Climate Resilient Estate Landscape in Baakse Beek

Towards a landscape architecture approach for water management, ecology, and spatial experience

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LANDSCAPE ARCHITECTURE

Preface

Fascinated by the impressive water issue in the estate landscape, Baakse beek under the uncertainty of the climate change, when I visit the Estate Medler in summer 2019. A large part of the Netherlands is more or less facing challenges in the water system and meanwhile, water has shaped the Dutch landscape, culture and lifestyle, distinguishing it from other countries. Various great projects can be found in different places in this country. With respect to the theme of the flowscapes studio, infrastructure as a type of landscape and landscape as a type of infrastructure, I start this graduation project with the question: As a landscape designer, what roles can we play in the design with green-blue infrastructures particularly when they are exposed to a changing climate?

This project is rooted both in a water and ecosystem restoration in the estate landscape under the uncertainties of climate change and in a spatial design to bridge the disjuncture between landscape ecology and our spatial perceptions on the landscape and its ecological function. During the research and design process, these two aspects have gradually grown towards each other, converging into a proposal for a rebalanced and future-proof landscape. It aims to provide stepping stones to the global challenge of climate change, to extend the definition of infrastructure beyond utility, and therefore landscape infrastructure could bring about ecology benefits concerning their spatial and cultural significance.

Over this year, I have had a chance to review and implement the knowledge gained in TU Delft. I have enjoyed working on my quest for a Dutch estate landscape through a thorough analysis and considering broader perspectives as a young landscape architect, although 2020 is a tough year for everyone due to coronavirus outbreak. I would like to particularly thank Steffen Nijhuis and Maurits Ertsen for their inspiring, motivating, critical and patient supervision throughout the guidance moments. Thanks to Steffen and people from the Gelderland Province for organizing field visits and lectures that help me understanding the opportunity and challenge of the Baakse beek area. I would also like to thank Bieke Cattoor for her valuable input in deciding research direction and analysis during the early stage of the research and supervision before P3. Special thanks to my friend Yanjiao Wang who is behind me all the way. Finally, I want to thank my family and classmates for their support.

Yingjie Zhang, June 2020

Abstract

The Netherlands has a long and fascinating history with water to keep its land safe and dry. Recently, when the country is exposed to a changing climate, it is at the turning point to shift from defensive water control to adaptive and integrated management. Landscape design has a role to play in endowing water and water management with new values and enabling the water as well as its related natures are adapted to be more resilient for the future.

The study area Baakse beek has a rich context in which the prominence of water greatly decides the water management and the landscape and also exposes the area to the challenge of climate change. Hence, one aim of this study is to review the local historical water management approach and take values from them to bring back wetness conditions and water balance. The long history with water also means there are many opportunities (ecology, aesthetic, and cultural heritage) in the area, but the difficulty is how to weave together ecological function and spatial experience in landscape design. So, the second aim of this study is to find ways to communicate ecological function through spatial design.

Through exploring the history with water over time, three categories of local historical water management approaches are summarized and they are adjusted to different water retention and ecological principles to formulate design strategies involving stream re-naturalisation, water retention, and water purification. For design, the core is to provide human with pleasure from the landscape appearance that involves beneficial ecological functions. landscape design needs to communicate ecological function and to conform to our cultural expectations of naturalness. This is achieved through two approaches, spatial modification, which gives an overall framework of landscape experience and cue to care, which gives hints of maintenance and neatness.

The design explorations take place on various scales and locations. Selected design principles are assigned to the most suitable locations in the Baakse beek catchment area to preserve and strengthen the landscape characteristics of each sub-area. Two landscape ecology models and two design options for spatial experience are built in the Medler-Wiersse cluster, estate landscape, to test various ways to bridge the gap between the environment and spatial experience. Combinations provide design possible options towards alignment between landscape ecology and spatial experience.

Keywords: estate landscape Baakse beek, ecology, water management, spatial experience, climate change

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Chapter 1
Introduction

1.1 Research context: towards an integrated water system design under the context of climate change

1.1.1 Fascination: Dutch vs. water

When taking our first field trip to the estate area in Baakse beek area in Summer 2019, I was shocked to see part of the stream is dried out on estate ground. Water in the estate garden and estate moat is kept via weirs, but at the same time, the scarcity of water in nearby agricultural fields and forest becomes even worse. The balance in landscape is, without doubt, broken as a consequence of the changing climate as well as the intense water management measure taken in the past few decades – stream canalization, land reclamation, water drainage. These days, not only the estate area but also many other places in the Netherlands are more or less facing challenges in their water system.

With much of the country below the sea level, the Netherlands is probably one of the most vulnerable countries to water issues in the world. Due to the low elevation, the Netherlands has a long and fascinating history with water to keep inhabitants safe and dry. Water management makes the water system very complex from all per-spectives. Nowadays, water management is at a turning point when the Netherlands is exposed to a changing climate. Policymakers keep developing long term water visions and solutions in reaction to the changing water problems. Various great projects can be found in different places in this country (e.g. figure 1.1-1.3).

Figure 1.1: Afsluitdijk

Figure 1.2: Sand motor

Figure 1.3: Room for the River project

1.1.2 An urgent reality: climate change

To this day, the carefully engineered water system continues to protect the low-lying part of the Netherlands and its inhabitants. However, it is a global issue that the climate has been changing and will continue to change. Sea levels are rising, the land is subsiding, and rainfall is heavier and more frequent. In the Netherlands, the average temperature has increased by 1.7 °C during the last 100 years, which is about twice as high as the global average. The annual number of summer days increased by nearly 20. Annual precipitation also has increased by about 20% and periods of heavy rainfall have become much more frequent (PBL, 2013). All these factors mean our way to landscape design and water management needs modification correspondingly.

Since the factors for change in climate in the future are uncertain, four climate scenarios are being used by the Dutch Meteorological Institute KNMI as the calculations of possible future. For example, figure 1.4 shows the schematic overview of the four KNMI'06 climate scenarios for 2050.

In these climate scenarios, G and G+ (G-moderation scenarios) suppose the temperature increases 1° C in 2050, while the scenarios W and W+ (W-warming scenarios) suppose that number could reach 2° C. Under the scenarios G + and W + winters could be moderately warmer and wetter and summers could be hotter and dryer compared to G and W scenarios. To sum up, the W + scenario is considered to be the most extreme scenario among the four, which means the area will expose to a greater risk of heavy shower in winter and drought in summer.

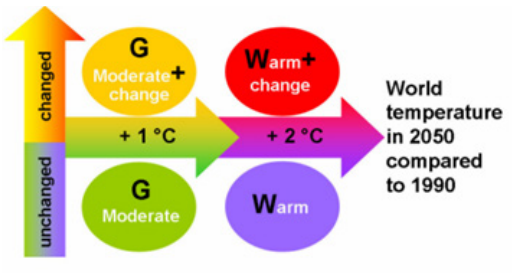


Figure 1.4: Schematic overview of the four KNMI'06 climate scenarios (Van der Hurk, B., et al. ,2006).

1.1.3 Landscape design and water management

The Netherlands has long been a prominent advocate of the “command-and-control” approach to water planning and management. Currently, it is at the turning point to shift from defensive water control to adaptive and integrated management, aiming to provide maximum protection and facilitate developments in all other sectors (culture, economy, ecology, agriculture, etc.) (Wolsink, 2006). The water system needs to integrate to and repeatedly adapted to spatial development, therefore both water and landscape are resilient for the future.

1.2 The study area and problem introduction

The Baakse beek is situated in the Achterhoek, The Netherlands (Fig. 1.5) begins in the west from East-Netherlands plateau and ends at the river IJssel in the west. The water basin has a rich context in which the prominence of water greatly decides the water management and the landscape and also expos-es the area to both opportunities (ecology, aesthetic, and cultural heritage) and challenges (climate change) for the future development.

The estate area located in the downstream part of the Baakse beek has rich cultural-historical values. Under the context of climate change, the approach to design and management needs to be opportunity-oriented rather than solution-oriented. In Baakse beek area, particularly the estate zone, the ecological function in the landscape has gained increasing attention among individuals. Furthermore, water has had various roles to play overtime in the estate. The climate-related problems are proposed to be solved in the process through the adaptation of the current blue-green infrastructures. So the design aims to restore the ecology. In addition to this, in the field of landscape design, a gap between ecological design and aesthetic design has existed for a long time, so this design is also an attempt to make people aware of the ecological value of the landscape. The concept of “ecological aesthetics” will be introduced as a tool to communicate ecological functions. Based on the above-mentioned considerations, Baakse beek and its estate area forms an excellent multiscale testing site for design.

Water is one of the most important landscape elements for estates (its building, garden, hinterland), and it results in a spatial coherence in the system of estate & between estate. Water elements actively contribute to the cultural, ecological, and spatial values. Recently, the presence of water is missing and the wetness condition is inadequate. Stream, rabatten forest, ditches, estate moat, and artificial ponds in the estates are dried up during summer. Furthermore, the loss of forests, wetlands makes the situation even worse. The ecosystem is weakened, particularly the water-related ecological value is put under pressure. The hydrological relationship between estate and their hinterland has been changed or even lost. Therefore, the spatial quality cannot be positively perceived by visitors.

The water and ecosystem in the estates are never independent. So, it is important to have a systematic understanding of it and find solutions from the regional scale and history. Climate change and its consequences on water management and the ecosystem are undoubted facts in Baakse Beek area. The seasonal imbalance of the rise in temperatures and precipitation results in extreme wet and dry conditions. To combating floods and giving way to agricultural development, numerous changes in water system management have been taken place. As a result, the land and water system in Baakse beek area is no longer adaptable to climate change. Land extraction greatly decreased the soil's capacity for water retention and result in a dropped groundwater level. The hydrological relationship between landscapes is weak. The stream is canalized so the water cannot stay in landscape and the stream is partly dried out in summer. The spatial coherence in the landscape is unnoticeable. The banks are standardized and lose diversity which means many flora and fauna are absent in landscape. A decrease in woodland and heathland after land consolidation has broken the continuity of the ecology. Many flora and fauna lose their habitats. Mono-functional land use, as well as stream pattern and nature typology, makes the landscape no longer attractive.

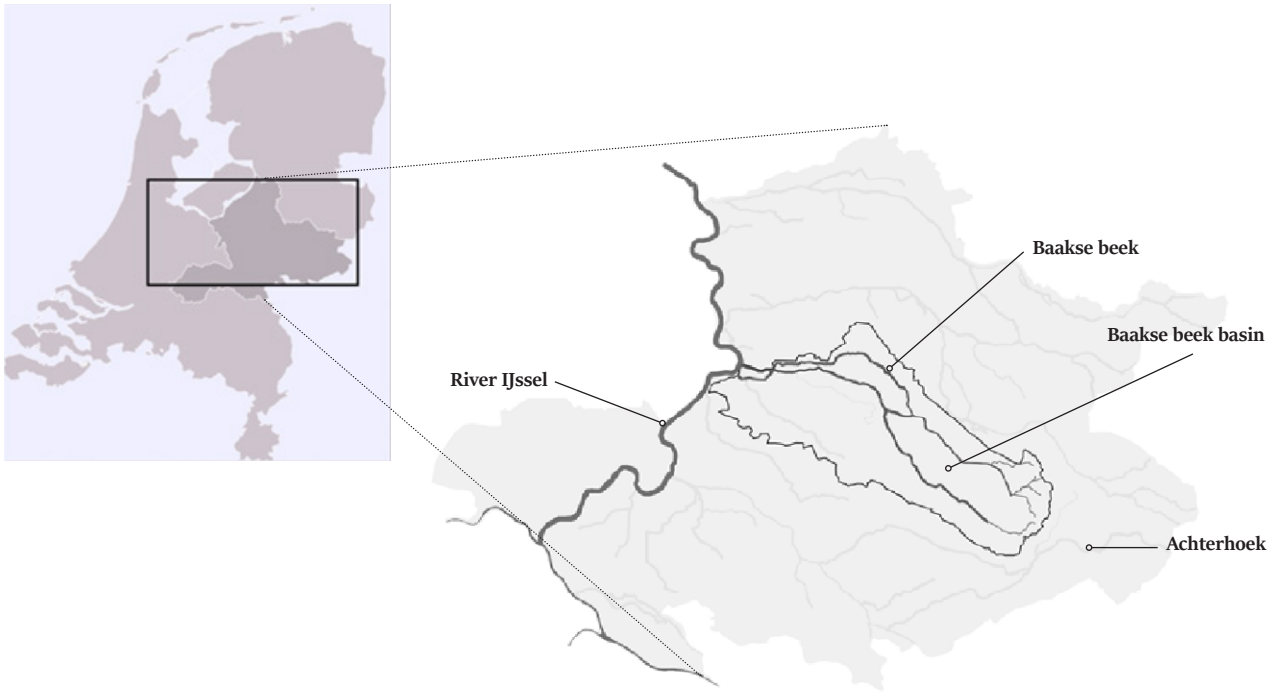


Figure1.5: The location of Acterhoek in the Netherlands & Baakse beek in Acterhoek

1.3 Research objectives and Research questions

The climate and Baakse beek are changing continuously. Various interventions in the water system over time has led to the present water and ecology problems. If we reconsider the value of historical water management approaches and the relationship between ecology and human perception in the landscape, a balance would back to the landscape. More importantly, this could become a bridge that links the history and the future of the estate and open up new possibilities of redefining the value of the estate landscape. The project might also provide building stones to address climate change. This leads to an improved hydrological relationship between estate, their hinterland, and broader area. The future-proof landscape might greatly eliminate effects from climate change to the water and ecological quality. People living in and visiting the area might gain an increasing awareness of the ecological values in the landscape.

To achieve these goals, the research question is set up as follows:

RQ: How to develop a resilient estate landscape in the Baakse Beek region that integrates climate-proof water management, landscape ecology and spatial experience?

To answer the question, two sub-questions are formulated:

Sub-RQ1: What is the local historical water management approach and how can they be integrated into a climate-proof landscape ecology design?

Sub-RQ2: What spatial design principles and cultural-aesthetics landscape elements would be applicable to fit the climate-proof landscape in estate area?

1.4 Relevance

This work will be essential to answering the current global question of how to design with the uncertainty of climate change. The design not only lies in providing building stones to address the climate-related issues in Baakse beek area but also explores ways to bring together the environment and humans in the landscape. Concerning the guiding theme of the studio, landscape as infrastructure, infrastructure as landscape, the definition of green-blue infrastructure goes beyond utility and therefore acts as a basis for exploring potentials for the site concerning their civic and cultural significance. Restoration or adjustment of the historical water structures, in this case, is one of the most common and important landscape elements used to communicate naturalness and translate the ecological patterns into cultural language. This implies a new relationship between landscape design and water management towards a future-proof spatial development.

1.5 Research outline

This thesis combines design research and research-by-design during the research process. The starting point is to deliver building stones to address climate change and to find ways to remedy the threatened landscape towards a rebalance between landscape ecology and human perception of the landscape. The estate area is selected as a test field to explore the potentials of the site through design. Comparison analysis and layer approach are taken in the design process to achieve this.

In chapter 2, the theoretical background - ecological aesthetics and the research methodology are introduced to provide a run-through of research basis, tool and setup. In chapter 3, the social, economic and aesthetic values of the estate as a landscape unit are taken as the key-driven of the water-centered analysis, including the changed function of water and land use in estate ground over time, the hydrological history of the Baakse beek basin, and the current water situation. Additionally, an investigation into landscape spatial typologies is also taken to help to understand the spatial characteristics of the different landscapes in the study area therefore providing a theoretical basis for the design in specific locations.

Chapter 4 introduces the disjuncture between landscape aesthetics and ecology to address the difference between the human spatial experience in the landscape and the ecology function of the landscape and the necessity to bridge the gap between them. This helps to break down the complex climate-related goals into two aspects. Therefore, the rest part of this chapter explores solutions and principles for landscape ecology and spatial design correspondingly. A series of water and ecology principles are generated from the values of the historical water management practices in the area. On larger scales, the spatial relationship in the landscape could be rebuilt through adjust the spatial layout, which is called spatial modification and at a very local scale, it is also important to design with cultural-aesthetics elements to give hints on human impact in the landscape to communicate ecology function. finally, in this chapter, three precedent studies are taken to examine in what way these principles could communicate ecological functions with spatial experience in real design cases.

Chapter 5 discusses the application of the design principle on various scales and locations in the catchment area. Five strategies are formulated by design principles to achieve the design objectives. Selected design principles are assigned to the most suitable locations to preserve and strengthen the landscape characteristics of each sub-area. Detailed design exploration is taken in the Medler-Wiersse cluster in the estate landscape. The design provides two landscape ecology models and two spatial experience design options are building on that to test various possible ways to bridge the disjuncture between landscape ecology and our spatial perceptions on the landscape and its ecological function in the estate landscape.

The final chapter is a summary of the project in terms of its limitations in the research processes and discuss, but focuses on discussing the contributions of this project and the relation of the research to the topic of Flowscapes studio and the larger social, professional and scientific framework.

Chapter 2
Methodological framework

2.1 Theory: interactions between landscape aesthetics and ecology - ecological aesthetics

In the field of landscape ecology, the dual goals of landscape aesthetics and ecological sustainability have been highlighted (Parsons, 1995). There is a broad literature on landscape aesthetics and landscape ecology, in general, high ecological qualities are assumed to be highly related to aesthetic qualities, therefore people tend to give more attention to aesthetic benefits from the landscape (Gobster, et al. ,2007 and Lee, 2018). Nevertheless, the actual link between landscape and ecological quality has been overlooked and there have been little principal concerns on how landscape aesthetics might influence the ecology and the way we understand and experience the natural world and its spatial quality (Lee, 2018 and Kovacs, 2006).

However, landscape aesthetics does help to provide a critical linkage between humans and ecological processes, stimulate landscape change, and influence the way people perceived the space, the landscape and its ecological function (Gobster, et al. ,2007). Landscape aesthetics is defined as the enjoyment and pleasure perception through the experience in environmental scenery (Swaffield and McWilliam, 2013 cited in Tribot, Deter and Mouquet, 2018). It is widely known that ecological quality is important to the appearance of the landscape. Since humans cannot directly sense ecological qualities, the aesthetic experience helps tie ecological quality to our feelings of pleasure and experience of space. In this process, the work of landscape architecture delivers the ecological quality and epatial quality of the landscape to people through translating them into a feeling of enjoyment and pleasure.The desire to live in or visit beautiful places leads people to change the landscape into a more suitable habitat that conforms to our cultural expectations of naturalness. The landscape changes might have consequences on the ecological process and ecological functions, and finally enables a better perception and understanding of ecology (Gobster, et al. ,2007 and Lee, 2018).

More recently, there is increasing concern on environmental issues and the imbalance between people and the environment after the twentieth century, particularly when our planet is facing a changing climate. Therefore, the importance of ecology in the landscape aesthetic perception has been even more stressed. The concept of “ecological aesthetics” emerged, bringing together the beauty of the landscape and its healthy ecology, translating ecological patterns into cultural language, and communicating culture and nature (Nassauer, 1995 and Lee, 2018). In this project, the idea of "ecological aesthetics" provides pathways for landscape designers to rethink the relationship between human spatial experience in landscape and the ecology function of the landscape, develops principles for spatial experience design, and offers indicators to examine the outcome of the design.

2.2 Research strategy: the role of design

This thesis follows a research strategy that systematically combines design research and research-by-design into a coherent research approach for landscape architectonic design. It implies a relationship between design and research that combines research-based-design and design-based-research. The first half of the research follows the research-based-design approach. Landscape design is considered to be a goal-oriented interdisciplinary method (Nijhuis and Bobbink, 2012 and Nijhuis & De Vries, 2020). It breaks down the climate-related problems in Baakse beek area into two parts, water-ecology and spatial experience, that can be investigated individually to find design principles. The second half of the research follows the design-based-research approach. In design-based-research, the design is exploring the spatial consequences or potentials for the site through testing different ways of combining the findings from research (Nijhuis and Bobbink, 2012). The design is considered as a ‘journey of discovery’ (Short, 2008 cited in Nijhuis and Bobbink, 2012).

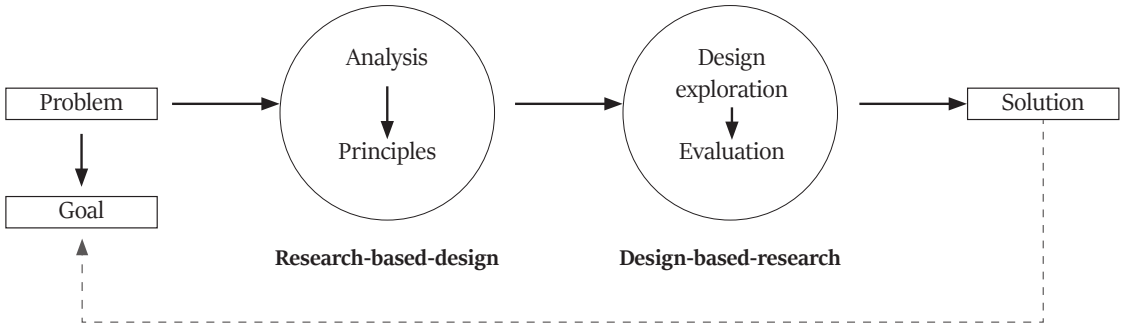


Figure 2.1: A research strategy combines design research and research-by-design

2.3 Research setup

Figure 2.2 shows the framework of research and design. The first stage, which corresponds to analysis and data-collecting, begins with a study of the spatial, socio-economic, and cultural value of the estate and its hinterlands, particularly the potential values for water and ecology there. This stage also involves mapping of the existing and past characteristics of the water system and landscape in broad area and literature studies on the ecological-aesthetics debate under the context of increasingly stressed global and local environmental issues to address the gap between landscape ecology and human understanding on spatial quality in landscape design.

The second stage, which corresponds to the date-interpreting and design principles, involves a future-oriented water opportunity and new value definition in multiscale ranging from the individual estate to estate area and the Baakse beek area. In this stage, a selection of a series of water ecology and retention principles and spatial design principles are concluded, with a synthesis of site-specific spatial analysis and stakeholder analysis, possible area for assigning these principles could be found on the plan. Furthermore, a comparison study between several precedents will also be taken in this process to check the implementability of these selected principles.

In the third stage, design strategies formulated by principles will be assigned to multiscale. The design process involves four steps: micro-scale intervention in Medler-Wiersse cluster; micro-scale intervention in other spots with various landscape spatial types; implementation in mesoscale; and reflecting back to the macro-scale, check the impact of micro-scale and mesoscale on macro-scale. When delivering micro-scale interventions in Medler-Wiersse cluster, the design follows a design-based-research approach, exploring the spatial consequences or potentials for the estate ground through testing different ways of combining the landscape ecology principles and spatial design principles. The spatial design act as an extra layer and landscape elements on an improved blue and green structure to translate the ecology quality into a cultural language and explore poten-tials for the site concerning their civic and cultural significance.

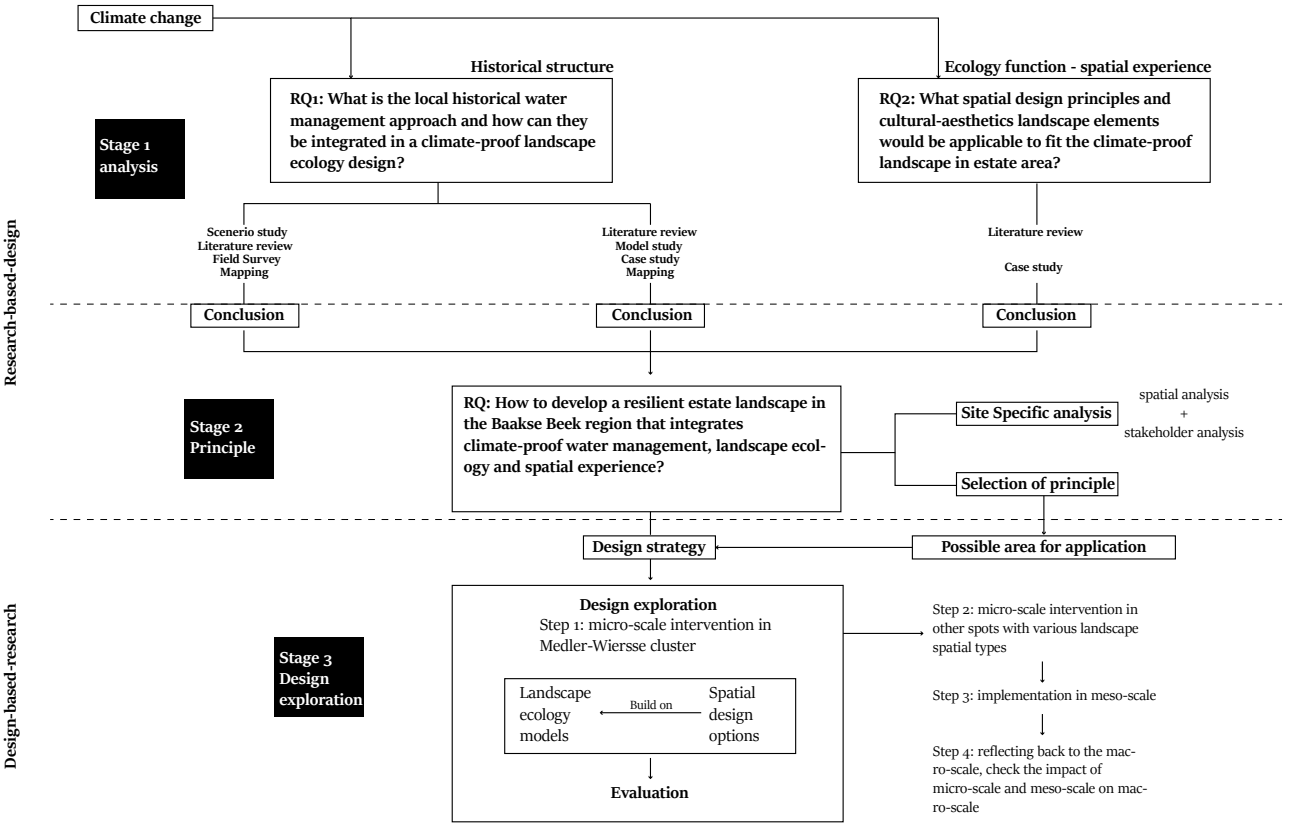


Figure 2.2: Framework for research and design

2.4 Conclusion

This research framework interprets an intertwined relationship between research and design. It provides a pathway towards an understanding on water and ecology in Baakse Beek, addresses disjuncture between landscape experience and ecology, people and environment. It delivers building stones towards a rebalance between water management, landscape ecology, and landscape spatial experience in design under the context of the uncertainly of climate change. The rest part of this thesis is built on this research framework following the process of analysis, principle and design exploration in Chapters 3, 4, and 5.

Chapter 3
Diagnosis

3.1 Country house development and estate values

The estate area in Baakse beek basin has an extensive collection of historical castles and estates. Valuable nature and culture concentrated in this zone retain its identity and offer plenty of recreational, economic, and ecological opportunities. The area is characterized by the many estates with old deciduous forests, castles and country houses, interspersed with agriculture. The estate is not only valuable for its buildings and beautiful gardens but more importantly, as a spatial, economic and social unit incorporates its hinterlands and surrounding environment as a part of the larger landscape (Figure 3.1a, 3.1b). In the map (figure 3.2) the areas owned by the estates are drawn in brown, with the ensembles within the estates themselves: country house, the lined trees (with gate), and the garden surrounding the house. These country houses are built between the thirteenth century and twentieth century. The medieval castles owned by nobilities (landed elites) have a more dispersed location along the stream and on the drier sand dunes. Those constructed in the sixteenth, seventeenth and eighteenth centuries use their land as an important source of income and displayed their property with the construction of avenues, forests and arable land. More recently, in the nineteenth and twentieth centuries, the transition from the clay to the coversand soil and new access routes and stations are preferable locations of new estates owned by new elites (Debie & Verkuijl, 2015). Today, all estates and country houses are listed buildings and/or have protected objects on their property (drawn in purple).

