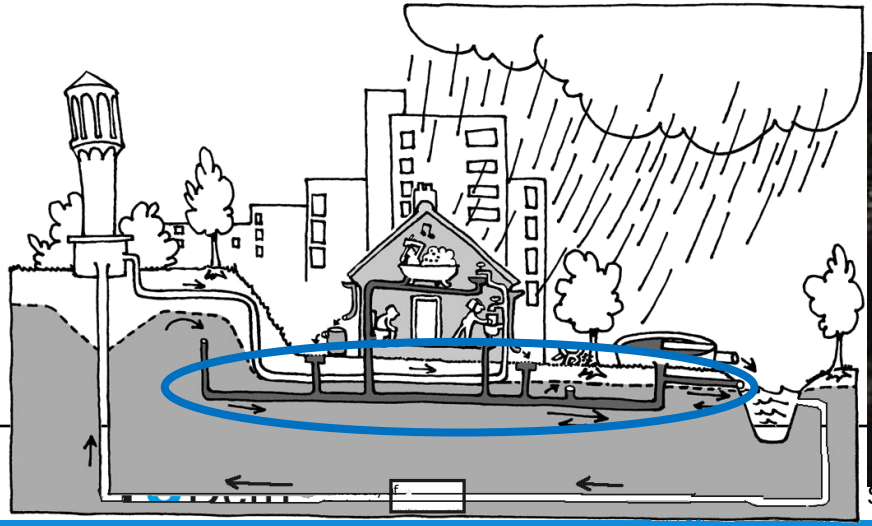
CIE4491 Urban Drainage and Watermanagement

Marie-claire ten Veldhuis, Watermanagement Dep., Sanitary Engineering Section

17-9-2013



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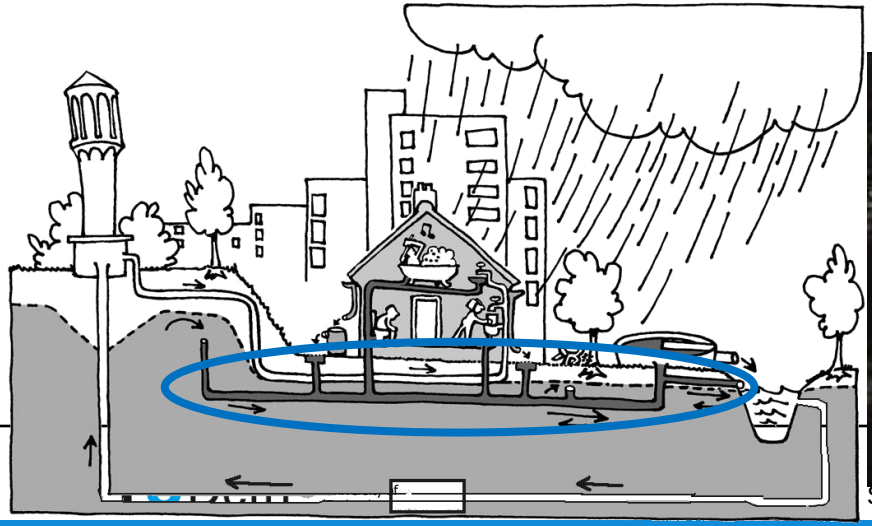
CIE4491

Lecture. Urban Water System Requirements

Marie-claire ten Veldhuis

17-9-2013



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Urban water systems - objectives and requirements

Think of your (to be) assignment area: what objectives should your system fulfil?

Objectives:

-
-
-

Urban water systems - objectives and requirements

Objectives:

- Protect public health
- Prevent flooding
- Prevent environmental pollution

System Requirements:

1.
2.
3.

Urban water systems - objectives and requirements

Think of your (to be) assignment area: how can you check these objectives?

Objectives:

- Protect public health
- Prevent flooding
- Prevent environmental pollution

System Requirements:

1.
2.
3.

How will you check whether your system design meets the requirements?

