

CIE4485

Wastewater Treatment

Dr.ir. J.G. Langeveld

7. Interactions between wastewater collection and treatment

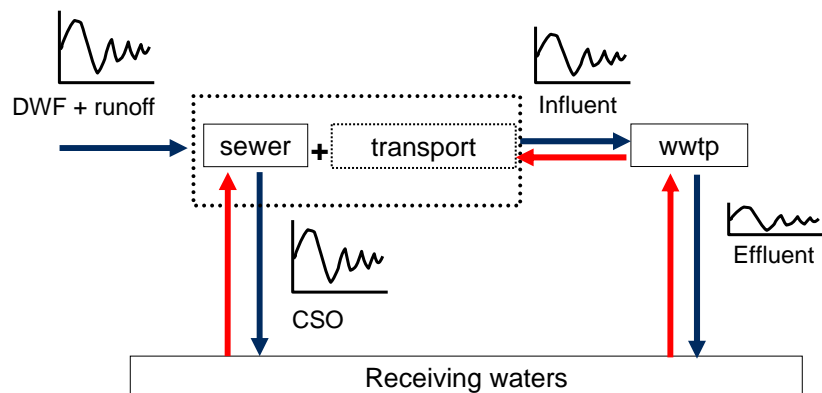


CT4485 Wastewater Treatment

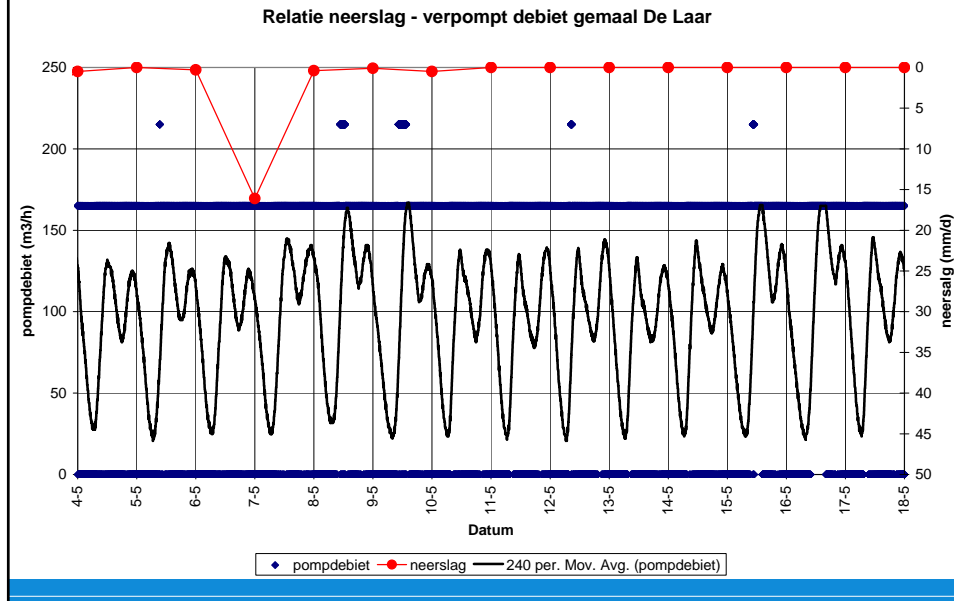
Lecture: Interactions between wastewater collection and treatment

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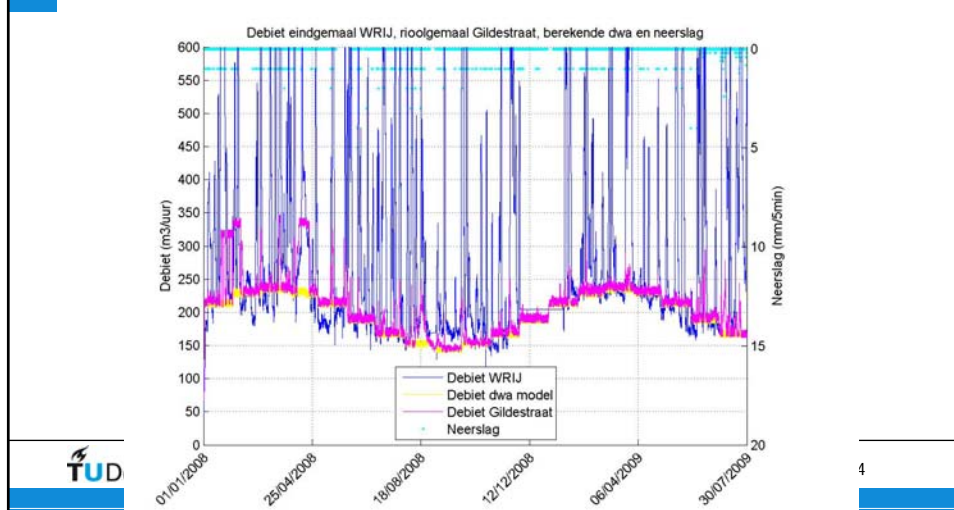
Interactions within wastewater systems



