



**AALBORG UNIVERSITY**  
DENMARK

**Aalborg Universitet**

## **Living with Water**

*Exploring Urban Transformation and Sustainable Engineering Techniques*

Wind, Simon; Laursen, Lea Louise Holst

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Aalborg University  
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AALBORG UNIVERSITY



ARCHITECTURE & DESIGN

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# WET CITY

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Contemporary societal issues are stirring the urban fabric, where among others extreme weather conditions are influencing the everyday life of the city. Cloudbursts, severe rain and rising sea levels are some of the climatic challenges that affects the built environment and for which the urban design profession have to develop innovative solutions. At the same time, a demographic densification is taking place within the larger cities, which, from a sustainable perspective, calls for a denser living. Thus, the profession of urban design needs to develop holistic urban environments that handles the water in the cities, and at the same time create dense, livable and experience rich neighborhoods.

*Seeing the city as an ever-changeable urban landscape, where not only the open green areas of the city are understood as landscape but also the architecture and infrastructure enter into a holistic landscape approach. Hence, addressing the urban landscape as space, scale and process ... seek to capture and transform sites while keeping manifoldness and contingency in the design process and project: ... a space-time ecology that treats all forces and agents working in the urban field and considers them as continuous networks of inter-relationships*

*James Corner*

Through the 1st semester master program in urban design the students have been working with the challenging task of exploiting the synergies between dense living and water management; creating design proposals for sustainable and long-term proof urban development. The focus of this studio has been on designing for humans and water; exploring new urban typologies that create livable urban spaces that adapts to the issues of rainwater and flooding as well as creating livable urban areas. In this work, the students have exploited the different affordances of water: that of technical water management and waters affordances of recreation, play, atmosphere etc. A special emphasis has been on the (urban) landscape of the city, due to its vital role in order to create a functional and aesthetical urban ecosystem that accommodate water and people; working deliberate with the relation between built structures and green/blue structures.

This booklet showcases the urban design students' hard and consistent work with this challenging design task; where the students have developed a site design with a landscape character as well as detailed designs of the spaces between the buildings. Thanks to the students and teachers that have participated in and contributed to the studio.

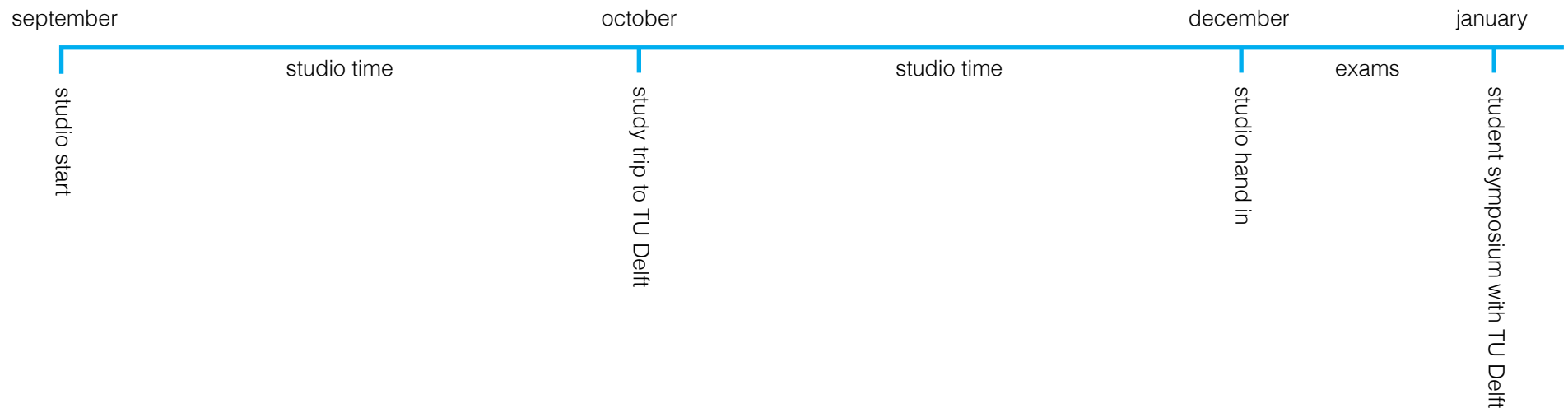
Lea Holst Laursen and Simon Wind  
Studio responsible



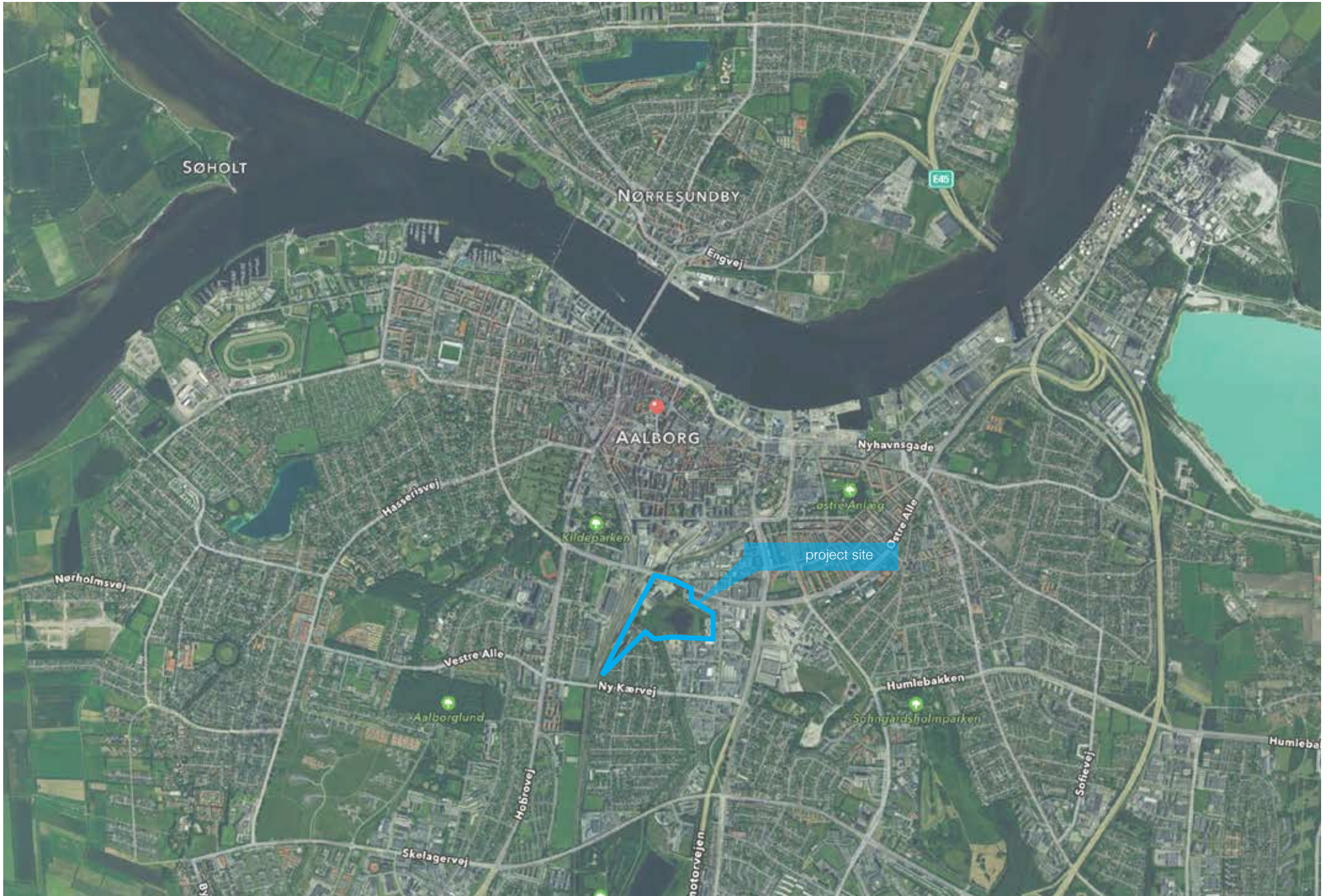
Symposium with TU Delft students at the Utzon Center in Aalborg

The studio was organised to run throughout the semester. In parallel, the department of Architecture and the Built Environment at TU Delft (NL) was conducting a studio (lead by architect Olv Klijn) also focusing on living with water, however at the architectural scale. For the second year, we have established a collaboration with between the two studios, getting the students together this year through a study trip to Holland, visiting Delft, Amsterdam and Rotterdam, and a student symposium in Aalborg, Denmark. Although working in different environmental and cultural contexts, sites and scales, both studios have embraced the same topic of living with water.

