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1.2 Surface water management plan in modern city

Surface water management plan is very important for every modern city. In general, such plan outlines the preferred surface water management strategy for every small part of the city particularly and general unified plan for a hole city. Such plan should take into account all local advantages and disadvantages for every street of the city. Thus, in order to prepare a concept of the surface water management plan for particular city we need to take an experience for other similar city or cities. Analyse all positive aspects of their plans and pay attention to all problems with they still face with. In Lviv this problem become more and more important, especially in recent decades (fig 1).

Fig. 1. Flooding of the central part of the city Lviv during rains.

As a base city for cooperation for preparing surface water management plan can be the city with similar sewers networks and climate conditions. So, as a base city can become London, which have a lot of common characteristics with Lviv. For example, London passed through its sewers networks as Lviv. The combined sewer system built by Joseph Bazalgette more than 150 years ago has served to the city well, but it was designed for small towns with more green areas. Exactly as in our case. The combined challenges of London's growing population, changing land use and climate change mean that if they continue to rely on our current water and sewer systems, all city

citizens are at risk the increasing life of the flood front. Thus, in order to keep their existing and planned water infrastructure and avoid the greater risk of flooding, they needed to change the way London's water system works. Rain should be managed as something useful rather than wasteful [10]. The same problem stands in front of Lviv nowadays. We must bring back the inexhaustible surface water. They should be replaced with "sustainable drainage" systems that mimic nature's way of managing rainwater and add to the functionality provided by our drains and sewers. The need for sustainable water supply is now being recognized globally and is being incorporated into our local and regional planning processes. This action plan recognizes the need to raise awareness and improve sustainable water systems across Lviv. It has a series of actions to make our water system work normally, which will bring many different benefits, including:

- steadily reducing flood risks by easing the burden on our drains and sewers
- reducing pollution of our tributary rivers and streams
- creating more pleasant landscapes, streets and settings for Lviv’s buildings
- providing opportunities to save water

The main goal of the surface water management plan program is to improve sustainable water systems for existing buildings, land and infrastructure. It is understood that financial pressures mean that there will not be direct funding for large-scale watershed improvement programmes [11]. Instead, the key is to identify when and where maintenance, repair, or improvement projects are planned, and identify opportunities to improve sustainable drainage as part of the project. In this way, permanent drainage can be introduced at low cost. In some cases, these processes can also save money, for example when 'reclaimed' rain represents large amounts of water used for irrigation, toilet flushing or car washes. The action plan should aims to set a direction for the next 20 years, but includes 40 specific actions for the next five years. Thus, we need to analyse the surface water management in London and try to modify it according to Lviv’s realities.

Surface water is the rain that falls on the city; on the ground, in the street, on the road, on the roof, in the park and in the garden [12]. Flooding When water does not

enter the ground or flow through the drainage system properly, but instead sits or runs off the ground, it can cause flooding. above. While London is now well protected from the Thames flood, it has little protection against surface flooding. The London Regional Flood Risk Assessment (RFRA) identifies the major risks of surface flooding in London (GLA, 2014). He identifies London's over-development, unaffordable high-rises and a general lack of registration as problems.

The Mayor's Climate Change Action Plan (GLA, 2011) identified the risk of surface flooding as the most significant short-term climate risk for London. In 2007 other parts of the country, including parts of West England, Sheffield, York and Hull, experienced severe flooding. This comes from high water following heavy rains, and from the river as rainwater flows through it. London was spared the worst of these storms. However, it is clear that if these storms were concentrated in some parts of London, it would have caused great problems, great economic impact and a long recovery time, especially if a large infrastructure has been affected.

In London there are many local examples of surface flooding - the most recent during the summer rains in 2015 and 2016. Using sustainable drainage systems will help reduce the impact of floods. these winds. Water quality the water quality of London's rivers is generally poor to moderate. Of the 41 London boroughs assessed under the Thames River Management Plan in 2015, three were rated as poor, five as poor and 33 as moderate. No water is listed as good or very good. Division may change from year to year. The overall objective of the EU Water Framework Directive is to improve the water quality of rivers and lakes [13].