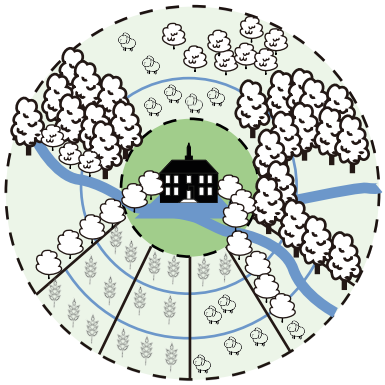


Figure 3.1a

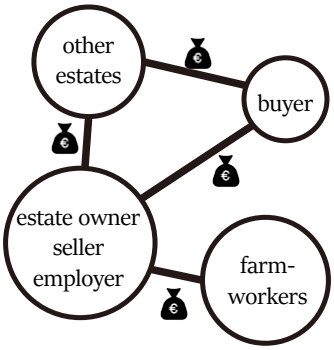


Figure 3.1b

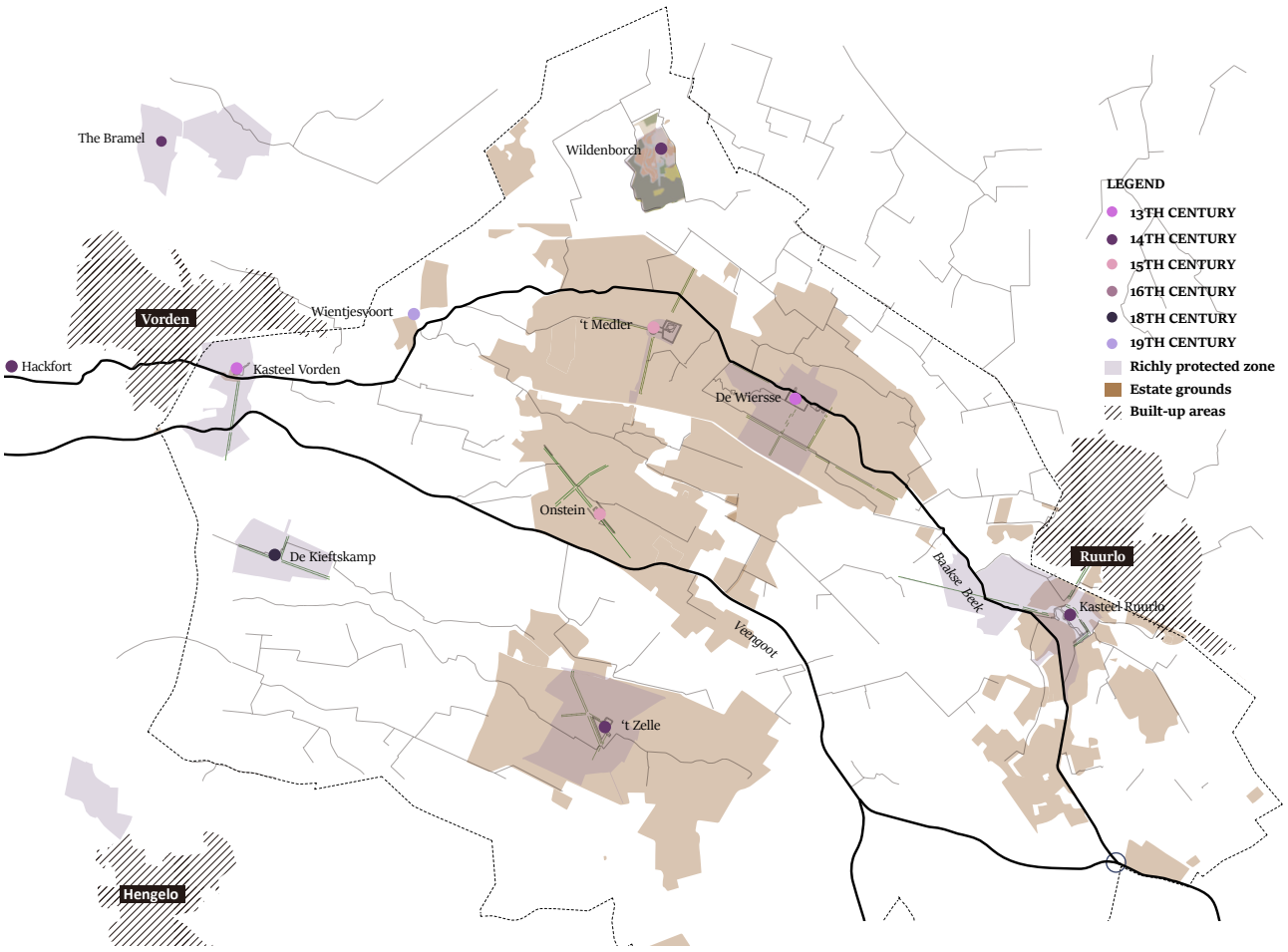


Figure 3.2 estate ground and protected objects on their property (adapted from Waterschap Rijn en Ijssel, 2019)

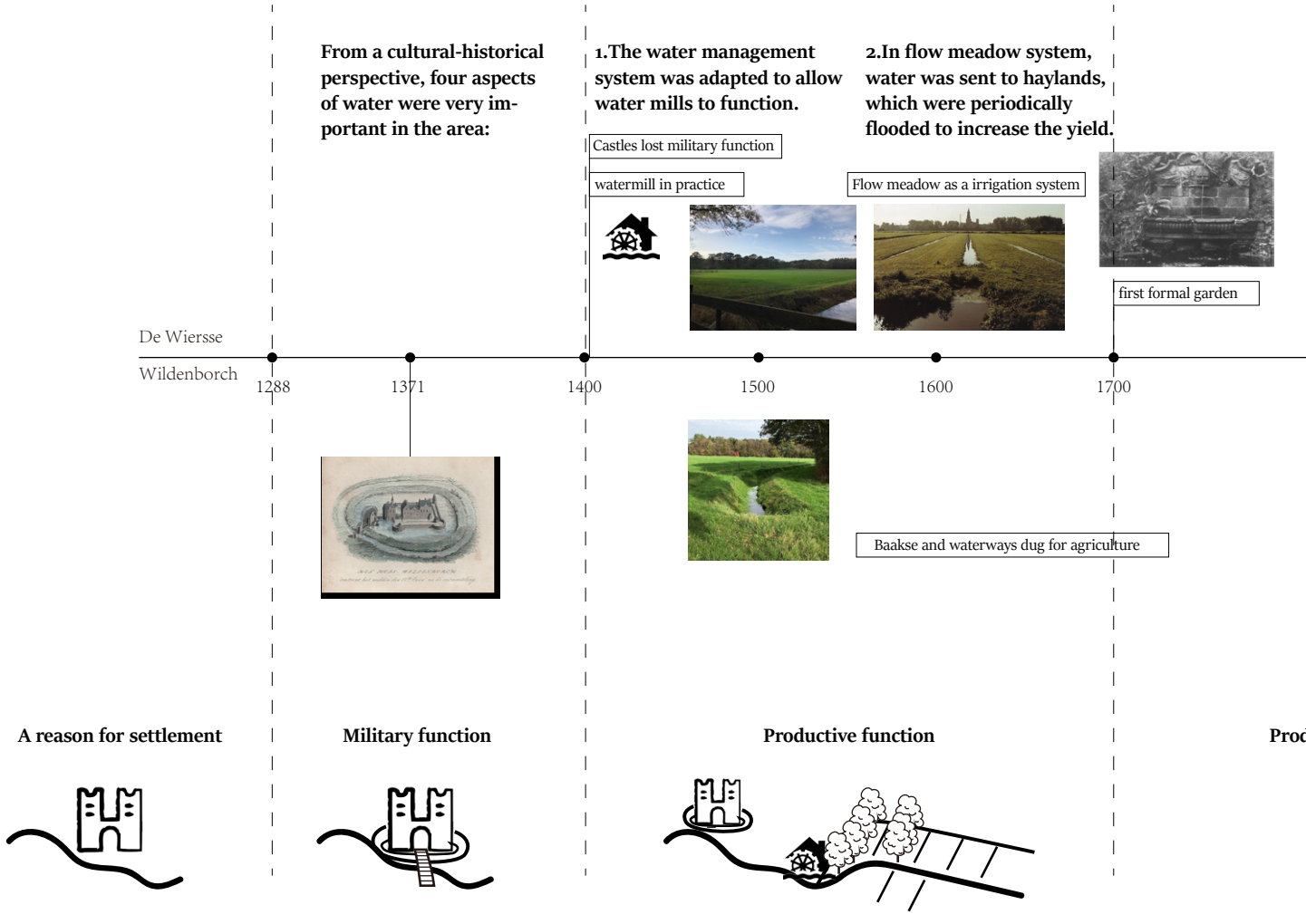
3.2 Water values in estate ground

Originally, water was prominent in the estate zone, functionally and visually connected the estates and their surroundings. The following timeline (figure 3.3) provides an overview of the changed water function in estate landscape overtime in two representative estate ground (De Wiersse and Wildenborch). In general, water plays four different roles in the estate ground. The role of water changed as a result of human interventions for economic, agricultural and aesthetics purposes.

Firstly, already in the early Middle Ages, access to fresh water from the rivers and streams is one the most important reason for choosing the castle locations because the stream is the source of refreshing and lime-rich water for living, production and transportation.

A second role of water in Medieval period is the defensive function due to the warlike character of some castles. These military water features are characterized by the moats.

The third role for water is the productive function. From a cultural-historical perspective, three aspects were significantly meaningful. Firstly, the water management system was adapted to the operation of water mills, diverting and pushing up water in the canal enabling the supply of water for the production of beer, paper, grinding grain, sawing wood and the irrigated fields. Four water mills were found along with the Baakse Beek but were all demolished by the 1800s. Secondly, the water was used in the irrigation system called flow meadow where water with nutrition was sent to periodically flooded grassland to increase the yield (Waterschap Rijn en Ijssel, 2006). Meanwhile, this also stimulates the natural process of the river. Later on, due to the introduction of chemical fertilizers, this system was abandoned. Thirdly, from the early nineteenth century, rabatten forests were planted in places with poor drainage, and thus some popular tree species for wood industries such as oak and beech could also be planted in these places (Waterschap Rijn en Ijssel, 2006). The system also enables water to be stored.



Finally, from the nineteenth century, water increasingly gained an aesthetic function in the garden and park layout around the country houses (Waterschap Rijn en Ijssel, 2006). Water aesthetics are elaborated in various forms ranging from different shapes and scales of ponds to fountains or springs.

To sum up, a few conclusions could be learned from the research on water in the estate ground. Water is one of the most important landscape elements for estates (its building, garden, hinterland). It results in a spatial coherence in the system of the estate and between estate. Water elements actively contribute to the cultural, ecological, and aesthetic values. However, recently the presence of water is missing and wetness condition is inadequate. Therefore, the water ecosystem is weakened, water-related ecological quality is put under pressure (figure 3.4 and 3.5). Land extraction decreased the water storage capacity of the soil. Groundwater is heavily extracted in dry seasons when some part of the stream is dried out which has put groundwater level under pressure (figure 3.6). The spatial coherence in the landscape is unnoticeable. A large number of weirs were built to maintain the surface water at a certain level which is hidden ecological barriers for the area (figure 3,7). Hydrological relationship between estate and their hinterland has been changed or even lost. So, it is important to restore the water system and the ecology and redefine the value of water and landscape in the estate system concerning the past and for the future. For that purpose, it is important to have a systematic understanding of the water system and water guided landscape to find solutions from the regional scale (Baakse beek basin).

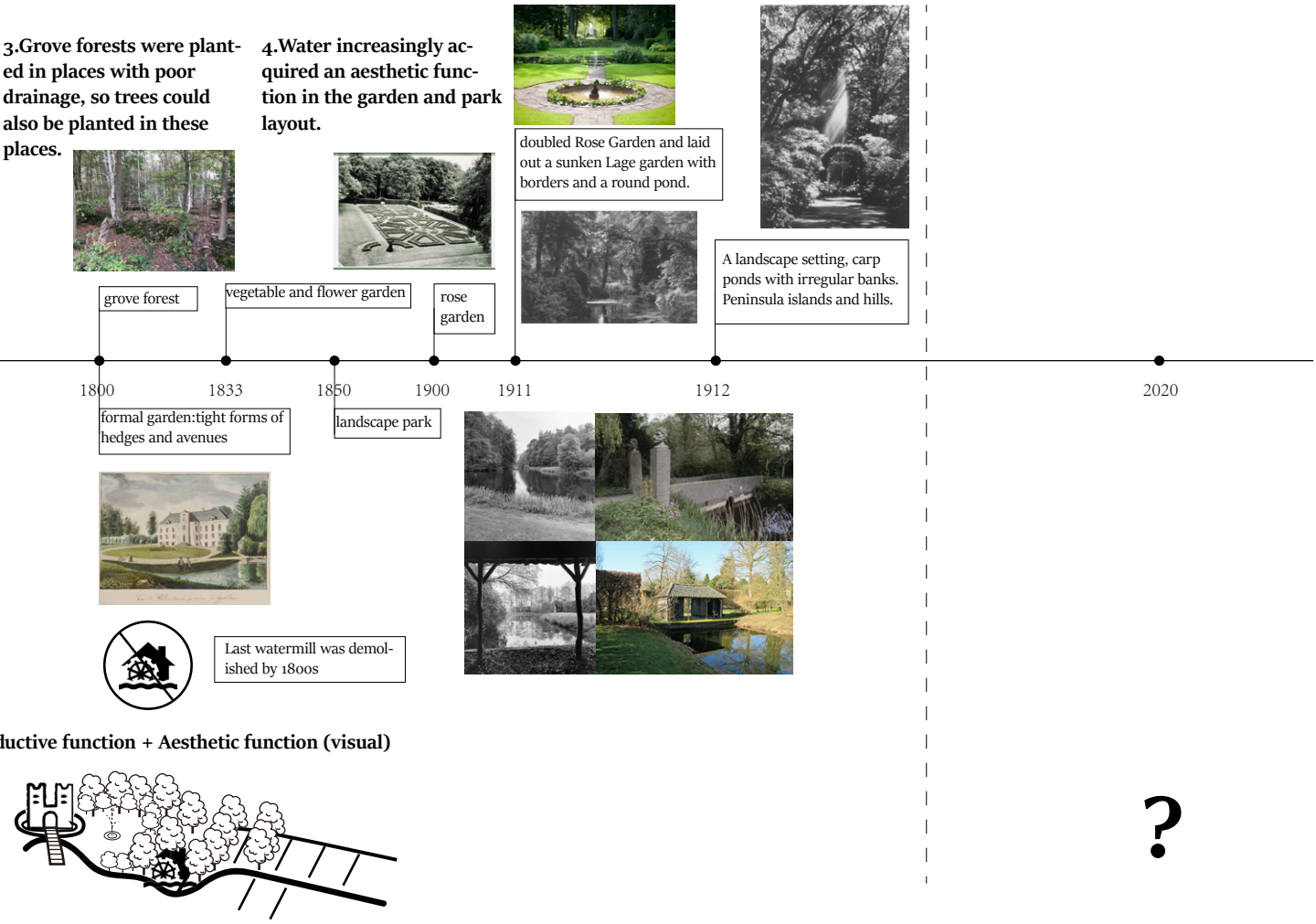
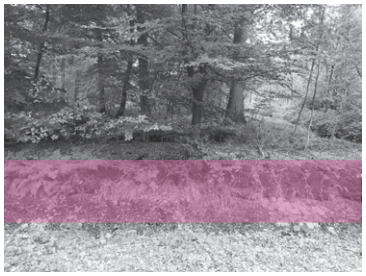


Figure 3.3: timeline on changed water function in estate ground overtime



Rabat forests

Used for water storage from bogs in history but become a wasteland today.

Flow meadow

The meadow is no longer irrigated with water from streams.

Estate Moat

Lower water level in estate moat fails to protect the architecture.

Forest stream

The streams are dry during summers and therefore poor water quality in forest.

Arable land

Shortage of water for arable land and therefore have consequences on prodicivity.

Figure 3.4: Scarcity of water in estate landscape

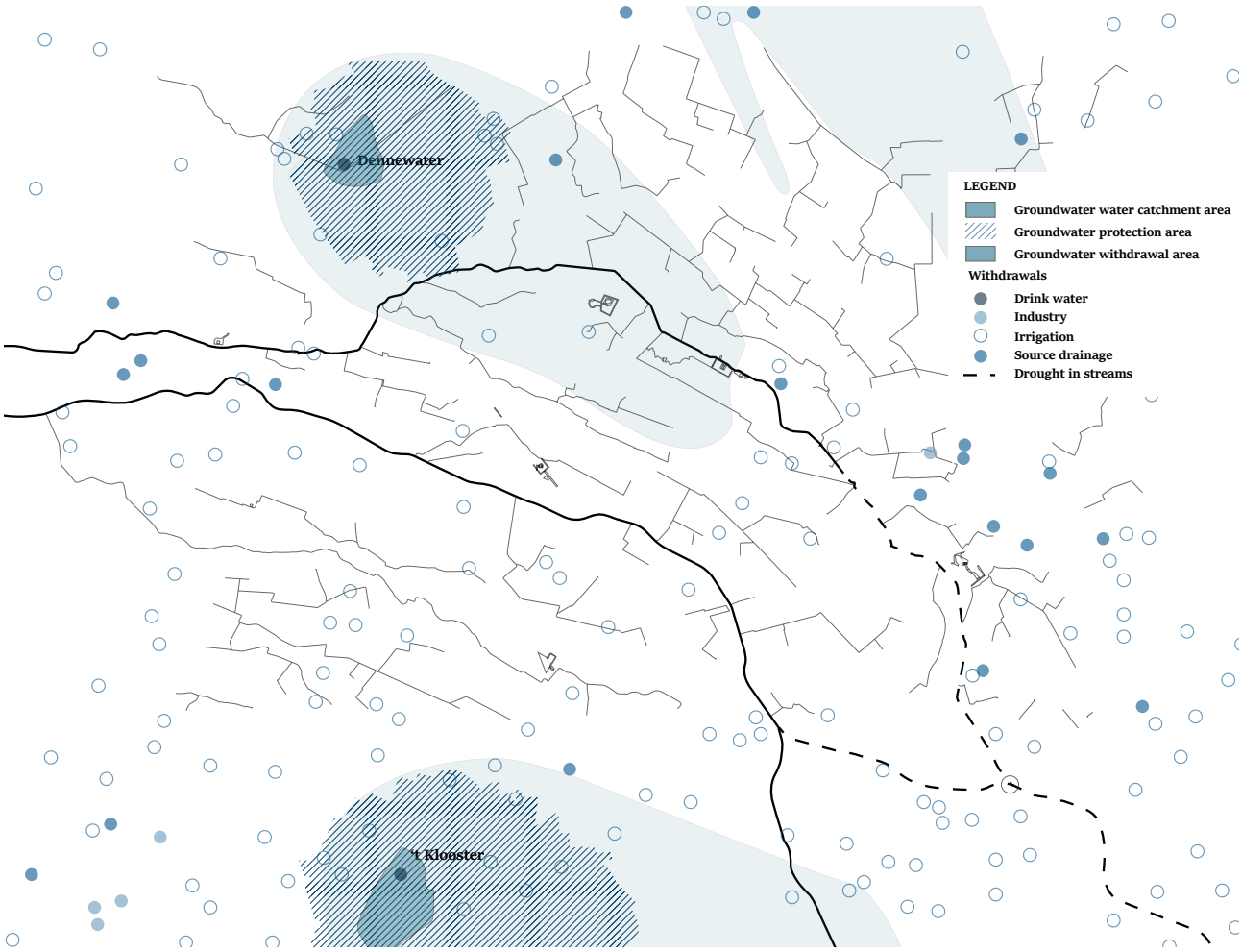


Figure 3.6: In dry seasons, groundwater are extracted for irrigation, drink water and industries. Large part of the Baakse beek is dried out in summer.

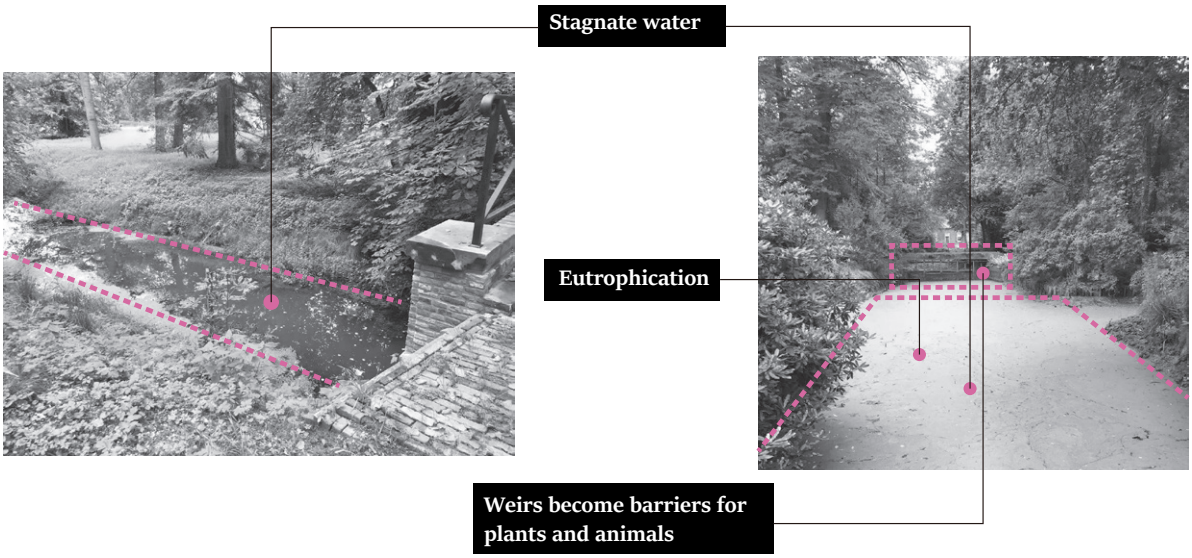


Figure 3.5: Water ecology is threatened on estate ground

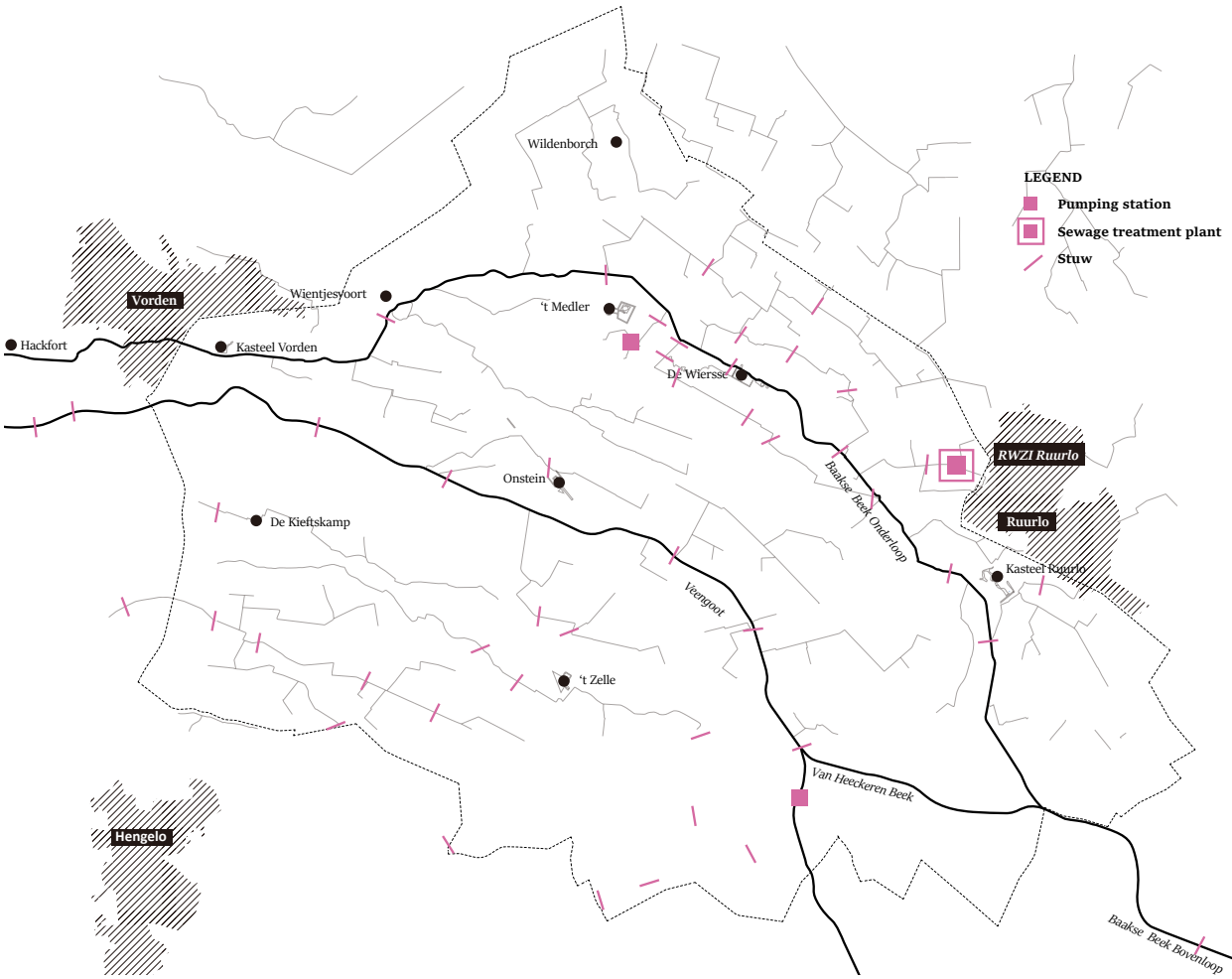


Figure 3.7: A lot of weirs are built on stream for level management. Weir helps retain water in the stream, at the same time slow down the flows and become barriers for migration.

3.3 Baakse Beek Basin hydrological history and changed landscape over time

3.3.1 Before 1000: Natural flows

There is no human intervention to the water system in the Baakse beek basin before 1000. Various water flows characterized by small meandering streams from the melted water valleys on the edges of East Netherlands Plateau feed into the central lower-lying basin following the relief and permeability of soil layers (figure 3.8). The large swampy area in the central basin is bordered in the west by the sand ridge of Ruurlo-Zelhem. This sand ridge is slightly higher than its surroundings and directs the water discharge partly to the north and partly to the west. The bog that accumulates peats acts as a sponge. The west part of the basin, between Ruurlo and the Ijssel, has a moderate high change where the precursor of the Baakse beek runs in between (Waterschap Rijn en Ijssel, 2019).

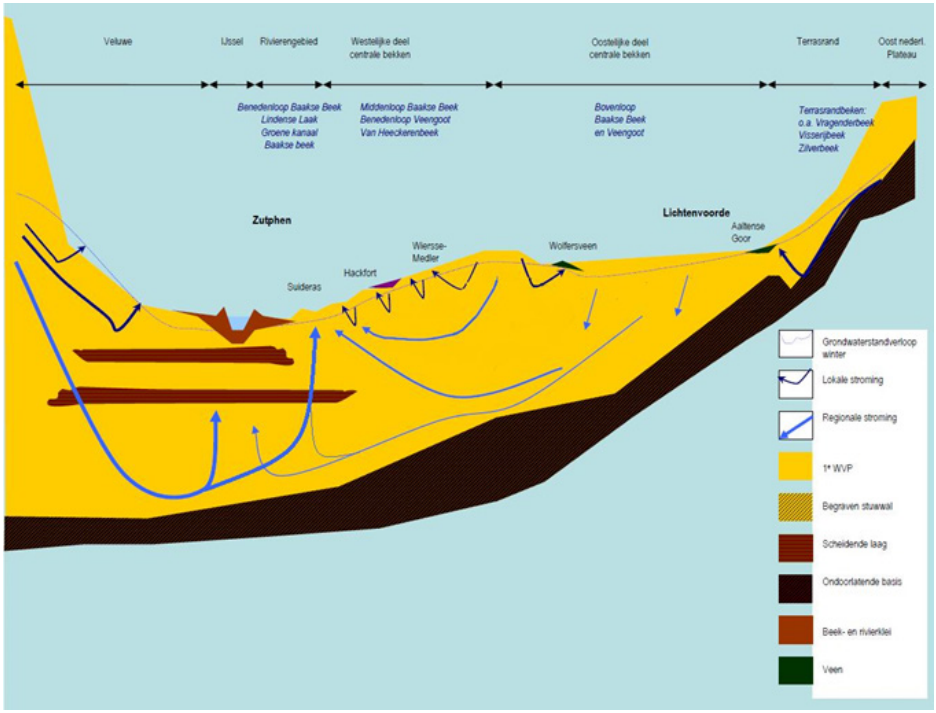


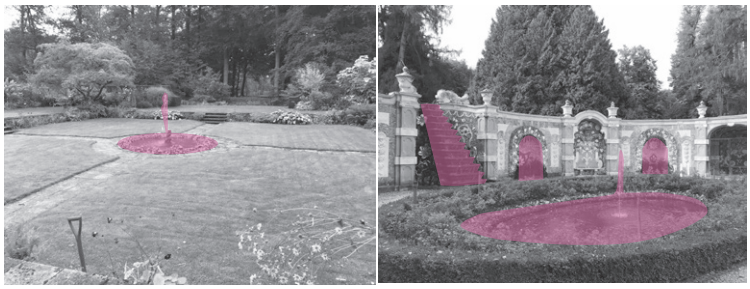
Figure 3.8: Cross section and geology of the Baakse beek basin (Waterschap Rijn en Ijssel, 2019)

3.3.2 1000 – 1850: Working with water; canals, water mills, irrigation systems, water for aesthetics

Recorded water management and hydrological history could date back to the eleventh and twelfth centuries when people began to settle on higher grounds with an adequate water supply. Small scale dewatering of the swamps and forests could be found in the area with the castles and possessions developed in the estate area, whereas the peat-filled central basin was still difficult to mine.

From the fourteenth century, to achieve a higher agricultural output in the estate area, the system of flow meadow is characteristic of the place with many level management works and ditches could be found. The downstream part from Ruurlo was also excavated which is probably the origin of what is now the Baakse beek. Meanwhile, more streams are dug and connected to feed the water mills with an increasing water supply to the estates, such as castle Ruurlo, the Wiersse, castle Vorden and Hackfort (Waterschap Rijn en Ijssel, 2019 and Waterschap Rijn en Ijssel, 2014).

From the sixteenth century, when the castle lost its defensive function, the use of water also changed to decoration features in gardens attached to the country houses. Later on, influenced by the emergency of picturesque style park and garden design, ponds of irregular shapes are being laid out on the estate (figure 3.9). Additionally, there are increasing concerns on the devastating and threatening for the environment and the landscape as a result of the transformation in the industrial revolution. These aesthetic water features that conform to our cultural expectations of naturalness are also assumed to be ecological healthy.



geometric garden style dominated during the 17th and 18th century

the middle of the 18th century the so-called landscape style

Figure 3.9: Aesthetics use of water in estate gardens

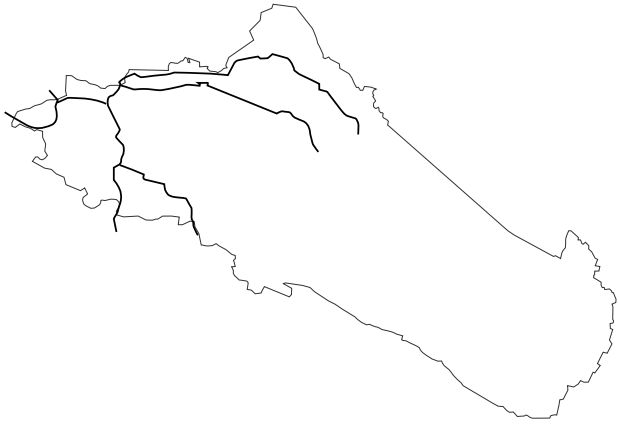


Figure 3.10: Watercourse in Baakse beek basin in 1200

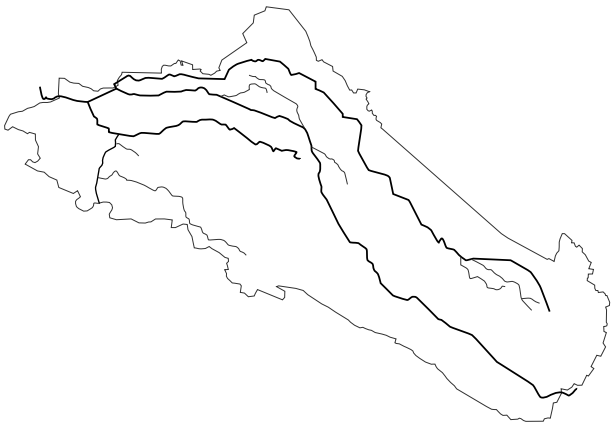


Figure 3.11: Extended and canalized watercourse in 1835

3.3.3 1850-1980: Dewatering; drainage, standardization, land consolidation

The allotment in the flat middle basin was limited until the early nineteenth century. This swampy area was drained in the first half of the century due to its favorable conditions for agriculture. At the start of the reclamation, forests were cut down and ditches were dug and connected in this portion. At the same time, the new stream was dug in between 1818 and 1834 to connect streams at the Lichtencoord terrace and the Baakse beek (figure 3.10 and 3.11). In this way, the storage capacity of the swamp lost and the water from upstream flows away faster to the estate area and this has major influence on the water management there. To prevent floods in the estate area, Baakse beek was relocated and a new canalized waterway was dug (Waterschap Rijn en Ijssel, 2019 and Waterschap Rijn en Ijssel, 2014). The discharge of the Baakse Beek became more irregular characterized by larger peak discharges and earlier drainlessness. Water management in the downstream led to the drying up of some streams at the plateau ridge as well (Waterschap Rijn en Ijssel, 2014).

