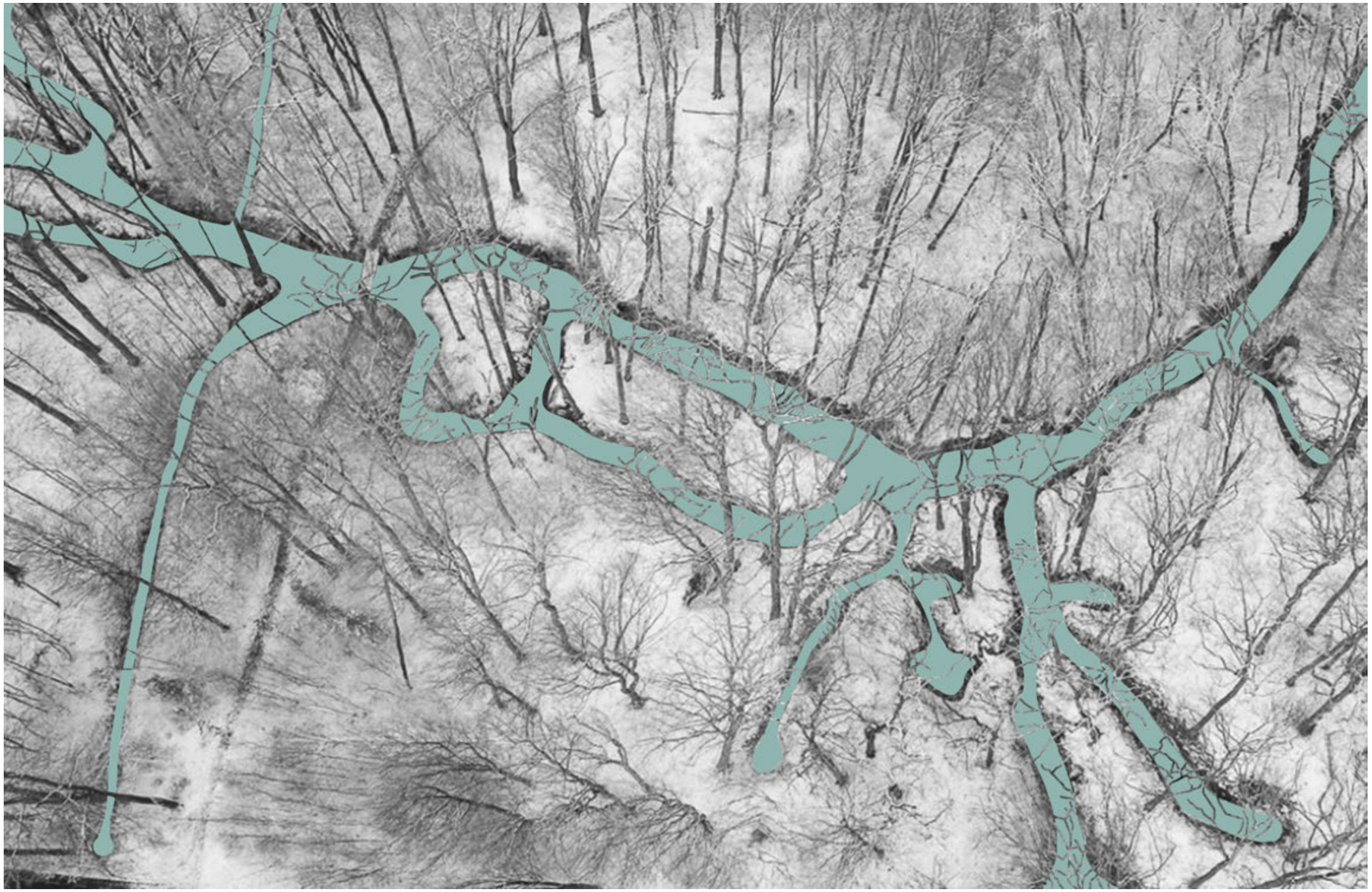

REVIVE THE SPRENGENBEEK LANDSCAPE

Integration of a heritage water system into the renewed circular agricultural landscape at Vaassen, Veluwe

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Landscape Architecture MSC
09/2022

Revive the Sprengenbeek Landscape
- Integration of a heritage water system into the renewed circular agricultural landscape at Vaassen, Veluwe

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Graduation lab
Flowscape- Circular Water Stories

Delft, Netherlands, Sep, 2022

ACKNOWLEDGEMENT

I am about to fish this two-year journey from TUDelft and leave the Netherlands as I type these words. However, as a result of this whole year research and design, I have really bonded with the Netherlands and its landscape. The project reflects my understanding of the landscape and strengthens my capacity for research.The project has enhanced my research capabilities and reflected my design skills and understanding of the landscape to date.

First and foremost, I want to thank my first mentor Dr Ir. Inge Bobbink and my second mentor Geert van der Meulen. You have helped me in a lot of ways and tolerated me so many times during this year. You always supported my design concepts and ideas with many of your opinions. It is because of you that I can enjoy the design process so much and gain more passion for landscape. I am so lucky to have you as mentors.

Second, I want to express my gratitude to my family for their financial assistance. Without you, I would not have been able to complete my studies at TUDelft.

Thirdly, I also want to express my gratitude to my roommates and all of my friends for keeping me from feeling lonely and listening and encouraging me all the time. Additionally, I want to express my gratitude to CWS studio friends and all of the landscape classmates for your companionship and shared knowledge.

Finally, I'd like to thank myself for all of my efforts and patience, for this wonderful experience, and for life.

ABSTRACT

A Sprengenbeek is a stream that has been dug or deepened to tape groundwater from the hill. Most streams were built to drive watermills in order to generate energy, but they were also built to irrigate and supply water to moats, canals, or other waterworks.

The efficiency of the water mills was overruled by modern energy supplies. Therefore most of the water mills were demolished, and the Sprengenbeek gradually lost its main function. At the same time, the landscape around changed into a productive agricultural landscape, causing today's environmental problems. The connection between the landscape and the Sprengenbeek disappeared. Moreover, due to climate change, the Sprengenbeek landscape is facing droughts and flood issues.

The design aims to enhance the spatial, ecological and circular quality of the Sprengenbeek landscape by a slow transformation and the creation of a series of public spaces in which the cultural-historical elements of the Sprengenbeek contribute and can be experienced.

The Sprengenbeek landscape can be divided into five areas: infiltration area, upstream, midstream, urban area, and downstream. Each area has different issues and asks for different strategies in terms of sustainability, management and possibilities for the development of public spaces.

The result is a diverse, sustainable, readable Sprengenbeek landscape that provides approaches and is an inspiration for areas facing similar problems.

CONTENT

01 | INTRODUCTION

01 - 1 FASCINATION

FIG. 1.1 The watermill in Vaassen
Source: By Author

Water driven landscape

The water we use to make a cup of tea could have once gurgled along an ancient Roman aqueduct, hissed from a steam train's boiler, or powered a turbine in the Three Gorges Dam. Throughout history, water has always driven the development of societies and also driven the formation of cultural landscapes.

If we enumerate the power that drove the Industrial Revolution, steam power and coal mine combustion are easy to think of. But water also played an important role during the Industrial Revolution: but cotton mills powered by water mills provided the prototype for manufacturing in the earliest stages. In the beginning, most of the water that drove the water mill was a natural river. Later, people dug artificial canals or aqueducts.

On the edge of the Veluwe massif in the Netherlands, there are special watermills. What makes them special is that the water that drives the watermills comes from groundwater, and the water is transported through man-made ditches which are called the Sprengenbeek System. They were dug in the 17th century to keep two hundred paper, grain and copper mills running. The sprengenbeeks on the Veluwe are actually industrial landscape monuments.

What kind of story does the Sprengenbeek System have with people and cities? What is his future now that the watermill has been abandoned or destroyed due to inefficiency? I want to explore the answers to these questions.

FIG. 1.2 The **Enclaves landscape in Niersen**
Source: By Author

Reading the palimpsest

For me, the landscape was about form at the beginning, with beautiful lines and harmonious patterns, about design interesting and comfortable space. With the deepening of learning, I understand that landscape is a multi-layer dynamic system. I like to understand the cultural landscape that is reshaped by humans, and its process. The landscape is also palimpsest. Reading the palimpsest of the landscape is as interesting as reading a story.

Sometimes cultural landscapes are easy to read. They are written in history books. For example, the urban landscape settings of ancient Roman decorative public fountains and baths provide fresh water, they remind citizens of the wealth, power, and technological advantages of the empire.

But the landscape sometimes hides the history of social and economic development like a veil. Because of the development of technology and cities, the landscape has changed its original appearance and is no longer easy to read. Finding clues from the remaining landscape to the read previous story is something I am interested in.

This project will present a record of reading and exploring the cultural landscape of vaassen in veluwe from the perspective of water. And, as a landscape architect, I always think about what role the historical and cultural landscape should play in the current society.

01 - 2 LANDSCAPE IN VELUWE

In the flat and densely populated Dutch delta landscape, Veluwe is a special presence. It rose without warning in the flat middle of the Netherland.

Veluwe has many different landscapes, including woodland, heathland, some small lakes and the largest sand mound in Europe. These landscapes hint at the formation of this mountainous region.

The site of this project, located on the east flank, is a part of a gradient area from the moraine hill to the flood plain.

FIG. 1.3 The location of project
Source: By Author

FIG. 1.4 Forest in veluwe
Source: Jan Neefjes, Landschapsbiografie van de Veluwe, 2018

FIG. 1.5 Heathland in veluwe
Source: Jan Neefjes, Landschapsbiografie van de Veluwe, 2018

01 - 3 SPECIAL NATURE IN VELUWE

The Veluwe area was once crossed by the Rijn, Maas and Vecht rivers. During that time, the river deposited a thick bed of sand, gravel and clay in the area.

And later, in the Saalian period, the Scandinavian ice sheet expanded, covering the northern part of the Netherlands. These ice blocks push frozen layers of sand, gravel and clay sideways, creating "pushed moraines" and causing the impermeable clay layer beneath the IJssel valley itself to be squeezed into vertical clay partitions. (Minkman& Hoekstra,2012)

These clay partitions create a complex groundwater system in the east Veluwe area. What's more, certain clay separators prevent upstream groundwater from flowing rapidly downstream and infiltration. It leads to the opportunity to use the remaining groundwater where groundwater accumulates. The Sprengenbeek is the water system in which people tap and use this groundwater for productive activities.

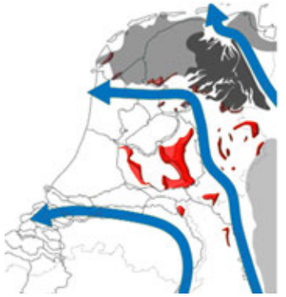


FIG. 1.6 Direction of Rijn, Maas and Vecht river
Source: https://slideplayer.nl/slide/10332868/

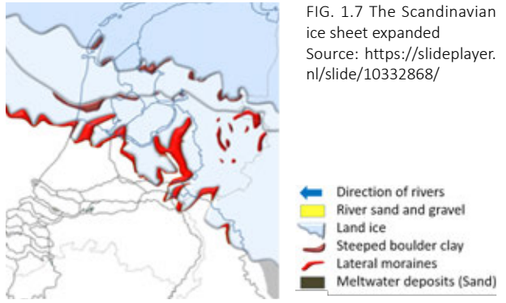


FIG. 1.7 The Scandinavian ice sheet expanded
Source: https://slideplayer.nl/slide/10332868/

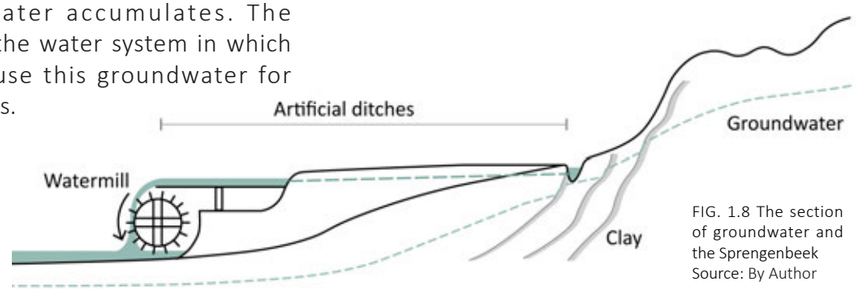


FIG. 1.8 The section of groundwater and the Sprengenbeek
Source: By Author

01 - 4 THE SPRENGENBEEK SYSTEM

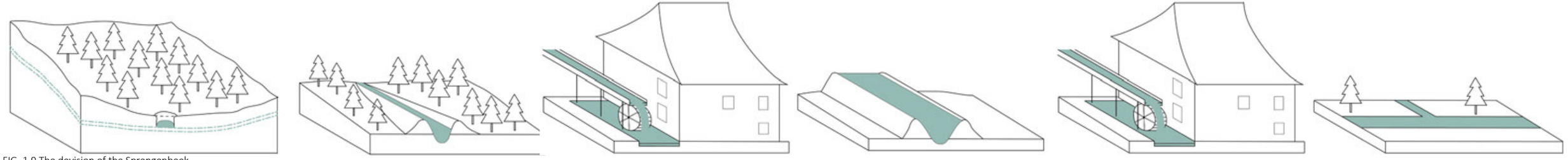


FIG. 1.9 The devision of the Sprengenbeek
Source: By Author

FIG. 1.10 The Sprengenkop
Source: https://paulinewandelt.com/arnhem-langs-de-sint-jansbeek-naar-de-neder-rijn-deel-1/

FIG. 1.11 Artificially raised streams
Source: by Author

FIG. 1.12 Achterste Molen
Source: Wikipedia

FIG. 1.13 Artificially raised streams
Source: Source: by Author

FIG. 1.14 Wasserij van Delden
Source: by Author

FIG. 1.15 Down stream near Grift cannal
Source: by Author

In order to obtain more water, people dig underground water and build artificial diversion channels. This is the Sprengenbeek system.

Here is how the Sprengenbeek system works:

In the Upper stream of the Sprengenbeek, the land is dug until it comes into contact with groundwater, and the excavation points are also known as Sprengenheads ('Sprengkoppen'). Usually, they are rounded and often reinforced with wooden berms along the edges to channel the watercourse and thus prevent the dug-out stream from silting up. Most streams have more than one source of Sprengenheads, and there are often several Sprengenheads in a forest.

In the middle stream of the Sprengenbeek, the stream has left the moraine landscape. It is characterized by artificially raised streams. The banks of the streams are reinforced with the roots of trees to protect the banks from erosion by the running water. Elevated streams are usually around 3m, and the water falling at this height drives the water mill and provides power for production.

A single Sengenbeek can drive many water mills, and when the stream leaves the last mill, the Sprengenbeek flows into the downstream area. The lower reaches are usually agricultural areas with very flat terrain. Finally, it flows into the Grift canal, which connects with the Apeldoorns canal. (Minkman& Hoekstra,2012)

01 - 5 THE STORY OF THE SPRENGENBEEK

The story of the Sprengenbeek system is about how people use this water in different ways. Not only to drive the watermills but also for irrigation, fishponds, defence and moat, etc. The diversity of Sprengenbeek is the most attractive.

02 | PROBLEM FIELD

02 - 1 LOSS OF INHERITANCE

1. Springs are invisible in city area

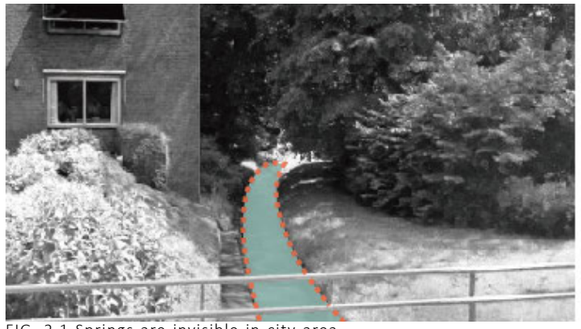


FIG. 2.1 Springs are invisible in city area
Source: by Author

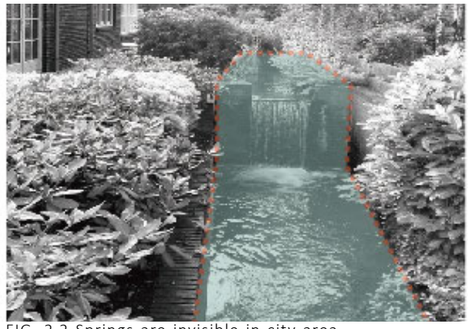


FIG. 2.2 Springs are invisible in city area
Source: by Author

2. The watermill are demolished or losting function

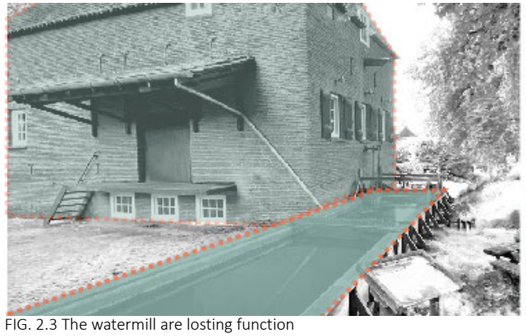


FIG. 2.3 The watermill are losting function
Source: by Author

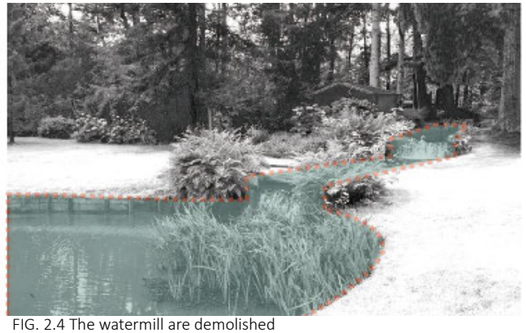


FIG. 2.4 The watermill are demolished
Source: by Author

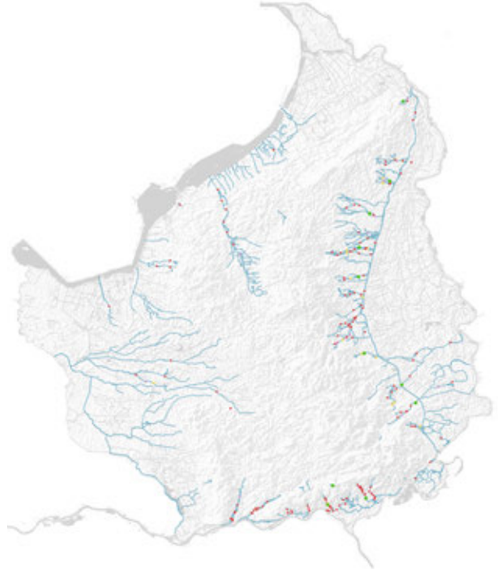


FIG. 2.5 Sprengenbeeks and watermills in veluwe
Source: http://www.bekenatlas.nl/
redrawn by author

The diagram below shows the changes in the number of water mills in history. And also, from the map, we can see the green dot, which means the surviving mills are scarce. Most of the water mills were dismolied in the 19th century because they were no longer efficient enough.

Not only was the water mill dismantled, but nowadays, the Sprengenbeeks are invisible in urban areas. They are hidden in the bushes at the back of the building.

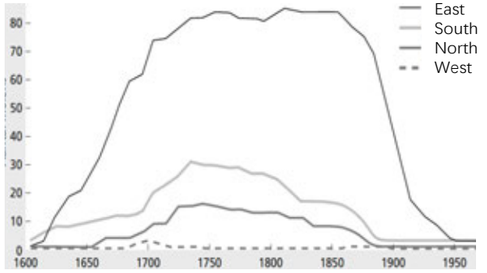


FIG. 2.6 Number of watermills
Source: H. Menke, H. Renes,V eluwe bekenen sprengen,2018
redrawn by author

02 - 2 DROUGHT AND FLOOD

1. The dried up Sprengenbeek (Summer)

FIG. 2.7 The dried up Sprengenbeek
Source: by Author

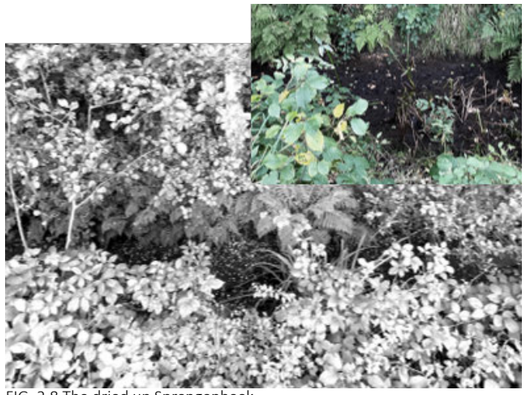


FIG. 2.8 The dried up Sprengenbeek
Source: by Author

2. The Flooding Sprengenbeek(Winter)

FIG. 2.8 &2.9 The flooding in Sprengenbeek of Epe
Source: https://www.gelderlander.nl/regio/flinke-overlast-door-regen-in-epe-tuinen-en-weilanden-onder-water-het-lijkt-wel-limburg-hier~ad96361a/

"All streams are very full of water. It flows beyond the banks. We brought sandbags to keep the water out of the houses. So an awful lot of water falls in succession, it is now raining again," says a spokesperson for the Vallei en Veluwe Water Board. (from Mark Broersma,02-2022)

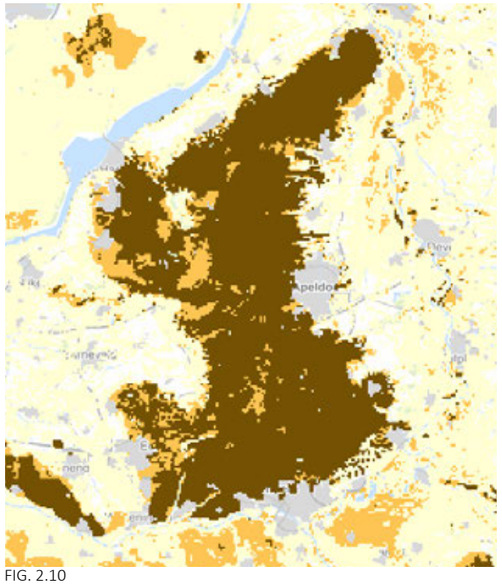


FIG. 2.10
Source: E, Jolijn.,Impact of Changes in Groundwater Extractions and Climate Change on Groundwater-Dependent Ecosystems in a Complex Hydrogeological Setting (2018)

Drought & Flood Reason 1: Climate Change

The Royal Netherlands Meteorological Institute (KNMI) has constructed climate scenarios for the Netherlands based on global and regional climate models. KNMI looked at trends in two areas: rising temperatures and changes in air circulation (precipitation), and combined these trends into four climate scenarios. (FIG. 1.25) All scenarios show more precipitation in winter and more drought in summer. They also predict greater evaporation in summer. Therefore, in the future, the climate will become more extreme. And according to the news in February this year, there was a flood in the Sprengenbeek in Epe (FIG. 1.22&1.23)

Another diagram is about the maximum annual water deficits (in mm) in a continuous field of grass during a consecutive 10-day period.(FIG. 1.24)Under the WH scenario, drought stress will increase considerably by 2050, especially in elevated sandy soils.

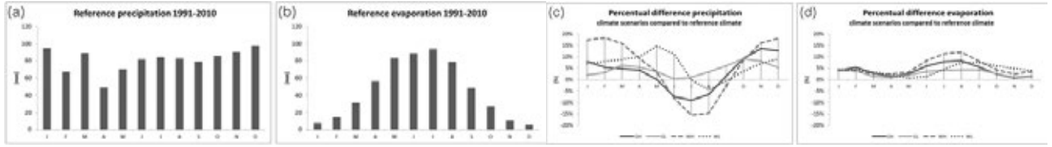


FIG. 2.11 climate scenarios for the Netherlands based on global and regional climate models
Source: E, Jolijn.,Impact of Changes in Groundwater Extractions and Climate Change on Groundwater-Dependent Ecosystems in a Complex Hydrogeological Setting (2018)

02 - 2 DROUGHT AND FLOOD

Drought Reason 2 : Groundwater Extraction

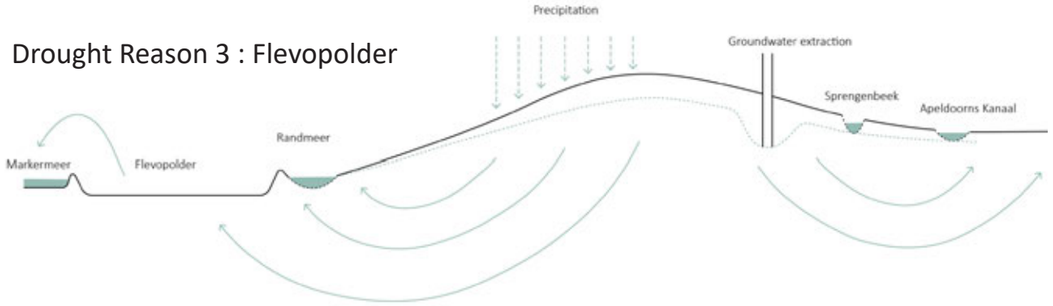
Veluwe catchment area (clearly marked on the map). Blue circles show the location and size of current drinking water extractions. Veluwe's groundwater is extracted for drinking water and industry. Annually 130 mm3, of which 90 mm3 is extracted within the catchment area (M. Witte,2019).

Graph showing average groundwater recharge in the Veluwe region
Blue line: Result in the condition of constant land use from 1850 to 1880
Red line: Result in the condition of Actual land use from 1850 to 2016
Grey line: Recharge under actual land use

It is thus clear which part of the reduction in inflow to rivers and seepage zones is attributable to extraction and which is attributable to land use. Changes in land use have a larger impact than groundwater extraction. But we can say that both greatly affect groundwater recharge(M. Witte,2019).

FIG. 2.12 &13 Ground water extraction
Source: M. Witte, J., (2019). Met het historische landschap verdween er water van de Veluwe. KWR Watercycle Research Institute, Nieuwegein.

Drought Reason 3 : Flevopolder



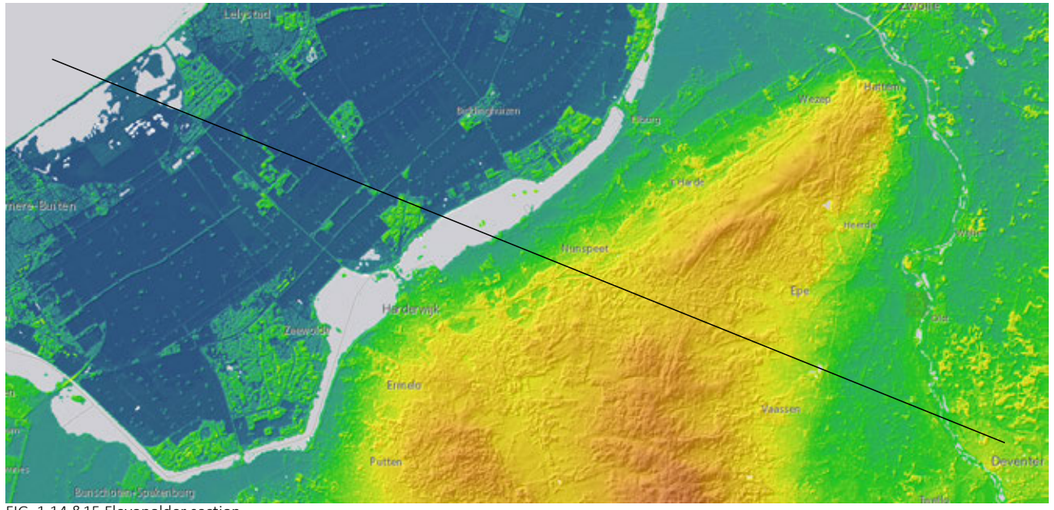


FIG. 1.14 &15 Flevopolder section
Source: E, Jolijn.,Impact of Changes in Groundwater Extractions and Climate Change on Groundwater-Dependent Ecosystems in a Complex Hydrogeological Setting (2018)

The Flevopolder has been drained, and due to land consolidation, the water levels have been lowered in many areas. All these interventions have resulted in faster drainage of the deep groundwater in the Veluwe, which means that groundwater levels are now structurally lower than in the past.

