Under the High Patronage of His Majesty King Mohammed VI

International Water Resources Association
IWRA

XIX WORLD WATER CONGRESS
International Water Resources Association (IWRA)
Marrakech, Morocco | 1-5 December 2025

Kingdom of Morocco
Ministry of Equipment and Water

With Digitalization and AI to intelligent combined sewer network management

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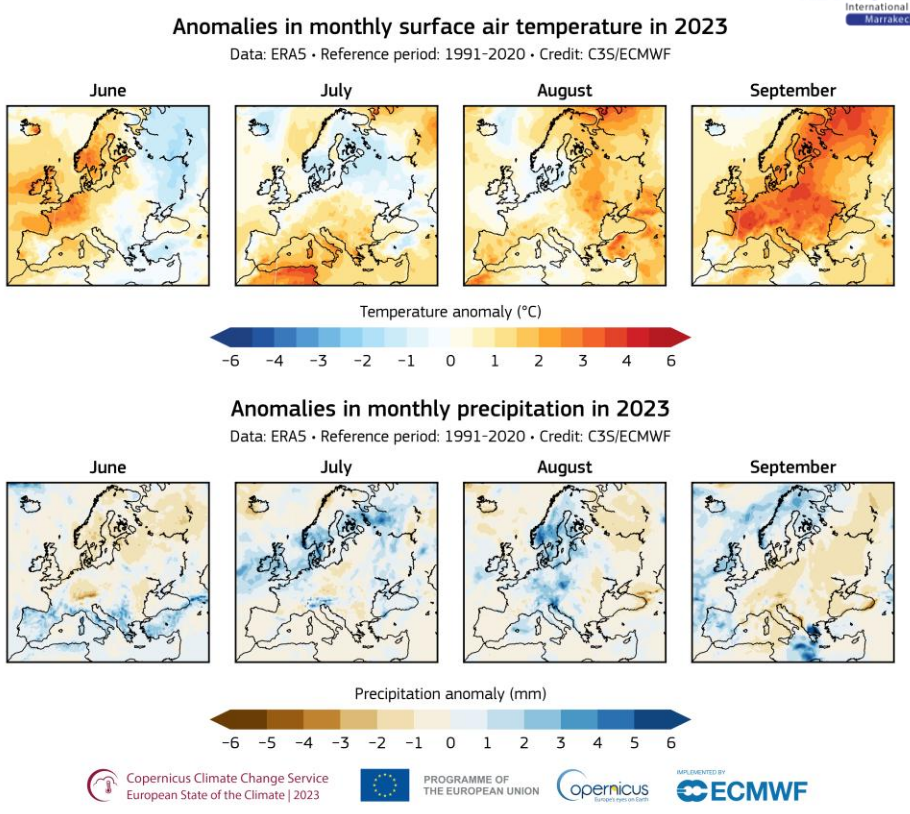
03 December 2025

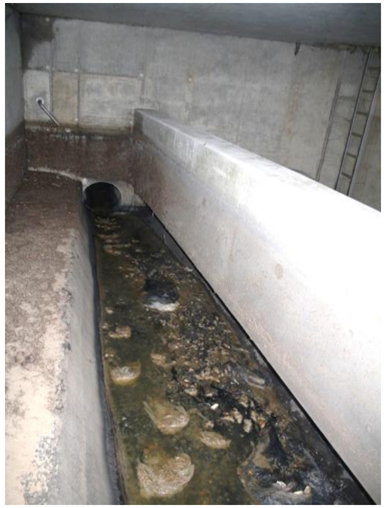
Hochschule Magdeburg • Stendal

Climate change will affect the sewer system

Effect on river- and sewer systems
- lower water flow in the summer months
- lower O_2 solubility at warmer water temperatures
- longer periods of drought in summer
- increased concentrations in precipitation runoff
- local rainfall events with high runoff



(Top) Average surface air temperature anomalies (°C) and (Bottom) precipitation anomalies (mm) over Europe for June to September 2023, relative to the monthly average for the 1991–2020 reference period. Data source: ERA5. Credit: C3S/ECMWF



Storage sewer with downstream overflow (source: J. Wiese)

Impact:
- deposits in the sewer system
- remobilization and hydraulic stress with contamination from combined sewer overflows

Combined sewer overflow into the Elbe River in Magdeburg in summer 2019 (source: A. Feistel)

