# DEVELOPING LOCAL MANAGEMENT MODELS FOR IMPROVED TREATMENT OF INDUSTRIAL EFFLUENTS

## Final report of BEST GoA 4.1

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BEST Better Efficiency for Industrial Sewage Treatment
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FLAGSHIP

# Contents

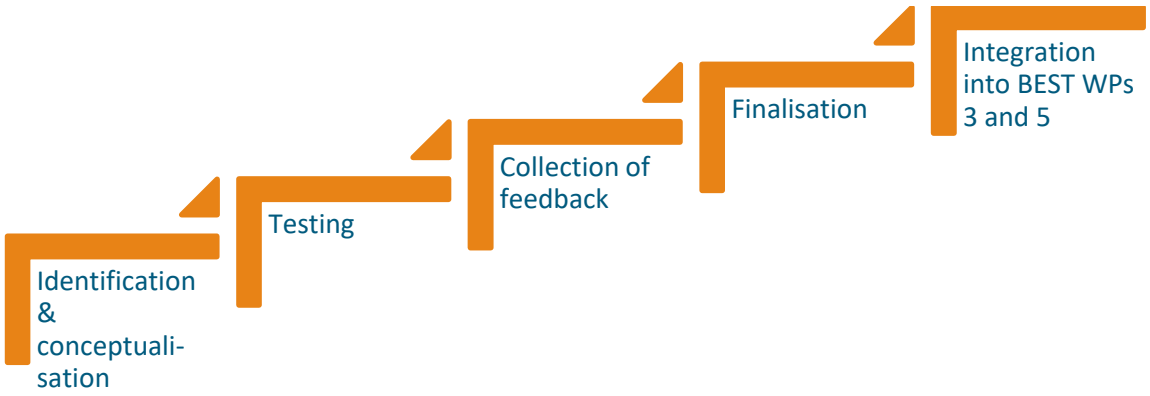
# Introduction

Along with technological developments, the challenges in co-treatment of industrial effluents can be solved by improving practices such as joint planning, communication and cooperation between water utilities, industrial operators, and environmental authorities.

In project BEST, the investing partners were encouraged to test in practice, how, in addition to well-planned and cost-effective technical investments, development of better management and cooperation between stakeholders can contribute to improved treatment of industrial wastewaters. All investing partners - Leszno water utility (PL), Doruchow Commune (PL), Latvijas Piens dairy company (LV), E-Piim dairy company (EE) and Põltsamaa water utility (EE) – participated in the development work and selected the models for testing based on their own circumstances and needs. In addition, two other project partners, namely Riga Technical University (LV) and City of Warsaw (PL), contributed to the development process by their own analyses.

This report summarises the development process in which models were chosen for testing and investing project partners developed their wastewater management in dialogue and cooperation with municipal water utility staff, industrial companies discharging effluents to the municipal WWTP, or local/regional permitting and monitoring authorities. Development ideas were collected in conjunction with project activities such as interviews, workshops and expert presentations in project events, conceptualised, and finalised after testing and comments by partners. Later on, the ideas were also integrated into other BEST deliverables such as GoA 3.1 Toolbox of best practices (i.e. Learning package), 5.1 National and regional guidelines and 5.2 Guidelines for the Baltic Sea Region (Figure 1).

*Figure 1. Process for improving management models*



# Recommended models for testing

The first models for testing were selected based on an ideation session at the Helsinki kick-off event (6-8.2.2018) and consequent interviews of project partners. In total 8 partners/associated partners were interviewed, including HSY, FIWA, EVEL, Leszno, Doruchow, Latvijas Piens, E-Piim and Põltsamaa. The interviewees were presented a list of development ideas and they responded to the following questions:

- From your point of view, what are the main challenges / problems related to industrial sewage treatment?
- Who are the key stakeholders to be involved to find solutions to your challenges / problems?
- Have a look at the cooperation practices and tools referred to at the Helsinki kick-off session. Please indicate
  - If they are / are not currently in use in your organisation
  - If you think they are relevant / irrelevant for your organisation
- Have you come up with good practices (with regard to people, tech or regulatory issues) that you could share with the consortium?

