

Retention of Sediment and Nutrients at Crake Trees Manor, Cumbria

Research

Three field wetlands created at Crake Trees Manor (Figure 1) were surveyed annually for annual accumulation of sediment (Figures 2 and 3) and nutrients - phosphorus (P), nitrogen (N) and carbon (C). Water samples collected automatically during storms and fortnightly during low flows (December 2011–November 2012) allowed the effectiveness of the wetlands for reducing diffuse pollution to be determined (Figure 4).

Results

Over three years, the three field wetlands at this site trapped a total of:

- 40 tonnes of sediment (Figure 2), including
- 30 kg of P
- 100 kg of N
- 1200 kg of C

Much of the sediment came from a few major rainfall events when surface runoff over bare soil eroded sediment (Figure 3a) which was trapped in Bill & Ted Surface wetland (Figure 3b) and India Stream wetland.

Nutrient concentrations during baseflow were low (nitrate-N < 0.5 mg l⁻¹, soluble reactive phosphorus (SRP) < 0.04 mg l⁻¹, both below WFD limits for 'good' status), but could be high during rainfall events (SRP > 0.5 mg l⁻¹). Wetlands reduced concentrations of both sediment and phosphorus (Figure 4).

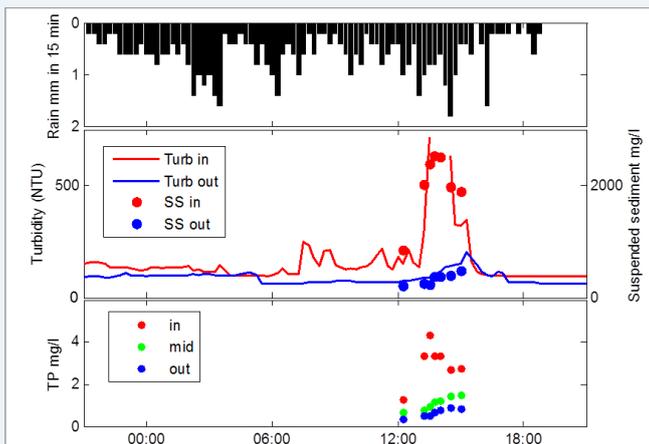


Figure 4. Rainfall event on 10 May 2012 (52mm rain) showing reduction in concentrations between the inlet and outlet of Bill & Ted wetland.

Dye tracing tests indicated that water residence time in the wetlands was 7–20 times longer than in the equivalent length of ditch.



Figure 1. Field wetlands at Crake Trees Manor: a) Bill & Ted Surface, b) William Drain c) India Stream.

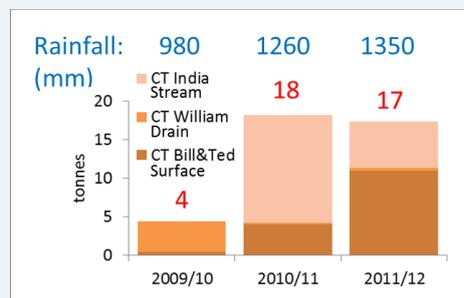


Figure 2 (above). Annual rainfall and mass of sediment trapped in each of the wetlands at Crake Trees Manor, for the hydrological years 2010–2012 (1 October—30 September).



Figure 3. (a) Overland flow over bare soil resulted in sediment erosion which was deposited in Bill & Ted wetland (b).

Key Messages

- All the field wetlands had a positive impact, with net accumulation of sediment and nutrients in each field wetland on an annual basis.
- The water quality improved as water moved through the wetland/ditch system, with lower concentrations of sediment and nutrients at the field wetland outlets than the inlets, particularly when inlet concentrations were high.
- Field wetlands can store water for an order of magnitude longer than the adjacent/receiving ditch or stream under the same flow conditions, thus providing an opportunity for sediment and nutrients to settle out or be taken up by plants and micro-organisms.