Methodology

Evaluation of the operating data of the sewage treatment plant

- Operating data analysis for the years 2018-2021
  - ➢ Evaluations of inflow volumes and inflow loads
  - ➢ Cleaning performance and infiltration water

Hydrostatic sewer network simulation

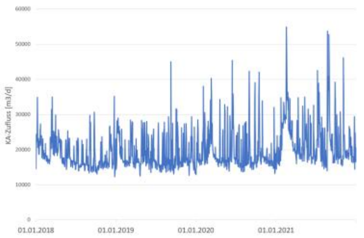
- Update of the existing model
  - ➢ Storage and discharge behavior of all combined sewer structures

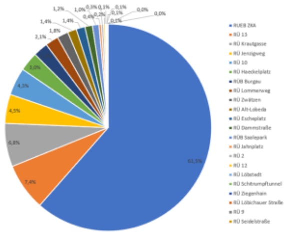
Analysis of possibilities

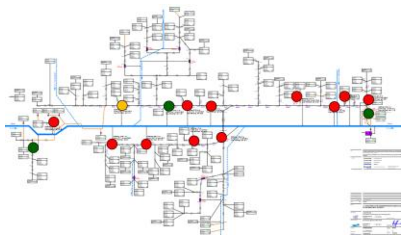
- Optimization at the local or holistic level
- Possible storage volume potential

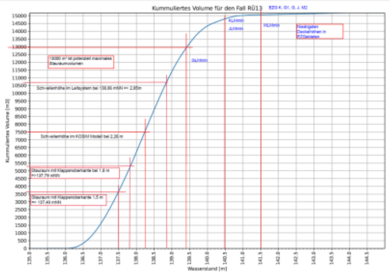
Hydrodynamic sewer network simulation

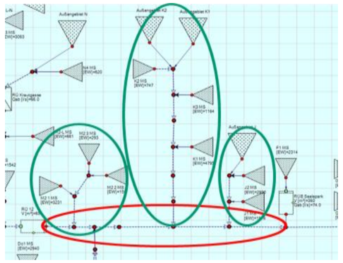
- Detailed sewer network model with over 7,000 nodes and real-time rain data
  - ➢ Flow behavior and wastewater levels for different control strategies
  - ➢ Discharge and inflows to the WWTP





