

Automatic Modelling Using Hec-Ras for Steady Flow Analysis

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Abstract

River Bârzava and its tributaries drain an area of approximately 1202 km² and springs from the Semenic Mountains, located at 1190 m altitude. In this study had used Hec-RAS software, which effectively simulates changes in hydraulic behavior. After importing the TIF file and creating the digital model, the geometry of the watercourse was created. Representative cross-sections for hydraulic analysis were also defined. To perform the hydrodynamic analysis of the watercourse studied, it is necessary to define the type of flow regime used in the calculation. Thus, for the chosen scenario, the steady flow regime was chosen. The results, including velocity and cross-sectional maps, provide precise information on critical parameters, allowing the identification of areas with high occurrence velocity. The study area is a sector of the River Barzava between the localities of Ghertenis and Sosdea. The results of this work can be a possible alternative for flood risk strategies and an appropriate tool for flood risk management and early warning systems.

Keywords: river, Hec-RAS, the cross-section, flow steady, slope map.

1. Introduction

Floods represent the phenomenon by which a certain territory is covered by water, as a result of the elevation above the land level. Among the classifications of floods, the classification determined by the causes that cause the floods is retained:

- natural floods, determined by a natural phenomenon: increase in the level, respectively of the flow of watercourses following precipitation and/or snow melting; water runoff from slopes and stagnation on certain terrains; preventing leakage due to the increase in the level in the outfall (emissary);
- accidental floods, determined by anthropogenic causes, therefore by actions (conscious or not) of people: arrangements in the hydrographic basin

that can lead to an amplification of the maximum natural flows; arrangement of riverbeds that strangle the drainage section; improper exploitation of the large water discharges of the reservoirs or the triggering of new phenomena by damaging or breaking the constructions and hydrotechnical systems; sudden sliding of slopes in accumulations; Earthquakes induced by arrangements.

In the paper, using the HecRAS program, a water sector of the Barzava River is modeled in order to see the potentially flooded areas and highlight the negative economic, social and ecological effects. The geometric description of the channel and the flow values are the main inputs of the model to the Hec RAS program [1-4].

The hydraulic model allows for modification of some variables, such as Manning's n, to perform sensitivity tests, thereby assessing the importance of each variable in determining the final water surface elevations [5-8]. The Steady flow component calculates water surface profiles from steady input discharge data at an upstream cross-

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section, from river geometry as well as surface roughness data for the river sections.

The negative social effects produced by floods include: the possibility of human victims, the state of panic created among the population, the danger of epidemics, the destruction of cultural values, etc.

The ecological effects of floods, water pollution, the deposition of alluvial material on the affected lands, the modification of the biotope of the flooding areas, negatively influence the environment. The runoff on large areas leads to significant amounts of pollutants from the soil surface, by flooding the residue deposits, the treatment plants, and can produce bacteriological pollution. The impact of floods on the environment is short-term, and the consequences are long-term. These floods also have indirect consequences on groundwater [9-11].

2. Materials and methods

For this study we have used the Hec-RAS software, which allows the user to perform one-dimensional constant flow calculations. The HEC-RAS software is a program developed for modeling the river flowing through open natural channels and used to calculate the water surface profile. In the first stage, the river geometries were realized, such as centerlines, bank lines, flow ways and cross-sectional lines, which are the major parameters processed in HEC-RAS to generate flooding areas. The digital altitude model (DEM) with a resolution of $1\text{ m} \times 1\text{ m}$ pixels was used as the input data to extract the major parameters. The study area is the Barzava River which is a part of the Banat hydrographic area located in the south-western part of Romania and occupies an area of 18,320 sq km.

