# Stormwater management from an integrated hydrological perspective –

## a modeling study from Vänersborg, Sweden using MIKE URBAN and MIKE SHE

Maria Roldin, Lars-Göran Gustafsson & Cecilia Wennberg, DHI

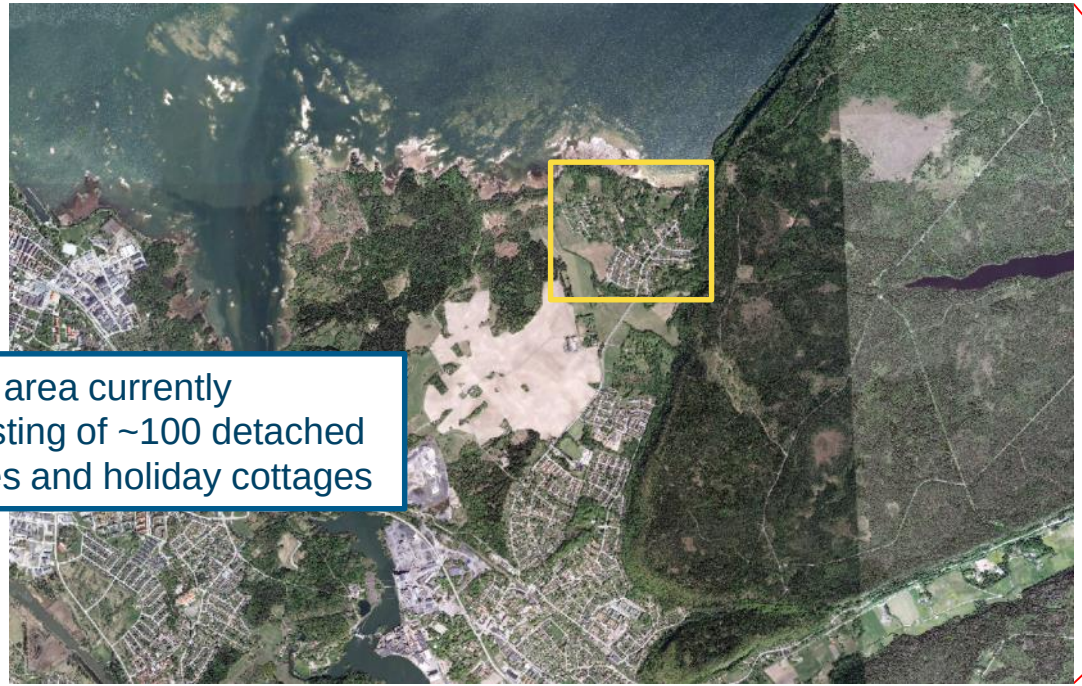
Anders Dahlberg, Vänersborg Municipality

# Contents

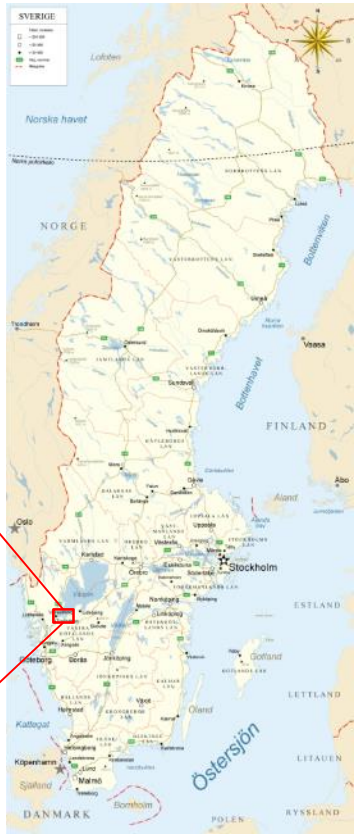
- Description of the development area
- Purpose of study
- Methodology
- Results
- Conclusions

