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## **Rewilding Sjølyst**

Transformation of an urban estuary

Maren-Anna Gilberg Nyjordet

Landscape Architecture

### INFORMATION

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## **REWILDING SJØLYST**

TRANSFORMATION OF AN URBAN ESTUARY

Maren-Anna Gilberg Nyjordet Master's thesis spring 2021 Faculty for Landscape and Society The Norwegian University of Life Sciences

"We don't own the planet Earth, we belong to it. And we must share it with our wildlife"

Steve Irwin

## PREFACE

This Master's thesis marks the completion of my Master's degree in Landscape Architecture. The thesis was written for the Institute of Landscape Architecture at the Norwegian University of Life Sciences and is weighted 30 ECTS.

## ABSTRACT

## SAMMENDRAG

Since the beginning of the 20th century, the coastline of the Inner Oslofjord has been dramatically changed to the degree that parts of the urban coast now can be described as "lost nature". At the same time, increased development and construction in the beach zone have led to limited public access to the beach zone.

This thesis has chosen the area of Sjølyst at Skøyen in Oslo as the case area. The river "Hoffselva" has its estuary at Sjølyst, but the current situation is that it feels neglected and not suited for biodiversity. Therefore, the primary goal of this thesis is to answer the following research question:

How can the area surrounding the estuary of Hoffselva be transformed into a robust ecosystem that contributes to increased biodiversity and at the same time facilitate human activity?

In addition, the thesis includes five sub-goals:

1. Strengthen biodiversity and green corridors/stepping stones through the dense, urban parts of Skøyen

2. Strengthen the connection between Skøyen and the fjord.

3. Create social meeting places that do not go to the detriment of point 1 and 2.

4. Acquire knowledge about ecosystems along the fjord, estuary and restoration of such ecosystems.

5. Improve the connection between ecosystems on land and in the fjord.

A document study reveals the need of rewilding to increase biological diversity and at the same time create a connection for people and fauna between the fjord and Skøyen. A case analysis shows which types of native species that can be reintroduced when transforming the area of Sjølyst to an estuary. The proposed design is the first proposal in this area, that the author of the thesis know of, that is a holistic design which combines the focus of native biological diversity and the needs and wishes of inhabitants of Skøyen.

Sub-goal number 2 is achieved by the an overall plan that suggests new connections between Skøyen and the fjord. These connections make Sjølyst a lot more available to the inhabitants of Skøyen. Further the detailed design proposal shows how the biological diversity can coexists with human recreation, which is the primary goal of the thesis. The rest of the sub-goals are also addressed by the detailed design proposal.

Siden begynnelsen av 1900-tallet har kystlinjen til Indre Oslofjord blitt dramatisk endret i den grad at deler av bykysten nå kan beskrives som "tapt natur". Samtidig har mer byutvikling og bygging i strandsonen ført til redusert offentlig tilgang til strandsonen. Denne oppgaven har valgt Sjølyst på Skøyen i Oslo som fokusområde. Hoffselva renner ut ved Sjølyst, men dagens situasjon gjør at den føles forsømt og ikke egnet for biologisk mangfold. Derfor er hovedmålet med denne oppgaven å svare på følgende problemstilling: Hvordan kan området rundt munningen av Hoffselva forvandles til et robust økosystem som bidrar til økt biologisk mangfold og samtidig tilbyr menneskelig aktivitet? I tillegg inneholder oppgaven fem delmål: 1. Styrke biologisk mangfold og grønne korridorer gjennom de tette, urbane delene av Skøyen

2. Styrke forbindelsen mellom Skøyen og fjorden.

Lag sosiale møteplasser som ikke går på bekostning av punkt 1 og 2.
Tilegne deg kunnskap om økosystemer langs fjorden, elvemunning og restaurering av slike økosystemer.

5. Forbedre forbindelsen mellom økosystemer på land og i fjorden.

Et dokumentstudie avdekker behovet for "rewilding" for å øke det biologiske mangfoldet og samtidig skape en forbindelse for mennesker og fauna mellom fjorden og Skøyen. En "case-analyse" viser hvilke typer innfødte arter som kan gjeninnføres ved å retransformere området på Sjølyst til elvemunning. Det foreslåtte designet er det første forslaget i dette området, som forfatteren av oppgaven kjenner til, der et helhetlig design kombinerer fokus på opprinnelig biologiske mangfold og behovene og ønskene til beboerne på Skøyen. Delmål nummer 2 oppnås ved en overordnet plan som foreslår nye forbindelser mellom Skøyen og fjorden. Disse forbindelsene gjør Sjølyst mye mer tilgjengelig for innbyggerne i Skøyen. Videre viser det detaljerte designforslaget hvordan biologiske mangfoldet kan eksistere sammen med menneskelig rekreasjon. Resten av delmålene er også behandlet i det detaljerte designforslaget.

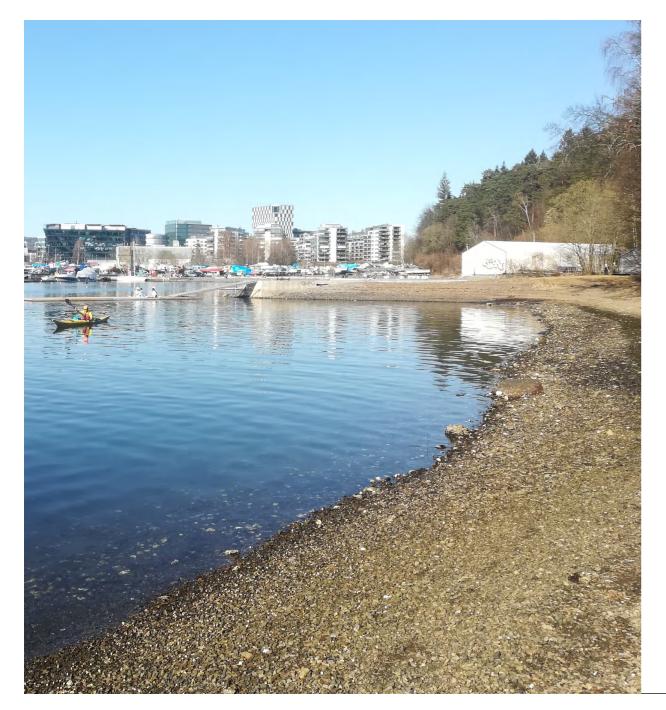
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# **01 INTRODUCTION**

INTRODUCTION TO THE CASE AREA SCOPE RESEARCH QUESTION AND GOALS METHOD STRUCTURE SCOPE THE ROLE OF THE LANDSCAPE ARCHITECT

## INTRODUCTION TO THE CASE AREA

### An overview

Since the beginning of the 20th century, the coastline of the Inner Oslofjord has been dramatically changed. Human activities such as reshaping, landfilling and pollution have led to that parts of the urban coast now can be described as "lost nature", both functionally and aesthetic (Rinde et al., 2019)

Skøyen is located in the Ullern District, western part of Oslo. Sjølyst is the part of Skøyen facing the water. This part of the fjord is known as Bestumkilen, the northernmost part of the Oslo Fjord. Hoffselva flows through the area and has its estuary at Sjølyst.

The area called Sjølyst is owned by the City of Oslo, and is the last large property along urban waterfront in this part of the city that is not yet developed. Today the property is used by a number of boat associations for boat storage, both on land and water. Hoffselva is one of few rivers in Oslo that actually has enough place to have a proper estuary, but today the river feels forgotten and neglected.

If Skøyen is to be developed into an even more attractive residential area, the coastline and the connection to the fjord must be taken seriously. Skøyen is already covered with a lot of hard surfaces. Prior landfill and development, there used to be wetlands surrounding the estuary. As landscape architects, we should work with the water, not against it. I will investigate the area in two different scales:

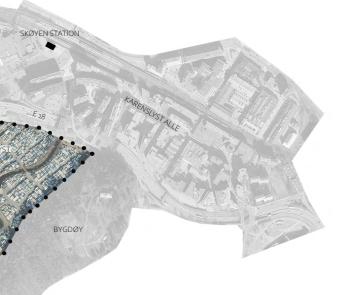
Overall: Look at how Skøyen can be better connected to the fjord. Identifying barriers, improve access, make new connections and improve existing ones are important topics at the overall scale.

An overall plan suggesting green stepping stones through the dense urban Skøyen will be part of this scale as well.

Detail: A detailed design proposal for Sjølyst, looking at the estuary, marine biology, and how to increase biological diversity. Reshaping the topography, and making a holistic landscape that connects the area below and above water is the focus. Use of vegetation and creating habitats are important parts of the detail scale.

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## SCOPE

#### Geographical

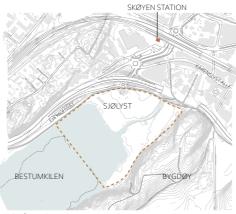
The case area is Sjølyst, located in the innermost part of Bestumkilen. This area surrounds the estuary of Hoffselva.

**OVERALL**: At the overall scale the thesis proposes connections between Skøyen and the fjord. At this scale the thesis also places the case area in a context and shows connections to its surrounding areas and important destinations such as Skøven station and the central street, Karenslyst alle. Sub-goal 2, presented on the next pag,e is answered throgh the overall scale.

**DETAIL**: The detailed design proposal is located to Sjølyst, the area around the estuary. The detailed design proposal is an anwer to the research question, the primary goal and the sub-goals (except number 2), presented on the next page. Illustrationplans and plant plan are made in 1:2000/A4.

#### Thesis definition:

The proposal shows an alternative to the existing plans regarding development of Sjølyst. Instead of developing the area into a residential area like some of the feasibility studies have proposed, this thesis suggests a generous, open green area with a robust ecosystem, facilitating both ecosystem services and human activity. The use of vegetation is not only aesthetic, it aims to solve challenges in the area and offer experiences.



The figure shows the case area Sjølyst delimited by the red line.

## **RESEARCH QUESTION**

How can the area surrounding the estuary of Hoffselva be transformed into a robust ecosystem that contributes to increased biodiversity and at the same time facilitates human activity?

## **PRIMARY GOAL**

The goal of the thesis is to come up with a design proposal for Sjølyst, the area surrounding the Hoffselva estuary. By using wildlife-inclusive urban design and ecological areal principles for green structure in the transformation of the area, the goal is to come up with a robust design proposal for the site where flora, fauna and people can co-exist.

The design proposal is supposed to be a complementary contribution to the existing "Fjordbyplan" and contribute to increase the variation in the urban waterfront of Oslo. Today, most of the waterfront is designed for people, and little has been done to increase biodiversity in the areas facing the water. Most of the existing urban waterfront consists of hard surfaces and large height difference between land and the water surface. This results in absent connection between land and water is in many ways.

Reestablishment/restoration of the ecosystem around the estuary of Hoffselva search to offer a robust zone where both people and flora/fauna can thrive.

## SUB-GOALS

- 1. Strengthen biodiversity and green corridors/ stepping stones through the dense, urban parts of Skøven
- 2. Strengthen the connection between Skøyen and the fjord.
- 3. Create social meeting places that does not go to the detriment of point 1 and 2.
- 4. Acquire knowledge about ecosystems along the fjord, estuary and restoration of such ecosystems.
- 5. Improve the connection between ecosystems on land and in the fjord.

## THE ROLE OF THE LANDSCAPE ARCHITECT

#### Landscape architects should be included early

The process I suggest in this thesis supports the vision of nature first. It includes construction of a green area in and around the estuary and at at the same time contributes to the idea of reorganizing the way landscape architects are being used: Often buildings and infrastructure are being planned first, and the role of the landscape architect is secondary.

My proposal is based on that the landscape architect should be included from the beginning in the process. Our knowledge about topography and vegetation is important if one is to create a solution that works both for people and nature.

#### We should care more about the water

Norway has the second longest coastal line in the world. Landscape architects and urban planners often limit their plans to stop at the water's edge. We need to include and think about the meeting between land and water both for the sake of biodiversity and for tackling climate change. I hope that this thesis can at least be a small contribution to this.

## METHODOLOGY

A literature study, a hstorical study, a document study and site surveys forms the backgound information and theory presented in chapter 2 and 3. These two chapters form the basis for the case study and design approach.

The **literature study** forms the basis of the theoretical acknowledge and have been done to get necessary information about marine ecosystems, estuaries and sustainability. It also gives important information of which species that are observed in the area. The literature study is presented in chapter 3.

The study of **historical** documents, maps and photos gave an important impression of how the area used to be when it was less developed and not as affected by human activity. The historical study is presented as a part of the case study. Studying rapports and registration of biodiversity was useful to see what species used to live in the area earlier and how the ecosystem once were. This gives the basis for which types of species I can use in my design. It also makes it more likely that the new ecosystem will succeed. Exploring the historical layers was also helpful when it came to understanding the identity of Skøyen and Sjølyst and how the area have developed over the last century. A **document study** has been done to get an overview of relevant guidelines and existing and ongoing plans for the area. This also includes feasibility studies. The document study is presented in chapter 2. The UN's sustainability development goals, the municipal plan of Oslo as well as reports and local guidelines put the task in a context and actualize it.

Looking at registrations of what species that has been observed in the area gave important knowledge of what species that could be used to create a native and nature-like design with the use of local vegetation.

A short summary of existing feasibility studies gives an impression of the ongoing development of the area, the different opinions and processes. These also made me aware of the existing offers along the waterfront of Oslo, and that it lacks to offer more variety. I summarize the different feasibility studies and takes with me whats relevant for my design proposal.

#### CASE STUDY

#### Site surveys

Several site surveys have been done, both in the winter, spring and early summer.

These have been important to observe the atmosphere in the case area, the access, the use throughout the year, who are using the case area and what are they doing there. The site surveys has also been important to observe and see what kind of species that lives in the different parts of the case area. The findings from the site surveys contribute to my design proposal.

**Analysis and mapping** have been done both based on the site surveys and document study. These have revealed qualities and barriers in the area, future possibilities and an overview of the existing situation.

Analysis of green structure and biological diversity have been useful when it comes to creating new ecosystems. Analysis of the water and sediment regime have been important to see what factors I am dealing with. The **design approach** has been discussed with Jeremy Anterola from Studio Dreiseitl Hamburg: Wildlife-inclusive design. This approach was chosen after looking at the "Fjordbyplan" and realizing how much of the urban waterfront were designed for people, with a lot of hard surfaces. Ecological areal prinsiples for green structure planning are actively used in the proposal to design green areas that benefit biodiversity.

Analysis of the area and literature study supports this choice. This studies show a great need of creating healthy ecosystems and how important these are for people in cities. A green, large space where vegetation is chosen on background of being a good habitat creates qualities for both people and animals. This also create a robust area, when it comes to flooding, erosion and water quality. By not further densifying areas like Sjølyst, public access to the waterfront is secured. Public access to the fjord is a concern in the Oslofjord region.

Design of social meeting places and programming has been done based on results from **user participation** and the report "Sluttrapport Kafedialog Skøyen". Kafedialog Skøyen was arranged by Oslo Metropolitan Area and Folkeaksjonen for Human Skøyen Områderegulering. Information from this user participation is important to create relevant meeting places and activities that offers something the inhabitants actually want.

Due to Covid-19, an user participation has not been done as a seperate part of this thesis. nor is user participation a main focus of this thesis.

## STRUCTURE OF THE THESIS

The presentation of the structure of the thesis is based on the suggested structure of the master thesis of Bothner and Aanderaa (2017)

The thesis is divided into 6 parts:

01 INTRODUCTION

#### 02 BACKGROUND

The background puts the thesis into context and roots it in existing international, national, regional and local guidelines. This chapter gives an overview of feasibility studies and ongoing processes in the case area. The document study reveales a need of and a wish for both connecting the district of Skøyen to the waterfront and to recreate the marine ecosystems around the estuary of Hoffselva. This forms the basis for the goal of my design proposal. My comments to the existing plans and feasibility studies could be regarded as views that would be a part of the discussion in a more traditional academic thesis.

#### 03 THEORY

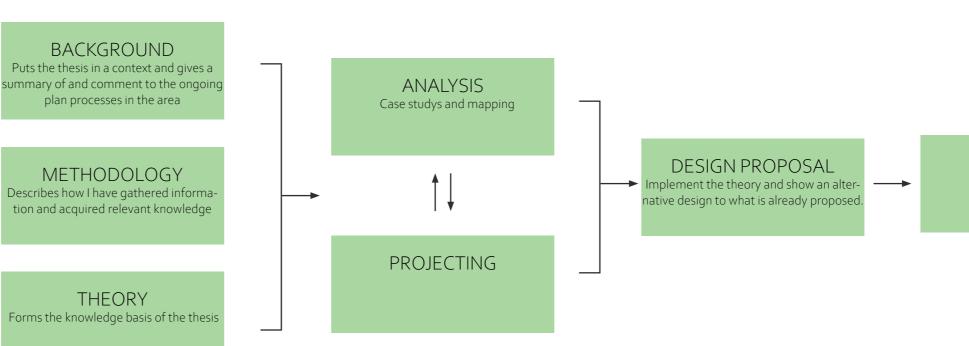
Litterature study about estuaries and marine ecosystems. This chapther forms my knowledge basis which I later implement in my design proposal.

#### 04 CASE AREA

This chapter presents the alalyzis of the case area. This have given important knowledge of local conditions which i apply in my design proposal.

05 DESIGN PROPOSAL

#### o6 REFLECTION AND CONCLUSION



# REFLECTION & CONCLUSION

## 02 BACKGROUND

THIS PART PUTS THE THESIS INTO CONTEXT AND ROOTS IT IN EXISTING INTERNATIONAL, NATIONAL, REGIONAL AND LOCAL GUIDELINES. IT ALSO GIVES AN OVERVIEW OF THE DIF-FERENT FEASIBILITY STUDIES AND ONGOING PLANS IN THE AREA. THE LITERATURE AND DOCUMENT STUDY HAVE REVEALED A NEED OF AND A WISH FOR BOTH CONNECTING THE DISTRICT OF SKØYEN TO THE WATERFRONT AND TO RECREATE THE MARINE ECOSYSTEMS AROUND THE ESTUARY OF HOFFSELVA. THE SOLUTION WILL BE SHOWED IN THE DESIGN PROPOSAL IN CHAPTER 05.

