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

The Sem, sub-catchments of the Hampshire Avon DTC, are underlain by clay and drain through a lowland landscape dominated by low intensity livestock grazing. The sub-catchments are typical examples of clay landscapes with good seasonal flow and hydrology dominated by surface runoff.

The hydro-chemistry in the Sem sub-catchments was monitored at Priors Farm and Cools Cottage between 2011-2013. This data provides the baseline assessment of current water quality before pollution mitigation strategies are implemented in the manipulated sub-catchment (figure 1). Rainfall and runoff over the monitored period are shown in figure 2. Key features of river flow during this period include:

- The clay geology in the Sem sub-catchment results in rapid, flashy responses to rainfall events.
- The drought conditions in 2011-2012 can be observed through a lack of storm events (figure 2).
- In general storm events cause the flow to increase from a baseflow of under 0.1 $m^3 s^{-1}$ up to between 0.5-1.5 $m^3 s^{-1}$ depending on the rainfall duration and intensity.
- Storm peaks generally only last a few hours to 1-2 days before receding.

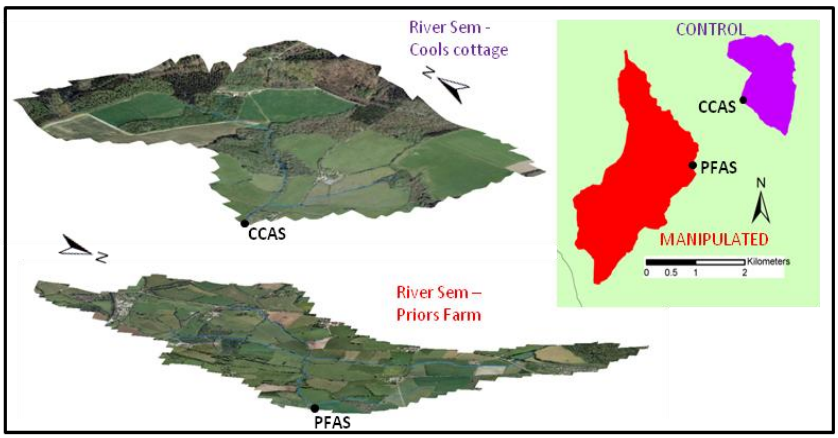


Figure 1: Location of the Sem DTC sub-catchments. Black dots show sampling stations.

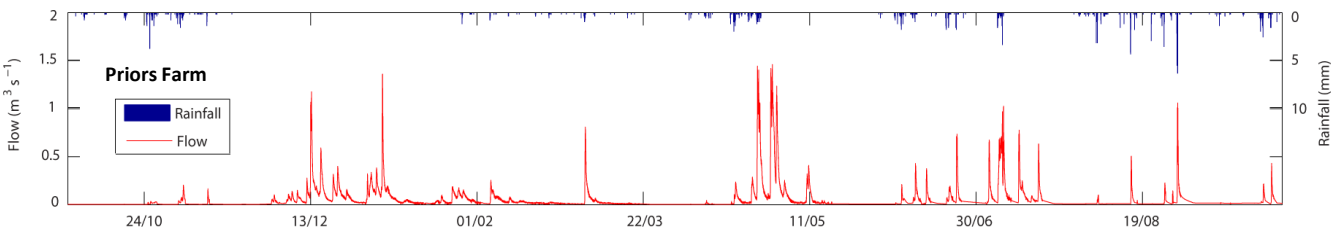


Figure 2: Plots showing example rainfall and discharge data for the Priors Farm field site during Water Year 2011-2012 (Oct 2011 - Sept 2012).

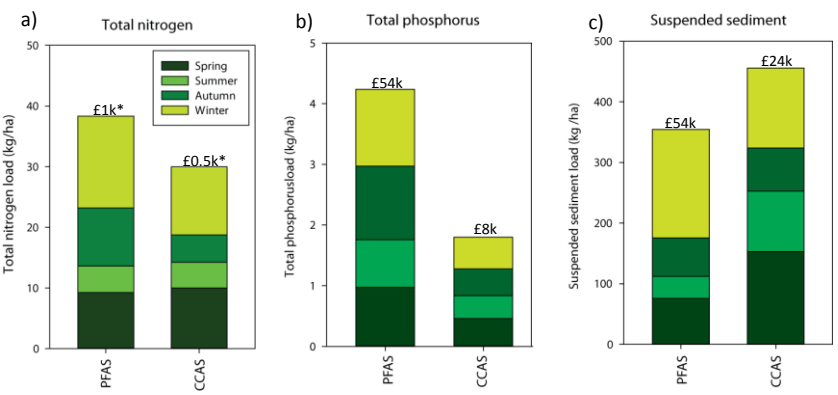
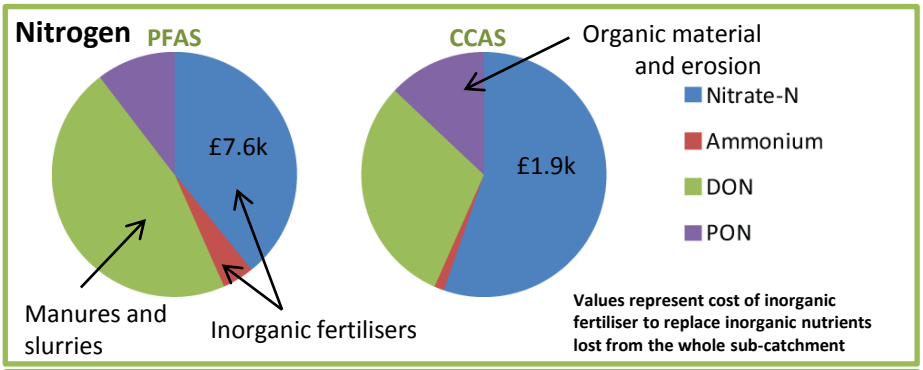
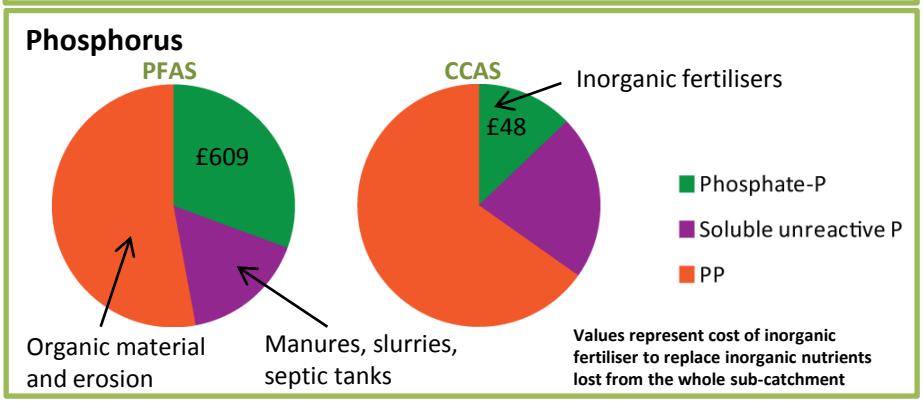


