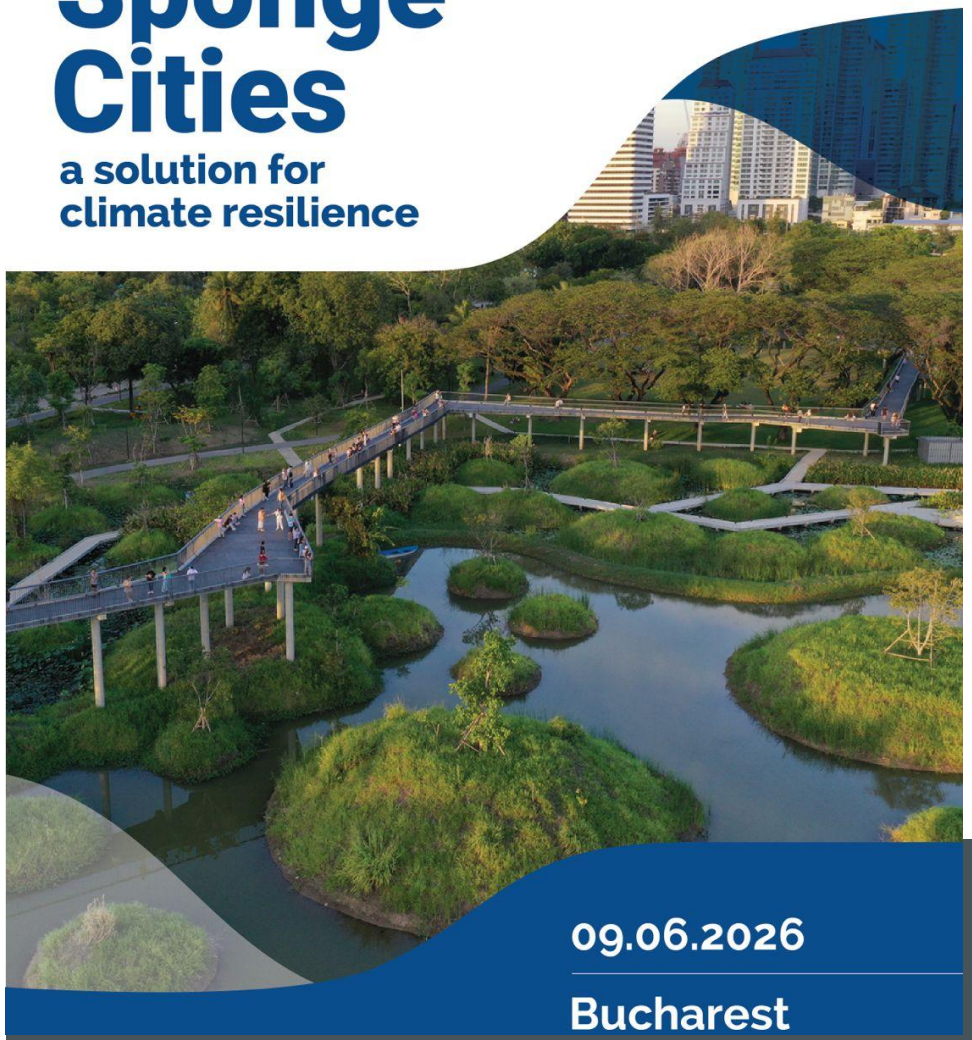
INTERNATIONAL CONFERENCE

ARA Asociația Română a Apei | Consiliul Tehnico-Științific

Sponge Cities

a solution for climate resilience



09.06.2026

Bucharest

35 Years of Stormwater Management in Europe

from Urban Drainage to Urban Water Resources Management

Prof. Dr. Ing. Ulrich Dittmer

University of Kaiserslautern–Landau (RPTU), Germany

CONTENT

- Paradimgs in Stormwater Management
- Looking Back
- Looking Ahead
- Final Remarks

CONTENT

- **Paradimgs in Stormwater Management**
- Looking Back
- Looking Ahead
- Final Remarks

PARADIGM SHIFTS IN STORMWATER MANAGEMENT

- What is a paradigm?

  "A paradigm is a shared set of **assumptions**, concepts, values, and practices that constitutes a framework for viewing reality and solving problems within a group or discipline.

  Paradigms act as (…) **subconscious** filters that dictate habits, behavior, and interpretations (…)." *Gemini, 2026*

PARADIGM SHIFTS IN STORMWATER MANAGEMENT

- How do paradigms shift?

  "When a paradigm ***produces unfavorable results***, it may undergo a "paradigm shift," which is a fundamental change in basic assumptions."

- Stormwater Management
  - No strong, definite evidence of „failure"
  - Incomplete observation of the „experiment"
  - Consolidation of negative experience

→ Are we shifting in the right direction?

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- Paradimgs in Stormwater Management
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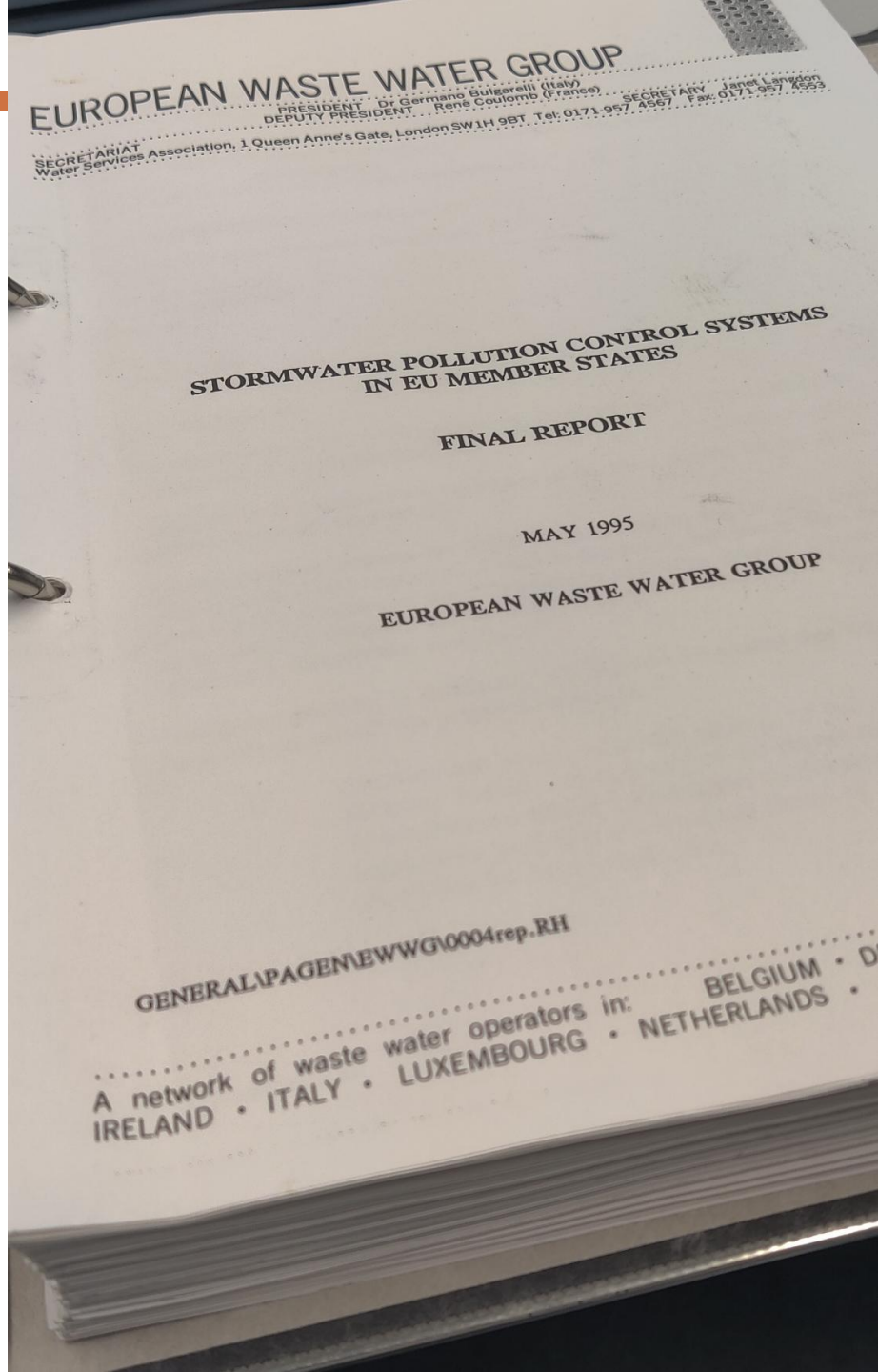
35 YEARS AGO – STATUS QUO

