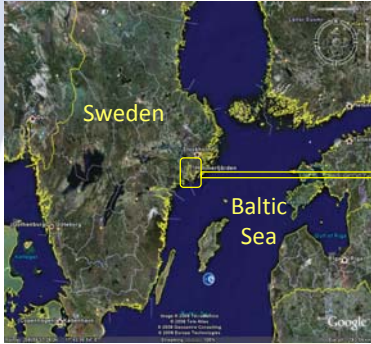


# SSA No. 04 - HIMMERFJÄRDEN, SWEDEN

- The policy issue is "ALGAL BLOOMS", defined as increased algal biomass due to increased nutrient loads.

- One main aim is to identify a cost-effective mix of measures to reduce nutrient loads from the major sewage treatment plant, agriculture and private sewers, in order to achieve a given reduction in phytoplankton biomass and increase in Secchi depth (water transparency). In addition, the recreational benefits of an improved water quality are estimated.

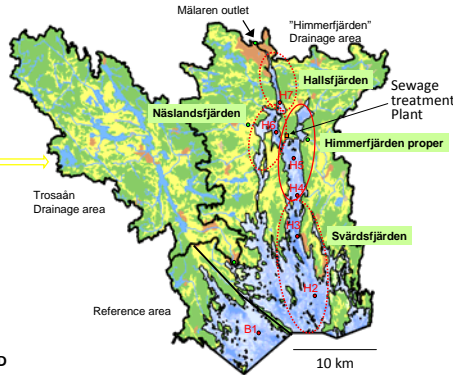


FORMATION OF THE STAKEHOLDER GROUP AND IDENTIFICATION OF THE POLICY ISSUE

The stakeholders were identified based on the WP1 list of potential stakeholder groups. The list was revised and completed and the invitation to the stakeholder meeting was finally sent out to about 50-60 persons representing an institution/organization or interest group. The first stakeholder meeting was held on November 13, 2007 in co-operation with the local water authority. Once held, the meeting successfully identified a main policy issue for the study area - **eutrophication** - and a representative stakeholder reference group was recruited. The meeting also discussed different human activities affecting the area, mainly concerning eutrophication.



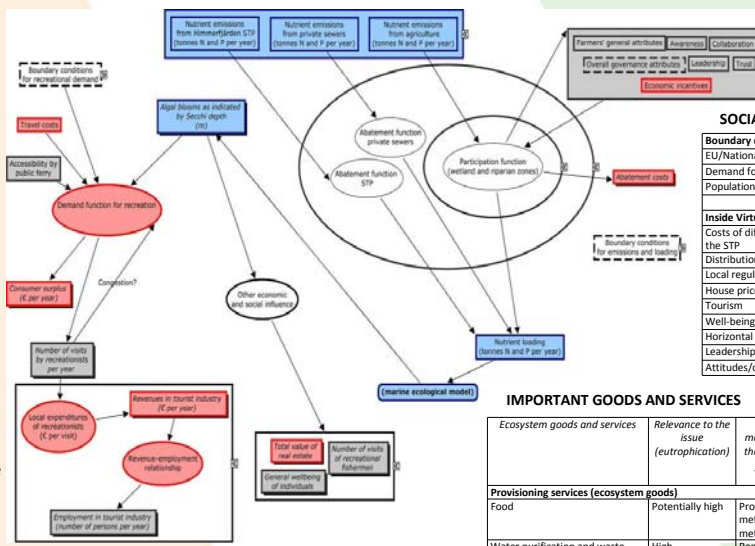
The stakeholder meeting was co-organized with the local water authority. The photo illustrates the stakeholders' mind mapping of different environmental problems and policy issues in Himmerfjärden. Photos: Ulf Larsson.



## THE STAKEHOLDER GROUP

Participant	Organization/institution/interest group
Göran Andersson	County Board in Stockholm
Carl Rolff	County Board in Stockholm
Bo Ljungberg	Environment dept. at Södertälje municipality
Ronald Bergman	Environment dept. at Södertälje municipality
Dan Arvidsson	Botkyrka municipality
Anders Forsberg	Botkyrka municipality
Magnus Dybeck	Nynäshamn municipality
Robert Sehlén	Astra Zeneca (pharmaceutical industry)
Jan Bosander	Himmerfjärden STP company
Bertil Svangren	Himmerfjärden Nature Protection Society
Carl Bonde	Estate manager of Hörningsholm LRF
Per Pettersson	Municipality/local department of LRF – the Federation of Swedish Farmers

## OVERALL CONCEPTUAL MODEL



## SCENARIOS TO BE TESTED WITH THE MODEL SYSTEM

### Himmerfjärden Sewage Treatment Plant (HSTP)

- Nitrogen (N) in discharge from HSTP reduced to 10 mg nitrogen per liter.
- Full N reduction in HSTP (to 4 mg N/L).
- HSTP discharge point moved to top of summer thermocline and N reduction to 10 mg/L.
- HSTP discharge point moved to top of summer thermocline and full N reduction (to 4 mg/L).
- HSTP discharge point moved to an outfall in the open sea south of Himmerfjärden and full N reduction (to 4 mg/L).