## INTRODUCTION

#### Norway has the worlds second longest coastline.

(Regjeringen, 2020). It is 83 000 km long, stretches over 14 latitudes and includes great variation in climate, coast - and beach types, nature types and biological diversity. (Direktoratet for naturforvaltning, 2013).

Traditionally, the waterway was important as a transport artery, and the sea was a source of food. Therefore, many of our cities are established along the coast or around estuaries.

During the 20th century, the Oslofjord has suffered from pollution. What used to be a healthy fjord with lots of fish and a healthy underwater flora became empty. Heavy industry and highways were established along the urban coast line. (Arvnes, 2019)

The water quality has been improved since the 1970s. Knowledge, purifying facilities and better sewage systems, among other things have made the situation better. Nutrients from households are still affecting the fjord, and the drainage and nutrients from rivers will probably increase in the following years due to more rain (ibid). Pollution from leisure boats and sewage flowing directly out in the fjord because of heavy rain is part of the impact. (Klima og miljødepartementet, 2021)

The government has focus on these issues. Holistic plans regarding the fjord are made, and areas that previously were occupied by heavy industry are now given back to the citizens. The situation is improving but there is still allot that needs to be done for the state of the fjord to be satisfactory. (Ibid)

Plans are often made for people and with city development in the main focus.. Landscape architects and urban planners often limit their plans to stop at the water's edge. Some things have started to change. Landscape architect Elin T. Sørensen is among those who has started to focus on the connection between the city and the fjord.

## THE UNITED NATIONS DECADE ON ECOSYSTEM RESTORATION 2021-2030

The UN Decade on Ecosystem Restoration is about preventing, halting and reversing the degradation of ecosystems worldwide . Healthy ecosystems are important for reversing the climate crisis, strengthen the security of food supply, water supply and biodiversity. This thesis mainly focuses on the aspect of biodiversity.

Restoring nature is important for biodiversity and life in nature and also for climate change. Life on earth depends on healthy ecosystems. Ocean and coastal ecosystems are important (United Nations Environment Programme, 2021)

## LOSS OF BIODIVERSITY

In addition to being the area with most inhabitants, the Human activity causes negative impacts on ecosystems, Oslofjord region also has the highest amount of species both on terristic and marine. The Oslo fiord region has in Norway (Smevold, 2019). the highest amount of endangered species in the country (Arvnes 2019). Of the endangered species in Norway, Among the threats against biodiversity is the change 90 % are endangered due to various types of changes in in land use, pollution, climate changes and invading land use, such as deforestation, demolition, degradation species. Change in land use, including loss and fragmenand cultivation. Other factors with a negative impact on tation of habitats is most the most important of these biodiversity and habitats are fishing, shipping, industry and marine litter. This leads to change and destruction threats. (Kålås, 2010) of habitats, reduced biological diversity, decline in stocks and increased strain on vulnerable species. (Nor-The Oslofjord is among Norway's most species-rich fjords, but suffers from human influence. Loss of biodiwegian environment agency, 2020)

versity is a serious threat to ecosystems and their services. Together with climate changes, loss of biodiversity is considered among the largest global environmental challenges (Direktoratet for naturforvaltning, 2013)

Because of the special geological conditions, the area surrounding the Oslo fjord has a lot of rare species that needs to be better taken care of. Some beach types with dry meadows on chalk ground are important here, wetlands as well. These nature types are habitats for many endangered species. (Arvnes, 2019)

The Oslofjord used to be a fjord rich of fish, especially cod, but due to a heavy reduction in the tribe, fishing in many areas are now prohibited. Seaweed and algeas suffers from reduced light due to black water, which has affected their habitats negatively. (Ibid)

The most important limiting factors for biological diversity in the inner Oslofjord, are terrain- and growth surface characteristics, light access into the water-masses, nutrients, oxygen and environmental toxins (Rinde, 2019).

## **URBAN NATURE - REWILDING URBAN ARFAS**

If cities are to stay healthy and livable, they need healthy ecosystems, provided by biodiversity. Such systems provides important services, called ecosystem services, among these are provisioning, regulating, cultural and supporting services. Biodiversity are today addressed in planning, but not really integrated. It is also a fact that wildlife-rich areas often lack in areas where people live and work (Apfelbeck, 2020) (Sabima, unknown).

#### MY COMMENT:

From what I have learned by studying the documents and ongoing processes in my case area, I see that many of the plans include areas for greenery, to a greater or lesser degree, but from what I can see, if often looks like the green areas are included for aesthetic reasons. Grey infrastructures and buildings are often placed first, then comes the green areas, often placed on the leftover space

We need to think new when it comes to designing green areas. Parks do not have to be strict and cultivated with parden flowers, it can be nature like with meadows and native vegetation that contributes to native biodiversity.

### URBANIZATION

TODAY, more than half of the world's population lives in cities, and the share is estimated to increase to 60 % in 2030 and 80 % in 2050 (FN-sambandet, 2021). Cities are responsible for 75 % of all greenhouse gas emissions. This increases the pressure on the space and resources in urban areas, and in the future we need to utilize resources in a sustainable way.

The Oslo-region is a fast growing region in terms of population. 1,6 million people llives along the Oslofjord. In 2050, the population in areas close to the fjord is estimated to two million people. Prognoses estimates that Oslo in 2040 will have approximately one million inhabitants. (Arvnes, 2019).

This leads to increased pressure both on the fjord itself and on areas connected to the fjord. Increased development and construction in the beach zone have led to limited public access to the beach zone. (Klima- og miljødepartementet, 2021). It also leads to pressure on the biological diversity in general.

The Oslofjord is among the Norwegian fjords with the highest sea traffic density, both leisure boats, ferries and freight traffic (Østenstad, 2018). Large agricultural and industrial areas drains to the fjord and, this leads to more nutrients in the sea water. (Arvnes, 2019)

This entails an increased risk of pollution and disturbances in ecosystems.

## CLIMATE CHANGES

Climate change is affecting sea temperatures. This leads to storm surge, sea level rise and changes of ecosystems below water. Marine ecosystems purify water and are important during storm events by reducing the energy of the storms. They are also important in controlling sediments and filter nutrients.

Climate change leads to more and intense rainfalls, increased temperatures and rise of the sea level. Since 1985, the average air temperature in Oslo has been warmer than normal, and it is getting warmer. More heavy rain, especially since 2000.

Increased temperatures and more rain has an impact on the physical conditions in the Oslofjord. Warmer and more rainy winters causes more drainage. Intense and heavy rain causes floods, and this will have an impact on the circulation. (Arvnes, 2019)

When climate change provides warmer climate, the risk of invading species increase, as they find new habitats further north. The pacific oyster is a local example of this, found in Bestumkilen on site survey. This makes it even more important to create robust ecosystems with local vegetation.

## PUBLIC GUIDELINES

#### INTERNATIONAL GUIDELINES

#### United Nations sustainability Development Goals

The thesis is rooted in the United Nations Sustainable Development Goals and the plans of the City of Oslo. Norway has committed to stop loss of biodiversity through the United Nations Convention on Biological Diversity. (Evju, 2020)

The sustainability development goals are global guidelines with the aim to combat poverty, inequality and stop climate change.

Our climate depends on healthy and intact ecosystems, while a rich and robust nature can mitigate the effects of change. According to the United Nations' Intergovernmental Panel on Climate Change (IPCC), the conservation and improvement of natural carbon capture is one of the surest ways to combat the most extreme climate change. Therefore, it is important to preserve and restore nature, both for the climate and the natural environment. (IPCC, Intergovernmental panel on climate change)



To face challenges in connection with the sea, the United Nations have a sustainability development goal for Life below water. The goal is to conserve and sustainable use

the oceans, sea and marine resources for sustainable development.

One of the sub-goals aims to protect and restore water-related ecosystems, including rivers and wetlands.

The oceans is the world's largest ecosystem. Oceans, seas and marine resources are increasingly threatened, degraded or destroyed by human activities, reducing their ability to provide crucial ecosystem services.

Climate change, marine pollution, unsustainable extraction of marine resources and physical alterations and destruction of marine and coastal habitats and landscapes are among the threats. The deterioration of coastal and marine ecosystems and habitats is negatively affecting human well-being worldwide. (United Nations, 2021)

In order for marine resources, seas and oceans to contribute to human well-being, ecosystem integrity with properly functioning bio-geochemical and physical processes is required. Ecosystem integrity allows for the provision of supporting ecosystem services which are the bases of important regulating, provisioning and cultural ecosystem services that are crucial for humans (Ibid).



Goal 15, Life on land, states to protect, reestablish and strengthen sustainable use of ecosystems, secure sustainable maintenance and stop loss of biodiversity. Subgoal 15.1 states among other things that

We need to preserve and restore sustainable use of water systems and wetlands. 15.5 focuses on the importance of reducing the demolition of hab-

itats and prevent endangered species of dying out.



Goal 11 aims to make cities and human settle ments inclusive, safe, resilient and sustainable. Pa goals 11.3 states that urbanization needs to be in cluding and sustainable. (FN-sambandet, 202

More than half of the worlds population lives in cities, Th will increase to 60 % in 2030 (FN-Sambandet, 2021). U banization leads to increased pressure on coastal area

When cities grows, it needs green areas and open spa es, both for people and biological diversity to preven bad living condition. When cities grows too fast and a developed too dense, this leads to loss of such areas, ar bad conditions for both people and ecosystems. A wor case scenario is a collapse of important ecosystem



Goal 13, Climate action states that we need to act now t prevent climate changes. We need to be capable resist ing climate risks and nature catastrophes. This require collaboration and long-term sustainable planning. No way is committed to this through the Paris agreement

#### NATIONAL LAWS AND GUIDELINES

#### Nature diversity act

e- art n-	Improvement of the condition of endangered species and habitats is one of Norway's main goals for conserva- tion of biological diversity.			
21) his Jr- as.	The nature diversity act states that. "The diversity of habitat types is safeguarded within their natural distribu- tion area and with the species diversity and the ecological processes that characterize the individual habitat type". this is the management objectives.			
nt	Planning and building act			
re nd rst	The outdoor law from 1957 states "allemannsretten": we are allowed to walk almost everywhere.			
to st- es or- nt.	The plan and building law states a building ban in the beach zone to protect free public access to the sea/ fjord. 100 meters belt along the coastline to prevent private roads, houses and cabins. (Regjeringen, 2020)			
	However, this law can allow dispensations, and over the last two decades, an area of 11 900 football fields have been removed from the free accessed beach zone. (SSB, 2020)			

## RELEVANT NATIONAL GOALS AND GUIDES AND PLANS

#### "Helhetlig tiltaksplan for en ren og rik Oslofjord med et aktivt friluftsliv"

#### By the Norwegian Environment Agency

The Oslofjord region is of national interest, both as a recreational area and due to the rich flora and fauna in the area. The Oslofjord serves as food supply and is an important part of the infrastructure.

The comprehensive action plan for Oslofjorden shows the Government's most important priorities for the Oslo Fjord, initially until 2026.

The Holistic Plan for the Oslo Fjord is part of the follow-up of the UN's sustainability development goals with emphasis on goal 6 (Clean Water and Sanitation) and goal 14 (Life Below Water).

The holistic plan for the Oslo Fjord includes the sea and coastal areas from the Swedish border to the county boarder towards Agder and aims to **coordinate**, **supplement** and **strengthen** what is already being done for the Oslo Fjord's environment and outdoor life. Measures from different sectors are put in context.

(Klima - og miljødepartementet, 2021)

"Ren og rik Oslofjord med et aktivt friluftsliv"

#### Selected goals

- Protect vulnerable species, selected habitats and restoration of natural values.
- Improve public access to the beach zone.
- Maintain and strengthen the attractiveness of areas which are important for outdoor life, including facilitation of areas and contiguous coastal paths, as

well as speed limits for ship traffic and leisure boats

- Access to recreational areas for everyone
- Reduce emissions from municipal sewers, among other things through the purification of organic substance/nitrogen and faster pipe network renewal, as well as better regulation of boat septic.
- Reduce land drainage from agriculture
- Cleanup of contaminated sediments
- Mapping of selected habitat types
- Maintenance of established protected areas
- Measures for a more comprehensive management of land use along the Oslo fjord

"The Storting asks the government to present a comprehensive report plan for the Oslo fjord- with the goal that the fjord will achieve good environmental condition, restoring important natural values, promote an active outdoor life and take care of the biological diversity in the fjord"

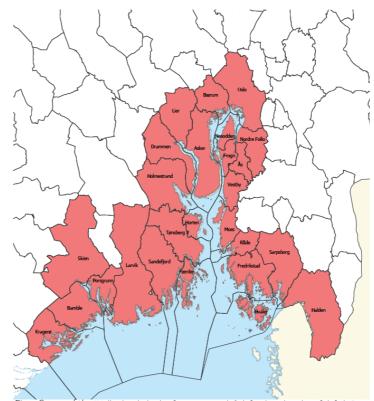


Fig 1: Scope of the "Helhetlig tiltaksplan for en ren og rik Oslofjord med et aktivt friluftsliv". The municipalities that is committed to the plan is marked in red. (Ibid)

#### **MY COMMENT**

Change requires collaboration. To improve the conditions of the Oslofjord, it is essential to look at the whole region, especially areas that contains watershed leading to the fjord and agricultural areas with drainage of nutrients into the fjord.

The strength of this plan is that it includes all municipalities surrounding the inner part of the Oslofjord and states important goals. The plan predicts overall guidelines and collects knowledge.

Most relevant for the thesis are the goals regarding access to the fjord, restoration of habitats and the goal about maintenance and strengthening the areas important to outdoor life.

#### **"Fjordbyplanen"** By the Agency for Planning and Building Services

The plan is part of the follow-up of the City of Oslo's Council's decision regarding the Oslo Fjord of 19th January 2000 and is further specified in the Municipality Plan of 2004.

The overall vision is to develop the waterfront in a sustainable way and secure access, variation, culture and recreation. It also states that further development should be climate friendly.

It predicts principles for the political guidelines and forms the basis for the rezoning maps for the areas included in the plan.

The plan has two main purposes:

- Give political guidelines for the further work with the Fjord City as a whole and for further regulation plans for part areas.
- Determine the plan program according to the Planning and building act for the subareas.
- The plan also states that the waterfront should be developed in such a way that it is robust in facing the future.

Different focus areas supadd variety to the whole. posed to The City of Oslo's ambition is that Skøyen is going to be a pioneering area for climate-smart development. climate-neutral urban and

(Plan- og bygningsetaten, unknown b)

#### The Blue and the Green, the City in Between"

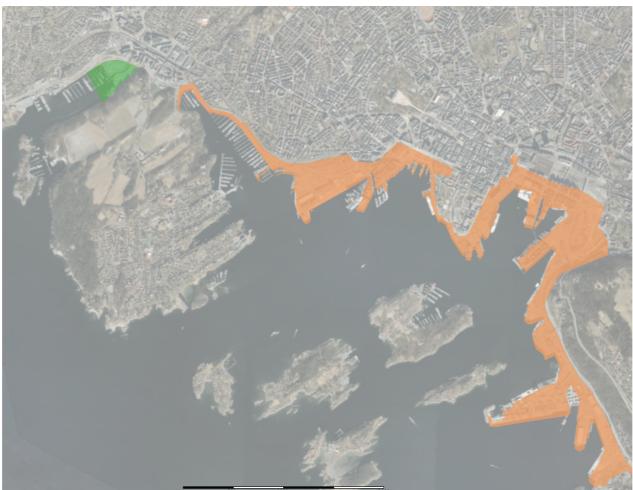


Fig 2: Orange marks the scope of "Fjordbyplanen" .Bestumkilen as an extension markes in green and is suggested as an extention of the plan. (ibid)

#### **MY COMMENT**

If the City of Oslo is serious about Skøyen as a pioneering area for climate-smart and climate-neutral urban development, Bestumkilen should be included into "Fjordbyplanen". Skøyen is growing, several new residential areas are planned, and this requires long term and future-orientated planning. It will be important to secure enough green spaces and to connect this part of the city to the city center with connecting recreational routes and bicycle routes. It will also be important to secure a network of green spaces, both for people and biodiversity and reduce the amount of hard surfaces.

A lot of the urban waterfront consists of buildings and hard surfaces. Sjølyst has the opportunity to be designed as an unique green area. This is a measure that will complete what the urban waterfront is already offering. In this way, Sjølyst will be an extension of the recreational areas at Bygdøy. This will improve the connection between Skøyen and Bygdøy. The area gives a possibility of dragging the nature into the urban center of Skøyen and strengthen the connection between the green areas in the north (Skøyenparken and Frognerparken) and Bygdøy. This will strengthen the blue and green structure between Nordmarka forest and the fjord, which is another important goal of the guidelines.

#### **"Byplangrep Skøyen"** By the Agency for Planning and Building Services

"Byplangrep Skøyen" is the first step in the process with site regulation and rezoning plan for Skøyen. This is an ongoing process per may 2021.

The goals of Byplangrep Skøyen is to secure a future orientated and holistic approach of the development of Skøyen. The ambitions are to develop the area into a multi-functional, dense 24- hours city that opens against the fjord. Blue and green structures, squares and meeting places are in focus, so are also making better connections between the urban center of Skøyen and Bygdøy, Frognerparken, Nordmarka and the fjord. The focus is also on streets that invites to urban life and active facades in the ground floors. (Plan- og bygningsetaten, 2015)

More apartments, less car traffic and parking lots, and better conditions for soft road users are being prioritized. The plan also states, among other things, that the highway E18 and the boat storage at Sjølyst are removed.(ibid)



Figur 3: "Byplangrep for Skøyen". The illustration shows a new urban street in the old trasse of the highway E18 and new residential areas where the boat storage used to be. (ibid)

#### MY COMMENT

This plan has many good measures, especially the removing of E18 and the boat storage. On the other hand, densification at Sjølyst is not so good, and should be made elsewhere to secure public access to the fjord and enough green space in the area. The former area of the highway is a better option for a residential area, then being placed between the urban center and the fjord. In this way they also protect the green area against noise from the railway and roads in the urban center.

