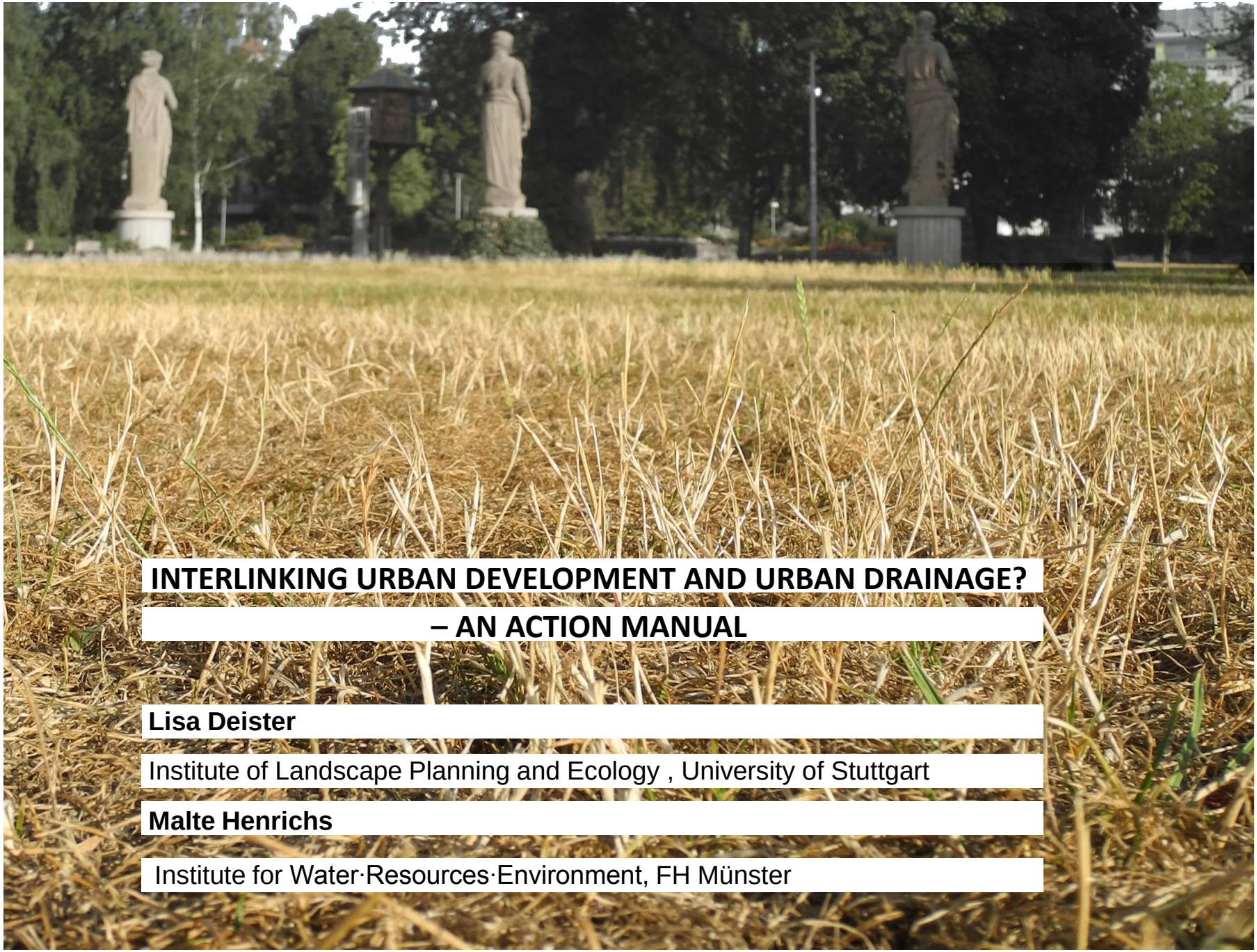

INTERLINKING URBAN DEVELOPMENT AND URBAN DRAINAGE? – AN ACTION MANUAL

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samuwa

THE CITY - A CHANGING HYDROLOGIC SYSTEM: STEPS TOWARDS MANAGEMENT OF THE URBAN WATER BALANCE ADAPTABLE TO CHANGE.

Interlinking urban development and urban drainage? – An action manual

02.11.2015, RE-WATER Braunschweig

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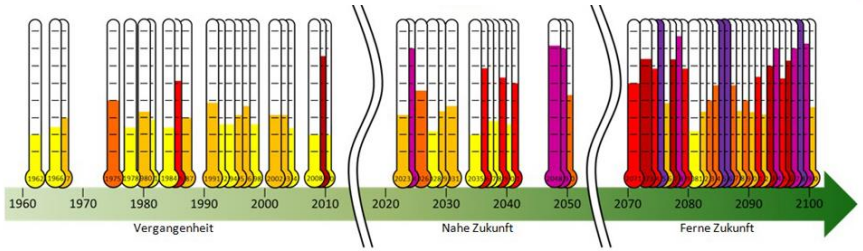
INIS
Intelligente und multifunktionelle Infrastruktursysteme für eine zukunftsfähige Wasserversorgung und Abwasserentsorgung

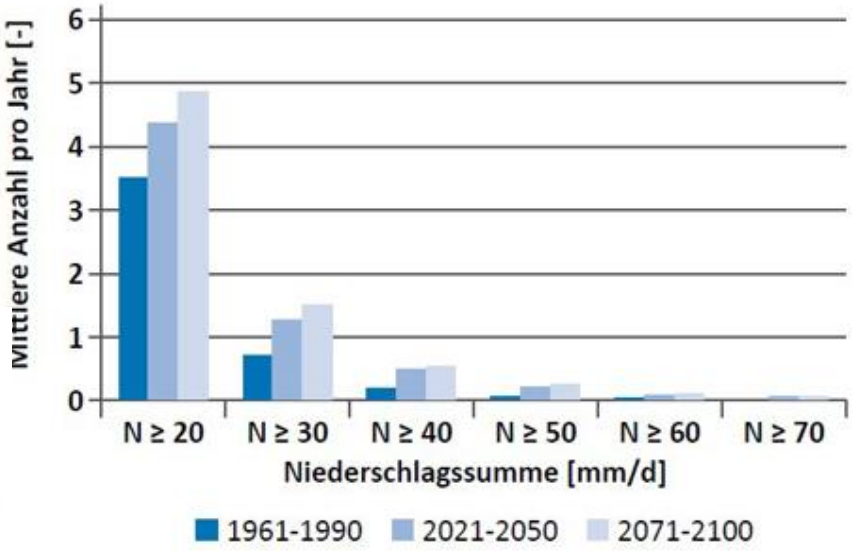
THE CITY – A CHANGING HYDROLOGIC SYSTEM

INCREASING HEAVY RAINFALLS, HEAT WAVES AND DROUGHTS

Climate model projection based on scenario A1B for the Emscher-Lippe region:

- Longer and more intense heat waves, when temperatures can reach 40 °C
- In the future scarcer heavy rainfalls may occur (T ≈ 5a – 20a)



