

Elaboration of a city wide development concept for waterbodies in urban areas - the approach of Rostock

Elaboration d'un concept d'aménagement urbain des plans d'eau en milieu urbain – l'approche de Rostock

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RÉSUMÉ

Les plans d'eau dans les zones urbaines remplissent de multiples fonctions pour la société urbaine mais sont en même temps soumises à de fortes pressions. À Rostock, dans la plaine de l'Allemagne du nord, il existe une interaction étroite entre l'utilisation du sol, le système d'assainissement urbain et les eaux réceptrices, qui doit être bien comprise pour que tous les systèmes d'eaux urbaines soient développés de façon durable. Dans le cadre d'un projet de recherche en coopération avec toutes les parties prenantes concernées, un concept global a été élaboré et appliqué avec succès : de la gestion des données à l'évaluation multifonctionnelle de l'état des systèmes en passant par la proposition de mesures de développement à haute résolution spatiale. Un ensemble de mesures appropriées pour évaluer les fonctions hydrauliques, écologiques et socioculturelles a été élaboré, et complété par la quantification des impacts du système d'assainissement. Toutes les informations sont systématiquement compilées et traitées dans un SIG fonctionnel, qui est utilisé entre-temps par les parties prenantes.

ABSTRACT

Water bodies in urban areas fulfil manifold functions for the urban society but are simultaneously subject to severe pressures. In Rostock, located in North German lowlands, exists a close interaction between land use, urban drainage system and the receiving waters which demand an integral understanding as prerequisite for a sustainable development of all urban water systems. In a cooperative research project with all relevant stakeholders, a holistic concept, ranging from data management over multifunctional assessment of systems state to spatially high resolute proposal of development measures has been developed and successfully applied. A set of appropriate measures for assessing hydraulic, ecologic and socio-cultural functions has been developed, completed by the quantification of impacts from the drainage system. All information is systematically compiled and processed in a functional GIS, meanwhile in use at stakeholder level.

KEYWORDS

Development concept, GIS, stakeholder, urban drainage system, Waterbody,

1 INTRODUCTION

The situation in densely populated urban areas is characterized by close interrelation of natural and anthropogenic water systems. Here, the urban water bodies provide multiple functions for the city's society and are subject to heavy anthropogenic impacts (Teurlincx et al., 2019). The complex interactions, splitted responsibilities and partly diverse interests of stakeholders are making an integral development urban water system so challenging.

This applies also for the city of Rostock, located in the North-German lowlands with a close network of small creeks and ditches, standing water and wetlands. In combination with low slope and the dominant separate system this yields a closely linked urban water system. The inner part of Rostock is drained by a combined system with CSO's into the estuary Unterwarnow. Parts of the system and the main sewers are, due to further increase of impervious areas at their capacity limit. The stormwater system in the outer areas discharge via 200 effluents into small creeks and ditches with significant impact for the physico-chemical state. This water bodies provide an important function for the urban drainage system but can also lead to flooding when overcharged, as realized in some rain events in the past. Because of their size, most of the small water systems are not subject to reporting according to the EU-WFD. In consequence, their ecologic state has not been assessed, so far.

Table 1: Key numbers of the project Region Rostock

| Inhabitants | Area | # flowing waters | km flowing waters | # standing waters | # wetlands | length stormwater system | Length combined sytem |
|-------------|---------------------|------------------|----------------------|-------------------|------------|--------------------------|-----------------------|
| 202.000 | 181 km ² | 200 | 196 thereof 39 piped | 138 | 270 | 430 km | 150 km |

Starting with these boundary conditions, the research project KOGGE aimed at a city wide collaborative development of urban water bodies.

2 MATERIALS AND METHODS

2.1 General approach

The goal of integrated development of water bodies in urban areas can only be achieved, if all relevant stakeholders are working closely together and are supported by experts for diverse technical, ecologic and socio-cultural questions. Therefore, the KOGGE team consisted of

- City of Rostock (Department Building and Environment)
- the regional wastewater utility
- the regional operator for maintenance and development of natural water bodies
- local and regional water authorities
- Scientists for Geodata management, Water Management, hydrologic/hydrodynamic modelling, ecologic and socio-cultural analysis

Figure 1 illustrates the methodological approach. A key target was a sound systems-analysis. This analysis is focusing on the main functions of water bodies in urban areas

- Hydraulic function to safely drain the city
- Ecologic function as habitat for aquatic or aquatic bound flora and fauna
- Socio-cultural function for the urban society

For each of these functions, appropriate sets of evaluation methods were developed. The results of the function oriented assessment lead finally to the development of a holistic water development concept, which now will be implemented into sectoral planning of all concerned stakeholders.

