ADVANCE HYDRAULIC MODELING USING HEC-RAS, BARAOLT RIVER, ROMANIA

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Abstract: *To exemplify of flood risk map achievement with HEC-RAS hydroinformatic tools was considered a sector of Baraolt River, located in center Romania. Considered sector have a length of 4,9 km, representative 36 cross sections are considered in the right of localities Baraolt and in river Baraolt. Cross sections have been raised by the Romanian Water Basin Administration. The input data are: area plan with location of cross sections; cross sections topographical data and roughness of river bed; flood discharge hydrograph in section Baraolt. After simulation with HEC-RAS result the water level in each cross sections. Based on contour maps we can establish the flooded area, the flood risk map for the maximum discharge.*

Key words: *management, flood, flood risk management plan, hydroinformatic tools.*

INTRODUCTION

Access to the area is done through DN 13 to Măieruş respectively by DJ 131 locations from Baraolt and Biborţeni.

The work planned will be located in different areas, a distance of approx. 9-10 km, between the localities and Baraolt Biborţeni on both sides of the brook Baraolt.

Investigated area is Baraolt area, surrounded by mountains on the right bank Harghita respectively Baraolt Mountains in the left bank.

In the area between Biborţeni and Baraolt, p Baraolt has a minor channel openings 8-25 m (in some erosion cuvettes touch 70-75 m) lower in town Baraolt (ca. 6-8 m), respectively downstream in some areas where the distance between the sides is reduced to 4-5 m.

The banks are generally asymmetric (except in designated areas inside or outside the village Baraolt) generally steep and variable heights between 1.50 to 5.00 m dams that meet the banks Baraolt heights 1.50 to 2.00 m and height sometimes still natural bank collapses because they have affected.

Baraolt creek in some areas is decorated with gabions, pitching built concrete parapets concrete revetment slabs concrete embankment.

Floodplain has extensions ranging approximately between 800 - 1300 m

The slopes of the two sides formed of formations preholocene are asymmetric:

- slope as steeply somewhat smoother and continuity;
- left side shows steep slopes is more fragmented in the meeting of the landslide and the base to limit the accumulation meadow as ponds, ponds with vegetation hydrophilic from runoff and underground springs.

Shares in the land of the banks are summarized approximately 493 mdMN upstream and 464 mdMN downstream.

Baraolt is right tributary stream of r River, flowing in a NE - SW, has a marked sinuous meanders, dead arms, Disentangling thresholds submerged, variations in the flow section and the following characteristics river:

- a length of 40 km;
- a basin area of 121 km2;

- an average slope of 22 ‰;
- tortuosity coefficient of 1.17.

The stream has a high flow rate, force erosion and solid transport rate very high.

In some areas of minor riverbed due to erosion and alluvial erosion funnel is created true major diameter over 50-60 m.

During the year between Biborţeni and Baraolt stream receives several courses leaking rain upstream and generally in areas where the stream based approach slopes.

Surface hydro consist of coarse silt bed of major groundwater mainly put free level or slightly ascending. Hydrostatic level of groundwater is influenced by rainfall, the relationship that exists between aquifer hydraulic floodplain coarse of geomorphological units and adjacent aquifers - deluvial, proluvial and colluvium, terrace - on the one hand, and the relationship established with the main drainer of hydraulic area - p Baraolt.

Groundwater level was encountered generally 2.50 to 4.00 m depth. There are areas in which an hydrogeological relationship with volcanogenic sedimentary bedrock aquifers and groundwater debited under pressure with a high mineral content and CO2.

Objectives designed to regulate river Baraolt between Biborţeni and Olt confluence are located both in the minor bed (shore defenses thresholds) and the main riverbed (dams).

This area has a sinuous river Baraolt marked by numerous bends of varying degrees of openness, submerged sills, meanders, arms, dead (magnitude and higher frequency near the confluence with river Olt where floods and prolongs its remuneration lead to training material saturated with low mechanical strength of the sides), variations in the geometry and flow rate, ramble, Disentangling.

The plan view is presented in Figure 1.