Most of the new buildings in the plan are placed in areas that are in risk of storm flooding. The buildings takes up a lot of space, and reduces the size of what could have been a really large green area.

The illustration shows a waterfront that is better adapted to public access than todays situation, and more varying as well. But this proposal is still very traditional in the way the waterfront is designed, and there are not much room for a proper estuary ecosystem.

To establish both a new dense residential area and park at Sjølyst, more landfill is needed. In my opinion this should be avoided.

#### Rezoningplan for Skøyen- 19.04.2021

By the Agency for Planning and Building Services

Rezoning-plan for Skøyen is a further development of "Byplangrep Skøyen". The development has taken public consultation and inspection into account and per june 2021 the rezoningplan is up to political consideration

Essentials from the rezoning:

- 9500 new inhabitants, 3900 new workplaces, 4800 new apartments, 500 of these are proposed at Sjølyst
- Reduce parkings lots, from 10 000 today to somewhere between 1400 and 4000 lots.
- Train, bus, metro and tram are going to be localized around Skøyen station area. This gives space to a large park at Hoff Torg with a new school included.
- 30 acres with new green space, 60 acres with new squares and improvement of the existing water-front promenade
- Boat storage moves to other areas in the Oslo fjord.
- Soft road users are given priority. Walking- bicycleand pedestrian routes with connections through the area.

(Agency for Planning and Building Services, 2021).

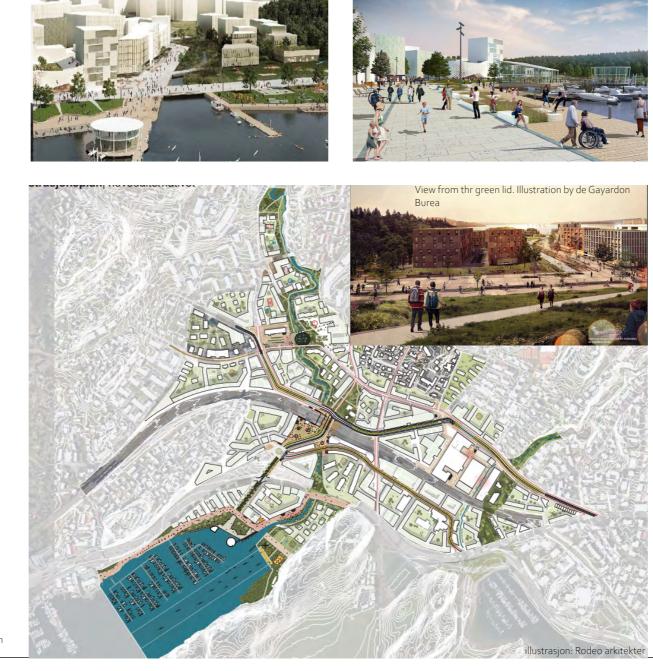


Fig 4: Main proposal Site rezoning. The plan shows that the area of E18 is taken out of the plans due to innsigelse from Statens vegvesen. (Ibid)

#### **MY COMMENT**

Most important for this thesis is the fact that the Norwegian Public Roads Administration objected the proposal in "Byplangrep Skøyen" about removing he highway E18. The reason is that the proposal requires less traffic than today, and the Norwegian Public Road Administration believe expected traffic still poses a danger of poor traffic flow on E18, hence they refuse to accept the new route for E18.

In my opinion there are so many negative aspects with keeping E18 as it today. The highway is a huge barrier reducing the connections between the urban Skøyen and the fjord. E18 also leads to noise- and air pollution. Buildings can not be placed close to it as noise protection as the plan suggests. To establish both apartments and a park at Sjølyst leads to a need for further landfill into the wedge, and this is not a good idea when it comes to biodiversity.

To me, the measures in the rezoning plan lacks a holistic and long-term aspect. The measures appear as small dots in a mosaic that seems short-sighted and expensive. Especially when it might turn out that E18 can be (and should be) placed elsewhere later.

Also, there are several contradictions in the revised plan. Among others, E18 is now to be developed as an integrated part of Skøyen and at the same time the plan aims to reduce the amount of private cars.

#### "Sluttrapport for Kafedialog Skøyen: Oslo nye folkepark"

#### By Bydel Ullern, Oslo Metropolitan Area and Folkeaksjon for Human Skøyen områderegulering

The main reason for the dialog process was that the inhabitants of Skøyen and developers had a common goal of developing Skøyen to a place that attracts people.

Essentials from the user participation:

- Skøyen station is the heart of Skøyen and the most important meeting place. This area should be developed as a square and work as a social meeting place. The station itself must be designed and recognized as the important station it is.
- The local connections at Skøyen needs to be improved. Especially the existing connection from Skøyen Station over the green lid to Bestumkilen and Bygdøy must be developed. This is considered as the main axis by the inhabitants and needs to be strengthened.
- If more people are to use the area after work and in weekends, Skøyen needs a more offers such as culture, meeting places.
- Bestumkilen must be developed. A blue and green zone must be available for inhabitants with water quality to swim in. The connection to Bestumkilen needs to be improves.
- Karenslyst Alle are the urban city street. It needs to be developed to create more activity and generate more use in the evenings. Connection to the Thune area must be strengthened, the same with the connection to Bygdøy.

Bydel Ullern, 2019)

- Further development of Hoff as a multi-functional area with activities in the evenings. A new square surrounded by apartments, culture and school with Hoffselva as a central axis through the area is wanted. Strengthen the connection between Hoff and Bygdøy.
- Thune needs a tighter connection to Karenslyst Alle. More trading and outdoor seating to create new meeting places and activity. Create a local loop and improve the connection to Skøyen station.



Fig 5: Illustration made by" Folkeaksjon for Human Skøyen områderegulering". Grass is better than asphalt, but the area still lacks spatial design and atmosphere. (ibid)

#### **MY COMMENT**

This rapport says something about what the inhabitants of Skøyen want. The user participation will be important when it comes to the programming of the case area and establishing social meeting places. The voice of the inhabitants is important for creating activities that actually are needed and will be used. It is also important when it comes to strengthen the connections at Skøyen.

The proposal of the inhabitants shows a generous green space, without residential houses. But like the proposal made in "Byplangrep Skøyen", this one also seems rather traditional. Little has been done for biodiversity, and the river is not given more space. The tidal zone is developed for people. The proposal lacks spatial design and atmosphere.

I have produced a mapping that summarizes the needs and wishes of the inhabitants. This is shown in figure 14 in chapter 4. Taking the needs and wishes of the inhabitants into consideration is key to design a well functioning proposal.

#### "Sjølyst Maritime Folkepark - Et sted for alle"

By Aksjonsgruppen for et fellesskap på Sjølyst (Boat society)

The boat society proposes a common place for boat life, sport and recreation, used through the year. The area is supposed to be a sustainable area where people from the whole city can explore maritime activities.

#### Essentials from proposal:

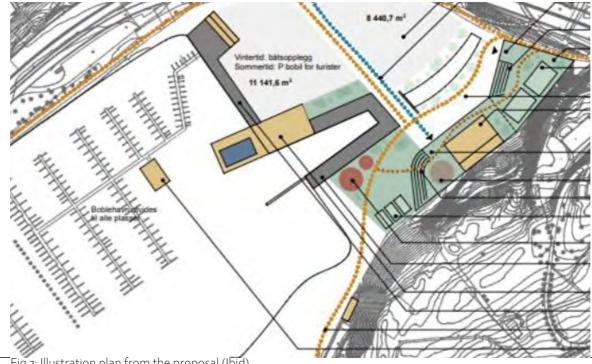
- A new sport hall
- Multi-functional use of the area through the year
- Some green areas are added
- Facilitate swimming and recreation
- Maintain the maritime heritage

Some of the areas used for winter storage of boats are reduced, but on the sea, its just as many boats as it used to be. (Aksjonsgruppen for et fellesskap på Sjølyst, 2020)

It is an ongoing process where the Agency for City Environment investigates a new location for boat storage. (Agency for Planning and Building Services 2021)



Fig 6: Illustration from the proposal (Aksjonsgruppen for et fellesskap på Sjølyst, 2020)



#### MY COMMENT:

The Boat society shows a willingness to adapt, but boats on the water is still a problem for the condition of the fjord, because it reduces light access and circulation in the water. The risk of pollution from boats is still there. Because this wedge is so protected, it is vulnerable, and the boats should be put elsewhere. In my opinion a boat storage does not need such a central location.

However, this proposal pointed out and made me aware of the maritime traditions and community when people meet to prepare their boats. By removing it, I am aware of that I remove a piece of history as the storage has been at Sjølyst since the 1960s. In my design proposal I continue the thoughts about marine activity in some ways. Keeping the Kano- and row society clubhouse, kano rental and sauna is among the activities in my proposal. A small guest harbor is also possible.

In this proposal, little has been done to increase biodiversity.

#### SUMMARY OF THE PLANS AND FEASIBILITY STUDY:

As I see it, the plans and feasibility studies previously presented indicates a conflict of interest with four opposites:

- Agency for Planning and Building Service (Rezoning plan for Skøyen)
- Ullern Bydel, Folkeaksjon for Human Skøyen områderegulering ("Sluttrapport for Kafedialog Skøyen: Oslo nye folkepark")
- Aksjonsgruppen for et fellesskap på Sjølyst (Sjølyst Maritime Folkepark)
- Norwegian Public Roads Administration

On one side, the inhabitants of Skøyen express that they have not been proper listened to by the Agency for Planning and Building Services. Especially when it comes to how dense and high the rezoning plan proposes the buildings in the area and the limited size of green areas.

This lack of user participation resulted in the establishment of "Folkeaksjon for Human Skøyen områderegulering" which did their own user participation resulting in "Sluttrapport for Kafedialog Skøyen" and a proposal "Oslo nye Folkepark" as an alternative to the Agency for Planning and Building Services rezoningplan.

On the other side, the Boat society that uses Sjølyst today made their own proposal, in an attempt to secure Sjølyst as a boat storage.

The Norwegian Public Roads Administration opposes the proposal from the Agency for Planning and Building Services due to the removing of the highway E18.

#### CONCLUSION

Although many of the plans and feasibility studies proposes green areas, non of them really takes into account the estuary and the marine ecosystem in the tidal zone. All the green areas proposed, do not seem very thoughtful when it comes to biodiversity, the meeting between fjord and land or the opportunity to give the river more space to form a natural outlet in the fjord.

The proposals are all very traditional, and mostly planned for people, despite the adding of green space.

My proposal shows an alternative design where the nature and the services of ecosystems are taken into consideration. It investigates how people and nature can coexist without compromising the quality of the green areas.

# **03 THEORY**

This chapter present relevant theory for the thesis. With this chapter, sub-goal 4 is achieved

## ESTUARY AND REGIMES

#### What is an estuary?

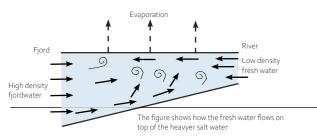
The term estuary is derived from the Latin *aestus*, which means **tide**.

"An estuary is a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage"

- D. Pritchard, 1967. *Observations of circulation in coastal plain estuaries.* 

Worldwide, there are different types of estuaries, both how they were formed, in size, share of fresh/salt water and more. In this thesis estuary is defined as where the river meets the fjord. In other words: where a freshwater river, in this case Hoffselva, meets the salty fjord, in this case Oslofjorden. In such areas a mixture of fresh water brought by the river and salty fjord water will occur, this movable zone is called brackish water. Brackish water is thus salty, but less salty than the fjord. How salty it is depends on the size of the river, the salinity of the fjord and also factors such as heavy rain, wave/ stream, air density and change in seasons.

There are also different classifications, but the estuary in this thesis can be classified as a salt wedge estuary. The fresh water from the river flows on top of the salt water in the fjord, and the salt wedge moves back and forth with the tides. (Schulz, 2012)



#### Where fresh and salt water mix

#### Sediment regime

"Sediment regime includes inputs and outputs of mobile sediment from a length of channel and storage of sediment within the channel and floodplain over a specified time interval". (Wohl, 2015)

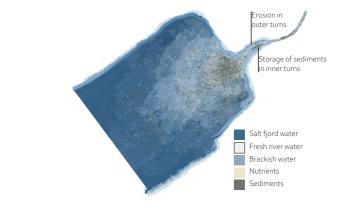
Water and sediment inputs are fundamental drivers of river ecosystems. The size, quality, sorting and distribution depend on and vary between stream types, due to their proximity to the sediment source, topography and their hydrological regime.

- Balanced sediment regime is when the energy of flow available to transport sediments is in balance with sediment supply. Hence the river form remains dynamically stable over a specified time period.
- Natural sediment regime describes conditions prior to the construction of dams and the intensive human disturbance of topography and land cover in the form of removed native vegetation through crops, timer harvest, urbanization and other land use.

(Wohl, 2015)

#### Hydrological regimes

The hydrological regimes of rivers and streams include the alternation of wet and dry phases in the stream channel and the highly dynamic lateral, vertical, and longitudinal connections with the rivers adjacent ecosystems (Magand, 2020)



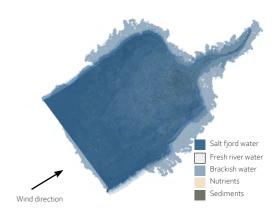
## Event 1: Strong water flow in the river due to heavy rain or snow melt



This event occurs during snow-melt or heavy rain, and leads to more water in the river than usual. This will increase the amount of fresh water in the estuary and the transportation of nutrients will be larger and faster than usual. This also include sewage. Sediments are transported further before they fell to the bottom. More water in the river makes it go faster, and this leads to increased risk of erosion in the outer turns, where the water flows fastest.

#### Average situation

#### Event 2: Strong wind from the fjord and high tide



This event would lead to less fresh water flowing out from the river because the tide and strong wind leads salt fjord water further up the river than usual. Such an event would also cause a flooding situation on the banks, and affect infrastructure, buildings and vegetation in the flooding zone. The amount of nutrients will not go as far and fast out in the fjord as usual.

## MARINE ECOLOGY:

#### Estuaries and tidal zone as ecosystem

Estuaries as an ecosystem provides many important ecosystem services. In fact, they are considered among the most productive ecosystems in the world (U. S. National Ocean Service, 2021)

#### Abiotic factors in estuaries and beach zones

The beach zone is exposed for abiotic factors such as salty water, flooding and wind (mechanical). It is a niche, and requires specialists to live there. The beaches are often open, and thus there are no competition from higher vegetation that gives shadow. Nutrients from seaweed are a fact. Fresh water is a limiting factor, and the soil/seabed, often sand or rock, holds the fresh water poorly. (Ryvarden, 1997)

#### Tide

Tides are a major ecological factor in marine ecosystem such as the beach zone and estuaries. The lunar cycle and local topography are crucial to how the tides occurs. (Direktoratet for naturforvaltning, 2013). Twice a day, the tide goes in and out. This results in low water twice a day which means that flora and fauna in the tidal zone must withstand both flooding, drainage and also freezing. It is large regional differences in the tide. In the Oslofjord, the difference between high tide and low tide is small, approximately 40 cm (Ryvarden, 1997). Wind condition and air pressure conditions have impacts on the tide.

#### Salinity

Salinity is the most important factor in the estuary, nowhere is variation in salinity more pronounced than in estuaries. The salinity varies horizontal, vertical and seasonal. These variations are caused by the amount of freshwater input, evaporation and the tide.

#### Zones

There are different types of beaches, but when it comes to vegetation in the beach zone, zoning is characteristic for all types. The zoning are parallel to and defined by the tide, and forms belts, depending on length and degree of the tidal flooding.(Ryvarden, 1997)

Sublittoral zone: Environment below the low-tide mark. Species in this zone is permanently under water.

<u>Hydrolittoral</u>: Environment between normal low-tide mark and normal high-tide mark.

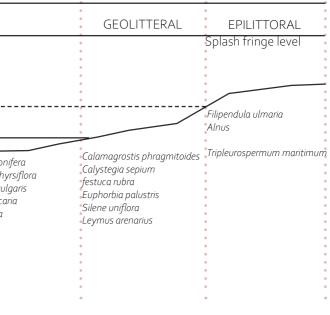
<u>Geolitteral</u>: Environment between normal high-tide mark and upper astronomical tide mark.

<u>Epilittoral:</u> The "Spray" zone above the upper astronomical tide mark.

The case area is very protected against wind and waves, thus the vegetation belt occurs parallel with the tide water zones.