The dewatering before 1900 was not aimed at maintaining a certain level and draining, but at draining the water present at ground level. From the twentieth century, the old irrigation system (flow meadow) gradually lost its significance and agriculture was further intensified because of the introduction of the chemical fertilizers. The Baake beek water board was founded in 1919 due to the increasing need for drainage and water management. From then on, the area witnessed the largest interventions in its water system. The water boarders deepen, broaden, relocated, straightened, shift, connect and increase the water-carrying capacity of many existing and newly dug watercourses. Weirs were also installed in these works to regulate levels. For example, due to the limited drainage capacity of the Baakse Beek in the estate zone, the Van Heeckerenbeek was dug in 1967 connecting the two main waterways. Water is drained from the Baakse Beek to the Veengoot via this connection, especially at peak discharges. Although all these water management measures aim at improving drainage in the summer period and reducing undesirably low groundwater levels, the area was still facing unwanted inundations regularly. The dewatering system is further intensified in the post-war land consolidation carried out between 1950 and 1980. As a result of this, there was very rapid drainage, lower groundwater levels throughout the area and a substantial reduction in seepage flows (Waterschap Rijn en Ijssel, 2019 and Waterschap Rijn en Ijssel, 2014). What is even worse, many water-related woodland and heathland disappeared, the ecosystem is indirectly threatened.

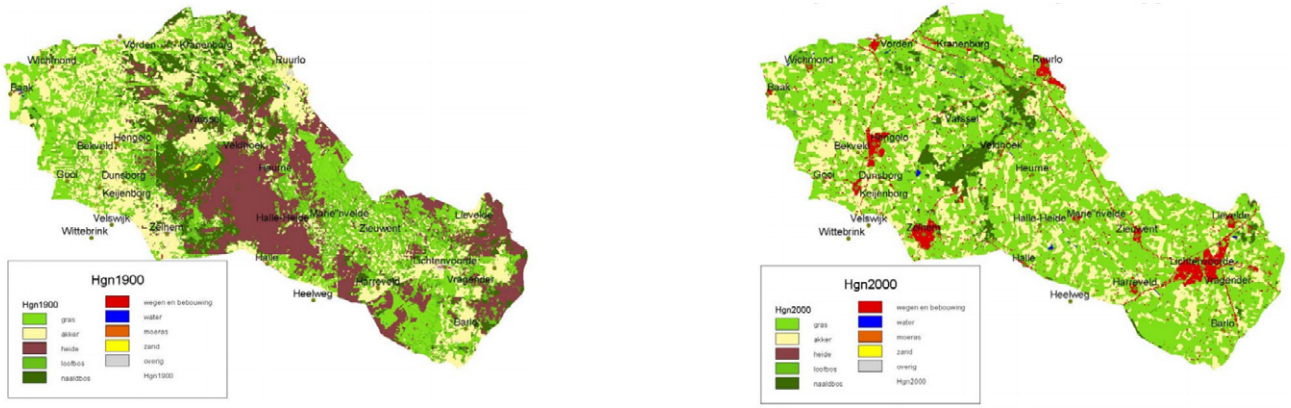


Figure 3.12: Land use of Baakse beek area (Source: Massop, 2007)

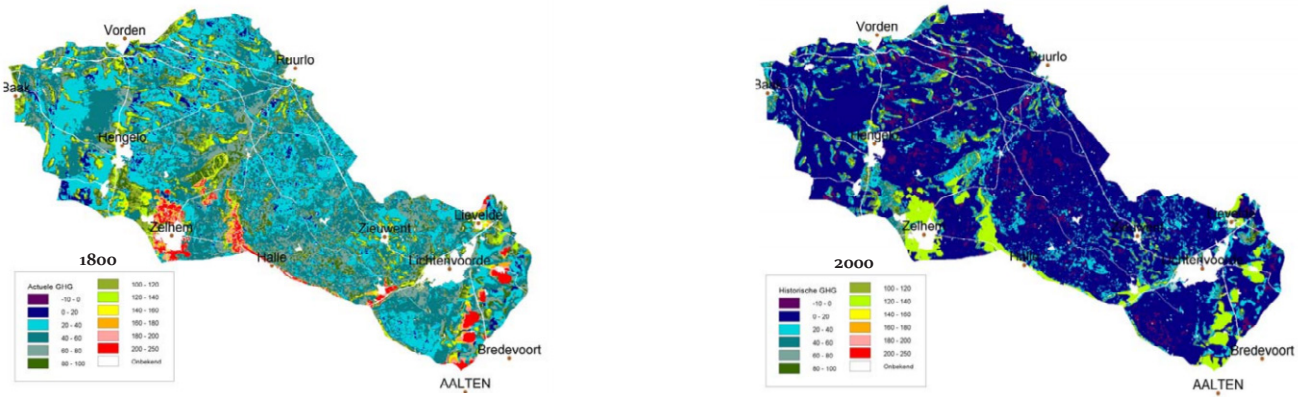


Figure 3.13: Highest ground water levels of Baakse beek area (Source: Massop, 2007)

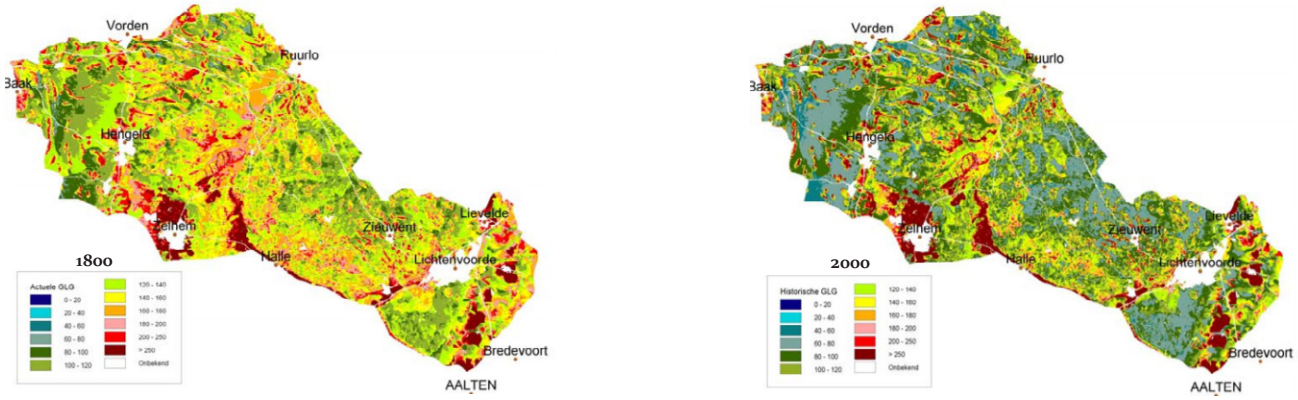


Figure 3.14: Lowest ground water levels of Baakse beek area (Source: Massop, 2007)

3.3.4 After 1980: Drought, floods, groundwater extraction and toward a balance recovery

In recent decades, water levels in the area are greatly controlled and regulated via weirs, but they are not primarily for level management. The initial purpose for them is inhibiting flows at peak discharges for agricultural development. In the management area of the Baakse beek, there are approximately 273 weirs, the density of weirs is larger particularly when there are greater height differences in the east of Lichtenvoorde and west of the Zelhem-Ruurlo sand ridge.

However, the low groundwater level is an issue. This is not only because the soil lost storage capacity as a result of land reclamation in the past. It is partly as a result of climate change; the summers are increasingly hot and dry and there is a lack of water. Therefore, much more groundwater extracted to irrigate the land in dry seasons. There is almost 10 million m^3 groundwater extracted annually and the level could drop below the weir level or to the water bottom (Waterschap Rijn en Ijssel, 2014). There is hardly any water could be seen above the ground level.

Looking back on the timeline of history, the period of dewatering has been short and intensive. The effect of the water management structure is also temporary. The primary cause of the current desiccation is the rationalization of the landscape (Waterschap Rijn en Ijssel, 2019). the balance between the water and the landscape, between water and topography has been disrupted. To restore this balance and bring back wetness conditions, landscape design should take a more active role in working with water management and ecology.

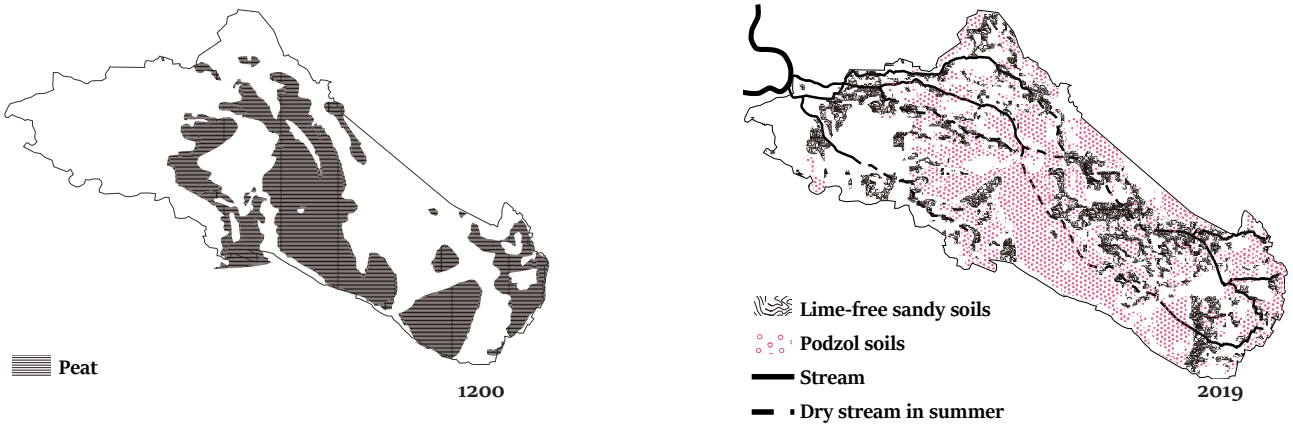


Figure 3.15: The soil lost storage capacity as a result of peat mining

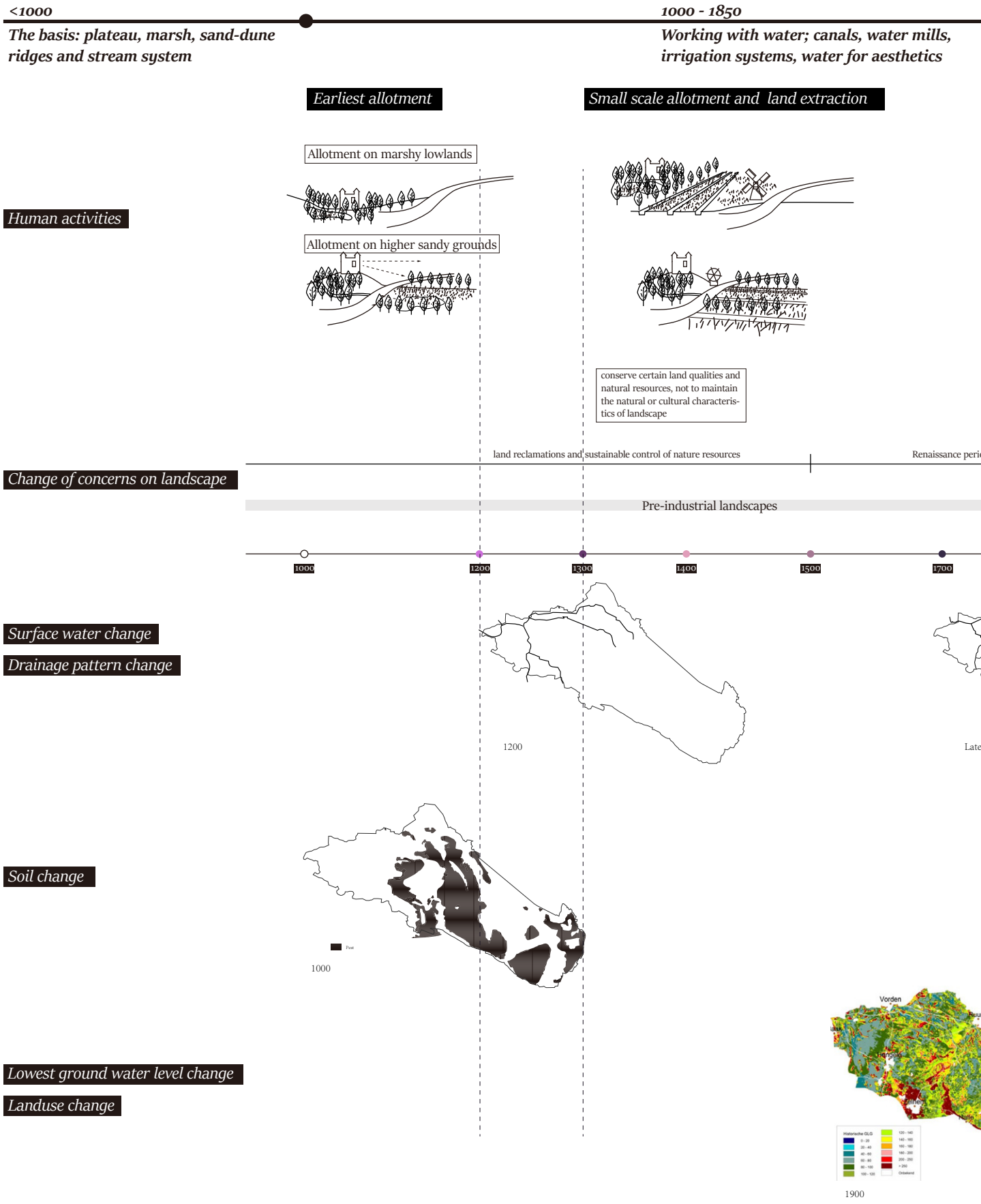


Figure 3.16: A summary of the history of people working with water in Baakse beek area

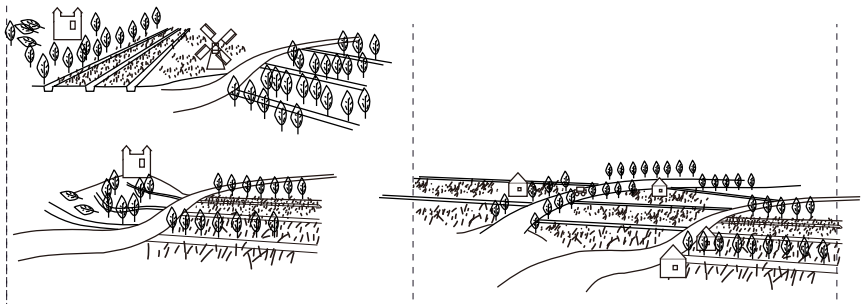
1850 - 1980
Dewatering; drainage, standardization, land consolidation

1980 - 2018
Drought, showers and groundwater extraction

> 2019
Balance recovery

Intensive allotment and land mining

Land consolidation



start concerns the devastating and threatening for the environment and the landscape of transfornation in industrial revolution

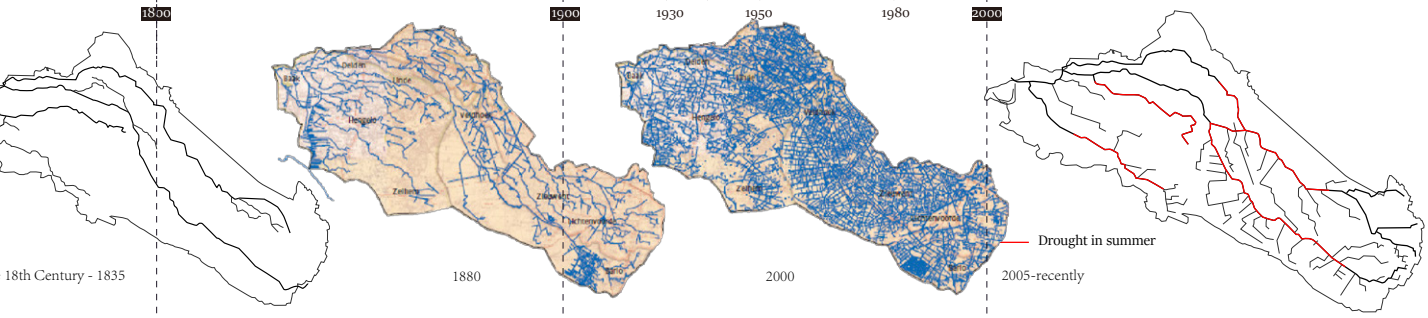
a more ecological approach towards integrated land-scape manage-ment

holistic approach to the landscape

Landscape of the revolutions age

Post-modern new landscapes

1800 1900 1930 1940 1950 1980 2000



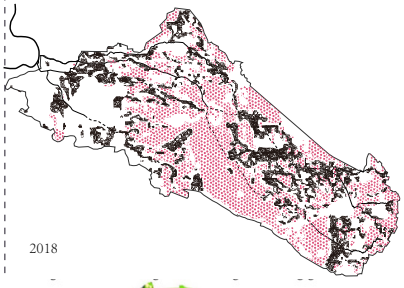
18th Century - 1835

1880

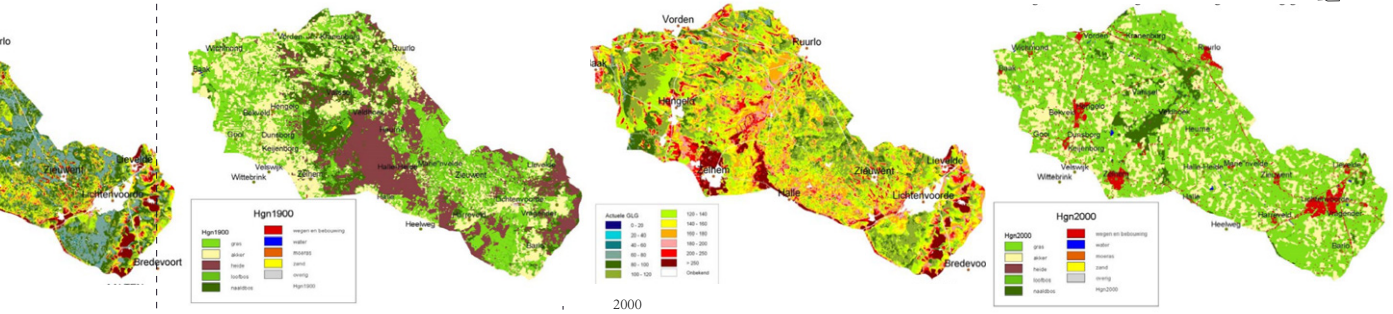
2000

2005-recently

Drought in summer



2018



2000

3.4 Spatial landscape typologies, stream typologies, and stakeholders

The water system as well as the vegetation pattern, land use, topography decide the spatial characteristics of the landscapes in the Baakse Beek region. The landscape of the Baakse beek catchment area could be fell into five categories. From the most east to the west are the terrace-edge landscape, the camp landscape, the peat mining landscape, the sand ridge landscape, and the estate landscape. Each type of landscape provides people with distinct spatial experience when walking in the landscape ranging from higher and lower, dryer and lower, enclosed and open, productive activities, buildings, and main user groups (figure 3.17).

The Terrace-edge Landscape is located on the eastmost part of the Baakse beek management area just outside the eastern plateau. This landscape is strategically important in the management area because the source of Baakse beek and Veengoot streams is formed here. Due to its high altitude, the stream type is recognized as Terrace-edge stream which is characteristic by relatively fast-flowing waters with some meanders holding a certain amount of water in the area. The stream could have diverse banks but mainly forest or arable land here, which means many flora and fauna are absent in landscape (Baker, 2002). Furthermore, several important residential clusters are located in the area. Drinking water and irrigation water supply are greatly in need of local residents and farmers. Meanwhile, they also produce polluted water. These characters make the water quality a significant issue. Linear vegetation pattern along the stream is also recognizable.

The central basin has a flat landscape and is supposed to be the wettest part. However, the area was completely mined in different periods of history and the landscape could be distinguished as two types. The Camp Landscape is located in the east half of the central basin and was mined in the Middle Ages. The rest part is recog-nized as the peat mining landscape ending at the line of Ruurlo-Zelhem. Before being mined, both of the landscapes have a Wetland Stream with meanders and shallow slow drain. The stream banks are flora and fauna rich (Baker, 2002). However, the landscape here was greatly changed with the development of agricul-ture. The stream is canalized with its bed more standardized. The drainage system is dense and connected to drain fast. The whole central basin becomes monofunctional after many forest and heathland are erased in the landscape. The shape of lands is more regulated in the peat landscape comparing with that in the camp landscape.

There is a sand ridge formed at the line of Ruurlo-Zelhem during Holocene. The Sand Ridge Landscape is higher and drier than its surroundings and mainly covered with softwood forests. There is a Temporary Stream running through the landscape connecting Baakse beek and Veengoot. The stream is characterized by hollow banks fails to provide adequate gradients for stream vegetation to grow. The area is an important holiday destination. There are several camp fields and holiday houses ranging from different scales located along the stream.

The Estate Landscape is known for the castles and estate clusters interspersed with agriculture and forests. This is one of the most diverse landscapes consist of wet forest, dry forest, grove forest, wet meadow, agriculture, and most importantly, cultural heritage attracting tourists. The stream type is recognized as Lowland Stream. This stream historically passed through marshes but the landscape is less messy compared to the wetland stream guiding landscape. More recently, the stream has been canalized to regulate the discharge. The flow rate is very slow in the area. Numbers of weirs in the streams regulate water for supply. For estate owners, weirs also enable water to be present in the estate garden in dry seasons.

3.5 Conclusion

This chapter discovered the multifunctional role of water in the estate landscape. The challenge of scarcity of water and threatened ecology are addressed. To overcome these challenges and find solutions for design, a systematic analysis on people working with water and landscape overtime and spatial typology on larger scale (whole Baakse beek area) is taken. These analysis set foundations for finding water ecology principles and spatial design principles in the next chapter.

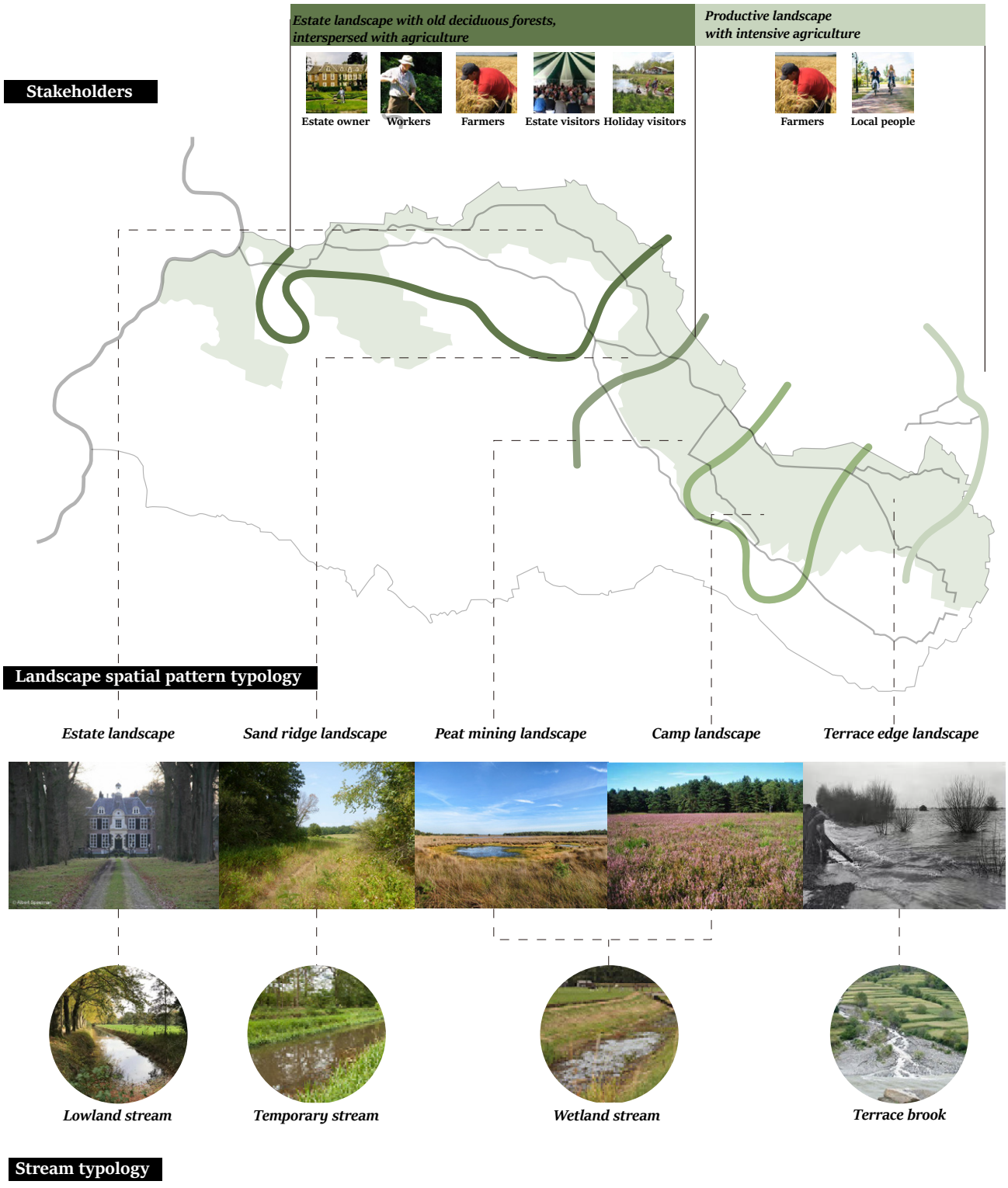


Figure 3.17: Spatial landscape typologies, stream typologies, and stakeholders

Chapter 4
Design principles

4.1 The disjuncture between landscape aesthetics and ecology

Traditionally, landscape aesthetics perception was considered different from ecology experiences. The disjuncture between aesthetic experience and ecological function has been at the centre of many academic discourses and landscape design for a long time. In many landscape cases, aesthetic pleasing and ecological pleasing are not always positively correlated (Gobster, et al. 2007). In landscape design, the improved ecological qualities might hardly be recognized and appreciated for people who are not educated to look for ecological values in the landscape. At the same time, the ecologically valuable landscape might not be well-protected if it receives fewer cares and maintenances (Nassauer, 1995).

Our desire of seeking aesthetic experiences in the landscape is reflected in landscape management policy. When aesthetics first started to influence landscape management policy, however, there are little ecological concerns such as biodiversity, ecological service and ecological health heard in policy (Gobster, et al. ,2007). Environmental aesthetics roots in the idea "aesthetic of nature" of the seventeenth to the nineteenth century, which initially concerns the aesthetic value of natural environment and later extended to a human-influenced environment. In the first half of the twentieth century, environmental aesthetics was ignored instead, the construal of aesthetics became more art-driven because nature was messy and thus attract less philosophical interest comparing with arts (Lee, 2018). More recently, although ecology is gaining increasing policy concerns and public awareness in many aspects of landscape change due to the exposed environmental issues, particularly the challenge of climate change and sustainable development, such ecological knowledge still fail to be translated into an aesthetically appreciated ecological landscape (Gobster, et al. ,2007).

Therefore, a gap exists between aesthetic experiences and ecological functions. Though high ecological quality is assumed to be associated with a high aesthetic quality, in many cases, there are no guarantee aesthetic and ecological values will always be positively correlated (Gobster, et al. ,2007 and Lee, 2018). Ecological services and aesthetic attractiveness are two parallel lines that need to be weaved together under the context of the changing climate. Another conundrum is the gap between the human-centered landscape design and the work of the ecologists. The ecologists are trained to be more sensitive to the development and change and they tend to attribute beauty to landscapes that are less visually attractive to those who are not educated for it (Kovacs et al., 2006 and Nassauer, 1995). With the "aesthetic of nature" returning to our sight and its critical relationship with human and ecology, "ecological aesthetics" have emerged in the late twentieth century provide pathways for landscape designers to rethink the relationship between human spatial experience in landscape and the ecology function of the landscape, develop principles for spatial experience design, and offer indicators to examine the outcome of the design.

4.2 Development, definition and indicators for ecological aesthetics

Motivated by the recognized disjuncture between landscape aesthetics and ecology and the increasing environmental issues, the concept of "ecological aesthetics" has its root in the studies of the aesthetics of nature but broadens the idea of landscape aesthetics beyond scenic aesthetics (Gobster, 2010 and Lee, 2018). Early ideas of ecological aesthetics mainly come from four different sources. The first one comes from the field of natural science. On one hand, some natural scientists assert that when places of outstanding scenic aesthetics attracted more attention, some other landscapes of important ecological value but less aesthetically pleasing will be overlooked in natural science studies. On the other hand, natural scientists also help discover the multidimensional aesthetic qualities of places lie beyond the scenic one (Gobster, 2010).

