A sustainable regeneration of brownfields for the growing population of Stockholm region.
This P5 report shows the research and design proposal of my graduation project for the studio Urban Regeneration at the TU Delft. This studio is focusing on the improvement of the physical environment and the providing of better social and economic opportunities for citizens.

The subject of the graduation project is the regeneration of brownfields for the growing population of Stockholm region. The aim is a sustainable integration of the brownfield Värtan Frihamnen into the urban network of Stockholm.

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INTRODUCTION

“Sweden shall be a leading force and an example to other countries in its efforts to create ecologically sustainable development. Prosperity shall be built on more efficient use of natural resources - energy, water and raw materials” (The Government’s policy declaration, 17th September, 1996 in Lidskog and Uggla 2000)

This declaration, done by the Swedish Prime Minister in 1996, shows the wish of Sweden to be one of the leaders in the transition to sustainable development and to propose new visions and structures for recreating humanity’s harmony with the environment. (Mega, 2010) To do so, the Swedish government implemented legislation that support the wish towards a more sustainable urban planning, like for instance the Environmental Protection Act, the Natural Resources Act and the Planning- and Building Act. Next to that, national-, regional- and local governments formulated long-term goals for reducing air- and water pollution. (Malbert in Guinchard, 1997)

Stockholm, the capital of Sweden, has made big steps in putting this legislation into practice. With Hammarby Sjöstad, an environmentally friendly neighbourhood built on a brownfield, the municipality of Stockholm created in 1996 a pilot project for sustainable urbanism in Sweden, Europe and the rest of the world. In line with this development, the municipality of Stockholm and several stakeholders developed a plan for the brownfield Värtan Frihamnen which is called ‘Royal Seaport’ (figures 2,3 & 4) This area could function as the next step in sustainable urbanism by using the lessons that have been learned during the design process of Hammarby Sjöstad. Besides that, new technologies in terms of sustainability can be used for the regeneration of the area. Värtan Frihamnen is in its current situation the most important harbour for ferries from the Baltic states, Finland and Russia and function in that respect as an entrance to the city. Because the other activities in the harbour will move to the South of Stockholm, there are possibilities to give this entrance to the city a more suitable program. This program could also help by the accommodation of the growing population of Stockholm, and will give opportunities to make better connections between Värtan Frihamnen and the urban network of the city. This graduation project will focus on those three elements. Besides that it will address the possibilities of doing this in a sustainable manner.
PROBLEM STATEMENT

Stockholm’s population will grow the coming decades. (CITY OF STOCKHOLM 2007) (figure 5) To accommodate all these inhabitants without creating urban sprawl, a need for other more sustainable solutions must be developed. Building the city inwards by using brownfields around the city core could be one of the solutions. The brownfield Värtan Frihamnen is therefore indicated as a new living and working environment. The area in its current state is not useable for this new function and needs to be redeveloped. Therefore, a long term planning of at least 20 years is needed.

Sweden has performed itself the last decades as a leading force in creating sustainable developments to come to a society that is less depended on fossil resources. This will influence the development of Värtan Frihamnen as well. The area could be the next step in building in a sustainable way. But only if the cooperation between municipality and stakeholders is sufficient enough to translate the theoretical guidelines of sustainable urbanism into practice. The question is how to achieve this goal and how to create this sustainable neighbourhood which should not only provide living- and working space for the inhabitants, but must also become an meaningful part of the urban network of Stockholm.
40% of all trade in Sweden is with the Baltic Sea Region.
(nordregio 2006)
PROBLEM FIELD

Stockholm (International / regional scale)
Stockholm region is a strong region in the world economy and known from its good business climate. (number 23 on the global cities index 2010, FOREIGN POLICY (2010) (figure 7 & 8) This position could become in danger because of globalisation. The world is shrinking and competition from other strong regions around the world is on the increase. Stockholm should find new ways to stay in its position of important region in the world. The economic prosperity of Stockholm has caused an significant population growth in recent years and all indications show that this trend will continue. By 2030, the population of the City of Stockholm is expected to grow to almost one million, (830.000 inhabitants in 2010) and that of the Stockholm–Mälar region to nearly 3.5 million (CITY OF STOCKHOLM 2007) This growth should not only carried by the satellite cities in Stockholm’s region, because that will create an high pressure on the borders of the city and will create unnecessary traffic movements. Besides that it will encourage the already existing urban sprawl which could threaten important green areas in Stockholm’s region.

Stockholm (city scale)
Stockholm`s vision to solve the problem of urban sprawl is to build within its city borders. Because of the change from an industrial based economy towards a knowledge based economy, brownfields around the city core became interesting to develop. This trend could encourage the development of sustainable high density build neighbourhoods with excellent public transport and low car use of the residents. To achieve this, big investments in public transport has to be made. The existing Tunnelbanan network (metro) of Stockholm does not have capacity enough to serve all these new inhabitants. (CITY OF STOCKHOLM 2010) (figure 9) At the same time the highway structure of the city can be improved by an accomplishment of the ring road. (figure 9) This could solve a lot of problems in the highway network of Stockholm region but is also very expensive to build. Both projects are located high on the political agenda, but the municipality of Stockholm struggle with the question how to explain an big investment in roads in a time that the city of Stockholm wants to perform itself as one of the most sustainable and green cities in the world.
Värtan Frihamnen (district scale)
The regeneration of brownfields around the city core is part of the “vision 2030” made by the City of Stockholm (2007). After the successful regeneration of the brownfield Hammarby Sjöstad, other projects are in development. (figure 10) One of these projects that is on this list is the new sustainable neighbourhood of Värtan Frihamnen. The plans for this project are made by the municipality in cooperation with the harbour of Stockholm, energy company Vattanfall and other stakeholders. It is called “Royal Seaport” (figure 12). The district of 236 hectares is owned by the municipality of Stockholm and will be transformed the coming 20 years into a working and living environment that contains a ferry terminal, offices and dwellings. Although there is a rough plan for the area, there are still a lot of challenges in terms of infrastructure, program, landscape and sustainability.

Infrastructure
The existing infrastructure of Värtan Frihamnen is based on the industrial background of the area and is therefore not suitable for the proposed program. The connection with the (inter)national network is present by the ferry terminal which has connections with all main cities around the Baltic Sea. (figure 11) The terminal will influence the area a lot because of the peak in passengers and cars during a short time of the day. The connections on local scale however are poor. Although the area is close to the city centre, it is hard to reach by public transport. Besides that, the connection between the ferry terminal and the public transport network of the city as well as the connection with the highway network can be improved.

Program
The current program of the harbour, especially the container and oil terminal does not have a connection with the proposed program. There are plans to move this industry to other parts of the region. This will give the opportunity to adapt the program of the area towards its new function. The move from the industry will take time and will be a crucial element in the planning process of the project.
The current spa\textit{\textsuperscript{al}} context of the area is based on the harbour activities which result in an isolated area with non accessible harbour fronts. Because of that, the spatial possibilities and qualities of the area are not utilized in the current situation. Not only the harbour front is isolated, the area itself is visually and mentally closed off from the city centre by the National Stadsparken, a green belt between the North and the South of Stockholm. This green belt can be seen as a barrier, but also as a change to give the new inhabitants access to green. (figure 4) The new situation will cause a higher pressure on the park, which could damage the existing role of the park and its flora and fauna.

\textbf{Sustainability} \\
After Hammarby Sjöstad, Värtan Frihamnen will be the next step in sustainable urbanism. It is important that the lessons that are learned during the design process of Hammarby Sjöstad should put into the Värtan Frihamnen project. \\
The ‘Hammarby model’, (CITY OF STOCKHOLM 2007) can be used in the Värtan Frihamnen project. (see page 25 for an explanation of the model) \\
A threat could be that the context of this project will differ from the ‘Hammarby model’. In that case an adaption of the existing model in needed.
Royal Seaport

Area: 236 hectares
New apartments: 10,000
New work spaces: 30,000
Commercial areas: 600,000 sqm
PROJECT AIMS

Stockholm (international / regional scale)
Globalisation is not only a threat for Stockholm region. It will give a lot of opportunities as well. In the next few decades, the Baltic Sea region expect a significant economical growth. (European Union, 2010) To benefit from this development, Stockholm region should have the ambition to take full advantage of this by cooperate with the other countries around the Baltic Sea. Sustainable transportation of goods and people via the Baltic Sea could be a change for Stockholm to stay one of the main players in the region.
The expected growth of the population in Stockholm region can be accommodate by building within the existing borders of the city. A higher density within the borders could save the green areas around the city and give opportunities to use the existing parks in the city more efficient. It is important to have a clear vision on how to do this without damaging the green structure in the city and the link between the city green and the regional green. Because of a higher density within the city, it is crucial to know how Stockholm region could invest in infrastructure. With this higher density, there are possibilities to strengthen the public transport network to come to a more sustainable way of transportation.

Stockholm (city scale)
There are opportunities to use brown fields around the city core to accommodate new inhabitants. This could create a revitalization of the surrounded neighbourhoods and the (inner) city. It is important to do research on the influence of these kind of developments. It could have a positive effect on the creation of a sustainable public transport network with as result lower car use in the city. But it could also give negative effects like

the move of high educated people from the suburban areas towards the city centre. This could result in an unbalanced (social) situation between city and suburb.

< figure 12. Royal Seaport
Värtan Frihamnen (district scale)
The regeneration of Värtan Frihamnen will give a lot of opportunities for the neighbourhood itself, the city and the region. Important to say is that the cooperation between the municipality and the different stakeholders who are involved in the project will make or break the success of a good connection between infrastructure, program, landscape and sustainability.

Infrastructure
Värtan Frihamnen has the change to become the connection between Stockholm and the Baltic Sea region. Not in terms of goods, because this part of the harbour activities will move to the South of Stockholm, but in terms of people by welcoming ferry- and cruise ships. It could be an excellent entrance to the city and an starting point for all kind of activities. Besides that, Värtan Frihamnen has the opportunity to become a working and business district. The current infrastructure in and around Värtan Frihamnen has to be adapted for this new role of the area in the urban network.

