

# Risk assessment in trans-boundary cooperation between the Netherlands and Germany



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## Presentation overview

- Introduction
- Study area
- Risk-assessment method
- Sensitivity analysis
- Summary and future plans



## Introduction



Rijkswaterstaat



- Flood protection in boundary area of Germany and the Netherlands
- Identify and reduce flood risk for 2 dike ring areas along the Rhine

provincie  
**GELDERLAND**



Ministerium für Umwelt  
und Naturschutz, Landwirtschaft  
und Verbraucherschutz des  
Landes Nordrhein-Westfalen



Universität Karlsruhe (TH)

- Cooperation!



Waterschap  
Rivierenland

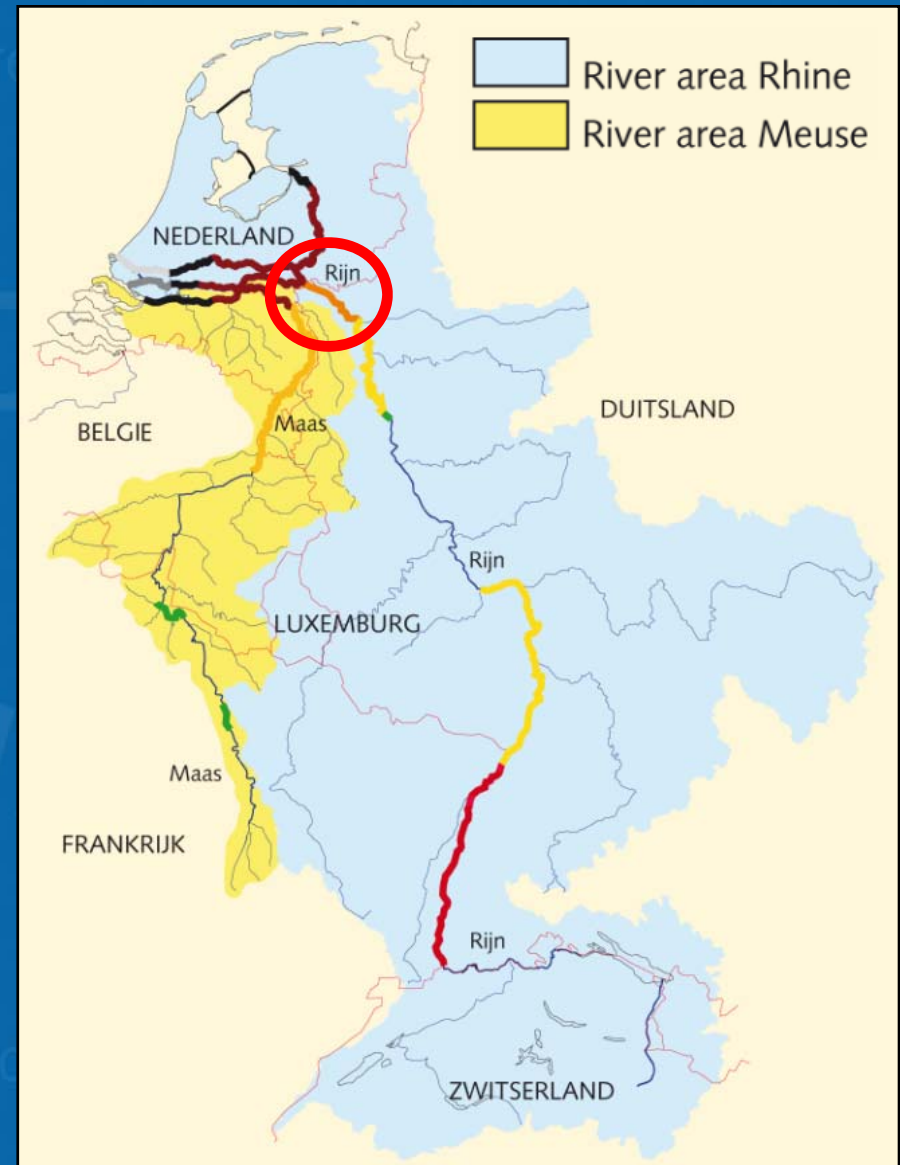
# Introduction

- Project initiation: 2005
- Three phases
  1. Communication and identification (2006)
  2. Risk-analysis of right-hand side dike ring (2007)
  3. Risk-analysis of left-hand side dike ring (2008)
- Joint method, based on existing software/techniques
- Time horizons: 2006, 2015 and 2015+