Philosophy is the second source for understanding the application of ecological aesthetics to landscape perception. The root idea comes from Aldo Leopold's "ecological and evolutionary land aesthetic" more firmly grounded in evolutionary history and ecology rather than the previous studies on the aesthetic of nature (Callicott, 2004 cited in Gobster, 2010). Other environmental philosophers also underline the importance of scientific knowledge, engagement, imaginary, and ambient qualities of nature experience in the aesthetic appreciation of ecological values (Gobster, 2010). To avoid making the "ecological aesthetics" a repetition of "scenic aesthetic" that relies on static visual cues, it should base on a more dynamic, multisensory, knowledge-based, and active engagement with the environment.

The third source comes from ecologically inspired art and design exploring in what way an applied ecological aesthetic could facilitate a better understanding of the connection between aesthetic expression in design and ecological sustainability. Works in this field offer particular opportunities to raise public awareness on the ecological system and to reveal the hidden ecological functions and processes, and to help learning and appreciation, comparing to other works of non-designed fields (Gobster, 2010).

The final source comes from the study of perception where a more comprehensive idea of landscape perception was built. The study of perception emphasizes the outcome of human-landscape interactions and its conse-quences on both human behavioral and environmental changes (Gobster, 2010).

In general, ecological aesthetics is considered as a better alignment between the delivery of aesthetics, spatial and ecological values in landscape and claims that it is desirable for human to take pleasures from the land-scape appearance that involve beneficial ecological functions (Gobster, et al. ,2007 and Lee, 2018). Hence, the aesthetic appreciation of the spatial design in the landscape could benefit the sustainability and the health of ecological systems and indirectly contribute to human well-being (Gobster, 2010 and Lee, 2018). When placing the idea of ecological aesthetics in a landscape perception framework, it does not differ from the scenic aesthet-ics in terms of its outcome of human-landscape interactions but goes beyond. An ecological aesthetics requires design for a more multidimensional experiential type of individual-landscape interaction. On the human side of the interaction, it stimulates the perception through multisensory, spatial and temporal, and interpretive knowledge-based landscape design. On the other side, either the ecological values or the beauty of the land-scape might be self-evident as dynamic or resilient ecological processes. And finally, these outcomes will be deep and long-lasting (Gobster, 2010). These indicators also imply the initial goals of the design in this project, to design for an integrated water-ecology system as the basis, and then to examine how could spatial design communicate the cultural, aesthetics values in the landscape with its ecological function, and towards con-forming our cultural expectations of naturalness and the ecological stability at the same time.

Figure 4.1 below summarized the main ideas from the diverse field of study ranging from natural science to landscape perception. It provides a comprehensive comparison between the scenic aesthetics and ecological aesthetics on both the human side land landscape side and their interactions and outcomes. The research and design in this project will take the value of these indicators to select the most preferable design principles and examine the ecology and spatial consequences of the design.

Scenic Aesthetics	Ecological Aesthetics
Human	
Direct/affective/emotional	Mediated/cognitive/knowledge-based
Stimulus-response/snapshot in time	Experiential/temporal-spatial dimensions
Visual	Multisensory/movement
Preference	Appreciation
Landscape	
Visual/static/inanimate	Multimodal/dynamic/animate/ephemeral
Picturesque/formal/composed/face value	Vernacular/symbolic/indicator species
Bounded/fixed/framed/specific places	Surrounding/entire landscape/ambient
Naturalistic/dramatic/vivid/scenic	Natural/subtle/not easily discerned/unscenic
Tidy/scenery	Messy/ecological processes
Interactions	
Perceptual	Experiential
Passive/object-oriented	Active/participatory/engaging/involvement
Accepted as given	Invokes a dialogue
Outside/detached observer	Inside/full immersion
Outcomes	
Pleasure	Understanding and pleasure
Short-term/mood change	Long lasting/restorative/unity/sense of place
Descriptive/preferred	Normative/ethical/preferable
Status quo	Catalyst for internal and external change

Figure 4.1: Some major distinctions between scenic versus ecological aesthetics (Gobster, 2010 adapted from Gobster, 1999).

4.3 Principles for landscape ecology design: Water balance principles from history

Before starting search for spatial design principles for design from external literature, it would be better to review the water management history in the Baakse Beek and find the principle for water management and landscape ecology first as the water form, and the environment is the basis in a landscape. Therefore, two questions are raised to help find the optimal water ecology principles, they are: what values could be taken from the local history of working with water and whether these measures in history could help to bring back wetness and redefine the water values under the context of the climate change?

The local historical water management approaches mentioned in the analysis section are fallen into three categories, existing and valuable, abandoned but ecologically valuable, and existing but not ecologically valuable (figure 4.2). To design for a resilient water ecosystem, there are three ways to dealing with each category in design. To be more concrete, there are principles that could be implemented under each category (figure 4.3). For example, the adaptive reuse of rabatten forest to store water in the dry season and drain extra water during peak discharge. The flow meadow system could be combined with the constructed wetland to store water and at the same time purify the polluted water before they are brought back to the system. The re-naturalization of the stream and its bank will slow down the flow and give water more space in the stream and the landscape. When working together with the measures like removal of some inactive weirs, this offers more opportunities for the richness of flora and fauna and finally benefits the ecological function.

By integrating these water management principles into design, a considerable amount of water is proposed to hold in Baakse beek water system. The ecological quality of the water and its surroundings can be greatly improved. These effects brought from landscape design are multidimensional and long-lasting.

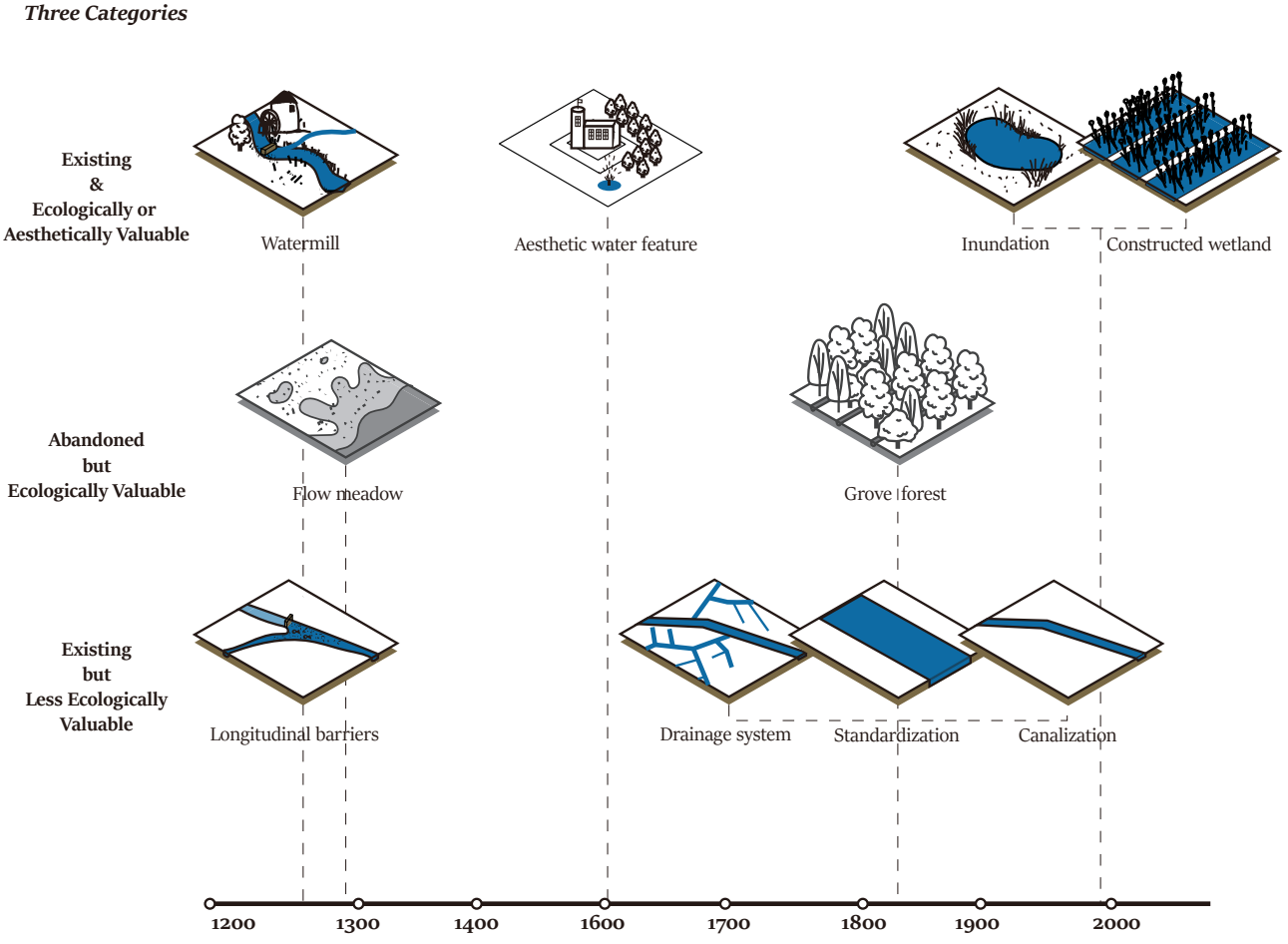


Figure 4.2: The local historical water management approaches in Baakse beek area are fallen into three categories.

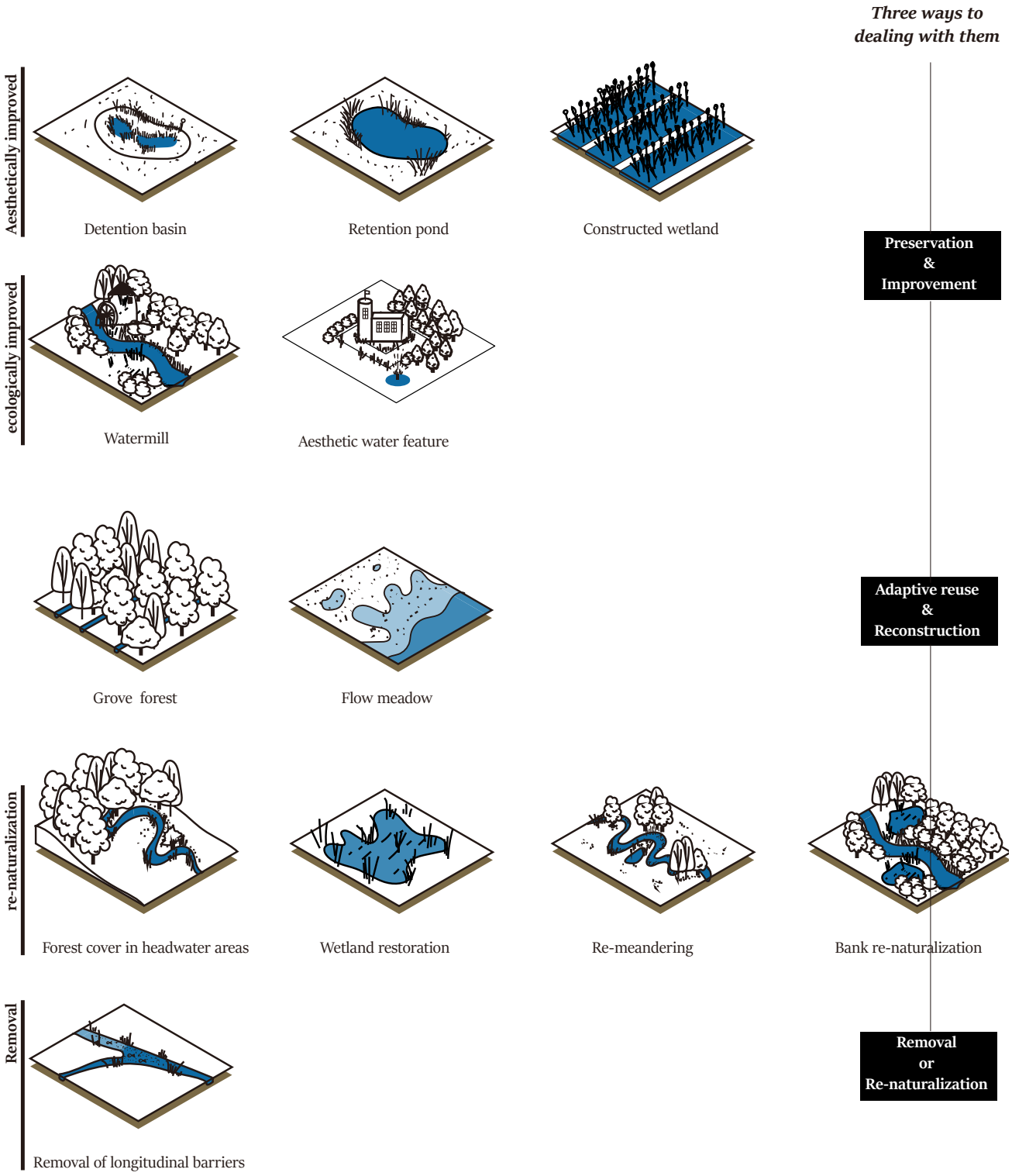


Figure 4.3: Design principles

4.4 Principles for spatial experience design: spatial modification and 'cue to care'

The indicators for ecological aesthetics outlined by Gobster are still so abstract that they cannot be used directly as practical principles in design but they are still very useful in examining the outcome of the design. People perceive and understand the landscape on different scales. On a larger scale, the spatial feeling is delivered through the landform, land use, vegetation pattern, and water pattern. At a very local scale, it is also important to design with cultural-aesthetics elements to give hints on human impact in the landscape to communicate ecology function. Water has an important role to play on various scales in Baakse Beek, to find ways for spatial design there, it is necessary to understand the complex interrelationships between water and the rest of the landscape components. These interrelated components together in many cases could be strong languages self-explain the ecological functions and the spatial quality of the landscape. This relationship in the landscape would set foundations for new developments or adaptation.

Interconnected landscape components make up spatial experiences and bring about feelings of pleasure. Water as a multisensory resource in the landscape contributes to the environment and perception. Litton and Tetlow (1974) in their report developed a classification framework for water in the landscape to show the interrelationships among water, landforms, and vegetation (figure 4.4). Normally these landscape elements are strongly linked but now this link is weak in Baakse Beek. On larger scales, This relationship in the landscape could be rebuilt through adjusting the spatial layout of landscape elements like the land use, vegetation pattern, or specific architectonic features to deliver or strengthen the spatial feeling of contrast, diversity, repetition, gradation or even fragmentation.

Following this classification framework by Litton and Tetlow (1974), the spatial experience is made up of a series of components ranging from large to relatively small scale and from general to the very specific character. Some important components related to this project include landform pattern, land use pattern, boundary definition, enclosure, vegetational pattern, features, prominence, continuity, transition, movement, appearance, and the aquatic environment. Three criteria – unity, variety, and vividness – are used to identify aesthetic qualities and the consequences on the spatial experience of these landscape components.

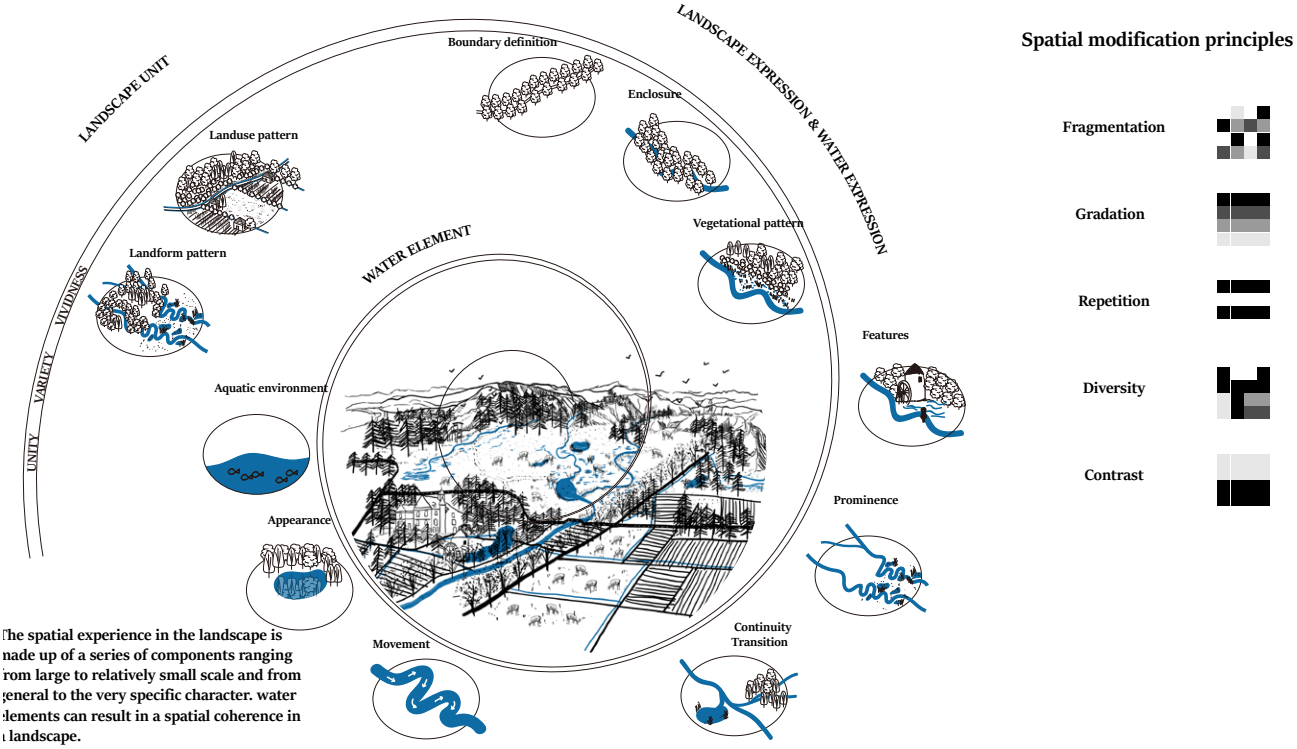


Figure 4.4: Classification framework based on Litton and Tetlow (1974) for water in landscape to show the interrelationships among water, landforms and vegetations, and spatial design principles to rebuild this relationship in Baakse Beek

Unity concerns the joint of distinct elements into a coherent and single harmonious unit. Unity is not simple (Litton and Tetlow, 1974). There is ecological and spatial unity expressed by fragmentation, gradation, or repetition in landform, land use, vegetation, and water patterns. There is hydrological unity formed by the continuity of water movement, appearance, and the aquatic environment. There is also very specific unity achieved by the design language of different materials, surfaces, and sections. Any of these unities are recognizable and contribute to spatial quality in the landscape.

Variety maximizes the opportunity for sensory stimulus. Variety refers to both diversity and richness. Diversity concerns both aesthetic quality and ecology. Richness implies an enjoyable organization of landscape components (Litton and Tetlow, 1974). Appropriate land use planning that does not harm the natural diversity could increase the richness of variation in natural patterns. It is noteworthy that the variety could be greatly achieved by contrasts of scale within the enclosure, the contrast between types and degree of enclosure, contrast between adjacent and opposing landforms, setting the contrast of vegetational patterns opposite edges of slopes, contrast in the degree of water prominence in landscape settings, and dramatic contrast between water flows, colors, stream patterns, and recognizable features in the water.

Vividness is a quality that gives distinction or a strong impression. Contrast, again, is an obvious way of giving distinction and therefore vividness. For example, the presence of immediate change from fast water to slow water (Litton and Tetlow, 1974). The man-made elements can also provide vividness through designing with specific water features, landform, or tree patterns.

Although each of these criteria is complex in itself, they need to be thought of as a process of integration and synthesis in examining the ecological aesthetic quality of the landscape. Fragmentation, gradation, repetition, diversity and contrast are five characteristics of the complex interrelationship between water and landscape settings. They could also be interpreted as design principles translating ecological functions into perceptual the spatial qualities. By playing with these principles appropriately, the multisensory and temporal-spatial quality could be strengthened in an ecological pleasing way.

Apart from the landscape itself, At a very local scale, it is also important to design with cultural-aesthetics elements to give hints on human impact in the landscape to communicate ecology function.To be more specific, what kind of intervention and to what extent design should impact the landscape are two core questions need to be discussed.

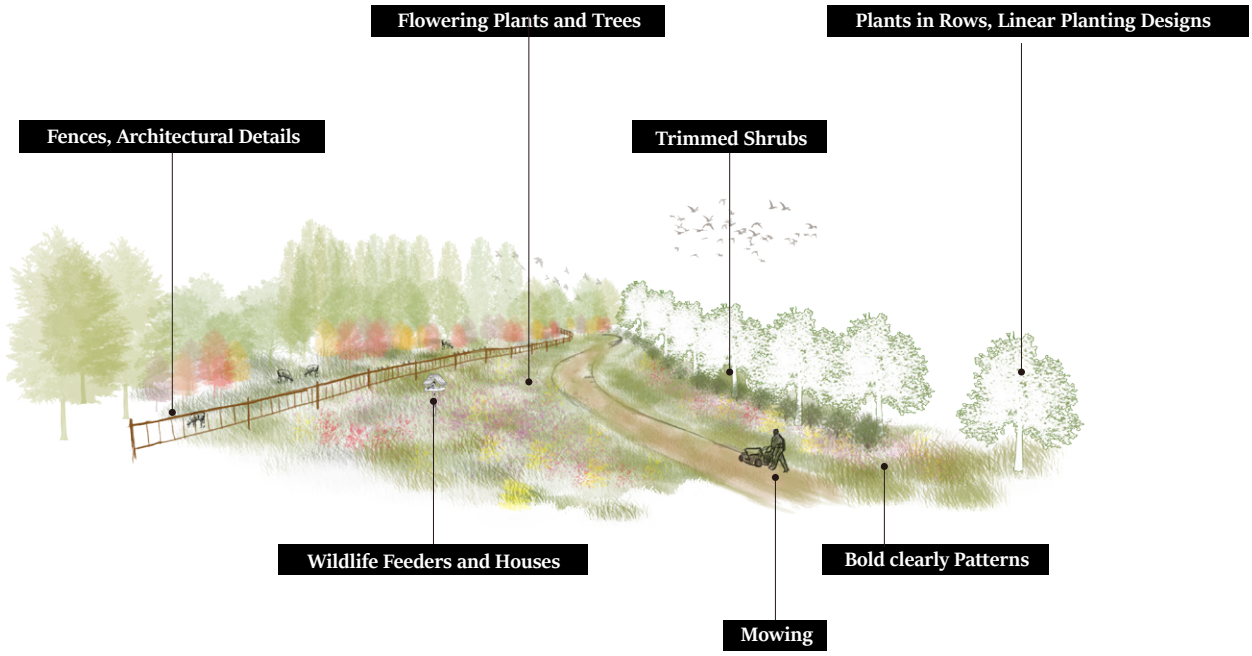


Figure 4.5: Landscape aesethetics design principles - cue to care

People prefer to see neatness and tended nature because they are often perceived as natural in one's mind influenced by their aesthetic conventions (Nassauer, 1995). Ecological functions are elusive for most people who are not educated for it. It requires careful use of landscape elements, water, trees, shrubs or landscape architects to communicate ecological functions in a new way. A crucial principle raised by Nassauer (1995), cues to human care, gives a way for presenting ecologically quality of landscapes to people and entering to vernacular culture. She further elaborates the cue to care as follows:

> **"Mowing. While the omnipresent, large, continuous lawn is not necessary to communicate care, mowing a strip along human paths (streets, walkways) frames patches of greater biodiversity with clear signs of human intention.**
>
> **Flowering Plants and Trees. Wetland and prairie plants with small flowers tend to be misunderstood for weeds. If restorations or gardens include an "unnaturally high" proportion of plants with larger, brighter flowers, at least in the first few sea- sons, people are more likely to find them attractive. Compared with shrubs or grasses, people are more likely to immediately appreciate trees, especially those they themselves can maintain in some way.**
>
> **Wildlife Feeders and Houses. People widely appreciate songbirds, and while people may not be able to identify the necessary habitat for the birds they enjoy, and they may not find the "brushy" quality of the habitat attractive, they do associate bird houses and feeders with the birds they enjoy. The feeders and houses are structural cues to care for wildlife and habitat.**
>
> **Bold Patterns. The rural landscape studies described above strongly suggested that the bold, clearly visible patterns of soil conservation practices like stripcropping, grassed waterways, and terracing were vivid cues to care, even for people who are not farmers or know little about agriculture. These patterns indicate human intention by their crisp edges and landscape scale. Similar patterns can be adapted to urban land uses.**
>
> **Trimmed Shrubs, Plants in Rows, Linear Planting Designs. At a smaller scale, obvious trimming and pruning of shrubs and linear planting clearly indicate human presence and the intention to care for a landscape.**
>
> **Fences, Architectural Details, Lawn Ornaments, Painting. These are all structural cues to the care of the adjacent landscape. Where a fence is well-maintained, or especially freshly painted, where nearby buildings are well maintained and painted, where lawn ornaments or architectural de- tails like window boxes or shutters indicate human attention to a place, the landscape nearby is more likely to appear to be well cared for. In the Midwest, the color white used to paint buildings and fences is particularly associated with care."**
>
> **Nassauer (1995) pp.167-168**

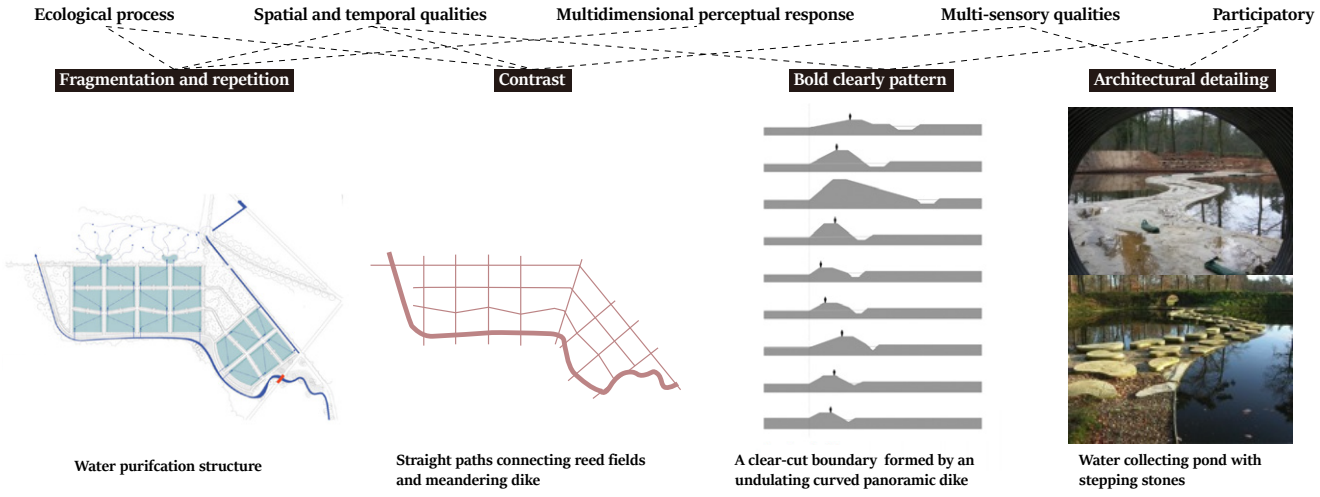
"Cue to care" stimulates a multidimensional response to the landscape. People respond to landscapes not only aesthetically but also respond in perceptions of the spatial quality, ecological health, safety, and cleanness. Accompany with the delivery of selected cue to care, symbolic meanings and motivational messages are expressed in the new landscape. Furthermore, landscape perception carries not only psychological meaning but also border social, cultural, philosophical, and ethical ones, therefore result in internal and external changes for the environment and humans.

In terms of the question 'to what extent design should impact the landscape?', the answer is 'intervention as little as possible.' Especially in the case of water ecosystem restoration, a principle of design with nature and process should be followed to give space for water to find its own dynamic and develop with time. Therefore, the ecological diversity rebuilt itself, the complexity and the spatial coherence between water and the landscape are again self-evident (del Tanago and de Jalon,2004).

4.5 Precedent studies

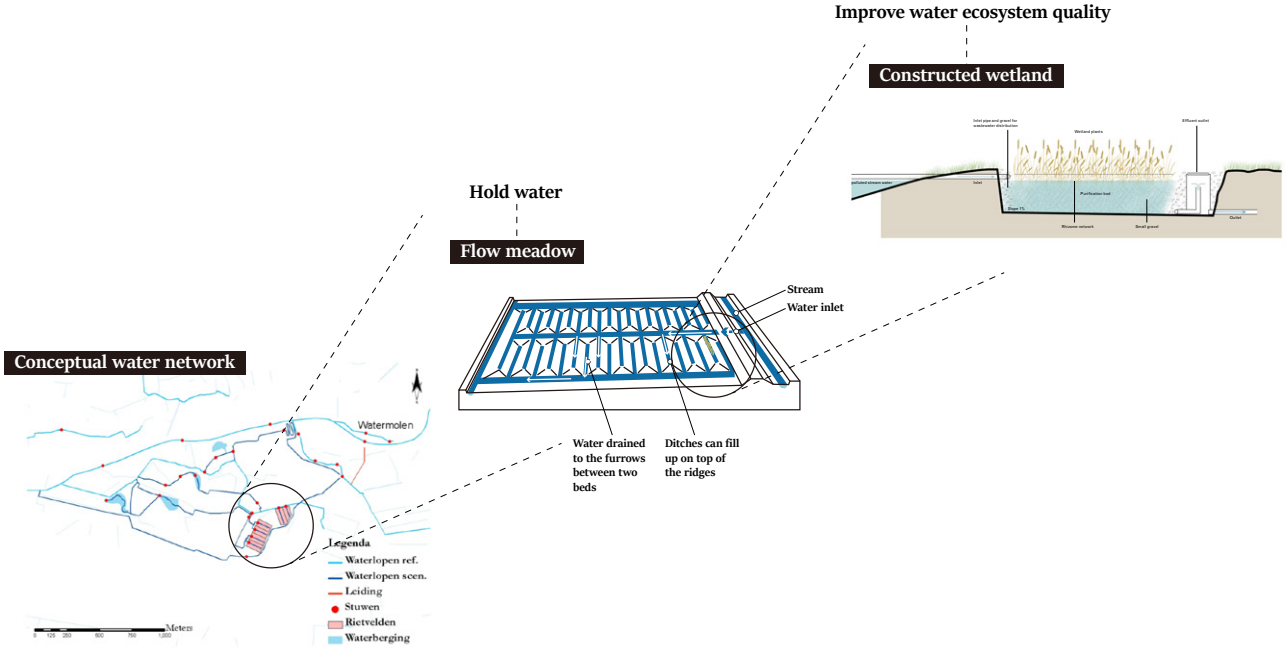
Three precedent studies are taken to examine in what way these principles on ecology and spatial design can build upon each other to ecological functions with landscape spatial perception in a real design case.

