

Regulating stormwater flow using perforated risers and in bloked ditches; Effects on water quality



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What is a perforated riser?

A perforated riser is a vertical pipe which constrains surface water to pass through an underground conduit. When it's installed in an agricultural ditch, its purpose is to reduce the flow of water from rain events. Thus, a sedimentation basin is formed in the ditch where sediments and nutrients are partially deposited. This is preventing their exportation from the field to the watercourses.

Problematic

In Quebec, perforated riser have been largely installed in rural areas based on a very optimistic estimated effect of amelioration of water quality.

Goal

Evaluate the water filtering efficiency of different types of regulated ditches in agricultural areas:

- a floating skimmer;
- a standard perforated riser;
- an adapted perforated riser enabling variable flow;
- a control ditch.

Objectives

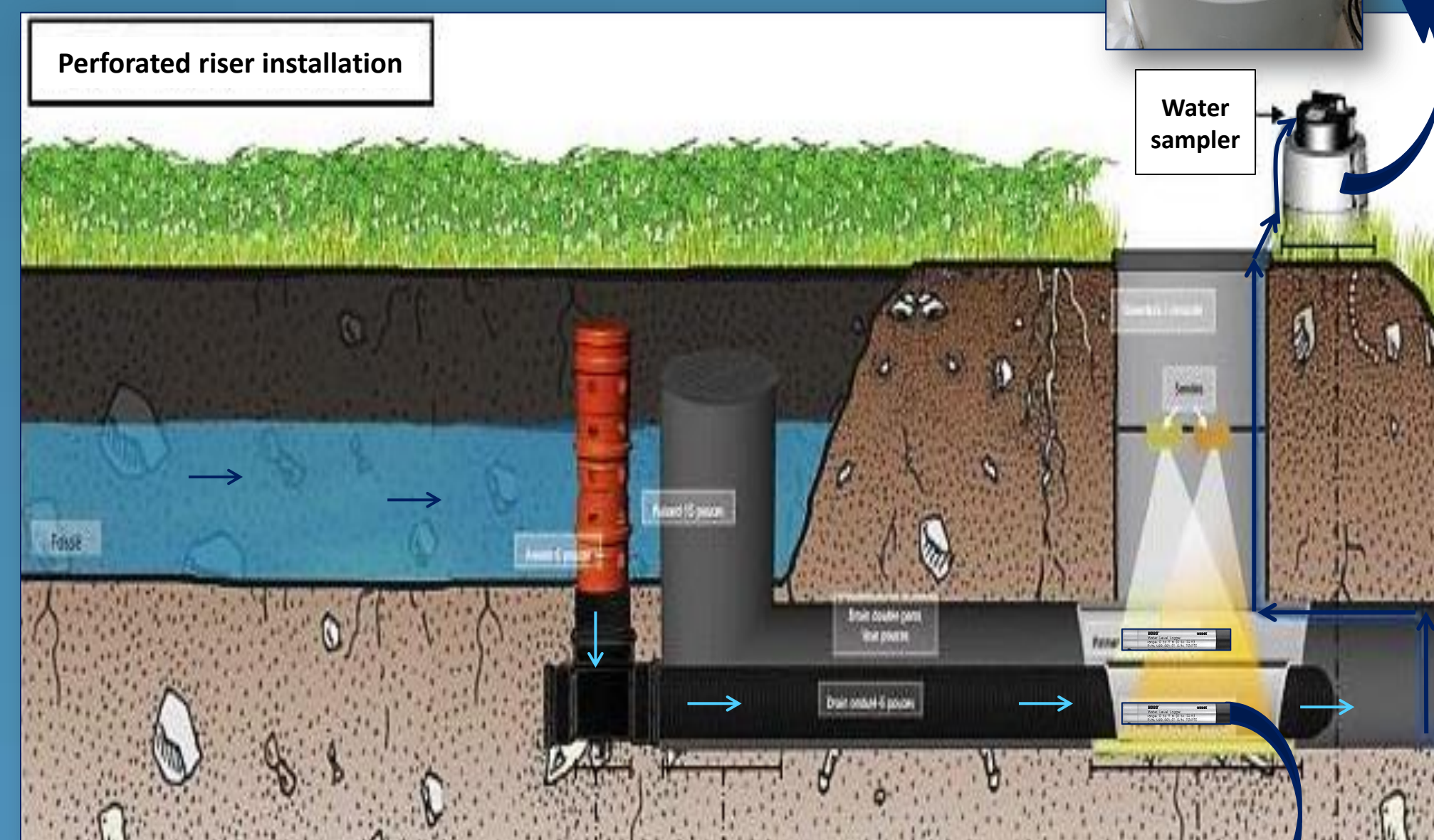
- Measure, during rain events, the flow, the quantity of suspended sediments (SS), and the concentration of phosphorus (P) and nitrogen (N) discharging of the three different systems and the control ditch;
- Compare the event mean concentration of SS, P and N in order to estimate the efficiency of the 3 different systems to ameliorate the water quality.

