Petite Sarine river
Sediment transport restoration

Introduction

Since the construction of Rossens dam in 1948, bed load transport in the Petite Sarine river is highly reduced. The absence of floods since 2007 led to the proliferation of algae and clogging of the riverbed. The objective of this study is to generate an artificial flood that satisfies the constraints:

- economic, minimizes discharge volumes;
- safety, minimizes the inundation of Pila landfill;
- ecological, preserve wildlife;

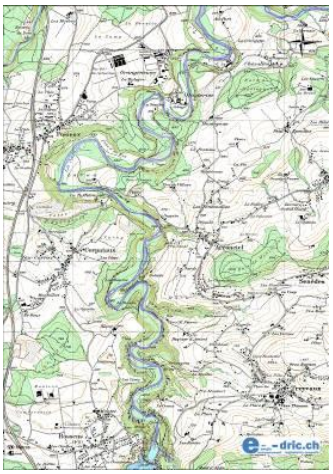

Fig. 1: Petite Sarine river, between Rossens dam down to “la Gérine” junction.

Methodology – Numerical simulation

Based on a multicriteria analysis, it was decided that the sediments used to generate the bed load comes from alluvial deposits in the floodplain.

In order to evaluate the various potential sites to mobilize the bed material, two types of simulations are performed: purely hydraulic model and sediment transport model. The numerical simulations are performed using the BASEMENT software (VAW-ETHZ).

Hydraulic model

To determine the water discharge required to re-mobilize sediments on the alluvial banks, it is important to calculate the critical shear stress for entrainment of the particles. For example, the shear stress required to mobilize a 2.5 cm diameter particle is 20 N/m^2. With a water discharge of 75 m^3/s, the shear stress is insufficient to re-mobilize the alluvial sediments.

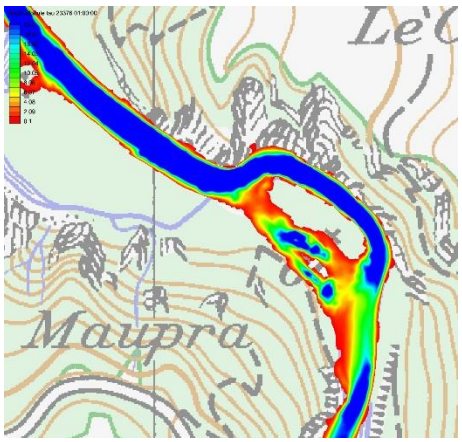

Fig. 2:

Bed-level shear stress for a discharge of 75 m^3/s. (blue: threshold of 20 N/m^2)

Sediment transport model

In a second step, it is necessary to quantify the distance over which the sediments, once re-mobilized, move to lower the duration of the hydrograph and the number of remobilization sites. The main uncertainty is the amount of mobilized sediments. In different models, a constant sediment inflow of 0.01 m^3/s is injected immediately downstream of the site where the alluvium is re-mobilize.

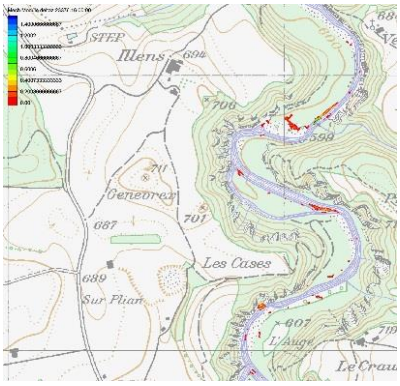

Fig. 3: Deposition height after 3 hours of artificial flood.

Hydrograph

To satisfy various constraints, the flood hydrograph must:

- meet the rising levels of the flood and the recession to preserve wildlife;
- achieve a flow rate of 255 m^3/s during 3 hours to erode materials;
- Be kept at 210 m^3/s during 2 hours to transport the sediment.

This hydrograph represents a volume spilled of 11.6 Mio m^3. According to the flood of July 2014, such a rate has not led to the flooding of the Pila landfill.

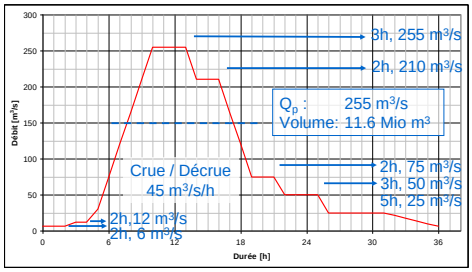

Fig. 4:

Artificial flood hydrograph

Site intervention

8 interventions sites are needed to cover the entire line of the Petite Sarine river. Preparatory work is essential to promote erosion.

An obstruction of the main river flow leads the water to flow through re-created channels.

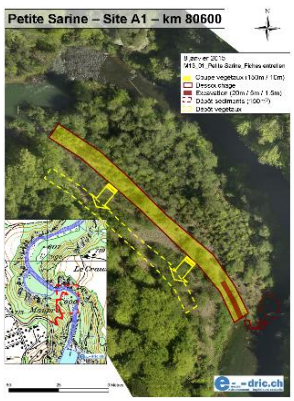

Fig. 5: Action plan

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