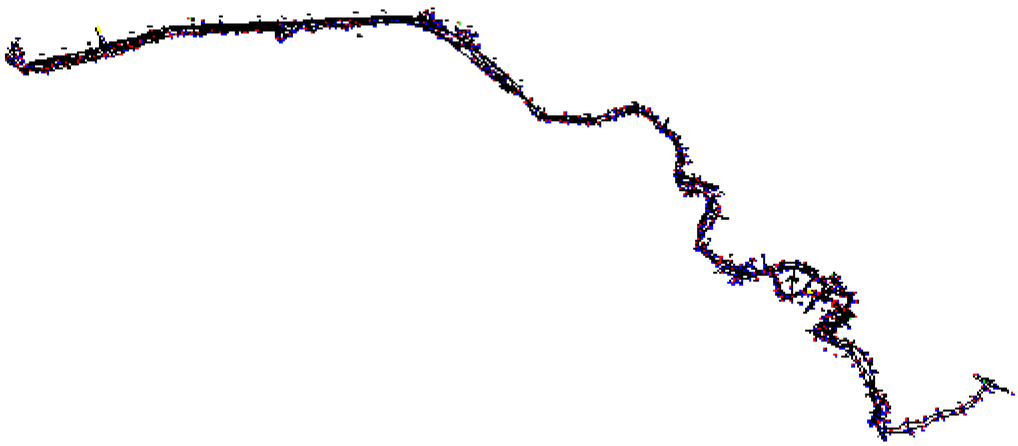

Figure 1: Plan view

Brook Baraolt presents overall high capacity solid flow erosion and transport.

Opening the minor riverbed is variable, ranging from 6-8 m and 30-35 m in some areas the river channel is created true "funnels" erosion openings 60-70 m, which recognize both strong erosion and massive alluvial (S.C. AQUAPROIECT S.A., Project 94/4311).

The work planned in connection with the settlement pr. Baraolt in the towns Biborţeni - Baraolt are:

- cant dams;
- recalibration minor bed;
- bank consolidations;
- bottom sills riverbed stabilization.

Areas that have executed works were divided into 3 areas as follows:

- District 1 - Olt river confluence - Baraolt
- District 2 - Inside Baraolt
- District 3 - Baraolt - Biborţeni

MATERIAL AND METHODS

HEC-RAS is a computer program that models the hydraulics of water flow through natural rivers and other channels. The program is one-dimensional, meaning that there is no direct modeling of the hydraulic effect of cross section shape changes, bends, and other two- and three-dimensional aspects of flow. The program was developed by the US Department of Defense, Army Corps of Engineers in order to manage the rivers, harbors, and other public works under their jurisdiction; it has found wide acceptance by many others since its public release in 1995.

The basic computational procedure of HEC-RAS for steady flow is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction and contraction / expansion. The momentum equation may be used in situations where the water surface profile is rapidly varied. These situations include hydraulic jumps, hydraulics of bridges, and evaluating profiles at river confluences.

For unsteady flow, HEC-RAS solves the full, dynamic, 1-D Saint Venant Equation using an implicit, finite difference method. The unsteady flow equation solver was adapted from Dr. Robert L. Barkau's UNET package.

HEC-RAS is equipped to model a network of channels, a dendritic system or a single river reach. Certain simplifications must be made in order to model some complex flow situations using the HEC-RAS one-dimensional approach. It is capable of modeling subcritical, supercritical, and mixed flow regime flow along with the effects of bridges, culverts, weirs, and structures.

HEC-RAS is a computer program for modeling water flowing through systems of open channels and computing water surface profiles. HEC-RAS finds particular commercial application in floodplain management and flood insurance studies to evaluate floodway encroachments. Some of the additional uses are: bridge and culvert design and analysis, levee studies, and channel modification studies. It can be used for dam breach analysis, though other modeling methods are presently more widely accepted for this purpose.

HEC-RAS has merits, notably its support by the US Army Corps of Engineers, the future enhancements in progress, and its acceptance by many government agencies and private firms. It is in the public domain and peer-reviewed. The use of HEC-RAS includes extensive documentation, and scientists and engineers versed in hydraulic analysis should have little difficulty utilizing the software.

Users may find numerical instability problems during unsteady analyses, especially in steep and/or highly dynamic rivers and streams. It is often possible to use HEC-RAS to overcome instability issues on river problems. HEC-RAS is a 1-dimensional hydrodynamic model and will therefore not work well in environments that require multi-dimensional modeling. However, there are built-in features that can be used to approximate multi-dimensional hydraulics (HEC-RAS Reference manual) .

RESULTS AND DISCUSSIONS

To exemplify of flood risk map achievement with HEC-RAS hydroinformatic tools was considered a sector of Baraolt River, located in center Romania. Considered sector have a length of 11 km, representative cross sections are considered between Baraolt and Olt River confluence (Fig. 1). Cross sections have been raised by the Romanian Waters, Olt Water Basin Administration.

The input data are: area plan with location of cross sections (Fig. 2); cross sections topographical data and roughness of river bed (Fig. 3); flood discharge 1%, 2%, 5% and 10% in section79 and Bridge culvert data in cross section 9.5,23.5,28.5,30.5,40.5,42.5 and 45.5 (Fig.4).

After simulation with HEC-RAS result the water level in each cross sections (Fig. 5).

