TRANSBOUNDARY RIVER BASIN FLOOD RISK MANAGEMENT

Conducting flood hazard and risk mapping for the complex Evros River Basin

Z&A P. Antonaropoulos & Associates S.A. is the leader of a Greek consortium tasked by the Special Secretariat for Water of the Ministry of Environment (Greece) with developing the Flood Risk Management Plan for the Greek part of the Evros River Basin. Shared by Bulgaria, Turkey, and Greece, flooding in one part of the transboundary Evros River Basin can have far reaching consequences in other parts. After completing our MIKE FLOOD training course and with our support (provided throughout the project), Z&A designed flood hazard and flood risk maps for the Greek part of the Evros River Basin. As the first milestone towards implementation of European Union Flood Directive 2007/60/EC in Greece, the plan will help the country mitigate the effects of flooding along the Evros River.

A COMPLEX TRANSBOUNDARY RIVER

The Evros River Basin covers an area of 53,000 km^2 in the southeast of the Balkan Peninsula and is shared by Bulgaria, Turkey, and Greece. At 528 km, the Evros River is the second longest river in the Balkans. It has a normal discharge of 50-100 m^3 per second.

Through the years, catastrophic flood events have occurred along the approximately 200 km of the river that borders Greece and Turkey. As a result, extensive flood protection works have been constructed over the last 50 years, including primary and secondary embankments, aligned and straightened riverbed, drainage channels, and small dams and reservoirs.

Area of Didymoteicho Wastewater Treatment Plant (taken on 19 February 2010). ©George Tsesmelis, Alexandroupolis Aero Club.

CLIENT

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CHALLENGE

Need to:

- prevent failure of embankments and mitigate the resultant financial losses due to flooding of urban and agricultural areas
- coordinate flood management with neighbouring countries
- address data scarcity for better transboundary flood management planning
- mitigate risks to infrastructure and public health due to flooding

SOLUTION

Use of coupled hydraulic modelling of flood events (with different recurrence intervals) combined with continued support provided by DHI throughout the project (from training to presentation of results)

VALUE

- Optimised flood preparedness and mitigation measures
- Reduced costs associated with flooded agricultural and urban lands, damaged infrastructure, and flood clean-up
- Focused assessment of potential overbank spilling and embankment failure during flooding

LOCATION

Evros River Basin, Greece

SOFTWARE USED

MIKE FLOOD / MIKE 11 / MIKE 21

This project was carried out by the client using MIKE Powered by DHI software.

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Secondary embankments (up to 3 m high along a 120 km stretch of the river) were constructed for agricultural purposes on both the Greek and the Turkish banks of the Evros River. However, this reduced the floodplain width – from 1,000-2,000 m to 150-180 m – which significantly decreased river conveyance. In addition, the regulation of reservoirs and dams in Bulgaria drastically influences flood conditions in the Greek part of the Evros River.

MODELLING THE EVROS RIVER

To decrease the risk of flooding along the Evros River, Z&A P. Antonaropoulos & Associates S.A. (the lead on a Greek consortium developing the Flood Risk Management Plan for the Greek part of the Evros River Basin) took a MIKE FLOOD training course.

Using their excellent knowledge of the physical system and what they learned from the course – in addition to support provided by DHI throughout the project – Z&A designed flood hazard and flood risk maps for the Greek part of the Evros River Basin. For this project, they used our MIKE FLOOD software to simulate the coupling between:

- a one-dimensional (1D) MIKE 11 hydraulic model of the Evros and Ardas Rivers – 202 km long for the Evros River, based on 250 cross-sections
- a two-dimensional (2D) MIKE 21 hydrodynamic model that simulated flow at the floodplains

The available river geometry data included a longitudinal section with river bed elevations, the height of the secondary embankments, and the floodplain width for every kilometric position. For better management of the river model, the main river branch was divided into eight branches. Boundary conditions of the model included one inflow hydrograph, nine lateral hydrographs at the confluences of the main river branch with its tributaries, and one rating curve at the river mouth.

CALIBRATING THE MODEL

Z&A calibrated the model so that it correctly reflected the extent of the historical 12 February 2010 flood, which lasted 25 days. They utilised 115 low altitude aerial photographs, kindly provided by the Alexandroupolis Aero Club, to identify landmarks and characteristic points on the ground as well as map flooded areas on satellite photographs in order to qualitatively validate the results of the MIKE FLOOD model. Basic and alternative hydrological scenarios were then simulated for the Evros and Ardas Rivers for different recurrence intervals.

Z&A then modelled flooding originating from the Evros and Ardas Rivers. Model results for the scenario with high probability of flood occurrence showed that the main embankment constrains flooding, if no structural failure occurs, except for in the southern part where the embankment would be overtopped and the delta flooded.

Approximately the same results are depicted for medium probability of flood occurrence (100 years recurrence interval). For the 1,000 years recurrence interval scenario, flooding extends to the largest part of the Potentially High Flood Risk Zone in the delta area with local depths exceeding 2 m.

Basic scenario results of the Evros River and detail of delta inundation for 100 years recurrence interval. Data: SIO, NOAA, U.S. Navy, NGA, GEBCO ©2015 Basarasoft ©2015 Google.

FLOOD RISK ANALYSIS AND MAPPING

The flood risk analysis and mapping for the Greek part of Evros River Basin revealed that thousands of people, several kilometres of road, several irrigation and drainage pumping stations, and two environmentally protected areas could be affected by both river flooding and sea level rise in the future.

Using this information, the Flood Risk Management Plan will be prepared, taking into account potential embankment failures.

PUBLIC ACCESS TO MAPS

The public can access the flood hazard and flood risk maps on the Special Secretariat for Water website here: http://maps.ypeka.gr (in Greek). Authorities responsible for social security and water resources management can consult the maps online.

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> *The set of MIKE modelling tools allowed us to maximise the use of available data and information, and to overcome the significant uncertainties involved in the project in an efficient way.*
>
> *Ioannis Niadas — MSc Hydrologist, Project Manager — Z&A P. Antonaropoulos and Associates S.A.*

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