DWF variations: diurnal and week profile

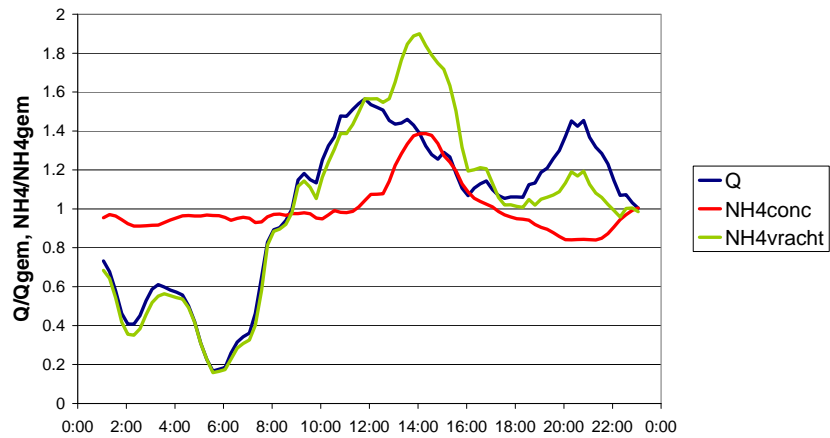


Annual profile



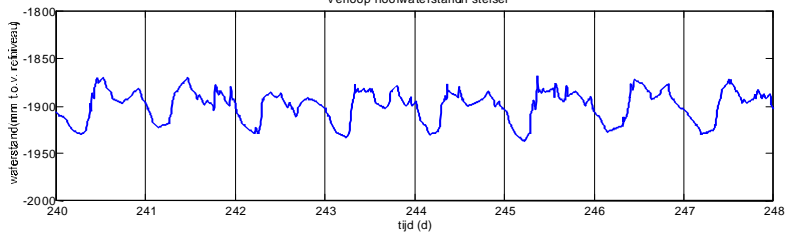
Impact transport system

DWA profiel

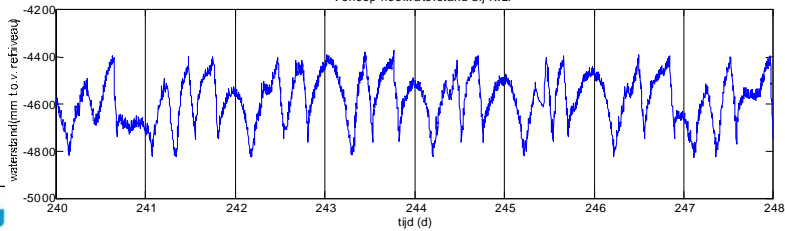


Impact pumping station

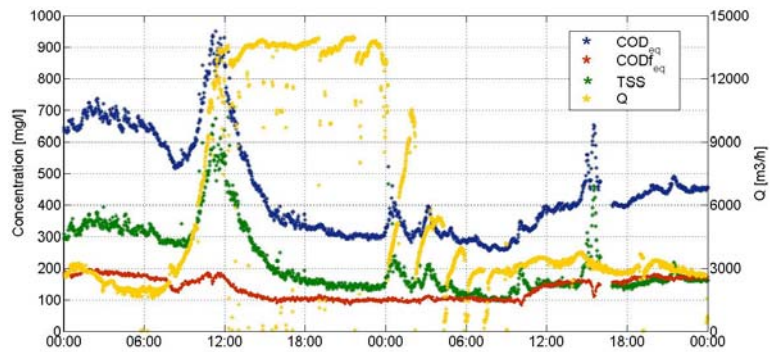
Verloop rioolwaterstandn stelsel



Verloop rioolwaterstand bij rwzi

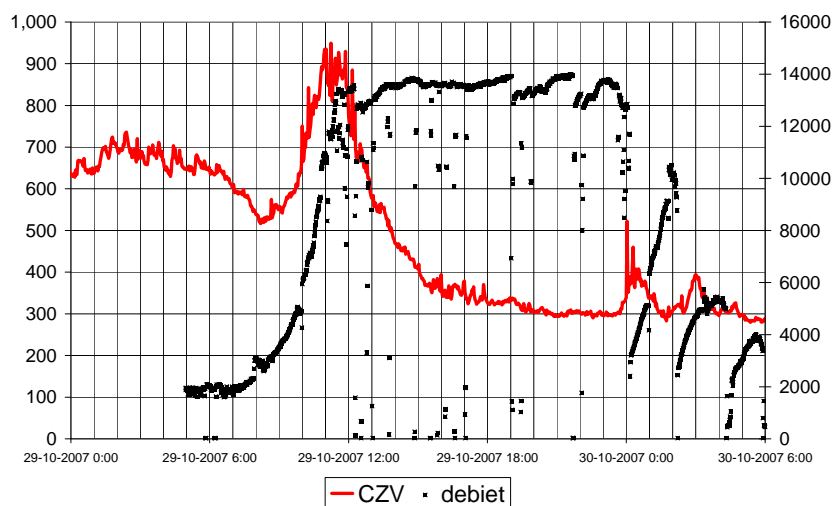


WWF: storm event 29/30 October 2007

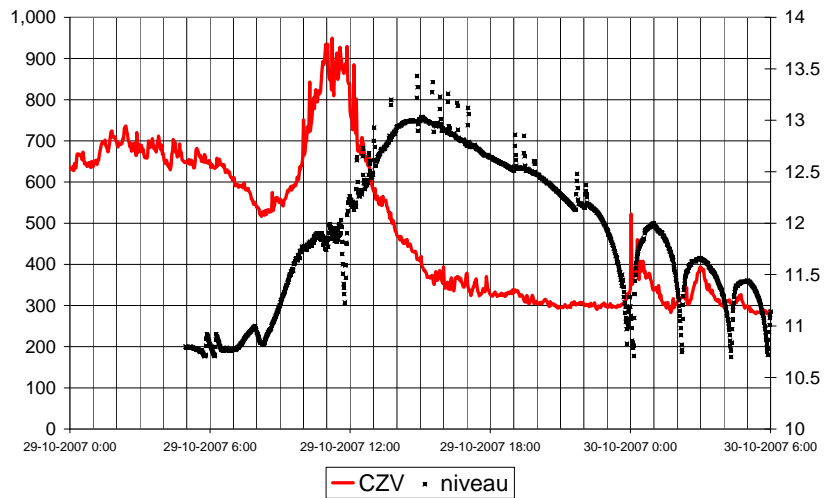


- Eindhoven Stad
- Dilution ~ factor 2
- Overall increase of loads during storm events