However, it is clear that there is considerable room for improvement in London. Removing pollutants from surface water discharges will be an important part of any improvement. Many sustainable drainage systems can help with this. A sustainable water supply will also help maintain healthy growth in our own rivers, which will further contribute to improving the health of these rivers. London's drought is often mistaken for a rainstorm. However, London (and indeed all of Southeast England) is classified as "hard" water. This means that more water is removed from the environment than the environment can support in the long run. Fifty-five percent of all

rain that falls in the Thames Valley is captured and used. That's more than anywhere else in the UK, and almost anywhere else in the world. London is prone to drought, and it takes twice as many winters in a row to create a water supply problem. In 2006 and 2012, London experienced severe droughts, and in 2012 it only avoided severe water restrictions by having the most rainfall in a century [14].

Some sustainable irrigation systems retain water for later use, either through a direct rainwater harvesting system or indirectly through irrigation. It is also important that permanent lawn systems are resistant to rain and that permanent irrigation of new green infrastructure does not require large amounts of water during dry weather. Surface water management challenges the frequency and severity of furtherance floods, droughts and poor water quality in London depends on a number of factors. Some of these are physical, some are social, and some are from the historical development of London, while others are the result of projected future trends. These are explored in detail in the following sections. The climate of the future will be very different from the past. Southeast England is expected to experience heat, monsoons and heat and temperatures. It is also expected that there will be frequent extreme weather events, such as extreme heat and heavy rain.

By mid-century, the chance of a storm flooding the river system will drop from 1 in 30 (3.3%) to 1 in 13 (7.7%), one year of pregnancy (UK IPC, 2002). Like all cities, London has a high number of impervious surfaces, which prevent water from entering the ground. On top of this, the clay soil found under the part of London reduces the amount of infiltration, which causes the water to come to the surface. This is often used as a reason not to install a permanent waterproofing solution. However, there are different methods of drainage that do not depend on the installation. Soil in many places has a certain degree of permeability and should be tested as a best practice (BRE, 2016). London also has an ancient drainage system. Always built to a very high standard, it was designed to handle storms with a lower return period than is currently used and to cater to the needs of smaller populations. In general, the drainage system can be divided into two different systems. In central and central London there is a combined sewer system that carries both rainwater and sewage through a single pipe

and sewer to the sewage works in Beckton and Crossness. The main challenge with combined sewers is that rainwater can quickly fill sewers. This leads to the flow of untreated sewage into rivers (especially the Thames) and rainwater. These are known as Combined Sewer Overflows (CSOs).

In 2014 the government gave permission for the Thames Tideway Tunnel (TTT). The project is seen as necessary to address the current problem of bridging the sewers flowing into the river Thames. The main cause of these problems is rainwater flowing into the combined sewer system. The TTT will not increase the capacity of the combined sewer system but will prevent all but the worst sewers from flowing into the Thames. Thames Water is moving ahead with applications for the Counters Creek relief canal in the Kensington and Chelsea/Hammersmith and Fulham area. This will solve the sewage and flood problems in the area.

Outside of London, there are separate systems that deliver rainwater to local catchments and sewage to sewage treatment plants. There are two main problems with different liquid systems. First, there is the widespread problem of "unsanitary" contamination from pipes installed in surface water systems in various sewer areas. This means that untreated sewage ends up in local waterways. Second, there is a feeling of "early harvest" after the rain. This is especially important when it is dry for a long time. The storm had the effect of washing the surface of the city into rivers and streams. It picks up trash (such as leaves and bird/animal droppings), human waste/debris, tires, metal, and motor water from the surface of the road. This has serious implications for the water quality of these streams. It is increasingly complex and expensive to increase the capacity of London's drainage system using traditional pipe networks, such as the Tideway Tunnel and Counters Creek projects. This is due to the need for large scale and comprehensive analysis of many roads. It is also important to work on and around the large infrastructure that is currently under many roads.