Program
The program for Värtan Frihamnen could be very diverse. Therefore, it is important to investigate what is needed in this part of Stockholm. The ferry- and cruise terminal can have a positive effect on the area, if there could be found a suitable program that can ensure that tourist and other passengers will stay longer in Värtan Frihamnen.

Landscape
The unique harbour front is an opportunity to interweave program and landscape with each other. The National Stadsparken has the change to become an connecting element between the city centre and Värtan Frihamnen. Besides that, it could give the new inhabitants a place for outdoor activities like sport or -on city scale- a place for festivals. These kind of activities can have a positive effect on the area.

Sustainability
Hammarby Sjöstad put sustainable urbanism on the map of many cities and countries. Värtan Frihamnen could do the same. It has the opportunity to be the next step in creating sustainable neighbourhoods for the future. Important is the role of the stakeholders and the municipality of Stockholm in this process. They have to cooperate with each other to make the projects a success. therefore research about the design process of Hammarby Sjöstad is needed to avoid mistakes in an early stage of the project.
RESEARCH QUESTIONS

Which conditions are needed for the regeneration of Värtan Frihamnen into a sustainable neighbourhood that can contribute to a better East-entrance for the city in order to improve the urban network of Stockholm?

The main question contains three challenges in three different scale levels.

<table>
<thead>
<tr>
<th>Scale level:</th>
<th>Challenge:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbourhood</td>
<td>The regeneration of the brownfield into a sustainable developed neighbourhood.</td>
</tr>
<tr>
<td>District</td>
<td>The improvement of the East-entrance of the city by making better connections between the district and the city.</td>
</tr>
<tr>
<td>City</td>
<td>The strengthening of the urban network by a better interwoven East part into the urban network of Stockholm.</td>
</tr>
</tbody>
</table>

These challenges will form the basis for the design proposal which will address all three scale levels. The context of the project, Värtan Frihamnen ask for more detailed questions in the fields of sustainable development, infrastructure and program. Therefore sub-questions are made to support the main question of the project. After each question a short explanation of the method of research is given. The methods will be more explained in detail in the Methodology part of this report.

Sustainable development
What can we learn from sustainable redevelopment of brownfields in the past, present and future?

Method of research:
- Case study about the impact of sustainability on the Hammarby Sjöstad project in Stockholm. (figure 16)
- Theory paper “the role of sustainable development in Swedish urban planning”

Infrastructure
What are the opportunities to create a better connectivity of the area on different scale levels?

Method of research:
- Mapping the infrastructure of Stockholm

Program
What kind of program can contribute to the sustainability and variety of the Värtan Frihammen area?

Method of research:
- Analysis of the program of Hammarby Sjöstad.
- A case study on building blocks of similar areas.
MAIN QUESTION
Which conditions are needed for the regeneration of Värtan Frihamnen into a sustainable neighbourhood that can contribute to a better East-entrance for the city in order to improve the urban network of Stockholm?

Q1. SUSTAINABILITY
What can we learn from sustainable redevelopment of brown fields in the past, present and future?

Q2. PROGRAM
What kind of program can contribute to the sustainability and variety of the Värtan Frihamnen area?

Q3. INFRASTRUCTURE
What are the opportunities to create a better connectivity of the area on different scale levels?

CASE STUDY
HAMMARBY SJÖSTAD STOCKHOLM

THEORY PAPER
"THE ROLE OF SUSTAINABLE DEVELOPMENT IN SWEDISH URBAN PLANNING"

RESULT
better understanding of the existing program in Stockholm

RESULT
better understanding of the existing infrastructure in Stockholm

MAPPING THE EXISTING PROGRAM IN STOCKHOLM
RESEARCH ON SIMILAR NEIGHBOURHOODS

RESULT
better understanding of the conditions that are needed to come to a sustainable developed Värtan Frihamnen

knowledge of sustainable urbanism

recommendations for the regeneration of Värtan Frihamnen into a sustainable neighbourhood.

design proposal
METHODOLOGY

Main model
This graduation project can be seen as a location-based project and has therefore many ‘challenges’ in different aspects of urbanism. Because of that, many different methods will be used to get a better understanding of these ‘challenges’. The main model give structure to this search. (figure 13) It is set-up in different parts. The first part of the model -which represents the research part- consist out of the main research question that raise challenges that will be answered during the next steps. Three sub-questions with the subjects: sustainability, program and infrastructure contribute to the research part. The results of these three questions will form the starting point of the design phase which can be seen as a collection of recommendations. Lessons that are learned in the design phase will generate input for the research part and a cyclic process is created. Next to this, the result of the design part can contribute to the general knowledge of sustainable urbanism.

Model parts
The main model consists out of three parts that will be addressed separately. In the model, the research and the design phase are behind each other, but in practice this can be seen as a overlapping part of the process. In the beginning of the process, research will be the main part. Later on the design part will be more important. Interaction between research and design is crucial to make the project a success. (figure 15) Research and design will influence each other, which is shown in the time schedule. (figure 14) A more detailed explanation of the used methods in the three parts of the main model can be found on the next pages.
1. Case study / Theory paper “the role of sustainable development in Swedish urban planning”

The first part of the model will focus on sustainability, which will be an important topic of the project. To know more about sustainability, this topic is split-up in two parts. The first part shows research about Hammarby Sjöstad in Stockholm (figure 16) The design process and the results of that will be researched in order to get a clear view of the lessons that can be learned from this project.

The second part is a theory paper about “The role of sustainable development in Swedish urban planning”. This paper will search for answers why Sweden is one of the driving forces behind sustainable urbanism in the world and how this could help other countries to make the step between the theory and practice of sustainable urbanism.

Methods

Study Hammarby Sjöstad in Stockholm
- Literature study
- Site visit.

Theory paper “the role of sustainable development in Swedish urban planning”.
- Literature study

Products

- An overview of lessons that can be learned from the design process of Hammarby Sjöstad.
- A better understanding of the history and future of sustainable urbanism in Sweden.
- An indication of the social (un)balance between city and suburb caused by building on brownfields around the city centre.
2. Mapping the existing program in Stockholm / research on similar neighbourhoods.

The second part of the research will focus on the program of Värtan Frihamnen. This study will be done in two parts. The first part will be about the existing program in Stockholm. This will not mean that the whole city has to be investigated. It is about the parts of the city that could have a future link with the project area. The area itself is also part of this research. The other part is about the research on similar neighbourhoods. A case study about building blocks in several neighbourhoods in The Netherlands and Sweden will form the basis to come to rules in density, building height and program.

Methods
Research on the existing program in Stockholm:
• Mapping the existing program of parts of the city that are relevant for the project.
• Mapping the existing program in the project by visiting the area

Research on building blocks and program of similar neighbourhoods:
• A case study about building blocks in IJburg, Java Eiland and Hammarby Sjöstad.

Products
• An overview of the existing program of the relevant places in the city. (mapping)
• A better understanding of the existing program of the project area. (mapping)
• An overview of possible building blocks and program that could fit in the area.

< figure 16. plan of Hammarby Sjöstad
3. Mapping the infrastructure of Stockholm

The third part of the research will focus on the infrastructure of Stockholm. (figure 17) It is important to know how the current infrastructure can contribute to the project area and what the missing links in the network are. The main focus is on public transport because of the wish to come to a sustainable neighbourhood. Research on the impact of the ferry and cruise terminal are also part of the investigation.

Methods

Research on the infrastructure of Stockholm:

- Mapping the infrastructure of Stockholm.
- Research on sustainable infrastructure.
- Research on the impact of the ferry and cruise terminal.

Products

- An overview of the infrastructure of Stockholm (mapping)
- Recommendations for the missing links in Stockholm’s infrastructure.

End products

Based on the previous research, all recommendations and maps will form the basis for the design proposal. The design will be the final product of the project and will not only contribute to the regeneration of the brownfield Värtan Frihamnen, but will also influence the structure of the East part of Stockholm’s urban network.

- Methods
- Mapping
- Design research
- Drawings
- Visualizations

Products

- A detailed design proposal for a sustainable regeneration of Värtan Frihamnen, which contains maps, drawings, visualizations, street sections etc.
- A public transport model for the city of Stockholm.
- A 20 year planning for the regeneration of Värtan Frihamnen.
- A (possible) contribution to the “body of knowledge” about sustainable urbanism.
This chapter of the report shows how Stockholm deals with sustainable urbanism in the past and present. The aim is to create a theoretical framework for the design of the Värtan Frihamnen area. The chapter starts with a short overview of the history of sustainable urbanism in Sweden and Stockholm which will point out the importance of the Miljonprogrammet in the sixties on the redevelopment of brownfields around the city core. This history part can be seen as a background for the second part of this chapter which is about the role of sustainable planning in Swedish urban planning.

THEORETICAL FRAMEWORK

This chapter of the report shows how Stockholm deals with sustainable urbanism in the past and present. The aim is to create a theoretical framework for the design of the Värtan Frihamnen area. The chapter starts with a short overview of the history of sustainable urbanism in Sweden and Stockholm which will point out the importance of the Miljonprogrammet in the sixties on the redevelopment of brownfields around the city core. This history part can be seen as a background for the second part of this chapter which is about the role of sustainable planning in Swedish urban planning.

