PILOT INVESTMENTS IN PARTNER MUNICIPALITIES

Output 3.4 of Interreg Baltic Sea Region project NOAH

Protecting Baltic Sea from untreated wastewater spillages during flood events in urban areas

Contents

Introduction

The NOAH project aims to protect the Baltic Sea from untreated wastewater spillages during flood events in urban areas. For this purpose, passive and active methods like holistic urban planning, real time control of urban drainage systems and raising stakeholder awareness are harnessed.

For that, WP3 will experiment and introduce new solutions in drainage system operation not widely used before in urban conditions. The idea is to install on-line sensors (measurement stations) and actuators (gates) into the existing system to utilize the capacity of the pipeline to accumulate excessive flows and thus avoid combined sewer overflows to the natural waters. In some cases, adjustments in the operation of the existing facilities (pumping stations) is also helpful to achieve this target.

The first activity of WP3 was data acquisition from pilot UDS systems in 6 partner towns and utilities - Rakvere, Haapsalu, Jurmala, Ogre, Liepaja, Slupsk. Separate and combined sewer systems were selected for the pilots. The internal report (O3.1) provides information on pilot areas, undertaken actions in terms of controlling stormwater, faced deficiencies and found solutions. Third activity of WP3 analyzed the present systems and defined the locations with RTC potential and the most efficient RTC tools for each pilot. The internal report (O3.3) gives recommendations for the control solutions to be implemented within NOAH project and beyond by further investments.

The fourth activity of WP 3 aimed to invest into RTC features at pilot sites that demonstrate the smart way of UDS implementation that allows to accumulate excessive water in the system and thus avoids combined sewer overflows (CSO) and wastewater treatment plant bypasses (WWTPBP).This in turn, will reduce discharges of untreated wastewater into the BS. As the effect of RTC is highly dependent on sensors and actuators in the system, the aim was to demonstrate a cost-effective way to add these additional elements (measurement stations and weirwalls) in order to make drainage controllable.

The report will be finally presented as a part of the project handbook (A4.3) and contributes case examples of how to implement RTC systems for UDS with specifications of:

1) Preparation of procurement documentation;
2) Procurement process and contracting;
3) Design, construction and installation;
4) Testing and implementation.

Report on undertaken actions, faced deficiencies and final solutions is the output of the activity A3.4. Manual for implementing RTC and procurement guideline for AHS and SWS will be provided as supplementary information.

The final report was compiled in period 4 (the implementation of the RTC was extended due to COVID19).

1 Overview of the pilot interventions

1.1 Main tasks and objectives of the pilot investment

The purpose of this activity is pilot implementation of the real time control (RTC) system in 6 pilot areas with installation of necessary additional sensors (measurement stations) and actuators (gates) to fill control gaps in the system.
The objective of this activity is to:
1) **Demonstrate innovative real time control system (RTC)** of UDS that allows to accumulate excessive water in the system and thus avoids combined sewer overflows (CSO) and wastewater treatment plant bypasses (WWTPBP) which will reduce discharges of untreated wastewater into the BS.
2) **As the effect of RTC is highly dependent on sensors and actuators in the system**, our intention is to demonstrate a cost-effective way to add these additional elements (measurement stations) and actuators (weirwalls) in order to make drainage controllable. The following elements will be tested:

a) **Automated hydrological measurement stations** (AHS) to gain on-line information from the water levels.

b) **Smart actuators** – Smart Weirwall Systems (SWS) that are capable to close the sections of the system to accumulate temporarily excess water and thus avoid overload at the downstream.

3) **Raise institutional capacity** of water utilities to implement RTC to operate UDS in a way that activation of CSO-s and WWTPBP-s is minimized.

1.2 Description of the existing control system with deficiencies

Detailed descriptions of pilot sites is given in report O3.1, out of which a brief overview is given in Table 1.