Public Flood Risks Most affect the poorest communities. The poorest people tend to live in areas that are at risk of flooding. They most likely have insurance to cover any loss or damage. They are also likely to be able to install flood barriers or moving systems. So this flood could affect the poorest people in London. Over the past

few decades, many front gardens (and to some extent, back gardens) have been covered with impenetrable vegetation. Plans vary, but two-thirds of the front yard is covered at least partially with non-herb cover (London Assembly, 2005). The average annual loss of grassland in London is equivalent to 2.5 Hyde parks (London Wildlife Trust, GiGL GLA, 2010). A recent study for the Royal Horticultural Society also suggested that almost a quarter of London's gardens have been fenced off (RHS, 2015). This put increasing pressure on our water system. Not only must it be stopped, but changed if the risk of flooding is to be addressed. Over the past 25 years, London's population has grown dramatically, by almost two million people. The London Plan estimates that the population will be over 9 million in 2020 and nearly 10 million in 2031. The London Infrastructure Plan suggests that by 2050 the population will - more than 11 million. The increase in population will certainly increase the sewage demand for water. If it is planned and organized in a traditional way, the increase in population will also lead to an increase in the area that cannot be done. Such actions will worsen the pressure on the water and the water system of the country, potentially increasing the risk of floods and droughts. Thames Water has mapped the impact of predicted population growth on London's climate change and its vulnerability and linked canals to understand how they will cope with these challenges in the future [14].

It shows that for frequent rainfall events in 2050 (expected to average once every two years), some areas of London will not have enough water for irrigation capacity to manage water is expected. This will lead to a greater risk of flooding of surface water and canals. Figure 2 shows the graphical output of this model for the year 2050. The red areas on the map are where the system is expected to exceed capacity and where flooding is expected.

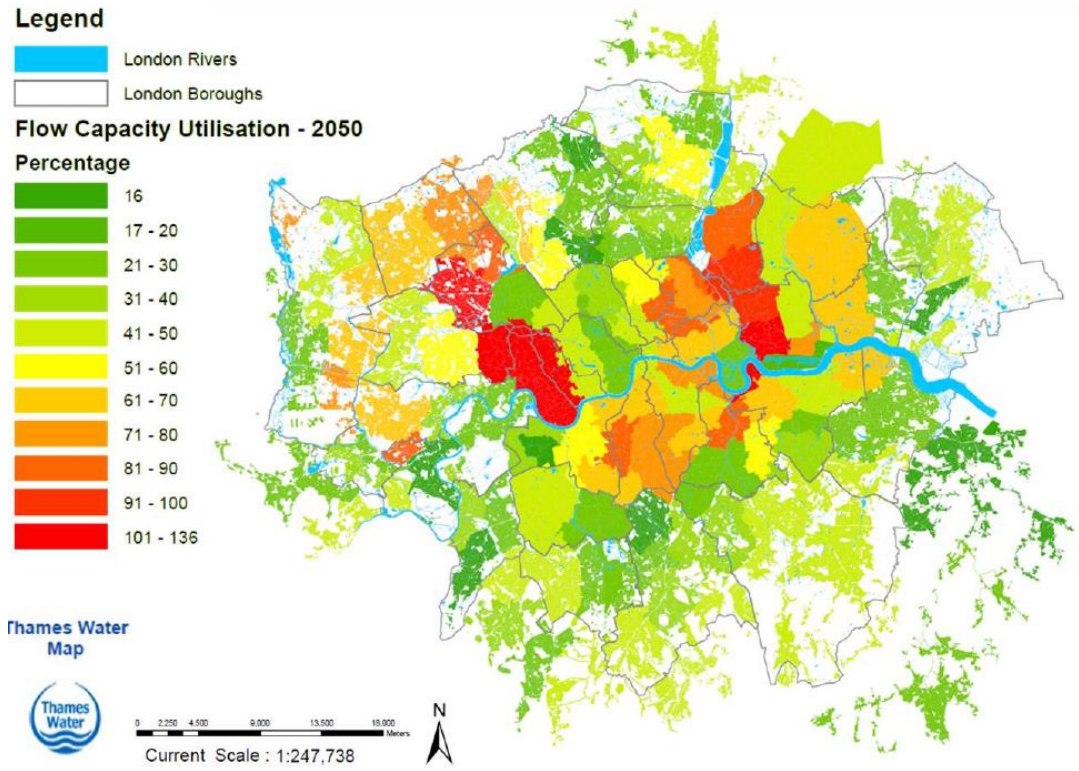

Fig. 2. Modelled foul and combined sewer capacity for the 2050s.