Figure 3: Seasonal comparison of the measured load of a) total nitrogen, b) total phosphorus and c) suspended sediment. Costs show total damage costs for nutrient losses from the whole sub-catchment based on impact on drinking and bathing water quality and biodiversity loss. * costs for nitrate fraction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

- Total nitrogen loads were higher at Priors Farm, and double the damage cost due to the larger catchment size.
- Total phosphorus loads are high all year round, with emphasis on autumn and winter transport at Priors Farm.
- Winter is particularly important for suspended sediment loads at both field sites, where it accounts for 50% and 30% for Priors Farm and Cools Cottage, respectively.

What are the sources of the nutrients?





- Nitrate-N contributes between 40-55% of the total N in the Sem.
- Organic sources of N are also important, particularly at Priors Farm where it contributes 46% of load.
- Particulate N contributes a smaller but significant proportion of N at ~10% at both sites.

- Phosphate-P contributes a smaller proportion of the total P load compared with N (12-30%).
- 70-80% consists of organic and sediment sources, which is likely to be derived from inputs of slurries and manures or from septic tanks.
- Particulate P is of particular concern, making up 65% of the P at Cools Cottage.

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

When is pollution transported?

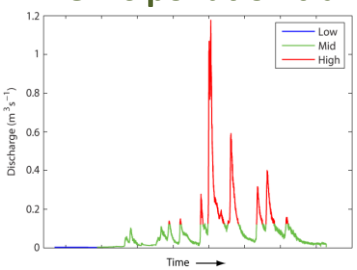


Figure 5: Example of time series showing flow, where low represents lowest 10% of flow duration record and high the top 10% of the flow duration record.

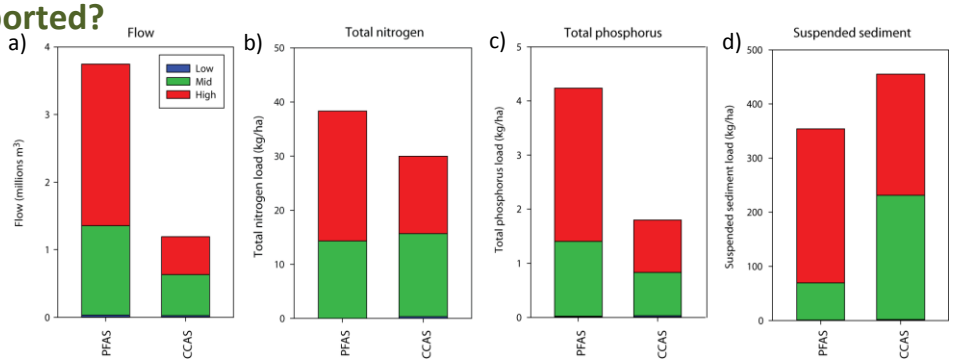


Figure 6: Bar charts showing the proportion of a) flow, b) total nitrogen, c) total phosphorus and d) suspended sediment moved during low, mid and high flows.

Key messages

- Overland flow is rapidly generated in the Sem sub-catchments due to the impermeable clay geology, allowing a rapid transport mechanism for nutrients and sediment.
- Nitrate-N and organic sources are important in the Sem sub-catchments.
- Sediment and the associated particulate phosphorus are efficiently moved during storm events, resulting in a combined damage cost of ~£100k in the Priors Farm sub-catchment.
- Mitigation needs to focus on reducing overland flow, thereby reducing erosion and impeding the main transport mechanism.

- Both mid and high flow events are important for the transport of nitrogen, suggesting the sources are easily mobilised.
- Contrastingly, high flow events are the most important for the transport of sediment and total phosphorus.
- Larger storm events result in more potential for erosion of fields and stream banks.

Figure 7: Surface runoff over impermeable clay cause rapid high flow events.