PATCHING UP THE METROPOLITAN CARPET WITH WOODS

An exploration on how a forest-based strategy can enhance the landscape identity and drought adaptation within Stedelijk Gebied Eindhoven

Xinyi WANG

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THESIS PROJECT
P4 Report

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Abstract

This study investigates how forest-based strategies can strengthen drought adaptation and enhance landscape identity within the metropolitan region of SGE. The research is twofold: it first examines the nature of forest-based spatial strategies and the research and design methods they represent; second, it explores how these strategies can bolster landscape identity and drought adaptation.

The study reframes forests and trees from traditional land types or natural capital into pivotal elements and methods of landscape design, emphasizing their ecosystem services. For drought adaptation, forest-based strategies link hydrological challenges with the regulating services of trees, integrating them into conventional hydrological strategies. For landscape identity, the focus is on tree language—a tree-based design approach that interprets and intervenes in the landscape, viewing the metropolitan territory from a forest perspective.

By clarifying and legitimizing landscape identity and drought adaptation as parallel issues, the study addresses these challenges through spatial, cultural, social, and environmental dimensions of forests and trees. It develops typological forestry strategies and design principles, translating challenges and opportunities into design objectives at three scales: regional, local, and intermediate.

At the regional scale, forestry strategies enhance diversity, narrative, and a healthy regional groundwater system. At the local scale, key sites demonstrate the spatial integration of these strategies, addressing conflicts or synergies in the visions and transforming over time. The intermediate scale results in a coherent blue-green spatial structure, experiential network, and hydrological function, reflecting the forest-based intertwining of city and landscape. This comprehensive approach shows how forests and trees can address diverse challenges through various spatial, cultural, social, and environmental lenses.

Keywords: Forest-based strategy, drought adaptation, landscape identity, SGE

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SECTION 1
INTRODUCTION

1 INTROUCTION TO THE SITE

Lieshout

Son en Brugel

Aarle-Rixtel

Best

Stiphout

Helmond

Nuenen

Eindhoven

Mierlo

Veldhoven

Geldrop

Lierop

Aalst

Waarle

Heeze

0 1 2 3 4 5 km

Fig.1 **Research area**

Stedelijk Gebied Eindhoven is an inter-municipal administrative entity referring to a continuous urbanised area centred on eindhoven. It includes Best, Eindhoven, Geldrop-Mierlo, Helmond, Nuenen, Oirschot, Son en Breugel, Veldhoven en Waalre.Considering the research topic of this thesis, the sites in this study do not strictly coincide with the extent of the administrative boundaries of the SGE, but rather focus on the the denser metropolitan landscape between Eindhoven and Helmond and the natural systems based on the dommel and Aa watersheds. This means that the study excludes parts of Oirschot, Best, Son en Breugel and Veldhoven, which would otherwise belong to the SGE, and includes parts of Lieshout, Aarle-Rixtel, Lierop, Ommel and Astend, which are not administratively part of the SGE.

The development of SGE

Fig.2 **Formation of sand ridge and streams**

The area in which SGE is situated, historically known as Brabantse Kempen (Abrahamse, J.E. et al. , 2021), has been predominantly agriculturally productive over the past centuries; known for its countryside, streams, churches and, later on with the development of the canals, small crafts such as tannery and beer production, it is a humid and idyllic region. Accelerated population growth and modernisation of agriculture from the late 19th century onwards, and high rates of industrial economic growth in the 20th century - marked by the arrival of the Philips company - radically altered the traditional spatial pattern and social structure of the region, and gave it the appearance it has today the way it is today.

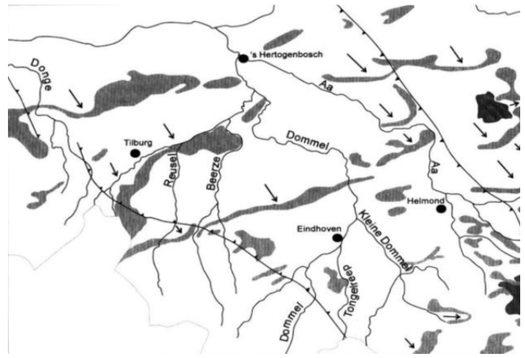


Fig.2 **Formation of sand ridge and streams**
(Ecologische Kring Midden-Brabant, 2011)

1.1 Geological formation

About 238,000 to 126,000 years ago, winds blew sand away from river beds, which mainly ended up in the tundra landscape of today's North Brabant Province. This flattened the landscape, creating a ridge of sand that stretches from north-east to south-west. Because rivers and marine clays were deposited in the northern part of the province, the sand accounts for only about three-quarters of the total surface area(https://www.brabantserfgoed.nl/landschap).

The layer of sand and loam that covered Brabant Province was covered by a new layer of sand(Ecologische Kring Midden-Brabant, 2011). The resulting differences in landscape heights are still clearly visible in Kempen, with alternating stream valleys and higher sand ridges.

As temperatures increased, dense forests began to form. Elm, common ash, willow, and black alder thrived in the brook valleys. In the lower reaches of the Dommel, reeds began to proliferate due to the increased moisture in the valley bed. Fine sandy loam was deposited in the stream valleys, and the presence of iron-rich seepage water led to the creation of bog iron (Ecologische Kring Midden-Brabant, 2011). Higher elevations saw the growth of mixed oak forests, including lime trees and elm, interspersed with clearings of heather, bracken, and wormwood. The soil in these areas became more fertile than it is today.

Additionally, the formation of peat in fens and swamps continued to advance. (Ecologische Kring Midden-Brabant, 2011).

1.2 Pre-roman and Roman age (Until 500BC)

Around 4300 BC, agriculture likely began in North Brabant. Farmers practiced shifting cultivation, clearing forests to use the nutrient-rich soil for both crop cultivation and livestocking (Ecologische Kring Midden-Brabant, 2011). By around 2000 BC, the landscape in North Brabant featured a mix of forested areas, open grasslands, heathlands, and cultivated fields (Arts, 2020).

The arrival of the Romans in the Netherlands had a relatively minor impact on the Eindhoven region. Cattle farming became essential, utilizing the increased expanse of open grasslands effectively (Janssens, 2010). This era saw an initial population growth and was characterized by predominantly open grasslands and heathlands, fixed arable fields, and forested areas on wetter soils. In addition to smaller fields used for crops, much of the landscape remained uncultivated grass- and heathland. The chopping of forests led to the formation of sand drifts. (Ecologische Kring Midden-Brabant, 2011). After the departure of the Romans, the forests in the area were revived.

City-landscape relationship



1000AD
1900AD
1940AD
1970AD
Now

Forest development

Important policy

Agricultural landuse

Population

Start of heathland afforestation(ca1900)
Foundation of Koninklijke Nederlandse HeideMaatschappij(1888)
Streekplan Zuidoost-Brabant (1930)
Welvaartsbalans en het Ontwikkelingsplan (1965)
Construction of Zuid-Willemsvaart.(1825)
Introducing of 'Voorpoortrecht'
Welvaartsplan (1947).
Construction of rail lines and Eindhoven station(1866)
VINEX(1991)
Agrarisch Welvaartsplan (1955)
Introducing of 'potstalsysteem'
Foundation of Staatbosbeheer(1899)
Construction of A2/A67(1955)
Foundation of Philips & Co(1891)

Pre-roman and Roman age (Until 500BC)
Reclamation from Middle age (1000AD-ca.1850AD)
Age of consolidation and industrialization (from 20c)
Age of Fragmentation (From 1970s')

1.3 Reclamation from Middle age (1000AD-ca.1850AD)

From about 800AD the area was re-entered into a process of development, with agricultural settlements moving from the highest points to flank the sandy ridge and marsh or brook valley boundaries. The stream valleys were converted into meadows for grazing livestock and water mills were introduced. In addition, noble orders claimed these lands for castles and abbeys.

The method of heaping up turf from the moorland and using it to fertilise the farmland ('potstalsysteem') was introduced in the 11th century, and over time the ploughed land was heaped up to a metre in height. This activity had a crucial impact on the character of the local landscape. At the beginning of the 19th century this system reached its peak. The landscape is dominated by large areas of heathland, farmland enclosed by fine hedgerows and stream valleys that serve as hay fields.(Ecologische Kring Midden-Brabant, 2011) The gradients in the landscape are very well defined.

Equally important is the "Voorpootrecht". Granted to the people in the 14th century by the then Duke of Meierij, it meant that landowners had the right to plant, own and cut down trees on the edges of roads around their land. This resulted in an extensive network of street trees, laying the foundation for the SGE as a tree-rich region.



Fig.3 **Tree network due to Voorpootrecht**
Photo: https://www.topotijdreis.nl/kaart/1945





Fig.4(Left) **Philips factory & village established by Philips**
Photo: Royal Philips

Fig.5(Right) **Large scale afforestation of waste lands**
Photo: https://www.knhm.nl/historieknhm/

1.4 Age of consolidation and industrialization (1866-1970s')

As artificial fertilizers, machines, and wool imports became more common, the old way of using sod for fertilizer faded away. This led to disapearance in how fields, pastures, and unused lands interacted. (Abrahamse, J.E. et al., 2021).Eventually, a lot of the unused land was turned into farmland again. However, some areas that weren't good for farming were instead planted with lots of similar-looking conifer trees.

As farming became more modern, people didn't need as much oak and willow wood anymore. So, those who owned the rights to plant trees started growing poplar trees instead. Poplar wood was useful for making clogs and matches, which were becoming popular items. This shift in tree planting led to the typical poplar tree landscapes from the 1700s to the 1800s

1.5 The formation of the fragmented metropolis

The present-day metropolitan landscape of SGE, which has been called "Nevelstad"(which means cloud cities or fog cities) because of its decentralised and mixed state, is shaped by its historical evolution, influenced by various factors:

Initially, there was a focus on small-scale, decentralized growth and the preservation of cultural and rural landscapes. Each town prioritized accommodating local industries and promoting local employment, aiming to minimize travel (Welvaartsplan, 1947-1949).

However, the forces of industrialization eventually led to centralization, with large industrial areas emerging around major towns like Eindhoven and Helmond. Despite earlier efforts for decentralized growth, these large towns lacked sufficient housing, resulting in the expansion of uniform settlements around smaller towns and villages. This expansion was accompanied by increased commuting to larger cities and the extensive development of transportation infrastructure. This period also witnessed the modernization and intensification of agriculture (Agrarisch Welvaartsplan, 1955), with villages and towns expanding beyond their traditional boundaries but stopping near protected areas such as forests and stream valleys.

The subsequent rapid expansion of transportation infrastructure reignited decentralized development, bolstered by neoliberal policies like VINEX (1991). This led to the proliferation of new industrial zones, residential areas, and real estate developments along the road network, a trend that persisted until around 2010.



Fig.6 **Establishment of Philipswijk as residential enclave**
Photo: https://indebuurt.nl/eindhoven



Fig.7 **Construction of A2/A67**
photo: www.wegenwiki.nl

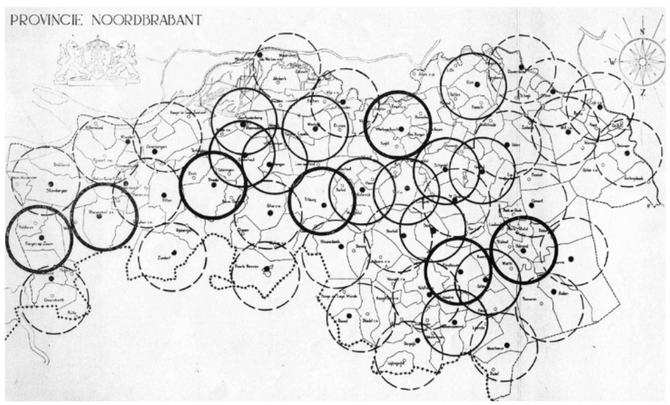
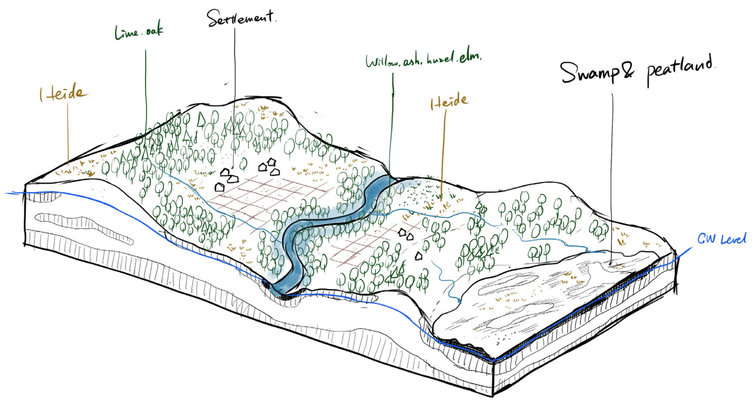


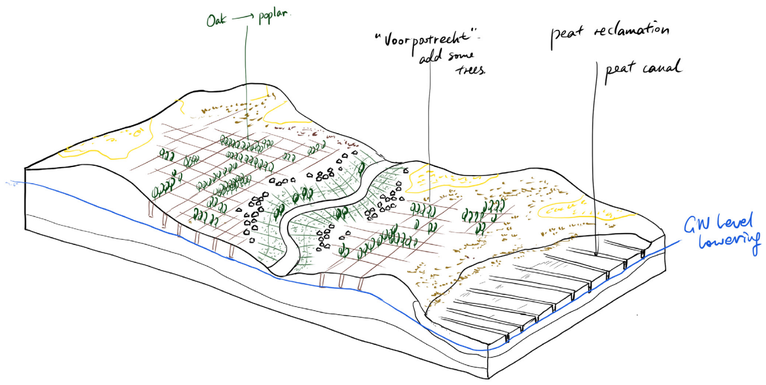
Fig.7 **Welvaartsplan**

"...The home and workplace were preferably no more than 6km by bike apart. A decentralization agenda for industry and urbanization. In all municipalities, space was made for the establishment of small, independent, craft businesses. The growth of cities had to be slowed down considerably."

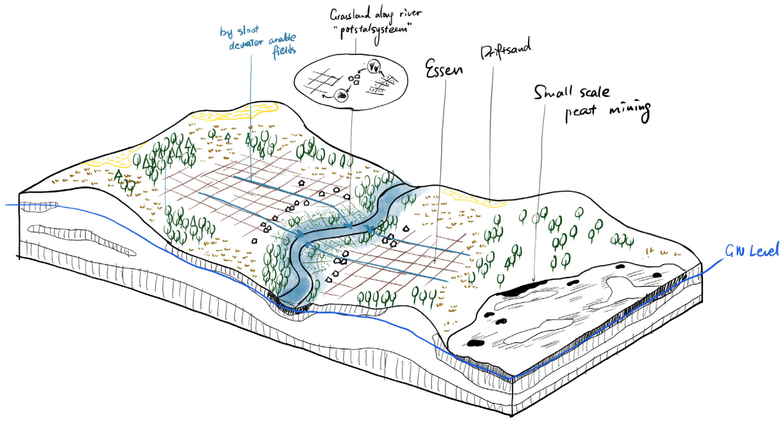
Source: www.brabantserfgoed.nl/collectie/object



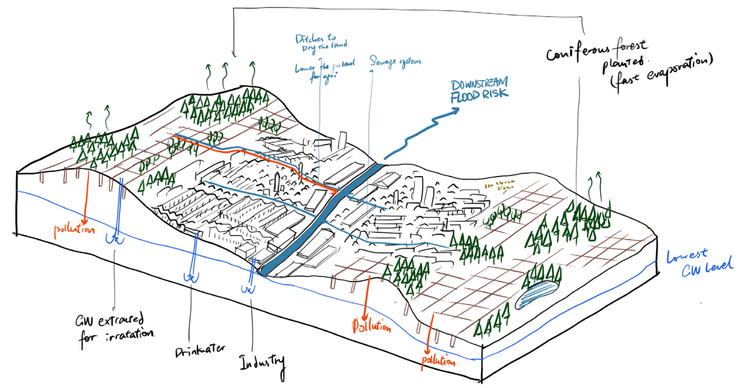
Forest Landscape



Consolidated landscape



Reclamation landscape



The fragmented landscape

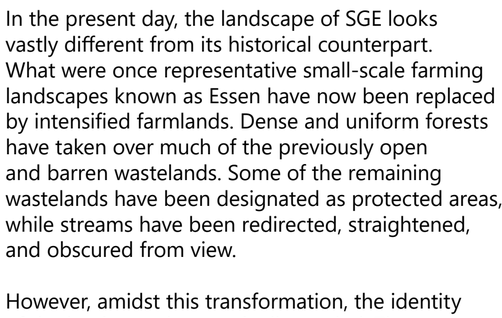
2 THE PROBLEM FIELD

2.1 A landscape losing identity

In the present day, the landscape of SGE looks vastly different from its historical counterpart. What were once representative small-scale farming landscapes known as Essen have now been replaced by intensified farmlands. Dense and uniform forests have taken over much of the previously open and barren wastelands. Some of the remaining wastelands have been designated as protected areas, while streams have been redirected, straightened, and obscured from view.

However, amidst this transformation, the identity of the landscape has gradually eroded. The once-cohesive spatial gradient has given way to a haphazard assortment of patches, featuring residential grids, industrial campuses, consolidated farmlands, and reclaimed forest areas scattered throughout. This has weakened the connections between urban and rural areas, making it difficult for people to grasp the regional landscape and form a mental image of their living environment. The balanced interaction between people and nature, as well as between the city and the landscape, has also been lost.

SGE, being a significant economic hub for the province of Brabant and the Netherlands, faces the challenge of attracting more workers and providing housing. To address this, efforts are underway to densify existing urban areas while also developing the urban and rural outskirts. Although the open spaces outside the city are appealing due to their natural attributes, they are also vulnerable to urban sprawl, which threatens their spatial quality (Alkemade, F. et al., 2014).



ED.nl

Expats zoeken woonruimte rond Eindhoven

Geplaatst op 03 oktober 2013; Laatste update 09 september, 07:44;

EINDHOVEN - Het wordt dringen op de woningmarkt voor internationale kenniswerkers in en rond Eindhoven. Op dit moment verblijven naar schatting maximaal dertigduizend hoogopgeleide buitenlandse werknemers in de regio.

Zowel bedrijven als huisvesters rekenen op een toename in het komende jaar. De Technische Universiteit Eindhoven (TU/e) haalde dit studiejaar zelfs het hoogste aantal internationals tot nu toe binnen: zo'n vijfhonderd. "We krijgen ze gehuisvest, maar het wordt moeilijker", aldus medewerker Willem van Hoorn.

Beschrijving

David Wilmot (uit Ierland) en zijn vriendin Kaitlin Mihalov (uit Amerika) in hun Eindhovense

De huisvesting van internationale



Fig.8 **The rural landscape under pressure of urbanization and recreation**
(Stuurgroep Van Gogh Nationaal Park, 2020)



Fig.9 **New housing project**
source: Google

2.2 A landscape of thirst

As a metropolitan area situated on sandy soil, SGE faces a critical environmental challenge: drought. Increasingly extreme weather patterns, combined with rapid drainage and excessive groundwater extraction, have left the entire region parched.

Drought has become a recurring problem, particularly in recent summers. In the past, this area was characterized by high humidity, with lush stream valleys and wet, barren moorlands. However, extensive land reclamation, intensified agriculture, and urban expansion have turned the region's water system into what can be likened to a drying machine.

The absence of large water reservoirs to store water exacerbates the issue, as water is drained away swiftly to replenish the groundwater. Furthermore, the sandy soil's low water retention capacity and extensive groundwater pumping contribute to further lowering the groundwater table. Many areas that were once naturally wet have now dried up, leading to a significant decline in plant growth and biodiversity.

This ongoing drought poses a significant threat to the ecological balance and sustainability of the region.

50 tot 60 miljard liter water: zo dorstig is de Brabantse natuur

30 oktober 2020 om 06:00 • Aangepast 2 november 2020 om 12:04

'Elke druppel telt'

Aanpak droogte: oproep tot mijden waterverspilling en sproeiverboden

22 juni 2023 13:31 • Aangepast 22 juni 2023 16:49

De verdroging is een taai probleem: regenwater vasthouden is lastiger dan het lijkt

16 juni 2020 om 09:00 • Aangepast 22 juni 2020 om 15:54

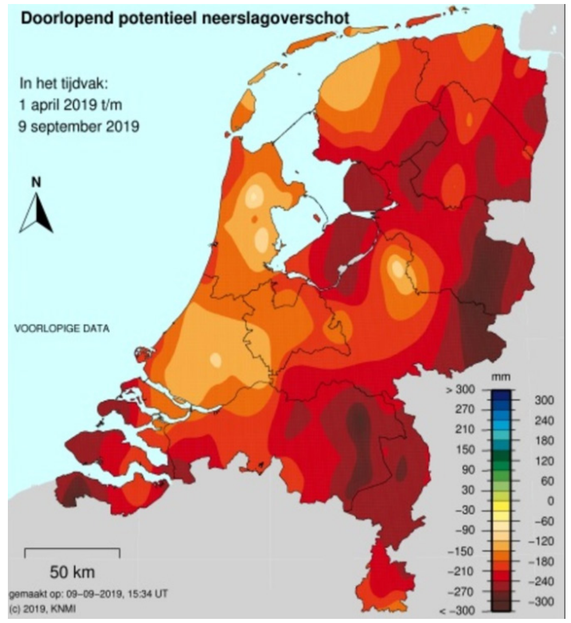


Fig.10 **Map of the ongoing potential precipitation surplus in dry season 2019**
source:https://www.knmi.nl/nederland-nu/klimatologie/geografische-overzichten/archief-neerslagoverschot



Fig.11 **The extensive water use in agricultural sector of Noord-Brabant**
source: Waterstad Brabant(2005)

2.3 A landscape of forest and to be afforestation

Vast expanses of forests vanished from SGE long ago and the landscape has been without dominant forests for quite some time. Most of the forests seen today are the result of human planting efforts. Over the past few centuries, forests have been both a means of reclaiming land and a vital part of the region's landscape, covering about 30% of the area, though this estimate may actually be higher. Forests and trees are central to many local landscape plans and policies.

On the sandy ridges, pine, spruce, and oak-beech-birch forests remain as remnants of past production forests, forming the foundation of existing nature reserves. In wetter areas, ash-alder and willow-alder forests serve as important ecological habitats and recreational spaces. The unique countryside features poplar-oak avenues, hedgerow landscapes, and nurseries, setting the region apart from the rest of the Netherlands. In urban areas, trees contribute to historical continuity and climate regulation, among other benefits.

The province of Brabant has set a goal of creating 13,000 hectares of new forest by 2030, with 8,000 hectares planned within natural networks and 5,000 hectares outside these networks (2,000 hectares in SGE specifically) (Actieplan Brabantse Bomen, 2020). By making appropriate adjustments to existing forest landscapes and implementing new reforestation initiatives, there is significant potential to address the challenges posed by drought and landscape transformation.



Fig.12 **Impression of SGE forest**
source: Brabant landschap.nl

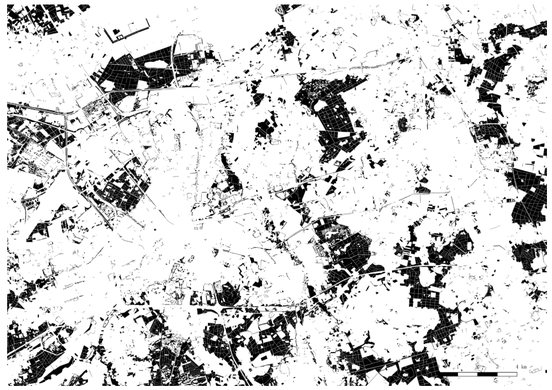


Fig.13 **SGE forests in official land-use data**



Fig.14 **SGE's trees identifiable in 5-meter resolution satellite images**

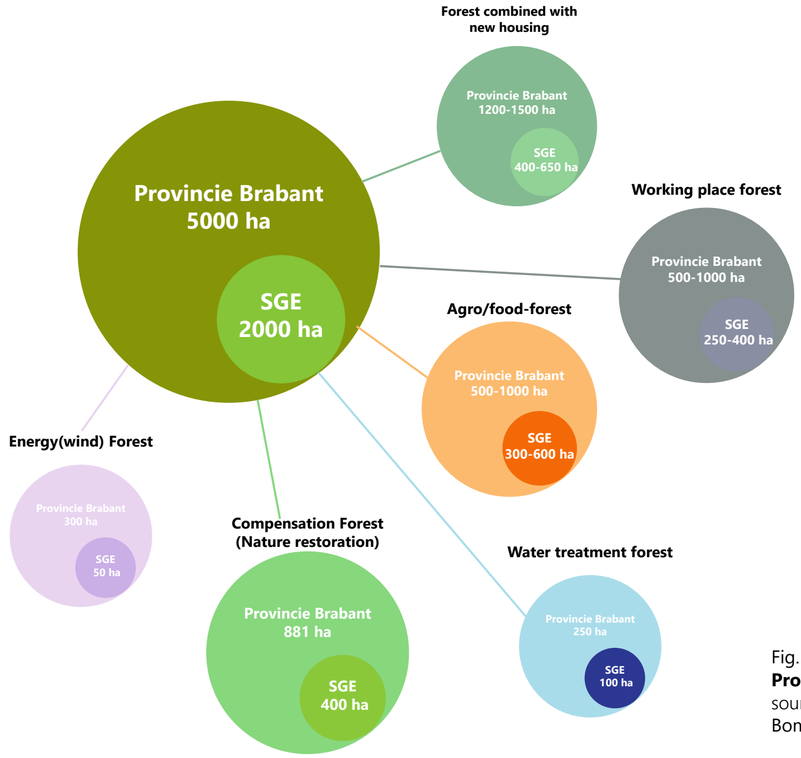
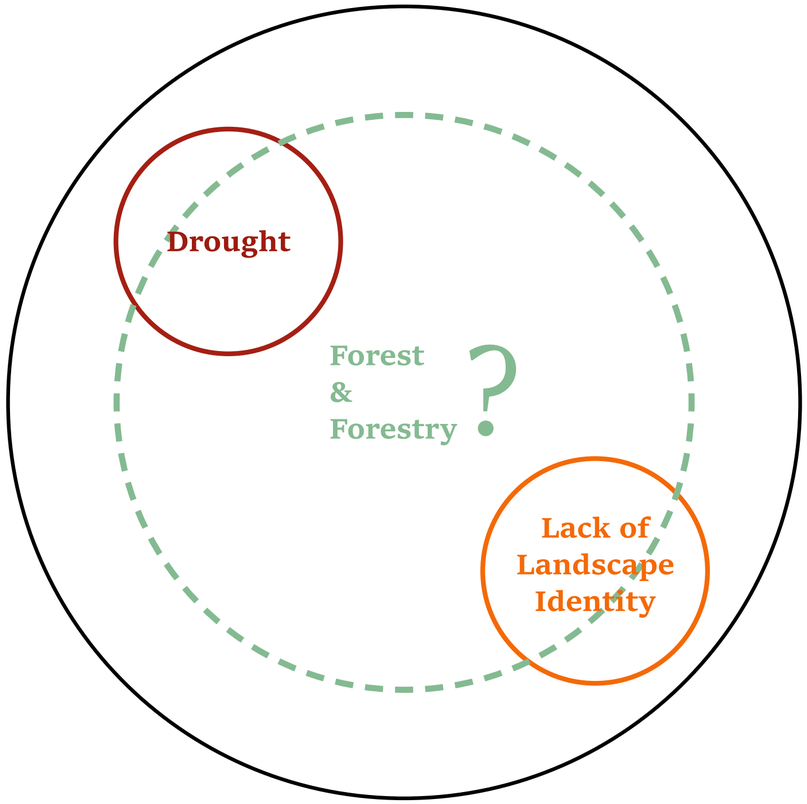


Fig.15 **Afforestation projective of Province brabant and SGE**
source: Adapted from Actieplan Brabantse Bomen(2020)

2.4 The Combined Problem Field



Overall, the SGE needs to better connect urban and rural landscapes, and landscape identity needs to be enhanced in order to provide a better quality of living; The territory is also threatened by drought and needs to be restored to a healthy water system. At the same time, SGE needs to fulfil the objective of afforestation.

It is yet unclear and if and how to combine these challenges to achieve synergies.

3 RESEARCH QUESTIONS AND OBJECTIVES

The overall objective

This graduation project is an exploration of how the forest and forestry could be utilized to strengthen the landscape identity and drought-adaptation within SGE.
For this purpose, the forest is meant to enhance or re-invente landscape character, renegotiate human-landscape relationships and mitigate drought.

The main question

How can Forest based strategy strengthen drought adaptation and enhance landscape identity within SGE?

Sub RQ related to theory study

What theories and concepts respond to SGE's context, concretise its problems and provide a basis for further analysis?