SUBLITTORAL	HYDROLITTORAL		
Upper high water mark			
Lower tide level Zoestra marina Pelevetia canaliculata Focus spiralis Focus vesiculosus Ascophyllum nodosum Focus serratus	Bolboschoenus maritimus Carex vacillans Carex paleacea Glyceria maxima Schoenplectus lacustris Schoenplectus tabernaemont	ani	Agrostis stolor Lysimachia thy Lysimachia vu Lythrum salica Festuca rubra
	LONG	FLOODING TIME MEDIUM	SHC

Fig 8: The figure show how the tide affects the vegetation, and makes characteristic belts of vegetation. (Based on a figure from Direktoratet for Naturforvaltning, 2013. Species are selected based on species in the case area )



#### ORT

## HARD BOTTOM HABITATS

Hard bottom habitats include the parts of the seabed where rocks, stones and other hard surfaces, generally known as reefs. Artificial reefs are when the hard bottom is man-made. Light exposure, geology and mechanical forces such as waves are important for life in such habitats.(Ryvarden, 1997)

#### ALGAES AND SEAWEED

Benthic algae is the common name of seaweed (macro algae) and kelp. They require a substrate to grow on such as solid rock, stones, or other algae. Rifts in rocks are also great habitats: The seedling plant can easily attach here and hide for snails that eats them. The benthic algae absorbs nutrients from the water, so the "roots" is only there to keep the algae at the same place. (Grevlingen)

As the different species all have different requirements for sunlight, depths and growing place, they form characteristic belts. In the inner part of the Oslofjord, the algae only survive down to 8-10 meter, due to dark water. In protected beach zones, like Bestumkilen, species such as *Himanthalia elongata* and *Fucus serratus* are good examples of species in the middle zone. *Ascophyllum nodosum* and *Fucus spiralis* increase the more protected the area is . *Pelevetia canaliculata* is found in the upper part of the tidal zone in protected beaches. This species has to be dried twice a day. *Fucus evanescens* is also found in Bestumkilen and seems like an algae that easily grows in former polluted areas. (Kroglund, T., Berge, J.A., m fl. 2017)

Focus spiralis

Pelevetia canaliculata

Hard bottom

Ascophyllum nodosum

Focus vesiculosus

Focus serratus

Himanthalia elongata

## SOFT BOTTOM HABITATS

Soft bottom habitats include the parts of the seabed consisting of fine sediments, mud, clay and sand. Depth, light exposure, sediment size and temperature are factors that affects the biodiversity and productivity in such areas. (Ryvarden, 1997)

#### EELGRASS MEADOW Key species: Zostera marina

Eelgrass meadows grows in shallow wedges on soft seabed, both clay, mud and sand. It can grow in the tidal zone, but is most common from 0,5 - 1 m to 4-5 m depth in the Oslofjord. It can grow deeper, but this depends on the access of light, as it requires 15 % of the light on the surface. (Christie,unknown year)

Eelgrass is a macrophytt and an important primary producer. It is one of few marine plants that is flowering and thus also photosynthesizing. Eelgrass meadows are important habitats for small fish fry, crustaceans and birds such as ducks and swans. These meadows work as hiding place, nesting and food supply. (Sørensen, 2021)

Due to the roots of the *Zoestra marina*, they reduce the effects of waves and contributes to stabilize the sea bed. This prevents erosion. (https://artsdatabanken.no/Pag-es/171903/Marin\_undervannseng)

Along the norwegian coast, Zoestra marina is among the most commong species of eelgrass.

## ZONES ON LAND

#### **BRACKISCH MARSH**

A brackish marsh is defined as a coast ecosystem in the tidal zone which is regularly flooded by the tide and which is often dominated by salt-tolerant species. (Borgersen G., m fl 2020). Substrate, depth, salinity, nutrients and waves affects how the brackish marsh is. (Nibio, 2017).

In wedges and at estuaries with brackish water, *Phragmites australis*, *Bolboschoenus maritimus* and *Schoenoplectus tabernaemontani* can be found. These species can often be up to two meters. Such areas are important ecosystems for birds.

Brackish marshes are important both in a climate context as a carbon storage and when it comes to biological diversity as nesting- breeding- and grazing areas for birds, animals and fishes and crustaceans. (Borgersen G., m fl., 2020)

Brackish marshes purify the water for both nutrients and environmental toxins, protects the coast against erosion and are habitats for endangered species. For migratory birds they are important as migration stopovers on their way back and forth to destinations. (Ryvarden, 1997): The lower parts tolerate salty water two times a day when the tides comes in. Further in, the vegetation is normally not affected of salty water during the summer, but in the winter, seaweed and driftwood are being thrown to land. Due to the seaweed, this area can be nutritious, typical species are *Juncus gerardii* and *Festuca rubra*, plus *Armeria maritima*, *Triglochin maritima*, *Tripolium pannonicum* and *Lotus corniculatus*. The amount of species increase the further from the fjord one gets. (Ryvarden, 1997)

Further away from the fjord, the soil determines which plants exist. At wet places with supply of freshwater *Filipendula ulmaria* and *Lysimachia vulgaris* can be found.

#### WET MEADOW

Such meadows consists of moist and wet soil, located in poorly drained areas, hence they are to be found along rivers and in depressions in the terrain. Typical for these meadows are a dense herbal layer, dominated by moisture demanding herbs, grass and half-grass (Nibio, 2017).

#### DRY MEADOW:

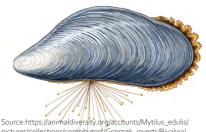
Such meadows are located on well drained places, often with small amounts of soil. The soil is salt-bitter, this is due to the rising water flow in the summer due to little precipitation and high evaporation.

## **KEY SPECIES**

Key species are often referred to as structuring species. If one succeeds in establishing these, they will generate biological diversity, as other species will emerge. As a design principal it is important to facilitate local species. This can be done by using local geotops, both in the water and on land.

#### BLUE MUSSEL Mytilus edulis

Blue mussels grows in colonies on hard surfaces. These colonies are important as habitats for smaller species that lives among the mussels. It is a filtrating species, which means that it absorbs nutrients by filtrating the water. This keep the water purified.



pictures/collections/contributors/Grzimek\_inverts/Bivalvia/ Mytilus\_edulis/

## A LOCAL EXAMPLE OF A NUTRION NETWORK

The population of filamentous algae is increasing in the Oslo fjord. These algae grows on the leafs of the eelgrass and suffocates it.

Amphipodes and isopodes graze on eelgrass and eat, among other things, filamentous algae. In other words, they prevent the eelgrass from being suffocated.

Overfishing reduces the large individuals of fish. In the inner part of the Oslo Fjord, especially the large individuals of cod has been reduced in the recent years. When the large fishes are being reduces, the smaller individuals survive and increases. These small fishes eats amphipodes and isopodes.

(Elin T. Sørensen, podcast "Biologisk mangfold i Oslo". Episode: "Den blå parken")

## 04 CASE AREA

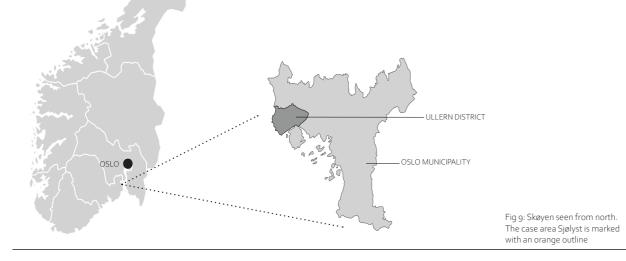
INTRODUCTION LOCATION HISTORICAL TIMELINE Analysis

This chapter gives a more detailed introduction to the case area and location, including local conditions, needs and challenges. Further, a historical study and the site survey are presented. Analysis and mapping reveals the identity of the area, especially in form of the biological state. The mapping and the survey of the surroundings of the case area reveals the native species of the area.

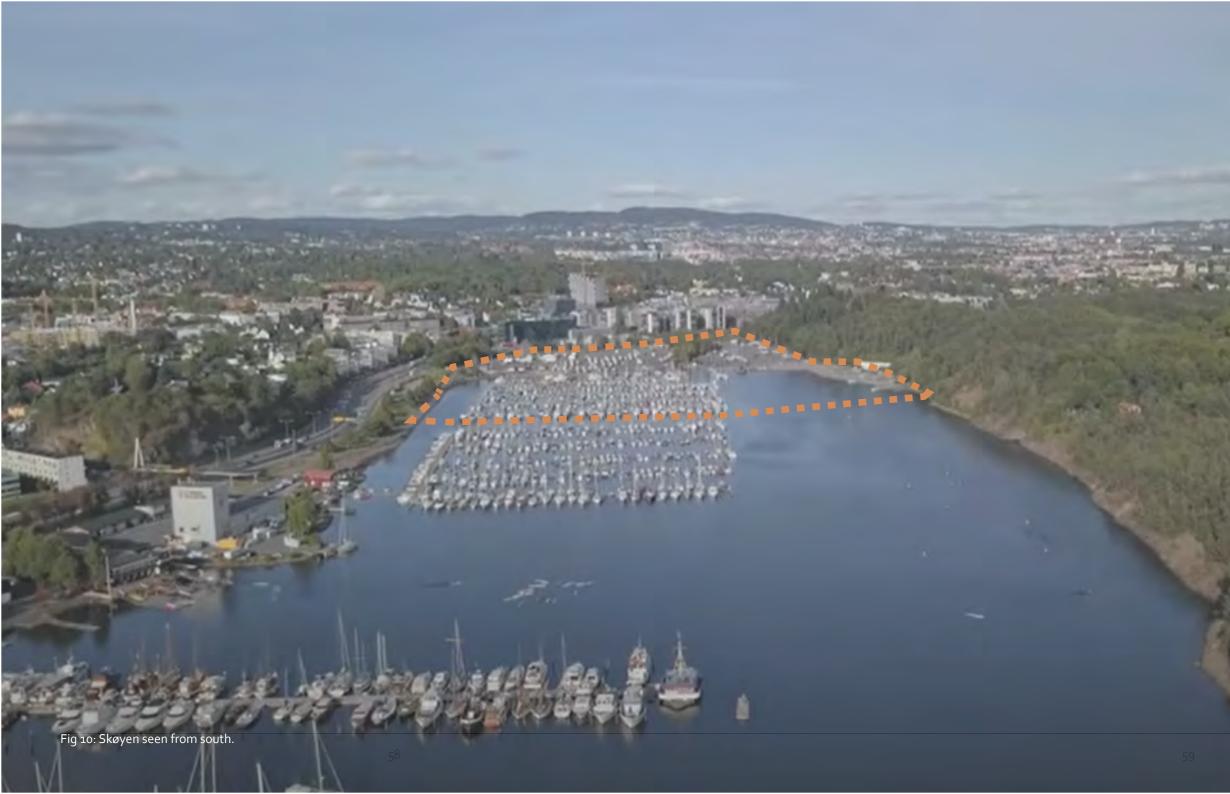
## INTRODUCTION

### SKØYEN

**Skøyen** is a neighborhood located in Ullern district in the western part of Oslo. The name "Skøyen" comes from Old Norse *Skoðin*, a "vin" name, where "vin" can be translated to grassland





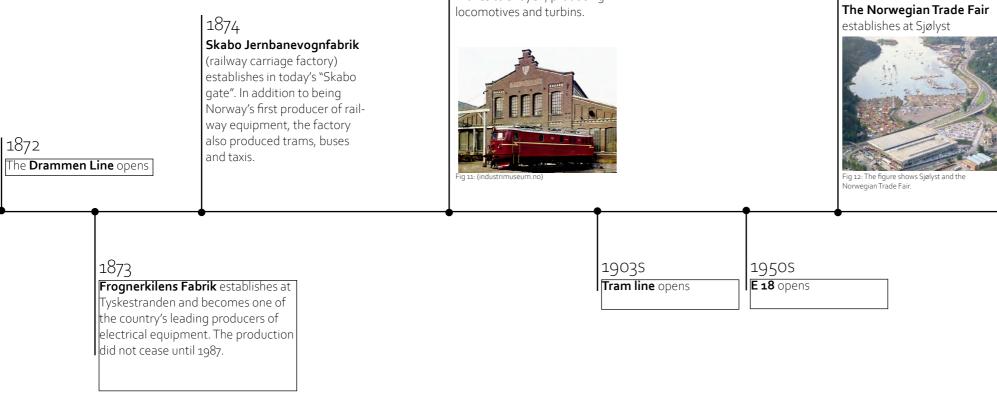


### SJØLYST

**Sjølyst** is located in the innermost part of bestumkilen, where Hoffselva has its estuary. The area has its name from the property Sølyst, today known as Sjølyst, one of many "løkkaeiendommer", agronomic properties used as food supply for citizens.

## TIMELINE

Until the end of the 19th century, Skøyen consisted mainly of cultivated land and farms. Skøyen Station opened in 1872, and in the following decades, the area grew as an industrial center by the Drammen railway. Both heavy industry with locomotive production, power plant equipment and concrete products, food industry, pharmaceutical industry and electrical industry were located in the area. (Industrimuseum, 2021). As the industries were phased out in the 1980s, the area has been through a rapid development, mainly dominated by business purposes, offices and car dealerships. Today, Skøyen marks the start of urban Oslo in the west.



1901

Thune Mekaniske Verksted

moves to Skøyen, producing

1962

Sølyst, today known as Sjølyst, was one of many "Løkkeeiendommer", agronomic properties used for food supply for citizens. The property gave name to the neighborhood. In 1842, a swiss chalet styled house was built, and people started to live there. The City of Oslo bought the property in 1898 ,and planned to built a natural gas power plant, but Aker municipality said no. The house was demolished in 1957 as part of the development of the area and the changed route of Drammensveien.

#### 2007

Sjølystlokket (green lid) is completed in connection with the development of a new residential area where the Norwegian Trade Fair used to be.





Fig 13: Painting from 1820. Karenslyst to the left, Sølyst in the middle, to the left for the road. Looking at old paintings can give an impression of the landscape before it was developed. Such sources can also give a clue aboth species in the area.

Source: Oslo Museum, https://www.oslomuseum.no/

#### DEMOLITION OF THE COASTAL ZONE

Demolition of the coastal zone is a threat against marine life and biodiversity. Worldwide natural coastlines have been straightened out, and transformed into hard, straight and smooth lines built in materials that are not optimal for biological diversity.

During the last 100 years, the seabeds in the urban parts of the Oslofjord has been radically changed. The Hoff Rivers Estuary used to be a large wetland area, but in the 50's, it was gradually demolished. (Sørensen, 2020)



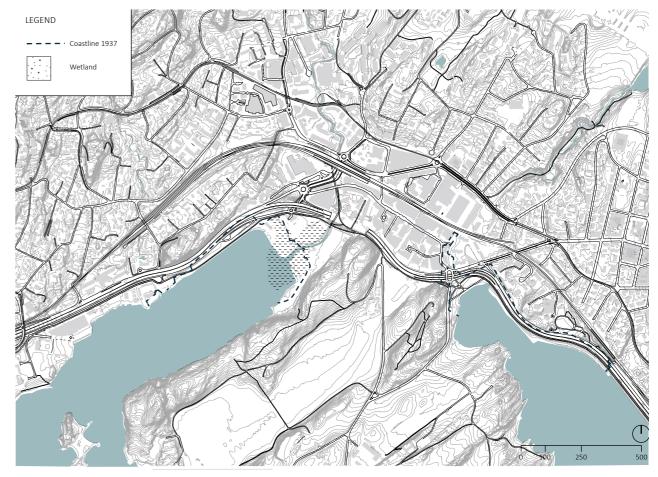
1926: The Hoff River's estuary with wetlands Photographer: Anders Beer Wilse, Oslobilder.no



1936: The Hoff River with wetlands Photographer: Anders Beer Wilse, Oslobilder.no



1953: In the 50s, the area around the estuary and river is gradually being demolished. More boats can be seen on the water. Photographer: Anders Beer Wilse, Oslobilder.no



The mapping shows the historical coastline in 1937 Map source: gulesider.no



### CASE AREA: SJØLYST

The orange color shows the case area. Photos to the lefts from the site surveys gives a first impression and shows the existing

Existing situation: A fence around the whole area, lack of entrances and connections to the surroundings, asphalt, noise from the highway and a forgotten river. In the spring and summer, the activity at Sjølyst is associated with boats and the rowing club. During winter the place is almost empty (except for boats) and it does not feel welcoming. The atmosphere is rather gloomy.

The area has great potential, due to its central position close to Skøyen station, access to the fjord, great view and the size of property. In the Oslo context it is quite unique, as Hoffselva is one of few rivers that actually has the space to flow into the fjord.





View from the green lid towards the case area. The boats makes it almost impossible to get a glimpse of the fjord.

One of two entrances in the fence. Not exactly inviting. A small path along the river leads to the coastline



View upwards Hoffselva from the bridge that connects the western and the eastern part of



the case area.

The boat storage.



Great view from the bench at the coastline but the surroundings are rather sad.



Most of the case area is covered with asphalt. This part is used as parking lot by camper wagons during summer.



Small recreational path. Difficult to find and a sad view to the left. It is simple standard on the path itself however it feels natural, kind of a "path in the woods"

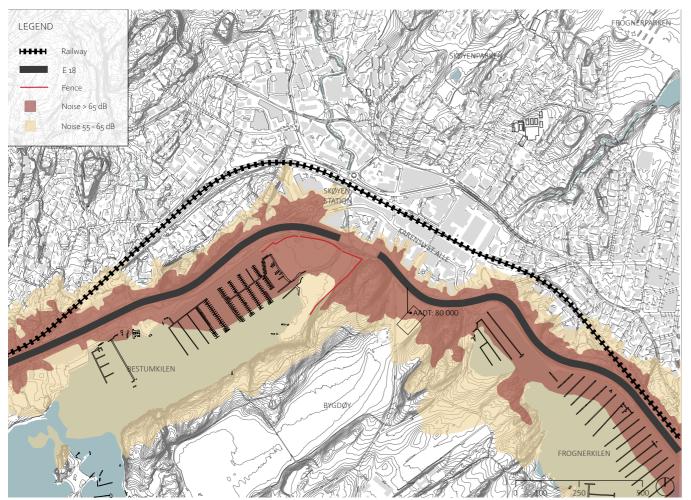


View upwards Hoffselva, from the estuary. Hard, smooth surfaces dominates the constructions.



The southern part is a natural beach. It continues further south before steep rocks takes over.

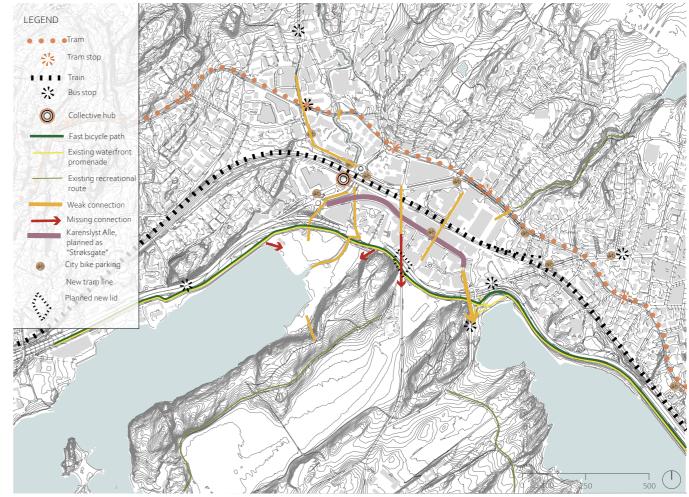
#### BARRIERS



The case area is located between the fjord and E 18. A fence runs along the entire area, and makes it feel closed to the public. There are only two small entrances, which makes it disconnected and poorly integrated into the surroundings.