Additional ideation sessions were organised at later project events in 2018-2019. Based on the responses gathered, the main topics of interest to partners were

- Improving knowledge of impacts of industrial wastewaters
- Negotiation of wastewater contracts, evaluation of the need for contracts, updating outdated contracts and interpretation of penalties when exceeding the limit values
- Operating the sewage treatment (need for pretreatment, possibility to track pollutants down to the source, balancing of industrial and municipal wastewater)

Altogether 6 models were selected for testing:

1. Organising educational visits to the WWTP
2. Collecting information (“a cadastre”) of industrial wastewaters
3. Using an excel tool for instructions in emergency situations such as accidental leaks and load peaks
4. Organising regular meetings with industries
5. Organising regular meetings with environmental authorities
6. Publishing of an annual report on industrial wastewaters

## Organizing educational visits to the WWTP

The main goal of educational visits is increasing the understanding of policymakers, industrial operators and service providers (e.g. hospitals, harbours, airports) of WWT process. Such a visit

might start with a lecture or presentation introducing visitors to the wastewater system, followed by a tour on the site.

Most often, industrial partners have no knowledge of how harmful the effects of abnormal industrial wastewater load are to the municipal sewage system. They can disturb the sewer network and/or the wastewater treatment process at the WWTP, and cause health risks for water utility workers. They may also cause increased discharges of nutrients and harmful substances to the receiving watercourse and problems with sludge contamination.

An educational visit could raise industrial partners' motivation to increase cooperation to improve the treatment of wastewaters (e.g. early warnings in abnormal situations can increase the capability of the WWTP to handle discharges).

## Collecting information ("a cadaster") of industrial wastewaters

A cadaster includes information on wastewater sources, wastewater flows and wastewater quality on an industrial operator level. Examples of data include:

- Contact details
- Industry sector and wastewater characteristics
- Water supply, chemical and raw material use
- Wastewater volumes
- Pretreatment method
- Environmental permit (e.g. limits for industrial wastewater quality and quantity)
- Industrial wastewater contract (e.g. limits for industrial wastewater quality and quantity)
- Monitoring plan
- Monitoring results

## Using an excel tool for instructions in emergency situations

Such a tool has been developed by dairy company Valio in Finland. In case of a severe leak, this simple tool in Excel format gives clear instructions for the industrial operator and describes the leak using a terminology understandable for the WWTP operator (e.g. BOD, COD, fats). Based on it, the WWTP operator understands (for instance if the leak is cream or milk), what is the corresponding BOD amount).

As explained more in detail in a Powerpoint presentation on the tool, the industrial operator fills in the substance and estimated volume leaked. The tool evaluates the scale of the leak, based on categories "No problem", "Intermediate problem" and "Emergency".

The tool contains contact details of the officer on duty for the wastewater treatment plant, thanks to which information about the leak can be transmitted immediately. The WWTP officer on duty

receives a prescriptive instruction of conduct adequate to the specific type and volume of leakage.

## Organizing regular meetings with industries

Lack of cooperation between a WWTP and the industry prevents knowledge transfer and can lead to problems in WWT. Annual / biannual cooperation meetings can be used to learn from the past and to jointly plan the future (e.g. aligning of maintenance breaks). A model agenda for these meetings was provided to the BEST investing partners, including e.g. an update on activities since the last meeting and a presentation of future plans. In the model agenda, each meeting ends with checking that contact info for emergency situations is up-to-date and with agreeing on the timing of next meeting.

## Organizing regular meetings with environmental authorities

Lack of cooperation between a WWTP and environmental authority prevents knowledge transfer and may lead to discrepancies in environmental permits and industrial wastewater contracts.

By organising regular meetings with environmental authorities, the WWTP will receive information on legal requirements and possible changes in the regulatory environment. On the other hand, the environmental authority will become more aware of practices and challenges related to the co-treatment of industrial and municipal wastewaters. A model agenda for these meetings was provided to the BEST investing partners, too.

Joint inspections by environmental authorities and WWTP representatives supervising environmental permits and industrial wastewater contracts at an industrial operator save time for all parties.

## Publishing of an annual report on industrial wastewaters

It is advisable for the water utility to publish an annual report on industrial wastewater either as part of annual reporting or as a separate report. The report will improve the transparency of water utility towards its customers.

The report may include information on e.g. trends in industrial loads, network sampling results and industrial wastewater monitoring results, any damages to the WWTP or the sewerage network, and development projects related to industrial wastewater. The WWTP can highlight abnormal discharges to sewage system (discharges, blockages, odors) and also successful measures to reduce industrial loading.

# Testing

## Leszno Water Utility

Leszno Water Utility (LWU) has created **a cadaster** of industrial wastewater producers.

