



Swedish Civil
Contingencies
Agency



SWEDISH NATIONAL PLATFORM
for Disaster Risk Reduction

MAKING CITIES RESILIENT IN SWEDEN

Six inspiring examples of DRR action



Resilient Cities in Sweden
Six inspiring examples on DRR action

Swedish Civil Contingencies Agency (MSB)

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INTRODUCTION

In order to support more city-to-city exchange's we have produced this folder with six examples on local DRR action in Sweden. We hope that you will find it inspiring and look forward to further exchanges.

The Swedish Civil Contingencies Agency, MSB, is commissioned to be the national focal point for the Hyogo Declaration and the HFA. The MSB is also responsible for coordinating the national platform for DRR. For Sweden's policy work in accordance with the HFA, the Ministry of Foreign Affairs is the focal point.

The Swedish National Platform for Disaster Risk Reduction was established in 2007 and consists of 22 authorities and organizations. Participation in the platform is voluntary. MSB finances the platform's secretariat; however, the platform's activities are funded by the participating members. Activities are governed by an action plan that is updated annually.

MSB and the national platform encourages municipalities to join the UN Making Cities Resilient campaign. Today nine Swedish municipalities are in the campaign: Arvika, Gothenburg, Jokkmokk, Jönköping, Karlstad, Kristianstad, Malmö, Vellinge and Ängelholm.

On the MSB website – <https://www.msb.se/makingcitiesresilient> – there is information about how municipalities can join the campaign, fact sheets, a knowledge bank, conferences, exchanges and links to municipal information on DRR.

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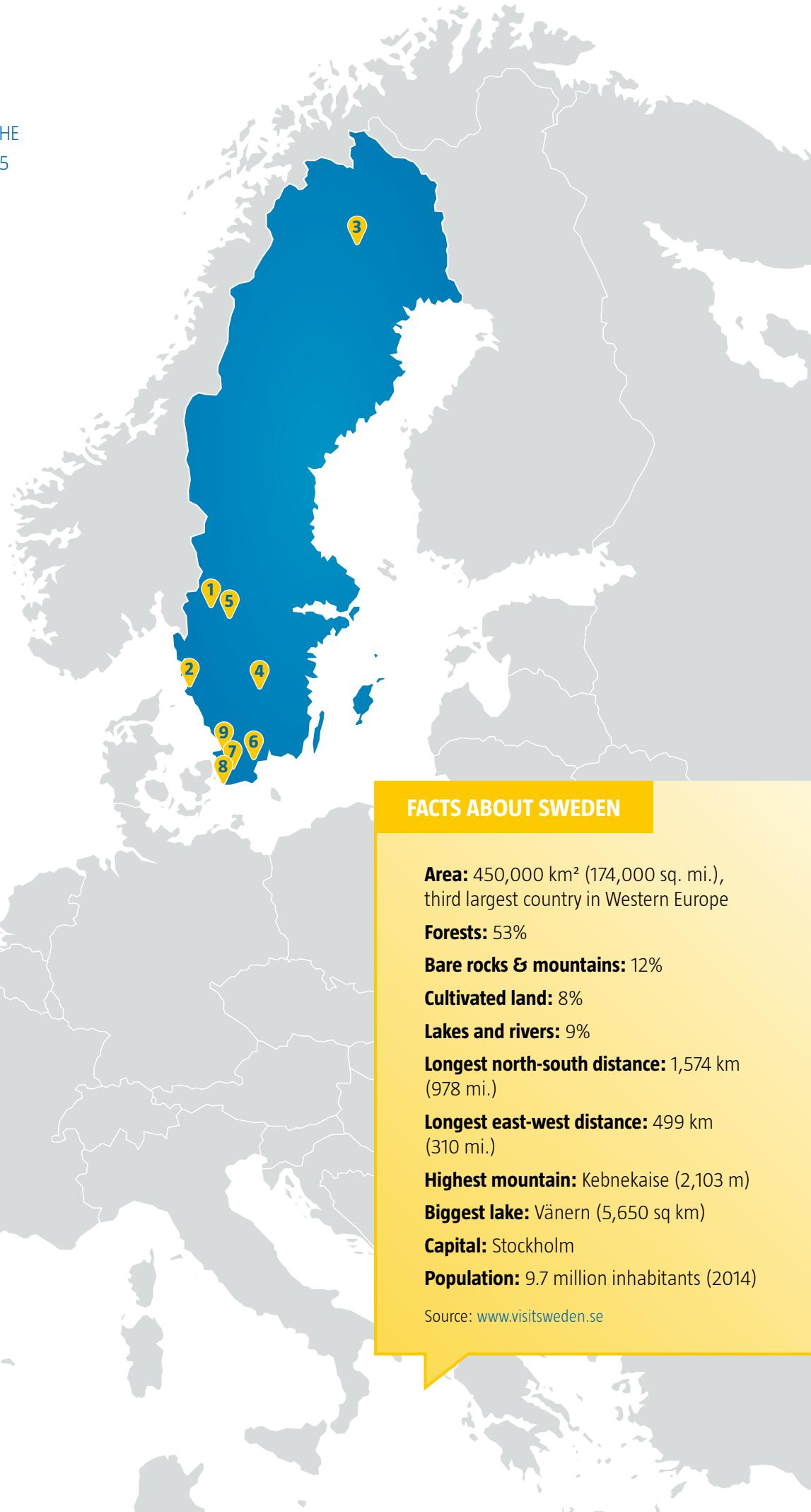
THE HFA FIVE PRIORITIES FOR ACTION

