



Study site:
Quarter Vauban, city of Freiburg, Germany



Drainage system:
Modified separated sewer system with rain water infiltration by infiltration ditches and trenches

- assumptions:**
- municipal drainage plan
 - municipal development plan
 - technical guidelines
 - legal regulations
 - hydraulic, hydrological, climatic parameters (based on available measured data)

design storm
for dimensioning: rain event (10 min, 10a return period) extracted from a 30 a time series of a nearby weather station

hydraulic-engineering calculations, optimised with long-term simulation using a 10-year time series of precipitation

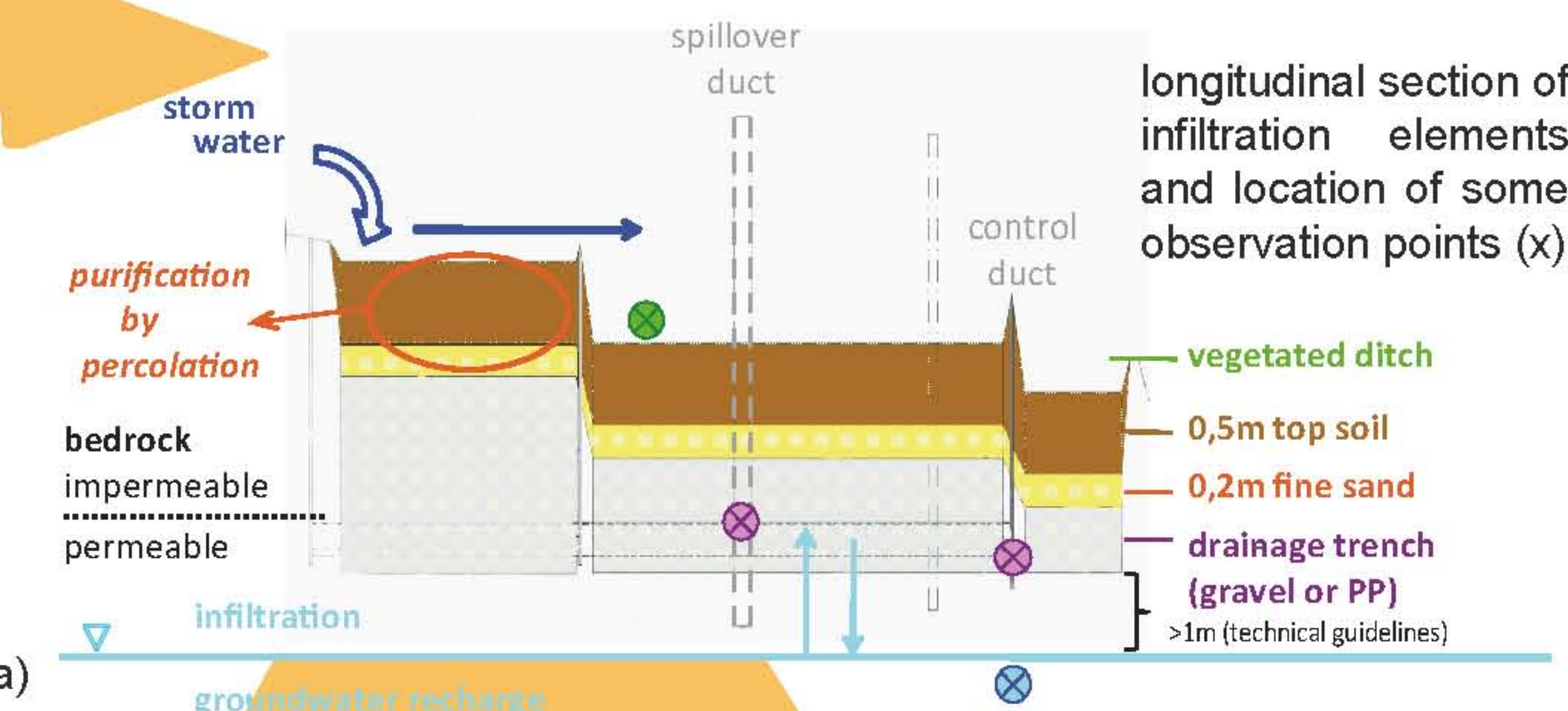
Urban storm water drainage planning

- further construction
further development of:
- legal requirements
 - technical guidelines, possibilities
 - state of the art
 - potential changes in:
 - hydrogeological conditions
 - soil and infiltration properties
 - climatic conditions
 - landuse
 - demography