As a first step, LWU created a preliminary list of industries producing wastewater and biodegradable waste based on publicly available sources of information (websites of local authorities, the Voivodship Inspectorate for Environmental Protection, Internet databases of companies, etc.). Initially, there were approximately 100 plants of agri-food sector identified in the Functional Area of the Leszno Agglomeration and its immediate vicinity.

Next, taking into account the size and production profiles, a selection was carried out, based on which approximately 70 entities were chosen and contacted. The selected plants were sent questionnaires to collect information on the specific quantities and characteristics of generated waste. The e-mails were followed by telephone conversations with the representatives of all selected plants.

A number of the surveyed plants expressed their initial interest in establishing cooperation. 13 plants sent back filled questionnaires and declared their readiness to cooperate. These companies have also shown their interest in transferring waste for processing in the sludge digestion system that is planned to be built at the premises of the LWU wastewater treatment plant in Henrykowo.

As a final step, LWU agreed with the selected companies of details concerning transferring of waste and sent letters of intent to them concerning the transfer of waste to be treated in the co-digestion process.

According to LWU the cadaster helps in
- Monitoring the wastewater from industry and commerce
- Providing easy access to the contact data
- Analyzing industrial wastewater quality and volumes
- Getting full information about pretreatment

The LWU also planned to start a series of **educational visits** at the WWTP, but the COVID-19 pandemic delayed the start of the programme, which will start after pandemic.

In 2019, LWU began **regular meetings** with one of the largest wastewater suppliers - Agro-Rydzyna meat processing plant. Meetings are more often held at the level of technical operators of both companies. Boards meet irregularly - on average, biannually.

## Doruchow Commune

In its development work, Doruchów focused on **improving cooperation** with its industrial partners. There are 3 industrial plants delivering wastewater to the municipal WWTP in Doruchów: a meat processing plant, a cattle slaughterhouse and a poultry slaughterhouse. The amount and load of industrial wastewater delivered to the WWTP cause periodic problems with obtaining adequate levels of phosphorus and nitrogen in the treated wastewater:

- Meat processing plant is the largest industrial wastewater supplier to the Doruchów WWTP. It delivers wastewater by a truck tanker with a capacity of 10m$^3$, which means that significant amount of wastewater is discharged to the WWTP operating as a flow-through installation. The wastewater from meat processing contains a lot of fats and dissolved compounds. Within a few hours, the plant can deliver numerous transports, which causes a disturbance of the biological treatment process and a problem with obtaining adequate parameters of wastewater quality.
- The cattle slaughterhouse carries out slaughter several times a month. Technology used in the process does not require washing half-carcases with water. The plant has a system for recovering blood from slaughtered cattle. That's why amount of wastewater is relatively low. Wastewater is delivered by a truck tanker. Due to the small scale of production, this particular business is not able to build a sewage pretreatment plant, nor is there a significant impact to the municipal WWTP caused by the cattle slaughterhouse.
- The poultry slaughterhouse is directly connected to the Doruchów municipality sewage network. At present, the outcoming wastewater reaches WWTP mixed with household wastewater. What is more, the owner's private property is located on the plant's premises, where household sewage is produced as well. The plant only slaughters poultry. No other processing activities are carried out. The plant is currently constructing an industrial wastewater pretreatment plant.

Steps taken by Doruchów municipality to solve problems in cooperation with industrial partners:

- Defining problems occurring at the WWTP,
- Locating the sources of problems,
- Analysis of the situation directly at the premises, together with the designers of the new pre-treatment installation,
- Individual consultations with the industrial partners,
- Proposals for problem solution by the Municipal Authority,
- Proposal acceptance by the owners,
- Implementation of the proposed solutions,
- Evaluation of the effect achieved.

Cooperation models developed:

- With meat processing plant: Due to the large amount of wastewater delivered in a short time, **the distribution of delivery** was agreed at different intervals. In addition, an

**emergency tank** was built in the industrial part of the WWTP, eliminating the negative effects of sudden sewage discharges, thanks to which municipal WWTP will be evenly operated. It was agreed that in the event of a breakdown or uneven operation of the WWTP, the Municipality would **notify** the plant staff, that it would **suspend the delivery of sewage** for some time until the problems were resolved. In addition, it was agreed that the industrial partner would be **financially charged in proportion to the load in the sewage** delivered.