Paradigms in practice
Urban areas have to be drained fast and completely
The main concern regarding water pollution are CSO
Pollution of surface runoff is in general harmless



35 YEARS AGO – STATUS QUO

Paradigms in practice	Consequences
Urban areas have to be drained fast and completely	Underground drainage systems
The main concern regarding water pollution are CSO	Regulations in certain member states only for CSO
Pollution of surface runoff is in general harmless	No regulations on stormwater Dilution as main criterion for CSO

Development in early 90s: Paradigms are being questioned

IMPLEMENTATION OF „NEW CONCEPTS“

- New paradigm:

  Source control systems can substitute conventional drainage

  … with lower environmental impact

  … at the same „service level“.

Goal: Reduction of runoff

Bioretention (=infiltration) systems

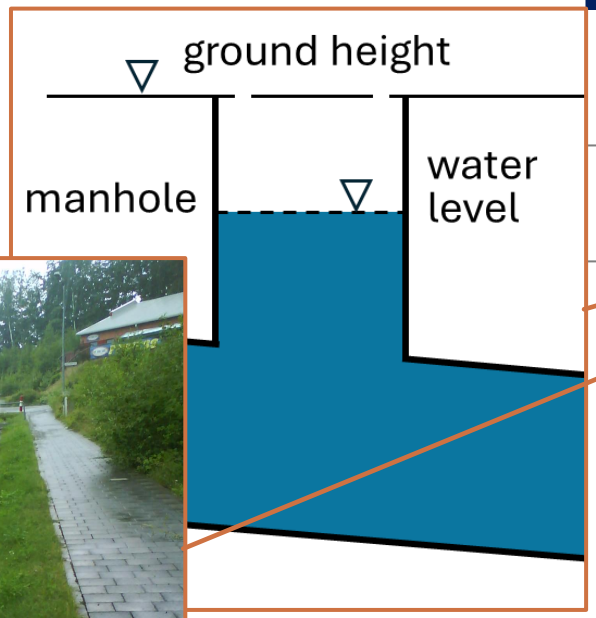
→ Design Storms: around T = 5 a

→ Required area: 10 – 20 % of A_{imp}

Source: RPTU (2009), PRE-Park K´lautern

lhallenplatz

CONSIDERING EXTREME EVENTS



Task	Flood Prevention		Risk Management
Weather or climate data *)	design storm T ≈ 5 a	intense storm T ≈ 10 to 50 a	extreme storm T > 50 a
Goal	*No surcharge*	*No damage by floods*	*Mitigate damage*

DWA, 2008 (modified)

*) *characterization not translated literally*

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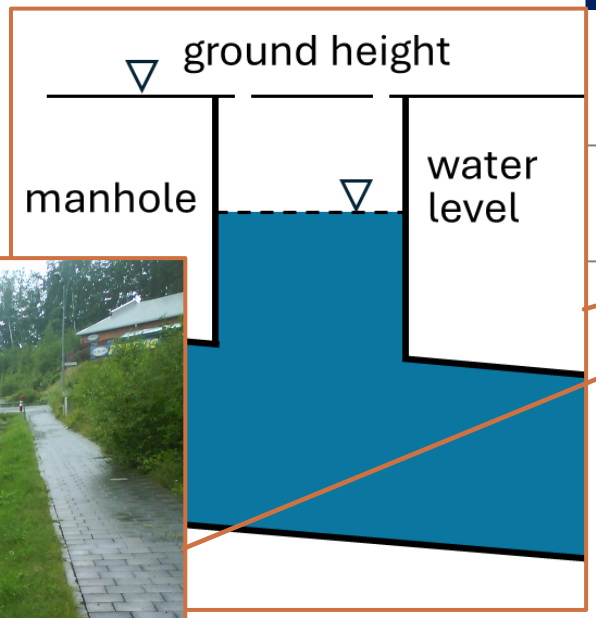

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Measures			

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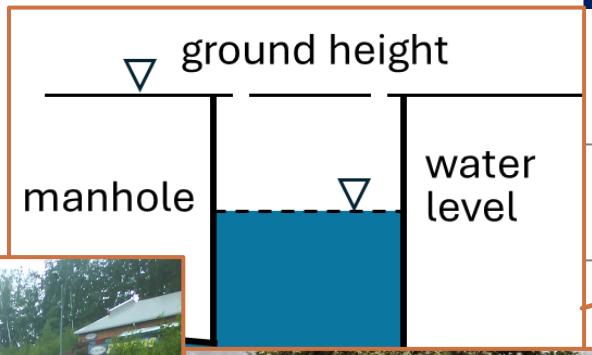

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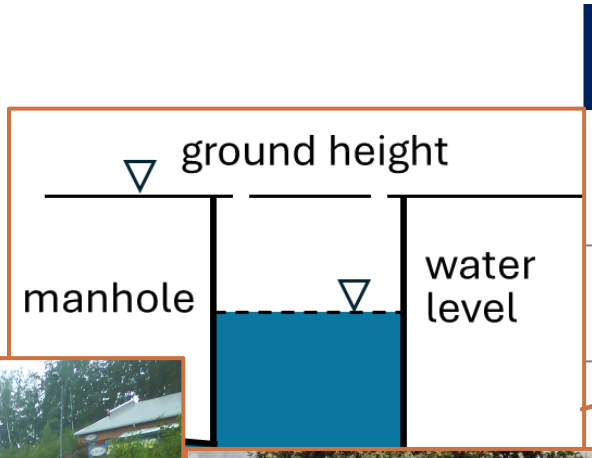