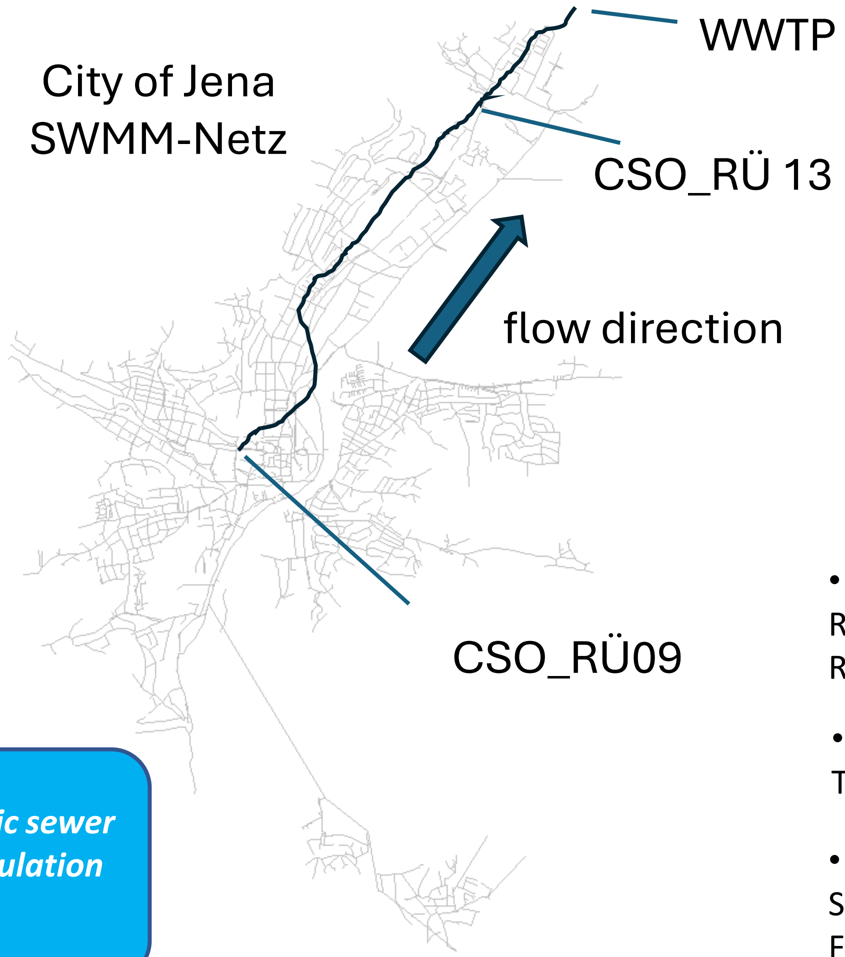


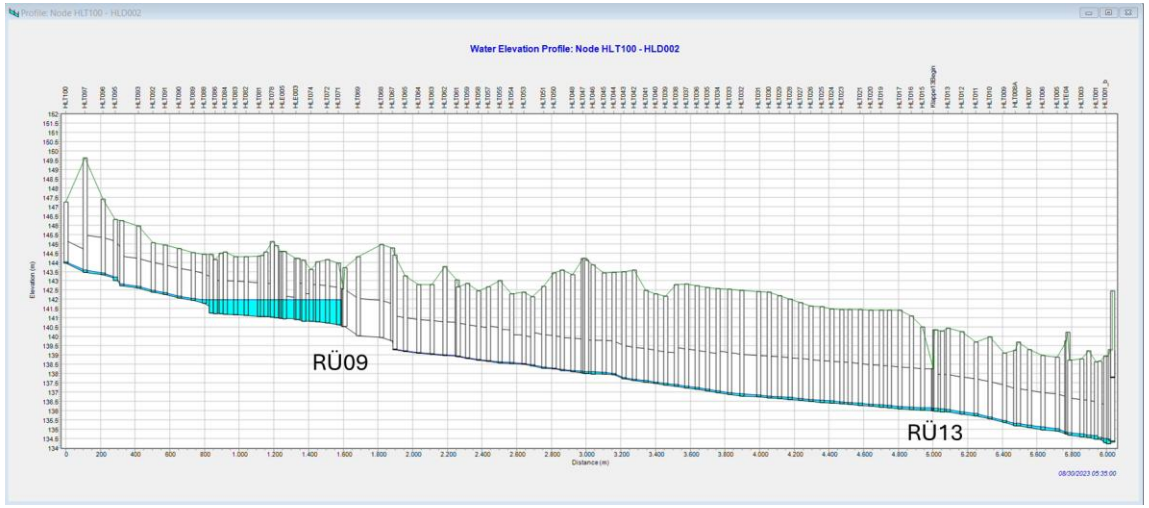




(source: *J. Wiese, H. Oeltze [2023]*)

