UPSTREAM THINKING IN ACTION: THE RIVER COBER

About the catchment

Background site information

The River Cober catchment (Figure 1 and Figure 2) lies within the Cober and Lizard EA Operational catchment which falls within the wider Cornwall West and Fal EA Management Catchment. It drains a 53.75 km^2 area of West Cornwall. The River Cober (Upper and Lower) itself rises at Nine Maidens Down, winding across Porkellis Moor and passing alongside Helston to reach Cornwall's largest natural lake, the Loe Pool.

Agricultural activity within the catchment is centred around intensive dairy farming, with rough grazing taking place on marginal land. Interventions in the catchments were led by **Cornwall Wildlife Trust** (CWT).

Catchment Challenges

The River Cober was identified as at-risk for pesticides and ammonium. Ammonium has been problematic in the past and can have significant impacts on the water treatment and its cost. The primary source of this pollutant is manure and slurry from agriculture. Concentrations of ammonium can increase rapidly under spate or flood conditions when the sources of ammonium are directly connected to the surface streams and rivers. To deal with this issue, the water treatment works has auto-shutdown facilities in place, which prevent the works from abstracting and treating water when its quality deteriorates beyond certain thresholds. As the security of the water supply is compromised during these periods, it is important that they do not persist for too long.

- The water quality issues in the Cober catchment have been identified as ammonium levels (over 2 mg L^{-1}) and pesticides (MCPA and Mecoprop in particular);
- Ammonium levels were elevated for ca. 1.88% of the time, but the threshold of 2 mg L^{-1} was exceeded in 0.85% of time, adding up to around 74 hours per year (on average across the study period);
- Overall, a positive contribution of Upstream Thinking in the catchment is likely to have reduced the frequency of ammonium detections in the catchment since 2015, as seen in the continuous ammonia signal;
- Use of the Chemcatcher passive sampling devices has shown high numbers of pesticide detections throughout the monitoring period; the regulatory limit of 100 ng L^{-1} per compound and per detection was exceeded on four occasions in the River Cober;
- MCPA and Mecoprop remain present throughout the catchment; metaldehyde has not been detected in the Releath Stream.

Figure1 The River Cober; picture by Emilie Grand-Clement

Catchment Activities

Activities in the Cober catchment started in 2015, i.e. later than some other Upstream Thinking catchments. Ammonium can originate from diffuse and point source pollution and therefore a focus of CWT activity in the Cober catchment was to work with farmers to identify opportunities to improve dirty water management and prevent ammonium runoff. In addition, work was undertaken to improve land management to reduce erosion, buffer run-off and reduce nutrient inputs to the soil and streams.

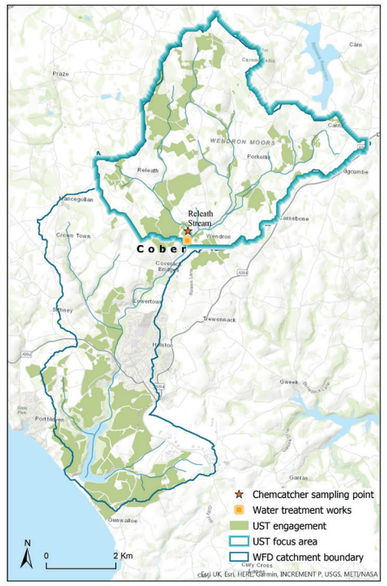


Figure 2 Map of engagement by the CWT as part of UsT in the Cober catchment.

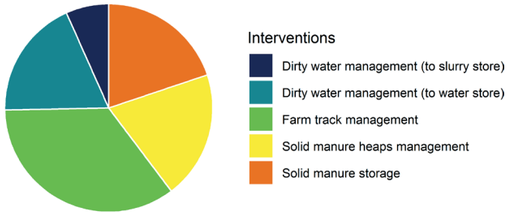


Figure 3 Top 5 interventions (quantified in Farmscoper) used in the Cober catchment.

Figure 2 illustrates the level of farm engagement in UsT2 within the Cober catchment. Whilst the area of catchment engaged appears small (8% of the total UsT focus area), this is mainly because only a small number of farms could be targeted for very specific interventions following identification of key opportunities to reduce ammonium, based on farm type (dairy), proximity to watercourse and land slope.