< figure 18. Hammarby Model

The core of the environmental and infrastructural planning of Hammarby Sjöstad jointly developed by Stockholm Water Company, Fortum and the City of Stockholm Waste Management Administration can be summarised in an eco-cycle model known as the Hammarby Model. This model shows the interaction between sewage and refuse processing and energy provision, as well as the added benefits to society of modern sewage, energy and waste processing systems. The overall goal “twice as good as the norm” required new ideas for energy, water, waste, transport, building design, construction site logistics – all those systems that we normally take for granted in a modern city. (City of Stockholm, 2007)
Even though Sweden was late to urbanize, most Swedish cities and towns have a history of many centuries. But they were very small. In 1825, only nine of the 85 towns in Sweden had more than 5,000 people. The towns started to expand in the 1880’s. The urban population grew fast, but did not exceed the rural population until the 1930’s. Nowadays, the proportions are reversed, with 85 percent of the population living in urban areas. (STATISTICS SWEDEN, 2007) The leading cities have multiplied their populations about tenfold, but are in international comparison still quite small. Only Stockholm has grown to international proportions. During this process of growth, dense townscapes have changed into low density urban landscapes that surround the historic cores. The urban landscape is separated into large districts of housing, industry, retail, leisure and education. The housing stock is relatively young. Two third of the Swedish population live in buildings that are less than fifty years old. (Nyström in Guinchard, 1997) As in many European cities in the sixties, buildings and site layout follow modernist planning principles. Which were a reaction on the crowded and unhealthy environment of the nineteenth century Grid Iron City. The ideals of sunlight, natural surroundings and neighbourhood community resulted in single family houses and peripheral tower blocks in park like settings. The road, the open landscape and the shopping centre replaced the street, the city park, and the square. During this period – between 1965 and 1974 - one million houses were build with as aim affordable houses for everyone. This period is in Sweden also known as the ’Miljonprogrammet’ (figure 19)
Brownfields

In the 1970’s and 80’s a strong public opinion came up against the Miljon-programmet that only gave priority to basic human needs as health and shelter. Context, identity, cultural meaning and diversity became important as well as the importance of historic place. As a result of that, the abandoned city core were revitalized into working and living environments, which became popular among small households and professionals. To understand why especially these groups of inhabitants came back to the historic city core, it is necessary to look at how demographic and work patterns changed. Swedish households are part of the smallest in the world. (STATISTICS SWEDEN, 2007) Not because Swedish are not family oriented, but because the nuclear family period is very short. This is because Swedes have, next to the Japanese, the longest life expectancy in the world, which means that a typical Swede divides his or her adulthood into two approximately equal parts. One with children at home and one without, including singlehood before creating a family. (Nyström in Guinchard, 1997) Many couples and singles are attracted to the inner city living as it is more comfortable to live closer to work and cultural activities. This can be seen as a trend in Europe. (STATISTICS SWEDEN, 2007) Next to that, the post industrial society is higher educated. Quality of life and making life worth living are very important nowadays. This results in two groups of people in Sweden. ‘The new agrarians’ who want to live close to nature and ‘the new urbanites’ who want to live in the city centre close to all the facilities a city could offer. (Nyström in Guinchard, 1997) This last group is mainly high educated. It is interesting to see that both groups assert their ecological commitment; the new agrarians by a more simple lifestyle including the cultivation of the land, the new urbanites by minimizing their car use. The last group can be seen as a target group for the redevelopment of brownfields around the centre of the city. (figure 20) The former brownfield of Hammarby Sjö is a good example in that respect. It shows the possibilities of living close to the city core and the reduction of car-use of its residents by investing in public transport.

<figure 19. buildings from the ‘Miljonprogrammet’
<figure 20. the relation between new urbanites and brownfields

The former brownfield of Hammarby Sjö is a good example in that respect. It shows the possibilities of living close to the city core and the reduction of car-use of its residents by investing in public transport.
**Theory sustainability**

After Hammarby Sjöstad, Värtan Frihamnen is the next project of the municipality of Stockholm in terms of sustainable development. But what could sustainable development be? And what could it mean for Värtan Frihamnen? This part of the report will address several aspects that are needed to answer this question. It will start with giving a general overview of what sustainable development could be. It also shows the need of cooperation between municipalities and stakeholders on local scale in that respect. After this it shows the role of sustainable development in Swedish urban planning in order to create a background for the Hammarby Sjöstad project. A short introduction of this project and two evaluations of Grontmij and KTH will give an overview of the successful and unsuccessful parts of this project. It will end up with recommendations for future projects, like the Värtan Frihamnen project. The last part of the chapter will be about which conditions are needed to make Värtan Frihamnen a sustainable neighbourhood by addressing: brownfields, infrastructure, program and the Värtan Frihamnen Model.

**Sustainable development**

The environment is now very close to the top of the political agenda in many countries. There is a widespread consensus that progress towards ‘sustainable development’ is essential. However, there is considerable debate as to what this term means. The most widely used definition of the concept of sustainable development came from the 1987 report Our Common Future from the United Nations World Commission on Environment and Development (WCED): “Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” (WCED in Berke, 2002) It contains within it two concepts: The concept of ‘needs’, in particular the essential needs of the world’s poor, to which overriding priority should be given. And the idea of limitations imposed by the state technology and social organization on environment’s ability to meet present and future needs. (Malbert in Guinchard, 1997)

We are in a time that speaking about sustainable development is not enough to save the planet. It is time to act like it as well. This means that there is a challenge in the coming decades to develop all (urban) projects in a sustainable way. But in what way can this challenge be realized? On the surface, sustainable development is a simple concept. Current and future generations must strive to achieve a decent living for all people and live within the limits of natural systems. Despite this simplicity, there has been no general agreement on how the concept should be translated into practice (Jepson in Berke, 2002) Although there is no question that the concept is increasingly being used to guide planning (Krizek and Powers in Berke, 2002), its implementation in not immediately apparent. Ecological planners Beatley and Manning (1998) argue that within the planning profession “there is a general sense that sustainability is a good thing, but will... require definition and elaboration, as do terms such as freedom and quality of life” (Beatley and Manning in Berke, 2002)
Although sustainability is a good thing like Beatley and Manning mentioning, it is only a good thing if you use it in every day practice. If we look in that case to sustainable urbanism, what are the preconditions to make cities sustainable? Is it the compact city? (Beatly in Wheeler and Beatly, 2004) Urban history shows us for instance that high density and compact form were common in urban development prior to the 20th century. Can we use history to conclude that high density is more sustainable? (Grant, Sorensen, Marcotullio, 2004) No, because there are a lot of projects in the past that failed and shows us that sustainable urbanism does not have strict rules. This argument is strengthened by the book “Achieving Sustainable Form” by Katie Williams, Michael Jenks and Elizabeth Burton (2000). They argued that the form of a town or city can affect its sustainability. It is now widely accepted that a relationship exists between the shape, size, density and uses of a city and its sustainability. However, consensus is lacking about the exact nature of this relationship. The relative sustainability of, for example, high and low urban densities, or centralised and decentralised settlements is still disputed. Certain urban forms appear to be more sustainable in some respects, for example in reducing travel, or enabling fuel efficient technologies, but detrimental in others, perhaps in harming environmental quality or producing social inequalities. Some forms may be sustainable locally, but not be beneficial city wide or regionally. This means that the single sustainable city, based on the same principals does not exist.

So: The search for the ultimate sustainable urban form perhaps now needs to be reoriented to the search for a number of sustainable urban forms which respond to a variety of existing settlement patterns and contexts... (Jenks et al.,1996, p.345)

By using different kind of forms, the goal of creating more sustainable cities will be easier to achieve. But in what kind of way can cities and countries try to do this in the future? Philip Berke, (2002) professor at the University of North Carolina came up with an interesting conclusion for this question by saying: “There is now a fascinating development as an overarching guide to planning that is taking place at the international, national and local government levels around the world”. This announcement shows the necessity of cooperation between governments on different levels. But since the concept of ‘sustainable development is primarily a political concept (Malbert in Guinchard,1997) this will not be enough. Cooperation between different levels of government and companies could result towards a better result to create a more sustainable urbanism. But how to start with this cooperation? Sweden is a good example in that respect. Besides a good cooperation between government and companies, it also managed to bring the agreements of Agenda 21 into practice, - the Hammarby Sjöstad project - which seem to be very difficult for most countries and cities. To know how Sweden managed to do this, we have to look at the urban planning in Sweden.
The role of sustainable development in Swedish urban planning.
Planning has a long tradition in Sweden. Strong government machinery, an important public sector, and self governing municipalities that have a so-called planning monopoly, (Cars and Engstrom in Guinchard, 1997) have all helped to create a system geared to developing important elements of social welfare: good housing, good transportation, facilities for social services, education and healthcare, technical supply systems, and land for an expanding economy. (Alfredsson and Wiman in Guinchard, 1997) This traditional role of regulation has changed since the seventies to a role that is more focused on providing the means for development and other opportunities. At the same time, the Swedish government was very active by organizing the United Nations Conference on the Environment in Stockholm in 1972, whereby global environmental issues were put centre stage on the international agenda. Also the next conferences like the WCED in 1987 the Agenda 21 in 1992 and the HABITAT II in 1996 were actively supported. After this period the Swedish Prime Minister has declared that:

“Sweden shall be a leading force and an example to other countries in its efforts to create ecologically sustainable development. Prosperity shall be built on more efficient use of natural resources - energy, water and raw materials” (The Government’s policy declaration, 17th September, 1996 in Lidskog and Uggla 2000)

This declaration means that the government should take action. But how to do this? Planning for sustainable development ties to integrate social, economic and ecological aspects. And this challenge is surrounded by many uncertainties as to why, by whom and how societal changes, of what kind, should be implemented. (Malbert in Guinchard, 1997) The only way to answer these questions is to formulate them on local level. Because every local situation is different, so the answers must rely on knowledge and experience from many different scientific disciplines, administrative units, and others sectors of society. To do so, the Swedish government implemented legislation that supports the wish towards a more sustainable urban planning, like the Environmental Protection Act, the Natural Resources Act and the Planning and Building Act. Next to that, national, regional and local governments formulated long-term goals for reducing air and water pollution. To keep control on sustainable urban development on local scale, the national government introduced the Planning and Building Act that put pressure on the local authorities to develop land use plans that include the efficient use of natural resources as well as aesthetics and quality of life. These institutionalized restrictions are, on the whole, geared towards sustainable development, but they are policy-based, elaborating more on what to achieve than how. (Malbert in Guinchard, 1997) The connection between the what and the how will not come from single initiatives. No local actors – public or private – have the ability to tackle the problems and solutions of sustainable development. Changes in that direction can only be achieved through coordinated decisions and actions taken by various, more or less independent actors. (Malbert in Guinchard, 1997) Cooperation between local and regional authorities, private industries and citizens are essential to make sustainable urbanism into a success. Sweden has several examples of this approach.
Like for instance Hammarby Sjöstad an eco-friendly neighbourhood build on a brownfield, where the overall environmental goal is that the impact placed on the environment by emissions shall be 50 % lower than the corresponding level for newly constructed housing areas dating from the early 1990s in Stockholm. (hammarbysjostad, n.d.) As Värtan Frihamnen can be seen as ‘the next step’ after Hammarby Sjöstad, it is interesting to see how the planners of Hammarby Sjöstad brought the theory into practice.

