

BANK EROSION IN THE BÜNZ FLOODPLAIN: MANAGEMENT BASED ON THE RISK CONCEPT

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INTRODUCTION

The Bünz River is a small stream in the Swiss lowlands with a catchment area of 107 km². As many other rivers it has been canalised at the beginning of the 20th century. However, during extraordinary floods in 1999 and 2007, the banks eroded, the river course migrated and new meanders formed. The Bünz River reoccupied its ancient floodplain. As a consequence of the 1999 flood, a natural reserve along a 3 km long reach was created. In the conservation area, morphologic dynamics should be tolerated to a certain extent. However, morphological dynamics of the river clash with the demand for protection of landowners, who farm the land next to the river and of the owner of infrastructure along the river reach. To what extent morphological dynamics should therefore be tolerated and how can bank erosion be managed?

In order to answer that question, a management plan based on the risk concept was elaborated. Because neither hazard processes nor damage processes could be quantified in a reliable manner, a semi quantitative approach was chosen.

WHAT CAN HAPPEN? RISK ANALYSIS OF BANK EROSION

Based on field studies and morphologic parameters of the river, scenarios for bank erosion along the Bünz River were defined. On one hand, small-scale scenarios were defined that consist of local bank erosion niches caused by hydraulic load on the bank with short duration. On the other hand meandering scenarios describe large-scale channel migration processes during long lasting flood events. The bank erosion processes along the Bünz River are not coupled to flood events with a certain peak discharge and recurrence interval. It was therefore not possible, to establish a magnitude-probability relation for the defined erosion scenarios. The scenarios were therefore called 'possible' and 'thinkable'.



Fig. 1 Bank erosion along the Bünz River after the 2007 flood.

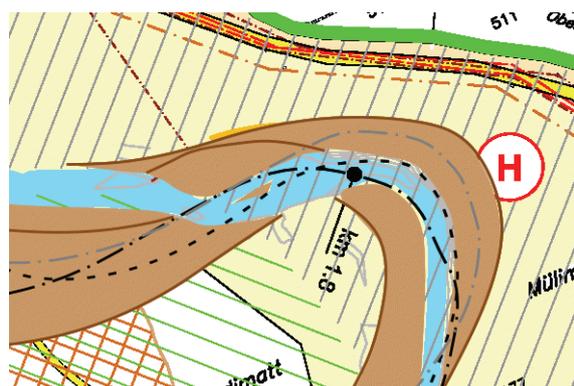


Fig. 2 'Thinkable' scenario for channel migration through meandering process

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The expected damage in case of bank erosion has been assessed for about 50 objects that are situated along the river (access roads, farm land, drinking water wells, sewers, etc.). Three kind of damages were distinguished:

- Destruction of material assets
- Outage of a infrastructure service and
- Water pollution

The extent of the damage was either quantified (reconstruction costs for destructed material assets) or qualitatively estimated (e.g. constraints for the public in case of the outage of an infrastructure service) and rated.

WHAT IS ALLOWED TO HAPPEN? MATRIX OF PROTECTION OBJECTIVES

The protection objectives for the objects were defined as a function of the erosion scenario and the expected damages (cf. matrix in Fig. 3). In case of 'possible' bank erosion, little damages are accepted, medium and large damages not. In case of 'thinkable' bank erosion, medium damages are also accepted.

large damages (5–6 pts)	<i>avoid</i>	<i>avoid</i>
medium damages (3–4 pts)	<i>avoid</i>	<i>accept</i>
little damages (0–2 pts)	<i>accept</i>	<i>accept</i>
	possible scenario	thinkable scenario

Fig. 3 Matrix of bank erosion protection objectives.

WHAT SHOULD BE DONE? MANAGEMENT PLAN

The management plan foresees three type of measures:

- Constructive bank protection measures: They will be realised, where a protection deficit exists today. This is mainly the case, where 'thinkable' bank erosion may destroy sewers and cause large damages.
- Intervention lines: They define a limit to which bank erosion is tolerated without intervention. If the line will be passed over after one or a series of erosion events, pre-defined constructive bank protection measures will be implemented. The intervention line is placed where – after a series of events – a consequent 'possible' erosion scenario could provoke medium damages.
- Evaluation lines: They define a limit to which bank erosion is observed without intervention. If the line will be passed over after one or a series of erosion events, the risk situation will be reviewed. The evaluation line is placed where – after a series of events – a consequent 'thinkable' erosion scenario could provoke large damages.

CONCLUSION

Along the Bünz River, the risk concept was applied in a semi-quantitative way. This approach allowed evaluating hazard processes like bank erosion and channel migration that are usually difficult to quantify.

Keywords: bank erosion, meandering, risk concept, protection objectives, intervention line