Interreg
North Sea Region
FAIR
European Regional Development Fund

EUROPEAN UNION

Pilot Helsingborg

A Practice Brief from the Interreg
North Sea Region FAIR project

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Preface

The FAIR project

FAIR brings together flood protection asset owners, operating authorities and researchers from across the North Sea Region (NSR) to share the policy, practice and emerging science of asset management. Despite the diverse character of the NSR, asset managers face common challenges across the region.

The FAIR project aims to develop and implement improved approaches for asset management of flood protection infrastructure. It will optimise investment planning by exploring mainstreaming of these investments with other policy domains, and by mapping planned investments across a wide portfolio of flood protection assets. FAIR will also identify cost-optimal adaptive infrastructure upgrades by exploring a variety of technical designs, with adaptability and life cycle costing for various performance levels.

This Practice Brief

FAIR supports the delivery of local upgrade or maintenance projects and schemes for flood protection assets or systems. This Practice Brief presents **why** the project or scheme has been proposed. It provides an overview of the key challenges and intended outcomes. It elaborates on **how** these challenges have been addressed, and presents **what** has been the outcome from implementing this approach. Finally, the Practice Brief reflects on the innovation of the pilot with respect to the best practices in the FAIR end report and the FAIR recommendations.

The FAIR results

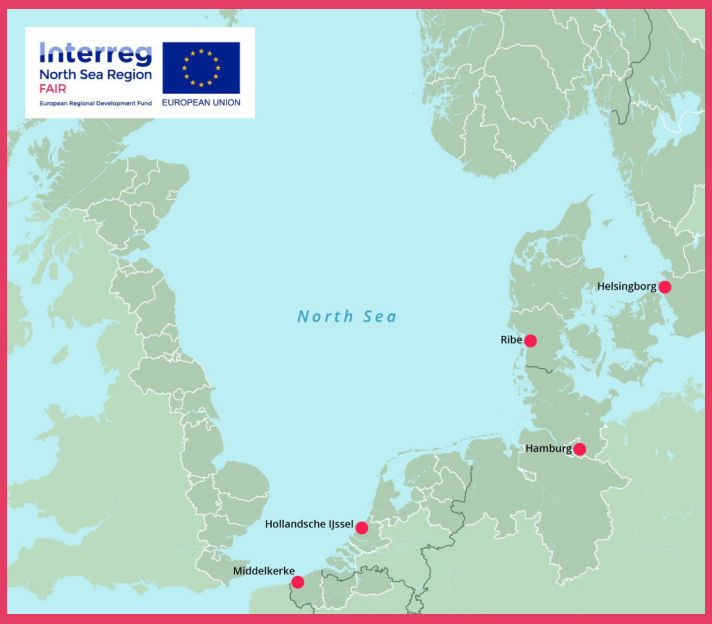
The demonstration and subsequent widespread implementation of the improved approaches and techniques will reduce the probability of flooding and minimise the impact of floods across the North Sea Region. This will improve the climate resilience at target sites covering most of the NSR. 'Target sites' are those areas being protected by entire flood protection systems (e.g. Danish coast, Swedish Coast, Flemish Coast, Dutch Delta) and individual assets (e.g. Hollandse IJssel storm barrier, Hamburg flood gates, etc).

The result indicators for the FAIR project are:

1. Reduce the life cycle costs of flood protection infrastructure through better targeting of investment;

2. Encourage the multi functionality of flood protection infrastructure through mainstreaming (that is, connecting) investments with other policy objectives;

3. Increase the life span of flood protection infrastructure through smarter maintenance and renovation.



Summary

Helsingborg Municipality's participation on the FAIR project has been the starting point for our work to protect the central parts of Helsingborg from rising sea levels and storm surges. Previously studies have been focussed on the effects of elevated sea levels, but through FAIR we have been able to focus on how we can protect the city and at what cost.

