DORDRECHT FLOODSCAPES. TOWARDS THE AMPHIBIOUS CITY

Maria Sachsamanoglou
MSc Landscape Architecture
TU Delft
DORDRECHT FLOODSCAPES.
TOWARDS THE AMPHIBIOUS CITY
MSc Landscape Architecture  
TU Delft  
Graduation thesis report  

Graduation studio:  
Flowscapes  

First mentor:  
ir. Frits van Loon  

Second mentor:  
ir. Kristel Aalbers  

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This research is the result of my Graduation Project for the Master of Landscape Architecture in TU Delft. Here, I would like to express my gratitude to all those who contributed, directly or indirectly to this project, giving me strength to complete it.

First and foremost, I would like to thank my parents and family in Greece, without whom I would not even have considered the possibility of pursuing and accomplishing a Master’s programme abroad. Thank you for encouraging and loving me, despite the distance.

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Last but not least, thanks to Peter van Veelen, Berry Gersonius, Ellen Kelder and the Municipality of Dordrecht for providing important information, allowing me to present my ideas to a wider, non-academic public and embracing my enthusiasm for Dordrecht.
The aim of this project is to explore the possibilities of establishing a new relationship between water and the city of Dordrecht, aiming towards a sustainable future. In one of the lowest parts of the Netherlands, increasingly threatened by climate change and cloudburst flooding, focusing in the area of the 19th century Schil, the feasibility of a stormwater management plan is explored, intertwined with urban life through solutions such as inundation parks and floodable zones, seasonal buffers, watersquares and visible waterlines. Drawing inspiration from precedents such as the Copenhagen climate adaptation strategies, the island of Dordrecht can stand up to future challenges, through a water-resilient landscape architecture that succeeds a shift of attitude towards sustainable practices, but also strengthens the identity of Dordrecht as an attractive, historic watercity, designed to work with water, rather than against it. Water, here, becomes an agent able to transform the city into an adaptive, amphibious spatial entity, that can offer alternative urban experiences.

**Keywords**: amphibious, floodscape, water, cloudburst flooding, climate adaptation, sustainability, network, multifunctionality, adaptability, experience, attitude shift, urban life, public space

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**ABSTRACT**

The aim of this project is to explore the possibilities of establishing a new relationship between water and the city of Dordrecht, aiming towards a sustainable future. In one of the lowest parts of the Netherlands, increasingly threatened by climate change and cloudburst flooding, focusing in the area of the 19th century Schil, the feasibility of a stormwater management plan is explored, intertwined with urban life through solutions such as inundation parks and floodable zones, seasonal buffers, watersquares and visible waterlines. Drawing inspiration from precedents such as the Copenhagen climate adaptation strategies, the island of Dordrecht can stand up to future challenges, through a water-resilient landscape architecture that succeeds a shift of attitude towards sustainable practices, but also strengthens the identity of Dordrecht as an attractive, historic watercity, designed to work with water, rather than against it. Water, here, becomes an agent able to transform the city into an adaptive, amphibious spatial entity, that can offer alternative urban experiences.

**Keywords**: amphibious, floodscape, water, cloudburst flooding, climate adaptation, sustainability, network, multifunctionality, adaptability, experience, attitude shift, urban life, public space

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*We are the first generation to feel the sting of climate change, and we are the last generation that can do something about it.*

Jay Inslee, Governor of Washington
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1. FOREWORD
J.M.W. Turner, Snow Storm, Hannibal and his Army Crossing the Alps, oil on canvas (source: http://www.tate.org.uk/art/images/work/N/N00/N00490_10.jpg)
Where can you house all the water, shy rivers, since you are used to pouring softly your network of streams from your full water pitcher into the swollen ocean’s belly? This plague of the sea comes to torment your streams, to conquer them and to chase them from their beds.

The North and South Sea was full of wrecks, masts snapped off, crates and packages, and money and property were hurled around, and washed ashore along the lifeless coasts together with their owners who had remained at that place. […] The sea rages and goes its way. […] Yes, the sea […] it howls, and foams, and consumes, and rapes.

Are wind and weather possessed by hate, bitterly furious with our conceit? And the wild power of the sea rages to avenge itself, it knows how to gain ground, in its passage and in its roaring. […] Does the sea seek to repay the Dutch for the harm they did by altering the laws of nature without shame?

“About the terrible night storm [which occurred] in the winter of the year 1660”, by J. Vollenhove
On 19th December 1660, a severe storm raged over the Dutch isle of Texel, causing serious damage and proceeding to destroy parts of the city of Amsterdam. The priest Joannes Vollenhove wrote a poem about this natural disaster, where he personifies the winter storm, struggling to understand it. Vollenhove felt that the Dutch people had lost all respect for nature: his rhetorical questions suggest that he believed this to be the cause of the storm.

For a long time, the water had been considered as a threat, an unexpected intruder able to cause great harm and sorrow. Legends and myths cultivated the fear of water, for instance the Deucalion myth of the Greek mythology or the biblical Noah’s Ark. Natural disasters also contributed to this, such as the severe Saint Elizabeth’s day flood of 1421 as well as the more recent flood of the North Sea in 1953, which resulted in huge areas being submerged, changing radically the form of the Dutch, Belgian and British landscape.

The water, once a source of life for harbor cities, serving as the main infrastructural network until the 19th cent., became gradually detached from the main city functions and the city turned its back to it. Now it is only considered as an enemy, solely able to bring about disaster. A mentality and a way of thinking deeply rooted in peoples’ minds.

In this war against water all possible measures are employed to keep the water away and out of the city borders. Long dike ribbons surround countries, ditches are dug out in rectangular patterns, a system of windmills and pumps is installed, while the most exposed areas are later protected by huge dams and storm surge barriers.
Yet today, even these seem to be inadequate. Climate change accompanied by phenomena such as sea level rise and extreme cloudburst events, pose an additional threat. The forces of nature have all conspired against mankind, who for so long struggled to dominate and control them. Vollenhove’s questions, though referring to a different framework and time, seem to fit perfectly into a contemporary scope.

How can we answer to these new challenges? Is it time for an attitude shift towards water? Should we finally befriend a long-considered enemy? Can a truce provide the grounds for a long-term solution?

These questions were the cornerstones of this research, triggering me to think from a different perspective. Using the city of Dordrecht as a case study, I will attempt to give sufficient answers, but also create the conditions for establishing a new relationship between man and water, or rather restoring a problematic and weakened bond. Water is the word that best describes this city, even more a whole country. It is the element that over time shaped the Dutch identity, culture and way of thinking, meaning that, for the Dutch, it is much more than a natural feature. For me, the challenge is to reverse a negative attitude towards it, incorporating it again into the urban realm and embracing its dynamic nature. Dordrecht has the chance to become a resilient watercity, an amphibious spatial entity designed to work with water, rather than against it.

The fear of water (collage by author)
2. INTRODUCTION
The island of Dordrecht is one of the most flood-prone areas of the Netherlands, with a flooding probability of 1 in 2,000 years, but also a vulnerable part of the Hollandse Delta area, with a hazard zone of 3-4.

If we add to this the sea level rise caused by climate change, which is expected at 0.5 m. every 100 years, then the hazard becomes even more severe. The risk of extreme cloudburst events in combination with the increase of urbanization and the limited evacuation possibilities, asks for an urgent solution.
The flooding problem has been up to now tackled through rigid engineering approaches which have reduced significantly the risk, however in case of failure, for instance a dike breach, the results will be much more devastating. These strictly monofunctional approaches have failed to incorporate aspects of urban life, address other problems, such as ecology, or take advantage of existing potential. Solely serving a functional purpose, they form a landscape detached from urban life with little or no meaning for the people living nearby. It is a “no man’s land”, an entity constructed only as a defense against water, often ignoring ecological, social or other implications and possibilities. What is more, these approaches contributed to the alienation of the city from water, altering the identity of many watercities and diminishing their inherent qualities. Water is considered as an invader that has to be fended off, instead of an immanent value of the landscape that needs to be fostered and strengthened.

The island of Dordrecht is surrounded by a primary dike ring leaving out the historic harbor area, the higher outer flanks and the floodable Biesbosch area. The inner area, which is divided by a system of secondary dikes, is under threat of fast and deep flooding in case of a dike failure. With a population of 118,450 people and with only four main evacuation routes, only 15% of the inhabitants would stand a chance to escape in case of flooding. The dikes, themselves, function as flood defenses that usually also form the main infrastructural lines of the city, accommodating streets on their top. Apart from that, however, they play little or no role in urban life and provide minor ecological benefits, as green lines mainly serving for bat migration. Within the inner city itself, someone barely remembers that they are in a watercity and that the water is in fact only a couple of kilometers away. Nothing reminds its presence apart from several fragmented waterways or traces of old creeks. The dikes have isolated the city from its impressive river context, superseding its most important value.
Weaknesses, however, can be identified within the urban fabric itself. With the ratio of permeable surfaces severely decreasing, giving their place to hard, paved areas with little or no green, the available room for rainwater diminishes. Often dense and congested, these areas form bottlenecks that not only are unable to accommodate water, but even worse increase water velocities in case of flooding.

In Dordrecht, almost half of the city is paved with hard surfaces that account for over 50% per neighborhood, with the respective percentages of green being limited to less than 40%. The biggest problem can be found in the northern parts of the city, including the historic city centre, the 19th century area, the Old and New Krispijn, parts of Indische en Vogelburt and Land van Valk and the area around the second Merwedehaven. Within these high-risk areas, the potential water depths in case of an extreme downpour, may even exceed the 10 metres in certain spots, which means that the water can neither be retained nor disposed, but is instead cumulated, trapped between hard surfaces and high built elements.
2. INTRODUCTION

Potential water depths (on the base of: http://www.klimaateffectatlas.nl/nl/kaartverhaal-wateroverlast)

District typologies in relation to flooding (on the base of: http://www.klimaateffectatlas.nl/nl/kaartverhaal-wateroverlast)
Finally, as precipitation levels rise exponentially with time, the existing sewage facilities become insufficient, often overflowing and necessitating a separate system for rainwater management.

The predictions for the average annual precipitation are discouraging, with the numbers rising by 40 mm. in the next 30 years and by 60 mm. in the next 70 years, within the wider area of Rotterdam. At the same time, the largest part of the sewage system in Dordrecht consists of combined sewers, while there is only a limited number of separate sewers in the western industrial area and in the Oudelandshoek district. This means that, given the increase of precipitation levels, the city’s sewage system will soon be inadequate and probably overflown.

Hence, it becomes evident that:

Dordrecht is faced with a major flooding hazard, in which climate change adds up to its inherent vulnerable nature, while the existing defensive structures alter its identity isolating it from its most valuable feature; water.

If the city’s flooding capacities are to be exceeded in the near future, a more sustainable approach needs to be elaborated and applied; an approach that will welcome water within the urban fabric, reducing the flooding probabilities, but most of all creating a meaningful, humane landscape.

The local authorities of Dordrecht -municipality, water board and province, having realized the existing risks, but also trying to redefine the city’s relationship with water, have already proposed and implemented several projects which prove a tendency towards a new direction. However, these attempts were up to now fragmentary proposals, while a solid, comprehensive vision for the whole city is missing.

This project can, therefore, be seen as an attempt to create a unified climate-proofing vision for Dordrecht that, apart from the aforementioned water-related problems, will also deal with challenges related to the city’s microclimate, as well as to urban biodiversity. Phenomena such as the UHI effect or drought are often recorded in the contemporary city, while urban flora and fauna are faced with hostile conditions. Dordrecht is not the exception of the rule, since next to flooding problems, drought is yet another trouble, where “paalrot” (rotting of wooden poles) threatens the foundations of the oldest structures. What is more, despite the island’s diverse ecology, there are still fauna bottlenecks to be solved and room for enhancement of the urban nature.
2. INTRODUCTION

2.2 RESEARCH OBJECTIVE

The increasing threat of cloudburst flooding in the city of Dordrecht makes us wonder:

In an era of rapid climate change, how can Dordrecht transform into an amphibious, multifunctional spatial entity with increased flooding capacities, but also a testing ground for an attitude shift towards water within the city boundaries?

