

THE STUDIES ON DRY RESERVOIRS ON THE USZWICA RIVER IN ORDER OF FLOOD MITIGATION FOR BRZESKO TOWN

A. Lenar-Matyas, M. Łapuszek

*Cracow University of Technology, Institute of Water Engineering and Water Management, Cracow, Poland
alenar@iigw.pl, młapusze@iigw.pl*

Introduction

The Uszwica River in the southern Poland, provokes many issues for the adjacent and downstream areas. The main problem is flooding of Brzesko Town. The next, is the riverbed and bank erosion, which occurs along the river course. In order to solve both mentioned above problems, two dry reservoirs upstream the problematic river reach are proposed. However, the proposed structures are more like the typical weirs with the controlled overflows. These constructions are very expensive. Moreover, they will be completely dangerous for local fauna and flora.

In our paper, we present the critical studies on the planned reservoirs impact on environment and flood protection. We discuss another idea of the construction of the real dry reservoirs. These studies could provide the stakeholders help to make the appropriate decision, because the current projects are not accepted by the population.

Description of the Uszwica River catchment

Uszwica River is the right-bank tributary of Vistula River (confluence at 151 km), its sources are located on the hills of Beskid Wyspowy Mountains. The total area of Uszwica catchment is 323 km². On the river course, the only one gauging station is located: in Borzęcin (km 16+300). The most important tributaries of Uszwica River are:

- Leksandrówka (Aleksandrówka) –left-bank tributary: 15.6 km long, with total catchment area 60 km²,
- Niedźwiedź – right-bank tributary: 16.6 km long, with total catchment area 44 km².

Uszwica catchment is a typical mountainous area, with rather big slopes of land and streams, with low capacity of water retention, and with flood waves which are formed rapidly in time. The characteristic flows of Borzęcin gauging station of Uszwica River is presented in Table 1.

River training on Uszwica was carried out in the end of 19th century. The main works were done throughout the course located close to Brzesko Town. The river channel was diverted to the non-urban area. However, these engineering activities has not mitigated the floods in the upper area of Brzesko commune, and also in the town. The flooding problems appeared again after the urban area development, and is not solved till now. Moreover, this river training intensified the process of riverbed erosion. During the 1963-1995 years, the riverbed lowered of about 0.7-1.2 meters. The groundwater level lowered also, and the surrounding area are now excessively drained.

Table 1. The characteristic flows of Borzęcin gauging station [m³·s⁻¹]

Mean annual flow	$Q_s = 1.56$
Flood flows	$Q_{50\%} = 52$
	$Q_{10\%} = 148$
	$Q_{5\%} = 190$
	$Q_{2\%} = 243$
	$Q_{1\%} = 285$
Mean low annual flow	$Q_{SNQ} = 0.36$

Brief description of proposed two dry reservoirs

In order to solve the flooding issue, two dry reservoirs are proposed (Figure 1, Table 3):