- With cattle slaughterhouse: The owner of the plant was informed about the need to build a **pretreatment plant** at the slaughterhouse. The proposal did not meet the consent and approval of the owner. Due to the scale of slaughter, the owner expressed the opinion that he is not able to build such a pretreatment plant. It was agreed with the owner that if raw wastewater is delivered, he will pay a proportionally **higher rate** than other industrial wastewater suppliers, which have operational pretreatment plants. The design assumptions of the municipal WWTP indicate that the reconstructed treatment plant is able to handle such wastewater loads. The proposal of the Municipality is to introduce **a schedule of transferred wastewater loads**. The slaughterhouse owner has built large **transitional tanks** and is ready to deliver sewage according to the schedule indicated by the Municipal Authorities. It was agreed that in the event of a breakdown or uneven operation of the WWTP, Municipality would **notify** the slaughterhouse staff that it would **suspend the delivery of sewage** for some time until the problems were resolved.
- Poultry slaughterhouse: Due to the direct connection between the slaughterhouse and the municipal sewage network, **several meetings and on-site visits** were carried out with the owner. The Doruchów Municipality proposed to separate industrial and household wastewater by building **a new municipal sewage connection**. **An additional sewage connection for industrial wastewater collection** will be built by the Municipality, in which the valve will be synchronized with the work of valves in the municipal WWTP, and additionally the owner declares that he **synchronizes** the work of his pre-treatment plant with the municipal WWTP. The construction of the new connection will allow for 24-hour collection of household wastewater from the private household property located on the premises of the industrial plant. In addition, it was proposed that the plant will be **financially charged in proportion to the load in the wastewater**. The plant will deliver industrial wastewater in a **set schedule** at night time, so that the industrial wastewater goes to the treatment line without mixing it with the household wastewater.

## Latvijas Piens

Latvijas Piens is a milk processing company with an average production volume of 250 tons of milk per day. The company's activity in Latvia is focused on making of cheese and industrial dairy products. In the context of BEST project, Latvijas Piens pilot investment will improve the quality of

wastewater discharged to the WWTP in Jelgava, owned by municipal water utility Jelgavas Ūdens. In addition, the company has made use of educational visits and regular meetings as described below.

**Educational visits** of the Latvijas Piens engineers and technologists to municipal WWTP took place regularly before the implementation of the BEST project. In this case, it can be concluded that the knowledge of treatment processes among specialists of Latvijas Piens is fully satisfactory, therefore communication between the two companies is based on a full mutual understanding of the technical issues of the other party.

**Meetings** between representatives of Latvijas Piens and Jelgavas Ūdens are held regularly. The accession of Latvijas Piens to the BEST project was the result of these meetings, during which the problems that Latvijas Piens wastewaters create to municipal WWTP, a specific goal containing the target quality of industrial wastewater, and a technical way to achieve this, were defined.

To achieve the target quality of industrial wastewater delivered to municipal WWTP, Latvijas Piens has constructed a pretreatment plant, by including part of it in the pilot programme of the project BEST, and by investing its own financial resources (more than 80% of total costs of the new plant). A functioning pretreatment installation will improve cooperation between Latvijas Piens and Jelgavas Ūdens, because the industrial wastewater will stop creating problems for the municipal WWTP.

Latvijas Piens used the pandemic time to improve internal processes. **An additional tank** was installed to collect milk and whey residue. In this way, COD was reduced by half. This result is still present in the weekly results of the sample analysis.

## Põltsamaa water utility

In the context of project BEST, Põltsamaa water utility studied the **quality of wastewater** in its wastewater collection area, focusing in particular on hazardous substances (Estonian Environmental Research Centre 2020).

Põltsamaa is a town in Jõgeva county in Estonia with a population of about 4,000 people. The size of the catchment area of Põltsamaa is 436.7 hectares and the pollution load is 22,330 population equivalents (PE). The Põltsamaa River divides the town into East and West bank parts. There are predominantly smaller households on the West bank, while on the East bank most of the businesses and enterprises are located, as well as larger apartment buildings. There are 15 companies in the Põltsamaa wastewater collection area whose wastewater, based on the field of activity, may potentially contain hazardous substances or substances that inhibit the treatment process. Five companies operate on an industrial scale (2 food industries, 2 metal industries and a wood

industry).

The two largest industrial customers of the WWTP provide on average 65% of the wastewater that reaches the treatment plant. The remaining 35% is rather domestic in properties (includes both domestic wastewater from households and wastewater from other companies in the town). These food companies account for almost 90% of the carbon load, 32% of the nitrogen load and 21% of the phosphorus load. Most of the nitrogen and phosphorus load originates from other sources in the town. The wastewater is treated in the Põltsamaa municipal WWTP. The municipal WWTP has also its balancing tank to protect biological treatment process from shock loads and to achieve more stable inflow. The wastewater treatment plant is doing well at removing nutrients, the efficiency in total phosphorus removal being 97,5% and that of total nitrogen 98,1%.