Simulation





Software: SWMM 5.2,
Quellen: J. Simancas-Suarez, H. Oeltze

- activated volume

RÜ09 approx. 2000 m³
RÜ13 approx. 6000 m³

- Equalization of inflow to the WWTP

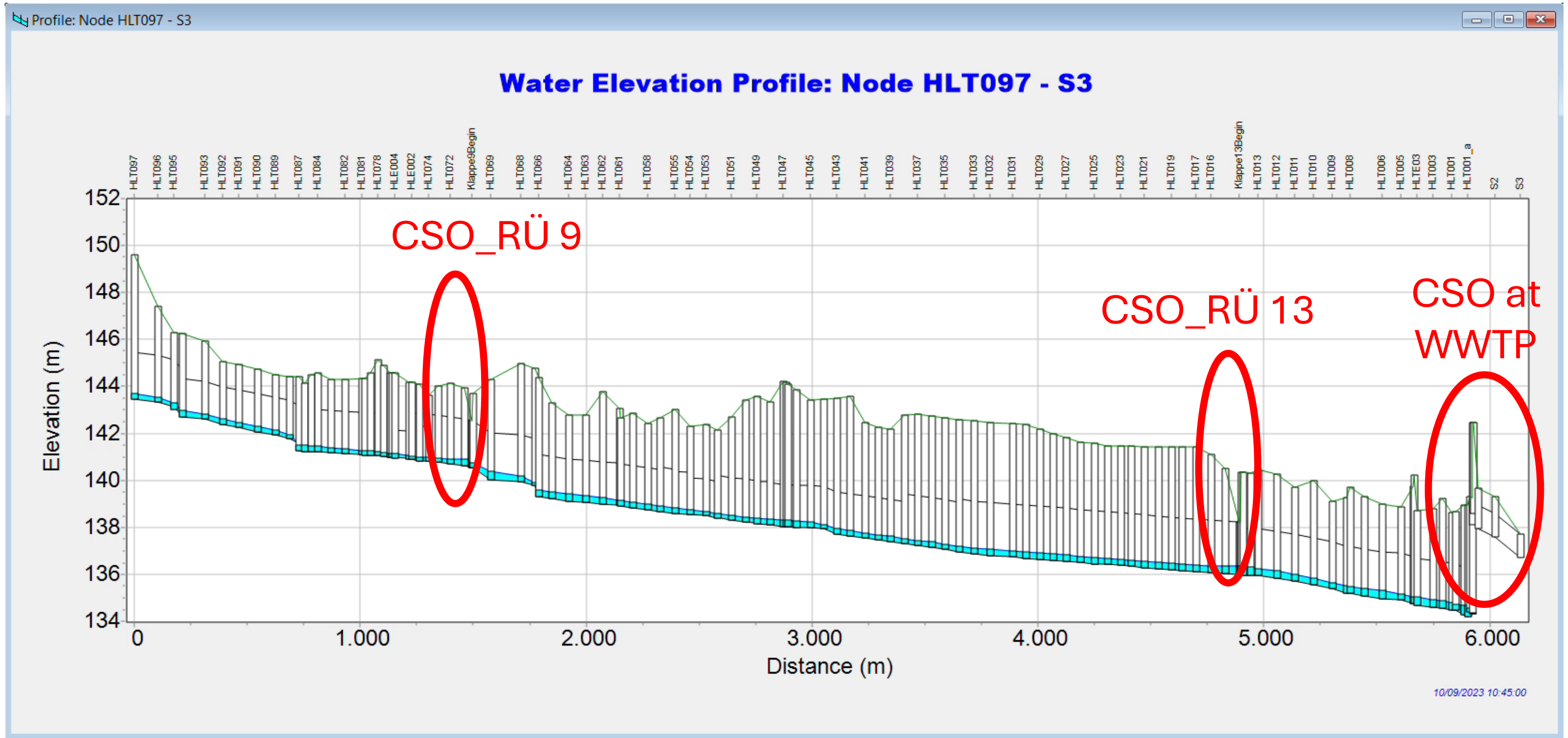
Throttling function from 0 to 700 l/s

- Flushing applications

Speeds: up to 2.7 m/s
Flushing distances: CSO_RÜ09 to WWTP approx. 4 km

Hydrodynamic sewer network simulation

Simulation



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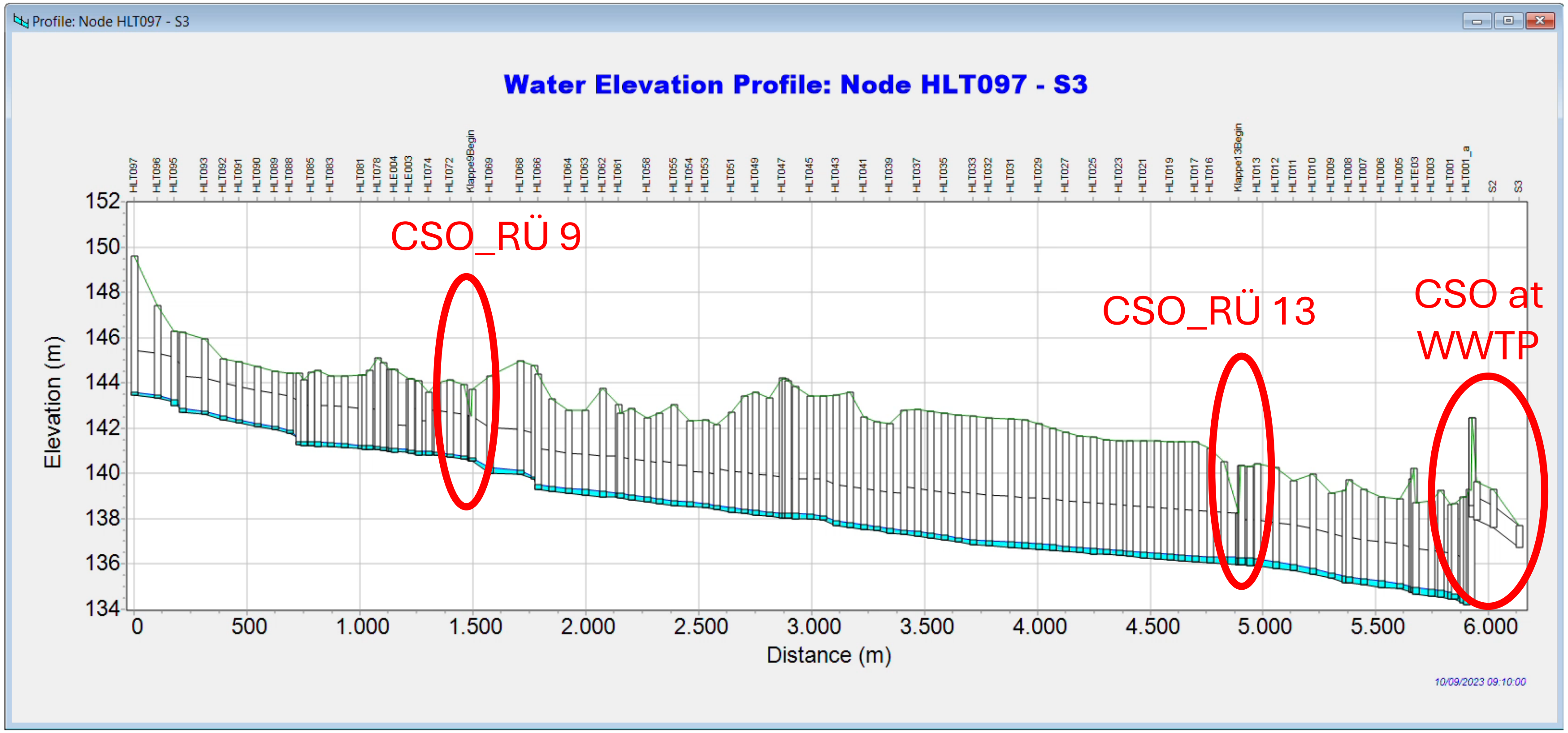
Hydrodynamic sewer network simulation

Video: Short-term rainfall with 10.6 mm rain, without the use of flush gates, based on an SWMM simulation (source: H. Oeltze)

Simulation



Result:
The flush gates reduce the discharge by 20% or 5.361 m^3

Hydrodynamic sewer network simulation

Software: SWMM 5.2,
Quellen: J. Simancas-Suarez, H. Oeltze

Video: Short-term rainfall with 10.6 mm rainfall, using the flush gates for a maximum of 4 hours (CSO_RÜ 13 with a throttle setting of 300 l/s) based on an SWMM simulation (source: H. Oeltze)

