

Flow optimization of pump stations

Växjö municipality offers a 30 credits master thesis for one or two students. The issue is flow optimization for sewage water by control of three pump stations.

Background

Sewage pipes are sealed when they are new. However, after decades in the ground they start to leak. Groundwater and rainwater penetrate the pipes and increase the flow of water processed at the sewage treatment plant. The flow is especially increased during intense rains.

The main sewage treatment plant in Växjö, Sundet, is mainly served by two parallel $\text{\O}600$ mm pipes. The pipes originate from the old main pump station. Later a second pump station, Våtmarken, was built and connected to the same pipes along the way to the sewage treatment plant, see Figure 1. The Våtmarken pump station increases the total flow but also counteract the main pump station due to an increased static pressure whenever it is running. Field tests have shown that the capacity in the main pump station goes down when the pump station Våtmarken is operated at too high motor speeds.

It is important to achieve the highest possible flow of sewage water to the sewage treatment plant during intense rains. The reason is that the abundance is released untreated into the nearby lakes.

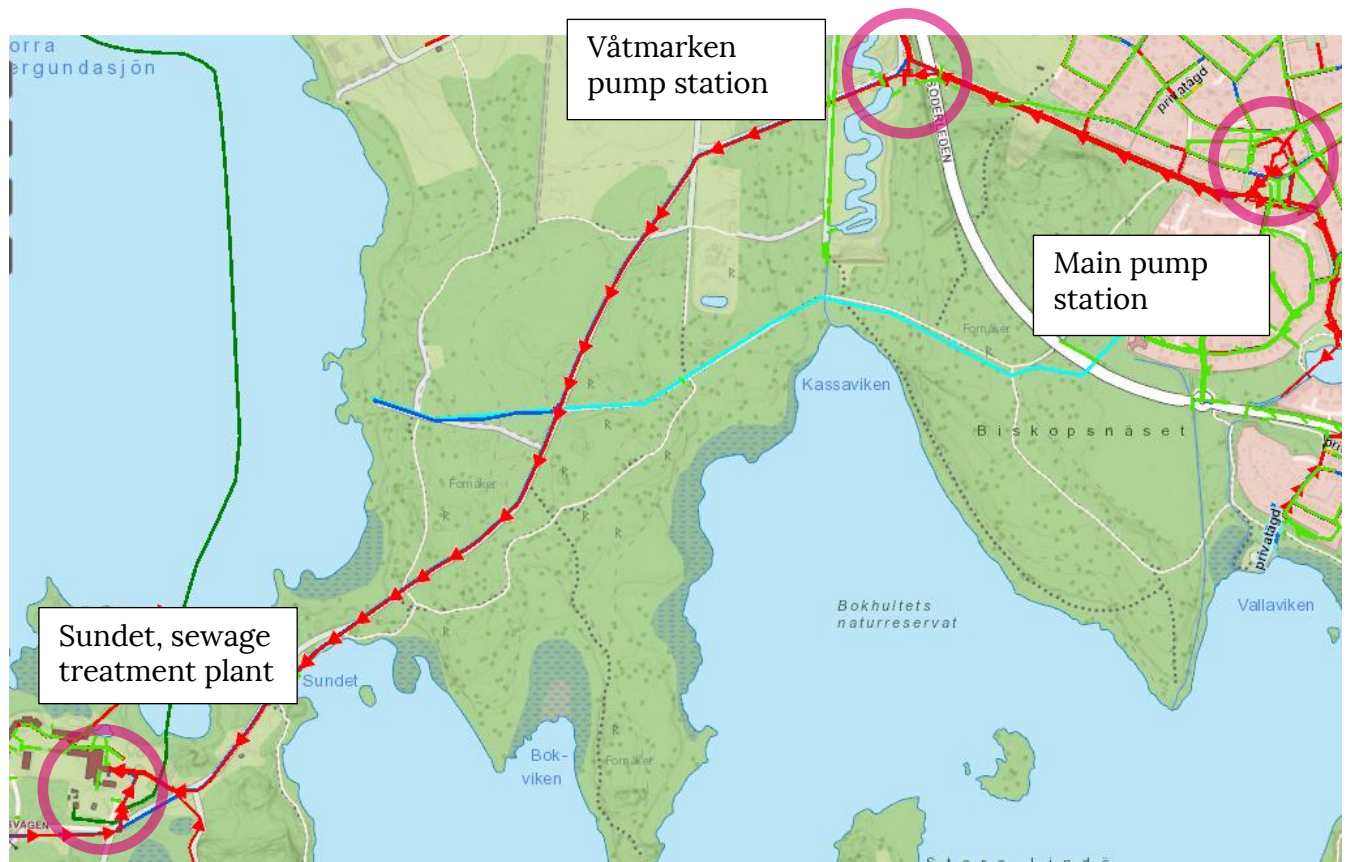


Figure 1. The pump stations and the sewage treatment plant.

To add a further dimension a new distress pump station has been built which increases the possibilities to distribute the sewage water to either the main pump station or the Våtmarken pump station, see Figure 2.