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CONSIDERING EXTREME EVENTS

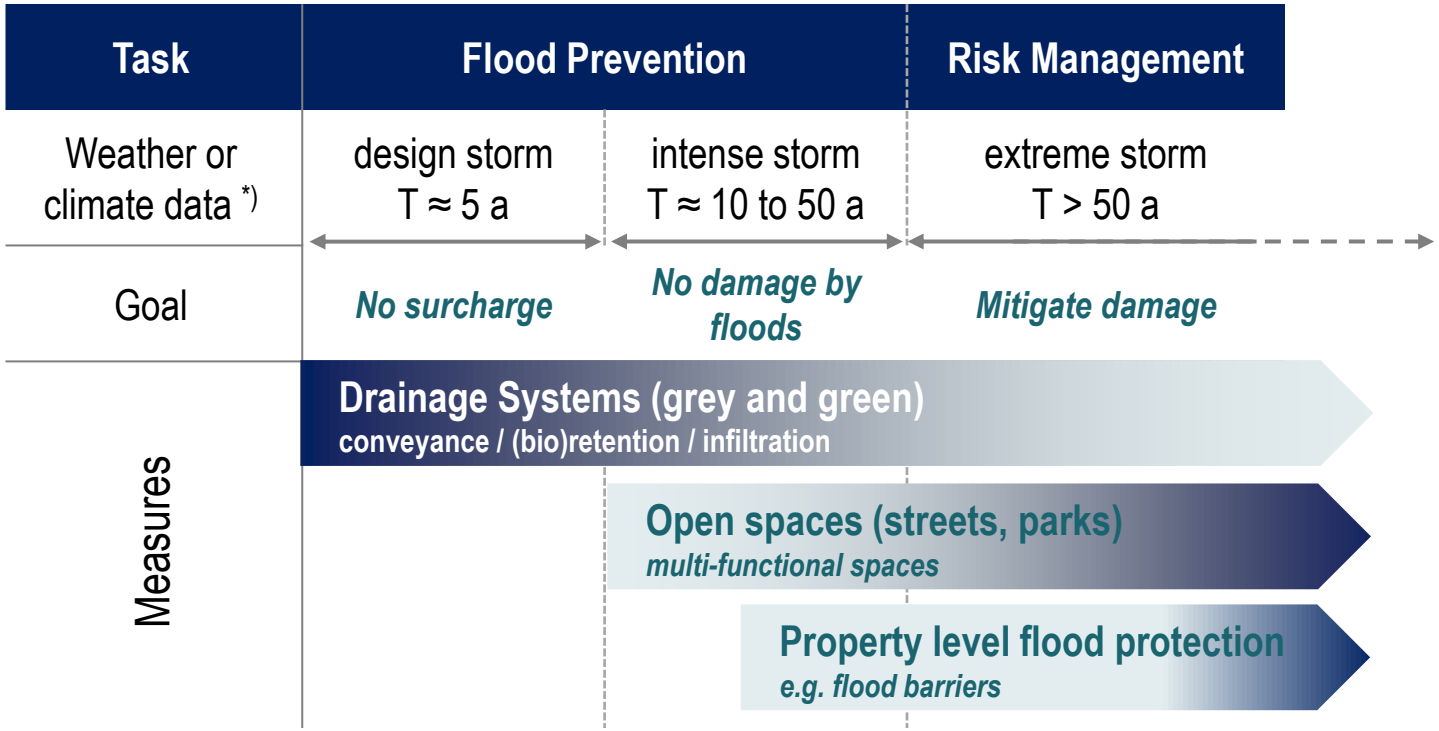
Stormwater Management

... must not stop at a design storm,

… must apply a wide **range of measures**,

… requires an **inter-disciplinary** approach,

… is a **joint effort** of various stakeholders.



Source: DWA, 2008 (modified) and Sieker, 2026

URBAN WATER BALANCE

- Additional Goal

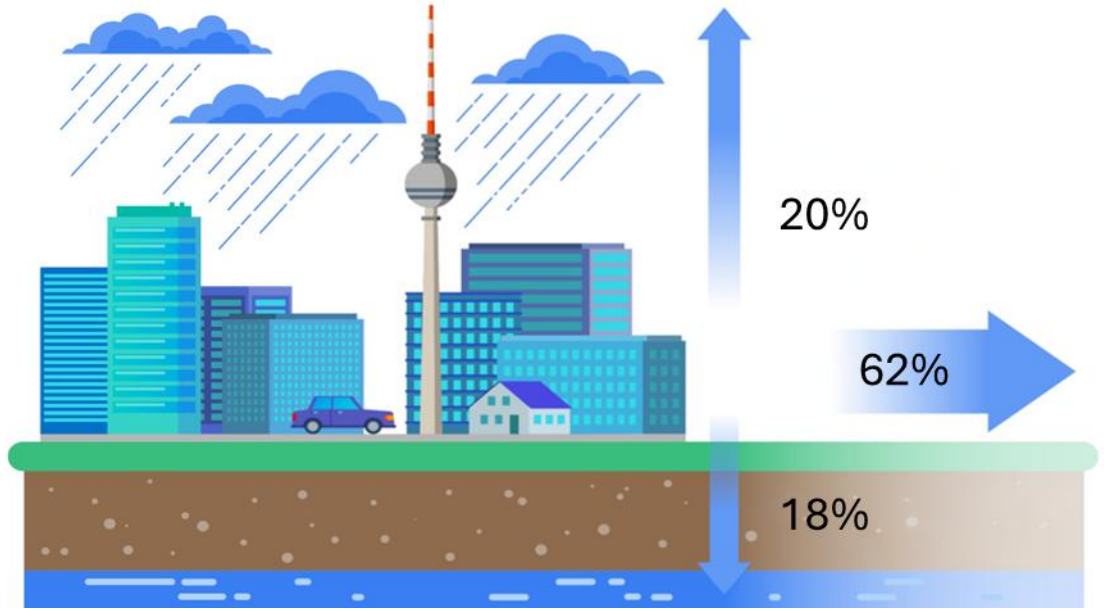
  Minimize alterations of the natural water balance

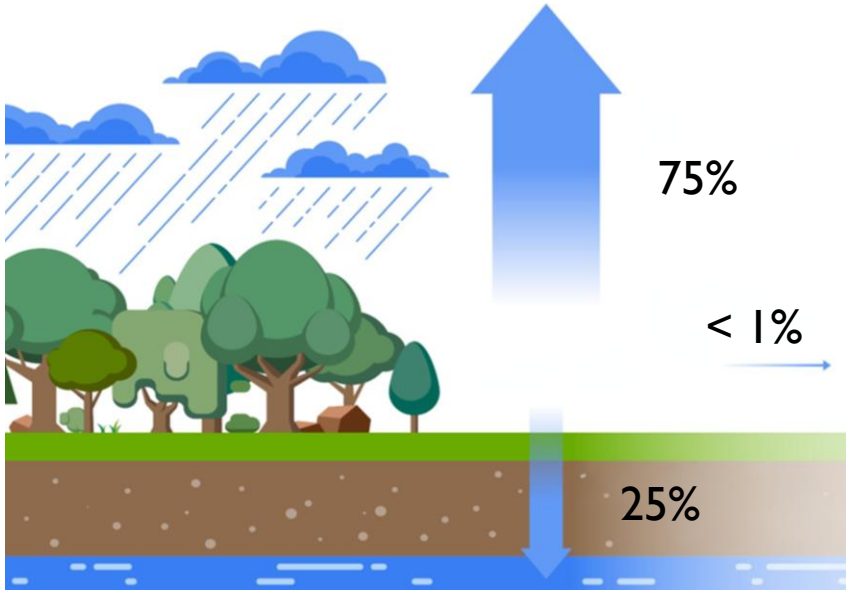
  … to reduce impacts on flow regime of urban waters