# Study area

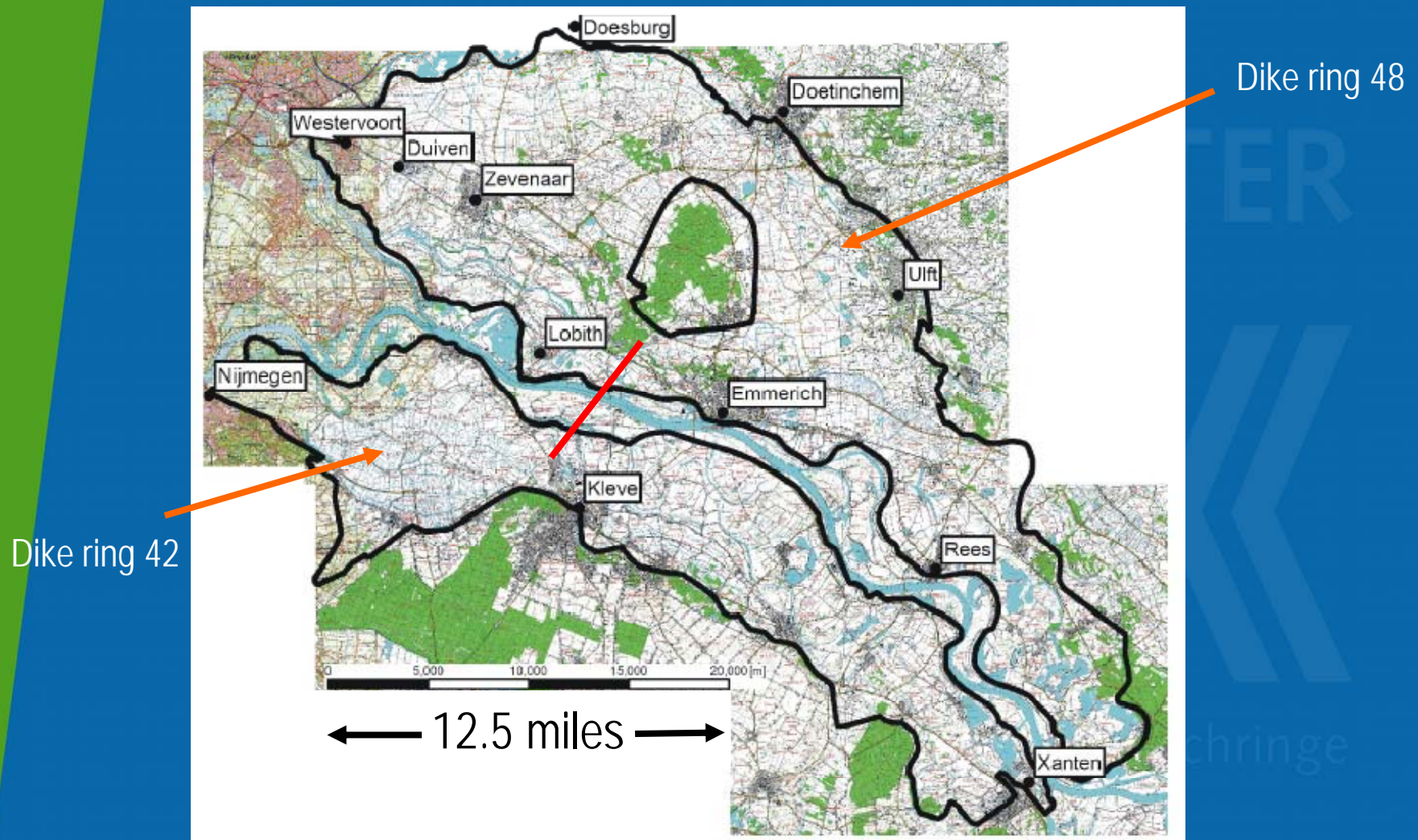


Transboundary  
dike rings along the  
river Rhine



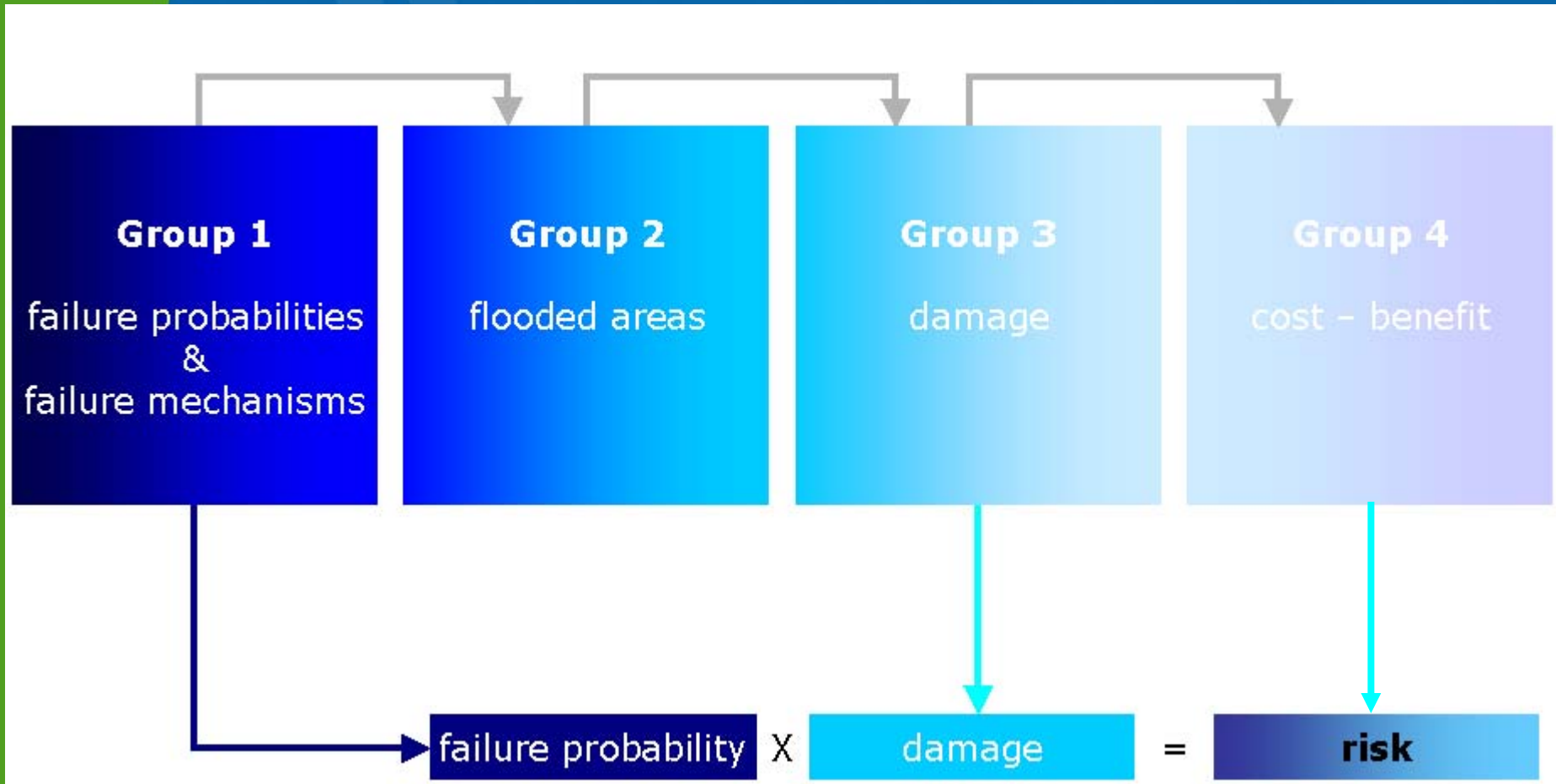


# Study area



# Risico analyse voor grensoverschrijdende dijkringen

## Scope of the project





# Risico analyse voor grensoverschrijdende dijkringen

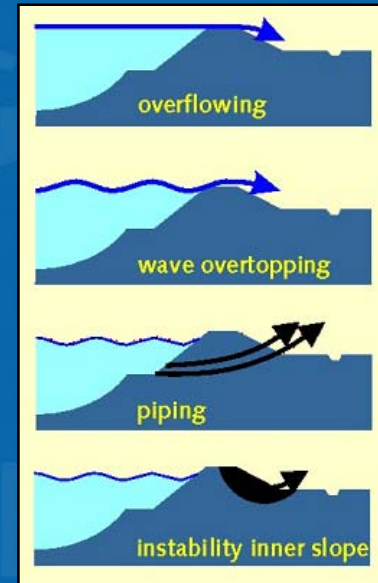
## Failure mechanisms





# Computation of failure probabilities

- Overflow
- Wave overtopping
- Bursting of the soil & piping
- Stability of the slope
- No structures

