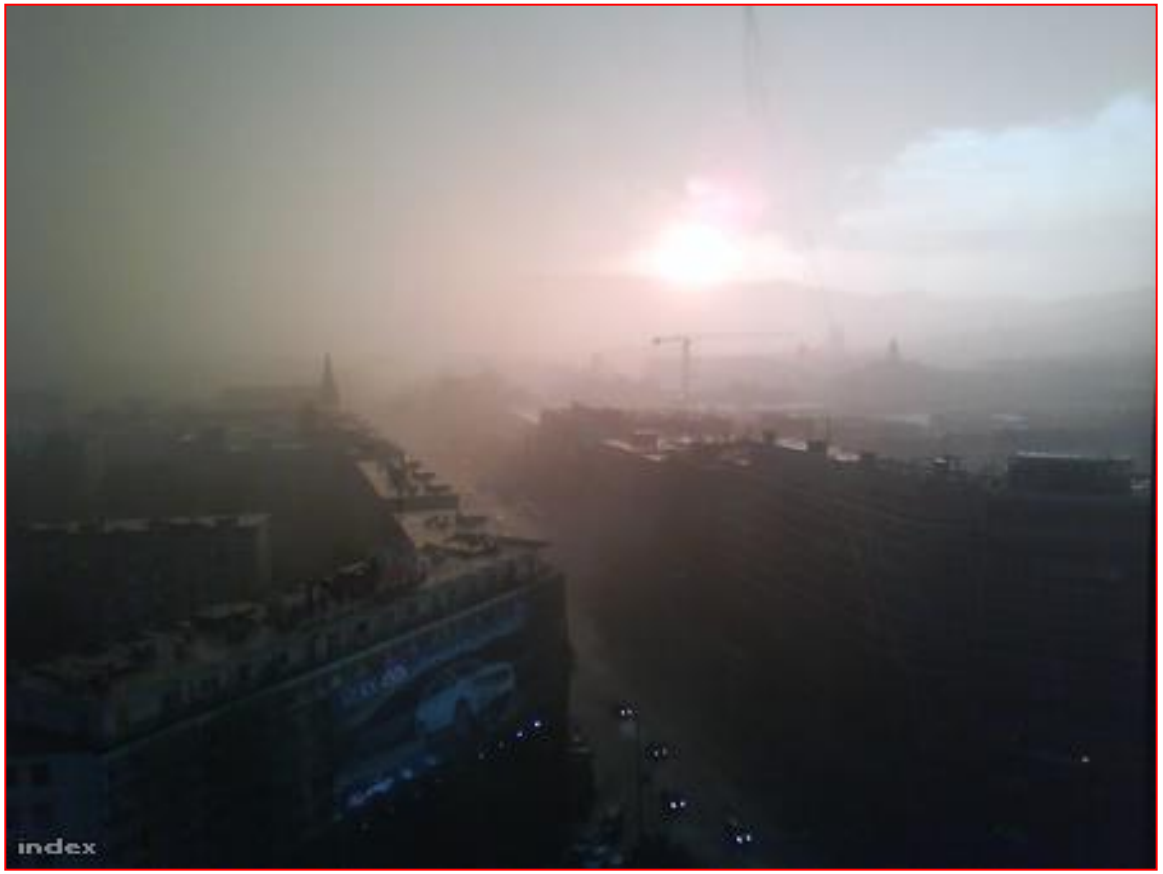
WATER MANAGEMENT AND CLIMATE CHANGE
BUDAPEST



Rácz, Tibor
head of Flood Control Department
Budapest Sewage Works Pte. Ltd.

Water management in urban environment

MOST IMPORTANT ISSUES

Water supply (drinking water & industrial water)

wastewater drainage and treatment

Rainwater management

Groundwater management

Flood protection

Climate Change: Probable Scenario for Budapest and its waters

Temperature: In Middle Europe the temperature increases in every seasons.(1-2˚C to 2050, 3-4˚C to 2100)

Precipitation:

- The average sum will not change significantly, winter will be more wet,
- The other seasons remain cca similar or dryer
- The rain will fall mainly from convective storms
- The distribution of precipitation will less equal