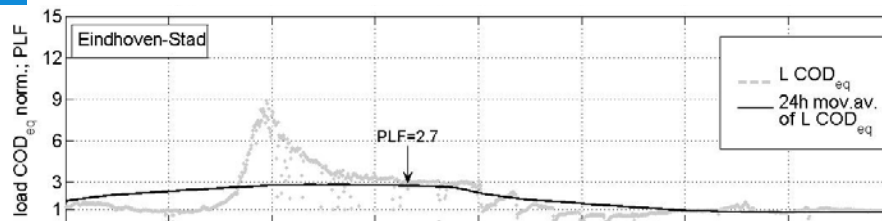
WWF dynamics: first flush?



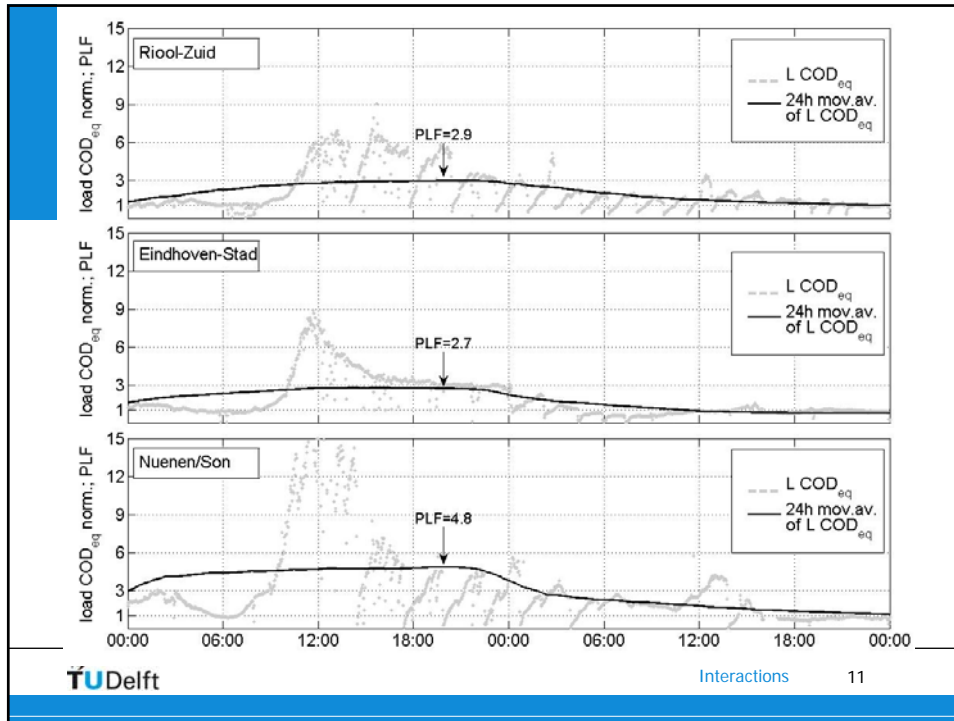
WWF dynamics: first flush??



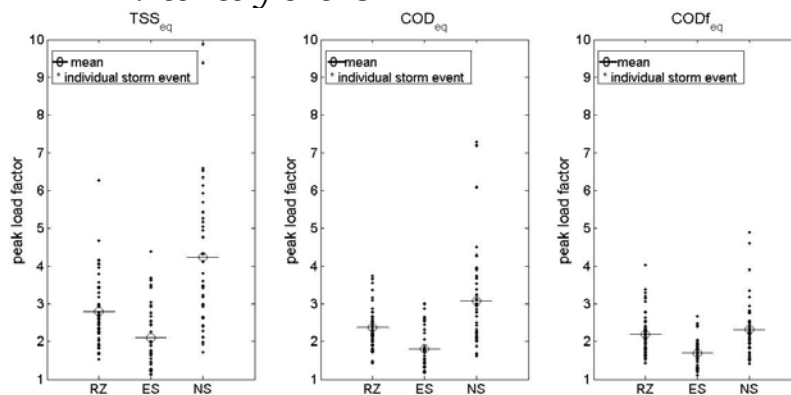
WWF: storm event 29/30 October 2007



- Normalization of concentration & flow
- Calculation of normalized load
- 24h moving average of loads → Peak Load Factor



WWF: analysis of PLF



- TSS highest followed by COD followed by COD_f
- Differences between catchments
 - Contradicts earlier research (Kafi *et al.*, 2008)

WWF: origin of additional pollutant loads

- total mass of pollutants (M_{pt}):
 - in-sewer stocks (M_{ps})
 - run-off (M_{pr})
 - dry weather flow (M_{pd})

$$M_{pt} = M_{ps} + M_{pr} + M_{pd}$$

Gromaire *et al.*, 2001

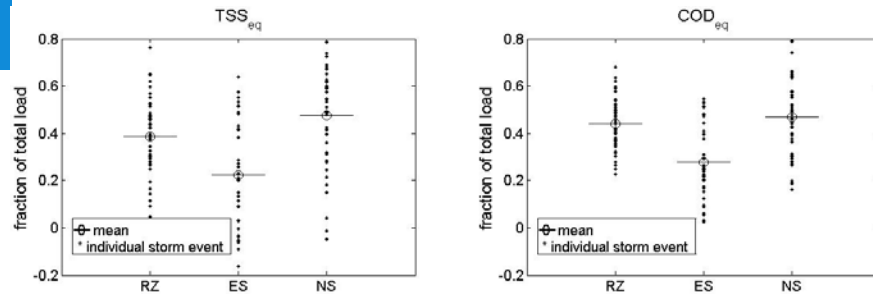
WWF: origin of additional pollutant loads