Sub RQ related to Analysis

What are the challenges and opportunities of enhancing landscape identity within SGE from the lens of forest and forestry?

What are the challenges and opportunities of strengthen drought-adaptation within SGE from the lens of forest and forestry?

Sub RQ related to Design

How can forest based strategy enhance and reinvent the landscape identity within SGE?

How can forest based strategy strengthen the drought-adaptation within SGE?

How can forest strategies spatially integrate in design transformation for cases of local scale?

SECTION 2
THEORIES & METHODS

This section primarily responds to the following Research questions:

What theories and concepts respond to SGE's context, concretise its problems and provide a basis for further analysis?

4 THEORETICAL UNDERPINNING

4.1 On the dispersed territory

Although, as demonstrated in the diachronic analysis of 2.1, the SGE experiences a decentralisation with centralised attributes, which is a specific spatial process resulting from its specific cultural attributes; it can still be placed in the theoretical context of the dispersed territories and derive from it insights and principles that can be appropriated.
Like other such spatial phenomena in Europe, the urbanisation of the North Brabant area, where SGE is located, has an alias, which is **''Nevelstad''**. The word refers to the image of a thin, stretched cloud of mist hanging between cities in Flanders region (Dehaene, 2016).

4.1.1 The emergence of the dispersed territory

Dispersed territories take many forms and go by many names: the Tapijtmetropolis, the Horizontal Metropolis, the Città Diffusa, the Zwischenstadt,Territories in Between, etc. (Wandl, 2020; Barcelloni Corte & Vigano, 2022). They all respond to the process of intertwined urban and rural development and the failure of traditional planning dichotomies. They often do not have a clear structure, taking the form of polycentres or networks-nodes, or a complete patchwork of fragments.

As described in the omelette model proposed by Cedric Price (Gheysen, 2020), “This ancient medieval city with a strong wall (boiled egg) was under the pressure of military technological innovation and the beginning of industrialization between the 17th and 19th centuries. Collapse. ” What followed was a period of urban expansion, making room for growth in demand for industrial and housing-related space. Although there was still a distinction between urban and rural areas, this began to change after the war. The economic boom and the resulting Great Acceleration led to a notable spatial transformation, marked by a surge in private car ownership, the proliferation of supermarkets, the development of business parks, and the creation of allotment gardens (Gheysen, 2020). This has resulted in cities becoming scrambled eggs – the boundaries between urban and rural areas are no longer clear or even discernible.

For many spatial designers they still mean the loss of idyllic landscapes or the lack of urban functionality and urbanity. As such, they see the need to change settlement patterns to return them to their pre-decentralised state. However, as Pisano (2013) points out, all attempts to translate the structural image of the historical European city directly into a general model for the future are destined to fail. The centralisation and scaling of functions and practices related to production and recreation have made it impossible for them to be contained within the city any longer, and have escaped into equally more artificial landscapes. The hierarchical structure of traditional city organization has been found to be insufficient for addressing the needs of metropolitan

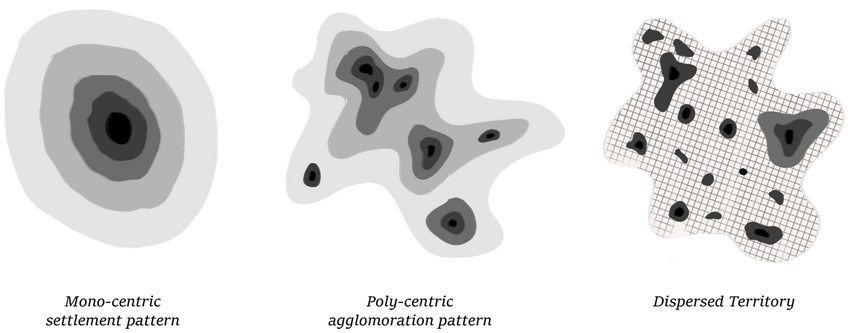


Fig.16 **The patterns of urban dispersed development**

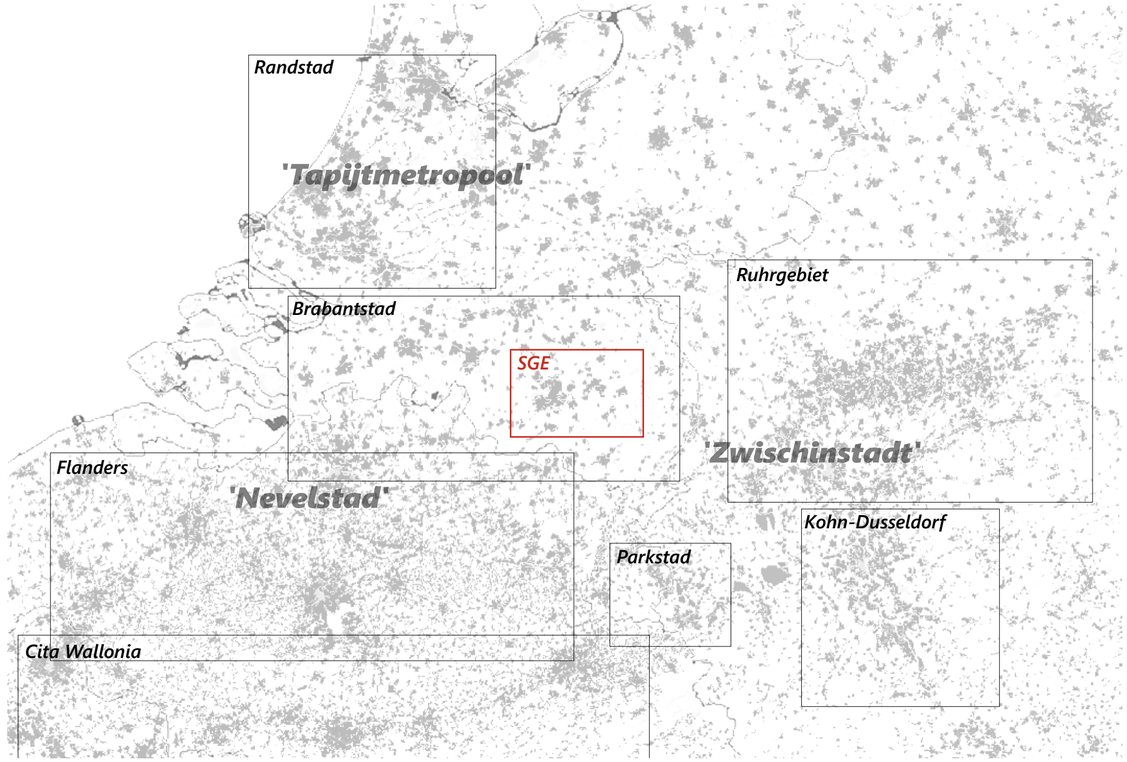


Fig.17 **SGE situated in the context of the decentralised territories of Western Europe**

4.1.2 A few inspiring studies of decentralised territories

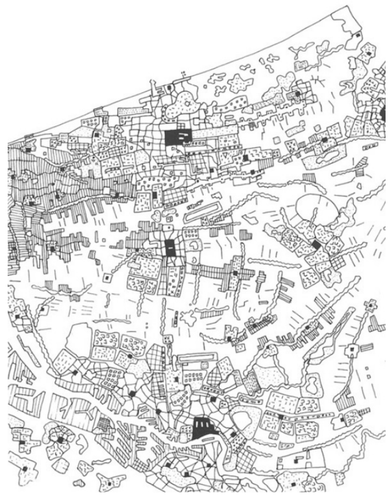
Dispersed territory in Dutch planning background-
The Patchwork Metropolis(Tapijtmetropool)

Among a series of better-known research cases of decentralised metropolises, the PM is the one that is closest to the sge in terms of spatial proximity and socio-culture, and is still having an impact.

In 1989, Wilhelm-Jan Neutrin coined the term 'carpet metropolis' as an urbanisation strategy for the Hague-Rotterdam region. This eschewed the traditional dichotomy between city and countryside, describing the region as a 'collage of fragments': "The increasing number of business parks, shopping cities, parks, residential areas, university campuses is shaping the territory towards a All these functions are laying together, side by side, without sharing any facilities or interests, without All these functions are laying together, side by side, without sharing any facilities or interests, without being connected between each others, but instead plugged with the nation or international traffic network. that are shaping the land into a mosaic of functions and places. All of these functions sit side by side, sharing no facilities or interests, not connected to each other, but to a national or international traffic network."

Neutelings' assertions about the Patchwork Metropolis largely view the territory as fragmented and static, with patches being added and fixed at a stroke, isolated from each other, questioning the need for masterplanning on a regional scale.

Pisano (2013) further develops Neutelings' theory by mentioning that "patches do not take into account any syntax, but simply follow a vocabulary of patches governed by some rules of compatibility and incompatibility". In his study, he emphasises the development of diversity in different patches through design and borrows the theory of landscape ecology as a metaphor (ecotone and ecocline) for adaptation and transition between patches.



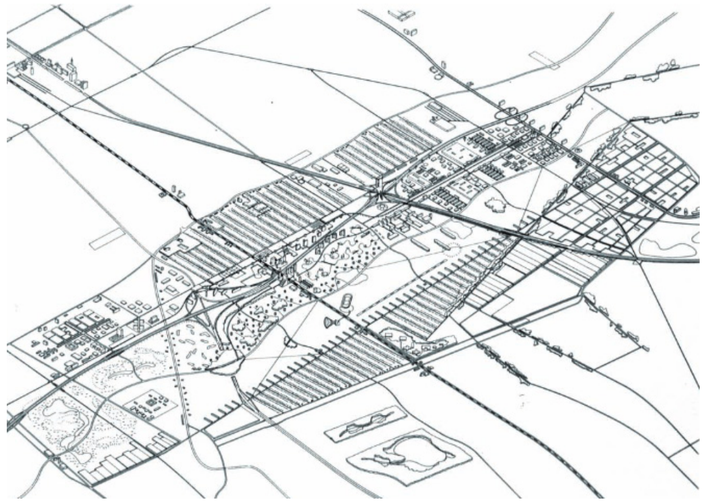
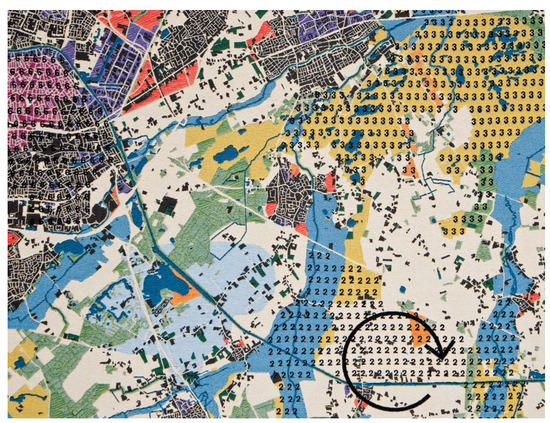


Fig.18(Left) **The Hague-Rotterdam region as a patchwork metropolis (Neutelings, 1989)**
Fig.19(Right) **In Ypenburg's plan, a combination of patches on a meso/inter-patch scale replaces overall coherence.**

Patchwork metropolis provides some inspiration for the analysis: in a context where continuity is replaced by contiguity, there is a need in SGE to identify discontinuities in space (patches) and to respect their diversity, and to reinforce their heterogeneous but also coherent spatial experience at an intermediate scale. This can be summarised in two principles, coherence and diversity.

The 2014 IABR project BrabantMosaic is to some extent based on this idea (Verstedelijkingsstrategie Brabant 2040). This project recognises the patchwork status quo of Brabantstad and wants to maintain and enhance its diversity. Here, the water system is the basis for creating coherence, with streams and canals assuming the role of corridors, connecting patches with different hydrological functions and forming new water machines.



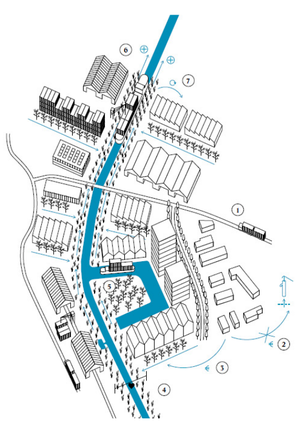


Fig.20(Left) **Project MosaicBrabant (IABR, 2014) take Brabantstad as a 'carpet' of different kinds of urban, rural and natural patches**

Fig.21(Right) **Water elements combines patches with different functions together to form a resilient water machine**

Study on landscape metropolis -
The choreography of metrolopitan landscape

At a time when the contemporary metropolis has lost its traditional, hierarchical clarity of structure, and there are fewer and fewer tools to understand and contribute to the contemporary urban environment, landscape has moved beyond its traditional meanings as an idyllic landscape or garden planting, and now engages with spatial issues of urban territories within the framework of landscape urbanism (Van der Velde & De Wit, 2009). In the flat , extended non-city, landscape is the last relevant 'ground' for development and serves as a basis and tool for organising metropolitan space.

In a study by Van der Velde & De Wit (2009), they propose that from a landscape architectonic perspective, the metropolis consists of three basic

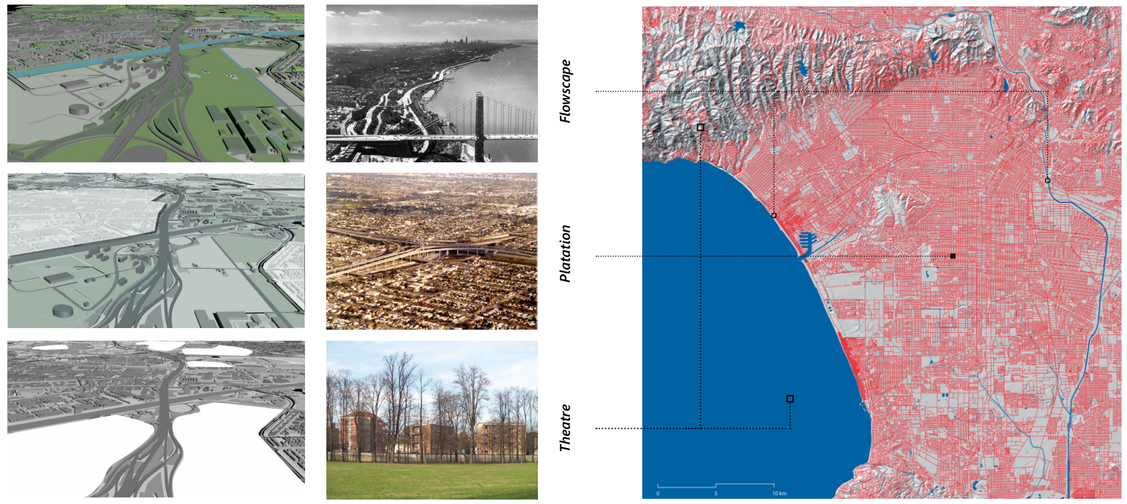


Fig.22(Left) **The three basic forms of landscape metropolis**
Fig.23(Right) **The metropolitan landscape of Los Angeles as a choreography of the basic forms**

forms:

Flowscape: Movement space – In the landscape of the infrastructure network which can recognize an architectural staging
Plantation: Programme of the urban colonisation grid is staged in landscape architectual terms
Theater: Spatial and visual 'devices' of landscape to percieve the city or 'holes in the urban fabric' - The apprehension of landscape space is restricted to voids within and between urban tissue , the city-dweller stands face to face with natural process, such as natural groeth, silence and emptiness.

In an increasingly fragmented and disorientating metropolitan environment, these three forms are appropriately 'choreographed' on the surface to reveal and give meaning to the landscape and the city in different places.

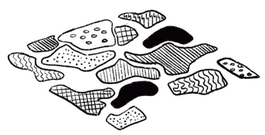
They emphasise the importance of **'*narrative places*'**, which embody the spatial and temporal discontinuities of the metropolis and are seen as rhetorical landscapes that reveal genius- loci from the generic grid of the metropolis through a heterogeneous composition of the same materials as elsewhere. loci.The narrative site can be a theatre or a series of elaborate choreographies along the flowscape.

This thesis will draw on this landscape-based approach to structuring SGE's metropolitan landscapes, but does not directly follow these three basic forms as tools of analysis, as each metropolis has its own unique spatial narrative. The notion of ''narrative places'' can be taken as an important principle, and the clarification of narrative places in the analysis of metropolitan landscapes contributes to the strengthening of their overall landscape identity.

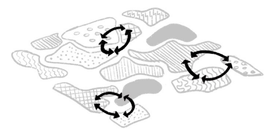
CONCLUSION

- SGE can be recognised as a despersed territory
- Insights can be gained from a number of relevant and important spatial studies on dispersed territories which are summarised in a number of parameters of particular importance for the spatial identification of SGEs as dispersed territories:

Diversity within the Territory: diversity of spatial identities based on dispersion and fragmentation



Coherence: not the continuity of the whole area, but the transition and articulation of space within a certain range of diversity (compatibility).



Narrative places in the territory: heterogeneous spaces reflecting genius loci in a metropolis.



4.2 On landscape identity

4.2.1 Landscape identity: the dual construction of perception and action

Stobbelaar and Pedroli define the concept of landscape identity as " . . the unique psychosociological perception of a place defined in a spatial-cultural space" . (Stobbelaar & Pedroli, 2011) It can refer to both the landscape itself and its differential characteristics, as well as how people use the landscape to construct their individual or collective identity.

This suggests that landscape identity is based on individual and group understandings of landscape as both a physical and existential entity. In Ramos' (2016) study, this duality of landscape identity is linked and a TRANSACTION MODEL is constructed.In this model, landscape identity is formed through the mutual interaction of people and the landscape at two distinct levels – a sphere of perceptions and a sphere of action. The first sphere builds on the perceived character of the landscape，the second sphere relates to the way society and landscape interact on a physical level by taking action on the landscape (e.g. policies, planning, management); They describe process of the forming of landscape identity as a circular process: people are influenced by the landscape; they change or interact with the landscape; which again creates conditions for new relations and thereby influencing people's perceptions of it. Humans are thus viewed as co-creators and not mere users of the environment. (Conrad, 2017)

The landscape identity here could be seen as constructed from two aspects, the physical-spatial aspect and the existential-social aspect. They are two sides of the same coin, not separable, but dynamically interdependent in the construction of Landscape identity. However, in order to make LI more operational in the subsequent analysis and design phase, I will collate and summarise the theories and concepts related to each of these two aspects separately, to find their respective attributes or ''contents'', or parameters for assessment. ''content'', or parameters for assessment.

4.2.2 The physical-spatial aspect of Landscape identity (Perception)

Landscape character is described as “a distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another” and “it is what makes each part of the landscape distinct, and gives each its particular sense of place” (Swanwick, 2002, p. 8).

This aspect of landscape identity can be interpreted as how the physical or spatial features of the landscape contribute to people's identity. Spatial in this sense has a broad meaning; far broader than, for example, the visual aspects of landscape it includes orientation, distances, ordination, etc. Spatial identity of landscapes is based on forms, patterns and elements (Stobbelaar & Hendriks, 2006).

There are many studies that have established description methods and evaluation systems for the spatial characteristics of landscapes. Tveit et al. (2006) carried out an extensive review of literature on landscape perception and identified 9 key concepts

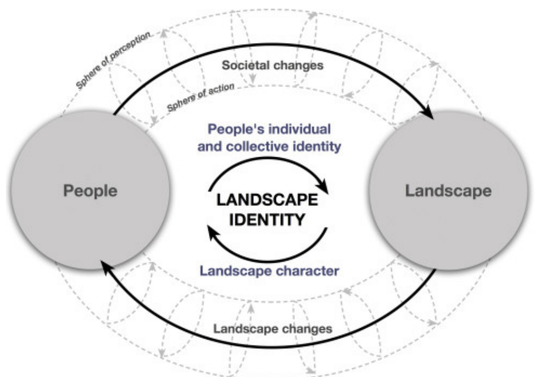


Fig.24 **Transactional model of landscape identity.**
(Ramos et al, 2016)

to describe the visual character of a landscape, such as Coherence, disturbance, historicity, visual scale and complexity. Gulinck et al. (2001) explain the value of landscape with the following criteria: integrity, diversity, construction, aesthetics and ecological qualities.

It is worth noting that the spatial characters can be reflected and studied at different spatial scales, such as place identity level and regional identity level. (Mucher et al. 2007). For the specific region of SGE, the discussion of dispersed territories summarises some principles (Coherence, diversity and narrative place) that respond to the concern for spatial identity at larger scales in landscape identity.

On a smaller scale, the focus is mainly on the quality of an individual's perception of specific landscape elements and how this affects people's behaviour in the landscape.Kevin Lynch (1960) is one of the most important scholars in the branch of science that deals with individual spatial orientation. He wanted to know how people use their surroundings to orientate themselves in urban landscapes. He found that paths, boundaries, zones, nodes, and landmarks are five elements that influence people's orientation, which is related to the legibility of the landscape, and that improving the legibility of an area allows us to navigate through that space more easily. A concept related to legibility is imageability, which refers to the unique, recognisable and memorable qualities of a place that help to form an internal image of the landscape in people's minds. They are related to the fitness between functionality, spatial form, and the natural features, as well as to historical continuity (Erwing et al., 2006). These studies define a landscape with good physical-spatial characteristics as a clear landscape that is widely explored but not lost.

Another concept that complements legibility is the complexity of a landscape, referring to the visual richness of a place (Erwing et al., 2006). In Kaplan and Kaplan's (1989) study of landscape preferences, they articulated complexity as a seemingly opposite but mutually reinforcing factor to legibility. This is because visually complex places are often considered to have a good human scale as well, as they correspond to the speed at which humans move through space (Erwing et al., 2006). Spaces designed with a human scale and a high degree of complexity tend to be more amenable to walking and exploring and work with legibility to shape positive perceptions of landscape characters.

4.2.3 The social-exsitential aspect of Landscape identity (Action)

In this respect, the content of people's identities also varies at different spatial-group scales.Stobbelaar et al. (2011) note that cultural landscape identities may be characterised by icons in the landscape, care for the landscape, or shared memories of events, triumphs, and religious features . At larger scales, such as the national or regional scale, people's existential landscape identities are constructed from cultural practices, traditions, and shared histories/memories associated with the landscape, reflecting longer time scales and a broader population (e.g., a nation).

In specific scenarios of people's lives, people can interact with the landscape or act on the basis of perceived landscape features that are relevant to their well-being, e.g. as consumers or as producers, in a variety of capacities. This can be understood as a stewardship commitment or impulse (García-Martín et al, 2018). Arguably, the socio-existential dimension of landscape identity is closely related to stewardship.

The formation of stewardship in the landscape is predicated on a variety of activities related to the well-being of life. Engagement in activities in the landscape contributes to what Sarah Nettleton refers to as existential capital (Nettleton, 2015) , and is fundamental in the formation of landscape identities. this requires the multifunctionality of the landscape.

Fisher et al. (2017) argued that monofunctional landscapes increase people's sense of alienation from their local environments because the value of the landscape there is are severely restricted and only a limited number of participants can benefit from them. Meanwhile, van Ripper and Kyle (2014) suggest that 'the diversity and intensity of values assigned by respondents suggests that multiple services (landscape functions) should continue to be offered to the public to facilitate stewardship'.

Among the wide variety of activities that enhance stewardship an important point is the involvement of people in the management of the landscape. The management/care/maintenance of the landscape is an ongoing activity that responds to the temporal element that is so important in the construction of landscape identity places (Ramos, 2016). This process of long-term appropriation through individuals and communities can result in the formation of familiarity and attachment to the landscape as a container and medium for collective memories that ultimately become the creators of the landscape (Eiter, 2010). There are a number of studies that show that users who participate in management can benefit through increased satisfaction with their neighbourhood (Nannini, 1998), expanded recreational and social uses of green spaces (Glover et al., 2005; Jones, 2002), and an increased sense of attachment to the green space (Van Herzele, 2005).

CONCLUSION

According to Ramos' (2006) transactional model of landscape identity, landscape identity consists of two elements: landscape character and human identity. They represent two dimensions of human-landscape interaction: perception and action, which interact with each other in the course of time.

Combined with other related researches, in order to make the concept of landscape identity operational, it can be grasped from two aspects: the spatial-physical aspect and the social-existential aspect.At the same time, landscape identity is also related to scale, which can be divided into two scales: regional and local.

-At the regional scale, the spatial-physical aspect or perception aspect, the key parameters are ***diversity, coherence and narrative space***; the social-existential aspect or action aspect, the key influencing factors are are ***cultural tradition*** and ***common history/memory***.

- On the local scale, the spatial-physical aspect or perception, the key parameters are ***legibility*** (including spatial form, sensory perception and historical continuity) and ***complexity***; the social-existential aspect or action The key influences are the ***multifunctionality*** of the landscape and ***participatory management***, which contribute to the formation of ***stewardship***.

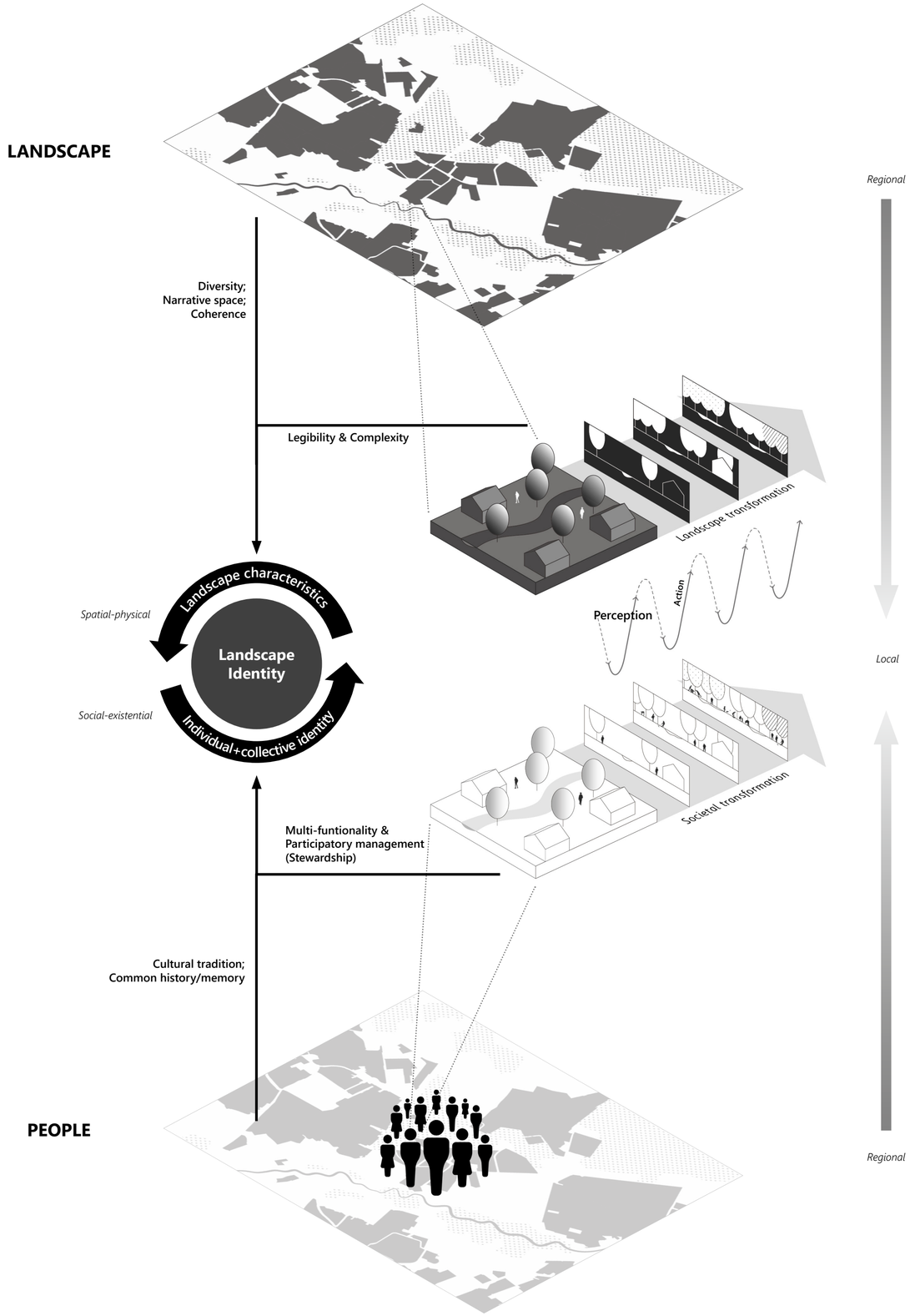


Fig.25(Page 37) **A summarizing schemetic drawing shows the components and key influences of landscape identity, including the conclusion of study on dispersed territory**

4.3 On drought adaptation

4.3.1 Mechanisms of drought

Dry weather is the underlying trigger for drought - low precipitation as well as high temperatures leading to excessive evaporation. If dry weather persists for a long period of time, it leads to disturbances in the hydrological cycle, and droughts arise when conditions go beyond normal (van den Eertwegh et al., 2021).