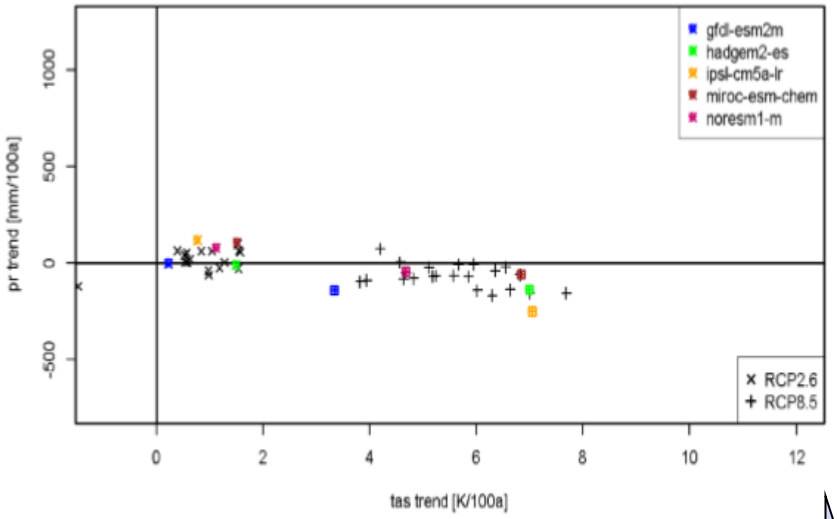
River Flood Characteristics of Danube Climate Change effects

Precipitation in Middle Europe in the XXI century:

Summer half year: decreasing precipitation

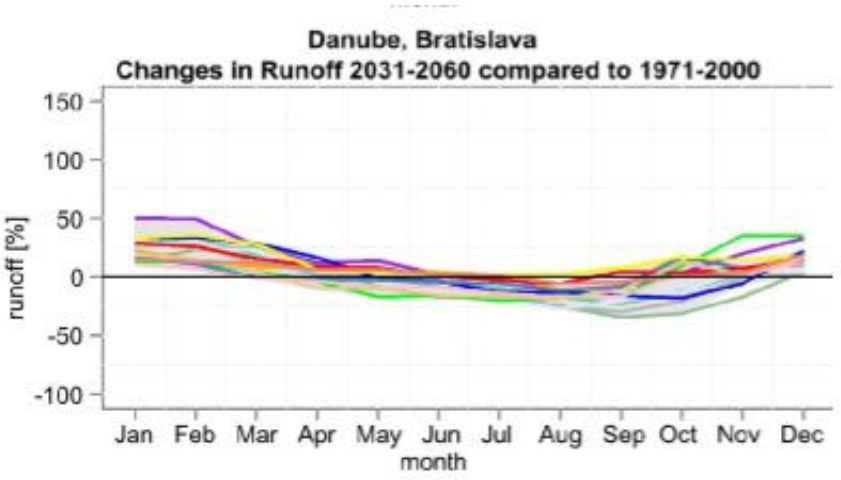
Winter half year: increasing precipitation

The change of the sum of yearly rainfall will not be significant



Probable precipitation trends of different climate models for the Danube basin in the XXI century

Probable yearly runoff trends of different climat models for the Danube (Bratislava) in the XXI century



(Stangl-Hattermann: Impacts of Climate Change on the Hydrological Regime of the Danube River and Its Tributaries Using an Ensemble of Climate ScenariosPotsdam Institute of Climate Change, 2015, Potsdam Institute for Climate Impact Research)

Climate change impact on urban water management

Water supply: quantity and quality problems

Wastewater: sedimentation and sewer odour

Rainwater: more frequent heavy rainfalls and droughts

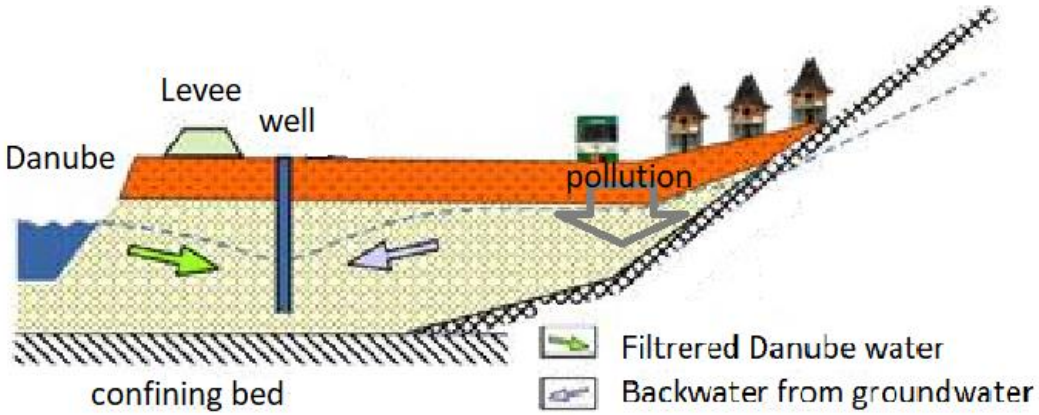
Groundwater: decreasing groundwater table