1. How is Dordrecht related to water and how is the flooding nuisance expressed in the city?
2. How can we increase a city’s flooding capacities using a set of climate adaptation measures and principles?
3. How can Dordrecht transform into an amphibious, multifunctional spatial entity with a redefined relationship with water?
4. How can we answer to climate change by testing new approaches, but also contribute to an attitude shift towards water within the city boundaries?

The objective of this research is, therefore:

To create a blue-green network that can accommodate excessive rainfall, but at the same time act as a series of public spaces intertwined with urban life, enhancing biodiversity, fostering social dynamics, offering alternative and contrasting spatial experiences and strengthening the identity of Dordrecht as a contemporary watercity, where water is a visible and tactile feature.

In this way, the term ‘controlled flooding’ can be introduced, that aims to resolve flooding nuisance, while upgrading the urban environment and the experience of the city, charging the project with a dual meaning and proving that water can, in fact, be a desired quality.

Sustainability, hence, is the first goal of the project, a 3-dimensional goal including ecological, social and dynamic aspects.

Ecology is approached in terms of flood protection and relief of the sewage system, but also in terms of water management, regarding the city as a sponge that can retain, store or dispose higher quality water. A general environmental upgrading can be achieved through this green-blue network with a richer and more diverse urban nature. The ecological aspects will focus on the mapping and analysis of existing problems and potential and on the design of a new urban system for managing rainwater and for establishing more favorable conditions for biodiversity within the city.

The social aspect aims to improve social life in the city, by upgrading the public spaces and offering better recreational possibilities. In these redesigned public spaces, the community spirit can flourish and the city’s identity can be redefined, becoming a place where people will ascribe new, stronger meanings and form an innovative, prosperous society.

The dynamic aspect seeks to highlight the inherent fluidity of an adaptive landscape, such as the one of Dordrecht. The everchanging outline of the island, exposed to the forces of the rivers and the sea, can be a motivation to embrace this dynamism, by introducing it into the urban realm and providing the grounds for a more exciting, unexpected and surprising urban life.

The second goal concerns experiential aspects aiming to discover how materiality and more specifically the presence/absence of water can create totally contrasting spatial experiences in an everchanging, amphibious city. It is, therefore, rather focused on the intangible and the perceived, the senses and the interaction with our surroundings. This part is more of an experiment that seeks to accommodate varying living environments in the same place under different circumstances, for instance how a specific area is perceived in dry, wet and flooded conditions and how humans react to these changes.
2. INTRODUCTION

Research objectives

sustainability + experience
Watercity, experiencing the amphibious urbanity (collage by author)
Dordrecht is located in the Netherlands and belongs to the province of south Holland, in the central river area of the country. It is the converging point of the Rhine and the Meuse, but also a strategic location next to the national park De Biesbosch and close to the southwestern delta. It is in fact an island in the heart of the Netherlands surrounded by the rivers Oude Maas, Noord, Merwede and Holl. Diep.

Country: Netherlands
Province: South Holland
Elevation: 1m (av.)
Area: 99.47 km²
2. INTRODUCTION

It is the oldest city of Holland with a history dating back to the 12th cent. It started out as a dike city along the Thuredrecht river which over time expanded towards the inland. During the 16th and 17th cent., it flourished thanks to the wood trade, becoming a major economic force, until Rotterdam gradually took over. Its relationship with water is what formed the city’s identity; the rivers were the only connecting links with the rest of the country, while the picturesque harbors and the canals acquired an almost symbolic meaning for the city, in which many painters found their inspiration.

Dordrecht is a typical example of a reclaimed clay polder literally taken out of the water, especially after the devastating 1421 Saint Elizabeth’s flood, which inundated the whole area.

This very strong water-city bond is what triggered me to start this research, look closer into it and try to highlight its significance for Dordrecht. If water means a lot to the Dutch, in this case it is the fundamental source of life; everything starts and ends there, owing it their very existence.

Map of Dordrecht, 1652
(source: https://upload.wikimedia.org/wikipedia/commons/1/1f/Blaeu_1652_-_Dordrecht.jpg)

Watertoren, 1912 (source: https://www.villa-augustus.nl/geschiedenis/)

Visbrug- Groenmarkt, 1910 (source: http://fotos.serc.nl/zuid-holland/dordrecht/dordrecht-6939/)
Reclamation and urbanization processes in Dordrecht (on the base of: http://dordrecht.serc.nl/typo3temp/pics/a0bba417e0.png)
Despite its vital importance, however, water is also a source of trouble and anguish for the Netherlands. For this reason, the country is divided into separate “waterschappen” (water boards), regional government agencies in charge of water management in different areas. Among 24, Dordrecht belongs to the Hollandse Delta waterschap. This area is influenced both by the sea and the river dynamics, which means that factors like tidal changes or different river discharges can affect the water flow directions. This is what makes the area extremely susceptible to flooding, but also an ideal case in which new flood management policies can be applied and tested.

Therefore, both its particular location and unique relationship with water, but also its inherent vulnerability were the factors that defined the site selection, making Dordrecht seem as the most appropriate and possibly fruitful choice.

Dordrecht and the Dutch ‘waterschappen’
(on the base of: https://commons.wikimedia.org/wiki/File:2015-NL-Waterschappen-prov-1250.png)
2. INTRODUCTION

Nieuwehaven - view to the Noord and the Merwede (personal archive)

Statenplein (personal archive)

Weizigtpark (personal archive)
2. INTRODUCTION

Views in Dordrecht (personal archive)
2. INTRODUCTION

2.4 READING ITINERARY

The structure of this research consists of the following chapters:

In chapter 3, the research framework will be presented. Firstly, the theoretical background will be analyzed, explaining the main theories that form the basis of the research. Following, the research methods will be elaborated, illustrating the ways in which the research will be carried out. Then, the research design will be presented, clarifying the structure and the process that will be followed.

In chapter 4, various precedents will be studied. The most interesting cases will be presented separately and, eventually, common design principles that could potentially inform the project will be derived.

In chapter 5, the area will be analyzed on a macro and meso scale, leading to a diagnosis of its main features and potentials. Then, the main principles that will be employed in the project will be presented and analyzed. Next, the proposal will be presented, based on the diagnosis and the application of the principles, showing how the detailed design will transform the site.

In chapter 6, some thoughts on how this thesis can provide an answer to the initial problem statement will be elaborated, but also on how it can relate to the wider academic and societal context.

In chapter 7, a glossary of some key terms used throughout the research will be included.
3. RESEARCH FRAMEWORK
3. RESEARCH FRAMEWORK

3.1 THEORETICAL BACKGROUND

The landscape as a process

Four principles of study and practice define the character of landscape architecture as a discipline: understanding the landscape as (I) three-dimensional construction, (II) history, (III) scale-continuum and (IV) process (Nijhuis, 2013). All of them seem to fit into the context of this research, however more emphasis is given on the landscape as a process, since the landscape is regarded as a system in which different processes and subsystems influence each other and have different dynamics of change (Meyer & Nijhuis, 2016).

More specifically, the landscape is seen as a spatial entity formed and transformed by the dynamic interplay of different systems-flows, that act upon the landscape affecting each other. Flows of water, green and people, in this case, the agents of this interplay, therefore the project is fully integrated into the theme of the Landscape Architecture Graduation Studio “Flowscapes”. Waterways, eco-corridors and human movements will be investigated in an attempt to reveal interrelations and establish or restore connections between them. The urban landscape is, thus, a larger system enclosing these smaller subsystems and resulting from their action and interaction.

Since change, instability and uncertainty is what characterizes all three subsystems, the resulting entity is never stable nor rigidly defined, but fluid and everchanging, showcasing a high degree of temporality; an open-ended process, rather than a definitive result. Open water levels are variable, covering different parts of the area each time, depending on precipitation. This, in turn, affects the flora and fauna that are attracted in the specific area. And vice versa, the presence or the absence of green directly affects the amount of water that is accumulated in the area. Eventually, water and green have an undeniable impact on environmental perception and on human behavior and can play a decisive role on peoples’ flows throughout the city, who tend to ‘prefer’ a certain landscape over another.

The landscape as a space of flows

Water, fauna and people move through the city in different directions forming networks of flows. It is, therefore, important to research and record these flows in order to reveal hidden interrelations or existing potential that could be used for the creation of a desired future.

The flow perspective shifts the focus to the space of flows, rather than to the space of places. The space of flows can be defined as the formal expression of structures for the (1) provision of food, energy, and fresh water; (2) support for transportation, production, nutrient cycling; (3) social services such as recreation, health, arts; and (4) regulation of climate, floods and waste water. This shift of focus to the space of flows allows landscape architecture and other design disciplines to acquire a fundamental role in territorial transformation processes (Nijhuis & Jauslin, 2015).
Understanding landscape as a space of flows and movement can facilitate the relationship between natural and human systems, between the processes and the built environment. These landscapes, or flowscapes, are then becoming operative structures that create conditions for future development and aim towards sustainability.

In this approach, the concept of the longue duree is crucial; this concept addresses the landscape as a long-term structure which is changing rather slowly (Nijhuis & Jauslin, 2015). Landscape is not understood as a stable structure, but rather as a system of dynamic actions, containing a network of interrelations between space and processes.

The landscape as a layered system

A widespread landscape architecture theory is the three-layer approach, which was developed in the Netherlands during the 70s and was greatly influenced by Ian Mc Harg’s work and his book “Design with Nature”. McHarg introduced a new way of working, in which he used overlay mapping as a tool of inductive reasoning. After representing different factors on transparent maps, he superimposed them in order to draw conclusions for the suitability of specific land uses in each area (Conan, 2000). What his method missed is that his layers included information from the past and present, but did not take into account the uncertainty of the future.

This was further elaborated by the three-layer approach, which addresses the landscape as a system of abiotic, biotic and anthropogenic factors (Meyer and Nijhuis, 2013). The three layers of this approach include the substratum, the networks and the occupation; time plays a major role here, since each layer is transformed over time with a different pace -the substratum with the slowest and the occupation with the fastest. The re-arrangement of the layers from bottom to top according to their time relationship can set priorities and conditions for spatial plans (Chung, 2014). However, the translation of this approach into a real design remains unclear. These ideas were later developed in the Framework concept (Casco model), “for conducting the complex interrelationship between nature and human landscape” (Chung, 2014). This concept is based on the paradox of change and uncertainty, which are both fundamental in natural and cultural systems (Ahern, 1999). According to this approach, the layers or functions of the landscape are categorized as either “low dynamic” or “high dynamic”. The “low dynamic” ones, such as ecological processes require a level of stability to function properly. The “high dynamic” ones, by contrast, such as processes influenced by social or economic factors require more flexibility, since they inherently involve a high degree of uncertainty. The Casco model combines both, by providing the necessary long-term stability to the first and, at the same time, more flexibility concerning land use change to the latter (Ahern, 1999). The planning challenge, here, is how to create ecologically sound landscapes, where conflicting types of land use can be developed (Van Buuren and Kerkstra, 1993).
3. RESEARCH FRAMEWORK

3.2 RESEARCH METHODS

Throughout the whole project, a continuous loop between research and design will be carried out, with the one informing the other and vice versa and with the objective gradually narrowing down to more specific ideas and solutions. Therefore, the succession of various activities in the fields of design research (the analysis of existing designs or precedents) and research-by-design (the formulation of new designs) means that the project will be carried out in a gradual process, with the one field informing the other in a repetitive way, until knowledge can move from generic to specific (Nijhuis and Bobbink, 2012). The further goal is to be able to move again to generic, so that the site-specific design solution can become a guiding framework, the principles of which can potentially be applied to other similar cases.