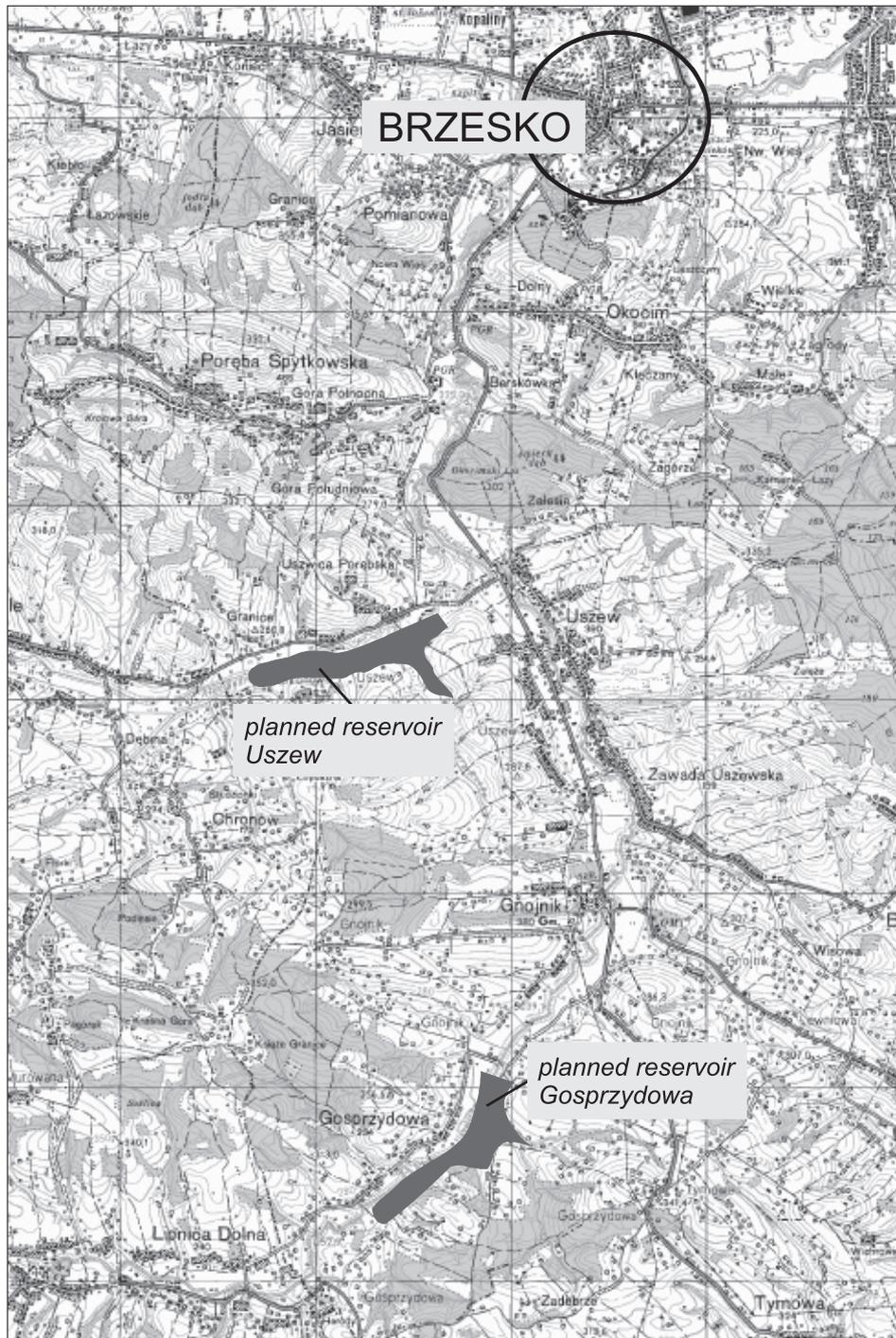


Figure 1. Location of proposed two dry reservoirs

Table 2. The most important flood waves registered on Uszwica River

YEAR	$Q_{max} [m^3 \cdot s^{-1}]$
1960	265
1962	162
1965	216
1966	182
1970	293
1972	161
1973	267
1974	135
1983	139
1987	157
1996	144
1997	240
1998	147

Table 3. The characteristics of proposed dry reservoirs

	Uszew dry reservoir	Gosprzydowa dry reservoir
River	Leksandrówka	Uszwica
Dam construction	Earth dam with concrete weir	Earth dam with concrete weir
Capacity	0.44 million m^3	0.94 million m^3
Height		8 m
Outflow pattern	Bottom outlet and circular weir	Double circular weir+ two bottom outlets
Safe discharge	$Q = 41 m^3 \cdot s^{-1}$	$Q = 37 m^3 \cdot s^{-1}$
$Q_{50\%}$	41	70 ($Q_{50\%zred} = 37 m^3 \cdot s^{-1}$)
$Q_{1\%}$	116	197
$Q_{1\%zred}$	72	145
$Q_m = Q_{0,5\%}$	127	217
$Q_{0,5\%zred}$	85	-
$Q_K = Q_{0,2\%}$	145	245
$Q_{0,2\%zred}$	97	-

Uszew Dry Reservoir Project:

Planned reservoir is situated in Uszwica River Catchment, on Leksandrówka (Aleksandrówka) Torrent (left-bank tributary) in 1+214 km. Average torrent slope upstream of the reservoir is: $S=0,15\%$, in the reservoir: $S=0,1\%$ and downstream: $S=0,2\%$. The the reservoir is located in the natural hollow land. The temporary inundated area is rarely used for agriculture. The construction will consist of an earth dam with concrete weir with a bottom outlet and controlled overflows.