Digitization of information

Management-concept

scenario 1	dry weather
scenario 2	preventive flushing
scenario 3	preventive flushing
scenario 4	rain weather management
scenario 5	rain weather management
scenario 6	rain weather management
scenario 7	rain weather management
scenario 8	rain weather discharcge reduction
scenario 9	rain weather discharcge reduction
scenario 10	rain weather discharcge reduction
scenario 11	rain weather discharcge reduction
scenario 12	extrem weather discharcge reduction
scenario 13	extrem weather, preventive flushing

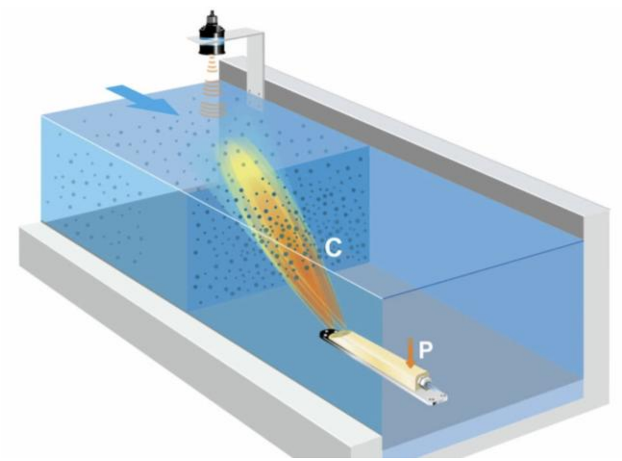
rainfall [mm]
0 bis 1

days without flushing		
medium		unnecessary
strong		necessary

season	rainfall [mm]
summer	1 bis 5
winter	
summer	5 bis 10
winter	

intensity	rainfall [mm]
long-term event	10 bis 15
short-term event	
long-term event	15 bis 20
short-term event	
	rainfall [mm]
	over 20
flushing	
meaningful	
necessary	