Precipitation shortage (evaporation greater than precipitation) is used as an indicator of drought. In the Netherlands, the term 'drought' is usually used for situations where there are problems due to water shortages (Kennisportaal Klimaatadaptatie, n.d.-a).

In fact, the average total precipitation in the Netherlands, including Brabant, is higher than the total evaporation throughout the year. Precipitation shortages occur because rainfall and evaporation are unevenly distributed both geographically and seasonally. Typically, autumn and winter see excess rainfall, while spring and summer experience deficits. Droughts can become particularly severe when these shortages exceed 200 mm (Leenaers, 2021).

Van den Eertwegh et al. (2021) describe four stages of drought affecting water and soil systems (Fig.27):

1) Meteorological drought: almost no precipitation with high evapotranspiration.

2) Soil Drought: The top layer of soil dries out due to a lack of precipitation. This leads to a reduction in the water available to plant roots, which in turn decreases actual evaporation.

3) Groundwater Drought: Groundwater levels tend to drop more significantly. The extent of this decline depends on factors such as the depth of the water table, water management practices, and overall water usage.

4) Drainage drought: Reduced or drying up of water flow in rivers, ditches and streams.
As the stages advance, the time it takes for dry weather to have an impact in the soil and water system becomes longer. In the same order, system recovery also takes longer. In this case, the depth to the water table is critical. The deeper the groundwater is in the soil, the longer it takes to recover (van den Eertwegh et al., 2021).

4.3.2 Causes of severe drought in sand areas

The sandy soil
Various regions in the Netherlands exhibit varying degrees of vulnerability to drought. The low-lying clay and peatlands in the western and northern parts of the country benefit from the ability to receive river water inflows, which can replenish groundwater levels when needed. Conversely, the elevated sandy lands in the eastern and southern regions are more susceptible to drought, relying solely on precipitation and groundwater. Without the option of river recharge, water shortages occur more rapidly in these areas (Kennisportaal Klimaatadaptatie, n.d.-b).

The climate change
Studies indicate that overall precipitation levels are still rising, both during summer and winter. However, this increase is countered by a rise in evaporation, driven by higher temperatures and increased sunshine. The uptick in evaporation outweighs the precipitation increase, leading to a rise in summer precipitation deficits (Leenaers, 2021). Moreover, alongside shifts in average climate conditions, the risk of extreme weather events is on the rise. For instance, 2018 ranked among the five driest years recorded since 1906, with a precipitation deficit exceeding 300 millimeters. Such extreme weather occurrences, previously happening every 30 years, are now becoming more frequent and are projected to continue increasing in frequency (Leenaers, 2021).

The land use
The Netherlands has a rich history in hydrology,

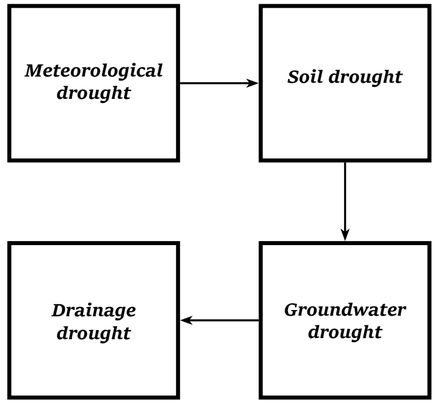


Fig.27 **Four phases of drought.**
(Van den Eertwegh et al. 2021)

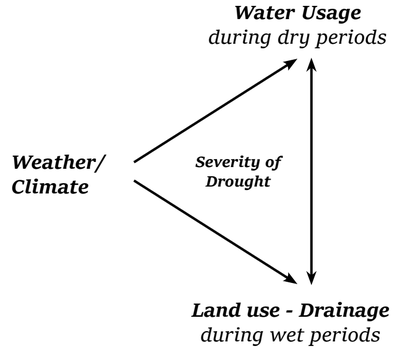


Fig.26 **The Severity of drought on high sand area**
(Van den Eertwegh et al. 2021)

shaped by centuries of struggling with floods. This legacy has heavily influenced the prevailing mindset in water management, which has long prioritized drainage (Rijkswaterstaat & Unie van Waterschappen, 2019). Consequently, despite experiencing increased average annual rainfall, the country faces water shortages because water is no longer retained when it's needed. Instead, it is swiftly discharged into the sea. Furthermore, the proliferation of hard surfaces and soil compaction in urban areas, driven by land use practices, hinders the infiltration of rainwater into the soil, exacerbating the issue.

The water use
When the weather is dry, farmers use streams or groundwater to irrigate their land. Weather and irrigation withdrawals lead to a decrease in surface water, which ultimately leads to an increase in groundwater withdrawals. Similarly, residential and industrial water demand increases. Two thirds of this withdrawal comes from groundwater and one third from surface water. As a result of the increasing demand, supply and demand are out of balance. This ultimately leads to an irreversible decline in the water table (van den Eertwegh et al., 2021).

This ultimately leads to desiccation. Desiccation is often used to describe nature-related problems and is used to indicate a decline in the water table or a decrease in seepage in nature reserves. This means that there is not enough water to secure the ecological values associated with the groundwater system, such as habitats that depend on seepage for their existence. The term is also used to describe lower quality water in the soil, with pollutants also contributing to impaired ecological values (van den Eertwegh et al., 2021). Desiccation due to drainage and water use is a structural problem in Dutch nature.

CONCLUSION

Drought is a systemic problem, with extreme weather acting as a trigger mechanism on sandy soils and exacerbated by land use and water use. The key to mitigating drought on sandy soils is to restore a healthy groundwater system.

4.4 The forest approach

4.4.1 The benefits of forest and trees

Forests represent a multi-dimensional and multi-scalar entity capable of addressing a diverse array of concerns, spanning environmental, ecological, social-cultural, spatial, and economic domains (Research Fellowship Urban Forestry TU Delft, 2019). Forests and trees are also increasingly being used to address landscape and spatial related challenges, for example in the previously mentioned province of Brabant where 13,000 hectares of new forests are planned for 2030 (Actieplan Brabantse Bomen, 2020) to help address concerns ranging from environmental and ecological, to socio-economic ones, a figure that in the whole of the Netherlands is 37,000 hectares. (Interprovenicaal Overleg & Ministryie van Landbouw, Natuur en Voedselkwaliteit, 2020)

5.4.2 Approaching drought adaptation with forest

The most distinctive feature of trees is that they act as a living ecological entity that can provide a variety of regulating services. Trees contribute to cooling their surroundings by providing shade and engaging in transpiration, while also acting as carbon sinks and filtering out pollutants from the air. Furthermore, healthy forests and woodlands play a crucial role in preserving soil health (Zhiyanski et al., 2018) and nurturing diverse ecosystems that support a wide range of plant and animal species.

Most relevant to drought adaptation is the role of trees as sponges. Individual trees can reduce the amount of precipitation reaching the surface through leaf retention and slow runoff through their root systems and litter, which can act as a flood attenuator; litter also holds rainwater and allows it sufficient time to infiltrate into the soil, which is porous as a result of root growth, thus retaining soil and water, preventing erosion and mitigating land subsidence. Forests as tree assemblages allow these hydrological services to be scaled up into self-sustaining and renewing reservoir organizations, while meeting the principles of drought adaptation (retaining water, storing water, replenishing water).

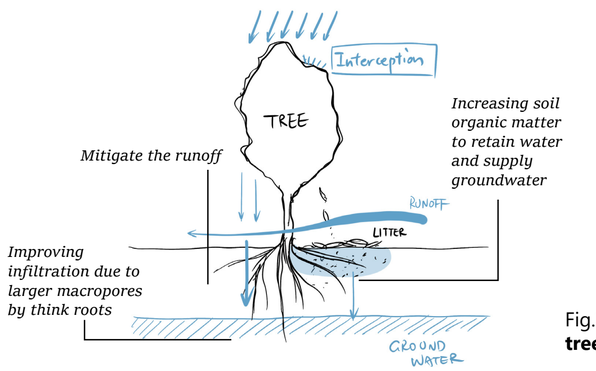


Fig.28 **The hydrological regulating services provided by tree- as sponge in the water circle**

5.4.3 Approaching landscape identity with forest

In addition to these regulating ecosystem services, forests provide a variety of cultural ecosystem services. Forest and tree elements can be used to integrate fragmented or cluttered landscapes (legibility) and reinforce spatial identity as striking landscape elements. The abundance of trees as a landscape building material can provide a great

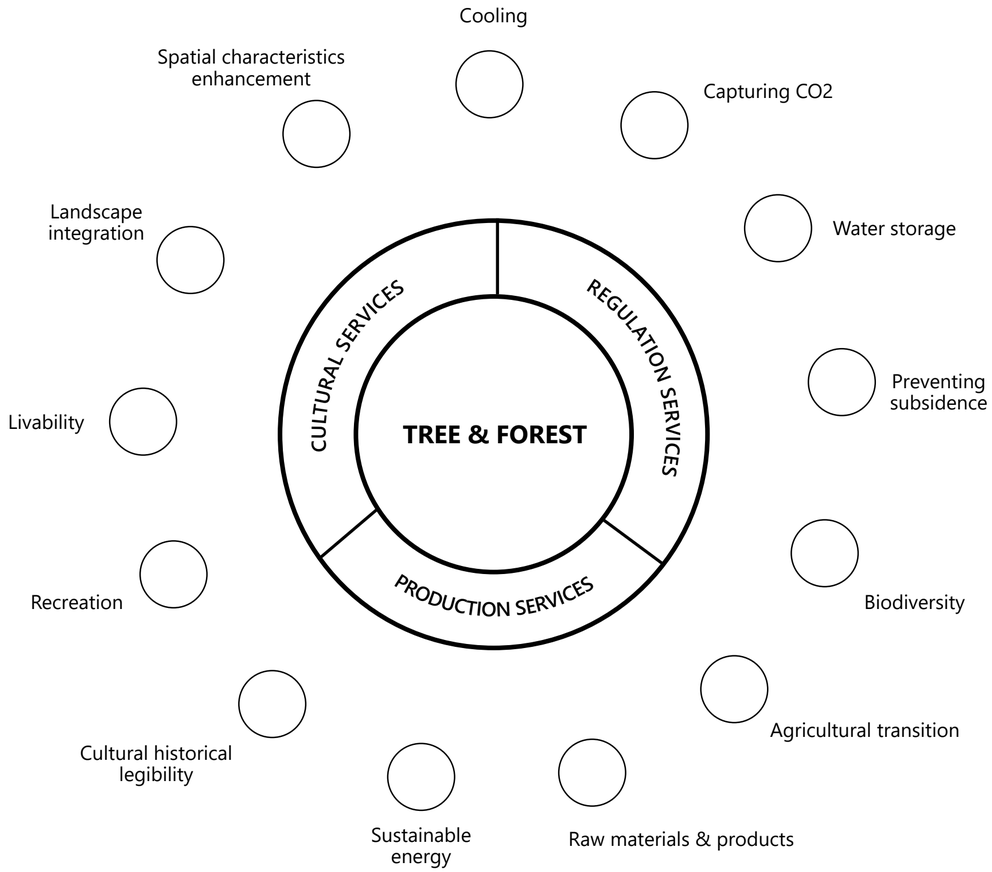


Fig.29 **Ecosystem services provided by forest and trees**

variety of sensory experiences and spatial forms, while the strong cultural images and narratives of forests have the potential to enhance historical continuity.

Forests play a vital role in enhancing both the "quality of life" and the "quality of place" by fostering social interaction, creating spaces for recreation and education, offering pleasurable sensory experiences, and reinforcing a sense of identity or belonging (O'Brien et al., 2017). Forests and forest-based green infrastructure can encourage active lifestyles, thereby improving overall livability (Carrus et al., 2017). Additionally, green and forested areas are known for their restorative qualities, capable of alleviating stress and fatigue, thus positively impacting mental health (Carrus et al., 2017). Furthermore, trees and forests provide various provisioning services, including fuel, timber, construction materials, and a range of non-timber products such as food and fodder (Tiwary et al., 2018). This fits well with the multifunctionality required by the socio-existential aspect of landscape identity.

Forests as a living bioscape emphasise the importance of the time dimension. Forest landscapes are ideally suited to participatory management, where people can be involved in the cultivation, maintenance and management of trees and woodlands, reinforcing stewardship as they accompany the forest through its ongoing changes, making it a 'container of collective memory' (Cosgrove (1998)). increased focus on engaging local communities in their "neighbour-wood" is part of a general governance trend toward increased user involvement in the management of local green space, especially in urban settings (Mattijssen, 2017).



Fig.30 **Delft as a forest composed of various spatial configurations of trees**
(De Wit & Van der Velde, 2024)

This paper argues that the role of forests or trees in shaping space in the landscape is the basis for intervening in landscape identity through forests. In terms of looking at urban or even metropolitan landscapes through the lens of forests and making them operational, the approach mentioned by De Wit & Van der Velde (2024) in their study of the spatial configuration of trees in Delft is considered to be particularly useful: they make a detailed categorisation of spatial configurations of trees (points, lines, groups, and volumes), thus removing trees from their typically 'vague, cloudy image' to an architectural material with a distinctive character. By applying this typology of spatial configuration of trees to Delft, the original city becomes a mosaic of characterised wooded areas that are uniquely Delft, dissolving the dichotomy between the city and its outlying areas and enhancing spatial coherence. This echoes the previous spatial claim for a decentralised urbanised territory.

The spatial configuration of the urban forest can serve as a vehicle for landscape identity (De Wit & Van der Velde, 2024), it can improve the perceived quality of the space, reflect historical continuity, carry a variety of ecological and use functions and contain possibilities for diverse management practices, thus serving as a starting point for transformation. This paper further develops this spatial morphology-based **'language of forest'** approach and explores its application to metropolitan landscapes.

CONCLUSION

- Forests provide a wide range of ecosystem services

- Spatial configurations of trees can act as carrier of spatial identity
- The activities that trees and forest spaces can host contribute to multifunctionality; as a living landscape, the planting, nurturing and management it requires offers the possibility of fostering stewardship over the process of time.

- The regulating services provided by trees and forests can fulfil the needs and principles of drought adaptation on sandy soils.

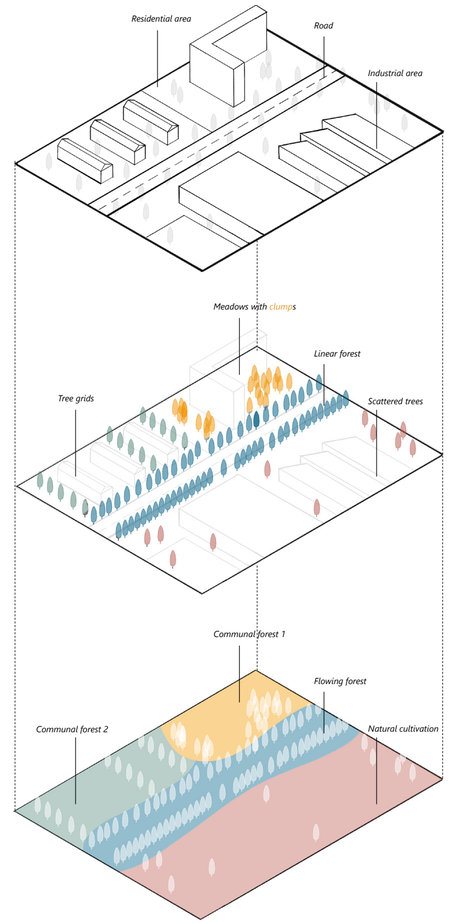


Fig.31 **Seeing (urban) landscape as forest from spatial and social perspective**

Trees and forest as the carrier for :
Spatiality;
Perception quality;
Historical continuity;

Trees and forest as the carrier for:
Activity;
Functionality;
Participatory management;

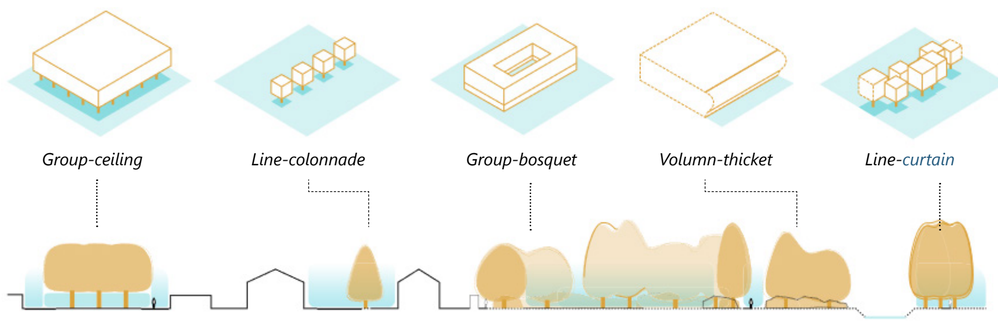


Fig.31 **The tree configuration types of a neighborhood in Delft that define the spaces**
(De Wit & Van der Velde, 2024)

4.5 Theoretical synthesis

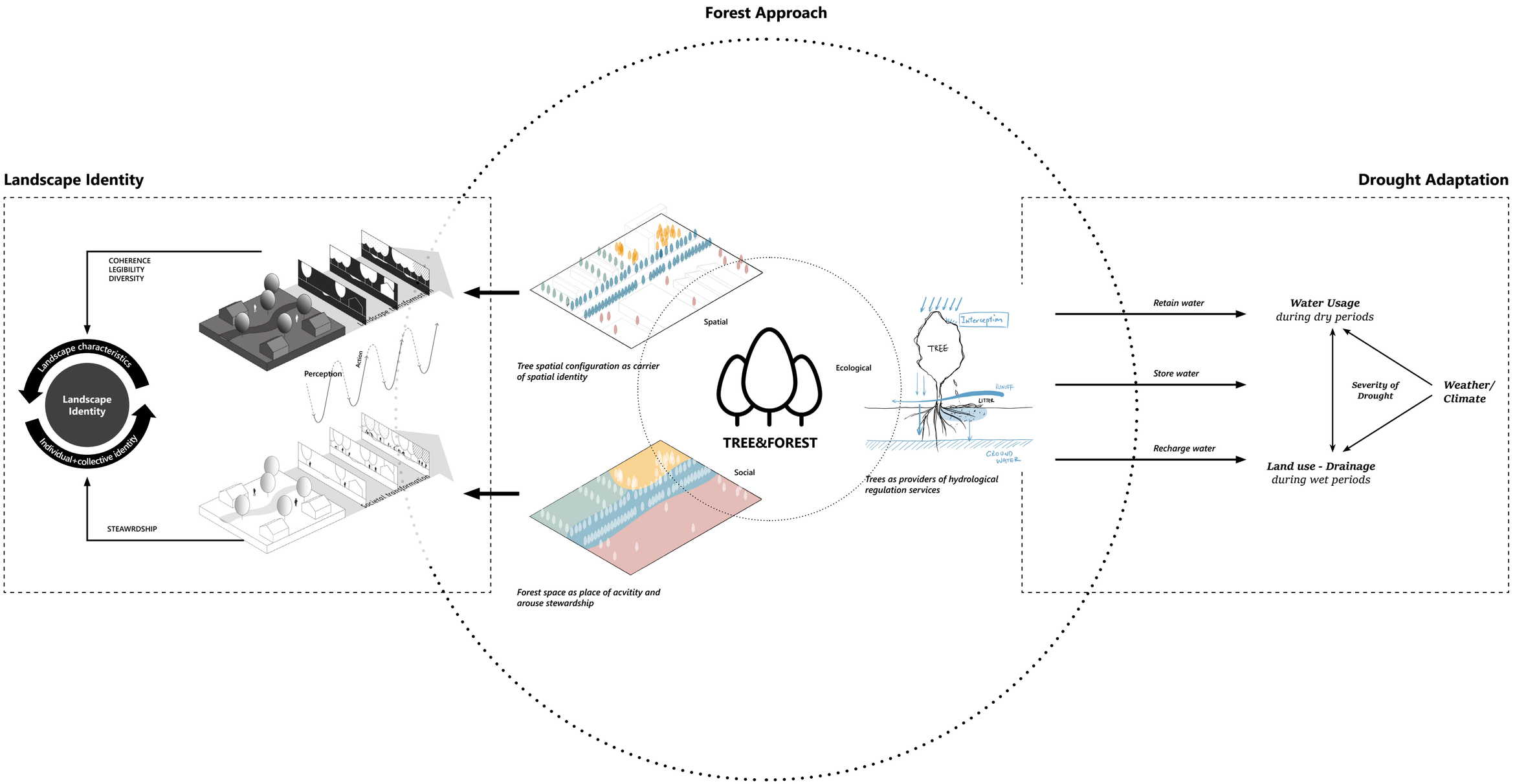


Fig.32 **Summative illustrations: theoretical approaches for forests and trees to enhance landscape identity and drought adaptation**

5 METHODOLOGY

5.1 Methods and approaches

5.1.1 Two parallel perspectives

This study examines the region from two separate yet interconnected perspectives.

On the one hand, from a spatial-morphological perspective, SGE as a metropolis, where fragmentation of the landscape and further urbanisation pressures are forcing it to face the challenge of landscape identity/socio-spatial quality. In this perspective, the main goal is to enhance the landscape identity of this patchwork metropolis, and the related sub-goals are to enhance spatial and social quality, with the main evaluation criteria being legibility(imageability), diversity(complexity) and Engagement in the landscape(stewarship).

On the other hand, from a biophysiological perspective, SGE is a metropolis situated on sandy soils, threatened by drought due to extreme weather and unsustainable water systems. In this perspective, the main goal is to create climate (drought) adapted metropolitan landscapes, and related to this is the sub-goal of rataining more water, reducing groundwater abstraction and replenishing groundwater.

This paper intentionally analyzes them (at the macro level) separately and generates corresponding design strategies for each. Following this process, synergies or conflicts can be expected to develop, which will form the basis for design integration at a smaller scale.

5.1.2 Three scales

<u>Macro-scale (regional)</u>: The two perspectives mentioned earlier will form a regional spatial vision and design toolbox, reflecting regional concerns in the topics of interest, such as the diversity of regional scales and the narrative places, in terms of landscape identity, and the operation of regional water systems, in terms of drought adaptation, among others. Focus on reflecting typologies and the range of strategies used, etc.

<u>Meso-scale (area)</u>: the meso-scale is reflected here as a spatial proposal and transformation scheme for a case area that responds to synergies and conflicts of strategies in the macro-scale; specific spatial qualities should be reflected. Focus on reflecting spatial structure (blue/green), operation of systems/functions, time-based development strategies, etc.

<u>Micro-scale (local)</u>: design location critical for the case area at the meso-scale, where design testing will be site-based using the design toolbox and generating formal intervention traces and reflecting conclusions back to the case area. The focus will be on reflecting spatial form, experience/perception, planting schemes, time-based change, etc.

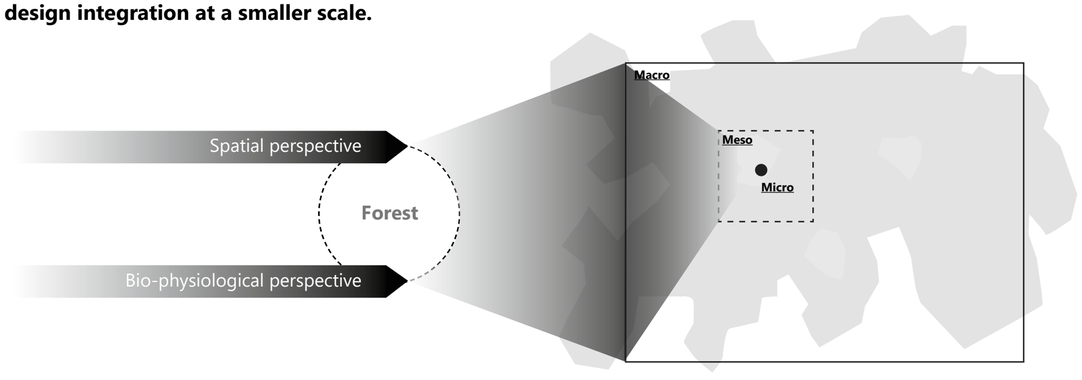


Fig.33 **Approaching the site with two parallel perspetives and throught three scales**

5.1.3 Research methods based on sub research questions

SRQ1:
What theories and concepts respond to the SGE context, concretise its problems and provide a basis for further analysis?
Method:
Literature review; Conceptual analysis;

SRQ2:
What are the challenges and opportunities of enhancing landscape identity within SGE from the lens of forest and forestry?
Method:
Literature review; Diachronic analysis; (GIS-based) Spatial Analysis; Fieldwork

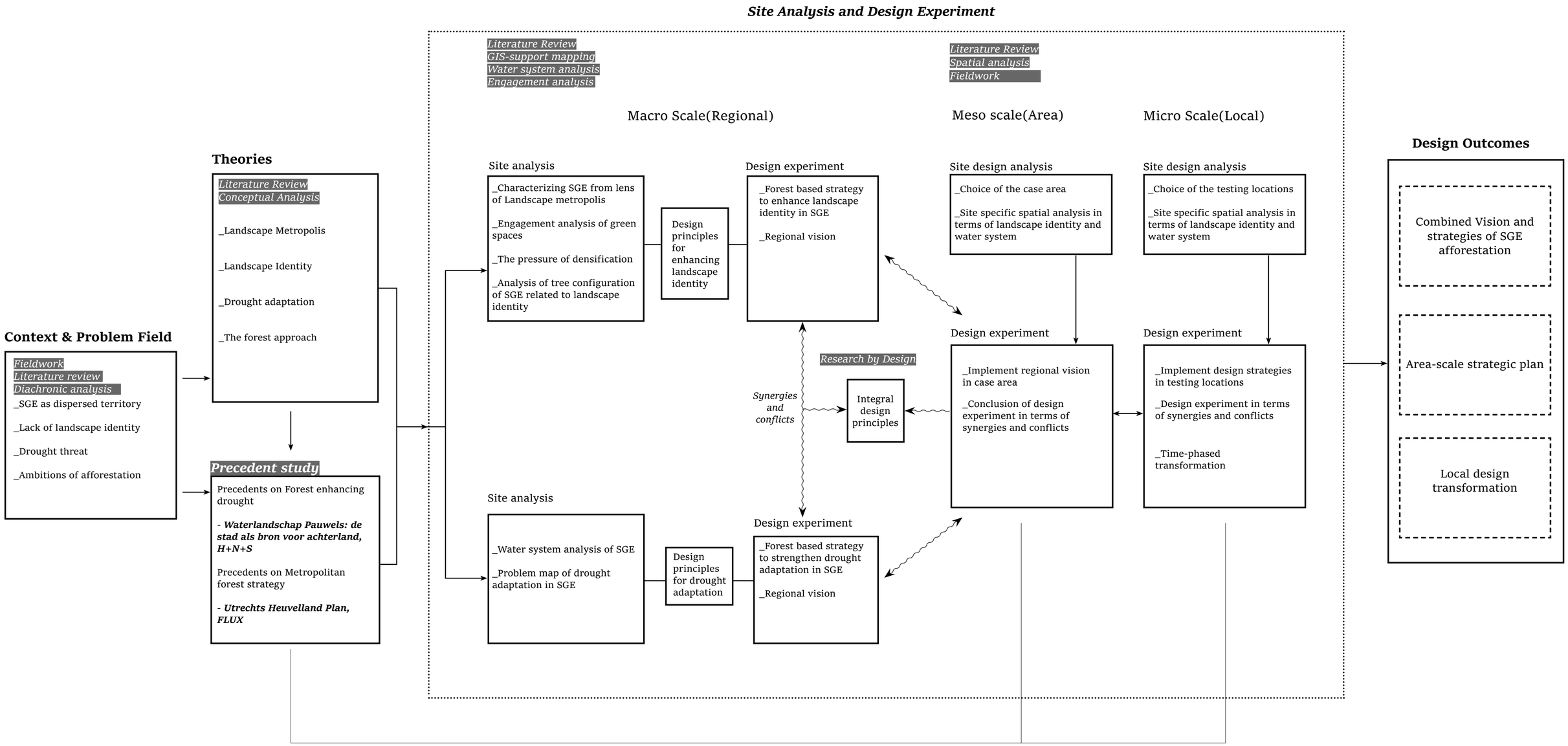
SRQ3:
What are the challenges and opportunities of strengthen drought-adaptation within SGE from the lens of forest and forestry?
Method:
Literature review; Water system analysis

SRQ4:
What kind of forest based strategy can enhance and reinvent the landscape identity in SGE?
Method:
Literature review; Precedent study; Research by design

SRQ5:
What kind of forest based strategy can strengthen the drought-adaptation in SGE?
Method:
Literature review; Precedent study; Research by design

SRQ6:
How can forest strategies spatially integrate in design transformation for cases of local scale?
Method:
Precedent study; Fieldwork; Research by design

5.2 Methodological framework



SECTION 3
SITE ANALYSIS

This section primarily responds to the following Research questions:

What are the challenges and opportunities of enhancing landscape identity within SGE from the lens of forest and forestry?