Urban water systems - objectives and requirements

Objectives:

- Protect public health
- Prevent flooding
- Prevent environmental pollution

System Requirements:

1. Prevent exposure to wastewater
2.
3.

Urban water systems - objectives and requirements

Objectives:

- Protect public health
- Prevent flooding
- Prevent environmental pollution

System Requirements:

1. Prevent exposure to wastewater
2. Acceptable flood risk
3.

Urban water systems - objectives and requirements

Objectives:

- Protect public health
- Prevent flooding
- Prevent environmental pollution

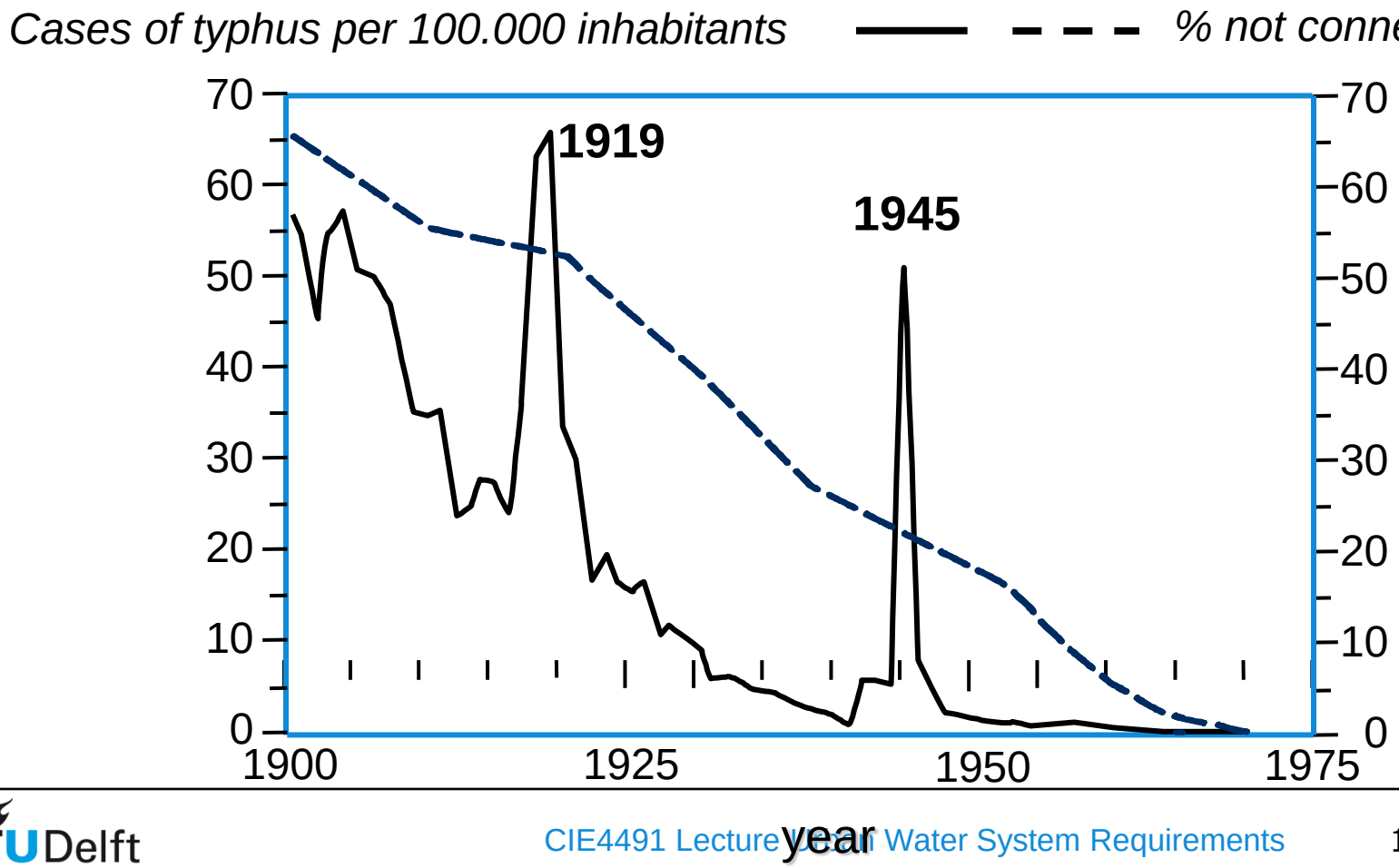
System Requirements:

1. Prevent exposure to wastewater: acceptable health risk
2. Acceptable flood risk
3. Acceptable pollution of environment: surface water, groundwater