Working through scales (design research and research-by-design)

In this project, research will be conducted on all scales: On a macro-regional scale (province), I will try to understand the wider framework and the conditions that may affect in any way the subject. On a meso-local scale (city), I will research on flows, such as water, ecology and people, to understand how they are related to the subject and to reveal interrelations and establish/restore connections between them. Finally, on a micro scale (neighborhood), I will dive into the experiential part to discover how the concept of the amphibious city can provide an alternative urban experience, challenging our idea of the conventional street, park or square.
The first two scales will be mainly used for reading-analysing the site, while the third will also be employed to edit the site through the detailed design. This does not imply in any case that the scales serve a one-sided purpose; on the contrary, research will not stop at the city scale, while, similarly, design does not only concern the neighborhood scale, but has more or less direct impacts on the city or even the province scale.

**Discovering correlations (research-by-design)**

Time and scale will be correlated in a matrix, that will record the changes over the years (now, in 10 years, in 50 years) through the different scales (neighborhood, district, city), in order to better express the various implications of the project and its evolution. Furthermore, three different situations will be compared; the current one (year 2018), and two future situations (year 2048); one that will emerge if we do not intervene and a desired one that includes the detailed design. In this way, design choices will be justified on the grounds that, they not only provide a better future but also improve or solve the shortcomings of the present.

**Mixed methods approach (design research)**

The research methods I will use will be both quantitative, including numerical data and calculations (floodling probabilities, expected maximum precipitation levels, additional retention space etc.), but also qualitative ones, through e.g. study and application of social sciences theories or personal observations (psychology of space, perception, human behavior etc.), incorporated into a mixed methods approach (Creswell, 2009) for data collection.

**Precedents study (design research)**

A separate chapter will be devoted to the study of precedents that have in the past addressed similar cases and, mostly, to how they tackled them. This study will reveal correspondencies among projects seemingly different at first; correspondencies originating from common principles, which defined the fundamental choices in each project. Through a process of generalization, knowledge will become detached from the context and, hence, generic and applicable to other contexts. This generic knowledge, the extracted principles, can eventually inform the research in question and be applied to the case of Dordrecht, becoming again specific and context-related.
3. RESEARCH FRAMEWORK
3.3 RESEARCH DESIGN

The research design will be a circular process, starting with the problem statement—the reason why I am conducting research, leading to the research question and objective—what is the research about, leading in turn to the methods that will be used, the tools of the research, and from which I will derive the principles that will form the base of the design. This does not imply in any way that research and design will consist two successive stages, but rather, as mentioned previously, that they are being conducted simultaneously, mutually supporting and promoting each other.

The research design is an open-ended process, where the design itself is not a final product, but only a means for reflecting if and, to what extent, it has answered sufficiently to the initial problem statement.

Overall, the research design consists of the following steps, which correspond to the time-planning stages of the five presentations:

1. organization of general framework and structure of the research, study of literature and precedents, mapping of main features—flows (blue-green-mobility) and articulation of intentions forming an initial vision
2. revision and elaboration of maps, results and conclusions of the analysis, articulation of concept and principles, choice of focus site, analysis and mapping in smaller scale
3. collection and processing of quantitative and qualitative data, revision and elaboration of smaller-scale maps, results and conclusions for focus site, start of detailed design
4. elaboration and completion of detailed design, overall conclusions and reflection
5. development of alternative-supportive means for the presentation of the detailed design
4. PRECEDENTS STUDY
As inspirational references, we could include various climate-adaptation projects for Copenhagen and other Danish cities, as well as smaller scale projects, such as the Bentemplein in Rotterdam or the Potsdamer Platz in Berlin. These projects, by restructuring public spaces or parts of the infrastructure, aim to increase the city's flooding capacities and create adaptive places, as a response to climate change. The variation in scales proves that a small individual intervention can function as a framework-guideline for the restructuring of the whole city.

City centre cloudburst strategy, Tredje Natur

**Location:** City center, Copenhagen, Denmark  
**Responsible partners:** Ole Schrøder and Flemming Rafn Thomsen  
**Design Team:** Kristina Madsen, Sofie Mandrup Andreassen, and Christian Kuczynski  
**Client:** HOFOR and Copenhagen Municipality  
**Project period:** 2013  
**Type:** Urban design and climate adaptation

Tredje Natur has created a vision for stormwater management in Copenhagen’s city centre through the design of a robust and resilient infrastructure; this includes the creation of a network of stormwater boulevards, green ditches, open channels and underground pipes for the disposal of the rainwater to the harbor, lakes or green areas. The city is, therefore, split into eight water catchment areas, for which separate proposals have been developed. Tredje Natur proposes the expansion of green, blue and soft infrastructure giving more room to pedestrians and cyclists within the city and aiming, thus, to the enhancement of the sustainable transportation profile of Copenhagen. At the same time, emphasis is given on the creation of open, visible solutions, rather than underground ones for small and large rain events. When they do not serve for rainwater distribution, these networks promote biodiversity while providing opportunities for recreation. Air and rainwater purification are also thought of, through technical installations such as mulch layers, filters and compositions of purifying plants. This approach sees the rainwater, not as a problem that needs to be diverted, but on the contrary as a unique quality with recreational potential, that can upgrade the urban experience and the local identity.

[Copenhagen cloudburst plan, Tredje Natur (source: http://tredjenatur.dk/portfolio/indre-by-skybrudsplan/)]
The soul of Nørrebro- Hans Tavsens Park and Korsgade, SLA

**Location:** Nørrebro, Copenhagen, Denmark  
**Collaborators:** Rambøll, Arki_Lab, Den Nationale Platform for Gadeidræt, Aydin Soei, Social Action  
**Visualisations:** Beauty and the Bit  
**Client:** Copenhagen Municipality  
**Project period:** 2016 – 2022 [est.]  
**Type:** Urban design and climate adaptation

SLA’s project ‘The Soul of Nørrebro’ addresses the issue of water management—whether it has to do with its increase, pollution or lack of it—through the Nordic Model for city development; a highly scalable model based on co-creation, dialogue and humanistic, nature-based design solutions. ‘The Soul of Nørrebro’ supports and strengthens the intricate urban systems that define the character of Nørrebro: The hydrological circuit, the biological circuit and the social circuit. By founding all solutions in a strong city nature, the project amplifies the synergy between the different circuits. The result is a project that solves a series of urban challenges while at the same time creating new possibilities for social co-existence. Based on continuous dialogue and co-creation together with the citizens and authorities, the project aims towards an evolving, participatory process, that will embody the soul of the city. In this project, Hans Tavsens Park functions as a natural rainwater catchment basin, while the Korsgade street as a waterway that leads the water to the lakes. The water, thus, becomes a visible feature in the cityscape used for irrigation and enhancement of the microclimate, while creating a series of new, blue-green public spaces. Water purification is crucial, here, through designed biotopes along the Korsgade, that cleanse either the rainwater before its disposal into the lakes or, in dry periods, the phosphorus-filled lake water that is pumped into the site. The result is a continuously self-cleansing circuit.
The soul of Nørrebro, SLA (source: http://www.sla.dk/en/projects/hanstavsenspark/)
Benthemplein watersquare, De Urbanisten (source: http://www.architektur-wasser.de/referenzen/watersquare-benthemplein-rotterdam.html)

Watersquare Benthemplein, De Urbanisten

**Location:** Agniesebuurt, Rotterdam, The Netherlands


**Client:** Rotterdam Climate Initiative, City of Rotterdam supported by the Waterboard Schieland & Krimpenerwaard

**Project period:** Design 2011-2012, completed 2013

**Type:** Public space- watersquare

Benthemplein, the first water square to be realized, combines water storage with the improvement of the quality of urban public space. While water storage facilities become visible and enjoyable, new recreational opportunities are generated and a central space of the neighborhood is upgraded environmentally, acquiring a stronger identity. Benthemplein is the result of a participatory, bottom-up process, where the involvement of the local community played a major role. The function of the watersquare is based upon the creation of three basins; two shallow ones receiving water whenever it rains and a deep one that is only flooded after prolonged, heavy rain. Rainwater is collected from the surrounding area and transported through a system of steel gutters. Other special water features are added within the square to enhance the experience of the water, making it more dramatic and intense. After the rain, the water of the shallow basins flows into an underground infiltration device and then seeps back into the ground water, maintaining its level in a stable condition, even in dry periods and facilitating irrigation and reduce of the UHI effect. The water of the deep basin flows back into the open water. Water management is achieved through a separate water system, relieving the existing sewage facilities and avoiding grey water from flowing into the open water areas. In a dry condition, the water square can be used for sports or as a gathering space, where the materials, the colors and the planting schemes create separate zones.
Despite their site-specific nature and different scale, all these projects are based upon a number of common principles. Among them, the most important ones are:

- rainwater collection, storage and re-use
- increase of permeability (green or permeable paving)
- creation of floodable (wet) areas and safety (dry) zones
- use of visible flooding techniques (above-ground waterbodies)
- link of flood protection-ecology-social life
- creation of different typologies for different street profiles/ public spaces (toolbox)
- use of infrastructure as waterways/ public spaces as basins
- vision of a changing, adaptive, dynamic city


Gro Nørrebro, EFFEKT & De Urbanisten (source: https://www.effekt.dk/cac/)
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5.1 ANALYSIS & DIAGNOSIS

The following chapter includes an analysis of the main systems of the area, in order to provide a better insight of Dordrecht and its context as well as a concrete base for design.

The analysis is focused on three different scales, two of which are presented here: the macro scale (province) and the meso scale (city). Different themes such as water, ecology, urbanization, mobility, city characters etc. are examined, so that their hidden potential and interrelations are revealed, acting as stepping stones from reading to editing of the site.
The island of Dordrecht is located in the central river area of the country, as part of the Rhine-Meuse estuary. It is, therefore, the crossroads of numerous important waterways, but at the same time a focal point close to North Sea arms, such as the Haringvliet, Grevelingen and Oosterschelde, now protected by storm surge barriers; the Delta Works.
It is also part of the national ecological structure, next to the Biesbosch, but also surrounded by large green areas, such as the green heart in the middle of the country, the North Sea coast and the delta area, a fact that reveals great ecological and recreational potential for the city, which could become the connecting node of these areas.
At the same time, Dordrecht is situated in one of the most densely urbanized deltas, at the crossroads of major European corridors: the urban area between Amsterdam and Antwerp and the industrial zone between the mainports of Rotterdam, Antwerp and the hinterland. It is the center of the Drechtsteden, a conurbation of "cities at the water", but also part of the South wing of the Randstad.
In this “red” delta, Dordrecht is surrounded by a large number of urban formations, most of which have developed on river banks. The biggest cities can be found on the north, such as Rotterdam, Zwindrecht, Papendrecht and Sliedrecht. Rotterdam plays the role of the economic authority of the area, concentrating most industrial functions.
These urban areas are interconnected through a network of railways, highways and waterbuses, such as the one starting from Rotterdam, going to Kinderdijk and finally to Dordrecht. For the island of Dordrecht, the main infrastructural connections are on the north-south axis (Rotterdam-Breda) and on the west-northeast axis (Haringvliet-Utrecht and Nijmegen). The national LF network that goes through the city, connects it with the rest of the country, in thematic cycling routes.
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Water typologies

Dike system

Drainage areas

meso scale: WATER
The water structure of the city consists of a complex system of dikes, waterways, pumps, inlet and outlet points and open water areas. A primary dike ring surrounds the island, leaving out the historic city centre, the higher outer flanks and the Biesbosch, while the inner-dike area is divided by a system of secondary dikes, enclosing separate compartments. The main waterways form a denser structure close to the city edges and on the south part of the island, where they follow the creek patterns, while within the inner-city, they are much more fragmented and sparse.
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Green typologies

Green & recreation corridors

Ecological structures

Nature policies

meso scale: ECOLOGY
The ecological structure of the island is diverse, including different habitats and accommodating different species. Nature manifests a range of characters: the wall vegetation of the historical centre, is succeeded by green fragments in the inner city, open land habitats and finally by the rich tidal nature of the Biesbosch. The dike canopies form green lines serving for species migration, while green zones, usually of recreational character, are formed in the city, connecting it with the Biesbosch.