- total mass of pollutants → measured
- in-sewer stocks → ????????
- run-off → $(Q_{wwf} - Q_{dwf}) * \text{mean conc. Dutch stormwater}$
- dry weather flow → measured, equal to DWF conc.

$$M_{pt} = M_{ps} + M_{pr} + M_{pd}$$

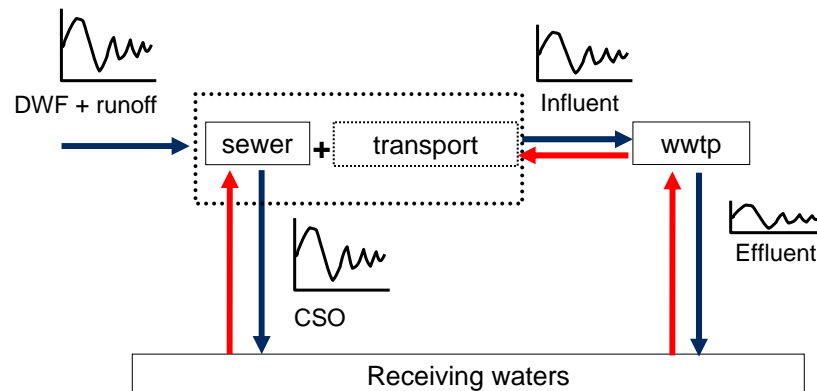
Gromaire *et al.*, 2001

WWF: origin of additional pollutant loads



- Mean contribution of in-sewer stocks 20-50%
 - Gromaire *et al.* (2001) 50-60%
- Relative contribution in-sewer stocks larger for smaller catchment