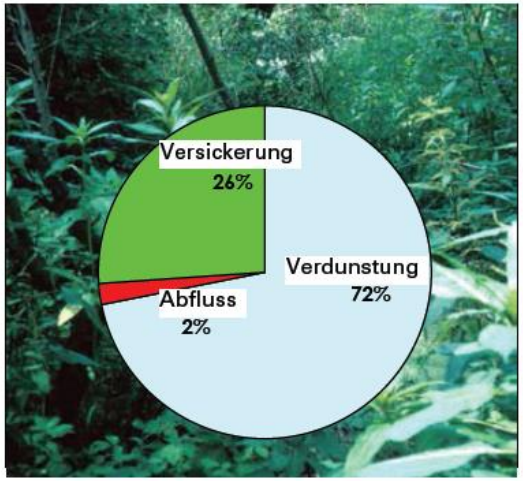


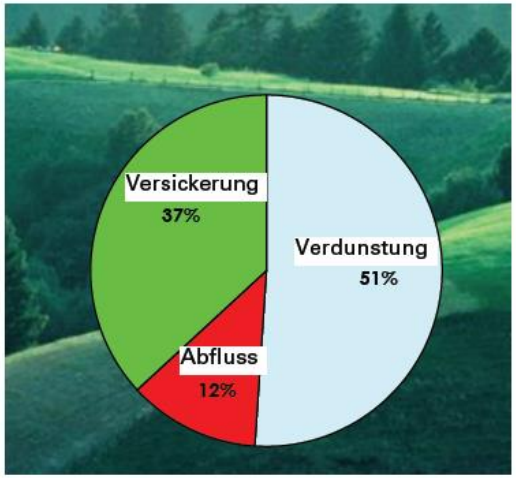
Source: dynaklim

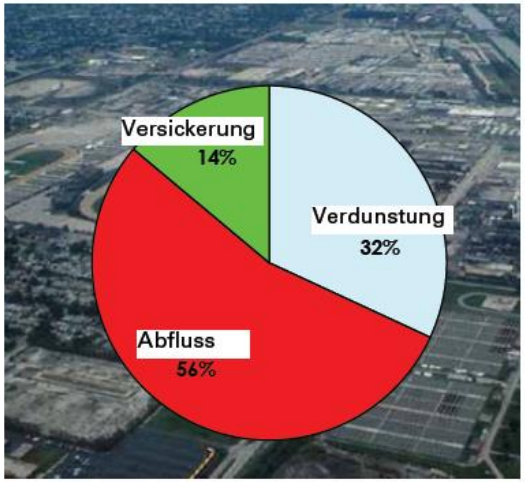
THE CITY – A CHANGING HYDROLOGIC SYSTEM

RELATION BETWEEN URBAN DRAINAGE AND URBAN DEVELOPMENT

Forest **Agriculture** **City**







THE CITY – A CHANGING HYDROLOGIC SYSTEM

PARADIGM SHIFT TOWARDS WATER SENSITIVE URBAN DESIGN

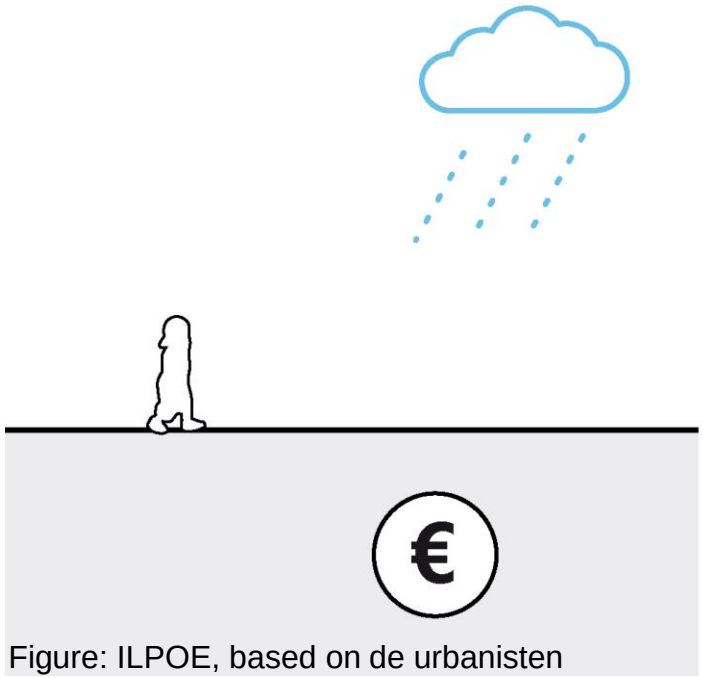
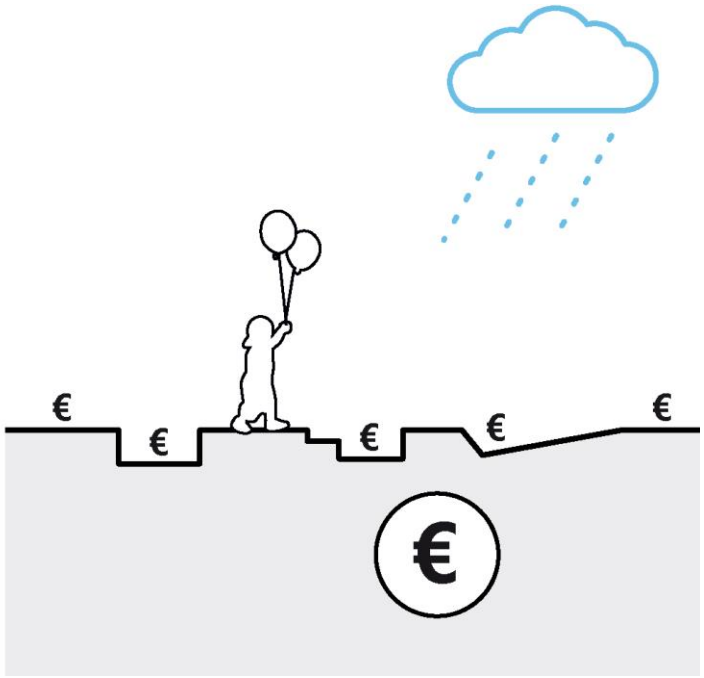


Figure: ILPOE, based on de urbanisten



The old paradigm:
Stormwater should be collected as fast as possible into the drainage system and discharged into water bodies

→ Investment in underground infrastructure

The new paradigm:
Stormwater should be infiltrated, derivated and used

→ Investment in water sensitive urban design

THE CITY – A CHANGING HYDROLOGIC SYSTEM

WATER MANAGEMENT AS AN IMPULSE FOR URBAN AND OPEN SPACE PLANNING

Sydney park, Australia

Benthemplein Rotterdam, Netherlands (de urbanisten)

Opfikerpark Zürich, Austria (Hager Landschaftsarchitekten)

Zollhallenplatz Freiburg, Germany (Atelier Dreiseitl)

THE CITY – A CHANGING HYDROLOGIC SYSTEM

WATER MANAGEMENT AS AN IMPULSE FOR URBAN AND OPEN SPACE PLANNING

- Loss of interdependencies between spatial planning and water related processes
- Ideal of „clean urbanism“: invisible water infrastructure enables urban development

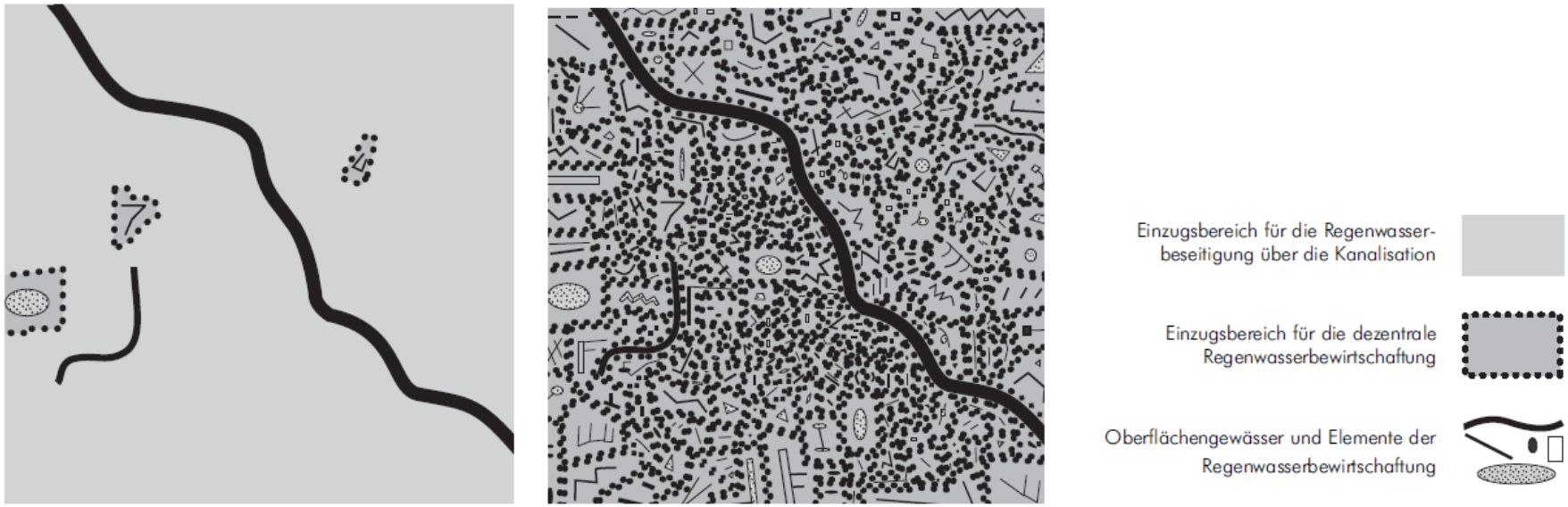
Schlossgarten above the Nesenbach sewer
Foto: ILPÖ