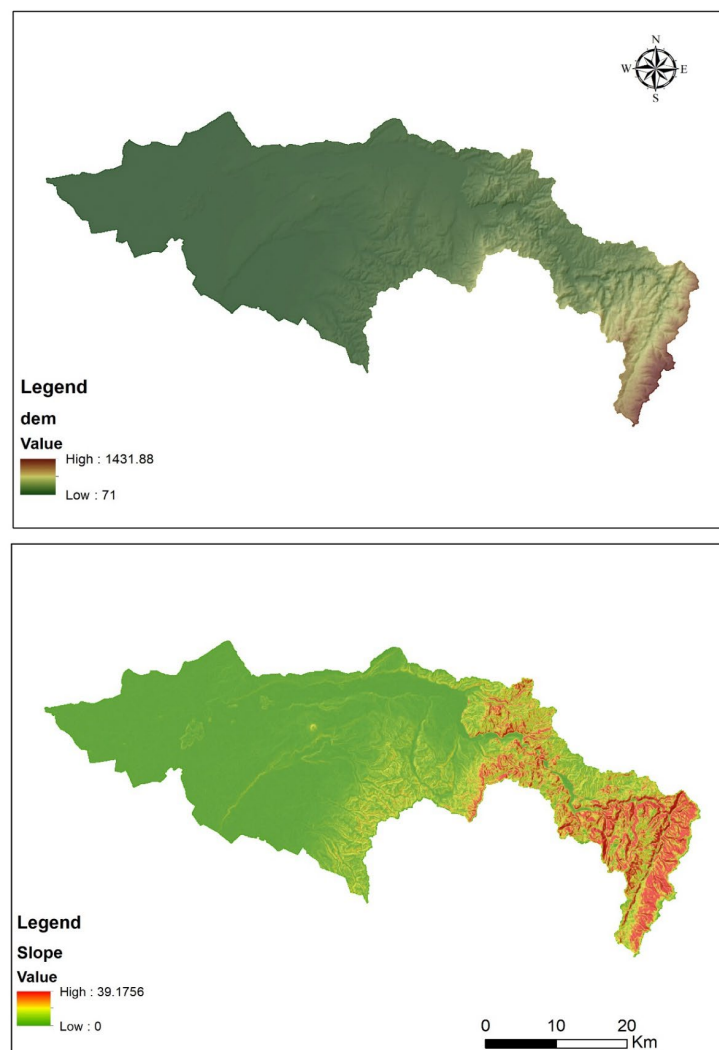


Figure 1 – Barzava River Basin and slope map

The area drained by Barzava River and its tributaries on Romanian territory is 1202 km². Barzava, whose spring is in Semenice Mountains placed at 1190 m altitude, has a general SSV-NNE flow direction, presenting a narrow valley, deep, lacking flood channel and with an average slope of 15 m/km.

Downstream of the town Bocsa, river enters the plain area (Plain Moravita) in which the flood channel is well developed, reaching until the width 3-4 km, slope drops below 1 m/km, the water course becomes meander, reason for which it has been embanked. From its spring to the Romanian-Serbian border, Barzava flows through all forms of relief from mountain to plain.

The climatic regime constitutes another basis element when characterizing water resources. Barzava River Basin benefits from a moderated continental temperate climate with Mediterranean influences that confers to the temperatures a moderated regime and implies the presence of a second pluviometer maximum at the beginning of

the autumn. The average annual temperature are framed between 6-9°C, the average rainfalls have values of 600 mm/year in the lowlands and 1000 mm/year in the highlands, and the average evapotranspiration is about 580 mm/year.

A very large influence on the changes in the hydrological regime of maximum runoff is due to human activities, of which the largest share is held by hydrotechnical constructions, afforestation and deforestation, hydro-ameliorative management. The dams were executed on the middle and lower courses of all the main collectors in the area, and the polders were placed at the entrance to the plain area.

3. Results and discussion

This study presents a model made with the HEC-RAS program for flood mapping in the Barzava river basin; the study area is the water sector for the Barzava river between Ghertenis and Sosdea localities, as shown in figure 2.