02 - 2 DROUGHT AND FLOOD

Drought Reason 4 : Land Use

The fourth reason is land use. Different vegetation types have different amounts of evaporation and infiltration. The infiltration ratio of the coniferous forest is the lowest 18%. It is the lowest among all the land use types in the Veluwe area.

In the 19th century, the Veluwe was still an area with heath. This has been transformed into a forest area with a lot of coniferous wood and is now increasingly changing to a deciduous forest. Forests have a greater evaporation rate than heathland, which means that less rainwater is absorbed into the ground over time. Conifers are green all year round, while deciduous trees have leaves only half of the year. The needles of conifers, therefore, ensure that part of the precipitation cannot infiltrate into the soil but evaporates throughout the year. In deciduous forests, water can be absorbed directly during the winter months. The increase in the number of deciduous forests, therefore, leads to a higher groundwater level. And strong stratification of vegetation, on the other hand, creates more biomass on which the rainwater remains and will evaporate again.(Kernteam RAP,2022)

Coniferous forest
Evaporation=680mm
Infiltrate=150mm(18%)

Deciduous forest
Evaporation=520mm
Infiltrate=310mm(27%)

Dune Bush
Evaporation=480mm
Infiltrate=350mm(42%)

Bare sand
Evaporation=200mm
Infiltrate=630mm(75%)

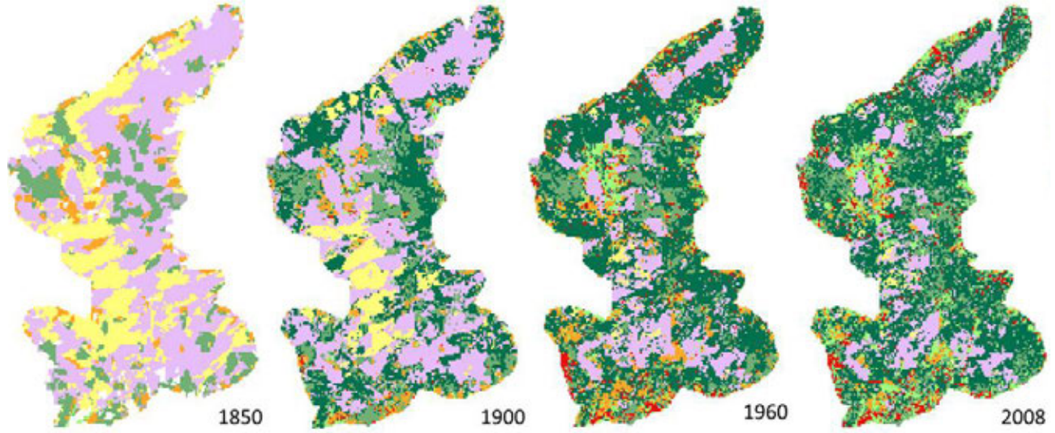


FIG. 2.16 &17 Flevopolder section
Source: E, Jolijn.,Impact of Changes in Groundwater Extractions and Climate Change on Groundwater-Dependent Ecosystems in a Complex Hydrogeological Setting (2018)

02 - 3 INTENSIVE AGRICULTURE

1. Acidified soil & Lose of biodiversity

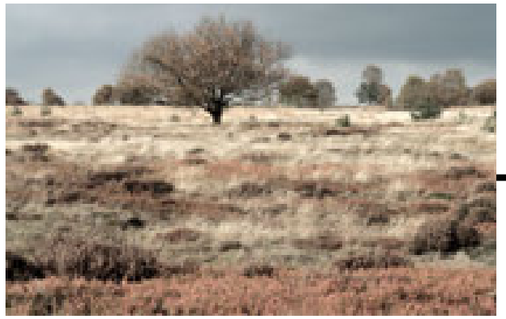


FIG. 2.18 Diverse heathland
Source: gelderland.nl

FIG. 2.19 Nitrogen-degraded heath, Veluwe
Source: R. Bobbink.

2. Monofunctional landscapes

FIG. 2.20 Previously field in the flank of veluwe
Source: gelderland.nl

FIG. 2.21 Field in the flank of veluwe
Source: gelderland.nl

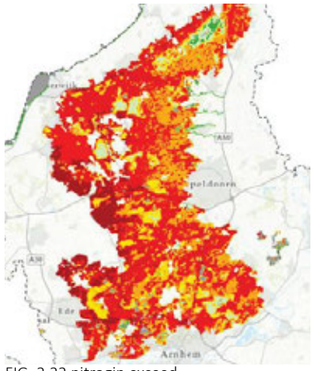


FIG. 2.22 nitrogin exceed
Source: gelderland.nl

FIG. 2.23 pasture map in Veluwe
Source: gelderland.nl

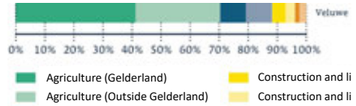


FIG. 2.24 the origin of the nitrogen precipitation
Source: gelderland.nl

Agricultural development, enhanced in many areas by land development projects, has moved in the direction of **monofunctional landscapes**, in which agriculture supplanted all other activities, and therefore more difficult to combine with other functions.

In addition, intensive agriculture has created environmental problems, mainly in terms of soil acidification and reduced biodiversity due to excessive **nitrogen emissions.**

The critical deposition value (KDW) indicates the nitrogen sensitivity of an area. The lower the KDW, the more nitrogen sensitive an area is. If the KDW is exceeded, the risk of damage to nature increases. The map left(FIG. 2.22) shows the exceedance of the KDW in Natura 2000 areas in Gelderland.(Provincie Gelderland, 2022)

The chart(FIG. 2.24) shows the origin of the nitrogen precipitation on Natura 2000 areas in Gelderland. The green part is agriculture. the other colors represent transportation, construction and housing, and industry. Approximately half of all nitrogen precipitation comes from agriculture. And form FIG. 2.23 we can see the wide distribution of pastures

02 - 4 PROBLEM STATEMENT

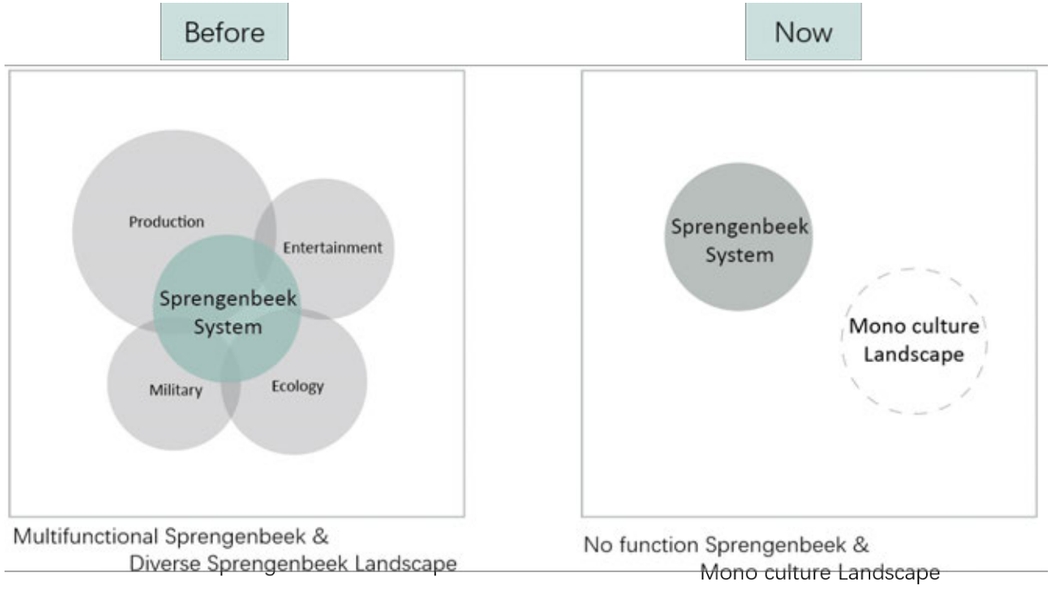


FIG. 2.24 Problem statement
Source: by Author

Problem statement

The Sprengenbeek System used to be multifunctional and has been strongly connected with the local cultural landscape. However, nowadays, the Sprengenbeek is facing the loss of inheritance, the risk of flood & drought, and it is also no longer linked to the landscape context, which is monoculture.

From problems to opportunities

The optimization of the Sprengenbeek system is not unrelated to the sustainable development of agriculture. For example, water scarcity may be improved if appropriate measures are taken in agriculture or other forms of agriculture are developed. These measures, as well as landscape interventions, in turn, offer the possibility to activate or moisten the Sprengenbeek system.

These will create opportunities for sustainable development and identity enhancement of the entire region.

03 | METHODOLOGY

03 - 1 OBJECTIVE AND RESEARCH QUESTION

Research Question:

"How to enhance the identity & spatial quality of the Sprengenbeek landscape, and at the same time, improve its ecological and heritage values?"

Sub Research Question:

1. What is the characteristic & values of the Sprengenbeek landscape in the selected area?

2. What it the roles of the Sprengenbeeks in the future landscape?

3. How to make the Sprengenbeek landscape more sustainable and diverse?

4. How to make the heritage of the Sprengenbeek System and the identity of the cultural landscape become more spatial recognizable?

5. Can we find common design principles and strategies for the Sprengenbeek landscape in east Veluwe?

Objective:

To understand the study location and the Sprengenbeek system there.

To address the issues and challenges faced by Sprengenbeek itself

To diversify the Sprengenbeek Landscape

To explore the spatial structures that experienced by people

To build up the toolbox for broad research and design.

03 - 2 THEORITICAL FRAMEWORK & CASE STUDY

Based on the problem statement, I conducted the following theoretical studies and case studies in order to solve the research question. This helped me to generate design concepts and also supported my further design.

1. CULTURAL LANDSCAPE

Regarding "cultural landscape", it has come to be used in a number of related ways with different shades of meaning. The divergent concepts are not in all cases mutually irreconcilable, and the use of this term for landscape architecture, I found definitions of it from different organizations or individuals:

The U.S. National Park Service (2022) defines a cultural landscape as a geographic area, including cultural and natural resources and the wildlife or domestic animals associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

In this sense, a cultural landscape is a historically significant property that shows evidence of human interaction with the physical environment. The Sprengenbeek and the landscape in which it is located reflects local traditions, customs, and social context, and are definitely included in the cultural landscape.

UNESCO Centre - "Combined works of nature and of man" that illustrate the evolution of human society and settlement over time, under the influence of physical constraints and/or opportunities presented by their natural environment, and of successive social, economic, and cultural forces, both external and internal.

From this definition, I realized that the cultural landscape is not a fixed object but a complex, dynamic process. I need to support the transformation of the landscape in my design, not to make it a "specimen", which means to stop changing and to isolate it from other things.

The Cultural Landscape Foundation - "Cultural landscapes provide a sense of place and identity; they map our relationship with the land over time, and they are part of our national heritage and each of our lives."

Such an interpretation is more like understanding the cultural landscape as a heritage that is within tangible objects or places but intangible values which could help to seek collective national identity. So from the the designer's point of view, the heritage character of cultural landscapes allows them to provide place for scenic, ecological, social, recreational, and educational opportunities helping communities to better understand themselves.

2. NARRATIVE LANDSCAPE

Based on the value of Sprengenbeek in the cultural landscape, and in the problem analysis that Sprengenbeeks are "losing inheritance", how to make the story of the cultural landscape **readable** to strengthen its heritage value is what I need to consider in the design.

The theory of narrative landscape is worth learning from: A story must be connected to relevant parties beyond its control. These stories often contain references and traces of other stories created by different authors, and these stories can be interpreted from different perspectives in different contexts. (Potteiger & Purinton, 1998). This involves the contextual and intertextual domains of narrative, as well as the perception of the reader

Contextual & Palimpsest

The contextual realm of narrative emphasizes that stories reveal the social and geographic context. So the narrative landscape is based on the palimpsest of the site, which can be seen as stories written in different layers of the same page by multiple authors. The remnant of the previous author was always left, overwritten but still visible (Bobbink & de Wit, 2020). Therefore, our mission is to find these traces that are still visible and present them to the landscape readers through design.

Intertextual & Representation

For the intertextual realm, the meaning of a text is made up of other texts and spread in other forms into reference. The embodiment of this in landscape design is the representation, that is, the reference to the existing things when designing. There are different manners of designing this representation: replication, citation, adaptation and abstraction. (Treib, 2005). And designers can also be influenced by these four manners.

A replication is a representation as similar to the natural landscape as possible.

A citation is the use of a specific element or specific elements from the natural landscape in a new spatial construction.

With an adaptation, parts of the original are transformed into new forms.

Abstraction often requires interpretation to see a reference or representation to the landscape, and the association with the landscape is primarily a psychological association. While associations usually occur through the body's sensory perceptions.(Emmerik, 2022)

Perceptions & Routes

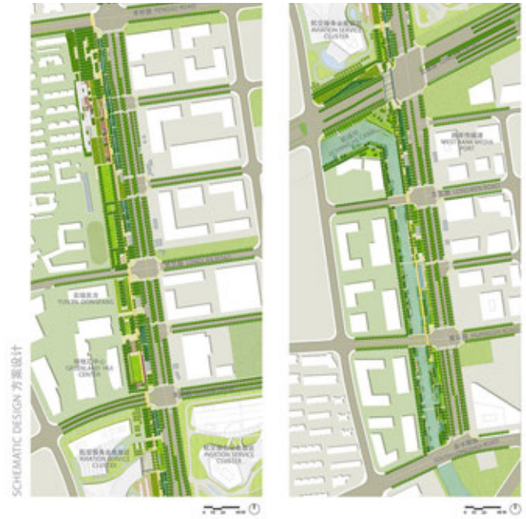
When understanding the representation of landscape, perception is crucial. The perception of the landscape involves the shape and proportion of the space, its surface, volume, and even its appearance in terms of colour, texture and light (Bobbink & de Wit, 2020).

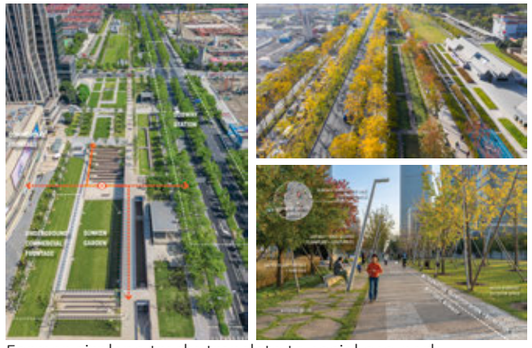
Also, routes are important operative structures in perception. It determines the sequence of experiencing the spaces. It defines the tactile and kinesthetic experience and is the means of organizing the visual logic of the site by directing the individual's eye to the view or focal point and its sequence.(Nijhuis,2015).

03 - 2 THEORITICAL FRAMEWORK & CASE STUDY

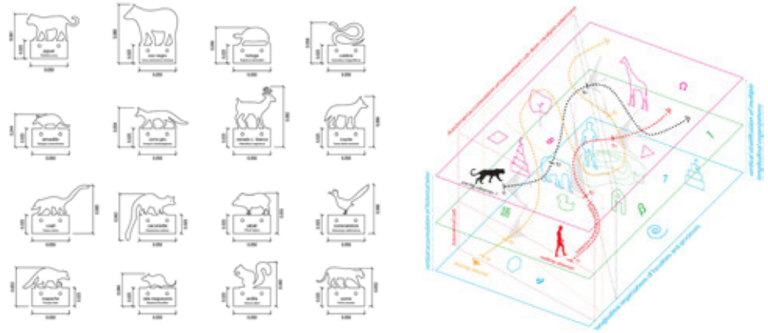
Case Study For Narrative Landscape

Metamorphosis of the Thyssen-Meiderich iron works into a landscape park
Landschaftspark Duisburg Nord by Latz + Partner





Former airplane tracks translate to social eco-park
Xuhui Runway Park by Sasaki



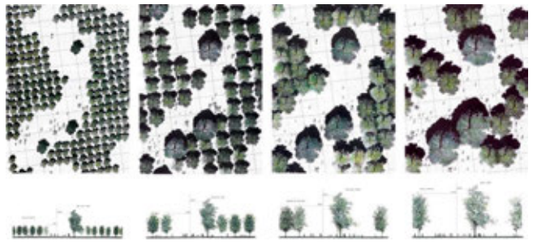
Multifocal exploration that merges the humans and animals
The Symbiotic Matorral by by Pasini Garza Ramos Rosas

3. DESIGN BY PROCESS

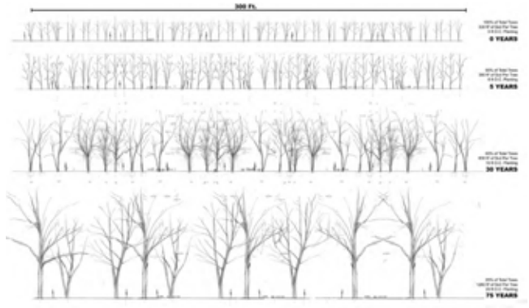
The landscape is considered as a process rather than a result. Natural and social processes constantly change the landscape, making the dynamics of the transformation a key issue in research and design. The design is like an open strategy aimed at guiding developments, with no blueprint design. Projects play a role as an open-ended strategy, as in staging or setting up future conditions. (Nijhuis,2015)

A famous example is Freshkills Park by James Corner Field Operations. The core of this restoration program is programming, which improves the lives of all participants in the ecological chain, beginning with a multi-level user. The overall procedure is divided into several steps: first, the land is restored to fertility through the use of inexpensive and efficient "cross-planting." Second, after restoring the soil, local trees are chosen and planted, zoning is rationalized and graded according to topography, and buildings are added to meet the needs of human activities. Finally, a monumental landscape was created to preserve the atmosphere of the post-industrial era. The project combines the natural evolution of Fresh kills Park from landfill to ecological park with the changing urban activities, resulting in a design that focuses on dynamic processes over time.

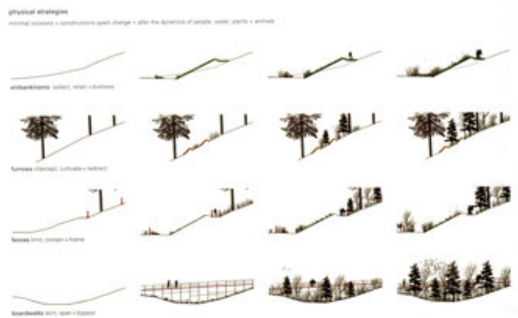
Freshkills Park by James Corner Field Operations
source:http://indalandscape2011.blogspot.com/2011/01/fresh-kills-park-case-study.html



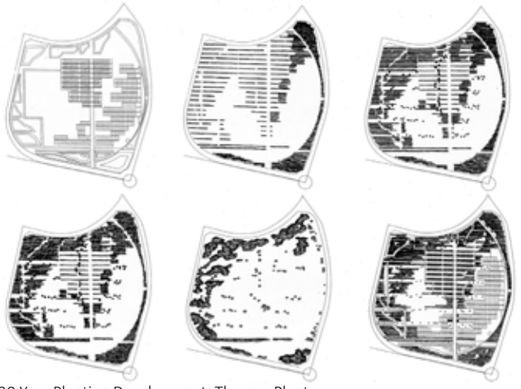
Plan drawing showing 4 four points in time.Greenwich Millennium Park,
Michel Desvigne paysagiste (FR), London, realized, 2000.



Successional Hedgerow Development, Brooklyn Bridge Park.
MVVA, Graphic by Mike Smith and Matthew Urbanski.



Physical operations: Minimal incisions and constructions that spark change,
Mount Tabor Resevoir. stossLU, 2003.



30 Year Planting Development, Thomas Plant,
Michel Desvigne Paysagistes, Guyancourt, France, 1989.

03 - 3 METHOD

Several approaches were used in the project for understanding, analysis, and experimenting with different perspectives.

Description: Organize pictures of site history. Observe the vision and sensory experience in the field trip

Literature review: Learn more about the background knowledge of the site from literature: how the site forms, how the water system work, the historical value of the water system, climate change adaptation, etc.

Modelling: Mapping traditional water systems in the catchment scale and collecting the past story in upstream, midstream, Vassen built-up, and downstream. It helps us understand the mechanism of the water system.

Classification: Enclaves landscape, Kampen landscape, Enken landscape, Kamer landscape, and "IJssel valley" are the types of landscapes that are widespread in the Veluwe region. Classify their characteristics and check if they exist in the design area.

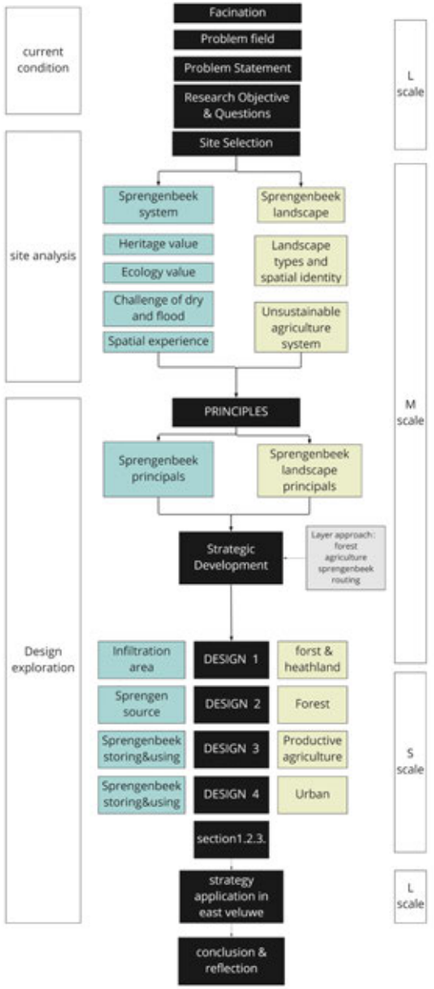
Mapping: Visualize the data. Understand the site by overlaying the soil, geological features, and agriculture layer. And make design strategies based on the mapping.

Interpretation: Explore and analyze the traces of the blurred cultural landscape from the existing landscape.

Stakeholders interviews: Collecting oral information can help us know the people's perception of the landscape and history of the site, as well as people's current needs

Case study: Learn water management methods on sandy soil and landscape narrative methods.

03 - 4 METHODOLOGICAL FLOWCHART



04 | ANALYSIS

04 - 1 SITE SELECTION

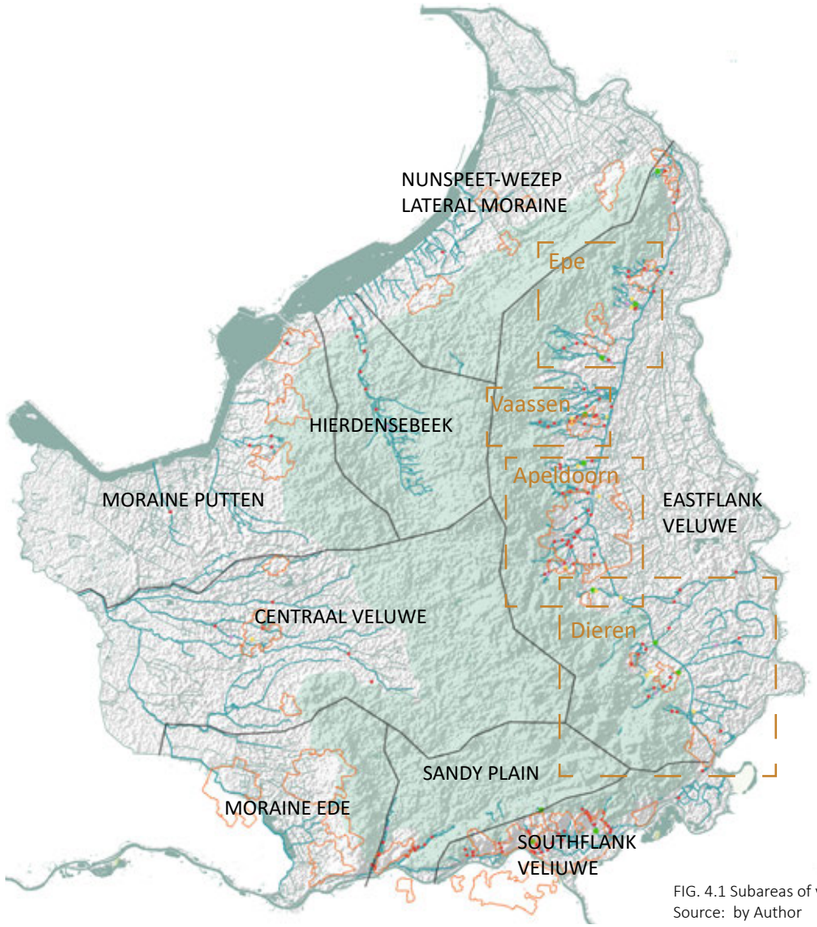


FIG. 4.1 Subareas of veluwe
Source: by Author

Subareas of veluwe

The groundwater system in the Veluwe is a coherent whole in which subareas influence each other. However, several subareas can be distinguished, each showing its own characteristics for the groundwater. The Eastflank Veluwe runs from the watershed on the highest parts of the Veluwe to the IJssel valley. The vast majority of the Sprengenbeeks are produced on the east Veluwe, along the entire moraine from Epe to Dieren. And quite a few meltwater valleys are known there. So I further confirm that a Sprengenbeek basin in East Veluwe will be selected for an in-depth study.

We set the criteria for choosing a site:
It must represent the Sprengen landscape as completely as possible, with a long history, including nature reserves, estates or castles, urban areas, and agricultural areas. And finally, we found Vaassen meets these criteria.

The Sprengenbeek system around Vaassen is still very intact. The surrounding landscape is also a good illustration of how Sprengenbeek was formed. In addition, the Sprengenbeek are used to provide water for the laundry and fish ponds, as well as the ponds around the cCannenburch castle.

FIG. 4.2 The Sprengenbeek in Vaassen
Source: by Author

04 - 2 THE SPRENGENBEEK WATER SYSTEM

FIG. 4.3 The Sprengenbeek system in Vaassen
Source: by Author

FIG. 4.4 The historical development of the Sprengenbeek system in Vaassen
Source: by Author

In the Vaassen , there are five important streams. Rode beek, Dropsbeek, Geelmolense beek, Nieuwe beek, Hartense beek.