  … to reduce heat island effect

  Reference: Pre-development water balance

  Challenge: Increasing Evapo-transpiration





Source: Kompetenzzentrum Wasser Berlin (KWB) / AMAREX: www.amarex-projekt.de

URBAN WATER BALANCE

- Additional Goal

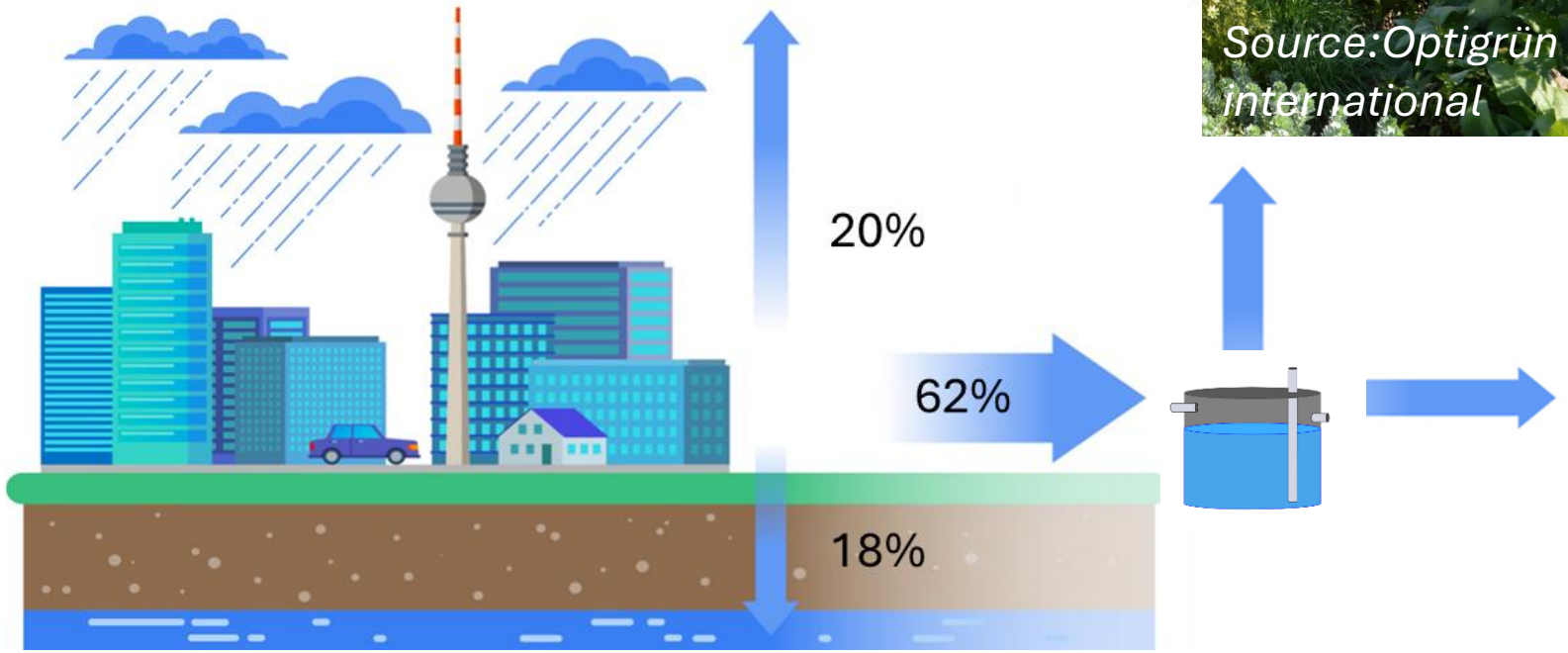
  Minimize alterations of the natural water balance

Measures:

- Bioretention
- Green roofs
- Irrigation

→ WSUD / BGI / Sponge City / …

Source:Optigrün international



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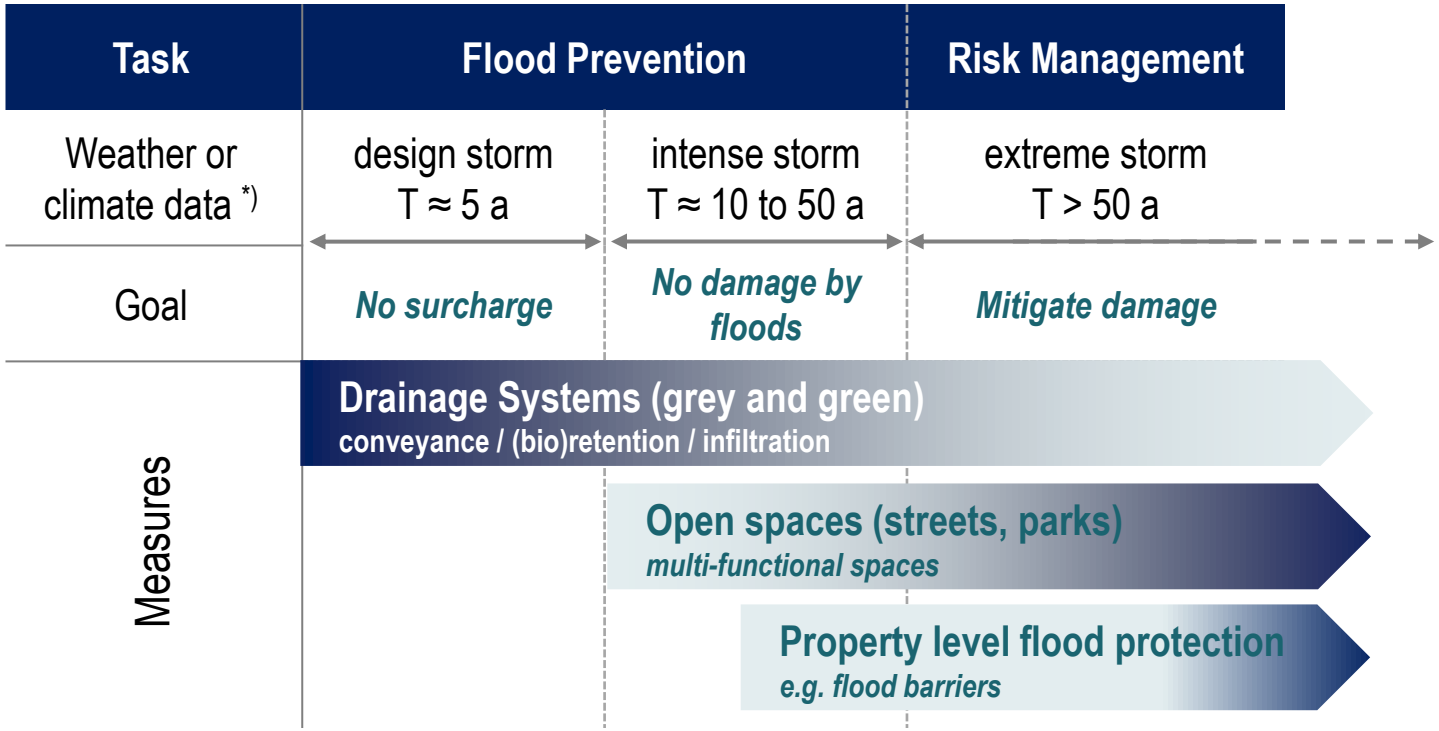
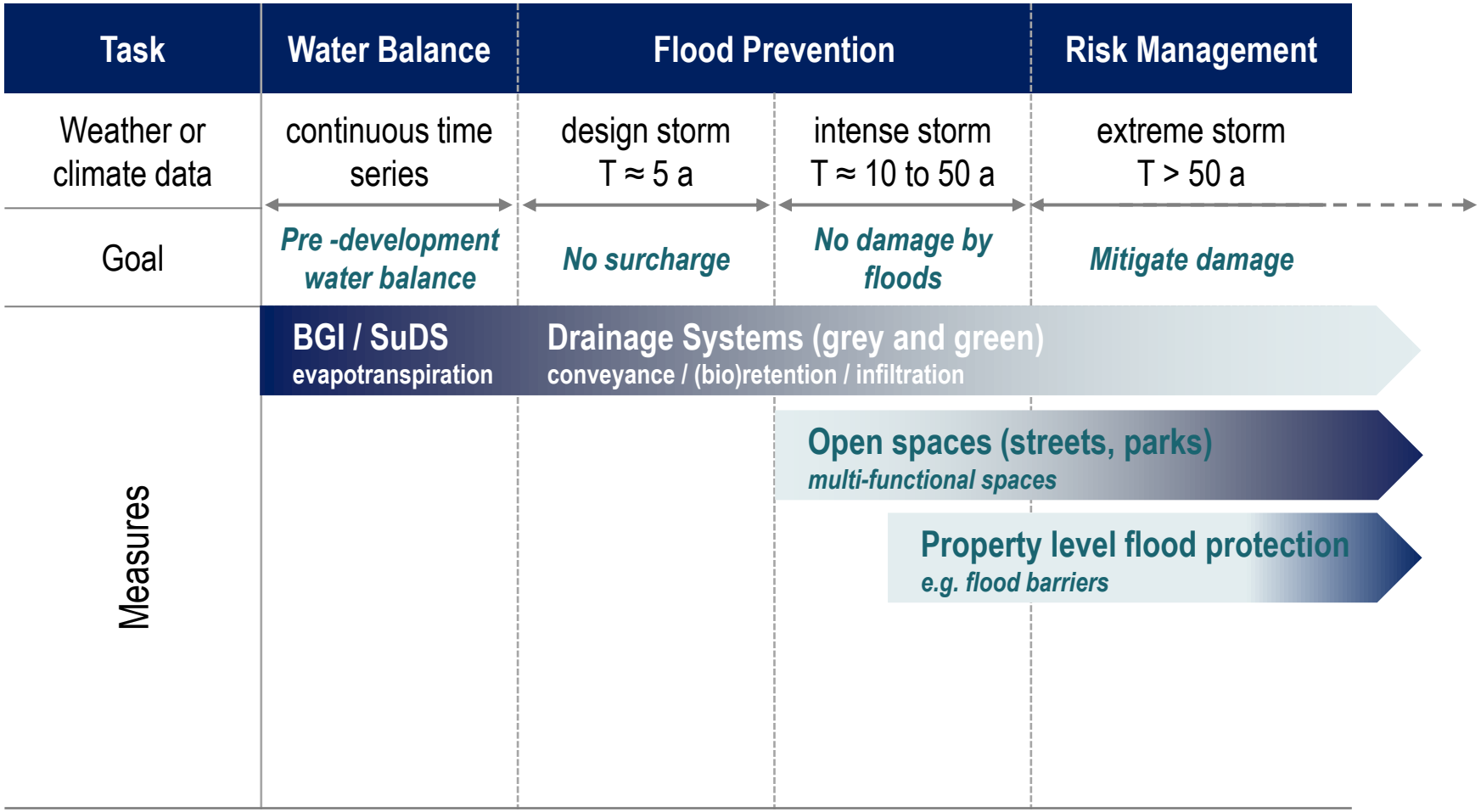