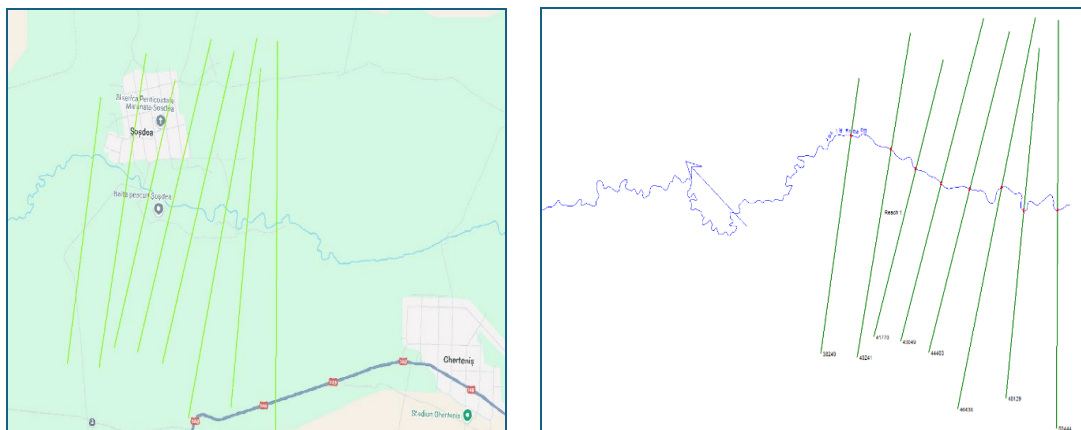


Figure 2. Study area on River Barzava

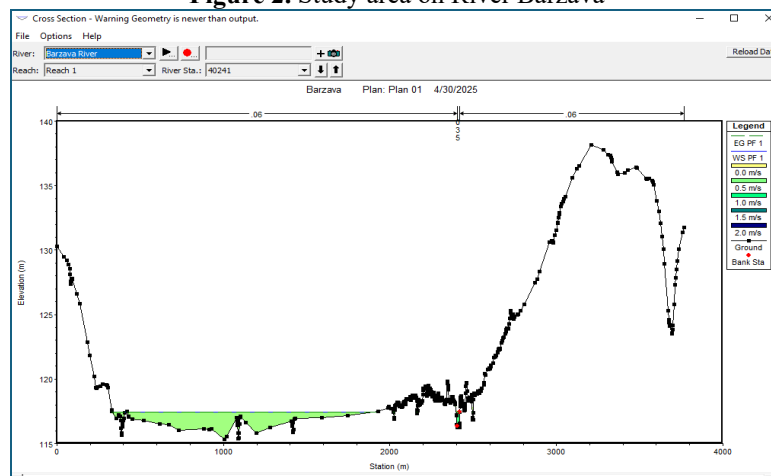


Figure 3. The downstream cross section

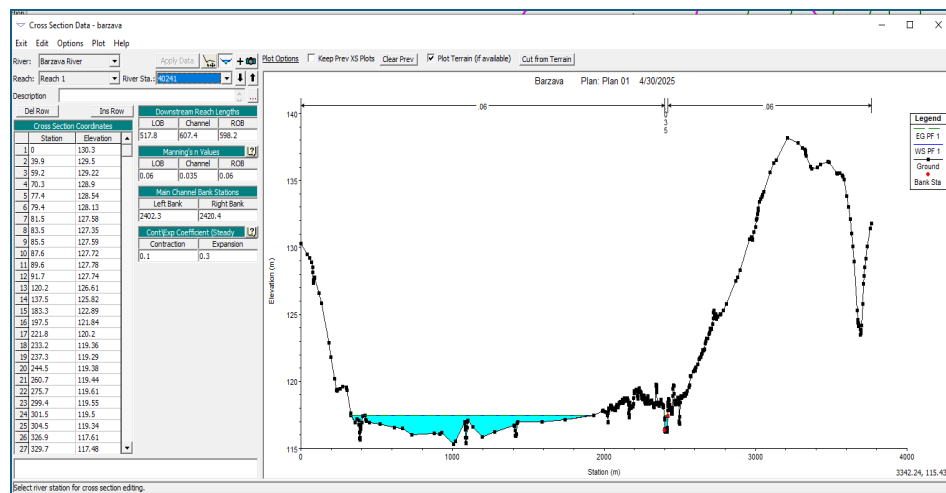


Figure 4. Detail of a cross section—Hec-Ras in 40241

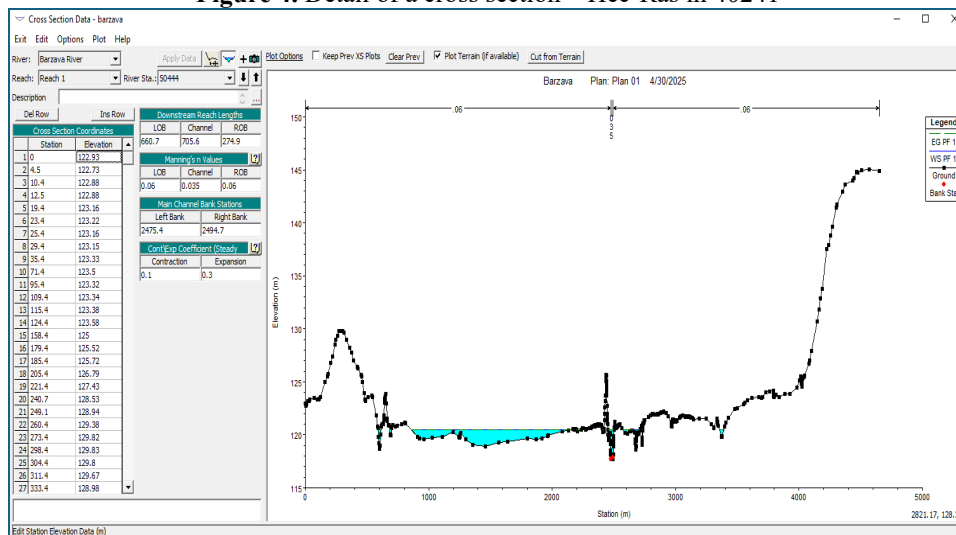


Figure 5. Detail of a cross section—Hec-Ras in 50444 section

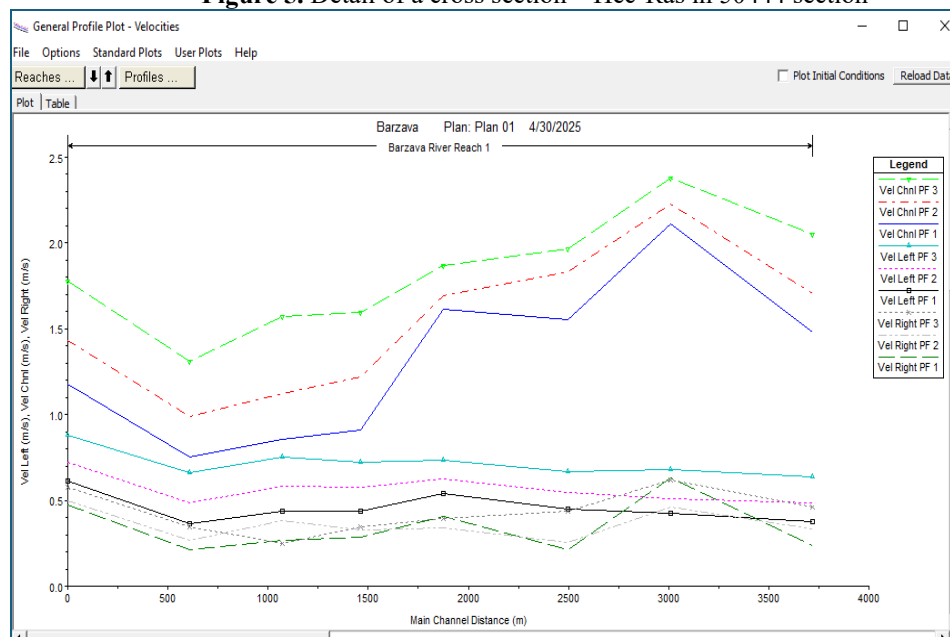


Figure 6. Flow velocity at the channel for flows Q1 and Q2.

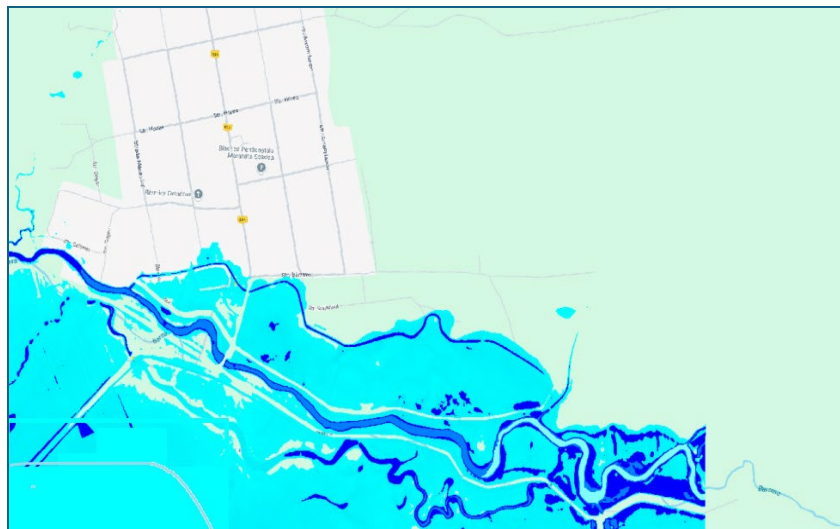


Figure 7. The flooding map

The Manning's n value of 0.06 on LOB & ROB and 0.035 for the channel is provided for the river at all cross sections, and it depends on the land use, land cover, channel type, slopes of the channel. The generated cross-section graphs show that the available areas and adjacent roads are safe for all profiles up to a fairly large distance, and the locality of Sosdea is not affected, and for profiles with return periods of 100 years and 50 years, a flooding of farms in that area is seen (Figure 3-6).

The slope of the energy gradient reflects how quickly the elevation of the water surface changes along the river section, and higher values indicate steeper slopes, which often correspond to higher flow velocities and increased erosion potential. In contrast, lower values suggest more gradual changes in elevation, which can lead to reduced rates of erosion and deposition.

Following the running of the program, the flooding map was generated, which provides information about the spatially distributed depth of the flood-prone areas along the Barzava River (Figure 7).

Conclusions

In this study, the modeling of a water sector with the HEC-RAS program for flood mapping along the Barzava River is presented. The results of this work can be a possible alternative for flood risk strategies and an appropriate tool for flood risk management and early warning systems.

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