

# PhD

## **Title and Author**

Flexible Urban Drainage Systems – Flexible Design of Urban Drainage Systems during the Development of new Land-Use Areas – Jochen Eckart  
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## **Date of Completion**

Planned in 2012

## **Website Link**

Deliverable 2.1.4 (<http://www.switch.watsan.net/page/4210>)

Journal article (<http://www.iwaponline.com/wpt/005/wpt0050072.htm>)

## **Abstract (~500 words)**

The design of urban drainage systems is confronted with a dilemma. The performance as well as cost of urban drainage systems are affected by several local and global change drivers like climate change, urbanization and more. No sufficient future predictions of the development of these future drivers for the long operation life span of urban drainage system from 50 up to 100 years are possible. For the development of new land-use areas long-lasting decisions about the urban drainage system have to be taken, even if the future development is uncertain and it is expected that the basis for these decisions will change. It is not possible to defer the decisions until the future uncertainties are reduced. An approach to deal with this dilemma could be the flexible design of urban drainage systems. Flexible urban drainage systems should guarantee that current decisions do not affect the capability for subsequent adaptation measures adversely.

In urban drainage and general in urban water management the discussion about flexibility is still in its infancies. Hence there are several unanswered questions about the flexible design of urban drainage systems.

- In technical literature the knowledge about the flexibility of urban drainage systems is limited. Approaches for definition, measurement, developing and optimization of flexibility of urban drainage systems are missing. On the contrary there are several profound approaches for definition and measurement of flexibility in business management as well as engineering science. It has to be investigated, how these approaches can be transferred to the field of urban drainage.
- The present knowledge about the options, which offer flexibility for urban drainage systems, is limited. The available flexibility options for urban drainage system are unknown. Approaches for the utilization of flexibility options of urban drainage system during the development of new land-use areas has to be developed.

- While developing new land-use areas beside urban drainage systems other public infrastructure systems are designed at the same time (sewage disposal, water supply, traffic planning, green infrastructure etc.). There are reciprocal interactions between urban drainage with other urban services as well as with urban planning (rivalry for space, interactions for urban structure, influence of urban design etc.). Hence the flexibility of urban drainage systems could not be developed and optimized without consideration or even in rivalry to urban planning and other urban services. Approaches for an integrated planning of flexible design urban drainage systems together with other spatial planning disciplines are required.

Based on the knowledge gaps identified above research questions for the thesis are developed. The overall research question is:

- How can the flexibility of urban drainage systems be designed during the interdisciplinary development of new land-use areas?

The overall research question is subdivided in detailed questions:

- Which general approaches for definition, measurement and developing of flexibility can be transferred to urban drainage systems?
- What amount of flexibility is required for urban drainage systems in new land use areas?
- How to identify and optimize flexibility options for urban drainage systems?
- How to consider the interdisciplinary interactions between different urban services in the design and optimization of flexible urban drainage systems?

## **SWITCH Deliverable Contribution**

Christian Peters, Heiko Sieker, Jochen Eckart, Assessing future uncertainties associated with urban drainage using flexible systems – the COFAS method and tool, 2010, SWITCH Deliverable 2.1.4 (<http://www.switch.watsan.net/page/4210>)

## **Description of how PhD contributes to goals/objectives of deliverables**

The PhD contributed to third chapter of 2.1.4 'Measurement of Flexibility'. In this chapter the scientific foundation for the measurement of flexibility is presented. In several disciplines, but particularly in engineering science and business management clear concepts of the measurement of flexibility exist. On the contrary, in urban stormwater management the quantification and assessment of flexibility is still at its infancies. In a literature review, different generic measurement approaches are presented and the transferability of these generic approaches to the field of urban stormwater management systems is analyzed. The different measurement approaches are grouped according to their theoretical background in indicator-based measurement, approaches from preinvestment analysis, approaches from decision analysis, approaches from system

analysis and simulation methods. Furthermore a suitable approach for the measurement of urban drainage systems is presented.