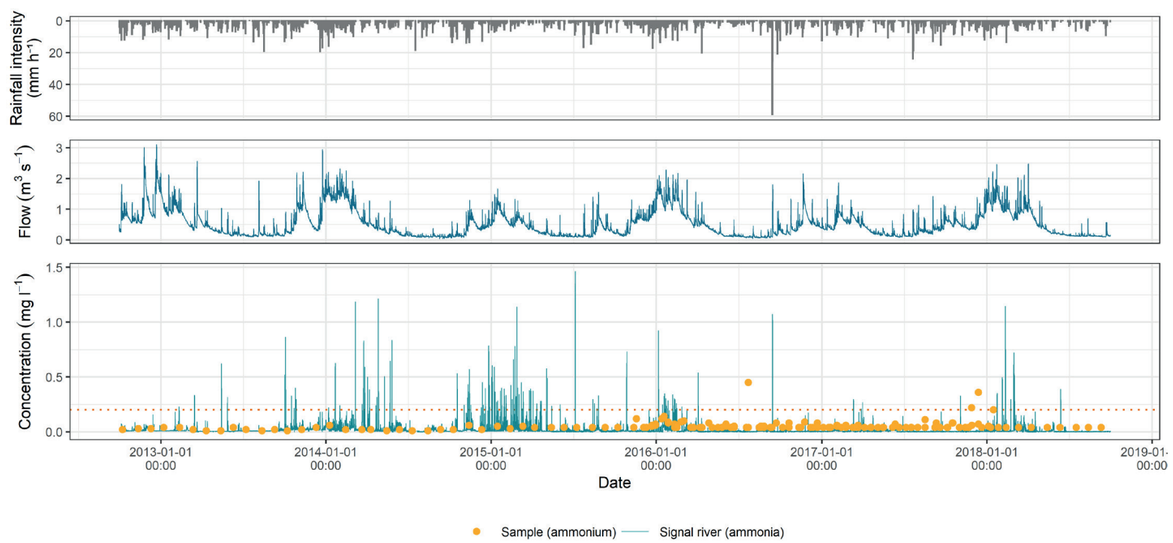
Physical interventions completed via UsT, which were quantifiable within the Farmscoper software, amounted to a cumulative total of 1,026 ha. The most commonly used interventions are shown in Figure 3. They are mostly aimed at targeting nutrients, although farm track management is also thought to have an impact on sediment losses to streams and rivers.

Water quality in the Cober catchment

Ammonium in river water

In the River Cober, the mean concentration of ammonium from samples analysed over the last 15 years is 0.23 mg L^{-1}; in the Releath Stream the mean concentration is 0.094 mg L^{-1}. For the period 2015 to 2018 this drops to 0.044 mg L^{-1} and 0.064 mg L^{-1} for the Cober and the Releath, respectively. Concentrations in the blended raw water at the SWW water treatment works were typically lower, with an average of 0.032 mg L^{-1} over the last 15 years, increasing to 0.047 mg L^{-1} more recently. The median values for sampling points are at or below the limits of detection, showing a positive contribution of Upstream Thinking in the catchment to reducing the frequency of ammonium detections in the catchment.

Figure 4 Timeseries for rainfall, flow and ammonium samples and continuous measurements alongside a threshold (orange dotted line) of 0.2 mg L^{-1}.



High-frequency signals from sensors in the river also play an important role in understanding the behaviour of ammonium. Figure 4 shows the seasonal patterns in flow, ammonium signal, and ammonium samples, with a threshold value of 0.2 mg L^{-1} displayed. Above this level, the works are temporarily shut down to protect the drinking water supply, as such levels are difficult to remove from drinking water.

Values for ammonium are elevated over this threshold for a small proportion of the time (0.85%). Each year these exceedances occur on multiple occasions for short periods of time, adding up to around 74 hours per year (on average across the study period). The signal is elevated for a greater proportion of time (1.88%) over winter in January, February and March (Table 1) and more peaks are seen during these months. Sensor levels for ammonium are, in general, lowest in the summer (July, August and September).

Time Period	Time threshold exceeded	
	Hours	Percentage of time
Winter (OND)	10.6 hr	0.48%
Winter (JFM)	41.3 hr	1.88%
Summer (AMJ)	19.6 hr	0.89%
Summer (JAS)	3.1 hr	0.14%
Hydrological year	74.2 hr	0.85%

Table 1 Average time per season where the signal exceeds the shutdown threshold of 0.2 mg L^{-1}.

