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INCREASING AREAS SECURITY PROJECT FOR THE RISK FLOODING TERRITORIES OF UKRAINE

Abstract. *Currently, the increasing annual number of natural and man-made disasters in the world is of urgent need to take action to improve the management for their security. The article deals with methodology usage of the software HEC-GeoRAS and HEC-RAS in the project of security situation improving on the example of Ukrainian region that may be subject for flooding as a result of increasing water levels in rivers. Taking into account data from previous years rate the quality of product designed.*

Key words. *Natural and man-made disasters, software, flooding, quality of product, project management.*

Introduction

Project management of the areas safety increase deals with the application of knowledge, skills, tools and techniques of the project activities to meet the requirements that apply to the modeling process of water objects. This approach requires efficient management of the emergency processes modeling [1-3].

The process of watershed simulation is a set of interrelated activities and operations carried out for watersheds modeling, ranks runoff and flooding territory modeling [2]. The process is characterized by its inputs (raw data), simulation tools and methods that can be applied, and the resulting outputs (product of the project) that are achieved.

The purpose and objectives of the research

The aim of research is to reveal the methodological bases usage of the software HEC-GeoRAS and HEC-RAS to improve the security situation in the areas that can be the subject to flooding as a result of raising water level in rivers.

In terms of turbulent environmental processes that affect the final result the improving of areas safety project is uncertain. This entails a deviation from normative quality of the final product of the project. Also it is necessary to keep in mind that the constantly changing environment and necessity limitation of work time and resources can play an important role [4]. Therefore, to ensure the quality of the final product of the project and given the constraints in time and resources specific to the project, we use the assisting software HEC-GeoRAS and HEC-RAS to meet the needs of all stakeholders and users [5].

Additional software HEC-GeoRAS is used in tandem with ArcGIS software in the set of procedures, tools and utilities for processing spatial data in ArcGIS [5]. Software HEC-GeoRAS helps in preparing geometric data for import into HEC-RAS and process simulation results with complementary software HEC-RAS. The initial data for the digital elevation model (DEM) of format GRID – TIN files or files of the areas data set were mentioned in [2,5]. Next to the DEM is maps creation based on a series of points, lines and polygon layers, outlining geometric objects, such as the middle line of the river, the coast line, axial flow lines and line cross-sections of the river, as shown in Figure 1. For example modeling flooded areas at the confluence of rivers Stryi and Opir in Lviv region, Ukraine are considered.

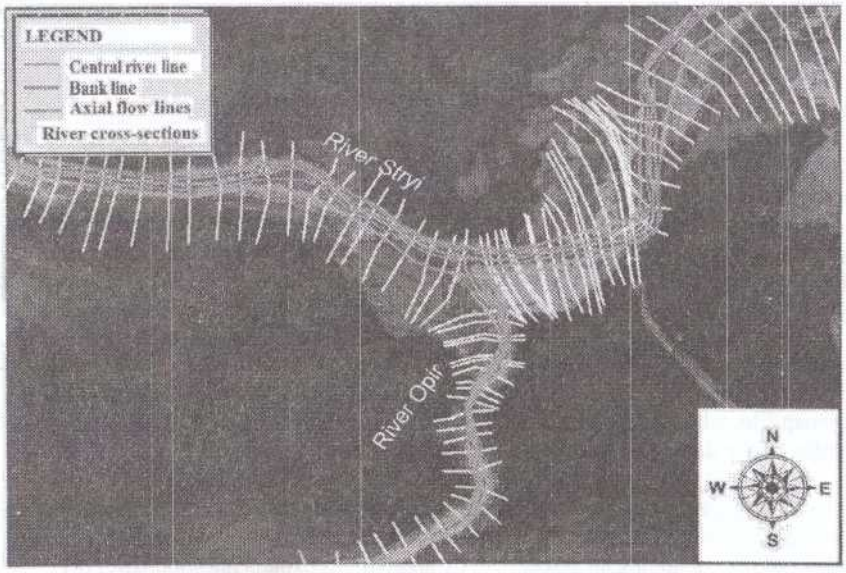

Figure 1. Digital elevation model map treated with geometric objects in ArcGIS using software HEC-GeoRAS presented

This area was chosen in order to verify the quality of the final product of the areas safety improvement project based on the results of Lviv regional water resources management center of State Water Resources Agency, Ukraine (SWRAU) [6, 7]. According to the data of SWRAU during rainy spring floods in Verhnye Synyovydne about 57 houses and 157 people, in Nyzne Synyovydne 10 houses and 35 people were affected [6]. Utilizing the project final product quality estimated improvement of security situation was carried out there [8].