Since Helsingborg has not been affected by major flooding, we can now conclude that it is crucial to have a long-term strategy. The need to inform and raise awareness is also crucial to be able to move forward. The FAIR project has funded a report that identifies critical points and objects in the city centre. With the help of this documentation and previously made impact reports, a risk and impact analysis has since been carried out and finally, for the first time, we have been able to produce a socio-economic cost analysis for an inner protection, and outer protection on a longer time scale, and for mobile protections feasible in the near future.

The outer protection is dependent on other major infrastructure investments and needs to be handled accordingly. A detailed feasibility study for the inner protection will be needed to map all aspects of surface water, sewage system, urban mobility, urban environment and impact on existing bridges and quays.

With the help of a long-term strategy, we can continuously implement flood protection in our urban environment, starting from now, to be well equipped for future climate change.

The Context

Helsingborg is located along the Öresund in southern Sweden. The city of Helsingborg has 146 000 inhabitants and is a regional centre in the region of greater Copenhagen. The busy ferry route to Elsinore connects passengers to intercity and commuter trains and buses at the central station which is situated close to the old city and the inner docks. At high sea levels and during storm surges, the northern portal to the railway tunnel, the busy alongshore main road, and the central station are at risk of inundation. This threat will increase with rising sea levels. As of today the city does not have a full scale flood protection or flood policy, but awareness amongst politicians, inhabitants and the municipality is increasing – which has led to the generation of this pilot report.

Figure 1. The inner docks of Helsingborg with the city centre on a low level. The old tower "Kärnan" in the background is in the upper part of the city. Courtesy Helsingborg Municipality.

The city of Helsingborg is both the asset owner and operating authority of any existing storm protection. There is a small wall protecting the northern portal to the railway tunnel but it is only designed for a storm event with a 100-year return time. We are currently preparing for mobile temporary protections around stairs and lifts to the underground central station. New urban development in the harbor area is raised to +3.5 metres, which corresponds to the still water level of an extreme storm event. There is a plan for future changes to the infrastructure in the area. In about ten to fifteen years the main railway line will be expanded and the existing tunnel will probably be extended, which will decrease the risk of inundation. A road and railway tunnel to Denmark between Helsingborg and Elsinore is also a longer term possibility. This would affect the existing ferry route to Elsinore, and provide new possibilities for storm surge protection in the future. In the municipality of Helsingborg, located on the ad hoc wing of the asset management maturity scale, flood protection planning needs to be coordinated with overall city development in both space and time.

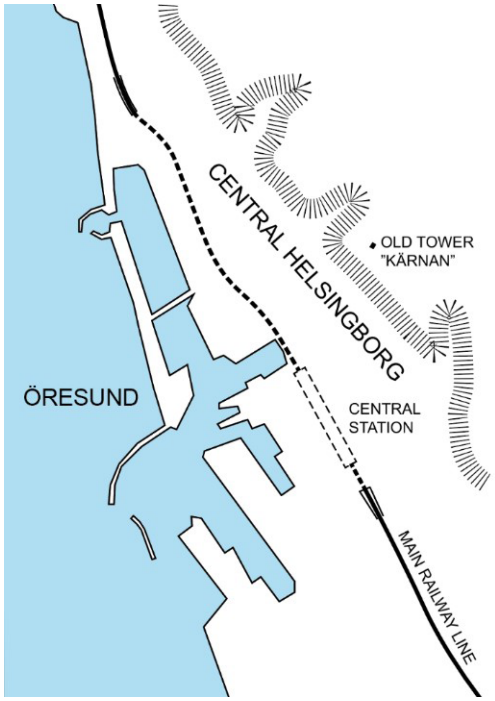


Figure 2. Map of the pilot area. Courtesy Helsingborg Municipality.

Why: The purpose

The key challenges

Helsingborg is one of many Swedish municipalities all facing the same challenges associated with rising sea levels but has not experienced a major flood in modern times. The city does not have a governing body or dedicated resources for flood protection and there is low awareness of the issue and no early warning system in place to protect citizens.