Table 1 Description of the pilot sites

Pilot site	Existing control system and its deficiencies
Haapsalu	There are no pumping stations in the stormwater system nor are there storage facilities built for stormwater detention. No automated control system (sensors, controlled devices etc.) is used for the UDS operation. In Haapsalu pilot area there is a SUDS solution present, viz. there is a large bioswale area between the town and pedestrian road. No CSOs exist in Haapsalu, all wastewater is treated and the stormwater system is mostly separate. Main deficiencies to the present system are: sea water intrusion to the drainage system, maintenance of the bioswale (suffers from heavy eutrophication).
Rakvere	The selected pilot area of about 1 km^2 is located in the middle of the town. This area is the most over flooded area in Rakvere. Rakvere Vesi AS manages water supply communications (total length 156 km), wastewater sewerage system (132 km) and maintains stormwater system, consisting of more than 45 km of closed pipelines and 115 km of ditches. In the lower part of the selected area, there is a pond, instrumental to avoiding stormwater flooding in the center of the town. The pond will be used as a reservoir to temporarily hold surplus rainwater until the central town pipeline is free to take the rainwater from the southern part of the town. There are no stormwater pumping station in the UDS. There is a minor system of storage and infiltration in the UDS. In Rakvere there are SUDS in the new development area at Pika/Tallinna street and some minor ponds and ditches in pilot area. No automated control system - sensors,

	controlled devices are used for UDS operation. RTC is expected to be applied to Süsta pond (see the map).
Jurmala	The city has elongated shape and is located between two water bodies – river Lielupe in the South and the Gulf of Riga in the North. Jurmalas udens Ltd manages water supply communications (total length 303 km), wastewater sewerage system (348 km) and maintains the stormwater system consisting of more than 50 km of closed pipelines and 115 km of ditches. The pilot area has been distributed into three main sections located along the city line. There are three pumping stations in Jurmala UDS. No storage facilities (tanks) are built for stormwater detention and there are no SUDS. There are automated control systems - sensors, control devices - used for UDS operation in the pumping stations.
Liepaja	The NOAH pilot areas are located in two separate locations in the city - Tebras Street catchment basin and Cietokšņa channel/creek areas. The main problem is that if the Cietokšņa canal outlet into the Baltic Sea is clogged, the adjacent areas are flooded. There is one pumping station in the UDS, located near Veidenbauma and Ganibu street junction. There are no storage facilities (tanks) built for stormwater detention, no SUDS (bioswales etc.) in the pilot area and no automated control system - sensors, controlled devices - used for UDS operation. The total basin volume in the sewer system in ~30km^2.
Slupsk	The study area (pilot site) does not include the entire sewer system operated by the Słupsk Water Supply but the most densely built-up area of 22.03 km^2 where both, the separate and combined sewer systems exists. Just before the main pumping station (which serves as an outfall in the pilot area) there is an overflow, which separates an excess of the wastewater and directs it to the Słupia River. The pilot area is a main source of inflow to the Wastewater Treatment Plant (WWTP) of which 30% is storm water.
Ogre	The pilot area is alongside Ogre river in Ogre town and Ogresgals parish. This area has been selected as it has a major flood problem and it is strongly affected by a climate change. There are four stormwater pumping station in the UDS. There are storage facilities (tanks) built for stormwater detention. In Ogre there are SUDS (bioswales etc.) in the pilot area and automated control system - sensors, controlled devices (3 adjustable gates/weir/orifices) - used for UDS operation. The total basin volume in the sewer system in ~30km^2. There is one pumping station in the Slupsk UDS. There are two storage facilities (tanks) built for stormwater detention. There are no SUDS (bioswales etc.) in the pilot area. There are automated control systems used for UDS operation. There are two basins (including WWTP) connected to Combined Sewer Overflow (CSO) structures.

1.3 Description of selected solutions for each pilot site

Report O3.3 provides an elaborate argumentation for explaining the selection of the potential solutions for introducing RTC to UDS for all of the pilots in NOAH project, out of which a brief overview is given in Table 2.