Ecological networks
(On the base of: Dordrecht-Atelier: De Groenblauwe Linten van Dordrecht, De Urbanisten)
The recreational mobility network consists of a dense cycling structure of more urban or more rural character, that crosses and connects a large number of recreational areas, such as schools, play areas, shopping districts or sports facilities. This network also follows the main lines of the island, such as main streets or dikes, denser within the city borders and sparser outside.
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Infrastructural networks

meso scale: CITY CHARACTERS

- lively centre
- city living
- suburban
- peaceful green
- office area
- industrial area
- business district
- green & recreation
- agricultural land
- nature
Dordrecht itself is a place with many faces and atmospheres. From north to south, a number of varying characters appears, formed by factors such as density, scale of buildings and of open/green spaces, urban patterns, district typologies etc. Following a route from the binnenstad to the Biesbosch, the differences are obvious following a gradual transition; from the dense, congested city centre, the space gradually opens up, implying different urban configurations, more open/green spaces, larger scale.
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meso scale: CITY CHARACTERS

Historische Binnenstad Schil Krispijn Leerpark Dorstwijkzone Butegebied Biesbosch

radial orthogonal circumcentred unspecified dispersed Urban patterns

historical city centre pre-war building block garden village caulifower district post-war district agricultural land wetlands Distinct types

Scale of open spaces Number of open spaces Scale of green Amount of green Scale of buildings Number of buildings
From the analysis on the macro and meso scale, it becomes evident that:

1. Dordrecht is an urban and ecological crossroads, meaning that there is great potential for the island to work as a connecting node between different areas, in terms of ecology/recreation/etc. Because of its strategic location, any future change/intervention can have a major and direct impact on its wider context, while the role of Dordrecht itself might be able to change in relation to other cities.

2. The system of the city is a layered system, where the layers are interconnected and interrelated. The networks and, therefore, the flows of water, green and people create a dynamic interplay when acting upon the landscape. Since change is what characterizes all three subsystems, the resulting entity is fluid and everchanging.

3. The city-nature transition is a gradual one, shaping varying city characters and, therefore, different landscapes with their own identity, meaning that any intervention that seeks to respect these identities should comply to a number of specific characteristics.
From the overlay of the layers, we can see that water, ecology and recreational networks are all developed along main lines of the island and are, therefore, integrally connected and interwoven. These lines are either green (dikes), forming water compartments, serving species migration and main infrastructural connections, or blue lines (creeks), forming major waterlines, serving as inland water habitats and as infrastructural connections too. The lines succeed a city nature connection, but also the connection of a system of nodes (big green areas or areas of recreational character). The nodes form big zones as gaps in the urban fabric, where all 3 layers (water-ecology-recreation) meet their maximum (densification).

This system of lines and nodes could be the base for the creation of a new network, where the lines will either create compartments, enclosing smaller sub-systems or accommodate the main waterflows for the distribution of the rainwater. Similarly, the nodes could become water retention areas serving the main goal of flood protection, but intertwined with ecological or recreational purposes.
The system of lines and nodes, resulting from the analysis of the main structural elements of Dordrecht, generated the idea of "the city as a living organism", where the lines-waterlines are the veins and the nodes-basins the vital organs of the city. Together, they form a complex, everchanging system. The water runs from the veins to the organs and vice versa, endlessly transforming the city and supporting its fundamental functions.
The main principles of the design are four:
1. city-nature transition
2. the city as a sponge
3. visible flooding
4. multifunctionality

The principle of **city-nature transition** is actually following the existing transition of city characters that was mentioned before. From the fluidity of the wetland estuary to the compact urbanity, a number of different characters completes this transition, where “red” (built) and “green” (nature) function as negatives of the same image. Where the one increases, the other vanishes, restoring an immanent balance. In this chain, there is a missing link, whose character is still vague and ambiguous; the 19th cent. Schil. This is where I chose to focus my research, in an effort to restore the red-green balance, through the introduction of small green fragments in a fabric that is dense, but not as dense as the city landscape and sparse, but not as sparse as the area of the big green fragments. These green fragments will become the main bearers of the green-blue network, together with the waterlines, acting as nodes.
The second principle concerns water management, addressing the city as a sponge that can retain, store or dispose rainwater. The city can “hold” the rainwater through increased permeable surfaces, store it in underground tanks or lead it to the river. This implies the creation of a separate sewage system, that can withstand future increased precipitation. The city is composed of different sub-systems-compartment, within which the rainwater cycle is the driving force.
The third principle places the emphasis on the experience of space and on the everchanging landscape. Water becomes the agent of the transformation of space, through a visible flooding process and mainly above-ground waterbodies. Thus, the space acquires this amphi-quality, promoting the duality of wet and dry.

This duality is also visible in the Dutch mentality; the Dutch people might fear the water, but they also enjoy to live close to it. This project aims to solve the first, but at the same time highlight and enhance the second, creating a safe, but also exciting place.
Multifunctionality is the last principle, aiming to create spaces that can transform offering multiple possibilities and serving multiple purposes under different circumstances, rather than one single purpose. Thus, not only the experience differs, but also the active engagement of users with space, with a range of different activities encouraged by the presence or the absence of water.

The transformation of 3 spots in the 19th cent. Schil, of a street into a retention boulevard, a conventional square into a watersquare and a parking lot into a skate park-water reservoir, shows how the principles can be applied in practice and how a system of similar spaces could compose the concept of the multifunctional amphibious city.
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Wet vs. dry: a constant dialogue
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5.3 THE 19TH CENT. SCHIL

The following sub-chapters include an analysis of the 19th cent. Schil focusing on a micro scale, the scale of the district or the neighborhood.

This analysis, looking into historical, spatial and structural aspects, aims to provide better insight in the area and, therefore, more solid grounds for the design proposal to emerge.
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5.3.1 HISTORICAL ANALYSIS

The Schil is largely part of a peel-shaped extension to the south and east of the city centre in the second half of the 19th century. The protected cityscape includes the part in which the historical structure with the different residential environments is best preserved. The area is characterized for a non-planned, largely private initiative urban expansion before the implementation of the Housing Act.

Before 1800

After the St. Elisabeth flood of 1421, the submerged land was reclaimed in phases, still evident in the current dike structure (Noordendijk, Groenedijk, Blekkersdijk and Hoge Bakstraat). Along the Spuihaven a narrow strip of industry was developed. Outside this strip, there was a whole area of market gardens, nurseries, bleaching and pasturage fields. The area was hardly built, but there were several industrial mills. The area was intersected by dug out watercourses, which were used for transport and irrigation of the nurseries. Remnants of old tidal creeks are also visible on old maps. Economically, the area was entirely dependent on the city and the surrounding ports. Various street names (Blekersdijk, Warmoezenierspad) recall the old functions of the area.

First half of the 19th century

In the first half of the 19th century, the Schil gradually evolved into a residential area. Close to the nurseries, small houses were built for the owners, while along the paths (Geldeloze pad, Kasperspad, Matena’s Pad) workers’ dwellings arose. Because the inner city was full, several buildings with special functions appeared in the area, such as the Ministry of War. Already in the 18th century, more and more gardens and bleaching fields were bought by wealthy city dwellers, giving their place to large country estates, such as the Rozenhof, Bellevue, Merwestein, Noordhove and Zorgwijk, equipped with...
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English-style gardens. Although these expansions disappear in the second half of the 19th century, they have greatly influenced the development of the Schil.

Second half of the 19th century, beginning of the 20th century

After the gradual dismantling of the old city walls and gates, the construction activities in the Schil were intensified. Wealthy residents moved from the congested city to spacious villas and houses in the outskirts, while new residents were also attracted in the area. Private entrepreneurs responded to these developments with the construction of blocks of mansions. Villas and mansions arose along the main connections, especially along the Singel, which ran from the Kalkhaven in the west to the Noordendijk in the east.

The eastern part of the Schil was first built up. Around 1875, the area west of the Blekersdijk was still virtually undeveloped until the arrival of the railway and the construction of a large station (1872), which gave a strong impulse to the building activities in this part.

Parallel to the railway a new east-west axis was constructed, the current Burgemeester De Raadtsingel, where soon mansions, villas and a hotel arose. In the course of the 19th century, almost all market gardens were developed into housing areas by private investors. The basic avenue system of the 18th-century remained intact, along which closed building blocks with mansions for the upper class were constructed. The rise of Dordrecht as an industrial city with port activities, combined with the arrival of the railway, also led to a large influx of workers. The areas along the old cross roads (Geldelozepad, Matena’s Pad) and the inner areas behind the new building blocks soon evolved into a maze of streets and dead-end courtyards with small workers’ houses. The construction was usually of low quality and the densities were always high. Despite the remediation of recent years, there are some nice examples of workers’ houses in this area, such as the neo-classicist Clara Mariahof (1885), the Hallinghof (1902) and the Hof De Vereniging (1863).

After the disappearance of the nurseries and the introduction of sewers and water pipes towards the end of the 19th century, almost all watercourses in the area were muted and paved. One of the last watercourses was along the Blekersdijk (1899), on the place of the current median. The existing connecting roads between the new residential area and the old city developed after 1900 as shopping streets. This function has deteriorated over the past decades, but is still recognizable in the Spuiboulevard, in the station area and along the Stationsstraat - Johan de Wittstraat. Around the reconstructed Beverwijckplein, many historical buildings were demolished, including the old municipal hospital, the gymnasium and a few blocks of workers’ homes giving their place to offices and new apartment complexes. Around 1990, traffic interventions took place in connection with the new traffic bridge over the Oude Maas. As a result, the old Parallelweg and the Burgemeester de Raadtsingel were transformed into a busy artery.

In the eastern part of the shell, the character of the 19th century urban fabric was better preserved. In the nineties, some ‘inner areas’, in particular those between Kromhout and Singel, and between Singel, Noordendijk and Groenedijk, were restructured. The 19th century workers’ homes and industrial buildings have largely been replaced by contemporary public housing, where the original patterns of streets and courtyards were partly preserved.

20th century

In the sixties, various remediation operations took place in the Schil, mostly in the western part. Because the historic inner city had to be maintained, but at the same time its vitality had to be stimulated, the western part of the Schil was given the task of contributing to the strengthening of the regional function of the city center. This meant, among other things, additional traffic and parking facilities and the realization of office space.

On the basis of the Remediation Plan (1961), large-scale office developments took place along the Spuiboulevard, in the station area and along the Stationsstraat - Johan de Wittstraat. Around the reconstructed Beverwijckplein, many historical buildings were demolished, including the old municipal hospital, the gymnasium and a few blocks of workers’ homes giving their place to offices and new apartment complexes. Around 1990, traffic interventions took place in connection with the new traffic bridge over the Oude Maas. As a result, the old Parallelweg and the Burgemeester de Raadtsingel were transformed into a busy artery.

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5.3.2 SPATIAL ANALYSIS

In order to design a green-blue network for the Schil, it is essential to research on the existing qualities of the streets and the public spaces, that will eventually become parts of this network.

Through an inventorial process (p. 78-83), the main characteristics of the most important streets and public spaces were identified, like dimensions, materials and, therefore, vulnerability within small, typical strips, with a view to be used as a base for the interventions.
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Public spaces inventory
Parking Maasplaza

vulnerability: hard: 92%, soft: 8%

typology: parking area

Example of public space
Through this inventory, existing typologies were identified, in order to create afterwards specified design solutions that could correspond to one or more typologies.