What are the challenges and opportunities of strengthen drought-adaptation within SGE from the lens of forest and forestry?

6 ANALYSIS ON LANDSCAPE IDENTITY

The Nevelstad of the SGE lies somewhere between centralised and decentralised, compact and dispersed. Larger urban 'clouds' such as Eindhoven and Helmond show a centralised or radial development, with residential and industrial areas spread out in a grid pattern and interconnected by several main roads. Surrounding these urban centres are smaller villages and towns, such as Veldhoven and Best around Eindhoven, and Stiphout and Mierlo-Hout around Helmond, forming part of a radial spatial map linked to the central city.

Beyond these large 'clouds' are relatively coherent cultural landscapes (as the metaphorical 'sky') consisting of stream valleys, cleared forests, dense farmland, nurseries and small villages, where most of the heritage is located. However, these landscapes are threatened with further fragmentation and fragmentation by the spreading urban cloud. Small-scale towns (villages that have expanded beyond their traditional landscape boundaries) are intertwined with other 'fragments' such as industrial parks, greenhouses and golf courses. They are interconnected by infrastructural networks, creating a fragmented image in the 'sky' of an otherwise intact cultural landscape, and in many places an intermediate state of urbanisation.

The transport infrastructure not only shapes the landscape by framing the fragments in the urban clouds but also becomes a landscape layer itself, acting as a link between various areas.

Thus, the SGE metropolitan landscape can be divided into four components:

1. The cultural landscape: The main 'natural capital', with a rich and diverse spatial cultural heritage, but also under threat of further fragmentation through urban expansion.

2. The urbanisation patches: This layer represents the isotropic extension of urban colonial grids.

3. The fringe Landscape: The transition zone between urbanised areas and cultural landscapes, under pressure from urbanisation. It is important for local coherence in dispersed territories.

4. The metropolitan void Landscape : Where urban grids encountering obstacles and remnants of cultural landscapes, enclosed by urban patches and infrastructures. These ambiguous spaces can provide a sense of place and contrast with the homogeneous urban grid.

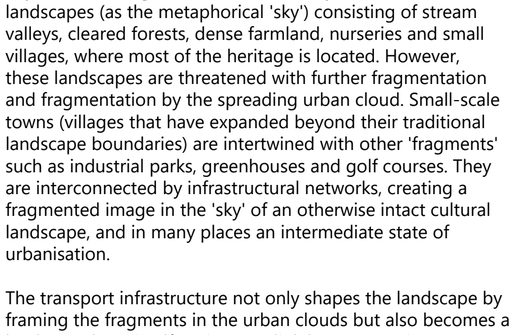


Fig.34 **The metaphor of ''Nevelstad''**

This chapter analyses and assesses the challenges and opportunities of SGE in terms of Landscape identity.

The analysis begins at the regional scale, responding to the recognisation of SGE as a dispersed territory and the corresponding theoretical concerns, i.e., deconstructing the landscape of the SGE metropolis and exploring the challenges and opportunities of its components in terms of ***coherence*** and ***diversity***, and the possibilities for the creation of ***narrative places***.

The typological analysis extends the forest approach - treating territories as forests - and explores how the challenges associated with landscape identity in each landscape type are reflected in the ***spatial syntax of trees*** and the socio-cultural functions they carry, as well as the potential to enhance both spatial characters and people's identities.

The assessment[1] was visualised using a radar chart and a rubric with the following five parameters: forest density, legibility, complexity, degree of participatory management and multi-functionality. In this context, ***legibility*** and ***complexity*** reflect the spatial-physical quality of landscape identity, i.e. the degree to which the landscape is clear and easy to understand and capable of stimulating rich sensory experiences; the degree of ***participatory management*** and ***multifunctionality*** reflect the quality of social presence, i.e. the adequacy of human interaction with the landscape; and ***the density of forests*** is an indicator of the amount of afforestation itself.

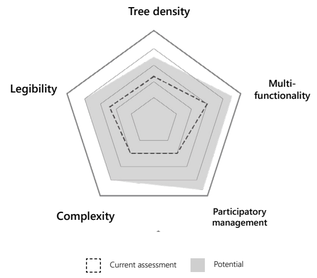
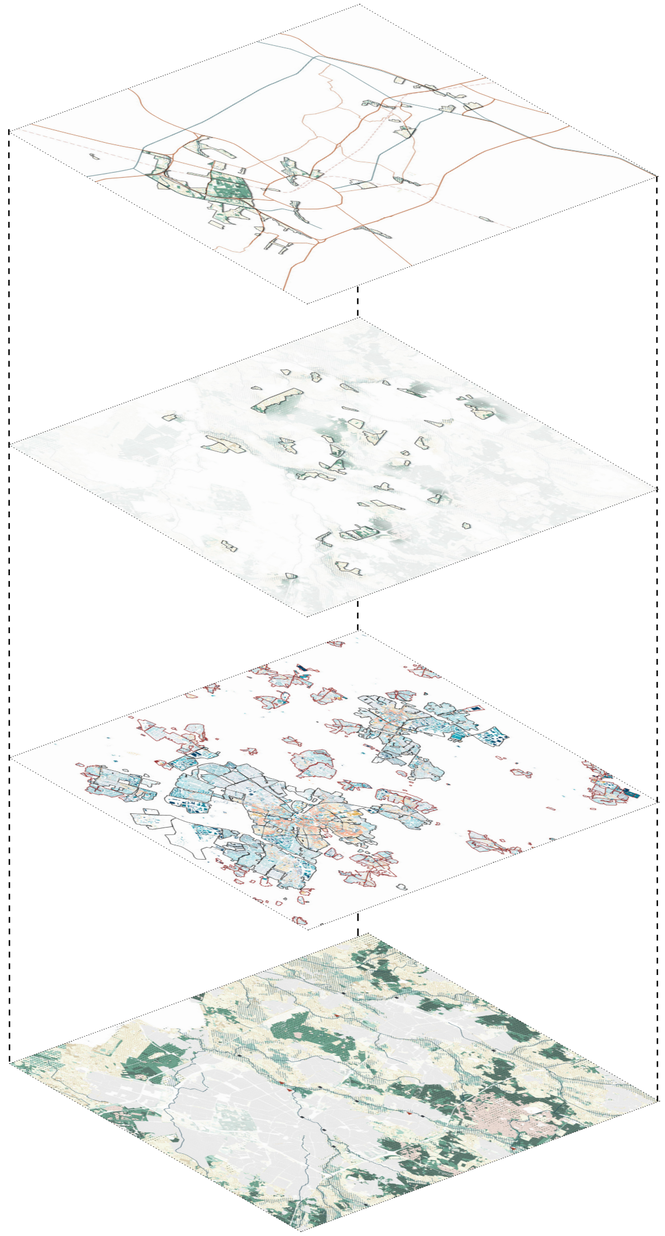


Fig.34 **Radar chart with parameters**

Legibility	Few unique landscape elements for orientation and navigation, cluttered or numbing	Limited guiding elements to not get lost	Very distinctive spatial elements for orientation and positioning, and which stimulate strong sensory impressions and cultural memories
Complexity	Constantly repetitive or empty spaces, highly homogenous	A more limited combination of several spatial types that can be experienced as varied	Very rich (tree) spatial forms and sensory experiences, highly heterogeneous
Multi-functionality	Only one function and difficult to engage	A limited number of functions, with specific groups of people participating at a few times	A wide variety of functions, with different groups of people at various stages of engagement
Participatory management	Single ownership/ management model, only private or managed by government agencies	Specific groups of people can be involved in management actions through limited channels.	Highly mixed ownership/management model, where a wide range of people have the opportunity to participate in management through multiple channels continuously.
Tree density	0-20 trees/ha	50-80 trees/ha	>120 trees/ha

Tab.1 **Rubric of parameters in the radar chart**
(Lynch, 1960; Kaplan & Kaplan, 1989; Erwing et al., 2006; García-Martín et al)

[1] *The assessment model was applied to all metropolitan landscape components except for the category of void landscapes, which is determined by the specific nature of void landscapes and will be discussed in more detail later.*



The metropolitan void landscape

The "narrative places" of metropolitan landscape
Important for regional legibility

The fringe landscape

Transitional zone

Important for spatial coherence

The urbanization patches

Diverse livability in new urban forest

The reclaimed landscape

Historical continuity and cultural heritage under pressure

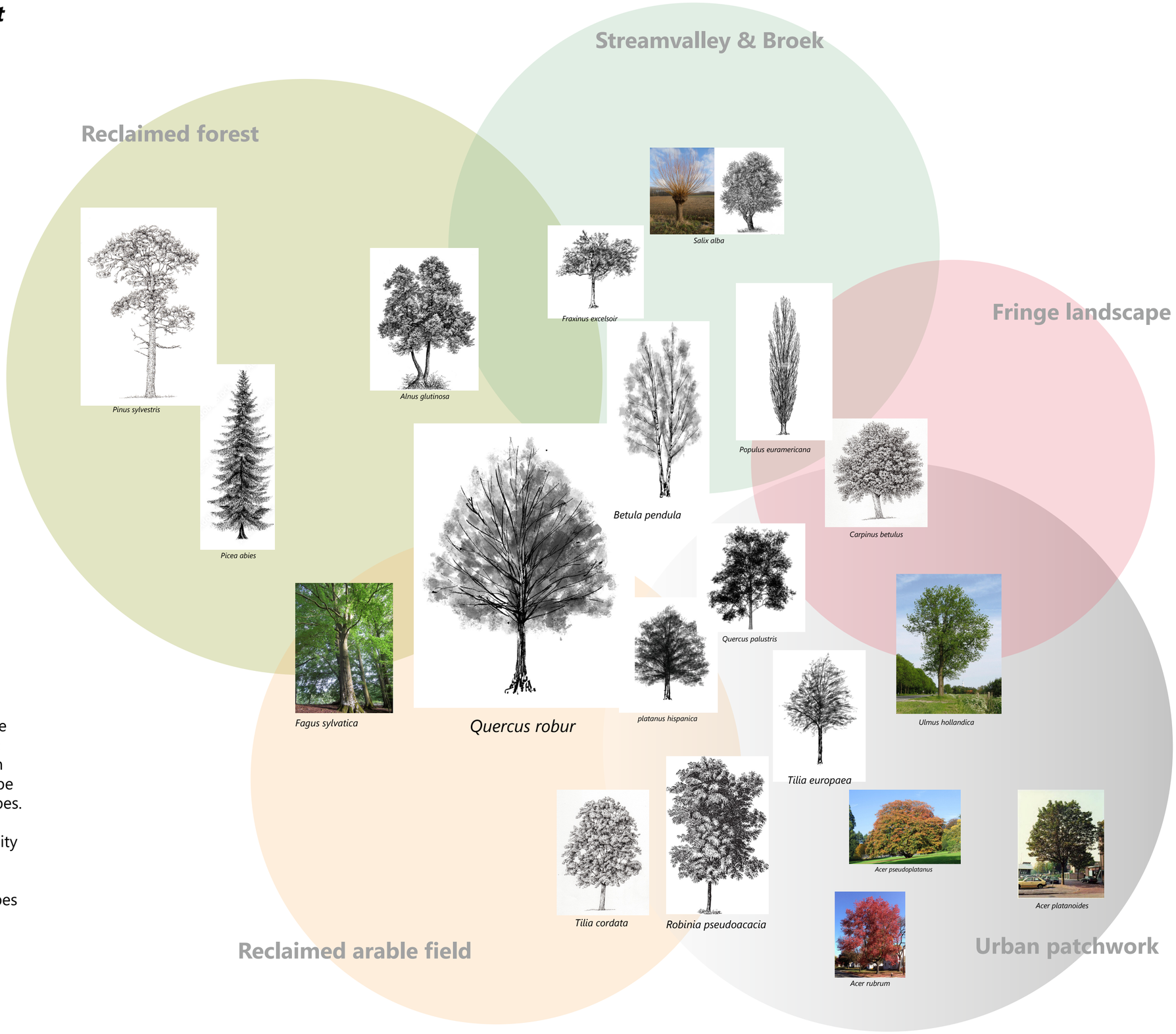
Protection and diversification with forest

Fig.35 **The four components of SGE metropolitan landscape**

6.1 The language of SGE forest

Species as vocabulary

Tree species are the smallest units that make up the SGE forest, or the 'vocabulary' of the tree language. Different tree species play an important role in the differences in landscape identity between different types of landscapes. The choice of specific tree species is particularly important in terms of the legibility of the landscape, especially at the level of historical continuity and spatial form. The ambiguity of the legibility of some landscapes is due to the wrong choice of tree species.



Spatial configuration as syntax of tree

The spatial configuration of trees, or syntax in the language of forest, is an aspect that directly affects the identity of a landscape, especially its spatial character; at the same time, different spatial configurations imply differences in the function of place use.

The syntax of trees in SGE can be classified into four categories, namely point, line, group and frame. Since the spatial configuration of trees varies with scale, the classification here is done at a resolution of 100 m x 100 m.

Point: Trees as points mark the space below the tree and emphasise the limited space around the tree, often identified as landmarks of some kind.

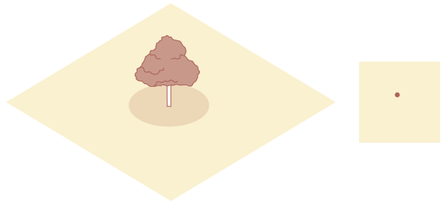
Line: trees as lines mark the space below them and divide the space on either side of the line. tree lines can extend indefinitely in space and form boundaries/visual guide lines/barriers/.... Tree lines are often highly recognisable and there is a rich variety of them in the SGE landscape.

Group: Trees as groups mark the space below them and can be recognised externally as a whole. groups thus have the property of aggregating space.

Frame: Trees as frames are an infill of 100m x 100m squares in various forms and are often not externally recognisable as a whole. Therefore, they mark the space under their canopy and distinguish between the space inside and outside the frame. Frames can be enclosed by lines or volumes and can contain other tree syntax. The arrangement and repetition of frames in space can create large forests. Frames are the most important tree syntax in SGE landscapes, which have a rich tradition of reclamation.

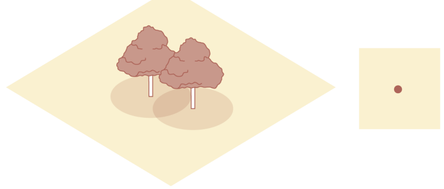
1. Point

1.1 Solitary



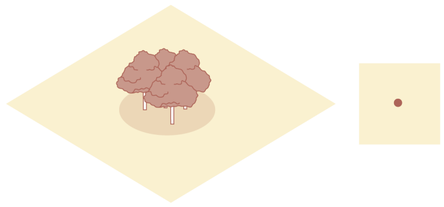
Spatial characteristics: Single tree, labelling/highlighting space under the tree.
Applications: As a landmark/memorial tree

1.2 Threshhold



Spatial characteristics: Two identical trees distinguish the space between inside and outside.
Applications: As an entrance to a neighbourhood/yard/farm

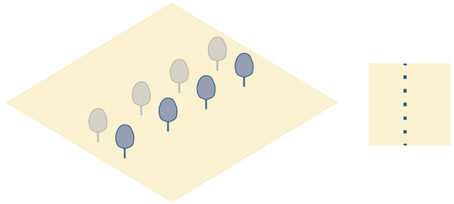
1.3 Pavilion



Spatial characteristics: A few close-growing trees mark the space beneath them
Applications: As landmark/memorial tree

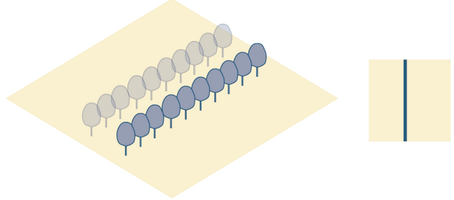
2. Line

2.1 Open row



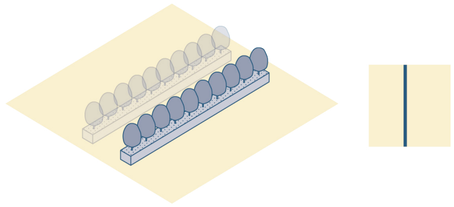
Spatial characteristics: Trees in rows, widely spaced, can be single or double rows, with less sense of guiding direction.High transparency
Applications: Presented as street trees in cities; appearing along roads in cultural landscapes.

2.2 Colonade



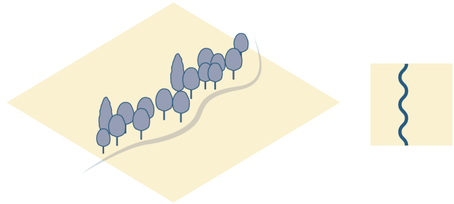
Spatial characteristics: Trees more closely spaced in rows that primarily define the space on either side, either single or double rows. Relatively transparent thresholds.
Applications: Presented as street trees in cities; appearing along roads in cultural landscapes.

2.3 Tree wall



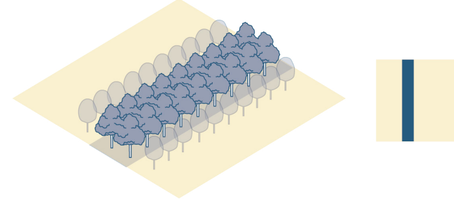
Spatial characteristics: The trees are more closely spaced in rows, with shrubs growing underneath them blocking the view and strongly differentiating the space between the two sides
Applications: Both sides of the highway; some residential boundaries.

2.4 Curtain



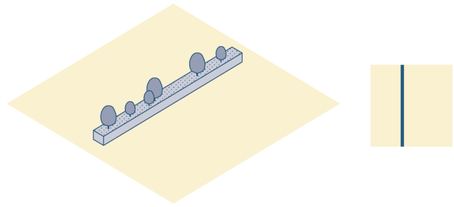
Spatial characteristics: Trees in rows, widely spaced, can be single or double rows, with less sense of guiding direction
Applications: Presented as street trees in cities; appearing along roads in cultural landscapes.

2.5 Arcade



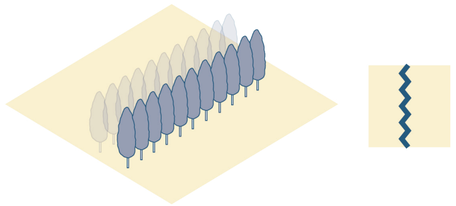
Spatial characteristics: Trees in rows, widely spaced, can be single or double rows, with less sense of guiding direction
Applications: Presented as street trees in cities; appearing along roads in cultural landscapes.

2.6 Hedge wall



Spatial characteristics: Trees in rows, widely spaced, can be single or double rows, with less sense of guiding direction
Applications: Presented as street trees in cities; appearing along roads in cultural landscapes.

2.7 Screen



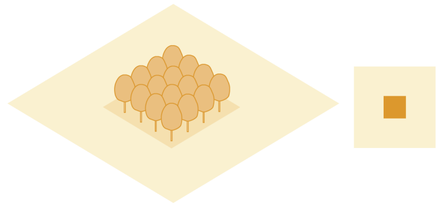
Spatial characteristics: Trees in rows, widely spaced, can be single or double rows, with less sense of guiding direction
Applications: Presented as street trees in cities; appearing along roads in cultural landscapes.

2.8 Dash line

Spatial characteristics: Trees in rows, widely spaced, can be single or double rows, with less sense of guiding direction
Applications: Presented as street trees in cities; appearing along roads in cultural landscapes.

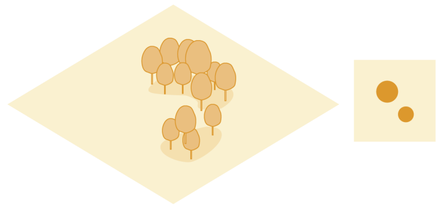
3. Group

3.1 Tree nursary



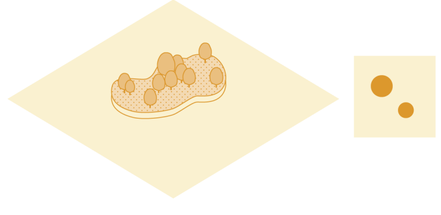
Spatial characteristics: The matrix of the same tree species is repeated with interconnected canopies and open views under the canopy. The space under the canopy is defined and the surrounding space is bounded by it.
Applications: Nurseries in cultural landscapes, tree line squares or neighbourhood event spaces in cities

3.2 Loose group



Spatial characteristics: The canopies of a variety of trees are connected and organically distributed, creating a continuous space under the canopy.
Applications: Common in parks and also in green spaces in urban patches as stemps

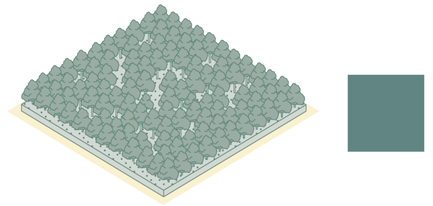
3.3 Clump



Spatial characteristics: Successive bushes limit the view, with a few trees dotted compactly in between. As an inaccessible whole.
Applications: Common background element in parks; common in stream valleys and broek landscapes, accompanied by watercourses.

4. Frame

4.1 Multilayered dense volumn

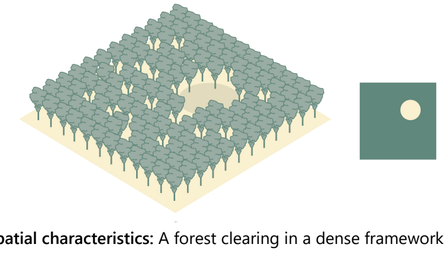


Spatial characteristics: Dense, continuous trees with intertwined canopies and undergrowth below make it closed and difficult to access.
Applications: Remnant woodland in urban areas; wet woodland in stream valleys and brook landscapes; few deciduous woodlands in reclaimed forests

4.2 High-ceiling dense volumn

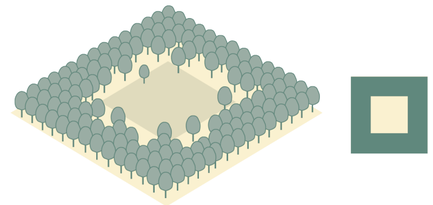
Spatial characteristics: Consists of continuous, tall, light-permeable trees (usually conifers) with limited undergrowth which opens up the space beneath the canopy.
Applications: Fir or pine forest on sand in The reclaimed forest complex

4.3 Clearing of dense volumn



Spatial characteristics: A forest clearing in a dense framework of trees.
Applications: Remnants of heathland or bog in the reclaimed forest complex, or building sites in the forest, are also often present in the fringe landscape.

4.4 Room of dense volumn

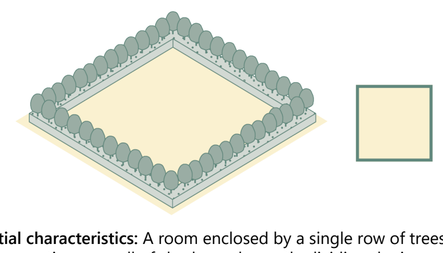


Spatial characteristics: The volume of trees of a certain thickness creates thresholds and internal spaces with a strong sense of enclosure.
Applications: Often found in fringe landscapes with a variety of internal functions

4.5 Transparent room

Spatial characteristics: A room enclosed by a single row of trees with a transparent barrier that divides and connects the inner and outer space.
Applications: In urban areas as communal space in residential areas; in cultural landscapes as traces of small reclaimed areas, this framework often marks the internal communal functions (e.g. community gardens and sports fields).

4.6 Closed room with tree wall



Spatial characteristics: A room enclosed by a single row of trees, with a continuous wall of shrubs underneath, dividing the inner and outer space.
Applications: As traces of small clearings in cultural landscapes, such enclosed frames often mark private territories or low-publicity functions (e.g., agricultural enterprises, warehouses, horse-training grounds, etc.), as do some cemeteries

6.2 The reclaimed landscape

The first component of the SGE metropolitan landscape is the reclaimed landscape, corresponding to the 'sky' in the nevelstad metaphor.

This is the place where heritage is gathered, representing to a greater or lesser extent the history and traditional way of life of the area. From the landscape metropolis point of view, well-defined cultural landscapes are also the strongest 'special places' or 'narrative spaces'.

There are various ways of interpreting and categorising the local cultural landscape. From a forest and landscape identity perspective, some landscape types are not clearly distinguishable from each other and can be merged into one category. Thus, cultural landscapes have been subdivided into three categories for study, spatially categorised as closed, semi-open and open:

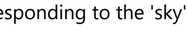
1.The reclaimed forest

Closed

2.The StreamValley and Broek landscape

Half-open

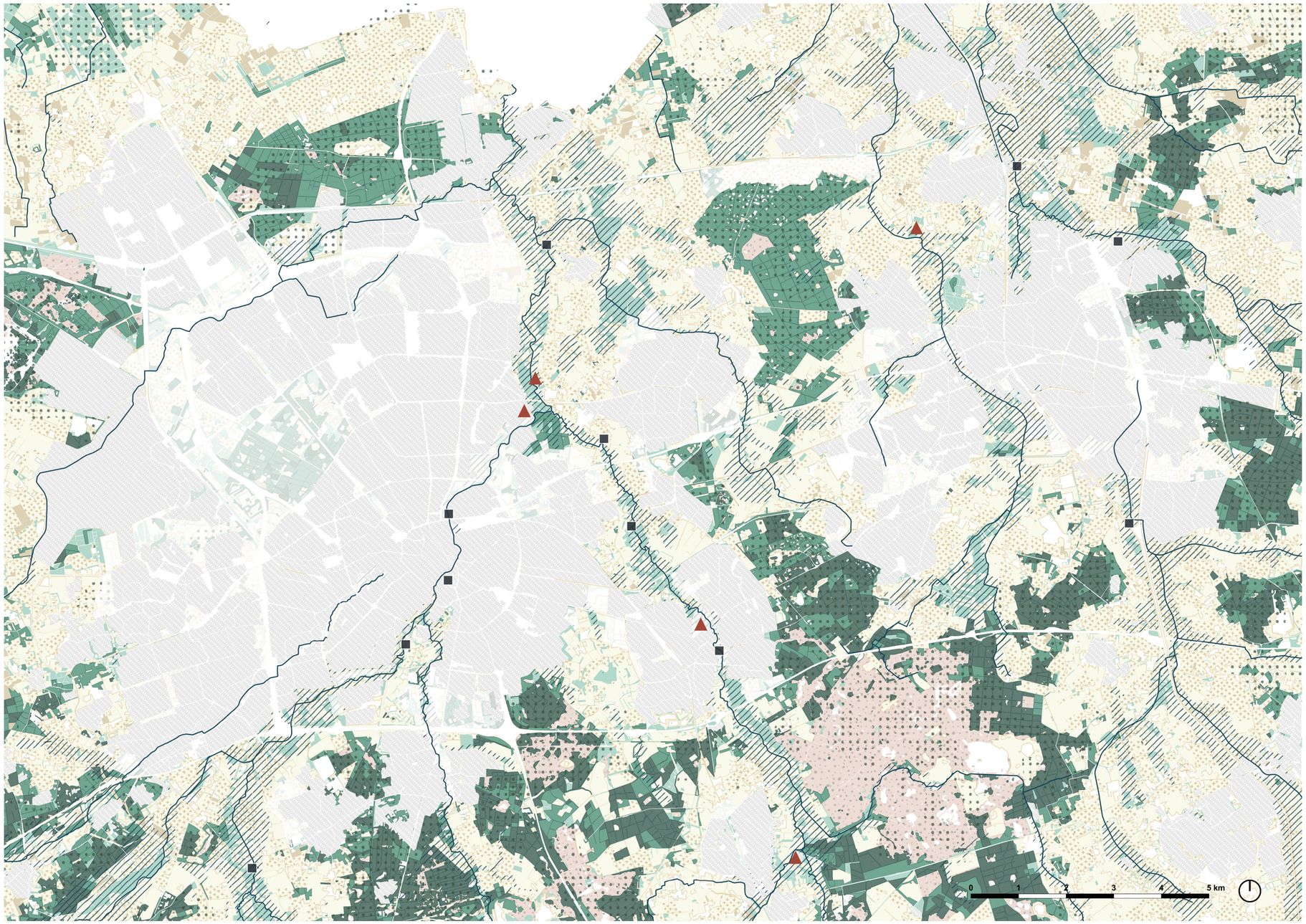
3. The reclaimed arable field

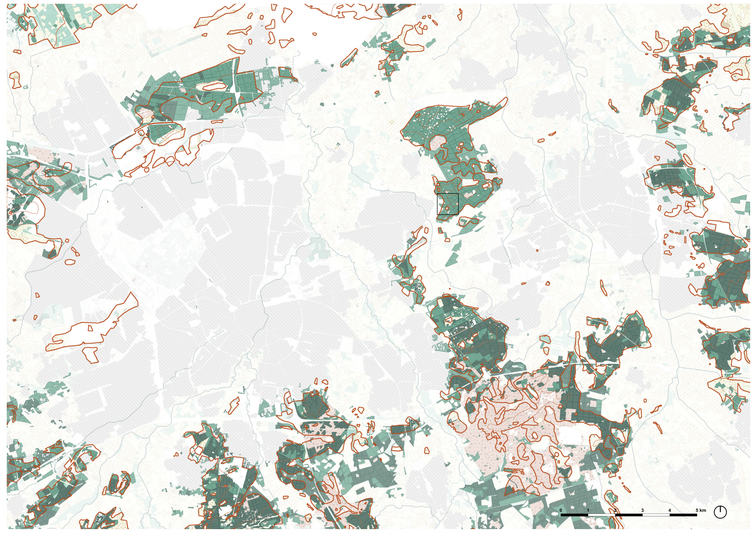


Open

Legend

- Coniferous forest
- Mixed forest
- Deciduous forest
- Tree nursary
- Streams
- Stream valley
- Heathland
- Arable field
- Grassland
- Sand ridge
- Urbanization patches





Legend

- Coniferous forest
- Mixed forest
- Heathland
- Deciduous forest
- Sand ridge
- Urbanization patches

The reclaimed forest complex

As mentioned above, although the region was covered by forests a long time ago, the existing forests do not contain primary forests. These forests were planted for economic reasons. These relatively large-scale clearings began in the 19th century, when wealthy industrialists purchased large tracts of heathland in order to reforest for industry, with the Limburg mining industry being an important customer.