Thus, then can become a good starting point for our plan before moving to next steps. And one of them is sustainable drainage. In order to achieve that we need to analyse how his goal was achieved by others and especially in London. The purpose of this approach is to outline a long-term strategy and action plan to implement sustainable water management. This method emphasizes using the best method or combination of methods for a building, development, land or region. This program should not be used to suggest that certain methods may or may not be used [15]. It wants to be involved in various organizations that will make the use of drainage sustainable for a long time. To accommodate long-term uncertainty, the plan makes tough, short-term decisions and sets long-term direction.

Implementation of the action plan should be monitored, and progress will be reported annually. If necessary, the practices will be changed and new practices introduced. The action plan should be reviewed, and progress will be reported annually to allow review of the process and evaluation of new opportunities. Quantities of known sustainable drainage system improvement projects will be reported along with discharge areas, volumes, and flow rates, where available (fig. 3).

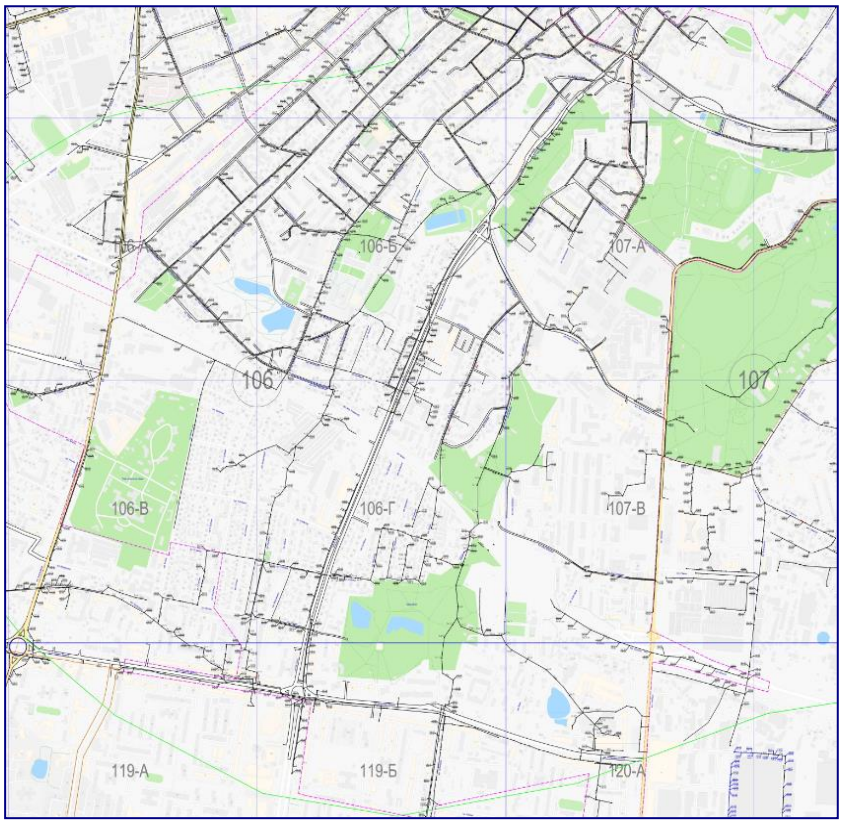

Fig. 3. The territory of the Frankivsk district in the city of Lviv with the tracing of sewage networks

The action plan should be reviewed, and progress will be reported annually to allow review of the process and evaluation of new opportunities. Quantities of known sustainable drainage system improvement projects will be reported along with discharge areas, volumes, and flow rates, where available. Measuring the online impact of the program and the above flood is, however, recognized as a difficult task. Several climate changes, new development trends, economic trends, water consumption patterns and investments in sewers and water infrastructure will change everything that goes into the sewers. However, in the interest of having a simple and reliable metric to report on, we will work with Poltva Water and others to develop a simple and useful measure of average and/or peak and point in the sewage network. This will be evaluated to determine the success of the program (fig. 4).