# Development area

- Nordkroken in Vänersborg municipality, Sweden



36 ha area currently consisting of ~100 detached houses and holiday cottages

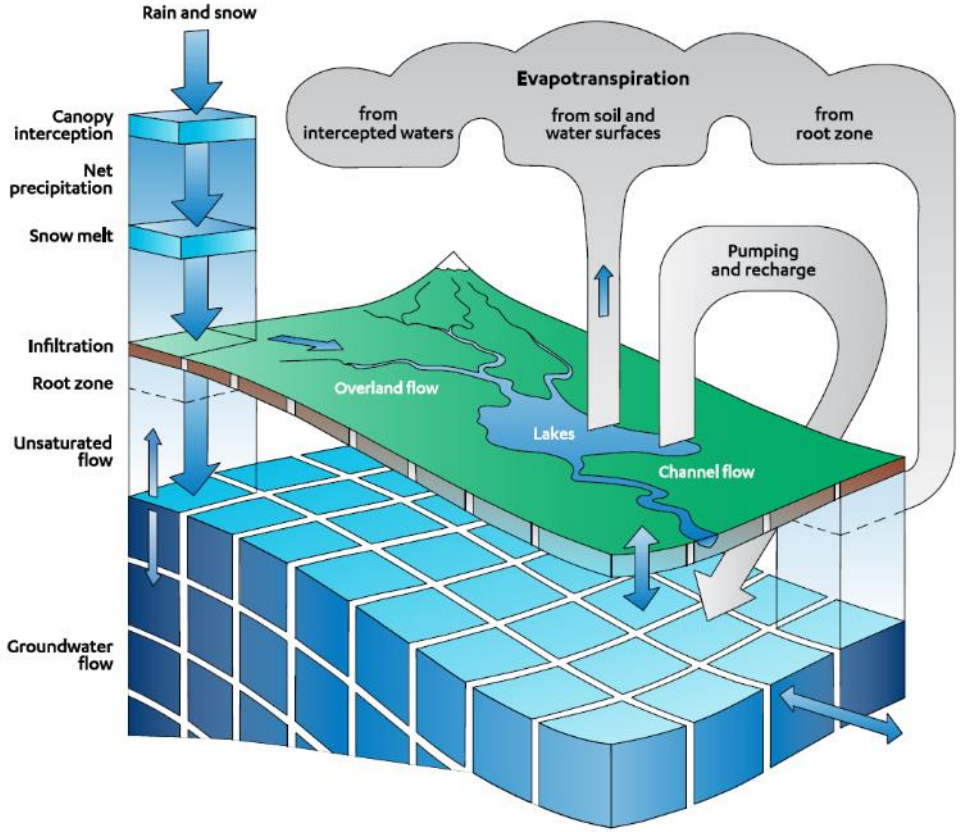


# Purpose of study

- Design a sustainable stormwater drainage system for Nordkroken
- Semi-urban / rural area where stormwater is closely linked to natural hydrology
  - Surface waters (watercourse, lake)
  - High groundwater levels
  - Runoff from both pervious and impervious areas
  - Major inflows from upstream areas
- AIM: develop methodology to design and test a sustainable stormwater management system for both existing and future developments

# Methodology

- Stormwater cannot be treated as a separate issue due to the hydrologic conditions at the site
- Close interaction between groundwater, surface water and stormwater.
- Modeling concept needs to include the above components!



# The MIKE URBAN – MIKE SHE modeling concept

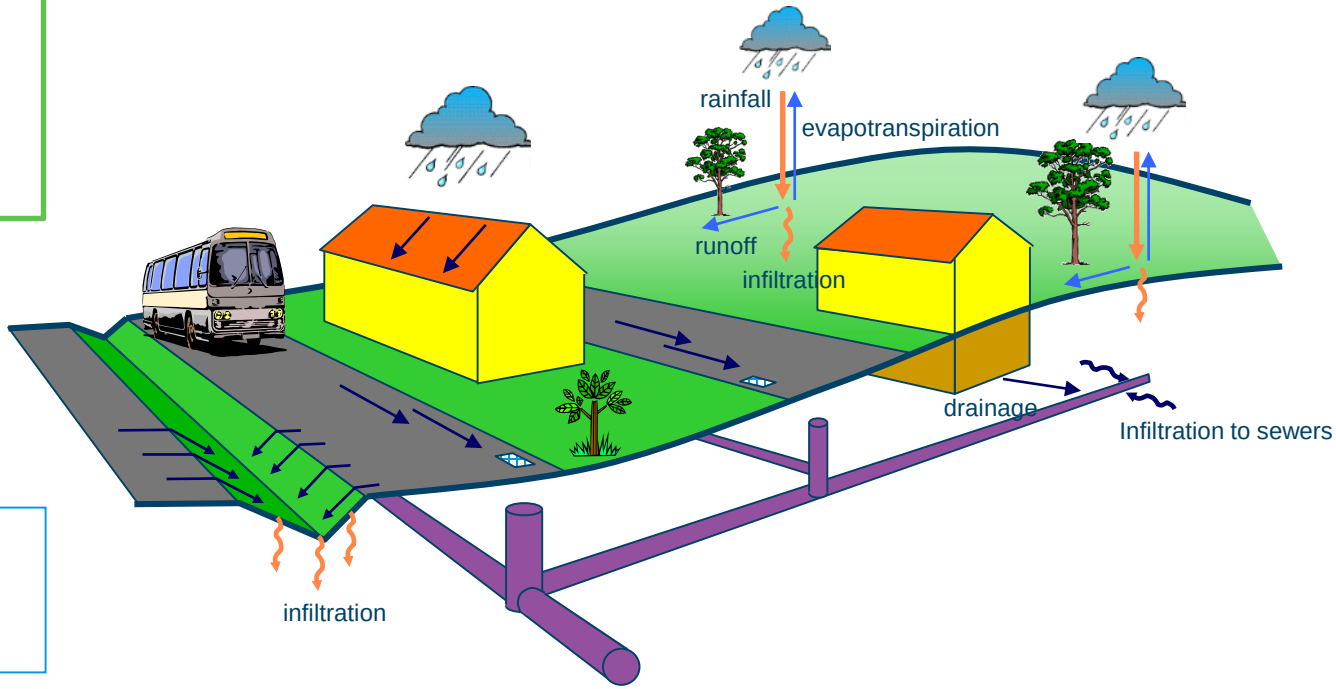
## MIKE SHE

- Runoff from pervious areas
- Surface water, infiltration, groundwater
- Evapotranspiration, snow melt, etc

- Base flow in ditches
- Infiltration to/from pipes and ditches
- Drainage from buildings
- Surface runoff and flooding to/from sewer network