The stream Nesenbach in Stuttgart, integrated into the combined sewer system. Foto: ISWA

THE CITY – A CHANGING HYDROLOGIC SYSTEM

WATER MANAGEMENT AS AN IMPULSE FOR URBAN AND OPEN SPACE PLANNING

- Stormwater management often follows a “parcellation approach“ (Beneke 2003:6) relating to small drainage units, often defined by property ownership
- The result is a variety of applied measures that are detached from each other and are not connected to the logics of the watershed



Konsequenzen der Regenwasserbewirtschaft nach dem Parzellenprinzip

Quelle: Gudrun Beneke (2003): Regenwasser in Stadt und Landschaft. Vom Stück-Werk zur Raumentwicklung. Plädoyer für eine Umorientierung

THE CITY – A CHANGING HYDROLOGIC SYSTEM

RESEARCH PROJECT SAMUWA – STEPS TOWARDS AN ADAPTIVE MANAGEMENT

A. Zukunft befragen
A.1 Szenarien der Stadt und Infrastrukturentwicklung
A.2 Stochastischer Niederschlagsgenerator

B. Bestand verbessern
B.1 Qualitätsabh. Steuerung
B.2 Prototyp integr. Steuerung
B.3 Systemoptimierung
B.4 Messdatenmanagement
B.5 Vereinfachter Simulator

C. Zukunft planen
C.1 Freiraumgestaltung
C.2 Wasserbilanzmodell
C.3 Potentialanalyse Regen-wasserbewirtschaftung
C.4 Fremd- und Grundwasser-bewirtschaftung

D. Hemmnisse überwinden
D.1 Zentrales Informationsportal
D. 2 Modul- und Stufenkonzepte
D.3 Integrierte, partizipative Planung

Anpassungsfähiges Management des urbanen Wasserhaushalts

A. Consult future
Analysis of drivers

B. Improve inventory
C. Plan future
Technical measures
and planning solutions

D. Overcome obstacles
Process and structure
development

Adaptive management
holistic solution

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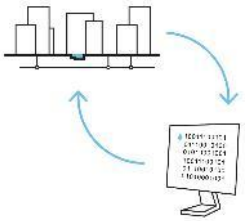
THE CITY – A CHANGING HYDROLOGIC SYSTEM

STEPS TOWARDS AN ADAPTIVE MANAGEMENT



Project C.1
How can hydrological planning and simulation tools be combined with integrated strategies for urban development and design?

Stormwater management
How can the water balance be integrated within urban development and design strategies?

Flood prevention
How can heavy rain events and flash floods be integrated within urban development and design strategies?

Case study Gelsenkirchen
Development of urban and open space planning strategies as well as appropriate design measures to manage stormwater based on the water balance model “WABILA“.

ILPÖ + IWARU

Case study Wuppertal
Development of urban and open space planning strategies as well as design measures to control floods based on hydrodynamic method of network calculation

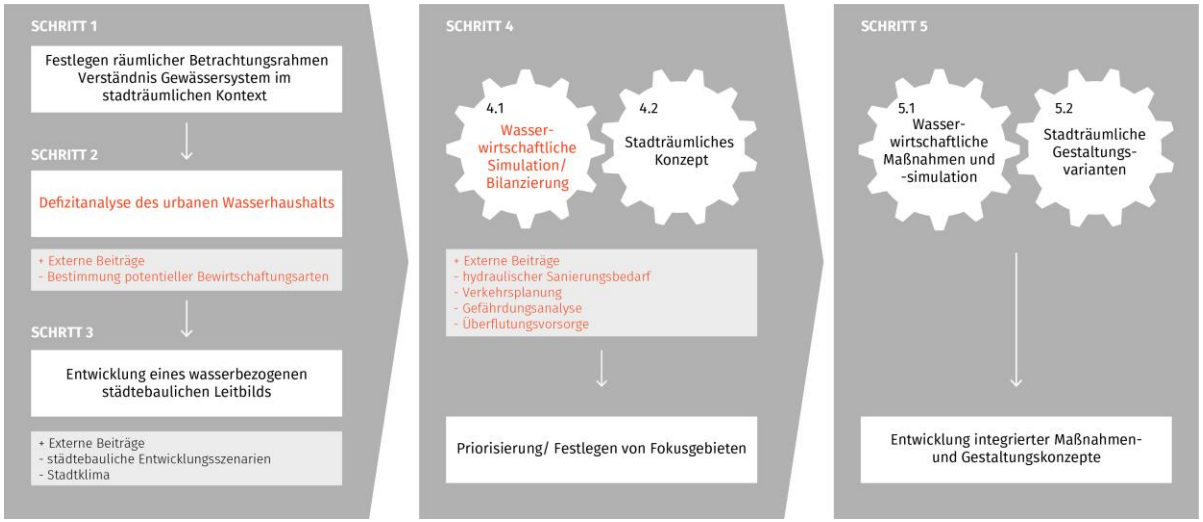
(Program system: ++SYSTEMS/ GeoCPM“)

ILPÖ + Dr. Pecher AG

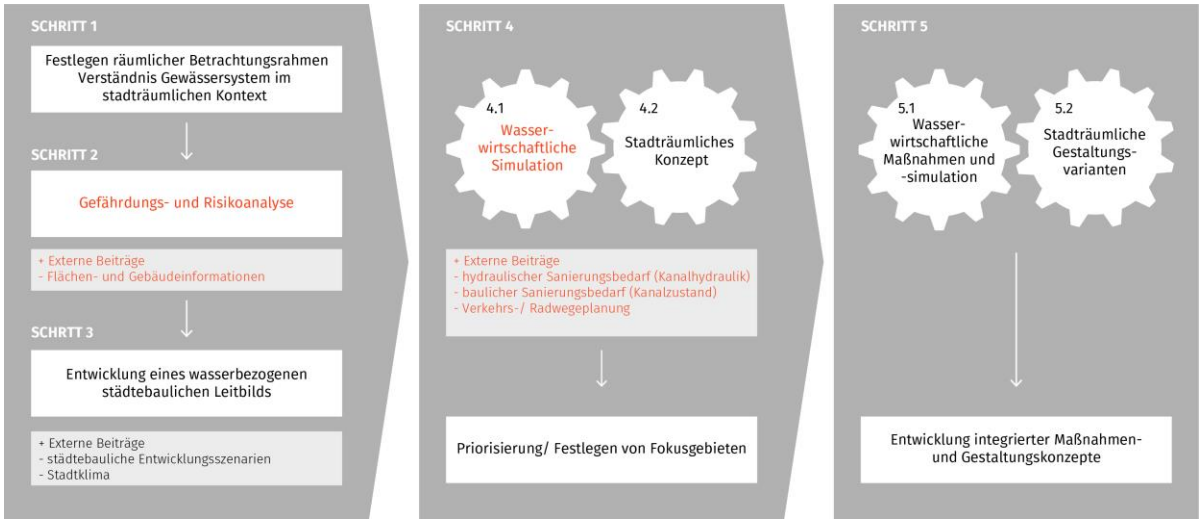
THE CITY – A CHANGING HYDROLOGIC SYSTEM

STEPS TOWARDS AN ADAPTIVE MANAGEMENT

Action manual for the case study Gelsenkirchen “Berger Feld“
Interlinking Urban Drainage and Urban Development