Source: DWA, 2008 (modified) and Sieker, 2026

STATUS QUO IN STORMWATER MANAGEMENT



Source: DWA, 2008 (modified) and Sieker, 2026

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LIMITATION: DENSE URBAN AREAS

Current Design

- 10 % - 20 % of A_{imp} as a result of design storm T = 5 a
- Paradigm of sizing: Source control substitutes sewer system

→ Complete disconnetcion

- Effect on Water Balance is a co-benefit

Source: Kriegebaum, BWB

LIMITATION: DENSE URBAN AREAS

- Paradigm shift (?)
  - Design based on Water Balance
  - Complementary to storm sewer

→ Hybrid Grey-Blue-Green Systems

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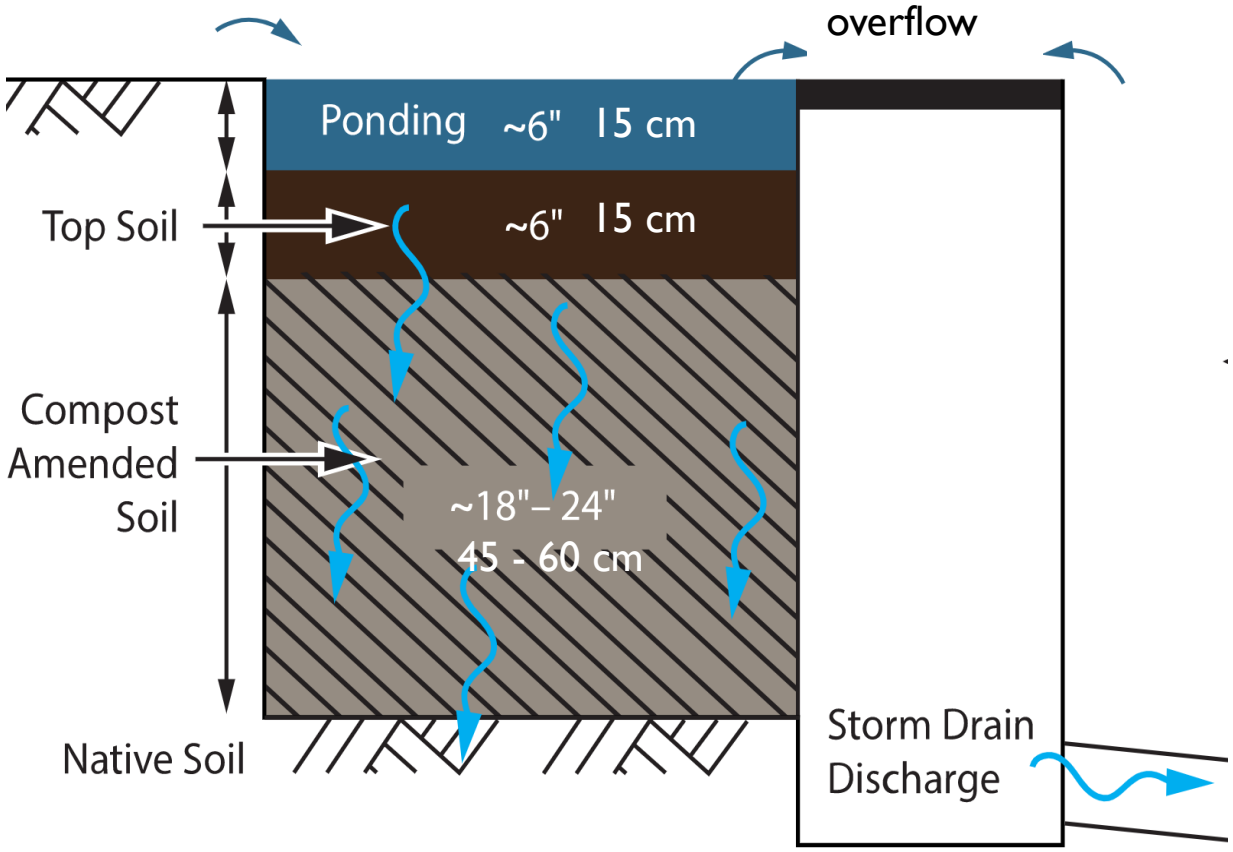
- Californian approach:

  85 % of Stormwater Capture

- Test case Berlin:

  1% of A_{imp} required *(Dittmer et al., 2013)*



Source: Office of Water Programs, 2022

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  - Design based on Water Balance
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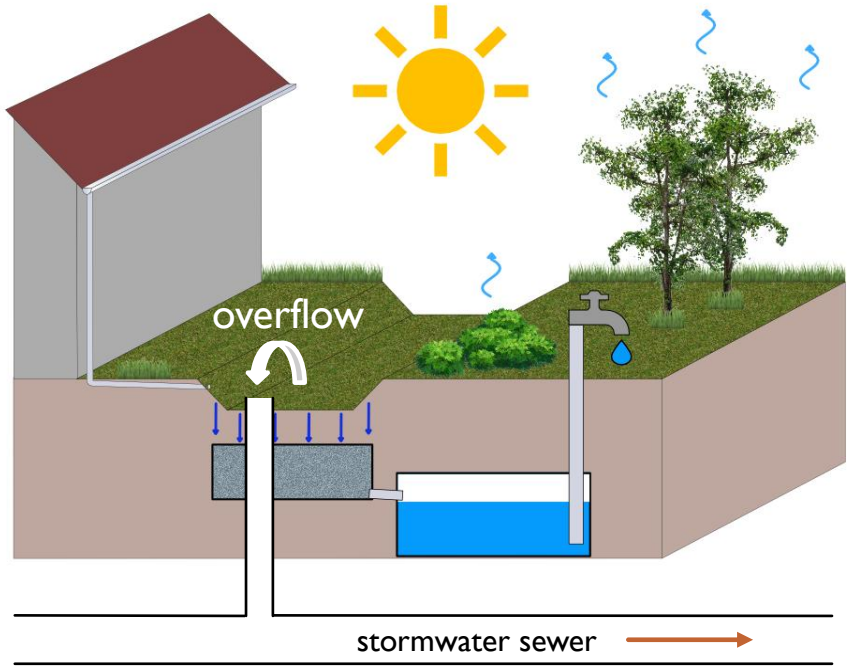
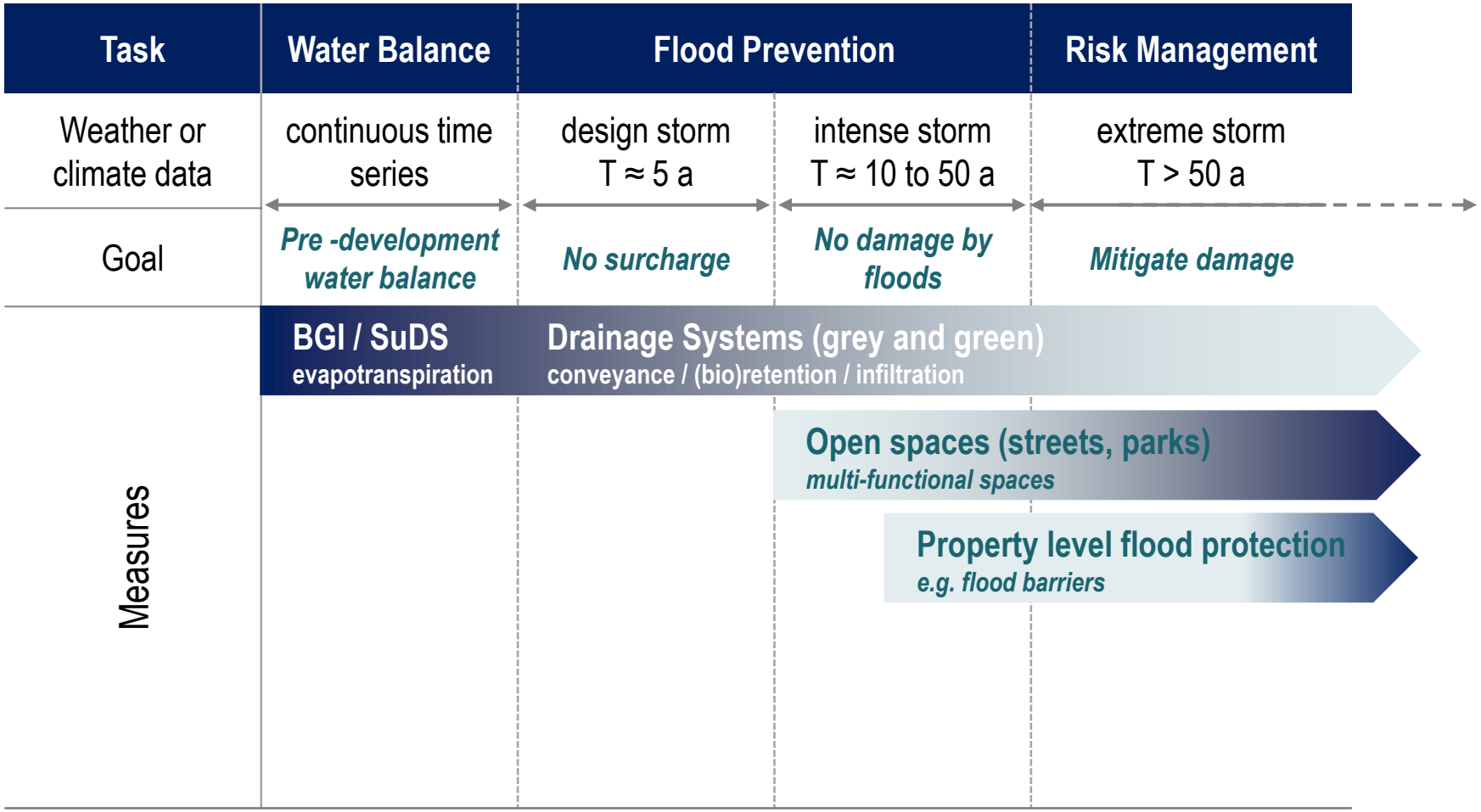


Concept of bioretention-harvesting system
Source: AMAREX-Projekt (modified)

STATUS QUO IN STORMWATER MANAGEMENT



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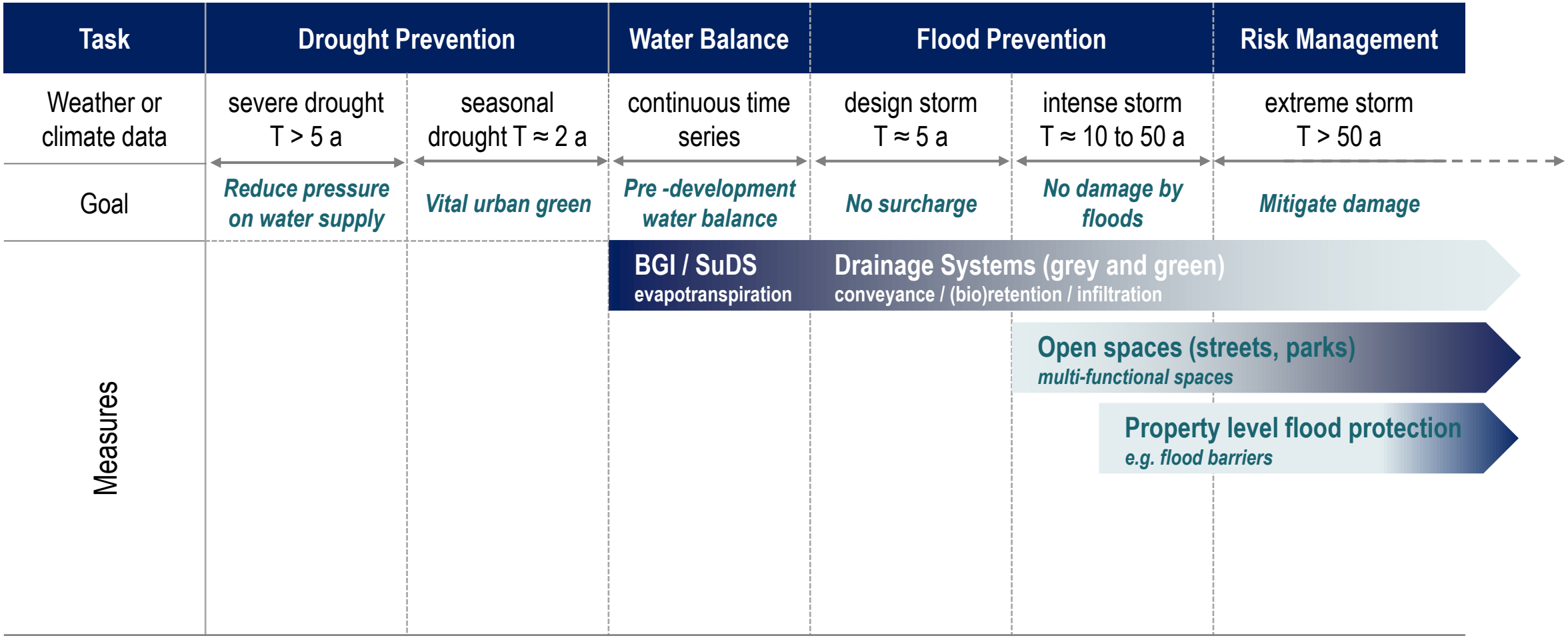
RETHINKING WEATHER EXTREMES