- 1** Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
- 2** Identify, assess and monitor disaster risks and enhance early warning.
- 3** Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
- 4** Reduce the underlying risk factors.
- 5** Strengthen disaster preparedness for effective response at all levels.



SWEDISH CITIES IN THE MCR-CAMPAIGN 2015

1. ARVIKA
2. GOTHENBURG
3. JOKKMOKK
4. JÖNKÖPING
5. KARLSTAD
6. KRISTIANSTAD
7. Malmö
8. VELLINGE
9. ÄNGELHOLM



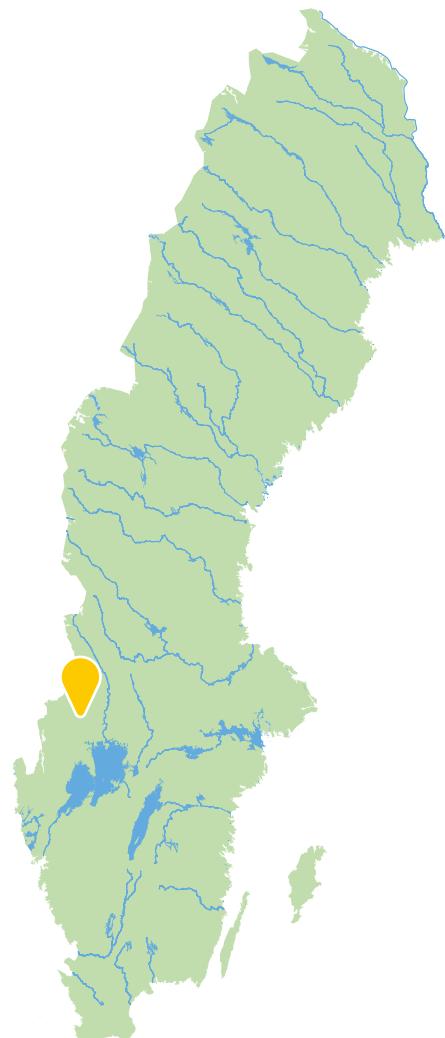
*The waterlevel of The Glafsfjord during
the flooding of Arvika in autumn 2000
is marked on the stone.*



POLITICAL COMMITMENT FOR FLOOD PROTECTION IN ARVIKA

SUMMARY

The autumn of 2000 was unusually warm and rainy in Sweden causing the water to rise higher and higher in Kyrk Bay and threaten the Municipality of Arvika. The excessive amount of water resulted in the largest flood event in Sweden. Fourteen years later, the municipality continues to improve flood risk management. In order for these flood protection measures to be in place, good political leadership and governance for disaster risk reduction helps in protecting the city from another major flood event.



FACTS ABOUT ARVIKA

Number of residents:

26,000 inhabitants, of whom 14,000 live in the central town of Arvika.

Area:

1 968.55 km²

Location:

Arvika is located in western Värmland close to the Norwegian border. Arvika is part of the river Byälven lake system, with a catchment area starting in Hedemark County, Norway, then flowing through the town of Säffle and into Lake Vänern in the south.

Web Address:

www.arvika.se

HFA priority:

- 1 Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

Description of Problem

Flood risk in Arvika has two causes. During rainy autumns and warm winters the soils in the watershed become saturated and the excess water flows straight into the rivers. The run-off quickly raises the water levels in Glaf Fjord and Kyrk Bay which can cause flooding. The other likely scenario is that Arvika receives excessive spring flooding.