Table 2 Overview of the recommended features of RTC to be integrated to the UDS in pilot sites of NOAH project (see report O3.3 for further details)

Pilot name	Suggested control system	Effect of solution
Haapsalu	Controlling the flow through the outlet from the downstream bioswale (connected with BS) using Smart Weir wall system and two sensors	Keeps the water level in the downstream lagoon low during the high water tables in the Haapsalu bay or in extreme rainfall events,

		which leads to reduced sewer overflows in the city.
Rakvere	Control of the discharge from an upstream pond using the Smart Weir wall System controlled by the water level in the downstream system.	Reduced downstream flooding and risk of pollution spillages from wastewater system during flood events.
Jurmala	Pump installed at the outlet from a part of the storm water system where the dry weather flow is particularly polluted. The pumping is controlled so that the dry weather flow is transported to the sanitary sewer system but the much cleaner water during rain events is allowed to flow to the recipient.	Potentially ~ 70% reduction in nutrient load to the recipient.
Liepaja	A tidal gate and a pump at the outlet to prevent sea water from backing up into the drainage system. The gate to control the inflow from a newly connected area was not recommended.	Less negative effect of high tide in the recipient.
Slupsk	No control recommended, since the system (as implemented in the SWMM model) would not benefit from this.	-
Ogre	A non-return valve/tidal gate and a pump could be implemented.	Stormwater would still be able to get out of the system when water level in the river is high.

2 Case examples of RTC pilot investments made in the frame of NOAH project

In this chapter, the general description of the technical information, procurement procedure and guidelines for each pilot investment is presented. The illustrative information about the pilot investments is added to the Annex.

2.1 Case Jurmala

2.1.1 Technical information about pilot investments and procurements

Procurement and contract documentation for AHS was prepared based on both Jurmalas udens Ltd. experience and consulting with Riga Technical University.
Procurement and subsequently contract for AHS included:

- on-site inspection of the respective equipment installation sites before the installation of the equipment;
- preparation of the sites for the installation of the equipment;
- delivery of the equipment;
- installation of the equipment;
- adjustment of the equipment;
- commissioning of the equipment;
- training of the customer's personnel to work with the equipment.

It was also requested both in procurement and contract that the data from the equipment is transmitted to Jurmalas udens Ltd. server in a *csv data format.

Separately from the general procurement, a market survey was carried out of laboratories for water sample analysis (samples from automatic sampler, which is part of AHS). For the market survey as well as the summary of market survey research and contract with laboratory Jurmalas udens Ltd. consulted with Riga Technical University.

2.1.2 Technical documentation for embedding automatic hydrological stations (AHS)

No specific manuals were developed. Producer provided each set of equipment with a factory manual. User training was carried out by the contractor. After the training, end-users had to sign an act document certifying that they have participated in the training.

At this point all the data from sensors/equipment is stored at Jurmalas udens Ltd. server. Jurmalas udens has provided server access to specialists from Riga Technical University who are in charge of creating a unite platform for visualizing the data. The work is in progress.

2.2 Case Ogre

2.2.1 Technical information about pilot investments and procurements

During the construction process of the pilot area, in accordance with the regulatory enactments of the Republic of Latvia, price surveys were conducted for Design and Construction Supervision services. In turn, the procurement procedure was applied to the construction process. All technical specifications were developed on their own, without external expertise, based on municipality's previous experience.

2.2.2 Technical documentation for embedding automatic hydrological stations (AHS) and smart weirwall systems (SWS) into existing control system

Exploitation of new infrastructure is in accordance with the operating rules included in the construction project.
According to automatic hydrological stations that are built in project municipality have developed a description of the principle of operation of the stations.
Municipality have signed a contract about data collection and maintenance of automatic hydrological stations with external experts. There has been no training on the operation of stations, as they are identical to the current one that municipality has built before NOAH project.

2.3 Case Liepaja

2.3.1 Technical information about pilot investments and procurements

In Liepaja case separate procurement procedures were made for design and for setting up and installation of the purchased Automatic Hydrological Stations (AHS). There were no external consultants involved to prepare documentation for the investments, everything was done based on the municipality's previous experience. Everything was done according to Latvian procurement legislation. As every case differs and in every country there is different legislation for this, there are no specific tips and tricks that could be advised for the procedure.