When forestry became less economically significant, many forested areas were logged to make way for agricultural land or were given protected status as nature reserves.
These forests, which often still retain their original heathland names (Gerwense Heide, Oostelbeersche Heide, Malpiebergsche Heide), are large, reasonably linear areas of forest allocation. They usually gain additional recreational networks later, especially near villages and towns. Planting initially consisted mainly of fast-growing coniferous species, but later diversified due to Staatsbosbeheer's new policy, with some deciduous species being planted, a considerable number of beech-birch-oak forests appearing, and a greater emphasis on recreation (Staatsbosbeheer 2013)

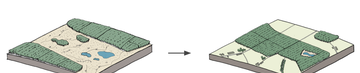
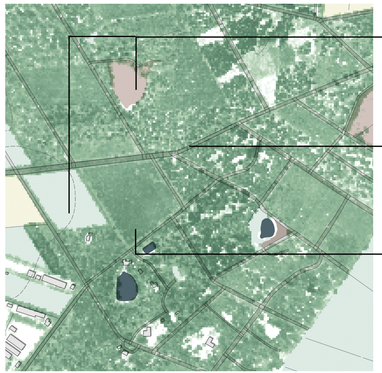


Fig.36 **The development of the reclaimed forest complex**



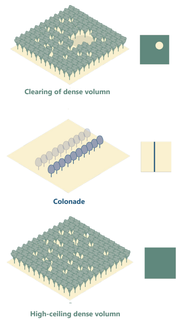
Spatial character

Remnants of small-scale heaths and bogs as well as reclaimed agricultural enclaves, which serve as heterogeneous forest clearings.

Straight roads and a grid-like layout; Oaks are the main roadside trees.

Continuous, single-storey volumn composed of productive woodlands of Scots pine or Norway spruce, or beech-oak-birch forest. Unattractive, monotonous spatial experience, lack of access and motivation.

Tree syntax and species



Functions



In the past, it was used as a production forest, but now it is planned as part of the natural network, as well as not rich in recreational functions.

Management



Mainly managed and maintained by government agencies, with a few private properties and few collective participatory practices



Dominant forest pattern:

Potential of Enhancing Landscape Identity

Spatial character(perception):

- Creating more heterogeneous spaces in a continuous dense forest volume
- The monolithic vegetation structure needs to be improved
- Spaces for roads as function-bearing structures need to be emphasised, possibly with more paths for exploration and experience

People's Identity(action):

- Combined with the diversification of spatial features, more functions can be accommodated in the forest, e.g. spaces for recreation and food production
- Improvement of the monoculture management and maintenance regime

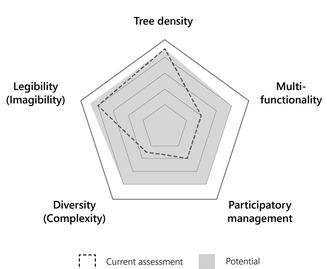




Fig.37 **Limited recreation functions**



Fig.38 **Limited recreation functions**



Fig.39 **Heathland and bog remains within the forest, now as the natural reserve**



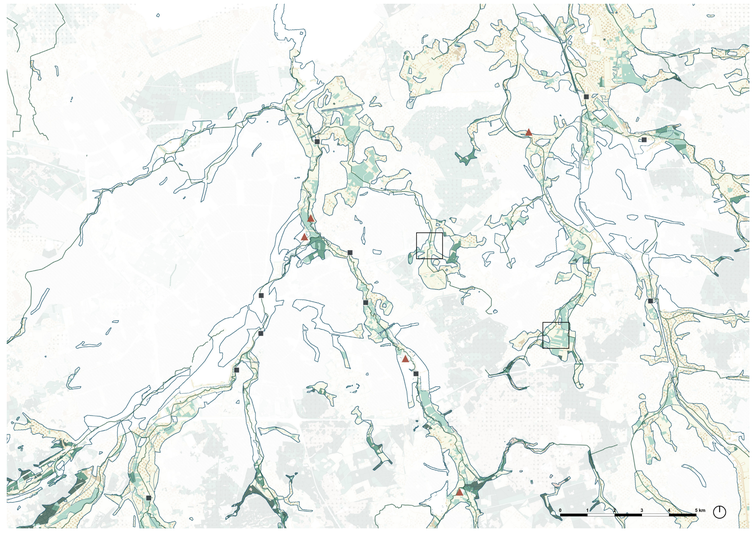
Fig.40 **Agricultural enclave within the forest**



Fig.41 **Monoculture coniferous forests**



Fig.42 **There are still some forests with productive functions**



Legend

Coniferous forest
Mixed forest
Heathland
Deciduous forest
Stream valley
Watermill
Castle

StreamValley and Broek landscape

Originally, the stream valleys were mostly moorland and marshland, which was too inaccessible to be cultivated. Around 1,100 AD, better drainage techniques made reclamation possible, which meant that people increasingly used them (Laarhoven 1978) and lived close to the stream valleys. The stream valleys were divided into **thin strips of plot** that could be hundreds of metres in length or reduced by inheritance to less than ten metres in width. This results in a very characteristic landscape that is still recognisable in some places. Wet valleys where no clear natural watercourses exist form the broek landscape. Plots in the landscape are also usually rational and rectangular, but less narrow.

What also gives this cultural landscape its distinctive character is the ***tree screens*** along water courses, the ***hedge lines*** marking ditches, the small-scale, ***multi-layered volume of trees*** accompanying the streams, and dense wetland forests dominated by willows and ash trees also characteristic in broek landscape. Important local cultural heritage, such as castles and watermills, are also located in the stream valleys.

To this day, the stream valleys and broek landscapes remain important vectors of identity(North Brabant 2010). However, in many places, such as narrow landscapes and scrublands, meandering watercourses, and checkerboard broek forests, have disappeared, to be replaced by large, consolidated meadows and farmlands. There are also stream valleys that are contained within patches of urbanisation, forming fragments that serve as parks or spaces that take on residual urbanisation functions (see 7.3 The Metropolitan voids). Social and administrative trends aimed at landscape restoration and natural development that began in the late 1980s have brought about a different fate for some of the broek valleys: these broeks have been formulated as "natural areas", planted with large meandering, irregular woods, and restricted to people's access. This approach to restoration based on nature conservation, while guaranteeing ecological values, seems to have neglected the spatial character and accessibility of the stream valleys as cultural landscapes from the point of view of landscape identity.

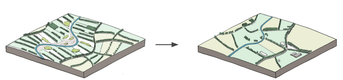
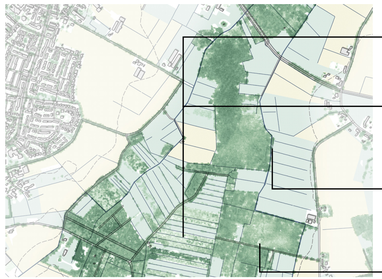
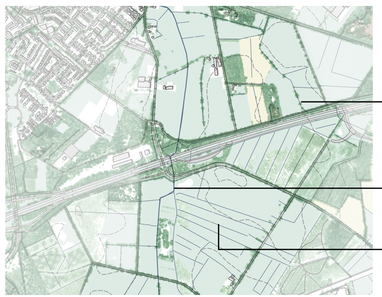


Fig.43 **The land consolidaton of the stream valley**





Spatial character

Extending ditches and plots at right angles to the stream(perpendicular), dense ditch pattern.

The ribbons with hedges and alder trees which marks the boundary of narrow plots

In some places, watercourses are still companied by tree lines

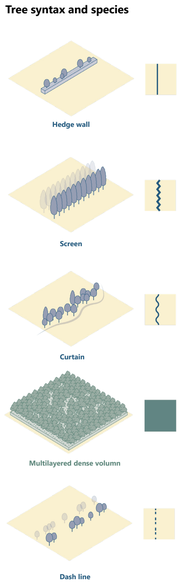
The multilayered tree volumns of wet-growing species(mainly willow and ash) attached to/ meandering with the stream course

The emphasis of the trees on the watercourse of the stream is no longer clear or has disappeared

Normalised water course.

Large-scale, consolidated grasslands in the broek landscape for livestock.

Tree syntax and species



Function



Management



A considerable portion of the dales and broeks are occupied by privately owned agricultural functions and lack attractions for recreational activities, and some are designated as protected areas.



Dominant forest pattern

Potential of Enhancing Landscape Identity

Spatial character(perception):
- The linear elements (watercourses and ditches) can be emphasised by appropriate forestry strategies (tree syntax and species), which both make the spatial character strong and at the same time enhance its historical continuity as a cultural landscape;
- Restoration of the forest in the broek landscape. The structure of the rooms in the tessellated forest needs to be preserved and emphasised;
- Accessible landscape with paths.

People's Identity(action):
- Transforming the current single agricultural function, ecological conservation and recreation or even housing tasks can be combined and integrated into subdivided plots.

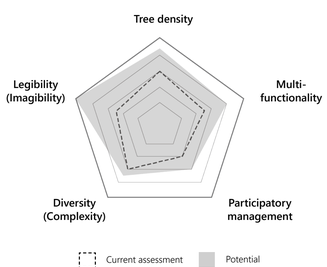




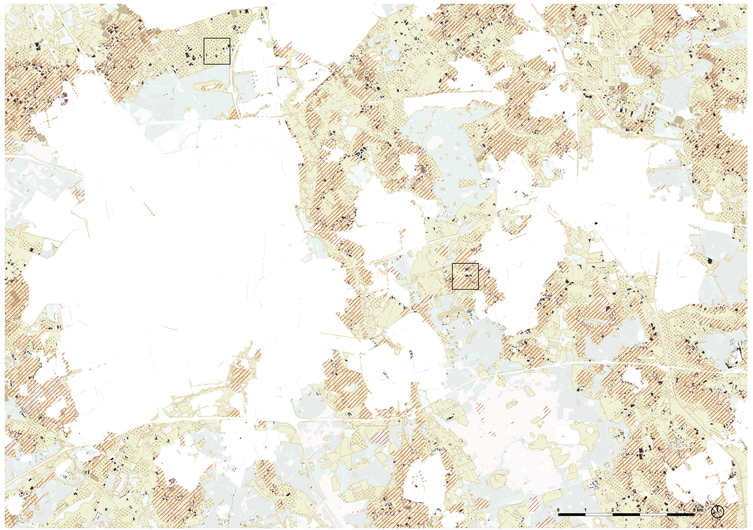
Fig.44 **Streams straightened and hidden in farmland**

Fig.45 **Room structure in a broek forest with a screen of tall poplars marking the stream in the background**



Fig.46
Design of High Tech Campus by Juurlink [+] Geluk;
The different treatments on either side of the stream retain the character as a cultural landscape while acting as a natural area





Legend

Grassland
Arable field
'Essen'
Tree nursary
Building in the landscape(Rural settlements, agribusinesses and others)

The reclaimed arable field

The reclaimed arable field derives from historical reclamation activities at different stages and scales, such as the Essen (old fertilised fields from the Middle Ages), the large-scale reclamation of wasteland (jonge heide-ontginning) at the same stage as afforestation, and the more recent 'kampen en hoeven' (small-scale reclamation of wasteland).

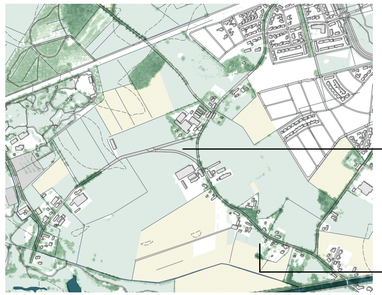
As a result of the intensification of agriculture in the last century, the original small-scale plots in the agricultural landscape, the widespread hedgerows (as a way of dividing property rights and preventing drift erosion) and the poplar screens based on the ''Voorpootrecht'' have now almost disappeared, replaced by consolidated large fields. The once intensive and productive interaction of people with the land has also dissolved into a wave of specialisation and mechanisation.

Current farmland landscapes typically consist of a few roads as the main spatial skeleton, often with oaks as street trees. As the roads extend, courtyards and small-scale woodlands framed by trees cling to them, containing buildings for habitation and production and looking after the outlying land. On older and smaller-scale cleared land, the roads show natural curves, and at the intersections of these roads there is the potential for small-scale villages or settlements to form. The structures formed at the intersections have been made into ''Frank triangles'', which are small plots of communal green space, sometimes presented as a tree group.In the younger, large-scale reclamation of wasteland to form farmland, the roads are straighter and more geometric, with larger plots of land and more open space.

Landscape identity enhancement in reclaimed agricultural landscapes is seen as highly promising in the context of agribusiness closures and the crisis facing the agricultural sector(bron:Brabantmosaic). Afforestation strategies can lead to a return to land practices while restoring spatial identity in conjunction with the task of agricultural transformation.



Fig.47 **The consolidation of the arable field. The 1942 map on the left shows small plots and extensive hedgerows.**



'The frank triangle' in the intersection of roads

Road with oak(sometimes birch) as spatial skeleton



Rectangular plots and straight roads in an orthogonal grid pattern

Consolidated plots are larger with open views

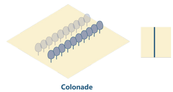
Small-scale volumes or rooms clinging to roads, forming belt structure

Spatial character

Tree syntax and species


Loose group


Open row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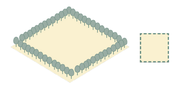
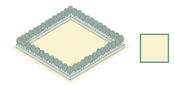

Transparent room


Closed room with **tree wall**

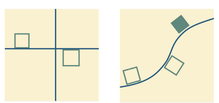
Function

Agriculture
Outdoor recreation

Management

Private

Extremely homogeneous intensive agriculture and private management; some farms with open access and agricultural activities, but few in number.


Dominant forest pattern

Potential of Enhancing Landscape Identity

Spatial character(perception):
- Based on the existing road skeleton, linear elements are reinforced by tree planting. Tree rows in the landscape make open spaces more recognisable and provide orientation, also reinforcing historical continuity (woodhedges and 'voorpootrecht')
- Vacant agricultural land can be used as space for afforestation. In the Kampen and Essen land, existing belt structures can be widened; in the young wasteland reclamation landscapes, more whole, diverse woodlands can emerge.

People's Identity(action):
- In connection with the transformation of the agricultural sector, productive functions can be integrated into new forests, such as production forests, food forests and livestock forests.
- Local people could be involved in the planting, use and maintenance of new woodlands. This is a landscape that changes in the time process through ongoing management.

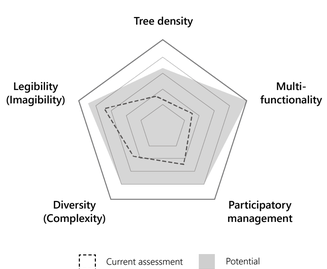




Fig.48 A typical countryside road with oaks,

Fig.49 **A courtyard surrounded by trees attached to the road**





Fig.x50"**Frankish Triangle", a small gathering area and public space formed at the intersection of rural roads**

Fig.51 **The poplar avenue left behind by "Voorpootrecht",such a complete and distinctive avenue is no longer common.**



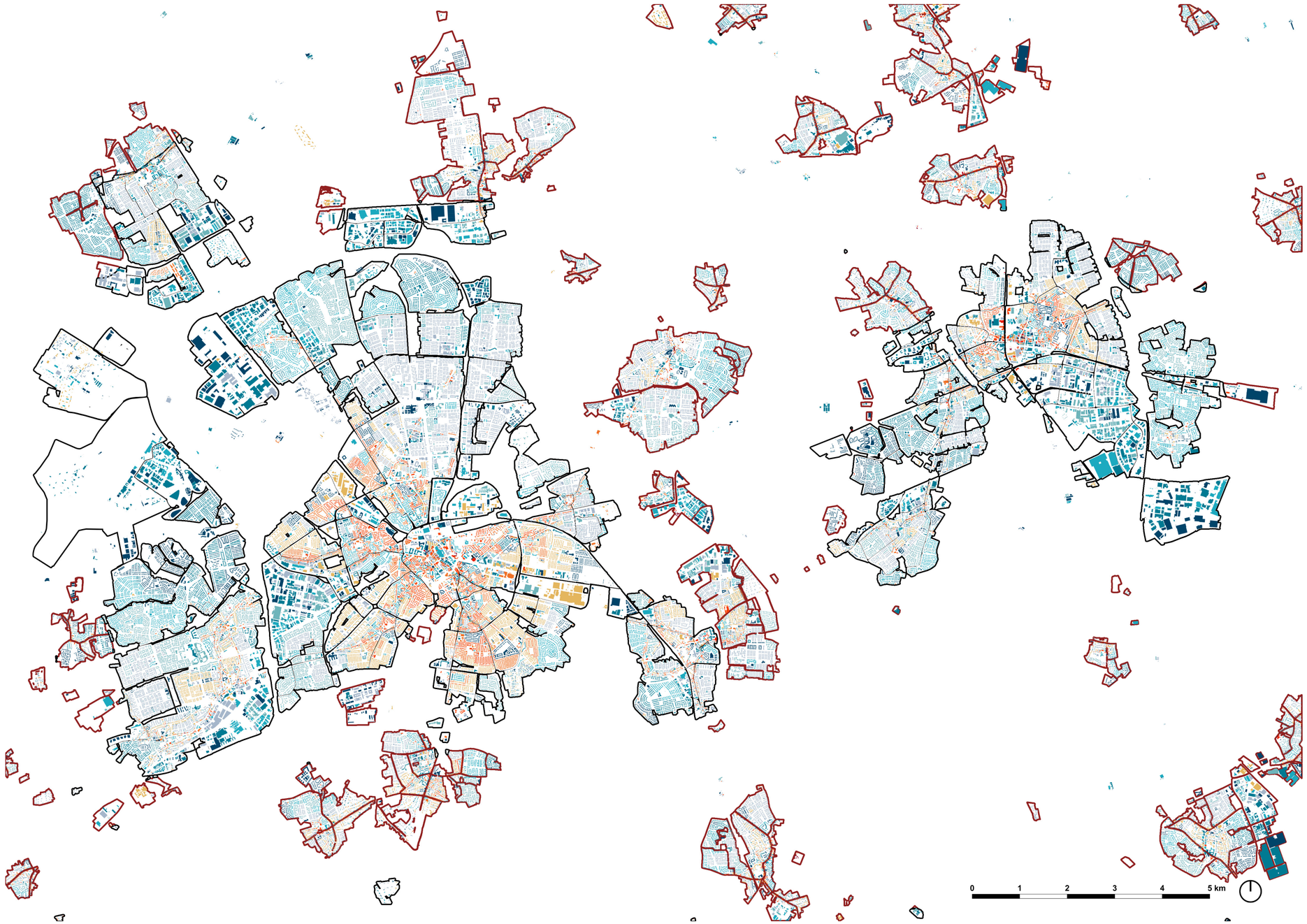
6.3 The urbanisation patches

The second component of the SGE metropolitan landscape is the urbanised patchwork. The region has had its own distinctive process of urbanisation, the present patchwork being a post-1950 attempt to meet the dramatic increase in housing demand resulting from high rates of industrialisation.

The larger urban clouds (Eindhoven and helmond) still maintain more or less concentrated or radial development, with a grid-like distribution of residential patches and industrial areas following a dense transport network and through which links to the centre are maintained. Smaller villages and towns at a closer distance from the big cities (Veldhoven, Zeelst, tongelre, Son en Brugel, Best and Eindhoven, Brouwhuis, Stiphout, Mierlo-Hout and Helmond) are linked to the centre and form part of its radial spatial map.

As well as smaller towns at a slight distance from the larger cities. They are smaller clouds and are woven together with other smaller clouds (small industrial areas, discrete residential neighbourhoods, greenhouses, golf courses) on a network of infrastructures that cut up the sky of the cultural landscape.

Whether larger clouds or smaller fragments, even if they show some degree of concentration or development around some centre, they are still a patchwork of patches of different densities and shapes and sizes in which there is no unifying planning principle. From this point of view, the urban patchwork is very diverse and heterogeneous, but on the other hand, they are homogeneous because the landscape consists mainly of a limited variety of buildings and a very homogeneous type of public space.

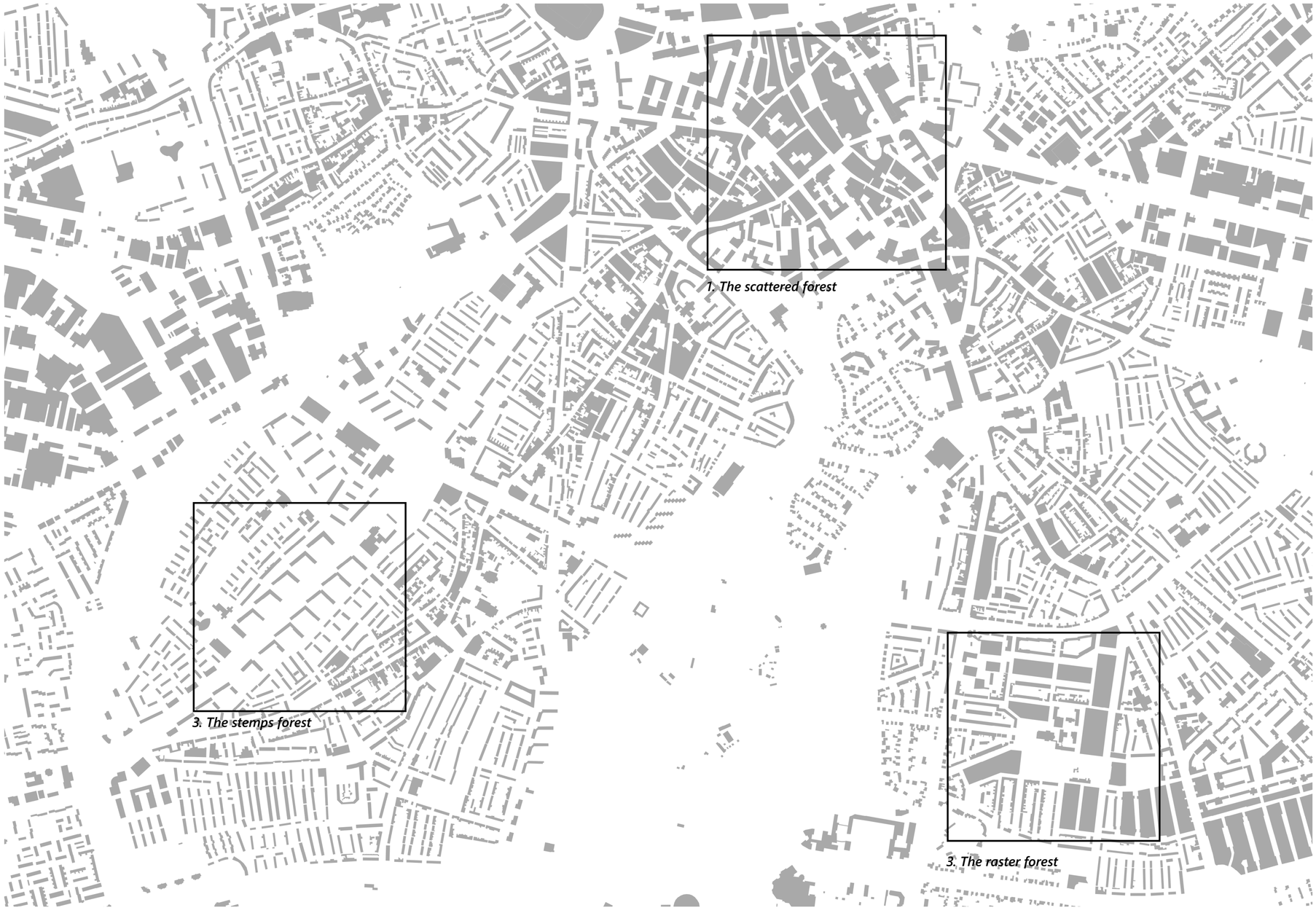


There is no uniform methodology for seeking landscape identity enhancement in such an urban patchwork, but it is still necessary to look at these patches and differentiate them through the lens of the urban forest in order to find opportunities to enable forestry strategies to intervene. Based on the syntax of the trees and the character of the public space, the urban patchwork can be divided into:

The patch of scattered forest: Continuous, organic urban fragments that are older, often attached to a winding historical road, and located in traditionally town or village centres. Today, these fragments have largely disintegrated, either being refurbished as high-density commercial districts due to their central location, or being subsumed by simple urban grids.

The patch of raster forest: Simple urban grid infill characterised by closed blocks and rational grids. These infills were built overnight, often driven by economic ends and dependent on the expansion of road infrastructure that ignored the qualities of the cultural landscape. The closed blocks represented by tuindorp in the post-war period, the more recent new housing estates based on the VINEX policy, and all industrial parks fall into this category.

The patch of stamps forest: has an open block pattern and large public green spaces. This space is derived from garden city blocks dominated by high-rise buildings, often not in the form of patches, but as heterogeneous spaces interspersed in the urban grid.



1. The scattered forest

3. The stemps forest

3. The raster forest

The patch of scattered forest



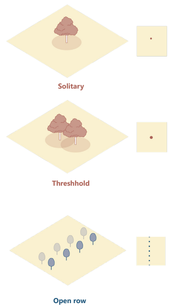
Spatial character

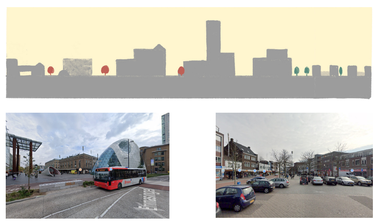
Although public green space is scarce, the richness of building types and squares in the centre makes up for the lack of diversity

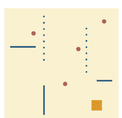
Isolated trees are scattered throughout the city with some monumental trees

Street trees are homogenous and widely spaced, somewhat reducing legibility and ability to act as escape routes

Tree syntax and species







Dominant forest pattern

Function



Management

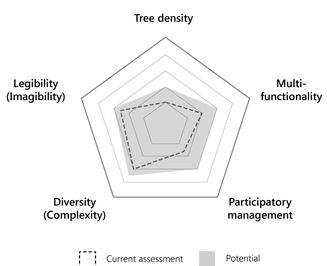


Due to the small number of trees, trees mainly play the role of general urban greening and lack the carrying capacity for social activities and interaction with nature.

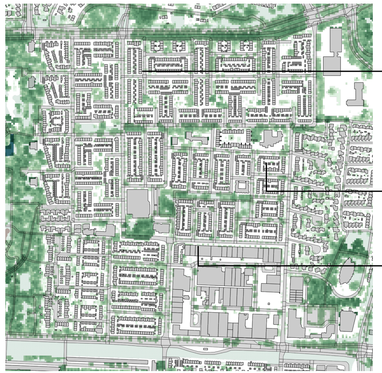
Potential of Enhancing Landscape Identity

Spatial character(perception):
- Increase the number of trees and use a greater variety of species;
- A significant increase in green space is unrealistic where building densities are high. However, it is still possible to make space for higher quality linear forests and tree clusters through street redesign and mobility changes.

People's Identity(action):
- Organise activities around existing tree points and potential tree groups as gathering, multi-functional green spaces and to promote a sense of community.