**Most relevant industries in Põltsamaa:**

| | **Field of activity** | **Average wastewater volume ($m^3$/d)** |
|---|---|---|
| **Industry 1** | Manufacturer of milled beams for garden houses and glulam, deep impregnated garden products, and heating pellets | 1.8 |
| **Industry 2** | Manufacturer of electric motors (including manual and robotic welding, CNC machining, surface treatment and final assembly) | 2.8 |
| **Industry 3** | Food industry | 321.3 |
| **Industry 4** | Dairy industry (E-Piim) | 469.9 |
| **Industry 5** | Manufacturer of stainless steel and metal products | 1.9 |
| **Industry 6** | Manufacturer of glued window blanks for windows and doors | 5.7 |

In early 2020, in total 72 substances were monitored in both the influent and effluent of the Põltsamaa WWTP. According to monitoring results, the concentrations of all the tested hazardous substances were below the detection limit in all industrial wastewater samples. Thus the limit values for hazardous substances were not exceeded during the study period. This may be partly thanks to the fact that all Põltsamaa customers have service contracts which contain conditions for usage of public sewer system and quality standards for wastewater.

At the WWTP, some samples contained nonyphenols, indicating that they occasionally enter the wastewater treatment plant, probably from the metal industry. It was recommended that Põltsamaa water utility consults the two largest metal industry companies to make sure they have brought their activities in line with REACH principles.

## E-Piim and Põltsamaa water utility

Dairy company E-Piim has already invested in a pretreatment facility involving a flotation process. In order to further optimise the treatment process at the WWTP, the company is in the process of taking into use a regulation tank.

In order to increase mutual understanding, E-Piim and and Põltsamaa WWTP representatives have held **regular meetings**. The troubleshooting steps taken by the municipal WWTP in cooperation with industrial partners and municipal authority include

- Defining the problems created by industrial wastewater for the municipal WWTP,
- Individual consultations with industrial partners,
- Support for the municipal WWTP activities by the municipality,
- Implementation of the proposed solutions,
- Evaluation of the effects achieved during regular meetings between municipal WWTP and industrial partners.

At present, the Guidelines for the Use of Põltsamaa's Public Water Supply and Sewerage System contain the framework for usage of Põltsamaa public sewer system for E-Piim. The food industry delivers its industrial wastewater to the municipal sewer system according to the contract conditions.

Although conditions in industrial contracts do not include obligation for pre-treatment and balancing of wastewater flows, today it has been achieved by combination of tax system, that is based on the contaminant concentrations in the wastewater and mutual co-operation. For the industry, this economic incentive encourages avoiding or reducing harmful discharges into the sewer.

## Development work by RTU

Riga Technical University (RTU) studied industrial wastewater management in Adaži wastewater treatment plant in Latvia and thereby elaborated Models 2 Collecting information (“a cadastre”) of industrial wastewaters and 5 Organising regular meetings with industries.

The WWTP receives wastewater from several industrial operators (fish, chips, and vegetables processing factories), and a public catering place. The aim of RTU was to improve risk management

of the municipal WWTP by (1) determining the main factors (technological and chemical) that can affect the operation of municipal wastewater treatment plant in Adaži and (2) developing recommendations for both industrial operators and the WWTP on how to improve the industrial wastewater management scheme. Results obtained at the BEST partner "Latvijas Piens" (dairy production facility) were also considered in the development work.

The work included the following steps:

1. Collection of information about the WWTP efficiency and failures;
2. Collection of information about the pre-treatment technologies of industries, their efficiency, and failures;
3. Development of a wastewater monitoring programme for each operator aimed at technological process problem identification;
4. Wastewater sampling, analysis, and data processing;
5. A process risk assessment and development of recommendations.

These steps are explained more in detail in RTU report "Industrial wastewater management models in Adaži wastewater treatment plant, Latvia" (Riga Technical University 2020).

As a result, RTU determined the main factors (technological and chemical) that can affect the operation of the municipal wastewater treatment plant in Adaži. These derive from

- the composition of industrial wastewater
- operation of the local pre-treatment systems
- failures in the monitoring system and
- inhibitors that can affect the wastewater treatment process at the municipal WWTP.