The weather in western Värmland, like the rest of Sweden, was both warmer and wetter than usual in autumn 2000. During the period 27 September to 16 December, there was constant rain except for a few days. In Arvika there was three times as much rain as normal for the season. On November 29, the water level in Glaf Fjord was 3 feet above normal and the critical situation lasted 1.5 months. Many property owners along the entire Glaf Fjord and the river Byälven waterways were affected. The most significant impacts occurred at the factories in Arvika. Major parts of the municipality's critical infrastructure like a water treatment plant, pumping stations, city hall, and a bus station were flooded and even social services such as a nursing home for senior citizens. All railway traffic was stopped for several weeks and the bus station was provisionally moved to another location. In addition, the basements of industries and private property were flooded. The costs of the insurance claims in Arvika totaled approximately 85 million SEK. The total economic cost to society from this flood event has been estimated at 273 million SEK.

During the spring and summer of 2001, a series of investigations were made about how Arvika's flood event was handled. Several national organizations evaluated their efforts and pointed out specific issues that could be improved. The municipal and national investigations laid the foundation for Project River Byälven that was initiated by three municipalities: Arvika, Eda and Säffle and by the County Administrative Board of Värmland.

Along with the river Byälven project and other initiatives, Arvika proposed the idea of a barrier at Kyrk Bay as a measure that could protect critical infrastructures and vital societal functions.

Solution and Results

During the 2000's, high water flows in the river Byälven threatened properties several times. Every winter all the organizations that manage flood risk, meet in a special stakeholders group called the river Byälven Group. Today the interaction between the parties is the most powerful tool for dealing with floods.

There is an elaborate plan for different scenarios and how they should be handled. With the help of meteorological and hydrological forecasts, power companies can regulate the water by opening the lock in Säffle or closing off the water at sensitive points along the watercourse.

Now, 14 years after a complicated permit process, a small dam at Kyrk Bay has been approved. The construction is planned for 2015-2016. A flood of the same scope as the autumn of 2000 would cost society at least 300 million SEK. The dam has been estimated at 60-80 million SEK, with a yearly operating cost of 440,000 SEK.

Factors Leading to Success

High flows in the river Byälven are not unique, almost yearly water creeps up towards the dock in central Arvika. Citizens, businesses and politicians are aware of the flood risk and are prepared to react. Since Arvika has implemented many projects and conducted several investigations, there are many factors that contribute to success. One of the most important is political commitment. In order to create a more robust municipality, there are a number of cases where policies have played a major role, like reorganizing the municipality, developing a crisis plan and providing for a budget for flood protection including the construction of the dam.

Another political decision was to raise the recommended height of new constructions along the waterfront. This is to prevent new properties from being built in flood-prone areas.

Lessons to Share

Arvika has good experience in crisis management and, above all, media management. One success factor during the flood was that all of the organizations handling the event were available during press conferences and at other times when questions from the media arose. This provided the media with first-hand information, allowing for better awareness. Members from the City Council also participated at press conferences.

A lot of people worked during the flood in Arvika in 2000. Everyone did what they could, whether it was about providing food or build dikes. It is important to consider the commitment that is created in the community during a crisis. Organizing voluntary work is challenging, but very important.

City-to-City Learning

Arvika is especially interested in research and technological developments for flood protection. During 2015 and 2016 the Municipality of Arvika participates in a European Union project about UNISDR's Scorecard for city resilience.

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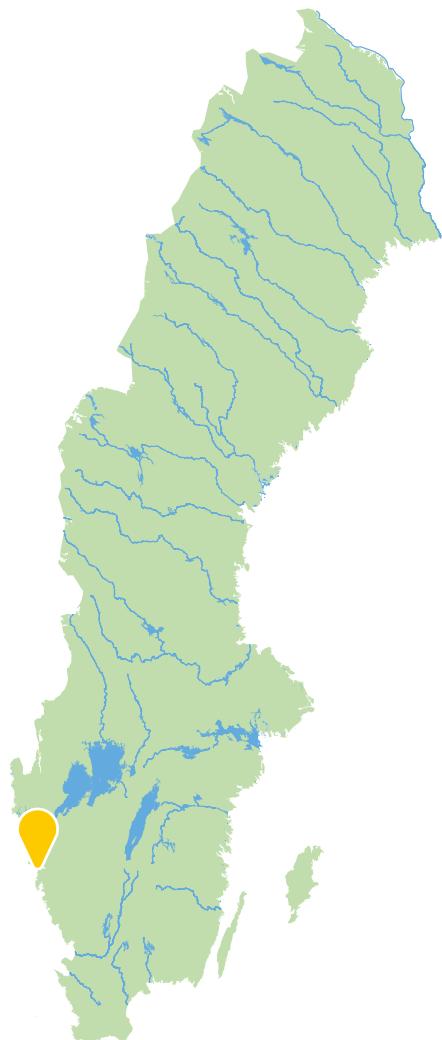
In central Gothenburg there is a major international port. Sweden's longest watercourse, the river Klarälven to the Göta River, flows through the city to the sea.



