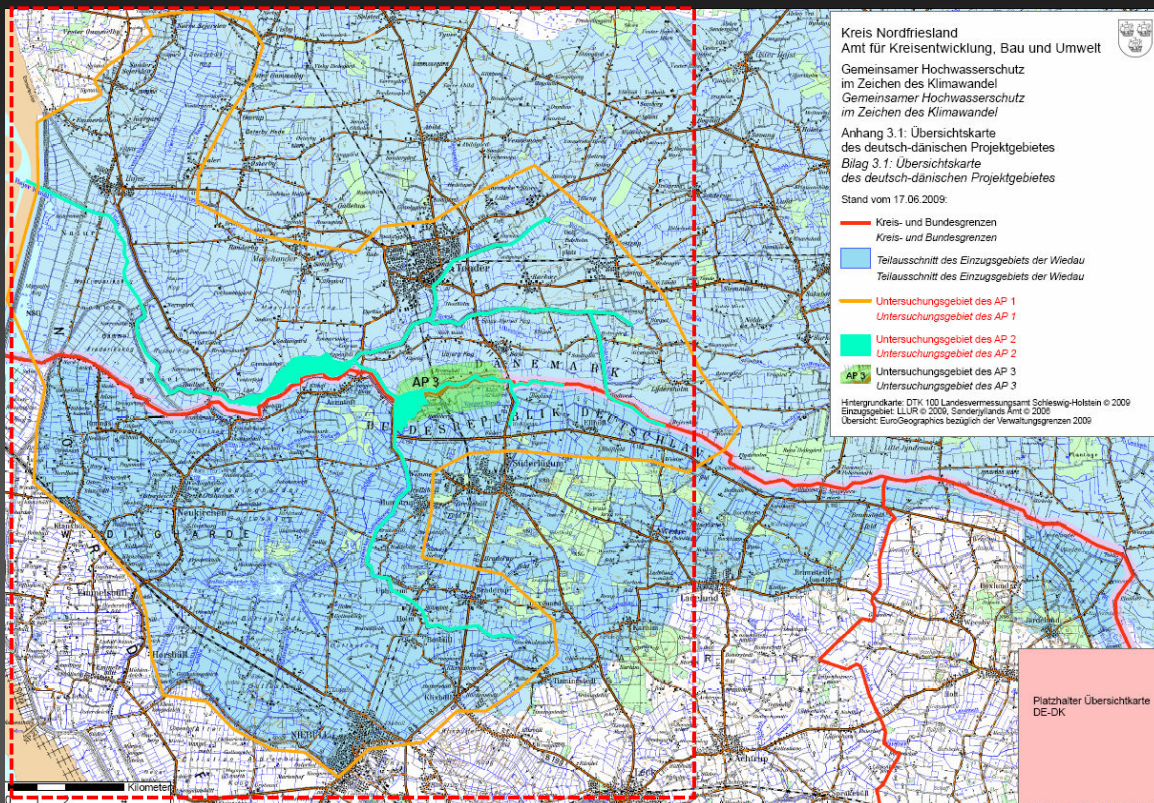




## Evaluation of dike safety and flood risks including future climate change

## Study area



# Overall model objectives

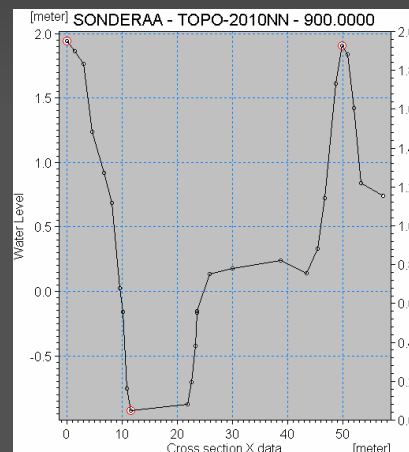


- Climate proof re-evaluation of the stream dike safety in the Tøndermarsk
- Including:
  - Present (i.e. the Nørresø and Bachmanns Mølle projects) as well as future water course restoration projects / remediation projects, such as e.g. the use of Hassberger See for controlled storage during high runoff.
  - Future climate scenarios in the form of water level increases in the Wadden Sea as well as changes in rainfall patterns and rainfall amount and other hydrological conditions.