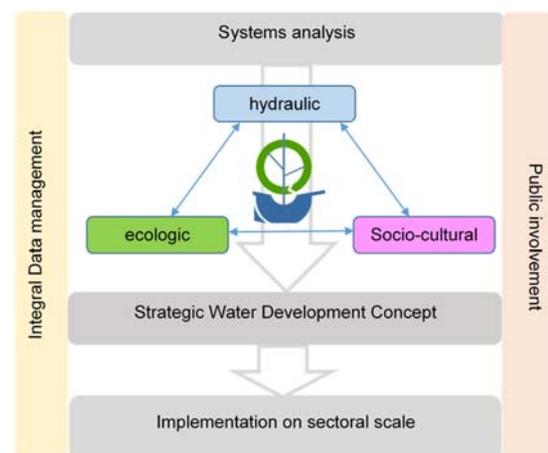


Figure 1: Project scheme

2.2 Integral Data Management

A key question for the whole process is the efficient data management. Which data are required? Which are available and where? How can the data be provided for the consortium and without redundancy? And how can the data efficiently be processed and used for planning and operation at stakeholder level? To answer these challenges, two basic products were developed:

- an operational web-based data portal for the project team, compiling all available data and project results (Hubner et al., 2017)
- a consistent and functional Water and Wetland cadastre (WWC) as GIS application compiling all relevant geodata and background information (Mehl und Hoffmann, 2017)

The WWC is built on the following basic structures

- geometries (water bodies, sewer system, polygons of standing waters and wetlands)
- primary attribute data (ID's of water bodies related subcatchments, geographic names, lengths, areas)
- secondary attribute data, object data (all derived, connected geo information, results of mapping, monitoring, modelling)

For a spatially differenced evaluation and development of measures, all water bodies were segmented equidistantly in 50 m segments. By applying topologic relationships, various helpful functions are provided.

2.3 Integral hydraulic assessment

The hydraulic function of water systems in urban areas must primarily be defined from an anthropocentric perspective: the flood risk. In closely linked hydraulic systems this can arise as interaction or conjunction of i) the technical urban drainage system, ii) urban stream system iii) limited infiltration capacity, iv) morphological conditions (namely depressions). According to definition of risk, this requires for a distinct area or object the assessment of i) flood probability and ii) related damage. As a favorable precondition, the city of Rostock has a real use mapping in a very high spatial resolution (single objects). For the here defined land use classes, distinct maximum flood risk probabilities were agreed with the communal authorities (Tränckner und Mehl, 2017). These probabilities are translated into modelling scenarios for the integrated model of river basin, river, sewer system and flooding. Merging flooded areas with the defined tolerable probabilities of the land use classes in GIS yields in spatially differenced identification of flood risk (Kachholz et al., 2019).

2.4 Morphology and Socio-cultural aspects

To assess the socio-cultural function of water bodies, the approach of König (2011) was slightly adapted. It evaluates the function in categories like visual perception, accessibility, quality of stay, special identity. These assessments were performed by combining terrestrial monitoring with an interpretation of aerial photos. This monitoring was combined with the assessment of morphological parameters of the water body and its land zone (Renner et al., 2018).

2.5 Ecologic assessment

A key task for the elaboration of a multifunctional water development concept of the small urban water systems is the bioindicative assessment of their functionality. Since these are not subject to reporting according to WFD, there exist no guidelines for those assessments and planning of measures. In KOGGE, a completely new ecologic assessment scheme has been developed, calibrated and successfully applied for most of the water bodies in the project area. It is based on monitoring of macrozoobenthos (bed), macrophytes (bed+bank) and lepidoptera (adjacent habitat) leading finally to an index of urban disturbance, GUI and the derivation of potential impacts (Thiele et al., 2017)

2.6 Strategic development concept

All results of the systems analysis are compiled in the WWC. For the urban water bodies, these are provided for the defined 50 m segments. For each of the three functions a set of criteria to assess the deficits and their intensity (3 classes) were developed. By merging these assessments, concrete demand for measures can be derived. These are linked with a database compiling best practices for integrated development of urban drainage and urban water systems.

3 RESULTS AND DISCUSSION

The achieved results are manifold. As an example, Figure 2 shows the whole project area, here with the