2.3.2 Technical documentation for embedding automatic hydrological stations (AHS) and smart weirwall systems (SWS) into existing control system

Each investment purchased and installed has been provided with user manuals and equipment installer emergency contacts in the case when something goes wrong with the AHS installed.

2.4 Case Slupsk

2.4.1 Technical information about pilot investments and procurements

As part of the NOAH project, devices for measuring the amount of precipitation (rain gauges) were purchased - 6 pieces, devices for measuring the water level at the main sewers - 12 pieces with a system for automatic data archiving, remote transmission and visualization.

The purchase was made in accordance with the rules of competitiveness carried out on the basis of the Company's public procurement regulations for tasks co-financed by the European Regional Development Fund under the INTERREG Baltic Sea Region Program 2014-2020. The procedure to select the supplier was carried out on our own, without using external consultants.

2.4.2 Technical documentation for embedding automatic hydrological stations (AHS) and smart weirwall systems (SWS) into existing control system

Along with the purchased devices, the necessary technical documentation with operating manuals was received. In addition, the Company's employees - end users who directly supervise the work of the purchased devices have been trained and prepared to work with the devices independently.

2.5 Case Rakvere

2.5.1 Technical information about pilot investments and procurements

Rakvere Vesi AS carried out two procurement procedures. The first procurement procedure was carried out as a simplified procedure, as the estimated cost of the works was below the public procurement threshold. The second tender was carried out as an open tender.

Prior to the public tender, an overview (in form of report) of the potential technical solutions for the Smart Weirwall System (including cost estimation) was ordered from an external expert.

A tender was carried out for the installation of smart weirwall system and measuring devices. Documentation was for the procurement was prepared in co-operation between TalTech, Rakvere City government and water utility. Output from report 3.3. “Real Time Control of urban drainage systems and model based data validation” was used as a base for technical description.

The first public tender failed due to too high a bid price. After the first procurement, the terms of reference were specified and a new procurement was announced.

In addition to the smart weirwall, water level sensors with data transmission equipment will be installed to the observation well on the Soolikaoja collector to measure the collector water level and transmit the corresponding information to the weirwall. During heavy rainfalls, when the water level in the Soolikaoja collector begins to reach a critical limit, a signal is sent to the weirwall, which begins to close thus reducing the water flow to the collector and buffering extra water to the Süstatiik pond. When the rainfall ends and the water level in the collector drops, the weirwall starts lowering the water level in Süstatiik as well. Such buffering reduces the risk of flooding in the center of Rakvere, which the collector of Soolikaoja passes through.

During the design work, it became clear that for the installation a smart weirwall system to the pond, the water level must be lowered for the period of the construction, which requires a permit from the Environmental Board. The process of obtaining the relevant permit extended the period of construction work.

Other obstacle initially unforeseen was related to the maximum water elevation in the existing pond. During design process, it became evident that the maximum water level in the pond should be increased +0.3m to improve the accumulation capacity and meet the objective of the regulative task. For that permissions had to be asked from the owners of the surrounding properties. That add extra time to design process, postponing the start and end dates of the construction works.

Construction is scheduled to be completed in December 2020, followed by adjustment work. This is a pilot project, the results of which can be applied in other regions of Estonia in the future.

2.5.2 Technical documentation for embedding automatic hydrological stations (AHS) and smart weirwall systems (SWS) into existing control system

The contractor provided all the necessary technical documentation with operating manuals. In addition, the system end users who directly supervise the work of the purchased devices have been trained and prepared to work with the devices independently.