Public health, exposure to wastewater, health risk assessment

Public health and sanitation

→ Aim at 0 exposure to wastewater

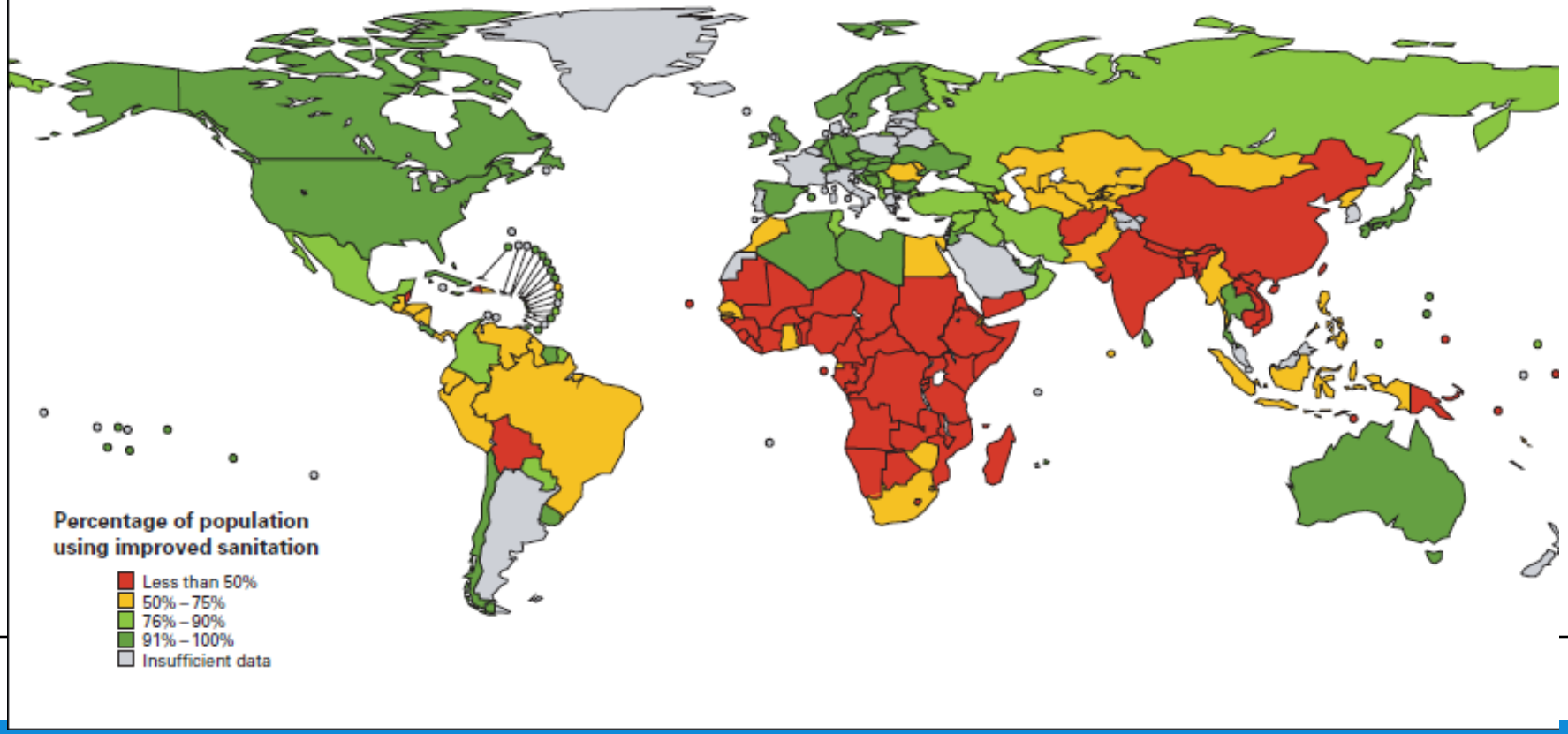


Millenium Development Goals

Target 7c: Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation

Half the developing world are still without improved sanitation

FIGURE 7 Sanitation coverage in 2002



Urban Water system requirements – Exposure to wastewater

Western world: 98% connection of households to sewer systems

→ 0 exposure to wastewater?