RTU determined both occurring risk factors and the frequency of their occurrence. In total, 18 failures or risks in total were identified and evaluated (See also the Table below):

1. The main **qualitative risk** for the municipal WWTP relates to the high concentration of chemical contaminants in industrial wastewater. Almost all failures were on acceptable levels except for the dairy factory, which significantly exceeded the permissible limits. The possibility of occurrence of this risk was rated as medium and significant due to the lack of appropriate pre-treatment technologies at the dairy factory.
2. The **technological risks** relate to the response of staff and relevant services. Proper functioning of the pre-treatment system has a significant effect on the sewage system. The identified failures may lead to disruption of municipal WWTP. The fixed technological failures such as a fat catcher, clogging of the settler, or disruption of biological pre-treatment were evaluated as low or medium taking into account response from the staff and concentration of contaminants in wastewater samples after dilution in the sewage system. Risks may arise as these events require a regular response from the staff. To remove these risks, a professional operator and regular technological service are necessary.

3. The **financial risk** is evaluated as significant due to its effect on wastewater quality, sewage system operation, and discharges to the environment. One failure was related to an operational mistake at an industrial operator and delay in the response from the staff. To reduce these risks, the funding for appropriate technology and a regular response from the staff are necessary.

**Table: Identified failures or risks**

| Nr. | Factory | Days of monitoring | Failure description | Numbers of occurrences | Effect on MWWTP[1] |
|---|---|---|---|---|---|
| 1 | A | 5 | Tot N too high | 4 | low |
| 2 | | | Tot P too high | 4 | low |
| 3 | | | High pH level | 2 | low |
| 4 | | | Salt concentration too high | 1 | medium |
| 5 | | | Fat catcher clogging | 1 | low |
| 6 | B | 5 | Oil emission into the sewage | 1 | significant |
| 7 | | | Salt concentration too high | 4 | low |
| 8 | | | Fat catcher clogging | 1 | low |
| 9 | | | Failure of the biological treatment process | 2 | low |
| 10 | C | 4 | Fat catcher clogging | 3 | medium |
| 11 | | | COD and $BOD_5$ too high | 2 | low |
| 12 | D | 4 | Settler clogging | 2 | low |
| 13 | | | COD and $BOD_5$ too high | 1 | low |
| 14 | E | 12 | Fat emission into the sewage | 12 | significant |
| 15 | | | Salt concentration too high | 2 | significant |
| 16 | | | Tot N too high | 12 | medium |
| 17 | | | Tot P too high | 12 | medium |
| 18 | | | COD and $BOD_5$ too high | 12 | significant |

[1]Effect on municipal WWTP is calculated as the ratio between produced WW amount and total WW amount received by MWWTP and comparison of the obtained value with legislation or literature data: low - concentration complies with legalisation rules or literature data; medium - concentration after dilution in the sewage system complies with legalisation rules or literature data; significant – contamination affect process of MWWTP.

4 of the detected risks were evaluated as significant and they resulted from the lack of pre-treatment technology and an operational mistake at the factory. 4 technological risks were evaluated as medium and 10 qualitative risks as low.

The recommendations for both industrial operators and the municipality on how to improve the industrial wastewater management scheme are the following:

1. regular communication between operators at factories and municipal WWTP to increase knowledge about the real situation at the wastewater discharge point (at factories) and at

the WWTP;
2. fair transfer of information about technological processing or failures;
3. attracting professional operators for work;
4. regular training for employees.

All the study participants have an interest in future cooperation to minimise the risks observed. Workshops for representatives from both industries and municipalities were planned but unfortunately cancelled due to Covid-19. The aim is to organise them later, though.

In addition, dissemination activities are necessary to increase knowledge about new technologies and processes in the wastewater sector, and as a result, increase interest and opportunities for putting appropriate technologies into operation.

## Development work by City of Warsaw

A study ordered by the City of Warsaw mainly touches upon Model 2 Collecting information ("a cadastre") of industrial wastewaters. The report "The characteristics of industrial waste water conveyance and treatment systems in the operation area of Miejskie Przedsiębiorstwo Wodociągów I Kanalizacji m.st. Warszawy S.A." (Maśliński 2019) summarises the regulation on industrial wastewaters in Poland and evaluates the industrial wastewater conveyance and treatment system operated by the municipal water and sewage management company in Warsaw (MPWiK). The report is available both in Polish and in English.