Challenge 1: Define a long-term strategy

Flood management must be integrated into overall city planning. As planning standards need to consider larger areas and public interests, an agile flood protection strategy is necessary. A clear strategy is needed in order to plan and build a storm surge protection over a longer timescale. Cost-effective solutions are needed for both the current situation and a future with higher sea levels. By doing a risk and impact assessment, we can get a much better picture of the investment that may be required in the short and long term. These will have to be compared with the cost of mitigation measures, in order to assess the socio-economic profitability. The outcome will provide a foundation for decision-making.

Challenge 2: Increase awareness

The second challenge is to increase awareness of flooding among citizens and politicians. This is important for funding and to create an understanding of the measures which will need to be taken to protect the urban environment. The awareness of our stakeholders also needs to be increased so that our work with flood protection becomes a natural part of all of the administration's work and assignments.

Challenge 3: Make space for innovation

To be able to solve future flood threats it will be necessary to support innovations along with traditional development. Since 2013, the municipality of Helsingborg has had a vision for the city in 2035. One milestone is the city's expo H22 which aims to make Helsingborg one of Europe's most innovative cities. This vision provides the city with the courage and energy to make positive change.

Figure 3. Visionary image of the inner harbor.. Courtesy Krook & Tjäder 2017.

The intended effects

Our intended effects of the pilot were:

- Short term future action plan on how to deal with rising sea levels in the inner city and the comparison with the current situation including a cost-benefit analysis.
- Long term future strategy for city planning and bigger measures.
- A communication plan to raise awareness with of the pilot results.

Through the FAIR project and the pilot report we can understand the nature and scale of the work that is ahead of us. The report will provide us with the initial information on how we should proceed with our work and an action plan for the initial stages. We can also see the socio-economic effects with a zero alternative demonstrating the consequences of not protecting Central Helsingborg. This can then put this against the cost of the various protection alternatives recommended in the report.

The report should also form the basis for how we should organise ourselves in order to meet future flood threats.

The outcome of this pilot will be the ability to cost effectively protect the most important objects of public interest in the city. Communicating our strategy and the results achieved over the coming years can positively influence urban infrastructure planning and make climate adaptation a central part of all future developments.

Figure 4. Visionary image of the inner harbor with example of inner protection. Courtesy Krook & Tjäder 2017.

How: The approach

The end product of the pilot project was in the form of a consultancy report proposing and evaluating possible flood protection measures on a shorter and longer timescale. The report is based on the SPR framework methodology. As the city currently is not in possession of any larger coastal protection infrastructure, the Source-Pathway-Receptor model was adjusted. In the analysis, Source was defined as high water levels and waves, Pathway as the flooding event and Receptor as buildings, infrastructure, people and the environment.

Step 1 was based on simulations of a 100-year flooding event in 2035, 2065 and an extreme flooding event in 2100. All scenarios followed the climate scenario RCP8.5. During step no 2 and 3, stakeholders responsible for the national railway system, sewage and water distribution, electricity network distribution and the harbor were involved in workshops regarding vulnerability, costs and maintenance.

The case report was conducted in six steps:

1. Analysis of existing high water model and flooding scenarios.
2. Identification of values to protect in the central parts of the city, such as the population, traffic system and infrastructure, buildings and key societal functions.
3. Impact assessment for flooding scenarios in the near and long term future.
4. Risk assessment.
5. Proposal of actions in order to protect the central city in the long and short term.
6. Cost-benefit analysis.

During the pilot other stakeholders were engaged in the process of collecting data and knowledge of existing facilities. The most important stakeholders are Swedish transport administration, NSVA (Water Services Company), Öresundskraft (Energy Services Company) and the rescue administration.