Action manual for the case study Wuppertal “Varresbeck“
Interlinking Flood Control and Urban Development



THE CITY – A CHANGING HYDROLOGIC SYSTEM

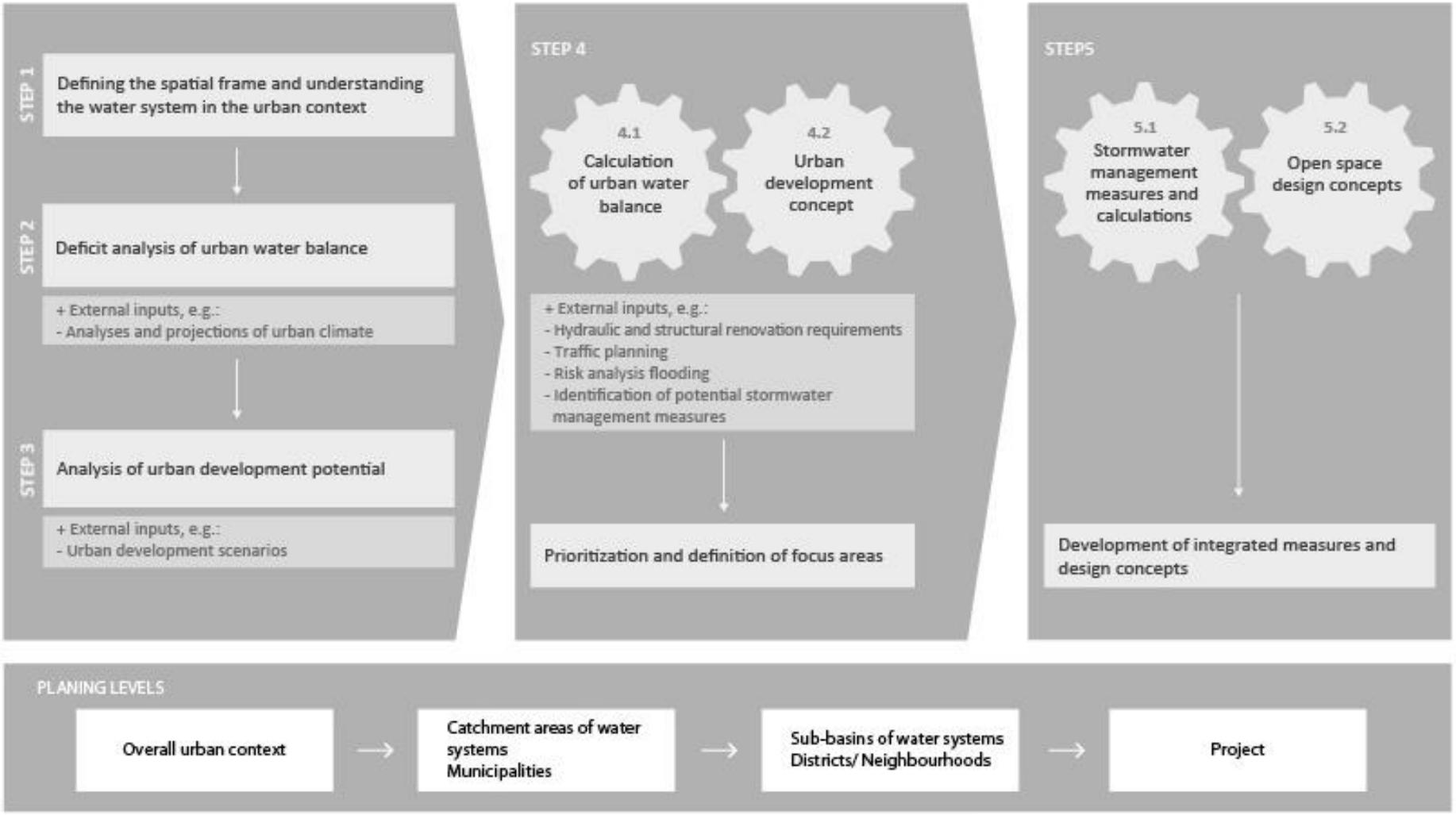
DEVELOPMENT OF AN ACTION MANUAL

that calls for an interlinkage between urban drainage and urban development strategies, in order to:

- consider the local deficits of the urban water balance,
- foster the promotion of a water sensitive urban development adapted to local conditions and take advantage of financial as well as spatial synergies,
- design water infrastructure in a more resilient and sustainable way in order to be able to respond to climatic and demographic changes.