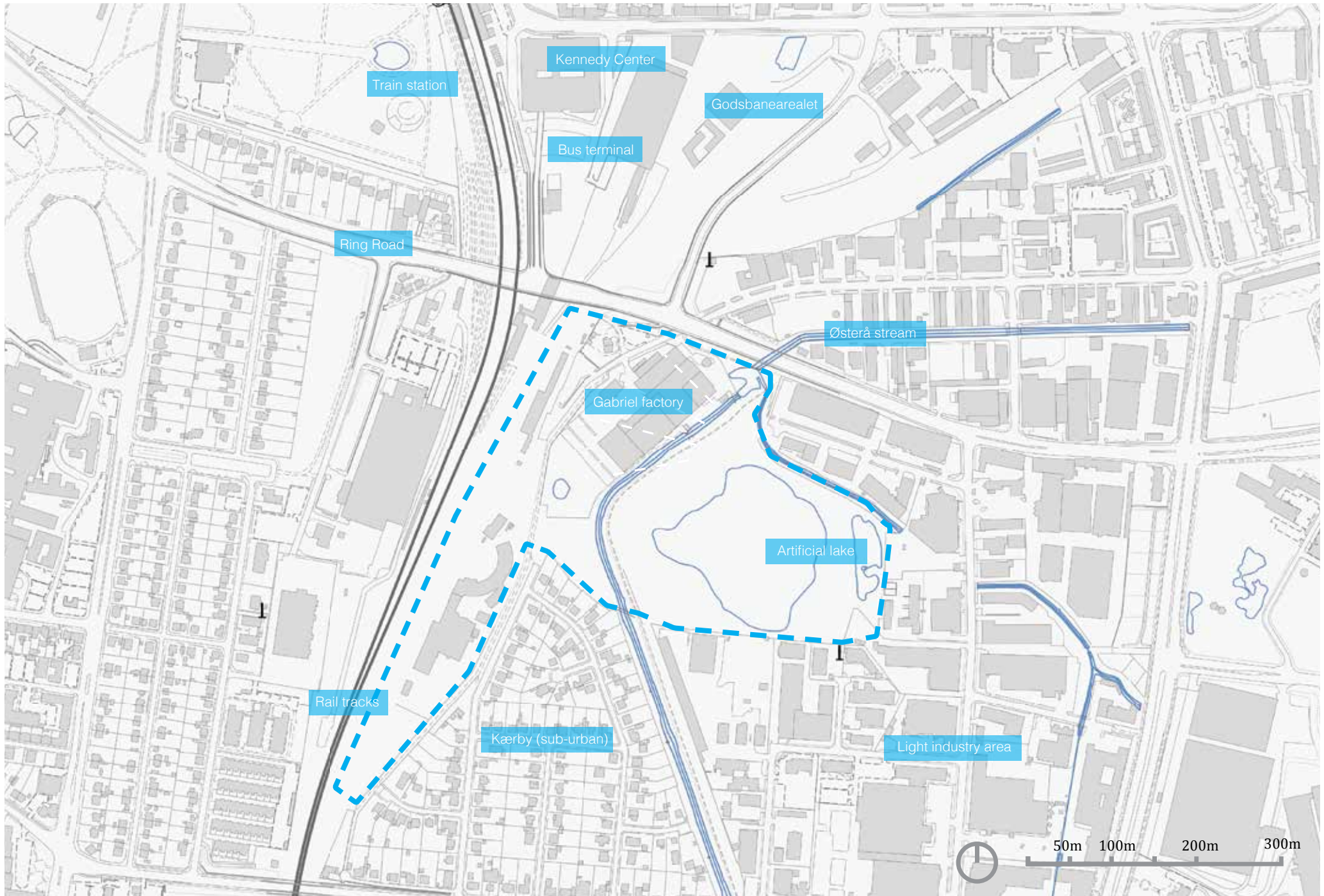
The study trip gave the opportunity to get knowledge of the specific Dutch environmental situation and engineering tradition for handling the water challenge. The symposium presented Danish cases with Katrine Wiberg from Aarhus School of Architecture, Rikke Hedegaard Christensen from Copenhagen Municipality and Rasmus Astrup from SLA. Also at the symposium the students got a chance to present and see each other's final projects.

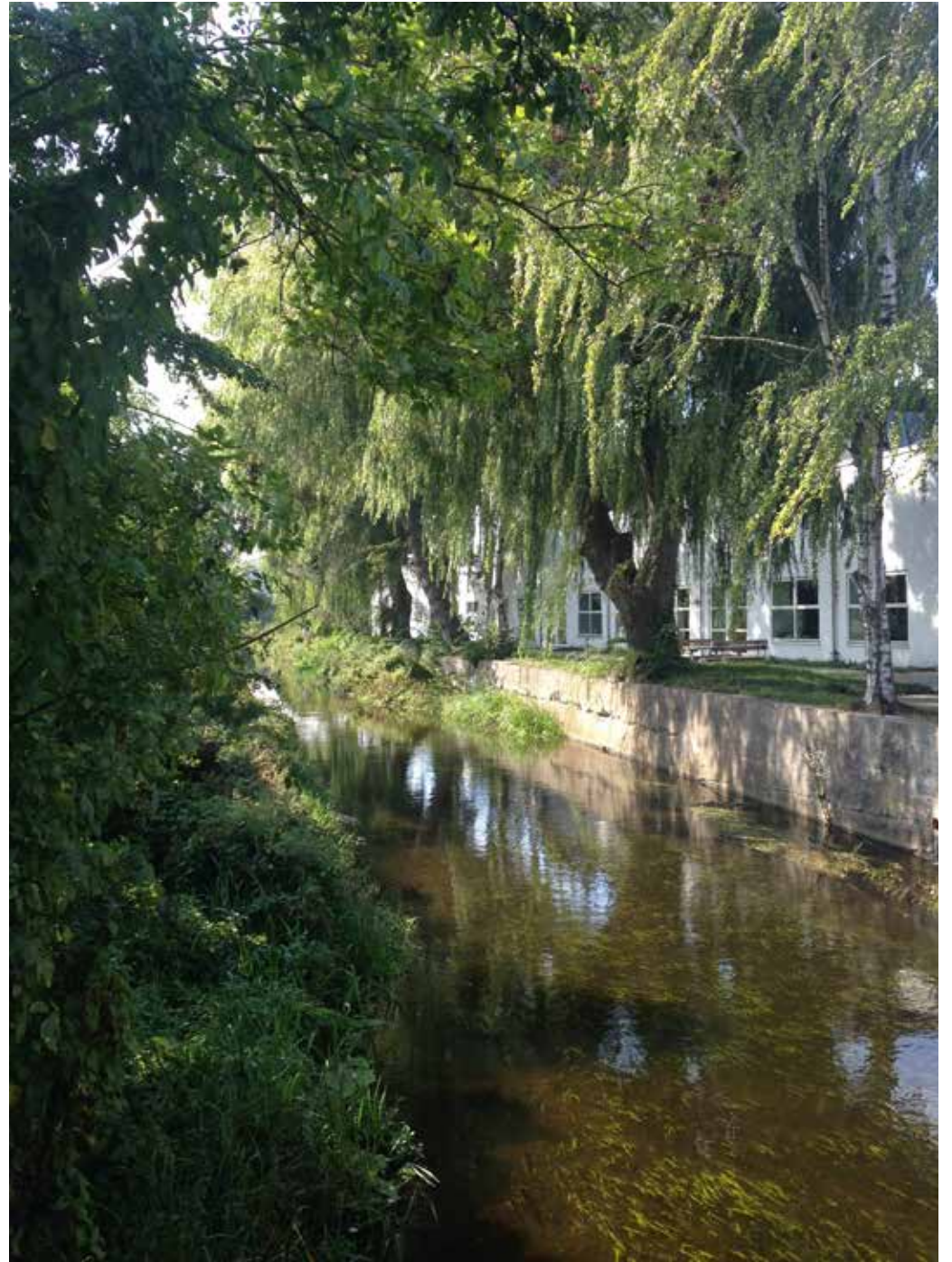






Project site in Aalborg





Pictures from the project site



*'We need to rethink our urban design and spatial structures. In Northern Europe 30 percent of all built-up and paved areas are at risk from flooding'*

*Rikke Jeppesen, Architect, RAMBØLL,  
rethinkwater.dk*



0,5m



0,6m



0,8m



1,0m

Flooding visualisation of project site

## **Flooding and rainfall in Aalborg**

To reduce the damages during extreme rainfall is crucial to identify the risks and to drain, so that the damage is as minimum as possible. Because of the flood in Aalborg (Vejgård) in 1994, Aalborg municipality included climate adaptation in sewer system - and wastewater planning. Through risk analysis, there have been conducted evaluating occurrences and extensions of upcoming floods in the area. The wastewater plan for 2008- 2019 and vision for year 2100 is that the combined sewer systems in the town shall be separated, which significantly will improve the water environment in the municipality. The torrential rain in the summertime is the most critical problem of any other rain events, and requires consideration of the capacity of sewer system in Aalborg. Here the main problem is that the water will not divert fast enough, and the area will be flooded. Climate adaptation in relation to drainage systems are expected to account through a longterm effort where the main keywords are:

- central management of waste water
- decentralized management of rainwater
- adaptation to climate change through planning, including local / decentralized rainwater management.

The two first points solves through a separation between wastewater and rainwater in the sewer. Here the risk of flooded basements directly from sewers will be eliminated, because the basement draining system is connected to the wastewater system.

The illustrations to the left show various flooding scenarios when the streams increase due to heavy rainfall. When the streams raise 0.5m they flow over the banks, and flooding happens when at 0.6m, 0.8m and 1.0m.