Pesticide detection in the Cober catchment

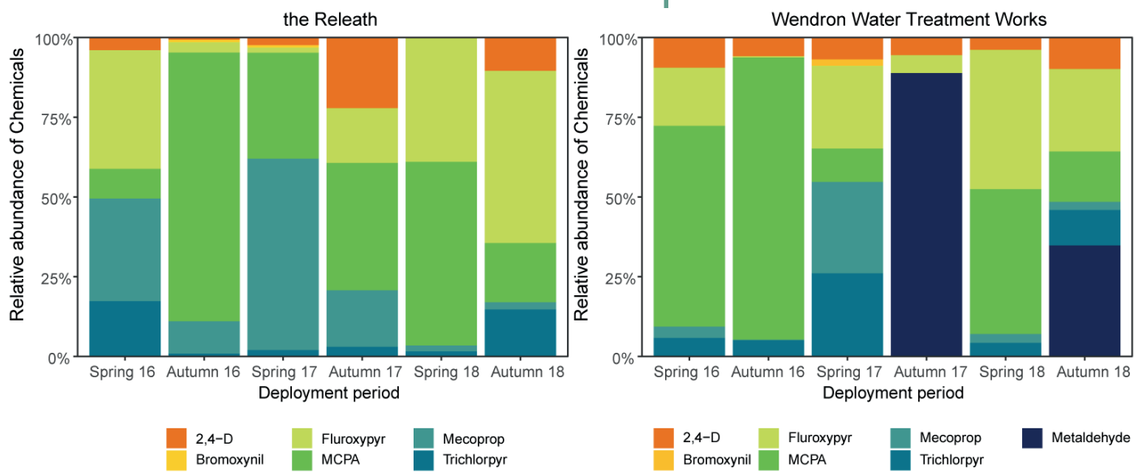
Since 2016, the Cober catchment has experienced a high number of pesticide detections (i.e. between 3 and 16) in all streams monitored (Table 2). This number of detections appears to be slightly lower in the second half of the monitoring period (i.e. between Autumn 2017 and Autumn 2018), with the number of detections in Autumn 2017 being the lowest across all sites.

Table 2 Total number of detections, exceedances above 100 ng L^{-1}, maximum concentrations detected and total number of compounds detected in the river Cober and the Releath stream between spring 2016 and autumn 2018. The blue shading indicates a severity scale separately applied to each parameter, from light blue (low) to dark blue (high).

		Spring 16	Autumn 16	Spring 17	Autumn 17	Spring 18	Autumn 18
Total number of detections	R. Cober (Burras bridge)	N/A	N/A	15	5	8	11
	R. Cober (Porkellis bridge)	15	11	16	3	10	9
	SWW asset - R. Cober	14	12	15	5	12	14
	SWW asset - Releath stream	15	13	14	10	9	8
Exceedances over 100 ng L^{-1}	R. Cober (Burras bridge)	N/A	N/A	1	0	1	0
	R. Cober (Porkellis bridge)	0	1	0	0	0	0
	SWW asset - R. Cober	0	1	0	0	0	0
	SWW asset - Releath stream	0	0	0	0	0	0
Max concentration of individual pesticide (ng L^{-1})	R. Cober (Burras bridge)	N/A	N/A	132	1	197	3
	R. Cober (Porkellis bridge)	92	153	29	1	57	2
	SWW asset - R. Cober	40	110	4	11	9	2
	SWW asset - Releath stream	7	31	27	13	29	3
Total number of compounds	R. Cober (Burras bridge)	N/A	N/A	7	3	4	5
	R. Cober (Porkellis bridge)	5	5	6	2	5	5
	SWW asset - R. Cober	5	5	6	3	5	6
	SWW asset - Releath stream	5	6	6	5	4	5

Similarly, the catchment is experiencing very high single contaminant detections, with values going beyond the regulatory limit of 100 ng L^{-1} on four occasions in the River Cober (e.g. between 110 and 197 ng L^{-1}), one of which was at SWW's water treatment works. Although the Releath Stream has a high number of detections, they never exceed 31 ng L^{-1}.

Figure 5 Relative abundance of compounds detected at SWW water treatment works, with water originating from the Releath Stream (left) and the River Cober (right).



Between two and seven different chemicals were found at each location. Figure 5 shows a comparison between the Releath Stream and the River Cober. The same chemicals are found in both streams, highlighting their usage throughout the catchment. MCPA and Fluroxypyr in particular are found in very high concentrations; the usage of Mecoprop is also consistent across sites and deployment periods but at lower concentrations. All of these compounds can be used in grasslands, which represents one of the main land use types in the catchment. Metaldehyde (the active ingredient found in slug pellets) is the only compound that has been detected in the River Cober (Autumn 2017 and 2018), but never in the Releath. This compound is typically used on edible crops, and may therefore have been used on the 22% of the catchment in arable land. Overall, this data is invaluable information for the Cornwall Wildlife Trust to target pesticide usage in the catchment.

Spring hedge in Cornwall; photo by Sue Hocking (CWT).