RAINMAN D.T.3.5.4 - ACTION PLAN WITH POTENTIAL RISK REDUCTION MEASURES AND IMPLEMENTATION GUIDELINE

Alan Cibilić[1], Ana Jelka Graf[2]

[1)] Hrvatske vode, Zagreb, [2)] VPB d.d., Zagreb

Our Project is funded by the Interreg CENTRAL EUROPE Programme that encourages cooperation on shared challenges in central Europe and is supported under the European Regional Development Fund.

Action plan with potential risk reduction measures and implementation guideline

Version 1 15.6.2020.

Authors Alan Cibilić[1], Ana Jelka Graf[2]

[1)] Hrvatske vode, Zagreb, [2)] VPB d.d., Zagreb

Contents

1. Context and goals of this study

1.1. Project context

The purpose of the RAINMAN Project is to establish joint integrated tools for heavy rain risk management and to strengthen the management capacities of regional and local public authorities. Heavy rain events have been identified as one of the key water management issues, and risks of floods and flood damage caused by heavy rain events are becoming more and more prominent, both due to intensive development of urban space and due to more and more marked impact of climate change.

The expected Project results are tools and methods for the assessment, mapping and reduction of heavy rain risks, tools to forecast and alarm about the possibility of such an event, and a proposal of measures to reduce the damage caused by heavy rain. These will be included in the RAINMAN-Toolbox, a set of five transferable tools and methods for municipalities and regional stakeholders.

1.2. Goals

The analysis of pluvial flood risks in the selected pilot areas which was implemented within the preliminary activity resulted in the identification of hot spots, i.e. areas with an unacceptably high risk. After that, it was necessary to come up with adequate protection or risk reduction measures for such areas, and propose measures for their successful implementation. The purpose of this activity is to indicate the scope of potential measures, the relevant stakeholders and potential difficulties in their implementation.

2. Characteristics of selected hot spots and proposal of risk reduction measures

Based on the results of the preliminary activities, problematic locations were identified in the selected pilot areas for which optimum risk reduction measures had to be defined. The RAINMAN working groups identified a number of measures which can roughly be divided into risk reduction measures using regional spatial planning instruments, preventive measures for urban areas and private structures, water retention and infiltration concepts, measures to optimise the management of flood defence systems (flood retention basins), measures of meteorological and hydrological forecasting, alarm and emergency measures, and other measures. Due to the characteristics of pluvial floods (marked variability in time and space, very little time to react), the focus needs to be put on the prevention measures. The responsibility for the implementation of individual prevention measures partly lies on official people (e.g. spatial planning measures, warning measures, etc.), and partly on private people (e.g. design or reconstruction of structures to make them flood-resistant, risk transfer by taking out an insurance policy, etc.).

Due to the generally different character of the two analysed pilot areas, the risk reduction measures differ significantly. A hot spot in the Zagreb pilot area is an area in the city centre with a large number of public facilities (museums, theaters, schools, hotels, stores, etc.) and through which significant traffic takes place. A significant part of the basin from the Medvednica hills gravitates towards this area, with only one part of the rain volume taken in by the city's sewer system.