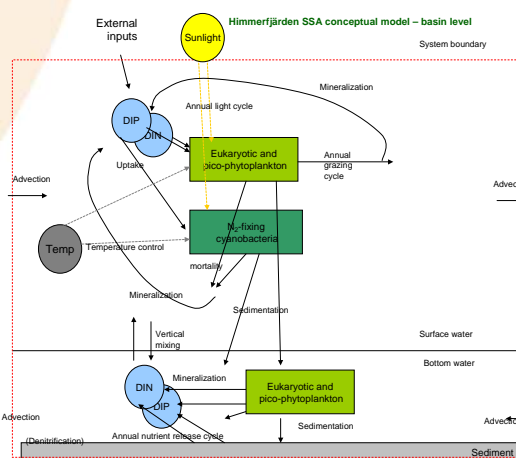
### Other measures

- Reduced agricultural nutrient leakage and more wetland creation in the drainage basin (several scenarios)
- Reduced nutrient emissions from private sewers and small sewage treatment plants in the drainage basin (several scenarios)
- Reduction of open sea nutrient concentrations according to the recently agreed HELCOM action plan.

## ECOLOGICAL COMPONENTS AND PROCESSES

State variables:	Processes:
Volume of water	Water exchange with adjoining water areas and between surface and sub-surface water layers
Dissolved inorganic nitrogen and phosphorus	Nutrient inputs with runoff and treated sewage discharges. Uptake by phytoplankton
Biomass of non-N-fixers	Primary production Sedimentation
Biomass of N-fixing cyanobacteria	Nitrogen fixation
Chlorophyll (important output)	
Secchi depth (important output)	
	Sediment release of nutrients

## CONCEPTUAL MODEL FOR ECOLOGY



## HIMMERFJÄRDEN

### A sea route south of Stockholm

Himmerfjärden with adjacent bays and islands is situated 60 km south of the Swedish capital of Stockholm, on the coast of the brackish Baltic Sea. It forms the sea route to the industrial town of Södertälje and through locks at Södertälje to other major towns on Lake Mälaren, such as Västerås and Örebro. The coastal area is much used for tourism and recreational houses, some of the islands are nature reserves and the water area includes a marine protected area. The commercial fishery for herring, eel and pike-perch has almost ceased, and recreational fishing is now more important.

### A brackish estuary

The bay system has a water area of 232 km<sup>2</sup>, a mean depth of 17 m and a salinity of 4-7 ‰, only slightly lower than the Baltic outside. Freshwater is received from 9 brooks and diffuse runoff (10 m<sup>3</sup>/s), from Lake Mälaren through locks at Södertälje (7m<sup>3</sup>/s), and from the Himmerfjärden Sewage Treatment Plant (1.5 m<sup>3</sup>/s). There is no perceptible tide, and up to 3 months of ice cover in winter. In May, the water column stratifies at c. 15m depth, with the surface layer reaching 20°C in most summers, while the deep water remains a frigid 5-10 °C. The stratification is broken up by autumn storms in October or November.

### Significant nutrient loads from a sewage treatment plant

The area receives treated sewage originating both locally and from Stockholm, with the Himmerfjärden sewage treatment plant treating effluents from 250 000 persons, as well as industrial waste and agricultural runoff. Nutrient loading has caused increased turbidity, loss of biodiversity, including submerged aquatic vegetation, deep water oxygen deficiency, cyanobacterial blooms, biodiversity loss. Formerly high industrial inputs of heavy metals have been much reduced.



## SOCIAL AND ECONOMIC COMPONENTS

Boundary conditions (outside Virtual System):	
EU/National regulations, subsidies, etc.	
Demand for agricultural products	
Population increase, economic growth	
Inside Virtual System:	
Costs of different measures for agriculture, private sewers and the STP	
Distribution of measures between HAs (e.g. stakeholder groups)	
Local regulations	
House prices	
Tourism	
Well-being	
Horizontal and vertical trust	
Leadership, key actors	
Attitudes/consciousness/opinions	

## IMPORTANT GOODS AND SERVICES

Ecosystem goods and services	Relevance to the issue (eutrophication)	Suitable valuation methods (only stated for those goods and services judged to have high relevance)	People/groups benefiting of good/service
Food	Potentially high	Production function method, Travel cost methods, SP methods	Recreational fishers, small-scale fishery, tourists
Water purification and waste treatment	High	Replacement cost method, Travel cost methods, SP methods	Publics and tourists living/travelling in the area.
Aesthetic values	High	Travel cost method, SP methods	Publics/tourists living or travelling in the area.
Recreation and ecotourism	High	Travel cost method, SP methods	Tourists + tourism industry and municipalities.

## CONTACT

### Himmerfjärden SSA team

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