Phosphorus load apportionment in Irish water-bodies

Lucy Crockford[1, 2], Philip Jordan[1] and David Taylor[2]
1. Agricultural Catchments Programme, Teagasc; 2. Dept. of Geography, Trinity College Dublin

1. Introduction

The main aim of this study is to investigate the phosphorus (P) load apportionment patterns and processes to two *at risk* water body types; rivers draining agricultural catchments on impermeable soil types; and an inter-drumlin lake as the receptor in a similar catchment. For rivers, the loads under investigation are *point* and *diffuse*. For the lake, the principal focus will be on *external* and *internal* loads. The rate of recovery from eutrophication for the two water-bodies will be investigated and compared with approaching Water Framework Directive deadlines.

2a. Modelling point and diffuse phosphorus loads

Load apportionment models (LAMs) of riverine P loads assume that point sources are diluted with increasing flow and that diffuse sources increase with increasing flow. Greene et al. (2011) recently apportioned P load in the Lough Sheelin catchment with an empirical formula based on historical concentrations and river flows (equation 1). Point sources in catchments are attributed to municipal and domestic effluents and diffuse sources from agricultural soils.

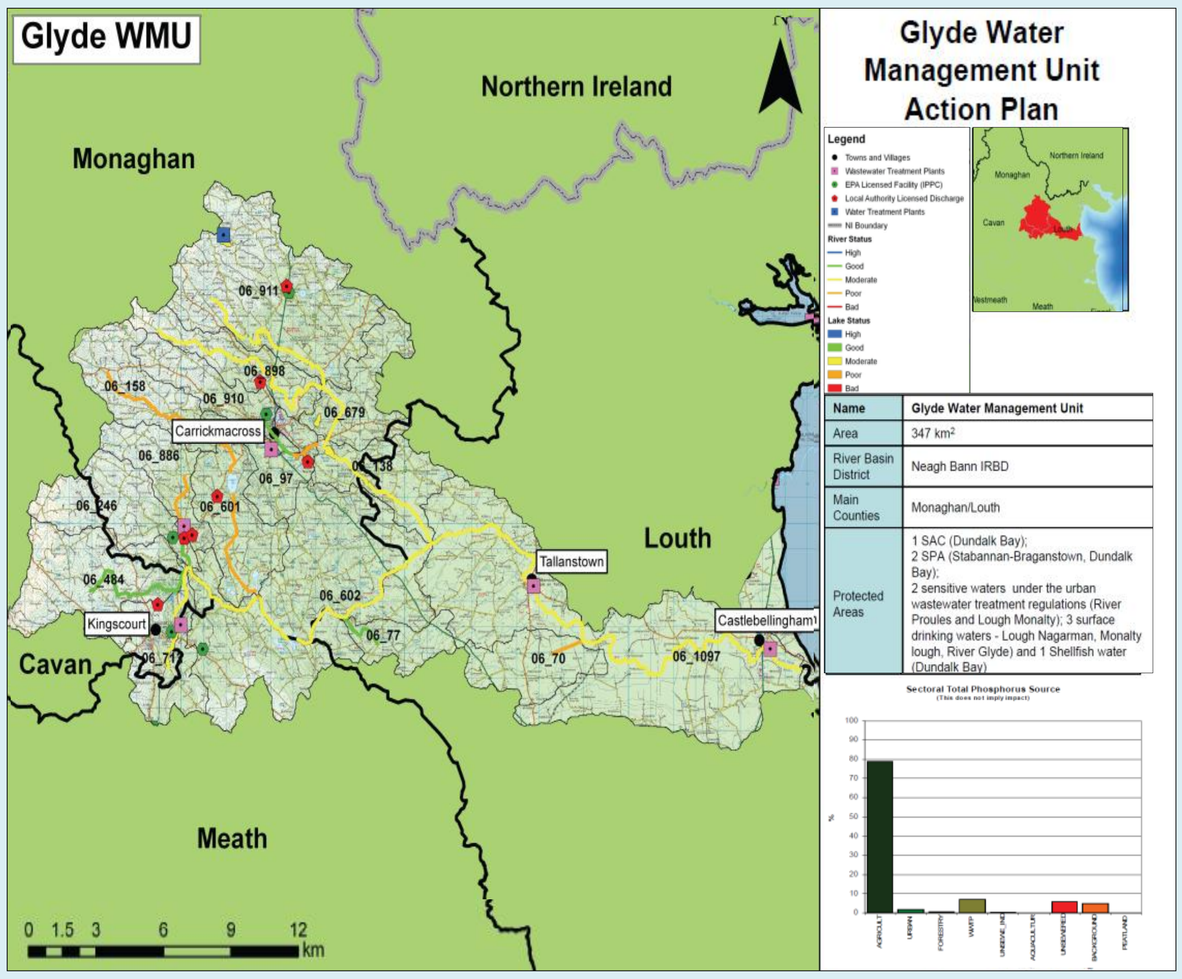

Fig 1. Glyde River Catchment

$$Cp = A.Q^{-1} + B.Q + C.Q^2 \quad \text{Eqn. 1}$$

C_p = P conc. at sampling point, $A.Q^{-1}$ = point source contribution, $B.Q$ = diffuse contribution due to moderate runoff, $C.Q^2$ = diffuse contribution due to sheet erosion during storm events
(A, B and C = empirical coefficients of relationships between P concentrations and flow.)

2b. Study sites

River Glyde

The R. Glyde is located in counties Monaghan, Cavan and Louth with a range of point and diffuse P pressures (figure 1); historical data from which will be used to build a LAM.

White River (Dunleer)

The neighbouring White River in Co. Louth is continuously monitored by the Agricultural Catchments Programme using a bank-side P analyser (figure 2). The LAM applied to the Glyde will be verified using this dataset to check on model uncertainty.