The first project is Lankheet water purification park in Lankheet country estate, Haaksbergen, The Netherlands. The water park concerns water purification, water storage, production of energy from biomass, recreational co-use, nature development and the experience of art and cultural history. The water retention and water purification function are designed in an ecological aesthetic way. by making repetition, contrast, bold pattern, like a dike and architectural detailing like stepping stone on water, the design creates a landscape of high multi-sensory, spatial and temporal qualities and therefore stimulating participatory and multi-dimensional perceptual responses.



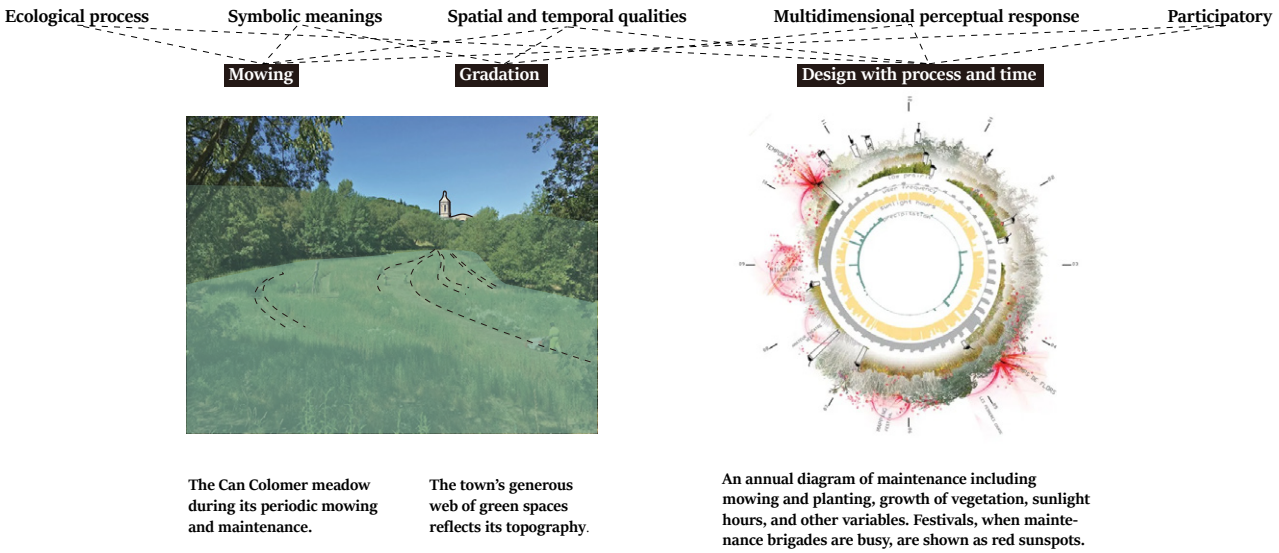
(Based on: Strootman Landschapsarchitecten, no date.)

The water system design is one of the highlights of this project undoubtedly. At the centre of this design, constructed wetlands are developed to purify stream water and at the same time produce biomass for green energy or fuel. The water of the Buurserbeek is let into the purification park, cleansed, and channeled back into a stream. Moreover, by allowing the purified water to flow through an existing but dried out marshy woodland, optimal conditions are created for a natural alder and bird cherry wood (Strootman Landschapsarchitecten, no date).



(Based on: Strootman Landschapsarchitecten, no date and Tilley et al., 2014.)

The second design case is called ‘its about time’ in Girona, Spain by Estudi Marti Franch. The landscape is specially designed with mowing and use it to represent certain ecological process changing over time. It also takes planting, growth of vegetation, sunlight hours, and other variables into consideration. The goal is to reveal the beauty of the whole of Girona’s landscape, opening up strategic views, providing access to the rivers, installing pathways and resting places, and, in doing so, encouraging the populace to value its surroundings more and creating a new relationship between the city and its surroundings. The meadow is periodically mowed and maintained. The web of green space reflects the topography of the place and creates a gradient of vegetation shaping the view towards the town centre (Waterman, 2017).



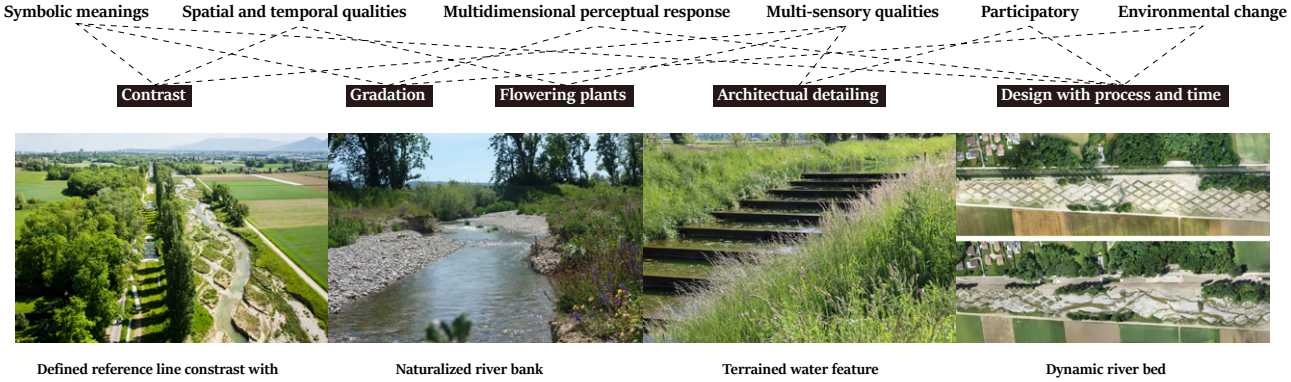
The Can Colomer meadow during its periodic mowing and maintenance.

The town’s generous web of green spaces reflects its topography.

An annual diagram of maintenance including mowing and planting, growth of vegetation, sunlight hours, and other variables. Festivals, when maintenance brigades are busy, are shown as red sunspots.

(Based on: Waterman, 2017.)

The last precedent study is taken on a river re-naturalisation project on River Aire in Geneva, Switzerland. The design proposed to combine the canal with a vast divagation space for the river instead of destroying the canal. In this way, the former canal and its riverside become a linear garden. In the process, the canal functions as a reference line indicating the transformation of the river and giving the possibility to understand the past and the present of the site. It follows the original morphology of the mountains in the watershed but provides some traces of human modification involving terraced water features, gradation on the naturalized river bank and flowering plants near the water.



Defined reference line constrast with undefined river space

Naturalized river bank

Terrained water feature

Dynamic river bed

(Based on: Group Superpositions, 2016)

4. 6 Conclusions

The disjuncture between landscape aesthetics and ecology addresses the necessity to bridge the gap between human spatial experience in the landscape and the ecology function of the landscape. Therefore, this chapter explores principles for water and ecology landscape ecology, taking the values from the historical water management practices. The spatial design principles on various scales are recognized as an extra layer that could bring back the balance between people and the environment. Three precedent studies are taken to examine in what way these principles could communicate ecological functions with spatial experience in real design cases.

Chapter 5
Design exploration

5.1 Design goals

After having these ecological aesthetic design principles, they are going to be synthesized and tested in various locations in Baakse Beek according to different spatial landscape types and the need for distinct stakeholders. For the first step, design objectives are set up for application. There are three key design objectives, which are water balance, improved ecological quality, and spatial expression of the ecological function. An overall goal of the design is to pave the way for a self-evident and future-proof landscape.

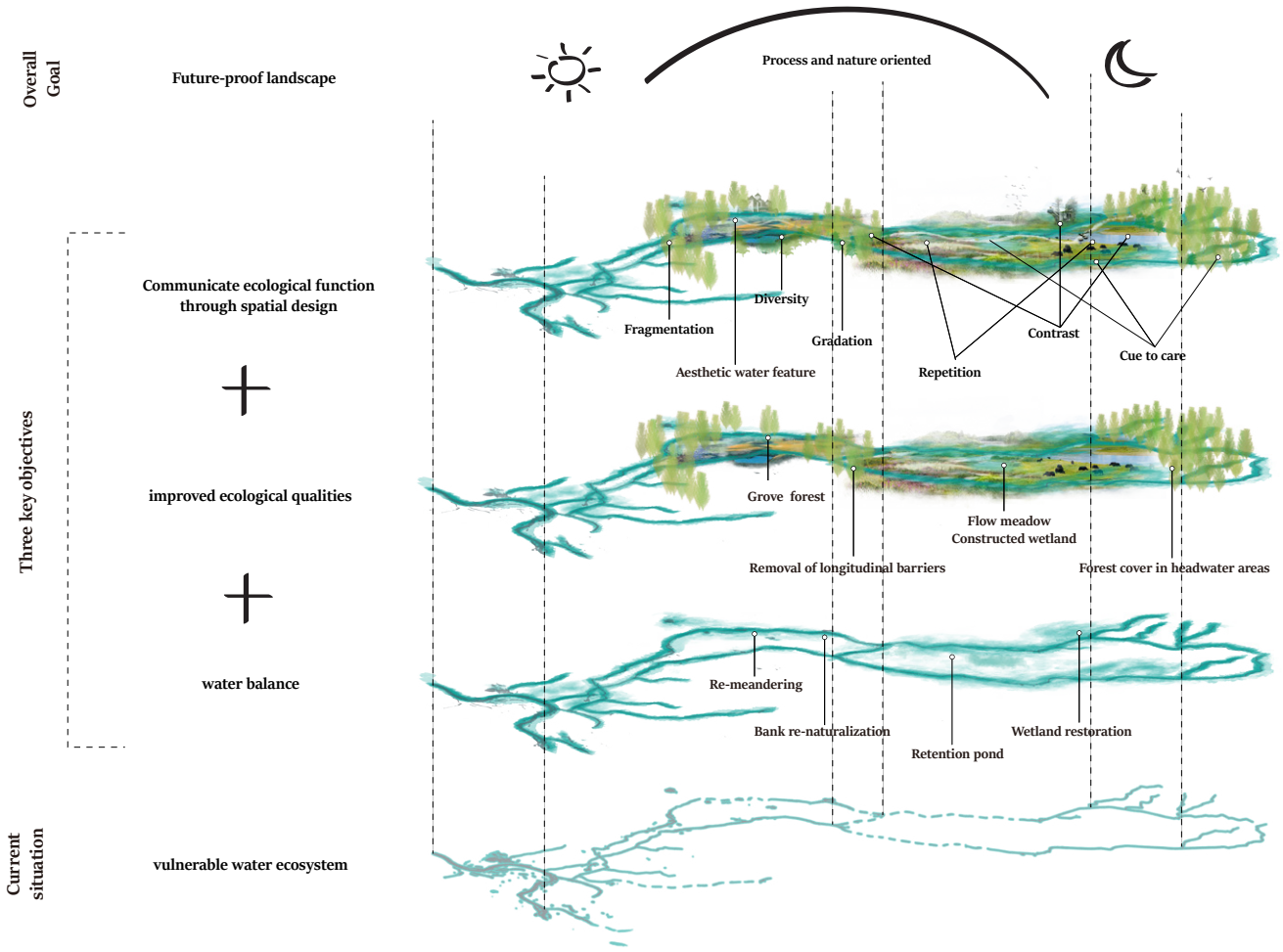


Figure 5.1: Design objectives

5.2 Design strategies

The second step is to generate design strategies for the Baakse beek and find suitable locations to assign landscape ecology principles and spatial design principles in each sub-area. Overall, there are five strategies to implement to achieve the design objectives (figure 5.2). The first strategic plan (figure 5.3) is more water-focused that will contribute to a better-connected and future-proofed blue and green structure across the entire catchment area. Three water-related landscape ecology strategies, stream re-naturalization, water retention, and water purification, are assigned to this plan. The second strategic plan (figure 5.4) emphasizes on strengthen multidimensional spatial experience through adjusting spatial layer and building cultural aesthetics layer on the blue and green structure. The rest two strategies, spatial modification, and cue to care, the area assigned to this plan. Each strategy incorporates several design principles correspondingly. By overlapping these two strategic plans, on one hand, a relatively comprehensive regional vision is reached with every single part of the landscape strongly joined together. On the other hand, the characteristics of each landscape (the terrace-edge landscape, the camp landscape, the peat mining landscape, the sand ridge landscape, and the estate landscape) will be well preserved and even consolidated (figure 5.5), The balance between environment and people, between landscape ecology and spatial perception, will be back on multiscale.

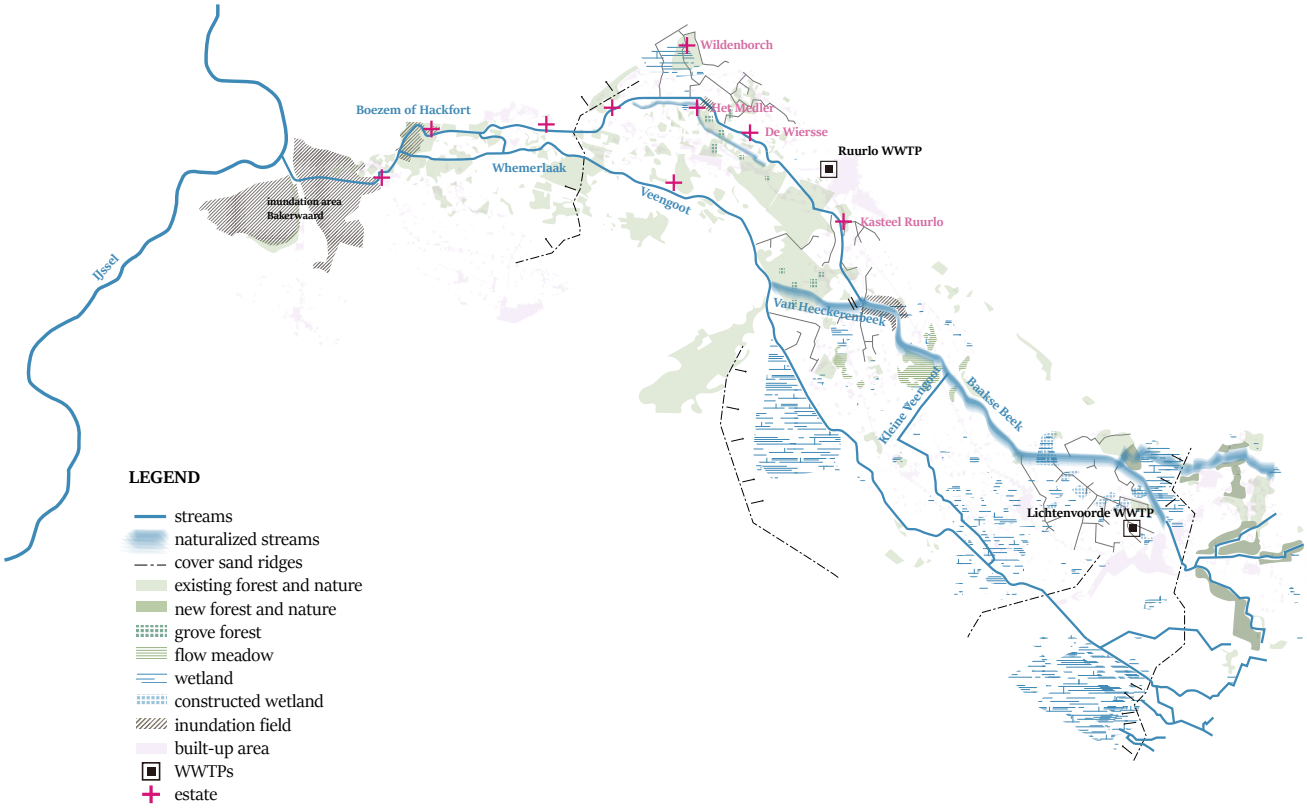


Figure 5.3: Strategic plan on water system restoration

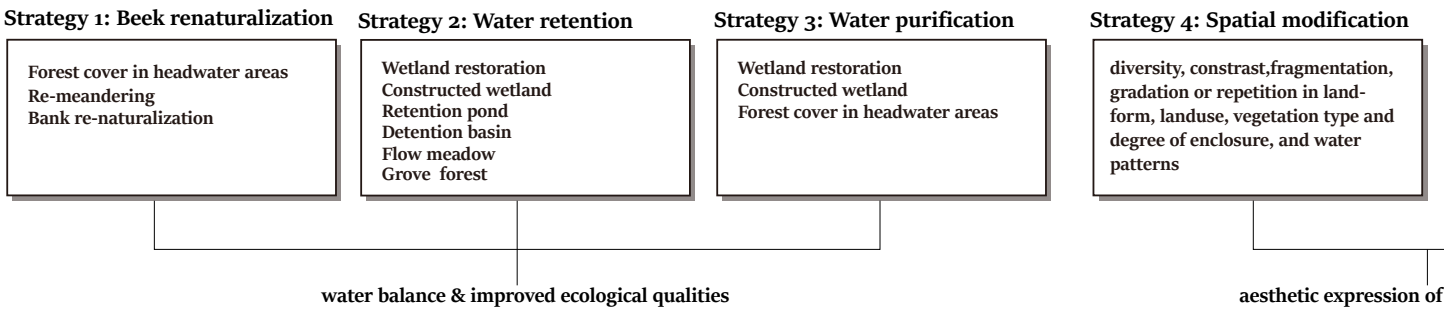


Figure 5.2: five design strategies fomulated by landscape ecology and landscape aesthetics principles

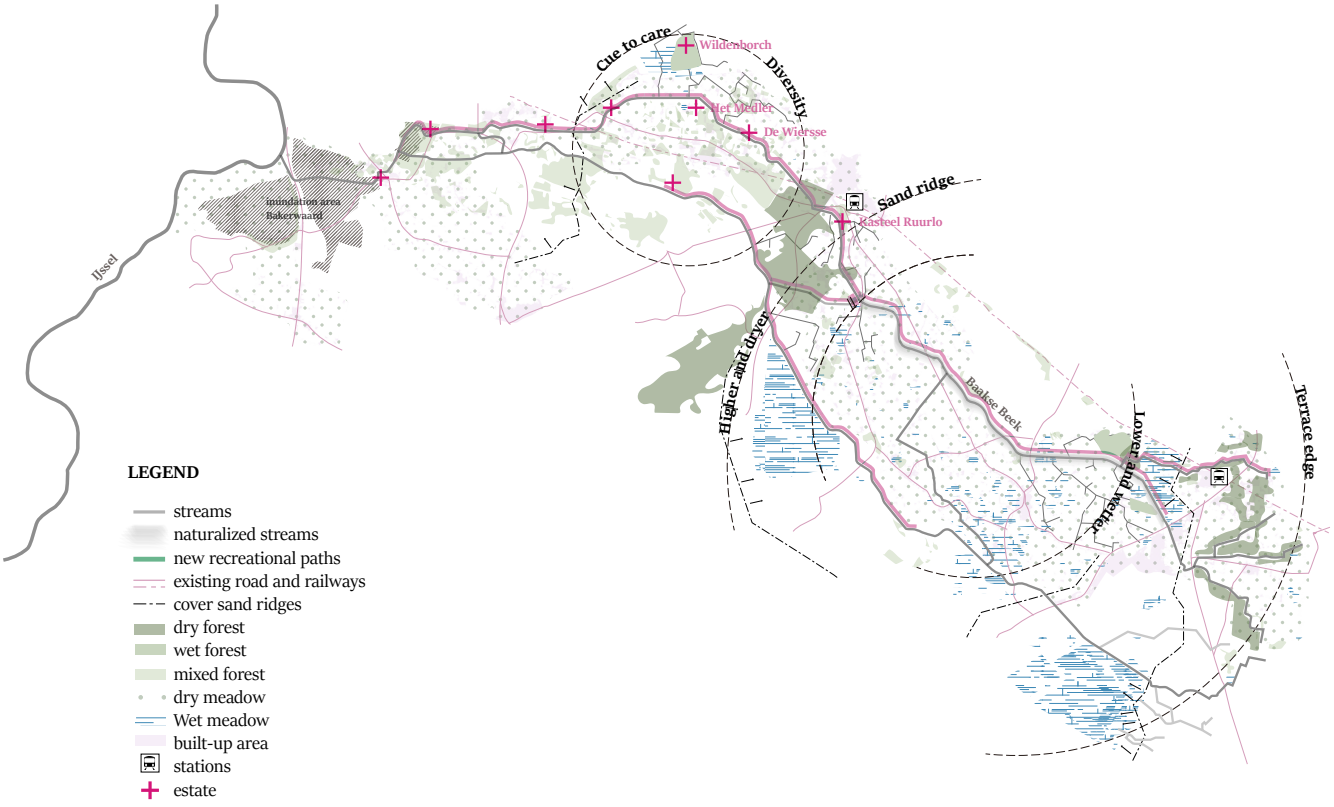
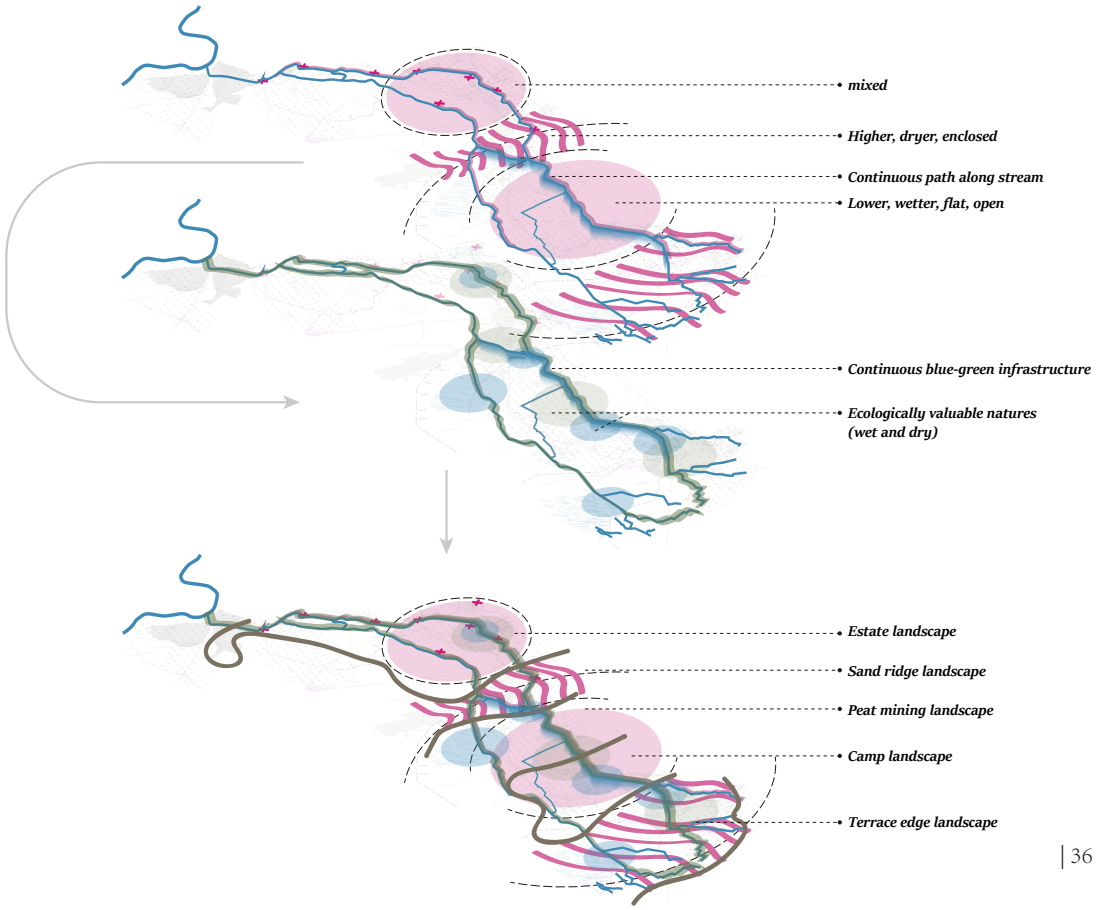


Figure 5.4: Strategic plan on spatial aesthetics experience

Strategy 5: Cue to care

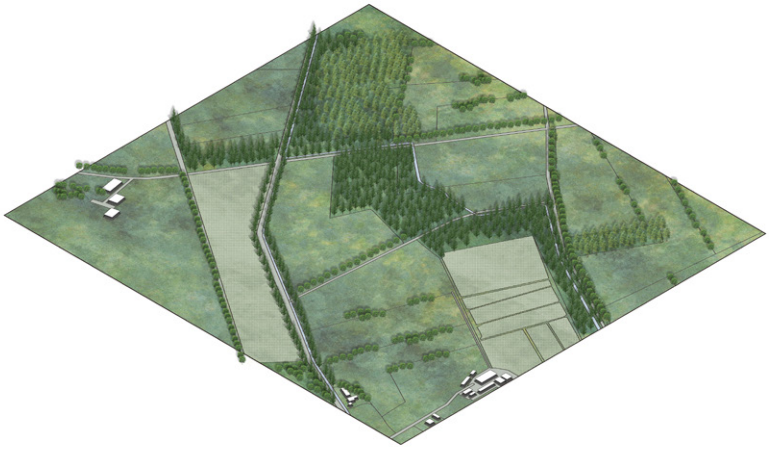
Mowing
Flowering Plants and Trees
Linear Planting Designs
Fences, Architectural Details
Bold clearly Paths

ecological function

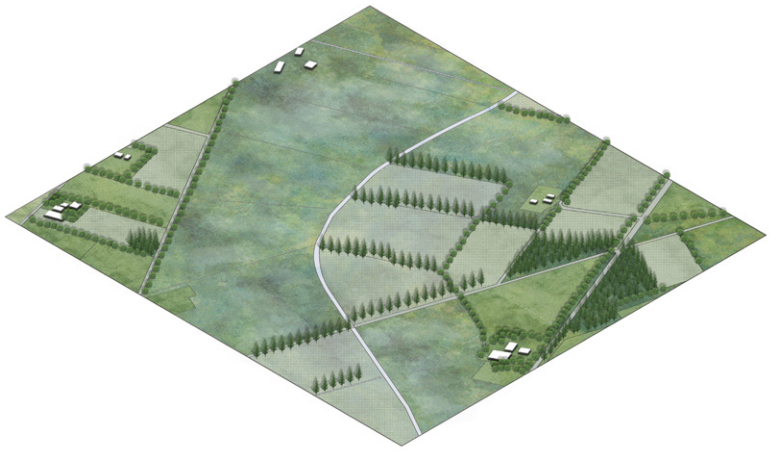


In the terrace-edge landscape, to protect the source water under the risk of being polluted, forest cover ratio in this place is proposed to be higher. Forest will be recognized as a linear pattern along fast water streams that will benefit the water quality, hold water, and at the same time strengthen a feeling of spatial continuity in landscape. Agriculture is suggested to be less chemical fertilizer relied. Some meadows will become wet meadows or wetlands to both retain water in the area and purify polluted water before it runs to downstream or being used in resident areas. This measure could bring back some absent flora and fauna in landscape and also provide people with an experience of spatial diversity.

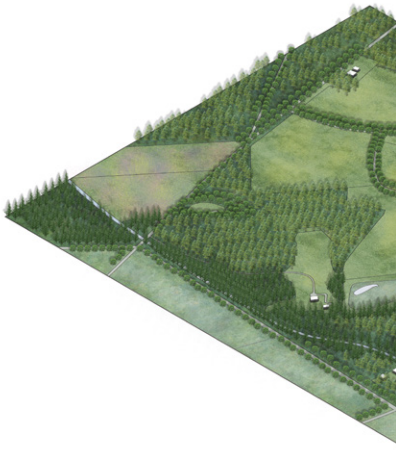
Flat and openness are the two most commonly used words to describe the camp landscape and peat mining landscape. Furthermore, the central basin used to be very wet and spongy before extraction. Hence, the interventions need to bring back the wetness condition in this area as much as possible by taking the historical landscape and topography as a reference, but at the same time, its influence on agricultural production needs to be minimized. Hence, the canalized stream needs to be restored as a wetland stream with meanders and a shallower river bed. Lower lands near the stream can be used as pasture for grazing. Small scale heathland or flora rich meadow will be added to the natural layer of the landscape to improve the biodiversity and ecological connectivity. Trees will be recognized as a linear pattern but in multiple layers to provide a feeling of gradient and continuity in landscape.