The whole system starts with A watermill on a natural stream. At first, only the mill of the Cannenburch existed, And then Dropsbeek separated from Rodebeek, and there were four watermills together. By 1650 other springs had been dug to supply the growing number of watermills with sufficient water. We have Geelmolense. In The most prosperous time, there were no less than seventeen mills along the Vaassen streams.

They are used as the power source, processing water, and later for laundry and fish farms. The fish pond is located upstream of Geelmolens. The exception is the Rodebeek which, as the name implies, contained iron-rich 'rodolm' water. This water could be used for driving watermills, but it was unsuitable as process water.

It is worth noting that there are some ponds next to the water system that are not connected to the water system. These pools indicate that in the past, in addition to using water from the Sprengenbeek, it was possible to dig groundwater directly.

04 - 3 LANDSCAPE ELEMENTS ON THE SPRENGENBEEK

1.Castel Cannenburch

Cannenburch Castle is an example of a geometric park layout that is strongly determined by the Sprengenbeek streams. The way in which the water was used in the geometric park layout on the west side of the castle turned out to be characteristic. The main structure is formed by a number of parallel axes, which consist of avenues and dug streams. During the later transformation of the central part of the park, the structure of the outer area did not change. This gives a landscape translation of the great importance that the streams and mills had for the Cannenburch.

2.The rode beek

The orange-coloured precipitations in the picture, between the leaves of the floating pondweed, are called rhodolm. It is an iron-containing compound that is formed under the influence of bacteria in places where iron seepage water comes to the surface. A wooden partition separates the clean water upstream of Nieuwe Beek from the iron-bearing "red" water at Rode Beek

3.Watermill

The Cannenburger mill is the only remaining mill in Vaassen and the oldest, but it is not currently open to tourists. Other mills have some recognizable remains after being demolished, most of which are waterfalls, as shown in the picture.

4. Sprengen source

More than 10 sprengen sources (sprengen koppen) are located upstream of the vassen.

5.Fishponds

There is a fish pond in Geelmolensebeek, which is still operating today, mainly for trout.

FIG. 4.5 Elements of historical value on the Sprengenbeek
Source: by Author

1. Castle Cannenburch



2. The rode beek



3.1 Exsiting Watermill

3.2 Watermill relics

3.2 Watermill relics

4. Sprengen source



5. Fishponds

04 - 4 THE ECOLOGY VALUE OF THE SPRENGENBEEK

The Sprengenbeeks represent special natural values in the stream and around it. Typical stream vegetation is fairly common; source communities also occur very locally. The natural values are related to the water quality and the stream layout and are also broadly linked to landscape patterns, structures and elements in the entire stream valley.(Menke & Meijer,2007)

Ecological communities have many determinants. For example, the flow rate of water, flowing water is home to completely different species than stationary water. The temperature of the water is related to whether the stream is sheltered or not.(Menke & Meijer,2007)

In streams upstream, the channel is narrower, and the flow is faster so that the soil and bank material are washed away. The water has very clean sand and gravel, some leaves and branches. The temperature of the groundwater here varies only within a narrow range of 8 to 1°C. (Menke & Meijer,2007)Trees are also planted on both sides of the stream to reinforce the bank, and there is a dense shade above the stream to prevent excessive evaporation of water. Therefore, during severe frosts, streams do not freeze.(Menke & Meijer,2007) This cool, clear, flowing water is suitable for the survival of stenothermic reophile species - stenos is narrow, and therme is warm. An example is flatworms. The name says it all: this animal looks like a bug, but instead of being round, it's flat. It glides on the ground or on wood and branches.

The situation middle stream is different. Streams are wider, the flow tends to be less steady, and there is more silt at the bottom. More aquatic plants are growing there, and the creek is often unshaded between the meadows, so the water is warmer or cooler.(Menke & Meijer,2007) Therefore, other animals are found here: more species that live on aquatic plants or in silts.

With the natural bank, the stream is wider, slower flowing, and has the characteristics of a lowland stream with a more natural look. Due to the highly moist pastures and fields, as well as the streams, meadow birds can benefit greatly downstream.

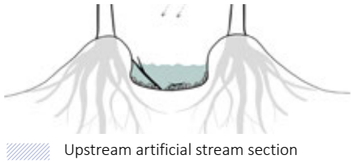
In addition, the ecological values are also linked to historical forms of land use and water management, such as stream diversion points, ponds and flow meadows, or to specific works of art.

The bullhead fish,
can be found in ponds and slow-flowing streams in muddy conditions, and can withstand a wide range of water temperatures.

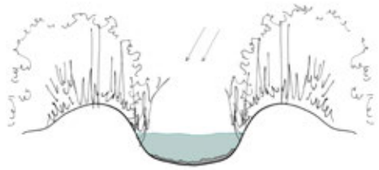
The brook lamprey,
has developed adaptability. For example, they are streamlined, which teeth can use to attach to stones to prevent them from being carried away by running water

For kingfishers and great yellow wagtails,
unpolluted and permanently flowing streams are a prerequisite. And running water provides a supply of insects.

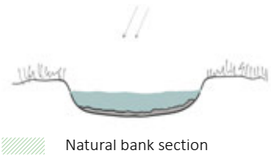
Water is also important for non-stream birds, such as sandpipers whose sensitive bills can only find food in soft, moist soil.



Upstream artificial stream section



Middlestream artificial streamsection



Natural bank section

FIG. 4.6 Parts of the Sprengenbeek that have ecological value
Source: by Author

04 - 5 THE GROUDNWATER FLUCTUATION OF THE SPRENGENBEEK

The groundwater system in the Veluwe can be divided into three zones: the high , transition zone and low zone. Future changes in groundwater levels may cause nuisance or additional drying at different locations.

High zone
On the higher parts of the Veluwe, the groundwater level is 1.5 meters to more than 20 meters below ground level.The vegetation is mainly dependent on rainwater and hanging water. Extreme precipitation does not easily lead to nuisance. In dry periods the groundwater level in the high zone was already deep so it makes relatively little difference. (Manifest Klimaat Vallei & Veluwe,2022)

Transition Zone
the groundwater level here is between 150 and 70 cm below ground level during wet periods. There are no ditches present that can drain the groundwater. In this zone occasional nuisance can occur. In extremely dry periods the groundwater level can sink further, which can cause drought damage. (Manifest Klimaat Vallei & Veluwe,2022)

Low zone
This zone has a lower ground level and therefore relatively higher groundwater levels. Ditches are present that can drain the groundwater. In drought conditions, the seepage water from the high zone can also be retained in the ditches. Drought is therefore less likely to cause problems here .(Manifest Klimaat Vallei & Veluwe,2022)

The site we designed is mainly located in the Transition Zone, which is a groundwater fluctuation zone.Therefore, we need some measures to cope with the climate during the dry and wet seasons.

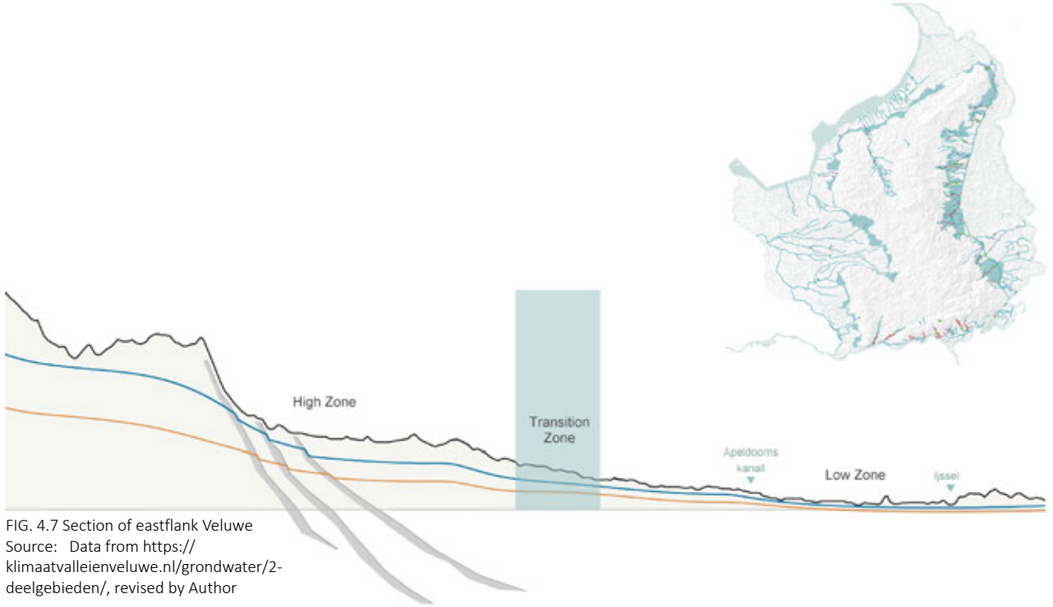


FIG. 4.7 Section of eastflank Veluwe
Source: Data from https://klimaatvalleienveluwe.nl/grondwater/2-deelgebieden/, revised by Author

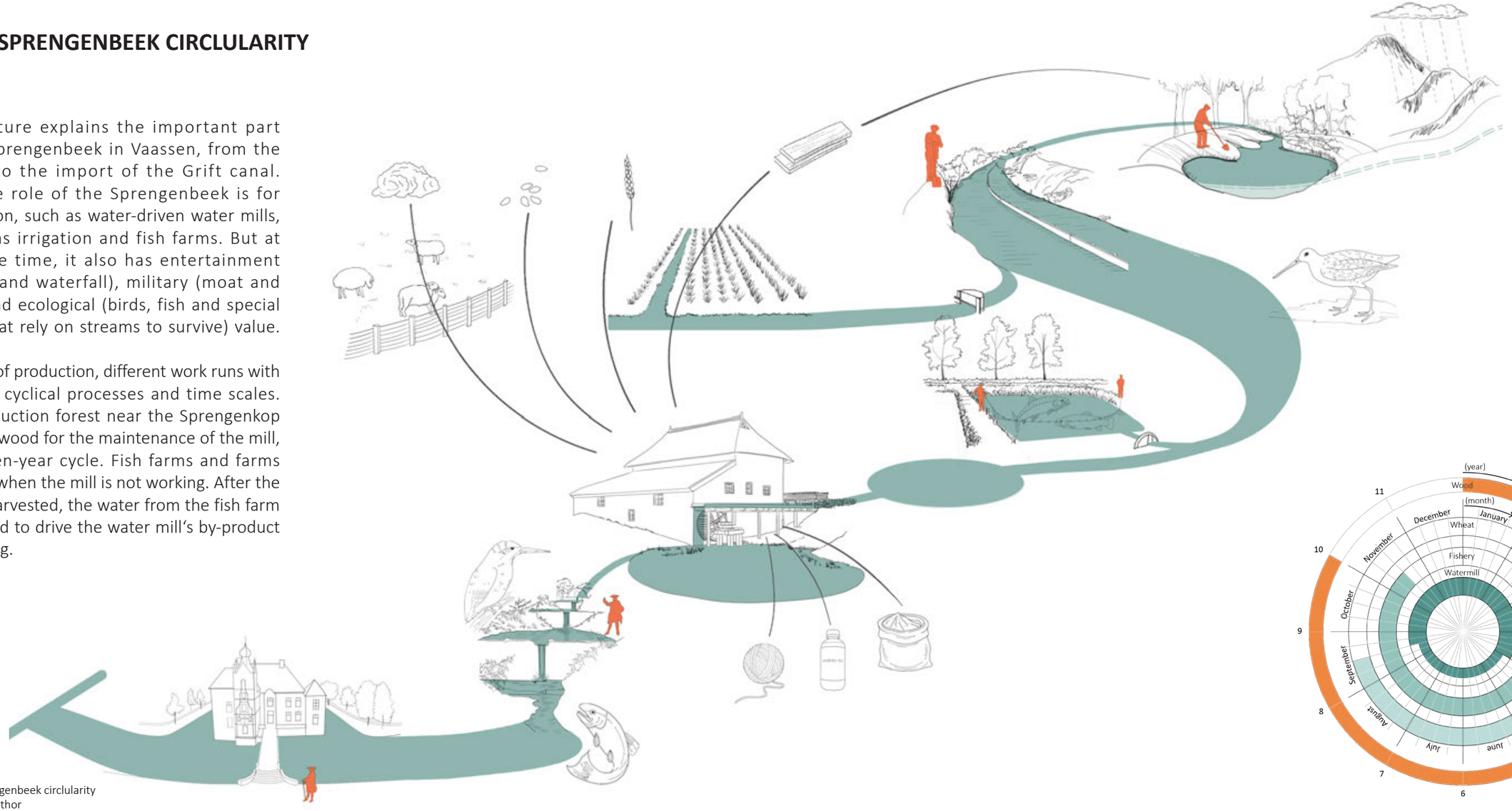
FIG. 4.8 Groundwater flucuation area
Source: data from pdok.nl

Groundwater fluctuation area

04 - 6 SPRENGENBEEK CIRCLULARITY

This picture explains the important part of the Sprengenbeek in Vaassen, from the source to the import of the Grift canal. The core role of the Sprengenbeek is for production, such as water-driven water mills, as well as irrigation and fish farms. But at the same time, it also has entertainment (garden and waterfall), military (moat and canal) and ecological (birds, fish and special plants that rely on streams to survive) value.

In terms of production, different work runs with different cyclical processes and time scales. The production forest near the Sprengenkop provides wood for the maintenance of the mill, with a ten-year cycle. Fish farms and farms produce when the mill is not working. After the farm is harvested, the water from the fish farm is released to drive the water mill's by-product processing.



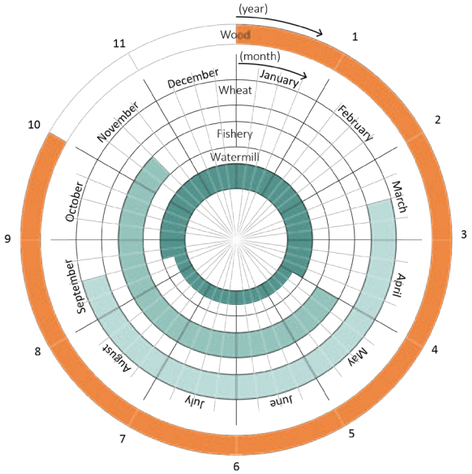


FIG. 4.9 Sprengenbeek circlularity
Source: by Author

04 - 7 LANDSCAPE LAYERS

Geomorphology layer

A moraine is a small mountain in the landscape, formed by a glacier pushing up the ground.The funnel-shaped dry valley is exactly where the sprengenbeek originated

FIG. 4.10 Geomorphology layer
Source: data from pdok, revised by author

Soil layer

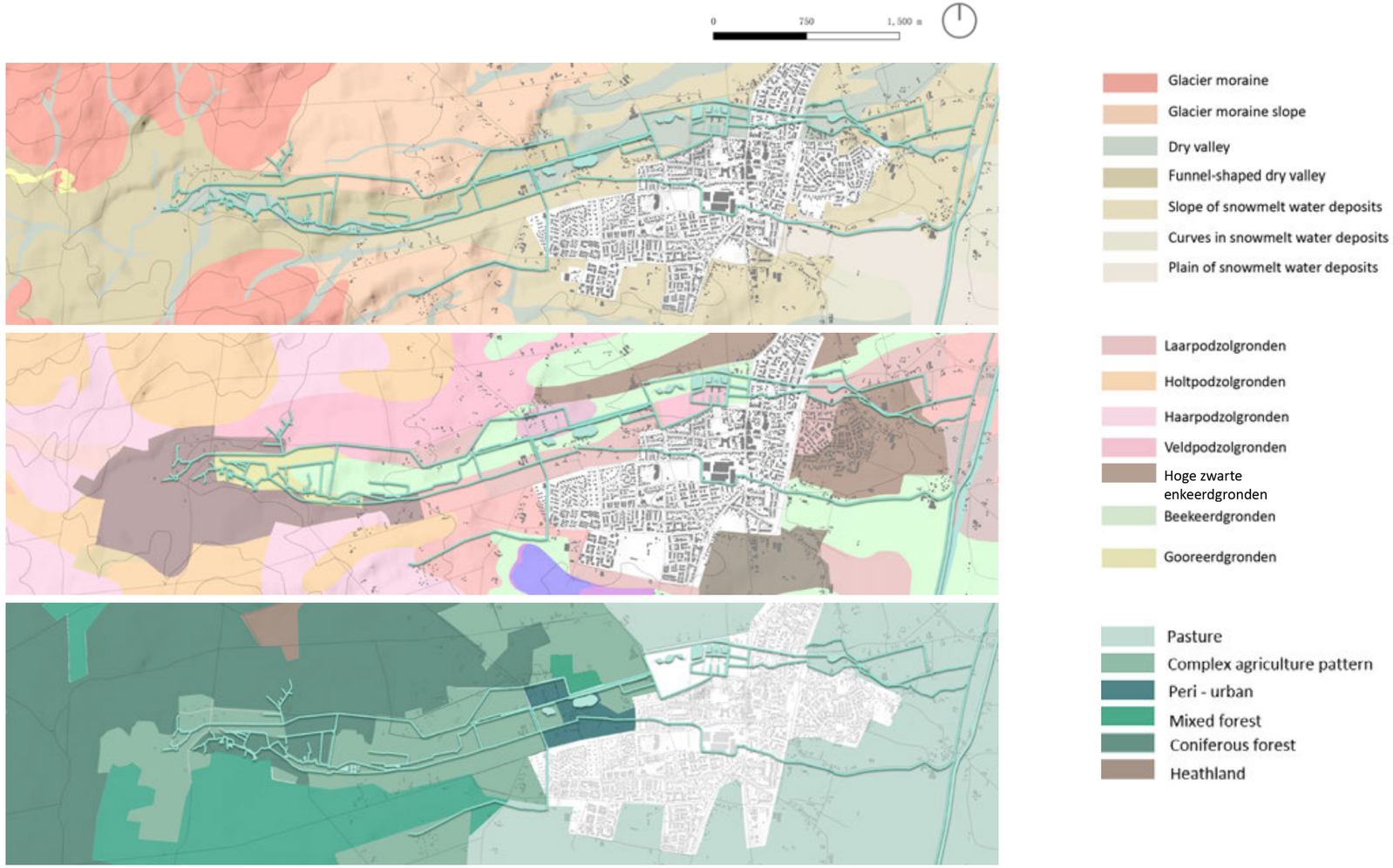
The nutrient richness of the soil determines which type of crop is suitable for which location. A detailed description of a specific soil and the adapted plants can be found in the appendix.

FIG. 4.11 Soil layer
Source: data from pdok, revised by author

Landuse layer

From landuse layer we could see, both sides of the dry valley are now covered with forest, while the middle and lower parts of the valley are agricultural areas, mostly used for pasture. in the middle area, livestock raised include, cattle, horses and a few sheep, etc.

FIG. 4.12 Landuse layer
Source: data from pdok, revised by author



04 - 8 LANDSCAPE TYPES

Veluwe forests

In the 18th century, investors and governments planted large areas of coniferous forests in dunes and heathland for logging and sand stabilization. New forests are usually divided into square or rectangular blocks by roads.

Enclaves

The enclaves here refer to the towns The enclaves here refer to the towns whose borders are surrounded by the forests of Veluwe. Small-scale communities in these lands are surrounded by enclosed highlands ("Kampen").

‘Kampen’ landscape

During the 16th and 17th century turf (‘plaggen’) fertilization made it possible to intensify the production on arable lands.The 'kampen' is individual, small-scale and enclosed plots with hedgerows surrounding each individual parcel.

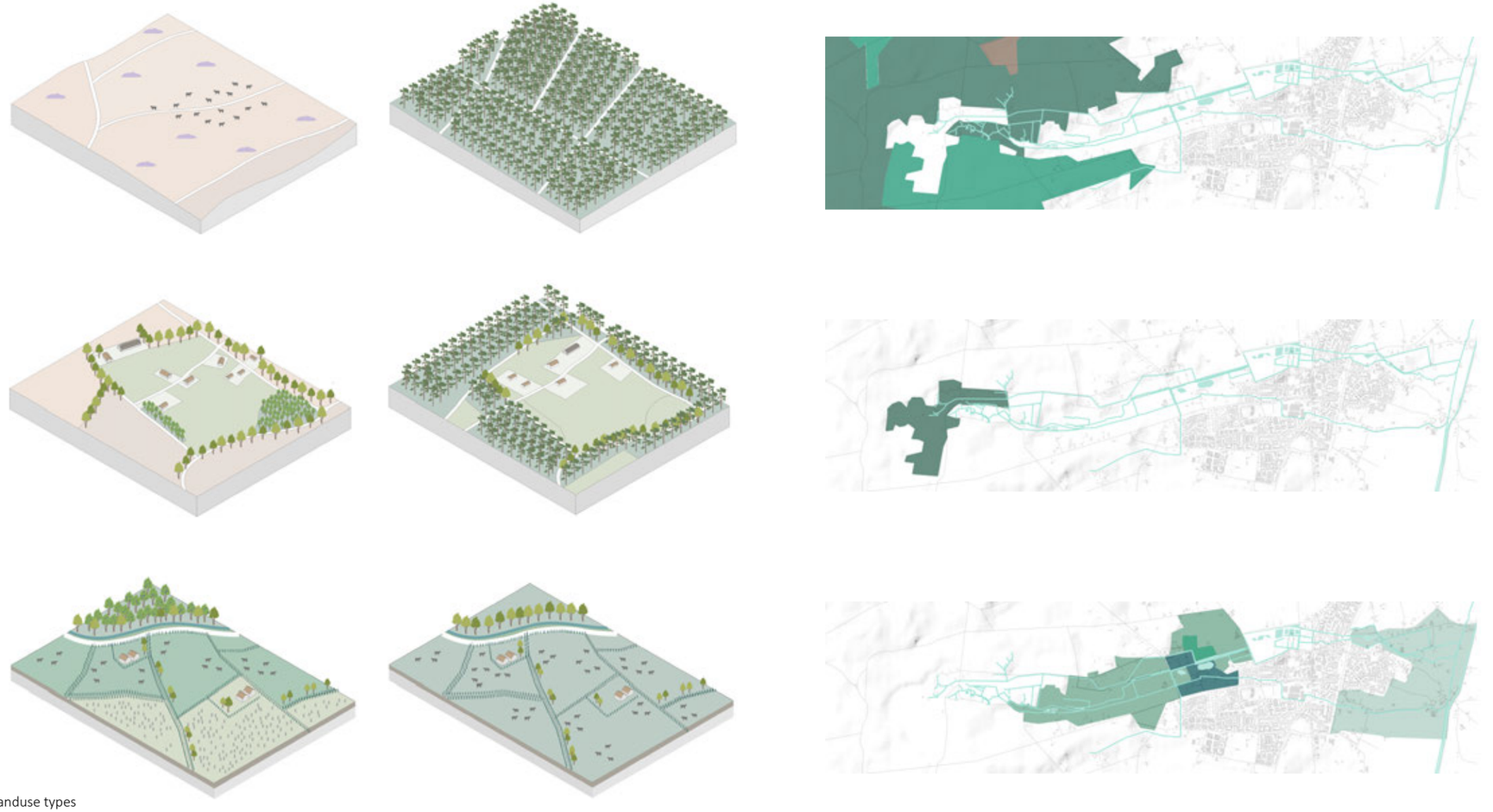


FIG. 4.13 3 Landuse types
Source: by author

04 - 9 CHANGES IN AGRICULTURE SYSTEM

1. Prevous heathland farming system

In the 15th and 16th centuries, due to the development of the cloth industry in the Dutch cities, there was a great demand for wool, and the farmers of Veluwe kept many sheep. Sheep graze on heathland and drink from the nearby fens. Later the growing Dutch cities were in great demand for food. Farmers intensified their farming, so the fields needed more sheep manure and forage. The heathland farming system is gradually perfecting.(Horst, 2016)

It is characterised as a crop-livestock farming system :
Sods cut from the heathland are spread out in a stable with a recessed bottom where the sheep live during the winter months. An initial layer of litter is spread for the animals to use as bedding material and to defecate in, and as the litter is soiled, new layers of litter are continuously added by the farmer. In this fashion, a deep litter bedding can build up to depths of several meters. The stable is emptied each spring, after which the manure is used to fertilise nearby fields. Over time, these grounds have risen and are now recognisable in the landscape. This arable land was used not only to cultivate the sheep's winter fodder but also for food for the region's inhabitants. (de Hoge Rielen, 2012; Sonneveld & Jongmans, 2010)

During the 17th and 18h centuries, water mills contributed to the rise of industry, and the population began to grow in the cities. Therefore, more fields are needed. Large-scale farmland requires irrigation; that's why the water source of the Sprengenbeek is cherished.

2. Current farming system

Around the 19th century, to stabilize the quicksand and for economic benefits, people began to clear heathland and try to plant forests on the dunes. Wood production is profitable. New forests are usually divided into square or rectangular blocks by roads. Coniferous forests are usually planted in these forest segments. (Neefjes, 2018)

At the same time, new fertilizers were also used. Sheep manure became superfluous. Much of the original farmland has been turned into pastures, especially in the downstream areas, where pastures are very dense. The nitrogen from pastures eventually falls on the soil through precipitation. This further reduces the biodiversity of the Veluwe area.

Economic forests and extensive pastures have transformed the landscape of this area. And the water mill on the Sprengenbeek was demolished after it lost its function.

FIG. 4.14 Agriculture circularity system
Source: by author

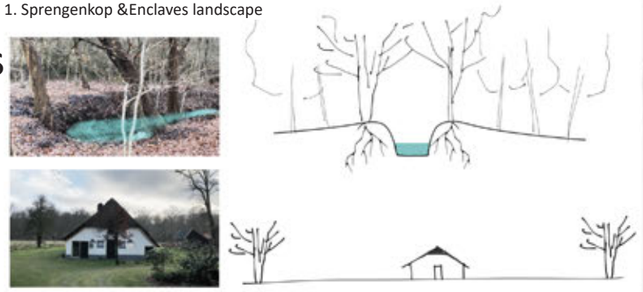
04 - 10 SPATIAL ANALYSIS

This area is the source of the Sprengenbeek. The source is inaccessible to people with typical enclaves landscape. Enclosed, elevated farms surround small-scale communities. Forests surround the farm.

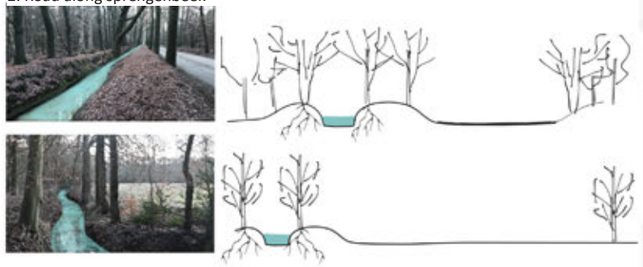
Giant bank for the Sprengenbeek and dense plantation is the feature of this area. The view is impermeable, the atmosphere is depressing, and the open space by the roadside allows light to penetrate.

