**Project no. 4CE439P3**

**URBAN_WFTP**

**Introduction of Water Footprint (WFTP) Approach in Urban Area to Monitor, Evaluate and Improve the Water Use**

# WP 5.2.2 Identification of Water Footprint improvement objective and policy declaration

## Wroclaw Urban Water Footprint Lab

**Start date of project: 1 November 2012** **Duration: 25 months**

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# 1 Introduction

As the city of Wroclaw serves over 600 thousands customers, the capacity of produced sewage is large. The modernized waste water treatment plant was designed for 140 000 $m^3$/day, which is 51 135 000 $m^3$/year. In accordance with the Regulation of the Minister of Environment dated 24 July 2006 on conditions to be met when discharging sewage to waters or to the soil and on substances of particular adverse impact on the water environment (Journal of Laws 2006 no. 137, item 984), the Nitrogen and phosphorous limits amount to 10 mg/l and 1 mg/l, respectively. Based on these limit values, the designed capacity of the wastewater treatment plant, and assumed natural Nitrogen concentration in the receiving water body of 0 mg/l, the $WFTP_{Grey}$ amounts to 51 135 000 $m^3$/year. This can be reduced by implementation of the appropriate technologies.

Another important issue to consider is a constant urbanization of the city, which contributes to an increased percent of the soil sealed as there are new houses, roads and other infrastructure built. Based on a linear regression analysis the Central Statistical Office (GUS) the urbanised area will increase from 93.09 to 97.64 $km^2$, by several percentage points, within a decade. The main problem with soil sealing is flooding of storm water and lack of retention of water for dryer periods. In addition, precipitation patterns become more extreme, therefore the amount of rainwater that falls in a short period of time is on the rise. Therefore it is important to improve the rainwater management system within the city.

# 2 Identification of the improvement objective

The waste water treatment plant was designed to not exceed the limit values for pollutants' concentration and this aim is met. However, in order to be always on the safe side and reduce the sewage impact on the environment it is worth analysing the impact of some modifications and adjustments of the installation on the effluent quality. The capacity and composition of sewage might change with city development and connection of the new customers to the sewage system, so it is worth to increase the margin for Nitrogen concentration in the sewage and consequently, in the treated effluent.

Therefore, as the water footprint improvement, the Municipal Water and Sewage Company will concentrate on potential investments that improve the Nitrogen removal from sewage. However, before the new solution is implemented it is important to carry out the appropriate theoretical and practical studies and analyses, and perform the pilot tests. If the tested solutions prove to be effective, and there will be enough investment means for their implementation, it will be carried out in the future.

With regards to progressing urbanization and limited ability of the storm water system (especially combined sewer system in Wroclaw city centre) to handle extreme events, it can be improved by implementing the Sustainable Drainage System. Different solutions improving the rainwater management within the city will be promoted and presented to the stakeholders in order to convince them to encourage investors and design engineers[1] to implement such solutions. This can be done by their promotion and by introducing relevant regulations, for examples incentives for rainwater harvesting, and/or fees for its discharge into the sewerage system.

## 3 Measures applied to improve the water footprint

Four solutions which might cause reduction of Nitrogen concentration in the treated effluent are considered. The first one is based on the change of the operational scheme at the biological treatment stage, i.e. transformation of the anaerobic reactors into denitrification reactors in order to increase the denitrification volume.

The next solution is improvement of internal recirculation capacity by nearly 50%. This will increase the amount of nitrates recirculated from nitrification to denitrification reactor and further improve the efficiency of Nitrogen removal by enabling full utilization of increased denitrification volume.

With higher internal recirculation flow more oxygen will be transported to the denitrification reactor. This may decrease Nitrogen removal efficiency so the third step is optimization of the aeration conditions in the aerobic reactor.

The last project is implementation of anammox or nitrification/denitrification process of sludge dewatering liquor in pilot scale. It is a part of an ongoing research project which is currently in the construction stage and ends in 2016. The project carried out in cooperation with Technical University of Wroclaw and Wroclaw University of Environmental and Life Sciences (PP9) and is called "Optimization of nitrogen removal – improvement of the treatment effects and a step towards energy self-sufficiency of Wroclaw Waste Water Treatment Plant” (Polish title: „Optymalizacja usuwania azotu – poprawa efektów

[1] Investors are mostly property developers and the municipality - those who pay for/ invest in a building, construction, infrastructure. Design engineers are architects and civil engineers - those who design a building, construction, infrastructure.

oczyszczania i krok na drodze do samowystarczalności energetycznej Wrocławskiej Oczyszczalni Ścieków", acronym: NWOŚ, ID: 211132). The project is partly financed by the National Centre for Research and Development in Poland, within the framework of the Applied Research Programme, path B for industry branches. If this project is successful, the chosen method will be implemented on a full scale, later in the future.

There are different elements of the Sustainable Drainage System, which could improve the rainwater management and flood control in the city. These are for example permeable green areas enabling rainwater drainage into the ground, improving water retention within the city drainage area. Having less concrete and more green space in an urban setting has ecological and micro-climate benefits. Constructed wetlands, which are artificially created wetland ecosystems to treat e.g. collected rainwater or wastewater, ponds and creeks within the city provide aesthetic value to a community, enhance ecology, and enable rainwater retention. Similar sustainable solution, which reduces the risk of urban floods, is rainwater harvesting, which is the accumulation and storage of rainwater for reuse before it could reach the aquifer. Harvested rainwater can be used e.g. for garden watering, car washing, as well as flushing toilets. It relieves some of the pressure on other sources of water supply and it reduces the costs associated with treatment of polluted rainwater. These solutions contribute to a reduction of $WFTP_{Blue}$ and $WFTP_{Grey}$, and a positive increase in $WFTP_{Green}$, which is a dominating WFTP in green areas.

Sustainable Drainage Systems, when appropriately designed, can be extremely cost effective. Their investment and maintenance costs are lower in relation to traditional drainage systems. This kind of system can eliminate the need for other drainage infrastructure or expansion of the capacities of existing assets. The benefits of these solutions will be presented to the stakeholders, and hopefully appreciated by them, and in consequence imposed on the investors and design engineers to be implemented.

Currently, in Wroclaw, the most common form of reduction of impervious surfaces is by using permeable pavers usable for vehicle and foot traffic, where water infiltrates directly into the ground instead of running off the surface into drainage systems, retention basins or another outlet, which is in the natural environment.