E18, with an AADT of 80 000 is a massive barrier between Skøyen and the fjord. It can be crossed at three points, only one of these, the green lid (Sjølystlokket) feels like a real connection, but even this one needs to be better. Today it consists of mostly grass and a few bushes.

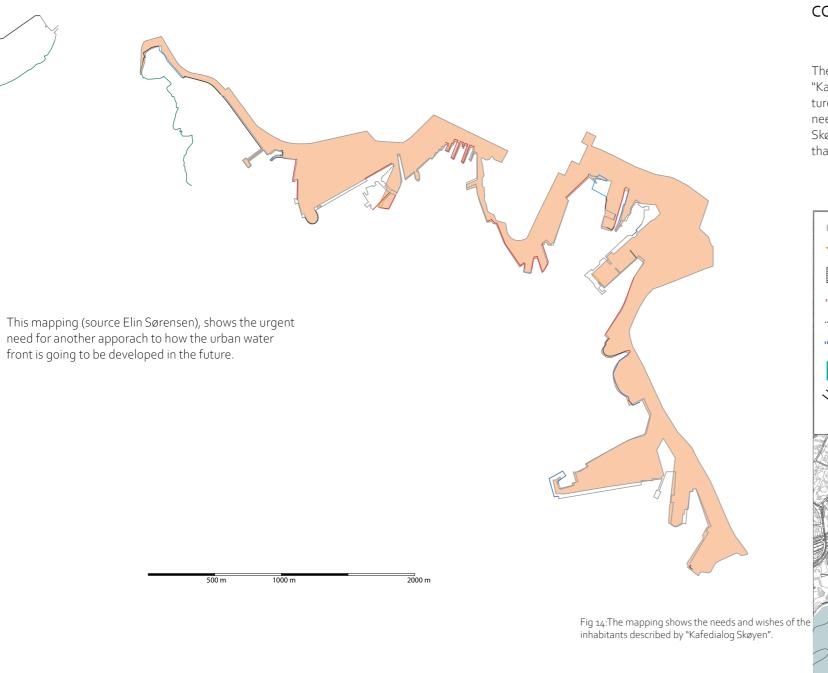
#### CONNECTIONS AND GREEN MOBILITY



The mapping shows green mobility and connections around and through the case area.

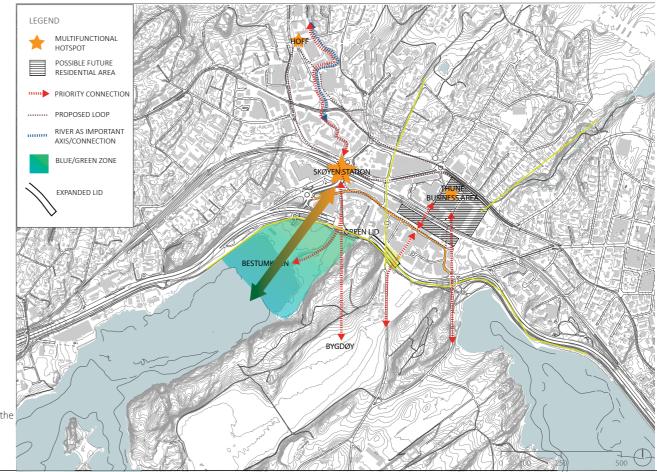
In the future, Skøyen is to be developed as a central collective hub. Fornebubanen (new metro line), will get a metro stop at Skøyen Staion.

The tram line will be relocated, and a tram station will also be located at Skøyen station.



#### COMPILATION OF RESULTS IN THE USER PARTICIPATION

The mapping shows a compilation of the findings in the user participation by Ullern Bydel in "Kafedialog Skøyen", (presented in the background chapter). This is usefull in the overall structure plan to show new connections and connects the urban Skøyen based on the whishes and needs of the inhabitants. The mapping also shows the three focus areas of "Kafedialog Skøyen": Skøyen Station, Hoff and Thune. These are to be developed and the inhabitants wants a loop that connects them better.



#### BESTUMKILEN

Bestumkilen is the northernmost part of the inner Oslofjord and is part of the Oslo fjord called Vestfjorden. It is located between Drammensveien and Bygdøy, and stretches from Killingen and Vækerø in the south to Hoffselvas estuary in the north. Sjølyst is located in the innermost part of Bestumkilen, between the fjord and the highway E18. The City of Oslo is the owner of the Sjølyst property.

#### Existing situation:

As mentioned in chapter 2, the area is used for marine purposes and most of the wedge is covered with pontoons and leisure boats. In the winter, Sjølyst is used as boat storage. During the summer, the area is used for caravan cars, reparation of boats and marine activities. Both sides of the river consists of wooden and concrete docks. A crane and a ramp is used for putting the boats on the water. Asphalt covers most of the area. A fence surrounds most of the case area and there are few entrances.

#### User groups:

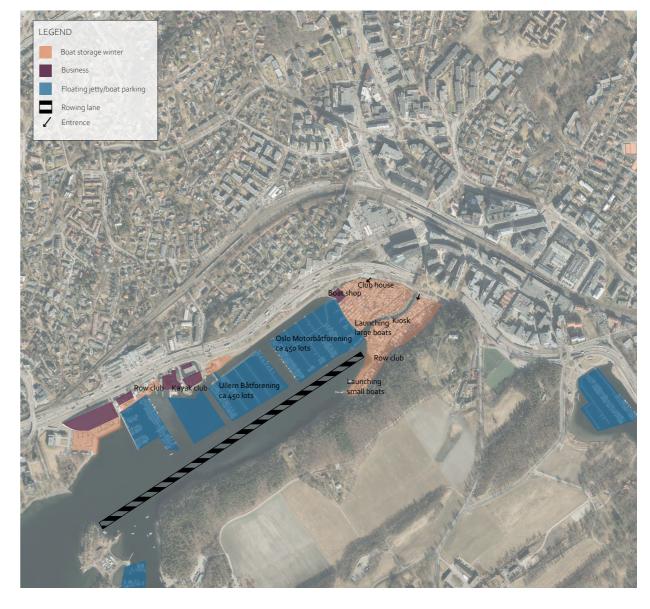
"Oslo Motorbåtforening", "Ullern båtforening", "Maritim båtforening", "La-Sa Båt" and "Motos AS" are among the boat associations in the case area. In total, there are 1060 boat places in the area. "Bestumkilens venner" consists of "Oslo Kajakklubb", "Oslo roklubb" and "Bestumkilen roklubb".

#### Challenges:

The area can be described as a blue parking space (Sørensen, 2020), where leisure boats covers most of the water surface in the innermost part of the wedge, and also on land during the winter.

Sound is among the important environmental factors for animals and fish at the top of the food chain; they uses this for communication and a sign for danger. (Ryvarden, 1997) A high amount of leisure boats entails great activity and thus noise from propellers.

Sunlight is another environmental factor that is essential, both for life on land and life below water. The sunlight is essential for plants to grow also in the sea. When most of the water surface is covered with pontoons and leisure boats, the sunlight reaching down to the sea bed is reduced, and this also reduce the biodiversity below water.



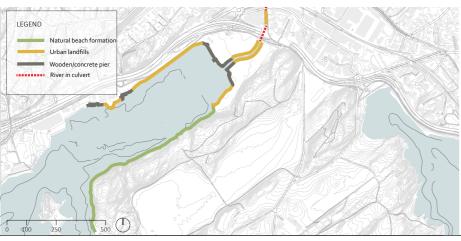


Fig 15: Shows which type of waterfront Bestumkilen has. (Based on Rinde & Sørensen, 2019)

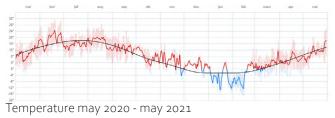
Fig 16: Shows the existing situation and current land use

## LOCAL CONDITIONS

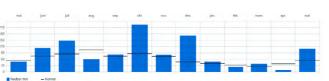
#### Climate:

The Inner Oslo Fjord is protected, and has a climate with warm summers and cold winters. (Arvnes, 2019). The case area is placed in climate zone H3, actually close to Climate zone H2 (Det norske hageselskap, unknown) The wedge is shallow and protected.

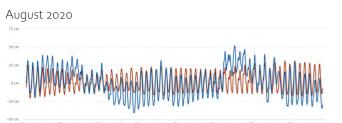
#### Annual precipitation: 881 mm Annual average temperature: +4,9 C



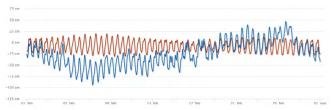
Map source: https://www.yr.no/nb/historikk/graf/1-72883/Norge/Oslo/Oslo/Bestumkilen







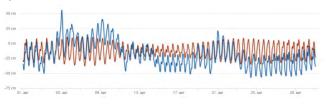
#### February 2021



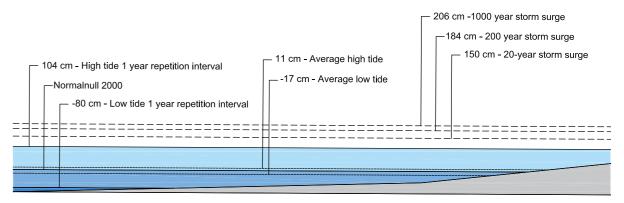


Water level

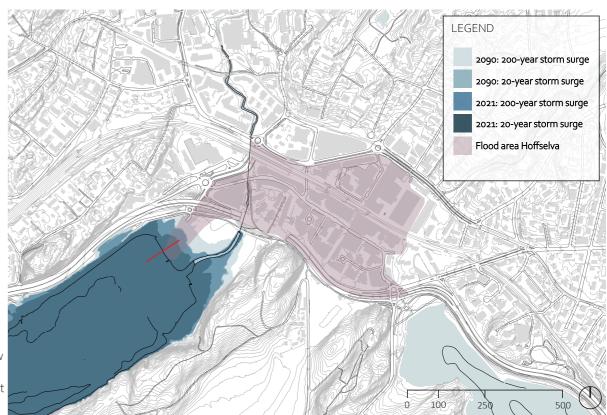
#### April 2021



The mapping shows how storm surge and flood caused by the river affect the area.



Section showing tides and different events of storm surges. Based on https://www.kartverket.no/til-sjos/se-havniva



Map source: https://www.kartverket.no/til-sjos/se-havniva/resultat?id=72673 74 Hoffselva is 10,1 km long and one out of then main watercourses in Oslo municipality. The river originates at Tryvannshøgda, flows through Holmendammen and Smedstaddammene, and forms at the confluence of Holmenbekken and Makrellbekken by Hoff Gård (Hoff Farm). The river empties in the Oslofjord at Sjølyst.

The watershed is 14,3 square kilometers and the runoff comes from Voksenkollen, Holmenkollen and Vettakollen. In the lower parts, the average water flow is estimated at 0,2 m<sup>3</sup>/s. 27 percent of the watershed consists of non permeable surfaces. (Eriksen et. al., 2021)

The upper part of the watershed consists of volcanic rocks with a thin layer of loose material. The flora is mainly pine and spruce. The lower part consists of limestone, slate and sandstone covered with clay or crumbling rock. The flora is mainly gardens.

#### Challenges

To ensure a healthy estuary, both as biological habitat and as a recreational area for people, it is important to look at the whole water body.

The culvert under E18 is exposed both to heavy rain and high water levels in Bestumkilen and the capacity is not sufficient for a 20 years flood. As there are no other drains, the area above the culvert inlet is exposed to flooding. Both E18 and adjacent buildings are at risk. In addition to this, the culvert and the tunnel interrupt the possibility to walk along the river. The culvert also damage the biological condition and is a barrier when is comes to the river as an ecological corridor.



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Hoffselva and its watershed

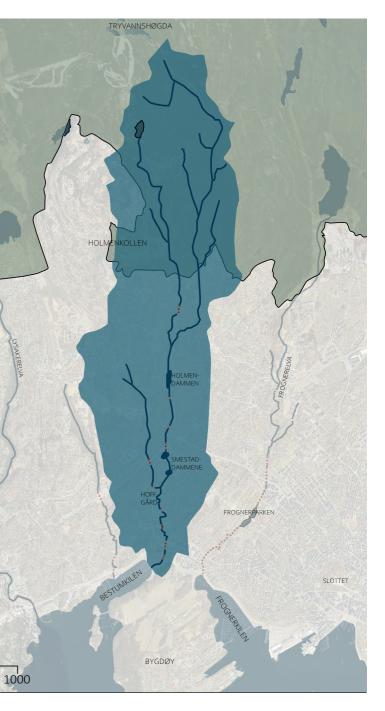
LEGEND

River

Watershed

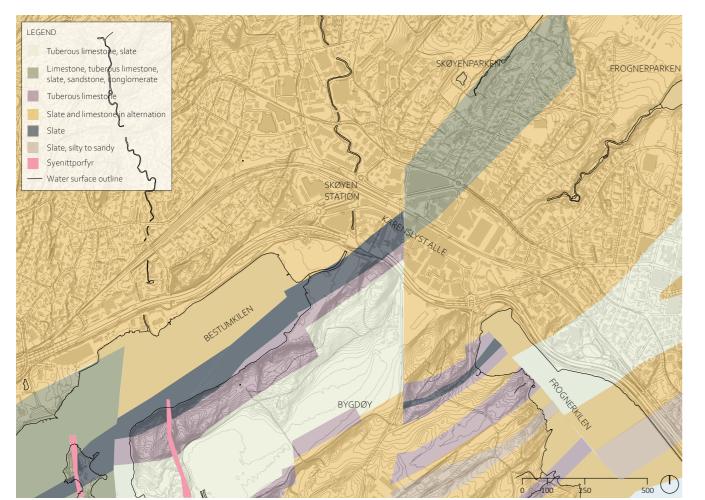
Nordmarka

Mapsource: Gule sider and Nevina



Bedrock





Bedrock: The Oslo region is placed in a interesting geological place

Mapsource: Gule sider and geo.ngu.no

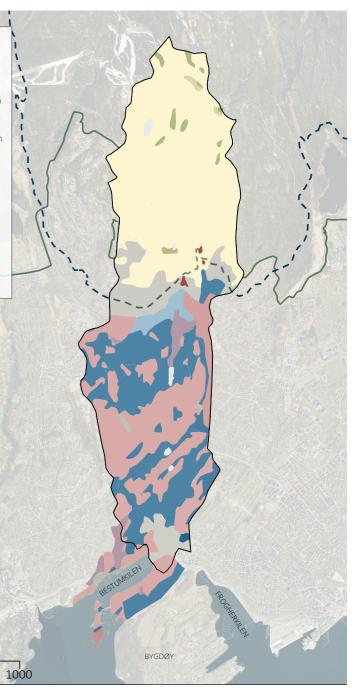
LEGEND Landfill Weathering material Thick Oceans deposition Thin Oceans deposition Marine beach deposition Water surface Bare rock Peat and bog Glaciofluvial deposition Marine material Marine border Nordmarka border Watershed Hoffselva

Soilmap of the watershed.

Mapsource: Gule sider and geo.ngu.no

 $\bigcirc$ 

500



The Oslofjord is characterized by the population density in the surrounding areas, as well as it's shape and form. The geological conditions, in addition to a favorable climate creates a rich flora and fauna.

The fjord is about 120 km long and consists of the Inner Oslofjord and the Outer Oslofjord. It stretches from Færder Lighthouse in the south to Bestumkilen in th north.

More than two million people have the Oslofjord as their nearest recreational area. It is one of the busiest fjords in Norway, thus an important part of the infrastructure, including freight traffic, passenger traffic and leisure boats.

Since the beginning of the 20th century, the inner part of the Oslofjord has been fundamentally changed. The seafront has been reshaped and filled out. Human activity contributed both to pollution and densification that displaces th nature. Parts of it must be considered as lost nature and not possible to reverse to a state without human traces. However, measures such as repair and restoration will improve and secure existing biological diversity. (Ryvarden, 1997)

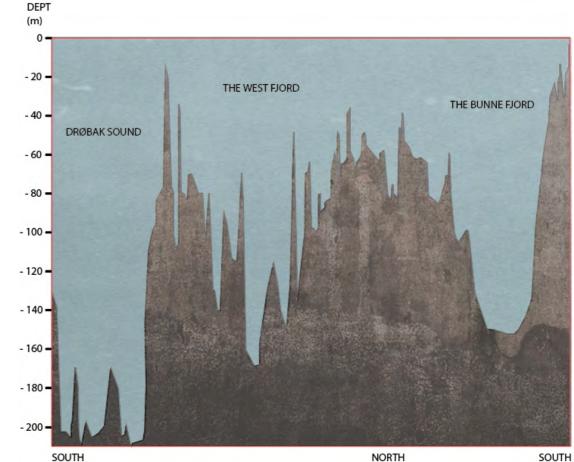
#### Geology

The area surrounding the Oslofjord is characterized by its special geology. The mainland on the east side of the fjord is part of the Baltic bedrock shield and consists of hard and acid granite. This formation ends in two faults, on that created Bunnefjorden, and runs along it today. The other runs along the west side of the peninsula Nesodden and the west side of Østfold county. Together, this two faults creates the fjords characteristic profile. The area west for these faults sunk and is today on the bottom of the fjord. Before this, most of the area consisted of slate rocks deposited in a large ocean. When the western part of the fjord sank, these rocks followed. The result is that the slate today is located on the west side of the fjord from Hurum to Sognsvann and on some islands. Slate weathers easily, and this has created many sheltered bays and shallow areas. (Ryvarden, 1997)

#### Challenges

The Oslofjord is a typical threshold fjord where the narrow and shallow stretch outside Drøbak is the main threshold in the fjord. The depth here is only 20 meters. This leads to limited water replacement and hypoxia in the deepest water masses. The climate in the area is calm weather with warm summers and cold winters. Shorter winters in the future will provide more runoff. (Ibid)

Oslo is growing fast, and prognoses indicate that one million people will live in Oslo in 2040. Runoff from the surrounding agricultural and industrial areas together with human activity poses great pressure and have a negative impact on the fjord.



Due to the threshold at Drøbak, the change of water in the inner fjord is reduced, but most areas have an annual change of water. This makes it vulnerable to changes.