INTERLINKING URBAN DRAINAGE AND URBAN DEVELOPMENT

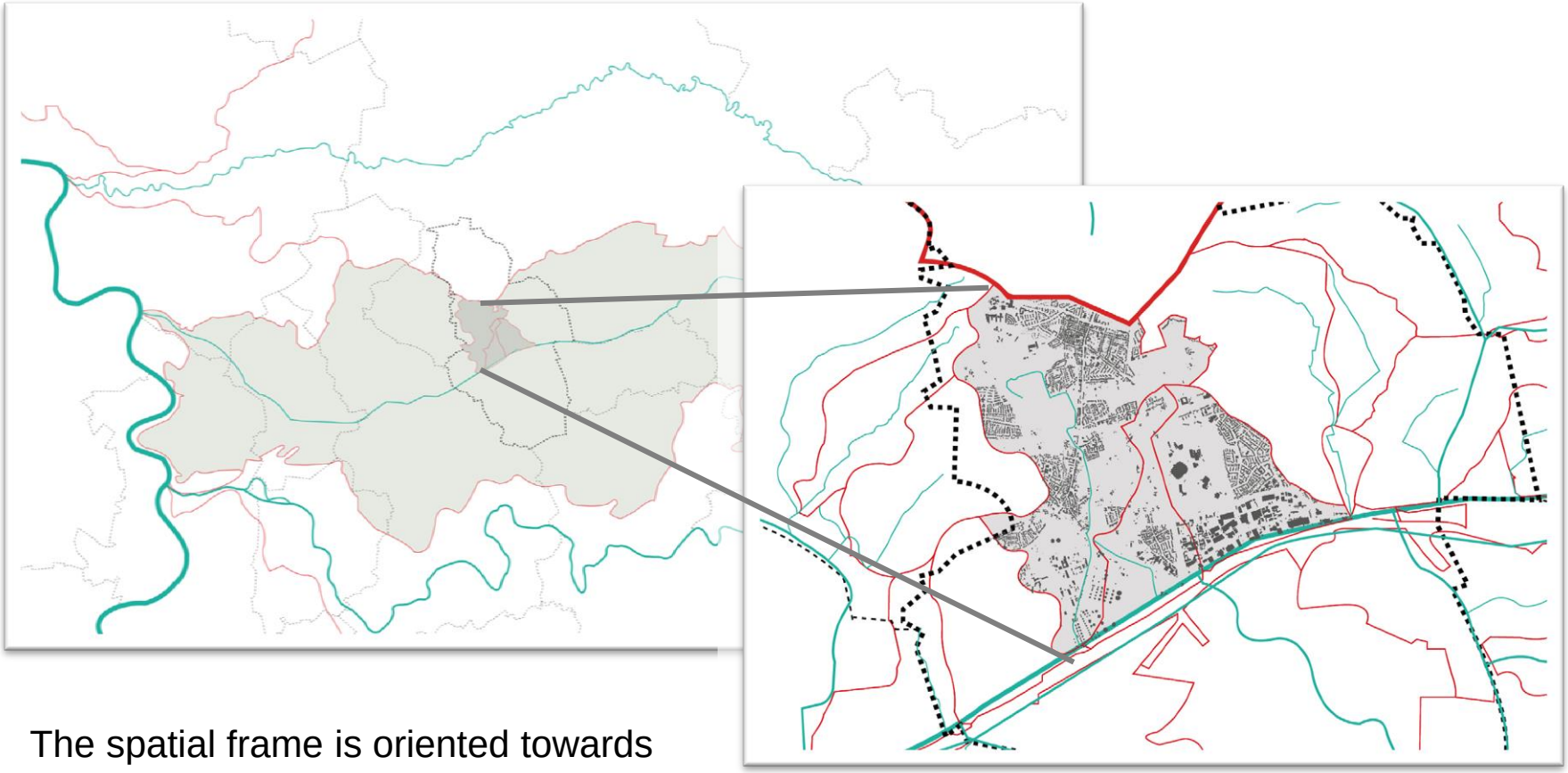
DEVELOPMENT OF AN ACTION MANUAL



Source: ILPÖ, Uni Stuttgart/ IWARU, FH Münster

STEP 1

DEFINING THE SPATIAL FRAME AND UNDERSTANDING THE WATER SYSTEM IN THE URBAN CONTEXT

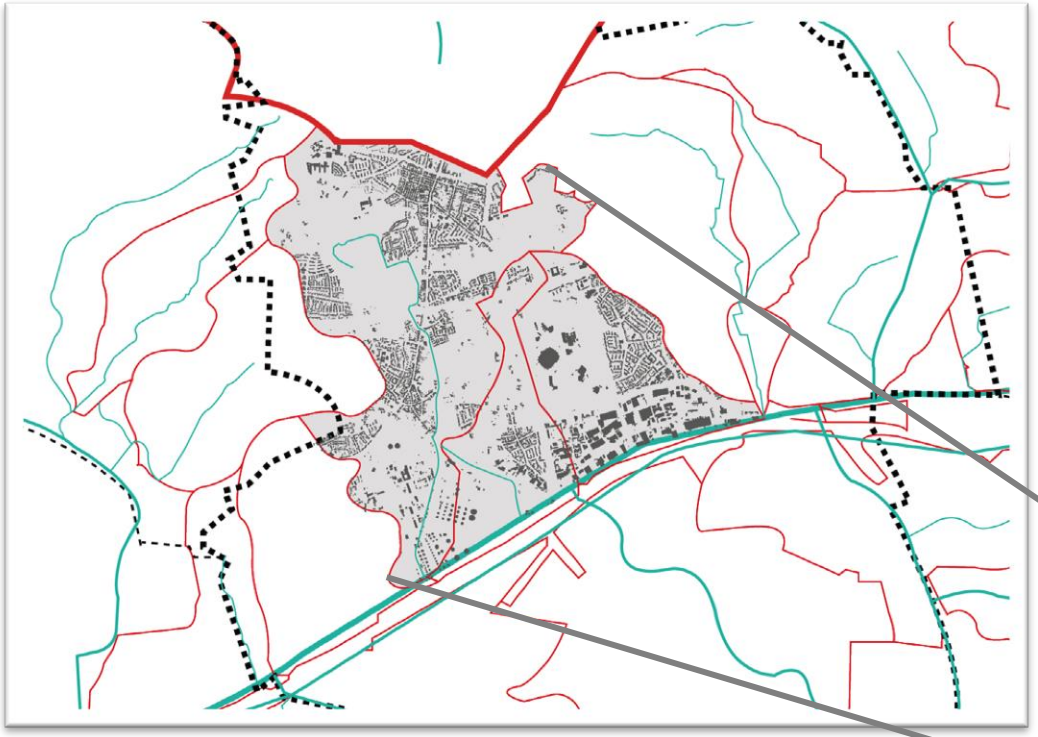


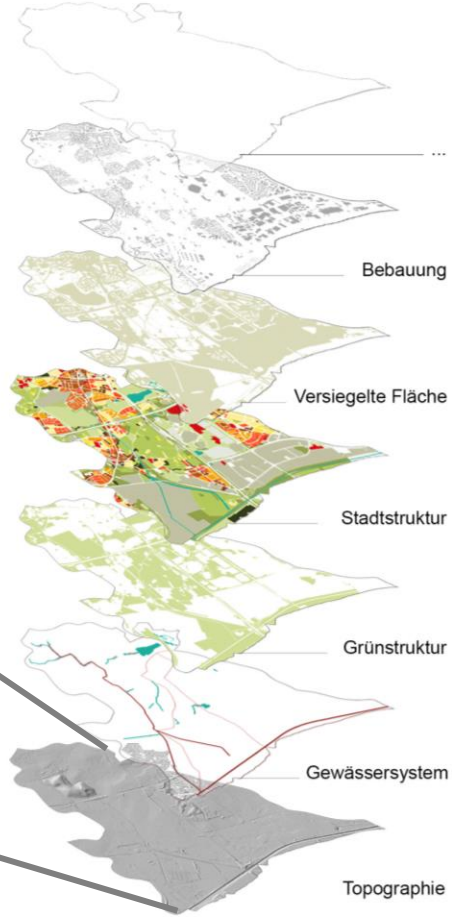
The spatial frame is oriented towards the water system and the catchment areas

Source: ILPÖ, Uni Stuttgart

STEP 1

DEFINING THE SPATIAL FRAME AND UNDERSTANDING THE WATER SYSTEM IN THE URBAN CONTEXT





Analysis of the influence of the spatial urban context on the natural water cycle

Source: ILPÖ, Uni Stuttgart

STEP 2
DEFICIT ANALYSIS OF THE URBAN WATER BALANCE

pre-developed (GWNeu)

- Climate data HAD (P and ET_a)
- Soil map 1:50.000 (soil types, groundwater ^level)
- DEM (Relief energy)
- Land uses (crops, grasslands and mixed, deciduous or coniferous forests)

built-up (WABILA)

- ALKIS-data (buildings)
- RVR-Land use maps (green areas, streets, traffic areas)
- Orthophoto interpretation (paved private areas)