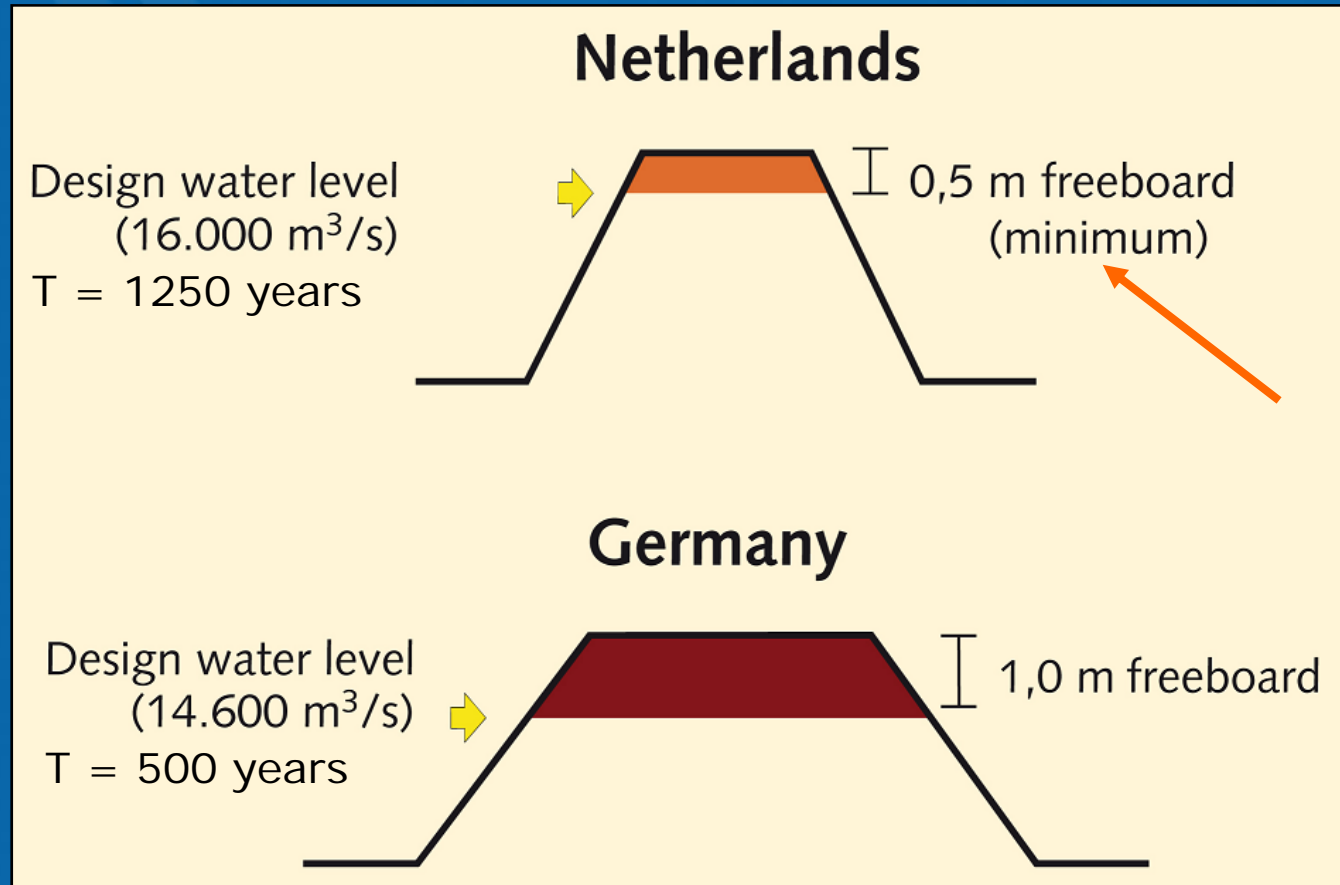


## Failure mechanisms / probabilities

- Identification of 10 weak spots, based on Dutch deterministic assessment method and local expert knowledge
- Probabilistic computation of failure probabilities every 100 meters for wave overtopping only
- Detailed probabilistic computation of failure probabilities for 10 weak spots

