Abstract

"The overall concept of geomorphology of the Lower Rhine.

Methodology for the development of overall concepts for large and navigated rivers with regard to the valuation of the structure quality of watercourses (stream morphology)"

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Overall concepts for watercourses describe "todays potential natural condition" of stretches of water (*Leitbild*), which would occur after the removal of construction measures as well as the omission of the total of the channel's utilization, its surroundings and riparian landscape, furthermore in the entire catchment area and under the given climatic conditions. The overall concept illustrates a dynamic stadium of climax in which the ecosystem could largely recover from human impacts. Yet, irreversible alterations of the natural environment that can determine the overall concept's characteristic value remain (e.g. mining subsidence). The overall concept of geomorphology deals exclusively with the abiotic. First and foremost, it serves as a basis for assessing the water structure quality (stream morphology) (*Gewässer-strukturgüte*).

The Lower Rhine is marked by that part of the Rhine starting at Rhine-kilometer 640 off the border line of Rhineland-Pfalz and ending at Rhine-kilometer 865,5 at the german-netherlandish border. This river course of the rhine is identical to the German federal waterway "Rhine" in North Rhine-Westphalia (study area).

From 1991 until 2001, regional idealized concepts were developed for all watercourses in North Rhine-Westphalia, except for the Rhine. The Lower Rhine's idealized geomorphological concept completes the typology development and description of reference conditions in North Rhine-Westphalia. As a result, it is the first region of all for which a complete stream typology could be presented, including every single watercourse, from small streams to large rivers.

The development of the Lower Rhine's regional idealized concept is the first description and visualization of a stream's (respectively stream segment's) overall concept, nationwide as well as internationally speaking. Therefore, it was necessary to develop a basic methodology, following the pattern of existing methodologies for constructing waters under today's potentially natural conditions. Especially for large and navigated rivers, type specific reference conditions had to be derived mainly theoretically. In order to work out overall geomorphological concepts for streams, a specially developed systematology is proposed.

The river channel of the lower rhine, which ranges in the Lower Rhenish Embayment, is dominated by gravel (stream type *Kiesgeprägter Strom des Tieflandes*). It flows in a flat valley which has a longitudinal zonal change of five differentiating valley bottom forms. As a consequence thereof, five different section types for large rivers (*Stromabschnittstypen*) can be accounted for, which in their longitudinal course correspond to alternating states of the overall concept of the river and its riparian landscape and which define the regional idealized geomorphological concept at large. Additional demarcation criteria are similar and/or heterogeneous characteristic values of morphological parameters for streams.

Moreover, the research work at hand makes an innovative contribution to the theorie of irreversible alterations of the natural environment. Focal point is particularly mining subsidence and the intensive river bed erosion of the Rhine, reaching and carrying off the tertiary subsoil.

Specifically on the section type for large rivers between Duisburg and Wesel must be placed emphasis since here, the riparian landscape under potentially natural conditions is anthropogenic widened: a landscape of lakes has recently emerged from spacious gravel excavation, furthermore rock salt and hard coal mining resulted in subsidence of the natural terrain surface in which in the state of the regional idealized concept, groundwater outcrops. Besides, these sections can be cut due to lateral erosion of the Rhine-stream, or their surface can be directly deformed by flood events. Hence, a landscape of lakes ranges in today's potential natural condition of watercourse on both sides of the Rhine.

The results of the regional idealized geomorphological concept's development for the Lower Rhine have already been used as a basis of valuation for the mapping of stream morphology (*Gewässerstrukturgüte-kartierung*) that is accomplished every five years in order to enquire and evaluate the extent to which morphological structures have been improved or deteriorated. Moreover, the overall concept serves e.g. as a basis for reference conditions in terms of the European Union Water Framework Directive, as a binding method to advance the near-natural development of watercourses or for identification of structures in need of protection.