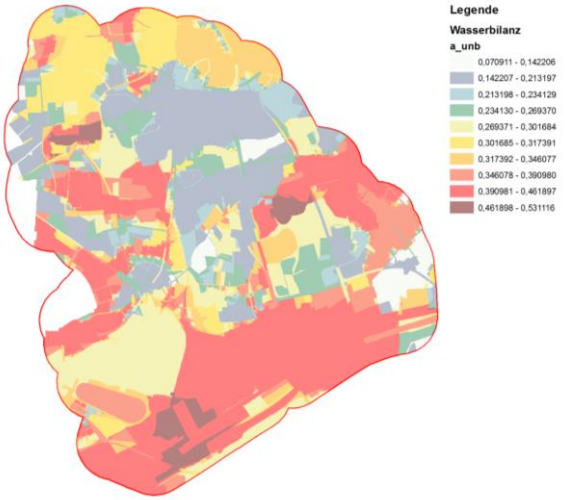
Evaluation

- Aggregation of the water balance for land parcels
- Sum of total deviations

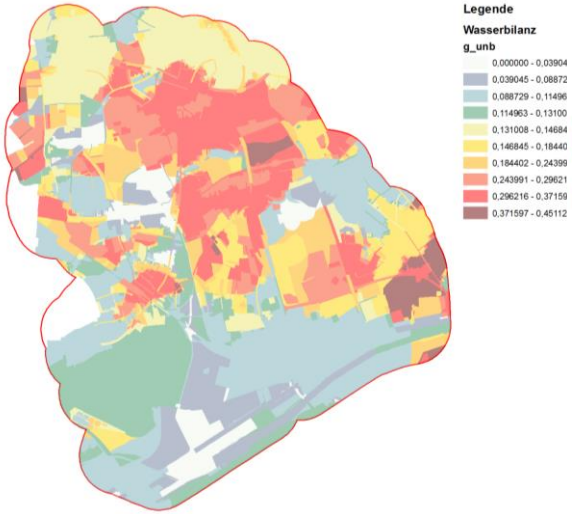
STEP 2

DEFICIT ANALYSIS OF THE URBAN WATER BALANCE

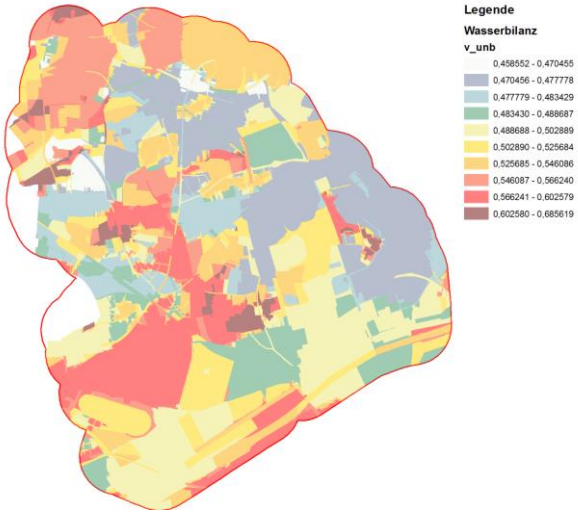
pre-development



surface runoff

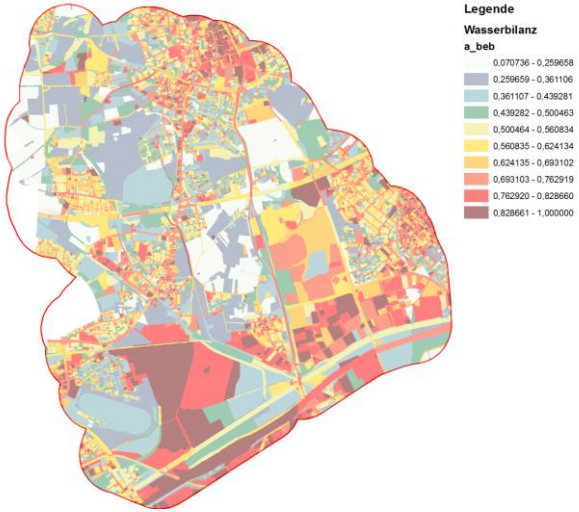


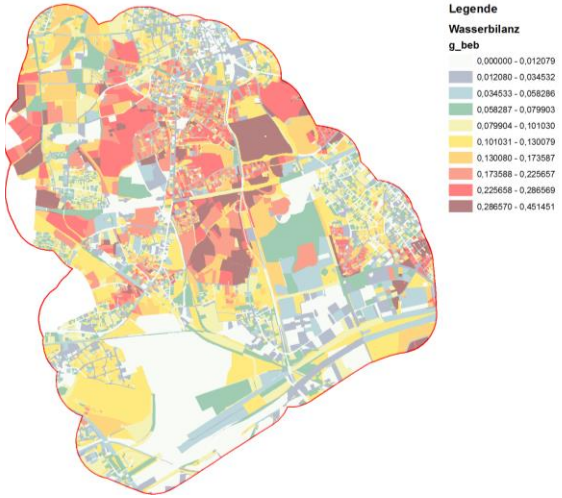
Groundwater recharge

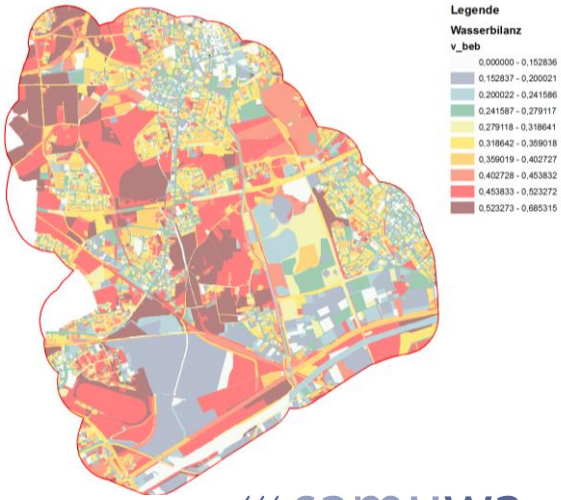


Evaporation

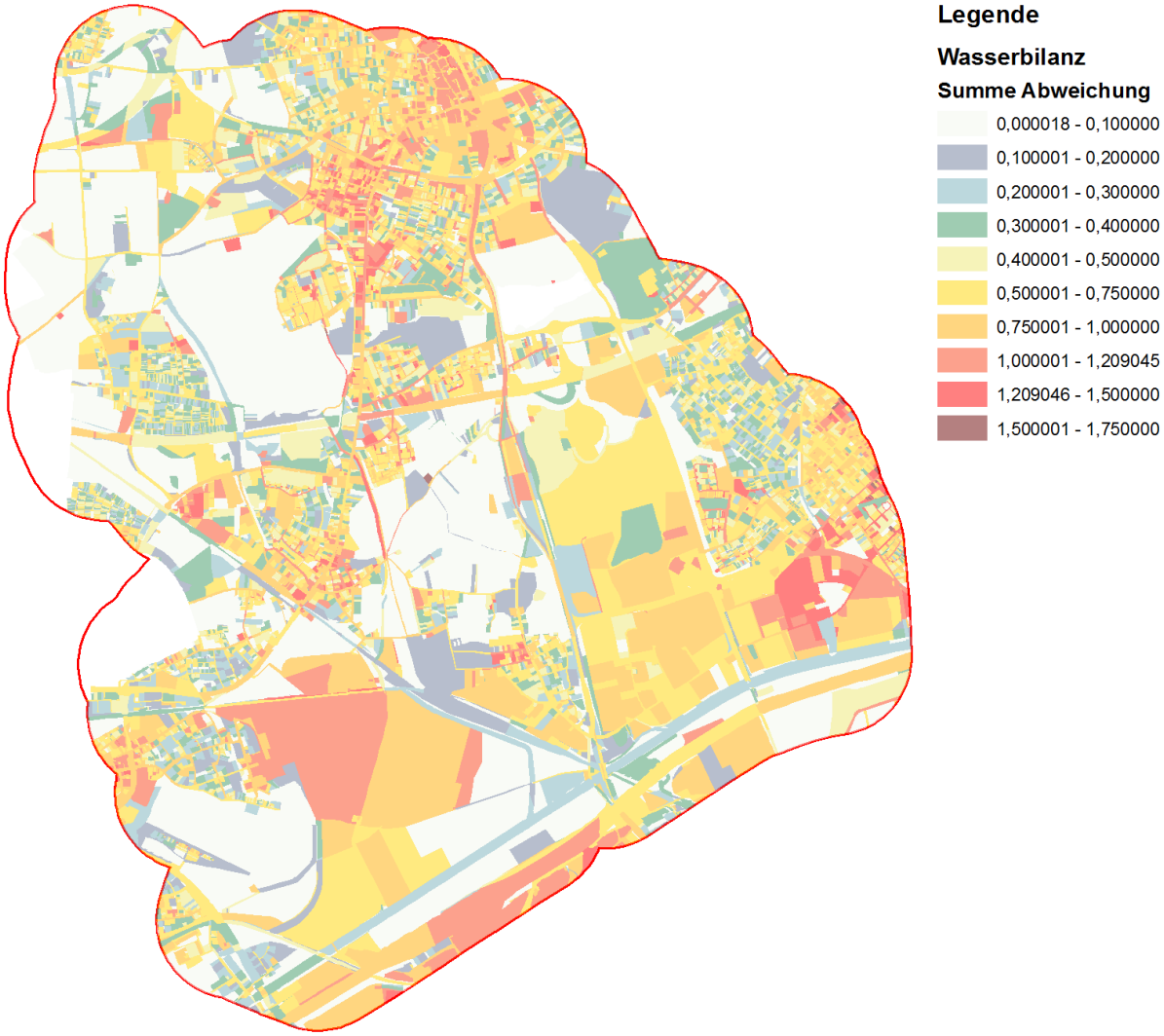
built-up



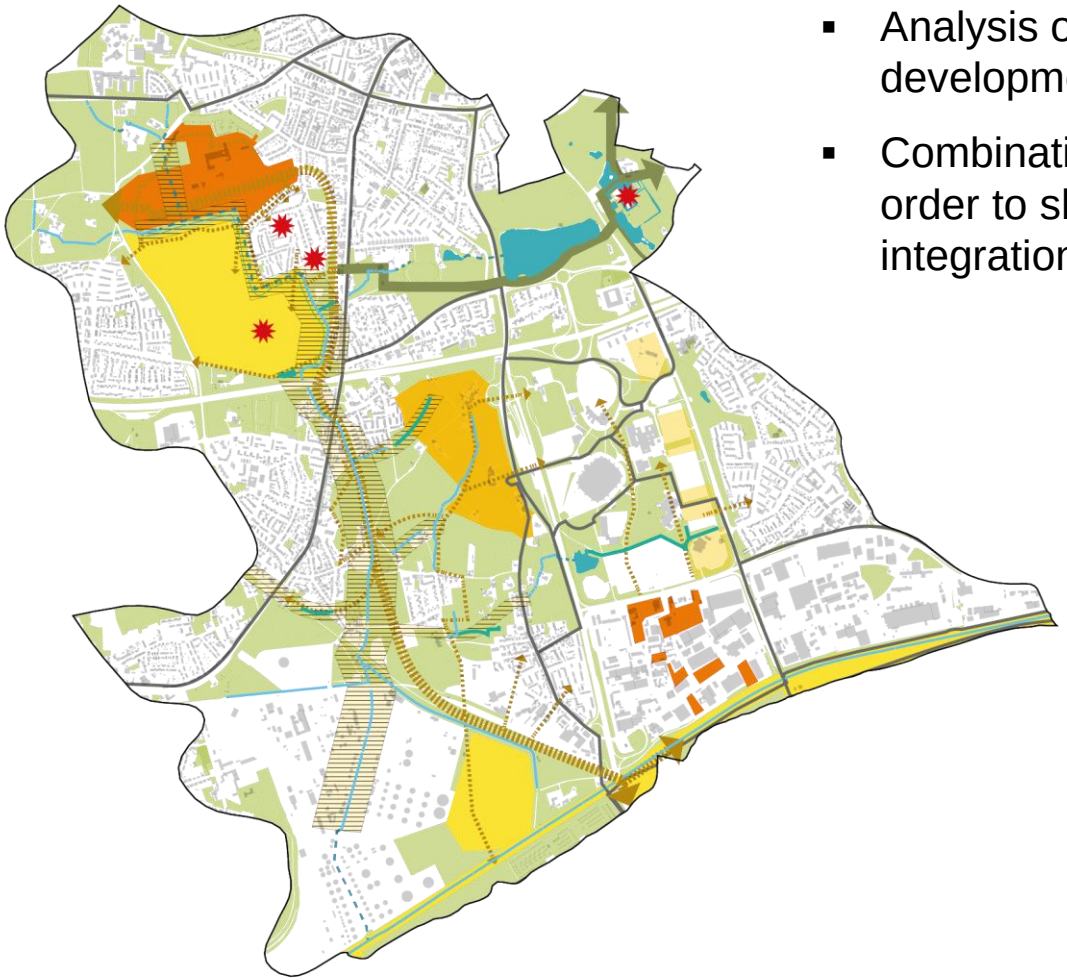




STEP 2
DEFICIT ANALYSIS OF THE URBAN WATER BALANCE



STEP 3
ANALYSIS OF URBAN DEVELOPMENT POTENTIAL



- Analysis of the urban and open space development potential
- Combination of existing concept and plans in order to show the spatial and content-related integration possibilities

Key urban development potentials

- Flächen, die Freiraum/ Konversionsflächen sind. Bei der zukünftigen Bebauung/ Umnutzung sollen die Belange der Freiraumentwicklung berücksichtigt werden (Angabe aus: Freiflächenentwicklungskonzept 2005)
- Neuinanspruchnahme von Freiraum: Sonderbaufläche für Freizeit, Erholung und Sport (Angabe aus: RFNP 2012)
- Wiederherstellung einer in ihrem Wirkungsgefüge, ihrem Erscheinungsbild oder ihrer Oberflächenstruktur geschädigten oder stark vernachlässigten Landschaft (Angabe aus: Landschaftsplan Entwicklungskarte, Stand 2013)