The bank of the Sprengenbeek is relatively lower. This is a very typical village landscape of a stream valley. The land is used as pasture. The farms are very scattered, and there are some estates. The watermill was demolished, and a small waterfall remains as a decoration for the garden.

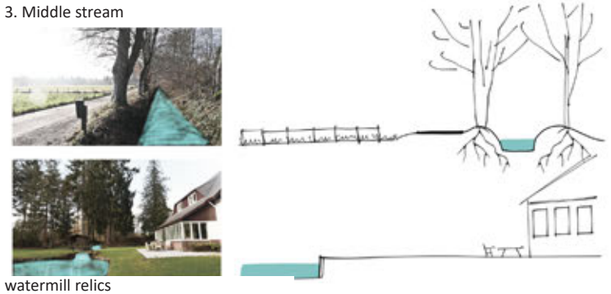
1. Sprengenkop &Enclaves landscape



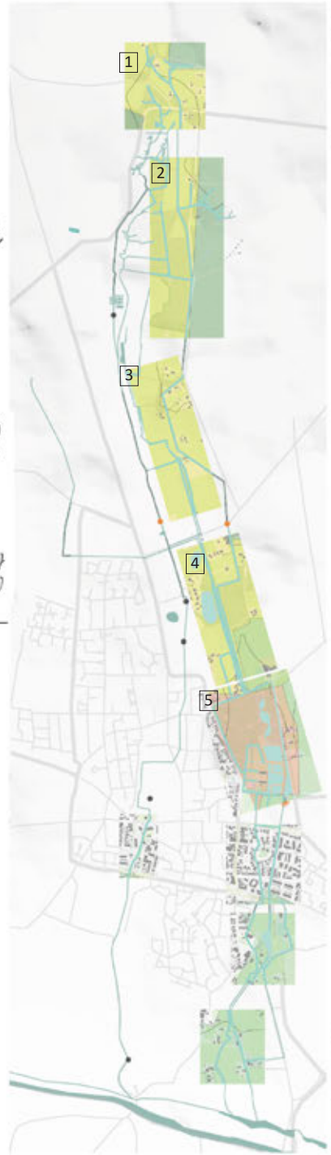
2. Road along sprengenbeek



3. Middle stream



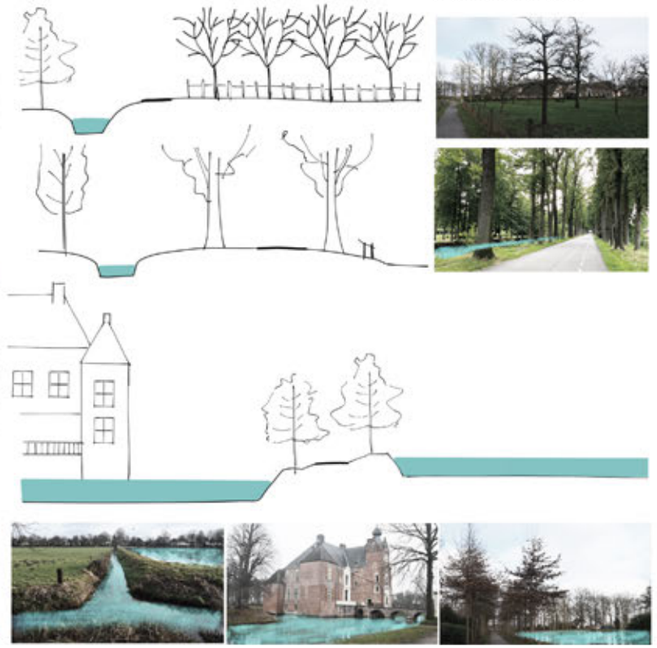
watermill relics



4. Middle stream

This is the area where the three streams run parallel. Both sides are forested, with occasional open clearings used as farms. Villages are larger and more concentrated. Both sides of the road are planted with dense shrubs, and the view is completely obstructed.

5. cannenburch castle



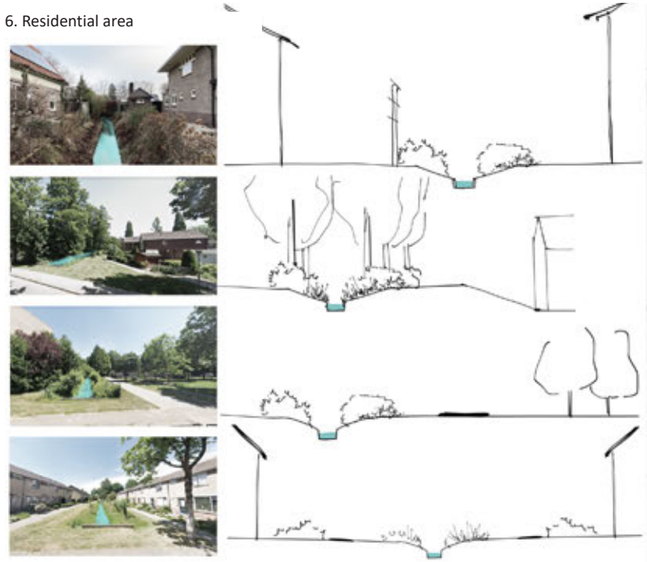
The Canenburch Castle layout has a strong axisymmetric order, and the spatial form is determined by the stream. The axis of the park on the west side is connected with the stream. The axis of the garden is almost perpendicular to the west axis. Where the two axes meet is the location of the castle. All three streams have been introduced into the castle and gardens to serve as moats, ornamental pools, and fish ponds.

FIG. 4.15 Spatial analysis
Source: by author

04 - 10 SPATIAL ANALYSIS

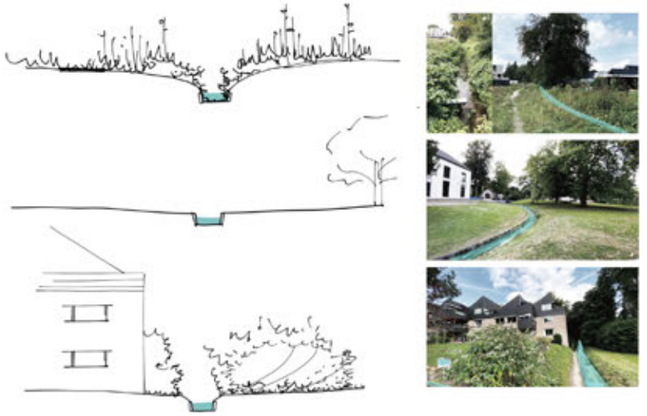
Two streams run through the neighborhood. Most of the time the sides of the stream are overgrown with shrubs or covered by thick branches. These bushes and tree columns act as fences, keeping people away from the streams. Sometimes the streams is partly shaded, and can be appreciated, but at the risk of excess evaporation.

6. Residential area



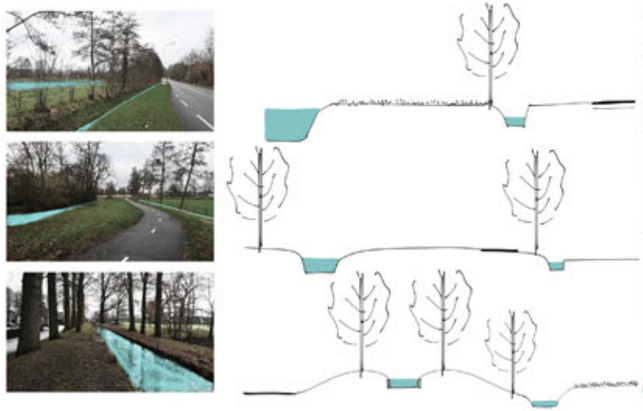
The sprengenbeek in this area is clearly under-maintained. Weeds float in the river. The sprengenbeek is either hidden in the bushes, inaccessible in private areas, or exposed outdoors.

8. in urban

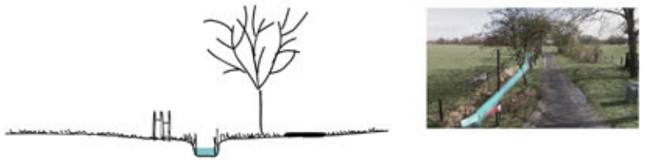


The sprengen channels in this area are very deep, Correspondingly, the bank of the channel is also very high. This probably because the channels may sometimes face larger runoff from the reservoirs. After the water mill in this area was demolished, the surrounding area is still used as farmland.

7. Edge of the urban



9. in field



This area of sprengenbeek is surrounded by farmland and most of the time there are no roads beside it. They face the risk of losing their identity.The farmland is dense here, and fences often surround the farmland.

FIG. 4.16 Spatial analysis
Source: by author

In general, this process of spatial analysis is more like a documentation. But it is also a process of studying and understanding the site through mapping. We can see the changes in the environment around the sprengenbeek and the width of the sprengenbeek, as well as the changes in the height of the two banks

05 | DESIGN

05 - 1 CONCEPT

EXISTING CHALLENGE:

As we analyzed before, now the Sprengenbeek is gradually fading out of people's sight, and few people can tell the story of the Sprengenbeek. And climate change is putting the Sprengenbeek on the brink of drought. At the same time, intensive agriculture brings severe environmental problems and separates with the Sprengenbeek.

STRATEGIES:

1. Warter management measures for the resilent and clean sprengenbeek

Different water management measures depend on the Sprengenbeek surroundings to keep the Sprengenbeek wet all year round.

2.Narrative landscape design

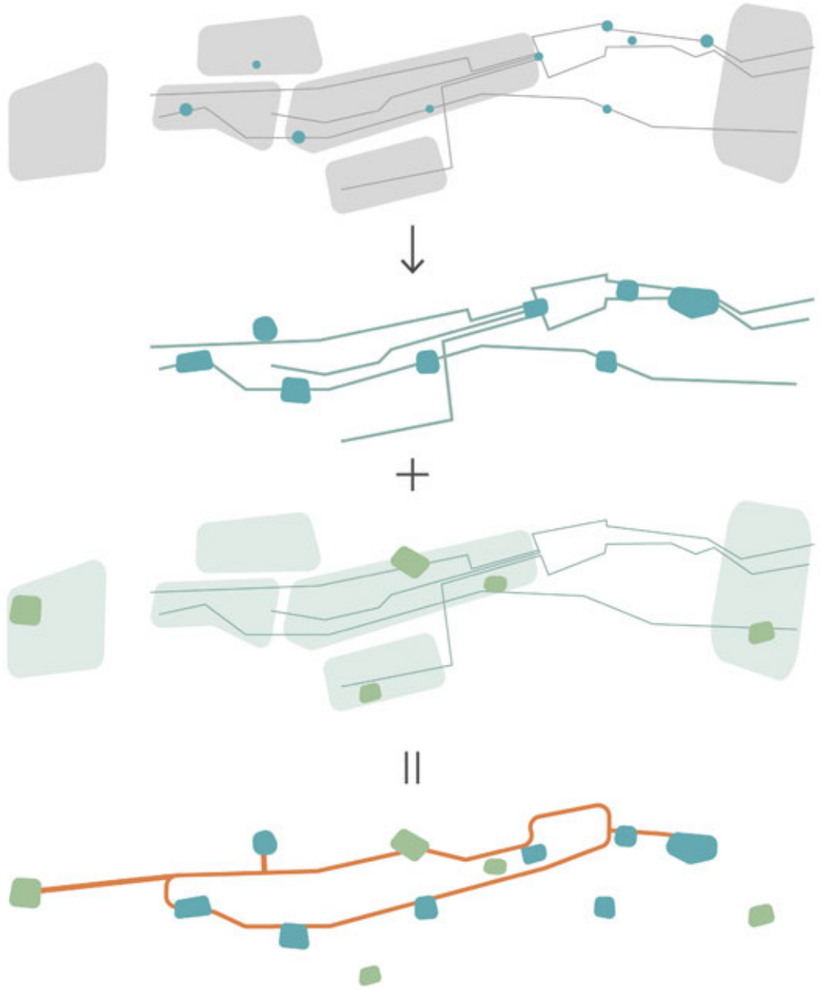
Sprengenbeek is a cultural heritage, it not only has the remains of many factories and water mills, but also artificially raised ditches, rode beeks, castles, and projects such as sprengenkop, dozens of sprengenkop gathered together, just Like land art. These elements are all distributed next to the sprengenbeek, and they all have the potential to become "genius loci" for public spaces within educational value.

3. Transformation of agriculture form

For the cultural landscape where sprengenbeek exists, Explore various forms of agriculture to achieve circular and clean aims. At the same time, this offers the opportunity to diversify the landscape. The new granges, nature reserves, heathland..., all become attractive elements for tourists. The Kampen landscape for the present and the future is defined.

GOAL:

Finally, there is a wealth of culturally and historically significant items in a varied and sustainable landscape context. Particularly suitable for cycling and walking. Therefore, the final product is an appealing routing system with numerous nodes in the Sprengenbeek landscape.



EXISTING PROBLEMS:
1. Lost of inheritance
2. Drought & flood of Sprengenbeek
3. Unsustainable Agriculture

STRATEGIES :
1. Warter management measures for the resilent and clean sprengenbeek
2.Narrative landscape design
3. Transformation of agriculture form

GOAL:
A sustainable & diverse Sprengenbeek landscape that can be explored through a routing system

FIG. 5.1 Concept
Source: by author

05-2 PRINCIPLES & STRATEGY

HEATHLAND FARMING:

Restoration of heathland systems on a small scale will contribute significant ecological value. It will also greatly increase the infiltration of rainwater. The runoff of the Sprengenbeek will be more abundant.

DIVERSE FOREST:

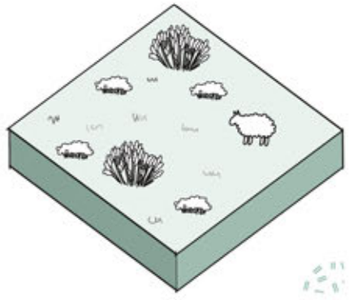
It means forests and thickets of different tree species and age groups. This requires regular maintenance and operation. As patches of diverse forests begin to form, diverse animal communities begin to emerge as well. This also helps to improve the infiltration of groundwater.

AGROFORESTRY:

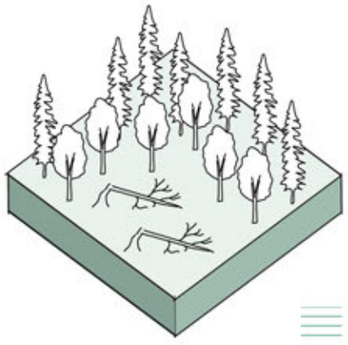
Agroforestry systems are land management practices in which trees and shrubs are produced on the same land area as agricultural crops or livestock. It combines trees, crops, or livestock to increase diversity, productivity, profitability, and environmental stewardship. (Oelbermann,2017) Agroforestry can have different forms, including forestry and cattle farming, forestry and corp farming and food forest, etc.

ADAPTED CROPS:

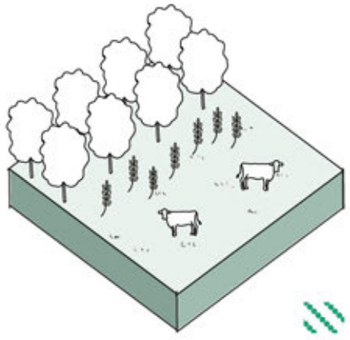
It means choosing crops based on natural conditions. The altitude determines the degree of dryness, the wetness, the nutrient richness of the soil and the permeability must also be considered.



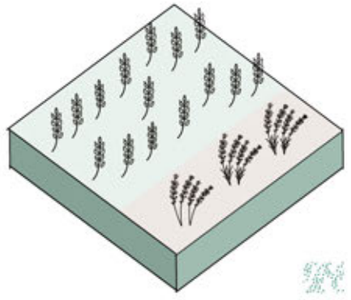
Heathland farming



Diverse forest



Agroforestry



Adapted crops

05-2 PRINCIPLES & STRATEGY

INCREASE INFILTRATION:

Increasing seepage is a solution to climate change. In the upper stream, the Sprengenbeek seepage is maximized through the development of heathland farming systems, coniferous forest thinning and mixed forests.

INCREASE WATER QUALITY:

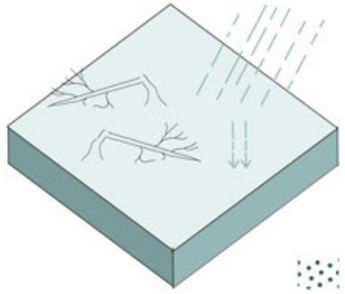
Water quality can be greatly improved by the bending of aquatic plants and streams. Beneficial for biodiversity in streams. Possibilities for entertainment are also provided in the later stages.

RETAIN WATER:

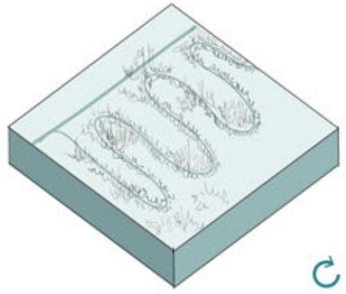
Water conservation becomes imperative in the face of the challenges of climate change. The ponds that already exist around the Sprengenbeek, the ponds that are used to hold water for the water mills, or the fish ponds, can be used as water storage containers.

SPRENGENBEEK PUBLIC SPACE DESIGN

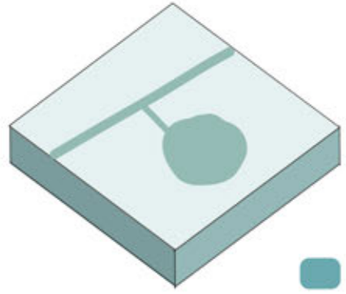
The heritage elements situated close to Sprengenbeek all hold the potential to be developed as "genius loci", and Some artefacts can bear symbolic markings. These can provide public space with educational value.



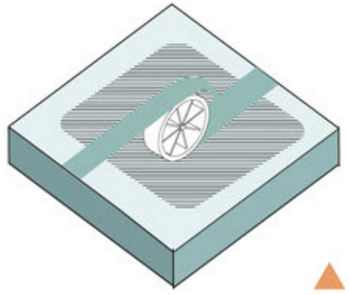
Increase infiltration



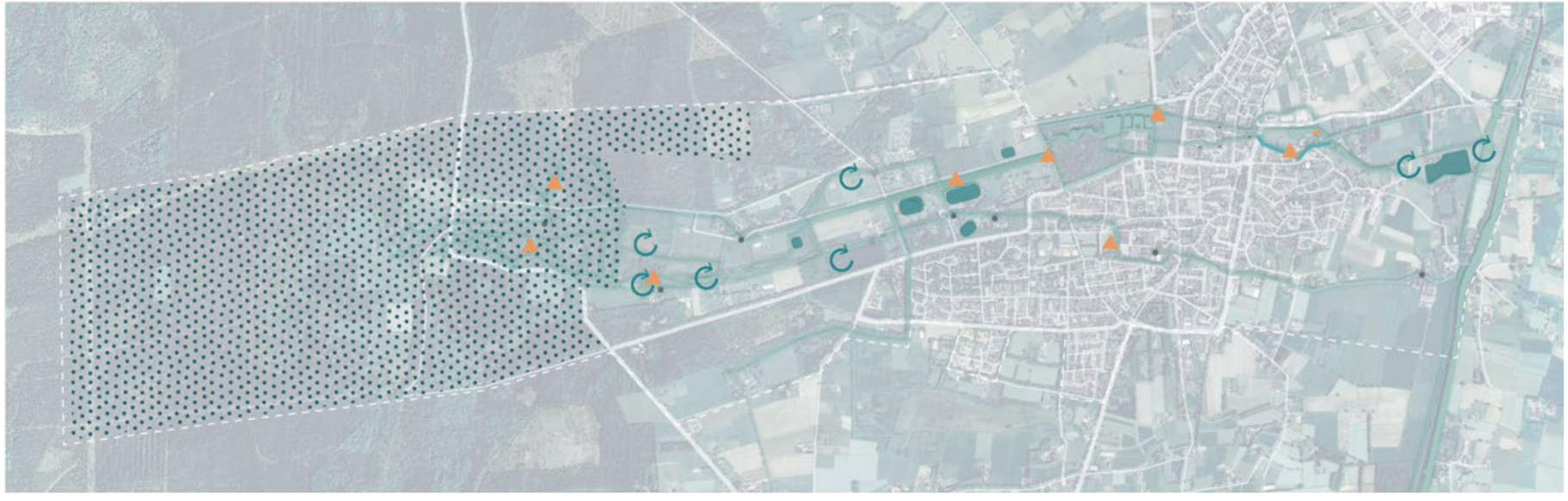
Increase water quality



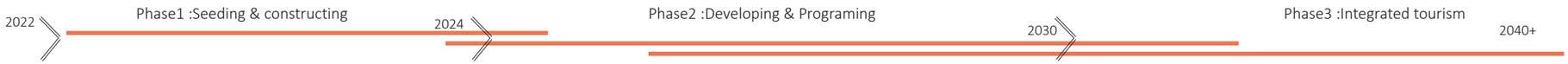
Retain water



Sprengenbeek public space design



05-3 STRATEGIC DEVELOPMENT



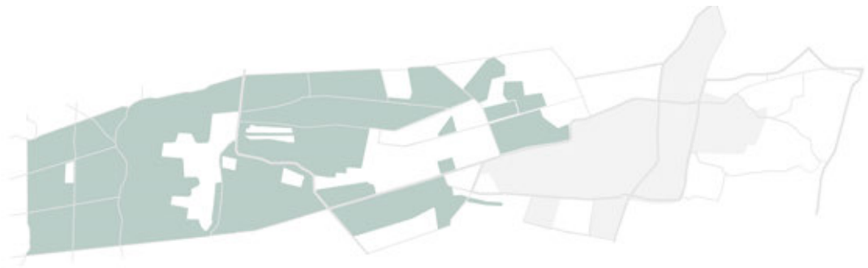
Forest Layer:

Phase1:
Cutting down part of the coniferous forest. Retain some tree branches upstream. Seeding for the deciduous forest and food forest

Phase2:
Further removal of coniferous forests in a seepage area. Started small-scale heathland farming for maintenance of heathland

Phase3:
Heathland, a mix forest and agroforestry formed. The diverse landscape and rich biotope formation

With the development of strategy, the monotonous artificial forest becomes "Mixed forest communities", "Heathland", "Productive food forest" and" Experience food forest".



Existing forest

Phase1

Phase2

Phase3

Land Use Changes

Overlap with other layers

05-3 STRATEGIC DEVELOPMENT

Agriculture Layer:

Phase1:
Planting suitable crops (midstream and downstream).
Seeding for 3 types of food forest (Experience food forest, productive food forest and strip forestry on the edge of pastures)

Phase2:
Started small-scale heathland farming for maintainance of heathland

Phase3:
Diversified agroforestry and heathland farming will replace the current monotonous pastures as a result of a strategy. The cleaned circular agriculture exists between the high and lowlands of the veluwe flank.

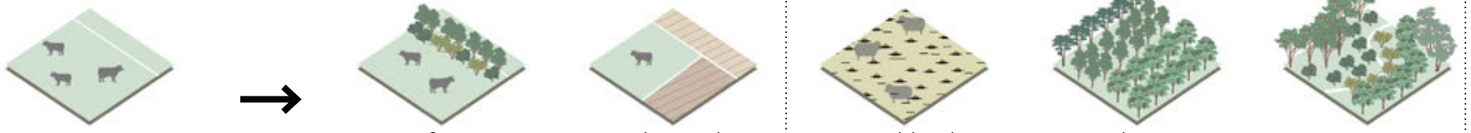
Existing forest

Phase1

Phase2

Phase3

Land Use Changes



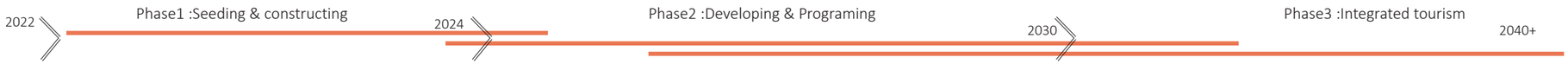
05-3 STRATEGIC DEVELOPMENT

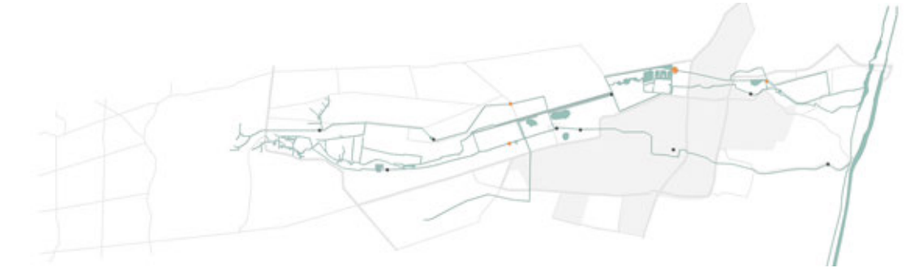
Sprengenbeek layer:

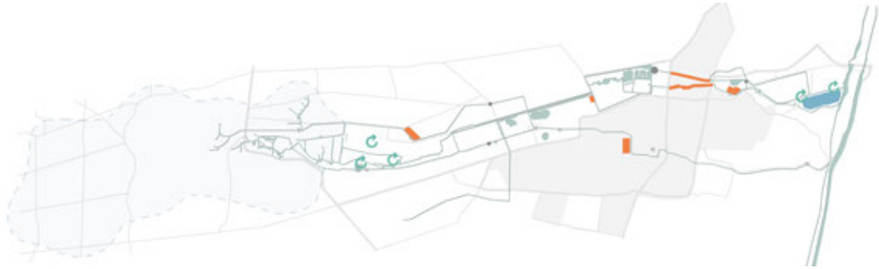
Phase1:
Construction of public space in urban and suburban areas
Construction of a new fish pond
Then the purification of old fish ponds start
Meandering of natural river banks upstream for Wetlands

Phase2:
With increasing infiltration , construction of retention ponds begins.
Water quality also increased.

Phase3:
Stream with clean and adequate of water.
Special plants and fishes growth in wetland and surrounding environment
Sprengenbeek leak in to pastures to for irrigation and creats small habitat



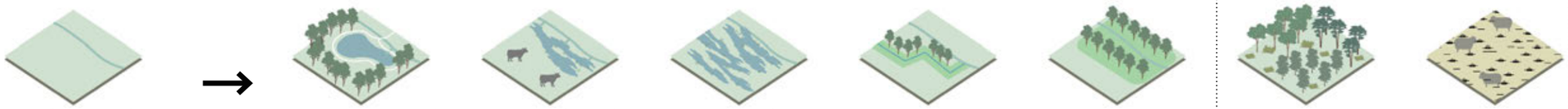

Existing forest


Phase1


Phase2


Phase3

Land Use Changes



Overlap with other layers

05-3 STRATEGIC DEVELOPMENT

Routing layer & Plan phasing

Phase1:
Construction of small public spaces in ueban area and form the initial routing system.

Phase2:
The Sprengen source, granges in the food forest area are included in routing system.

Phase3:
The wetland open to public
Ponds become natural park for swimming
Routing system with abundant nodes extended, attracting tourists nationally

05- 4 LOCAL IMPLEMENTATIONS

The local implementations of the strategies are shown below. But first, according to Sprengenbeek's structure, morphology, and surrounding environment, we can divide the site into five areas again.