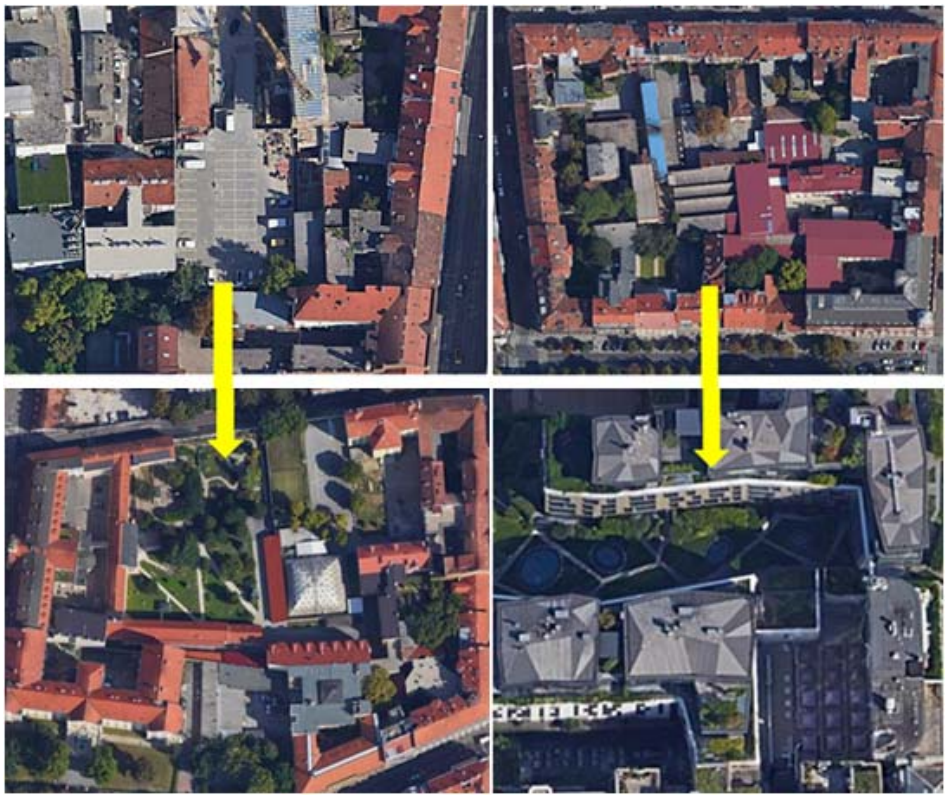
Zagreb pilot area hot spot

In order to increase the resiliance of the stormwater drainage systems, more and more frequently used low-impact development (LID) methods are proposed, with which stormwater is managed (retained, accumulated, infiltrated) as near to the place of its generation as possible. It was therefore proposed to establish underground retention basins in the upstream part of the basin, in the unbuilt part of the area,

to collect stormwater, retain it temporarily or extend runoff paths, thus reducing the peak load (Measure U13).

Potential location to establish underground retention basins

Furthermore, the results indicate that some rainfall is retained within the courtyards of city blocks which often serve as parking lots and storage areas. In order to improve the hydrological conditions in such micro-locations, it is proposed to install adequate sewer systems (Measure U09), which can be combined with different vegetation structures in order to increase infiltration and evapotranspiration, as well as with measures to replace standard rooftops with green roofs (Measure U04).



Examples of using green infrastructure measures to reduce runoff

On the other hand, a hot spot in the Umag pilot area is also an urban area, but with a completely different type of construction. Whereas the Zagreb area is characterized by an extremely high factor of development, individual construction is dominant in the area of the Town of Umag – family houses with

gardens and backyards. Furthermore, it is a coastal region characterized by the presence of a complex impact of seawater level fluctuations on the runoff, both on a daily scale and on a scale of several years.