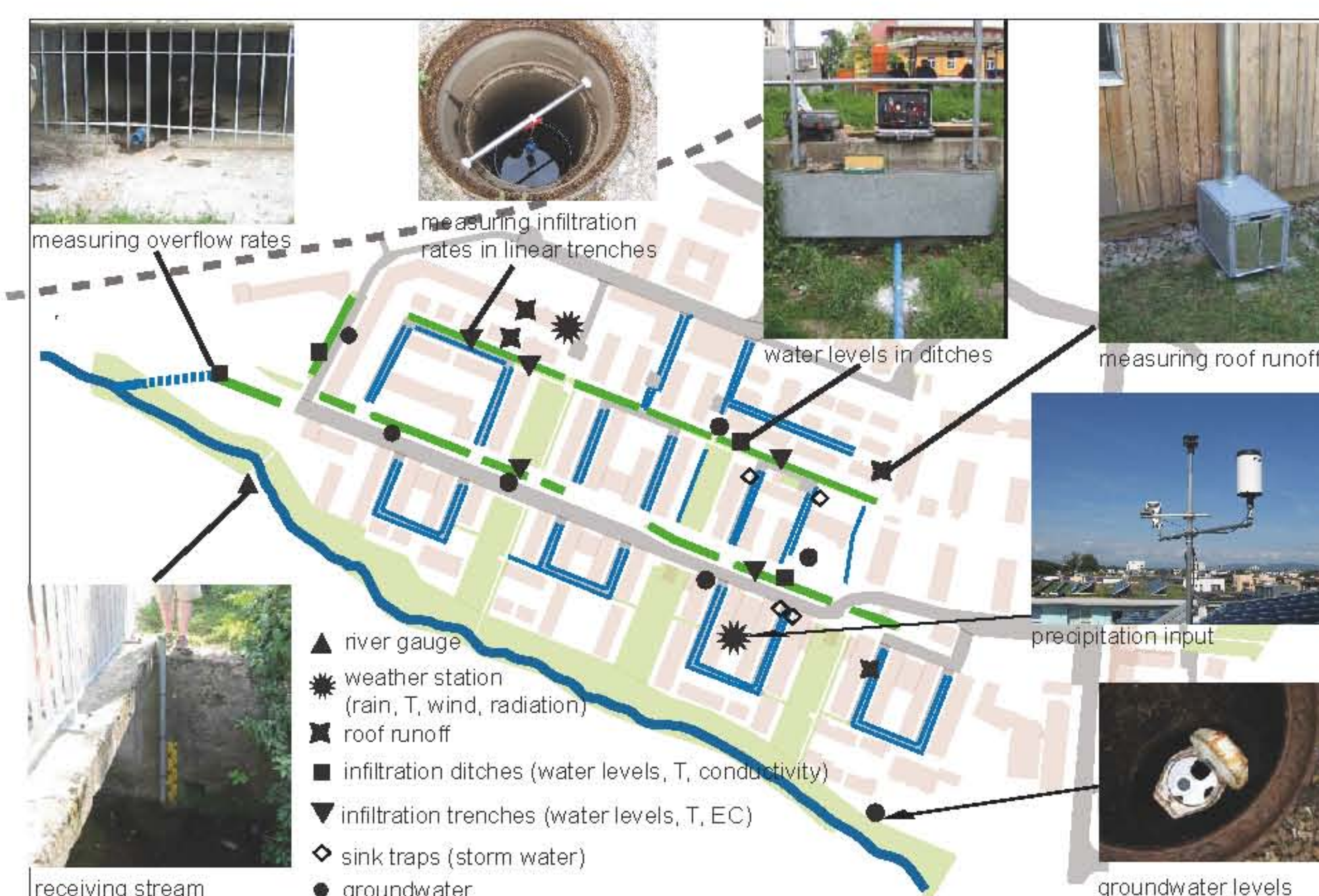


construction: 1997 - 2004

Evaluation process
with respect to
assumptions of
planning phase

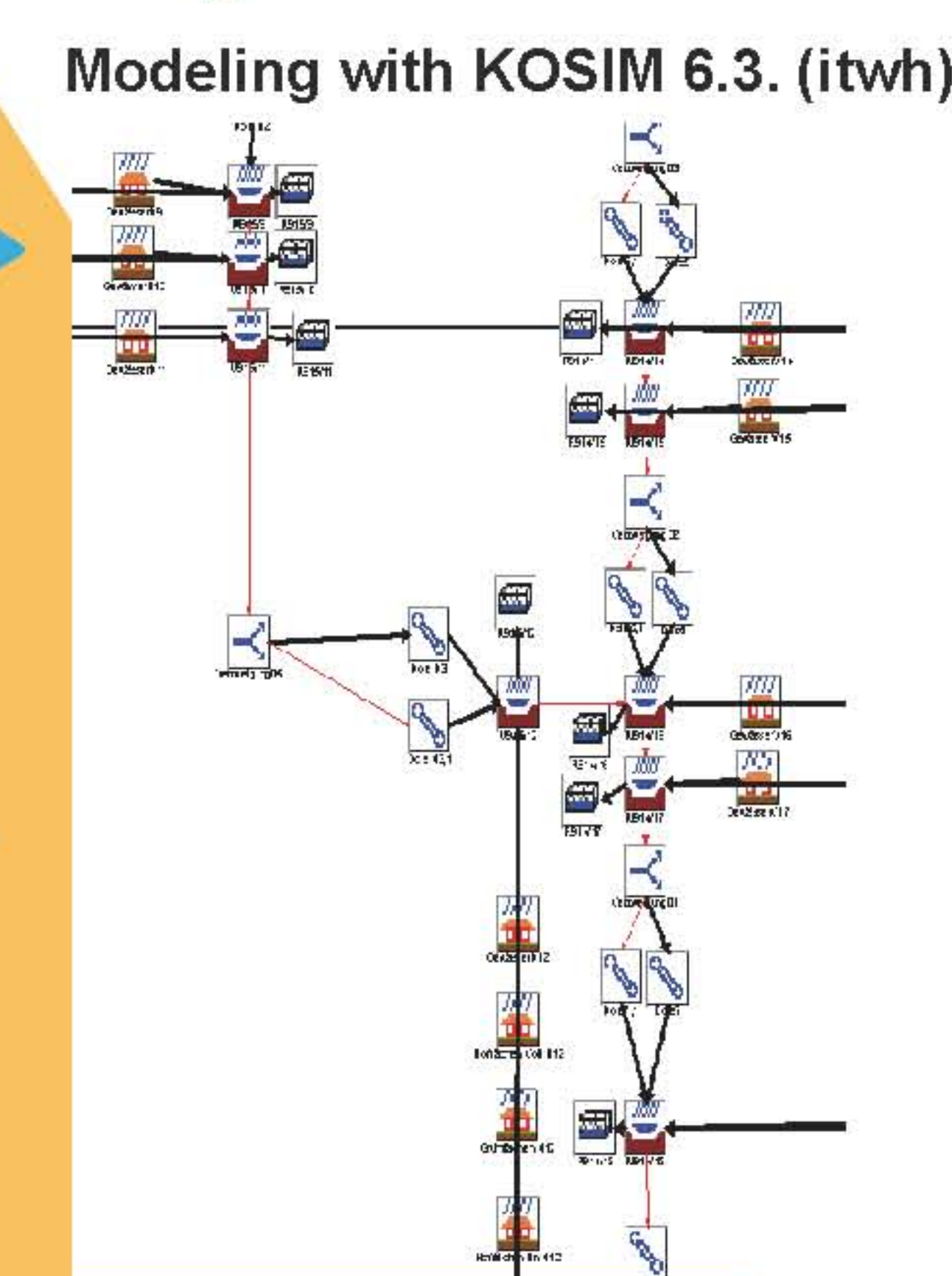


Monitoring network in the experimental urban water shed (16 ha)



field experiments and continuous monitoring of water levels, EC, T, soil moisture, 1 - 5 min, since 5.6.2010

comparison
comparison with assumptions
of planning phase
parameter optimisation
process conceptualization



simulation of observed rainfall-runoff events using observed precipitation as input



Assumptions:

To ensure adequate infiltration velocity but also sufficient time for physico-chemical reactions in the soil, in order to purify storm water during seepage, the hydraulic conductivities of the top soil should be in the range of: $k_f 5 \cdot 10^{-5}$ to $1 \cdot 10^{-5}$ m/s (technical guideline ATV 1990)

Long term simulations are used to test the performance of the designed drainage system with long term data series of precipitation. Unfortunately, as in most cases, no data is available to calibrate or verify the model and its parameters

Distance groundwater table to drainage trench > 1m (technical guideline DWA, 2005);

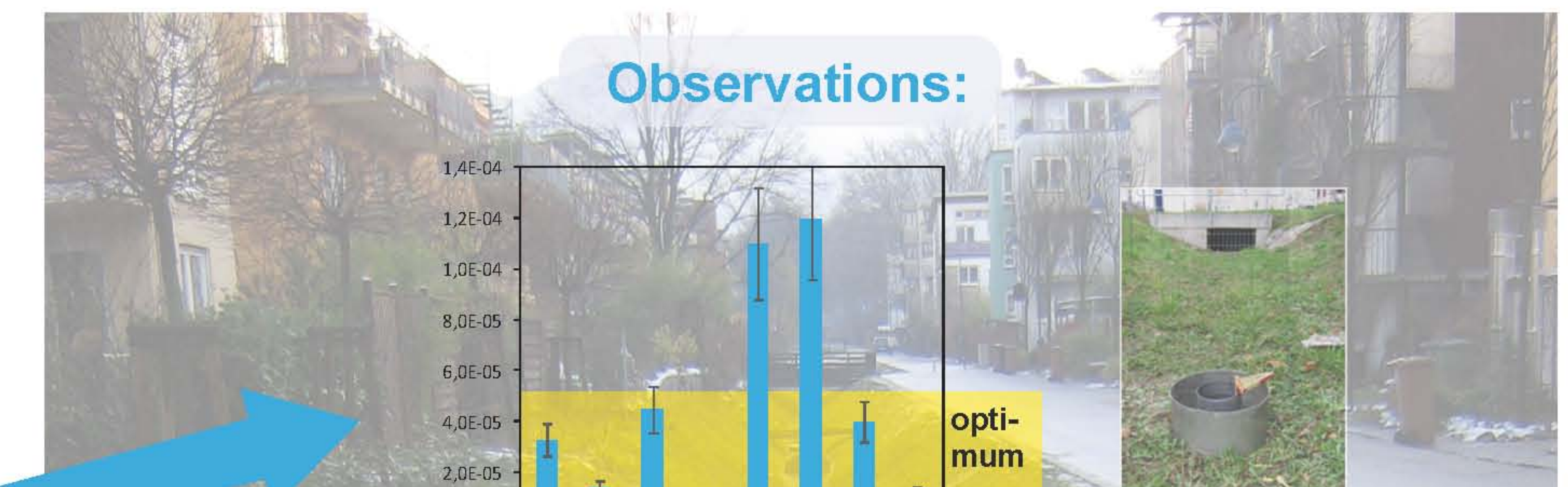
„...a potential groundwater rise up to the level of the drainage trench is likely to happen due to high groundwater tables. A rise up to the soil level might occur occasionally but will be limited to several weeks per year.“ (assumption based on statistical interpretation of a reference well 700m away with weekly fixed date measurements from 1929-1994).

The discharge of the rain water drainage system to the receiving stream will not exceed 1.5 L/s (assumption based on hydraulic calculations and simulations)