GOTHENBURG – CITY HYDROLOGICAL MODEL SIMULATES FLOODING

SUMMARY

The hydrological model is a GIS tool to simulate flood events from the sea, rivers and sky. The model can also simulate the City of Gothenburg's risk mitigation measures. The model serves as a basis for prioritizing actions. The model can show the extent of water flow paths and the depth of the water. Critical societal functions and features are part of the model's dynamic processes and can be simulated to see the consequences and possible measures that can be taken.



FACTS ABOUT THE CITY OF GOTHENBURG

Number of residents:

More than 500,000 inhabitants in the urban area.

Area:

722 km² of which 271 km² is water.

Location:

The city and a large part of the buildings are located at low elevation and are very vulnerable to the sea level. In central Gothenburg there is a major international port. Sweden's longest watercourse, the river Klarälven to the Göta River, flows through the city to the sea.

Web Address:

www.goteborg.se

HFA priority:

- 2 Identify, assess and monitor disaster risks and enhance early warning.
- 3 Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Description of Problem

Central Gothenburg has low elevation and, therefore, is threatened by future sea level rise. During the city's work with extreme weather events, it was found that a GIS tool would be needed to simulate flooding in the city. The work has been conducted with consultants. The City Planning Office and the Administration of Water has been involved. A major challenge in this work is to obtain financing and also to assemble basic data from different places where the data was already collected.

Solution and Results

The hydrological model is an excellent planning tool, especially when it comes to simulating the dynamic paths of water. The city has been able to see, for example, which low areas might be flooded at high tide from the sea. The reason for this flooding could be, for example, pressure in the underground water pipes. Another result is that the city, with relatively small actions, can protect large areas.



The hydrological model is an excellent tool to simulate the dynamics paths of water when the city is flooded.

Factors Leading to Success

Using scientific information in developing the model.

Gaining support from the city government for financing of the development of the model.

Lessons to Share

There are some lessons to be learned, including how to set up parameters and how to procure large complex projects. The city has also realized the importance of not only getting the results from the consultant, but also the basic data that can be stored and managed by the city.

City- to City Learning

Gothenburg would like to learn more about the following:

- How other cities organize and finance climate adaptation efforts.
- How cities elsewhere in the world, prevent and/ or mitigate water-related risks.
- Recommendations on how to build structures while avoiding risks from natural hazards.
- How to protect the city's essential societal functions from natural hazards.

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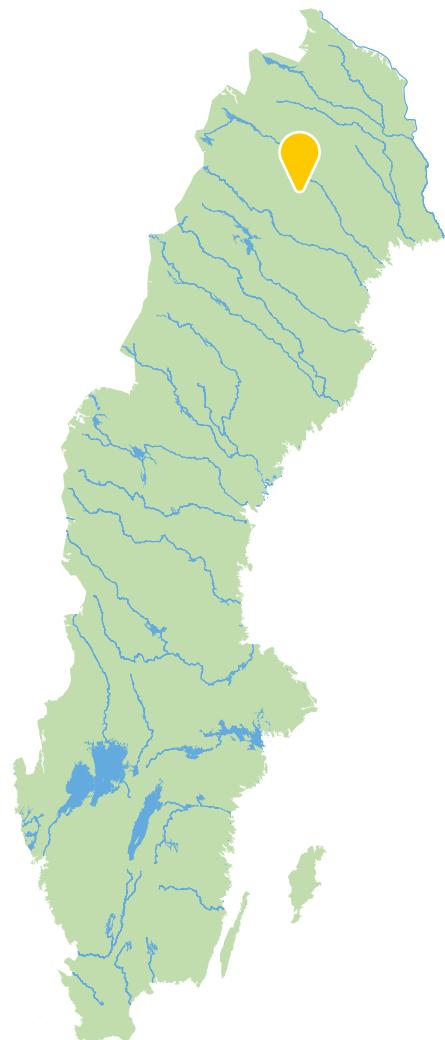
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*World Heritage Laponia and national Parks
Sarek, Padjelanta and Muddus are in Jokkmokk
municipality's borders.*



NORTHERN NETWORK ON CLIMATE CHANGE IN **JOKKMOKK** SECURES SUSTAINABLE FUTURE IN THE NORTH



SUMMARY

Jokkmokk's Northern Network on Climate Change is a center of excellence that promotes training in energy and climate issues. Its goal is to develop activities, and training for politicians, officials and companies from Norrbotten, other places in Sweden and other European countries.