## MIKE URBAN

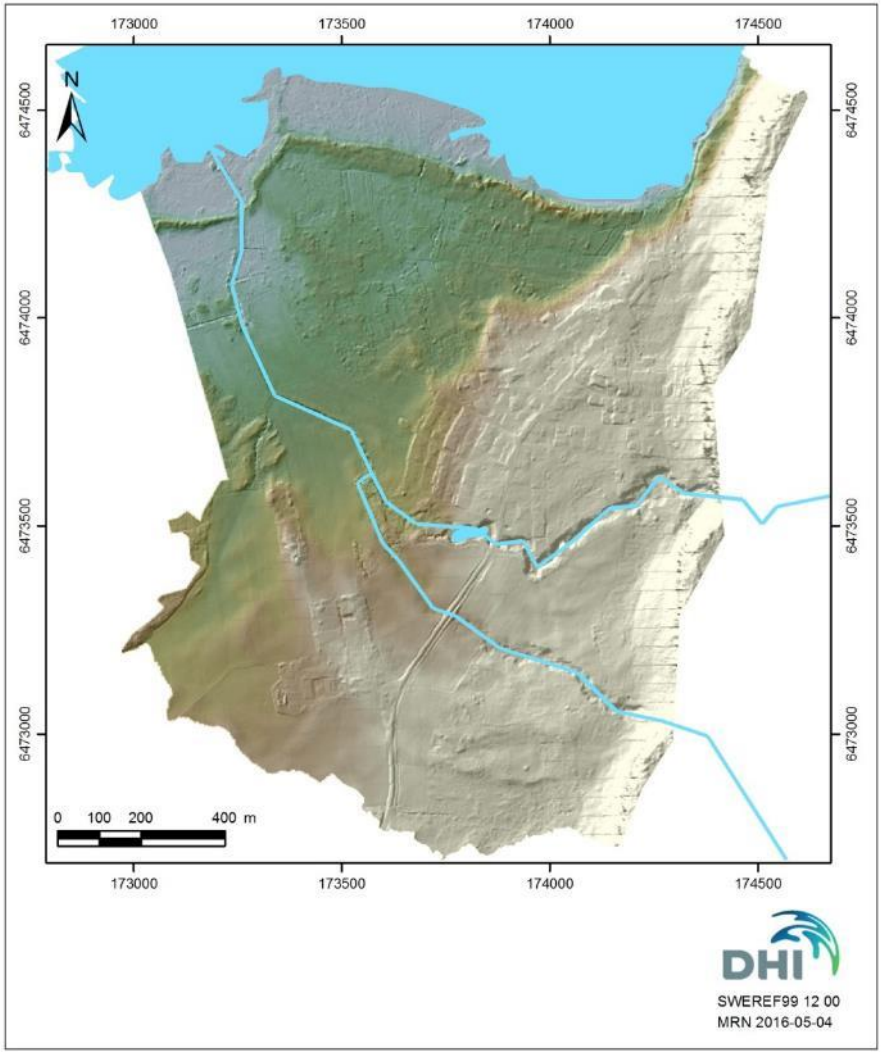
- Runoff from impervious areas
- Stormwater pipes and open ditches



# Methodology

## Three setups were created:

A. Natural conditions (without existing development)

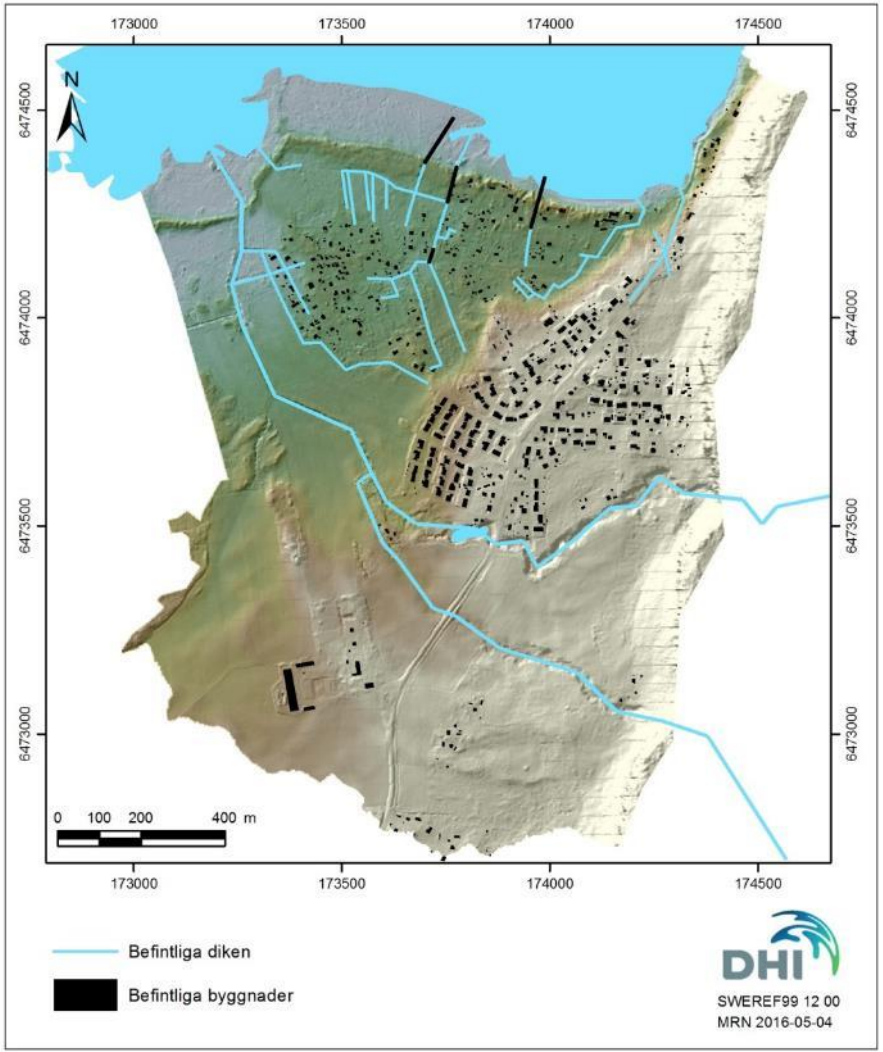


# Methodology

Three setups were created:

A. Natural conditions (without existing development)

B. Current situation (current buildings and no or limited stormwater drainage system)



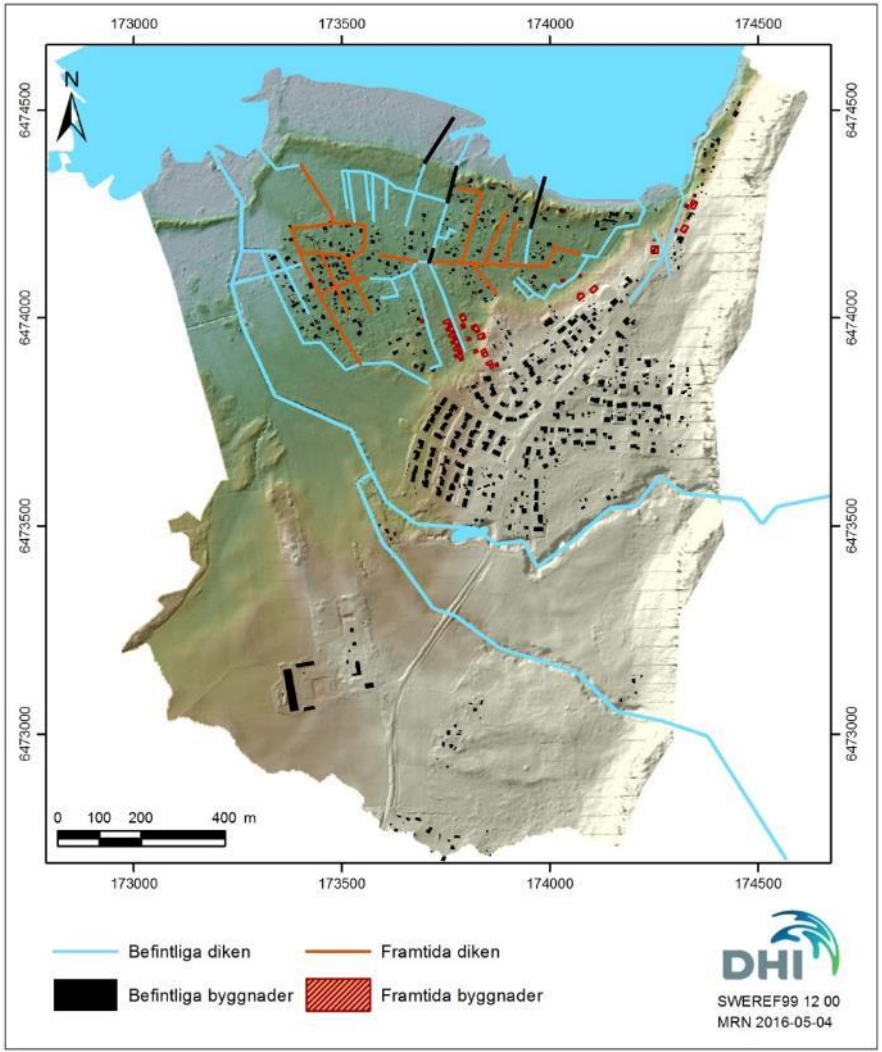
# Methodology

Three setups were created:

A. Natural conditions (without existing development)

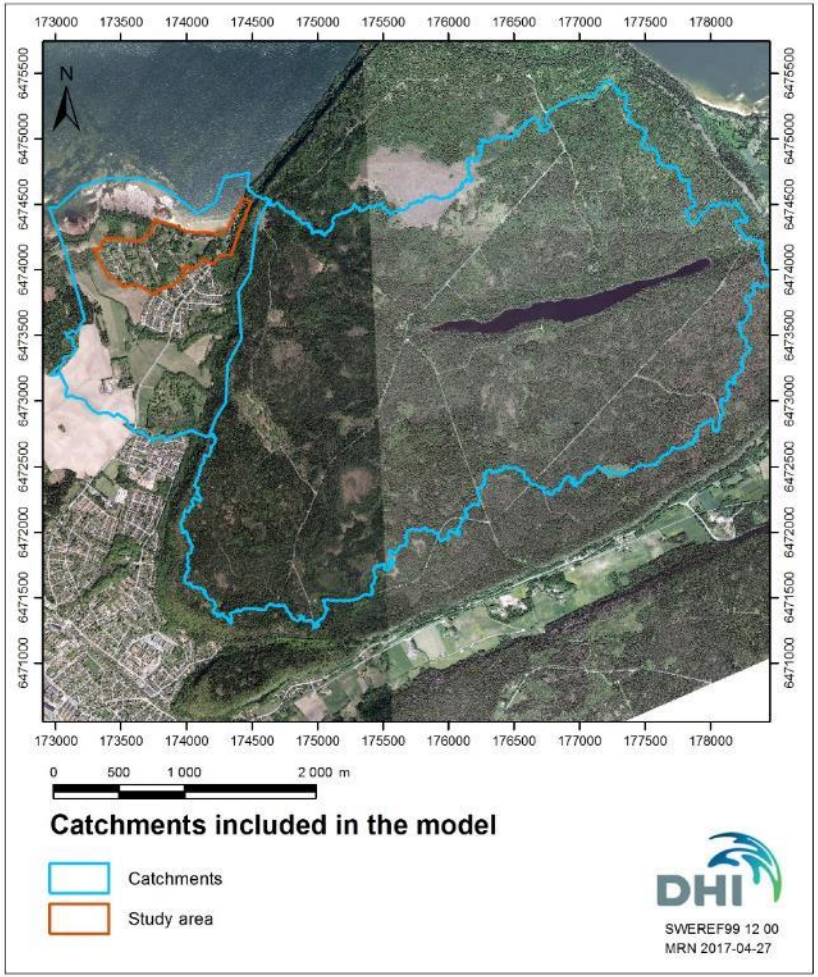
B. Current situation (current buildings and no or limited stormwater drainage system)

C. Future scenario (additional development and a stormwater drainage system)



# Methodology (continued)

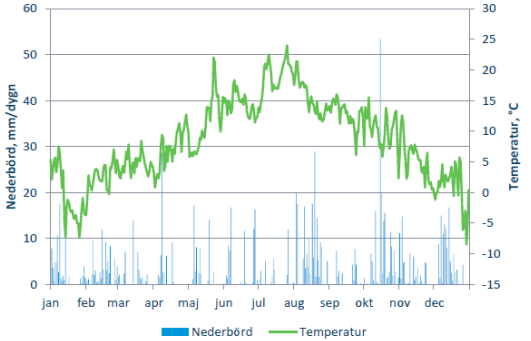
- Based on open data
  - DEM
  - Meteorologic data
  - Soil maps
  - Land use maps