Methods

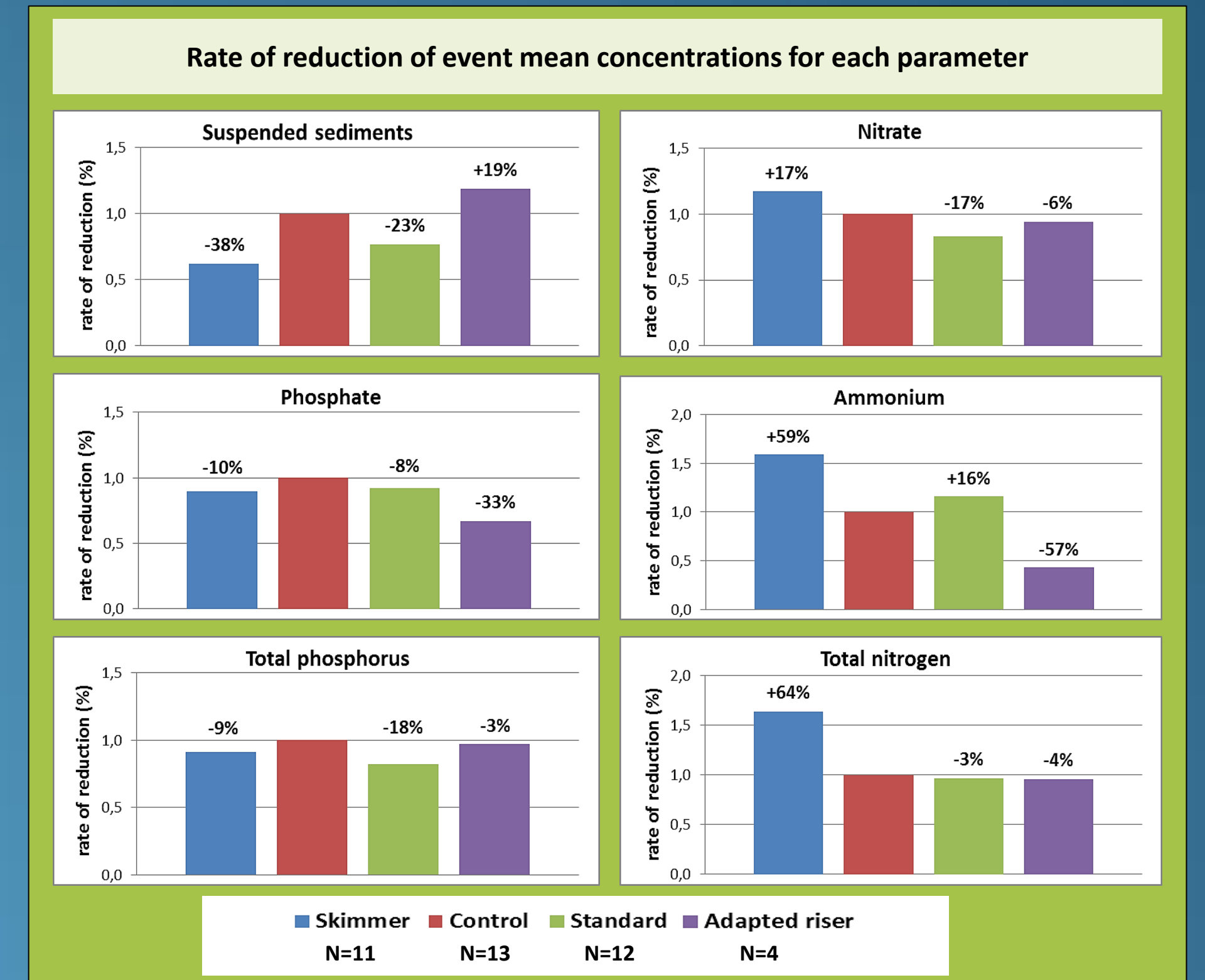
For each ditches and for all rain events:

- Collect pre-acidified water samples during and after a rain;
- Analyze the contents of SS, P and N in water samples;
- Convert concentrations into total loads using flow rate.