As far as streets are concerned, in the area we can find blue-green boulevards (e.g. Spuiboulevard), waterfront streets (e.g. Achtehakkers), high-traffic boulevards (e.g. Burgermeester de Radsingel), double-height streets (e.g. Sluisweg), elevated dike streets (e.g. Noordendijk), low-traffic residential streets (e.g. Blekkersdijk) and main urban connections (e.g. Singel). The streets, of course, do not strictly correspond to one typology, yet their main features and character allow their categorization.

The public spaces of the area can be more clearly defined as parks, playgrounds, parking lots, squares and sports fields.

These conclusions are summarized in the following maps (p. 85-86).
Existing street typologies in the Schil area
Existing public space typologies in the Schil area
Based on the previous inventory analysis, new typologies were created according to the specific characteristics of the streets or the public spaces.

The street typologies consist of waterlines serving for rainwater flows, while the public space typologies become seasonal buffers facilitating the retention and storage of rainwater.

In case the street dimensions and more specifically the pavement width allows it, but also if the vulnerability rate is not significantly high with enough permeable surfaces (e.g. Spuiboulevard), new public sitting spaces can be created in the form of outdoor living rooms, which can also be parts of the waterline system, filling up with water after extreme rainfall. At the same time, green-blue retention strips can be created along high-traffic boulevards (e.g. Burgemeester de Raadtsingel), reducing the vulnerability of the street and adding linear natural elements as an interruption of the chaotic profile. The waterfall is a solution suitable for double-height streets (e.g. Sluisweg) or elevated dike streets (e.g. Noordendijk), utilizing the height difference and allowing for the flow of
rainwater from the higher to the lower parts creating a waterfall effect and, thus, providing more benefits, e.g. soundproofing. The gutter can be applied in case the street profile is relatively narrow in low-traffic residential streets or in main urban connections (e.g. Singel), emerging as a linear element between the parking spaces and as an extension of the pavement, potentially accompanied by green strips. Finally, the waterfront—which can be considered either as a waterline or as a buffer—designed along waterfront streets (e.g. Achterhakkers), aims to enhance the buffer capacity of the waterbody through the creation of a light-construction promenade that leaves more room for the water which can flow underneath it, but can also be partly submerged when the water levels are too high.

The hofje and the private garden are created as public, private or semi-public spaces aiming to enhance the quality and permeability of spaces like playgrounds, parking lots, small squares etc. (e.g. parking Oranjepark) often allowing seasonal aboveground storage, while the watersquare can provide a multifunctional public space in low-quality areas with sufficient dimensions (e.g. Maasplaza parking, Energieplein), serving as a gathering spot for the residents as well as an important rainwater collector with high capacity. The parkway can be a means of improving existing public parks through the creation of height-differences and basins that can temporarily accommodate large amounts of water. Otherwise, it can be the reason for a complete transformation of an important traffic artery (e.g. Johan de Witstraat), as is the case in this project, serving both as a waterline and as a major buffer.

The previous are summarized in the following diagram (p. 89), illustrating how existing and proposed typologies are interrelated, allowing for multiple correspondencies.
Relation of existing and intervention typologies
In order to become more familiar with the Schil itself, understand the existing patterns and identify potential and weaknesses, an analysis focusing on its structural aspects needs to be carried out.

As we can see in the following map (p. 91), the Schil is a clear extension of the Binnenstad. Historically, it is the part of the city that was created in the 19th century as Dordrecht was expanding to the south. The Binnenstad, originally enclosed by fortifications was an area created in a radial form. The radials, starting from the Voorstraat, were oriented towards the five city gates (Hooge Sluyspoort, Spuypoort, Vriezeapoort, St. Jorispoort and Kleyne Sluyspoort) and were often terminated by landmarks or important structures. During the 19th century, the radials expanded to the south, forming the main axes of the Schil and playing an important role in the urban organizational schemes. The whole area consists of concentric rings, of which the middle one, the Singel, running from one end to the other, bisects it in two zones, with different organization.

In the inner zone, the upper and middle-class houses were arranged along the main streets, while the worker’s houses were built in-between, connected by secondary streets. In the outer zone, we have free-standing mansions with gardens and front yards facing the street and generally more open spaces.

The “hofje”, is a typical element of the city. In fact, it is an enclosed common courtyard usually of rectangular shape, surrounded by small houses. Since in the 19th cent. no permit was needed for building houses that could not be seen from the street, poor people invented the scheme of the “hofje”. Most “hofjes” can be found in the eastern part of the inner zone.
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Structural elements of the Schil
The maps above illustrate the main patterns of buildings, dikes, streets, green spaces and waterbodies.

In the buildings map it is evident that scale and density differ within the Schil; large, enclosed blocks and higher coverage rates can be found in the western part, between Blekkersdijk and Achterhakkers, but also on the eastern edge, while the rest, between Noodrendijk and Blekkersdijk is characterized by smaller scale and lower densities, especially in the area around Merwestein Park, where we mainly have free-standing mansions with gardens.

The radials Sluisweg-Hoge Bakstraat and Noordendijk, together with Blekkersdijk and Groenedijk form the dike structure of the Schil, reminding the original reclamation patterns. Sluisweg-Hoge Bakstraat and Noordendijk are also parts of the main ring dike of Dordrecht, protecting the lower inner city and leaving out the higher outer flanks.

In the street patterns, the original radials have been preserved and, together with the concentric rings (Spuiboulevard-Kromhout, Singel and Burgemeester de Radsingel-Toulonselaan-Oranjelaan), they form the primary infrastructural network. In the in-between spaces, secondary, often dead-end roads serve a more residential function.

Green is relatively limited, apart from Merwestein Park that covers a significant area and several, smaller green patches, like the Rozenhof and the Oranjepark. The adjacent Weizigtpark south of the Schil is another important plus, which is yet disconnected and hardly accessible from the Schil, since Burgemeester de Radsingel forms a barrier.

Open water finally is also limited to the north edge (Kalkhaven-Spuinhaven-Riedijk Haven) and to several waterbodies in and around Merwestein Park, while old creeks and watercourses (e.g. along Singel or Blekkersdijk) have disappeared.
The highest parts of the 19th cent. Schil are located in the outer-dike flanks, on the western and eastern edges, while the rest of the area does not display important differences. The dikes Sluisweg-Hoge Bakstraat and Noordendijk stand out on the map, clearly illustrating the borders of the inner-dike zone, while Blekkersdijk blends with the rest, stretching on approximately the same height.

Ground heights
(source: https://ahn.arcgisonline.nl/ahnviewer/)
The area has a generally residential character, while at some parts it is a mix of housing and offices. This fact is more evident in the western part, especially in the area around the Spuiboulevard, along the Johan de Witstraat and close to the station.
The most important locations are illustrated in this map including the old city gates, squares and parks, buildings with a special function and historic courtyards ("hofjes"). Most of them are concentrated in the eastern part of the Schil, between Blekkersdijk and Noordendijk.

**Important locations**
(on the base of: Beschermd stadsgezicht 19e-eeuwse Schil Dordrecht)
As the oldest city of Holland, Dordrecht can be proud of its monuments, including national and municipal monuments as well as iconic buildings. In the Schil numerous municipal monuments can be found along the Singel and the Blekkersdijk, around Merwester park -which itself is also considered one- and in the eastern outer flank (e.g. Energiehuis). At the same time, buildings like the Rozenhof complex, the station, the Schouwburg Kunstmin theatre, the Wilhelminahof and the Villa Augustus are considered national monuments.
Similarly, the oldest buildings of the 19th and early 20th cent. can be found around Blekkersdijk and Merwestein Park, as well as along the Singel, while the newest additions of the 20th and few of the 21st cent. are concentrated in the area around Spuiboulevard and in the eastern outer flank close to Noordendijk.

There is, therefore, a direct relation with the protected cityscape boundaries (see map p. 100) but also with the characterized monuments.

Based on this map and separating the buildings according to their age, the following diagram results (p. 98), illustrating how the Schil really developed over time, but also the importance of the radials and the Singel that are preserved almost intact through the centuries.
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Evolution of Schil
As far as water is concerned, it becomes clear from this diagram how the edges and the Spuihaven changed over the centuries, but also that for a long time, streets like the Singel, the Burgemeester de Raadtsingel and the Blekkersdijk included waterlines.

Evolution of water network

Blekkersdijk before 1900 (source: http://fotos.serc.nl/zuid-holland/dordrecht/dordrecht-51095/)

Singel around 1900 (source: https://www.dordtekaart.nl/geschiedenisgroot16.html#16blad8)
This map shows the most important elements in the area. We can see which parts are considered as “protected cityscape”, but also which other elements are iconic, defining the identity of the Schil, like monumental buildings, “hofjes” and workers’ houses, green areas, waterbodies, public spaces and streets, like typical city streets or villa avenues. We can also see which are the most important viewlines, that are worth preserving, like towards the villa Rozenhof, to and from the Station along the Johan de Witstraat and towards the windmill “Kyck Over Den Dyck”. 

Important elements (on the base of: ONTWERPEND ONDERZOEK EN BEoordeling VARIANTEN GESIEDS WISIE SPUIBOULEVARD E.G. EEN INTEGRALE AFWEGING VAN DE AMBITIE)
This map shows where the most important problems can be found, which is mainly the edges. The Spuiboulevard is a very problematic street, disconnecting the rest of the city from the Binnenstad and forming a barrier. There is lack of coherence in terms of size and scale, since the buildings there are considerably higher, creating a shady, unsafe street. The buildings are behind the normal building line and this, in addition to the vacant offices, creates a feeling of emptiness.

Apart from that, other problems are the numerous parking garages, the low quality of public space/architecture, incoherent urban patterns and high-traffic streets that form barriers.

PROBLEMS:
1. disconnection from Binnenstad, contrast in scale and size, lack of coherences/cores, shady place, high-rise, continuous facades, recession of building line, emptiness
2. vacant offices, 33%, emptiness, irregularity
3. parking lots, low quality of public space
4. lack of coherence with urban patterns
5. high-traffic streets, barriers
6. interruption of character of Singel
7. low quality of architecture and public space
8. low quality of architecture, irrelevant
9. low quality of architecture, lack of coherence with urban patterns
10. low quality of public space
The local community and the municipality of Dordrecht have many ideas and goals for the future of their city, targeted at the modern knowledge worker; more specifically, they are focused on issues of living, working, mobility, environment and safety. They see the lack of coherence in the Schil area as a problem that can be solved by using the public space as a binder. In a time, when the need for more housing becomes pressing, they are thinking of ways to combine quantity and quality. Dordrecht needs to find space for 10,000 more houses within the city limits, so the challenge is how to reconcile old and new, protected cityscape and high-rise. On the contrary, offices need increasingly less space, so the balance changes.

The initiative Gebiedsvisie Spuiboulevard is focused on the western part of the Schil and more specifically on the Spuiboulevard area. 3 scenarios have been recently formulated for this area, each of which prioritizes different things. The “compact city” addresses the issue of intensification with large scale blocks and high rises. In this case the contrast with the Binnenstad remains and maybe becomes worse. The “watercity” envisions a waterfront public space along a car-free Spuiboulevard, oriented towards recreation, as well as small-scale houses with green, open spaces. Finally, the “hoven-city” aims to redefine the typical hofje in a contemporary version with public, private or semi-private character and with a mix of scales and heights.

(source: ONTWERPEND ONDERZOEK EN BEoordeling Varianten Gebiedsvisie Spuiboulevard E.O. Een Integrale Afweging Van De Ambitie)
As far as water is concerned, data necessary for the water flow calculation in the area had to be extracted. In this case, factors like paved, green or open water surfaces were taken into account with a differentiation of materials that have a different infiltration rate. Two scenarios were examined; one that includes private green and one that doesn’t, if for instance all the residents were to completely pave their courtyards. Thus, the total retention area needed was calculated at around 14,000 m² and at 17,000 m² respectively.

