The XXXVIII International School of Hydraulics, 21-24 May 2019, Łąck, Poland

Dominant hydraulic conditions in the 2-D model – Vistula River from Zawichost to Słupia Nadbrzeżna

Jacek Florek[1], Maciej Wyrębek[2], Agnieszka Woś[3]

[123] University of Agriculture in Kraków, Mickiewicza Ave. 24/28, 30-059 Kraków, Poland

[1] rmflorek@cyf-kr.edu.pl [2]m.wyrebek@gmail.com [3]awos.ur@gmail.com

ABSTRACT

Complexity of the river's system, creating habitat conditions, natural, diversified was always a focus of attention and in the presented context is addressed by the use of the 2-D modeling results. Recognizing the importance of riverbed morphological elements and identification of hydraulic parameters suitable for its description by use of 2-D modeling and spatial relations with channel parts was presented. The section of the Vistula River Gorge of Lesser Poland was modeled, segmented according to proposed method and the results were interrelated pointing out limited diversification of narrow parts in the channel. The measurement material was collected in the summer of 2017. Data including measurements of riverbed bottom geometry, water surface position and flow, as well as data obtained from the numerical model of the terrain was used. Calculations were made using discharges with relation to the hydrology of the river's section. The spatial joining involved data located in the individual parts of the channel and hydraulic parameters derived from the model. Channel parts were analyzed: dominating depth on wide parts of the channel were found, impact of flow was established, dynamics of water velocities and depths on mid channel bars and sandbars point them out as the most sensitive places in the whole river. Minimal existing width of the narrow parts of the river was found as insufficient. The advantage of proposed approach is the free access to any possible questions about hydraulic and spatial interrelationships. The results prove that spatial and contextual analysis can be used as a tool to increase usability of 2-D hydraulic model in the field of scientific purposes.

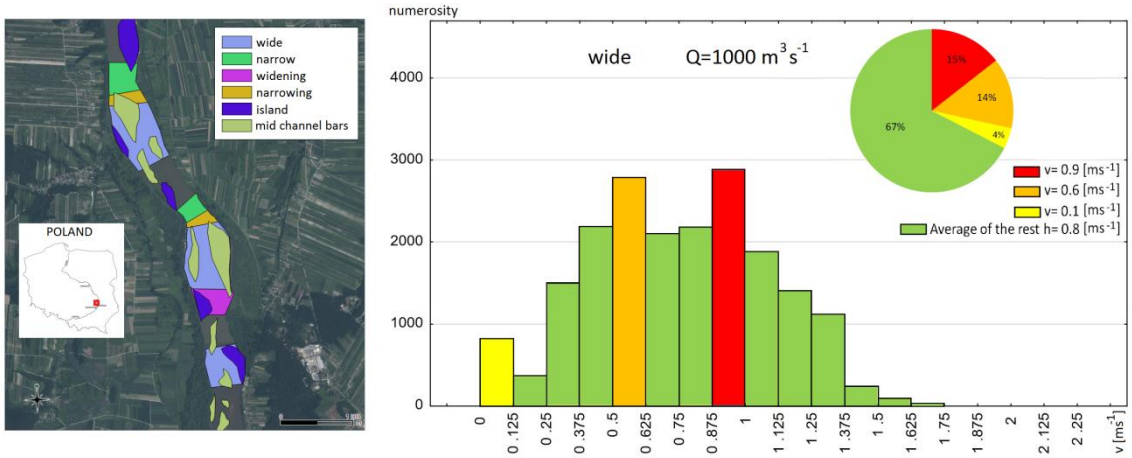

Fig. 1. Location of the sections and an example of the dominating surfaces (velocity, wide part of the channel).

Analysis of water flow conditions in selected zones required a clear distinction of their spatial interaction. This means individual zones have been interpreted both independently and in relation to others. The zones where the bed is expanding, narrowing, wide or narrow have been taken in to consideration without regulation areas. The purpose of this is to be able to distinguish between the impact of selected features without including places (in the model) above the water (or places where the water not moves). In this way it was possible to compare water flow conditions in the channel, without other unwanted elements. Interesting might be also to point out those places where water movement is not present at a lower flow and appears at the higher one.

There are no mid channel bars or islands on the segments of the river with a narrow channel while on a wide part a quarter of the area is occupied in this way. The majority of the channel areas with a dominant depth occur in the widening generally but in narrowing and wide channel parts only during low stages. As for the water velocities dominating parts can be found at the low stage in a narrow channel. The shallows around channel bars and islands are the most affected by the flow changes. This section of the river was modified many times in the past and, at least in some places, it reached width well below which mid channel forms do not appear anymore. Only limited surfaces with dominating depth could be found in narrow parts of the river (at the average width of 273m) and when the flow rises the total dominating surface only in narrow parts of the channel occupies still the same relative area. The approach was developed when it became clear the calculation results from the hydraulic model are beyond visual perception. In the river there are disproportions between length and width, the whole picture provides too much information at once. Similar, comparable conditions appear in places separated by long distances. The impact of discharge depending on location is unequal. The authors consider analysis of the modeling results as a potentially useful tool to utilize measured data of riverbed geometry, water stage and velocity gathered in larger collection over the years of investigation.