# Concepts



1. Establish a river network model ( MIKE 11) covering relevant streams and catchment in the German/ Danish Tøndermarsk region.
  - Model input comprise: river cross-sections, precipitation, evaporation, inflows ( e.g. from pump stations) and water levels in the Waden Sea (outside Vidaa sluise gate)
  - Output comprise: water levels and flows at all grid points (200 to 300 m)



2. Statistical analysis of extreme water levels in the Vidå River system based on updated MIKE 11 model simulations for evaluation of dike safety ( 30 years of historical data)
3. Establishing data for climate scenarios (projected for year 2030, 2060 and 2100) and evaluation of dike safety based on projected MIKE 11 model results

## Results and investigations

1. Re-evaluation of the dike safety (e.g. compliance with a 100 year return period) under the existing conditions (incl. Bachmans Mølle and Nørresø/Hestholm Kog and Haasberg Sø og Dreiharder Gotteskoog restoration projects) hereunder an:
  - Statistical analysis and trends of measured low and high water levels in the relevant part of the Wadden Sea.
  - Identification of storm events and related river flows where high water levels in the Wadden Sea prevent outflow.
  - Assessment of potential restricted outflow from the old Højer Sluise gate( does the Højer Sluise gate restrict outflow ?)
  - Assessment of the Sønderå sluicgate design ( ports and flap gates) in relation to upstream flood control.

## Results and investigations



- For selected extreme events the effect of dike withdrawal along the Sønderå on both sides of the Danish-German border and extension of the Hassberg See storage capacity will be assessed
- For selected extreme events the effect of expanded storage capacity in Sønderå from Møllehus and until the border at Sæd will be assessed. An increased capacity can be established by a combination of summer dikes along the Sønderå and withdrawn winter dikes.
- Assessment of the storage capacity in the eastern part of the Margrethe Kog. This part is presently protected by summerdikes. By controlled inflow into this area it is possible to increase the total storage capacity. In case Højer sluice restrict outflow the potential storage capacity of Sejersbæk Kogs will be assessed.

## Results and investigations



2. Evaluation of the dike safety under future restoration/ remediation schemes for selected locations.
3. Evaluation of the dike safety under future conditions for selected locations based on future climate scenarios , hereunder an:
  - Assessment of the expected long term development of low and high water in the Wadden Sea
  - Assessment of the long term development in precipitation and catchment runoff



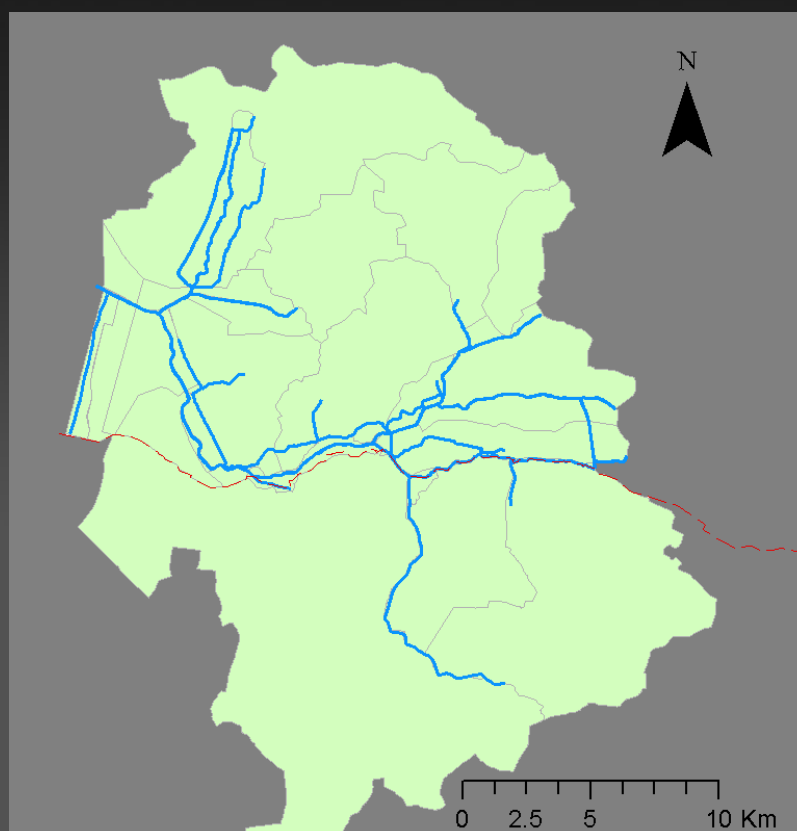
## Status regarding modeling



- The entire river network ( comprised by the study area) has been established
- All drainage areas have been indentified
- Historical meteorological data ( wind, air temperature, precipitation and evaporation ) are expected mid November from DMI.
- The model is presently updated with the latest survey(conducted in October this year) of Sønderå, Dreiharder Gotteskoogstrom and Geestableiter.
- Model validation and calibration is expected to be completed end of December or early January 2011
- The statistical analysis of extreme water levels ( dike safety aspect) and the future climate scenarios will be carried out in January / February 2011
- 