# Risico analyse voor grensoverschrijdende dijkringen

## Differences in dike design



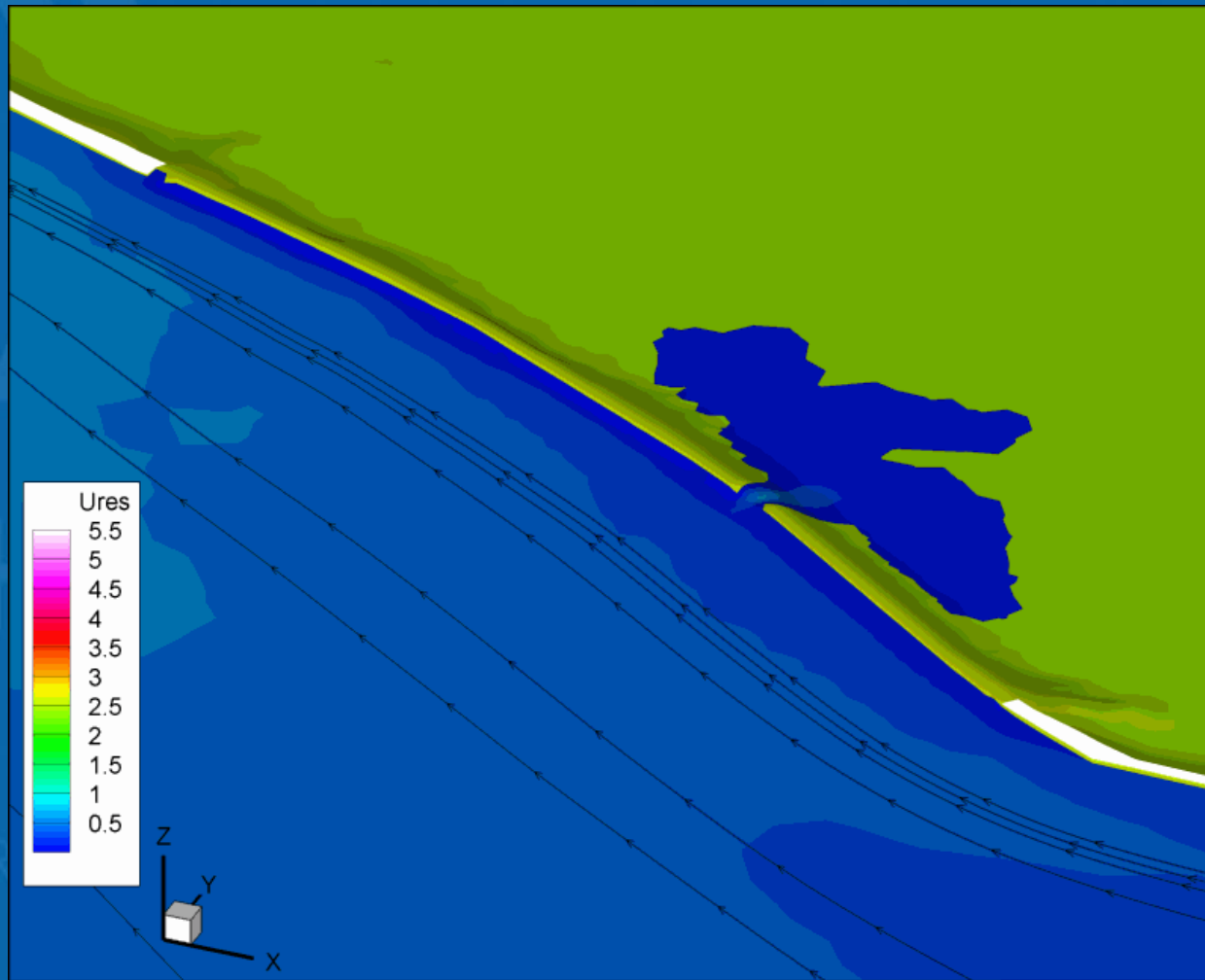
# Risico analyse voor grensoverschrijdende dijkringen