## GREEN STRUCTURE AND BIODI-VERSITY IN THE CASE AREA AND ITS SURROUNDING

The overall mapping shows the green structure at Skøyen. Bygdøy, Frognerparken and Skøyenparken are large public green areas, of different character. While Skøyenparken and Frognerparken are parks, Bygdøy consists of vulnerable forest with many endangered species.

In the urban center of Skøyen, there are almost no green areas and few trees. A lot of the surface is used as parking lots. This area needs more ecological stepping stones between the larger green areas Bygdøy, Frognerparken and Skøyenparken.

The rivers forms important blue and green corridors, but these are weak when crossing the urban center of Skøyen. The weakness is caused by culverts and pipes, and little place for the river in an increasing dense area.

Some of the smaller green spaces are trapped between different roads and must be considered as less vulnerable.



OK clear water, but almost no life. Som algae, but almost no seaweed.



l observed several individuals of the Pacific oyster, *Crassostrea gigas* on the site surveys, both on land and in the water. This species is invading and displaces local species and is thus blacklisted.



The green lid needs to be strengthened as a ecological connection.



#### VULNERABLE NATURE TYPES AND SPECIES

Due to the unique geology, climate and location in climate zone H2-H3, the case area has great potential to a lot of biodiversity.

Hengåsen: Northwestern part of Bygdøy. In the steep slopes in this area, consisting of loose slate that makes the ground unstable, many species are observed: *Pinus*, all the way down to the beach, *Seseli libanotis*, *Campanula rotundifolia*, *Hieracium Umbellata*, *Poa compressa* and *Lotus corniculatus*. Also some light loving species ,such as *Geranium sanguineum* and *Filipendula vulgaris* are located here. *Leymus arenarius*, *Sonchus arvensis*, *Silene uniflora* and *Tripleurospermum maritimum* are also among the species observed close to the case area and with the similar conditions. (Bendiksen et. al., 2005)

**Close to the rowing club**: Biological vulnerable spot with a small sump and a small meadow consisting of *Phragmites australiensis, Angelica archangelica ssp. Litoralis, Euphorbia palustris, Valeriana sambucifolia ssp. Salina, Calystegia sepium* and *Alnus incanata*. (Ibid)

**Close to Smedbråten**: Trees such as *Pinus, Acer, Corylus, Ulmus* and *Tilia*. The herbal layer consists of among others *Anemone hepatica*. (ibid)

Northwest of Bygdøy down to Bestumkilen. Three red listed species that are endangered lives here: Saxifraga osloensis, Sorbus aria and Sorbus Hybrida. (ibid)

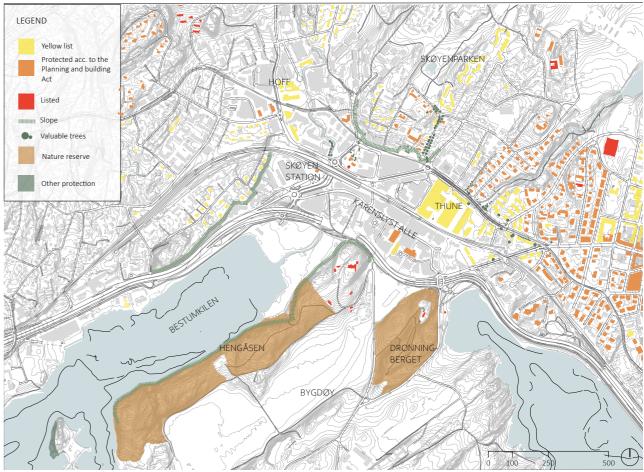


The mapping shows vulnerable nature types in the areas surrouning Sjølyst. Map based on http://naturtyper.artsdatabanken.no/

#### NATURE RESERVE

Prinsesseåsen, previously known as Hengåsen, plunges steeply down towards Bestumkilen. Cambro Silurian folded rocks and dark slate, sometimes pierced by syenite passages goes all the way to Huk. The purpose of the reserve is to protect lime Pine forest and limestone forest with great biological diversity.

The reserve has a lot of rare and endangered species that only lives in limestone tilia wood, among them insects, plants and fungi. Vegetation, dead trees and wildlife are protected. Motor traffic, use of bicycles and horses, bonfires and camping are prohibited.



The mapping shows protected buildings and vegetation, characteristic land shapes and nature reserves at Skøyen and Bygdøy



DESIGN APPROACH PROJECTING

## 05 DESIGN PROPOSAL

## DESIGN APPROACH

A part of the thesis' primary goal is to come up with a robust design proposal that contributes to increased biodiversity. In order to achieve this, the selection of vegetation and the placement of it is based on principals for restoring nature in urban areas and the ecological areal principles for green structure planning:

- Continuous. Maintain existing nature and original nature types in the area
- Structural variety, materials benefiting biodiversity in a beach zone. Variety creates habitats for more species.
- Biological diversity based on local species. Facilitate for species from surrounding area to come join
- Dynamic: the nature is in constant change. The area is designed in a way that implements this. Both daily and annual change such as tide water and seasons, but also long term change.

Multi-functional urbanity will include facilitation for people as well. Important aspects here are green mobility through the area and good access to surroundings, aesthetically experience provided by nature itself and the possibilities of achieving knowledge about nature. The latter contributes to that the more people know about their close nature, the more they will appreciate it and take care of it in their daily life.

#### ESTABLISHMENT OF HABITATS

In order to achieve sub-goal 1, *Strengthen biodiversity and green corridors/stepping stones through the dense, urban parts of Skøyen*, ecological areal principles for green structure planning is used.

In order to strengthen biodiversity and ecosystems, the green structure needs to consist of areas with certain qualities. The following principles in fig 16 are based on knowledge about what different plant- and animal requires.

Distance		
Size		••••
Shape		
Variation	°. O o	
Corridors		
Bufferzone	$\bigcirc$	
Variety in biot	tops	a fig afig a
Age	Ta vare på gamle biotoper	Rasere all eksisterende natur, for så å plante ny
Border effect	• • •	ムトナ
	EIG 16 Ecological areal pri	nciples for groop struc

FIG 16 Ecological areal prinsiples for green structure planning. Miljødirektoratet, 2014

## DESIGN PROCESS

#### CONNECTIONS

The design of the connections contributes to achieve subgoal nr 1, *Strengthen biodiversity and green corridors/stepping stones through the dense, urban parts of Skøyen* and nr 2, *Strengthen the connection between Skøyen and the fjord.* 

#### TREES - THE GREEN CONNECTIONS

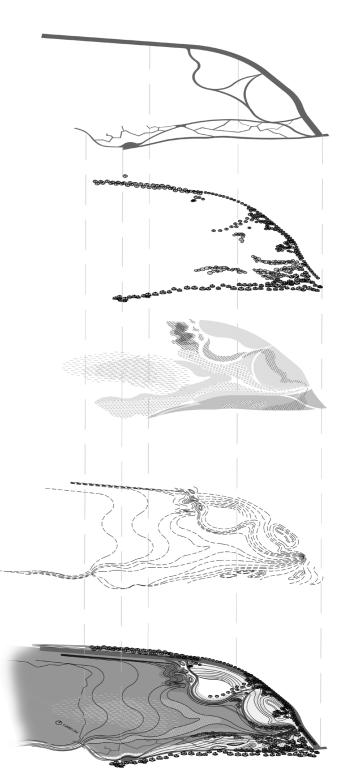
Trees contribute to green corridors/stepping stones through the dense, urban parts of Skøyen and work as a visual connection for people.

#### **VEGETATION ZONES**

The vegetation zones contributes to answer the research question regarding the creation of a robust ecosystem.

#### TOPOGRAPHY

Forming the terrain contributes to achieve sub-goal nr 5, Improve the connection between ecosystems on land and in the fjord.



## OVERALL PLAN

The overall plan shows how Skøyen can be better connected to the fjord. This plan is based on results from the user participation by "Kafedialog Skøyen", presented i chapter 2 and in the mapping in chapter 4.

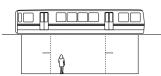
#### MEASURES:

- Expand the underpasses crossing the railway and E18.
- New underpass connecting the east end of Karenslyst Alle and Thune.
- Holistic use of materials for the city floor
- Use trees as a visual connection
- Marking of the river in culvert on the surface.

The overall plan also shows proposed green structure in the urban parts of Skøyen, as important connections for animals and insects. This smaller green spaces works as stepping stones between the large green areas Bygdøy and Skøyenparken/ Frognerparken.

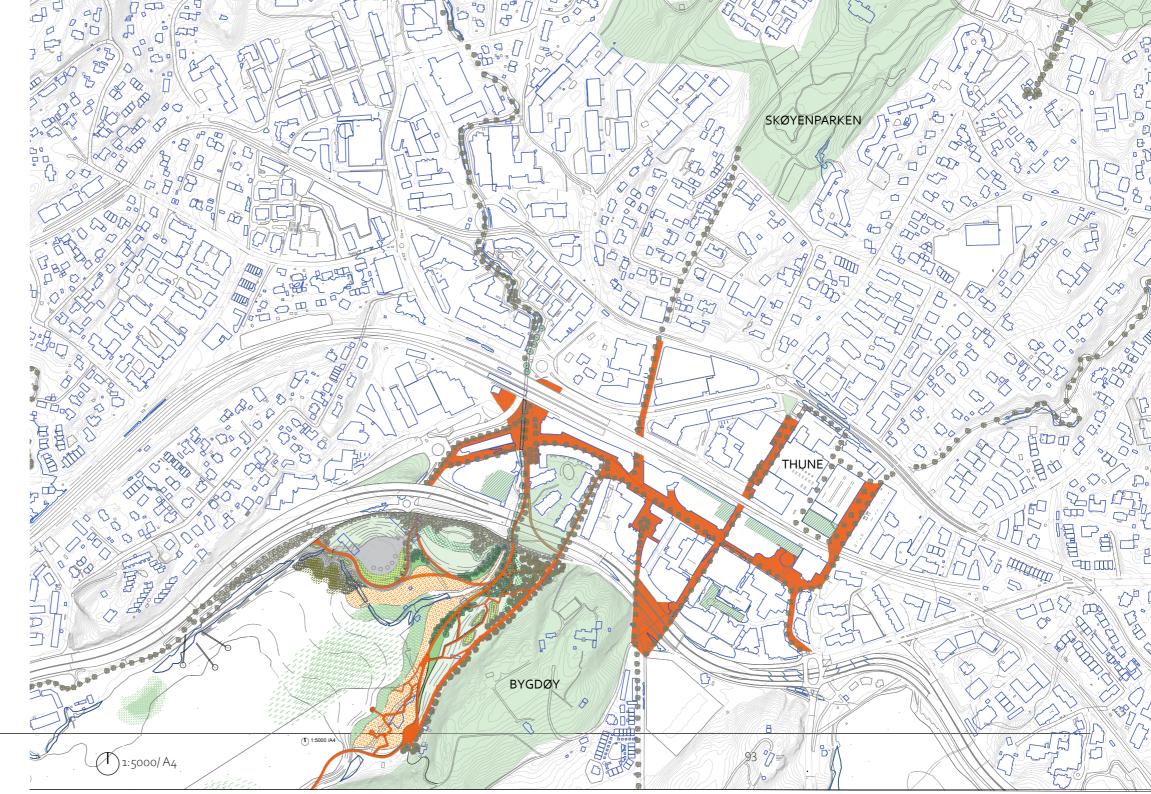
The overall plan achieves the sub-goal number 2, Strengthen the connection between Skøyen and the fjord.

The sub-chapter "Use of materials", presented later on in this chapter, gives the description of which materials i propose to use in my overall plan.



By expanding the underpasses, the railway and E18 feels less as a barrier. This also contributes to how safe it feels to walk there because one gets a better overview.

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## DETAILED DESIGN PROSAL

Sjølyst is designed as a generous green space, for both people and biodiversity. The large size of the proposed area is among its qualities. As Skøyen is in an ongoing rezoning process and the number of apartments and inhabitants in the area is planned to increase, the programming is made loosely to secure a flexible green area that easily can develop and adapt to the needs and wishes of future inhabitants of Skøyen.

The area appear as an open, large public area, this is among its qualities: offering inhabitants and visitors space, light and access to the sea and securing a flexible use. In this way, the area can further adapt and grow when new residential are to come in the future, and develop with new inhabitants and future needs.

Based on analysis and the surroundings, the area is divided by the river into two parts: the west side forms the antroposentric basis, the east side forms the ecological basis.

The figurs shows how the two sides are connected.

The area in the west has a anthropocentric basis. The cafe and activities for people are placed here. This side is chosen as the anthropocentric of many reasons:

- The building itself protects against noise from E18
- Proximity to the highway means better access for people using the row lane
- Closer to and easy access to the Skøyen station.

SAUNAS

POINT OF VIEW

AREA FOR OUT-DOOR TEACHIN

94

(T)1:2000/A4

95

ELEVATED PATHS

FLEXIBLE LAWN

The side on the east has a biosentric basis. This side is in close connection to the nature reservate Hengåsen. It is also better for creating habitats and peaceful surroundings for animals and birds when it is further from the highway. By moving the rowing club house to the other side of the wedge, cars don't have to drive in this area. People can walk here, but the pathways are elevated in order to protect wild life. At this side, people are visitors.

#### TOPOGRAPHY: A waved surface

#### Measures

- Natural connection between the seabed and land
- Creates micro-climate with sunny and shadow sides
- Protect case area against noise from E18
- Create a dynamic landscape that gradually reveals itself as one moves through it.

The main goal for the terrain is to create a natural connection between land and the seabed. Shaping of the seabed has been done according to different vegetations habitat requirements. The result is a holistic, soft waved surface, stretching from the sea bottom and spreads throughout the area, consisting of tidal pools, beach rocks, an integrated building and small hills. In the north, the formation ends in a ridge, working as noise protection and viewpoint .

By removing the harbor and move the coastline further in, closer to where it naturally used to be, the seabed is remade as a slack and terraced. The seabed connects with the terrain on land without large elevation differences. The river has been given more space, and is now allowed to have a proper estuary.

By doing this, I have created a robust landscape that is better shaped to be resilient during events such as storm surges, heavy rain and snow melt.

#### TREES

Trees are placed along the river, and at the boarders of the case area. The purpose of this is to make a protection against the highway. Trees are also used along the connecting pathways to create a visual connection. This also supports the idea that the pathways also are for insects. The vegetation being used are pollinator friendly or good for birds.

The heights of the vegetation: The highest vegetation is along the highway. The vegetation gets lower further in and at the center there is an open space. This, together with the topography creates spatial dynamic and contribute to make sequences in the landscape: When entering, you don't see the whole area at once, but parts of it appear when you start moving through it. This also allows different views depending on which angle you see the landscape from.

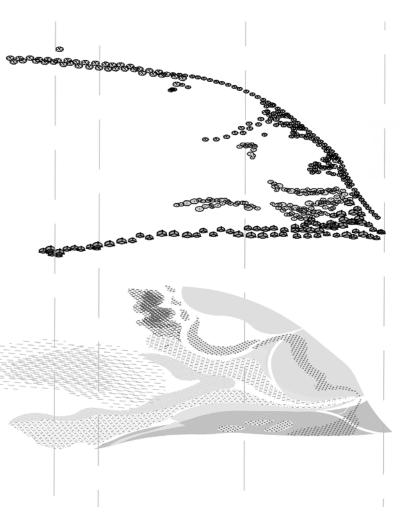
The vegetation along the river and in the tidal zone follows the tidal zones and offers a number of services: a buffer-zone, purifying, nesting and aesthetic services.

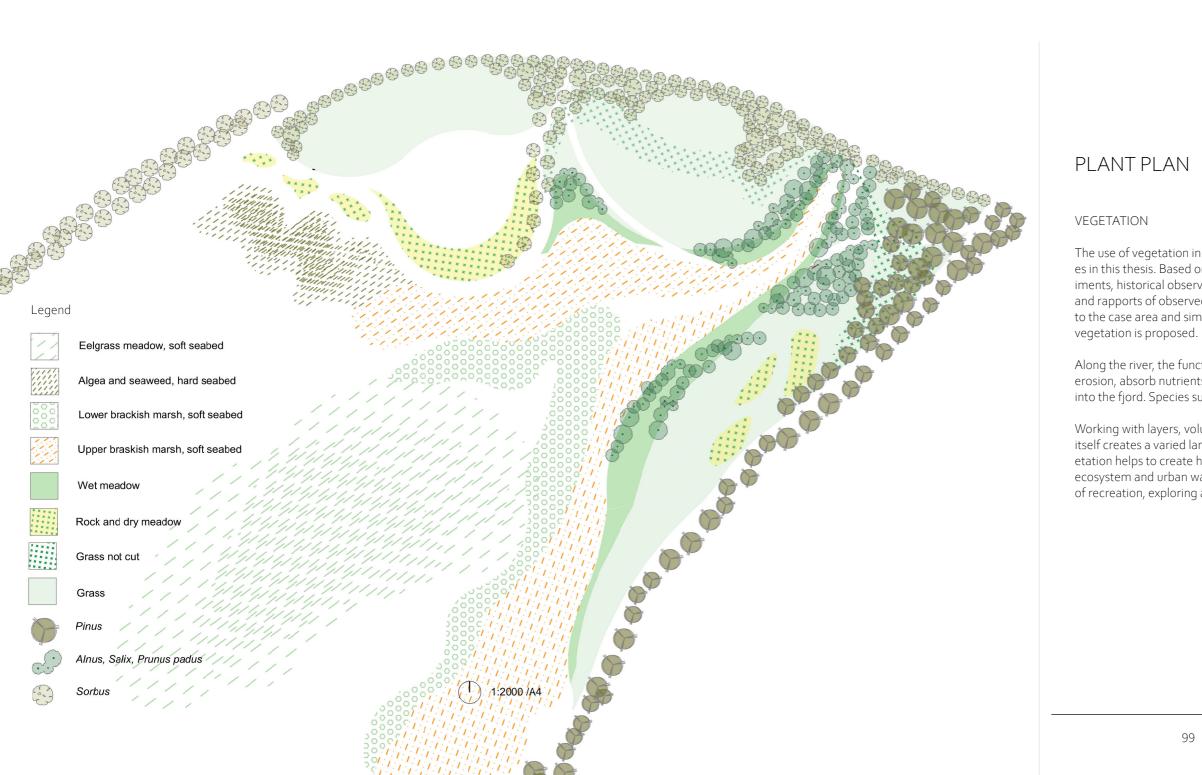
Trees are planted in the outer parts of the area, to protect against the road, to loosely frame the area and to make an impression of Bygdøy being dragged into the case area. This vegetation continues along the connecting pathways to the station and Karenslyst alle and to Thune and Hoff.