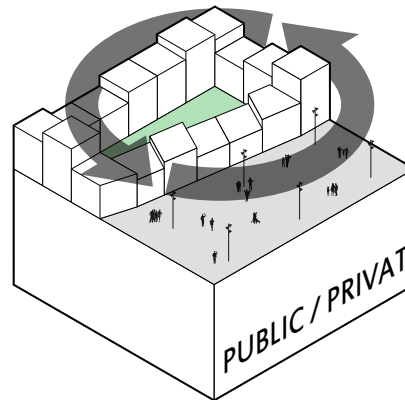
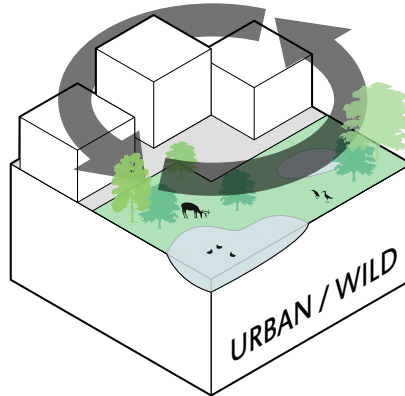
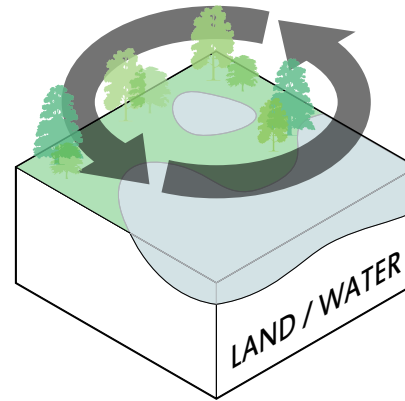
CROSSING BORDERS AS A PROCESS OF STAGING STRATEGY

The built environment is a system in an ever-changing process, where changes in climate, demography, the social and economical situations continuously poses needs for development and adaption of the urban fabric. This project deals with the transformation of an area in the immediate periphery of the inner city of Aalborg. A former industrial site is being transformed to accommodate the city's growth, where densification and adapting to the site's climate issues are the driving forces of the development.

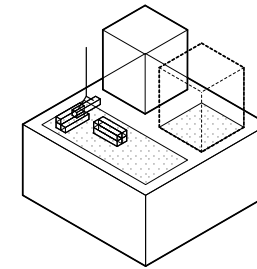
The design approach of this project proposes a different method of development than the traditional master planning. By introducing the strategy of staging, the site is developed according to time and space, and follows a more natural process, creating a resilient space that can accommodate both current and future demands. The process deals with time as one of the main parameters, resulting in four proposed successive stages of development, where each stage incorporates the sites current needs, both environmentally, socially and functionally.

The proposed design is based on the concept crossing borders, and how it can affect the use of an area in both positive and negative ways. Borders or edges has been part of the urban design field for many years – where the discussion encircles the conception of how different edges act as a barriers in both social and physical matters. The interest of borders derives from the registrations and mappings of the site, where it was discovered how the city's ring road and the stream running through the site act as a strong physical borders. Further on, the current situation of the refugee problematic drew attention to working with the social borders, and how people meet and interact on common ground.

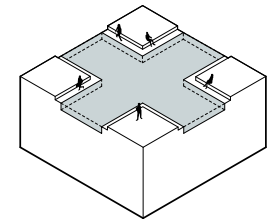
In order to organize the development of the stages, there is worked with four formative structures; the grey, the blue, the green and the built environment. These structures should evolve in symbiosis, without compromising one another, in order to create a resilient new layer to the city.



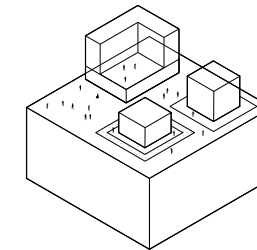
DESIGN PARAMETERS



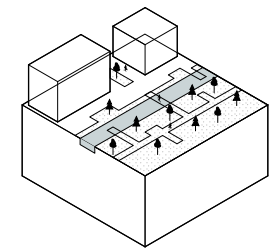
*Permanent and adaptable solutions*



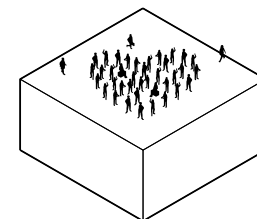
*Watermanagement with surplus value*



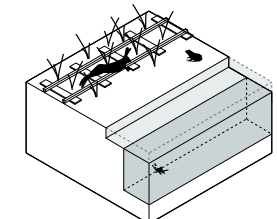
*border between public and private*



*Green, Blue and Grey connections*



*Creating new public domain*



*Stories of water, railroads, flora and fauna*









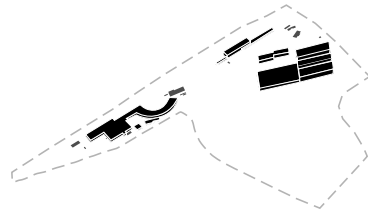


# AN EXPANDING CITY CENTER

The city of Aalborg is in a changing stage with a demand from a growing population and switching its focus from the industrial companies to the life of the inhabitants. It bases its values on knowledge and the city life.

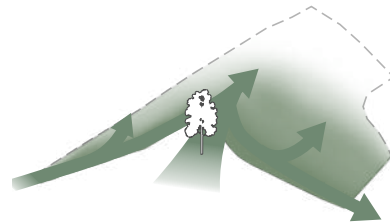
The project site is the Gabriel site, located south of Aalborg city center. The stream Østerå runs through the site on its way from Østerådalen in the south to Limfjorden in the north. The main focus of the project has been on creating dense living in an leftover industrial area where natural processes and ecology has resulted in a wild, natural character. At the same time there has also been a focus on water management because of the area's low ground level, and connections to the Østerå stream. The project site laying within the city of Aalborg takes its focus on this environment created by a changing city. The site, with its current state perceived as a drosscape, is dislocated from the city despite of its centralized location. The project seeks to create an extension of the compact inner city. It focuses on a holistic approach, which includes the development of the built urban environment and responsible strategies concerning the environment and the social structures confined within the city. The project works in multiple scales, with a focus that extent to the site as a part of Aalborg and on the qualities within, in search of a higher synergy.

## INTERVENTIONS



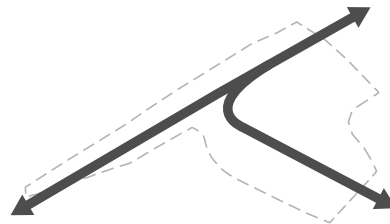
### KEPT BUILDINGS

Keeping some of the older industrial buildings, the remise, an old train related building and Gabriel, will relate the proposal to the site's history.



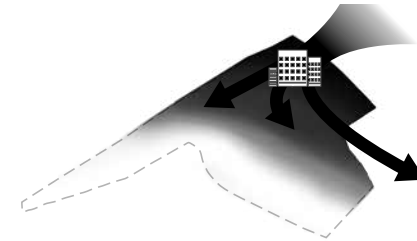
### GREEN GRADIENT

A gradient from the wild character of the southern green area, to the more controlled green areas in the city center is created. This to create a diversity in the city's green structure.



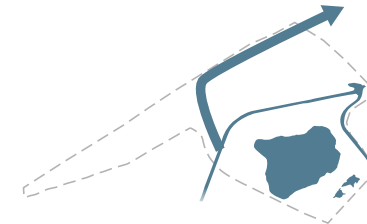
### CONNECTIONS

The main connection will be from the city center in north to Eternitten in the east, and to the areas south of the site. This will enhance the direction of the expanding city center from the city center to Eternitten, and the existing strong connection from north to south.



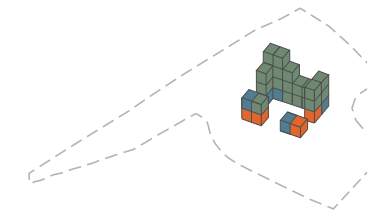
### URBAN GRADIENT

In the same way as the green gradient, a gradient from the very dense city center with hard surfaces to the more green, character of the south of the site.



### WATER

By creating a second stream, splitting the existing in two, an unbroken chain of water from the suburb to the city center is created.

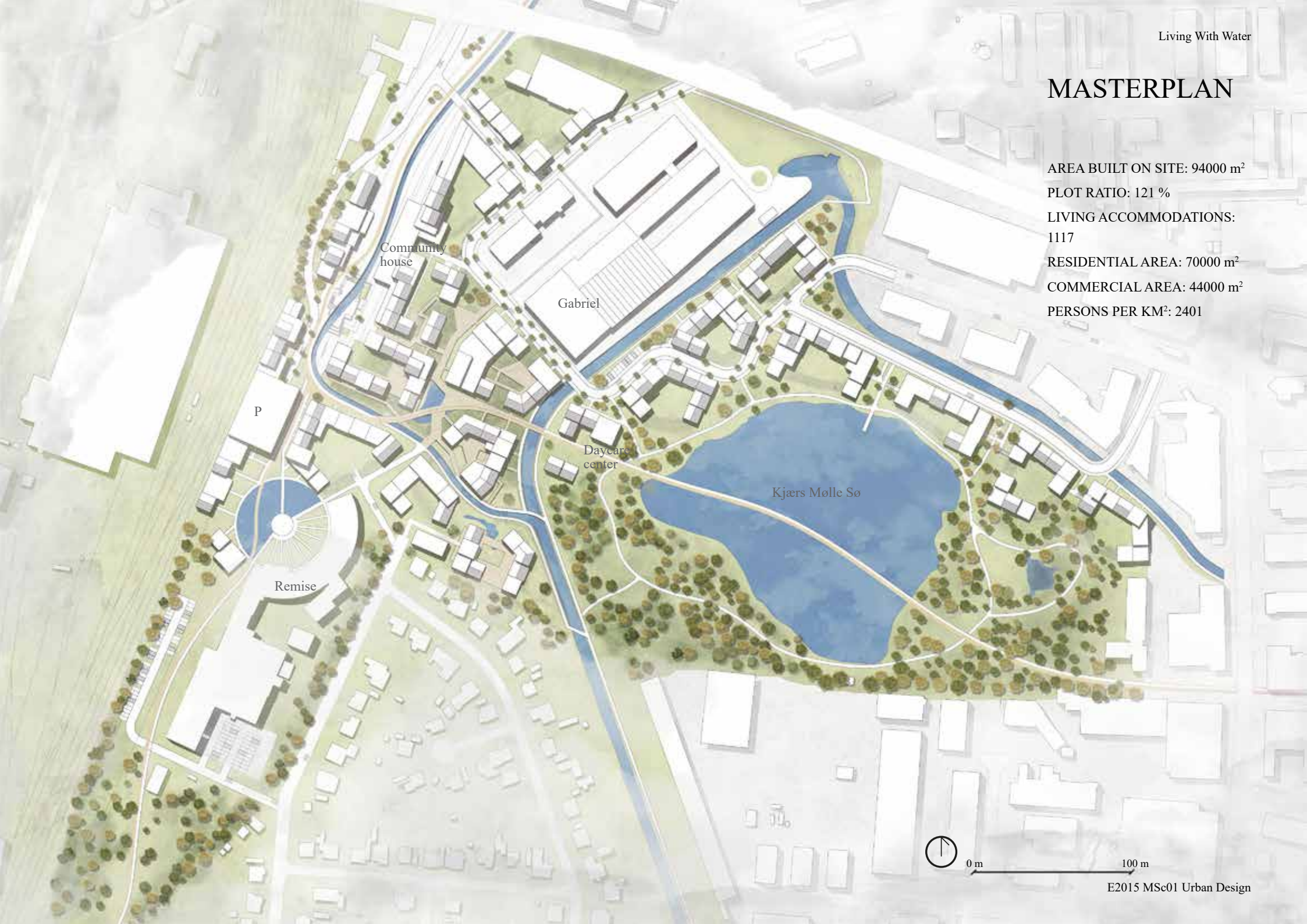


### MIXED USE

By mixing the use of the building and combining living, commercial and offices, a more active and diverse district is created.