Flood protection: frequent urban floods

Different weights of climate change on these issues in different territories and cities

Water Supply and Climate Change

Danube valley:
alluvial sediments, sandy gravel



Bank Filtration Water – main water resource of water supply, „disinfectation only" quality

Dependency of Danube water level:

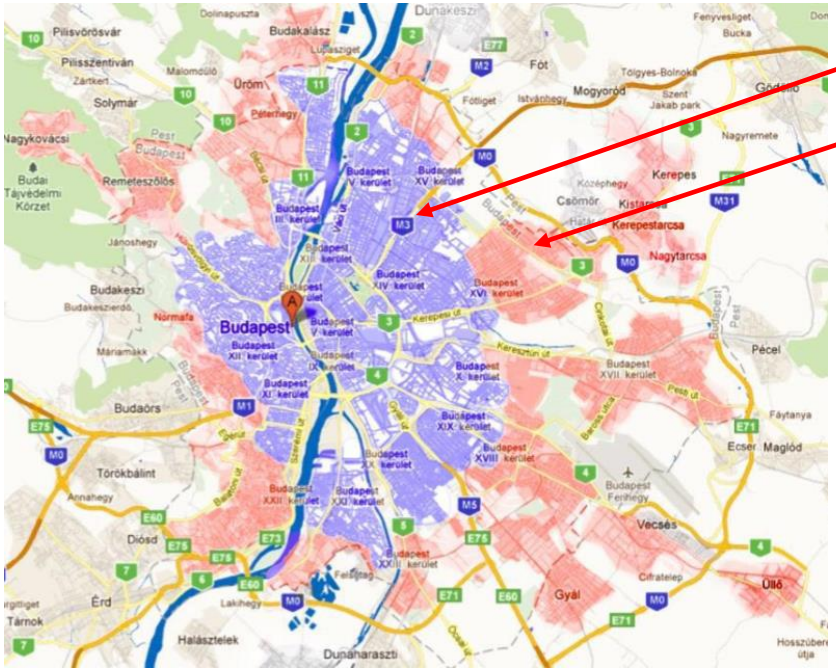
High water or flood → less effectiveness of bank filtering, pollution, inundation of well area, pending of water production

Low water → high percentage of polluted backwater (quality problem), less quantity of wells

Climate change effect: more frequent drought with low water
more frequent quality and quantity problems

Wastewater Management and Climate Change

The sewerage covers 100% of Budapest



Combined sewer system: in the downtown

Separate sewer system: in the outskirts

Operational problems of sewers:

Combined system:

In dry weather the sewers smell,
In stormy weather there are Combined Sewer Overflows (CSO)

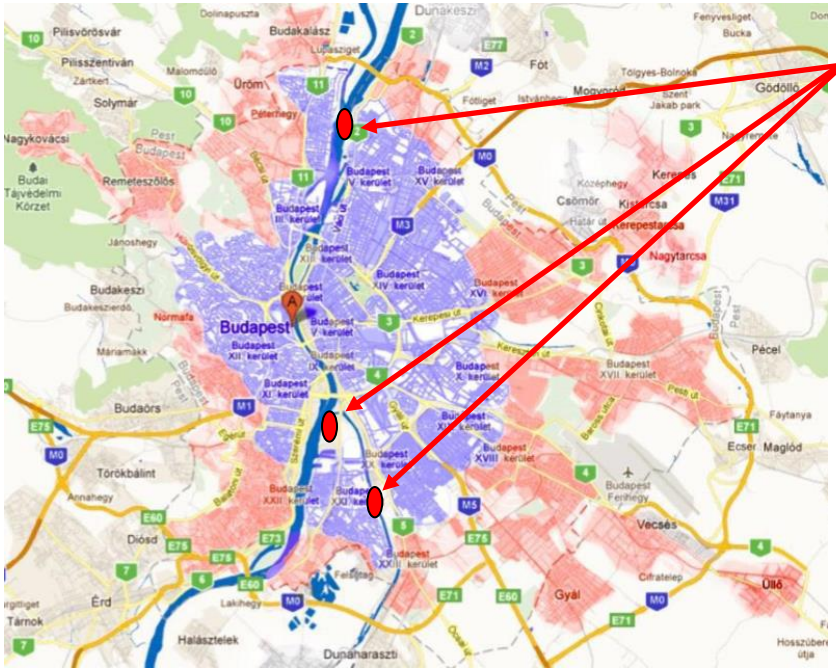
Separate system:

Illegal rainwater intakes, CSO-s in stormy weather! **Lack of rainwater sewers** in several parts of Budapest!