Each area has a distinct design focus. I'll do a detailed design for four different areas, and another three sections will also help explain the design strategy.

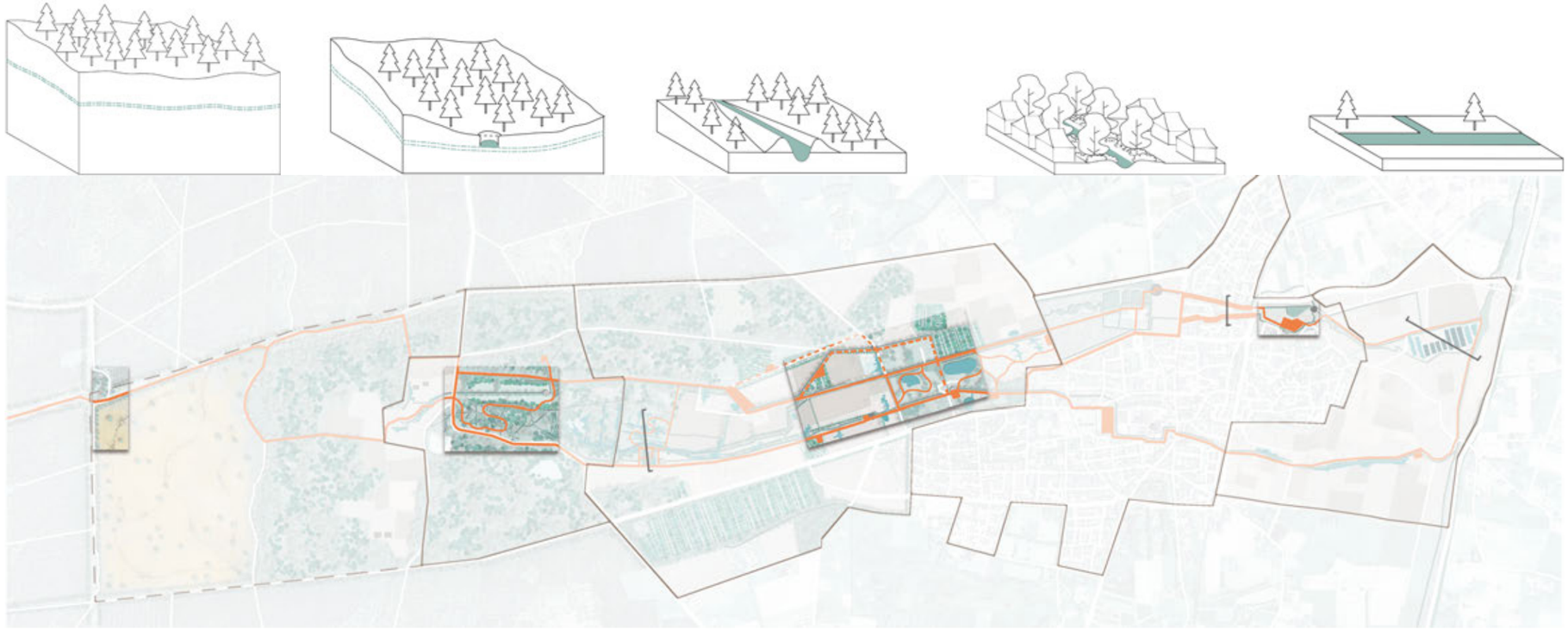
Infiltration area:
The main source of recharge for sprengenbeek is groundwater. Here is the higher part of the sprengen source, where the precipitation infiltrates and supplies the sprengenbeek.

Upper stream:
Sprengenbeek was dug up here. This area contains dozens of sprengen sources (koppen)

Middle stream:
The Sprengenbeek in the valley with artificially raised stream. The forest and agricultural area both exist here. And sprengenbeek can be utilized in various forms

Urban area:
Some of sprengenbeek in the built-up area still remains higher altitude, but some not.

Down stream:
Flat agricultural area, the Sprengenbeek with natural river banks, eventually joining the grift canal.



05- 4 LOCAL IMPLEMENTATIONS

1. INFILTRATION AREA DESIGN

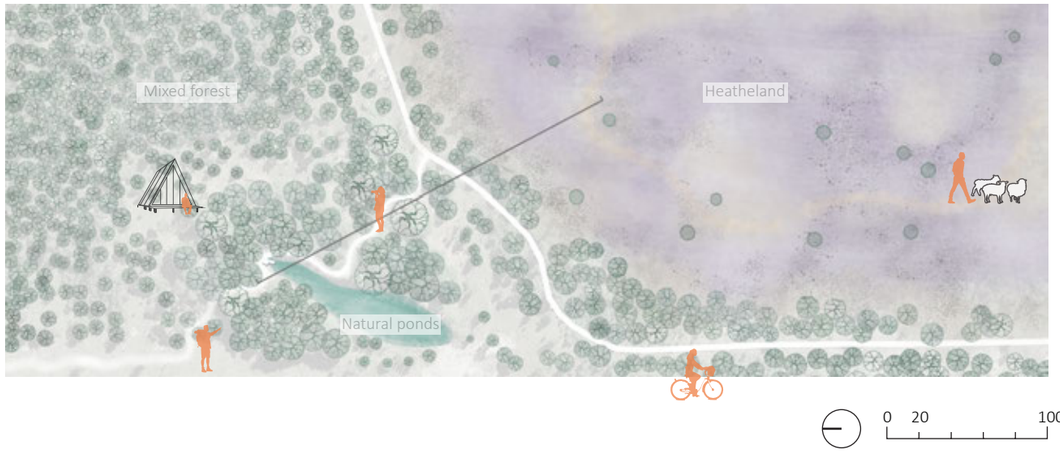
Current Status

Remnants of avenues among coniferous forest.

forest

natrual ponds

Proposed design



The area is now with dense artificial forests. During the past few decades, the most dramatic change in the area has been the reforestation of the heathland. This means that Sprengenbeek heads are now located in a completely different environment. The problems are: homogeneous forests reduce biodiversity and are expensive to maintain. Artificial coniferous will absorb most of the precipitation, reducing the seepage of sprengenbeek.

The landscape here will look wild and rugged in the future, with the dynamics entirely controlled by wild grazers and recreational use. Substantial grazing with wild animals and with sheep, combine with sodding, can reactivate the sand in heathland. The heathland will be interconnected on a larger scale, forming a migration corridor for animals and increasing ecological diversity.

Activities: shepherd,hiking, riding, animal photography, holiday cabin

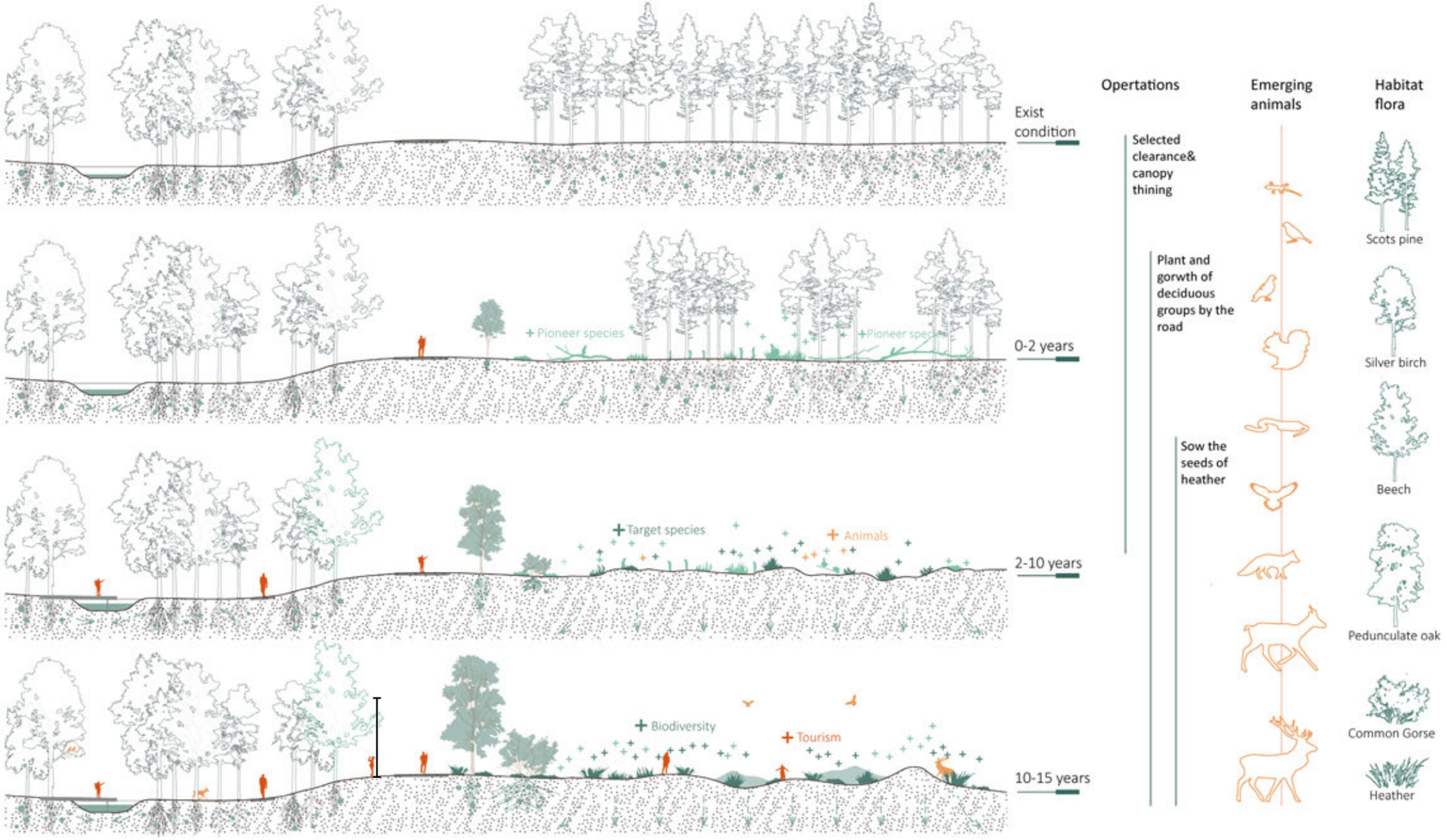
Section:From forest to heathland

Exist condition:
Dense coniferous forest, thin shrubs, few species of animals inhabiting here because sunlight is difficult to penetrate.

First stage:
Selective felling of coniferous forests, with canopy thinning. The felled tree trunks will be partially left on the site, promoting the development of biodiversity. The felled trees look like devastation to nature. However, a lot of new life is emerging in old stumps and dead wood.

Second stage:
The coniferous forest in the design area is gradually cut down. The tree remains rotted away. Sow the heather seeds when needed, and the wasteland begins to develop. More groundwater can seep out.

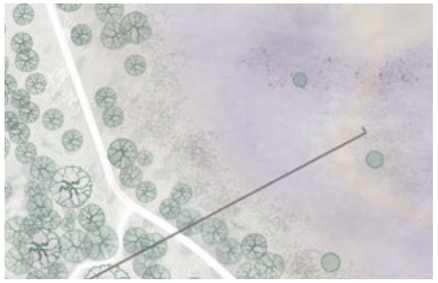
The third phase:
All tree remains will have rotted away, and the heathland ecosystem will form. Special insects, birds and butterflies are found in the open heathland and shifting sand areas. Tourists will find animals in underground seepage ponds to come and drink.

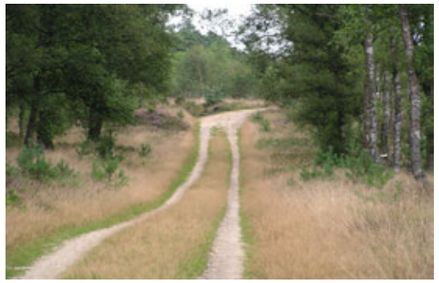


0 20m
Vertically expanded 4 times

Experience:From forest to heathland

Existing artificial forest ⟶ Heathland

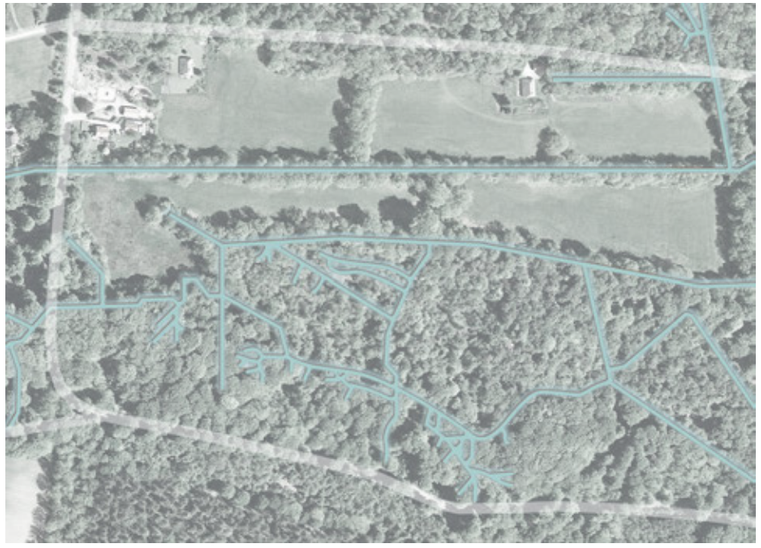




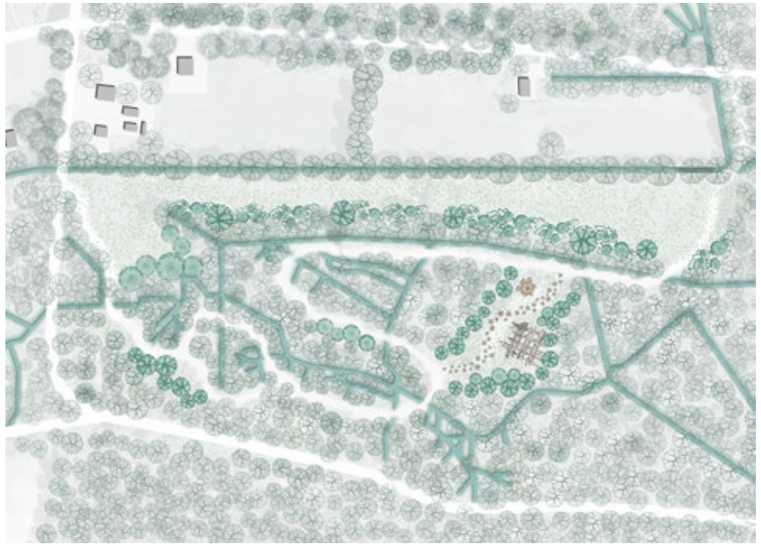
05- 4 LOCAL IMPLEMENTATIONS

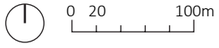
2. SPRENGEN SOURCE DESIGN

Current Status



Proposed design





The source of the Sprengenbeek is the most mysterious place in the whole system. There are dozens of Sprengenbeek heads in this area. This makes the site dramatic and artistic.

The Design idea is: Through forest management, make room for deciduous trees and shrubs in conifer-dominated forests. These areas gradually extend into ecological patches that serve as habitats for various animals.

Forest paths are created under the guidance of forest management, connecting nodes and adjacent roads. People can see the "Land Art" of the Sprengenbeek heads.

Both human and natural processes made this a unique place.

Activities: Hiking, source exploring

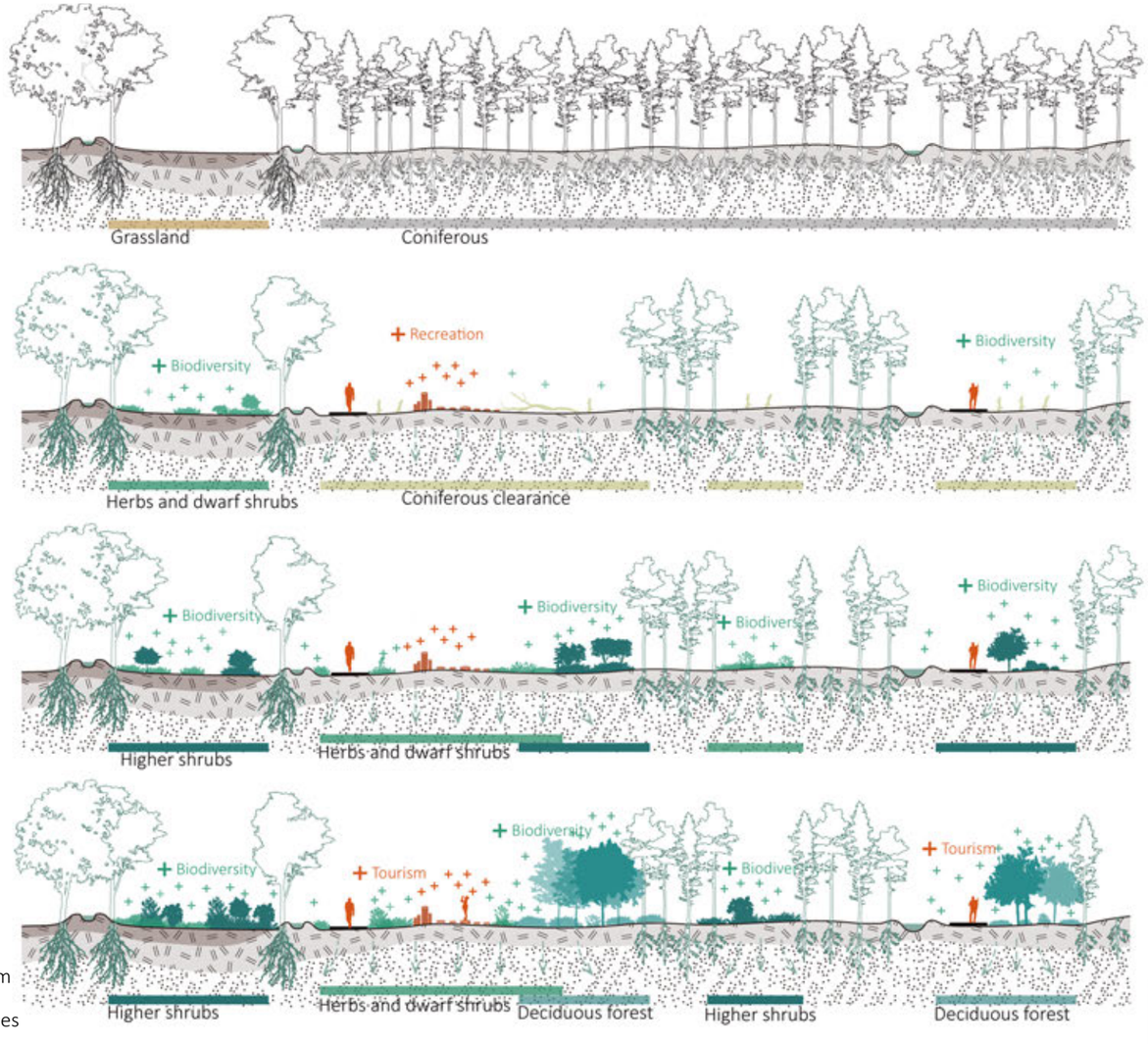
Section: Mixed forest succession & Exploring space

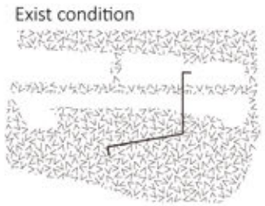
Current status:
Agriculture encalve, and inaccessible, monolithic artificial forests. The underlying photosynthesis is weak, and shrubs cannot grow, and the forest level is monotonous

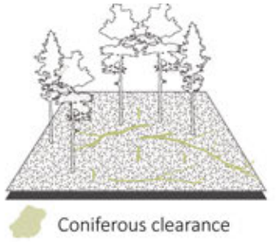
First stage:
Selective deforestation, create open spaces of different sizes in the forest to enhance photosynthesis. The felled tree trunks will be partially left on the site, promoting the development of biodiversity.

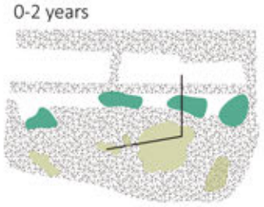
Second stage:
The most interesting scene in this stage is the different status of the trees. Some of them are thriving, some are dying, some have been artificially cut down, and some are collapsing and decaying.

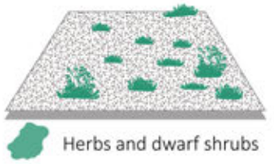
Third phase:
Different habitat patches developed, and multi-layered mixed forests formed. And diverse animal communities emerge during the process.

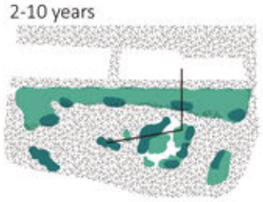


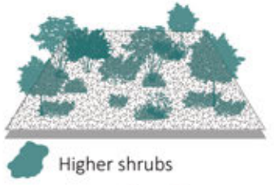


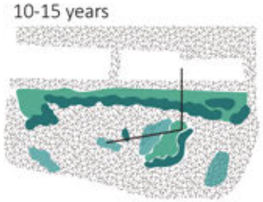




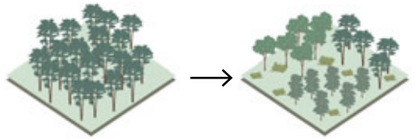




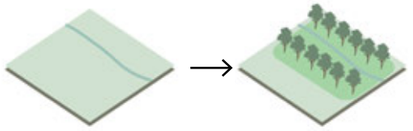




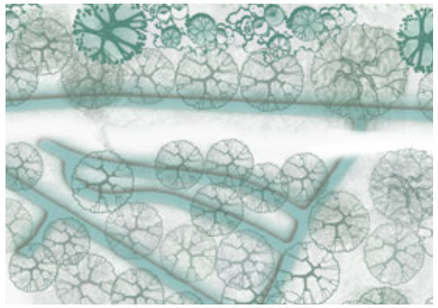
Experience: Exploring sprengen source in mixed forest

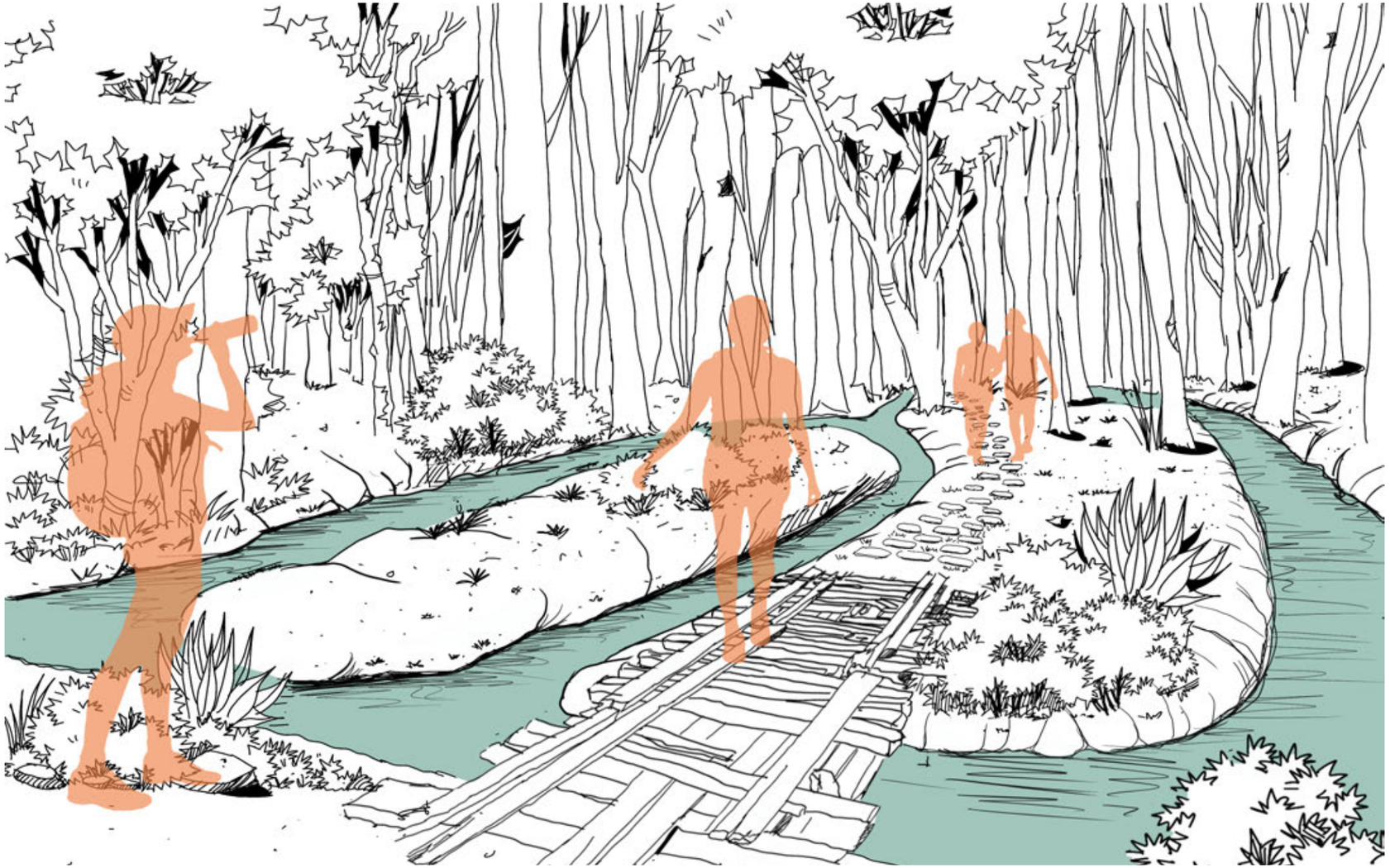


Existing artificial forest → Mixed forest communities

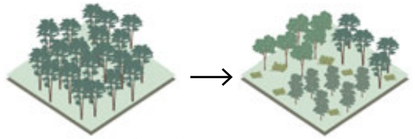


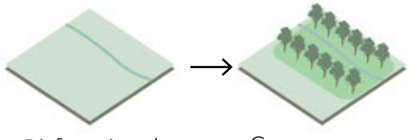
Disfunctional Sprengenbeek → Green space along the sprengenbeek