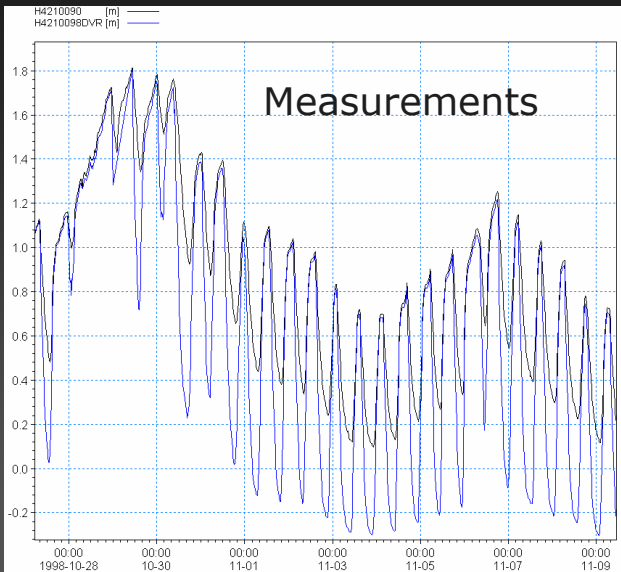
[www.dhigroup.com](http://www.dhigroup.com)

## River network and catchments

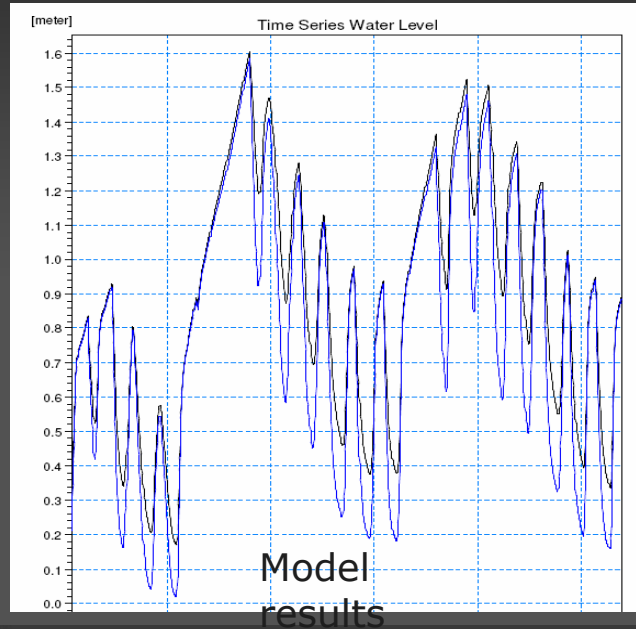


[www.dhigroup.com](http://www.dhigroup.com)

# Assessment of potential restricted outflow from the old Højer Sluise gate



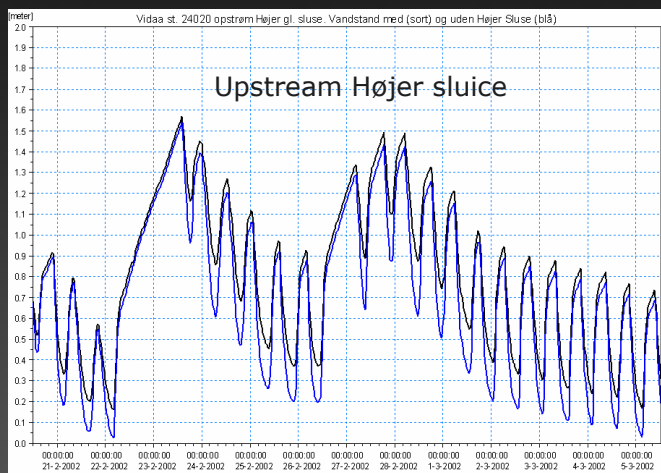
Up (black curve)-and downstream (blue curve) water levels