# MASTERPLAN

AREA BUILT ON SITE: 94000 m<sup>2</sup>  
PLOT RATIO: 121 %  
LIVING ACCOMMODATIONS:  
1117  
RESIDENTIAL AREA: 70000 m<sup>2</sup>  
COMMERCIAL AREA: 44000 m<sup>2</sup>  
PERSONS PER KM<sup>2</sup>: 2401



Community house

Gabriel

Daycare center

Kjærs Mølle Sø

Remise

P



0 m 100 m



# THE THREE ZONES



## URBAN VILLAGE

The Urban village provides the feeling of inner city and adds the significant qualities of water. The water becomes a part of the public square, the place where people drink their coffee while overlooking the kids playing by the water. The community house provides a space where the inhabitants can come together as a part of the community.



## WETLAND

The meeting of nature and the dense city creates an area that expose the nature in an alternative way, a more uncontrolled way. The view provided from the walkways let the people experience the changing of nature over time, a battle of water and vegetation.

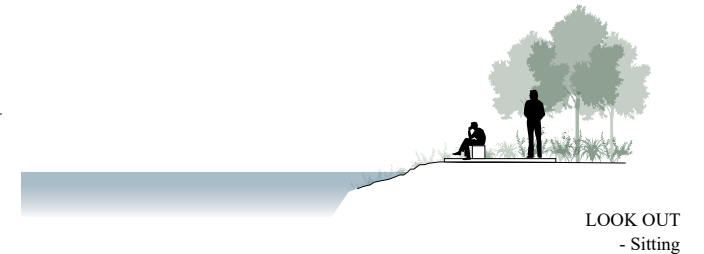
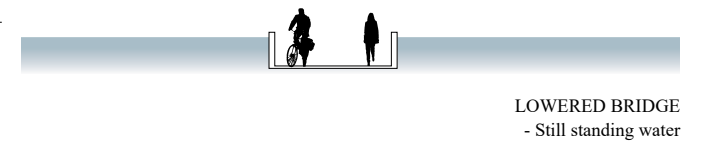
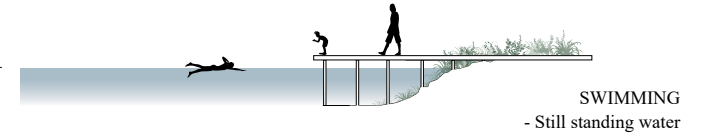
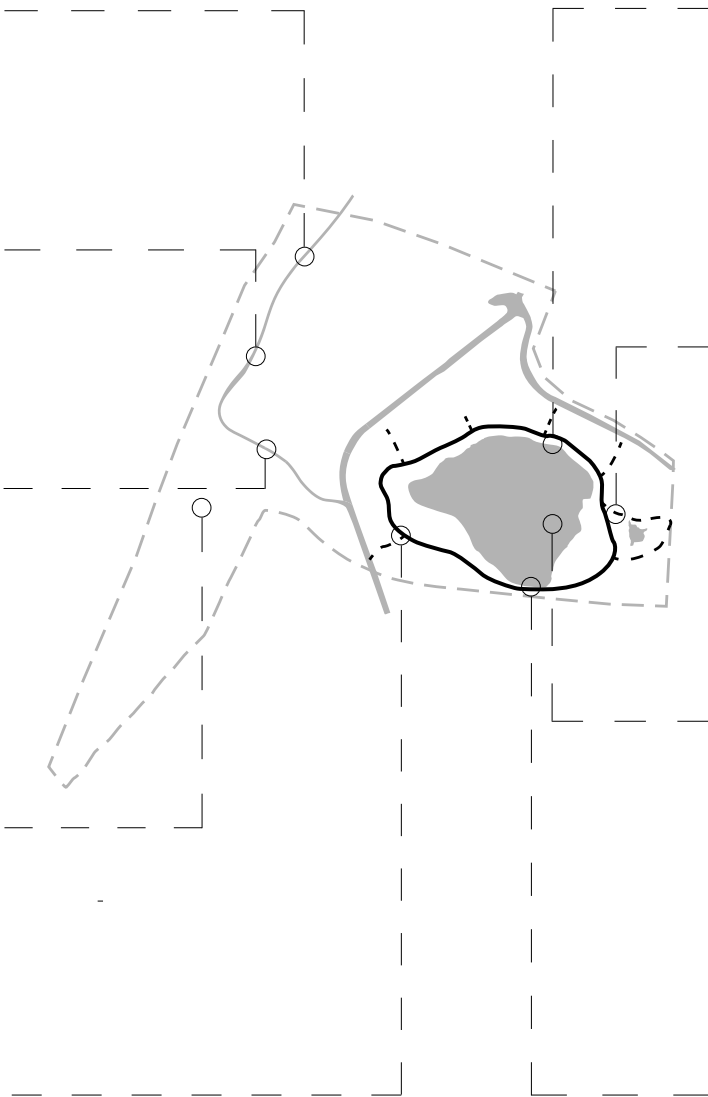
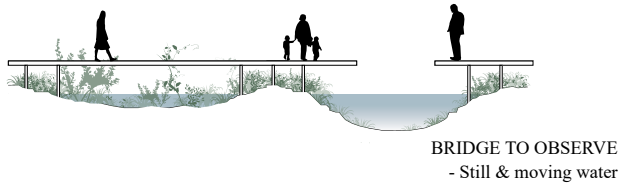
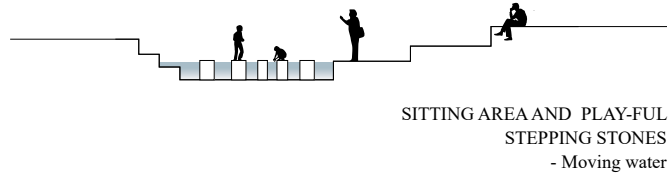
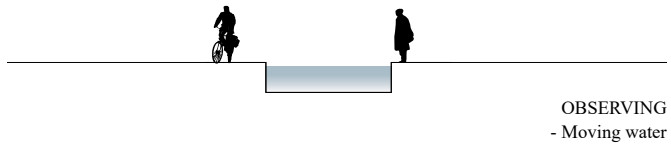


## URBAN FOREST

With the buildings in the background, there is a clear view of the city from the natural surroundings. The Urban Forest provides a transition zone from the inner city to the authentic landscape. The buildings overlook the lake, the nature which provides an exquisite location for living.



# EXPERIENCE NATURE







## DENSE LIVING WITH WATER

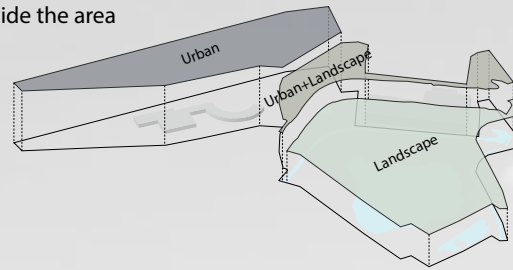
The Gabriel site is designated as an urban development area. The aim is to secure the course of the creek into a significant green spot in the city of Aalborg and as a link to Østerå, Østre Landgrøft and the railway. In connection to this, it is important to create the framework of a former landfill to a peri-urban landscape area with recreational opportunities.

In order to respect architectural regulations there should be an overall character of the creek, pond and landscape. It is also an aim to ensure the disused railway track as new culture tracks and as a path connection to Eternitten.

Furthermore an approach in the project is to look at new and innovative ways of catalyzing a development area. The approach is based on mobile living, by using the old train track and to strengthen the identity of the area. The project incorporates a local drainage of storm water as well to secure the area of flooding problems.

The approach of how to transform this area is to incorporate a catalyst in the area to make a phasing transformation. In the catalyzing process the identity and existing structures are very important to make a slowly and intelligible transformation. The catalyst is needed in the area to make a transformation that involves a participation of the users of the site and a more temporary usage to prepare the ground for more permanent housing. In this case one of the approaches in catalyzing is to make simple living which can be moved around the site, so the vegetation and the more permanent structures can be made while there is life on the site. To handle the simple living, inspiration is found in new nomads, and how they move around in different environments. Furthermore the new nomad includes the possibility to adapt to new surroundings quickly and how the benefit from the way of living free and without any attachments.