The patch of raster forest



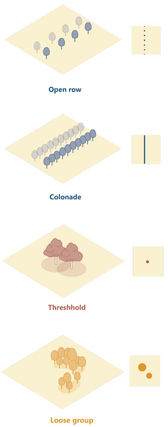
Spatial character

The tree line made up of elm or birch trees is the most prominent element, affirming the street pattern;

Single residential building types and enclosed blocks containing private gardens;

Small public spaces made up of tree groups are distributed throughout the residential blocks.

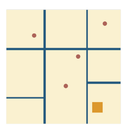
Tree syntax and species











Dominant forest pattern

Function



Management

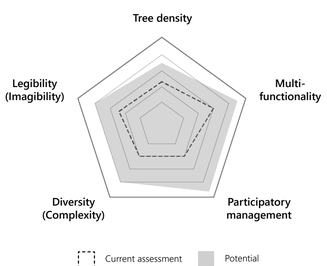


Most of the trees are located in private gardens. Scattered public green spaces are more homogenous and tend to be under-utilised due to poor function.

Potential of Enhancing Landscape Identity

Spatial character(perception):
- Thickness and diversity of existing linear elements can be enhanced by introducing new tree syntax
- Diversify existing tree groups and try to add more groups

People's Identity(action):
- **Enriching a diversity of function in the communal spaces such as food garden or city farming in which the local inhabitants can engage.**



The patch of stamps forest

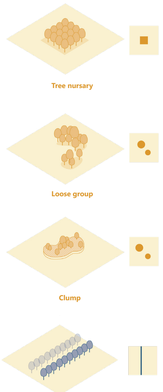


Spatial character

Mainly high-rise buildings

Each residential unit has a good-sized green space that is repeated like a postage stamp through the neighbourhood. The mix of trees is varied and mostly open and easily accessible.

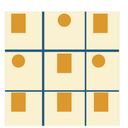
Tree syntax and species











Dominant forest pattern

Function



Management

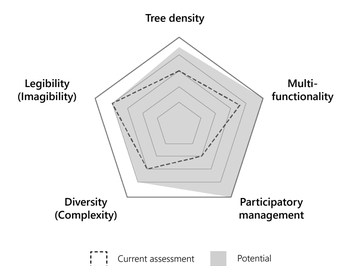


The spatial forms of these "stamp" forests are varied, but their functions are relatively homogenous or lacking. Some have become shared gardens for neighbours, while others are simply green spaces or have a small number of play facilities.

Potential of Enhancing Landscape Identity

Spatial character(perception):
- Introduced as an exemplary urban forest model for other neighbourhoods
- Diversify existing tree groups

People's Identity(action):
- **Enriching a diversity of function in the communal spaces such as food garden or city farming in which the local inhabitants can engage.**



6.4 The fringe landscape

The Fringe landscape is the third component of the SGE metropolitan landscape.

Often once part of a kampen or Heathland reclamation landscape, the interlocking tree lines form a room structure that is its most characteristic feature. Inside the rooms are distributed 'residual' features such as playing fields, car parks, small businesses, vocational schools, cemeteries, scout bases and collective gardens. These edges are formed gradually, usually without a master plan, and present an urbanised state somewhere in the middle.

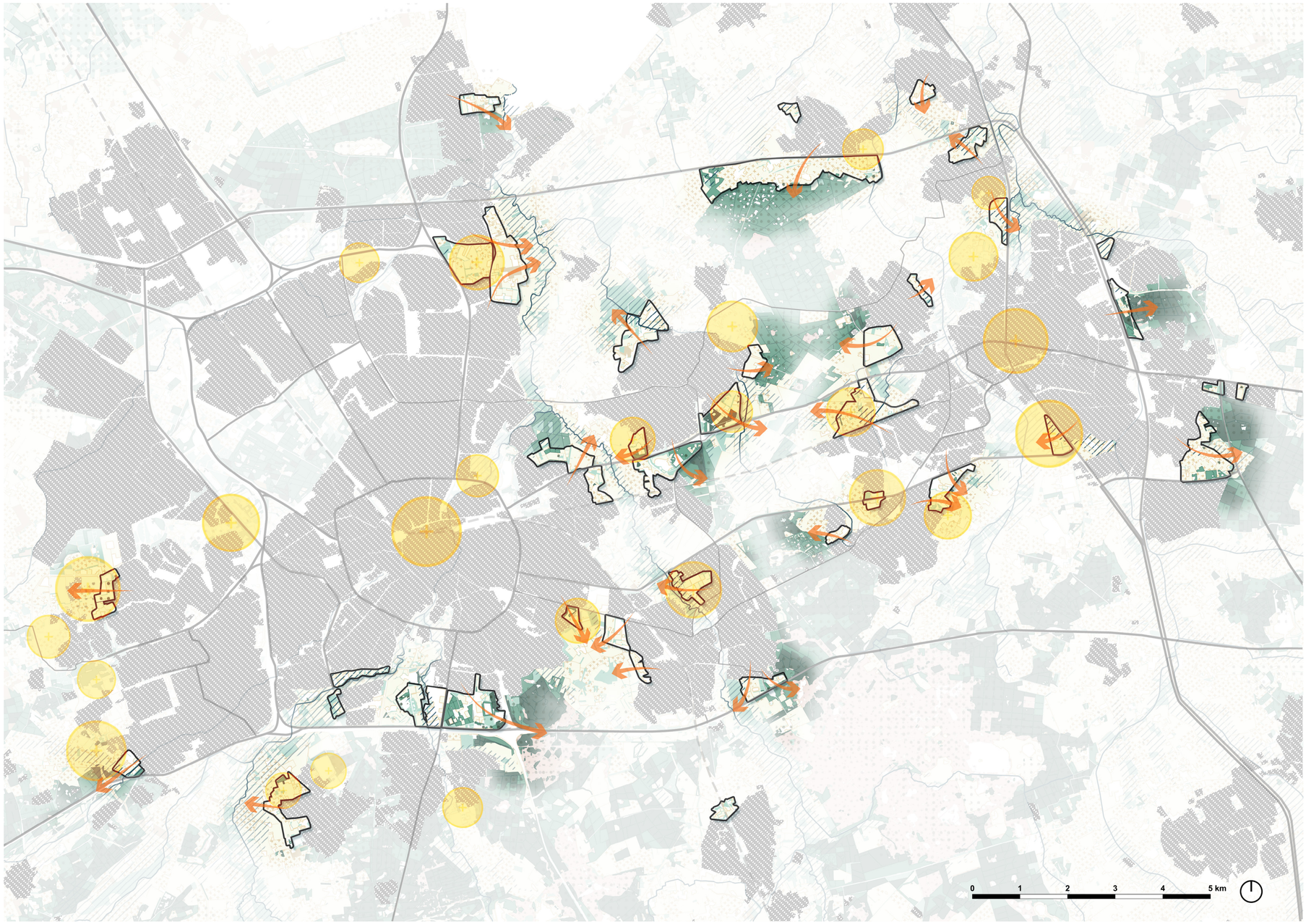
These tightly or loosely packed rooms become transitional zones in the urban patchwork and cultural landscape, where one can pass through a few vegetable gardens into a dense reclaimed forest, through a car park and a warehouse surrounded by trees into open farmland, or be blocked by a couple of sports fields on the way to the broek for a camping trip... These are all experiences of the fringe landscape.

The fringe room landscape represents a highly heterogeneous forest landscape, where woodlands of different functions and densities alternate to form a recognisable whole.

However, this room landscape is not found in all urban fringes. In fact, many edges are raw barriers - a wide road, dense walls of trees, or simply barbed wire. Legibility is often an issue in existing fringe landscapes as well, with people easily getting lost in cluttered and random rooms.

Edge landscapes face pressures brought about by the housing mandate. The construction of houses on the edge of the city to protect the landscape of the hinterland has been an important spatial policy in the region, referred to as 'ruimte voor ruimte' (Noord brabant 2004). However, dwellings built on the edge often lack integration with the landscape, instead making the residents' experience of the landscape more difficult.

Expanding and nurturing this landscape in conjunction with forestry strategies can integrate the housing task into the forest while facilitating the connection between the city and the countryside (landscape) (coherence). The naturally fine-grained network of room structures also provides the basis for rich spatial experiences and recreational activities, and edge landscapes have great potential to enhance landscape identity.



Legend

- The fringe landscape
- From urban patches to cultural landscape
- Housing assignment



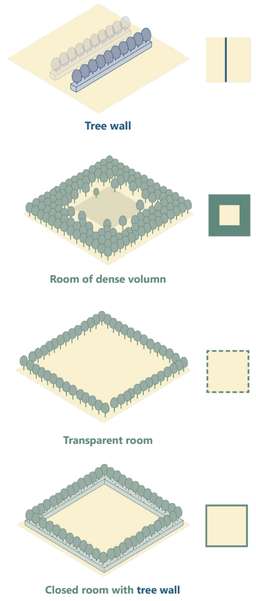
Spatial character

A lot of the edges are some kind of hard barriers - a wide path, a dense wall of trees

Diverse, cluttered forest rooms form a fine network.

Many of the rooms are closed and the overall layout is cluttered, lacking a clear backbone for organising the leisure network.

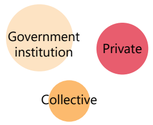
Tree syntax and species



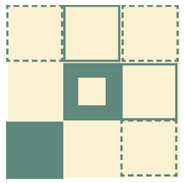
Function



Management



Both functionality and management pattern exhibit a highly mixed pattern



Dominant forest pattern

Potential of Enhancing Landscape Identity

Spatial character(perception):

- Expanding the scope of this small-scale landscape to form extensive transitional spaces
- Introduce more type of room to enrich the diversity
- More structured and accessible room through re-organisation of the road system
- Reduce the barriers

People's Identity(action):

- Designed to accommodate new housing in conjunction with forest rooms
- There is great potential for community engagement here, transforming the management model based on the richness of the existing features.
- Participatory planting and maintenance based on time process.

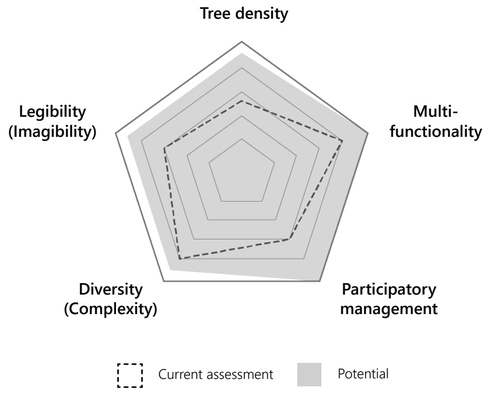




Fig.52 **A parking lot surrounded by trees**

Fig.53 **An equestrian venue in a fringe landscape**



Fig.54 **Allotment gardens**



Fig.55 **Private properties located on the fringe become a barrier to access to cultural landscapes**





Fig.56 **Sports fields are common elements in the fringe landscapes**



Fig.57 **Raw edges of residential areas and lack of connection with the landscape**

6.5 The Metropolitan void landscape

The void landscape is the fourth component of the SGE metropolitan landscape. The 'void' refers to the 'remaining space' within the urban patchwork. The expansion of urban patches and the construction of infrastructure have fragmented these otherwise coherent cultural landscapes. Their character follows a similar profile to the cultural landscape, but assumes more urbanising functions or is threatened with further consolidation.

These fragments can vary greatly in size, character and degree of development. Intact forests like the strijp, the remaining reclaimed land between the A2 and Beatrixkanaal, parks formed by remnant streams, or small pieces of residual land attached to highways all fall into this category of landscapes. Their common feature is that they are places where the isotropic urban colonial grid encounters obstacles, a tension that embodies genius loci (V/D VELDE 2009) and has the potential to become a narrative space for metropolitan landscapes, like a 'theatre' in the urban plantations.

These voids can be divided into two categories:

Linear void of stream: linear fragments of stream, where an otherwise continuous cultural landscape of stream valleys is cut through and contained within diffuse urban patches. Some of the stream fragments are used as urban parks (e.g. genderpark) or protected as water retention areas (e.g. grotebeek). The stream fragments are linked in this layer by road infrastructure and at the same time connected to the stream valleys outside the city as cultural landscapes.

Theatre voids: non-linear landscape fragments. Some fragments are smaller in size, with vacant land, retaining an open character and ready for urbanisation. Larger fragments, such as former cleared farmland or forests, still partially function as cultural landscapes and contain urban fragments within them, presenting a pattern similar to that of the rooms on the edges of the landscape.

It is worth noting that in the urban patchwork, road infrastructure divides space (as barrier) and acts as a connector of holes, so much so that it becomes a landscape element in its own right and plays an important role in the choreography of the metropolitan landscape. Forestry strategies may reinforce the character of infrastructure as a 'experience device', enhancing IMAGEABILITY of the metropolitan landscape as people move between theatres.

As remnants of cultural landscapes in the urban fabric, **the great variation between different open space landscapes makes them impossible to be summarised and assessed on a landscape identity rubric.** Forestry strategies here could emphasise the heterogeneity of voids according to the type of cultural landscape they correspond to, using an appropriate tree language in relation to their spatial characteristics (e.g. open, enclosed or room patterns), thus increasing identifiability and diversity. In terms of people's identity, the existing function of each open space and the social needs of its environment should be taken into account.

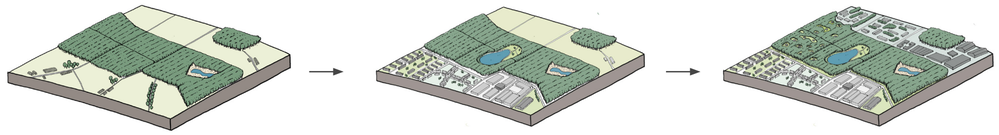
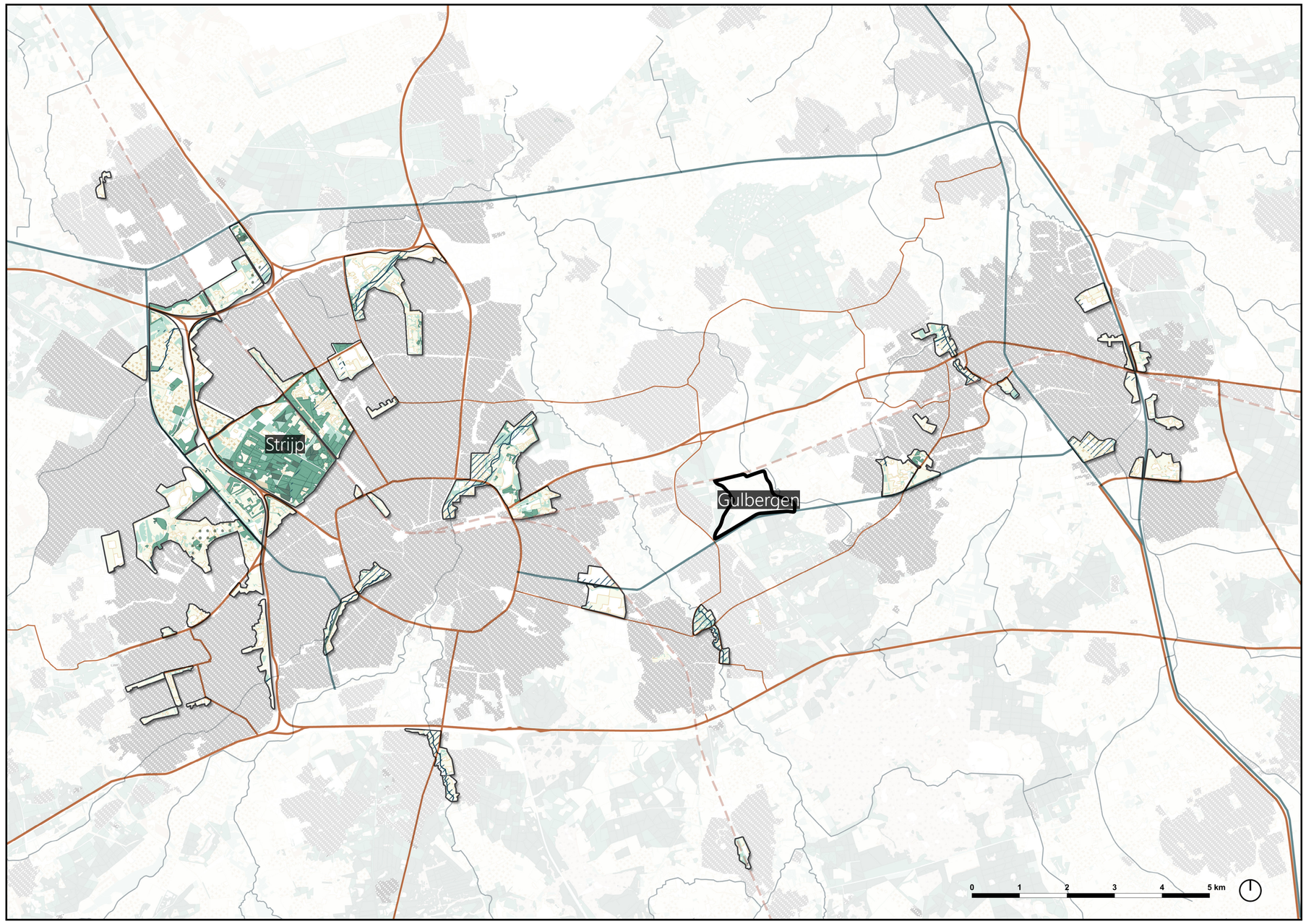
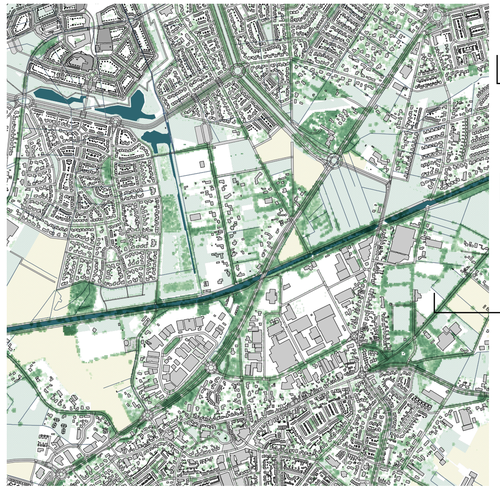


Fig.58 **How Strijp became a void inside Eindhoven**



Legend

- Metropolitan voids
- Kanaal
- Main road infrastructure



Spatial character

The void used to be a kampen landscape, with small-scale poldered plots and rooms of trees still visible.

The canal and a highway run through it and are important structures for experiencing the void on a metropolitan level.

There is a lack of transition or clear boundaries with the urban patches.

There is a lack of transition or clear boundaries with the urban patches.

A theatre void

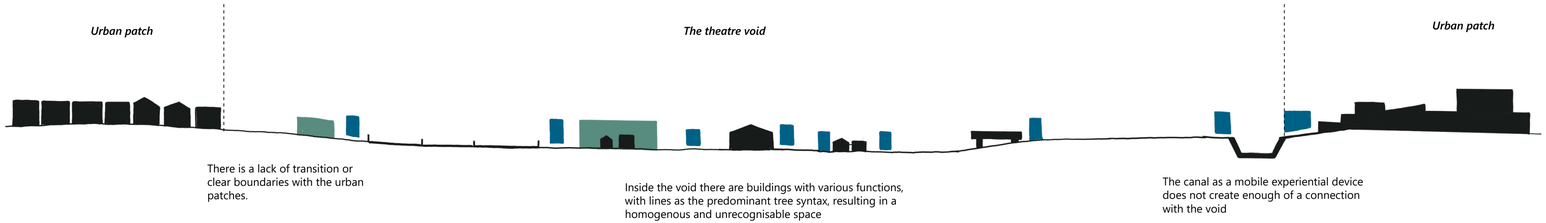


Streams appear fragmented and squeezed between urban patches

Lack of transition or clear boundaries with urban patches

The linear space of the stream is not emphasised and is hidden in the open space

A linear void of stream



Potential of Enhancing Landscape Identity

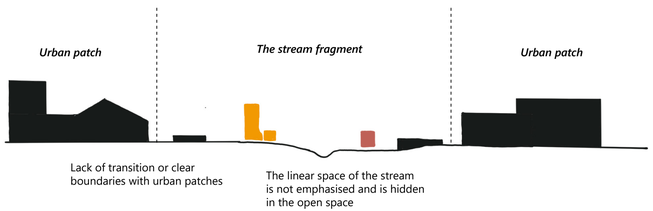
Spatial character(perception):
- The current void as a boring lost/attached space can be reinforced through forestry strategies to contrast with the surrounding urban environment and enhance its legibility as a a theatre.

- Creating a stronger spatial experience of 'entering' the theatre

- The diversity within the currently homogenous void can be increased through forestry strategies based on its inherent cultural landscape attributes.

People's Identity(action):

- Larger, complex voids can host intensive recreational and natural functions and become centres of activity in the area; smaller voids can be used as local participatory spaces to foster stewardship.



Potential of Enhancing Landscape Identity

Spatial character(perception):

- Enlargement of fragments to give the stream more room to flow
- Enhance linear planting along watercourses
- Unlike stream valleys as cultural landscapes, by being interspersed in urban patches, it is necessary by setting a certain threshold between fragments and patches. This can reinforce the heterogeneity of the space and the IMAGEABILITY of the stream fragments.

People's Identity(action):

- The originally diverse urban functions in the stream fragments can be retained as much as possible, e.g. sports fields, allotment gardens, etc.; provided that these functions do not conflict with the forest framework that enhances spatial perception.

- Enhancement of accessibility without compromising the ecological function of the streams.



Fig.59 **A void space attached to the A2 highway**



Fig.60 **A void space in the west of Helmond as water storage area**

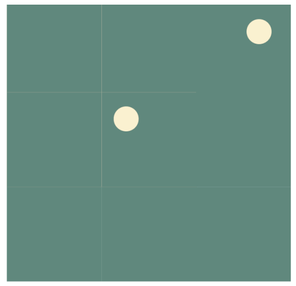


Fig.61 **Eindhovense kanaal**

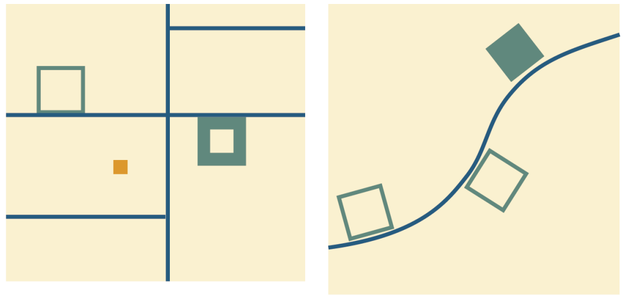


Fig.62 **A stream fragment**

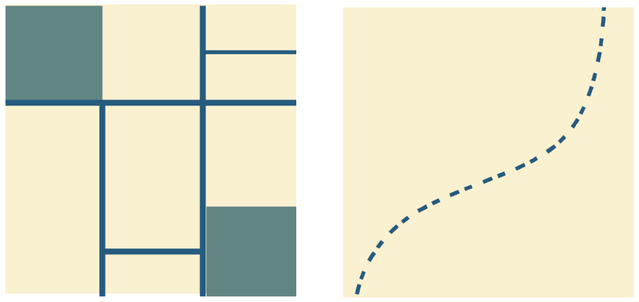
Combination of syntax as SGE forest pattern

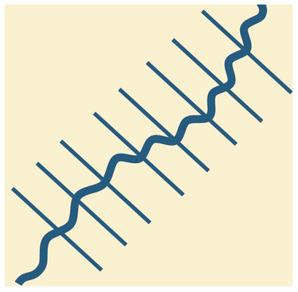


Forest pattern of the reclaimed forest



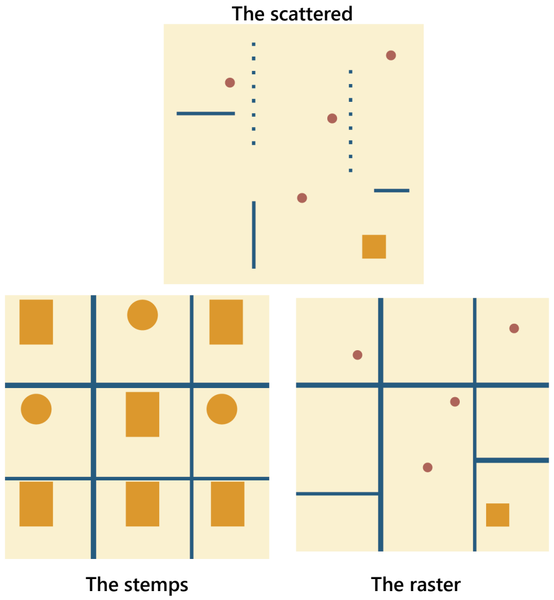
Forest pattern of reclained arable field



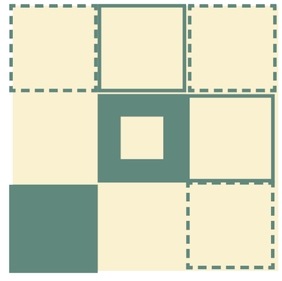


Forest patterns of Streamvalley and broek landscape

The combination of tree syntax forms forest patterns, which define and describe the SGE landscape from a forest perspective. The legibility of landscape identity is embedded in specific forest patterns, which form a holistic image of the landscape on a larger scale and reveal, to a considerable extent, the spatial patterns of social activities and management.Forest patterns are the starting point and the basis for the enhancement of landscape identity through forestry strategies, whether it is the design adaptation of existing forests or the planting of new forests.



Forest patterns of different urban patches



Forest pattern of the fringe landscape

7 ANALYSIS ON DROUGHT ADAPTIVE

From 'Braecbant' to the de-watering machine

In contrast to analyses targeting landscape identity, topography, landforms and land-use patterns become key elements in the perspective of drought adaptation.The SGE can be viewed as a system consisting of the ridge, the middleground and the valley. Groundwater flows, streams (surface water flows) and elevated canals run through it.

The ridge: Geomorphologically, this part is mainly dekzandrug, covered with sandy soil.

The Valley: Historically a low-lying area, this portion of the valley consists primarily of creek valleys and broeks covered with loamy soils and peat.Valley is the end point of drainage for the entire region, and drainage from the ridge and the middleground drains into the streams and feeds into the larger river (Maas River).

The middleground: the part in the middle between the ridge and the valley, where the city, where most of the population lives, and the main agricultural lands are located.

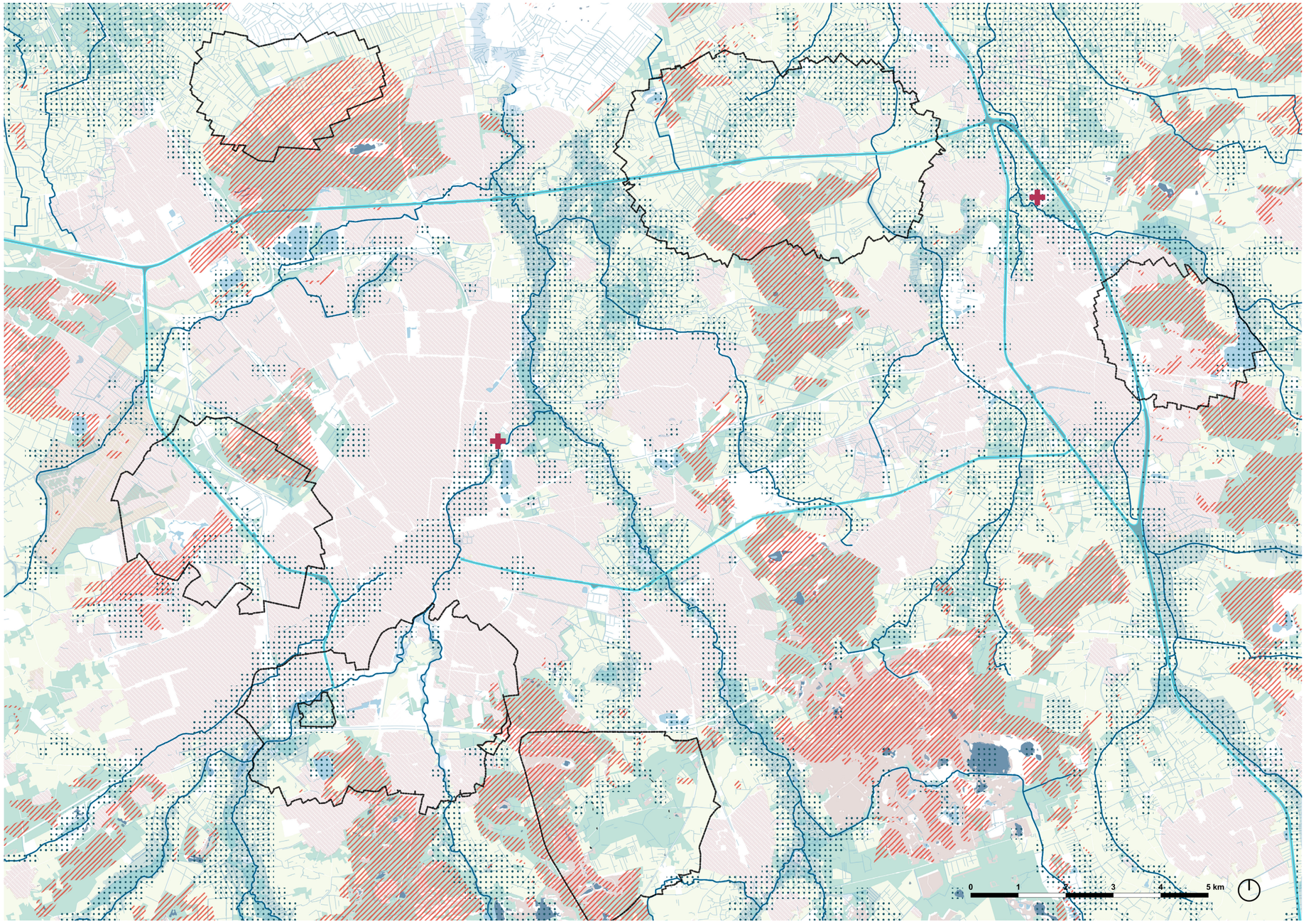
The prolonged transformation of the region's water system has made SGE a powerful dewatering and pumping machine. The problems associated with drought can be grouped into three categories:

too-fast dewatering (during the rainy season);

too-little replenishment (during the dry season); and

too-much water use (throughout the year).