2.6 Case Haapsalu

2.6.1 Technical information about pilot investments and procurements

Prior to the public tender, an overview of the potential technical solutions for the Smart Weirwall System (including cost estimation) was ordered from an external expert. Based on that a technical description for the SWS was created based on the previous expertise of the municipality staff and TalTech experts. The technical description covered the next paragraphs:

- Purpose of the system
- Source materials
- Existing situation
- Description of the new service well
- Description of the smart weir
- Description of the mechanical protection devices
- Electricity and communication solutions
- Sensors
- Control and data transfer (including data visualization)
- Description of the measuring well
- Landscaping

The general idea was to install a SWS between the sea and the bioswale in order to prevent the inflow from the sea to the urban drainage system (in case of the high sea level) and enable the free outflow from the UDS to the bioswale. The SWS is equipped with the water level sensors to automatically adjust the position of the weirwall based on the water levels at the upstream and downstream of the weirwall.

Haapsalu is already equipped with a smart street lighting solution. So it was required to add the weirwall control and management system with the existing solution.

Output from report 3.3. “Real Time Control of urban drainage systems and model based data validation” was used as a base for technical description.

Major obstacle occurred during the design process - geodetic survey revealed that the existing culvert was installed higher than it was estimated initially before the procurement. Therefore, additional works had to be planned to reconstruct the culvert by installing the pipe approximately 0.5 m deeper. Without the adjustment water would not have had free pass from the bioswale to the sea and smart weirwall installed on the culvert would not have met the objectives set by the NOAH project.

2.6.2 Technical documentation for embedding automatic hydrological stations (AHS) and smart weirwall systems (SWS) into existing control system

The contractor provided all the necessary technical documentation with operating manuals. In addition, the system end users who directly supervise the work of the purchased devices have been trained and prepared to work with the devices independently.

3 Lessons learned in implementing pilot investments

The lessons learned in implementing pilot investments in the NOAH project are highlighted in this section. The final guideline to implement the types of investments in any urban area in the BS region will be compiled after the evaluation stage in WP4 A4.1 is finalized and will become available as part of the NOAH Handbook (O4.3). The purpose of the implementation guideline will be to:

- Increase institutional capacity of utilities to have a control over CSO-s and WWTPBP-s and have smooth tender processes to install additional elements (AHS, SWS)
- Anchor project results into daily routine of public water utilities
- Transform and spread the project results outside the project partnership

Three main aspects need to be payed attention to when planning smart UDS investments: i. policies; ii. budget; iii. timeframe; iv. surrounding facilities and potentially affected properties.

The procurement procedures may be defined by organizations' internal policy, funder regulations or government acts. Generally, the procurement procedures differ for municipalities around the BS and it needs to be determined, which of the policies is superior.

Procurement scopes differ in terms of integrating technical solutions into the existing cityscape which in turn will affect the budgeting. Type of solution, expected visibility and needed level of accessibility of the installment will, for instance, affect the procurement extent. These will determine if e.g. additional funds for landscaping will be needed or if the installment will only comprise mounting a device into an existing construction.

The most important lesson learned is the necessity of thorough preparatory work. Feasibility study, preliminary tenders and external expertise consultation planned in logical sequence will help in making the investment process as smooth as possible. As exemplified by the planned and executed investments in the NOAH project it is possible to overestimate the costs of standard (Automated Hydrologic Stations' installment cost in Latvia pilots overestimated by a factor of 3) or underestimate the costs of custom (Smart Weirwall Systems' installment cost in Estonian pilots underestimated by a factor of 2) solutions in initial planning phase.

Finally, the expected timeframe needs to be considered based on the groundwork. Feasibility study, consultations with experts, carrying out the design and construction procurement, possible redoing of procurement in case of failure to find suitable tenders, obtaining relevant permits, e.g. environmental, construction etc., and construction/installment time that may be affected by shipping delays, all need allotted time.

4 References

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[3] “Ühisveevärgi ja -kanalisatsiooni seadus,” *RT I 1999, 25, 363*. https://www.riigiteataja.ee/akt/ÜVVKS.

[4] “Keskkonnamõju hindamise ja keskkonnajuhtimissüsteemi seadus,” *RT I, 21.12.2019, 7*. https://www.riigiteataja.ee/akt/116112010013?leiaKehtiv.