Climate change effect: more frequent extreme rainfalls
more frequent CSO-s,
pollution of surface waters

Wastewater Management and Climate Change

The 100% of sewage of Budapest is cleaned



Wastewater treatment plants

<u>Higher air temperure</u>

Higher tempreture of wastewater, esp. in summer,

<u>Storms, hydraulic overloads</u>

Frequent danger of flushing of living sludge

Stormwater reservoires, bypasses

<u>Increasing depuration demand</u>

Drought – frequent low waters in recipient watercourses

Rainwater drainage and Climate Change

Problem:

Management of extreme surface runoff

Over 20 mm/h intensity: sporadic local damages

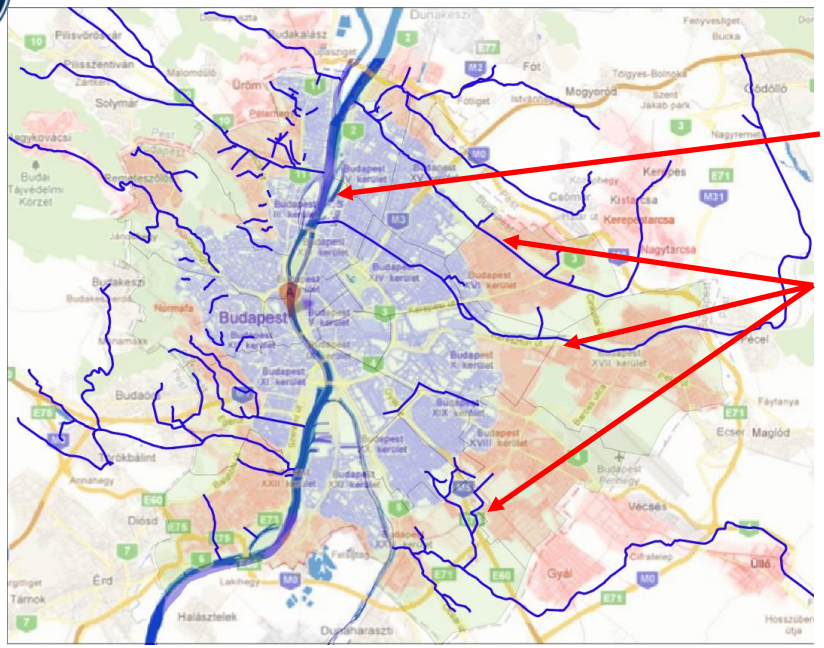
Over 40 mm/h intensity: several damages

Over 100 mm/h intensity: heavy inundations for hours, several damages in drainage system

(even if the recipients are ready to convey the water…)

FOR THESE STORMS THE SUDS SOLUTIONS ARE NOT SUFFICENT, THE WATER MUST BE TAKEN AWAY FROM T

Rainwater drainage and Climate Change



Recipients of rainwater:

Danube – combined and separated systems

Smaller watercourses – separated systems

Soil – not collected rainwater

Dependecy on recipient's water level

Combined system - Separate system:

Low Danube level:

storm-water regulators or free rainwater outlets

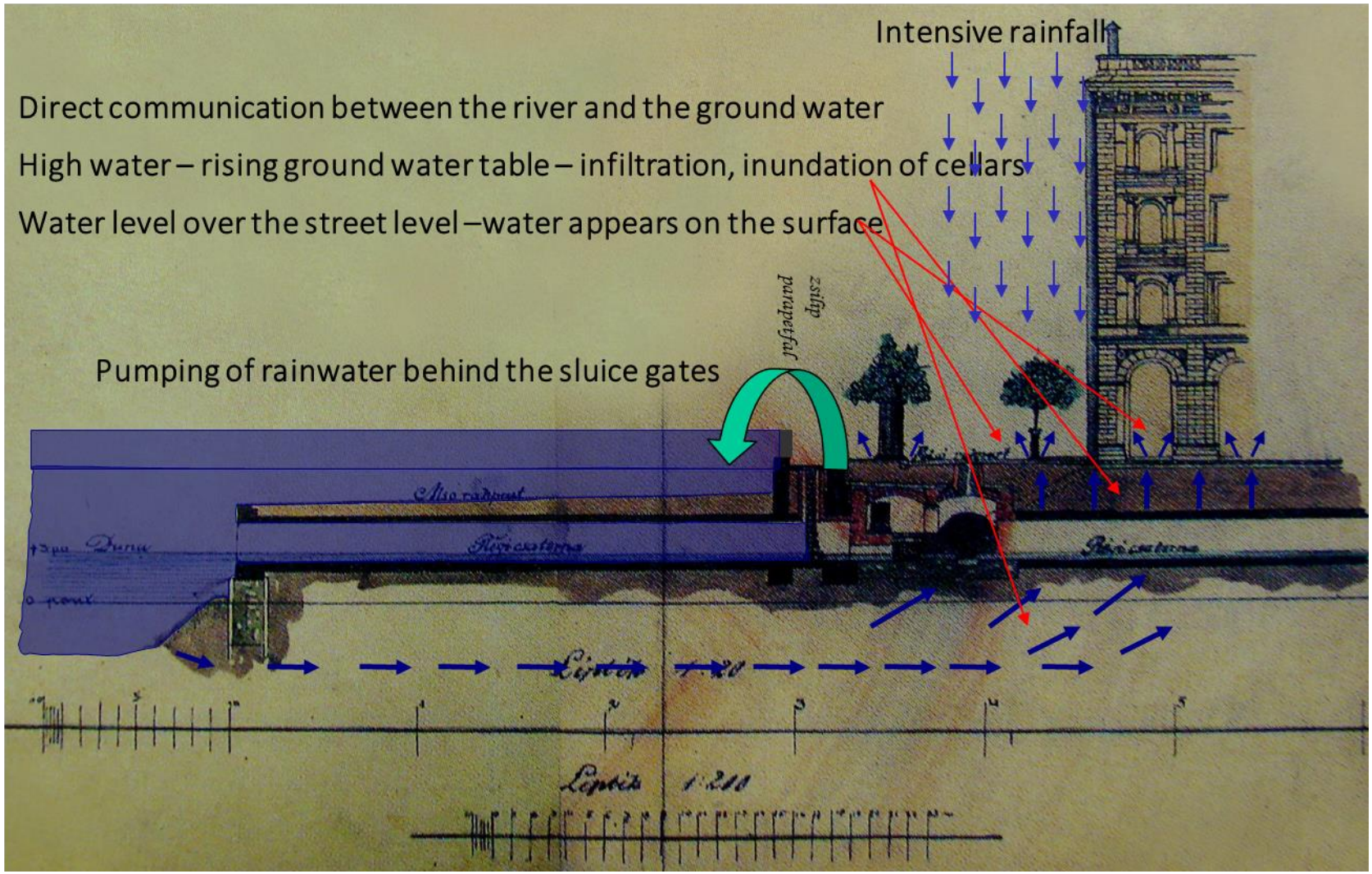
High Danube level:

Closed storm-water regulators, operation of pumping stations

→ TEMPORARILY LIMITED DARINAGE CAPACITY

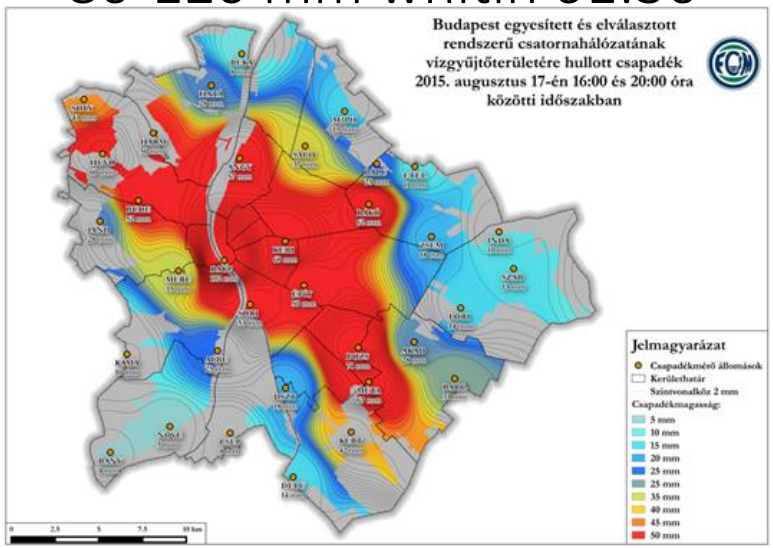
Rainwater drainage and Climate Change

Flood protection of cities – combination of flood with rainfall



Rainwater drainage and Climate Change

Extreme storm in 17/08/2015, 80-120 mm whitin 01:30



Rainwater drainage and Climate Change

Smaller Watercourses Recipients of Separated Rainwater Systems

Climate Change impacts:

Increasing hydrological load

- decreasing of peak discharges (SUDS solutions, reservoires, infiltrating of rainwater)
- enlargement of river cross sections (+revitalization)
- improvement of flood or complex use reservoires

Results:

Beginning of renewal of two watercourses (masterplan level)