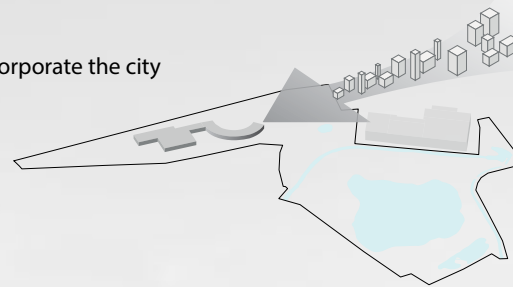
Divide the area



Prolong green corridors



Incorporate the city



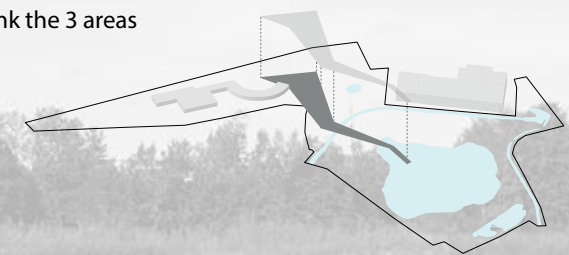
Enhance the biodiversity



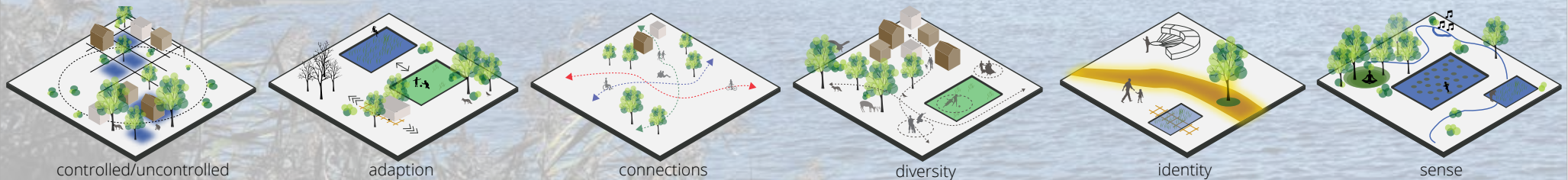
Incorporate residential area



Link the 3 areas



### DESIGN PARAMETERS:



- 0 - Therapy and Hotel units
- 1 - Community/healing gardens
- 2 - Therapy center
- 3 - Urban center, food courts, office space, apartments
- 4 - apartments and office space
- 5 - Residential housing
- 6 - Urban water park
- 7 - Occupation and Hotel units.
- 8 - Therapy units
- 9 - Student Housing



STAGE 03 - EXPANSION



STAGE 01 - FLOW



STAGE 02 - TRANSFORMATION

SECTION AA - urban area



SECTION BB - urban landscape area



SECTION CC - landscape area





Detail plan urban waterpark



Diagram urban waterpark - summer



Diagram urban waterpark - fall



Diagram urban waterpark - winter

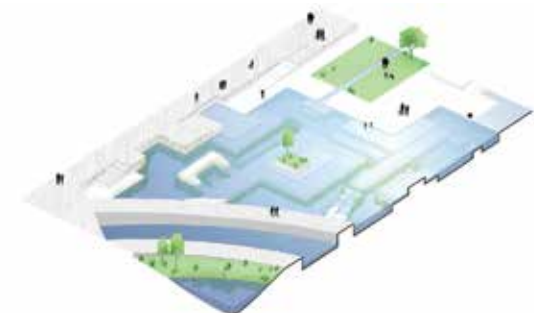
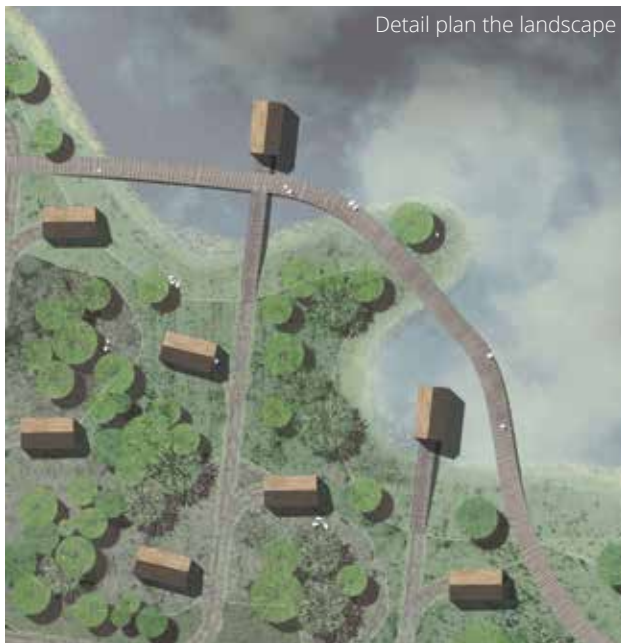


Diagram urban waterpark - spring



Detail plan the landscape

### Urban waterpark

The calculations show a needed volume of around 1800m<sup>3</sup> to manage a 10-year rainfall. Since one of the intentions with the water park is to see more frequent changes in the water level and the different paths it creates, the volumes from the lower return periods were just as important. The design of the pond and the specific heights of the levels are based on calculations that takes the level areas and detention volumes for return periods of 0,1, and 2 years into account. These calculations shows that a height difference between two levels should be around 25 cm to get frequent changes. The height between the permanent water table and the lowest walking paths is set to be close to zero, which also is contributing to these frequent aesthetic changes.

### The Landscape

The water management in the landscape is changing dependently on the phases of the project and the natural changes of the water level. The average water table in the pond is caused by the ground water table, which is slowly increasing. Rainwater in this area is only contributing to some minor short-term changes, due to the large area of vegetation around the area and the fact that the area does not collect any rainwater from surrounding areas (topography).



Visualization urban area



Visualization landscape area



Visualization urban water park







## WATERBILITY

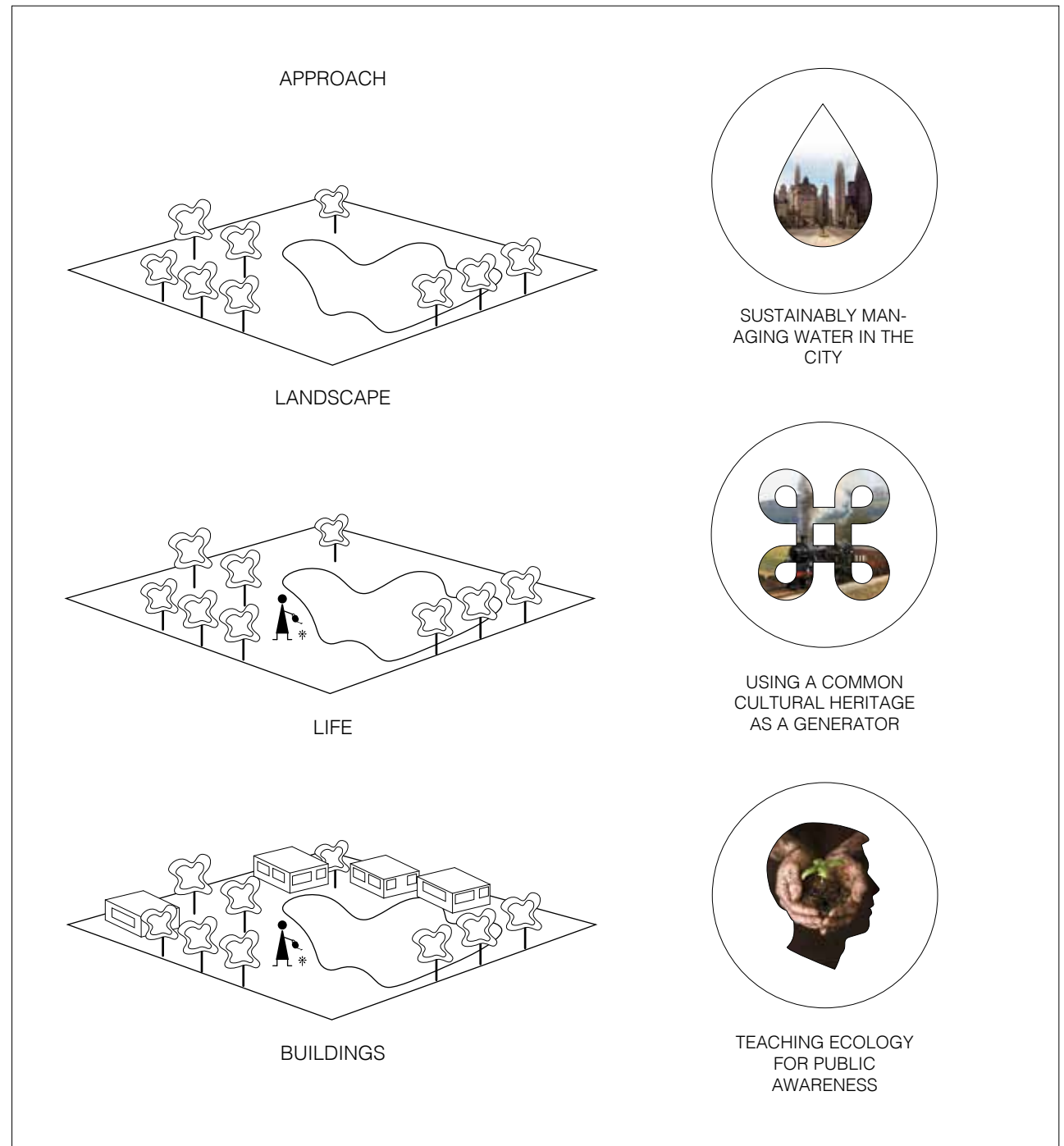
This project is an approach to finding urban solutions that are adaptable to climatic changes in the environment. The site design creates a landscape that incorporates *dwelling*s, *office spaces* and *public recreation* using the themes of *exploring urban ecosystems* and *sustainable rainwater management*. The design works within the existing landscapes and enhances their characteristics, finally naming three landscapes: **the cultural landscape, wet meadow, and marsh**.

