

# Small Catchments and Flood Risk in Ljubljana

## Summary

Besides the general seismic threat on the entire territory of the municipality of Ljubljana, some areas are heavily exposed to floods, what requires appropriate protective and, in particular, preventive measures. Most crucial is the risk of flooding in the southern parts of Ljubljana, where the flood waters of Ljubljanica and Gradaščica rivers can affect large number of people, residential, commercial and other facilities. However, significant flood risk is also present along small streams which at the time of intense local rainfall can rise very rapidly and flood the neighboring areas, especially on alluvial fans along northern and southern foot of Golovec hill, in eastern parts of the municipality and, to a lesser extent, at the foot of Polhov Gradec Hills and Rožnik.

Due to high demand of building and other urban areas, several watercourses were hydraulically and hydrotechnically reconditioned or 'improved' in the past, with the main goal of rapid drainage of rainwater and acquisition of valuable land for individual housing development. This has caused significant hydromorphological degradation of watercourses and water pollution in the settled areas, and therefore we lost valuable aquatic and riparian habitats and significantly reduced their recreational, aesthetic and emotional values as well.

As some of the most critical points urgently need improvement to reduce the imminent flood risk, it is necessary to seek the approach that will simultaneously allow the restoration of watercourses or parts of thereof into a more natural state (ecoremediation) and the amelioration of living environment for local population. Despite the current ecological degradation and fragmentation, these small streams within the settlements are still, at least partially, acting as corridors between headwaters areas which have remained largely in more or less natural state and under the forest, and confluences with larger streams. This function could be the starting point for the renovation of their great ecological and recreational potential.

Particularly along the streams in the eastern part of the municipality (Javorska reka, Podmolniški graben, Rastučnik) and along Črnušnica and Glinščica there are still quite extensive flood plains in a relatively natural state (meadows), which are effectively acting as natural reservoirs for torrential flood waters. The spatial documents of the municipality must ensure the continuation of this situation and prevent any spread of urbanization into these areas.

Even very short and localized storms can cause flash floods in small catchment areas. Based on data from meteorological station Ljubljana-Bežigrad for the period 1990–2007, in Ljubljana we can expect the following maximum amounts of rainfall: in one hour 61 mm of rain with a return period of 50 years and 54 mm of rain with a return

period of 25 years, in six hours 92 mm of rain (50-year return period) or 80 mm (return period 25 years), in 24 hours 134 mm of precipitation (return period 50 years) and 122 mm (return period 25 years).

Despite the lack of accurate data for specific discharge from small catchment areas, it is possible to calculate with sufficient accuracy the maximum discharges for different return periods. It is alarming that the current anthropogenic interventions in some of small streams (culverts, water-intake openings, the size of underground sewers, etc.) do not allow the drainage of all potential amount of rainwater. Therefore, we can expect localized flash flooding, which may cause major property damage and in extreme cases even human victims (occurrence of mudflows due to landslides in the headwaters areas).

In terms of flood risk, the most critical are the following small streams: Graben (Spodnja Hrušica), Bizoviški potok and Besnica. Due to inadequate anthropogenic interference, some small streams at the southern foot of Golovec hill are also perilous, especially the Gornji Rudnik I and Spodnji Rudnik I.

The upper parts of most small streams are generally in good condition (forested) and remediation is not required, but it is necessary to maintain the status quo. At the transition points from the upper parts into the settled areas, it is necessary to ensure the functional water-intake openings, which must be regularly maintained. The middle reaches of many small streams are situated in completely built-up areas and there the sustainable restoration of streams is necessary, wherever possible. The lower parts of streams are either natural or changed into completely artificial channels. In these lower parts the water is also polluted, so the appropriate ecoremediation arrangements should be introduced to improve the quality and biological state of water and thus the quality of living environment for local residents.

Ecoremediation interventions that would be carried out simultaneously with the flood protection do not present an additional financial burden, since it is available a comprehensive set of relatively mild measures with long-term and varied effects, e.g. deflectors (bumpers), artificial indentations, different types of thresholds, small wetlands, planting of riparian vegetation and the like.

With the European Water Framework Directive, the planning and water management received new guidelines and in particular the purpose for integrated and sustainable planning to achieve the central objective of the directive – good water status by 2015. The Water Framework Directive is focused primarily on preventing deterioration and improving the status of waters, while the flooding issues are addressed in detail in European Floods Directive (Directive on the assessment and management of flood risks). The latter requires from EU member states the preparation of flood risk management plans and points out the preservation and/or restoration of floodplains, which is also a guideline in the Water Framework Directive.

In built-up areas of Ljubljana municipality, many small streams have been changed into underground sewers. Their valley-floors are urbanized up to the headwaters, the streams have lost all the aquatic and riparian lands. There is a continuing process of spreading of built-up lands into headwaters areas and shrinking of flood water retention areas. Water-intake openings are generally too small for torrential water and can

be easily choked with wood, leaves and other debris from upstream forested areas. Large alterations of flood areas have occurred also downstream from sewers outflows (construction waste landfill and land reclamation), further increasing the runoff and reducing flood water retention capacities, with the deterioration of flood situation downstream as a consequence. In the field, unregulated sewage networks and direct discharges of waste water into underground sewers have been documented as well. In some places, the construction of sewers and waste water systems seems to be completely unregulated and probably illegal.

The European Floods Directive's approach to the problem of floods is mainly by prevention and points out the implementation of non-structural measures first, wherever possible. By enforcing the principle of preventive action by reducing the risks instead of guaranteeing a certain level of security, the situation in flood areas should be improved, especially by the prevention of urbanization of flood areas, the protection of existing retention and flood areas and preparedness for future flood events.

A special significance in achieving these objectives has the spatial planning in the areas of direct influence on small streams. It is necessary to manage potential risks in particular by setting spatial limitations to urbanization, by directing development away from hazardous areas and redirecting existing activities away from areas at risk from flooding.

*(Translated by Karel Natek)*