## Difference in maintenance

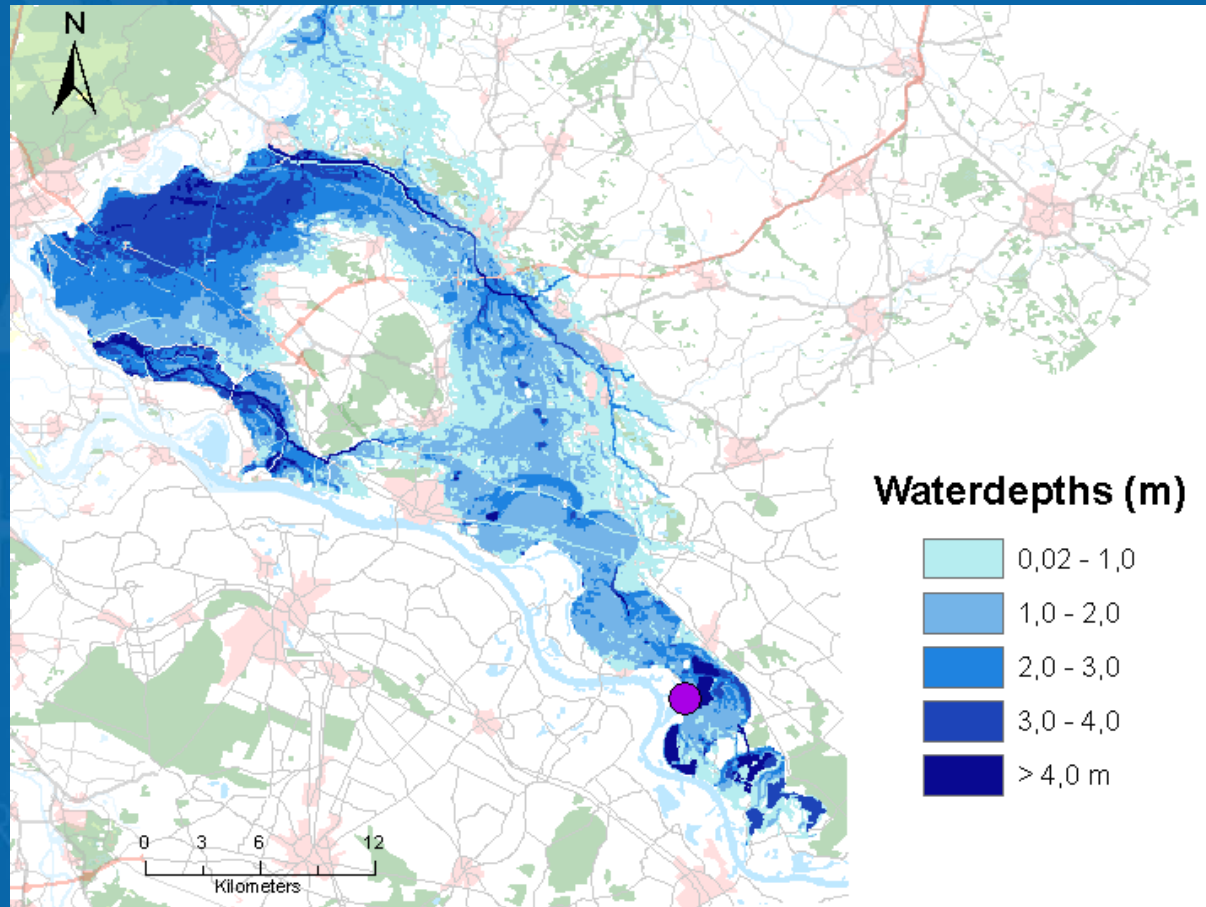




# Breach and flood simulation

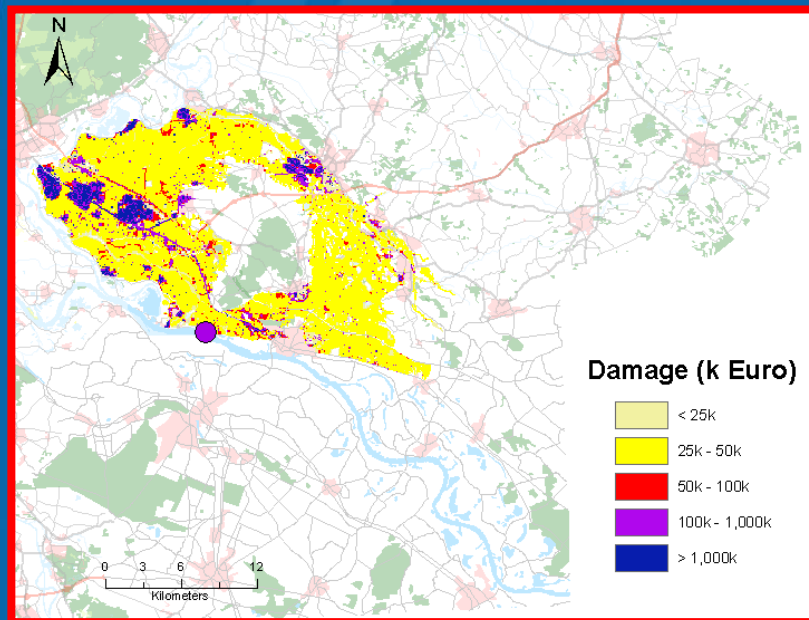


# Breach and flood simulation

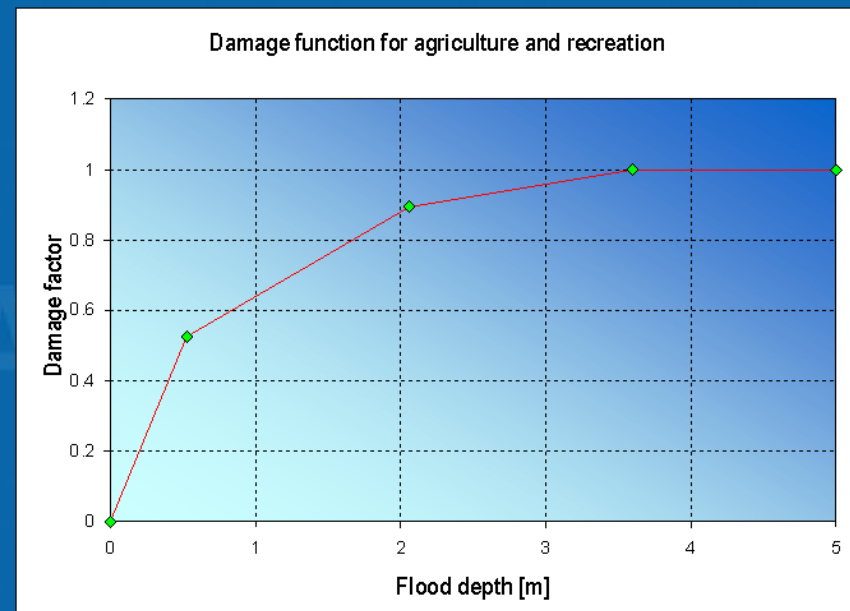


# Damage assessment

Flood simulation







Damage and  
loss of life module



Land use