In the herbal layer in the outer part of the case area, the grass is allowed to grow high, to create spatial quality. This is also a way to make flexible pathways. The pathways can be made by lawn mower and can change during the seasons to give visitors new experiences.

Vegetation is used to create a spatial quality. Sequences of vegetation in the area contributes to the effect that the whole case area is not revealed at once. The topography is pretty flat, so vegetation being used to create habitats and hiding places. The vegetation also creates a more dynamic and varying landscape.

The topography and placement of buildings are made in a way that the green area easily can be adapted and integrated when or if, the highway is to be removed in the future.





The use of vegetation in the design is one of the major focuses in this thesis. Based on mapping of geology, rocks and sediments, historical observation and old pictures, site surveys and rapports of observed biological biodiversity in or close to the case area and similar surrounding areas, a selection of

Along the river, the function of the vegetation is to prevent erosion, absorb nutrients and purify the water before it flows into the fjord. Species such as Alnus and Salix are placed here.

Working with layers, volumes and locations, the vegetation itself creates a varied landscape. At the same time the vegetation helps to create habitats and making a more robust ecosystem and urban waterfront. It also works as a landscape of recreation, exploring and learning for people.

## PLANTLIST

Botanical name Zostera marina	Common name Eelgrass	<b>Norwegian name</b> Ålegress	<b>height (m)</b> 0,5 - 1	Season
HARD BOTTOM: ALGEAS AND SEAWEED				
Botanical name	Common name	Norwegian name	Height (m)	Season
Ascophyllum nodosum	Egg wrack	Grisetang	2	
Focus serratus	Toothed wrack	Sagtang	1,8	
Focus spiralis	Spiral wrack	kaurtang	0,15 - 0,3	
Focus vesiculosus	Bladder wrack	Blæretang	0,3 - 2	
Himanthalia elongata	Thong weed	Knapptang	0,5	
Pelevetia canaliculata	Channelled wrack	Sauetang	0,1	
LOWER BRACKISH MARSH				
Botanical name	Common name	Norwegian name	Height (m)	Season
Bolboschoenus maritimus	Sea clubrush	Havsivaks	1,2	
Carex vacillans	Swinging sedge	Saltstarr	0,3	
Carex paleacea	Chaffy sedge	Havstarr	0,2-0,6	
Glyceria maxima	Greater sweet-grass	Kjempesøtgras	2,5	
Schoenoplectus lacustris	Lakeshore bulrush	Sjøsivaks	3,5	
Schoenoplectus tabernaemontani	Softstem bulrush	Pollsivaks	1-2,5	
UPPER BRACKISH, DOWN TO 50 CM DEP	тн			
Botanical name	Common name	Norwegian name	Height (m)	Season
Agrostis stolonifera	Creeping bentgrass	Krypkvein	0,4 - 1	
Lysimachia thyrsiflora	Tufted loosestrife	Gulldusk	0,8	Jun-jul
Lysimachia vulgaris	Loosestrife	Fredløs	1,5	Jun-aug
Lythrum salicaria	Rainbowweed	Kattehale	1,5	Jul-aug
WET MEADOW				
Botanical name	Common name	Norwegian name	Height (m)	Season
Calamagrostis phragmitoides	Gras	Skogrørkvein	0,8-1,8	
Calystegia sepium	Rutland beauty	Strandvindel	2 - 3	Jul-sept
Deschâmpsia caespitôsa	Tufted hair grass	Sølvbunke	1-1,5	
Festuca rubra	Red fescue	Rødsvingel	0,15-0,9	
Filipendula ulmaria	Meadowsweet	Mjødurt	1-2	Jun-sep
Thalictrum flavum	Yellow meadow-rue	Gul frøstjerne	0,4-1	Jun - jul

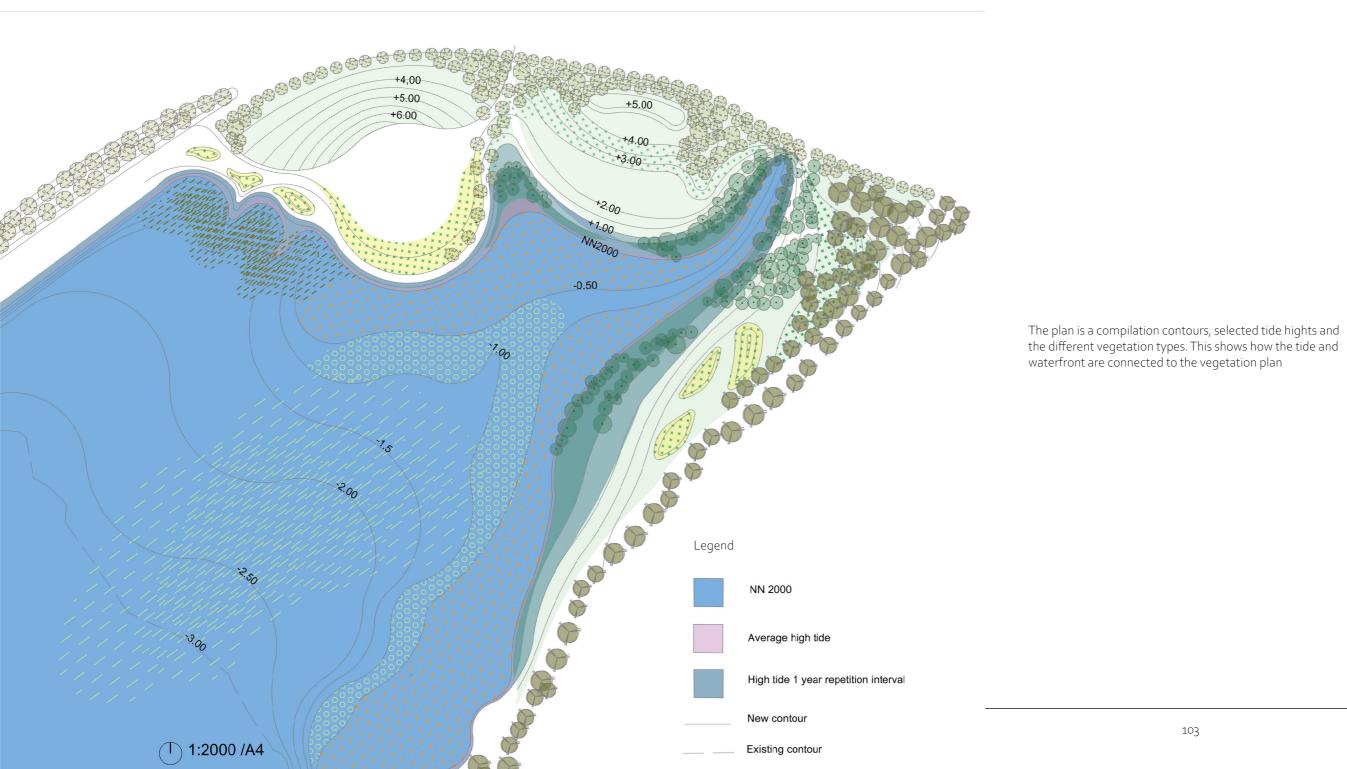
#### ROCK AND DRY MEADOW

Botanical name	Common name
Alchemilla millefolium	Yarrow
Angelica archangelica ssp. Litoralis	Norwegian angelica
Armeria maritima	Sea thrift/ Marsh-daisy
Campanula rotundifolia	Harebell
Euphorbia palustris	Marsh spurge
Filipendula vulgaris	Dropwort
Geranium sanguineum	Bloody crane's-bill
Lotus corniculatus	Bird's-foot trefoil
Poa compressa	Canada bluegrass
Saxifraga Osloensis	Saxifrages
Seseli libanotis	Moon carrot
Silene uniflora	Sea campion
Sonchus arvensis	Field milk thistle
Tripleurospermum maritimum	Sea mayweed
Leymus arenarius	Sand ryegrass
Trifolium montanum	
TREES & BUSHES	
Botanical name	Common name
Alnus glutinosa	Black alder

Botanical name	Common name
Alnus glutinosa	Black alder
Alnus incanata	Grey alder
Pinus sylvestris	Pine
Salix	Willow
Sorbus Aria	Whitebeam
Sorbus hybrida	Oakleaf mountain ash
Prunus padus	Birdcherry

Norwegian name	Height (m)	Season
Ryllik	0,1-0,6	Jun-okt
Strandkvann	0,5 - 1,2	June - july
Fjørekoll/Strandnellik	0,1-0,3	Mai-sept
Blåklokke	0,1 - 0,5	Jul-sept
Strandvortemelk	0,4-0,8	May
Knollmjødurt	0,5	Jun-sept
Blodstorkenebb	0,15 - 0,5	Jun-jul
Tiriltunge	0,1-0,3	Jun-sept
Flatrapp	0,2-0,3	
Oslosildre	0,15	May
Hjorterot	1,2	Jul-aug
Strandsmelle	0,2	Jun-aug
Åkerdylle	0,3-1,5	Jun-okt
Strandbalderbrå	0,1-0,6	Jun-sept
Strandrug	0,4-0,7	
Bakkekløver	0,15-0,45	Jun-jul

Norwegian name	Height (m)	Season
Svartor	30	
Gråor	20	
Furu	40	May - june
Pil	15	
Sølvasal	5-15 m	
Rognasal	3-8 m	May-sept
Hegg	18 m	May-june





The section shows how the river is given more space. More trees along the banks ensure a robust river zone. One of the main routes through the area goes along the bank, but it keeps some distance to protect the vegetation and fauna living there.







Upper brackish marsh

The upper brackish marsh goes down to minus 50 cm depth and are established on soft seabed between NN2000 and the - 50 countor. This part of the wetland works as a transition zone between the more monocultural wetland that grows deeper, and land. Species with floral splendor, such as *Lythrum salicaria* and *Lysimachia vulgaris* are placed near to the areas designed for people.

Lythrum salicaria

Lysimachia vulgaris

Agrostis stolonifera

High tide 1 year repetition interval

#### Dry meadow

Sorbus hybrida

Silene uniflora

The dry meadows are established at well drained places. Close to the fjord, it consists of species that tolerate salt. These meadows are important habitats for insects and many of the species are pollinator friendly. They are also important habitats for many redlisted species. The meadows are established according to the ecological areal principles. They vary in size and shape and works as stepping stones for insects through the area. They should connect to similar habitats outside the case area, to work as stepping stones between larger habitats, such as Frognerparken, Skøyenparken and Bygdøy.

Campanula rotundifolia

Sonchus arvensis

Seseli libanotis

Filipendula vulgaris

Poa compressa

#### Beach rock and tidal pool

In the artificial rock, the surface is made similar to the natural beach rocks in the area. In small depressions in the highest parts, species that requires well drained and box soil is places. They species occur point by point.

The tidal pools are located along the NN2000 contour, so they wil be flooded during the average high water. These pools will form brackish habitats, where species such as seaweed fleas, small snails and crabs can be found. They are also exciting to investigate for people.

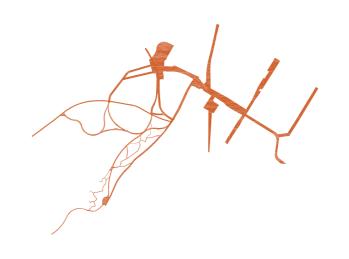


## USE OF MATERIALS

This sub-chapter is a description of the use of materials in both my overall plan and in my detailed design proposal.

The selection of materials are based on the following criterias:

- Salt tolerant where needed
- Sustainable and marine friendly
- Usable as habitats where possible
- Simple an comprehensive selection in color and expression



To create a holistic impression of the case area, and to make a visual connection to the central street, the materials used in the urban floor have one color: a warm earthtoned red. This will give a pleasant atmosphere, an important measure to the many grey surfaces in the area today. The use of a monocrome material is supposed to highlight the variety in the nature. The proximity to the fjord requires that materials being used are salt tolerant.

#### Main routes

In the central street Karenslyst Alle, the crossing connections and the main routes through the area, brickstone is used. The brickstone has a local and historical reference to the former industrial history of Skøyen: many traditional brickstone industrybuildings are still left in the area. This material is also sustainable with long lifetime when proper burned and salt tolerant.









#### Criteria for paths:

1. Use of perforated materials in the biosentric area. Secure access to light and anti slippery at the same time

2. Construction with a limited footprint

3. Use of the same colors for a visual connection

4. Surface given texture and structure where possible to create small habitats for small insects.

#### Elevated pathways

The smaller, elevated pathways are made of salt tolerant steel in the same color tone as the brickstone. They are perforated to secure light and rain access to the ground. The perforation also reduce the risk of slippery surfaces during rainfall and snow

Both the elevation and the perforation contribute to a contiguous habitat by allowing smaller animals to cross the path under it. .

By lifting paths from the surface, people lead to use the pathways. This will reduce the pressure on the vegetation, and by placing paths strategic, it can lead people so they don't walk into a habitat. By lifting paths, we also make sure that small animals can walk from vegetation surface to another, without have to use the same paths as humans.

## THE URBAN FLOOR OF SKØYEN

The veins of Skøyen - part of my overall plan

When more people start to walk and use bicycle as transportation, and Karenslyst Alle is to be a central street with urban life, more people will use the urban floor. As this street is supposed to be a urban room, it is important for its character what it is covered with. Asphalt is for cars. To make it attractive and to create a certain atmosphere, and also based on historical referances such as the former industrial brickstone buildings, Brickstone (marktegl) with a warm, redbrown color is a good choise.

By using the same materials in the main street and important connections across it, its possible to create an impression of Skøyen as a site. Use of the same color and texture connects the area to its surroundings. Putting effort in the city floor also makes it more intimate and inviting. A floor that shows quality also says something about that this place matter and is beeing taken seriously.

By using the same colors in the deail area, as in the urban center, the idea is to connect the detail area and integrate it in Skøyen and at the same time create seamless connections between Skøyen and the fjord.

The brickstone covers the urban main streets and the most important connections across it. Brickstone also covers the main routes in the case area.

When it comes to sjølyst, brickstone is used on the west side of the river. also in the place in front of the building. Brickstone is robust if it is burned in high temperature, it last for decades and it tolerates salt.

On the other side of the river, salt tolerant steel with the same color is used. using the same color on all pathways indicate that the pathways them selves is an important part of the design.



## SEAMLESS MEETING BETWEEN BUILDING AND LANDSCAPE

This collage illustrates the meeting between the cafe proposed in the detailed design proposal and the landscape.This building could be used as a cafe and an activity house. To make an exciting connection between landscape and the water, the floor is shaped like waves. Outside, a hard surface of rocks is established. This could be used to grow blue mussels.

The building is integrated in the topography, with a curved facade and has a landscape on top of it. The building is large enough to offer flexibility to future scenarios.

In front of the cafe, the surface consists of cast-in-place marine-friendly concrete. Clay is used as a substitute for cement. (Justnes, 2016). This is made in the same way as a skating ramp, but insted of a smooth surface, it consists of holes and curves to increase habitats. It starts on the sea bottom as the hard bottom habitat and continues in soft waves up and inside the building, creating a concluding wave in the floor.

The pathway between the concrete rock and the building is strictly shaped, only broken off by small elevations in the terrain. The brickstone in this pathway are partly covered with concrete and has the same colour as the concrete to keep the illusion of a seamless transition between water, landscape and building. A glass facade in the building is supporting this.



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The collage shows how the pathways can develope with the age of the vegetation. This is a future scenar-



The collage shows the upper braskich marsh and the pathway through it. This is just after the establishment of the green area, before the trees and other vegetation grows high.

# 06 CONCLUSION & REFLECTION

## CONCLUSION

The primary goal of this thesis was to answer the research question: How can the area surrounding the estuary of Hoffselva be transformed into a robust ecosystem that contributes to increased biodiversity and at the same time facilitates human activity? In addition the thesis listed five sub-goals:

- 1. Strengthen biodiversity and green corridors/stepping stones through the dense, urban parts of Skøyen
- 2. Strengthen the connection between Skøyen and the fjord.
- 3. Create social meeting places that does not go to the detriment of point 1 and 2.
- 4. Acquire knowledge about ecosystems along the fjord, estuary and restoration of such ecosystems.
- 5. Improve the connection between ecosystems on land and in the fjord.

The backgruond study of the case area revealed the need of rewilding to increase biological diversity and at the same time create a connection for people and fauna between the fjord and Skøyen. The case analysis shows which types of native species that can be reintroduced when retransforming the area of Sjølyst to an estuary and hence creating a robust ecosystem. My design proposal is the first proposal in this area, that I know of, that is a holistic design which combines the focus of native biological diversity and the needs and wishes of inhabitants of Skøyen.

Sub-goal number 2 is acheived by the measures of the overall plan by suggesting new connections between Skøyen and the fjord. These connections make Sjølyst a lot more available to the inhabitants of Skøyen. Further the detailed design proposal shows how the biological diversity can coexists with human recreation, i.e. the primary goal of the thesis is acheived. The rest of the sub-goals are also addressed by the detailed design proposal.

### REFLECTION

The topic of this thesis requires knowledge at a high level marine ecosystems, estuaries and local nature types and species. Even though it is possible to acquire knowledge through litterature study and site surveys, it would have been useful to discuss the selection of species and the location and shape of the different vegetation zones with a marine biolog. This would have helped to ensure the quality of the project.

Another possibility would have been to collaborate with a biology student about the thesis. Collaboration across diciplines is essential in professional life, so in addition to get an even better understanding of the theory, it would have been a good practice before one start working. It was time consuming work to make sure I got it right with the vegetation, so a cooperation would have freed up time that I could have spent on the design proposal.