Particle concentration (TSS) and digital rain data logger



P = Pressure sensor for level measurement
C = Particle concentration sensor

Partical concentration sensor by „nivus“
„NIRA.web“ rain-datalogger by „HST-Systemtechnik“

AI approach and control concept

Predictive and real-time measurements

historical operating data / simulation results

CBR database (case-based reasoning)

- Transparent control recommendations in a matter of seconds

control concept

- Based on online rain datalogger
- Request for decision every 2 hours

- Case database grows during testing
- Evaluation of control decisions

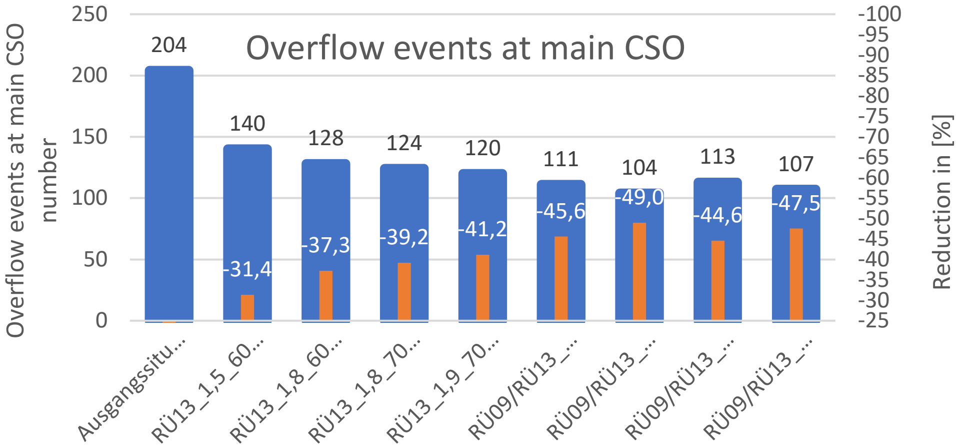
- **13 Scenario distinctions**
- **Initially 178 case constellations**

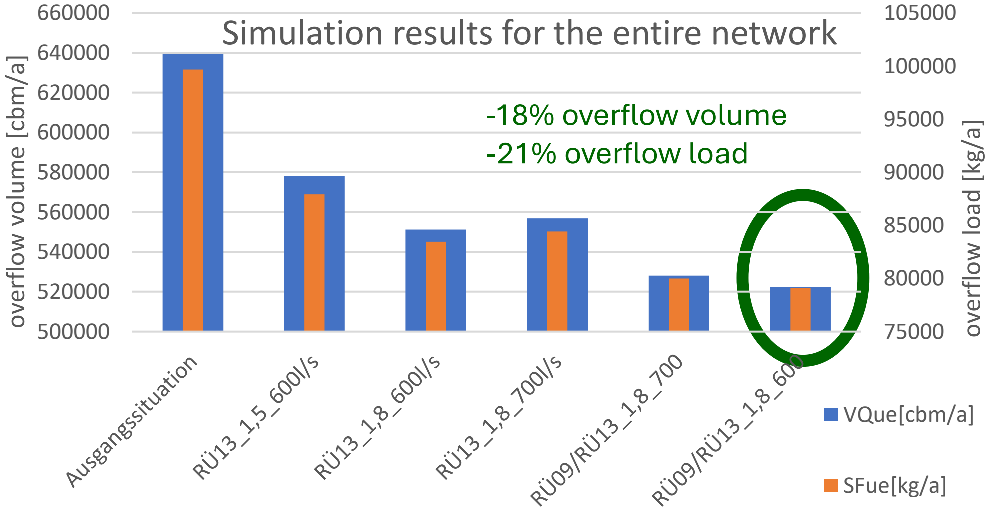
Results

- ➢ Up to 49% fewer overflow events at main CSO WWTP
- ➢ Up to 18% fewer overflow volume and 21% fewer load for the whole sewer system

(based on long term simulations)

- ➢ Real tests began in July 2025





source: H. Oeltze, data: JenaWasser

source: JenaWasser
built by „HST-Systemtechnik“

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Thank you!

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