- Wiedernutzung von Bauflächen/ Siedlungsbrachen (Angabe aus: RFNP 2009)
- Umbaubereiche im Rahmen der Entflechtung und Renaturierung des Lanferbachs und der Anbindung der Nebenläufe (Zukunftsvereinbarung Regenwasser, Route des Regenwassers)
- Vorgeschlagene Wegeverbindung (Hauptweg) (Angabe aus: Freiflächenentwicklungskonzept 2005)
- Vorgeschlagene Wegeverbindung (Nebenweg) (Angabe aus: Freiflächenentwicklungskonzept 2005)

- Bestehende Grünflächen
- Bestehende Wegeverbindung (Hauptweg)
- Bestehende Wegeverbindung Nebenweg
- Bestehende Radrouten
- Denkmäler/ Stationen der Route der Industriekultur

Source: ILPÖ, Uni Stuttgart

STEP 3
ANALYSIS OF URBAN DEVELOPMENT POTENTIAL

Development scenario for "Berger Feld", Gelsenkirchen: Current state (left) and possible urban change by 2070 through the implementation of the concept "Compact city" (right)

Source: S+U, Bergische University of Wuppertal

Urban development scenarios

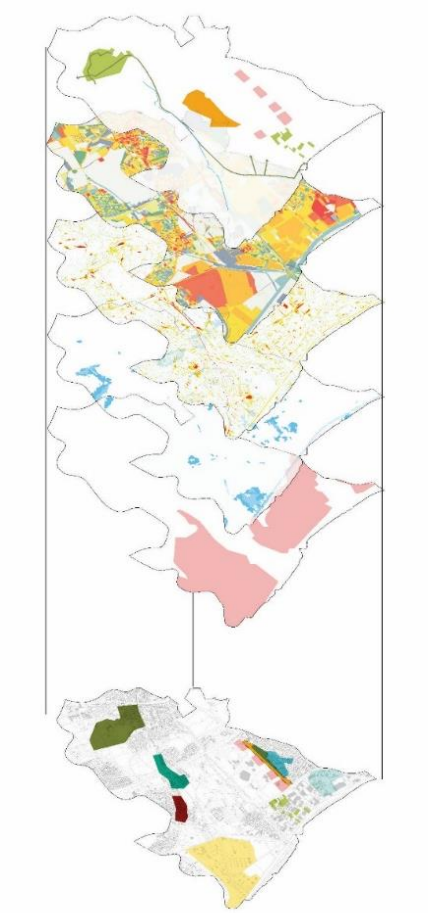
- Which changes in the urban structure can be expected as a consequence of shifts in the economic patterns, demographic changes and new demands of society?
- How can both fields water management and urban planning be interlinked ?