Fig. 2 Bank-side analyser at Dunleer

3a. Lake phosphorus loading

Lakes become eutrophic as a result of three loading processes. Firstly, as a result of increasing external P loads from the catchment, the net concentration of which remains in the water column. The two remaining processes as a result of much of the remainder of the external P load accumulating as bed sediments and becoming biologically available due to resuspension from summer anoxia or due to wind induced rolling, dependent on lake morphology. The aim of this part of the project will be to investigate patterns of all three loading processes using catchment and lake high resolution data.

3b. Study site

Sreenty Lough

Sreenty Lough is an inter-drumlin meso-eutrophic lake in Co. Monaghan. The neighbouring catchment has similar high resolution P monitoring equipment as the White River and the lake has been fitted with DO/temp/Chl a/conductivity/pH/redox profilers (figure 3). Early data indicate that seasonal anoxia is occurring with DO depressions in hypolimnetic water and thermal stratification at a depth of 6m (figures 4 and 5). The role of seasonal anoxia in the eutrophication of the lake will be investigated by monitoring chemistry and biology at a high resolution.

Fig. 3 Buoy containing lake quality profilers on Sreenty Lough

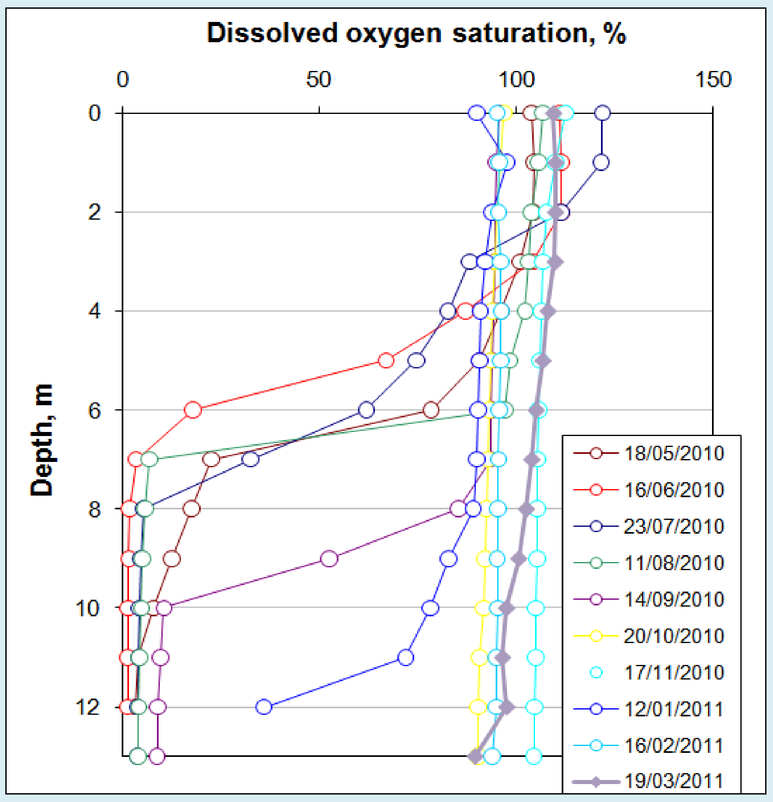

Fig. 4 Dissolved Oxygen Profile in Sreenty Lough

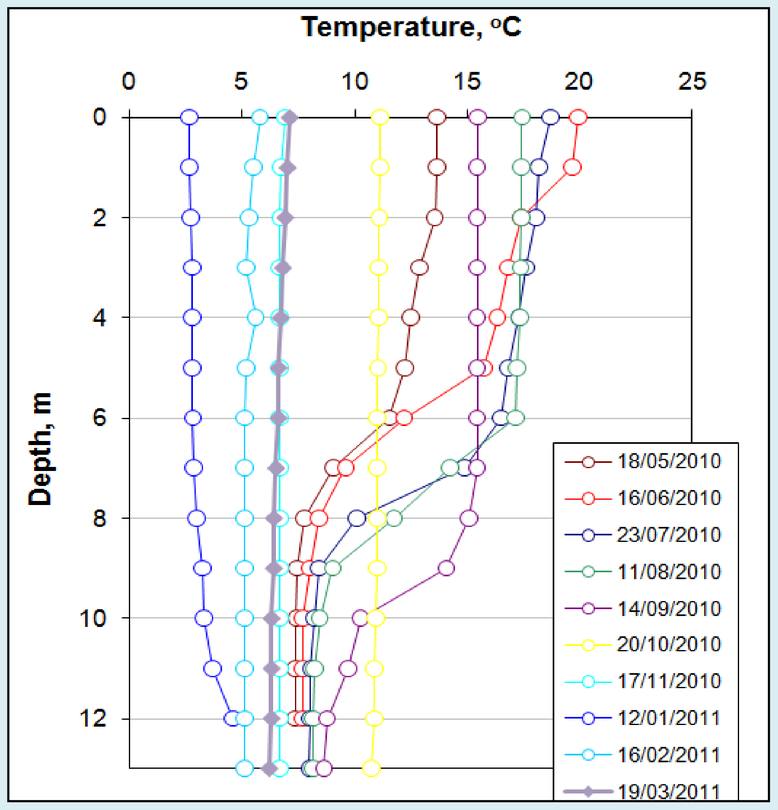

Fig. 5 Temperature Profile in Sreenty Lough

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Reference
Greene S, Taylor D, McElarney YR, Foy RH, Jordan P. An evaluation of catchment-scale phosphorus mitigation using load apportionment modelling. *Science of the Total Environment* – in press for 2011.