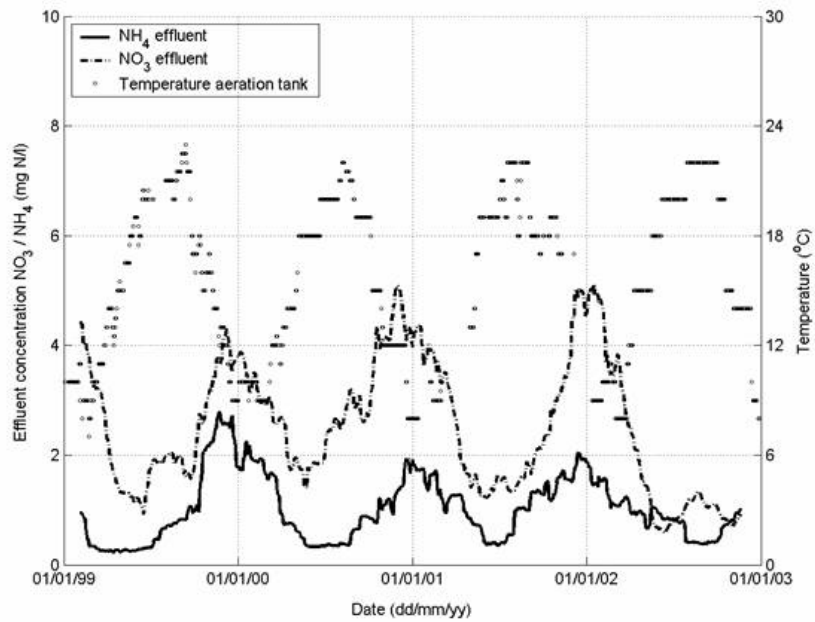
Interactions within wastewater systems



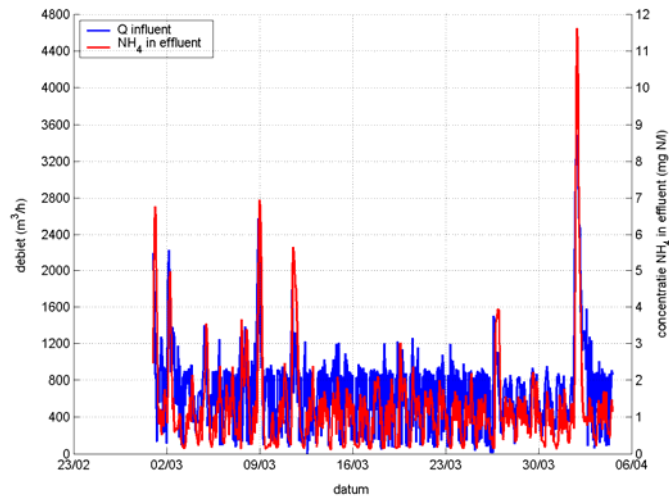
Impact on wwtp



Seasonal variation wwtp performance

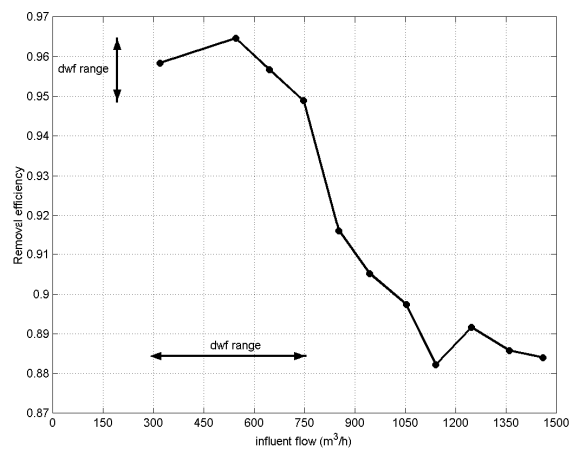


Short term impacts wwtp performance



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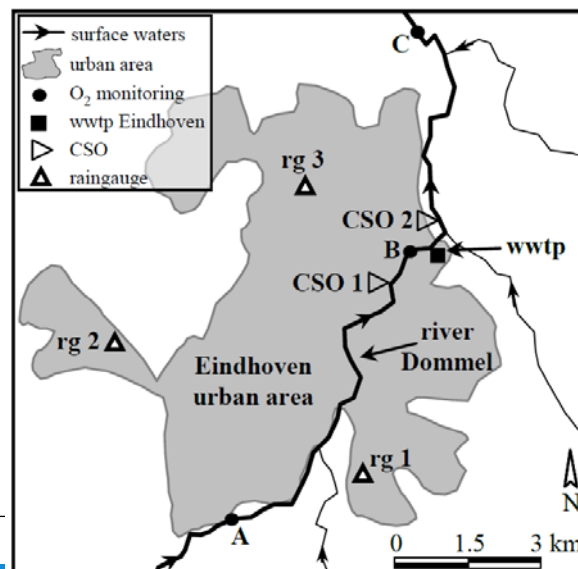
Short term impacts wwtp performance



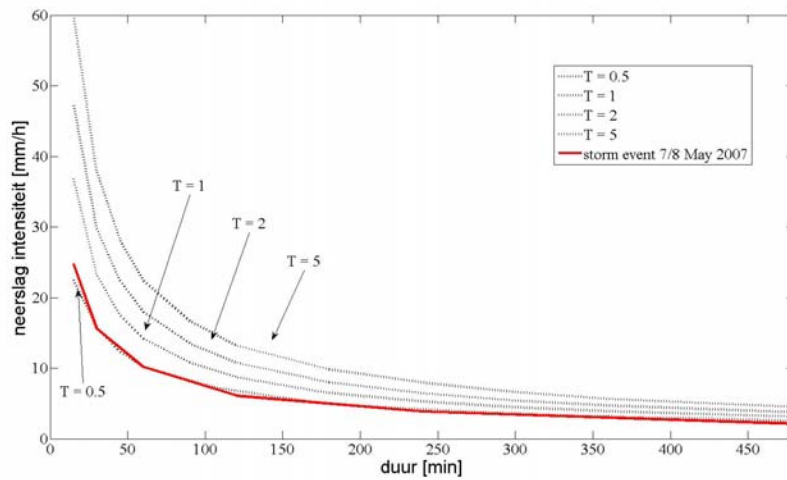
Interactions in the real world

- Spring 2007: 6 weeks without precipitation finalized by storm event of 33 mm on May 7th and 8th
- Monitoring data available of wastewater system Eindhoven:
 - wwtp: flow and water quality
 - sewer system: CSO monitoring at CSO vd Heuvellaan and Kosmoslaan: water level and samples for water quality
 - River Dommel: continuous oxygen measurements + sampling for water quality