The sharing of experience is an important factor, and we visited Esbjerg in Denmark and Gothenburg and Halmstad in Sweden. In Esbjerg, we learned a great deal about how outer protection could be constructed and the economic cost of various options. We also discussed similarities and differences in our local government, and how politics play a very important role. For example Gothenburg has the same problems regarding rising sea level and infrastructure as Helsingborg, but on a larger scale. In addition to technical lessons, officials from the city of Gothenburg emphasised the need for networks to disseminate knowledge and contribute to increased awareness of the flood issues of both politicians and officials. In Gothenburg, they have set a time limit for various measures, which we in Helsingborg should also start to consider. In Halmstad, we looked at the large elevation project in the industrial harbor from +2.2 metres to +3.0 metres, and the creation of an outer sea wall further reinforcing the protection level. Overall we built up a detailed understanding of how large scale storm protection can be organised and financed.

What: The outcomes

The predicted flood risks facing the city in 2035 are severe. A 100-year storm would cause the water level to rise to at least +2.22 metres causing flooding of the inner harbor and the southern tunnel entrance. The risk of flooding at the main entrance to Helsingborg Central station and the northern tunnel entrance increases. The busy ferry link would be rendered inoperable. A 100-year flooding event in 2065 would result in a more tangible risk to life and health. The sewage system would be severely affected and rail and road systems would shut down. An extreme event in 2100 will have roughly the same surface coverage as the 2065 event, but with greater water depth and greater damage to life and property. In 2065, the damage costs to buildings and technical supplies would also be significant. Cost estimations of a 100-year event in 2065 equate to roughly EUR 7 million and the figure rises to EUR 11.5 million in the 2100 scenario. Significant disruption of rail and ferry operations represent the highest socio-economic costs in these scenarios.

Protection actions proposed in the report:

- Small dedicated protection – mobile protection around stairs and elevators in the central station and other openings to the railway tunnel. Measures will also be needed in underground parking and the sewage system.

- Inner protection – walls and dikes can be constructed along the quays from north to south to protect the city centre and the railway tunnel. To handle surface water the barrier needs to have several smaller openings so as to not create flooding on the inside of the wall, which will require a mobile protection. The inner protection should have a protection level of +3.0 metres, which would be sufficient in order to handle an extreme storm event in 2100.

- Outer protection – existing groynes can be reinforced by landfill with sluice gates to the central harbor and northern harbor that closes at high sea level. The outer protection is mostly evident in connection with a new road and rail tunnel to Denmark. At that point, smaller boats will replace the ferry traffic. The outer protection can give long term protection at extreme events in 2100.

Small dedicated protections reduce the risk of impact on the main railway line at high water levels and during storm surge, which is a good cost-benefit. The establishment of an inner protection can achieve a positive cost-benefit if it is coordinated with urban development and the asset management of quays and public spaces over a longer period of time. To establish the inner protection in a short time would be much more expensive due to major unplanned costs for restorations of quays, boardwalks and the sewage system.

No action plan for either the coexisting outer or inner protection exists today. Whether either an outer protection or an inner protection is enough in itself is not investigated enough to provide a definitive answer. The outer protection has a low cost-benefit today, but could be the only way to protect the city in the long term. This will have to be further investigated.

The result of the study is that flood protection needs to be integrated into strategic planning and be incorporated into on-going operation and maintenance of quays, promenades and technical infrastructure.