Difficulties:

- Legal, administrative limitations
- Contrary to demands (technical-social-legal)

Rainwater drainage and Climate Change

Soil as Recipient of Rainwater

- Original solution, in outskirt districts it was common
- The legal rules aim the use of infiltrating of rainwater
- For intensive rainfall it is not enough, canalisation or reservoires (ponds) are needed

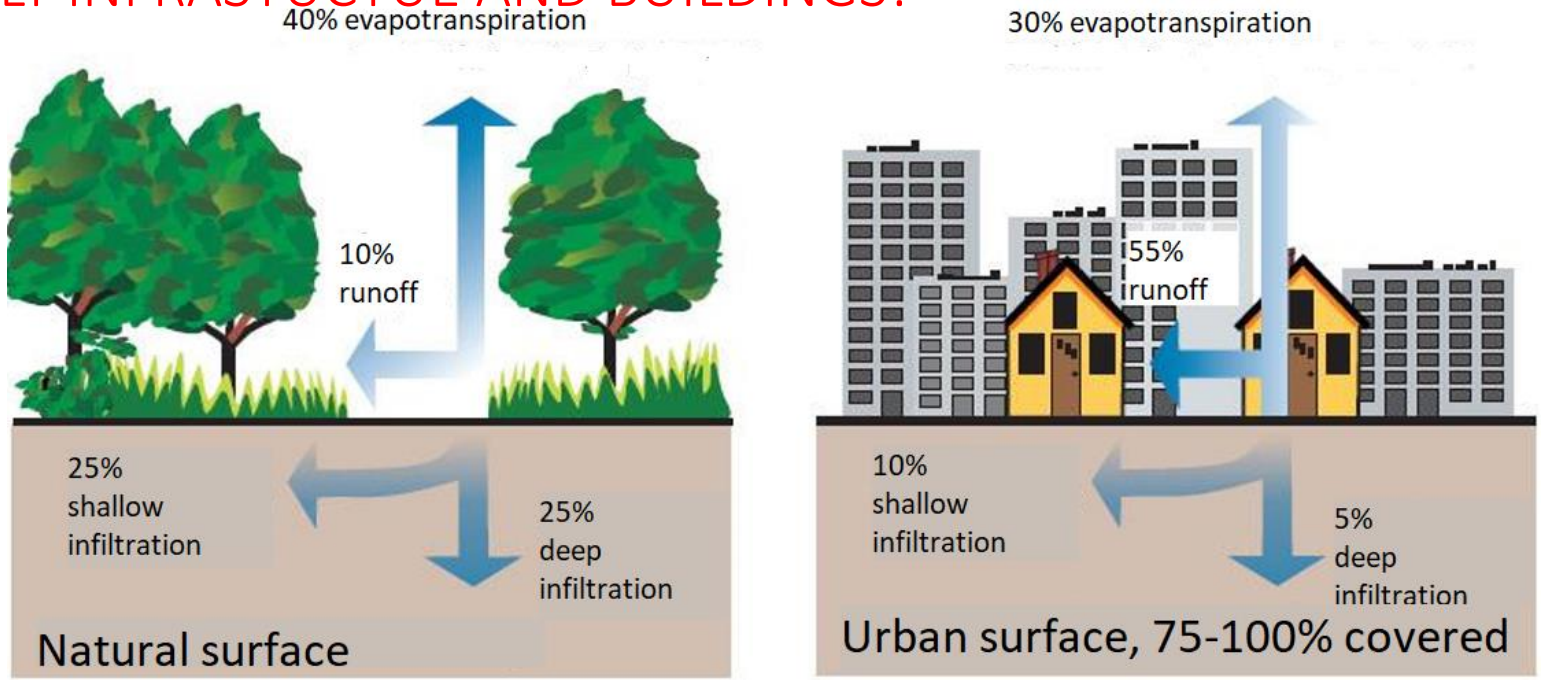