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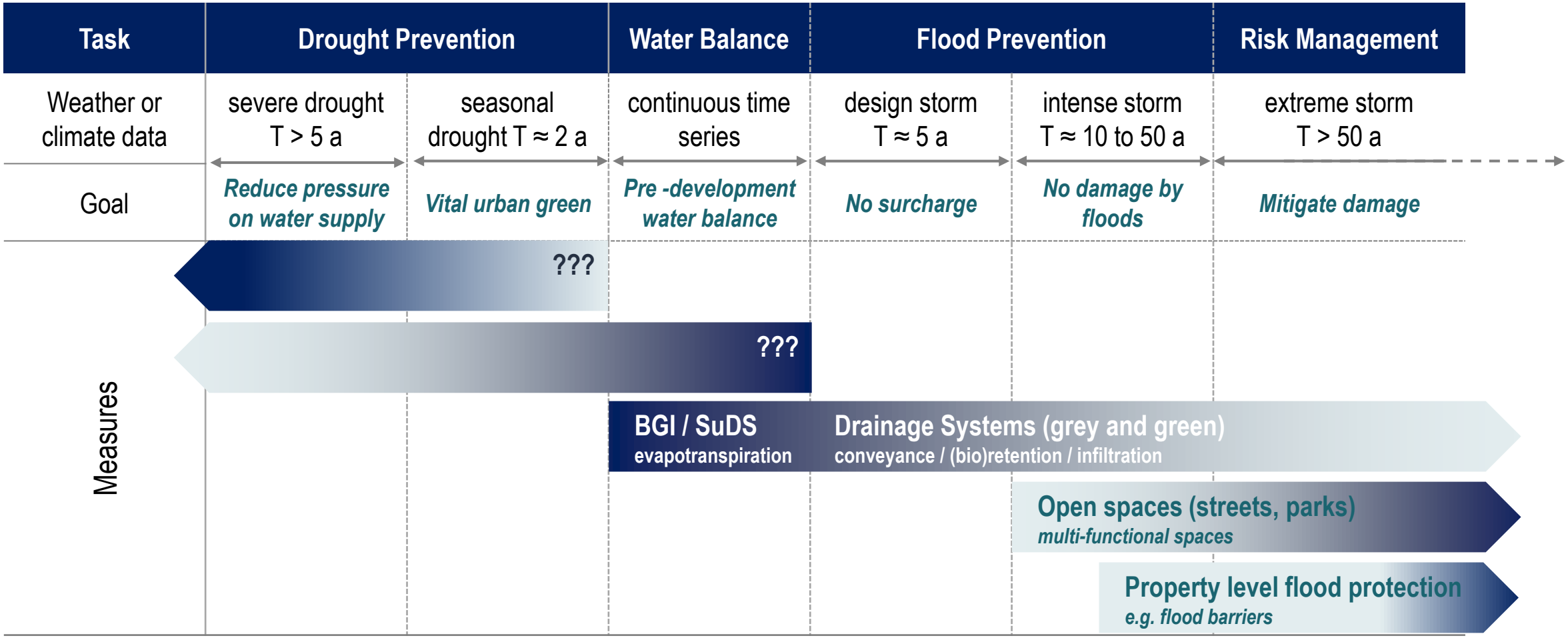

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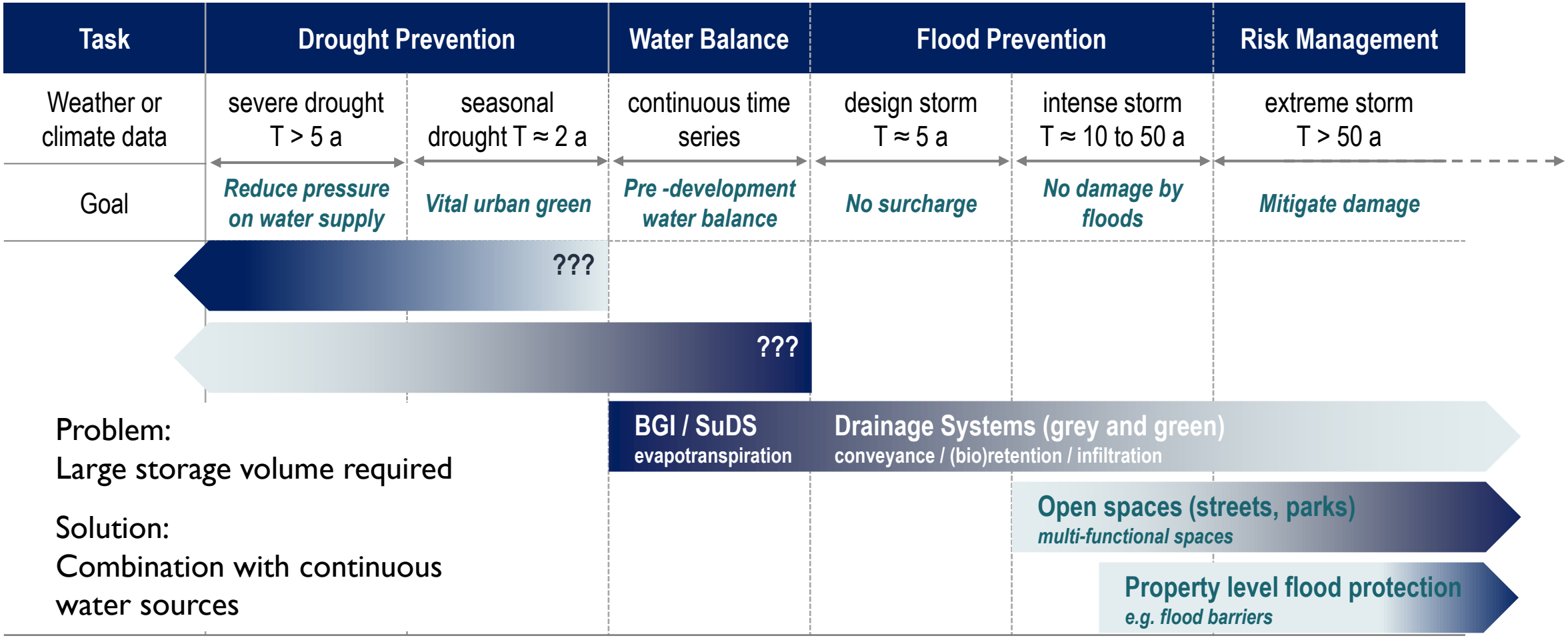


URBAN WATER RESOURCES MANAGEMENT

Task	Drought Prevention		Water Balance
Weather or climate data	severe drought T > 5 a	seasonal drought T ≈ 2 a	continuous time series
Goal	*Reduce pressure on water supply*	*Vital urban green*	*Pre -development water balance*

Rainwater & light grey water
Combined treatment and storage

Approach: Adding small amounts of lightly polluted grey water (showers)
→ small storage at low treatment cost

Limitation: Limited grey water flow & separation on household level (retrofitting)