The affordances of water as a medium for enhancing ability, possibility, adaptability, and sustainability of the urban environment are used to guide the designs in the project. Important consideration was given to improving *access* to and through the entire site, providing a learning environment, *maximizing ecological health*, and *strengthening cultural value*. The plan is imagined to occur in three stages in order to gradually create interest and use of the site, and to allow time to establish an identity for the space.

Water has the ability to offer many benefits to humans and nature. It is extremely valuable in daily household use, and it is therapeutic to people's senses visually and audibly. Its presence contributes to ecosystem services and provides a suitable habitat for wildlife.

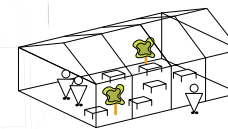
The site is divided into three different landscapes that are interconnected by a series of paths. These landscapes are called the cultural landscape, wet meadow, and marsh, and the stream of Østerå leads visitors from the north and south and spreads out into the green, inviting into a recreational breathing space. The cultural landscape is **a melting pot of historical, residential, work and urban gardening space**, and is a catalyst to activities across interests.

The meadow landscape acts as a meeting point and intersection of the bike and walking paths, and also incorporates housing on stilts, protected from flooding, taking place when small depressions fill like streams in heavy rainfall. The altered marsh waterscape on the east has soft soil islands throughout the water, housing that cascades down into the water, and **a learning centre inviting school children and the general public in for an informative experience of the wetland**. Two different types of paths are present in the marsh: a main path that is permanent, and an alternative path that is closer to the water and allowed to be flooded

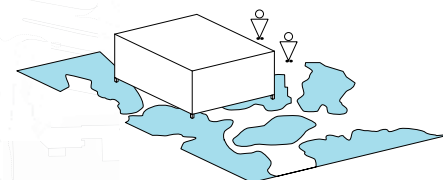




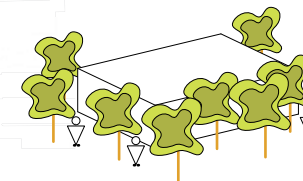
THE LEARNING CENTER FACILITIES



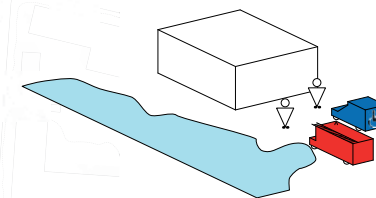
GREENHOUSE SOCIAL ROOM  
- administration and cafeteria



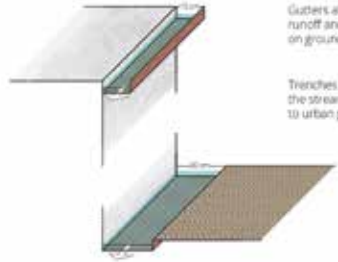
LEARNING CENTER IN THE MARSH  
- LAB/Experimental facilities  
- Observation and classroom



LEARNING CENTER SURROUNDED  
BY TREES  
- Observation and classroom

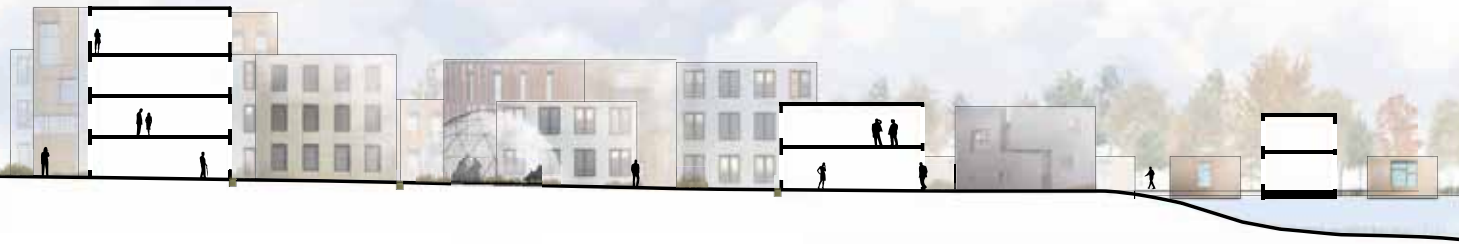
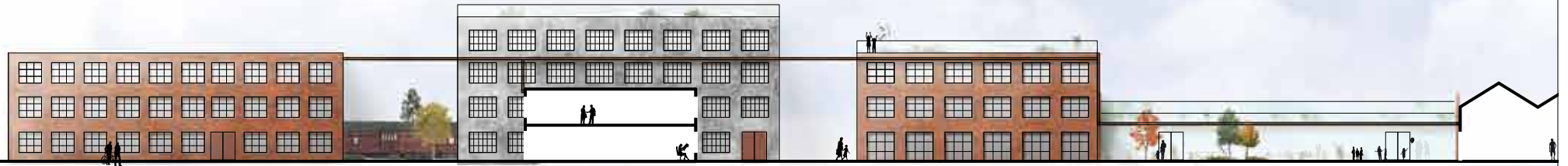
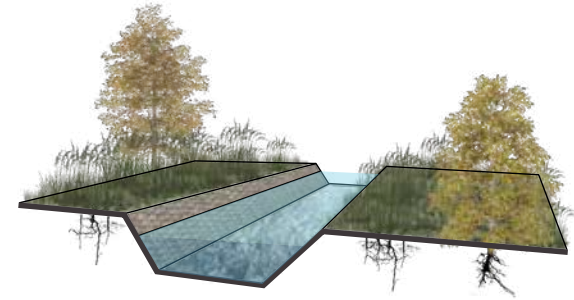


LEARNING CENTER IN OPEN LAND  
- Observation and classroom



Gutters along the built runoff and leads it to on ground.

Trenches carry water the stream. Water flow to urban gardens.











## The Converted Village

This project develops a residential area in the natural environment. The site is characterized by wetlands and is located between the city and nature, centre of Aalborg in the north and Østerådalen in the south. Aalborg Municipality's vision for the area is changing the former waste-deposit area in to active urban areas with new opportunities for recreation. The aim of this project is to create an exciting residential area where residents can enjoy recreation in nature within the city limits. Streams and raised terrain will be added and thus it will be easier to manage the rainwater. Residents of the area are therefore given the opportunity to enjoy the qualities that accompanies with living in vicinity of water. Cohousing gives the opportunity to enjoy the company of other people. By adding urban farming and gardening, it creates a symbiosis that can be beneficial to every species living in the area.

By combining a center, a cultural path, a residential area and student housing based on the concept of cohousing and self-sufficiency, it was possible to create a new developed area in the heart of Aalborg.

The lake is removed and the stream is split into multiple alignments through the area. The main alignment of the stream is led west around Gabriel, were a minor alignment is guided through Gabriel. This will be an aesthetic element in the cultural concept of the water museum.

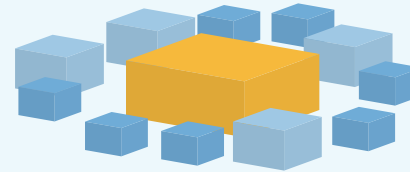
Another minor alignment is led through the area which is split into two equal alignments that surrounds the centre and are brought together at Gabriel.

All calculation has been based on Aalborg Municipality's requirements for waste water service. One requirement is a maximum emission of no more than 1 liter per second per hectare, in this case, the flow from the detention ponds to the streams.

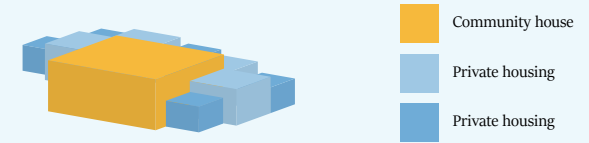
The water will be managed in two ways in the area. The primary management is in the form of detention ponds which are designed to be able to manage a 5 year rainfall event.

The secondary management is for rain events with a higher frequency than 5 years; here the stream will be flooded in a controlled manner. When it is flooded the expression of the area changes.

All the detention ponds are designed with an outlet, so when it rains more than a 5-year event the water will be carried out to the stream by channels. In this way the flooding of the settlement can be avoided

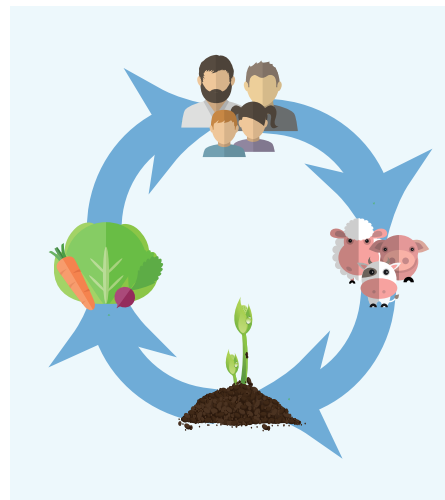
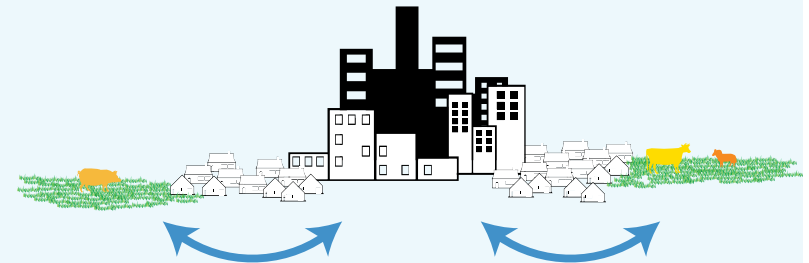


Combination of a community house and a spread of private housing.