STEP 3
DEVELOPMENT OF A WATER-RELATED URBAN CONCEPT

- Interlinkage between open space planning aspects, development trends and potentials for stormwater management
- Transference of the results into an overall strategic plan

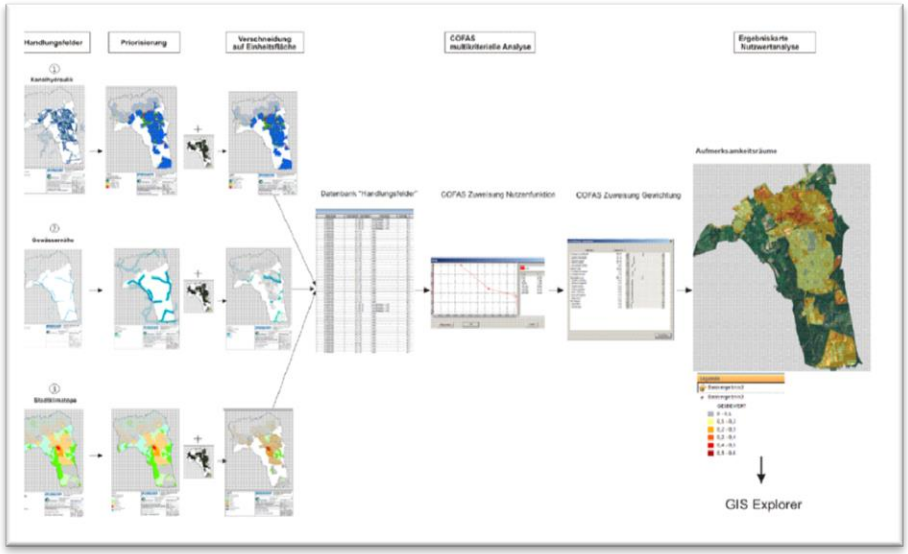
Rotterdam Waterplan 2030
Source: Waterplan 2, Municipality of Rotterdam

STEP 4
PRIORITIZATION AND DEFINITION OF FOCUS AREAS



Source: ILPÖ, Uni Stuttgart/ IWARU, FH Münster

- Identification of focus areas with the greatest possible synergy effects by overlaying information from different fields
- Urban development measures as a motor for water-related interventions (and vice versa)



Procedure for determining areas with needs for action / synergies with the help of the GIS-based cooperation module ZUGABE
Source: Abschlussbericht „Integrale Wasserwirtschaft als Motor der Stadt- und Freiraumentwicklung in Herten“, EGLV 2014

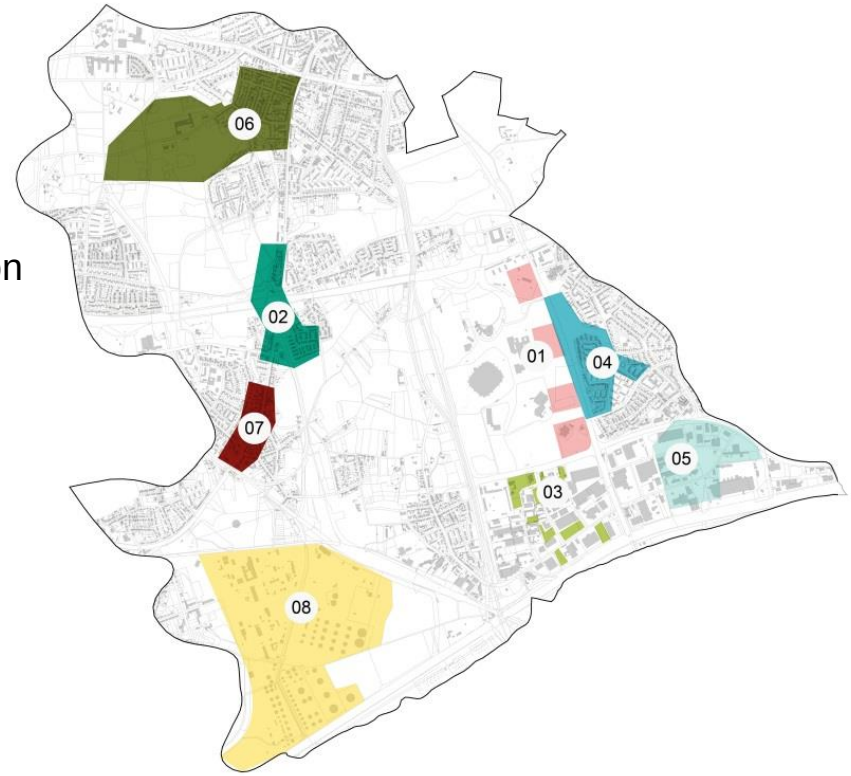
STEP 4
PRIORITIZATION AND DEFINITION OF FOCUS AREAS

(06) Residential area + open space: compensation of water balance, flood protection and attractive living environment

(02) Unbundling/ stream restoration, flood protection and attractive pathway

(07) Attractive street design including infiltration and flood protection

(08) Water sensitive industrial area in terms of water balance and flood control



Preliminary focus areas
Source: ILPÖ/ IWARU

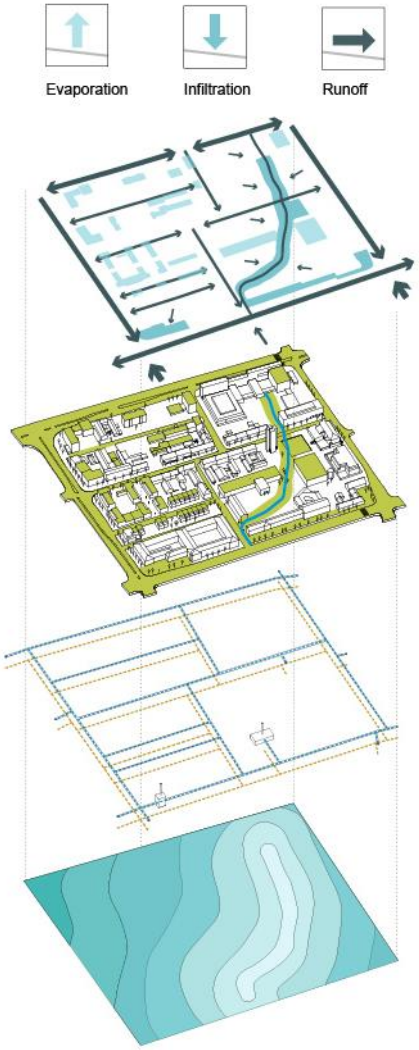
(01) Water sensitive commercial district

(04) Residential area + park: compensation of water balance and attractive living environment

(05) Industry + brownfield: compensation of water balance and open space design

(03) Water sensitive industrial area and expansion of green axis

STEP 5
DEVELOPMENT OF INTEGRATED MEASURES AND DESIGN CONCEPTS



Focus of measures

Potential areas for stormwater management in urban context

Urban development potential areas
- Multifunctional land-uses

Underground sewage system
- Separated system

Groundwater table

Source: ILPÖ, Uni Stuttgart

- Common strategy development and an intensive communication between urban drainage specialists and urban planners
- Interaction between urban drainage measures and open space design in terms of a multifunctional design that improves urban spaces
- Iterative design process with the help of simulation and calculation software
- Visualisation of design options

CONCLUSIONS

- The action manual intends to support interdisciplinary collaboration by synchronizing working steps and identifying points of interaction between urban drainage and urban planning disciplines.

- Different specific local measures and development scenarios can be compared with the help of WABILA-model, which allows the optimization of the water balance through the interaction between spatial planning strategies and water management

- As a result, this integrative planning process creates a new basis for creative solutions that maximize synergies and develop the urban system in a more resilient and sustainable way based on a more sensitive management of the urban water balance.

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