Umag pilot area

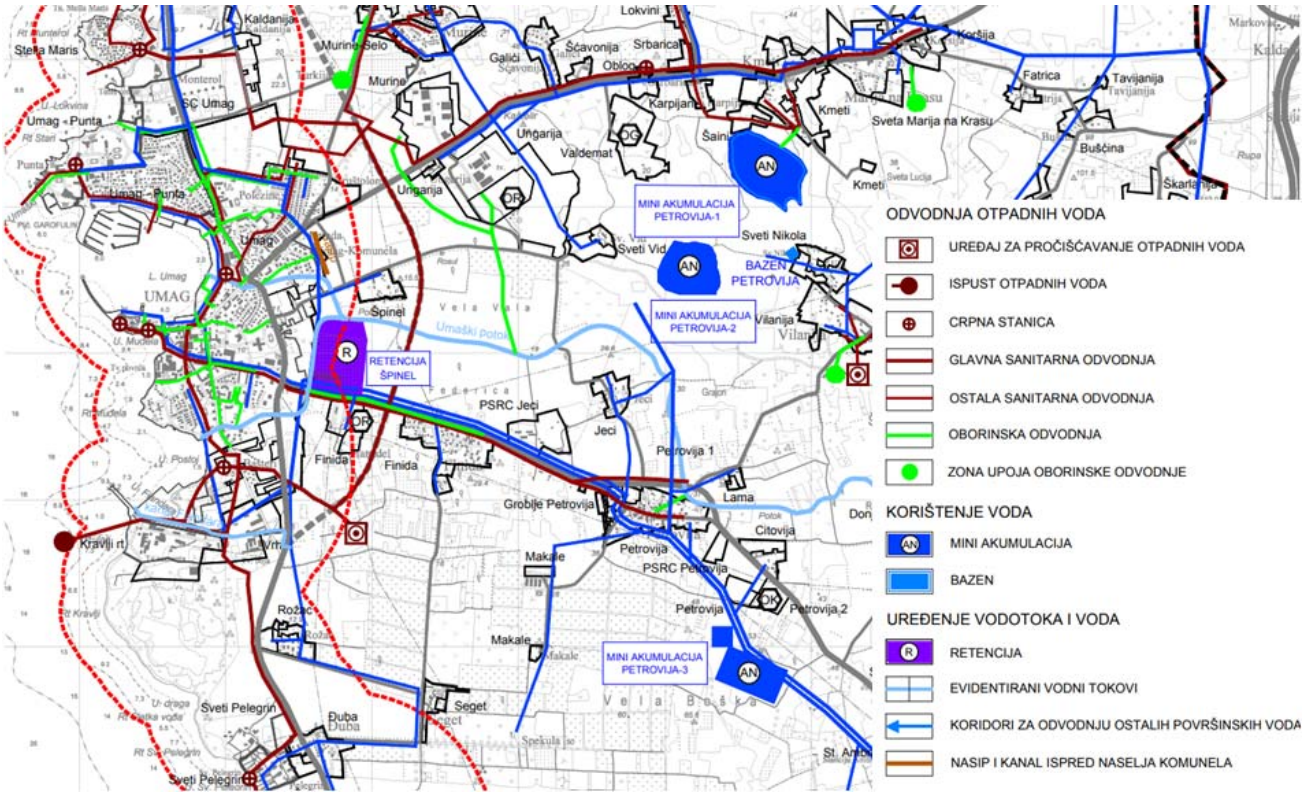
The biggest problem is exactly the high seawater level that hinders free runoff and causes problems in the operation of the sewer system in the wider town area. In the context of climate change and a trend of rising seawater level, the problem of pluvial floods in areas like this carries additional weight. Therefore, when planning the construction of sewer systems it is necessary to assess the potential impact of climate change on the rising seawater levels, in order for the efficiency of the planned systems not to decrease during their lifetime. In accordance with the "Development Strategy for the Town of Umag in 2016-2021 Period" (December 2015), the existing sewer system is planned to be extended under the "Smart City – Green City" Project, in cooperation with Hrvatske vode.

The most downstream section of the Umaški potok watercourse

Looking only at the selected micro-location and the general direction of water distribution, it can be concluded that the optimum measures for the reduction of risks at the selected location are those which retain water at the source of its generation, with the construction of detention basins, infiltration systems, semi-permeable traffic surfaces and the like (Measures U01, U04). Furthermore, since there are two educational institutions nearby (a school and a kindergarten), it is highly beneficial to connect these structural measures with measures for education about flood hazards (Measures P04 and P05) and the way in which we can reduce the flood risk through practical work (e.g. by building green roofs or rain gardens within school bounds – Measures U04, U01, U02).

Proposal of measures to reduce runoff in the town area

Looking at the wider Umag area, based on the DEM it was identified that there is a large number of natural depressions in its hinterland without the possibility of gravity surface drainage, with additional unfavourable circumstances being the composition of soil hindering the infiltration of bigger volumes of rain water and a high groundwater level. It is therefore necessary to increase the resiliance of such systems by inserting retention basins and/or reservoirs, and by planning new soil amelioration systems in such a way that account is taken of rain water as a potential resource to provide water for irrigation (Measure R02). In addition to the Ljubljanija retention basin, the purpose of which is to reduce the discharge of the Umaški potok watercourse and protect the downstream part of the basin, the Spatial Plan of the Town of Umag foresees the construction of the Špinel retention basin immediately next to the southern branch of the Umaški potok watercourse.