Calculation of land cover types and water flow

Therefore, the existing and desired ratios of paved, green and water were calculated according to the previous water flow results, information from the Klimaateffectatlas, as well as the principle of city-nature transition. Less paved and more green and open water surfaces are necessary to make the Schil able to stand up to the future challenges of climate change.

At the same time, taking into account, that the Schil is approximately 4.3% of the whole city, the Schil can have around 500 houses. Based on the existing office vacancy problem and the pressing need for more residential grounds, according to the Spuiboulevard vision document, more housing and less offices are two main goals for the future image of the Schil.

**Existing and desired ratios of land cover and uses**

<table>
<thead>
<tr>
<th></th>
<th>Total area 19th cent. Schil</th>
<th>Total area Dordrecht</th>
</tr>
</thead>
<tbody>
<tr>
<td>paved</td>
<td>1439844.2940 m²</td>
<td>30483317.5 m²</td>
</tr>
<tr>
<td>green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**existing situation**

- paved: 58.5%
- green: 35%
- water: 6.5%

**desired situation**

- paved: 52.5%
- green: 40%
- water: 7.5%
- living: 75%
- working: 15%
- other: 10%

Existing and desired ratios of land cover and uses

Data from: Klimaateffectatlas (http://www.klimaateffectatlas.nl/).
Ideas like using existing or new public/private spaces as seasonal buffers and transforming the Singel and the radials into waterlines but also upgrading the importance of the Johan de Witstraat as a crucial connection between the inner city and the Binnenstad and as a major element of the green-blue network, were articulated in the form of different scenarios that were later merged into the design proposal.

More specifically, two scenarios were formulated; the first one is called **the extrovert watercity**. In this scenario, the Singel retrieves its character becoming a major waterline, while there is a hierarchy of waterlines. The rainwater starts from the middle of the Schil and flows from the Singel to the radials and finally to the buffers. Four water compartments are created defined by dikes, while important public spaces function as buffers. Housing is developed along the water with commercial ground floors, while the offices are in-between and specifically close to the station, a hierarchy reminding of the upper-class houses and the workers’ houses in the past. The Spuiboulevard becomes a car-free waterfront promenade, while a plaza is designed around the station with a tunnel for cars and trains. A second waterfront is created next to the Energiehuis. The scale is similar to the Binnenstad, with only few high-rise, either in second line to not create shade or close to the edges to not obstruct views towards landmarks.

The second scenario is called **the hidden watercity**. In this scenario, opposite to the first, the offices are along the main streets and the houses in-between. This new housing is created in the form of “hofjes”, not on the edges but inside enclosing building blocks with an inward orientation. The “hofjes” differ in character (private, public, semi-private) and are interconnected through a secondary system of maze-like waterlines. In this case, the water is led from the centre of the radials to the “hofjes”. The Johan de Wistraat becomes an important pedestrian connection between the inner city and the Binnenstad, while bridges in focal points allow views to landmarks, like the church tower. A waterfront is created on the eastern edge of the Schil opening up views to the water and to the villa Augustus. The scale is similar to the Binnenstad with only few high-rise on the edges.
These ideas, generated from both scenarios, are more clearly illustrated in this series of collages, where the urban space is envisioned as a green-blue network able to transform by the presence or the absence of water, creating, thus, an everchanging landscape and offering contrasting experiences.

Johan de Wistraat, a former major traffic artery of the city, acquires a new character, becoming a green corridor in the heart of the Singel. Apart from creating room for rainwater, through subtle height differences, it also consists an important connection between the historic city centre and the newer districts, while at the same time fostering activities and social interaction. Vibrant city life unfolds in every corner.
In contrast with the parkway, the hofjes are envisioned as 'secret' gardens, within enclosed building blocks. Designed to function as small seasonal buffers able to temporarily store rainwater, they also encourage a more intimate bond with the residents who are solely responsible for their maintenance and care. Wet or dry, they are the centers of residential life, bringing people together and encouraging shared experiences.
5. AMPHIBIOUS DORDRECHT

Spuiboulevard, a problematic part of the Schil, is thought of as a lively waterfront promenade, with its previously steep bank now functioning as an accessible public space, attracting everyday activities and special events along submersible water steps. Modern life unravels on the edge of the historic core, turning a degraded area into an attraction pole for locals and tourists.
Singel, the most iconic street of the Schil, retrieves its character as a waterline, through small interventions along the pavements in the form of simple gutters or rectangular green strips, playing, thus, a key role in the distribution of stormwater. It becomes a major axis facilitating flows of water, but also of people, a space of movement and everyday social encounters.
The elevated Noordendijk now features water elements that take advantage of its height, often creating small waterfalls on the edge of the dike. It, hence, provides a sound-proofing effect for the underlying areas while adding a playful element for the residents and the passers-by.
Energieplein is transformed into an important water collector, designed in a way that it can retain big amounts of rainwater, but also a vibrant public space always lively, modern and with a youthful aura. Its location in front of the restored Energiehuis, but also next to a waterfront promenade make it popular among locals and visitors. When it is dry, it functions as a recreational node, attracting anyone who wants to sport or linger, while when wet, it turns into ponds of different levels encouraging play and interaction with water.
A changing city (collage by author)
The design proposal combines elements from both scenarios (p.105) but has an important difference; the water flows from the buffers to the waterlines and not the other way around.

In this case, the idea of the "hofjes" is fundamental for the water system, since they become the main buffers of the network, together with private green spaces. These buffers are the starting points, collecting the rainwater and storing it aboveground, until it exceeds a certain capacity and flows to the waterlines.

Here, too, there is a hierarchy of waterlines; a system of secondary waterlines connects the "hofjes" in maze-like loops, contributing to the purification of the water, since it is exposed to the sunlight for longer. These secondary waterlines lead to the primary ones, that are either the radials or the Singel (of the same importance). From there, the water is led to a major waterline that can both store or dispose the rainwater to the open water, the Spuihaven.

Therefore, two main compartments are created from which the water is collected and led to a central axis, the Johan de Witstraat, which acquires, hence, a major role in the proposal.

The previous are more clearly illustrated in the following diagrams (p. 114-115).
5. AMPHIBIOUS DORDRECHT

Buffers and waterlines
Water flow directions

- Water direction
- Outlet points
- Final rainwater outlet
The masterplan shows how these elements are incorporated in the urban fabric. The major interventions (new housing) are outside the protected cityscape boundaries and mainly in the area around the Spuiboulevard and on the eastern edge, in the Stadswerven.

Enclosing structures form the edges of the building blocks, while the “hofjes” are hidden inside. In the outer zone of the Schil, the original pattern of independent houses and gardens is maintained. The Johan de Witstraat becomes an important blue-green connection between the Binnenstad and the inner city, while the perpendicular streets are pedestrianized. A station plaza is created as a simple linear element to facilitate the access to and from the parkway with an underground tunnel for car traffic. The Spuiboulevard is narrowed giving more room for the water and restoring the Spuihaven to its original dimensions and a waterfront promenade is created. A second waterfront is created on the eastern edge, offering views to the Villa Augustus and to the river, while two watersquares, in the former Maasplaza parking and in the Energieplein are designed as important public spaces and water collectors.

The ground floors are commercial enhancing the livability of the area. Scale and size are similar to the Binnenstad (max. 5 floors) with few high-rises on the western and eastern edges.
Deconstructing the masterplan into separate layers, allows us to see more clearly the new patterns that are created, but also calculate crucial factors like the minimum additional water surfaces and the new green or paved areas and confirm whether the proposed scenario could be an answer to a desired future.

Using the water flow calculation formula (p. 103) with the new data, the total retention area needed is appr. 12,300 m², which is already improved from the initial 14,000 m². With 9,800 m² of additional water surfaces a goal of 80% is achieved, without considering the amount of infiltration from the new green spaces.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfronts</td>
<td>1,751.0953</td>
</tr>
<tr>
<td>Parks</td>
<td>2,224.0661</td>
</tr>
<tr>
<td>Watersquares</td>
<td>6,428.4816</td>
</tr>
<tr>
<td>Plazas</td>
<td>2,147.4884</td>
</tr>
<tr>
<td>Minimum additional water surfaces</td>
<td>9,778.3529</td>
</tr>
<tr>
<td>New green spaces</td>
<td>6,129.0774</td>
</tr>
<tr>
<td>New buildings</td>
<td>8,725.6105</td>
</tr>
<tr>
<td>Hofjes</td>
<td>1,266.7470</td>
</tr>
<tr>
<td>Private gardens</td>
<td>1,260.1776</td>
</tr>
</tbody>
</table>

Layers
The following toolbox includes climate adaptation solutions that address issues like cloudburst flooding, heat stress, drought etc., subdivided in separate categories like collection, storage, infiltration, purification etc.

Based on this toolbox, the map of the next page (p. 120) illustrates how each element of the design proposal contributes to climate adaptation, meaning that the interventions do not only provide an answer to the initial water problem, but also to a range of other issues, such as the UHI effect with the increase of green, shade and evapotranspiration especially along the axis of Johan de Witstraat, the paelrot phenomenon, helping to keep the groundwater levels to a sufficient height through the increase of permeable, infiltrating surfaces or the issue of water recycling and reuse through the creation of subterranean storage facilities with high capacities below the watersquares and the park.

Apart from the aforementioned benefits, however, it is crucial to emphasize on the importance of these measures in terms of raising public awareness about climate-related issues through tangible examples, as well as encouraging active participation by creating room for small-scale initiatives and for integration of different demands.

Climate adaptation toolbox (source: J. van Lohuizen, Climate adaptive solutions for the neighborhood)
5. AMPHIBIOUS DORDRECHT

Application of toolbox in the design proposal
5. AMPHIBIOUS DORDRECHT

Climate adaptation toolbox (source: J. van Lohuizen, Climate adaptive solutions for the neighborhood)
The following maps illustrate how the different intervention typologies that were mentioned before (p. 87), created as a toolbox, are integrated in the context of the 19th cent. Schil, concerning the waterlines as well as the buffers.

In most cases, the gutter typology is used either inside building blocks or along the streets as simple linear elements, while the outdoor living room and the retention strip are mostly found on wide pavements or public spaces.
As far as the buffers are concerned, there is a clear distinction between the two zones of the Schil (p.91), referring back to the original urban patterns of the area with holjes and enclosed blocks in the inner zone and independent housing with private gardens in the outer one.
5. AMPHIBIOUS DORDRECHT

- Plants filter and purify the water
- Stormwater flows from pavement into green gutter
- Inclination 2%
- Water flows through the gutter - waterline
- Stormwater flows from street into green gutter
- Water is purified by helophytes and natives plants
- Excess water starts forming ponds
- Stormwater flows along waterline
- Inclination 2%
- Water flows from waterlines to lowest basins
- Water infiltrates through soil

Detail of planter-waterline

Detail of waterline-park connection
5. AMPHIBIOUS DORDRECHT

Transformation of the area throughout a complete rain event loop.
Constant transformation is the most important element of this project, according to the amounts of water that are accumulated every time. The previous diagram (p. 125) illustrates how the area transforms from dry to wet and then again to dry through successive stages and throughout a complete rain event loop, with the hofjes and the watersquares first starting to fill up, reaching their maximum capacities and soon starting to drain towards the waterlines and the park, which also gradually fills up and, following, drains again to return to the initial state. Of course, in case the rain event stops and starts again in a short period of time, the loop goes back to the previous stages with the buffers filling up again.