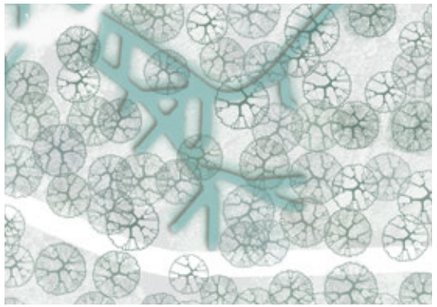


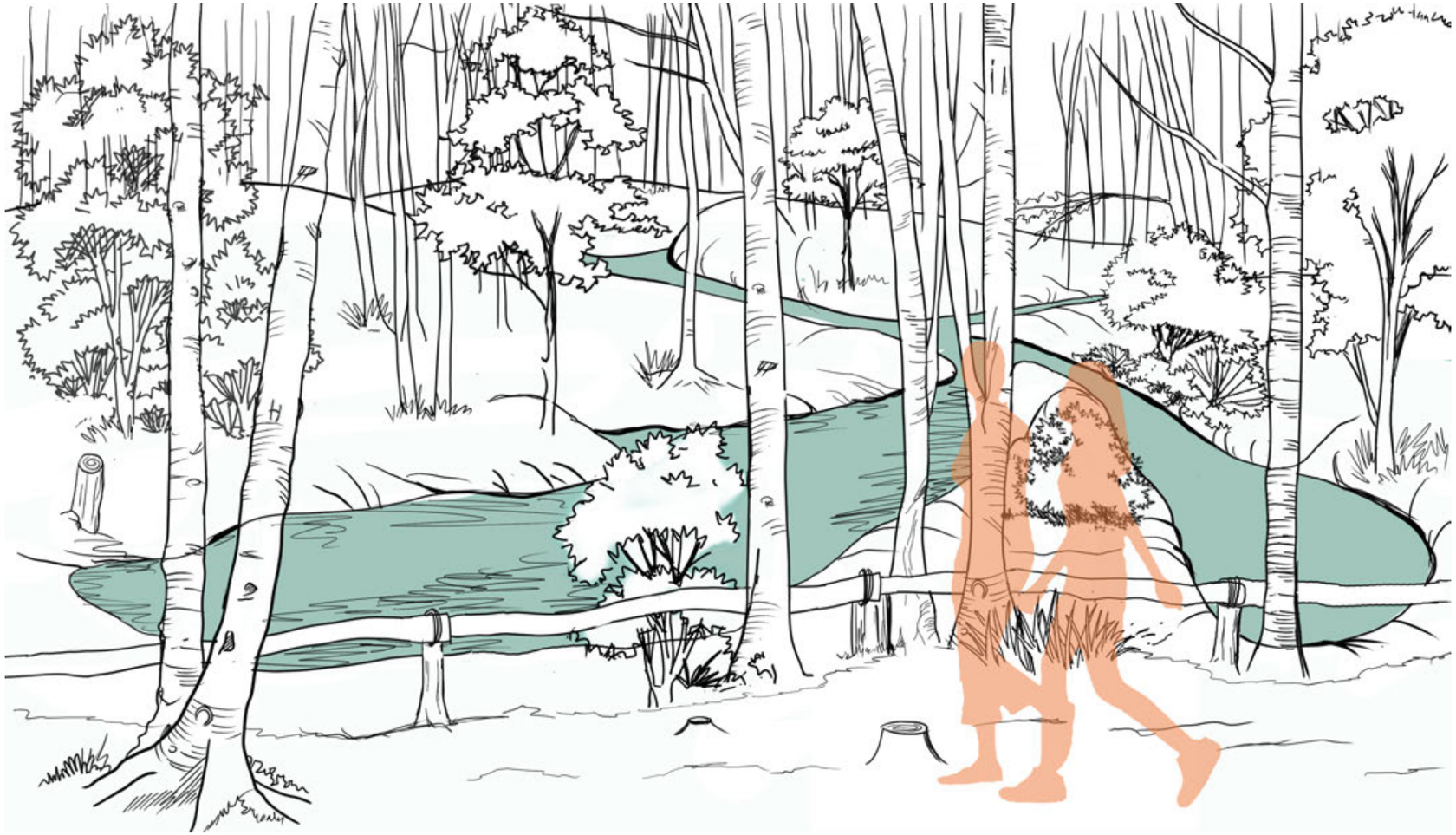


Experience: Exploring sprengen source in mixed forest

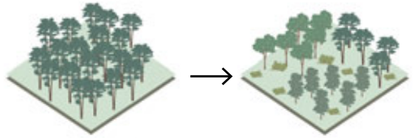




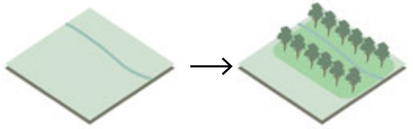




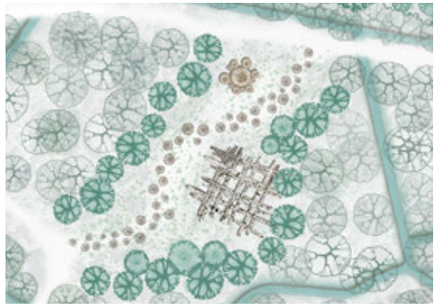
Experience: Exploring sprengen source in mixed forest



Existing artificial forest → Mixed forest communities



Disfunctional Sprengenbeek → Green space along the sprengenbeek



05- 4 LOCAL IMPLEMENTATIONS

3. SPRENGEN STORING & USING IN RURAL

Current Status

Proposed design

Here is the middle stream. The Sprengenbeek here is most at risk of having a drought. It is elevated and therefore not connected with other water but a long distance from the source. It is also the typical area of the kampen landscape.

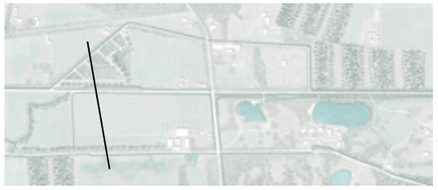
The main design aims are to Let the water be used and buffered here and avoid the monotony of agriculture. Through the development of agroforestry, the highest biodiversity can be developed here.

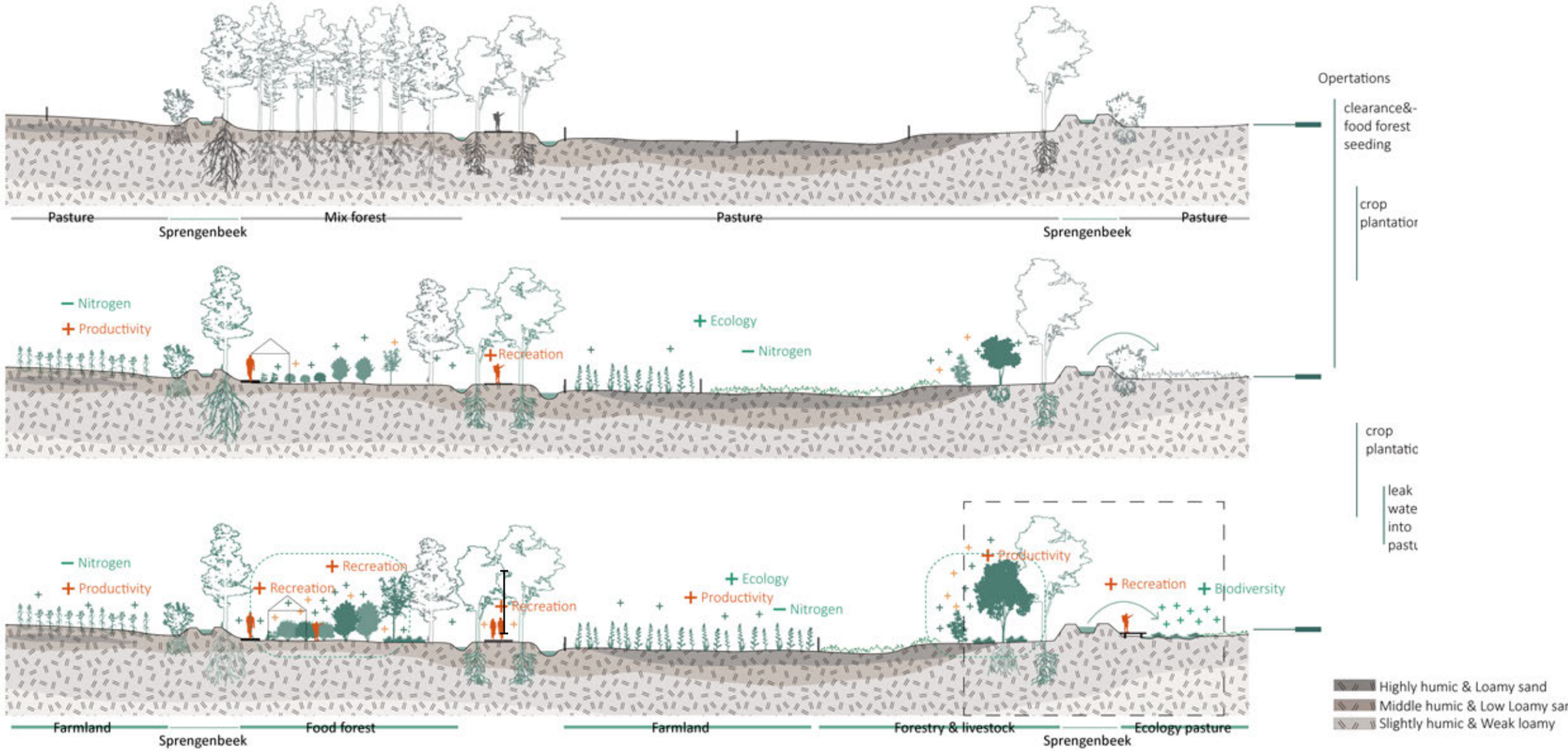
Activities: Farm picking, swimming, cycling, hiking, camping, horseback riding

Section1 : Sprengenbeek in Kampen landscape

Current status:
The process of fertilizing the land in the past can be seen from the fertility and height of the soil, but now most of the land is mu pasture. The soil condition is ignored. and the sprengenbeek is inaccessible.

After design:
The new kampen landscape for future with accessible and functional Sprengenbeeks.





0 25m

Vertically expanded 5 times

Experience: Ecological pasture & Sprengenbeek & strip forestry

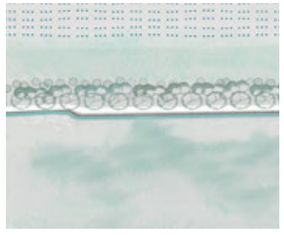
Disfunctional Sprengenbeek

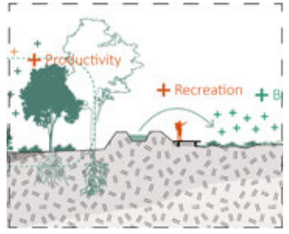
Wet ecological pastures

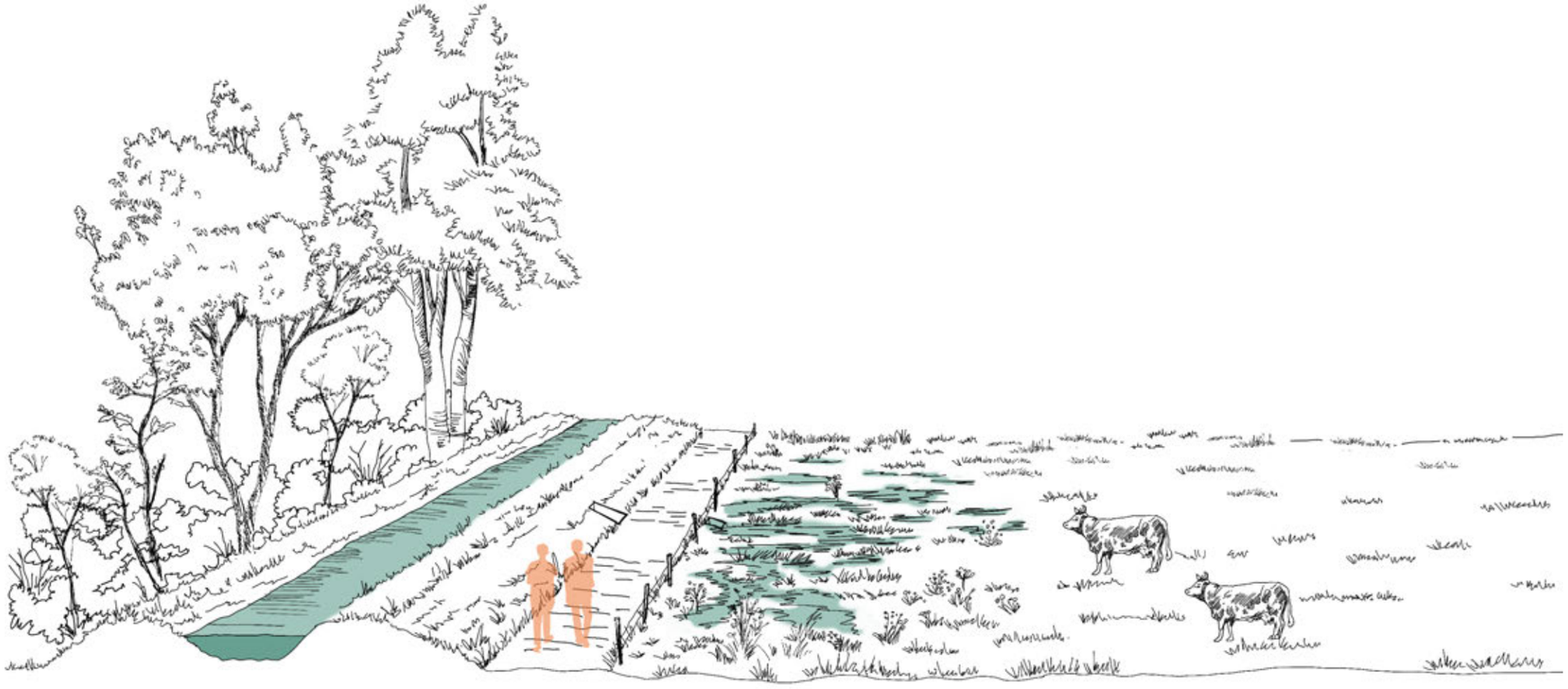
Green space along the sprengenbeek

Existing pasture

Strip forestry on the edge of pastures



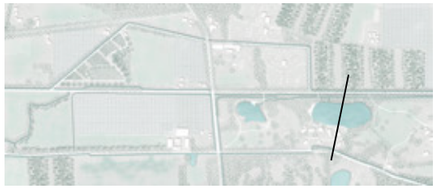


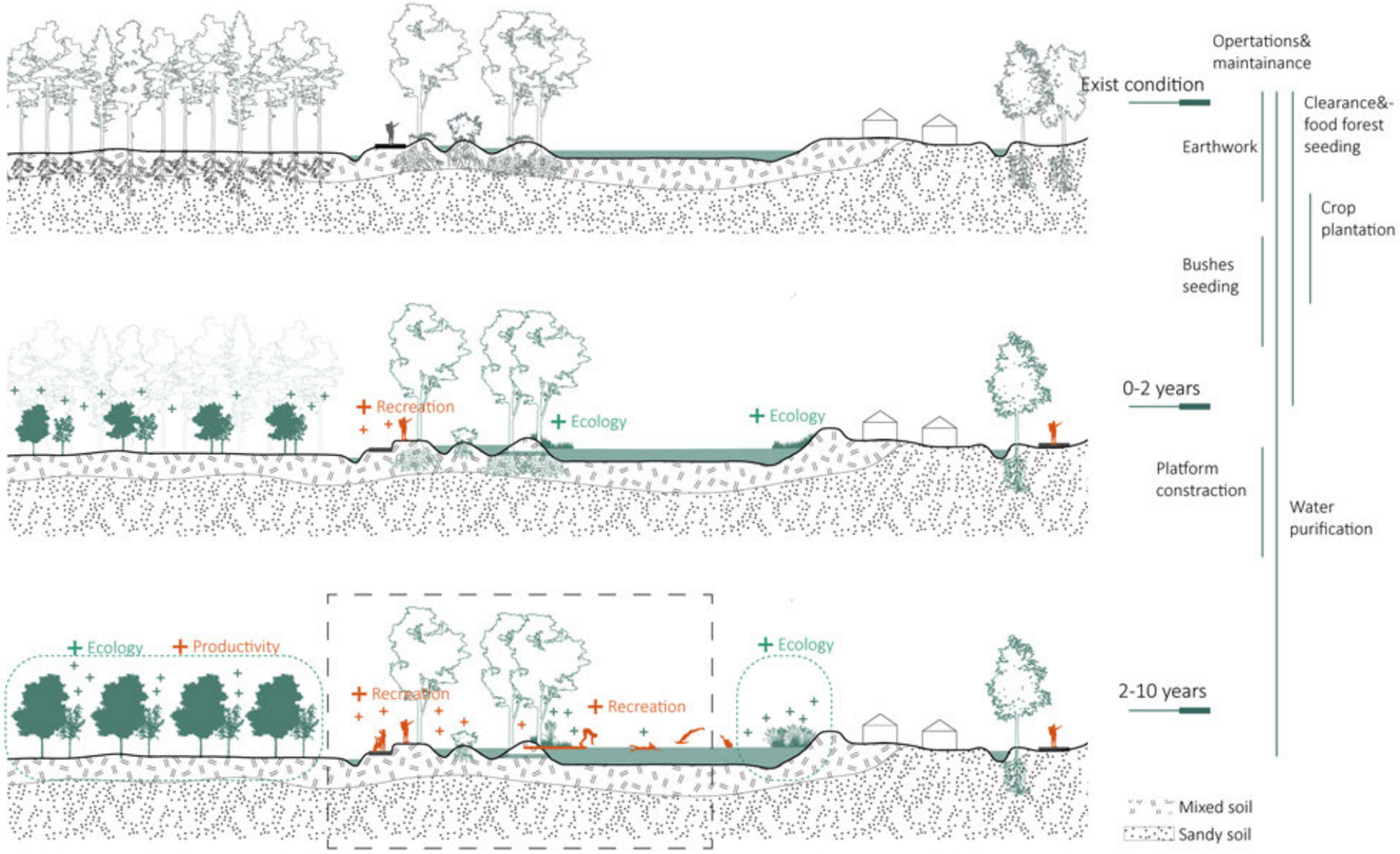


Section2 : Sprengenbeek in Kampen landscape

Current status:
The Sprengenbeek here is most at risk of having a drought. It is elevated and therefore not connected with other water but a long distance from the source.

After design:
We elevated the road on the side of the Sprengenbeek bank, so that people can more easily see the three streams and have a better experience with the Sprengenbeek aside. Additionally, connect the water ponds to Sprengenbeek. This will control Sprengenbeek's runoff and prevent it from flooding or drying up. And after several years, when we have more water, and the purification process begins in the upper stream, people will be able to swim in the water in ponds.





Vertically expanded 3 times

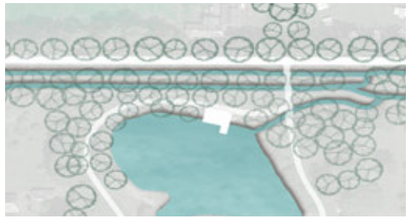
Experience: resilient sprengenbeek & recreation ponds

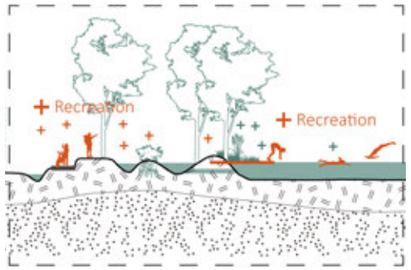
Disfunctional Sprengenbeek

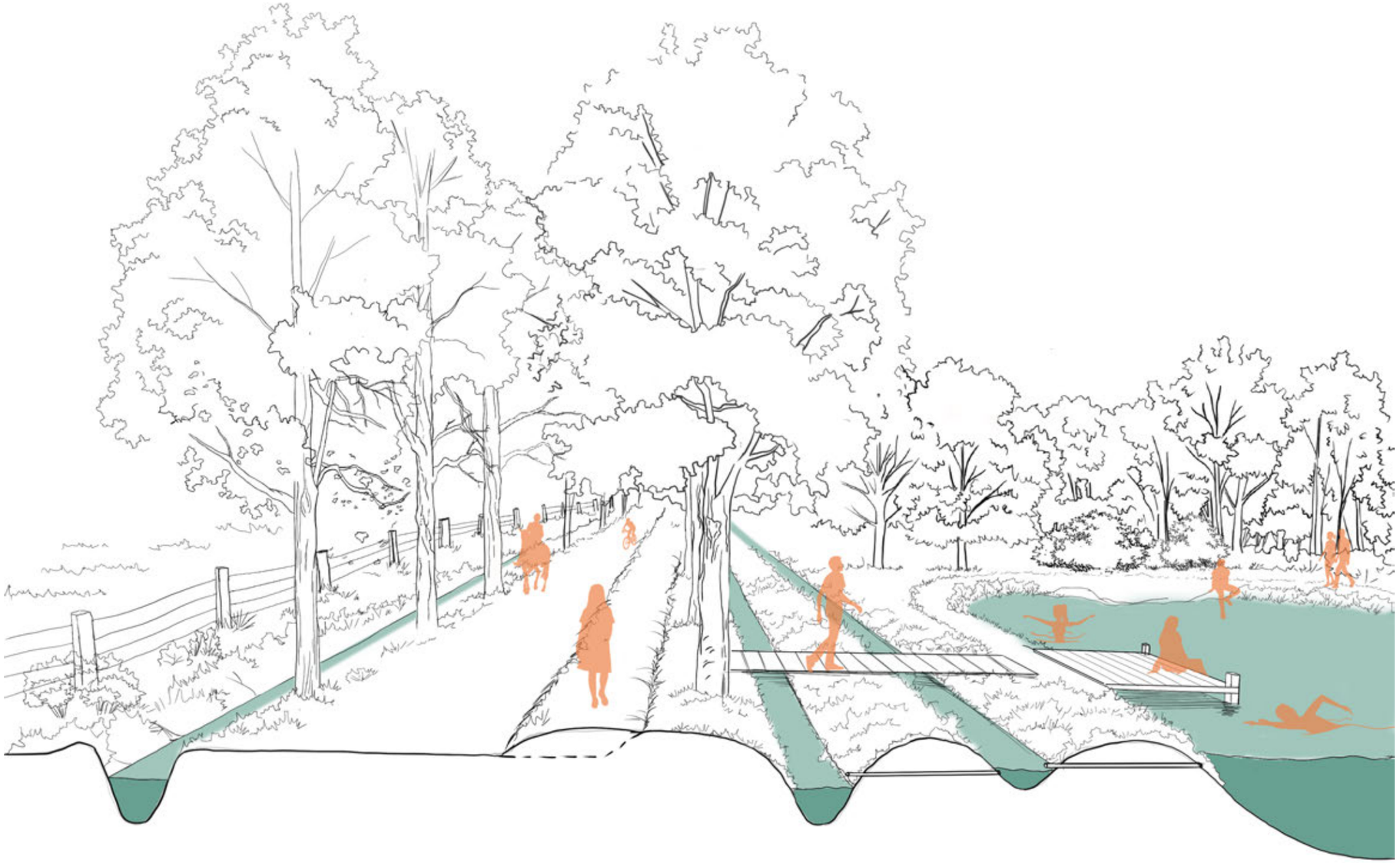
→

water retention & recreation

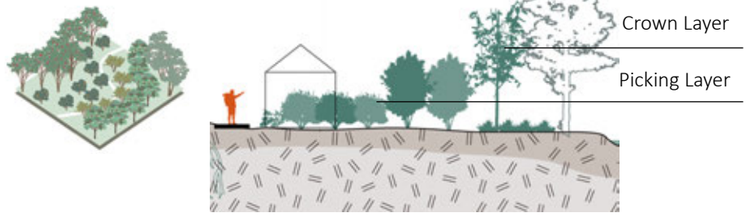
Green space along the sprengenbeek





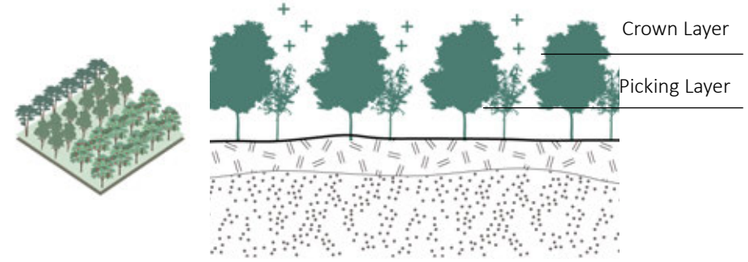


Plant Configurations: 3 types of food forest



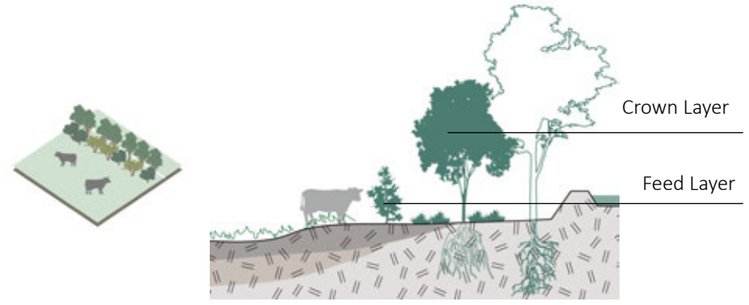
Experience food forest

It increases the experiential value of a food forest. It can be like a garden. By introducing classification of trees and shrubs, different spatial layout, and some activities,(such as barefoot paths, cableways and overnight accommodation) it will be given its own personal colouring.("Four food forest themes and their rationale", 2022)



Productive food forest

It is closer to the common management concepts in forestry. In this theme, the focus will be on the production of food products with market value, and the cultivation of quality wood should also have a place. It provides a springboard for the diversity and functionality of existing forests and natural areas.