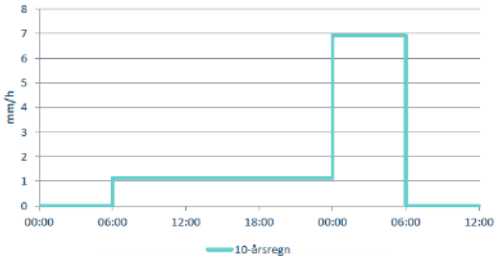


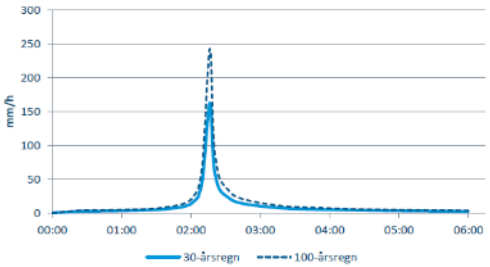
# Methodology (continued)

- Four rainfall series were used:

  1. A whole year (year 2014, 1006 mm)
  2. 10-year event in the autumn (62 mm, 24 h duration)
  3. 30-year event in summer (58 mm, 6 h duration)
  4. 100-year event in summer (85 mm, 6 h duration).



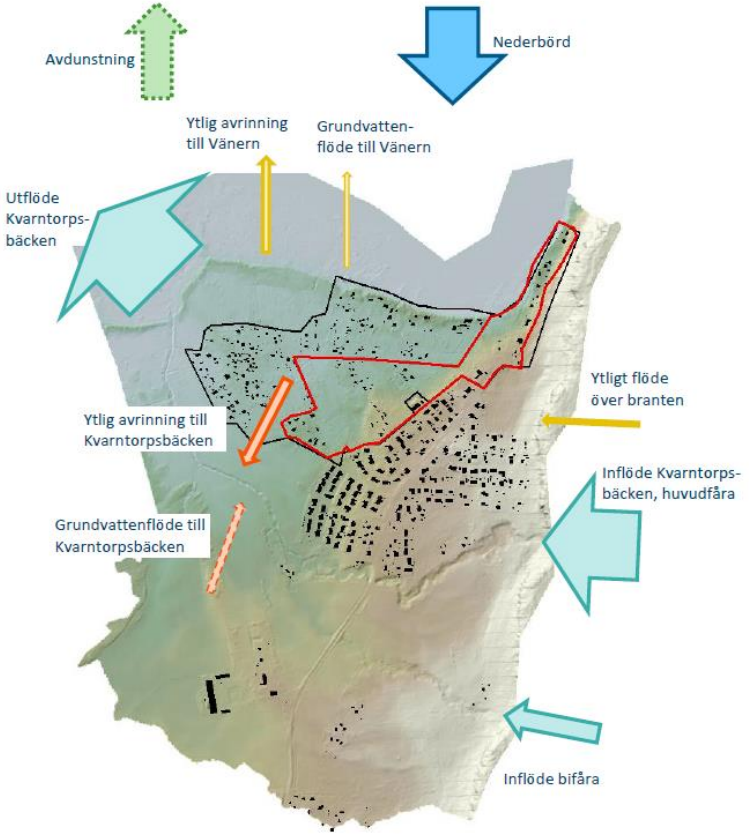
# 03

# Results

# Yearly flow volumes, natural conditions

## Comments:

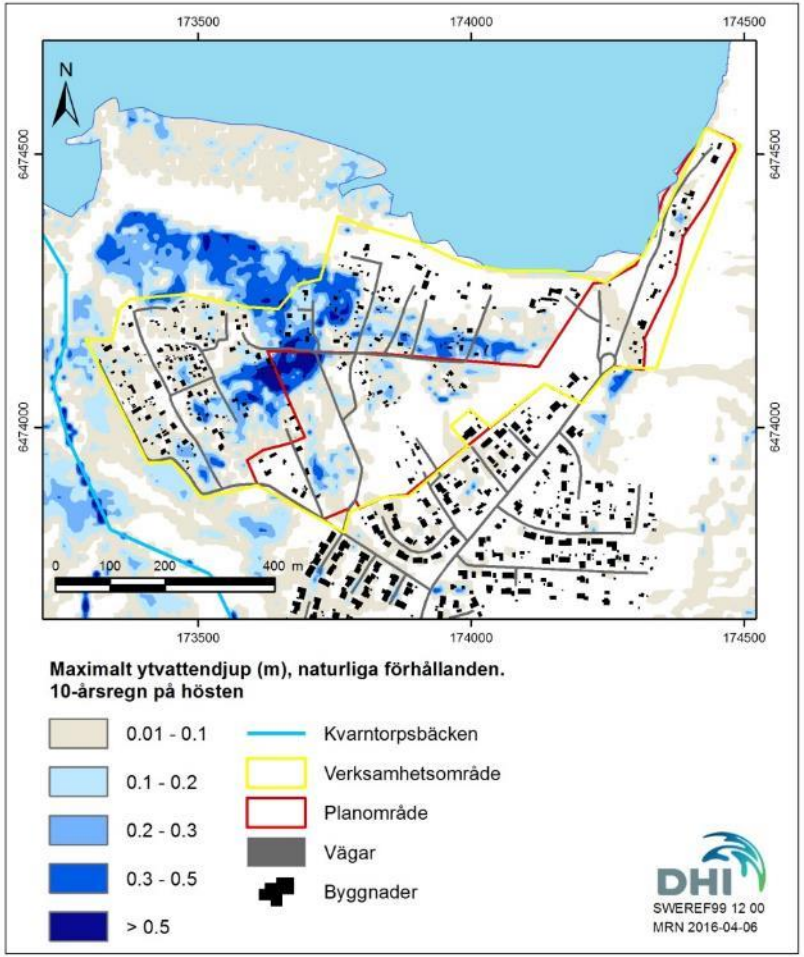
- 60% of precipitation becomes evapotranspiration
- 30% of precipitation becomes surface runoff
- 10% infiltrates to groundwater
- Accumulated inflow from upstream part > accumulated rainfall over area