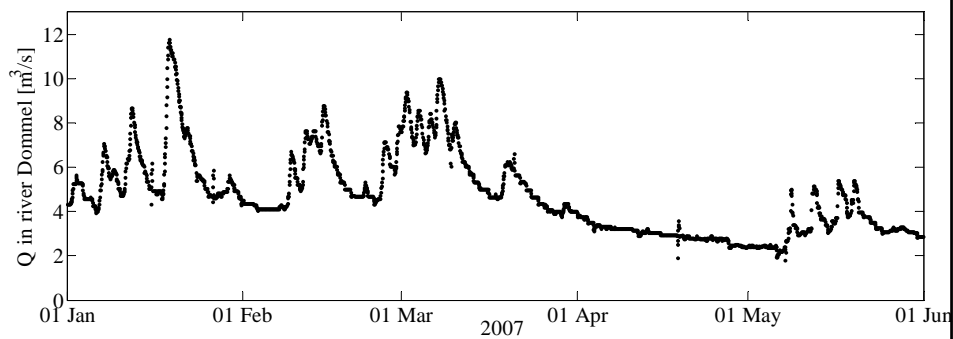
Monitoring locations Eindhoven area



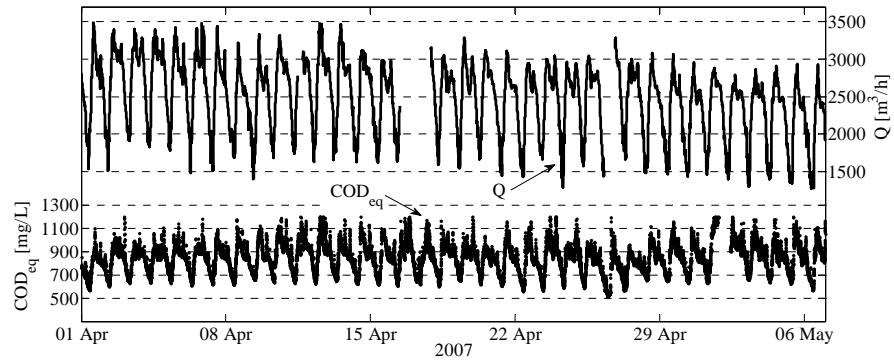
Storm event May 7/8 2007



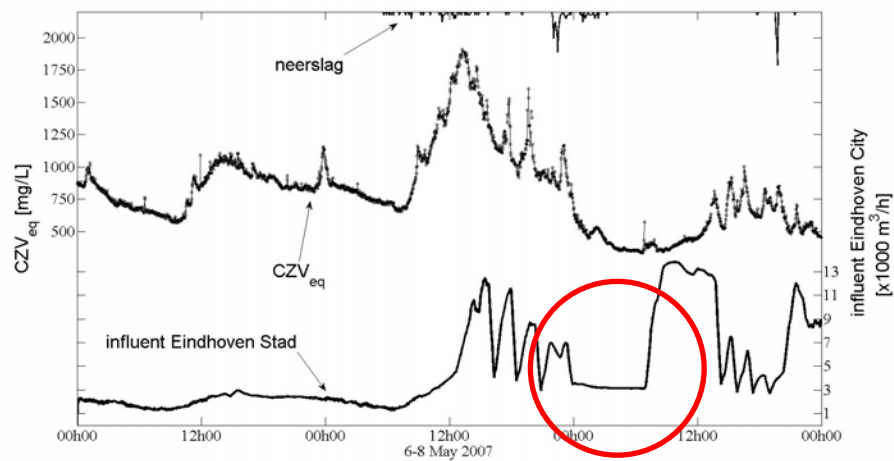
Flow river Dommel



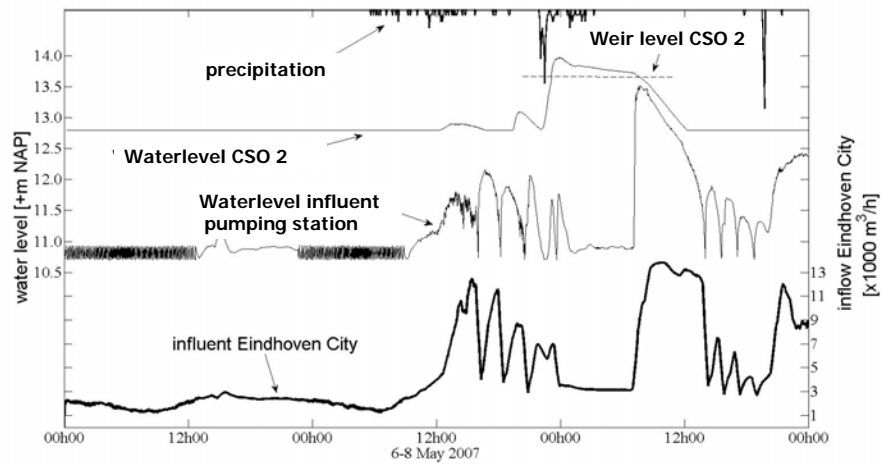
Influent monitoring: flow and COD



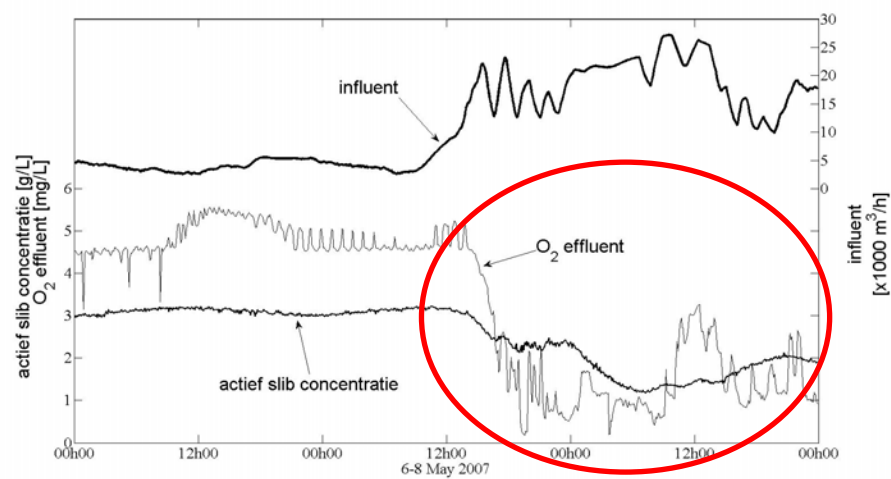
Hydraulic performance during event



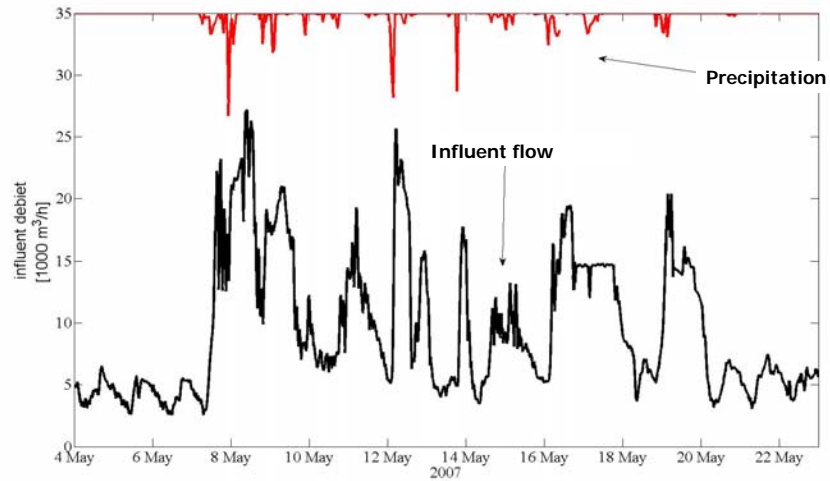
Hydraulic performance during event



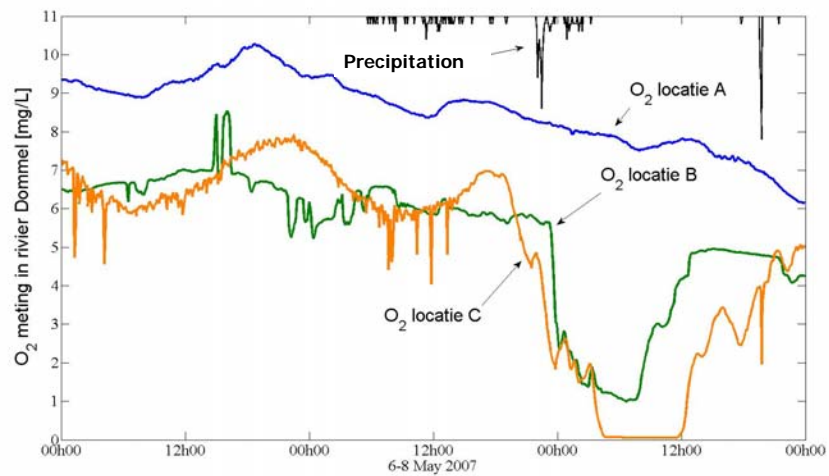
Impact on wwtp performance during event



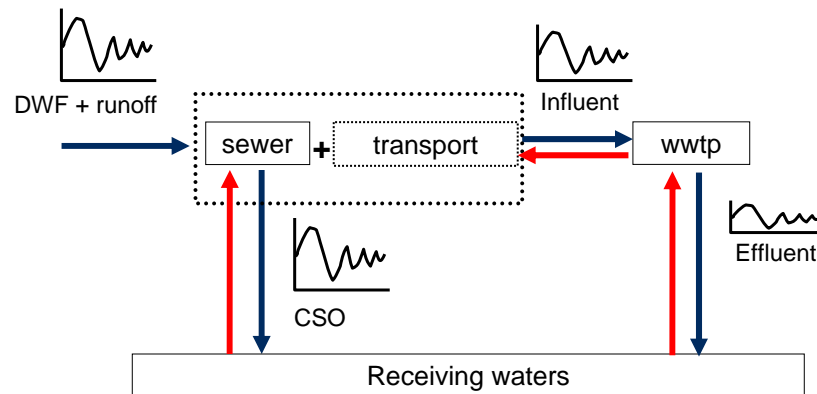
