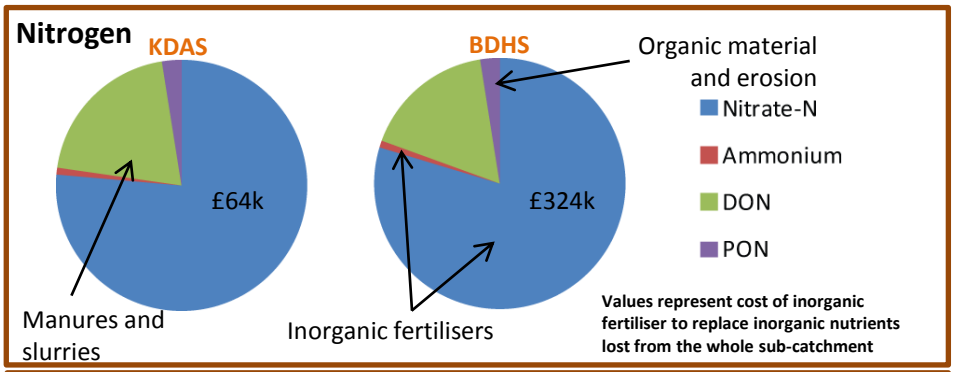
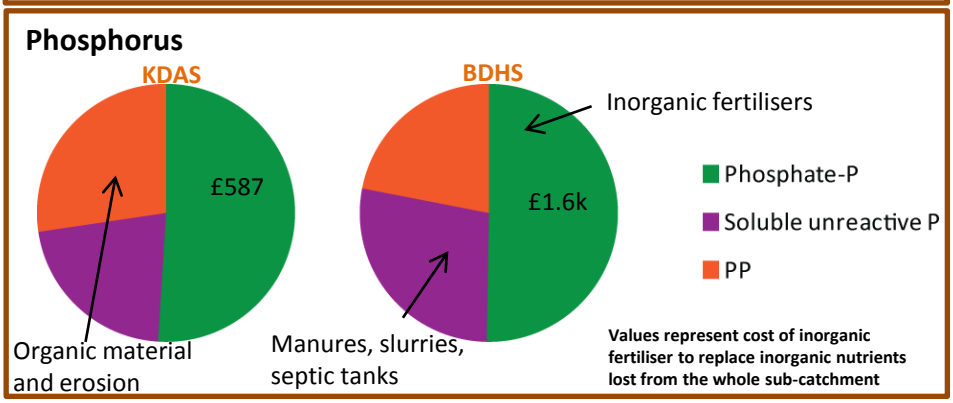


Figure 3: Seasonal comparison of the measured load of a) total nitrogen, b) total phosphorus and c) suspended sediment. Costs show total damage costs for nutrient losses from the whole sub-catchment based on impact on drinking and bathing water quality and biodiversity loss. * costs for nitrate fraction only.

- Total nitrogen loads were nearly twice as large at Brixton compared with Kingston, however the winter months were consistently important for N transport.
- Contrastingly total phosphorus loads and timings of fluxes were similar at both sites.
- Autumn and winter provided the majority of the suspended sediment load at both sites, however Brixton had a larger total load of ~3000 tonnes, and damage costs of £120k.

What are the sources of the nutrients?





- 78-85% of the total N is in the form of nitrate-N, which equates to fertiliser costs of £64k and £324k for Kingston and Brixton, respectively.
- The other important fraction is the organic N component, which contributes 16-20% of the total N in the stream.
- Phosphate-P contributes ~50% of the total P at both field sites (figure 4).
- The other 50% is made up of a roughly equal split of organic and sediment forms of P.
- While the proportions are similar, the total load is higher at Brixton resulting in higher equivalent fertiliser costs.

Figure 4: Pie charts showing the fractionation of the nitrogen and phosphorus and the potential sources.

When is pollution transported?

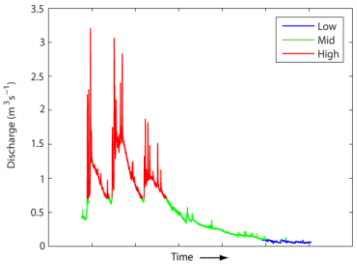


Figure 5: Example of time series showing flow, where low represents lowest 10% of flow duration record and high the top 10% of the flow duration record.

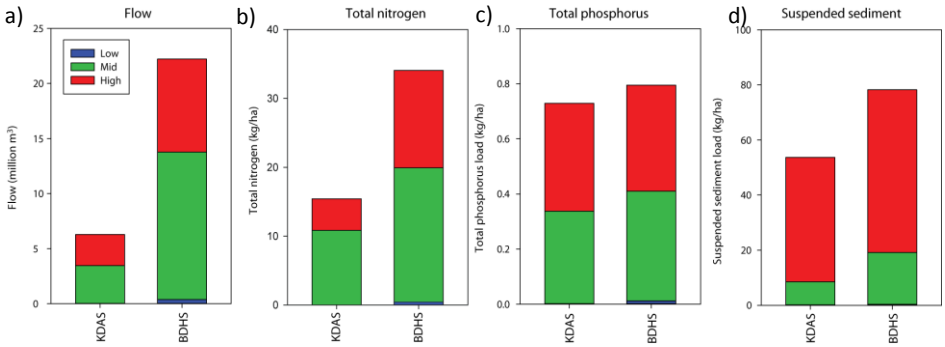


Figure 6: Bar charts showing the proportion of a) flow, b) total nitrogen, c) total phosphorus and d) suspended sediment moved during low, mid and high flows.

Key messages

- Nitrate-N is of particular concern in the Wylye; loads are high due to the influence of groundwater inputs, resulting in damage costs of up to £23k across the sub-catchment.
- A large proportion of the P load is phosphate-P, however organic sources are also important; these are likely to be derived from slurries and manures or from septic tank inputs.
- High flow events result in an increase in suspended sediment loads, as there is more potential for erosion of banks and nearby fields.
- Mid and high flow events are both important for N transport, particularly in the form of nitrate-N.
- Total phosphorus is also moved during mid and high flow events, when organic and particulate sources are more likely to be transported to the river.

Figure 7: High flow events can result in turbid water and changes in stream nutrient chemistry.