Hammarby Sjöstad
Hammarby Sjöstad is well known both national and international, due to its environmental profile. (figure 21) The neighbourhood was designed in 1996 and is one of the first eco-friendly areas in Europe and contains 11,000 apartments and 36,000 people living and working in this area. The core of the environmental and infrastructural planning of Hammarby Sjöstad jointly developed by Stockholm Water Company, Fortum and the City of Stockholm Waste Management Administration can be summarised in an eco-cycle model known as the Hammarby Model. (figure 18) This model shows the interaction between sewage and refuse processing and energy provision, as well as the added benefits to society of modern sewage, energy and waste processing systems. The overall goal “twice as good as the norm” required new ideas for energy, water, waste, transport, building design and construction site logistics. (City of Stockholm, 2007)

To see how these new ideas function in practice, the City of Stockholm assigned the department of Industrial Ecology at the Royal Institute of Technology, (KTH) to do an evaluation on the environmental profile of Hammarby Sjöstad. The starting point of this evaluation was the environmental program of Hammarby Sjöstad from 1996. The aim was to gather the most important results and experiences of the project which the City of Stockholm should bring into the planning of new urban districts. Besides this evaluation, Grontmij did research on the environmental impact of Hammarby Sjöstad. Both researches shows that, although the “twice as good as the norm” not has been reached, big reductions are made on several activities. Examples of reductions are:

- The total environmental impact for buildings, building plots and zones has fallen by ca. 32-39% for emissions into the air, soil and water in comparison with the referent.
- The index for consumption of non-renewable energy raw materials shows a reduction of ca. 28-42% for buildings, building plots and zones, and a reduction of 30-47% if buildings alone are studied (Grontmij AB 2008).
- The overall environmental impact of the area is 30-40% lower than for a typical similar district built in the 1990s.
- Daily water use is 150 litres per person (compared to 200 litres for the rest of Stockholm)
- The percentage of car journeys for personal transportation has fallen (14% lower), while the number of journeys made using public transport, particularly the “Tvärbanan” light rail link have increased in comparison with the 1990s.
- The ferry has contributed to an increase in the use of bicycles and walking to/from Hammarby Sjöstad. 24% of all travellers use the ferry. (Grontmij, 2008)
GLASHUSET
1. Glashusett – The environmental information centre of Hammarby Sjöstad. The place to find information on both environmental issues and exciting green technology (solar cells, fuel cells, sedan roofs, etc.). A partnership between the Stockholm Water Company, Fortuna, the Stockholm City Development Administration and the Stockholm City Waste Management Administration.

ENVIRONMENTAL BLOCKS
2. Holmen, NCC. Winner of the first prize in the City’s environmental competition. Best New Construction.
5. Sundet, JM. Winner of the third prize.

WATER
7. Prepared soil for filtration of storm water from streets.
8. Storm water basin with outfall for storm water from streets.
9. Storm water basin with filtration (also power grid station).
10. Channel for storm water from buildings and gardens only.
11. Green roofs and yards collect storm water locally.

ENERGY
14. Fortuna’s Thermal Power Plant. Supplies Hammarby Sjöstad with district heating and district cooling from treated wastewater and biogas.
15. Biogas cookers are installed in approximately 1,000 apartments on Sickla Udde and Sickla Kai.
16. Biogas production facility.
17. Solar cells on the roof of Jätte’s block, Fjäder, providing electricity used in the communal areas.
1. Solar cells on Glashusett.
2. Solar cells for the Holmen block.
4. Solar panels on the Vikan block to heat the hot tap water used by the tenants.
9. Power grid station (also storm water basin).

WASTE AND RECYCLING MATERIAL
19. One of the docking points where the refuse collection lorry connects to the pneumatic waste disposal unit.
20. Collection centre for the stationary pneumatic waste disposal system.
1. Glashusett also houses a collecting point for hazardous waste.

COMMUNICATIONS/TRANSPORT
21. Trafikbanan, a light rail line.
22. Ferry berth with boat traffic to Södermalm (also to central Stockholm at certain times of the year).
23. Old quay restored to form a footpath and cycle route.
24. Footbridge made from stainless steel for long-term durability.
25. Car-pool parking with the best parking spots, right in front of the door.
26. Fuel station for cars running on electricity, biogas or ethanol.

THE HEALTHY CITY
41. Cycle route along the Lugnshed, Hammarby Allé thoroughfare.
42. Hammarbybacken – slalom ski slope.
43. Sports halls.
44. The Nacka nature reserve.
45. Beach at Sickla Sjö.
46. Old quay restored to form a footpath and cycle route.
47. The Culture House.
49. Biogas cookers are installed in approximately 1,000 apartments on Sickla Udde and Sickla Kai.
50. Playground in Redaren and Sjöfarten.
51. Pleasure boat moorings.
52. Södra Länken (motorway) lowered to reduce traffic noise.

NEW AND EXISTING GREEN SPACES
27. New tree-lined avenues that stretch throughout Hammarby Sjöstad.
28. Luna Park. New local park with green hills, Japanese cherry trees (Prunus serrulata) and a playground. The park also contains a preserved old house.
29. Sickla Lock and salmon ladder.
30. Neat paths for seashore. The City of Stockholm Environmental Administration’s project designed to promote the biological development of Stockholm.
31. Reed path with wooden footbridges. Viewing points and rest areas.
32. Preserved riparian woodlands with birch and alder.
33. Ecotours. A green crossing providing enhanced access to the Nacka nature reserve. (A vast forested area with footpaths and cycle routes).
34. Oak-covered slope with 150 old oaks. One of the finest stands in the southern part of the city of Stockholm.
35. Special adaptation of buildings for the oak-covered slope.
37. The Lugnset partners.

OTHER
38. Listed factory buildings from the 1930s. Restored and now used as offices premises.
39. Sickla lock and salmon ladder.
40. Sickla Länken (motorway) lowered to reduce traffic noise.
Although it is interesting to see what the reductions in the area are, it is even more important to see what methods has been used to achieve the reductions, and how to improve these methods in order to create even better reduction in new projects. The report of KTH is for instance critical about the implementation of the environmental program of Hammarby Sjöstad. This program came late in the planning process of Hammarby Sjöstad, which resulted in contradictions between different goals in the project. This resulted in difficulties at the implementation of the environmental program. Next to that, the report shows that the governing of the City of Stockholm was not clearly manifested in the implementation of the environmental program; the goals of the environmental program were not clearly stated in written agreements between the City of Stockholm and the building contractors. (Pandis & Brandt, 2009)

According to the KTH report, some interventions have had a positive effect on the area and the behaviour of the residents: ‘for builders and contractors in Hammarby Sjöstad, the support from the local investment program (LIP) and the competitions in environmental technology have been successful incentives, speeding up the development of innovations and fronting the environmental work’... and: ‘The centre for environmental information and communication in Hammarby Sjöstad, GlashusEtt, has focused in influencing the behaviour of the residents. GlashusEtt has informed the residents in how to reduce their energy consumption, what not to throw in the toilet and how to sort their household waste’. (Pandis & Brandt, 2009)

The report does not only show the evaluations on the Hammarby project, but give also recommendations for new developments, like the Värtan Frihamnen area: ‘With a view to market Swedish technology in new urban districts the strength of the vision is crucial. The specific prerequisites of the new urban district should be taken in account choosing technical systems and infrastructure. The choice of technology and solutions should reflect the technology of the future and urban planning. It is important to connect the technology and infrastructure, in the new urban district, with already existing systems in the city. This applies both to infrastructural systems such as public transportation and boat traffic, and local energy systems’ and: ‘A new Hammarby Model should be created in new urban districts, possible also to connect to alternative technologies as wind and sun.’ and also: ‘A new centre for environmental information and communication (GlashusEtt ed.) should be established in new districts, with the view to support a systematic marketing of knowledge of system technology, environmental technology and urban district planning in Stockholm. The centre should also inform and support the residents influencing their environmental behaviour.’ (Pandis & Brandt, 2009)
Värtan Frihamnen

The recommendations of KTH shows that Hammarby Sjöstad has put sustainable urbanism on the map. However, for implementing the methods of the Hammarby Model to other districts, some adoptions has to be made in terms of context and program. This is strengthened by the ideas of Jenks Williams and Burton. They argued that it is important to look for a number of sustainable forms which respond to a variety of existing settlement patterns and contexts. (Jenks et al., 1996, p.345) So, every situation is different and needs therefore its own ‘model’. But how could the ‘model’ for Värtan Frihamnen look like? Next to the implementation of the sustainable ideas of the Hammarby model, the Frihamnen model could add other issues that will influence the level of sustainability of the area. These additions can be found in recommendations in four themes. Namely: lowering the emissions of cruise ships and ferries in the area, eco friendly energy generation, spatial conditions & program and infrastructure. (figure 23a)
Cruise ships and ferries
The Frihamnen model can only be successful if it includes the ferries and cruise ships that are anchoring in the area. These ships contribute considerably to the total emissions of the area. By putting them in the model, the shipping companies will become part of the ‘model’ and could (or should) cooperate with the other stakeholders to find solutions for the reduction of waste, energy use and sewage. The sewage of the ferries and cruise ships can for instance be used for making biogas for heating the neighbourhood or as fuel for buses. The area itself could also deliver its sewage to this system, which makes the investment more profitable. (figure 22)

Eco friendly energy
The use of environmentally friendly energy in Hammarby Sjöstad was initially not implemented in the Hammarby Model. This has changed during the building process, but could not prevent a relatively low use of these kind of energy resources. To prevent this situation for the Värtan Frihamnen area, the model contains environmentally friendly energy resources like wind, water and sun. (figure 23a) Although the use of wind- and water power is present in the model, this does not mean that the generation of this energy should take place within the district. It is better to locate it where these systems will generate the most energy. The use of sun power for energy and heating however can be used in the district itself as well as a system that use the water of the harbour for saving energy for cooling the buildings in the area. Although energy saving and eco friendly energy are important, they should not contradict with the quality of the architecture of the buildings or the liveability in the buildings. Focussing too much on energy savings could also lead to an urban plan that could function perfectly in terms of energy use, but fails in social coherence, flexibility and liveability. A balanced mixture between the different elements is therefore recommended.