Impact on wwtp performance after event



Impact on receiving water quality



Interactions within wastewater systems: wastewater system optimisation



Sewer characteristics

- Network
- Below groundlevel
- Dirty
- 'simple pipes'
- Over 100.000 km in NL.
- Municipality
- Focus on hydraulics
- Service life 40-80 year
- Up to 100* DWF

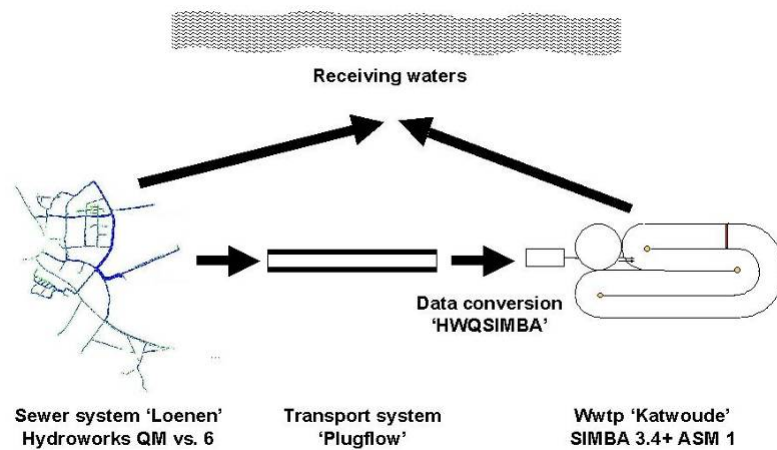


wwtp characteristics

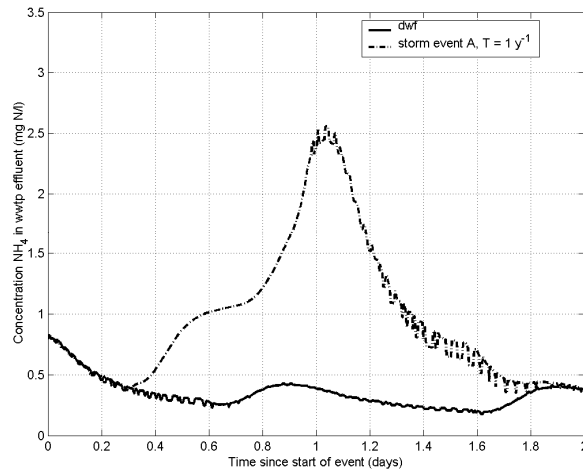
- 1 clear location
- visible
- High tech
- Microbiology/procestechnology
- waterboard
- Service life 20 year
- Up to 3-4* DWF



