Nutrient and Sediment Loads from Farm Drains – Fact Sheet

Linking lake restoration with end users for positive environmental outcomes

LERNZ
Lake Ecosystem Restoration New Zealand

Land Use and Nutrient Sources

Runoff from intensive agriculture has been identified as a major contributor to the decline of New Zealand's freshwater ecosystems. Excessive nutrient and sediment losses to lakes and rivers lead to reduced water clarity and quality, which in turn leads to reductions in biodiversity and amenity and aesthetic values.

Rates of nutrient and sediment loss to aquatic systems are dependent on a number of factors including soil type, slope, rainfall, vegetation cover and type of land-use. Typically, intensive pastoral land-use such as dairy farming has higher levels of phosphorus and nitrogen loss compared with sheep and beef farms. However, sheep and beef farms are often located on hill country, leading to greater soil erosion rates compared with dairy farms.

Limitations of Monitoring Data

Farm nutrient budgets and catchment models provide a means to quantify sediment and nutrient losses to aquatic systems. However, validation of these tools can be limited by availability of monitoring data and ability to resolve rapid changes over time. Monitoring of flowing waters is often conducted under base-flow conditions when contaminant concentrations are usually at the lower end of their ranges. During a storm event, concentrations can increase significantly due to mobilisation of sediment and mobilisation of catchment nutrient storages (Figure 1). When coupled with increased discharge this can lead to errors in estimates of catchment nutrient yields and loads to aquatic systems.

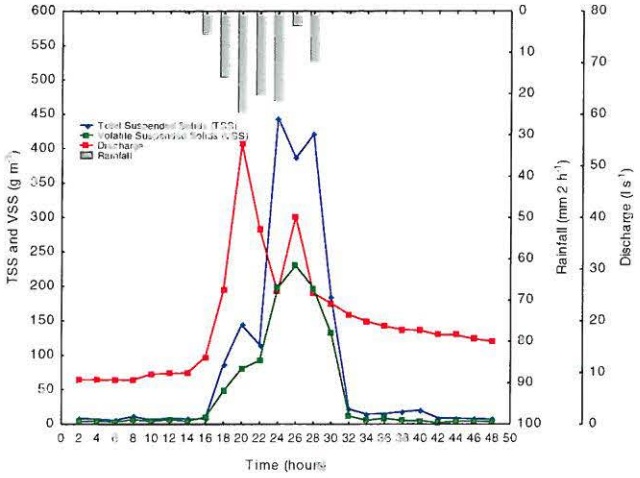

Figure 1. Inflow monitoring of a farm drain during a storm event displaying the short-lived peaks in discharge and suspended sediment levels.

Figure 2. Inflow monitoring site following 100 mm of rainfall in 24 hours. Discharge had nearly returned to base-flow levels 12 hours after cessation of rainfall.

Catchment Research

The LERNZ research group has undertaken a number of catchment related research projects examining the impacts of land-use and mitigation methods to improve lake water quality (Figure 2). These projects have included, high frequency monitoring of farm drainage systems, installation of sediment detention structures to reduce sediment and nutrient loads to lakes and use of catchment modelling programs such as SWAT and INCA to determine the effects of land-use change.

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Inputs from Storm Events

From 2013-14, farm-drain discharges to several Waikato peat lakes were sampled during four storm events. Substantial increases in dissolved and particulate material occurred in peat soil catchments. Suspended solids increased from <3 g m^{-3} up to 120 g m^{-3} and total phosphorus concentrations increased from 0.2 g m^{-3} up to 0.9 g m^{-3} within a few hours. In one case, an estimated 4 tonnes of suspended sediment was discharged from a single farm drain into an 8-ha lake (Figure 3).