A combination of a community house and smaller private rooms or apartments.

The concept is inspired by a typical village. Villages are usually small communities where a close interaction between its residents is common. Typically, villages are surrounded by fields and farming areas but in this concept, that notion is converted. The field and farming are in the centre, surrounded by build up area that is low rise near the centre and higher in the outskirts.

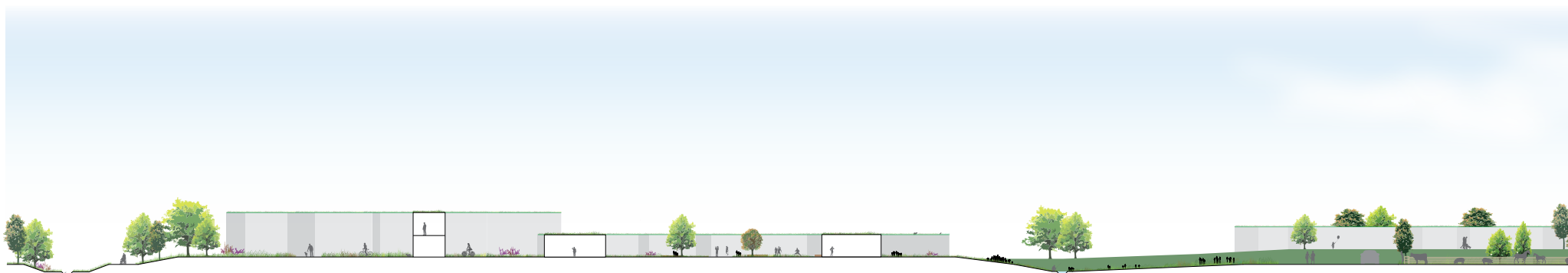




Masterplan: Normal situation

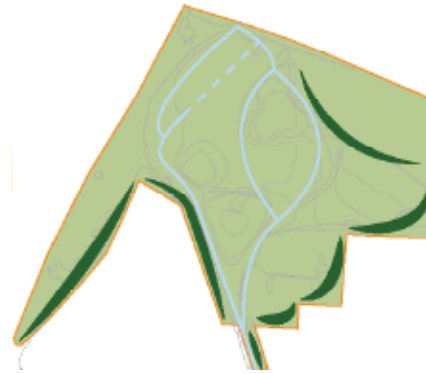


Masterplan: Flooded situation

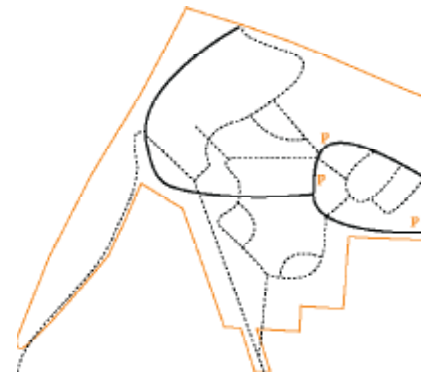




Program for the area



Trees, stream and levels on the area



Paths and roads



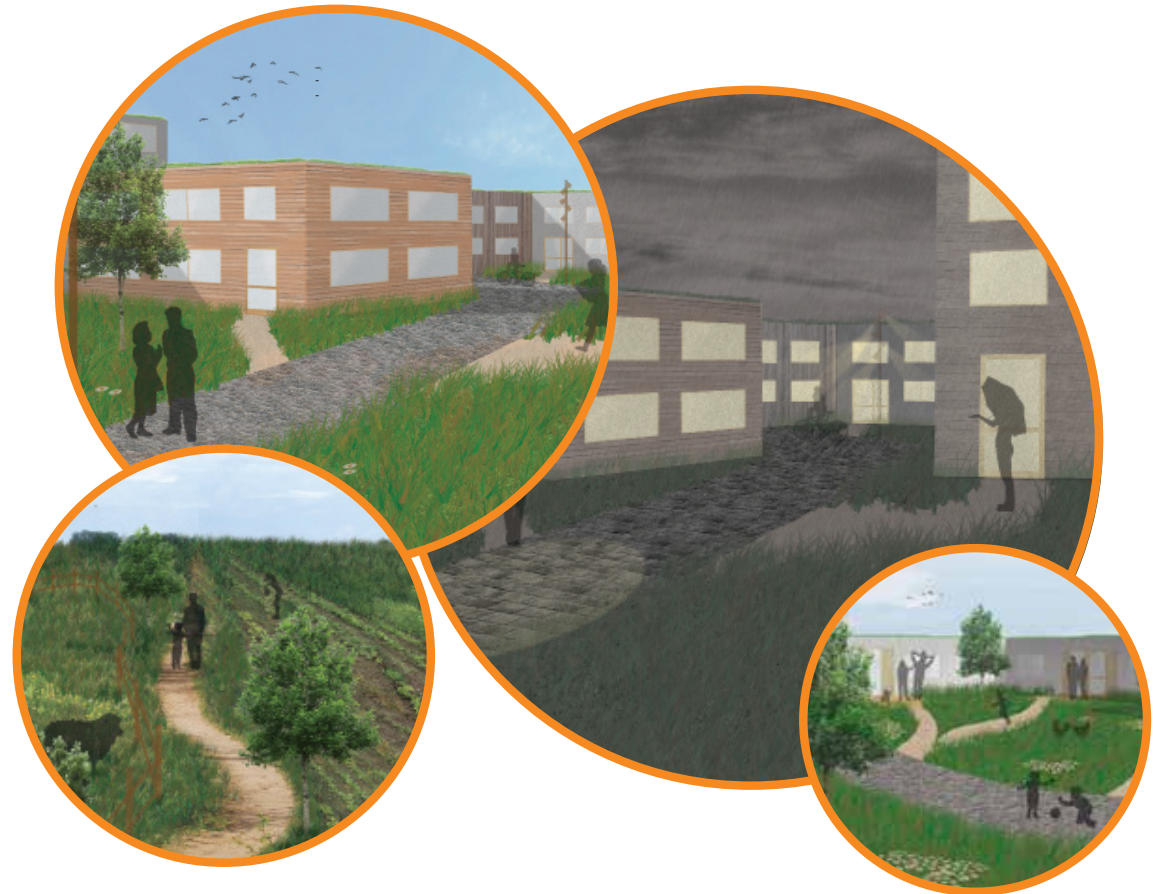
Buildings

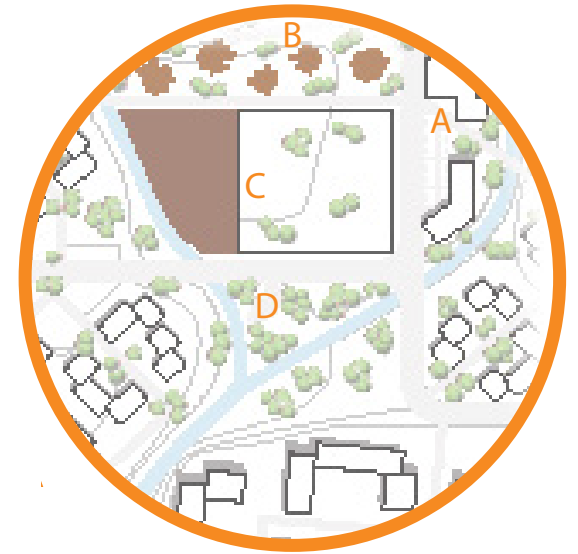
The program for the site is split in to zones. The culture is in the west side and the old industries in the northeast. A centre is in the middle of the site and around it the residential areas are placed.

Streams through the area give a feeling of nature and will have water manage qualities under heavy rains. A small stream runs through a new water museum in the Gabriel building.

Water, nature and green areas are a large part of the new site, supported by hiding the surrounding industry behind trees, bushes and hedges. Buildings are placed in clusters, where the space between the clusters will have a green character, which leads to the centre.

Every space near buildings is dedicated to pedestrian traffic, and parking areas will therefore be placed along the road.