Maximum depth of overland water

Natural conditions,

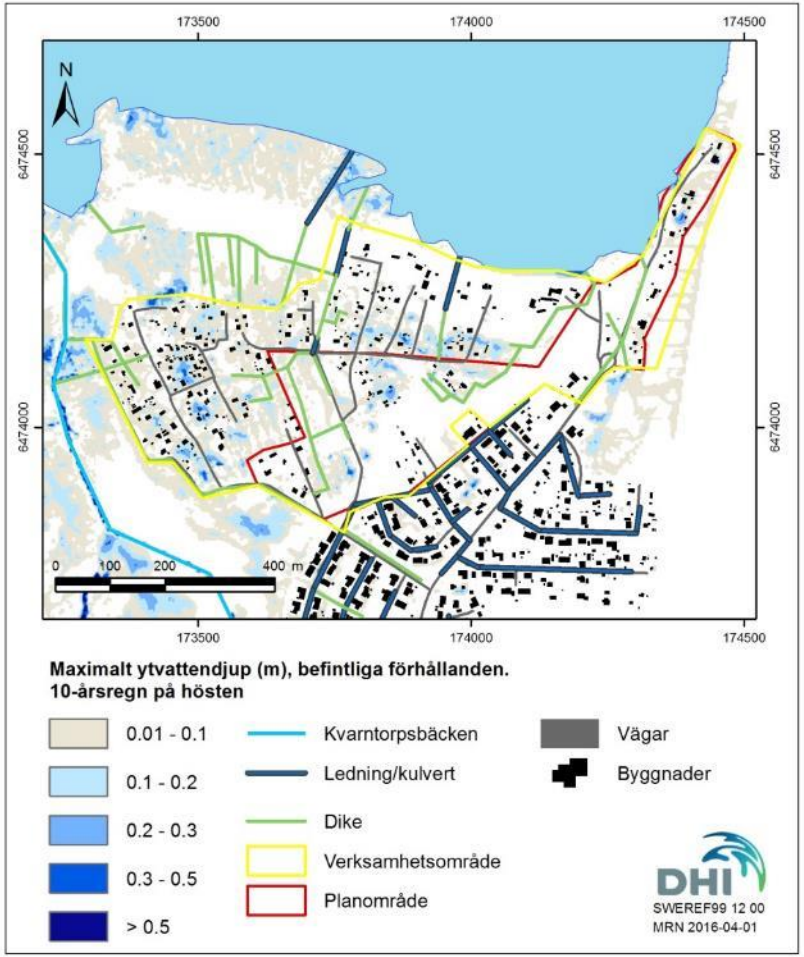
10-year rain in the autumn



Maximum depth of overland water

Current situation

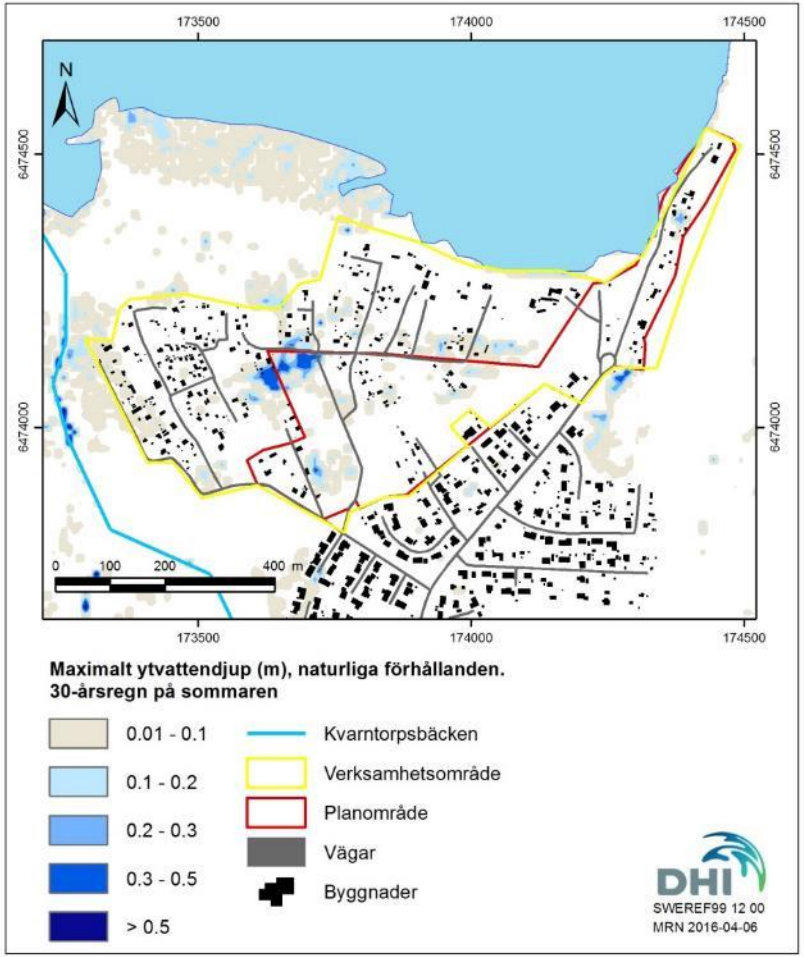
10-year rain in the autumn



Maximum depth of overland water

Natural conditions,

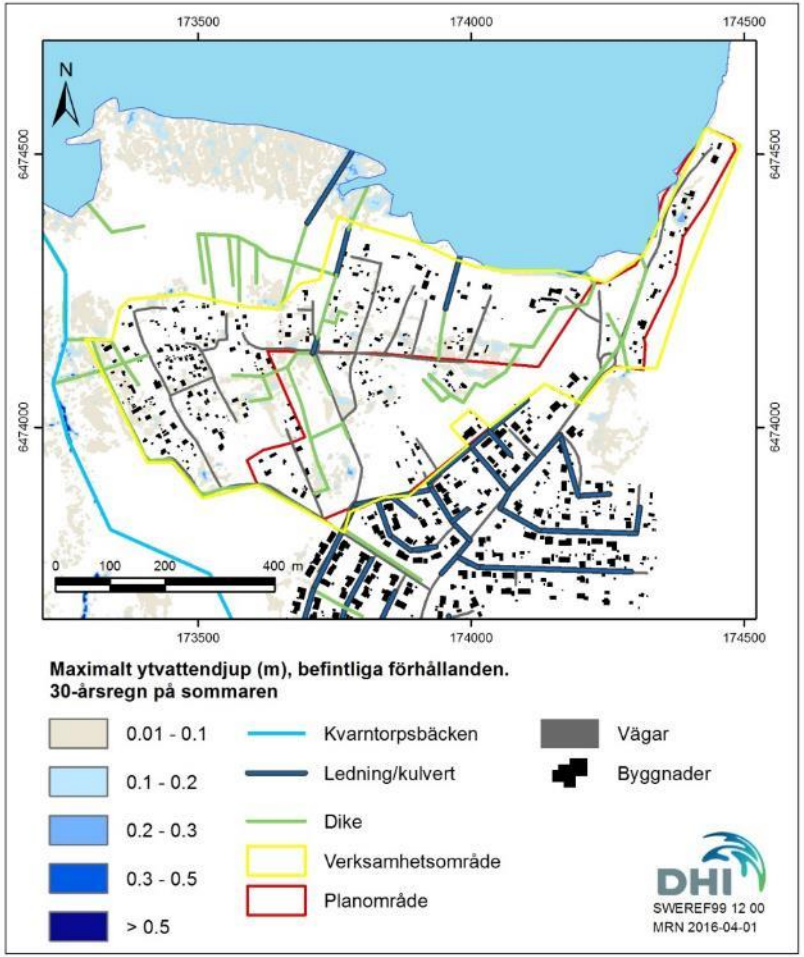
30-year rain in the summer



Maximum depth of overland water

Current situation

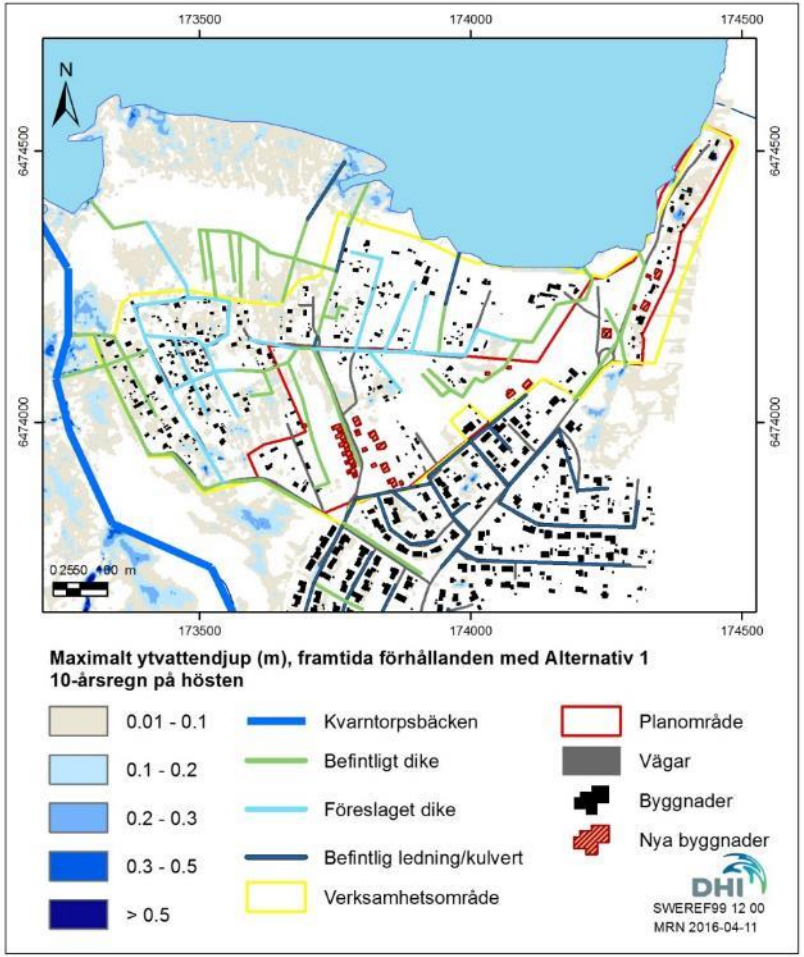
30-year rain in the summer



Maximum depth of overland water

Future situation