Part 1 of the report includes a detailed description of the legal framework, institutions involved, obligations of entities generating industrial wastewater, conditions for releasing industrial wastewater into the sewer network and principles for controlling industrial wastewater quality. The main conclusions include that wastewater management companies have a key role in the supervision of entities discharging industrial wastewater into the sewer systems. Supervision powers of Environmental Protection Inspectorate bodies and Wody Polskie are generally related to any direct impact on, or risk to, the environment. As a result, it is the entity receiving industrial wastewater that has the primary responsibility for supervising industrial wastewater suppliers.

In Part 2, an analysis of industries conveying wastewater to MPWiK WWTPs is carried out by combining various data sources. Industrial wastewater is found to mainly derive from the following sectors: accommodation and food services, manufacturing (e.g. chemical and pharmaceutical plants) and wholesale and retail trade; repair of motor vehicles and motorcycles. Activities within these sections represent almost 75% of industrial wastewater suppliers in the area covered by MPWiK's services. On average industrial wastewater in Warsaw is estimated to account for 9% of all the wastewater reaching the treatment plants and it is not considered as a serious burden for

the system.

Particular attention was paid to industrial plants not connected to the network but storing their wastewater in septic tanks and delivering it to MPWiK through septage receiving stations. Here it is suspected that some entities declare the discharge of domestic or municipal wastewater despite the fact that they actually supply industrial wastewater. Additionally, some companies are suspected of mixing domestic and industrial wastewater in a single vacuum truck, which is forbidden. The issue is complicated by the fact that out of 7 septage receiving stations 5 are managed by other entities than MPWiK. MPWiK has direct control over liquid waste transported to only two receiving stations. The share of industrial waste is only a few percent in the total amount of liquid waste, however.

The conclusions include

- Regulation of industrial wastewater is complex and fragmented. Consequently, a number of industrial wastewater producers may not have sufficient knowledge in this regard.
- MPWiK's current investments reduce risks for diversion of storm waters and entry of domestic and industrial wastewater into the environment. There is a risk, however, that rainwater washes pollutants from industrial areas to the sewer.
- On-site inspections and wastewater sampling by MPWiK work well as a preventive measure: despite the constant number of inspections in recent years, the cumulative amount of contractual penalties charged has decreased significantly.
    - Wody Polskie has found few violations of water permits, which is alarming.
- Some doubts are raised by the actual stream of industrial liquid waste transported to septage receiving stations with vacuum trucks.
- MPWiK is advised to provide more information on the procedure of connecting industrial wastewater suppliers and make industrial wastewater suppliers more aware of their duties associated with discharging this type of wastewater to the MPWiK sewage system.
- In addition, MPWiK and industrial wastewater suppliers are encouraged to
    - exchange experiences on pre-treatment in order to improve the quality of the discharged wastewater
    - consider the gradual automation of industrial wastewater quality control directly at suppliers' premises.
    - establish ongoing cooperation with bodies having in place separate tools for supervising industrial wastewater suppliers, in particular WIOŚ and Wody Polskie. Such cooperation can contribute to determining the potential group of entities violating environmental requirements related to industrial wastewater discharge. Furthermore, it is also recommended to establish closer cooperation with the Waste Management Department for a better identification of septic tanks in which industrial liquid waste is collected.

# Conclusions

## Feedback and modifications made

The cooperation models and development ideas presented by RTU and City of Warsaw were tested by investing partners and discussed in project events in Riga and Kaliningrad.

Unfortunately, the implementation of **educational visits** suffered from the COVID-19 pandemic. It had earlier been tested by Latvijas Piens and Jelgava Water Utility, however, and found to increase the understanding of industrial parties on municipal wastewater treatment. Therefore, the idea of educational visits of industry representatives and local government officials to the WWTP is highly recommended, as the level of knowledge about the processes taking place in the municipal WWTP and the impact of industrial wastewater on these processes is very low. Practice shows that increasing the understanding (by managers of industrial businesses) of the processes taking place in municipal WWTP has a positive impact on making decisions (e.g. timing of delivery of wastewater flows, washing machines and using detergents), taking into account the needs of municipal WWTP.

Most partners were interested in improving their **knowledge of the origin and quality of industrial wastewaters**. They systematically reviewed the industrial sources and utilised various information sources to focus activities on the most relevant sources. E.g.