# Flood risk

$$\begin{array}{c} \text{Risk} \\ = \\ \text{probability} \\ \times \\ \text{consequence} \end{array}$$

big probability big consequence	big probability small consequence
	
small probability big consequence	small probability small consequence
	



# Cost-benefit analysis of measures

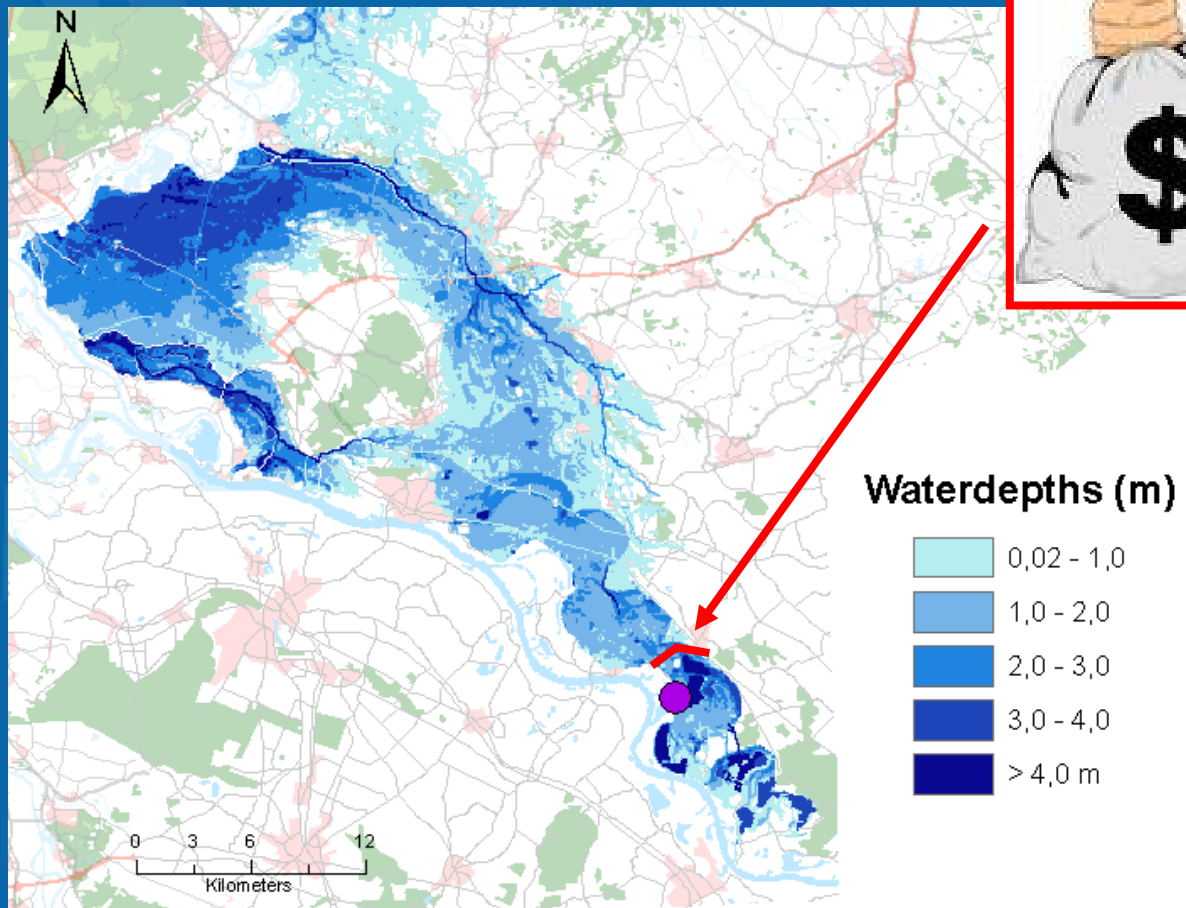
Types of (structural) measures:

- Dike strengthening
- Compartment dikes



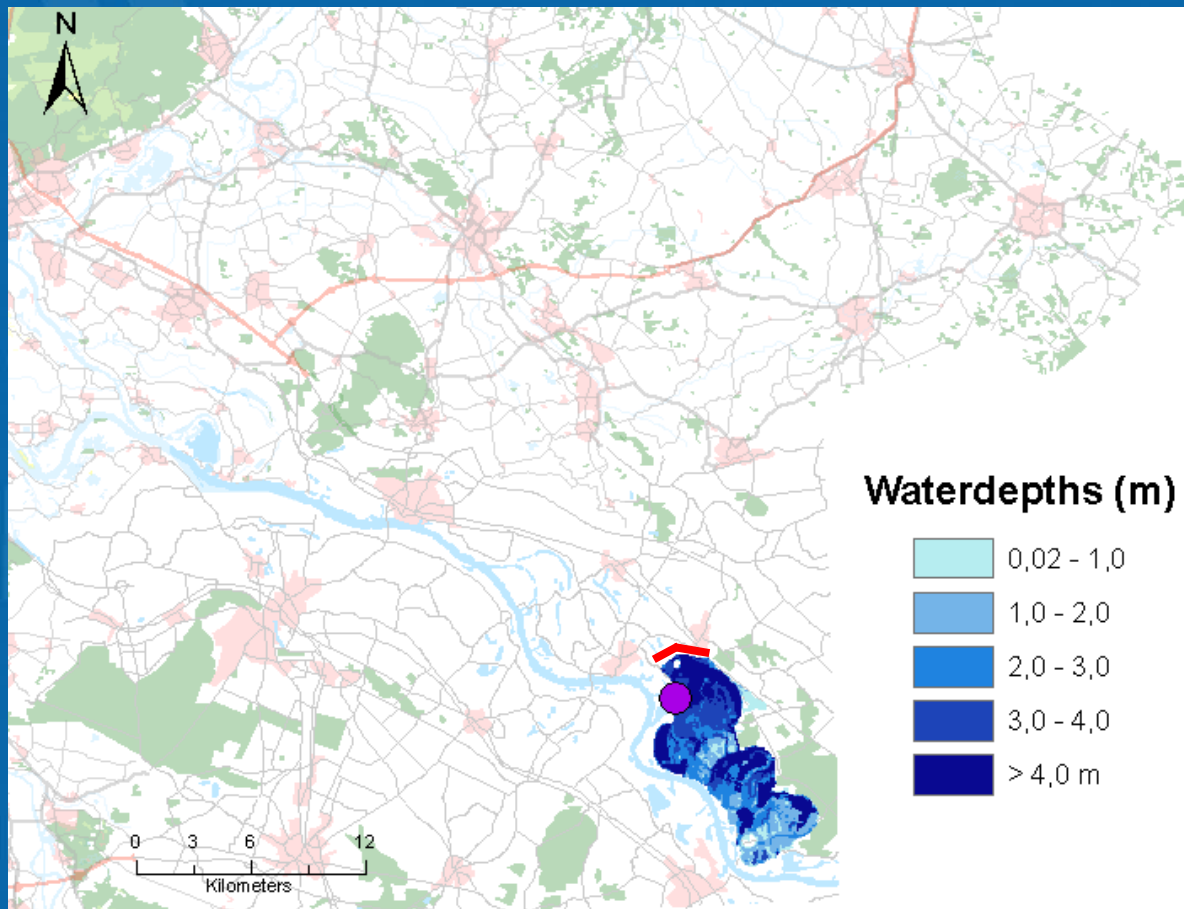
# Risico analyse voor grensoverschrijdende dijkringen

## Compartment dike



# Risico analyse voor grensoverschrijdende dijkringen

## Compartment dike



# Sensitivity analysis

## Verification of sensitivity to assumptions

- Critical overtopping discharge
- Breach development (width, water level, moment of breach)
- Flood wave (shape and height of discharge wave)
- Correction of damage and costs



## Summary and future plans

- Cooperation very successful as a result of the communication and identification phase
- Much added value because of different partners
- Project in last phase
- Final results this summer (symposium)



HOOGWATER

Thank you for your attention!

HOCHWASSER