Strip forestry on the edge of pastures

Nut trees, fruit trees, edible shrubs and layers of herbs can be planted in the edge of pastures, which are edible for both livestock and humans. The edible wooded banks also provide space for more biodiversity and in a spatial sense it keeps the spatial character of kampen landscape and make the height difference clearly visible and to accentuate it

Crown Layer


Castanea sativa
(oak chestnut)


Juglans regia
(walnut)

Picking Layer


Prunus dulcis
(Amandel)


Prunus avium
(sweet cherry)


Rubus adaeus
(raspberry)


Mespilus germanica
(mispel)


Chaenomeles
cathayensis
(dwarf quince)


Pyrus pyrifolia
(Nashipeer)


Cydonia oblonga
(quince)


Rubus fruticosus
(Braam)

Feed Layer


Salix alba
(wild)


Corylus avellana
(hazel)


Sambucus nigra
(Vlier)

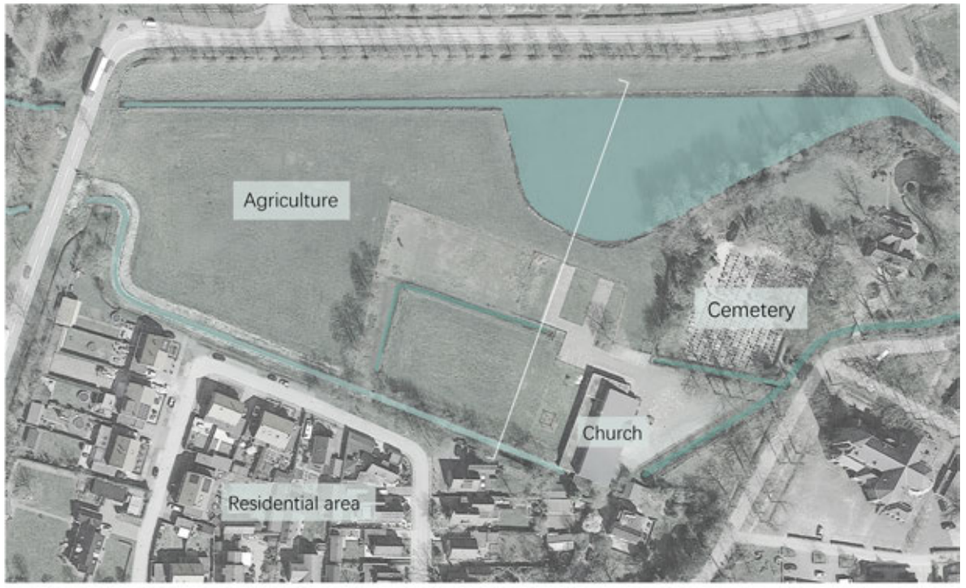

Acer campestre
(field maple)


Sorbus aucuparia
(rowanberry)

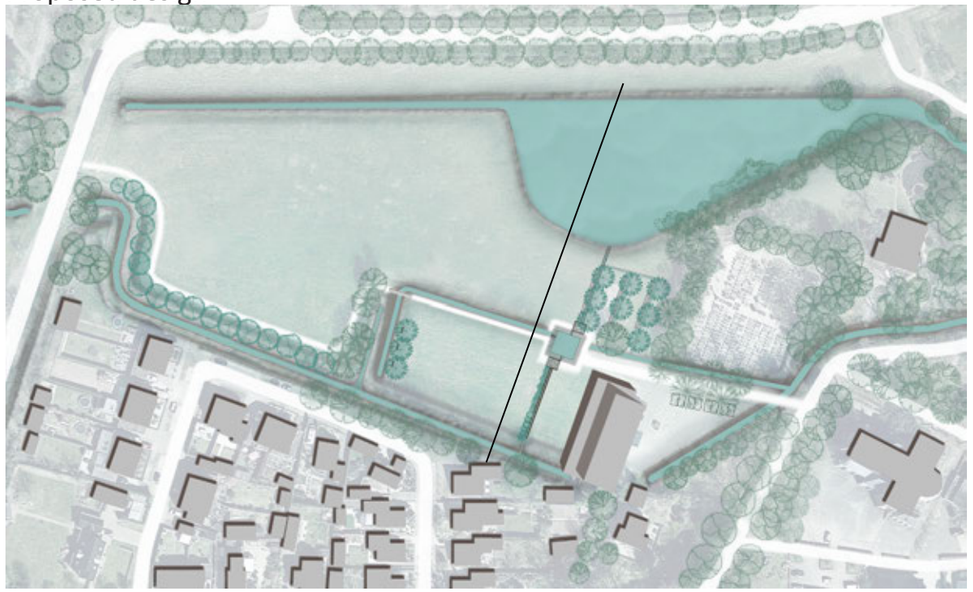
05- 4 LOCAL IMPLEMENTATIONS

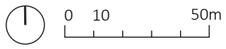
4. SPRENGEN STORING & USING IN URBAN

Current Status



Proposed design

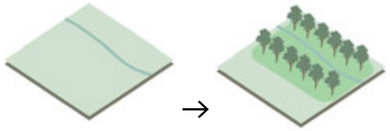




There are two sprengenbeeks pass by, and form the existing condition section, we can see the water level difference: There are three water level. So we can sure that there is a water mill relics. It's a good place to make design to represent the sprengenbeek story.

Spcae types accroding to the surrounding landuse: gathering, resting, semi-private

Section1 : Narrative space - Gathering space

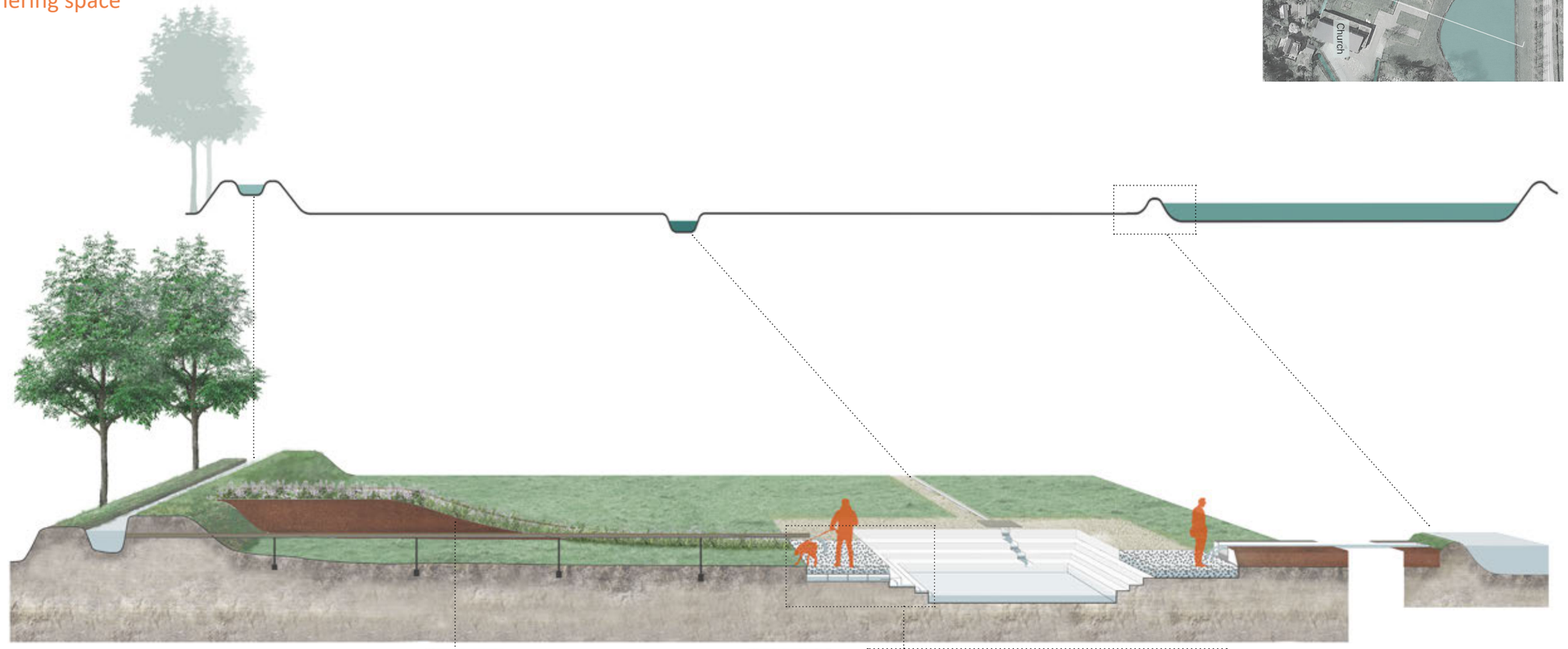


Disfunctional Sprengenbeek

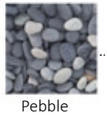
Green space extending from sprengenbeek

Current status:
There are two Sprengenbeeks and one ditch with three water level.

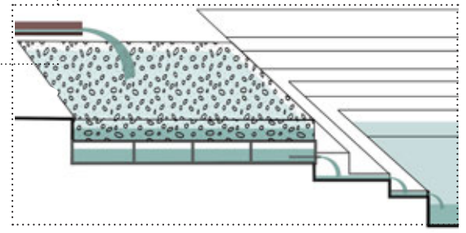
After design:
The water in the Sprengenbeeks is taped outside through the metal bridge. The water is transported to the centre of the site by a thin metal bridge, but instead of falling directly near the pool, it falls on top of pebbles. The water can pass directly through the cobblestone, be collected and then flow into the pool. The Planter and metal bridge represent how Sprengenbeeks works. Combined with a waterfall's sounds, this structure is the abstract of watermills on the Sprengenbeek.

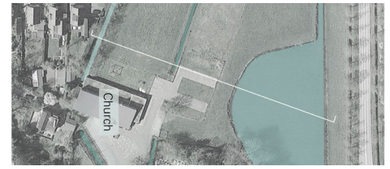


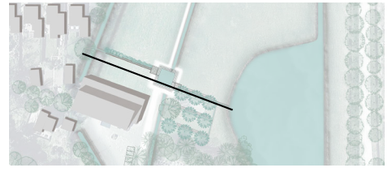
Climate resistant metal



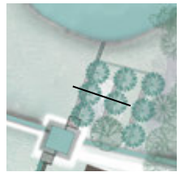
Pebble

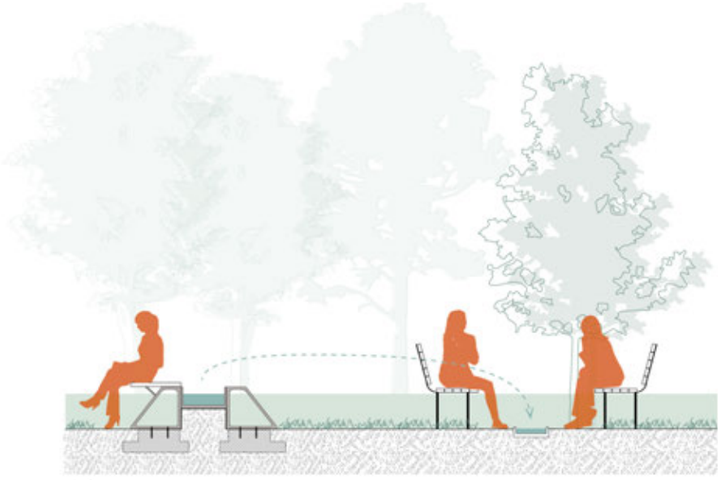






Section 2 : Narrative space - Rest Space

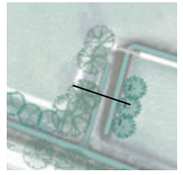


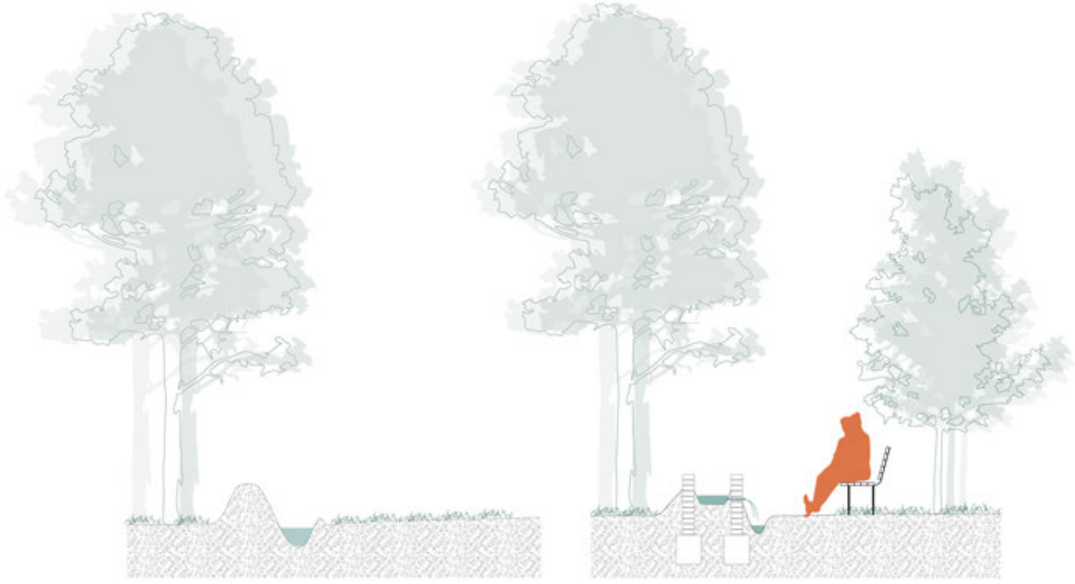


After

1m

Section 3 : Narrative space - Semi- private Space





Before

After

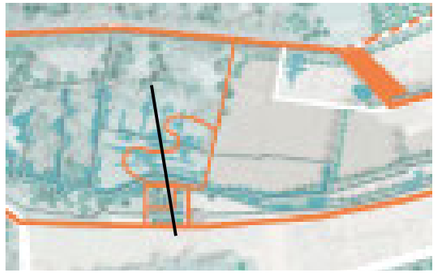
1m

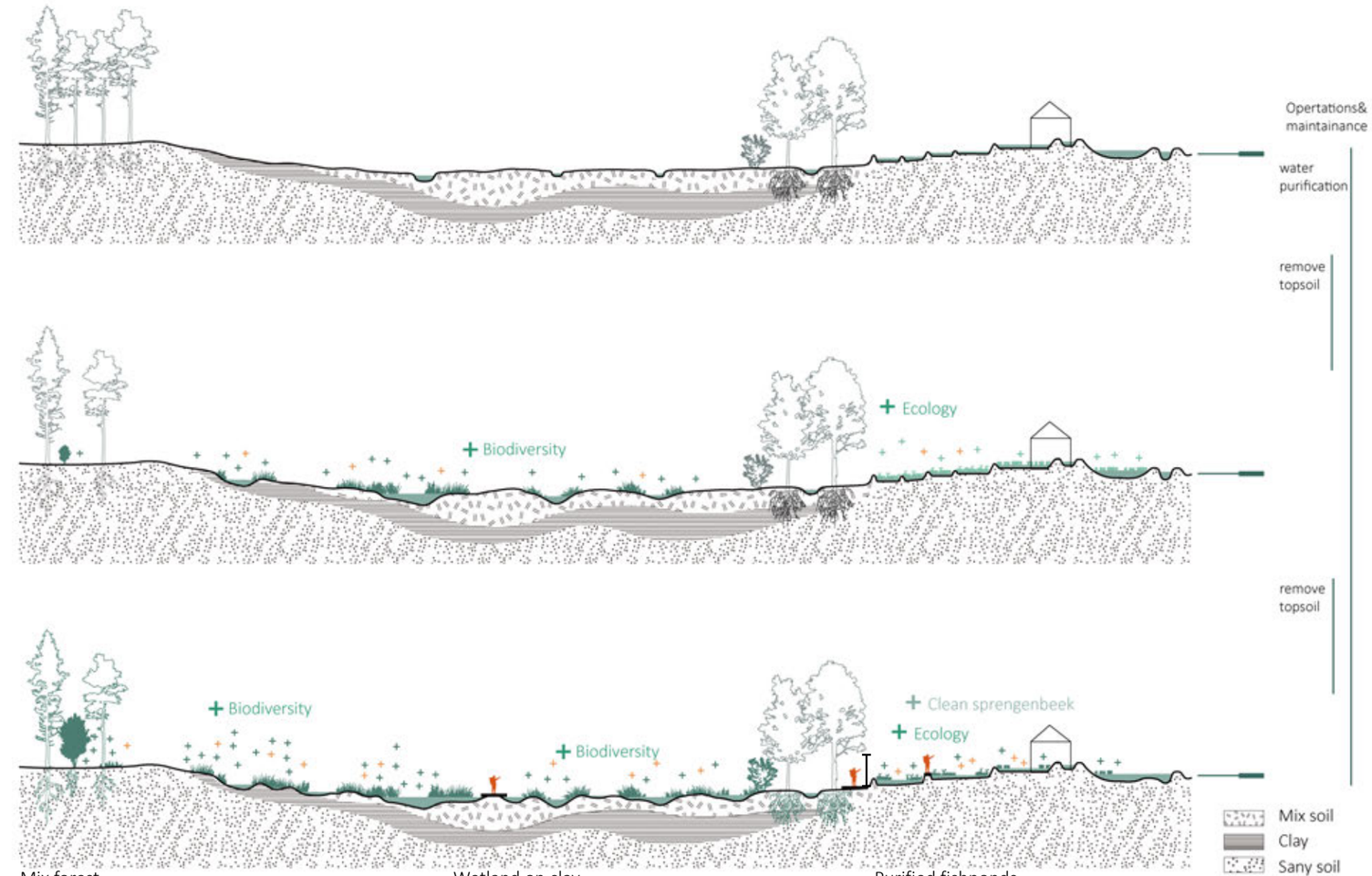
05- 4 LOCAL IMPLEMENTATIONS

5. SECTION - Previous fishponds

Current status:
The most distinctive thing is that the soil, under the sandy loam, has a rare layer of peat. This is also the reason why sprengenbeek can be tapped in its upstream.

After design:
A transition area between higher and lower. A wetland with clay, seepage streams and ditches can be formed. The purification of fish ponds can be combined with the development of marshland. Due to the diversity and specificity of soil types, many different plant species such as Cuscuta epithelium, sundew, bell gentian and beenbreek will emerge.





Special planys

Klein warkruid(Cuscuta epithymum),Source:
www.google.com/search?q=Duivelsnaaigaren&sxsrf=ALiCzsZ_1Oo-RPlUrzcB-Crtfn7jOwJ0dw:1661906909630&source=lnms&tbm=isch&sa=X&ved=2ahUKEwj89f3X7e_5AhXDxgIHHQ498SQQ_AUoAXoECAIQAw&biw=1920&bih=914&dpr=1#imgrc=k6l2GyyAvd517M

Kleine zonnedauw(Sundew)
Source:waarneming.nl/species/2478/

Bell gentian
Source: Nel Appelmelk

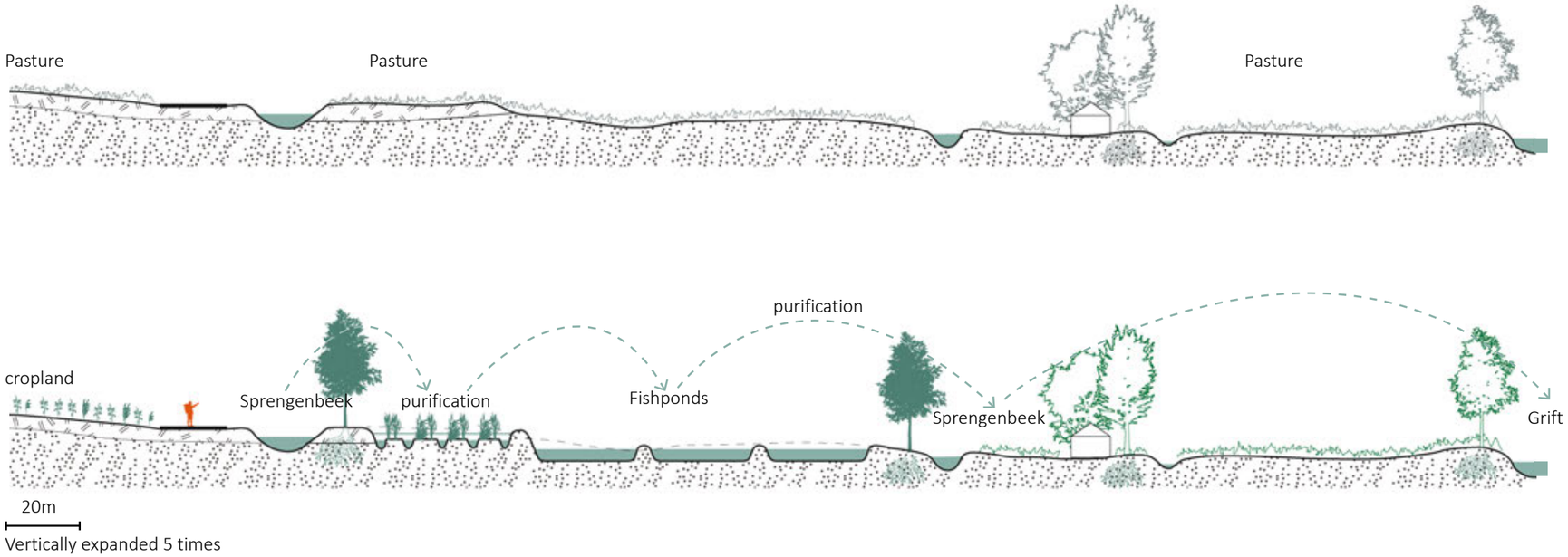
Beenbreek
Source:waarnemingen.be/species/2639/

05- 4 LOCAL IMPLEMENTATIONS

6. SECTION - New fishponds

Current status:
The open landscape with two sprengenbeeks

After design:
new fishponds with purification zone

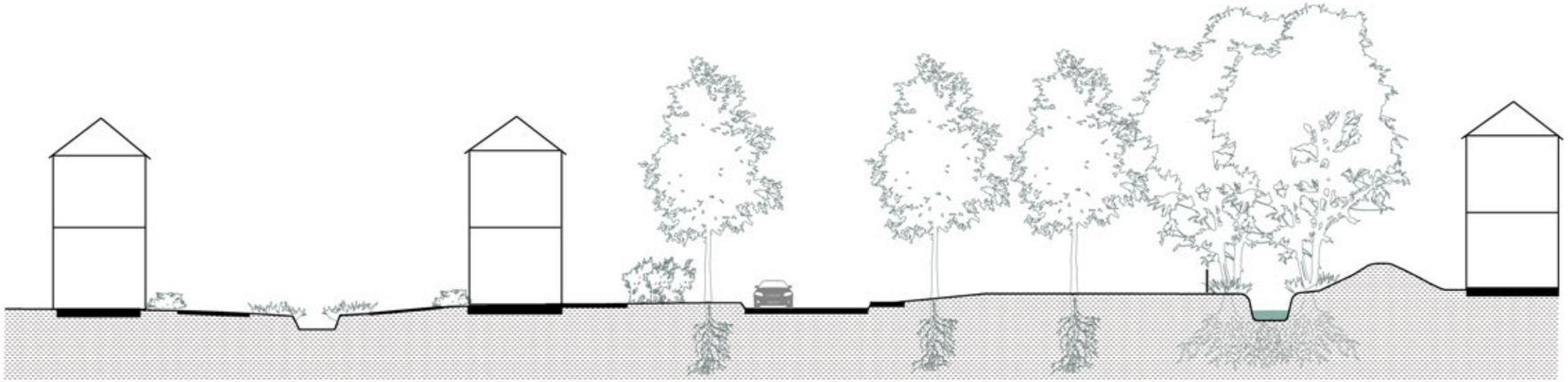


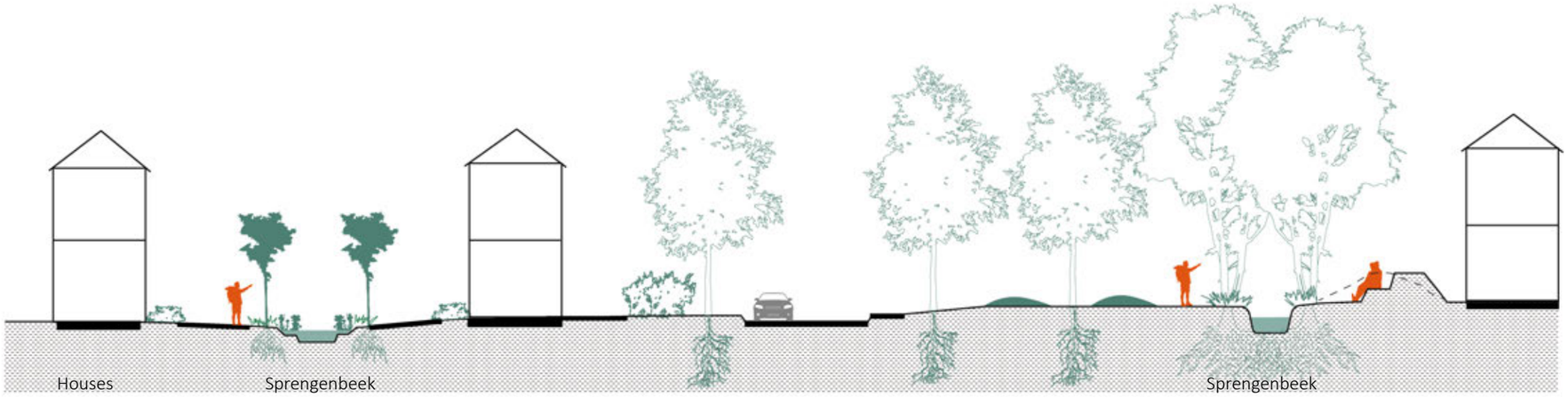
05- 4 LOCAL IMPLEMENTATIONS

7. SECTION - Sprengenbeek in residential area

Current status:
sprengenbeeks are hidden in the bushes

After design:
Visible & accessible Sprengenbeek





10m

Vertically expanded 3 times

05- 4 REGIONAL PLANNING

As I mentioned in the site selection part, the Veluwe can be divided into several subareas, and each subarea has its characteristics. So the regional planning I am discussing is for the Eastflank-Veluwe where Vassen is located.

The knowledge gained from the vassen and small scale design exploration can contribute to the improvement of the regional landscape framework overview. Here I proposed 5 strategic actions to revive the sprengenbeek landscape in east veluwe:

1. Promote infiltration by transforming coniferous forest.

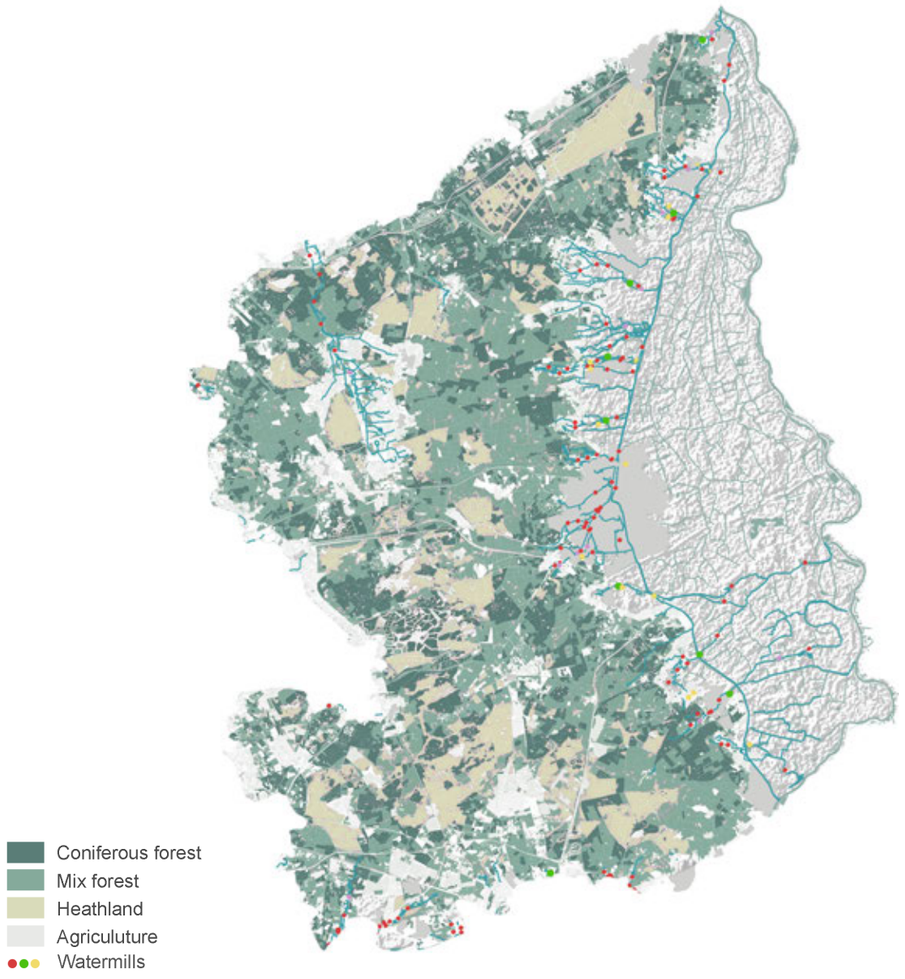
This is also the strategy that was applied on the Vassen scale. On a regional scale, by converting half of the coniferous forest into heathland, shifting sands and deciduous forests, the infiltration capacity will be increased, and the groundwater will be sustainably replenished. The heathland patches and corridor connect other isolated heathland areas, allowing plants and animals to migrate. Also, expanded heathland enhances the recreational value of Veluwe through connection to a suburban area.