Groundwater and Climate Change

The groundwater supply is decreased by impermeable urban surface

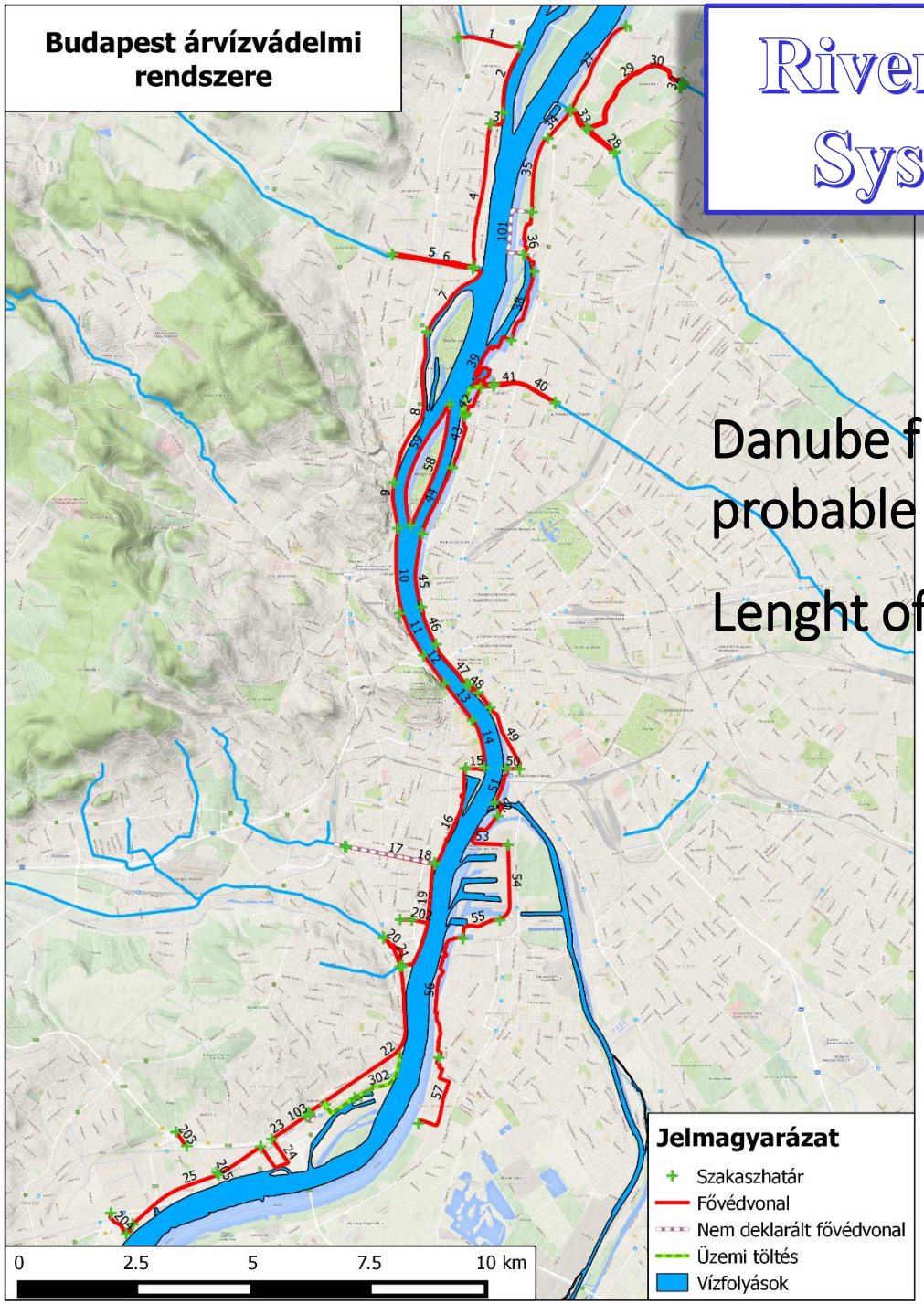
Less groundwater cannot supply the trees, parks further maintenance (or change to resistent plants) is needed

Dangerous for Green Infrastructure Services

IRREGULATED SUPPLY OF GROUNDWATER CAN CAUSE DAMAGES IN BUILT INFRASTUCTUE AND BUILDINGS!