FACTS ABOUT THE MUNICIPALITY OF JOKKMOKK

Number of residents:

Just under 3,000 inhabitants in Jokkmokk's urban area. The municipality has about 5,000 inhabitants, which means about 0.3 inhabitants per square kilometer.

Area:

19,477 km². The area of Jokkmokk is as large as half of Switzerland or two-thirds of Belgium. Approximately half of the area consists of protected areas. World Heritage Laponia and national parks Sarek, Padjelanta, and Muddus are in Jokkmokk Municipality's borders.

Location:

Jokkmokk is one of Sweden's northernmost municipalities in the middle of Norrbotten and in Lapland. Jokkmokk is located on the Arctic Circle and is bordered by Norway to the west, Gällivare Municipality to the north, Arjeplog and Arvidsjaur municipalities to the south and Boden and Älvsbyn municipalities to the east.

Web Address:

www.jokkmokk.se

HFA priority:

- 3** Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Description of Problem

Climate change is faster than expected. Recent research shows that the Nordic regions will be particularly affected. Therefore, it is essential for the Nordic regions to live up to and learn how to adapt to climate change and interest in the Arctic is greater today than ever. There are plentiful mineral resources in the Nordic region, and great potential for renewable energy such as wind, water and bioenergy.

Solution and Results

In Jokkmokk climate change is noticeable. For this reason the municipality is engaged in the debate on climate change. The Jokkmokk Winter Conference for young, aspiring decision makers, researchers and students started in 2008 and is now the largest environmental conference for young people.

The tasks of the Northern Network on Climate Change include:

- Conduct awareness campaigns and projects for the population and especially young people.
- Build networks within everyone who is working with climate issues, both climate protection and adaptation.
- Contribute to the future development of Jokkmokk.

Jokkmokk has become known as a small municipality that engages in issues related to climate change and sustainable energy. Jokkmokk was the first city in Norrbotten to sign the EU Covenant of Mayors and to join UNISDR's Making Cities Resilient: My City is Getting Ready campaign. Jokkmokk has also participated in several international projects, such as SEAP PLUS (www.seap-plus.eu.)

Factors Leading to Success

Local politicians are aware of problems and have a vision for a sustainable future.

A permanent local working group involving politicians, officials, experts, business community and young people.

Collaboration with partners and networks, regionally, nationally and internationally.

Use of the County of Norrbottens regional climate adaptation strategy.

There is a climate strategy and it is regularly updated. An emission inventory is made each year as requested by the European Union. The results are presented to policy makers.

Lessons to Share

Jokkmokk is a good example of how small rural municipalities can get involved in major global issues such as climate change. Jokkmokk was the only small European municipality to participate in the EU Covenant of Mayors.

RECOMMENDATIONS FROM JOKKMOKK:

- Close cooperation between local and regional authorities for the development of a local climate adaptation plan.
- Development of an energy plan, a climate strategy and adaptation plan.
- A local task force involving political officials, stakeholders, associations, etc.

City-to-City Learning

Jokkmokk would like to learn about how to maintain updated information on risks and vulnerabilities. The municipality also wants to learn more about how to develop risk assessments and use these as the basis for urban planning, how to identify safe land for residents and implement realistic building regulations.

Also important to Jokkmokk is finding the best ways to invest in and maintain a risk mitigation infrastructure.

How to evaluate the safety of all schools and health facilities, and how to measure the effectiveness of risk mitigation measures is also of interest for Jokkmokk.

In addition, the Municipality of Jokkmokk would like to learn more about how to apply prevention and mitigation in the reconstruction phase and ensure that the affected population's needs and participation is the focus of construction work.

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Karlstad is located on the largest delta in northern Europe, where the river Klarälven flows into one of Europe's largest lakes, Lake Vänern. Photo: Mikael Svensson



FLOOD RISK MANAGEMENT PLAN PROTECTS THE CITY OF **KARLSTAD**

SUMMARY

In 2007 Karlstad began to develop a strategy to address flood risk problems in the municipality. The strategy resulted in the Flood Risk Management Plan which was completed and embraced by the City Council in 2010. The plan consists of information about climate change and how it continues to affect the city of Karlstad. The plan includes responsibilities on local, regional and national level, guidelines for the city planning process and adaptation measures. The programme is now reflected in all municipal strategic documents. One result is a contingency plan for flooding.



FACTS ABOUT THE MUNICIPALITY OF KARLSTAD

Number of residents:

88,000

Area:

55,000 km²

Location:

Karlstad is located on the banks of the largest delta in northern Europe, where the river Klarälven flows into Lake Vänern. Lake Vänern is the third largest lake in Europe.