Urban Water system requirements – Exposure to wastewater

Potential exposure to contaminated water in urban environment:

Urban Water system requirements – Exposure to wastewater

Potential exposure to contaminated water in urban environment:

Combined sewer overflows in the Netherlands

Petten

Breda

Urban Water system requirements – Exposure to wastewater

Potential exposure to contaminated water in urban environment:

Combined sewer flooding

Rotterdam, Coolsingel

Urban Water system requirements – Exposure to wastewater

Individual assignment – design choices for your system and relations to health risks:

- Combined vs separate system
- Stormwater facilities – green roofs, infiltration systems, surface water storage, water squares

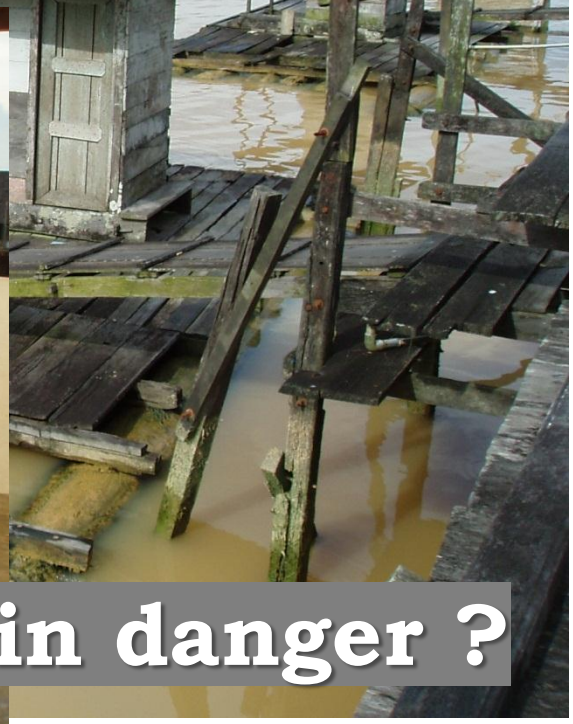
Urban Water system requirements – Exposure to wastewater

Potential exposure to contaminated water in urban environment:

- Combined: sewer flooding, combined sewer overflows
- Separate: illicit connections, wastewater to stormwater
- Stormwater facilities: illicit connnections, wastewater from other urban dwellers

Urban dwellers…

Exposure versus health risk



Is their health in danger ?

How to quantify public health risk related to wastewater exposure ?

How to quantify public health risk related to wastewater exposure ?

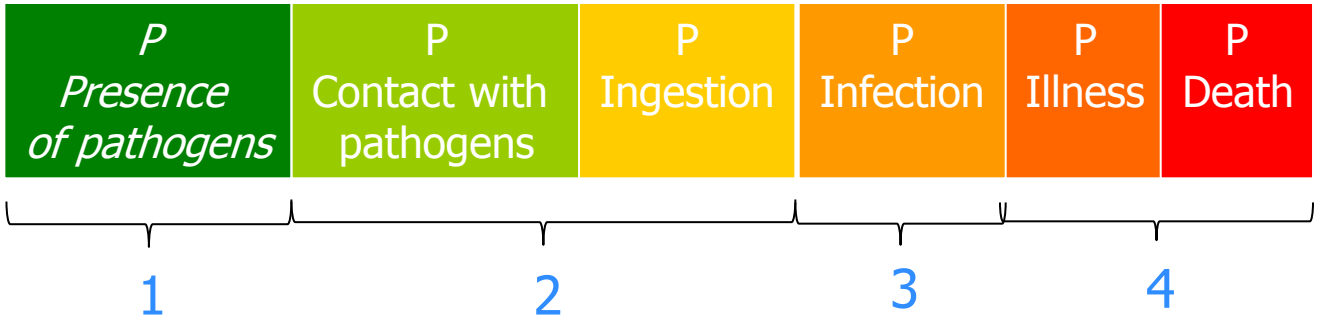
1. Epidemiological studies
   Difficult: Main effect of wastewater exposure = gastro-enteritis
   → How to collect data, if most cases not reported ?
   → How to distinguish between sources of pathogens (urban dwellers)?