Only marginal and only local impact

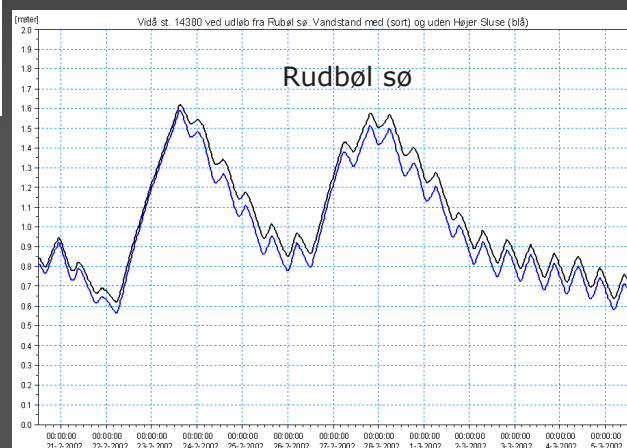
*Note: the model and the measurements represent different periods but agree well in results*

# Assessment of potential restricted outflow from the old Højer Sluise gate



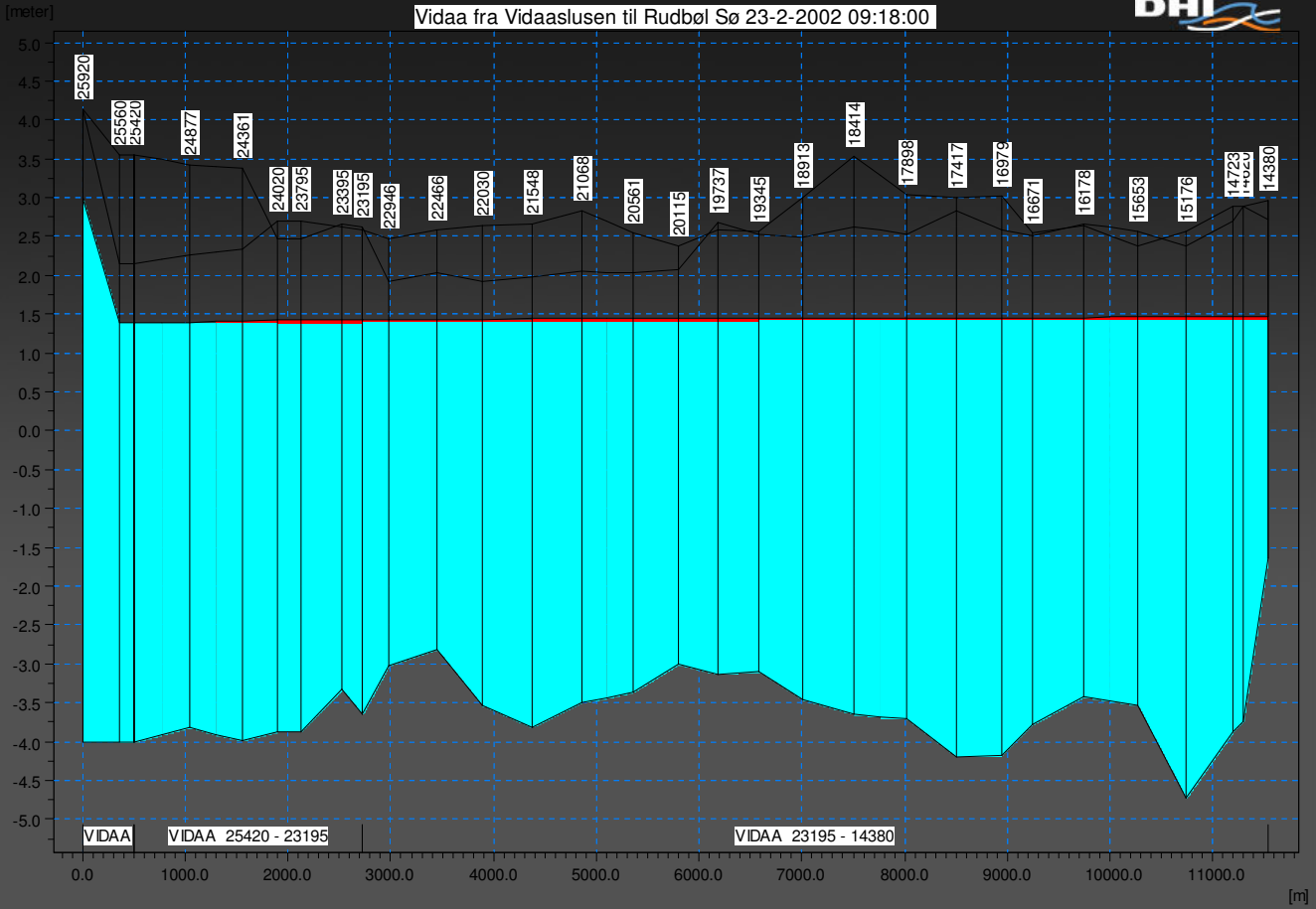
Model simulation with (black curve) and without (blue curve) Højer Sluice