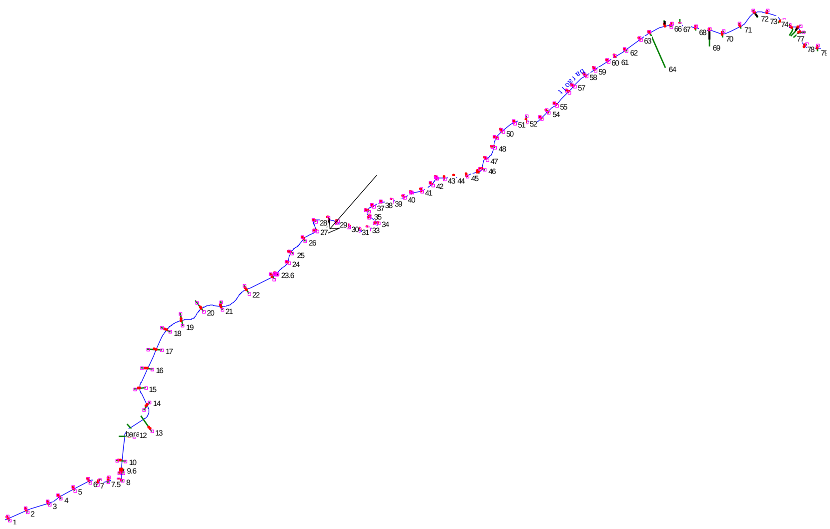

Figure 2: Area plan with location of cross sections

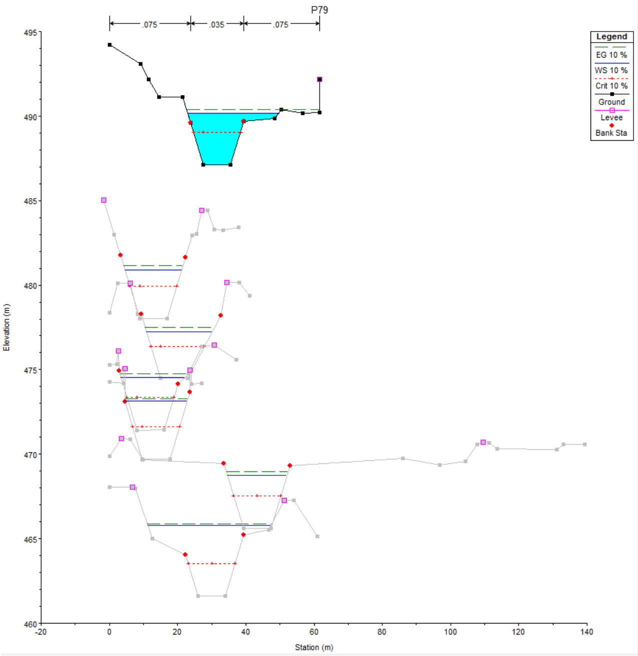

Figure 3: Cross sections topographical data (for example cross sections 1,10,20,30,40,50,60,79)

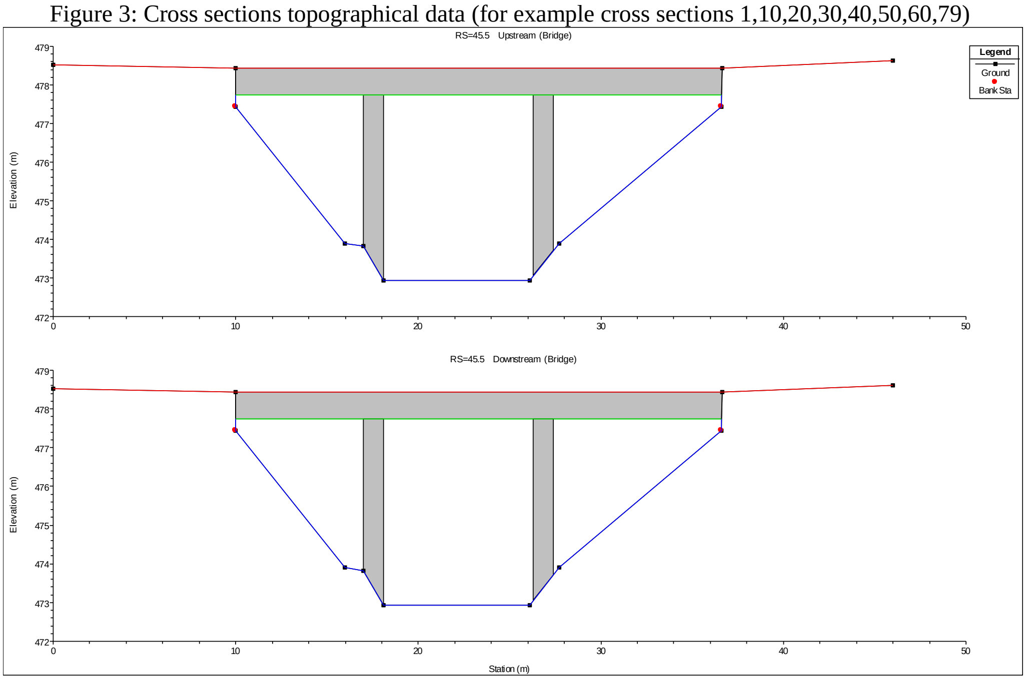

Figure 4: Bridge culvert data (for example in cross section 45.5)