2. Quantitative microbial risk assessment (QMRA)

Quantitative Microbial Risk Assessment (QMRA)

QMRA consists of four steps:

1. Hazard identification
2. Exposure assessment
3. Dose-response relations
4. Risk characterization



QMRA, example

1. Hazard ?
2. Exposure?
3. Dose-response?
4. Risk?

QMRA, example exercise, in pairs:

1. Hazard ?
   Define source of health risk
   Hint: where do pathogens come from?
2. Exposure?
   Define exposure
   Hint: how people get in contact w pathogens
3. Dose-response?
   Determine dose + define dose-response relationship
   Hint: dose = nr of pathogens, think of how to study probability of infection
4. Risk?
   How to quantify overall risk for such event
   Hint: think of event frequency, people density

QMRA, example, answers

1. Hazard ?
   Combined sewer flooding: pathogens in water on the street

2. Exposure?
   Ingestion of splash water from cars, bicycles

3. Dose-response?

4. Risk?

QMRA, example, answers

1. Hazard ?
   Combined sewer flooding: pathogens in water on the street

2. Exposure?
   Ingestion of splash water from cars, bicycles

3. Dose-response?
   Dose: *take samples: analyse concentrations of pathogens*
   *Estimate: volume of water ingested – Dose=C_{path}*$V_{ingested}$*
   *Dose-response relationship: I=f(C*Volume)*
   I: infection probablity, C: pathogen concentration, V: ingested volume
4. Risk?

QMRA, example, answers

1. Hazard ?
   Combined sewer flooding: pathogens in water on the street

2. Exposure?
   Ingestion of splash water from cars, bicycles

3. Dose-response?
   Dose: *take samples: analyse concentrations of pathogens*
   *Estimate: volume of water ingested – Dose=C_{path}*$V_{ingested}$*
   *Dose-response relationship: I=f(C*Volume)*
   I: infection probablity, C: pathogen concentration, V: ingested volume
4. Risk?
   Estimate: nr of people exposed ; Exposure frequency (events/year)
   Risk = INr_{exp}*$Freq_{exp}$*

QMRA, example

1. Hazard ?
   Combined sewer flooding: pathogens in water on the street
2. Exposure?
   Ingestion of splash water from cars, bicycles
3. Dose-response?
   Take samples: analyse concentrations of pathogens
   Estimate: volume of water ingested
   *Calculate from dose-response relationship: I=f(C*Volume)*

Interested in this topic?

- CIE5420 Public Hygiene and Epidemiology

Risk = $I*Nr_{exp}*Freq_{exp}$

Prevent urban flooding – acceptable flood risk

Urban water systems - objectives and requirements

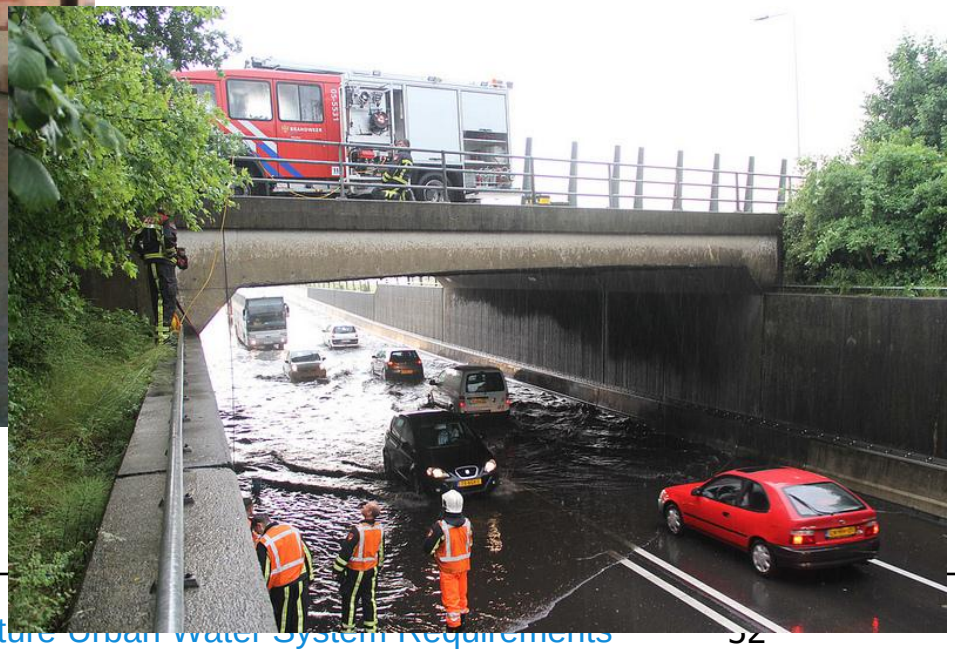
Objectives:

- Protect public health
- Prevent flooding
- Prevent environmental pollution

System Requirements:

1. Prevent exposure to wastewater
2. **Acceptable flood risk**
3. Acceptable pollution of environment: surface water, groundwater

Is this acceptable?