Maximum 5 cm difference at high water levels

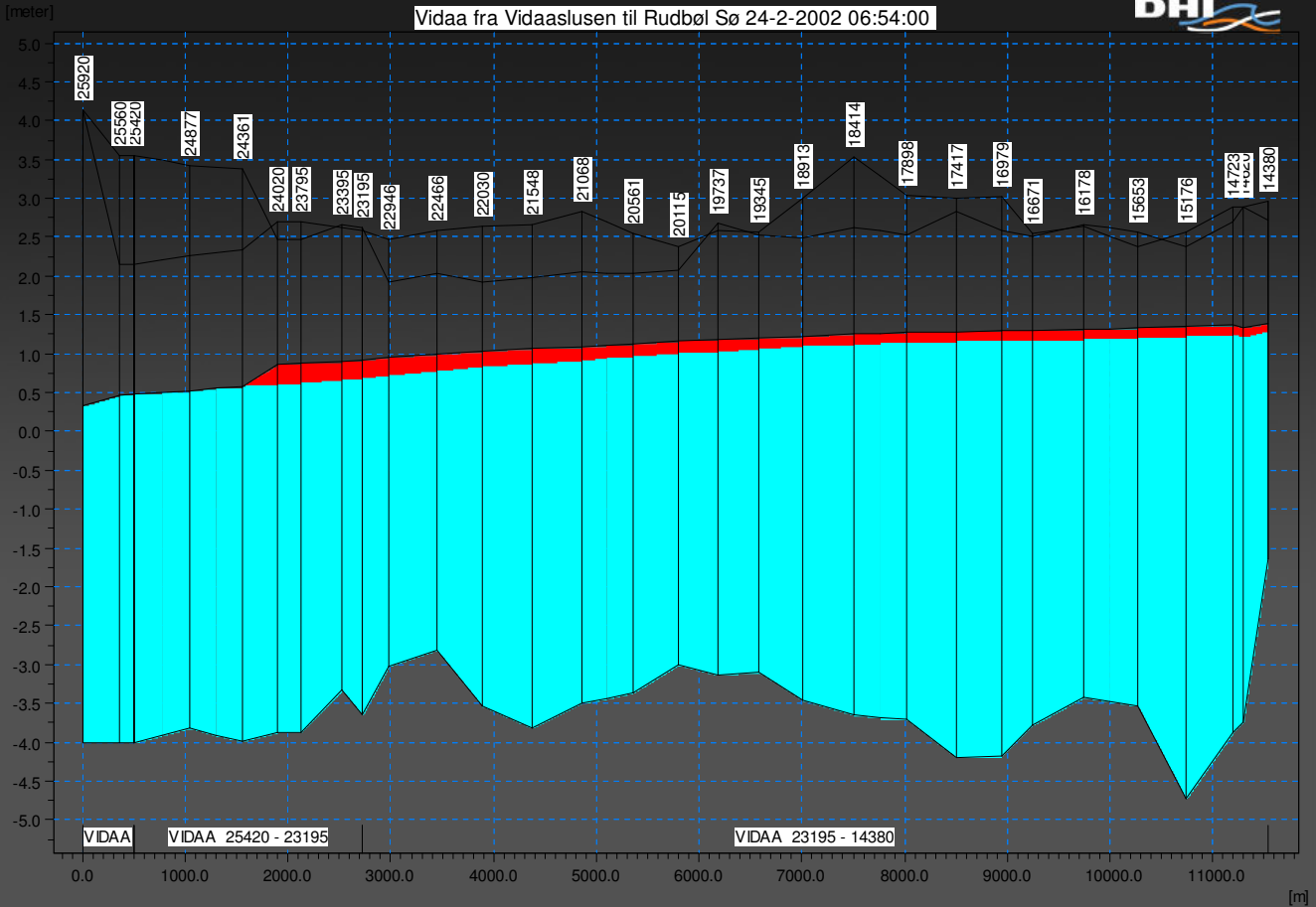


results

Vidaa fra Vidaaslusen til Rudbøl Sø 23-2-2002 09:18:00



Vidaa fra Vidaaslusen til Rudbøl Sø 24-2-2002 06:54:00



Vidaa fra Vidaaslusen til Rudbøl Sø 5-3-2002 14:41:59