2. Nature management by heathland farming

Enclave is a landscape type which is widespread in Veluwe. These fields on the enken lands are the best agricultural land in the Veluwe, and we can use them for production. Heathland is obtained by reducing coniferous forests and needs to be maintained by adapted agricultural systems. Heathland farming system can ensure maximum biodiversity on the flowery heathland, hay meadows and fields. In this system, sheep herds graze the open land, and sheep manure is used in the fields. This is the step towards circular agriculture on the higher sandy soils again.

3. Circular living - Adapted kampen landscape

Based on the design prototype I proposed in the local scale design, the single agriculture is transformed into a mixture of forestry and cattle farming, agriculture, food forestry, etc.. The various agricultural practices create a circular way of living. Finally, the Small-scale circular habitation with high biodiversity can be found in the Sprengen valleys on all the Kampen landscape.



Before

4. Response to Groundwater Fluctuations - multifunctional buffer zone

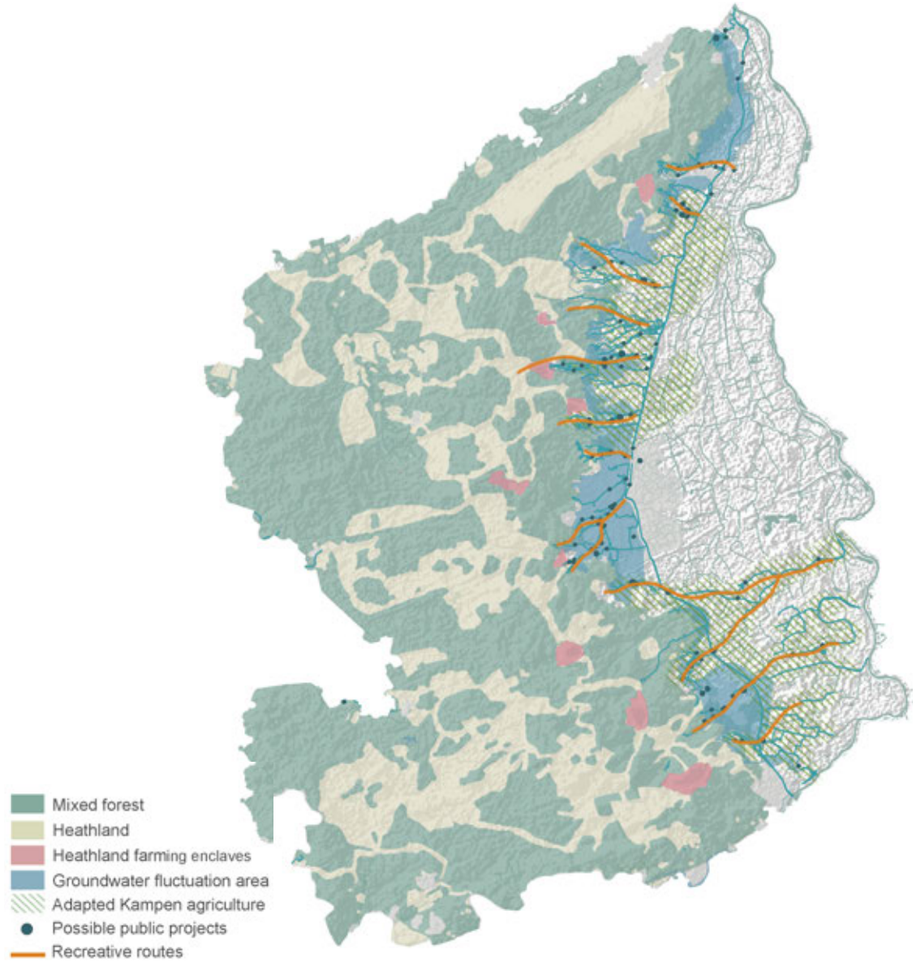
As a result of climate change, groundwater fluctuation areas will face nuisance and drought. We, therefore, need to develop climate-resilient infrastructure. These zones of multifunctional land use, such as nature and nature-inclusive agriculture, serve as a buffer against climate change and increase biodiversity. Rainwater and groundwater are collected and retained in this groundwater fluctuation area as a buffer zone so that the streams can supply water all year round.

5. Visible Sprengenbeek in rural and urban - Possible public projects

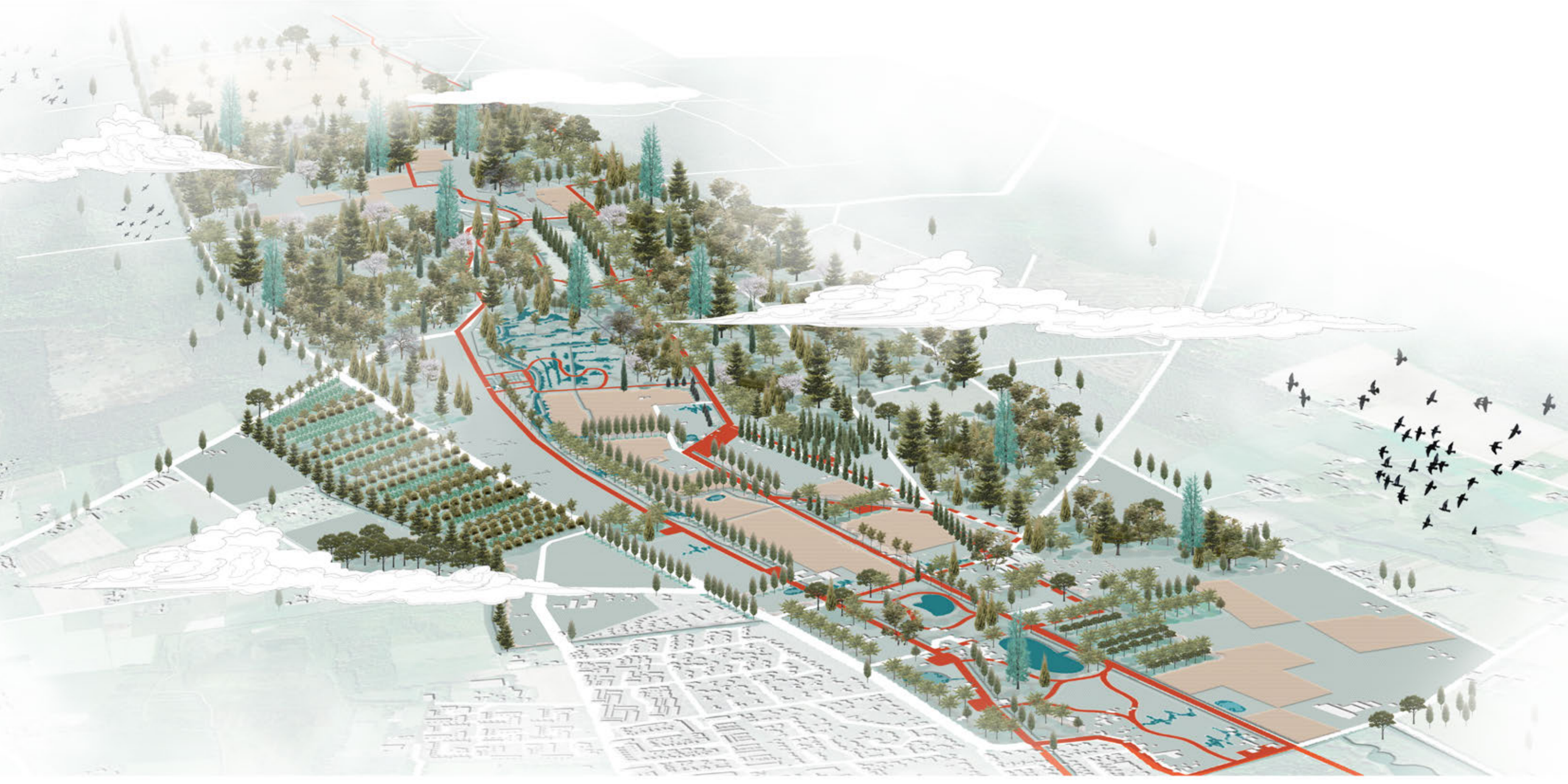
Through public projects, the rural Sprengenbeek is no longer silent in the weeds and farms. The remains of the water mill provide nodes for hiking trials. In the urban area, more storage space is created by giving the streams more space and allowing them to flow above ground again. Making the stream more visible improves the spatial quality of the urban area.

6. Fewer paths in the central, more paths on the edge - reorganize the recreative routes

There is a lot of recreational pressure on the central Veluwe. But in the future, because of the restoration of the Sprengenbeek, Eastflank Veluwe will have many recerational routes to experience the diverse sprengen valley's landscape. There can be a lot fewer paths without compromising the experience.



After



06 | CONCLUSION & REFLECTION

06 - 1 CONCLUSION

After the research and research by design processes, the main research question is answered by the design process of dealing with the five sub reseach questions :

1. What is the characteristic & values of the Sprengenbeek landscape in selected area?

As we defined, the main design area is the Sprengenbeek landscape in the vaassen .
The most distinctive features of the Sprengenbeek landscape here are the small-scale farming and forests on the flank of the Veluwe. It is defined as Kampen landscape, a cultural landscape that should be appreciated. The sprengenbeek based on it has the value of heritage, ecological, recreational and productive which is gradually declining.

2. What's the roles of the Sprengenbeek landscape in the future?

The sprengenbeek system will become legible and readable in the future. It will contribute to the region's ecosystem diversity, improve the region's resilience to climate change, and provide opportunities for the region's recreational and educational activities. The sprengenbeek landscape as a cultural landscape will also play a greater role in consolidating the collective identity.

3. How to make the Sprengenbeek landscape more sustainable and diverse?

Diversification: The monotonous economic forests and pastures have been transformed into multiple forms of agriculture, including three different forms of food forests and heathland farming systems.

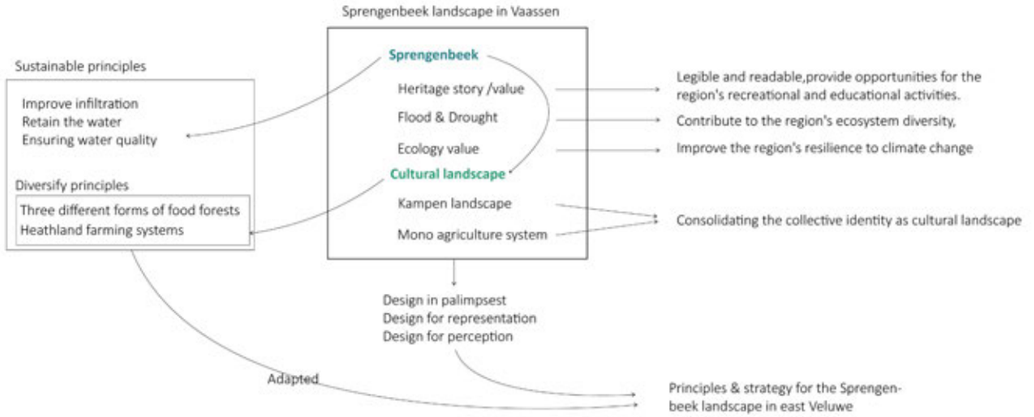
Sustainability: 1) Improve infiltration and allow groundwater to get more replenish. 2) Retain the water instead of letting it flow faster, including some sponge facilities. 3) Ensuring the quality of the water, which includes the use of specific plants and minimising water pollution when using it.

4. How to make the heritage of the Sprengenbeek System and the identity of cultural landscape become more spatial recognizable?

By designing with the theory of narrative landscape. It includes three aspects:
Design in palimpsest: it means always trying to find the history traces from the site and make it more accessible, and also maintain the spatial character of the site.
Design for representation: it means using abstract design to describe how Sprengenbeek works
Design for perception: in this project, the idea of soundscape will be tested to create different types of spaces. In addition to, this carefully designed tour sequence, as well as specific materials and plants, will enhance the public's perception of Sprengenbeek.

5. Can we find common design principles and strategy for the Sprengenbeek landscape in east Veluwe?

Most of the design principles can be borrowed. Scuh as "heathland farming,diverse forest,agroforestry,increase water quality,retain water,sprengenbeek public space design".
But when applying these principles in east veluwe, or other cities in east veluwe, we should choose the appropriate principle according to the location, and adapt them according to the specific conditions.



The relationship between research and design

The process of research and design is cyclical in my projects. The first thing I went through was the research for design stage. In this stage, I understand and analyze the relevant literature and site, the research provides the basis for the design, and I propose the possibility of the design on this basis.
After this, there is no fixed order for research and design. Because we cannot know all the things in limited time period. Research and design are carried out simultaneously.

For example, I make a test design based on a certain research conclusion, and then try to find a way to verify whether the design result is feasible, so I jump back to the research process, but the breadth or depth of the research is expanded. Design is an important tool for generating different concepts and ideas in this process.

There are also times, although there are research results, my inspiration is exhausted and I can't continue to design. In such cases, I do "research about design". That is research for relevant existing designs, and serve as a knowledge base for the design. Abstracted their design strategy and then adapt it for ourself.

In general, the relationship between design and research is dynamic.

The Ethical Issues and Dilemmas

Heritage contradicts ecological values: A big feature of Sprengenbeek is labour and channelization. This means that we cannot naturalise the banks of the river while maintaining its heritage character. In more detail, both the sprengenheads and the sprengen channel itself are very fragile heritage elements, and physical elements other than maintenance of the embankments and sheet piling are not desirable.

Some minor contradictions are also included: if diverting water from the stream is used for other functions, it is inconsistent with maintaining the amount of water in the stream.
I think here, the historical heritage value is the primary consideration and we can explore more possibilities to improve the ecological value. And invest in more refined management and maintenance of sprengenbeek, such as formulating current affairs policies on whether water can be drawn according to the amount of water

The limitation of the project

Firstly, in the space design part, I divided the site into four areas, which I think is a limited approach. Although this can give the reader or listener a quick understanding of the characteristics and problems of each area, such an understanding is not accurate. For example, the boundaries between upstream and midstream are not clear, and it can even be seen that there is a trend of gradual integration.

Secondly, The stakeholder analysis of this project is not deep enough. In the early stage, I derived the needs of stakeholders and the problems faced from the literature, but in the implementation of the design, I did not consider the different interests and positions of multiple land users, and even financial and policy constraints .

The relationship to the CWS & landscape architecture track

CWS lab focuses on water systems and takes the research of traditional water systems(TWS) to understand the relationship between people, water, and landscapes. In the TWS research, I chose the Sprengenbeek as the object and studied its catchment area, water system, water circularity, etc. Based on TWS analysis, this project takes the expansion of the Sprengenbeek water cycle as one of the starting design ideas.

In addition, we also carried out a water-themed lecture presented by ourselves. I studied rainwater harvesting methods, water heritage cases and strategies for water management in dry land, which are inspiring for the design principle.

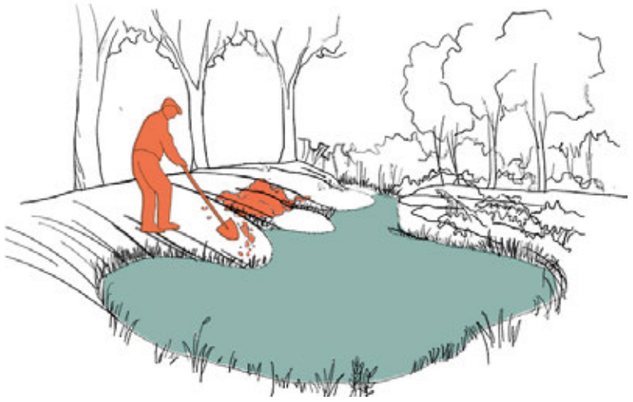
In the aspect of landscape architecture track, the courses, for example, Q1's routing system design, perception analysis, Q2's water management design and dutch landscape introduction have all given me a lot of experience and knowledge. The drawing methods and techniques practiced in the "Drawing time" workshop are also heavily used in this project.

In addition, the four aspects of evaluation: perception, process, palimpsest and scale, were highly emphasised in the landscape architecture track.This project interprets the palimpsest of the landscape and understands the process by which the cultural landscape is formed. In the design, the "natural process" is emphasized, and the scene of each stage is depicted. The design content also includes the design of perception aspects such as the routing system and soundscape. Finally, design strategies with universal value are applied to the larger scale planning in relation to the site.

APPENDIX

CIRCULAR WATER STORIES

Water landscape elements.

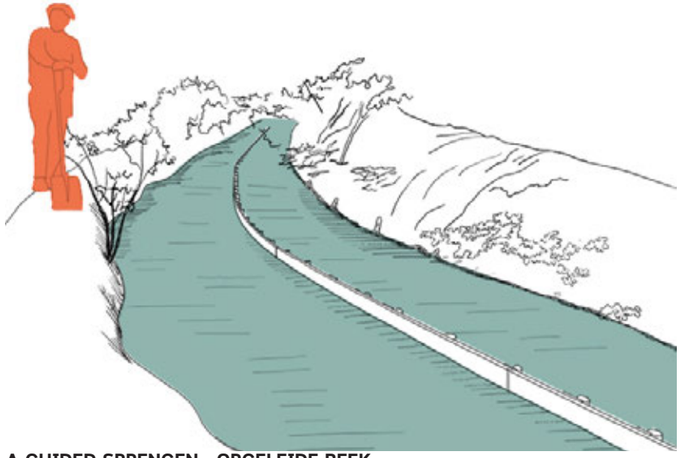


SPRENGENHEAD - SPRENGENKOP
Pond

To getting the groundwater to the surface, a pond-like opening was dug in the ground. Groundwater is released and guided into streams. The excavated clay was used to stablize the embankment of the water.

Project: The Sprengenbeek System - Veluwe, Netherlands.
Climate: Temperate maritime climate
Year: 17 Century till now
Water type: Freshwater
Landscape: Stream valley
Altitude: 35 m.a.s.l
Soil condition: Caly and sandy soil
Material: Excavated soil
Temporality: Fixed
Form: Surface
Use or Function: Access to groundwater

Water works.

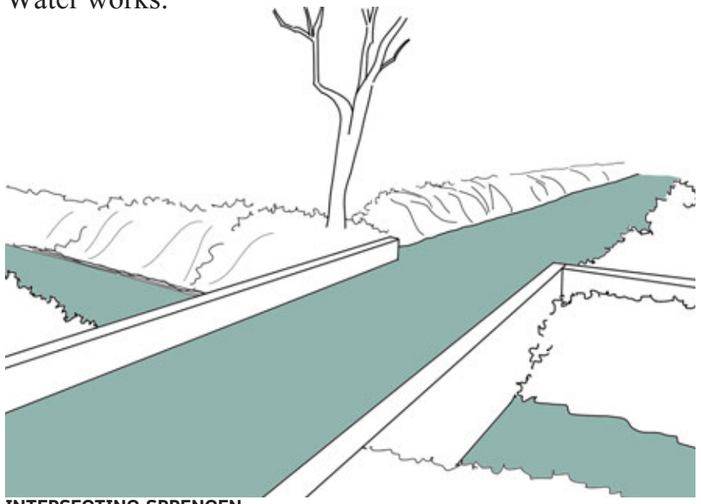


A GUIDED SPRENGEN - OPGELEIDE BEEK
Aqueduct

The water line? that people dug to guide the excavated groundwater while maintaining the water at the highest possible height.People divide the stream with wooden partitions, because the water on one side contains a lot of iron and cannot be widely used

Project: The Sprengenbeek System - Veluwe, Netherlands.
Climate: Temperate maritime climate
Year: 17 Century till now
Water type: Freshwater
Landscape: Stream valley
Altitude: 35 m.a.s.l
Soil condition: Caly and sandy soil
Material: Excavated soil and wood
Temporality: Fixed
Form: Line
Use or Function: Transport stream

Water works.



INTERSECTING SPRENGEN
Aqueduct

In order to keep the stream from falling to the lower level. people build bridges to transport water so that one Sprengenbeek can flow over another.

Project: The Sprengenbeek System - Veluwe, Netherlands.
Climate: Temperate maritime climate
Year: 17 Century till now
Water type: Freshwater
Landscape: Stream valley
Altitude: 35 m.a.s.l
Soil condition: Caly and sandy soil
Material: Concrete and excavated soil
Temporality: Fixed
Form: Line
Use or Function: Transport stream

Water Stories.

CASTLE
Moat

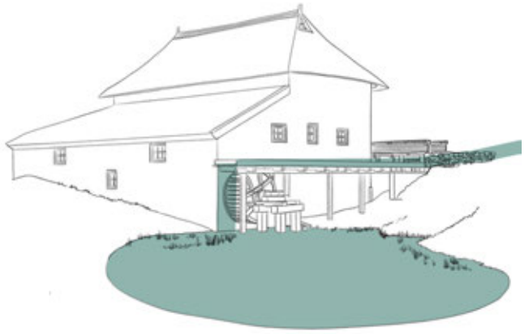
The castle is surrounded by water as a means of defense. The supply of water became a matter of life and death. It is best to choose a place where the castle can guarantee a continuous water supply. Nobles built castles near the Sprengenbeek because they can use the sprengenbeek as water source for the moat.

Project: The Sprengenbeek System- Veluwe, Netherlands.
Climate: Temperate maritime climate
Year: 17 Century till now
Water type: Freshwater
Landscape: Tableland landscape
Altitude: 35 m.a.s.l
Soil condition: Caly and sandy soil
Material: Excavated soil
Temporality: Fixed
Form: Surface
Use or Function: Defense and Military

GARDEN
Falls

Due to the difference in height, water from the sprengenbeek can also be used to create spectacular waterfalls and fountains in the gardens. For the owners of the Veluwe estate, owning and managing water is a symbol of power and wealth. They like to show off by building fountains and waterfalls in their gardens.

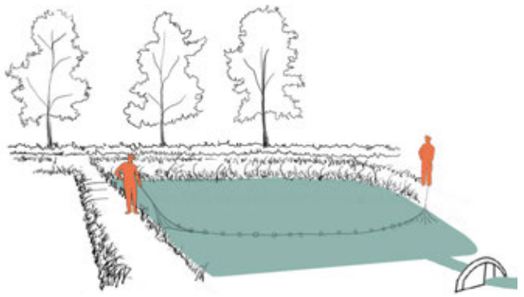
Project: The Sprengenbeek System - Veluwe, Netherlands.
Climate: Temperate maritime climate
Year: 17 Century till now
Water type: Freshwater
Landscape: Stream valley
Altitude: 35 m.a.s.l
Soil condition: Caly and sandy soil
Material: Concrete, Stone, Wood
Temporality: Fixed
Form: Surface
Use or Function: Recreation



WATERMILL

The Sprengenbeek was guided here. Then the energy is generated by the falling water and used to drive the watermills. Most common were paper mills, but food mills, metalworking mills, and laundries also exist. This allowed industry to flourish in the veluwe region.

Project: The Sprengenbeek System - Veluwe, Netherlands.
Climate: Temperate maritime climate
Year: 17 Century till now
Water type: Freshwater
Landscape: Stream valley
Altitude: 35 m.a.s.l
Soil condition: Caly and sandy soil
Material: Wood
Temporality: Year-round
Form:Surface
Use or Function: *Energy production*



FISH HARVESTING
Ponds

Harvesting very clean water from the ground made it possible to establish fish cultivation. Fish farming took also place in the fish ponds in the parks and grounds of the land lords or in the mill ponds.

Project: The Sprengenbeek System - Veluwe, Netherlands.
Climate: Temperate maritime climate
Year: 19 Century till now
Water type: Freshwater
Landscape: Stream valley
Altitude: 35 m.a.s.l
Soil condition: Caly and sandy soil
Material: Excavated soil
Temporality: May to Winter
Form:Surface
Use or Function: Production

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PLANTS TABLE ACCORDING TO SOIL CONDITION

Holtpodzolgronden
Haarpodzolgronden
Veldpodzolgronden
Hoge zwarte enkeerdgronden
Beekeerdgronden
Gooreerdgronden

Podzolgronden

Dry meager soil, retains little moisture by itself due to lack of loam and clay, low organic matter content, low rooting depth.

Suitable crops should meet:
Retain rainwater better by bringing back humus layer
Add organic matter (animal manure/compost)
Keep soil covered to prevent drying out
Deep rooting crops
Crops with low nutrient requirements

Birch
- Deep-rooted
- Product: wood

Lavender
- Drought-resistant
- Few nutrients needed
- Little water needed
- Lavender products

Quinoa
- Deep-rooted
- Drought-resistant
- Low nutrient and water requirement
- Protein-rich (forage) crop for humans and animals
- Nitrogen-fixing

Alfalfa
- Deep-rooted
- Drought-resistant
- Low nutrient and water requirement
- Protein-rich (forage) crop for humans and animals
- Nitrogen-fixing

Deep-rooted grass
- Deep-rooted
- Drought-resistant
- Protein rich forage

Enkeerdgronden

Moderately nutrient-rich loamy sandy soil, groundwater table sinks deep but water is better bound to the soil.

Suitable crops must meet:
Adding organic matter (animal manure/compost)
Keep soil covered to prevent desiccation
Deep rooting crops

Sunflower
- Deep-rooted
- Rich insects
- Handle water, nutrients, light efficiently
- Adds a lot of organic matter
- Product: oil, kernels, flowers

Sorghum
- Handles nutrients and water efficiently
- Protein rich cattle feed

Cereals
- Protein-rich (forage) crop for humans and animals

Hemp
- Deep-rooted

Products: linen, canvas, sailcloth and rope but also various construction materials, insulation, fiber-reinforced plastics

Flax
- Deep-rooted
- Hardly any pesticides needed

Products: linen, canvas, sailcloth and rope but also various construction materials, insulation, fiber-reinforced plastics

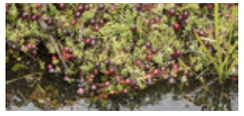
Beekeerdgronden

Moderately nutrient-rich loamy sandy soil, shallow water table and occasional flooding.

Suitable crops must meet:
Adding organic matter (animal manure/compost)
Dealing with moist soil

Grasses (hayfield)
- Protein rich cattle feed

Wet crops
- Few nutrients needed



Cranberry
- Few nutrients needed

Hemp
- Deep-rooted

Products: linen, canvas, sailcloth and rope but also various construction materials, insulation, fiber-reinforced plastics

flax
- Deep-rooted
- Hardly any pesticides needed

Products: linen, canvas, sailcloth and rope but also various construction materials, insulation, fiber-reinforced plastics