Enschede, 20 juni 2013: 49.6 mm
Normal June precip 79 mm

Is this acceptable?

Jakarta, 17 January 2013: 120 mm
Normal Jan precip 385 mm
(monsoon rains)

Acceptable flood risk:

How to set a standard?

Flood risk: Risk = Probability * Consequences

Probability: usually expressed as return period (not more than once every .. years)

Probability of what?

Acceptable flood risk:

How to set a standard?

Flood risk: Risk = Probability * Consequences

Probability: usually expressed as return period (not more than once every .. years)

Probability of what?

Verification? Water level, flood extent, rainfall intensity/volume,

Acceptable flood risk:

How to set a standard?

Flood risk: Risk = Probability * Consequences

Consequences: damage, casualties, traffic delays,..

Verification? Data on damage, casualties, traffic delays ?

➢More in: lecture 3.1: Urban flooding and flood damage estimation

Acceptable flood risk:

Current practice + in your assignment:

Design based on return period of rainfall

- More in: lecture 2.1: IDF curves, design storms

Prevent environmental pollution from urban drainage systems:
Limit spills of polluted water to surface water, soil, groundwater

Urban water systems - objectives and requirements

Objectives:

- Protect public health
- Prevent flooding
- Prevent environmental pollution

System Requirements:

1. Prevent exposure to wastewater
2. Acceptable flood risk
3. **Acceptable pollution of environment: surface water, groundwater**

Acceptable pollution risk

Remember QMRA?

1. Hazard identification ?
2. Exposure assessment ?
3. Dose-response relations ?
4. Risk characterization ?

Acceptable pollution risk

Remember QMRA?

1.	Hazard identification	Focus: CSO-s
2.	Exposure assessment	?
3.	Dose-response relations	?
4.	Risk characterization	?

Acceptable pollution risk

Remember QMRA?

1.	Hazard identification	Focus: CSO-s
2.	Exposure assessment	Focus: surface waters
3.	Dose-response relations	?
4.	Risk characterization	?

Acceptable pollution risk

Remember QMRA?

1.	Hazard identification	Focus: CSO-s
2.	Exposure assessment	Focus: surface waters
3.	Dose-response relations	?
4.	Risk characterization	?

EU Water Framework Directive: achieve "good ecological and chemical status" of water systems

NB: little data about dose (pollution loads) and response (surface water quality)…

Acceptable pollution risk

In practice: Two approaches

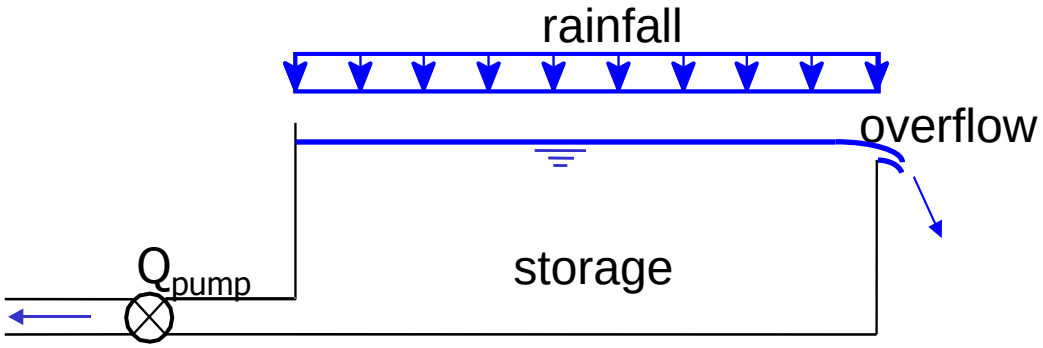
1. Bathtub approach (only in the Netherlands)
2. Hydrodynamic modelling