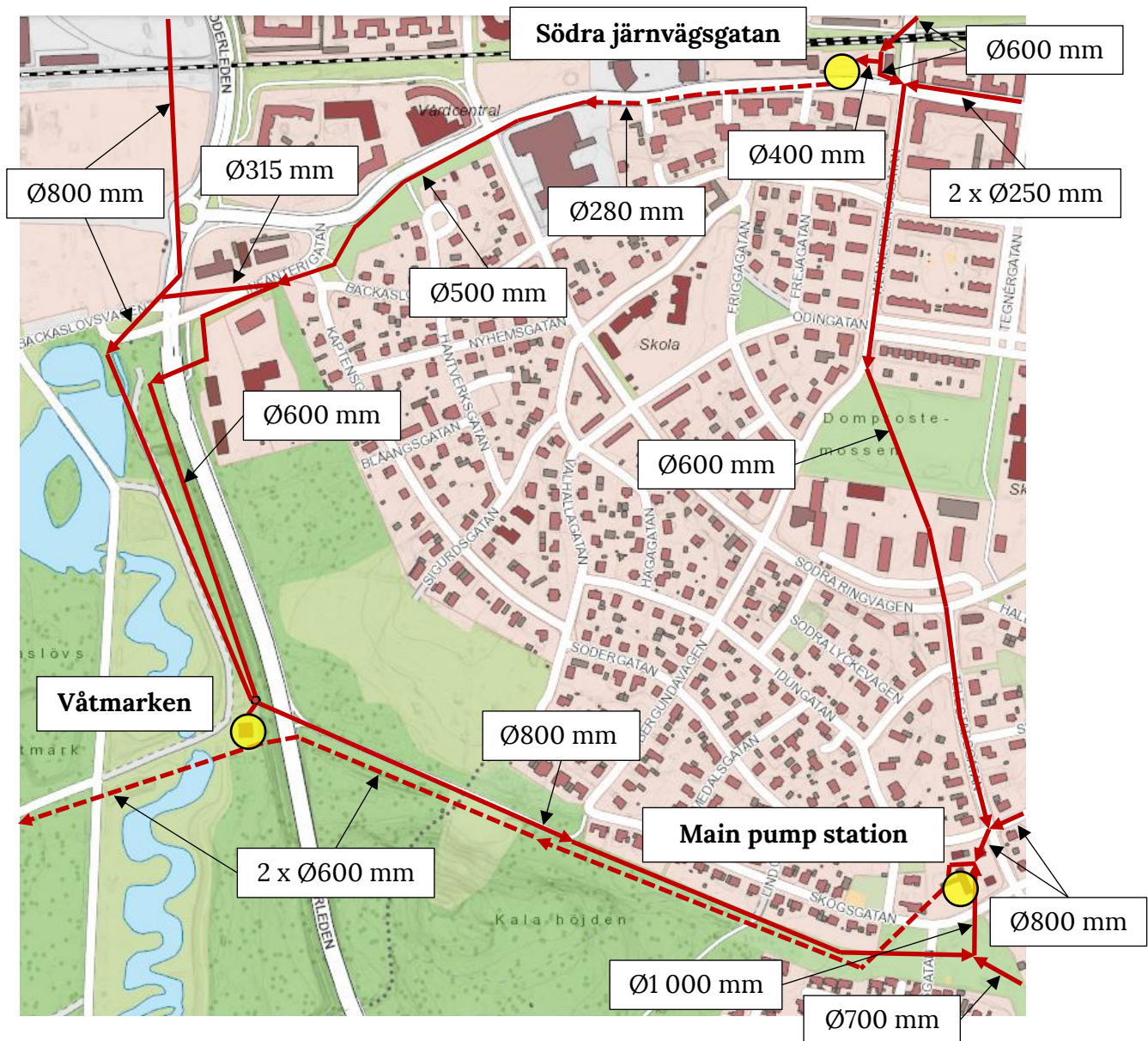


Figure 2. Pump stations. Dashed lines are pressurized pipes while solid lines are the sewerage collection pipes (flow driven by gravity).

There are two or more pumps in each pump station.

The incoming and outgoing flows to the pump stations are known since there are flow meters installed on all major pipes.

Proposal for master thesis

Växjö municipality would like to simulate different high-flow scenarios in order to optimize the flow to the sewage treatment plant. This includes co-driving of all three pump stations; the main pump station, Våtmarken and Södra Järnvägsgatan.

The aim is to develop a control strategy for the pumps in the different pump stations. This control strategy is going to be based on the incoming flows, in order to reach the maximum flow which can be transported to the sewage treatment plant. Pressure drops as well as pump curves and motor powers must be taken into consideration when investigating the maximum flow.

Student background

This master thesis is suitable for one or two students and should be possible to carry out within 30 credits.

An adequate student background could be:

- Master of science in mechanical engineering, industrial engineering, applied physics, applied mathematics or similar.
- Master program in mathematics.
- Something similar to the above proposals.

It is preferable that the student can set up an optimization model, a simulation model or both with many variable parameters.

Knowledge in fluid dynamics related to flows, pressure drops and pump curves is preferable but not necessary. The required basic knowledge can easily be explained as an introduction to the thesis work. The desired background knowledge is more focused on optimization and/or simulation.

Language

The master thesis can be written in English or Swedish. It is of great advantage if English speaking students can utilize a little written Swedish since the municipality mainly uses Swedish.

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Start date

The start date is flexible.

Location

The master thesis can be carried out remotely. However, it could be good with a few visits to Växjö.

Contact

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