See: Morandi, 2023

INTERESS-I

Bundesministerium für Bildung und Forschung

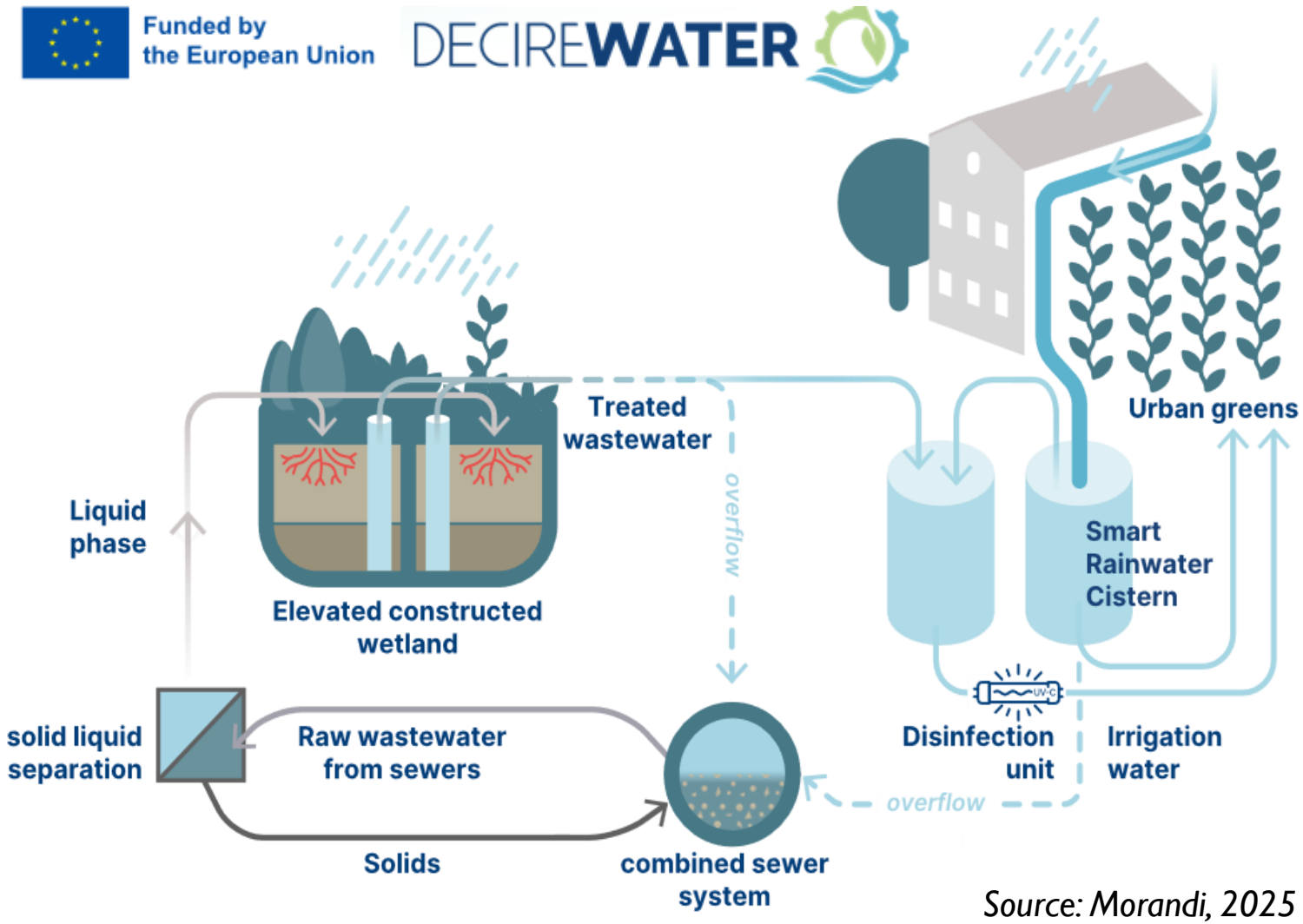
FONA
Forschung für Nachhaltigkeit

URBAN WATER RESOURCES MANAGEMENT

Task	Drought Prevention	
Weather or climate data	severe drought T > 5 a	seasonal drought T ≈ 2 a
Goal	*Reduce pressure on water supply*	*Vital urban green*
	Circular Water Management Decentralized treatment & storage	

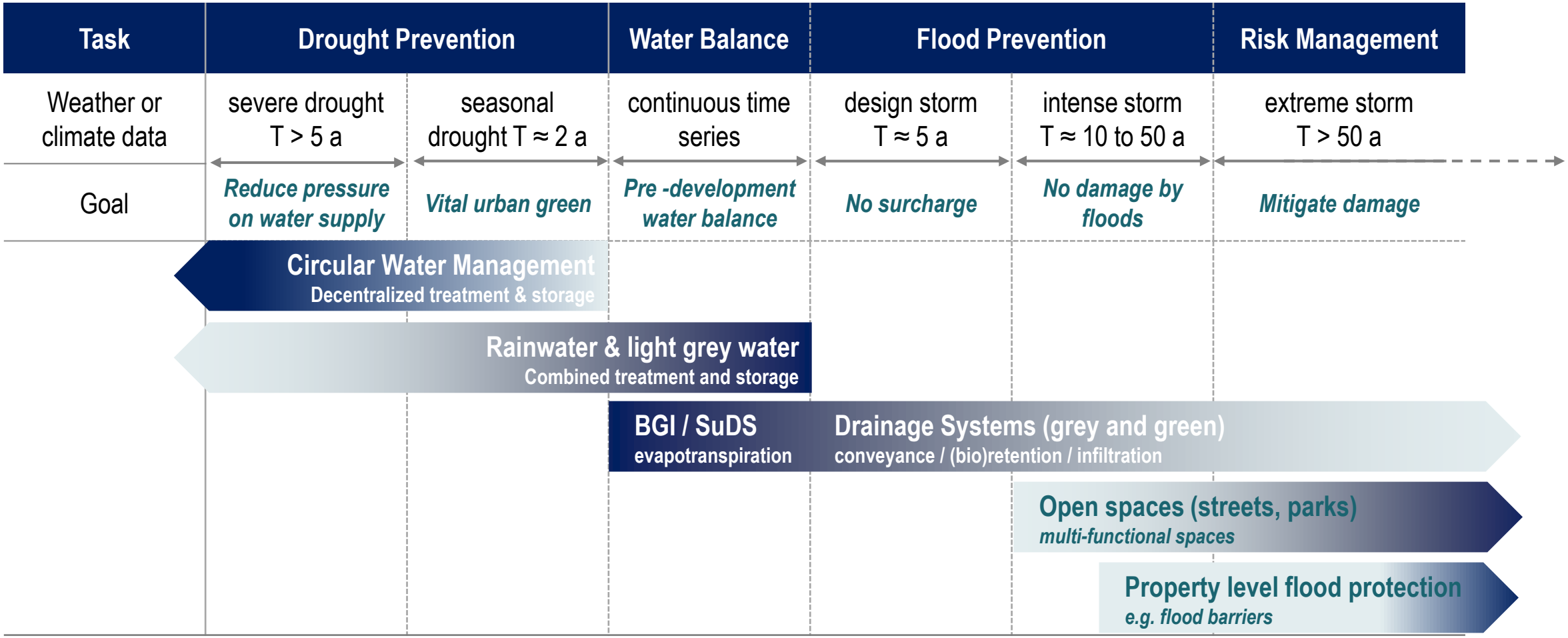
Approach:
Decentralized integration of wastewater & stormwater management

Large scale feasibility?



Source: Morandi, 2025

URBAN WATER RESOURCES MANAGEMENT



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FINAL REMARKS

- Further Aspects (not discussed)
  - Quality
  - Recieving Waters
  - Groundwater Interaction
- Challenges & Risks
  - Technical decentralisation must be accompanied by an organisational structure
  - Limits of Integrated Planning

FINAL REMARKS – ON PARADIGMS

- Why paradigms fail
  - Unforseen results – e.g. burying of urban streams)
  - Shifting expectations of society – e.g. bathing in urban streams
  - New drivers – e.g. climate change
  - Techical developments – e.g. monitoring technology
- Paradigms are inevitable in research and practice
- Ps should continuously be questioned
- Ps should be shifted actively if there is good reason
- Stormwater infrastructure is highly conservative

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THANK YOU!

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