## SUGGESTED FURTHER WORK

Main measures for further work

1. Create a detailed design proposal that connects this case area with Skøyen in a scenario where the highway E18 is removed.

2. Create a detailed design proposal where Hoffselva is opened all the way up to the square in front of Skøyen station. Give more space to strenghten the ecological blue and green corridor.

As the situation and plans are today, the proposal in this thesis is made based on that E18 still remains where it is. However, to really connect Skøyen to the fjord, and to make a proper bluegreen structure along Hoffselva, E18 needs to be removed and the river must come up in the day.

As E18 is a huge barrier, connecting Skøyen to the fjord is difficult without removing the highway. Due to the underdimentioned culvert and green lid, My suggestions are that E18 should be removed.

if the estuary and river are to be really reestablished, and also in a long term way of thinking, there is no doubt that reorganizing the trase of E18 is crusial. The highway is a great barriere both to people, in the way it cuts the connection between Skøyen and the fjord, both visually, emotionally and physical. The buildings along it is facing the road with their backs, and thus also Skøyen is turning its back to the fjord.

Removing E18 is also important if a proper blue-green corridor along Hoffselva is to be established.

## REFERENCES

Aksjonsgruppen for et fellesskap på Sjølyst. (2020). Sjølyst Maritime Folkepark - Et sted for alle. Accessed from: https://xn--bevarbtlivet-ycb.no/wp-content/uploads/2020/10/sjolystmaritimefolkepark.pdf (29.05.2021)

Arvnes, M. Et al. (2019). *Kunnskapsstatus Oslofjorden. Salt rapport nr 1036*. Accessed from: https://www. miljodirektoratet.no/globalassets/publikasjoner/m1556/ m1556.pdf (10.05.2021)

Apfelbeck, B. Snep, R. P. H. & Hauck, T. Et al. (2020). *Designing wildlife-inclusive cities that support human-animal coexistence.* Accessed from: https://docplayer. me/5353190-Faggrunnlag-for-alegras-zostera-marina-inorge.html#show\_full\_text (11.05.2021)

Bendiksen, E. & Bjureke, K. Et. al. (2005). *Naturverdier på Bygdøy*. Accessed from: https://www.nina.no/ archive/nina/PppBasePdf/rapport%5C2005%5C77.pdf (12.03.2021)

Borgersen, G., Rinde, E. & Moy, S. (2020). Har vi "saltmarshes" i Norge? En vurdering av begrepet opp mot norske naturtyper. Accessed from: https://www. miljodirektoratet.no/globalassets/publikasjoner/m1858/ m1858.pdf (02.05.2021)

Bydel Ullern. (2019). *Bestumkilen på Skøyen - Oslos nye folkepark*. Accessed from:https://www.skoyen. no/wp-content/uploads/2019/09/Bestumkilen-Folkepark-190824.pdf (02.05.2021)

Christie, H., Moy, F. & Rinde, E. (unknown). *Faggrunnlag for ålegras (Zoestra marina) i Norge*. Accessed from: https://docplayer.me/5353190-Faggrunnlag-foralegras-zostera-marina-i-norge.html#show\_full\_text (11.05.2021)

Det norske hageselskap. (unknown). *Klimasonekart* Accessed from:https://hageselskapet.no/hagestoff/ praktisk/klimasonekart-1 (28.03.2021)

Direktoratet for naturforvaltning. (2013). *Havstrandnatur. Tilstand, overvåkning*. Accessed from: https:// www.miljodirektoratet.no/globalassets/dokumenter/ publikasjoner/rapporter/dn-utredning\_6-2013\_nett.pdf (01.05.2021)

Eriksen, T. E. & Persson, J. (2021). Vurdering av økologisk tilstand i Oslo-elvene 2020 - Undersøkelser av bunndyr i Mærradalsbekken, Hoffselva og Hovinbekken. Accessed from: https://hdl.handle.net/11250/2735992 (06.04.2021)

Evju, M., Stabbetorp, O. E. & Olsen, S. L. Et. al. (2021). Åpen grunnlendt kalkmark i oslofjordområdet. Uttesting av overvåkningsmetodikk og resultater fra 2020. Accessed from: https://www.miljodirektoratet.no/publikasjoner/2021/januar-2021/apen-grunnlendt-kalkmark-i-oslofjordomradet/ (21.05.2021) FN-sambandet. (2021). *FNs bærekraftsmål*. Accessed from: https://www.fn.no/om-fn/fns-baerekraftsmaal (17.04.2021)

Justnes, H. (2016). *Lager miljøvennlig sement av norsk leire*. Accessed from: https://www.sintef.no/siste-nytt/2016/lager-miljovennlig-sement-av-norsk-leire/ (17.04.2021)

Kim Schulz. (2012). Lecture: *Marine Ecology - Estuarine Ecosystems*. Accessed from: https://www.youtube.com/ watch?v=GA8zUUFfBpQ (Watched 15.04.2021)

Klima og miljødepartementet. (2021). *Helhetlig tiltak-splan for en ren og rik Oslofjord*. Accessed from: https:// www.regjeringen.no/contentassets/7e80a758716344cbbb97adc5c7c27f18/t-1571b.pdf (15.04.2021)

Kroglund, T., Berge, J. A. Et.al. (2017). Endringer i horisontalutbredelsen av tang i Indre Oslofjord - betydningen av kommuens rensetiltak. Accessed from: https://vannforeningen.no/wp-content/uploads/2017/11/Kroglund. pdf (12.05.2021)

Kålås, J. A., Viken, Å. & Henriksen, S. Et.al. (2010). Norsk rødliste for arter 2010. Accessed from: https://www.nina. no/archive/nina/pppbasepdf/Rapporter%20i%20ekstern%20rapportserie/2010/K%C3%A5l%C3%A5s%20 Norsk%20R%C3%B8dliste%20for%20arter%202010. pdf (27.05.2021) Magand, C. & Alves, M. H. Et. al. (2020).*Intermittent Rivers and Ephemeral streams: What water managers need to know*. Accessed from: https://core.ac.uk/download/ pdf/326023325.pdf28.03.2021)

Miljødirektoratet. (2014). *Planlegging av grønnstruktur i byer og tettsteder*. Accessed from: https://www.miljodi-rektoratet.no/globalassets/publikasjoner/M100/M100. pdf (29.05.2021)

Nibio. (2017). *Fukt - og strandenger* Accessed from:https://www.nibio.no/tema/landskap/ vegetasjonskart/vegetasjonstyper/fukt-og-strandenger (02.05.2021)

Nie, T. (2011). Flood risk and impact assessment - Pilot project E18 Hoffsbekken. Accessed from: https:// vegvesen.brage.unit.no/vegvesen-xmlui/handle/11250/2582996 (12.03.2021)

Norwegian Environment Agency. (2020). *Miljøtema*. Accessed from: https://miljostatus.miljodirektoratet.no/ tema/ (22.04.2021)

Plan og bygningsetaten. (2015) *Byplangrep Skøyen.* Accessed from: https://docplayer.me/158858034-Avdeling-for-byutvikling-byplangrep-skoyen.html (06.04.2021)

Plan- og bygningsetaten. (Unknown). *Fjordbyplanen.* Accessed from: https://www.oslo.kommune.no/getfile.php/134073-1421674380/Tjenester%200g%20 tilbud/Plan%2C%20bygg%200g%20eiendom/Overordnede%20planer/Omr%C3%A5de%20-%200g%20 planprogrammer/Plan%20for%20Fjordbyen.pdf (22.04.2021) Regjeringen. (2020a). Norges kyst og havområder. Accessed from: https://www.regjeringen.no/no/tema/ klima-og-miljo/naturmangfold/innsiktsartikler-naturmangfold/hag-og-kyst---behov-for-a-sikre-artsmangfold/id2076396/(01.03.2021)

#### Regjeringen. (2020b).

Tilgang til strandsonen. Accessed from: https://www.regjeringen.no/no/tema/klima-og-miljo/friluftsliv/innsiktsartikler-friluftsliv/strandsonen/id2076261/ (06.04.2021)

Rinde, E. & Sørensen, E. T. Et.al. (2019). Reetablering av biologisk mangfold i Oslos urbane sjøområder. Accessed from: https://niva.brage.unit.no/niva-xmlui/ handle/11250/2631547 (17.02.2021)

Ryvarden, L. (1997). Kysten. Landskap, flora og fauna langs Norges kyst. Accessed from: https:// www.nb.no/items/URN:NBN:no-nb\_digibok\_2010060903028?page=5 (02.03.2021)

Sabima. (unknown). Økosystemtjenester- naturens goder. Accessed from: https://www.sabima.no/okosystemtjenester-naturens-goder/ (11.05.2021)

Saltveit, S.J., Bremnes, T. & Pavels, H. Et.al. (2016). Tilstand for bunndyr og fisk i Hoffselva og Sognsvannsbekken-Frognerelva i 2016. Accessed from: https://www. nhm.uio.no/forskning/publikasjoner/nhm-rapporter/ nhm-rapport-059-2016.pdf (15.04.2021)

Smevold, B. H. (2019). Biomangfold i hovedstadsområdet. Firbladet 2019-1. Accessed from: https://botaniskforening.no/biomanfold-i-hovedstadsomradet (24.03.2021)

Statistisk sentralbyrå. (2020). Byggeaktivitet i strandsonen. Accessed from: https://www.ssb.no/natur-og-miljo/areal/statistikk/byggeaktivitet-i-strandsonen (06.04.2021)

Sørensen, E. T. (2020). Podcast: "BiomangfoldOslo", Episode 5: Den blå parken. Accessed from: https://www.sabima.no/podcast-om-biomangfold-i-oslo/ (27.05.2021)

The Agency for Planning and Building Service. (2021). Områderegulering for Skøyen. Forsalg til politisk behandling 19.04.2021. Accessed from: https://www.oslo. kommune.no/getfile.php/13403320-1618988965/Tjenester%200g%20tilbud/Politikk%200g%20administrasjon/Slik%20bygger%20vi%20Oslo/Plan-%200g%20 bygningsetaten/Fjordbyen%20vest/Sk%C3%B8yen/ Dokumenter/Omr%C3%A5deregulering%20 Sk%C3%B8yen%202021.pdf (30.04.2021)

Unknown. (2021). Industrihistorisk vandring på Skøyen. Accessed from: http://industrimuseum.no/skoyen (02.02.2021)

United Nations. (2021). Oceans and sea. Accessed from: https://sdqs.un.org/topics/oceans-and-seas (06.04.2021)

United Nations Environment programme. (2021). Preventing, halting and reversing the degradation of ecosystems worldwide. Accessed from: https://www.decadeonrestoration.org/ (28.05.2021)

U. S. National Ocean Service. (2021). What is an estuary? Accessed from: https://oceanservice.noaa.gov/facts/ estuary.html 28.03.2021)

Wohl, E., Bledsoe, B. P. & Jacobson, R. B. Et.al. (2015). The Natural Sediment Regime in Rivers: Broadening the Foudation for Ecosystem Management. Accessed from: https://academic.oup.com/bioscience/ article/65/4/358/254680(28.03.2021)

Østenstad, P. & Hjelmervik, K, (2018). Innsamling av hydrografiske data i Oslofjorden - FFIs bidrag i prosjektet FiordOs II. Accessed from: https://publications.ffi.no/nb/item/asset/ dspace:4238/18-01333.pdf (20.05.2021)

## FIGURFLIST

Figur 1. Klima og miljødepartementet. (2021). Helhetlig tiltaksplan for en ren og rik Oslofjord. Accessed from: https://www.regjeringen.no/contentassets/7e8oa758716344cbbb97adc5c7c27f18/t-1571b.pdf (15.04.2021)

Figur 2. Plan- og bygningsetaten. (Unknown). Fjordbyplanen. Accessed from: https://www.oslo.kommune. no/getfile.php/134073-1421674380/Tjenester%20 og%20tilbud/Plan%2C%20bygg%200g%20eiendom/ Overordnede%20planer/Omr%C3%A5de%20-%20 og%20planprogrammer/Plan%20for%20Fjordbyen.pdf (22.04.2021)

Figur 3. Plan og bygningsetaten. (2015). Byplangrep Skøyen. Accessed from: https://docplayer. me/158858034-Avdeling-for-byutvikling-byplangrep-skoven.html (06.04.2021)

Figur 4. The Agency for Planning and Building Service. (2021). Områderegulering for Skøven. Forsalg til politisk behandling 19.04.2021. Accessed from: https://www. oslo.kommune.no/getfile.php/13403320-1618988965/ Tjenester%200g%20tilbud/Politikk%200g%20administrasjon/Slik%20bygger%20vi%20Oslo/Plan-%200g%20 bygningsetaten/Fjordbyen%20vest/Sk%C3%B8yen/ Dokumenter/Omr%C3%A5deregulering%20 Sk%C3%B8yen%202021.pdf (30.04.2021)

Figur 5. Bydel Ullern. (2019). Bestumkilen på Skøyen - Oslos nye folkepark. Accessed from:https://www. skoven.no/wp-content/uploads/2019/09/Bestumkilen-Folkepark-190824.pdf (02.05.2021)

Figur 6. Aksjonsgruppen for et fellesskap på Sjølyst. (2020). Sjølyst Maritime Folkepark - Et sted for alle. Accessed from: https://xn--bevarbtlivet-ycb.no/wp-content/uploads/2020/10/sjolystmaritimefolkepark.pdf (29.05.2021)

Figur 8. Illustrasjon. Direktoratet for naturforvaltning. (2013) Havstrandsnatur. Accessed from: https://www. miljodirektoratet.no/globalassets/dokumenter/publikasjoner/rapporter/dn-utredning\_6-2013\_nett.pdf (12.06.2021)

Figur 9. Photo. Plan- og bygningsetaten/Mediaweb AS. (2016) . Accessed from: https://magasin.oslo.kommune.no/byplan/176-merknader-til-planene-for-skoyen#gref(16.06.2021)

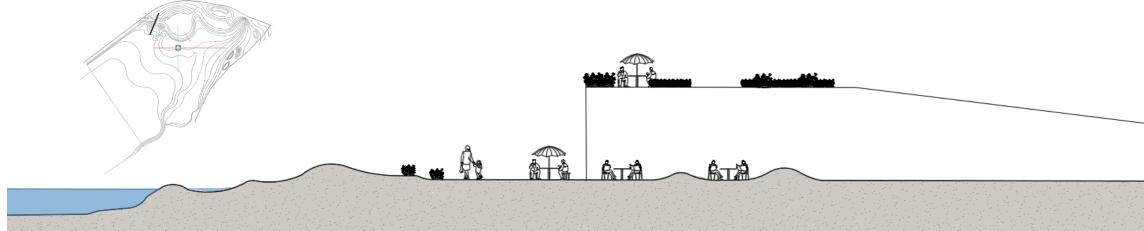
Figur 10. Photo. Shimas Eventyr (youtubekonto) (2021) . Accessed from:https://www.youtube.com/watch?v=qf-H3cRGMR5w (16.06.2021)

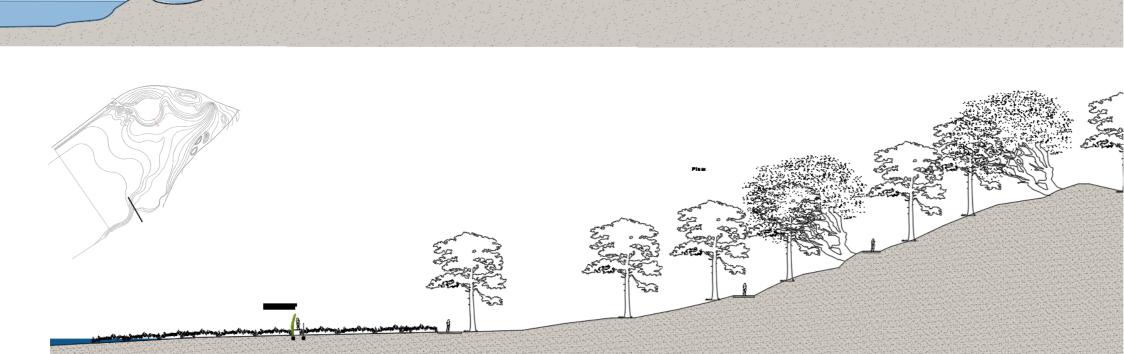
Figur 11. Photo. Industrimuseum (Unknown). Accessed from: http://industrimuseum.no/bedrifter/thunesmek\_ vaerksteda s (16.06.2021)

Figur 12. Photo. Ukjent/Oslo byarkiv (Unknown). Accessed from: https://digitaltmuseum.no/011012646283/ norges-varemesse-pa-sjolyst-sjolystveien-passerer-bak-messehallen-jernbanesporet (16.06.2021)

(16.06.2021)

Figur 13. Painting Foto. Unknown/Oslo byarkiv (Unknown). Accessed from: https://www.oslomuseum.no/ Figur 15. Rinde, E. & Sørensen, E. T. Et.al. (2019). Reetablering av biologisk mangfold i Oslos urbane sjøområder. Accessed from: https://niva.brage.unit.no/niva-xmlui/ handle/11250/2631547 (17.02.2021)





## APPENDIX 2

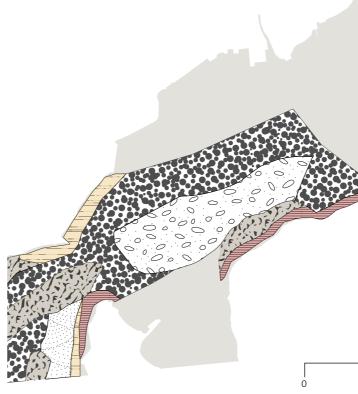
Analysis used during the process,

#### REFERENCE SYSTEM:

Reference system used is Normalnull 2000. This is the new, national high system, substituting the old Normalnull 1954. Normalnull is the high system used in land maps, andthe reference when meter above sea level is given (moh).

Bestumkilen, seabed sediments

Mapsource: Gule sider and geo. ngu.no



## LEGEND Unspecified Sludge/mud Sludge/mud a Gravelly- and



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