This is a comparison of 3 different situations, where the current image of the Schil is compared to an undesired future where no interventions have taken place and a desired future that includes the design proposal. For the second case, data from the Klimaateffectatlas were used concerning potential water depths in the area. This image actually refers to the present, but it is expected that in the future similar extreme conditions will appear more and more often, so it can also be projected to a 30-year horizon. On the other hand, in the desired situation, there is enough room for the water to be retained or stored above ground without causing nuisance in the streets (water op straat).
5. AMPHIBIOUS DORDRECHT

Matrix time vs. scale
In order to show a more elaborate image of the proposal, the design was focused on two areas: one including a hofje and part of the Spuiboulevard waterfront and a second one including part of the park along the Johan de Wistraat.
The *hofje*

As far as the "hofje" is concerned, scale and size are similar to the original scheme of the "hofje", reinterpreting it in a modern version. The contemporary "hofje", located in a central position of an enclosed building block, functions as the heart of it, collecting rainwater from small permeable areas (green or soil) within the block and storing it in basins of various depths. After reaching its maximum capacity, the "hofje" drains to the surrounding waterlines, in or outside the residential complex, in the form of linear gutters or public sitting areas. Apart from that, the Spuiboulevard is reorganized, by narrowing the street itself and creating a waterfront promenade. The promenade is a light metal construction giving more room for the water underneath, but also possible to be partly submerged when water levels in the Spuihaven rise considerably.

The sections in p. 132-133 illustrate how the water system functions, with separate pipes for water collection from the block to the "hofje" and for drainage from the "hofje" to the waterlines. The longitudinal section also shows how the hofje is linked to the water network of the wider area, outside the building block.

Opposite page: plan of the hofje area in a wet situation
Transverse section of the hofje area
Longitudinal section of the Hofje and the waterfront area
Impression of the hofje in wet and dry conditions (2)
Impression of the residential complex in wet and dry conditions (3)
The park

On the other hand, the park along the former high-traffic boulevard, plays a key role in the water network, being the final destination of rainwater, a buffer but also a waterline. It is created through a cut-and-fill process, consisting a hilly landscape and, thus, increasing even more the green surface. A slightly elevated central path crosses the park, surrounded by step-wise flower beds, that lead from the path to the different areas of the park. The lower parts are transformed into ponds after heavy rainfall and are surrounded by ramps that lead to the lawn or close to the water surface when it fills up, allowing for interaction with water. Walking on the central path when the ponds are filled up, one gets the impression that they are moving between water, they are surrounded not just standing next to it, something which further enhances the experience of space.

In the section (p. 139), we see how the water is collected from the surrounding area and led to the basins. The basins themselves are interconnected through an underground system of pipes, therefore, the lowest ones are always the first the fill up. When they are completely filled up, the rainwater is either disposed towards the Spuihaven or stored in areas under the new adjacent buildings. From there, it can be reused in the houses of the area and, finally, disposed separately as grey water.
Plan of the park in a wet situation
5. AMPHIBIOUS DORDRECHT

Transverse section of the park
5. AMPHIBIOUS DORDRECHT

Impression of the pedestrianized Singel in wet and dry conditions (3)
Impression of the park in wet and dry conditions (2)
Both the “hofje” and the park consist what here is described as the everchanging landscape, endlessly transforming under the presence or the absence of water, creating different experiences and encouraging different activities. After heavy rainfall, the lower parts of the garden and the park transform into ponds that call for play and interaction, while the reflections on the surface of water add another dimension to the space. Everything that triggers the senses seems to change and so do human reactions to their environment; all because of this sparkling, new element.

However, the experience changes not only by the presence or the absence of water, but also through the different seasons (p. 144-147). In the winter, the image can be totally contrasting in terms of scale and perception of the space, colours, vegetation or even the reflections on the surface of the ponds. In the park, during summertime all the trees and perennials are in full bloom, creating an enclosed shaded scenery, while the basins, transforming into ponds, reflect the nearby willow and the maples getting a vibrant green colour. In the winter, the landscape changes again; the space seems wider, the views to the surroundings are now open and unobstructed and the bare trunks emphasize the darkness of the scenery.
5. AMPHIBIOUS DORDRECHT

Impression of the hofje in the summer (1)
Impression of the hofje in the winter (1)
Impression of the park in the summer (1)
Impression of the park in the winter (1)
6. REFLECTION
This chapter is a reflection on the outcomes of the graduation project and its scientific and societal relevance. Firstly, the design proposal is evaluated in terms of answering or not to the initially posed research objectives, looking into each objective separately but also as a whole. Furthermore, the relationship of the project with the proposed scientific framework is discussed as far as inquiry methods are concerned, as well as its integration into the general theme of the Flowscapes Graduation Studio. Ethical issues and dilemmas that emerged throughout the process are also analyzed, revealing personal queries and agonies and, at the same time, explaining design decisions. Finally, the relationship of the project with the wider societal context is discussed, looking into potential non-academic extensions and emphasizing on the multi-faceted and powerful nature of landscape architecture, as a field with great potential that can form and re-form modern society.

6. Reflection

1. The design proposal as a response to the research objective

The project, after thorough research on the existing insufficiencies of the urban fabric of Dordrecht in relation to cloudburst flooding, focusing in the area of the 19th cent Schil and including factors like paved/ green areas, open water surfaces, specific materials of the streets and the public spaces, dimensions and character, resulted in the design of a green-blue network; this network can withstand future increased levels of precipitation and sufficiently accommodate the calculated water retention area, using a system of nodes (seasonal buffers) and lines (waterlines) that direct excess stormwater to an inundation park with high water capacity, solving thus the major problem of rainwater nuisance in the area.

Apart from that, however, the design proposal has also great value in terms of ecology and biodiversity, since it seeks to maximize the potential of urban nature thanks to this green-blue network providing, room for flora and fauna to thrive within the city; by reducing the paved ratio in relation to green and water, it contributes to the emergence of an urban wetland ecosystem that is further enhanced, especially in the Johan de Witstraat parkway through the creation of height differences; a cut-and-fill process results in a green, hilly landscape that allows the emergence of different plant species and the attraction of a rich diversity of insects, birds and small animal communities; it can, therefore, facilitate migration processes and species flows to and from Dordrecht via the 19th cent. Schil corridor.

The project is also an attempt to foster community spirit and social dynamics, by designing urban spaces of high quality, where personal engagement and sense of belonging will be top priorities. In these spaces, one can experience different degrees of privacy; from the private and semi-private “hofjes”, where a different, more, intimate bond is created with the residents that are fully in charge of their maintenance, to the more public “hofjes”, watersquares, waterfronts and the park, where everyday city life unfolds in all its grandeur. By creating room for small-scale initiatives and participation and promoting interaction and activity, they contribute to a lively urban environment, while at the same time they raise awareness in relation to climate issues, water management and ecology through tangible examples. Hence, they are transformed into “places”, to which new, stronger meanings will be ascribed and where a future, prosperous society can flourish and evolve.

In this context, water is the element that upgrades the experience of space through a visible flooding process and mainly above-ground waterbodies, which can be formed and transformed according to the amount of precipitation, taking up more or less space and creating, thus, everchanging landscapes where one can see, hear and touch different things every time. This constant dialogue of wet and dry, but also the in-between stages of filling in and drying out, is what makes the city so dynamic; amphibious. The water, now a prominent and tactile feature, calls for interaction and play; it is not merely a decoration, but on the contrary a major part of life, strengthening the identity of Dordrecht as a unique watercity.

In this sense, the design proposal fully responds to the initial research objective: “To create a blue-green network that can accommodate excessive rainfall, but at the same time act as a series of public spaces intertwined with urban life, enhancing biodiversity, fostering social dynamics, offering alternative and contrasting spatial experiences and strengthening the identity of Dordrecht as a contemporary watercity, where water is a visible and tactile feature.”

2. Relationship between the graduation project and the studio topic

Throughout this project, the landscape is addressed as a system, upon which different processes and flows create a dynamic interplay. The landscape, thus, is seen as an endlessly transforming spatial entity, characterized by change, instability and uncertainty. The flows, themselves -here flows of water, green and people-, are subject to change and transformation, hence the resulting entity, emerging from their interrelations and their interaction with the pre-existing spatial background, also bears a high degree of temporality. This space of movement and flows is one that enhances and promotes a dynamic interaction between natural and human systems, between processes and forms and is, therefore, directly related to the theme of the Landscape Architecture Graduation Studio “Flowscapes”.

Focusing on water infrastructure within an urban environment, the project aims to hybridize the concepts of “infrastructure” and “landscape”, where the first can overtake its strictly utilitarian purpose, embracing a more multi-functional nature and being upgraded from a no-man’s space to a place full of meanings and personal or collective memories; at the same time, the latter’s role in territorial transformations
can be enhanced and boosted, proving that landscape architecture can provide effective and multi-faceted solutions for urban infrastructure, which not only address and solve a specific issue—here stormwater management—but they also seize the opportunity to improve a range of other factors or give answers to different problems, such as ecology or social life.

3. Relationship between the chosen research method(s) and the graduation studio methodical line of inquiry (scientific relevance)

The “Flowscapes” graduation studio introduces and promotes a scientific approach, where design research and research-by-design are combined into an integral whole. More specifically, design research is defined as “the analysis of existing designs or precedents” (Nijhuis & Bobbink, 2012), while research-by-design as “the formulation of new designs” serving the goal of research. There is, therefore, a constant back and forth from generic to specific knowledge and from non-determined to determined context.

Throughout the “Dordrecht floodscapes” project both methods were merged into a constant dialogue. The project started with a thorough analysis of existing problems, networks and flows that make up the city system, as well as precedents. This extensive research led to valuable outcomes and conclusions that helped me formulate the principles and better structure the design goals. Soon before the masterplan, even before the completion of the analytical phase, I already started envisioning the design through experimental collages and sketches that helped me create a consistent image in my mind and keep pursuing it until the end, thinking how it could become possible. The study of precedents played a major role in this, triggering my imagination, inspiring me and allowing me to conceivably project these images to the context of Dordrecht. These design experiments, however, were calling for verification and more concrete data in order to be translated into a coherent proposal; that implied more research on a smaller scale on history, streets and public spaces, structural elements of the area, weaknesses and potential etc., a process that provided more insight into the 19th cent. Schil, where I would focus my design. And even then, there was more to discover, more to know before jumping to the masterplan: a series of models of street sections, more collages, data and calculations, scenarios and endless brainstorming.

The final design was, therefore, the outcome of all these processes, analytical and experimental, design research and research-by-design, where the one was constantly informing and enhancing the other and vice versa.

Models of street sections, scale 1:300
4. Relationship between research and design

From the previous paragraph it already becomes obvious that throughout the graduation project a continuous loop between research and design took place. Instead of them being two successive stages, they were blended together in a process that was not predefined and fixed, but endlessly evolving according to the findings extracted from the one or the other. In contrast with my usual way of working, this approach provided deeper insight into the topic and offered more possibilities, since both research and design were used as tools for gaining knowledge, rather than as expected results. Although this process might seem less structured or organized, the benefits greatly outnumber these weaknesses provided that the final goals are clearly articulated and explicit.

5. Ethical issues and dilemmas during research/design and in potential application of results in practice

Coming from a country with a long and rich history and having a background in architecture and in heritage issues, the design proposal was a challenging stage for me during the thesis. Since Dordrecht is the oldest city of Holland, with numerous traces of the past dispersed in its urban fabric, I was rather hesitant making outrageous design decisions. Diving in the micro scale of the 19th century, Schil, in the question “How much green?”. I had to think of a scheme that would respect the identity of the area, so I came up with the principle of the city-nature transition and the idea of the red-green balance.

Looking closely into the existing characters of the city from the historic core to the suburbs and the Biesbosch, I discovered that red (built) and green (nature) were following a gradual transition along this axis, acting as negatives of the same image. This landscape succession was following a normal pattern, apart from the area of the Schil, which seemed rather ambiguous; less dense than the “Binnenstad” but, at the same time, less green than expected. The introduction of small green fragments in this fabric would restore the balance, without however disrupting or altering the identity of the area. These green fragments were later interpreted in the form of the traditional “hofje”, an element so characteristic of the history of Dutch cities, linking, thus, culture and future development in a concrete bond.