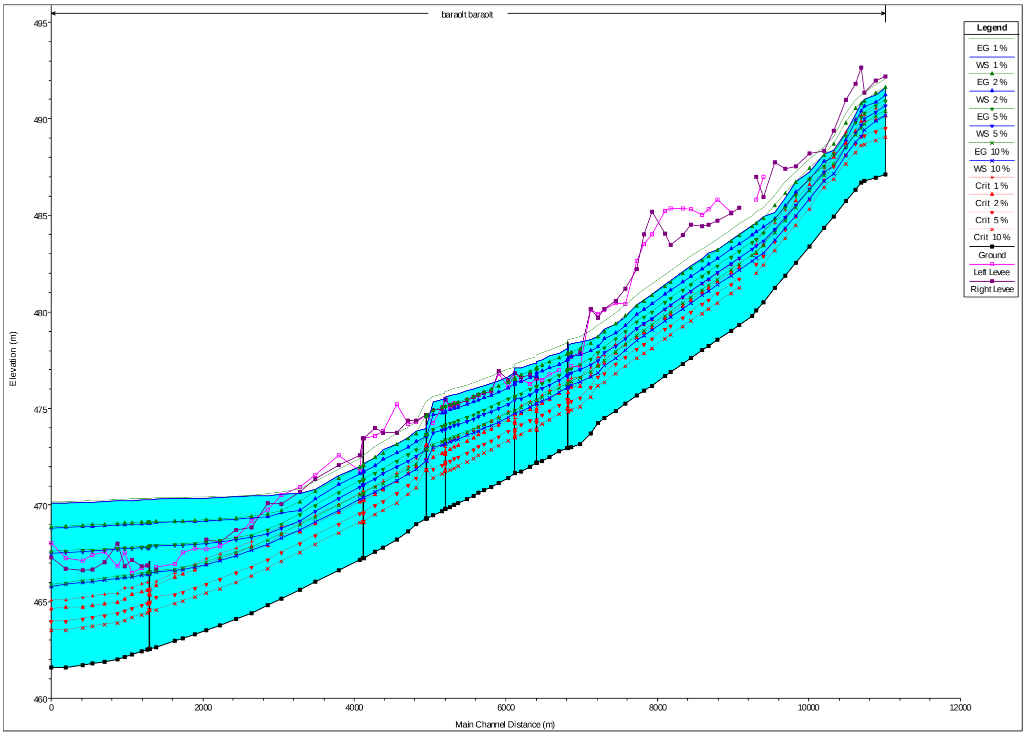

Figure 5: Water level in each cross sections

CONCLUSIONS

Besides the models mentioned above, have been developed over the years other models applied in the preparation of flood risk maps. In Romania, most flood risk maps were prepared using HEC-RAS and MIKE 11 models, which show a high degree of confidence.

Throughout the Community Countries different types of floods occur, such as river floods, flash floods, urban floods and floods from the sea in coastal areas. The damage caused by flood events may also vary across the countries and regions of the Community. Hence, objectives regarding the management of flood risks should be determined by the Member States themselves and should be based on local and regional circumstances. In each river basin district or unit of management the flood risks and need for further action should be assessed. In order to have available an effective tool for information, as well as a valuable basis for priority setting and further technical, financial and political decisions regarding flood risk management, it is necessary to provide for the establishing of flood hazard maps and flood risk maps showing the potential adverse consequences associated with different flood scenarios, including information on potential sources of environmental pollution as a consequence of floods.

Member States should assess activities that have the effect of increasing flood risks. Flood risk management plans should therefore take into account the particular characteristics of the areas they cover and provide for tailored solutions according to the needs and priorities of those areas, whilst ensuring relevant coordination within river basin districts and promoting the achievement of environmental objectives laid down in Community legislation. Member States should base their assessments, maps and plans on appropriate 'best practice' and 'best available technologies' not entailing excessive costs in the field of flood risk management (Directive 2007/60/EC).

ACKNOWLEDGMENT

Lifelong Learning Programme

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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