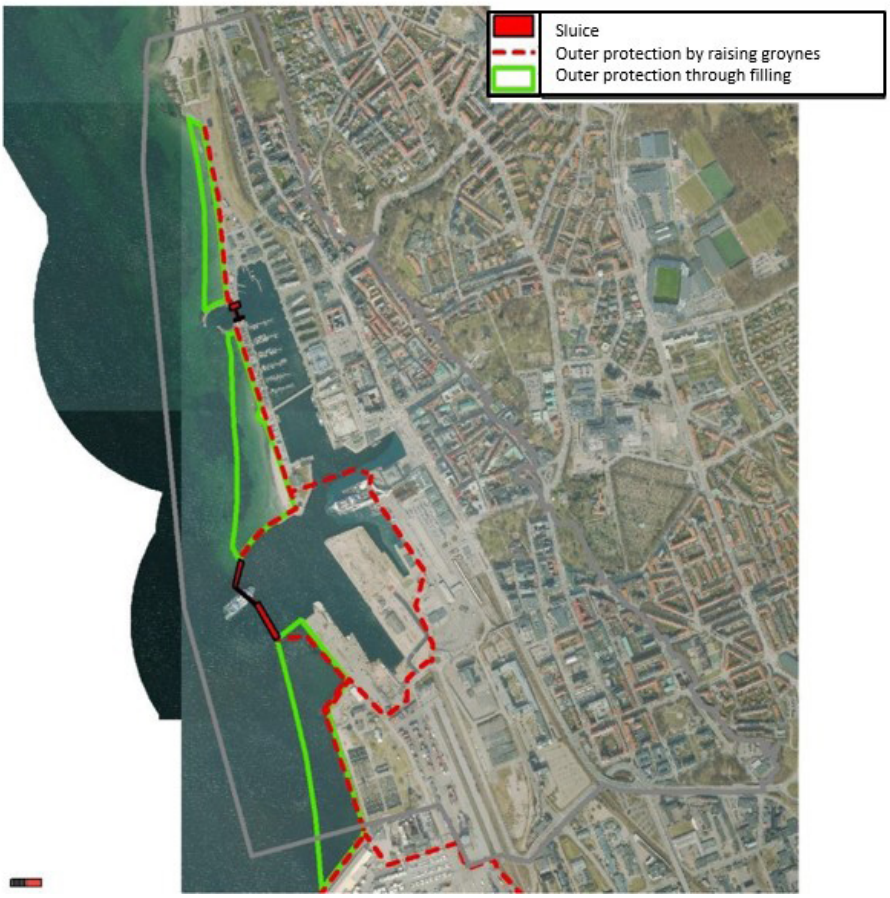


Figure 5. Proposal of outer protection including sluices, outer protection and reinforcement of existing groynes. Courtesy WSP 2019.