The following sections elaborate on how these problems manifest themselves in system components and the potential for drought mitigation through afforestation.



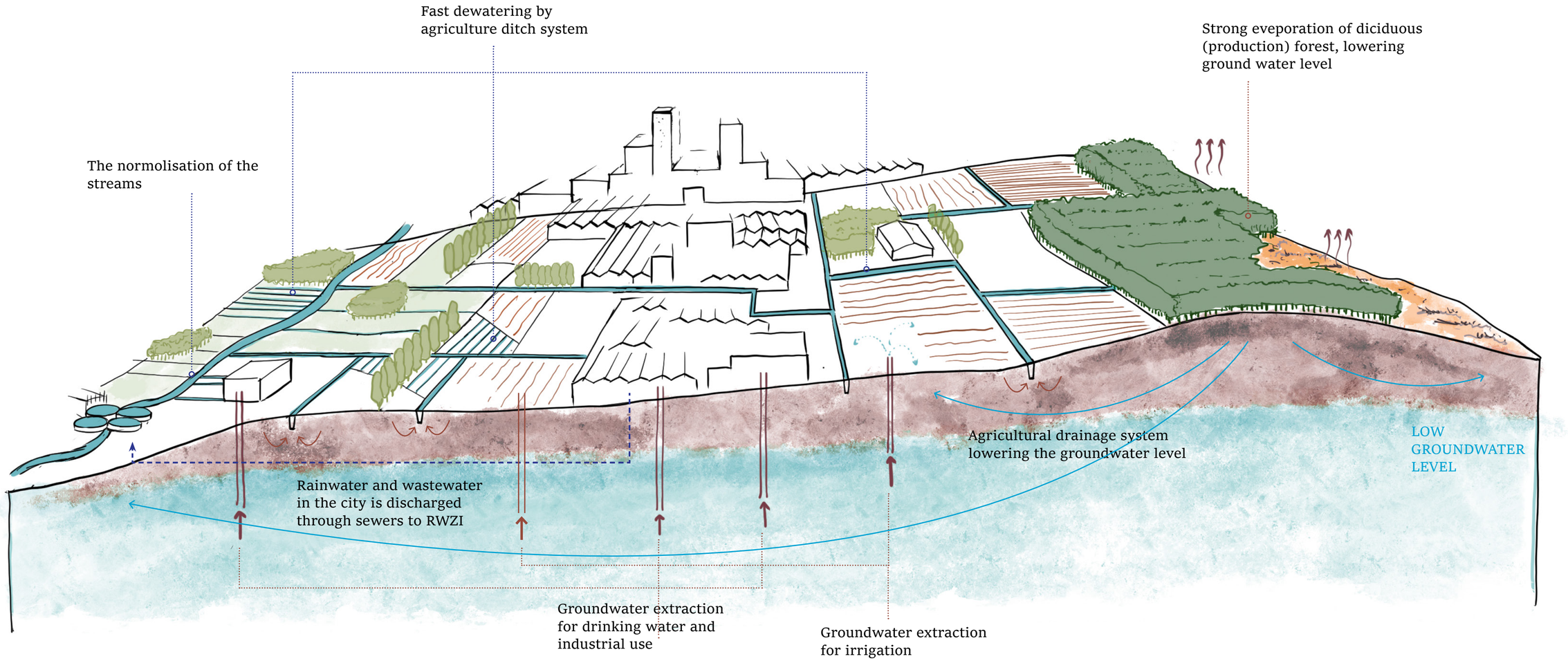


Fig.61 **SGE as a (ground)water system on the sand composed by three parts**

7.1 From the ridge

Too little infiltration and too much evaporation

As described earlier, a century of intensive reclamation has resulted in the loss of extensive heathland and bogs. Currently, the dominant land use on the ridge is reclaimed forest (which used to be used as a production forest) and agricultural land that has been reclaimed twice. The higher topography and loose, sandy soils make the ridge a major infiltration area. As the starting point for groundwater transport, most drinking water and groundwater protection areas are also located in the ridge.
The problem is that the large amount of coniferous forests leads to significant evapotranspiration, which exacerbates drought and leads to deterioration in the health of the forests and loss of habitat.



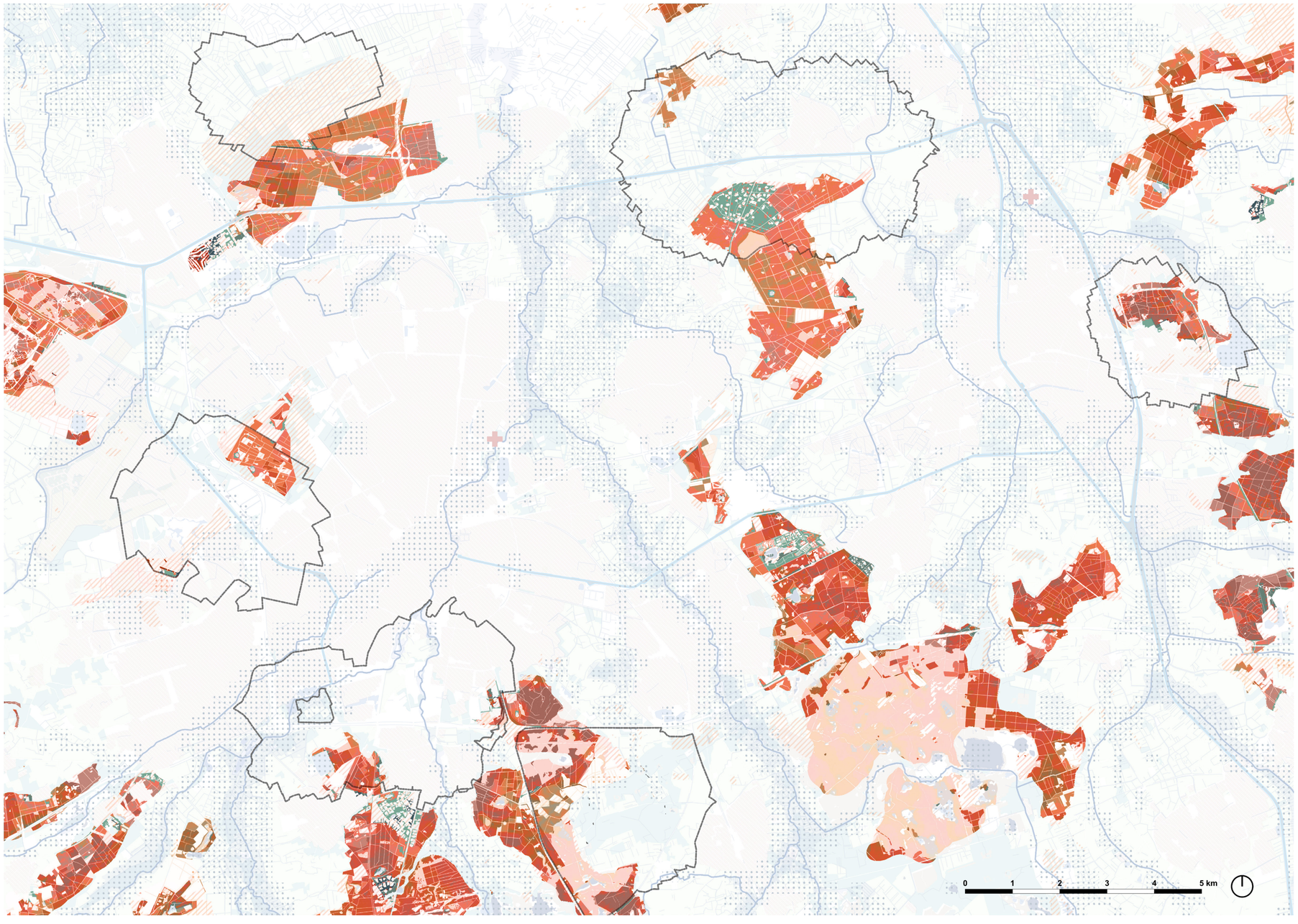


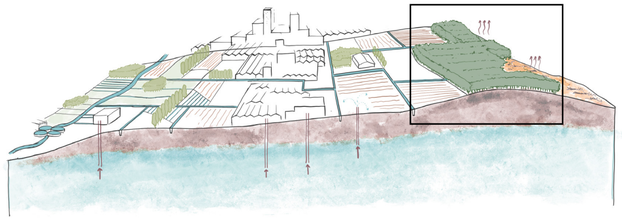


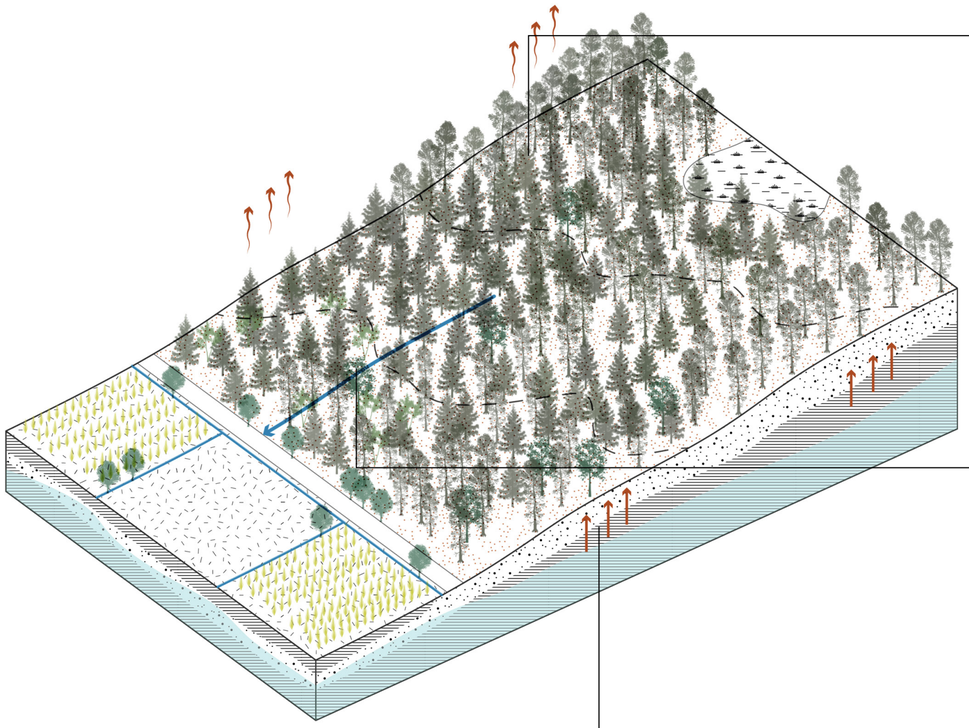
Legend

- Coniferous forest
- Mixed forest
- Heathland
- Groundwater protection area

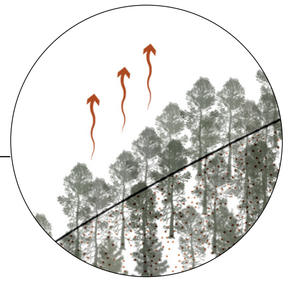
Severity of forest drought
(measured by lowest spring groundwater level)





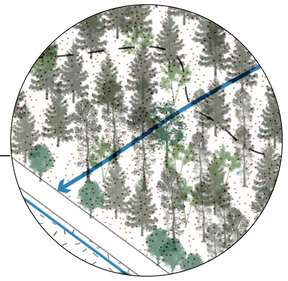


Problem



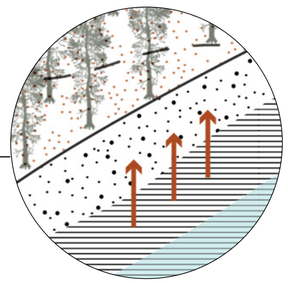
High evaporation

Evaporation from sandy soils is high due to sparse ground cover in coniferous forests



Rapid drainage

Surface runoff is enhanced by the lack of ground cover and remaining ditches from the reclamation period, and rainwater does not have enough time to infiltrate



High transpiration

Coniferous forests dominated by scots pine and norway spruce with high evapotranspiration, resulting in lowering of the water table

Potential

Increase in surface vegetation cover

Slower runoff, intercepting runoff if necessary

Species replacement through forestry

Legend

- Ditch
- Heathland
- Loamy soil
- Sandy soil
- Groundwater level

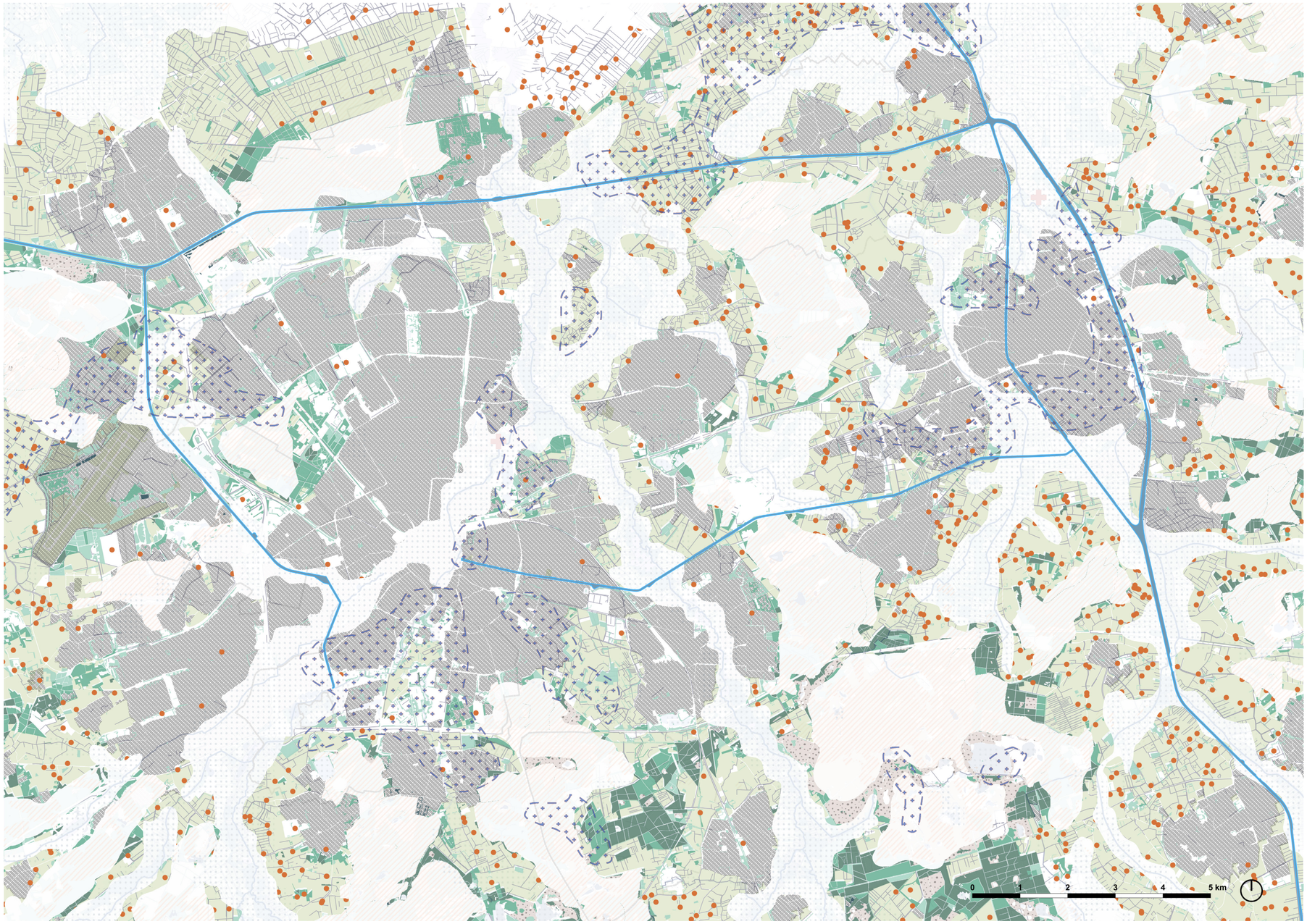
7.2 Through the middleground

Too fast drainage and too much water use

The demand for housing and production (droge voeten) resulted in a dense network of ditches, countless groundwater extraction points and an extensive sewerage system. Agricultural land drains excess water into streams through densely placed ditches, and rainwater and sewage from the city is collected by sewers and treated at a wastewater treatment plant (RWZI) before being discharged into streams.

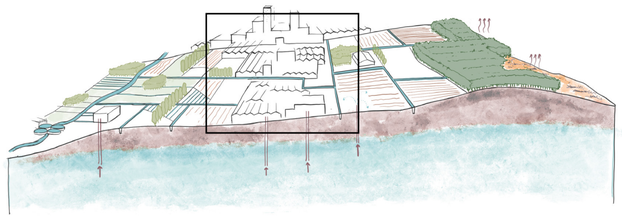


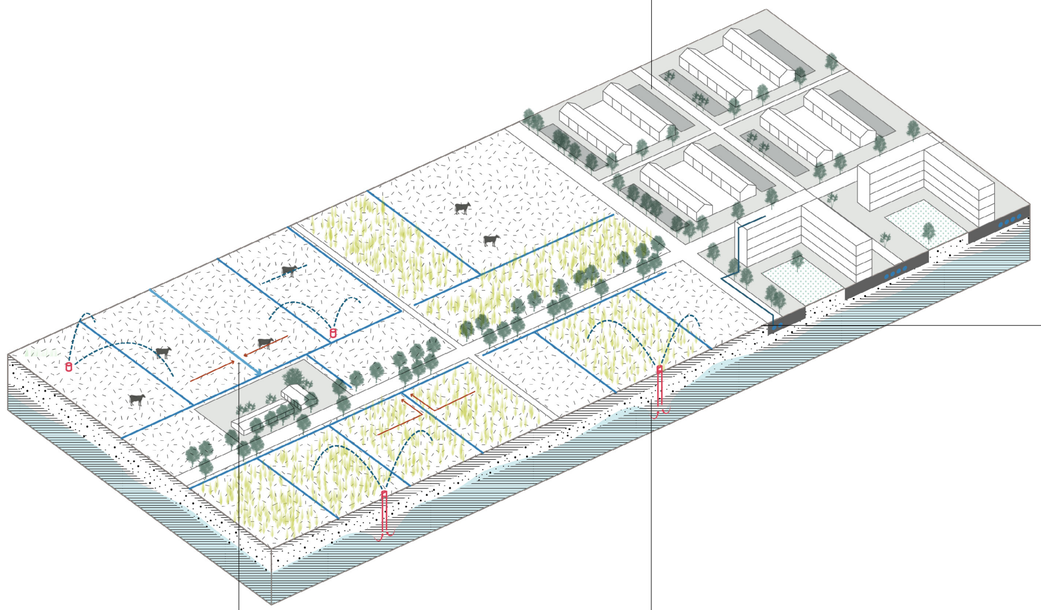




Legend

- Urbanization area
- Deciduous forest
- Agricultural landuse
- Lost seepage area
- Coniferous forest
- Mixed forest
- Ditches
- Water extraction point

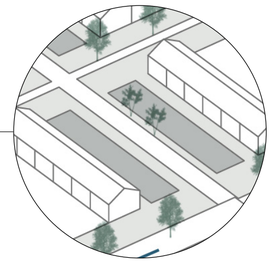




Legend

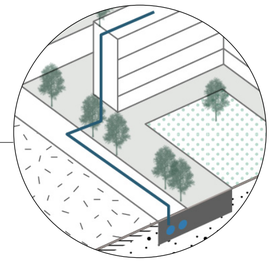
- Ditch
- Drainage
- Loamy soil
- Sandy soil
- Groundwater level

Problem



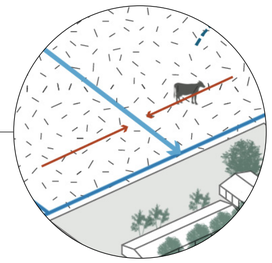
High evaporation

Excessive hard surfaces and low vegetation cover in cities leading to excessive evaporation



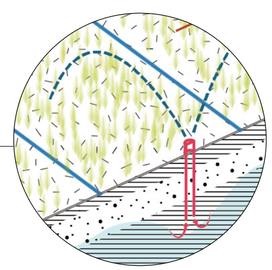
Rapid drainage

Rainwater in the city goes directly to the sewers and is not able to infiltrate



Rapid drainage|Pollution

Dense ditches in farmland make drainage too fast and lead to surface pollution



Groundwater extraction

As a result of the general water shortage during the summer months, agriculture needs to pump large quantities of groundwater for irrigation, leading to a vicious circle

Potential

More green surfaces and space for water storage

The city's drainage can be disconnected from the sewer system

Slows down drainage and purifies before water infiltrates and drains away

Space for water storage, or finding alternative water sources

7.3 Down to the valley

Too fast drainage and too little replenishment

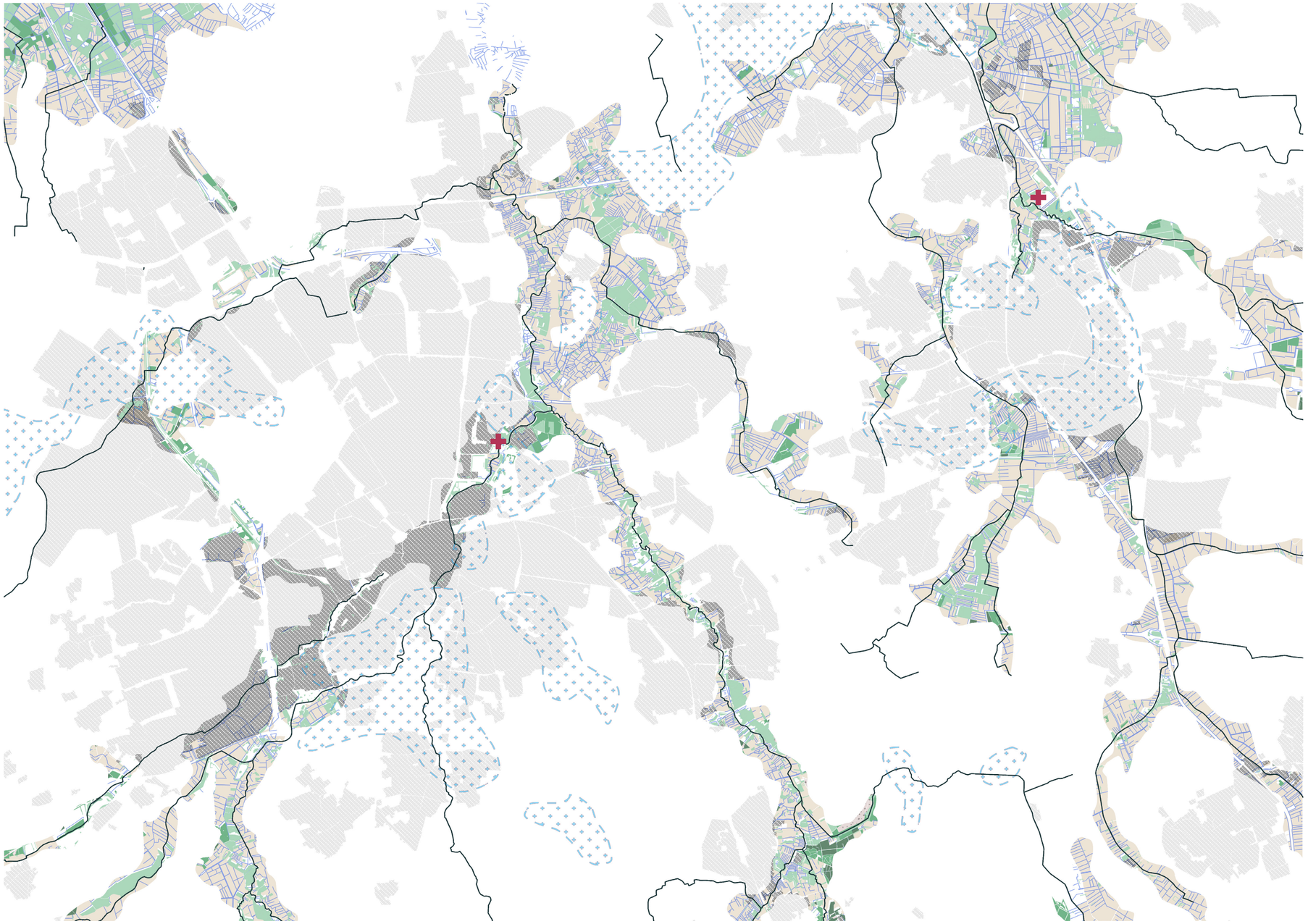
The Valley was historically a low-lying area consisting primarily of creek valleys and broeks covered with loam and peat. the lower topography and higher water table allowed seepage to occur, and in many places the unique moisture and soils became habitat for plants and animals with high ecological value.

Stream valleys and broeks, often used as hay fields in the past, have been consolidated into agricultural or pasture land, or turned into cities. The need for drainage for agricultural production and habitation has created a large number of ditches, which allow low-lying areas to be drained quickly.



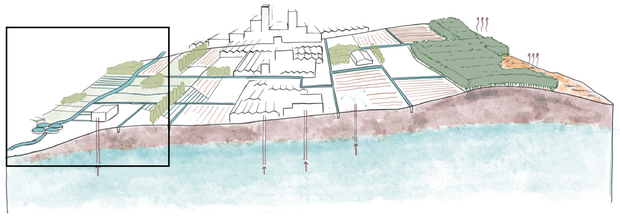


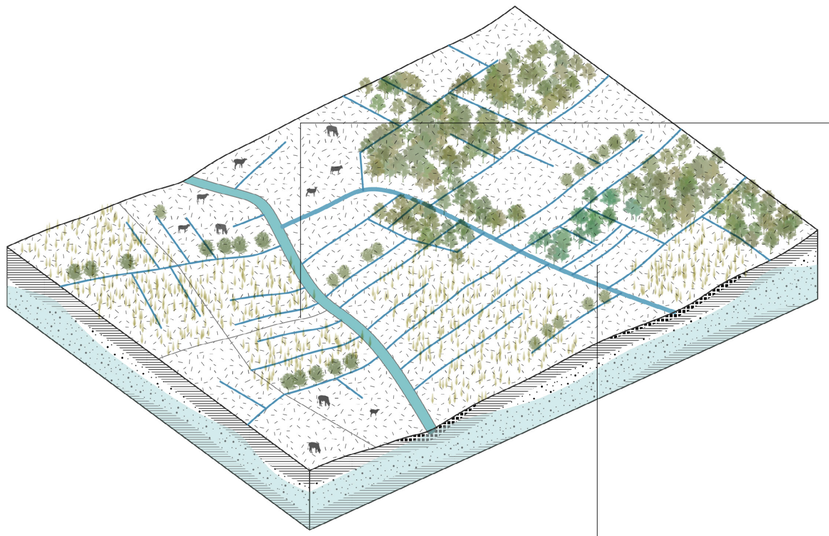


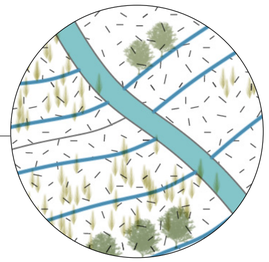


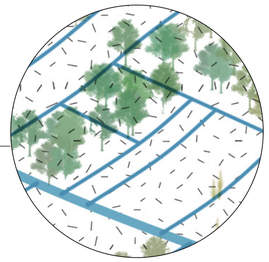
Legend

- Mixed forest
- Agricultural landuse
- Streams
- Historic seepage area
- Deciduous forest
- Urbanization area
- RWZI
- Ditches









Problem

Rapid drainage

The water courses of streams were normalised, and normerous ditches are set for a faster drainage

Rapid drainage|Little seepage

The agricultural function in the broek request for a low groundwater level, which prevent the seepage to happen. The native species in the broek thus suffer the drought.