First the center line of the river Stryi, then the center line of the tributary river Opir were modeled connected at the confluence of two rivers. Next right and left banks of the river channel along axial line flow were put in. The next step contains simulation of the cross-section of river Stryi and river Opir. Before exporting the map into HEC-RAS application all cross-sections of the river were verified. All cross-sections were applied strictly perpendicularly to the center line of the river and presented in the appropriate quantity to enable adequate modeling. They must be of sufficient length to cover an area of relief structure cross-sections in the model.

Next step is exporting result file into software HEC-RAS.

HEC-RAS is used here as integrated system designed for interactive procedure in multi-process network environment characterized by a large number of users. The HEC-RAS software usage contains following four analyzing steps for the river components:

- calculation of sustainable surface water flow;
- modeling of unsteady flow;
- calculation of the sediments (silt) movement;
- analysis of water quality.

Key elements of geometric data usage are general geometric and hydraulic equations. Software contains several hydraulic designed features that can be used as soon as the calculated basic parameters of the water surface are obtained.

After starting of the HEC-RAS program previously stored data from program ArcGIS were imported. ArcGIS contain necessary calculations and values, which are needed for further modelling. Next step contains the initial flow parameters set, which are determined experimentally, standard conditions of fluid flow and calculation of flooded areas.

After calculation results checked on correctness and adequacy, the result is transferred into the HEC-RAS GIS export file. Then the result is imported into ArcGIS, where software HEC-GeoRAS used convert it into XML file. When we open the flooding map file, which is created in the environmental software HEC-RAS along with the display of the depths of flooding, the flooding map is visualized.

In the next two steps expert assessment, that determines whether inundation zone is correctly predicted, is carried out. To ensure, if a reliable, objective and independent decision regarding this assessment by experts is used, the Delphi method is utilized (the method makes possible obtaining an assessment by anonymous experts questionnaire) [8].

After the approval of expert's position a detailed analysis of flood zones is conducted, which is the completion of the study process of flooding areas using the HEC-GeoRAS and HEC-RAS software in areas safety improving project.

Modeling of the resultant flooding territory is visualized as a flooding map of the rivers Striy and Opir confluence, as shown in Figure 2.

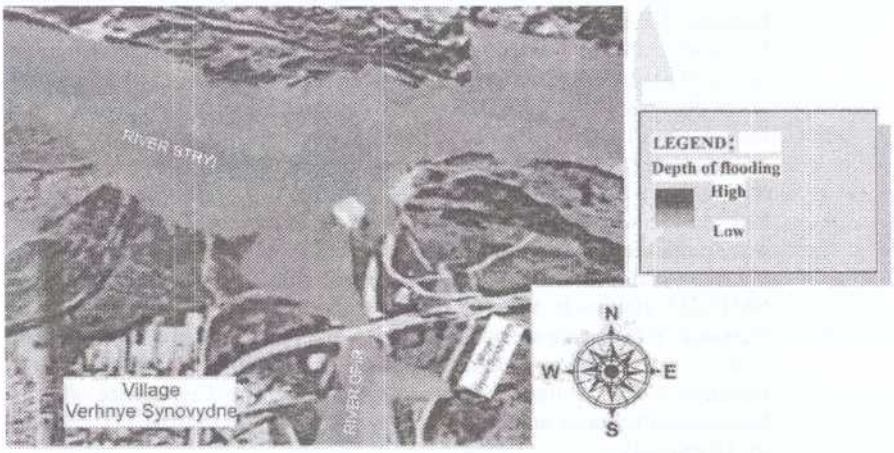

Figure 2. The result of flooding modeling in the Stryi and Opir rivers confluence area, Lviv region

If compared the visualized data model with the data from the website of State Water Resources Agency, Ukraine – as a result of an interactive prognostic simulation, approximate number of buildings in Verhnye Synyovydne, that suffer from floods will be 60 objects. It is the reason, why the northwest situated Verhnye Synyovydne flowed around by the river Stryi potentially inflicts maximum damages. For the damage of the village Nyzne Synyovydne definitive conclusions cannot be done, because the obtained resolution does not give a clear map for the possibility to calculate the number of damaged houses. However, one can assume that areas near river are to be flooded. There are about 10 objects referred on the website of the State Water Resources Agency.

Conclusions

The research conclusion are as following:

- usage of the HEC-GeoRAS and HEC-RAS software in improving of the security situation in project selected areas for modeling floods (Lviv region, Ukraine example) is proposed;
- algorithm of flooding territories modeling process using software HEC-GeoRAS and HEC-RAS is developed;
- using of the Delphi method for accurate product quality improvement independent assessment of the potentially flooded areas safety project is proposed.

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