Terrace edge landscape



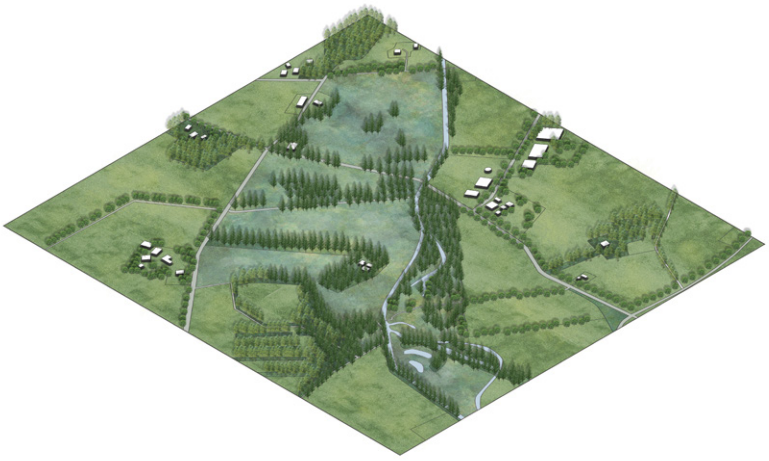
Peat mining landscape



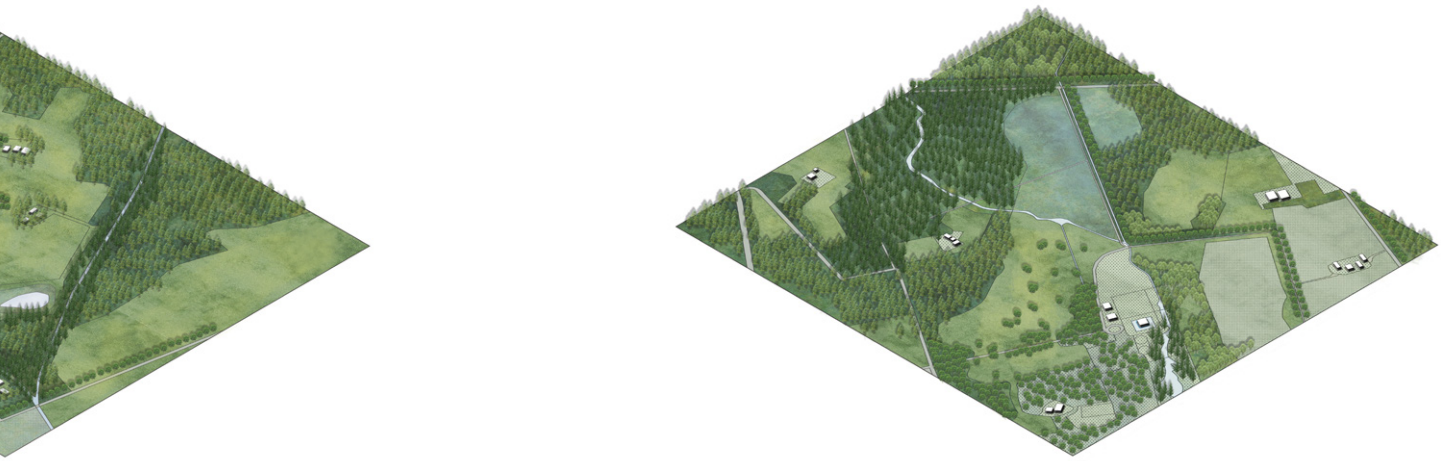
Sand ridge landscape

The sand ridge landscape is the driest and high part in the Baakse beek water basin. The area also has a high forest coverage rate which forms a dramatic contrast between it and the central basin. Since the landscape is already very spatially impressive as a holiday destination, the measure will focus on transfer the temporary stream – Van Heeckerenbeek into a green spillway that is temporarily worked when the levels in the Baakse beek is too high. The levels will be controlled via two weirs on two ends of the stream. Through this, the flow rate and the amount of water run to the downstream will be increased. In its upstream, water also stays longer in the landscape.

In terms of the Estate Landscape, there will be a mixed landscape consist of wet forest, dry forest, grove forest, wet meadow, agriculture, gardens, and the country house. The old stream will be activated with meanders and shallower and wider drain. Spatially, this will be a dramatic contrast between the old stream and the canal. This stream will pass through a large wet forest area and several new marshes but the landscape is less messy comparing to the wetland stream guiding landscape. Since the drainage capacity of the stream in the estate area is limited due to its landscape, additional water features and earthworks will be done in the landscape to enable the beauty of water and the wet landscape is visible and percipient. Intervention in the estate landscape will be explained in detail in the next subchapter.



Camp landscape



Estate landscape

Figure 5.5: the characteristics of each landscape are preserved and even consolidated

5.3 Design in Medler-Wiersse cluster

In the design area, the landscape has been changed greatly due to the intense human activities involving building water structure, productive activities, and creating views from the estate (figure 5.6). More recently, the balance in landscape and water system was broken not only because of the interventions on nature over time but also the changing climate. In previous chapters, this paper introduced the concept of 'ecological aesthetics' to address the gap between landscape ecology and spatial experience, and the necessity to bridge the gap in landscape design. To bring back the balance in the estate area, the landscape is broken down into layers. The design experiment is set up in three stages. In the first stage, two landscape ecology models were built based on three layers, water layer as the basis, vegetation (nature) structure layer as the carrier of ecology, and spatial layer as the consequence of the previous two layers. Two models will be compared and evaluated according to their contributions to water system restoration, ecological function, and spatial quality. The second stage is spatial perception focused. Several spatial design options on path design and placement of cultural-aesthetics elements are provided. They will become an extra layer to add to the ecology model to various possible ways to balance landscape ecology and spatial experience in design. And finally, one design option as the overlap of the ecology model and path and cultural-aesthetics elements will be elaborated in detail.

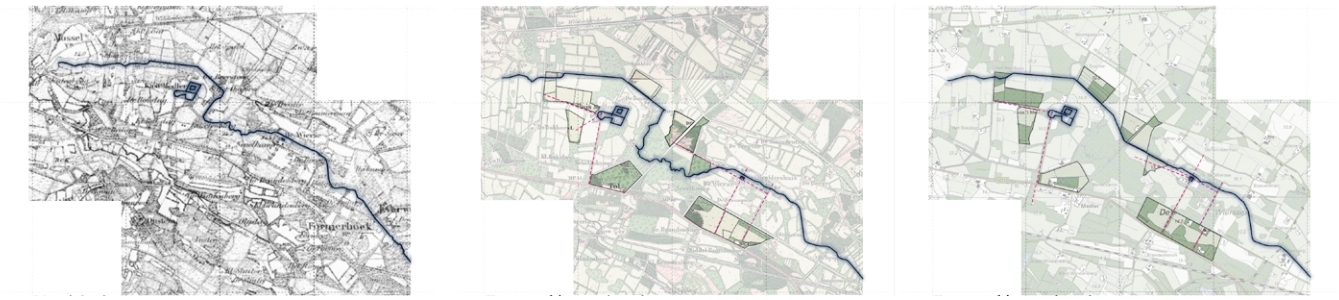


Figure 5.6: Topographic map of Medler-Wiersse cluster in 1850, 1800 and 2019 (changed nature pattern and views from the estate are highlighted)

5.3.1 Site analysis: topography, natural pattern, path system

Landscape in Medler-Wiersse cluster is characterized by an old stream forest interspersed with agriculture, grassland, and some dryer forest in between two estates. Some parts of the area located on small-scale sand ridges are slightly higher and dryer covered by dry meadows, birch, oak, and beech forests. The rest low-lying areas are distributed in the stream valleys of both the old stream and the new canal. Water in these low-lying areas has been discharged to protect the architectures and the agricultural activities from flooding. As a result, very dense ditches are dug in forest and meadow, which is recognized as the rabatten forest and the flow meadow system in the area. The old stream has been replaced by a canalized waterway parallel to it. These changed water patterns are visible on the topographic map and in the landscape today.

In terms of the path system, the current connections are mainly given on north-south directions, which is the direction that the estate gates are facing. Most of the streamside areas are not accessible and fail to provide people with a continuous experience with water along the stream. The large area in-between two estates is not only unreachable but also uninviting due to lack of stopping, meeting, or waiting locations along the path.

Figure 5.7: Current topographic and elevation plan (overlapped)

Figure 5.8: waterways in rabatten forest

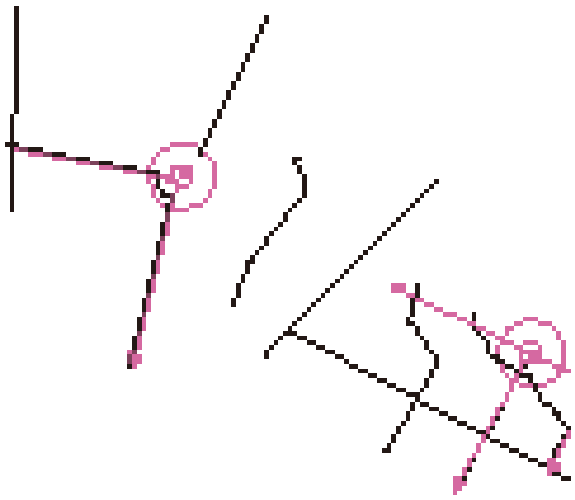


Figure 5.9: Current path system

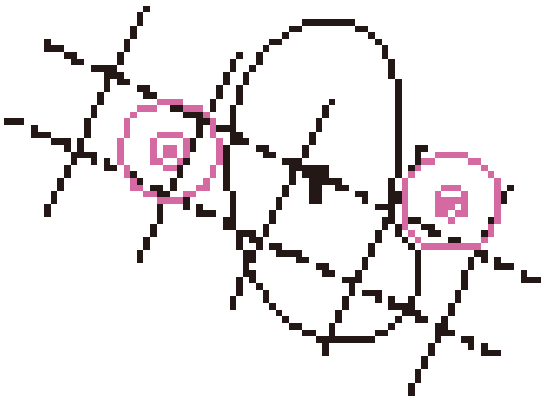


Figure 5.10: The large area in-between two estates are unreachable and uninviting due to a missing linkage on east-west direction and a lack of stopping, meeting or waiting locations along the path.

5.3.2 Landscape ecology models

Landscape ecology model 1: restoration of landscape in the past

Model 1 takes the landscape in the 1850s, which is commonly seemed as the ideal landscape in the Netherlands, as a reference to restore this ideal historical landscape. Historical water pattern is restored by activating the old stream and re-meander the artificial waterway. The spatial layer is adjusted by restoring the erased forest area. The elevation map gives clues to the wetness condition of the soil and decided the vegetation structure of each land parcel.

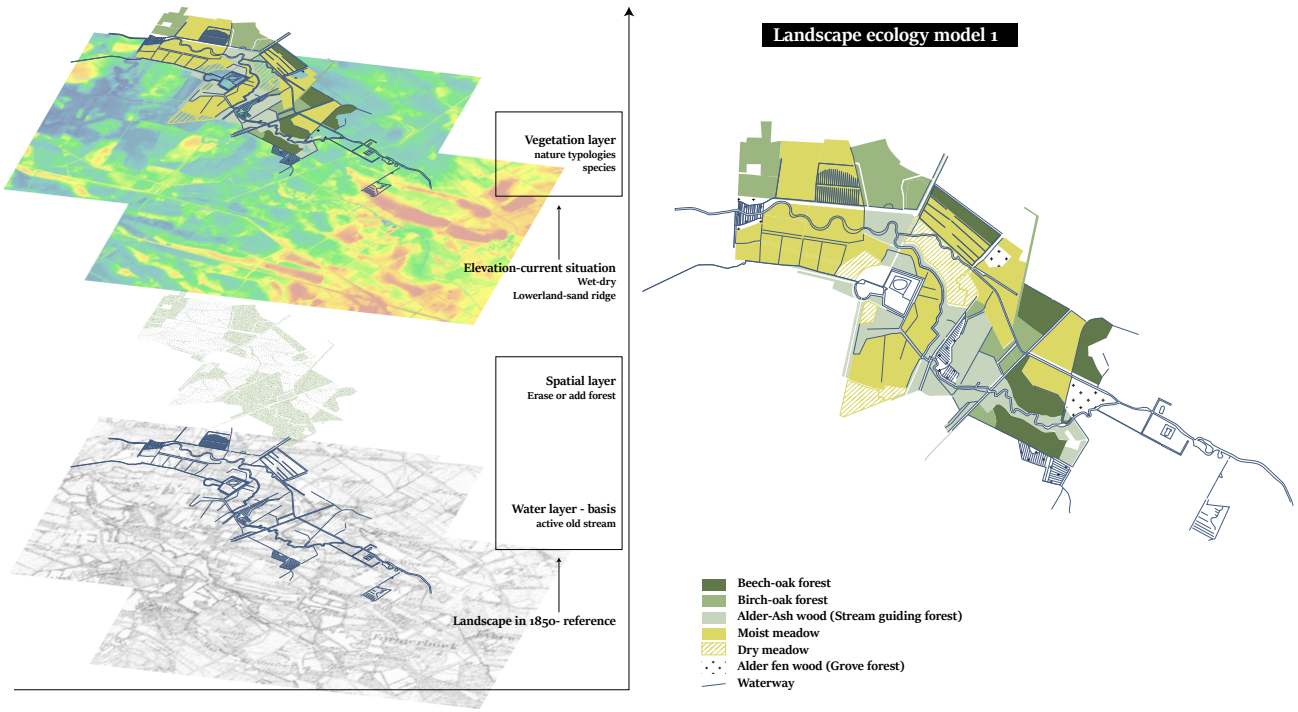


Figure 5.11: Building landscape ecology model 1 by layers based on landscape in 1850 and the current topography.

Landscape ecology model 2: new ecologically valuable natures and water elements

Model 2 is developed in accordance with the Gelder Nature Network plan, which is adding new natures and new functions to the current landscape. In terms of the nature layer, as part of the Gelder Nature Network, the Baakse beek and its streamside will function as a part of the linear corridor connecting diverse ecological valuable natures including wetlands, heathlands, and woodlands in the region. New forests, heathlands, and ecologically valuable agriculture fields will be added to the current green system to develop a diverse and better-connected nature network.

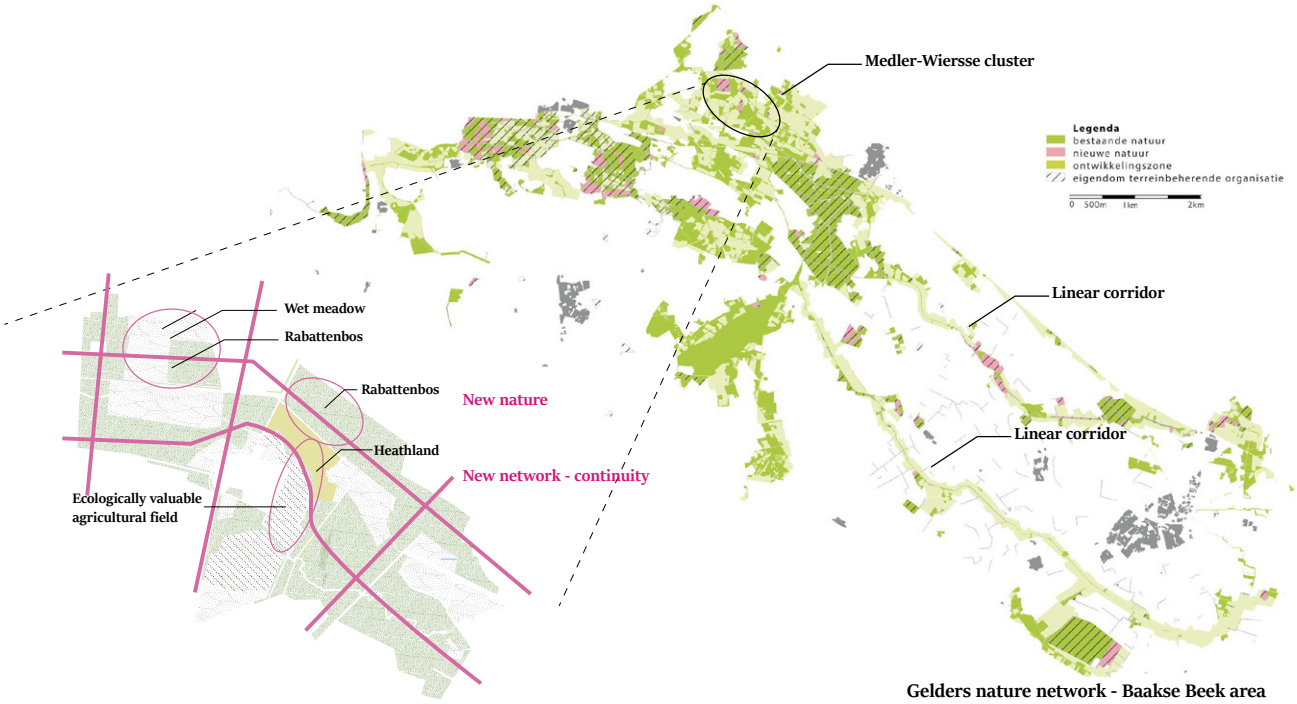


Figure 5.12: Adding new natures in accordance with the Gelder Nature Network plan

The goal of the water system design is to bring back wetness as much as possible through raise the groundwater level, and if possible to inundate the fields during a certain period of the year, so water will present above the ground in landscapes. The ground level of the area needs to be lower than the water level in the stream to enable the water could flow into the field from a higher point. By checking the water level and ground level of the low-lying fields and the current stream (figure 5.13 and 5.14), three areas are recognized as the most feasible to be inundated with a level of 12.9 (figure 5.16). Water from the upstream near the estate Wiersse with a level of 13.9 could feed these fields. The goal of improving water quality is also achieved by placing constructed wetlands in low-lying areas.

	Weir	high water level (m+NAP)	low water level (m+NAP)
a	Wiersse t Medler M	11.9	11.5
b	Stuw Medler	12.1	12.1
c	Wiersse t Medler C	12.5	12.2
d	Wiersse t Medler K	12.7	12.3
e	Wiersse t Medler L	12.8	12.3
g	Wiersse t Medler I	13.3	13.0

Figure 5.13: Average water levels at monitoring point (weirs)

(Source: Waterschap Rijn en Ijssel, 2019)

	ground level(m)	current groundwater level(high/low) (m-mv)
1	12.5	0.25-0.4/0.8-1.2
2	12.6	0.25-0.4/0.8-1.2
3	12.7	0.25-0.4/0.8-1.2
4	12.9	0.25-0.4/0.8-1.2
5	12.9	0.25-0.4/0.8-1.2
6	12.9	0.25-0.4/0.8-1.2
7	13.4	0.25-0.4/0.8-1.2
8	13.0	0.4-0.8/1.2-1.8

Figure 5.14: Levels of the low-lying areas in stream valley

Figure 5.15: low-lying areas in the design area

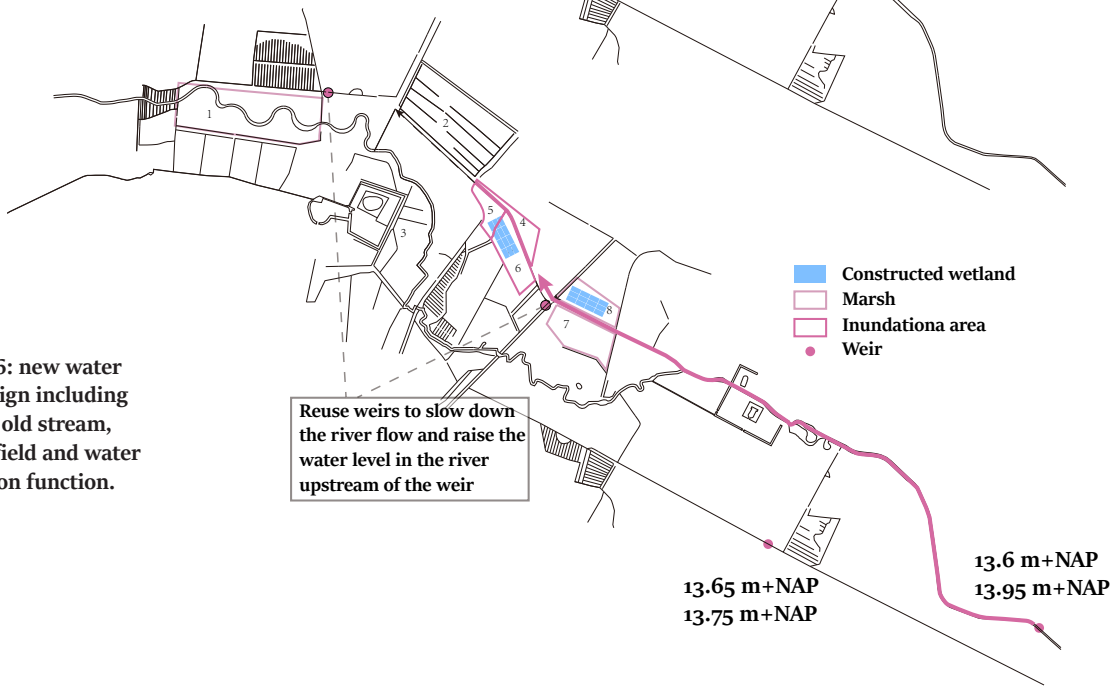


Figure 5.16: new water system design including activated old stream, inundation field and water purification function.

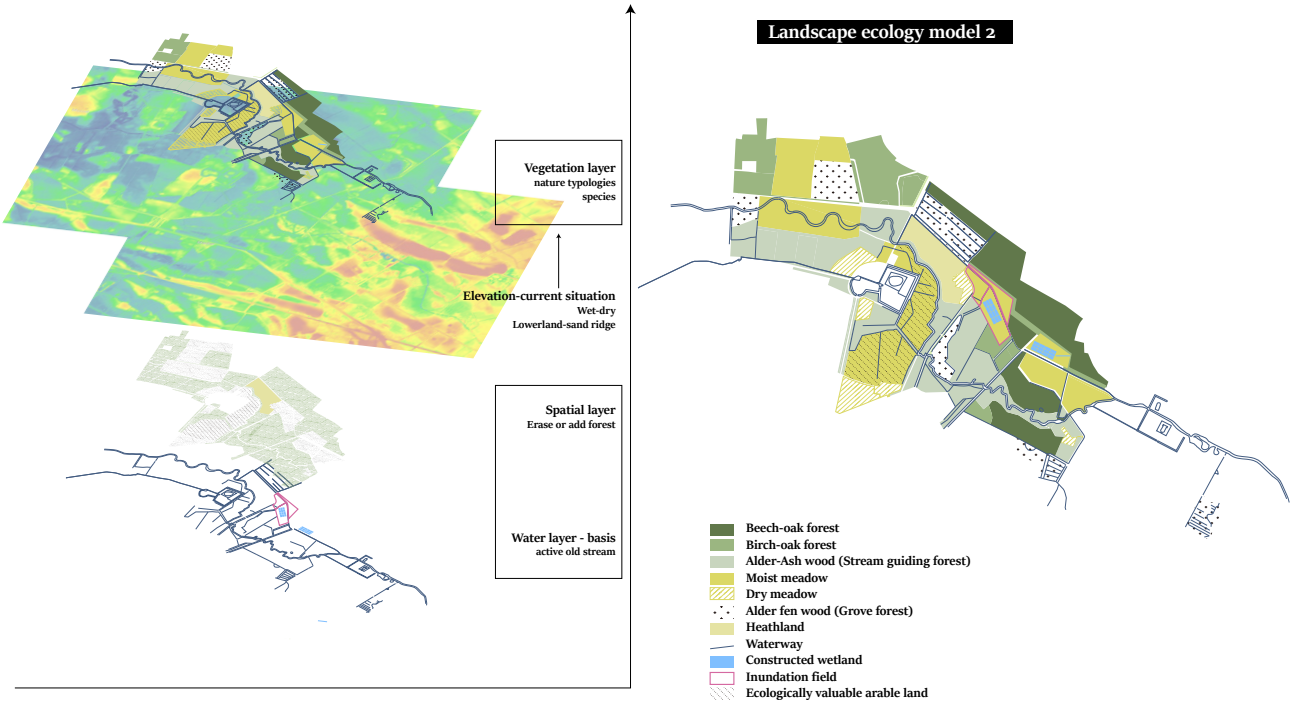


Figure 5.17: Building landscape ecology model 2 by layers

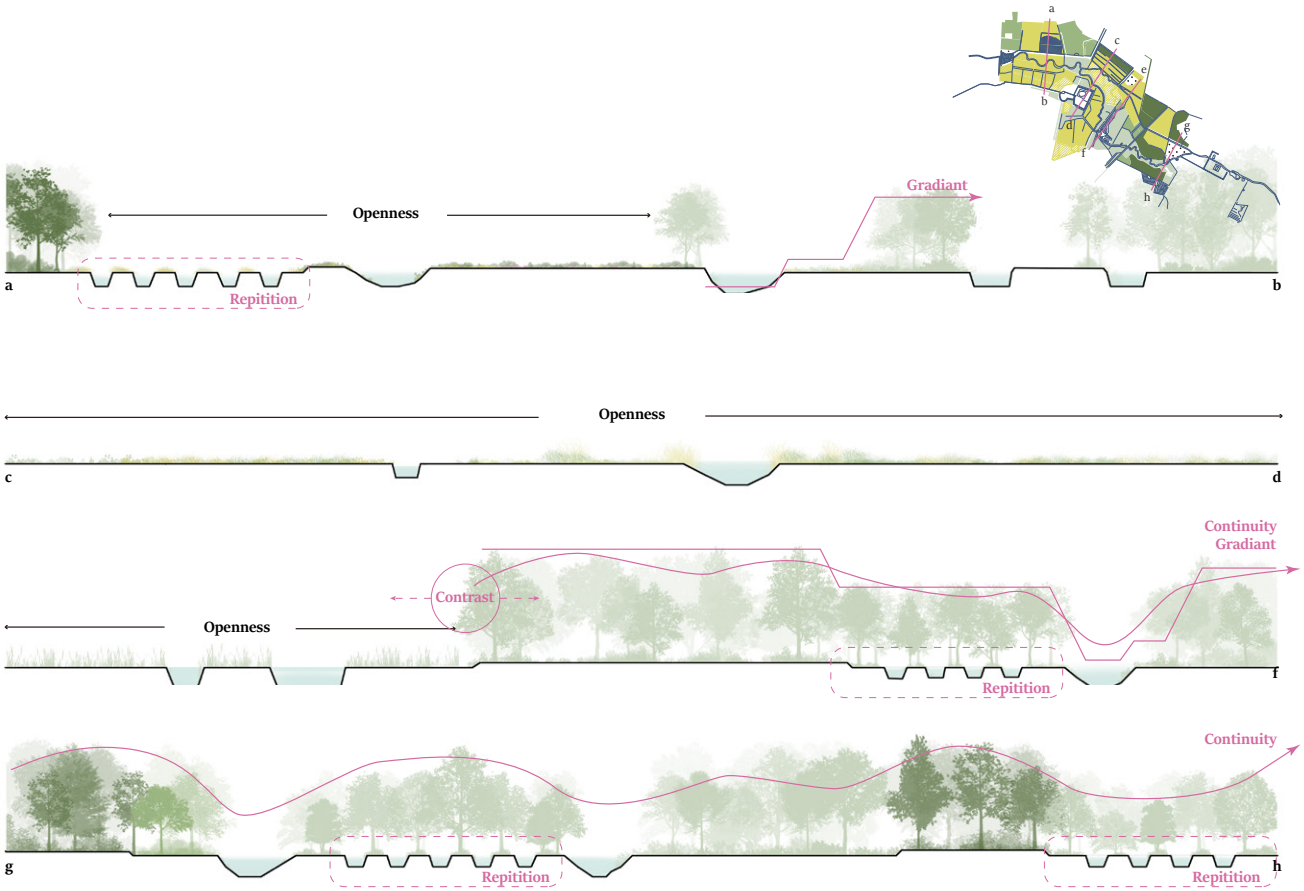


Figure 5.18: Landscape ecology model 1 - spatial consequence

Evaluation and selection between two models

Two landscape ecology models are compared and evaluated according to their contributions to water system restoration, ecological function, and spatial quality. These indicators for evaluation have a strong relevance with the principles and the design goals that have been explained in the previous chapters. Overall, both ecology models provide relatively eco-friendlier and more climate-compatible future scenarios for the site. Inundation fields allow model 2 to provide more space for water in the landscape. The idea of constructed wetland endows the traditional wetland with additional roles for improved water quality. Whereas, water might stay longer and flows slower in the area in model 1 because the canal is also naturalized apart from activating the old stream. The ecology network in model 1 is less connected and diverse comparing to that in model 2. This is a drawback of the landscape in 1850 when many forests or ecologically valuable nature has already been erased for agricultural or recreational purposes. Finally, in terms of the spatial consequences of these two models, it is hard to compare the pros and cons since one's feeling of the space is very subjective. Model 2 might contain a stronger feeling of diversity, contrast, and gradient due to a wider range of nature types are included in this model. To sum up, model 2 performs slightly better than model 1 in this comparison study and it will be taken as the basis for path network, and cultural-aesthetics element design.

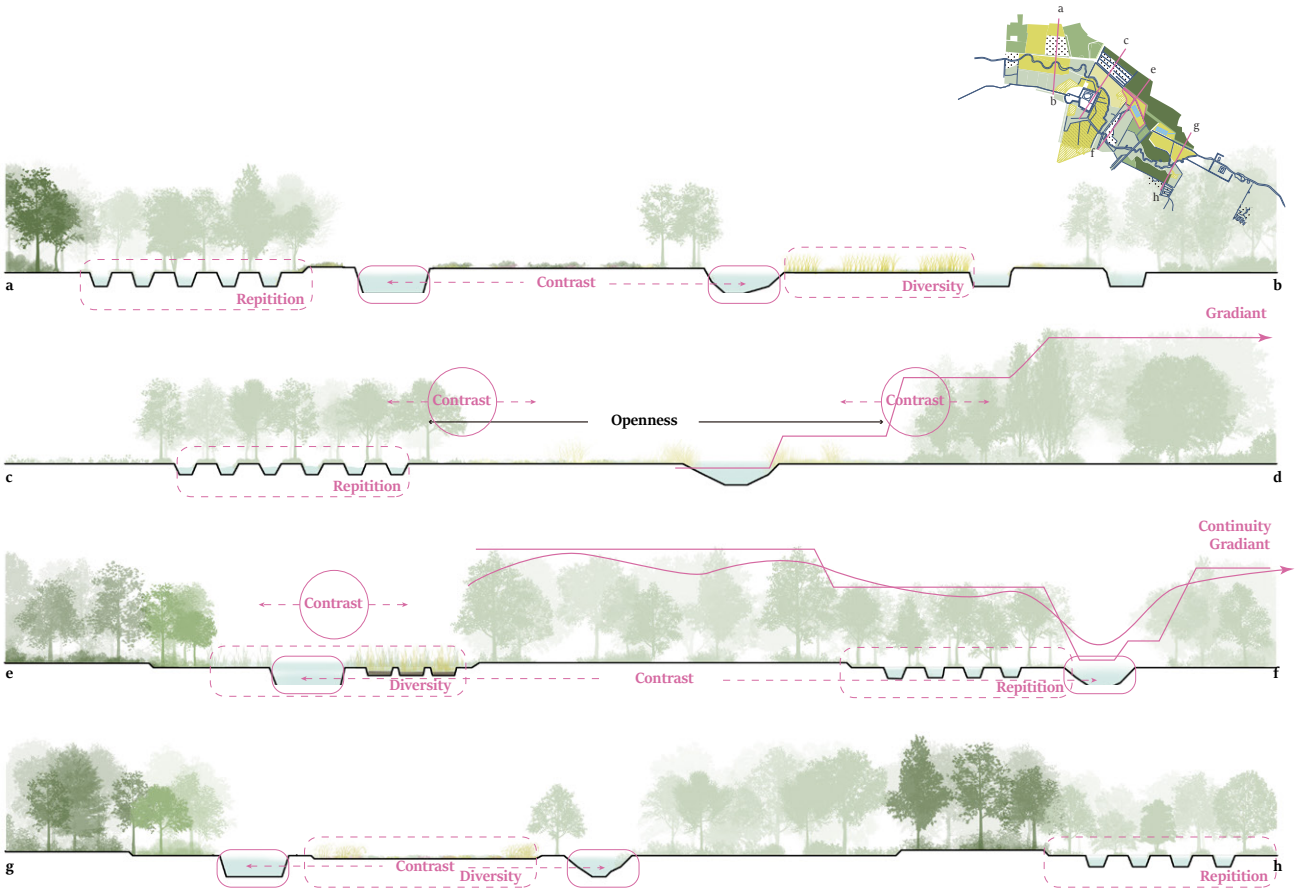


Figure 5.19: Landscape ecology model 2 - spatial consequence

Figure 5.20: Two landscape ecology models are compared and evaluated according to their contributions to water system restoration, ecological function and spatial quality.