Web Address:

www.karlstad.se

HFA priority:

- 5** The Flood Risk Management Plan fits into all five priorities for action.
The Contingency Plan for Flooding meets priority 5 Strengthen disaster preparedness for effective response at all level.

Description of Problem

Karlstad's geographical location has led to a unique city design that is attractive to both citizens and tourists. But the location of the city also contributes to significant risk of flooding from both high flows in the river and high water levels in Vänern. The Swedish Civil and Contingencies Agency have identified Karlstad as the city in Sweden with the largest number of people likely to be affected by a 100-year flood, according to the EU Flood Directive. The city also has had problems with ice jams.

To address the flood risk in Karlstad and to develop a strategy for the city's work within this area, the City Council assigned Technical Services and Property Management Department and the Executive Office to develop a flood risk management plan. Many different stakeholders were involved in the process. The sectors that participated included the local municipal government offices, insurance, academia and county government. The contingency plan was developed in a similar way, but with more specific stakeholders.

Solutions and Results

The Flood Risk Management Plan is a steering document for the whole municipality. It makes decisions regarding flood risk, much easier because there are guidelines to follow. It has also made collaboration between departments within the municipality better, and it has pointed out responsibilities within the municipality. The plan is also a good document to rely on when it comes to involving stakeholders. One measure in the flood risk management plan was to develop a contingency plan for flooding. The aim of the contingency plan is to prioritize which critical infrastructure should be protected based on different flood events. The process of developing the contingency plan also proved to be an excellent learning process for the stakeholders involved.

Factors Leading to Success

The key to success is to get the plans implemented into every department of the city. It is also important to have a broad stakeholder approach, so as not to miss any important sector. The development of the contingency plan proved to be an excellent learning process for the stakeholders. This turned out to be just as important for Karlstad's disaster risk reduction work, as the final plan was.

This is an ongoing process so there has been no evaluation yet. In 2015 Karlstad is going to look over the management plan because many measures have been done, and that would be a good time for an evaluation.

Lessons to Share

One lesson learned was that the process is just as important as the results. The process provided a good opportunity to inform about disaster risk reduction and climate change adaptation and raise the level of knowledge among the stakeholders. Next time Karlstad would like to involve the private sector more. The private sector plays an important role and it is of great value to have them as part of the process.

Every city should have a steering document like the flood risk management plan. It can also be an all hazards plan or a climate change adaptation plan. The key to success is to get it implemented in all city departments, from city planning to emergency management.

City- to-City Learning

Karlstad is active with city-to-city exchanges within UNISDR's Making Cities Resilient campaign. Karlstad is interested in exchanging knowledge and information about climate change adaptation, especially regarding critical infrastructure. In addition Karlstad is interested in learning more about the economic aspects within DRR and CCA for the entire city and how to use cost-benefit analyses in a more comprehensive way.

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The picture shows an older grassy embankment to protect the Falsterbo peninsula from flooding from the sea.



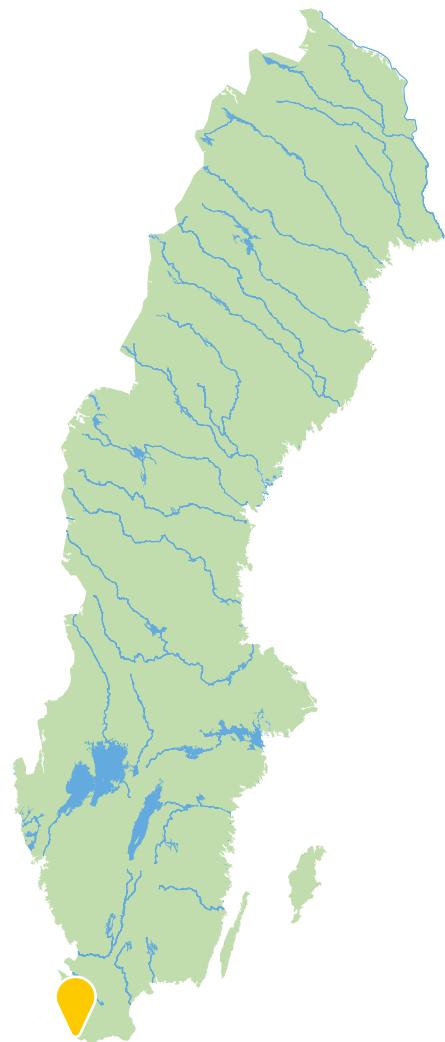
ACTION PLAN FOR PROTECTION AGAINST SEA LEVELS RISING AROUND THE FALSTERBO PENINSULA

SUMMARY

Falsterbo peninsula, located in southwestern Skåne, is extremely vulnerable to flooding due to its exposed position at the outlet of the Baltic Sea where large amounts of sand are transported due to geomorphological processes.