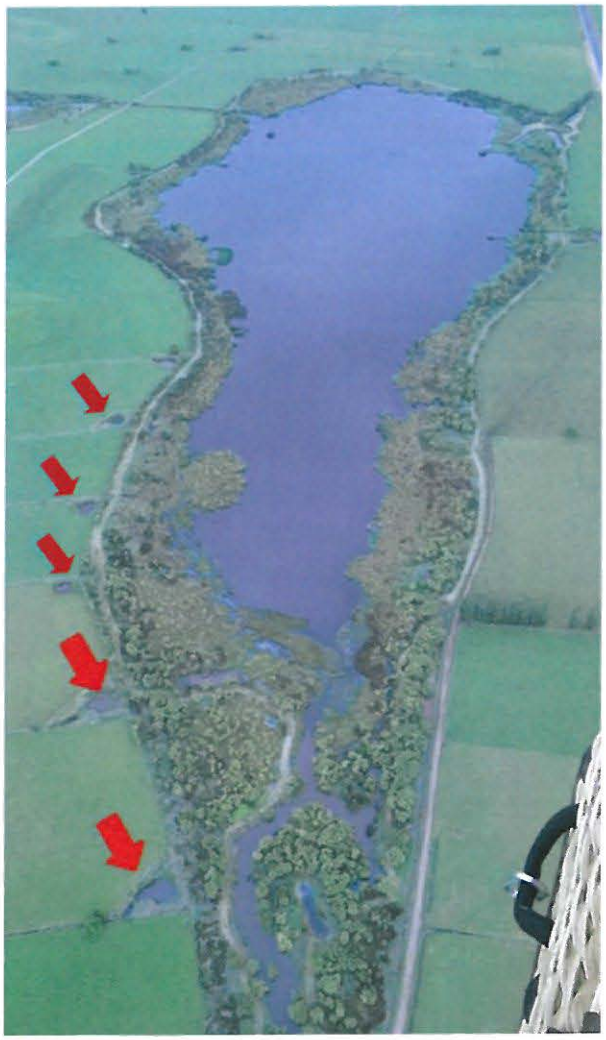

Figure 4. Lake Kaituna. Red arrows indicate sediment detention structures at the end of farm drains. Photo: Ashley Webby

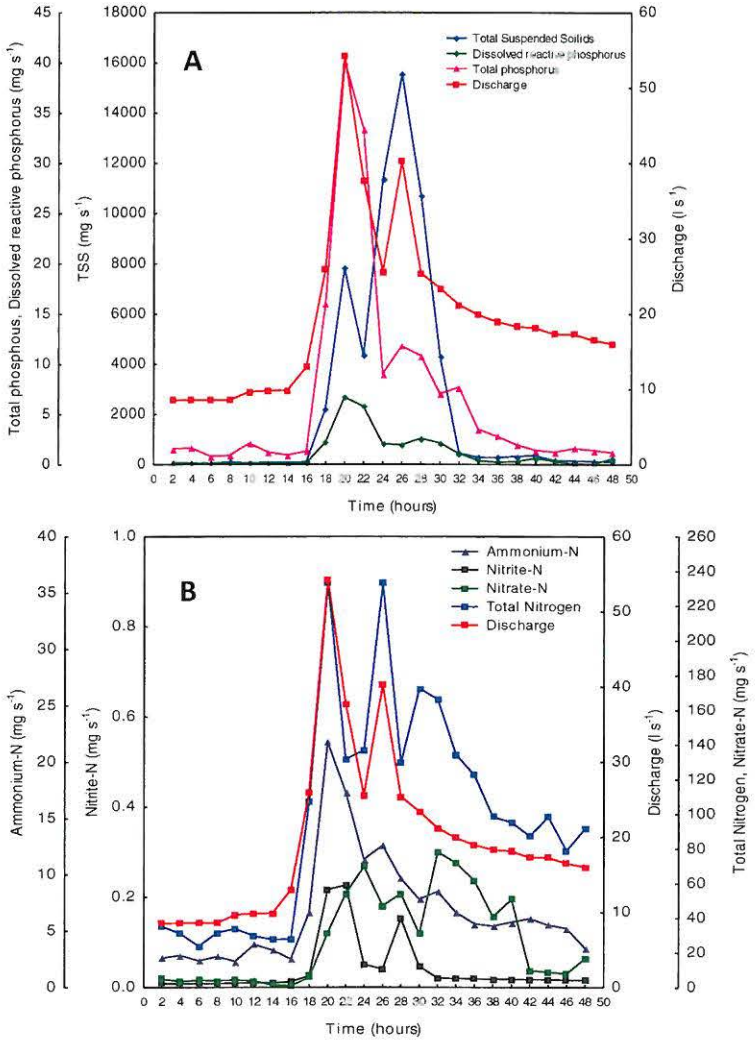

Figure 3. Instantaneous loads of **A**) total phosphorus (TP), dissolved reactive phosphorus (DRP), total suspended solids (TSS) and **B**) ammonium-N, nitrate -N, nitrite-N and total nitrogen in relation to discharge for a small Waikato peat farm drain during a storm event (100 mm rainfall) in September 2013.

Conclusions and Recommendations

Discharge from small, ephemeral farm drains during heavy rainfall events has the potential to be a significant source of dissolved and particulate material to the many small, shallow lakes in the Waikato region. Sediment detention structures, fencing and adequate riparian strips (Figure 4), coupled with best practice in pasture renewal and drain maintenance helps to reduce sediment and nutrient runoff. In addition, nutrient budgets and ecological models need to be reviewed to ensure that they adequately account for these findings.

Reference:
Tempero G, Hamilton DP, 2014. Final Report: inflow monitoring of the Rotopiko lakes and Lake Mangakaware. Client report prepared for Waikato Regional Council. Environmental Research Institute Report No. 49, The University of Waikato, Hamilton. 72 pp