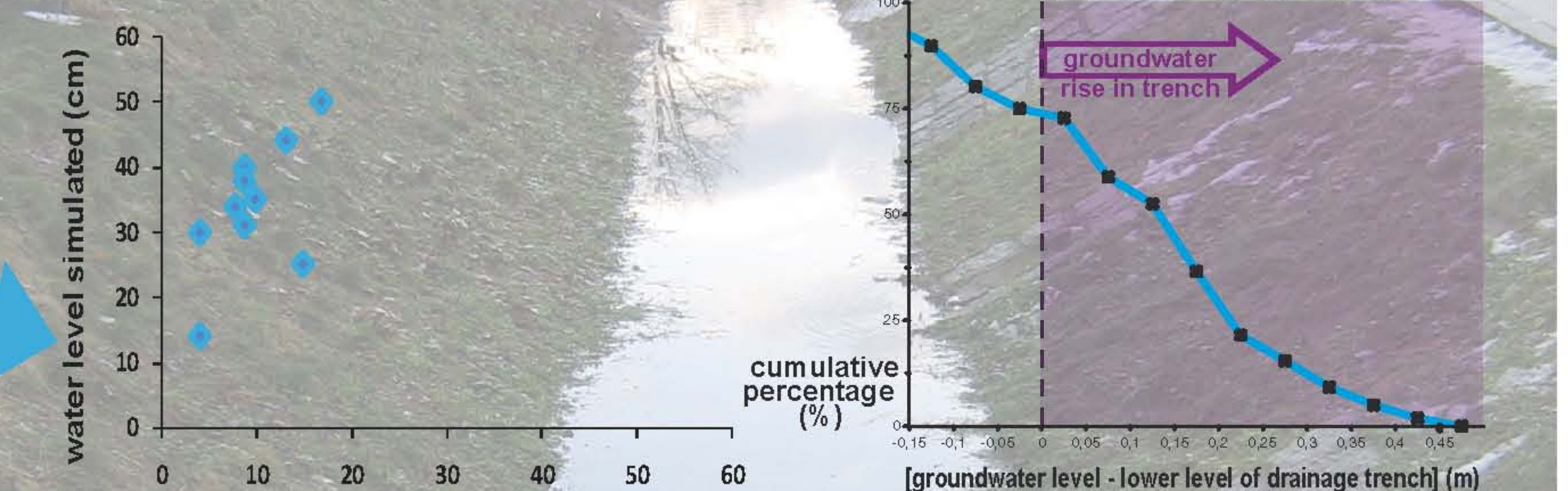
It can be assumed that about 50% of the annual storm water will be retained by the infiltration system (assumption based on hydraulic calculations and simulations)

Outlook:

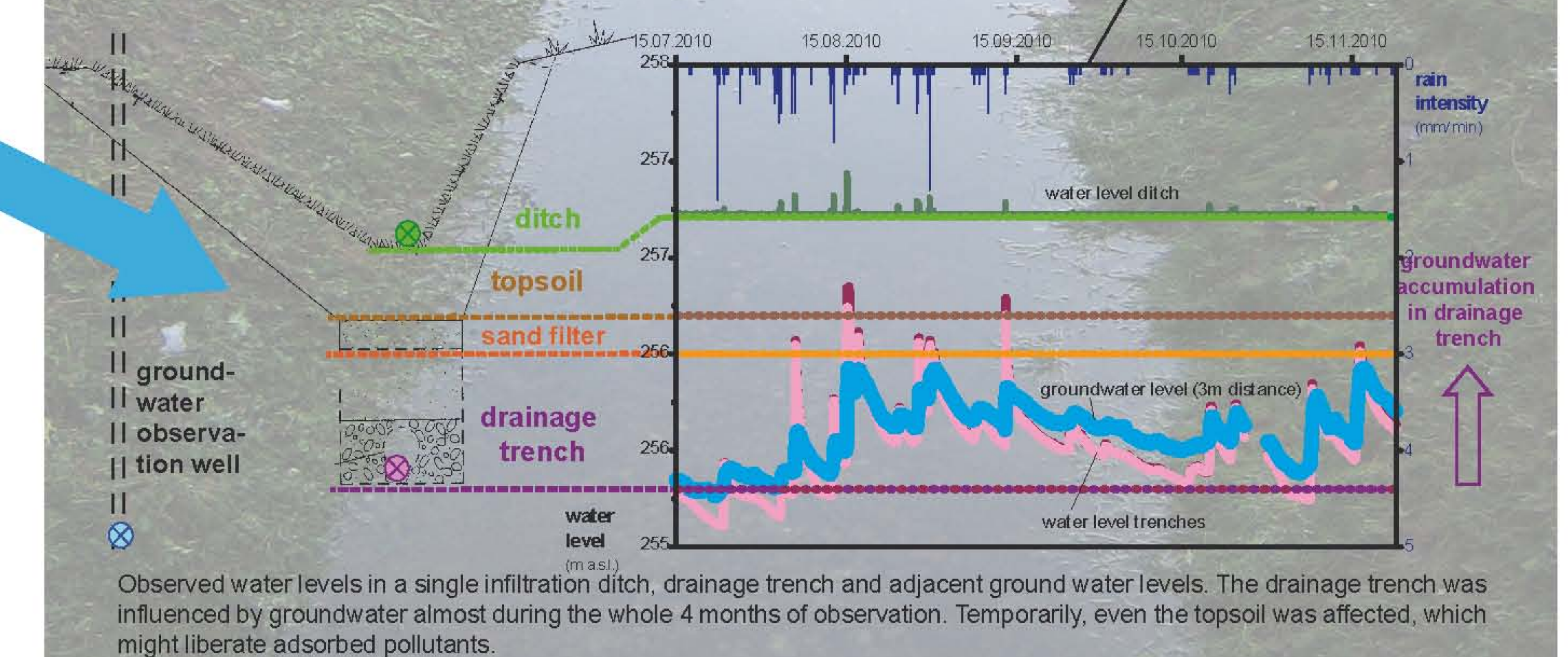
Continued evaluation of the system assumptions, especially regarding infiltration behaviour at changing ground water levels and effects of the infiltration system and landuse characteristics on the water balance.
Parameter optimisation of the model using observed and additional measurements.
Test of different models and their suitability for urban hydrological-hydraulic modeling.
Analyze single processes to improve process conceptualization.
Extract conclusions for improving further planning and management strategies of rain water infiltration systems.