Gosprzydowa Dry Reservoir Project:

Planned reservoir is situated on Uszwica River, in 47+856 km. Average torrent slope upstream of reservoir and in the reservoir is: $S=3\%$. The land upstream the reservoir, and reservoir bowl are used for agriculture. The construction of planed dry dam will be the same as in the case of Uszew Reservoir.

The construction of an earth dam with concrete weir with controlled overflows is not the classical „dry reservoir”. Moreover, the construction of the overflows is sophisticated, so there is a great possibility of high cost of the investment, and failure hazard.

Case studies and analysis of the results

We propose the construction of the real dry reservoir which should be constructed with as little negative effects as possible on the hydrosystem. The mean and low flows should flow out by the outlet. Damming should appear only during the flood flows. This rule assures the continuity of flows and the suitable condition for fauna. The outlet of the dam must allow invertebrates and fish migration from downstream to upstream and vice-versa, in particular, a long and dark outlet is an obstacle for most fish. The dam must be well-adjusted to the landscape.

In our case studies, we propose another solution for protecting Brzesko against floods, by testing the dry reservoirs located in the same place, as it was proposed, but with different way of dam operating. We propose the dry dam composed of a earth dam blocking the floodplain areas, but with an outlet. In the Figure 2 we present outflows from dry reservoir, for varied outlets. This results of computation concern the Uszew Dry Reservoir. We propose also another solution. Instead of dry dam construction, the main channel could be narrowed a little and closed the flooding areas upstream by the earth dikes.

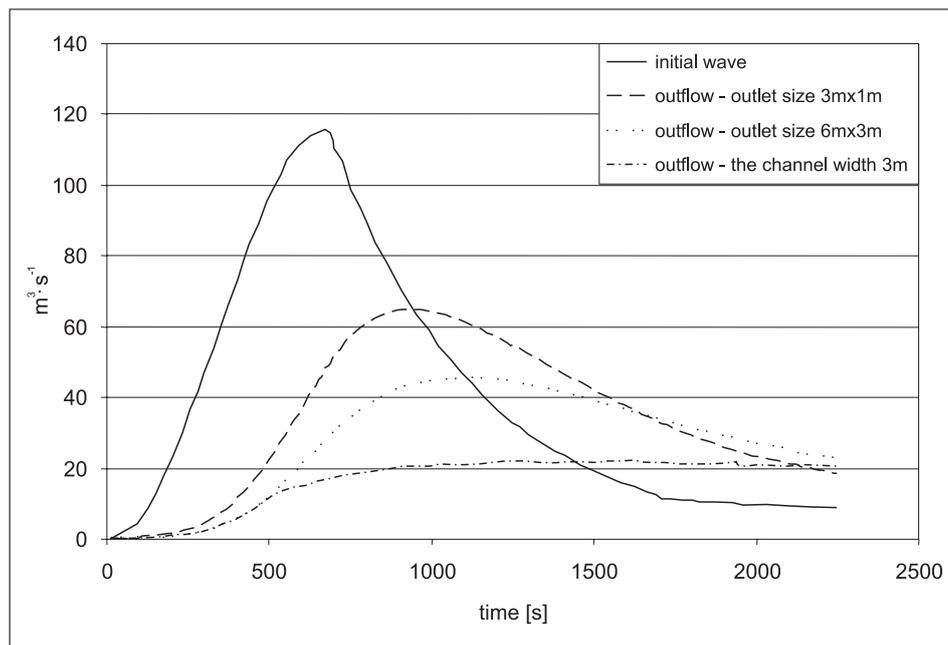


Figure 2. The flood and outflow hydrographs

References

- Lenar-Matyas A., Poulard C., Witkowska H., Szczyński J., 2004: *The choice of an outlet for Isepnica Dry Reservoir*. Selected Problems of Water Engineering, Politechnika Krakowska – Cemagref – results of cooperation, Cemagref Editions.