Acceptable pollution risk

In practice: Two approaches

1. Bathtub approach (only in the Netherlands, up to ca. 2000)

"Basic effort": 7 mm storage + 0.7 mm/h pumping capacity for stormwater



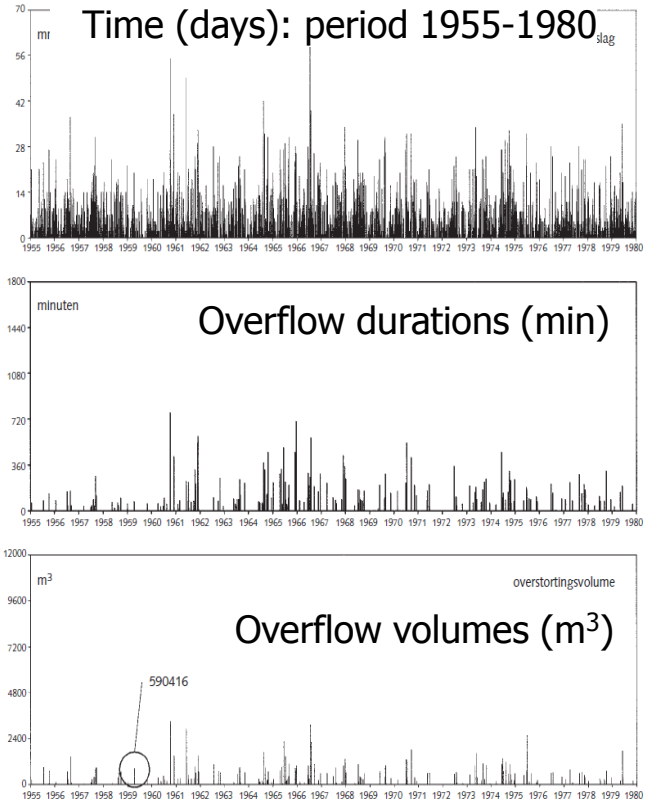
Acceptable pollution risk

In practice: Two approaches

1. Bathtub approach (only in the Netherlands)
2. Hydrodynamic modelling

Hydrodynamic calculations with simulation model
Rainfall period 25 years

Outcome = Combined sewer overflow volumes: multiply by average COD concentration for pollution load



➢ More in: Sobek workshop, week 4 (24 Sept)

Design requirements - Environmental impacts of urban drainage systems

- Combined sewer system: combined sewer overflows to surface water
- Separate sewer system: stormwater outlets to surface water
- Combined and separate system: wastewater treatment plant effluent
- Infiltration systems: stormwater to groundwater


Olofsbuurt
Westerkwartier
Poptahof
Course CIE 4491
Fundamentals of Urban Drainage
Reconstruction of the sewer system of the Olofsbuurt in Delft
Assignment report
Paul Strohschein 4129318
Supervisor: Nikola Stanic
Date of submission: [06-03-2013]
TU Delft
Faculty of Civil Engineering
Department of Water Management
Challenge the future
Westerkwartier
Design assignment
Course CIE4491 Fundamentals of Urban Drainage
Author M.J. Pruijssen (4011561)
Instructor Dr. Ir. J.A.E. ten Veldhuis
Supervisor J.A.B. Post
Date 6 April 2013
Design assignment
Poptahof
CIE4491 Fundamentals of Urban Drainage
Oude Kerk
Nieuwe Kerk
Delft
Hugo de Grootplein
Legermuseum
Westvest
Oude Delft
Hoornkade
Phoenixstraat
Koornmarkt
Kloksteeg
Smitsteeg
Raamstraat
Poptahof Noord
Akropolis
Troelstralaan
Martinus Nijhoffiaan
Aart van der Leeuwlaan
Rotterdamseweg
Rijnweg

Design assignment, this week:

- Choose area: Poptahof/Olofsbuurt/Westerkwartier
- Read manual (download from BB)
- Study area characteristics, specific requirements
- Choose type of system/system components for wastewater and stormwater drainage
- Sketch system layout for design area

Poptahof

Olofsbuurt

Course CIE 4491
Fundamentals of Urban Drainage

Design assignment
Poptahof
CIE4491 Fundamentals of Urban Drainage

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