Spatial conditions and program
A proved urban design, building in high density, but with access to green and water are the main principals for the design of Värtan Frihamnen. Next to that, a diverse and flexible program and the use of renewable materials are important as well. All these principals are part of the Frihamnen model because they could have the opportunity to contribute to this model in a positive way. The biggest contribution towards a sustainable neighbourhood could be the investment in brownfields close to the city centre, like Hammarby Sjöstad and Värtan Frihamnen. Not only for the area itself, but it could also influence the existing neighbourhoods around it. The attractiveness of the new area could work as a starting point for further sustainable development in the surrounded neighbourhoods. They can profit from the better public transport network of the redeveloped brownfield. Which will lead to new investments in for instance renovation of old buildings, with as result lower emissions for a bigger area as the brownfield itself and a better social coherence between the brownfield and its surrounding.
FRIHAMNEN MODEL

RELATIONS BETWEEN ELEMENTS IN THE MODEL
Infrastructure

Stimulating public transport as main transportation device for the residents of the area, could result in lower car use, as the evaluation of Hammarby Sjöstad showed us. It also give surrounded neighbourhoods better access to public transport and can improve the network on city scale. As proven in the Hammarby project, walking and cycling can become interesting options to lower car-use. Värtan Frihamnen can score even higher percentages by stimulating cycling as connector between the inner city and the project area. Optimal connections between Värtan Frihamnen and the National Stadsparken can stimulate recreational cycling, running and walking.

Relations between the elements in the model

The Frihamnen model does not only show the elements that are needed to come to a more sustainable urban plan for Värtan Frihamnen, it also shows the relation between these elements. An example of this is visualized in figure 23b. This figure shows the relation between the ferry, the light rail, high density and water cooling.

This relation starts with the growing amount of passengers of the cruise ships and ferries. Because of that, better public transport to the city centre is needed. A new light rail could be a solution to solve this problem, but the amount of passengers will not be enough to make this investment profitable. Building with a higher density on the brownfield could create these circumstances. Simultaneously with this development, the passengers of the cruise ships and ferries will give an impulse for a faster development of the light rail which will have a positive effect on the duration of the development of the brownfield. By building with a higher density, caused by the light rail and other circumstances, a cooling unit can be built. This unit could use the water from the harbour for cooling offices and dwellings, which will create lower energy consumption for the area. With other words, all the elements are profiting from each other.
This chapter shows the design proposal for Värtan Frihamnen. (figure 24) It will address the ferry and cruise terminal, the public transport network and the industrial heritage of the area. After this, the urban plan and the proposed building blocks will be explained. All the themes will be supported with case studies or theory as background for the design proposal. The chapter will end with urban rules and program, to keep control during the design and building process of the project.
The ferry and cruise terminal of Värtan Frihamnen is an important gate between Stockholm and the Baltic Sea region. (figure 25) However, in the current situation the terminal does not contribute to its direct surrounding. Passengers from the ferry and cruise ships have to walk through an industrial zone to reach the subway station (Gärdet). The whole area does not have the appearance of an important entrance of the city. New developments in terms of public transport and program can improve this. It could create that passengers will stay longer around the ferry and cruise terminals with as result a more lively area.
**Ferry terminal**

During 2008 there were 28 million passengers travelling to, from and within Sweden by ferry. Of these, 40 percent travelled via one of Stockholm’s ports, which collectively annually have approximately 11 million passengers passing through. Värtan Frihamnen is the biggest port for ferries and welcomed next to travellers who do not have Stockholm as end point, 1.9 million tourists that will visit the city. (Schubert, 2009) Interesting to know is what all these passengers contribute to the city in terms of hotel bookings, employment and what they spent during their trip. Recent research of Stockholms Hamnar (Schubert, 2009) shows this ferry passengers’ contribution to Stockholm. A survey of just over 1000 ferry passengers who visited Stockholm in conjunction with their voyage. The target group for the survey was travellers over 15 years of age, who in connection with their ferry trip spent two hours or more in the county of Stockholm, but who are not resident in the region. The results show that:

- The contribution of ferry travellers visiting Stockholm, by direct spending in the county of Stockholm, was just over 5.1 thousand million Swedish crowns – an increase of 76 percent since 2004-2005.
- Each visitor spent an average of approximately SEK 2630 (265 euro) per visit – an increase of 110 percent since 2004-2005.
- Each individual visitor spent an average of 2.3 days in Stockholm.
- SEK 5.1 thousand million equates to 23 percent of the entire financial turnover from visitors to the county of Stockholm.
- The spending by visitors to Stockholm generated 4200 annual full-time employment equivalents in the county of Stockholm.

- The ferry travellers visiting Stockholm occupied approximately 345 000 hotel rooms per year, which constitutes 12 percent of hotel room bookings in the county. This equates to 1000 hotel rooms each day, or 7 fully-booked hotels every day of the year.

These numbers show the importance of the ferry terminal for Stockholm’s economy. Värtan Frihamnen however doesn’t profit so much from this. This could change in the future, due to the growing amount of passengers since the expected growth on ferries in the Baltic Sea is high. The connection between Stockholm and the Baltic States for instance will increase between 15 and 42 percent the coming years. (Schubert, 2009) This growth will also influence the port area. It will be more busy, especially around peak hours. The maximum capacity of most of the ferries is around 2800 passengers. (Schubert, 2009) All these passengers have to find their way to accommodations in the city. Because of this growth, a new ferry terminal will be developed. *(figures 26,27,28)* The concept behind this new terminal is to interweave it with the city. This will create possibilities to connect other facilities like for instance restaurants and hotels to it.
Figure 27. Current amount of space needed for ferries and cruise ships.
Figure 28. Amount of space needed for ferry and cruise ships after completion of the new ferry terminal.
Cruise ship terminal

Stockholm is among the four largest cruise destinations in the Baltic Sea Region when it comes to number of calls, turnarounds and passengers together with St Petersburg, Copenhagen and Tallinn. Furthermore, the Baltic Sea Region is the fastest growing cruise market in the World and there is great potential for continued growth. (Stockholm visitors board, 2012) The impact of cruise passengers on the economy of Stockholm is considerable. In 2011, cruise passengers spent SEK 500 million (56 million euro) in Stockholm. Most of the passengers went sightseeing (62%) and/or shopping. A transit passengers spends an average of 7.6 hours in the city and spend an average of €100,- per person. A turnaround passenger (which is most interesting from an economic point of view) spends an average of over €250,- per person. (Stockholm visitors board, 2012)

As shown above, cruise ships have a big impact for Stockholm and its economy. In the future this impact could be even higher due to new, larger cruise ships which will increase the number of passengers visiting Stockholm annually. Over the last ten years, since 2001, Stockholm has experienced a growth in the number of port calls with close to 40 % and 170 % when it comes to number of passengers. The number of turnarounds has increased with close to 65 % and the number of Turnaround passengers with 175 %. (Stockholm visitors board, 2012) (figure 30) All these passengers would like to see Gamla Stan (the old city). Because there is no descent public transport from Värtan Frihamnen to the old city, touring cars have to bring the passengers. (figure 29) Besides that this is not environmentally friendly, it causes a lot of logistic problems in the old city. If we look for in-

stance to the amount of cruise ships that will anchors in Värtan Frihamnen between the 6th and the 13th of August 2012, (figure 31) we see that if the ships are full, 16.300 passengers could have the intention to go to Gamla Stan. (Stockholmshammar, 2012) This means that over 300 touring cars are needed to achieve this. Better public transport between the terminals and the city could solve this problem.

<table>
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<tr>
<th>Year</th>
<th>Number of calls</th>
<th>Number of passengers</th>
<th>Number of turn arounds</th>
<th>Number of passengers</th>
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<td>128</td>
<td>82 000</td>
<td>21</td>
<td>6 000</td>
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<td>1997</td>
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<tr>
<td>2012</td>
<td>276</td>
<td>480 000</td>
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Amount of cruise ships and passengers anchoring between 6 and 13 August

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<th>Cruise Ship</th>
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<td>2500</td>
</tr>
<tr>
<td>Quest for Adventure</td>
<td>440</td>
</tr>
<tr>
<td>Empress</td>
<td>1850</td>
</tr>
<tr>
<td>Costa fortune</td>
<td>2700</td>
</tr>
<tr>
<td>Marco Polo</td>
<td>820</td>
</tr>
<tr>
<td>Seven Seas Voyager</td>
<td>700</td>
</tr>
<tr>
<td>Aidasol</td>
<td>2200</td>
</tr>
<tr>
<td>Costa Pacifica</td>
<td>3700</td>
</tr>
<tr>
<td>Seabourn Sojourn</td>
<td>460</td>
</tr>
<tr>
<td>Crystal Symphony</td>
<td>920</td>
</tr>
</tbody>
</table>
*Uppdelning per linje redovisas i tabellbilagan, sid xx
Källa: ATR/MTS.
public transport

Stockholm’s metro network (Tunnelbanan) opened in 1950. It consist out of 106 kilometres of metro lines and 100 stations. Every day 1.1 million traffic movements are counted. The expected growth of citizens, from 830.000 in 2010 up to 1.000.000 in 2030 (CITY OF STOCKHOLM 2007) shows the need for further development of the infrastructure of the city. The decision of the municipality of Stockholm to accommodate more inhabitants around the city core leads to possibilities to strengthen the public transport network. This could contribute to a more sustainable way of transportation within the city.

In order to achieve this goal, the current public transport network needs to be updated, especially between T centralen and Slussen which covers the center of Stockholm called Gamla Stan (old town) Due to the historical growth of Stockholm in North and South direction, this part forms a bottle neck between the two parts of the city. And because there are no direct connections between the East and the West, passengers are forced to switch on T centralen or Slussen, to go to another part of the city. This gives a lot of problems during peak hours. (figures 32,33)

To solve this problem, the municipality of Stockholm introduced a new kind of transportation network called “tvårbanan” (crossways line in English). This new line connects the South-East and the South-West part of the city with each other. (see the orange line in figure 24) Every day over 50.000 passengers are using this line. (Veolia, 2010)

Because of the success of this part, a second line between Alvik and Solna -the second city in the region- has been introduced. It will be ready in 2013.