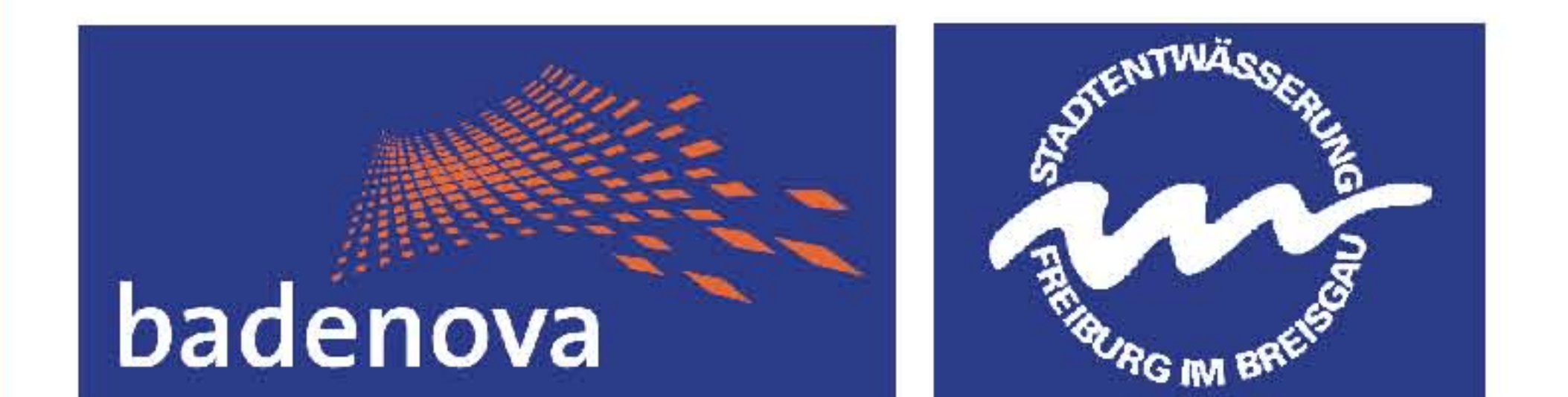
Vertical hydraulic conductivity of the topsoil in selected ditches, determined by double-ring infiltrometer tests (16. - 18.11.2009)
1 (N4) out of 8 analyzed ditches does not provide sufficient infiltration capacity whereas 2 ditches (B1, B2) are too permeable., what might influence the quality of the groundwater recharged by the infiltrated storm water.



Water levels in 1 of the monitored ditches as observed by field measurements and simulated with the model KOSIM for several rain events. Deviations between model and observations might be due to e.g. modifications in landuse, inappropriate model parameters amongst others, which needs further investigation



funding by



is greatly acknowledged