



**HAL**  
open science

# Numerical study of sediment transport and hydro-morphology of the Clain river using a hydro-sedimentary 2D numerical model for different scenarios

Alaa Ghzayel, Anthony Beaudoin, Sébastien Jarny

► **To cite this version:**

Alaa Ghzayel, Anthony Beaudoin, Sébastien Jarny. Numerical study of sediment transport and hydro-morphology of the Clain river using a hydro-sedimentary 2D numerical model for different scenarios. 15° International Symposium on River Sedimentation, ISRS, Sep 2023, Florence, Italy. hal-04316122

**HAL Id: hal-04316122**

**<https://univ-poitiers.hal.science/hal-04316122>**

Submitted on 30 Nov 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Numerical and experimental study of sediment transport of the Clain river using a hydro-sedimentary channel experiment and a 2D numerical model

A. Ghzayel<sup>1</sup>, A. Beaudoin\*<sup>1</sup>, and S. Jarny<sup>1</sup>

<sup>1</sup> Institut Pprime, SP2MI-Téléport 2, boulevard Marie et Pierre Curie, BP 30179, 86962 Futuroscope Chasseneuil Cedex, France

\*Corresponding Author, e-mail: Anthony.beaudoin@univ-poitiers.fr

## Abstract

The presence of man-made hydraulic structures, such as dams, on rivers can interfere with the natural bedload transport of sediments, leading to alterations in the river channel and degradation of habitats [1]. This disruption of sediment continuity is a limiting factor in achieving good ecological and chemical conditions in many river ecosystems. In France, there are approximately 60,000 man-made hydraulic structures that segment rivers [2], with a majority classified as low head dams. These dams, which do not exceed the elevation of the top of the channel banks, are poorly studied in comparison to larger dams. Therefore, two questions arise: how do low head dams disrupt bedload transport, and what solutions can be used to restore sediment continuity?

The Clain river is classified under French environmental regulations for the preservation and restoration of Ecological and Sediment Continuity, which prohibits construction of new structures or development of existing ones if they interfere with Sediment Continuity. The Clain river's waterbody has been divided into three sections for Restoration of Ecological Continuity (RCE), The Îlot Tison weir, located in the highly urbanized RCE 3 section of the Clain river, is considered impassable for sediments. To restore Sediment Continuity, numerical morphodynamic models can be used to predict the evolution of bed configuration over time, due to recent advancements in computational methods.

The 2D unsteady flow and sediment transport model in HEC-RAS will be employed to simulate the different scenarios to assess the ecological continuity of sediment transport [3]. The results of the model will be analyzed to evaluate the flow, sediment transport, and morphological change within the river for different structures and flow rates. The model will be calibrated based on terrain measurements such as the flow rate, the water velocity at different sections and the granulometry of sediments all along the studied river.

Using HEC-RAS, a study will be conducted on the transversal structures "Moulin des Cours et Scierie de Tison" and the weir of Saint Benoit, located 8 km to the south of Tison. The future modifications of the transversal structures will be numerically studied to provide a clear conclusion on the ecological continuity state of the Clain river. This research will aid in ensuring the compliance of the transversal structures with the good ecological status of the water body and contribute to the restoration of ecological continuity in the Clain river.



**Figure.1** Bed elevation morphological change (erosion and deposition) over 24 hours flood obtained with Hec-Ras for a flow rate  $Q = 156 \text{ m}^3/\text{s}$ .

**Keywords:** Sediment transport; CFD numerical modeling; Multi-phase flow; Hydro-sedimentary channel; ecological continuity

### Acknowledgment

The authors would like to express appreciation for the support of the University of Poitiers.

### References

- [1] Graf, W. L. (2005). "Geomorphology and American dams: The scientific, social, and economic context". *Geomorphology* 71(1-2): 3-26, <https://doi.org/10.1016/j.geomorph.2004.05.005>.
- [2] Askeyev A., Askeyev O., Askeyev I., Monakhov S. (2021). "Predatory fish species as indicators of biodiversity: their distribution in environmental gradients in small and mid-sized rivers in Eastern Europe". *Environmental Biology of Fishes* 104(7): 767-778, <https://doi.org/10.1007/s10641-021-01113-8>.
- [3] Nelson, A., S. Gibson, and A. Sanchez. (2022). "Development of a Two-Dimensional HEC-RAS Sediment Model for the Chippewa River, Wisconsin for Software Development and Sediment Trend Analysis". ERDC/TN RSM-22-2. Vicksburg, MS: US Army Engineer Research and Development Center. <http://dx.doi.org/10.21079/11681/44561>.