- *Except for the occasional sand dunes, soil levels on the peninsula are less than 4 meters above sea level. Most of the residential development is between 1.5 and 3 meters above sea level.*
- *Due to rapid changes in the weather related to low pressure patterns, the water in the sea rises from 1 to 1.2 meters in less than 12 hours.*
- *Climate change may additionally mean that within 100 years, the sea level will have risen by 1 meter. This will lead to flood risk during the regular high tide situations.*

After extensive studies, the City Council adopted an action plan for protection against rising sea levels. The City Council decided to apply to the Environmental Court for permission to carry out protection against sealevel rise for Phase 1 of the action plan. Phase 1 which starts in 2014 and ends in 2016, includes such mitigation actions as the construction of about 10 kilometers of grass and sand dikes to protect against flooding from the sea.



FACTS ABOUT THE MUNICIPALITY OF VELLINGE

Number of residents:

Vellinge has a population of just over 33,000 people. Falsterbo peninsula currently houses about 20,000 residents, of which about 2,000 residences are recreational facilities, commercial or municipal services. According to the Comprehensive Plan 2010, the estimated population in 2050 could increase to about 30,000 people on the peninsula.

Web address: www.vellinge.se

HFA priority:

- 3 Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
- 4 Reduce the underlying risk factors.

Description of Problem

The low ground level makes Falsterbo peninsula susceptible to rising sea level due to climate change. The area around the Baltic Sea outlet are affected by specific weather situations like high tides which may damage the built-up areas. The municipality has in various ways since the early 1990's, investigated flood risk.

Since the mid-1980's, erosion and sand movements around Falsterbo peninsula have been studied extensively. Later a simple terrain model was established to assess how many buildings would be affected by the high tide.

The master plan written in 2000 takes into consideration the consequences of climate change and proposals for action based on the study. In the mid-2000's awareness about climate change increased, both generally and with respect to the expansion of housing on the Falsterbo peninsula. In March 2007 the municipality commissioned the engineering, environmental and urban planning authorities to draw up an action plan for flood protection.

A private company commissioned by the municipality has summarized the requirements for banks and other protection measures. The mean sea level rise could be 1 meter within 100 years and the worst case high water level within a 100-year period could be 1.5 meters, for a total increase of +2.5 meters. Requirements for the heights of dikes have been calculated for the year 2050 and the year 2100.

Solution and Results

To illustrate the risk of high sea levels and methods for protection, an action plan has been adopted. A risk assessment has been made with the help of a detailed terrain model and investigations of the impacts on cultural and natural resources. The action plan was reviewed during the summer of 2011 by many stakeholders. A supplement to the action plan regarding alternative designs for flood protection in western Falsterbo was prepared in spring 2013. The City Council decided after a proposal by the municipal government, to adopt the action plan.

This study proposed building grass embankments 8.5 to 12 kilometers long that can withstand the relatively short duration of high water as well as sand filling of the beaches and dunes.

The City Council in Vellinge has now decided to apply to the Environmental Court for permission to carry out protection against sea level rise for phase 1 of the Action Plan. In the coastal zone the strategy includes these points:

- New buildings no lower than 3.5 m.
- Limited local protection of existing houses at low elevation. Consider demolition or relocation.

Factors Leading to Success

One success factor is that the Municipality of Vellinge took advantage of knowledge from the universities, government agencies and other experts. The study that was conducted, led to suggestions for prevention and mitigation.

VARIOUS TYPES OF ADAPTATION MEASURES ARE PROPOSED:

- Strengthen existing roads, footpaths and bicycle paths and former railway banks
- Build new sand and grass leys
- Take advantage of dunes
- Completion of storm water network, dissipate surface water inside the ramparts
- Protection against rising groundwater levels in selected areas
- Strengthen and increase the port facilities and similar structures.
- Sluice gates in streams and harbor entrances

Another success factor is to disseminate knowledge to the public, the provincial government and state governments.

The municipality applies building strategies that are appropriate for the physical geography.

Lessons to Share

Municipalities should follow a process in finding solutions starting with risk assessments and then develop action plans. Finally the actions need to be scrutinized before the decisions are made about which prevention and mitigation measures to undertake.

City-to-City Learning

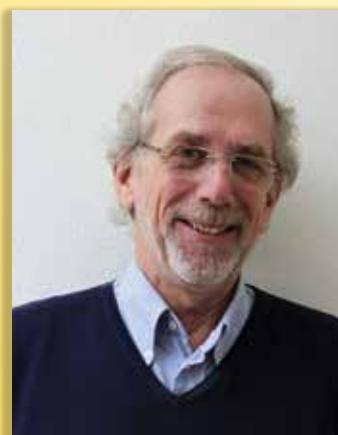
The geography of Vellinge is unique in Sweden; therefore, the municipality seeks a city-to-city learning opportunity with a municipality outside of Sweden that deals with similar challenges.