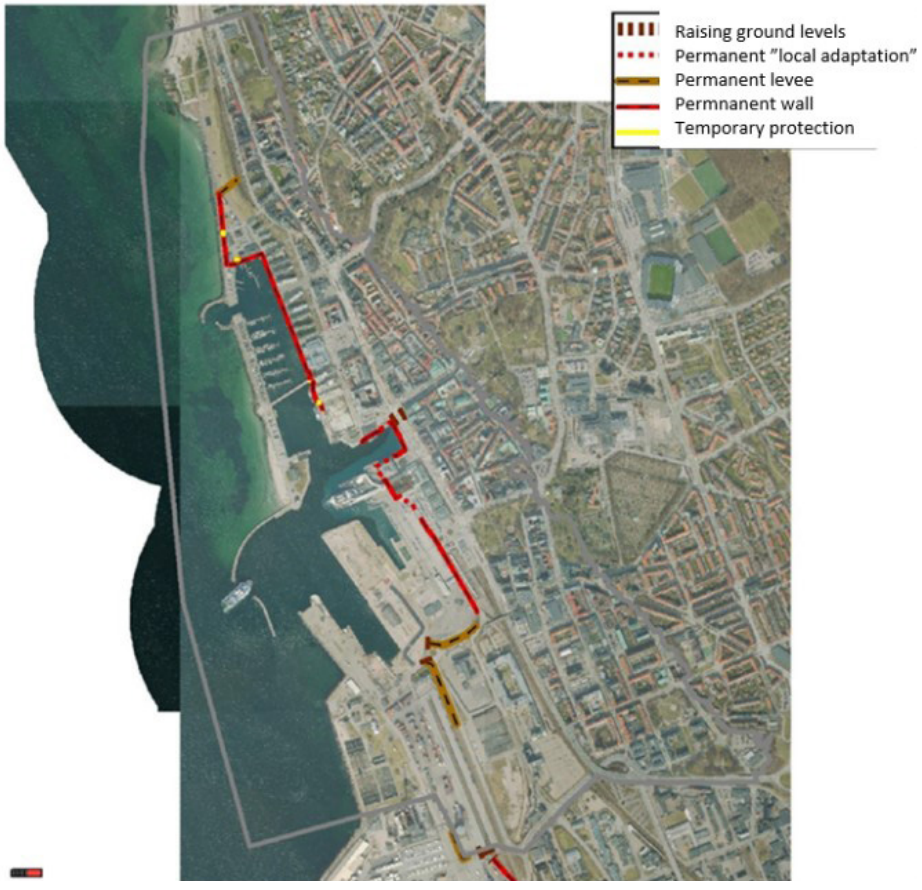


Figure 6. Proposal of inner protection including raising ground levels, permanent local adaptation, permanent levee, permanent wall and temporary protection. Courtesy WSP 2019.

The following conclusions can be drawn from the pilot project:

- Start with small, dedicated protection of functions with high public interest. As a direct result of the FAIR project, we have begun work on the proposed measures around Helsingborg Central Station and the entire tunnel to obtain the right measures and during 2020 are raising funding for completion.

- A detailed feasibility study for the inner protection is needed to determine the solutions from north to south including all aspects of surface water, sewage system, urban mobility, urban environment and impact on existing bridges and quays.

- The inner protection can, after that be built step by step, coordinated with urban development and asset management from 2030.

- An outer protection is needed to protect the city in the long term, but this could be constructed in stages, coordinated with a new tunnel between Helsingborg and Elsinore. A decision on this should be made before 2030.

Figure 7. Example of a protection along a quay to the left (inner protection) and a barrier with a sluice gate in Esbjerg to the right (outer protection). Courtesy Torgny Johansson, 2019.

- A detailed feasibility study for the outer protection needs to be carried out before or at same time as the planning of the tunnelling project. Important issues are the size of ships able to enter the inner docks, the environmental impact on landfill and how landfill could be multifunctional both ecologically and as a place for city life.

- The development of both inner and outer protection needs to be included in urban planning documents.

- We need to constantly monitor new research about rising sea levels, which will affect the strategy.

- Awareness is key to establish a sustainable organisation for storm protection today and in the future.

Reflection on innovation

As Helsingborg is initiator, funder, owner and maintainer of its own coastal protection, we have a unique opportunity to form a cost effective, integrated coastal protection program. Embarking on this journey will mean answering questions regarding investment returns, cost allocation, design, adaptation agility and parallel processes.

Reflection on best practices

The stakeholder analysis defined the network of stakeholders needed for the upcoming work. It is clear that when we approach the first flood defence actions, all stakeholders need to be involved at an early stage and in close collaboration. We aim to seek solutions that are suitable for all stakeholders in space and time.

Reflection on knowledge gaps

In the beginning of the project, we identified a few knowledge gaps. They were mostly related to how the railway tunnel is constructed. Few details are recorded and are not in the possession of the municipality of Helsingborg as the Swedish National Transport Administration governs the railway system. Now, we have identified and filled the knowledge gaps and we have a more collaborative approach than before, with railway and traffic stakeholders working together as part of a team.

Reflection on policy recommendations

The outcome of the project for Helsingborg is a strategy for the future, including feasible actions as well as the required planning processes for larger investments. The aim is to prepare for change by encouraging the multi-functionality of flood protection infrastructure through the correlation of investments with other policy objectives. The results of the study will be integrated into comprehensive planning as well as maintenance planning. In Helsingborg there is already a process for including many objectives in one single investment, but not on this scale and not so long in advance. The scope of this project includes securing land for future investments and communicating the strategy to co-workers within the organisation.

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Further reading

The documents relating to the FAIR project can be found on the following websites:

http://www.fairproject.org/

https://northsearegion.eu/fair/

Partners

FAIR brings together Asset Owners (facing real problems and challenges) and leading scientists (with domain expertise) to share and develop innovative solutions to the management of flood protection assets. In doing so, FAIR is the first collaboration of its kind.