5.3.3 Spatial experience design options

The current connections are mainly given in north-south directions. The large area in-between two estates is not only unreachable but also uninviting due to lack of stopping, meeting, or waiting locations along the path. This sector will provide different path and cultural-aesthetics design options to help build a spatial design layer on the ecology model 2. Comparing to what is done in landscape ecology models, the aim does not lie in comparing the pros and cons of each design option, but in regarding them as design principles to test multiple ways for organizing different types of paths and node design in one design.

There are two ways to organize paths (figure 5.21). Type 1 provides direct access from A to B that could give a feeling of coherence and orderly when moving between to destinations. On contrary, type 2 offers opportunities for a slower meandering exploration of the landscape. This contains anesthetics that appreciate the transaction of complex and mysterious.

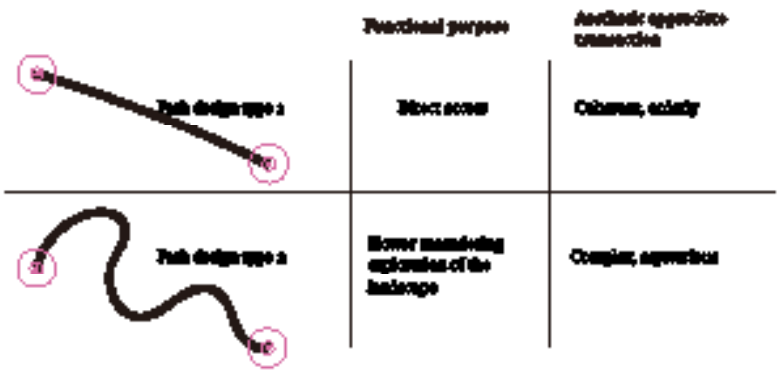


Figure 5.21: two ways to organize path

Cultural-aesthetics elements (figure 5.22) includes viewing points like the watchtower, bridge and platform. They are nodes for stopping or meeting. These elements could also be in forms of representative water elements like a pond or a fountain. They are attractors and more importantly the communicator of the cultural and ecology quality in landscape. They could also be in form of planting elements. Plants in rows could create paths and a beautiful single tree or group of trees could be a foci in landscape themselves.

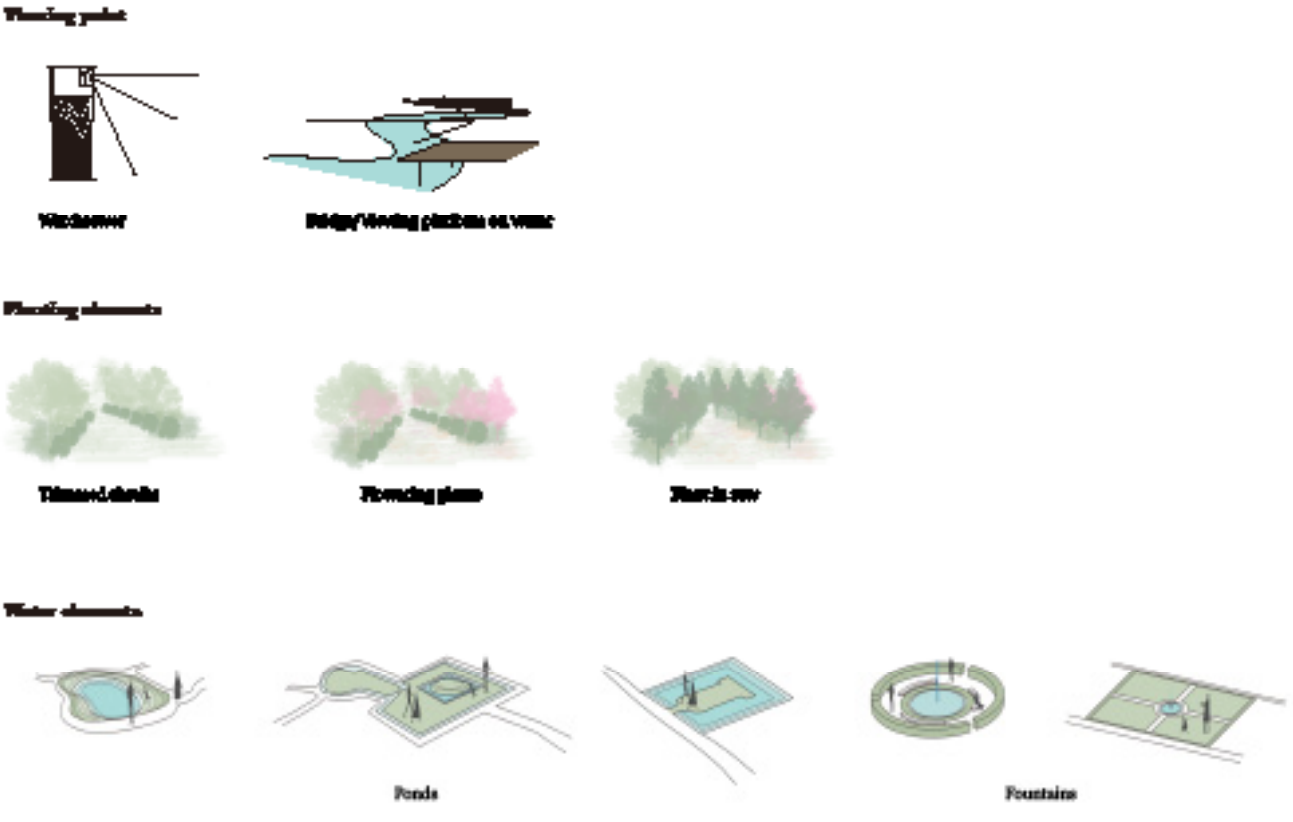


Figure 5.22: Selected elements

Six possible ways to place these landscape aesthetics elements are proposed. They provides quite different relationships between these elements and path or sometimes the stream (figure 5.23).

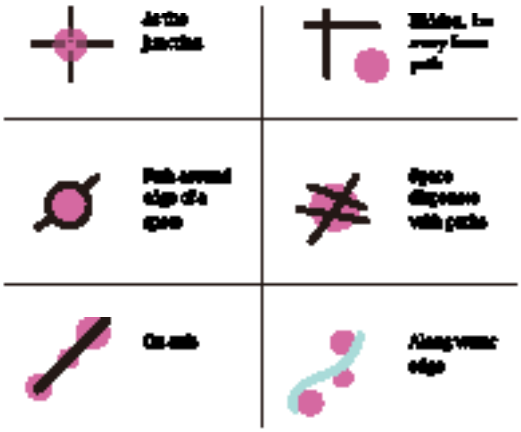


Figure 5.23: six ways to placing cultural-aesthetics elements

In accordance with these principles, two possible spatial design options are proposed and overlapped on ecology model 2 (figure 5.24).

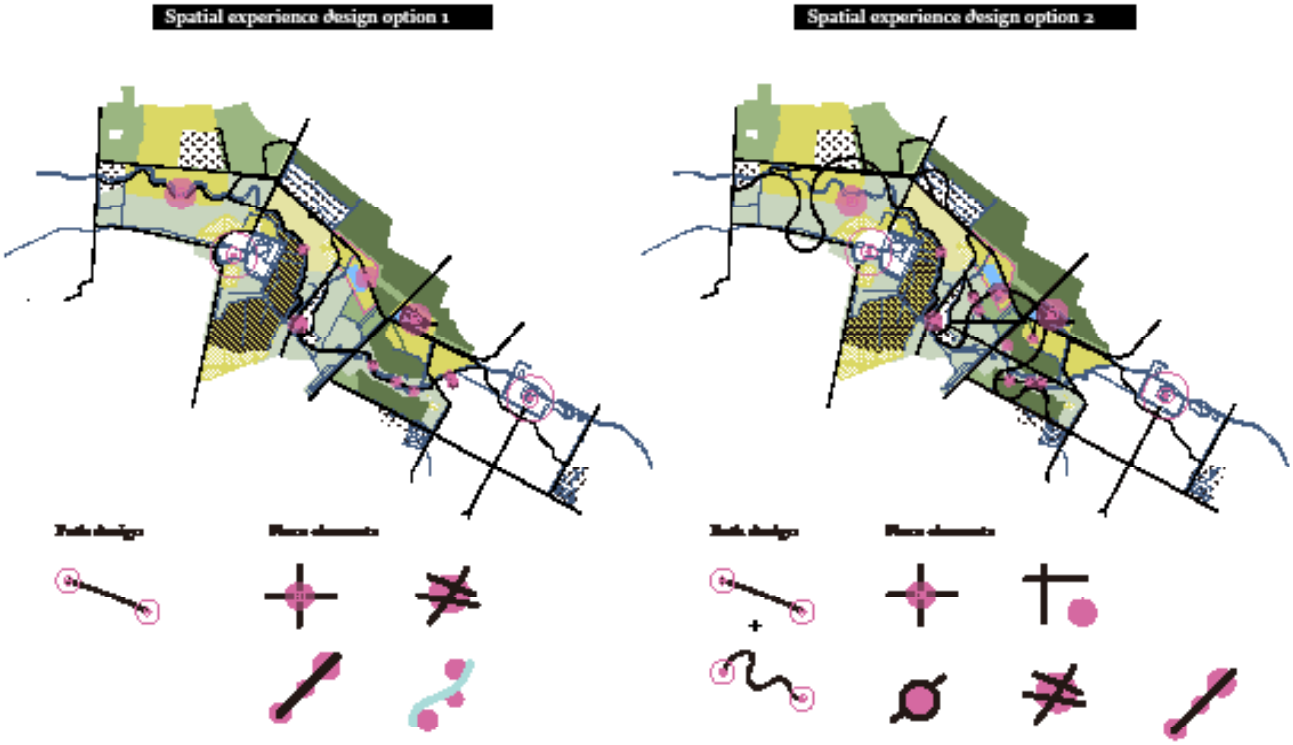


Figure 5.24: Spatial experience design options

5.4 Detailed design

5.4.1 Vision

This vision shows one option for design in Medler-Wiersse cluster. It takes the landscape ecology model 2 as the basis, testing one possible way to organise path and cultural-aesthetics elements in the landscape and to see the consequences of combination. This design will be elaborated by five strategies: stream re-naturalisation, bring back wetness, water purification, spatial modification, and cue to care. The first three strategies match the design in ecology model 2. Spatial modification is mainly achieved through the path and view design. Cue to care discusses the delivery of certain cultural-aesthetics elements to communicate landscape ecology and human spatial perceptions in the landscape. This sector is inextricably linked with the design with paths and views.


b
b'
c
c'
d'
d
N
0
100
300
500m

5.4.2 Stream re-naturalisation

Following the first strategy, Two interventions are taken to the stream. One is to create some new meanders, the other is to activate the old stream. To step further, the streamside is naturalized as much as possible and the continuity of the streamside experiences is also improved through four types of streamside design:

Type one is the open streamside characterized by open flat marshy area with a few trees planted.

Type two is the open streamside with tree in rows. The open heathland could be seem behind the trees through space in between.

Type three is the single side enclosed one with the agricultural landscape on one side and the forest on the other.

Type four is the enclosed streamside in the woodland.

Figure 5.26: Single side enclosed streamside

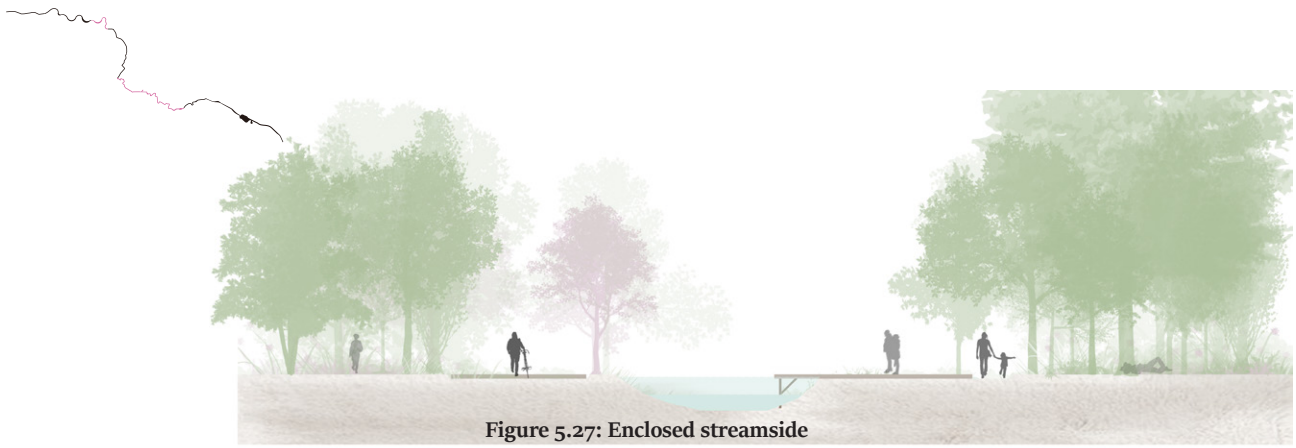


Figure 5.27: Enclosed streamside

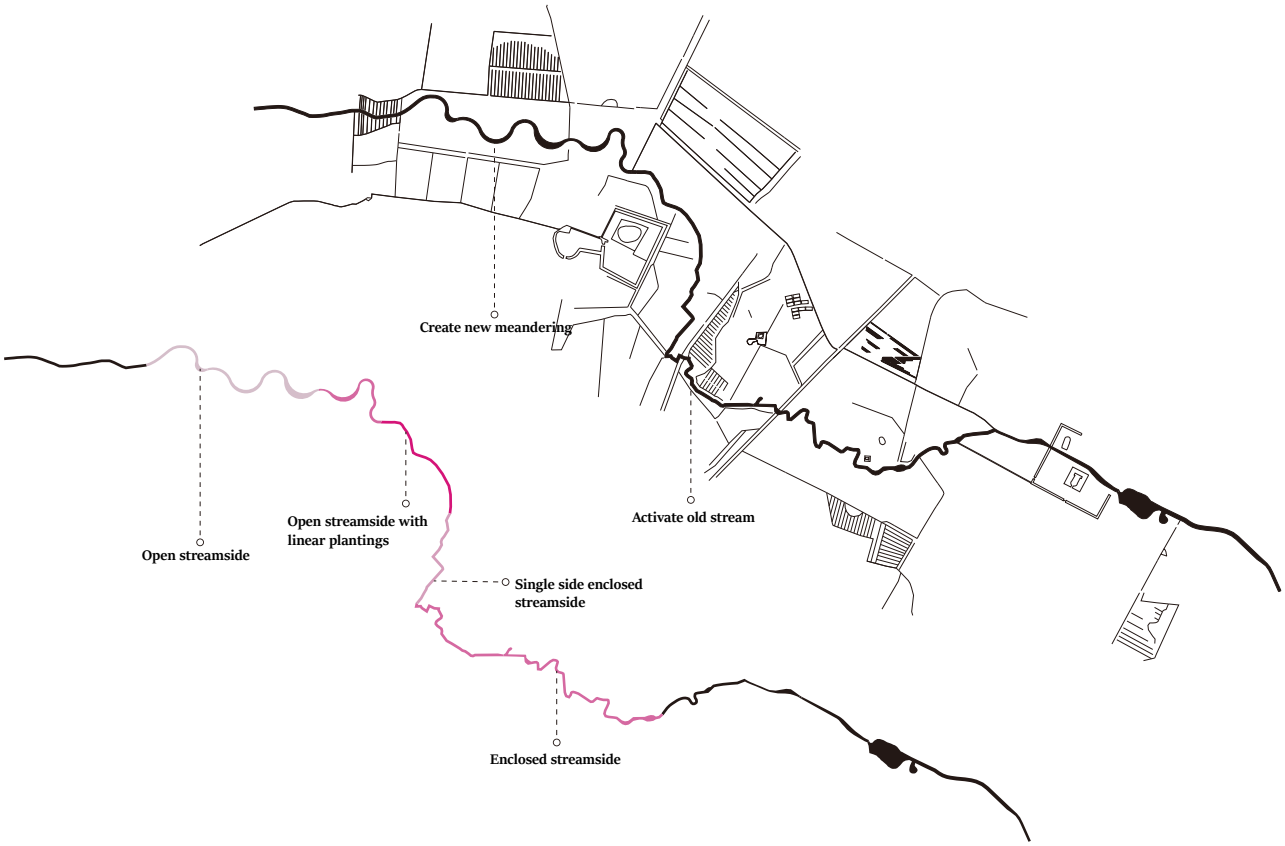


Figure 5.25: Naturalized stream with four types of streamsides

Figure 5.28: Open streamside

Figure 5.29: Open streamside with linear planting

5.4.3 Bring back wetness

The plan shows the areas have the capacity to retain water. These areas include the grove forest, swamp, marsh, and inundation field. Based on landscape ecology model 2, area 2,3,4 are inundated. Water could flow from a higher point with levels of around 14 to these three fields. Water could be seen above the ground level when the groundwater level is higher in wet seasons. Groundwater levels are also raised in area 1,5,6, which means these areas will become more marshy and spongy.

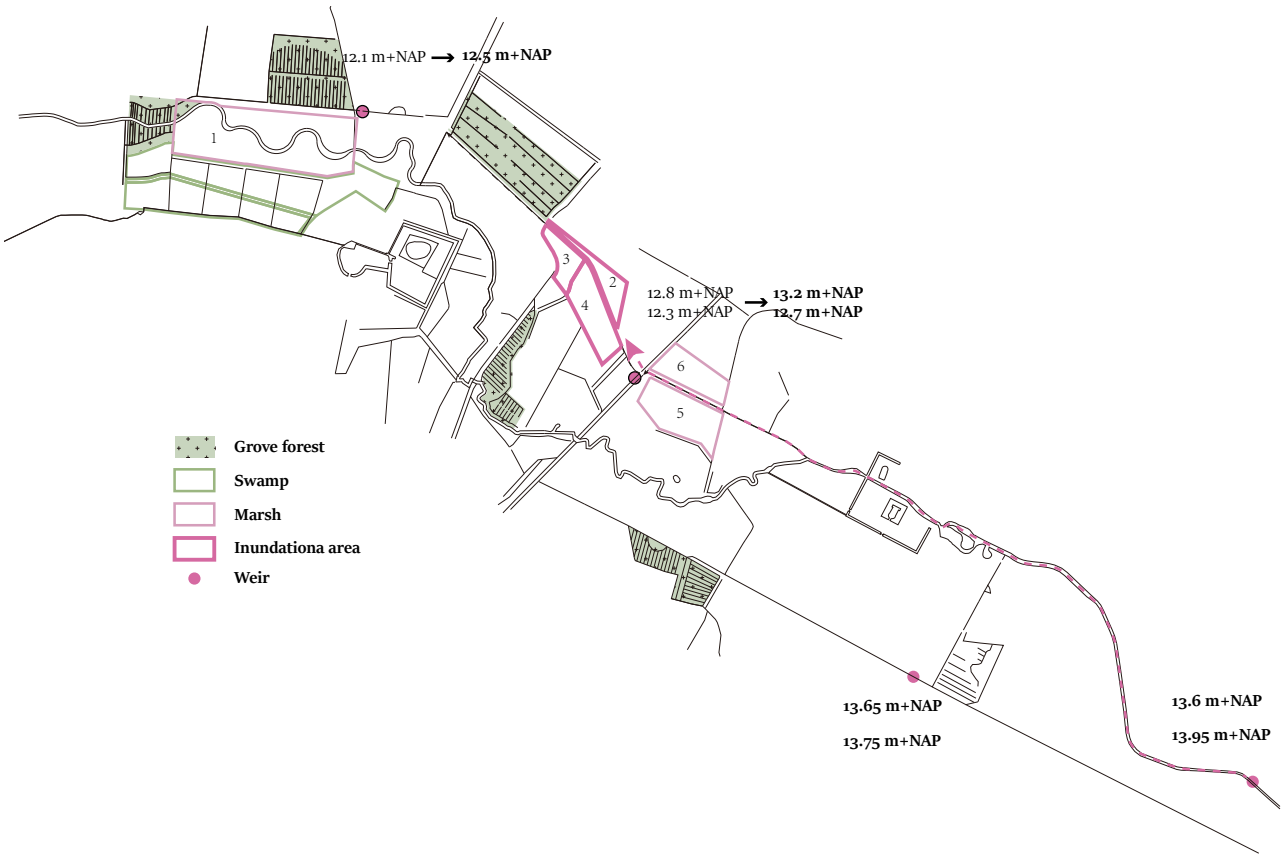


Figure 5.30: wetness restoration meatures in water system

5.4.4 Water purification

The design will help regain the water quality before it is brought back to the system. The following diagram shows the process of how nature water will be collected, transferred, used, purified, and brought back to the circuit. During peak discharges, extra water from the stream will be stored in the inundation field. The outflow the water in inundation fields will be controlled and directed to the arable land near estate Medler. After the water is used for irrigation, the polluted water is transferred to two places to purify. One is characterized as several constructed wetland tanks installed in the inundation field. The other is a combination of the reed purification system and the flow meadow system. Water could be stored, purified, and drained through a series of newly-dug ditches. These wetlands would also serve as cultural-aesthetics design elements in the landscape, which will be further elaborated in sections and drawings on the next pages.

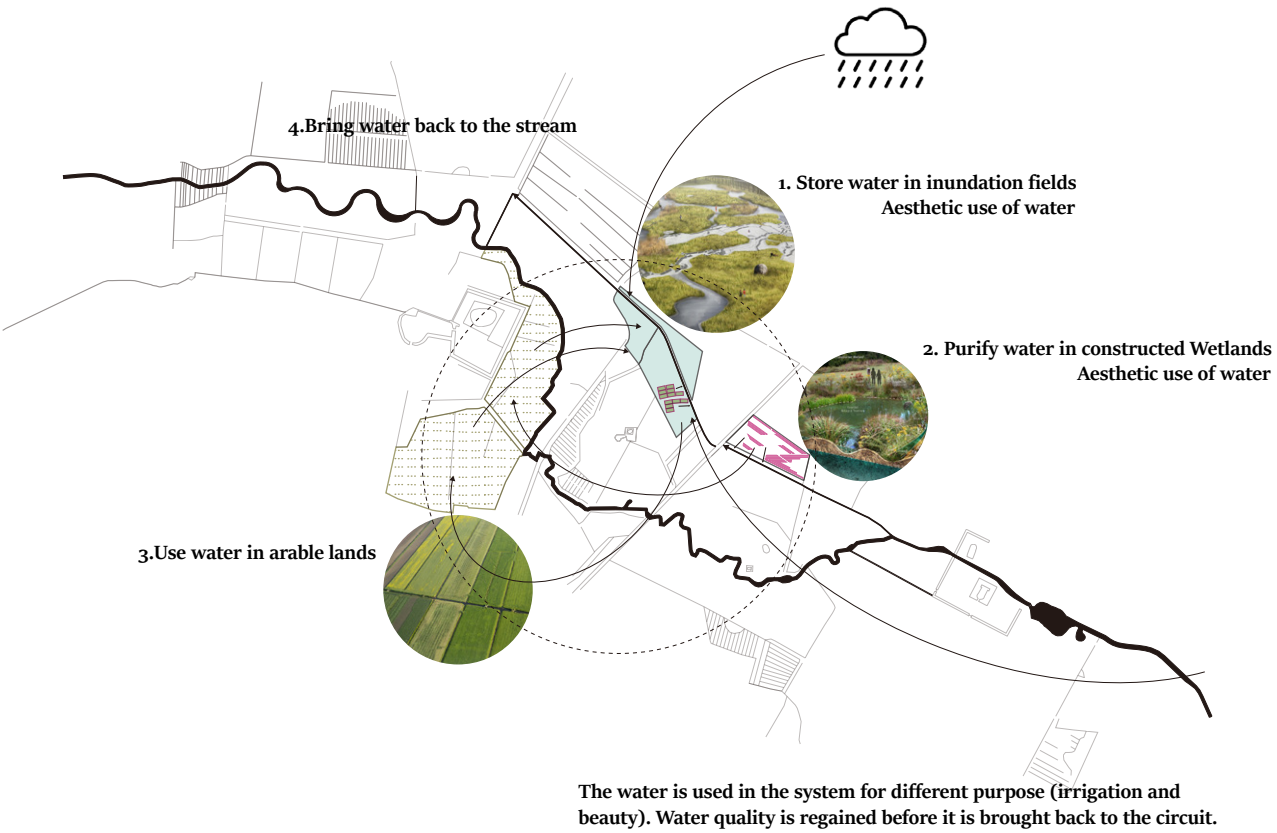


Figure 5.31: Water purification circuit

People tend to regard the rabatten forest as an uninviting place because there is no human path, it is dark and wet and there for messy in the forest. By design with water, ecology, and spatial experience, in the rabatten forest (figure 5,32 and 5,33), water could flow out when peak discharge but also partly retained in the ditches to create wetness conditions in the soil and the landscape. A human path is added to this forest landscape to make the trees as well as the water feature more accessible. The wet forest Flowering ground covers might eliminate the image of messy and wild in the forest. Rows of trees give a feeling of order and careful maintenance when walking in the forest.

Rabatten forest

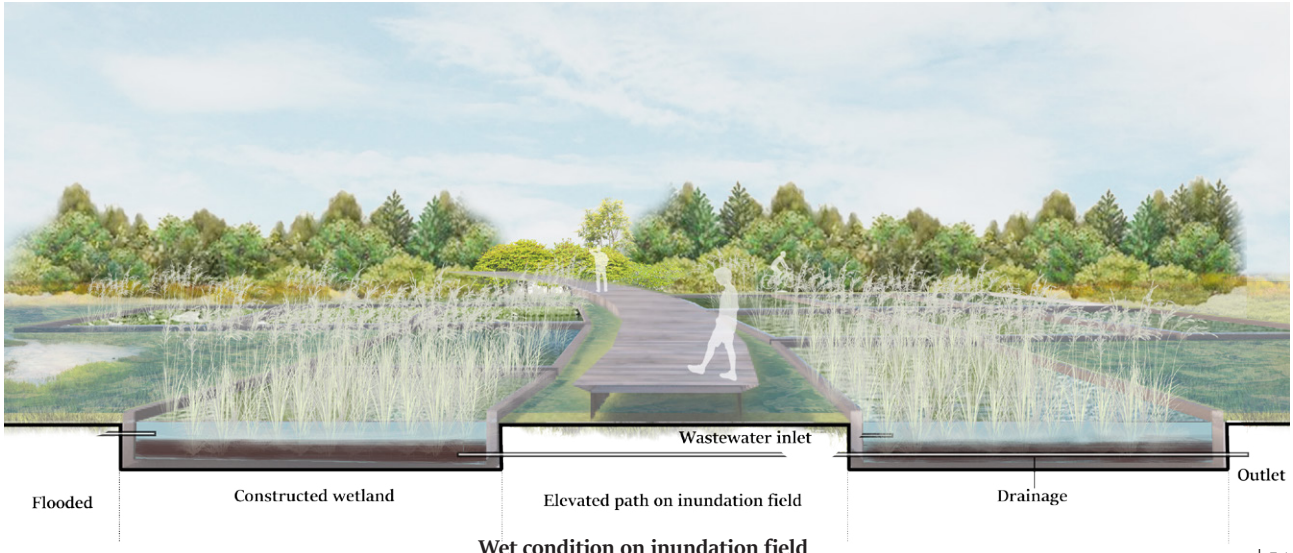
Figure 5.32: section of rabattenbos restoration

Figure 5.33: spatial experience in rabattenbos

In the inundation fields, the function of water retention and purification are joint together. Figure 5.34 shows the dry and wet conditions in the inundation field and the constructed wetland. The spatial experience in these two conditions is slightly different also the landscape is flat and open at any time of the year. In dry seasons, the meadow is accessible by visitors to see and to feel the flowers, grazing activities, and how wastewater is purified in reed tanks. In wet seasons when the area is full of water, people could walk through the wetland by the elevated path. This design on one hand enables the interaction between people and water, on the other hand, prevents people from getting wet.

Inundation field + constructed wetland

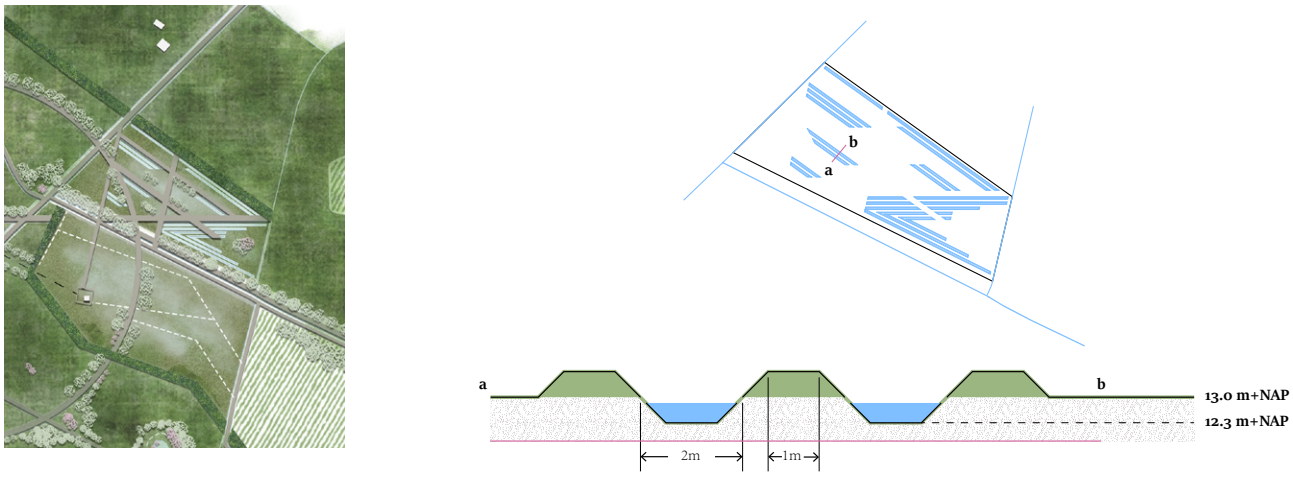
Dry condition on inundation field



Wet condition on inundation field

Figure 5.34: views from the elevated path on an inundation field with constructed wetland tanks installed

Some earthworks are done in the wet meadow, so part of the field will have a 0.7m lower ground level to ensure the water from the stream could flow into, and the water could be present in the landscape. The function of purification is also assigned to this landscape and people could walk along these ditches on a small dike (figure 5.35).