This North – South connection has the function of lowering the amount of people that has to travel through the centre to go from North to South. To respond on this development, a similar action can be taken in the North-East direction. (figure 36)
Tunnelbanan
Tvärbanan
Light Rail Lines
Suburban Railways
Figure 36. Proposed network
Figure 37. Proposed network Värtahamnen
The Tvärbanan line Solna – Loudden

The Vårta Frihamnen area and in particular the Gärdet metro station, has the opportunity to become an important ‘hub’ in the public transport network of Stockholm region. It could connect the local, national and international network with each other. In order to achieve this goal, many investments has to be made.

As mentioned before, and visible in figure 37 a new North-East connection can complete the Tvärbanan network. It will not only connect Vårta Frihamnen with the rest of the city, it also connects different facilities with each other. The new line could connect sport, health care, business, recreation, innovation and education with each other. Next to that, it connects all the important rail-, bus- and metro lines in the North with each other.

For Vårta Frihamnen, the new Tvärbanan line means a perfect connection between the Baltic sea region and the local and national public transport network, as shown in figure 35 & 36. A big part of this new line can be constructed on the existing infrastructure of a former train line. This line, including bridges and tunnels was needed to transport goods from the harbour to the national rail-network. Since these kind of harbour activities will move to other parts of the city, the line is not needed anymore, and is therefore free to use – after adaption- as part of the Tvärbanan line.

The line Ropsten - Centre

Next to the extension of the Tvärbanan line in East direction, a second line can be introduced. This line will connect the centre of Stockholm with Ropsten. (figure 36 & 37 purple line) Together with Tvärbanan, it will function as the backbone for the developments in and around Vårta Frihamnen. This new line will have a totally different character as the metro line adjacent to it. It will function as a connector between the centre and the green area just outside the centre. Besides that it connects many -mainly cultural- facilities with each other. Like for instance the theatre, the media park, modern art museums, the dance academy and at the end of the line, the new cultural developments in the former gas factory.

Both lines will connect the ferry and cruise terminals with the public transport network of Stockholm in order to create a more sustainable solution for the growing amount of passengers. (figure 30) This will reduce the amount of touring cars between Vårta Frihamnen and Gamla Stan. The cruise and ferry terminals can be seen as a boost to develop both lines. They will create a more or less constant supply of potential travellers for the Tvärbanan.
Figure 38. Characteristic buildings in the new urban fabric.
Värtan Frihamnen has many characteristic buildings. The harbour is well known for its Magasins (warehouses) from different ages. The first one, Magasin 1 was built in 1918. The last one in 1962. The Magasins are part of the history of Värtan Frihamnen and therefore interesting to preserve. Although the Magasins were built for storage, many buildings have large windows which makes them suitable for other functions. This could be the explanation why many of the warehouses have found new users. This started in 1979 when the Stockholm City Museum moved their central warehouse to Magasin 1 and 2. Later on, companies, archives and the Stockholm Konsthall have found their place in the warehouses. (figures 39 - 46)

Although this can be seen as a success, there are still vacant floors in the buildings. But with the development of the harbour into a working and living environment these characteristic buildings have a huge potential to become the main spots in the urban plan. The design proposal would like to give them a special place in the urban fabric. (figure 38)

The current program in some magasins will form good basis for further development. For some other magasins new program is needed:

- Magasin 1 locates in the current situation a car dealer, but it has the potential -due to its location as kink in the main axis of the area - to become an important building like for instance a kulturhuset. (house of culture)
- Magasin 2 will keep the function as terminal, but instead of ferries, cruise ships will anchor next to the building.
- Magasin 3 will keep its current function as Stockholm’s Konsthall and archive.
- Magasin 5 will keep its current function as office centre, but it has the potential to locate shops on the ground floor. In cooperation with the Konsthall and the waterpark it could also have a cultural function.
- Magasin 6 functions as an archive, but most of the building is vacant. Because of the future situation, it has the potential to become a new cruise terminal with on top offices, student housing and apartments.
- Magasin 10 will keep its current function as office building.
- The Banan Kompaniet building is in use by the importer of bananas for the Scandinavian market. Because the harbour will move in the future, this building can be used as lightrail station and has the potential to accommodate the GlashusEtt, a center for environmental information and communication. With this building, the GlashusEtt gets an important place in the new neighbourhood. It will not only profit from the lightrail station, the building will also function as meeting place for residents and tourists to inform them about how to reduce their energy consumption.

The function of the grain silo will move in the future to a new harbour. Although the silo looks impressive, it will be hard to find program for it due to its massive concrete construction and relatively small diameter. Possibilities are a climbing hall, a dive center or as viewpoint.
1. MAGASIN 1    current use: car dealer
2. MAGASIN 2    current use: ferry terminal
3. MAGASIN 3    current use: art center / archive
4. MAGASIN 5    current use: offices
5. MAGASIN 6    current use: archive / vacant
6. MAGASIN 10   current use: offices
7. BANAN KOMPANIET current use: storage
8. GRAIN SILO   current use: grain
3. MAGASIN 3

5. MAGASIN 6

7. BANAN KOMPANIET
Figure 47. Sluseholmen Copenhagen

Figure 48. The ‘Gouden Bocht’ Amsterdam

Figure 49. Orestad, Copenhagen

Figure 50. IJburglaan, Amsterdam
The character of Värtan Frihamnen is twofold. Broad views over the water are in contrast with the direct relation with nature in the National Stadsparken. These characteristics are the principals of the urban design. The broad view over the water forms the basis for a more formal ‘front side’ of the area. The broad boulevards alongside the water are creating perfect circumstances for walking and cycling. Tall buildings along the boulevard are placed side by side with narrow streets in between. This will give the boulevard a formal appearance but it also function as wind protection for the area behind. *(figure 52)* The boulevard around Gamla Stan, the old city centre of Stockholm shows a similar appearance. *(figure 51)*

The relation between site and the National Stadsparken creates a more informal character and is therefore more the ‘backside’ of the plan. This does not mean that this part of the area is less important. It creates opportunities of less strict rules within the urban blocks, which could create interesting solutions for living close to nature. The area has also the potential to become the connector between Värtan Frihamnen and the National Stadsparken. This connection is in its current situation insufficient because a road divides nature and harbour from each other.

The two characters of the site are part of a new urban fabric for Värtan Frihamnen. This fabric consist of traditional urban blocks with streets of different importance. The plan is roughly based on a grid of 90 x 100 meters and is shaped by the site and its surrounding. The main element of the design is an avenue which connects all the different parts of the plan with each other. This avenue is the main route for car and light rail and will have an urban character, with a wide variety of shops, culture and other functions. Characteristic buildings that refer to the history of the harbour are highlighted by giving them a position as important end of a street or to create more space around them. *(figure 38)* The curves in the avenue adding intimacy, curiosity and human scale to it and announcing a transition of the character of the street. *(figure 53)*

Good references of curved streets can be found in historic European city centres, like the painting of ‘de gouden bocht’ in Amsterdam by Gerrit Berckheijde illustrates. Sjoerd Soeters Sydhavn in Copenhagen is a more contemporary example. *(figures 47,48)*

Both references show that by bending a grid, the functionality of the rational grid is still present, but at the same time the curve add an extra dimension to the street, which is in my opinion sometimes missing in contemporary new districts like IJburg in Amsterdam and Orestad in Copenhagen. *(figures 49,50)*
figure 52. wind protection
Figure 53. Views

- Urban landscape view
- Water landscape view
- Green landscape view

Legend:
- Orange arrows: Urban landscape view
- Blue arrows: Water landscape view
- Green arrows: Green landscape view

TV tower
Figure 54. Tvärbanan, the connection between terminal and city centre
Figure 55. Main routes
The waterpark

The move of the ferries to the new terminal creates possibilities to develop the peninsula of the project area. The peninsula has a huge potential to become an extra value for the area. It has a 800 meters quay on the South side, which makes it an excellent place for restaurants, terraces, and outdoor recreation. Besides that it has some characteristic buildings and cranes, which could have a special place alongside the quay. In order to achieve this goal, some interventions have to be made. (figures 57 - 62)

The first step to make the area suitable for living is to create a better water quality. Because in the current situation the harbour is a dead end without good water circulation. By digging two canals trough the peninsula, a circulation of water occurs. This will contribute to a better bio diversity in the area. (figure 58)

The position of the cruise terminals creates a fragmented area for further development. Moving the terminals is not an option. All infrastructure for the cruise ships is present on these locations and it will take time and money to move them. It is better to use them as a boost for the further developments on the peninsula. By making a dam with bridges between the peninsula and the mainland, the cruise terminal will have better connections with the light rail. This connection creates also possibilities to develop the fragmented areas and to give them access to the public transport network of Stockholm. (figure 61)

To achieve more interaction between the narrow strip along the South quay and the mainland, more connections has to be made. This can be done by adding two islands in the middle of the harbour. (figure 56, 62) The concept behind these islands derived from several point of views:

- The character of the harbour with its quays, straight lines, hard edges and open spaces must be preserved because these characteristics are part of the history of the area. But this does not mean that they are the best ingredients for creating a good living and working environment. However, this can be achieved by preserving the existing elements and adding new elements to the area. By creating interventions with contrast between them, it will be clear what the original elements are and which are new. A good example of such intervention could be the hard edges of the existing quays versus the soft lines of the new sandy islands.