Vellinge wants to learn more about the methods that work well for protection from erosion and flooding in association with sea level rise.

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*One of the sand dunes before and after stabilization
shown by Maria Birgander, Manager, Department of
Urban Environment, Ängelholm.*

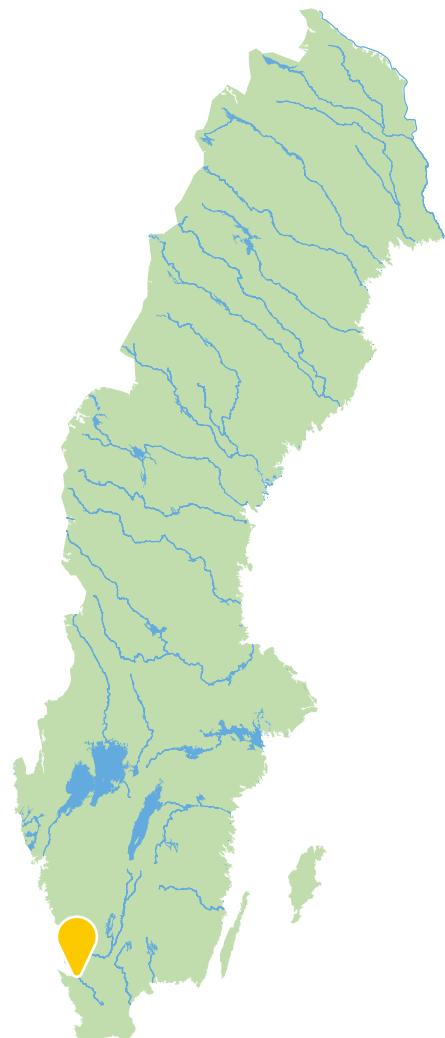


BEACH PROTECTION POLICY PRESERVES SETTLEMENTS AND INFRASTRUCTURE IN **ÄNGELHOLM**

SUMMARY

Ängelholm has developed a beach policy that includes measures to preserve the beach and protect buildings and infrastructure behind the beach.

Ängelholm is often adversely affected by storms that destroy the beach and parts of the dunes. Future sea level rise also demands attention. Mitigation measures are taken by the municipality including inventorying the beach and planting grass on the dunes. A study is in progress that will determine whether depositing sand or constructing a protective barrier is the best way to maintain the beach despite intensive storms and sea level rise. Several municipalities in southern Sweden have similar problems as Ängelholm.



FACTS ABOUT THE MUNICIPALITY OF ÄNGELHOLM

Number of residents:

40,201

Area:

480 km²

Location:

The municipality is located in southwestern Sweden in the Skälderviken about 80 miles north of Malmö and 190 km south of Gothenburg.

Web Address:

www.engelholm.se

HFA priority:

- 4 Reduce the underlying risk factors.

Description of Problem

Sand dunes create a natural protective barrier between the sea and buildings. Major storms can destroy parts of the dunes. The damage to the dunes depends on the size of the storm, but also on the wind direction. If there is a permanent rise in sea level, which climate experts predict, will cause even greater storm impacts on the dunes in the future.

The problem has been known for a long time; however, there has been no long-term, clear action plan. The municipality's Technical Office and Environment Office have been involved, as well as the County Administrative Board.

Solution and Results

Ängelholm has developed a beach policy that includes measures to preserve the beach and protect buildings and infrastructure behind the beach.

One solution that has been used in Ängelholm is planting grass on the sand dunes to stabilize them. Sand has been deposited on the beach as a preventive measure, but also as an emergency measure after storms. There is also an ongoing investigation of how the municipality can preserve the beach by building either hard surface barriers or sand barriers.

Work began last year and will continue for several years. Ängelholm does not have enough data to evaluate the measures carried out yet.



Planting beach grass on the dunes is one example of a disaster risk reduction action.

Factors Leading to Success

The Municipality of Ängelholm has a beach protection policy to support their actions.

Lessons to Share

Most coastal municipalities experiences similar problems as Ängelholm. Therefore, we can learn much from each other. There is already a network of Swedish cities that have joined the UNISDR's Making Cities Resilient campaign. By meeting two times per year, participating municipalities have the opportunity to exchange experiences and knowledge.

City-to-City Learning

The municipality would like to become better at treating the risks associated with the planning and development of new settlements. The municipality's staff is also eager to learn more about how other countries tackle this problem.

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