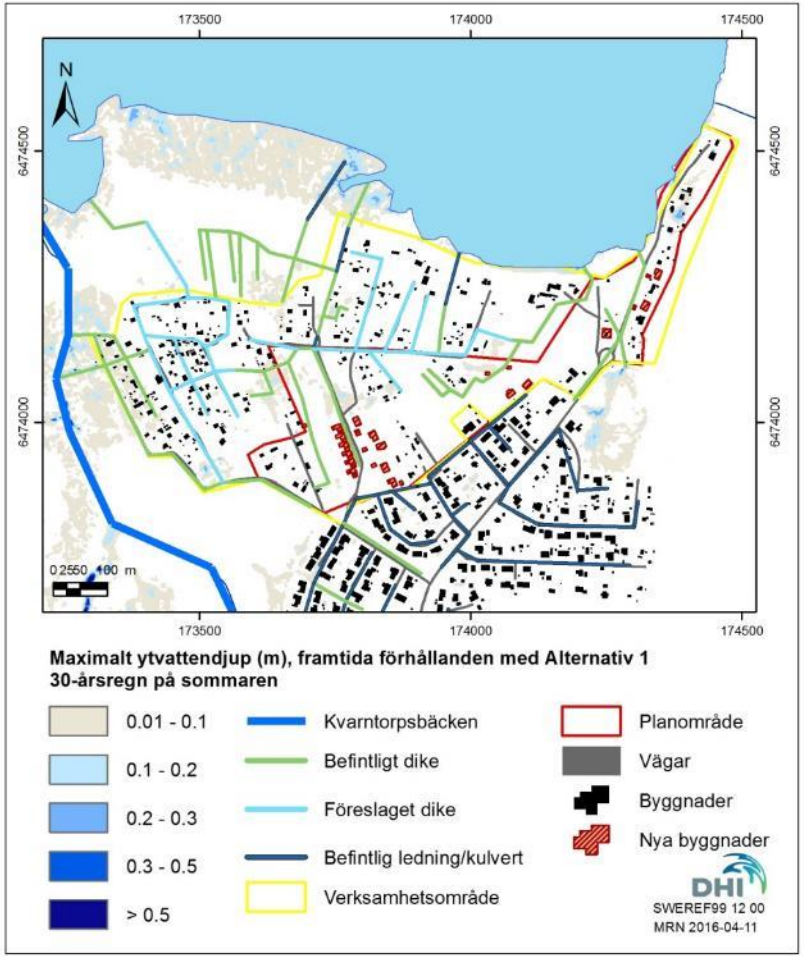
10-year rain in the autumn



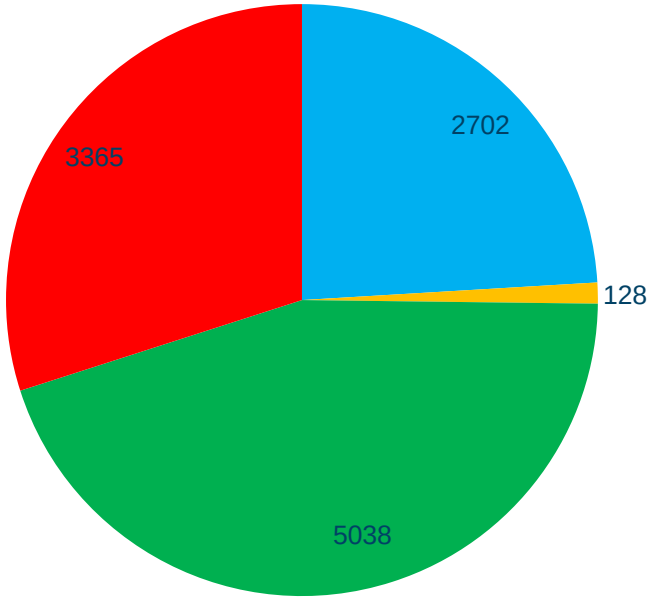
Maximum depth of overland water

Future situation

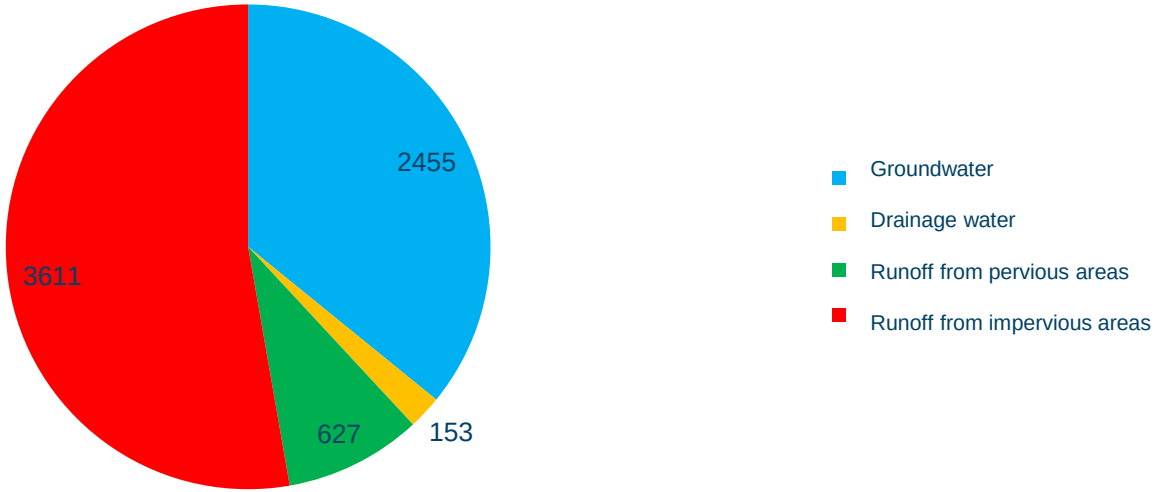
30-year rain in the summer



# Accumulated flow ($m^3$) in future drainage system
# 10-year event in autumn
# (accumulated over 48 h of which 24 h include rainfall)

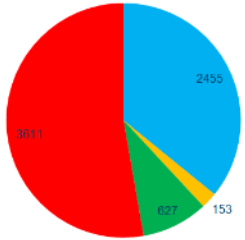


# Accumulated flow ($m^3$) in future drainage system 30-year event in summer (accumulated over 24 h of which 6 h include rainfall)



# Conclusions

- In the autumn, groundwater and runoff from pervious areas is the main ”problem” and constitutes the main part of the flow in the ditches
- In summer, groundwater flows are much smaller, and since groundwater levels are lower the stormwater (from both impervious and pervious areas) can infiltrate to a much higher extent
- The effects of this suggested solution could not have been verified without a model setup that included both groundwater, surface water, ditches and runoff from urban areas.


# Thank you!

Maria Roldin
mrn@dhigroup.com