- In many redeveloped harbours in Europe the hard quays a forming a barrier for new activities along the water. Residents who live in these kind of areas have most of the time a good view over the water, but it is very hard for them to make real contact with it. The islands in the harbour makes it possible to do this. They create possibilities for enjoying the water on a different kind of manner, like swimming in summertime or ice skating in wintertime.
figure 57. South oriented quay

figure 58. Water circulation for more biodiversity

figure 60. What to do with the left over area?

figure 61. Connecting the area with the main land bridges and a dike
• The program of the islands can add extra value to the program of the area. *(figure 76)* Together with the surrounded water, the islands can become part of a waterpark that has good connections with the National Stadsparken, which is in the current situation not present. *(figures 63 and 64)* The waterpark can attract not only residents from the neighbourhood itself, but could also be a good place for tourists and inhabitants of Stockholm. The program should be adapted to this goal. The Konsthall in Magasin 3 for instance could enlarge its activities by a sculpture garden on the islands. Other cultural institutions who have plans to establish themselves in the area could do the same. The islands could also accommodate nature, beaches, pavilions or they could function as festival area and have the opportunity to become the connector between the different institutions and functions alongside the quays.
museum / castle / amusement park
nature / outdoor life
cafe / restaurant

figure 63. harbour facing the water
figure 64. interweaving the area with the park
The two different characters of the site, - water and green – has found their place on both sides of the area. To create a better connection between the build environment, the green and the water, canals and green areas are interweaving the area. They create easy access to the broad view over the water or the woods in the park. *(figure 65)* This is done in a way that when you cycle along the main avenue you will never see them at the same time. It avoids the predictability of the rational grid and create circumstances for exploring the area.

The relation between build environment, water and green is also visible on smaller scale. Almost every block has a connection with both elements. This create multiple possibilities of filling in the block, which is the aim of this composition. Architects can find their own solutions within the block to create interesting living environments. By formulating restrictions it is possible to keep control during this process. A study of three comparable building blocks forms the basis of these restrictions.
Java Eiland

project: Java Eiland
architect: Soeters van Eldonk

floor space: 45455.m²
block: 20770.m²

built: 6729.m² (32%)
public courtyard: 5215.m² (25%)
public space around the building: 8216.m² (40%)
private gardens: 610.m² (3%)

GSI 0.35
FSI 2.22
OSR 0.29
L 6.30
Hammarby Sjostad

project:     block 55
architect:     White arkitekter

floor space:     27500.m2
block:      12000.m2

built:      4360.m2 (36%)
public courtyard:     2820.m2 (24%)
public space around the building:        4820.m2 (40%)
private gardens:       -

GSI  0.36  
FSI  2.29  
OSR  0.27  
L    6.30
Zijgevel
93,5% gesloten gevel

Gevel aan het groen
72% gesloten gevel

Gevel aan de hoofdstraat
100% gesloten gevel

Open gesloten gevel / aantal lagen
9L 6L 6L 6L 4L

90 meter

Doorsnede 1
Doorsnede 2
Doorsnede 3
Doorsnede 4

Hoofdstraat 1.66 / 1.3 (b/h)
Zijstraat variabel 0.85 /1.3 (b/h)

Groen 3.08 / 2.05 (b/h)
Binnenplein 1.08 / 0.72 (b/h)

Routing auto naar parkeergarages

P = parkeergarage

Routing voetganger

Doorsnede 1
Doorsnede 2
Doorsnede 3
Doorsnede 4
IJburg

project: block 11B
architect: KCAP e.a.

floor space: 15681.m2
block: 12500.m2

built: 3847.m2 = (30%)
public courtyard: 2820.m2 = (32%)
public space around the building: 4052.m2 = (23%)
private gardens: 1781.m2 = (15%)

GSI 0.30
FSI 1.25
OSR 0.55
L 4.07
OPEN GESLOTEN GEVEL / AANTAL LAGEN

- WATER ZIJDE
  - 78% gesloten gevel

- GEVEL AAN HET GROEN
  - 100% gesloten gevel

- ZIJGEVEL
  - 93.5% gesloten gevel

GEVEL AAN DE HOOFDSTRAAT
- 100% gesloten gevel

OPEN GESLOTEN GEVEL / AANTAL LAGEN

- doorsnede 1
  - 13 m
  - 23 m
  - zijstraat 1,75 (b/h)

- doorsnede 2
  - 21 m
  - 9 m
  - 13 m
  - 16 m
  - 10 m
  - 18 m
  - 10 m
  - 17 m
  - 10 m
  - 15 m
  - 45 m
  - zijstraat 1,6 (b/h)

- privé 1,23 (b/h)

- binnenplaats 1,38 (b/h)

- privé 0,64 (b/h)

- hoofdstraat van habel, 2,65 (b/h)

PROFIELLEN

P. = parkeergarage

ROUTING AUTO NAAR PARKEERGARAGES
Figure 68. Profile main avenue

Figure 69. Profile side street

Figure 70. Routing and parking car
Case study

IJburg block 11B in Amsterdam, Hammarby Sjöstad block 55 in Stockholm and Java Eiland in Amsterdam are interesting references that show the possibilities and potentials of the future building blocks of Värtan Frihamnen. Although not very common in Stockholm, IJburg block 11b shows the possibility of creating private gardens in the block. Besides that, it has an almost equal division of building mass in the whole block. The relatively low building height makes the block also suitable for family houses. A more calm environment along the National stadsparken could fit this block very well.

The Hammarby Sjöstad block however is a perfect block along the main avenue. The situation of the block is almost the same as it could be in the Värtan Frihamnen area. It could have an eight level high volume along the main street which could contain shops, offices and apartments. The back side of the block consist of ‘urban villas’ which are suitable alongside the green fingers of the park. (figure 71) The block has a public courtyard and is accessible from three sides of the block. The entrances of the apartments are also located in the middle of the block through which safety in the block is guaranteed.

The Java Eiland block fits in the idea of the formal waterfront. The eight storey high volumes are in line with the openness of the area and the size of the ferries and cruise ships. The waterfront of Värtan Frihamnen allows even higher volumes up to ten or more levels on condition that this will be occasionally. Both sides of the Java block are located along a canal. This is more or less the same situation as in Värtan Frihamnen. The routing to the indoor parking garage could be similar too. (figures 68,69,70)
As a result of the study of these three projects, some urban rules can be made for the blocks of Värtan Frihamnen. The building height within the project should be adapted to its situation. This means up to ten levels alongside the waterfront, eight levels alongside the main avenue and a maximum of six levels alongside the National Stadsparken. The side streets could have different building heights up to four levels. These are general restrictions. Acceptations can be made in several areas of the project which are illustrated in (figure 72).

Open and closed facades
Another result of the study is the amount of open and closed facades of the building blocks. If we compare the three projects with the Värtan Frihamnen area it is possible to come up with some restrictions. The aim of these restrictions is to create public accessible courtyards and the possibility for the inhabitants of the block to enjoy water as well as green. The amount of closed facades in percentages of the total façade (figure 75) will force architects to think about how to design the footprint of the block. Even if they use the highest percentages, they have to create for instance an public connection between the canal side and the courtyard, or connections between the courtyard and the park. It is not important where this connection will be in the façade, due to the fact that the main grid guarantees the possibility to walk from one courtyard to another.
Amount of dwellings and commercial area

If we take all these restrictions into account, it is possible to calculate the amount of dwellings that could be built on the site. The total building site of the project is 78 hectares. With an average of 6 levels it will create a Ground Space Index (gsi) of 0.33, a Floor Space Index (fsi) of 2.0 and an Open Space Ratio (osr) of 0.32, which is more or less comparable with Hammarby Sjöstad and Java Eiland.

The whole area could contain in this case around 11,000 apartments based on a standard apartment of 100m². This number is without the space for commercial area (offices, retail etc). A small part of this program can be located in existing buildings, but there will be a need for more square meters.

The municipality of Stockholm calculated for Royal Seaport 600,000 m² commercial area. (Stockholm Royal Seaport) (figure 73) If we take this as reference, the amount of apartments will drop to 6,800. However, the question is if there is still a need for so much square meters of retail and offices.

New communication tools like internet, laptops and smartphones give employees the opportunity to work wherever they want. This could influence the amount of office space that is needed. Besides that, it is plausible that selling goods via internet will become more popular, which will influence the total amount of shops in the area as well. Developing buildings that could contain a flexible program can be a solution for this question. (figure 74) These buildings can contain offices, retail or apartments according to the requirements in the future. To come to a calculation of the total amount of inhabitants in Värtan Frihamnen in the future, it is necessary to come up with some presumptions for the future.

So let’s say that half of this 600,000 m² program will be built in buildings that could have a flexible program; and that 70% of this 300,000 m² will be used as dwelling, 1700 apartments will be add to the dwelling program. This means a total amount of 8500 dwellings in the Värtan Frihamnen area. A standard apartment in Hammarby Sjöstad has an average of 2.27 inhabitants. (Urbed, 2011) Hammarby Sjöstad has a similar density and target group as the project area which makes it plausible that Värtan Frihamnen could have around 20,000 inhabitants in 2030.
CANAL FACADE
max. 4 levels
minimum open facade 1%
maximum open facade 5%

PARK FACADE
max. 6 levels
minimum open facade 20%
maximum open facade 40%

SIDE FACADE
max. 6 levels
minimum open facade 5%
maximum open facade 20%

MAIN FACADE
max. 8 levels
minimum open facade 0%
maximum open facade 1%

WATER FRONT FACADE
max. 10 levels
minimum open facade 0%
maximum open facade 5%

< figure 75. amount of closed facades
figure 76. the program of the design proposal
Figure 77. Current program that will fit in the new urban plan.
The intention of the urban design is to create a district with a diverse program and high flexibility. *(figure 76)* The current program of Värtan Frihamnen fulfils already a part of this intention. It has a couple of functions that could fit very well after the redevelopment of the area. *(figure 77)* They can function as boost for further development in the area. Especially the old warehouses can play a role in that respect. *(figure 82)*

The potential program of the urban design is based on this current program. *(figure 78)* Next to that it indicates potential places for offices, retail, culture and horeca. These places are chosen for their accessibility (for instance: the offices), potential target group (example: shops around the light rail stations), view (restaurants and terraces) or industrial heritage (culture). All these places together could create a network *(figure 79)*. Along the connections of this network, new program could emerge. To stimulate this development, buildings that have a flexible floorplan, especially on the ground floor, are needed. They are crucial elements for the success of a diverse and flexible network of functions. The light rail and main road DNA *(figures 80, 81)* are showing the effect of this network of functions. Together with views over water and green, they create diversity along the main routes of the area.
Figure 78. Potential program
<figure 79. potential grow directions of the program>
main route DNA