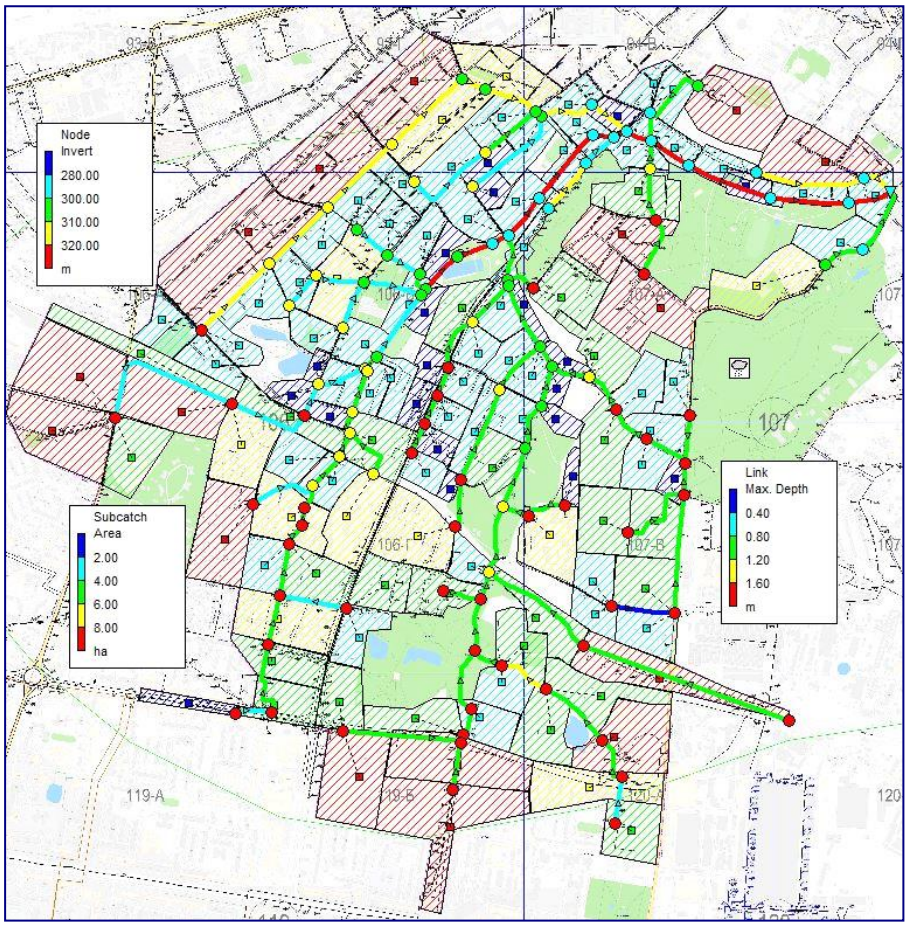

Fig. 4. Modelled foul and combined sewer capacity for the Frankivsk district in the city of Lviv.

We will be developing an online sustainable water mapping tool, where we will collect information about sustainable water projects to be delivered across the city. There are many opportunities to manage rainwater more sustainably, but often-quoted reasons why sustainable drainage techniques cannot be implemented or are limited apply. These include the presence of clay soils, ground contamination, and high groundwater.Part of the Drain London project is to map the opportunities for sustainable drainage at a London wide scale. The project will focus on any areas where there are either good or limited prospects for implementing drainage in a sustainable way. The findings from this project will be made available later this year. Maintenance is an important part of Drain London [14]. However, it's also worth investigating if there are any limits on the type or amount of sustainable drainage that can be implemented. For example, the installation of an inlet system can lead to long-term changes in the water level of the ground, and many small storage tanks require pumps

to remove rainwater when storms are likely to grow. This will be taken into account in future program revisions. However, the situation at the beginning of this plan is that it is necessary to increase the use of water permanently. As such, the implementation of existing opportunities should not be suspended or resisted in any way pending long-term research.

Evidence from planning applications sent to the mayor shows that many applications in recent years have included plans to reduce storm surges. These reductions are usually in the cost of clean site drainage but are almost always at a reduction of at least 50% of the previous site surface drainage. A small number of proposed developments on greenfield sites have included the cost of green fields. There is little monitoring and development planning. However, these are expected to provide few strategies for sustainable water management, especially at the household level. There are indications that in some cases creating an attenuation plan to reduce the peak for large events may mean that the reduction for the low return period is not necessary.