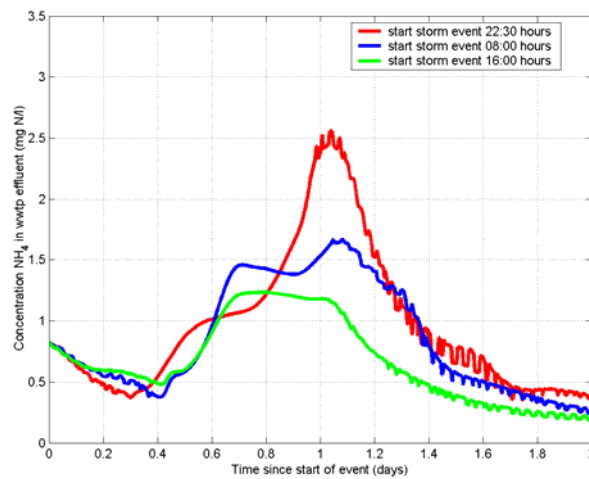
Example



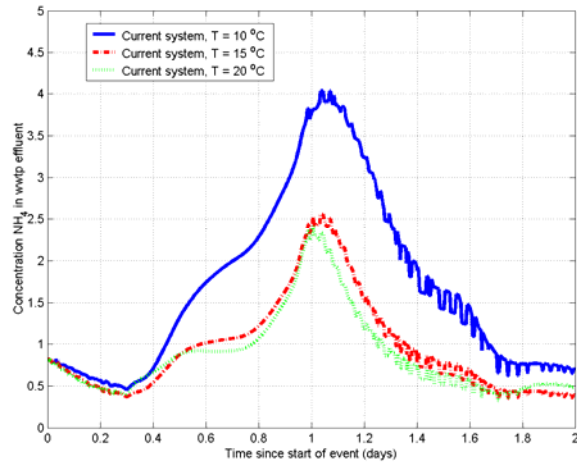
Impact of storm event



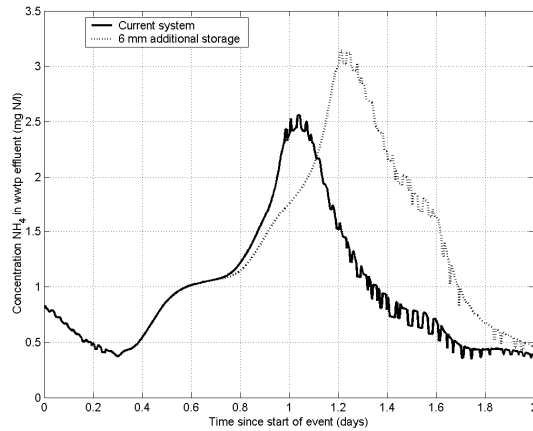
Impact of timing of storm event



Impact of temperature



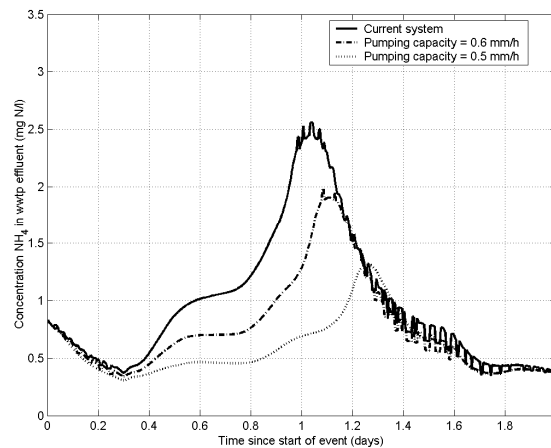
Impact of additional storage in sewer



Impact of storage on loads

Point of discharge	Ammonium load (kg NH ₄ -N)		N _{total} load (kg N)		COD _{biodegradable} load (kg COD)	
	current system	6 mm additional storage	current system	6 mm additional storage	current system	6 mm additional storage
CSO load	13	2	23	4	154	25
wwtp load	36	58	239	326	79	95
total load	49	60	262	330	233	120

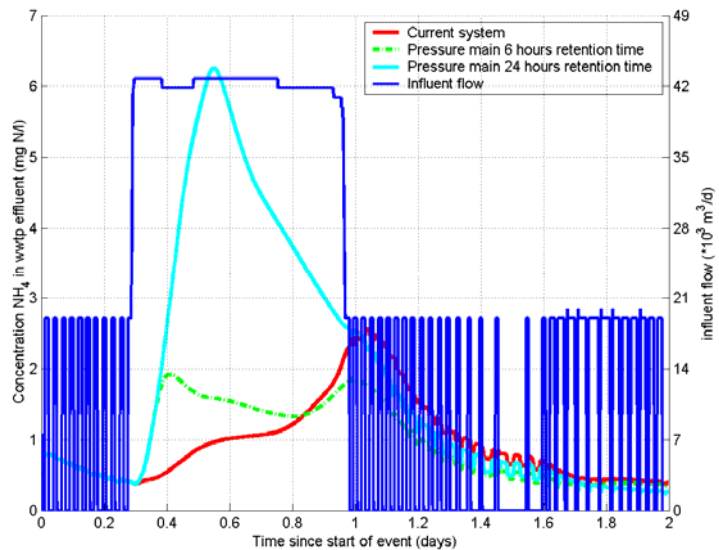
Impact of pumping capacity



Impact of pumping capacity on loads

Point of discharge	Ammonium load (kg NH ₄ -N)			N _{total} load (kg N)			COD _{biodegradable} load (kg COD)		
	current system	0.6 mm/h	0.5 mm/h	current system	0.6 mm/h	0.5 mm/h	current system	0.6 mm/h	0.5 mm/h
CSO load	13	14	16	23	24	29	154	164	196
wwtp load	36	28	19	239	207	176	79	74	69
total load	49	42	35	262	231	204	233	238	264

Impact of pressure main



Impact of pressure main

Point of discharge	Ammonium load (kg NH ₄ -N)			N _{total} load (kg N)			COD _{biodegradable} load (kg COD)		
	current system	6 h	24 h	current system	6 h	24 h	current system	6 h	24 h
CSO load	13	13	13	23	23	23	154	154	154
wwtp load	36	49	118	239	236	268	79	97	200
total load	49	62	131	262	258	291	233	251	354

Conclusions of example

- Timing of storm event determines impact – diurnal pattern, seasonal variation
- wwtp is part of wastewater system: anything you do in one part influences the other parts
- The effect of measures for optimization in a wastewater system depends on the selected parameter