- LWU created a cadaster of industrial wastewaters and made contacts with 70 largest industrial plants, collecting information on e.g. wastewater quality.
- By analysing contracts, sectoral statistics, and water permits, MPWiK increased their understanding of sources of industrial wastewater. For example, MPWiK identified 110 - 130 entities that have a water law permit for the discharge of industrial wastewater containing substances particularly harmful to the aquatic environment to the sewage systems owned by MPWiK.
- Põltsamaa water utility carried out an analysis of wastewater quality in its area, focusing on hazardous substances. The industrial wastewaters met all limit values, but at the WWTP, some samples contained nonyphenols. It was recommended that Põltsamaa water utility consults the two largest metal industry companies to make sure they have brought their activities in line with REACH principles.

The industry is afraid of **meetings with the municipal WWTP and local authorities**, because they do not treat them as partners but as institutions, imposing penalties for infringements. Industrial companies and municipal WWTPs expect environmental authorities to be partners to support cooperation, not just institutions that impose fines. This may require changes to the legal regulations.

Despite of this, project BEST encouraged **information exchange** between investing project partners and their main stakeholders. The project partners considered increasing cooperation between water utilities and industrial companies as beneficial and offering opportunities for risk prevention and joint planning of technical improvements.

- LWU initiated regular meetings with a major wastewater supplier (a meat processing plant).
- Doruchów Community has only 3 suppliers of industrial wastewater and developed individual solutions for solving problems related to their wastewaters.
- Latvijas Piens already had earlier experience with regular meetings with Jelgava Water Utility.
- According to RTU, the Adaži WWTP and surrounding industries have an interest in future cooperation to minimise the risks observed. Workshops for representatives from both industries and municipalities were planned but unfortunately cancelled due to COVID-19.
- MPWiK was encouraged to increase cooperation with industrial operators. They could offer more information for the industry and make industrial wastewater suppliers more aware of their duties associated with discharging this type of wastewater to the MPWiK sewage system.
- E-Piim staff says that thanks to regular meetings between representatives of E-Piim and Põltsamaa WWTP, they now fully understand the treatment processes.

Increasing cooperation between water utilities and environmental authorities can also support water utilities in contract negotiations and be valuable from the compliance point of view. This option was less studied by the partners, but MPWiK was encouraged to increase cooperation with supervising and municipal authorities e.g. by considering the idea of a septic tank register.

Overall, the topic of risk management was emphasised, and it was consequently raised up in the Guidelines for the Management of Industrial Wastewaters produced by project BEST (AFRY 2020).

- In the RTU study, the significant risks resulted from the lack of pre-treatment technology and an operational mistake at the factory.
- Based on the City of Warsaw study, MPWiK can consider measures to mitigate the observed risks. The measures include e.g.
    - Special supervision of intermediaries conveying wastewater from several companies into the MPWiK network, and
    - Improving the management of septage receiving stations, e.g. by developing the tanks register currently kept by the city districts and by automated quality control which enables blocking the discharge of the liquid waste.

## Inclusion of models in BEST WP3 Toolbox, WP5 Guidelines, and WP5 National annexes

Models 1-5 were included in the WP3 Toolbox (see https://bestbalticproject.eu/outputs/toolbox/).

The main topics of concern as well as possible solutions and other observations from the development of local management models were incorporated in the WP5 Guidelines document (AFRY 2020), which now includes separate chapters for

- Guidelines for legislative and institutional developments
- Guidelines for the co-treatment and pretreatment of industrial wastewaters
- Guidelines for industrial wastewater contracts
- Guidelines for cooperation

All in all, the guidelines tackle the theme of cooperation from many points of view (e.g. legal, technical, contractual and financial).

Thematically, the work on management models contributed to e.g.

- Adding *Annex 1 on Examples of substances to be investigated in industrial wastewater* to improve knowledge of impacts of industrial wastewaters
- Including *Chapter 4 on industrial wastewater contracts* and adding subchapters *Mapping out sources of industrial wastewater* and *Calculation of an increased wastewater fee*
- Devoting *Chapter 5* on cooperation issues only
- Highlighting the principle that WWTPs should be heard about limit values in the permitting process of industries

in the WP5 Guidelines.

RTU's findings were incorporated into the WP5 Guidelines by adding a subchapter on Risk management and preventing measures, and into the WP5 Latvian national annex by including in action points topics such as establishing cooperation and training of WWTP personnel.

The findings on MPWiK by City of Warsaw were incorporated into the WP5 Polish national annex by including themes "Clarification of regulation" and "Industrial liquid waste transports by vacuum trucks" in the action points. Moreover, the questions of sampling, automated wastewater quality control and cooperation and transparency issues were included in the WP5 Guidelines.

# References

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