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5 Annex

5.1 Haapsalu, Estonia

 Preparing site for installment of the RTC, deepening inflow ditches and removal of the reed in the proximity of the weirwall base	 Weirwall, which real-time control interface (RTC)
 Base for installing smart weirwall	 Weirwall testing
 Automatic precipitation monitoring station on the roof of Haapsalu town government	 Outflow to Haapsalu bay

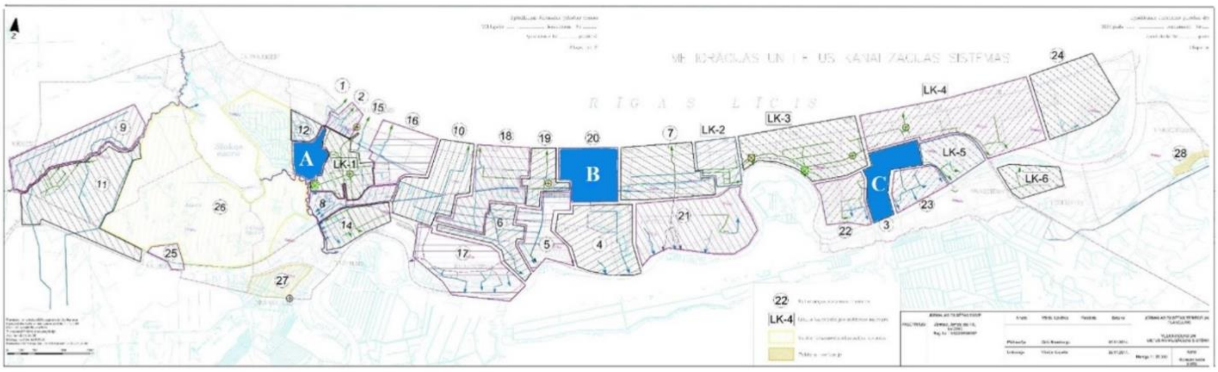
5.2 Rakvere, Estonia

 Location of the weirwall prior to the instalment	 Instalment of new bridge and base for the weirwall

Instalment of the smart weirwall

5.3 Jurmala, Latvia

Jurmala pilot site sections on the map (A, B, C)



Section A

 Jurmala_section A_Kauguri district_installation of automatic sampler with a level sensor in the storm water manhole	 Jurmala_section A_Kauguri district_installation of automatic sampler with a level sensor in the storm water manhole
 Jurmala_section A_Kauguri district_installation of automatic sampler with a level sensor in the storm water manhole	 Jurmala_section A_Kauguri district_installation of local meteostation on the rooftop of sewage pumping station

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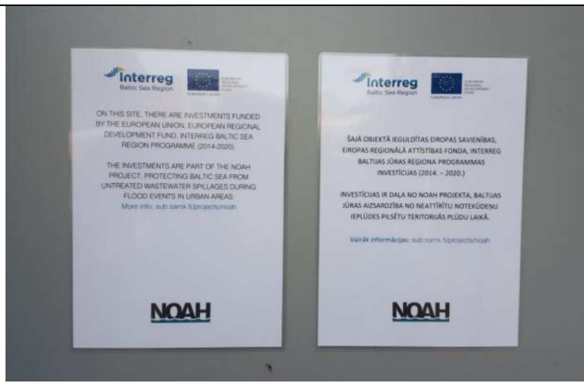
<td>

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Section B

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Jurmala_Project section B_Melluži district_poster of NOAH at Jurmalas udens Ltd sewage pumping station_Upes Street 7</td>
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Section C

 Jurmala_section C_Dzintari district_installation of automatic sampler with a level sensor in the storm water manhole	 Jurmala_section C_Dzintari district_installation of local meteostation on the roof of Jurmalas udens Ltd warehouse

5.4 Liepaja, Latvia

 Installing monitoring equipment	 Installing monitoring equipment

 Installing monitoring equipment	 Installing monitoring equipment

5.5 Ogre, Latvia

 Establishing electric connection for the automatic hydrological stations	 Instalment works

	
Instalment of automatic hydrological stations	Automatic hydrological station water level sensor location in Ogre river ice-blockage