Spatial Plan of the Town of Umag

In addition, watercourse restoration measures (Measure R03) are also appropriate, as well as a number of agricultural engineering measures in the upstream part of the basin which will contribute to the reduction of soil erosion and reduction of runoff.

Proposal of measures in the upstream part of the Umaški potok basin

3. Conculsions and recommendations

Looking at the characteristics of the selected pilot areas, marked differences can be noticed both in the characteristics of floods and in how the areas respond to their consequences. In the Zagreb area, a high factor of development has been identified as a limiting factor in the prevention of adverse consequences of pluvial floods, whereas in the Umag area that factor is a high seawater level, i.e. its impact on the sewer systems. Due to the character of short-lasting heavy rainfall, emphasis is placed on prevention, first of all on spatial planning. Since space is a valuable and limited resource shared by a large number of users, the purpose of spatial planning is to organize its rational and optimum use.

In the Zagreb area, the solutions based on the retention of larger volumes of water are applicable only in the piedmont zones, whereas in the area of the city centre emphasis is put on the measures of adaptation to pluvial flood, i.e. reorganization and change of use of individual spatial elements (e.g. gradual replacement of a combined sewer system with a separate sewer system, adaptation of construction methods, etc.). In doing so, the selection of optimum solution has to be considered through implementation costs and environmental and social impacts.

The last twenty years or so have seen the so called sustainable urban drainage systems (SUDS) introduced gradually into practice, through which the elements which partly imitate the natural hydrological events in the basin (bioswales, rain gardens, infiltration ditches, green roofs, etc.) are added to the drainage system. This increases infiltration and evapotranspiration, enables temporary retention of part of rain water at the place of its generation, and leads to the reduction of peak load.

The same recommendations apply for the Umag area. It is expected that their implementation will be easier, due to a larger share of individual construction and a larger number of green areas which can be adequately used. In the un-built parts of the basin, spatial planning measures can reserve the space for the acceptance of rain water (e.g. for the construction of retention basins), but they can also specify the optimum method of land use and tilling in order to minimise the potential adverse consequences of heavy rain (e.g. soil erosion, landslides, etc.). Furthemore, it is also recommended to integrate the climate change adaptation measures and effects into spatial plans, which refers particularly to the coastal regions where the seawater level rise and its adverse impact on the valuable cultural heritage (e.g. Town of Trogir, Diocletian's Palace in Split, Euphrasian Basilica in Poreč, etc.) is expected.

The successful implementation of the specified measures requires the definition of responsibilities in the management of the flood risk management system, the development of a legal framework and technical guidelines for the implementation of the measures.

RAINMAN Key Facts

Project duration:	07.2017 – 06.2020
Project budget:	3,045,287 €
ERDF funding:	2,488,510 €
RAINMAN website & newsletter registration:	**www.interreg-central.eu/rainman**

Interreg CENTRAL EUROPE
RAINMAN
European Union
European Regional Development Fund

Lead Partner

LANDESAMT FÜR UMWELT, LANDWIRTSCHAFT UND GEOLOGIE | Freistaat SACHSEN

Saxon State Office for Environment, Agriculture and Geology

rainman.lfulg@smul.sachsen.de

Project Partner

Saxon State Ministry of the Interior | STAATSMINISTERIUM DES INNERN | Freistaat SACHSEN

Environment Agency Austria | umweltbundesamt

Office of the Styrian Government | Das Land Steiermark – Wasserwirtschaft

T. G. Masaryk Water Research Institute, p.r.i | VÚV TGM

Region of South Bohemia | The Region of South Bohemia

Croatian Waters | HRVATSKE VODE

Middle Tisza District Water Directorate

Institute of Meteorology and Water Management National Research Institute | IMGW

Leibniz Institute of Ecological Urban and Regional Development | Leibniz Institute of Ecological Urban and Regional Development

Project support

INFRASTRUKTUR & UMWELT Professor Böhm und Partner

INFRASTRUKTUR & UMWELT
Professor Böhm und Partner

RAINMAN@iu-info.de