River Flood Protection System of Budapest



Danube flood – greatest source of a probable natural disaster

Lenght of levees: 90 km

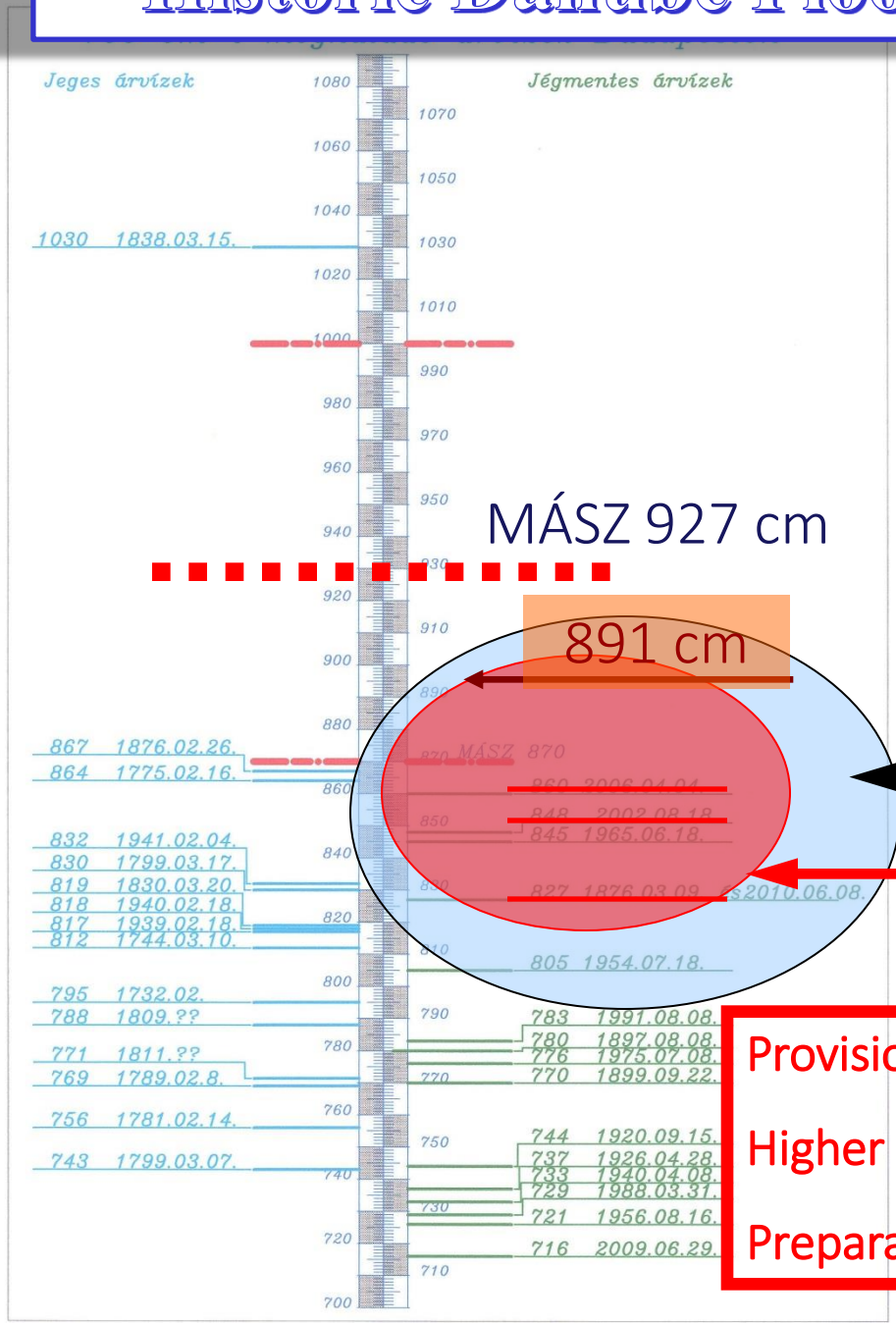
River Flood Characteristics of Danube

Danube flood - Fluvial flooding occurs as a result of sustained or intense rainfall or snow melting **in the Alps and Carpathians**.
(duration: days, often weeks)

Characteristics:

- Result of **regional hydrologic events**
- Possibility of **forecast (4-6 days)**
- **Preventive structures** (levees, flood protection walls)

Historic Danube Floods - Some Changes



Ice jam caused floods:

- Over 800 cm: 9 times
- The last one occured in 1956

2013.06.04:

891 cm: The 2nd greatest flood at Budapest

Free flowing floods:

- Over 800 cm: 7 times
- Since 2002 4 floods exceeded 800 cm

Provision:

Higher design flood level: +57 cm (927cm)

Preparation of projects to increase the levees

Flash Floods - Climate Changes

Flash Flooding – result of heavy, extreme rainfall on smaller rivers or ditches; very fast phenomenon, fast developing intensive flood.
(duration: hours, sometimes more than one day)
Strongly related to climate change

Characteristics:

- Duration: **hours**
- Result of **local hydrologic events**
- Only protection: building of **preventive structures** (levees, flood protection walls)
- **No way of building temporary constructions** (temp. dykes)
- **Fast formation of debris or sediment dams** ➡ exteme inundation

„The rain will fall mainly from convective storms"

more frequent great storms – more frequent flash floods

Provision:

Preparation of projects to increase the capacities of watercourse

Preparation of decreasing of runoff (flood reservoires)

Summary

The Climate Change related issues of urban water management are recognised

There are several projects to be start or developed by this guideline

The change of philosophy needs time, decision makers are to be covinced

THANK YOU FOR THE ATTENTION!