Another equally crucial issue was that this idea of the “hofjes” that would function as seasonal buffers included interventions in private spaces, even if these are public or semi-public. This implies that the interventions cannot be fully controlled apart from the initial planning. In case future owners decided to completely pave their plots, the concept would fall apart. In this dispute of ownership versus planning, I would have to come up with a proposal that would be able to reconcile these two.

One could argue that a solution would be the adoption of a legislative framework that would clearly define the green-paved ratios in each area and within each plot, preventing an 100% paved coverage of the plots but allowing the owners to design their courtyards in their own will. Instead, in this proposal, another scenario was generated: in this case, in the calculations of the additional retention area, the existing private green spaces were not included leading to a different numeric result than the initial one. This was translated into a concept where, instead of the “hofjes”, existing or new (concessed) public spaces would play the role of the buffers and the rest would remain unchanged.

Apart from that, I went even further to imagine a future scenario where no interventions whatsoever would take place and compare it with the current image of the area as well as with the scenario where the design proposal would be applied. Given the steady, exponential increase of precipitation, it became clear that this future image would certainly be worse than the present one, but also worse than the proposed scenario, giving credits to the design proposal and affirming its significance.

Finally, the question that is torturing all designers as I imagine is “Will it function the way I have envisioned it?”. Will the water flow efficiently along the waterlines or a general restructuring of the whole surface of the streets is necessary to create height differences in a relatively flat area like the Schil? Or even worse do we need to resort to the solution of water pumps? Will the chosen materials create a pleasant environment or will the design end up as a muddy swamp, repelling and hardly accessible? And what about people’s response to the interventions? Will they embrace the changes or will they reject them in favor of convenience and habit? Is it an economically feasible project or will the maintenance costs shoot the budget to unexpected levels? As a landscape architect, I can only partly answer to these questions, a fact that reveals the complexity of the proposal as well as the need for an involvement of multiple disciplines in the process of application.

6. Relationship between the graduation project and the wider societal and professional context (societal-professional relevance)

This project can be seen as part of an ongoing global discourse concerning climate change and its widely discussed manifestations; scientists talk about global warming, sea level rise and extreme weather events, such as sudden and heavy downpours or prolonged periods of drought, and politicians organize summit conferences to discuss on possible adaptation measures and prevention of natural disasters, while at the same time another part of the globe is struck by a storm, completely flooded or buried under tons of mud, because a stream was muted or because a forest
was recently burnt; after centuries of human over-exploitation, nature strikes back, reclaiming its lost territory. The reclamation process is fierce, often leaving hundreds of casualties on its way.

In this sense, the project is expressing the fears and desires of a society that dreams of a sustainable future and of responsive, adaptive new environments. Having a clear, climate-proofing orientation, it aspires to become part of a global agenda, contributing the least in the aforementioned discourse. It can, therefore, become a starting point towards cloudburst treatment and urban resiliency, highlighting the role of landscape architecture among the disciplines involved in this purpose and demonstrating how design can provide sufficient answers to major societal issues.

Despite the site-specific features addressing the city’s unique character, such as the principle of city-nature transition or the scheme of the “hofjes”, this research aims to develop a framework and an approach, the principles of which can be extracted and applied in any flood-sensitive urban context, transforming it into a resilient and robust spatial entity. Ideas like using existing networks (water, ecology, recreation etc.) to create a system of waterlines and buffers, addressing the city as a sponge with increased permeable surfaces and a separate water system for collection, storage and reuse of the rainwater, allowing visible flooding processes and aiming towards multifunctional, flexible spaces that can adapt to any given circumstance, could be applied in any other vulnerable area. Giving enough room for the water within the urban fabric, instead of restricting and suppressing it, seems in fact to be the key in these cases, welcoming it, instead of expelling it.

This graduation project, however, might have further extensions in the field of climate change, taking into account that cloudburst flooding is only one aspect of the problem. Its opposite, drought, is yet another phenomenon equally present in contemporary urban environments, such as the one of Dordrecht, since groundwater levels are severely decreasing during summer months. In Dutch cities, the phenomenon of rotting wooden foundations due to exposure to O2 is very common (“paalrot”). The project addresses the city as a sponge that can, apart from retain and dispose rainwater, also store it temporarily aboveground and for a prolonged period underground. Of course, this necessitates an extensive network of subterranean facilities -pippings, tanks etc., independent from the existing sewage network of the city and with sufficient capacities. The design of such a network is outside the boundaries of the project in question, falling into fields other than landscape architecture and can, therefore, only constitute a proposal.

Similarly to drought, the project can also provide an answer to the UHI (urban heat island) effect by increasing the ratio of green spaces in the city. More tree shade, better evapotranspiration and cooling are only few of the benefits that go along with the green-blue network and contribute to the prevention of a heat island within the city. At the same time, better water quality is ensured thanks to maze-like water loops; during this prolonged movement, water is purified under the influence of sunlight, while the introduction of natural banks around the buffers (hofjes, park etc.) along the waterlines or the use of helophytes (park) further enhances the water quality.

Since the graduation project is focused on flooding, concrete data are mostly provided for this aspect; it is yet important to emphasize on the nature of landscape architecture as a discipline that can and should provide multiple answers to crucial
6. REFLECTION

issues through a design that is inclusive and multi-faceted.

Multidisciplinarily, hence, is vital in landscape architecture practice, a fact that we as students learn from the very early days of our education and realize later in the professional realm. This means that various factors should be included and different fields should be embraced and incorporated. Economics is a knowledge field often pursued in technical education and practice, adding a new dimension and opening doors to the future, allowing urban planners and landscape architects to design based on possible -and impossible- scenarios and, therefore, better predict and control the evolution of their design.

In a Europe of economic decline, this climate-driven approach can trigger economic development, by introducing the concept of the “innovative watercity”, that can provide a role model for sustainable urban design and, therefore, attract investments and capital, thanks to new permanent residents, professionals, tourists or researchers; consequently, the role of Dordrecht itself might significantly change in respect to other cities, allowing, for instance, for an upgrading from Rotterdam’s “satellite city” to a major, self-reliant city of South Holland and proving, thus, that even small-scale design decisions may have a huge impact on the wider framework.

Finally, the project can contribute to a double attitude shift: from the conventional, monofunctional practices to more sustainable, multifunctional ones and from the fear of water to its re-integration in the urban realm, since it is no more considered as an unwanted feature but, on the contrary, a desired quality. We are used to urban water infrastructure that consists of underground pipes and carries clean rainwater together with grey household water. In the same way, we are used to dislike water that is accumulated above the surface of the ground, especially if that is within the city borders, considering that it can be dangerous threatening our doorstep or even unhealthy challenging public sanitation standards.

In their paper The emotional landscape, Dirk Sijmons and Machiel van Dorst discuss about the natural resistance of human to change and the fear of the uncertain in exchange for security. Talking about the aestheticization of our worldview, they argue that in Western society “the engine room should really be kept away from view”; and by engine room they mean all the production and infrastructure facilities where everything is generated: food, electricity etc. What if that engine room became again visible? What if the rainwater “engine” of the city went out unconcealed in open view? Would that shock us irreversibly or would it become a cause to overcome our fear of change and embrace the new?

This project aims, most of all, to unveil if design can subvert deeply-rooted mentalities and strongly established conventions, in a way that it can influence our worldviews and the ways we perceive our surroundings. The previous questions remain yet to be answered.

Conclusion

To summarize, this project is an attempt to prove that landscape architecture can, in fact, achieve much more than merely providing an answer to a specific problem, addressing a wide range of other issues of ecological, social, political, economic or anthropological nature. Most of all though, it is a discipline capable of revolutionizing our way of thinking, becoming food for thought and triggering conversation over matters considered given and established until today. It can, hence, be seen as a new expression of a democratic movement, allowing for polyphony, debate and change, challenging the old and welcoming the new. The latter may not necessarily be better than the first, yet we can only know by giving it a chance.

“Intelligence is the ability to adapt to change”

Stephen Hawking

Fires of change, Shawn Skabelund (source: http://artmuseum.arizona.edu/events/event/fires-change#!prettyPhoto)
7. GLOSSARY
7. GLOSSARY

A
adaptability: the ability to adapt to various circumstances and conditions, having a flexible, not rigid nature that allows transformation and/or evolution

amphibious: (Greek: αμφί + βίος) capable of living and surviving in both wet and dry environments, functioning perfectly in land and water, without being influenced in any way by different conditions

analysis: the process of deconstructing a subject into smaller parts, in order to gain a better understanding of it

attitude shift: a change of attitude, of viewing and considering a certain subject, often radically different or contradictory to a previously established attitude

B
biodiversity: the coexistence and abundance of various species of flora and fauna composing an ecologically rich environment

C
climate adaptation: any strategies or measures implemented in an area aiming to reduce its vulnerability to radical changes of climate conditions, e.g. global warming or sea-level rise

cloudburst flooding: flooding caused by an extreme amount of precipitation in a short period of time, during e.g. a storm event

D
design research: research through study and analysis of existing models for the acquisition of knowledge or principles that can be used or applied for design purposes

E
experience: a set of characteristics that affects human perception, understanding and memory of something (e.g. a place or an event) and, therefore, defines future response/reaction to this particular thing

F
flooding capacity: the maximum amount of water that an area can hold or retain without being flooded

floodscape: (flood + landscape) a landscape with a high retention capacity able to flood periodically in order to accommodate excessive amounts of water and, after their disposal, returns again to its initial dry condition: an adaptive, amphibious landscape

flows: movements or processes related to subjects that can move or evolve in space and/or time, e.g. water, ecology, wind, humans etc.

flowscape: (flow + landscape) a landscape or other spatial entity formed through the dynamic interaction and interrelation of different flows between them but also with the pre-existing spatial background

G
genius loci: the particular character, identity or atmosphere of a place resulting from natural characteristics, collective memories etc. that makes it unique and therefore different from any other place

green infrastructures: networks of interconnected green spaces that have an important ecological value, but can also provide multiple benefits to human communities (social, economic, aesthetic etc.)

I
identity: a set of tangible or non-tangible features that form the character of a person or the ‘genius loci’ of a place, contributing to their unique quality and oneness

infrastructures: man-made works and facilities or natural features that are of vital importance within human communities, supporting and improving contemporary living (buildings, transportation/telecommunication/energy/water/waste/food/green networks etc.)

L
landscape: a spatial entity whose character is the result of the action and interaction of natural and/or anthropogenic factors and of the interplay of multiple forces e.g. social, economic, political, aesthetic etc.

M
materiality: the qualities of materials related to sensory perception, having therefore a different impact on vision, hearing, taste, smell and touch (e.g. softness/
multifunctionality: the quality of incorporating multiple functions and serving various purposes, simultaneously or successively

network: a system of interconnected and interrelated nodes, usually of high complexity

open-ended process: a procedure that has no definitive or final result and that may include over-time transformation of a subject, which will never return to its original state or condition, but will keep evolving

product: a final, definitive result or outcome emerging from a closed-ended process that involves a starting and an ending point

public space: a - usually- outdoor space of the city, not belonging to one individual but to the wide public, which supports activities within a community and triggers human interaction; a space of great social value, generally open and accessible

research: in-depth and systematic exploration that aims to provide insight into a specific subject and will allow unexpected outcomes to emerge, through a critical attitude and a creative experimentation

research-by-design: research based on knowledge acquired through a design process, where the design itself is not the final result but only a means serving the research and triggering debate and reflection

resilience: the ability to recover quickly from difficulties or disasters

sustainability: the ability of a system to maintain its original features indefinitely e.g. in terms of ecology, economy, social well-being etc.

urban life: life within a city, an urban context

water infrastructures: infrastructures that serve for water management (collection, storage, recycling, purification, distribution, disposal etc.), facilitating its use within human communities

scape: spatial entity or structure that results from various cultural, social, economic etc. forces acting upon a given context

strategy: a system of measures aiming to achieve various long-term goals


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