



# **Reduction targets for nitrogen and phosphorous loads to the project area Norsminde Fjord.**

**Part of task 1.1 in the EU- LIFE project AGWAPLAN**

English Summary

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## Summary

According to the WFD coastal waters in EU must achieve as a minimum a “good ecological status” by the year 2015. Especially nitrogen but also phosphorus are the main environmental stressors in Danish coastal waters and the primary determining factor for numerous biological variables. In AGWAPLAN we have determined the critical load of nitrogen of Norsminde Fjord based on hydrodynamic models (Mike 21 and 3) and a bio-chemical module (Eco-Lab).

### Study area

Norsminde Fjord is a small and shallow estuarine situated in East Jutland, DK. It receives substantial amounts of fresh water and nutrients from the highly cultivated catchment area. Between 85 and 90 % of the nutrient load is discharged through Rævs to the inner part of the fjord. The fresh water mixes with salt water from the southern part of the Bay of Århus entering through the gate, thereby creating a highly dynamical brackish and some times stratified environment. The vegetation is dominated by macroalgae typical of highly eutroficated estuaries such as *Ulva lactuca* repressing the natural population of seagrass (*Ruppia sp.*) and charophytes. Sometimes heavy blooms of toxic planctonic algae occur.

### Methods and results

Initially the factors and processes of importance for the ecosystem of Norsminde Fjord were analysed in order to choose a suitable model set up. The models are based on surveys of the bathymetry of the fjord and a large number of meteorological, physical, biological and chemical data recorded during an extensive 2 year field campaign from 2005 to 2006. The models show very good results on the reproduction of physical parameters, temperature, salinity and water level as well as bio-chemical parameters, nutrients, oxygen concentrations and phytoplankton. The description of macro algae and rooted vegetation (Eco-Lab model) is more complicated since the model does not take into account grazing by swans or the wind induced transport of floating macro algae, making it difficult to reproduce the exact distribution of the vegetation. However the potential growth can be modelled and compared for various scenarios of nutrient loads from the catchment area.

Due to a delayed process in the EU-intercalibration network, classification of ecological status in surface waters has not been available in AGWAPLAN. A draft proposal in AGWAPLAN was based on data from reference rivers representing nutrient levels with minor antropogenic impact, historical and sediment data from other fjords in Denmark. The nitrogen and phosphorus concentration in reference conditions is 0,400-0,750 mg N/l and 30-50 P/l respectively. Two scenarios indicating a good ecological status were proposed (Table 1).

Table 1. Calculated nutrient levels (annual mean) in main inlet stream (Rævs Å) and in Norsminde Fjord.

Classification	Total-N, inlet µg N/l	Total-N, fjord µg N/l	Total-P, inlet µg P/l	Total-P, fjord µg P/l
Reference condition (1,09+/-0,46 mg N/l)	1090	480	50	26
Good ecological status scenario 1 (1,09 + 0,46 mg N/l) + 25%	1940	760	62,5	30
Good ecological status scenario 2 (50% reduction of annual N-load)	2600 (65 tons N/year)	850		

The reduction target of inlet P-concentration in scenario 1 will be reached by 2012 due to improved waste water purification, although release of phosphorus from the sediment may still cause high concentrations in the summertime. Scenario 2 was chosen for the project. We expect a lower production of macroalgae and phytoplankton, improved oxygen and light conditions thus improving conditions for rooted macrophytes, invertebrate fauna and waterfowls. This reduction target may be adjusted when the programmes of measures have been agreed on in the river basin management plans in order to meet the requirements of biological and physico-chemical indicators in the WFD.

Since 1980 there has been a 40% reduction of the mean inlet concentration of both nitrogen (total-N) and phosphorus (total-P) due to improved waste water purification and reduced runoff from agricultural areas. However there is a substantial variation of annual nitrogen-load with high loads in years with a high precipitation like 1994 and low loads in the dry period 1996-1997 (Figure 1).

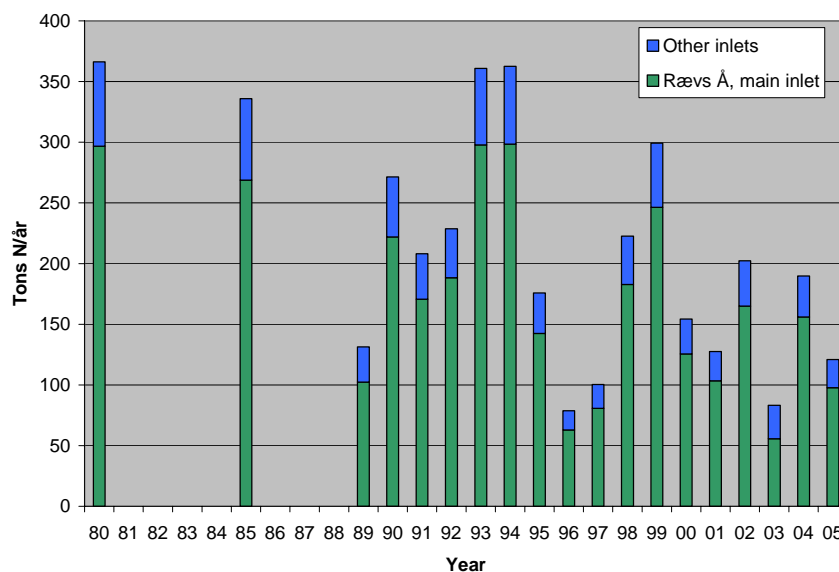


Figure 1. Annual nitrogen load of Norsminde Fjord

The present nitrogen load of Norsminde Fjord was calculated using the average discharge in Rævs Å in the period 1996-2005 (Figure 2). The main N-source is nitrate leaching from agricultural areas. According to scenario 2 the nitrogen load should be reduced from 129 tons N/year to 65 tons N/year (50% reduction).

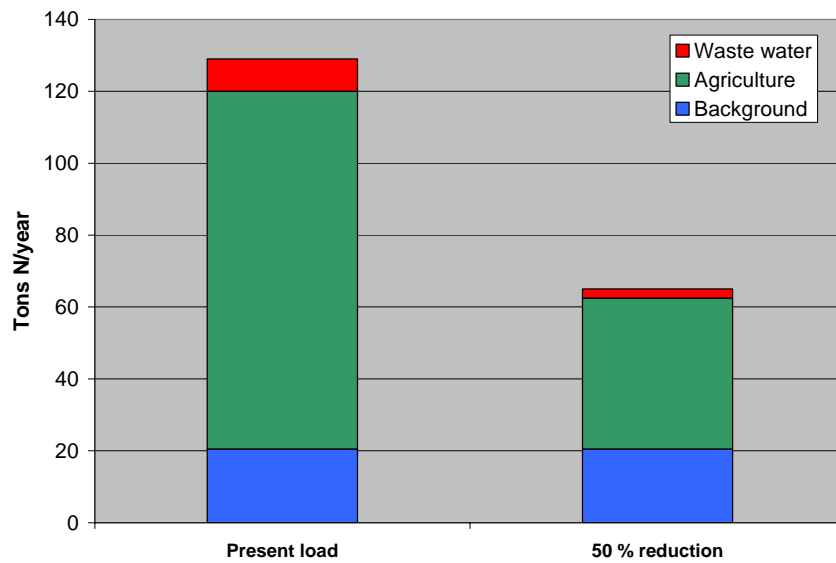


Figure 2. Present and scenarie 2 load of nitrogen from the main inlet Rævs Å