Flow meadow + constructed wetland

Figure 5.35: views from a flow meadow with water purification and aesthetics function

5.4.5 Spatial modification

Spatial modification is made through the path and view design. New paths will re-define the relationship between water, nature, and landscape. There are two ways to organise the path. Their functional purpose and aesthetics appreciate transaction has been explained in the early sectors of this chapter. In this design, these two path patterns are organized together to provide a feeling of complexity and mystery when exploring in the landscape but to deliver feelings of coherence and openness, especially when walking along the stream (figure 5.36). Two visual connections and some water feature in the forest to give a hint of the link between the estate and its hinterland (figure 5.37). Design with cultural-aesthetics elements is inextricably linked with the design with paths in terms of their physical relationship to the path. The principles of placing these cultural-aesthetics elements have already been introduced in 'spatial design options'. They will be further elaborated in strategy 'cue to care'.

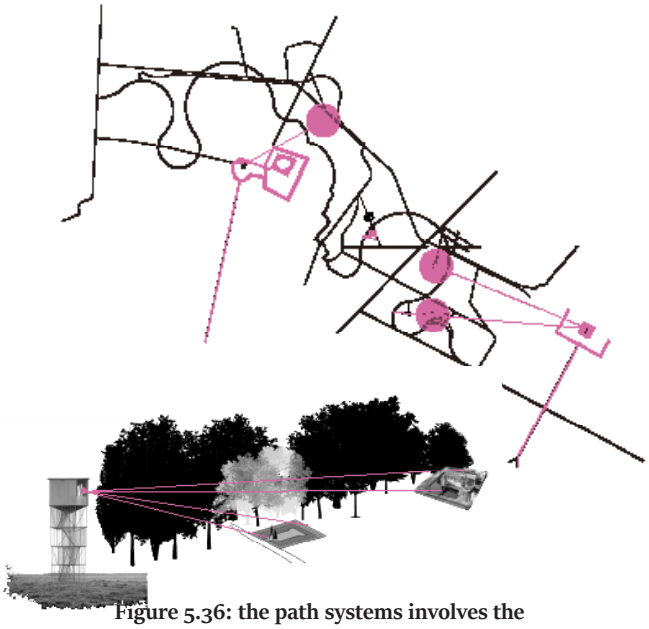


Figure 5.36: the path systems involves the organisation of two different types of paths

Figure 5.37: Visual connections from watchtower to the estate

Figure 5.38: watchtower in wet meadow, views from the ground and the tower

Figure 5.39: watchtower in dry meadow, views from the ground and the tower

Figure 5.40: watchtower in stream forest, views from the ground and the tower

Three watchtowers are placed on the site. One is on the dry meadow along the human path, the other is on the wet meadow but hidden in the landscape. The third one is placed in the forest. The views form the tower also differs (figure 5.38, 5.39 and 5.40).

The spatial layout of this design is largely fixed following the landscape ecology model 2 (figure 5.41). A selection of vegetation species in different types of nature is made (figure 5.42). These natures involve beech-oak forest, birch-oak forest, heathland, arable land, alder-ash wood (stream guiding forest), moist meadow, dry meadow, and alder fen wood (grove forest). Within each nature type, local species ranging from ground cover, shrub to the canopy are carefully selected according to their size, color, or texture. The human spatial experience has rearranged in a certain order considering the repetition, gradient, and diversity of the vegetation pattern.

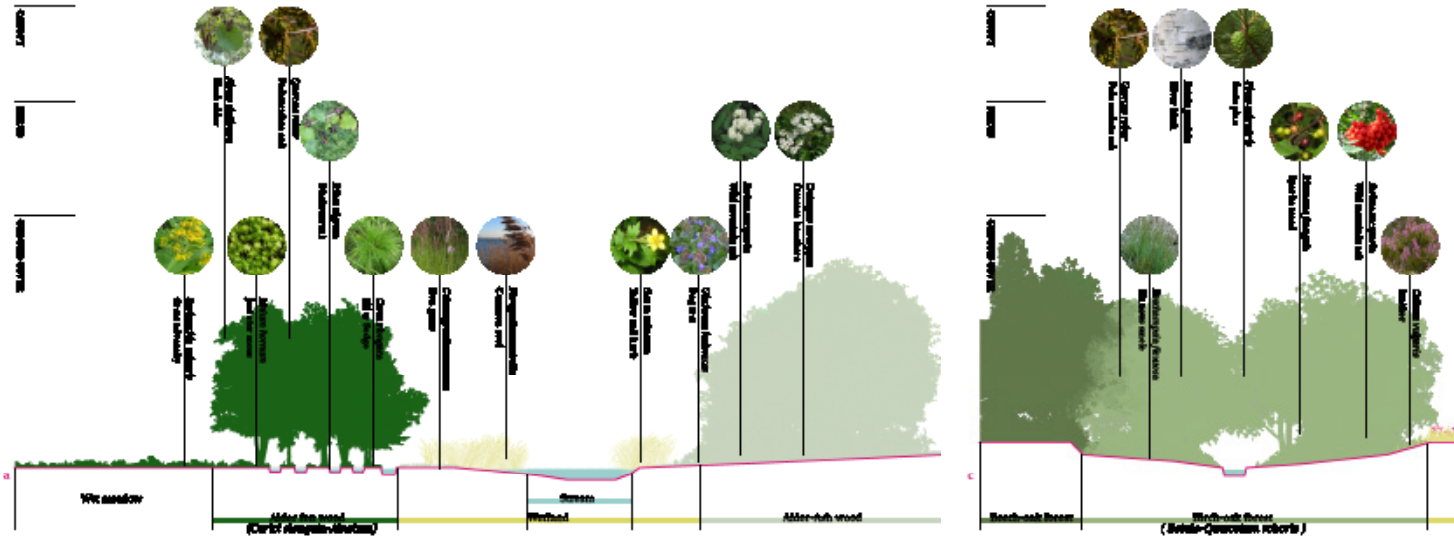


Figure 5.41: nature typologies base on topographic map

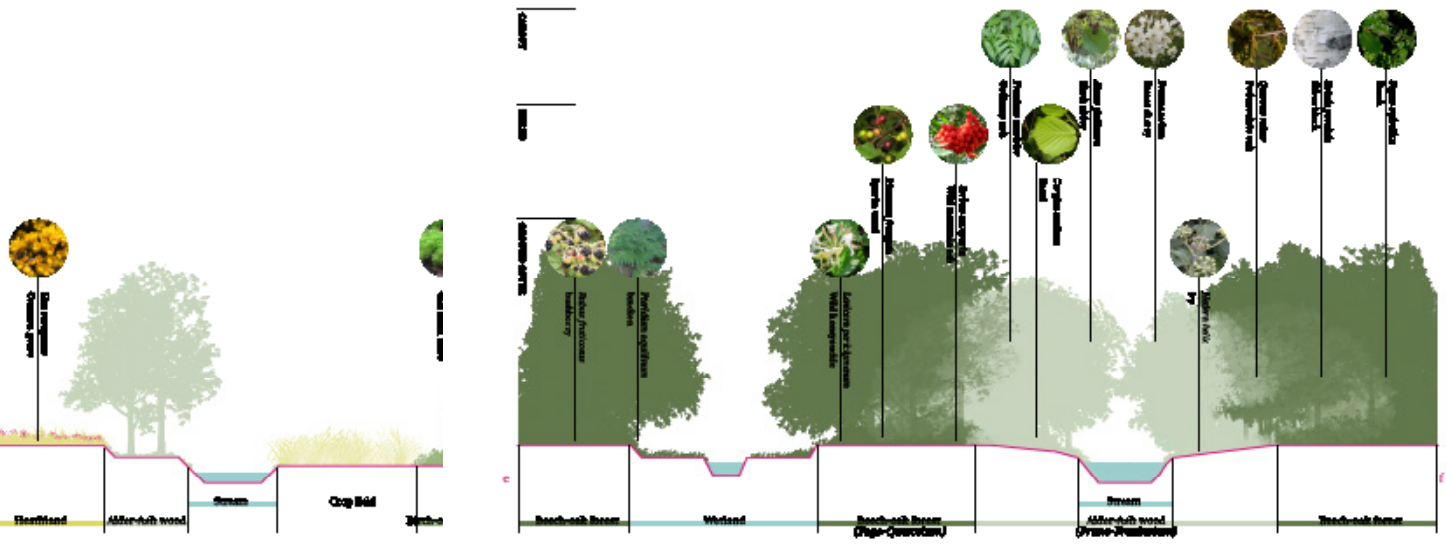


Figure 5.42: vegetation species selection

5.4.6 Cue to care

The final strategy concerns detailed landscape design elements that give cues to maintenance in landscapes. These elements include grassed waterway, strip cropping, plants in roles, lawn decorations, trimmed shrubs, strip planting, flowering plants, watchtower, and mowing. These elements are scattered in different locations in the landscape, but the location choice is based on the principles of 'relationship between path and cultural-aesthetics elements' (figure 5.43). Therefore, there will have landscapes, views, water elements, even single trees to be seen at certain locations. When walking on a route connecting these points for stopping meeting or waiting, the transition between each stops, between neatness and messy will create a changing spatial feeling (figure 5.45). People prefer to see neatness and tended nature in the landscape. Ecological functions are elusive for most people who are not educated for it. It requires careful use of landscape elements, especially water and vegetation, by landscape architects to communicate ecological functions in a new way. The landscape elements used in this design are based on Nassauer's (1995) elaborations on cues to human care. The functional purpose and consequence has been discussed in chapter 4.

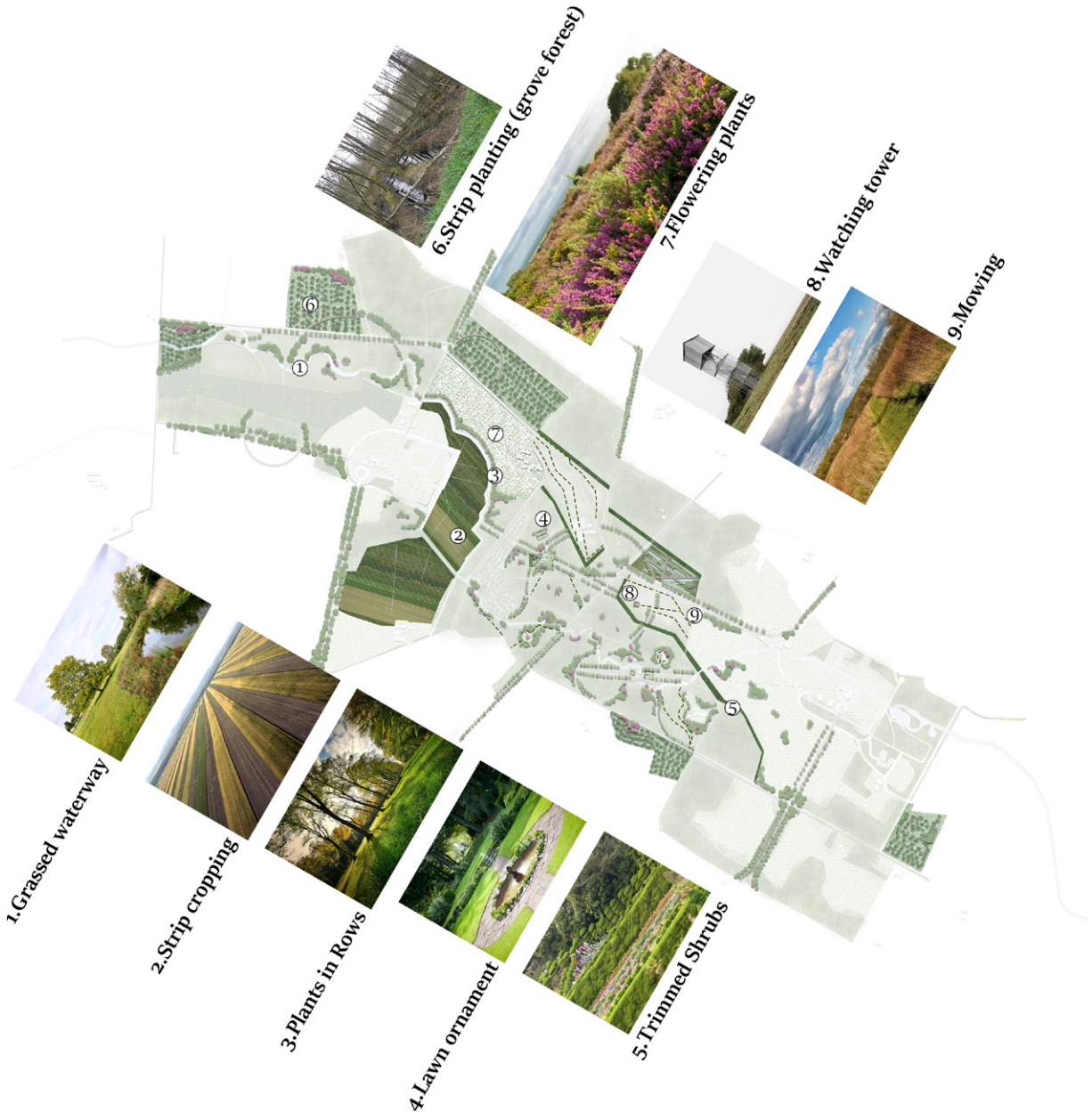


Figure 5.43: the location of cultural-aesthetics elements

Among these landscape elements, mowing is a popular way to communicate ecological quality through design. Mowing a strip along human paths provides clear signs of human maintenance. It makes a forest or a large meadow more accessible and inviting in the landscape without break the continuity of patches for biodiversity. Apart from a mowed path, mowing or grazing could be widely used in all types of natures to communicate nature. This design provides a systematic mowing and grazing system that is explained in the following toolbox.

It considers the factors involving the use frequency, elevation, wetness condition, flowering pattern, and nutrients from the soil to design the way and frequency for maintenance in each type of nature. Intensive grazing (twice a year) is assigned to most forests and the inundation fields (the wettest area), which are less often visited. This also protects the younger trees, shrubs, and herbs. Intensive grazing is applied to meadows to maintain the openness of the landscape. it is also used in some grove forest to show the water pattern there. Mowing, which is a more artificial approach will be used in arable fields for both productive and aesthetics purposes. The path will be mowed more often to show a clear boundary where people are more often visited.

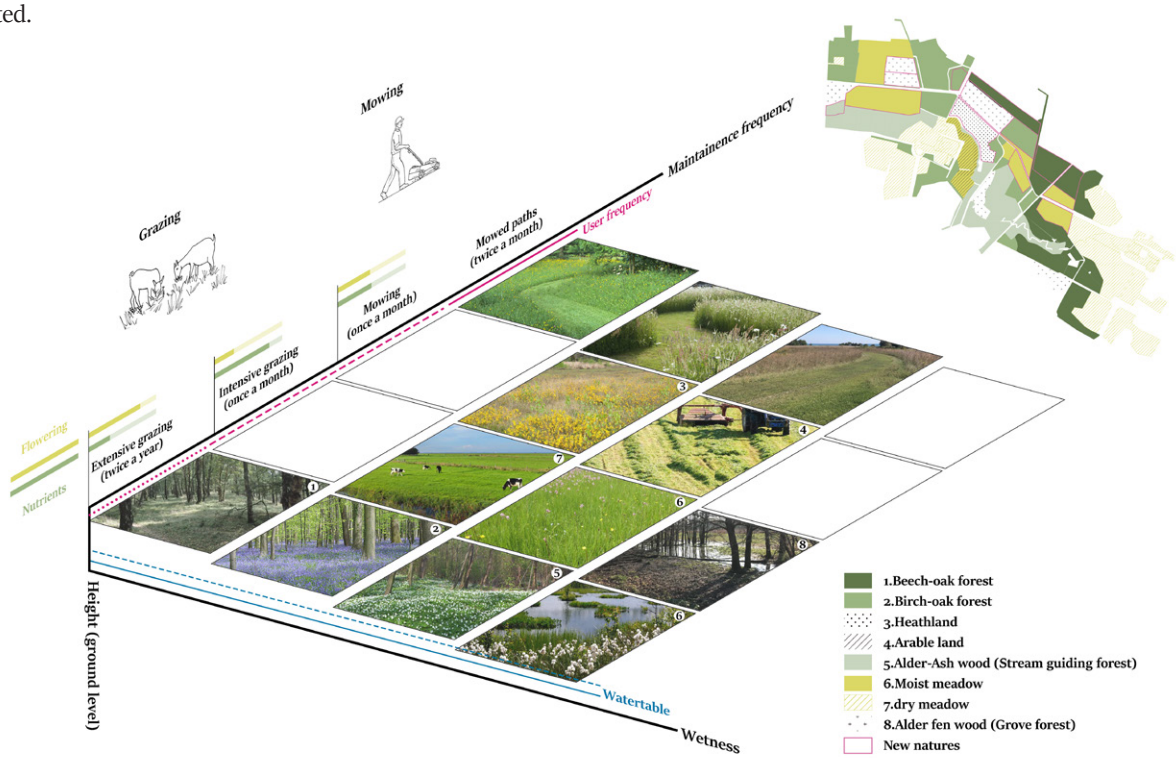


Figure 5.44: grazing and mowing toolbox

Figure 5.45: Mowing a strip along human paths

The selection of maintenance principles and the level of intervention on grassland, the agricultural field, water, and forest will create conditions for changes and transformations in the landscape. This change is not from 0 to 100. It will develop itself over time depend on the grazing or mowing frequency, disposal of the mowed grasses, the soil condition, and forest management method. The design could only provide possible growth phases and an expected future scenario for the estate landscape but the reality remains mysterious.

Current situation

5 years

20 years

5.46: Development over time on dry meadow/Agriculture

Current situation

5 years

20 years

5.47: Development over time on wet meadow

Current situation

5 years

20 years

5.48: Development over time in stream guide forest

Current situation

5 years

20 years

5.49: Development over time in Rabatten forest

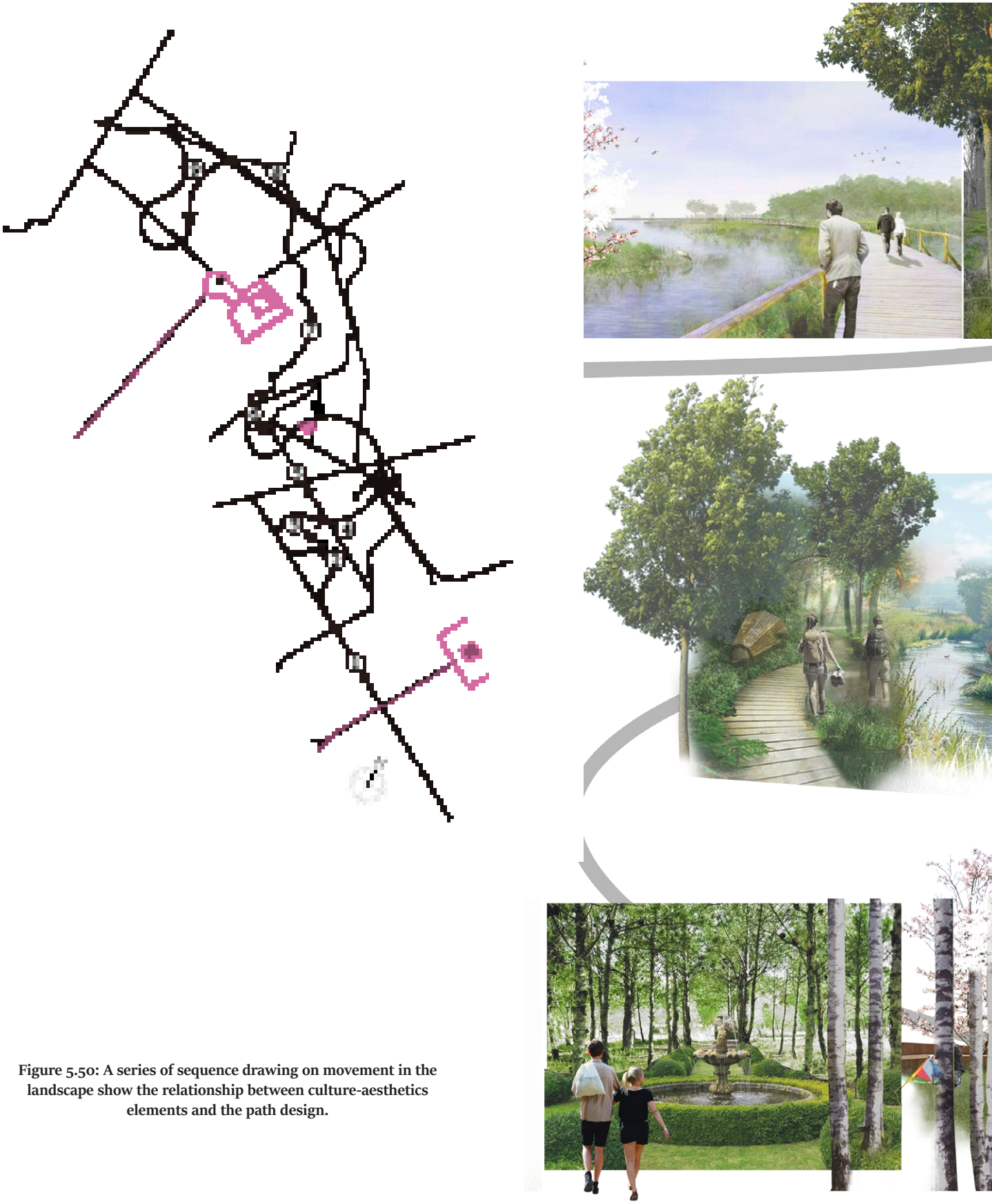


Figure 5.50: A series of sequence drawing on movement in the landscape show the relationship between culture-aesthetics elements and the path design.

5.5 Design conclusions

The design starts with the application of design principles on various scales and locations in the catchment area. Selected design principles will be assigned to the most suitable locations to preserve and strengthen the landscape characteristics of each sub-area. Detailed design exploration is taken in the Medler-Wiersse cluster in the estate landscape. The design provides two landscape ecology models with one restore the historical landscape and the other add new functions to the landscape. Spatial design options, including path design and location choice for cultural-aesthetics elements, are given to test various possible ways of composition these elements. In detailed design, one option for design in Medler-Wiersse cluster is explained by strategies. It takes the landscape ecology model 2 as the basis, testing one possible way to organise path and cultural-aesthetics elements in the landscape and to see the consequences of combination. Finally, it is worth to clarify there are many other ways to organize the path and nodes on this site under the framework I proposed in the 'spatial experience design options' sector. It is hard to say which logic for composition is the best for the site, but this design as an experiment does provide building stones to communicate water and ecology in the context of climate change.

Chapter 6
Discussion and conclusion

This project is rooted both in a water and ecosystem restoration in the estate landscape under the uncertainties of climate change and in a spatial design to bridge the disjuncture between landscape ecology and our spatial perceptions on the landscape and its ecological function. During the research and design process, these two aspects have gradually grown towards each other, converging into a proposal for a rebalance in the landscape.

Limitations

In this thesis, most water data including the water level, groundwater level are collected from the website of the water board. Considering some data on the estate area are not up-to-date, this might impact to result of selecting the field to inundate. In addition, since the detailed design exploration is taking place in the estate area located on the downstream part of the Baakse beek, the interventions on the water system there could only have very limited influence on the whole system.

In design exploration, I only proposed very few ecology models and spatial design options, although they are very carefully selected and would do good to the landscape, it is difficult to say these proposed designs are most suitable for this site. And there could have much more possibilities. Additionally, spatial experience and aesthetics perception of people could differ from one person to another because they are subjective and abstract. Ideally, the design should base on the views of different types of people visiting or living in the site through interviews and communications with local people. However, this sector is missing in the preparation stage of the analysis. Only the voices of estate owners and the municipality are involved.

Relation of the research to the topic of Flowscapes studio

The Flowscapes studio explores infrastructure as a type of landscape and landscape as a type of infrastructure. By focusing on landscape architectonic design of the green-blue infrastructure, the definition of infrastructure goes beyond utility and therefore landscape infrastructure could guide urban and rural development concerning their civic and cultural significance. The ‘Flowscapes’ also seeks for a renewed understanding of temporal-spatial dimensions of landscape in dealing with the contemporary challenges of climate change and ecological crisis.

With respect to the guiding theme of the studio, my graduation topic focuses on the restoration of the estate landscape in Baakse Beek-Veengoot catchment area through the hybridization of the historical water structures, landscape ecology design, and spatial experience design. Therefore, the design provides and compares two landscape, ecology models. Through readjusting the green-blue system, to solve the climate-related problems and strengthen the local ecological qualities. Two spatial design options are built on a preferred ecology model testing various path design principles and cultural-aesthetics elements placing options and translating the blue-green infrastructure into a perceptive cultural-spatial pattern in landscape respecting the cultural significance of the estate area. The strength of this thesis is that it provides a systematic study of the historical water infrastructure in Baakse beek area. By integrating them in the design, it respects the cultural history of the site, but the design provides a future-proof landscape scenario that addressing the challenge of changing climate rather than simply repeat the history.

Societal relevance

This work delivers building stones to answer the current global question of how to design with the uncertainty of climate change. I introduced and discussed the idea of ‘ecological aesthetics’ in this thesis to address the gaps between landscape ecology design and spatial experience design, between the ecologist’s work and landscape designer’s work. It is a common phenomenon that the improved ecological qualities might hardly be recognized and appreciated for people who are not taught to look for ecological values in the landscape. At the same time, the ecologically valuable landscape might not be well-protected if it receives fewer cares and maintenances. Under the stress of increasing environmental issues and climate change, it is urgent to bridge these gaps. In this work I break down the landscape into layers, taking water and nature layers as a basis to build a series of cultural-aesthetics landscape elements on that. This allows for an alignment of ecological function and spatial experience in the landscape.

As a landscape designer, I looked for ways to design with green-blue infrastructure to bring back the balance between people and the environment and between water ecology design and spatial experience design. The aim of delivering architectonic landscape elements is to provide a feeling of 'cue to care' to the ecology function in the landscape, to communicate naturalness, and to translate the ecological patterns into our cultural language. Therefore contributes to addressing the awareness of the spatial and ecology quality in the landscape.

Research-design relations

This thesis follows a research strategy that systematically combines design research and research-by-design into a coherent research approach for landscape architectonic design. It implies a relationship between design and research that combines research-based-design and design-based-research. The first half of the research follows the research-based-design approach. It enables a comprehensive understanding on the changes in the water system, vegetation pattern, land use, and topographic pattern over time in Baakse beek catchment area. It helps to break down the complex climate-related goals into several individual sectors, water retention goal, ecological goal, and spatial goal through a layered analysis. Therefore, I could find solutions or design principles for each sector correspondingly. In addition, it involves some site-specific analysis to help make decisions on the locations to assign various types of design principles like spatial character analysis and stakeholder/user group study. The landscape of the Baakse beek catchment area could be fell into five categories. From the most east to the west are the terrace-edge landscape, the camp landscape, the peat mining landscape, the sand ridge landscape, and the estate landscape. Each type of spatial landscape is different ranging from vegetation pattern to stream type and main stakeholders. I selected different principles to test on each category according to their characteristics. The aim is to protect and strengthen their characters when solving the site-specific problems and provide a comprehensive green and blue network in the area. This step contributes to linking the very general and abstract principles to the specific site.

The second half of the research follows the design-based-research approach to explore the spatial consequences of the interventions and the potentials for the site. A modeling approach and comparison analysis run through the whole design exploration process. The modeling approach helps explore more possibilities for the site. I developed two landscape ecology models. Model 1 takes the landscape in 1850 as a reference to restore the historical landscape. Model 2 is built on the Gelder Nature Network, which adds some new functions and new natures to the current landscape. Both models are more future-proof and climate-resilient comparing to the current landscape. Therefore, I step further with a comparison study to compare their contributions to wetness retention, ecology quality, and spatial quality.

Conclusion

Over this year, I have had a chance to review and implement the knowledge gained in TU Delft. As well as the new knowledge I gained during the process of this graduate project, it was a struggling but fulfilling experience. It gives me a better understanding on the evolution of the Baakse beek area, on its water system, and the rural cultural landscape. Although the research objective, questions, and methodologies have been set at the very beginning of this research, I constantly made changes in the whole research and design process to find and test different research paths and to build a strong linkage between each part of the research. My first attempt to only design with the water system is unsuccessful since the water is never an independent element in the landscape. Through following the research-based-design approach, I broke down the whole landscape system into layers, the water as the basis would still be a prominent design element in the landscape. When building other interventions on this basis, both the ecology function and spatial function of the water are strengthened. In the process of selecting locations for micro-scale interventions, I first have an attempt to design in an upper stream location since the influence on improving the wetness condition would be more significant. This is also unsuccessful due to the poorly documented information on the water system as well as the landscape. The relations between local people and water management are also unclear. When exploring the solutions in the estate cluster, my first attempt is building one environment-centered model and one people-centered model representing two extreme conditions through design. I tried to synthesis these two plans but failed due to too many conflicts between the two models. Finally, it is necessary to acknowledge that, although this project put much emphasis on study and reuse the historical water structures in Baakse beek area, the aim is to find paths towards a future-proof landscape rather than restore the historical landscape.

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