- **green**
- **water**
- **residential**
- **office / flexible space**
- **retail**
- **culture**

*figure 81. main route DNA*
PHASING

The municipality of Stockholm made a ‘vision 2030’ for the Värtan Frihamnen area. (city of Stockholm, 2007) The idea of this vision is to redevelop the harbour into a working- and living environment which should be finished within 20 years. This is fast, but there are some reasons why the project could be realized in this short period. First, the success of Hammarby Sjöstad, shows that living close to the city centre of Stockholm became very popular the last decades. This is also proved by Guinchard in his book ‘Swedish planning; towards sustainable development’. Next to that, there is a housing shortage in Stockholm (statistics Sweden, 2007) and finally, the economical crisis did not influenced the Swedish economy much. These three reasons gave the municipality of Stockholm the confidence that Värtan Frihamnen will be a success. But what if the economical crisis will influence the Swedish economy as well? In that case it is important to have several scenarios for developing the area. This part of the report will show two of them. First a scenario (A)that is in line with the planning of the municipality. (figure 83) Secondly an alternative scenario (B) which will show the crucial elements that will create a base for further development. (figure 84)

Both scenarios will be influenced by three interventions that will proceed in any case. The first intervention is the relocation of the ferry terminals from the peninsula and the main land to the new terminal in the North of the area. The second one is the relocation of the container terminal to a new harbour called Norvikudden in the South of Stockholm. Only when these terminals are relocated, a big part of the harbour is ready for further development. Another crucial intervention which could influence the success of the process will be the relocation of the oil depot to Norvikudden. After this relocation, the soil of this area should be cleaned before the re-development of this part of the project can start.

Tvärbanan

The development of the light rail (Tvärbanan) between the city centre and the ferry- and cruise terminals is an important element for scenario A as well as for scenario B. Without this line, development in this part of the city will not be possible in a sustainable way. It also will not give a proper solution for the growing amount of passengers from the cruise and ferry terminals to the city centre. These terminals will provide in an early state of the development of the area passengers for the line and it is therefore important to start and invest as soon as possible in this connection. The first part of this line could be the connection between the city centre and Ropsten, a newly built neighbourhood with all kind of cultural facilities. The light rail creates circumstances for development along the line. During this development, a new line between Solna and Loudden, (which is the South part of the area) could complete the public transport network. This light rail will connect several potential areas in the North of Stockholm with each other. The success of this line and the urgency for development in this early stage will depend on the success of the other areas and is therefore a more unstable factor then the Centre – Ropsten line and is therefore not implemented in scenario B.
Development of the area, scenario A

Like the calculation on page 77 shows, the design proposal will include 8500 apartments. These apartments could be built within the planned 20 years and will reduce the housing shortage in Stockholm in the coming decades. Although new developments like Hammarby Sjöstad reduced the housing shortage in recent years, there is still a major need for housing for people with limited finances and for housing in attractive locations. One indication of this is that over 100,000 residents of the City of Stockholm are in the housing service queue, although the majority of these already have accommodation of some sort. (city of Stockholm, 2007) Forecasts of the city of Stockholm suggest an average growth of the future population around 7,000 per year to 2030. This suggest that demand for housing will remain high. According to these forecasts, there will be a need for around 70,000 new homes by 2030, with an estimated of 3,000 – 4,000 new homes per year. (city of Stockholm, 2007) The contribution of Värtan Frihamnen to this number is around 500 dwellings per year over a period of 20 years. This contribution will split up in three phases:

The first phase of the project will consist of a mixed-use program with offices, dwellings and facilities for the future inhabitants of the area and for the surrounded neighbourhood. This neighbourhood doesn’t have so many facilities in the current situation, because of the isolated position to the city centre and the low amount of inhabitants. However, together with the ferry terminal and phase 1 of the Värtan Frihamnen project, the neighbourhood can contribute to an area that is big enough to offer basic facilities to its inhabitants. This could speed up the starting process for facilities in the new neighbourhood. Another reason to start with this particular area is the considerable amount of vacant land, which makes it relatively easy to build in a short period of time. During phase 1, the new lightrail between Ropsten and the city centre can be constructed, to link the neighbourhood to the public transport network of Stockholm.
Figure 83. Phasing of scenario A
The second phase of the project consists of building the main facilities for the area, the waterpark with the islands and the buildings and facilities on the peninsula. The current warehouses will function as strategic elements to create a network of basic facilities for the fragmented neighbourhood. *(figure 82)* Vacant floors of the warehouses can be used as office space for contractors, shops or other facilities like education or a kulturhuset. Together they will be the first steps in the development of the main centre for the area. The construction of the new islands in the harbour and the development of the centre can be a long process due to the supply and demand of retailers and residents. During this process, temporary initiatives like festivals or flea markets on the vacant quays can put this area on the map as an interesting place to visit for people outside the area. During phase 2, the light rail connection between Solna and Loudden can be constructed. The first part of this line could function as a fast connection between the cruise terminal and the city centre. Later on, this line can connect the area with the Northern part of Stockholm.

The third phase of the development of Värtan Frihamnen will start after the relocation of the oil-depot to Norvikudden and the cleaning of the soil underneath the silos. The last part of the Tvärbanan from Solna to Loudden can be constructed to connect the area with the public transport network. The line will also make a connection with a new ferry to a brownfield in the Lindingö area. Due to the perfect connection via ferry and light rail, this area has the potential to develop itself at the same time as phase 3 from the Värtan Frihamnen project.
Development of the area, scenario B

Scenario B (figure 84) is an alternative for scenario A. It shows the crucial elements of the design for further development of the area. As said before, the light rail will be the main key for creating a sustainable developed neighbourhood. The direction of scenario B is more or less the same as in scenario A. Again, the new ferry terminal will be the start for the development. Next to that, the light rail will have an important role for connecting the area with the urban network of Stockholm. These two ingredients will guarantee a certain amount of attractiveness to invest in the area. These investments can be done in the area that has the most potential for development namely along the light rail line. The building blocks around this line can be developed separately from each other and like in scenario A, the old ware houses can locate the basic facilities for the growing neighbourhood. Because of the smaller area that will be developed, the total amount of inhabitants will be lower compared to scenario A. This will influence the amount of shops and other program. To come to a more balanced situation, the program should be adapted and more flexible buildings have to be build. Later on, these buildings can have other program, according to the growing amount of inhabitant of the whole neighbourhood.

Unlike scenario A, the light rail connection between Solna and Loudden does not exist in scenario B. This is because this line is too dependent from (re)developments in Northern Stockholm. Without this line, the South-East part of the plan will not have optimal connections with the urban network and will be less attractive for investments. So, after moving the oil-depot and the cleaning of the soil -which has to be done anyway- temporary program could be developed. To create a framework for this, the green structure of the initially design can be developed in the most basic way. The space between this structure can be used for festivals, a camping or as sport fields. Later on -when the light rail will be constructed- the original plan can be built as well as the water park and the buildings on the peninsula. Another option is by building with lower density and without the light rail. This can be done by building between the green structure step by step.

Summarized, both scenarios will create end products that contain diversity and flexibility in it. This is captured in urban rules in terms of spatial quality, infrastructure and sustainability and program. Scenario A shows this in a more positive economical situation. Scenario B on a more negative economical situation. Both scenarios are more or less the extremes of direction of development of the area. Depending on the economical situation, the actual end product will be between these two extremes.
CONCLUSION

Värtan Frihamnen has the potential to become an important node in Stockholm’s urban network. Its position to the city centre and the connection with the Baltic Sea creates conditions for improvements of the existing program of the harbour, namely the ferry and cruise terminals, as well as development of supporting new program. The main question of this graduation project will focus on these conditions:

*Which conditions are needed for the regeneration of Värtan Frihamnen into a sustainable neighbourhood that can contribute to a better East-entrance for the city in order to improve the urban network of Stockholm?*

This question is split up in three parts: the regeneration of Värtan Frihamnen in a sustainable neighbourhood, a better East-entrance for the city and the improvement of the urban network of Stockholm. These parts will explained separately in this conclusion:

The housing shortage in Stockholm can be solved by building in brownfields close to the city centre. It avoids urban sprawl, and will keep the city compact, which creates perfect circumstances for high quality public transport. Therefore, the redevelopment of brownfields will add the most value to a sustainable developed neighbourhood. Other conditions to come to a sustainable plan for Värtan Frihamnen are described in the ‘Frihamnen Model’. This model, which is an extension of the Hammarby Model does not only focus on environmental issues, but add infrastructure, the ferry and cruise ships, spatial conditions and program to it. By doing this, relations between the elements occurred and create circumstances to start with sustainable interventions with as result lower emissions in the area. Next to the Frihamnen model, the flexibility of the plan is proved by developing two scenarios, one with for a positive economical situation and one with a negative economical situation. The actual end product will be between these two extremes.

The new ferry terminal will create a better connection between the ferries and a new developed high way. As a result of that, more space for other developments occurs. This space can be used for program that could improve the connections with other countries around the Baltic Sea. Besides that, the space can also be used for locating the growing amount of passengers of the cruise ships by adding program like hotels, restaurant and cultural facilities to it. This could result in a longer stay of the passengers in and around the terminals. A new light rail will connect these terminals with Gamla Stan (the city centre) with as result a decrease of the amount of touring cars and reductions of emissions. Next to that, the light rail creates conditions for sustainable development alongside the line.

The light rail (tvärbanan) connects the Värtan Frihamnen area with the public transport network of Stockholm. It also improves this network by introducing more connections between the North and the South of Stockholm. This will change the public transport network from a monocentric into a polycentric network, which result in better connections throughout the city. Because of the introduction of the Tvärbanan, other brownfields around the city centre can be developed as well. Värtan Frihamnen has the potential to became an example for these new projects, like it had Hammarby Sjöstad as inspiration to be the next step in sustainable development.
BIBLIOGRAPHY

ALFREDSSON, B., WIMAN, J. Planning in Sweden


CITY OF STOCKHOLM (2010) “the walkable city.” The City Planning Administration, Stockholm


GUINCHARD, C. Swedish planning: Towards Sustainable Development


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