24 pre-acidified bottles for collecting water.

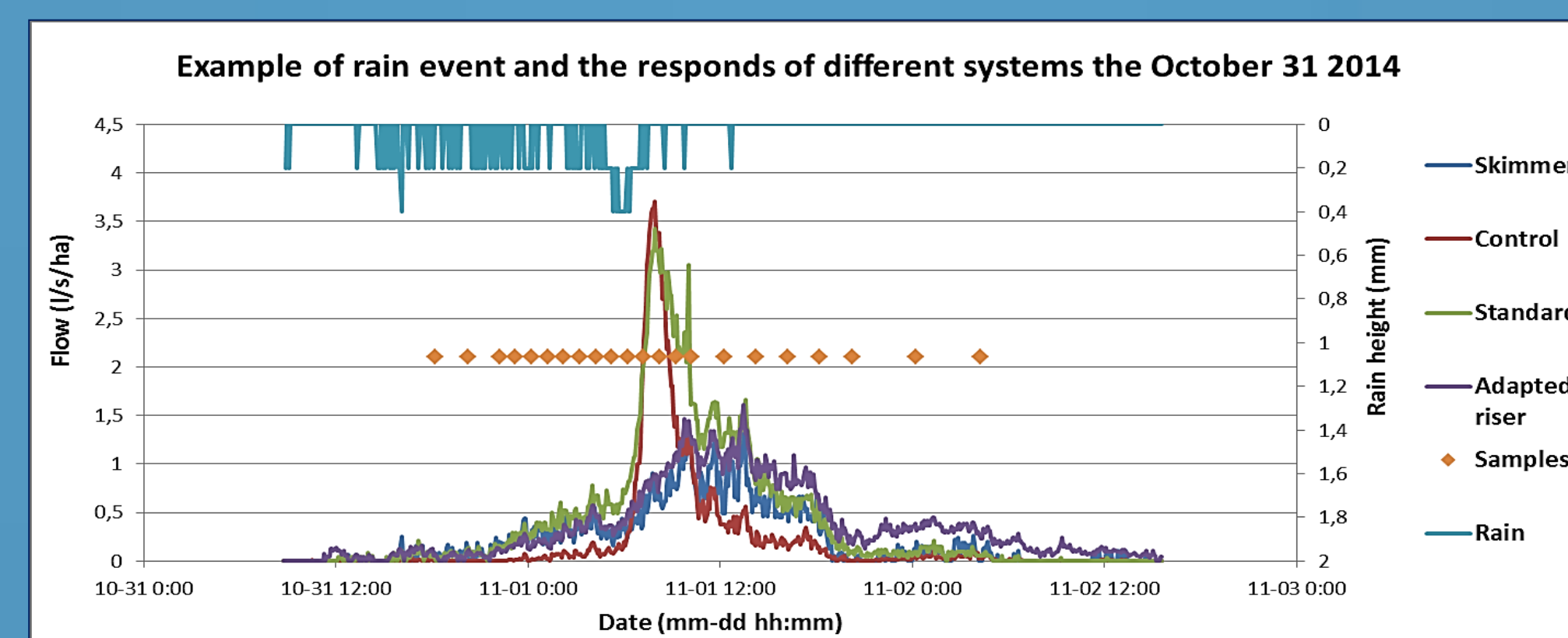


Submersible pressure sensor measuring the water depth.



Analysis

13 runoff events were analyzed. Water filtering efficiency of systems is determined by the rate of reduction of event mean concentrations when compared to control. These values were calculated for each water quality parameter and for each event. To obtain the event mean concentrations, the total loads was divided by the corresponding total volume of water.



Results

- The peaks flow for the skimmer were much lower;
- The efficiency of sediments retention was, in order of performance :
 1) Skimmer;
 2) Standard perforated riser;
 3) Control;
 4) Adapted perforated riser.
- The skimmer brings high nitrate, ammonium and total nitrogen output.
- The flow significantly influence SS ($p < 0,0001$) and total nitrogen ($p = 0,0446$) outputs. Values increase with the flow.

Conclusion

The reduction of SS was not correlated to P and N reduction. The most frequently used perforated riser retains more than the control ditch. The floating skimmer is not as affective as thought. SS retention results are quite lower than Jarrett and Barfield's research study (2004) with 80 and 90% for a standard and a skimmer. Sedimentation and water ponding in the basin lead to increased biological activities, which could explain the increased output of most nutrients.