## Kjærø Mølle

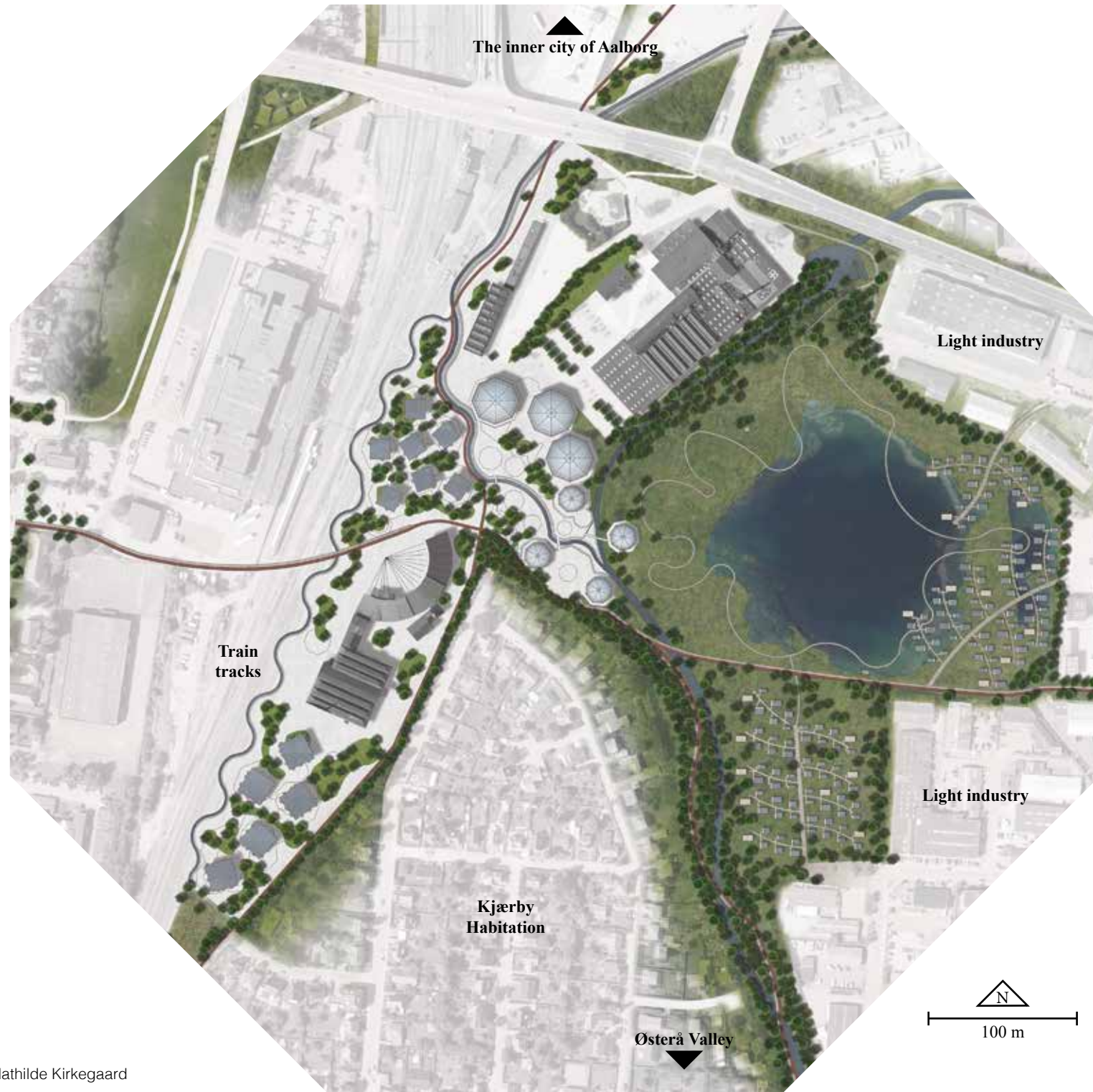
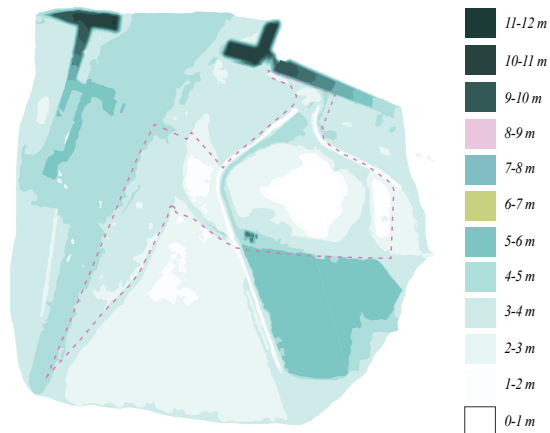
*A design of a low-lying area that integrates rain water solutions in both the natural and the urban landscape.*

This project is presented as a master plan, but it is developed through a process plan. Currently, the area is overgrown and inaccessible, but with a high recreational potential. It is a low-lying area, which experience difficulties during heavy rain (see diagram below).

Based on the analysis and the registrations, the design incorporates the municipality's vision for the site and the surrounding area. The main focus of the process plan is to preserve and enhance nature in combination with public spaces and habitation. The nature will be used to enhance life quality and biodiversity, expose nature and create a greater awareness of nature.

The rainwater is integrated in the design as an advantageous parameter and not as an obstacle. It is implemented as a stream-barrier to the train tracks, as recreative wet detention ponds and it is recycled to various use.

The topography of the area

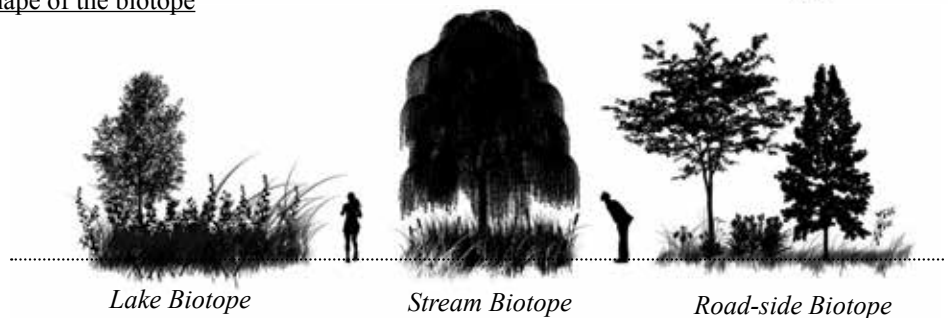


Nature as a part of the design

The design integrates nature in both a functional and aesthetic way. From the site there is created “green arms” to connect with the surrounding green areas. This is made in order to allow fauna and flora to travel through the green areas in the city. This will create a greater biodiversity in the long term.



The shape of the biotope



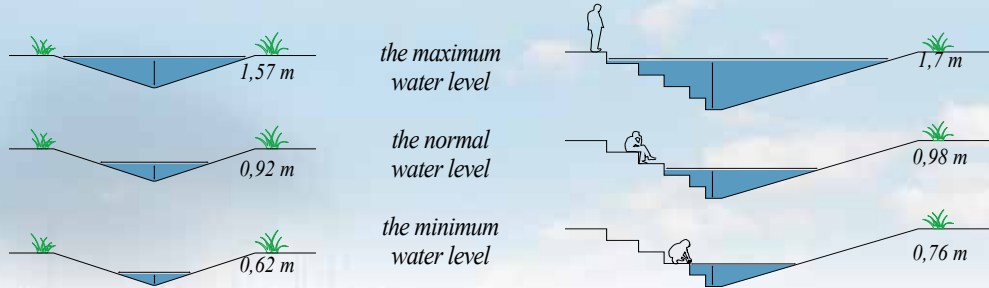
The expression of the Lake Biotope during the different seasons





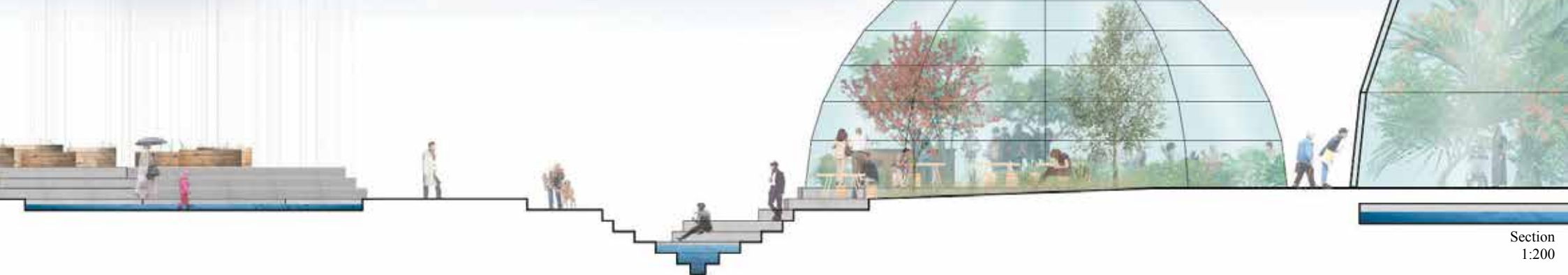


The stream and the water level



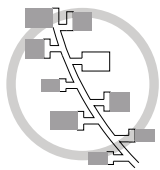
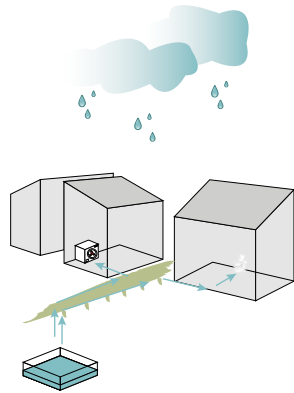
A public square and the rain water

In the center of the site is a public area designed by an artificial landscape that handles the rainwater with wet and dry detention ponds. Through the area is a natural stream that both has a green edge and an artificial edge with stairs, where people can get in touch with the water. Surrounding the public area will four multi functional green-houses expose nature and create different “green” activities; a healthy cafe, urban gardens, a tropical garden e.g.. Underneath the greenhouses are water reservoirs placed to collect the rain water for watering of the plants and toilet flushing.

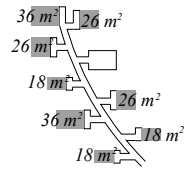


The alternative housing around the lake

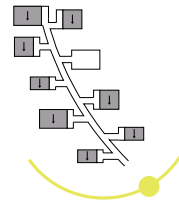
The Lake Area consists of a lake with a recreative walking path and habitation. The habitation is located on the east side of the lake. It is an alternative housing form where the units are very small, they reuse rainwater and have solar panels on the roof. The houses are lifted in pillars in order to allow green to grow underneath. This is also a method for rainwater to infiltrate in a natural way. The rainwater that hits the roof of the houses is collected in rainwater reservoirs underneath the houses. The excess rainwater from the path will be lead into the lake.



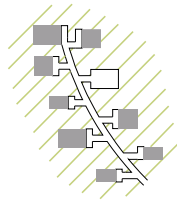
Community of 7 units



Small living of 18-36 m<sup>2</sup> per house



Sun panel on the roofs



Allowing green to grow underneath



Section 1:200