Potential

Slow down water drainage;
Retain the water on the ground, to make the stream to meander again

The ditch system can be adapted, both in terms of the hydrological characteristics of the ditches and the number of it.

Legend

- Ditch
- Peat
- Loamy soil
- Sandy soil
- Groundwater level

8 CONCLUSION OF ANALYSIS

8.1 Design objectives

The challenges and opportunities for SGE in terms of both landscape identity and drought adaptation were analyzed in the sections above. The focus here is to summarize them as design goals in conjunction with forests and in a targeted allocation at all three scales/resolutions. While many of the challenges can be represented at all scales in the SGE as a whole, some can only be addressed in a focused way at specific scales.

Enhancing Landscape Identity

Concerns about

Landscape-city relationship

Human-landscape relationship

Spatial identity

Social identity

Strenthen Drought Adaptation

Concerns about

Hydrological resilience

Ecology

Macro

- Preserving and enhancing the typical spatial character of cultural landscapes
- Introducing new (forested) landscape characters into traditionally urban and rural areas, enhancing the diversity of landscapes in the region.
- Strengthening of void landscapes as metropolitan narrative places through forestry strategies

- Restore straightened streams
- Protection of all infiltration areas and restoration of seepage areas
- Canals as a source of recharge at key locations

Meso

- Integration of landscapes (especially fringe landscapes) and enhancement of spatial coherence within the area through forestry strategies.
- Well-developed, landscape-matched (recreational) trail systems in the area to enhance imageability.
- Distribution and resolution of Housing assignments in the area

- Spaces for water storage and alternative water uses are well distributed in the area and form well functioning systems
- Designation of floodable areas in the area in relation to the existing spatial structure

Micro

- Creating a rich perception of forest space in urban residential environments through the innovative use of the language of trees
- Combining pathway settings to form readable forest space sequences from the everyday environment to natural or cultural landscapes
- Introducing forestry-based management approaches that allow residents to experience the landscape and work within it in the time process

- Restoration of streams and infiltration areas in the city in conjunction with existing built space
- Improvement of drainage and infiltration through forestry strategies in forests in the Ridge area, using the right species
- Selection of the right species in new water treatment spaces

8.2 Design principles

This section summarises design principles for enhancing landscape identity and drought adaptation. Some of these principles are general design principles derived from theoretical studies that, after specific analyses of problems and potentials, have became more specific and integrated with trees and forests; and some came directly from important influences identified in spatial analyses.

These principles will be reflected in forest-based spatial strategies that will later be applied to the establishment of a territorial forest framework and local design transformations.

It is worth noting that these principles can be combined with each other in spatial interventions, but may also conflict, as discussed in more detail in *10.3 Synergies & Conflicts*.

Design principles for Enhancing landscape identity

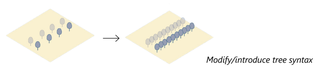
1. Spatial Coherence and Narrativity

This principle derives from the theoretical study of dispersed territories, whereby dispersed territories need to create coherent spatial experiences or 'locally adapted assemblages' while respecting spatial diversity (Pisano, 2013). It is also supported by spatial analyses, especially in studies of fringe landscapes, which reflect the importance of landscape integration of widespread transitional spaces, especially at larger scales.

2. Legibility and imageability

based on introducing/modifying tree syntax and transformation of forest pattern

Legibility and imageability point to a landscape that can be widely explored but not get lost; they are about the uniqueness, recognizability, and memorability of spatial elements in the landscape, and they are important factors influencing the perceptual dimension of landscape identity. They are related to fit with function, spatial form and natural character, as well as historical continuity (Erwing et al., 2006). Tree syntax, identified and summarized in site analysis, is an important means of improving legibility in the landscape through forestry strategies, the introduction and modification of which can reveal site uniqueness (e.g., by emphasizing hidden cultural traces through the trees) and add highly recognizable (forested) landscape elements; this process is also accompanied by a transformation of the forest pattern, which enhances the overall imaginability.



Modify/introduce tree syntax

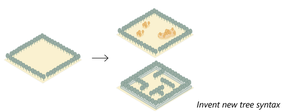


Forest pattern transformation

3. Comlexity and diversity

based on introducing/invent tree syntax

Complexity in the landscape implies that a place is visually rich and amenable to exploration (Erwing et al., 2006; Kaplan & Kaplan, 1989). This is reflected at a larger scale in the diversity of landscapes in a territory. Together with legibility, they shape positive perceptions of landscape character.
A rich tree syntax is the basis for creating complexity through forestry strategies. Introducing/modifying/inventing new spatial configurations based on the analysis of existing tree syntax in a place can create diverse (forest) spatial experiences (e.g. in monotonous production forests) and give a reasonable degree of heterogeneity to an otherwise homogeneous landscape.



Invent new tree syntax

4. Multi-functionality

Multi-functionality of the landscape is the basis for stewardship. Mono-functional landscapes increase people's alienation from their local environment (Fisher et al., 2017). Monotonous functions are often two sides of the same coin as monotonous spaces, and barriers to intensification, scale, and property rights may also limit people from experiencing multiple functions (e.g., in fringe landscapes). In terms of landscape identity, multifunctionality and complexity are different manifestations of the same principle at the level of action and perception. Providing more multifunctionality in landscapes that is not limited to cultural and aesthetic values, and fully utilizing the provisioning ecosystem services of forests, is important for livability.

5. Engagement in the time process

Engagement in the management and maintenance of the landscape is a long-term interactive process, and it is the most visible activity that changes the landscape and creates identity in the time process (Ramos, 2016). From the site analysis, it is clear that in many places, a single model of management (only by government agencies or only by private individuals) limits collective participation and people are powerless to change the landscape around them. Incorporating rich features in the landscape to create opportunities for people to sustainably engage in management in a variety of ways is critical to developing collectivity, a sense of belonging, and stewardship of the landscape.

6. Accessibility

One of the problems identified in the site analysis was that many types of landscapes (e.g. stream valleys and fringe landscapes) were difficult to access due to lack of paths or the presence of artificial barriers. Excessive grain sizes are also a contributing factor to limited accessibility (e.g. land reorganized brook landscapes and large areas of coniferous forest). They limit people's ability to read the landscape and understand the site (Erwing et al., 2006). Improved accessibility is important to activate the use of the site and improve the interactivity of the landscape, and spatial accessibility is the basis for making the landscape easily accessible to different residents and visitors in a spatial sense.

Design principles for strengthen drought adaptation

1. Minimize groundwater use

In models of drought in sandy soil regions, excessive water use during the dry season is an important cause of exacerbated drought (Van den Eertwegh et al., 2021).
The From the site analysis, it can also be seen that the demand for irrigation, mainly in the agricultural sector, is causing the groundwater table to be lowered to too low a level. Therefore, minimizing groundwater abstraction is the first principle in solving soil drought.

2. Retaining water

In sandy soils, drought is also exacerbated by rapid drainage during the rainy season (Van den Eertwegh et al., 2021). The large number of ditches and sewer systems seen in site analyses are all contributors to drainage droughts. These drainage machines should be reduced or modified to allow more time and space for water to flow.

3. Storing water as alternative source

The root cause behind excessive water use and rapid drainage is the uneven seasonal distribution of precipitation (Leenaers, 2021), which calls for the creation of spongy facilities to store excess water and use it as a source of supply during times of high demand.

4. Replenishment of groundwater

This is complementary to water storage and retention and aims to allow time (and space) for events such as infiltration to return to the groundwater table during the water cycle.

SECTION 4
RESEARCH BY DESIGN

This section primarily responds to the following Research questions:

What kind of forest based strategy can enhance and reinvent the landscape identity in SGE?

What kind of forest based strategy can strengthen the drought-adaptation in SGE?

How can forest strategies spatially integrate in design for cases of local scale?

9 THE TWO VISIONS AND DESIGN STRATEGIES

9.1 Design strategies and regional vision for landscape identity enhancement

The reclaimed lanscape

- More diversified reclaimed forests
- Forest necklace on the agricultural land
- More readable and diversified broek landscape
- More readable and experienceable stream valley

The urbanization patches

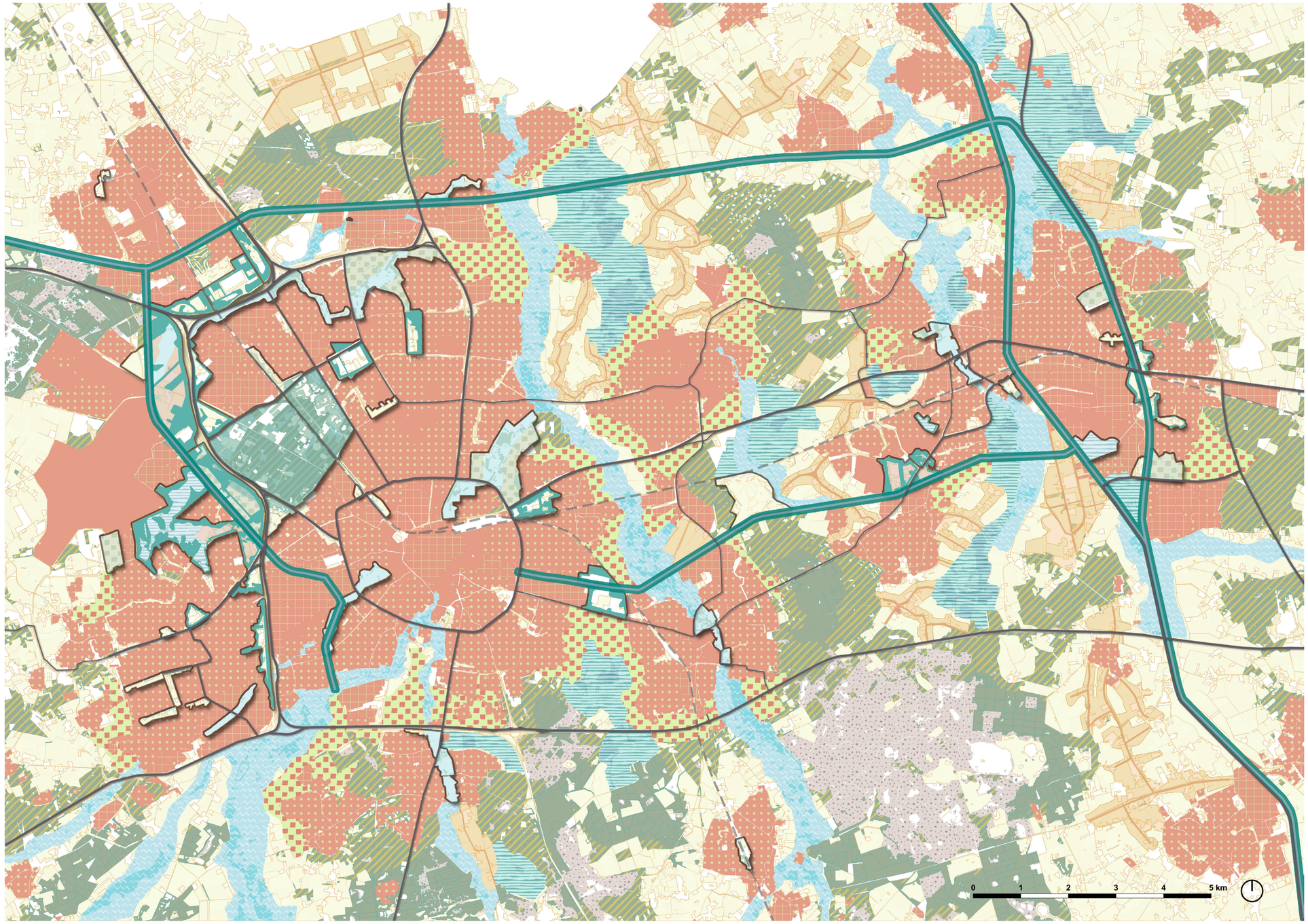
- Transformation to the new stemps forest
- Transformation to the new raster forest

The fringe landscape

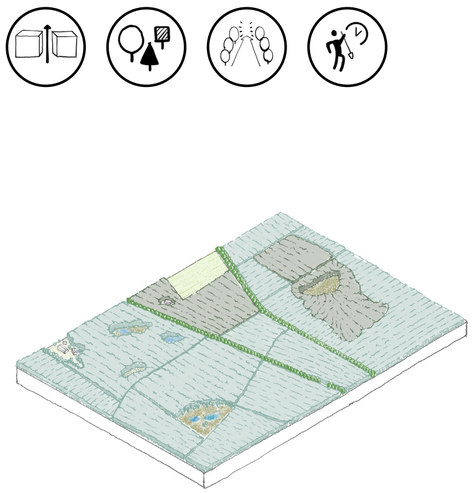
- The fringe landscapes as transition zone

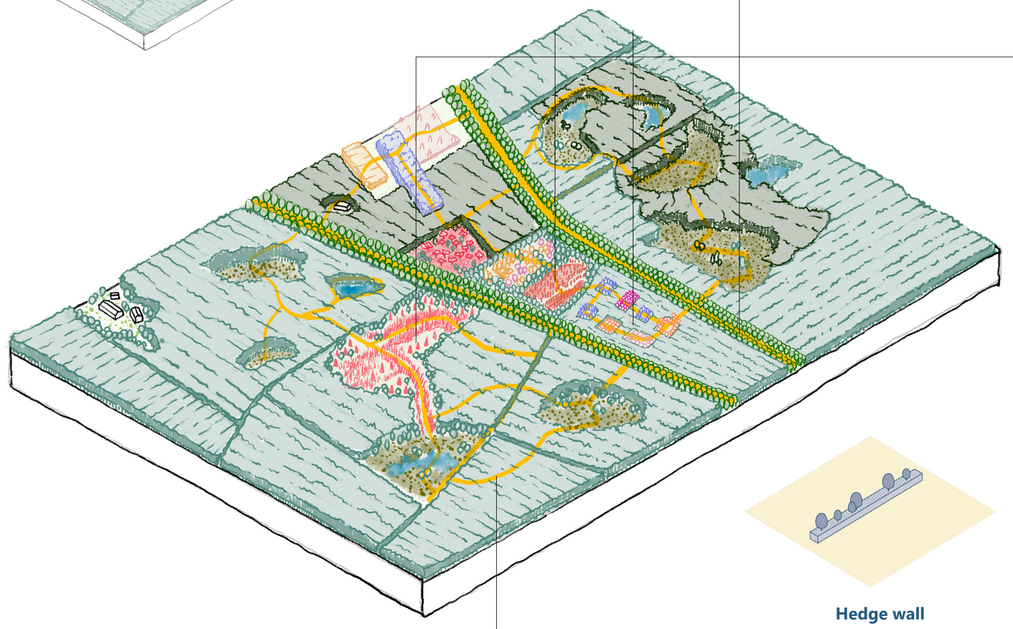
The void landscape

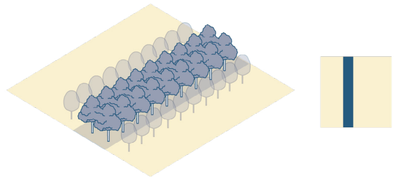
- The canal as corridor connecting voids
- A stream fragment
- Various theatre voids



Strategies for the reclaimed forest complex





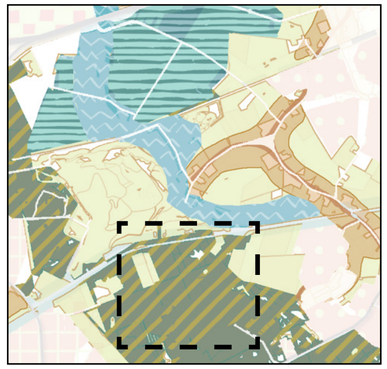


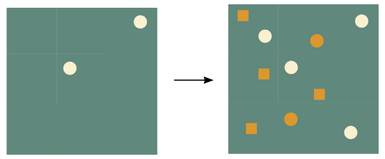
Arcade

The new Forest Boulevard as a carrying structure for recreation,and it enhances people's ability to navigate in the forest (legibility)

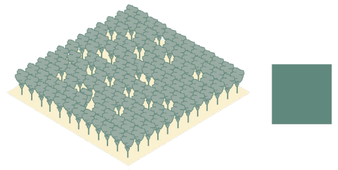
Hedge wall

The new route for forest experiencing

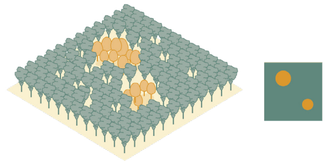




Transformation of forest pattern

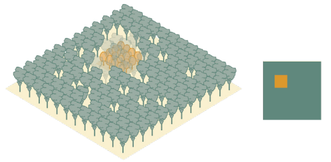


High-ceiling dense volumn



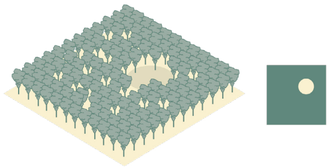
Planting - succession with limited maintenance

New communal space for resting and meeting



Planting - Continuous Maintenance

Foodforest
Natural-education



Felling - closed succession

Heathland and bogs recovery
Natural-education

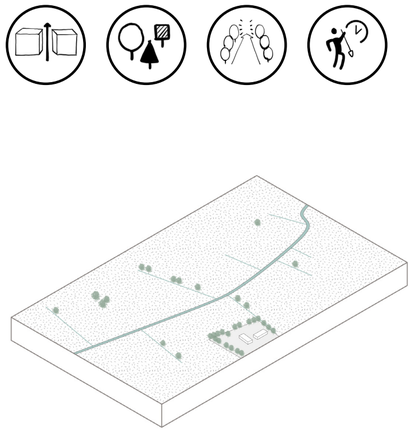
New space in the dense forest

Introducing diverse tree groups in high-ceilinged dense volumes, these forested spaces carry various functions such as socialising, resting, nature education, food forests, etc. They also imply different modes of management. They also imply different management modes.

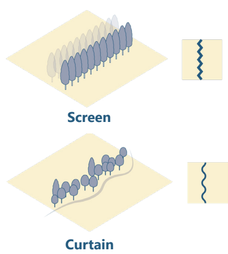


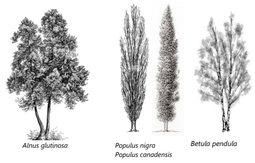
Fig.63 **Diverse experience moving through the dense forest**

Strategies for the streamvalley



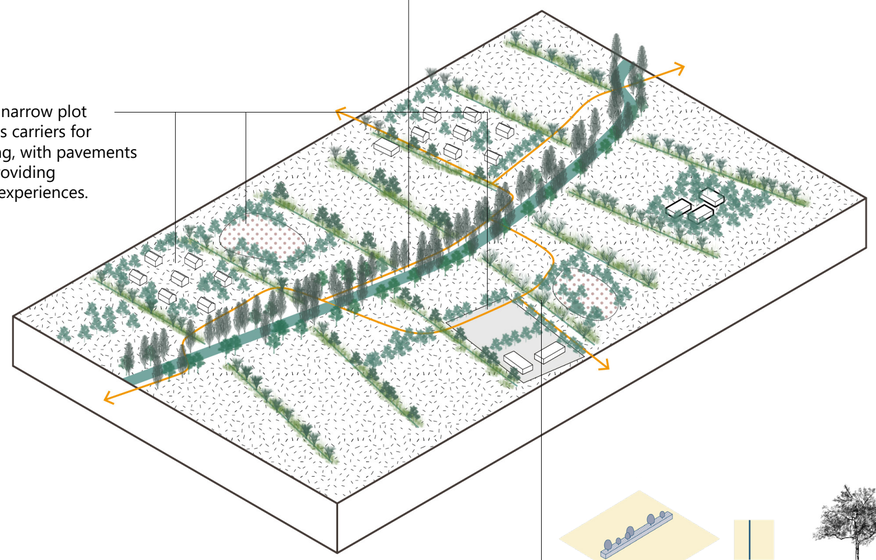
Enhance the landscape character of the stream by introducing a tree screen or tree curtain along the water course. Alder, black poplar and birch are long, lean, tall and softly textured, making them suitable species

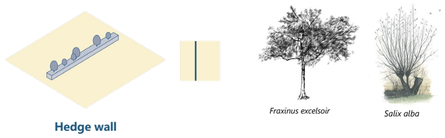




(Grey)Alder, black poplar and paper birch are long, lean, tall and softly textured, making them suitable species.

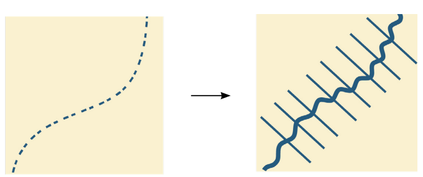
Formed/restored narrow plot structures serve as carriers for stream valley living, with pavements and bike paths providing connections and experiences.





The ribbon structure perpendicular to the watercourse is emphasised/restored by a hedge wall of ash or willow and shrubs

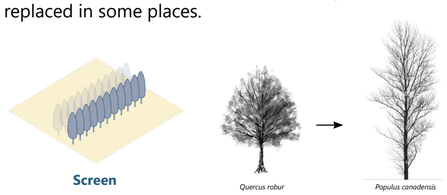


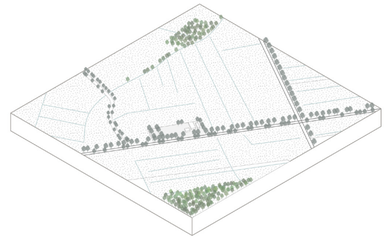


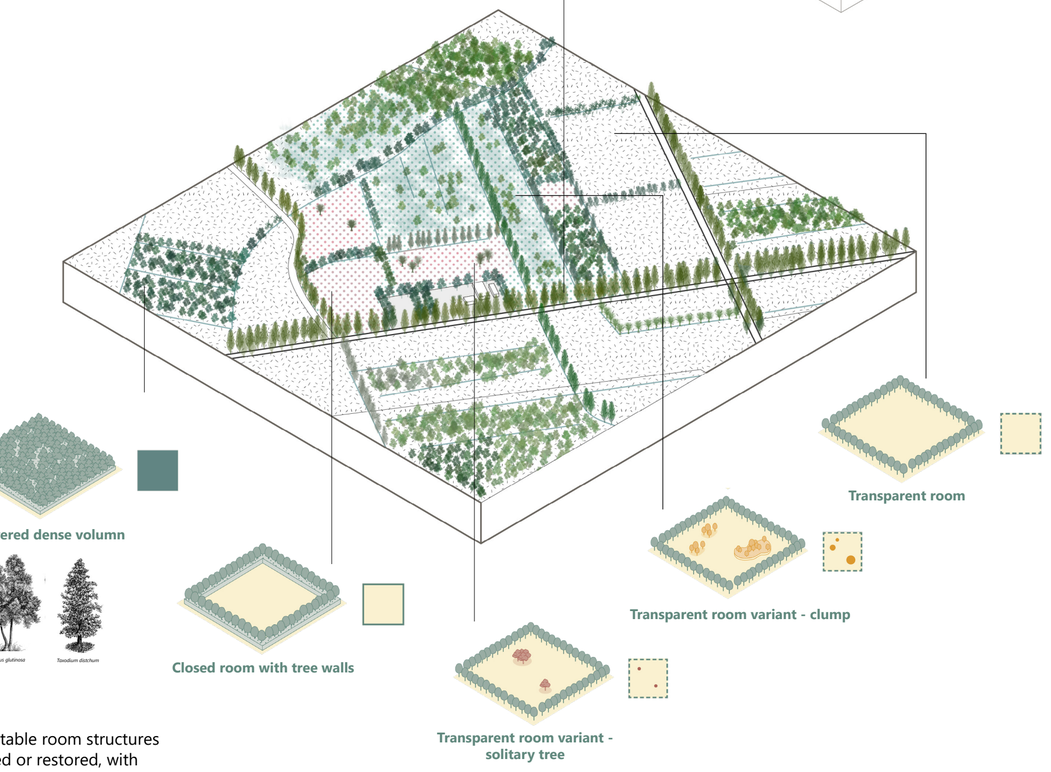
Transformation of forest pattern

Strategies for the broek landscape

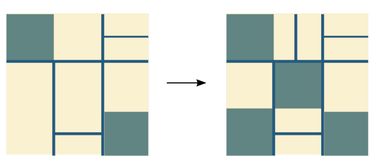
Emphasis on roads and watercourses as linear structures in the stream valley, poplars form screen as syntax applicable to wet conditions and historical continuity, oaks need to be replaced in some places.



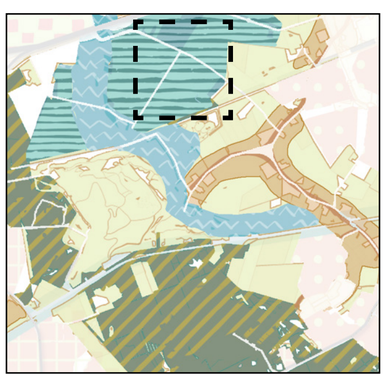




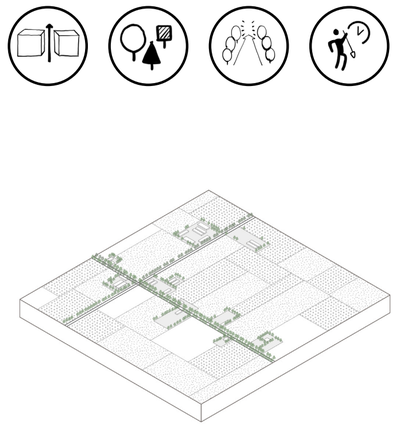
Broek's notable room structures are retained or restored, with dense floodable woodland alternating with transparent or enclosed rooms, staggered as natural nurturing areas and recreational spaces.

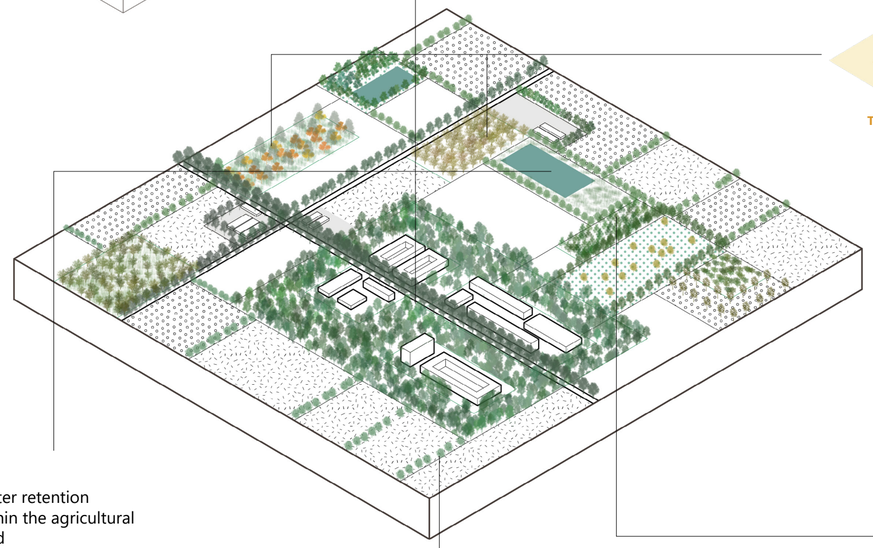


Transformation of forest pattern



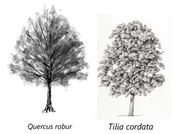
Strategies for the Reclaimed arable field(jonge ontginning)





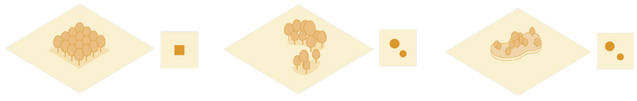
Water retention within the agricultural land



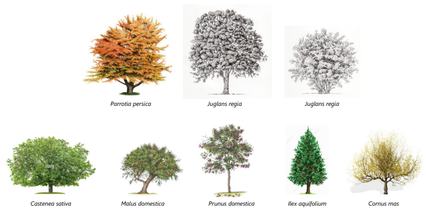


Quercus robur *Tilia cordata*

Emphasis on roads and watercourses as linear structures in the reclaimded arable filed by introducing and cultivating boulevard of oak or lime trees.



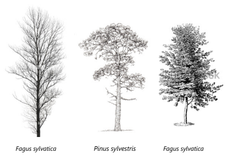
Tree nursary **Loose group** **Clump**



Parrotia persica *Juglans regia* *Juglans regia*

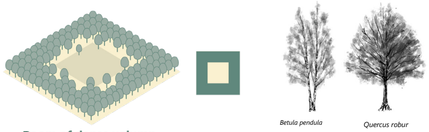
Castenea sativa *Malus domestica* *Prunus domestica* *Ilex aquifolium* *Cornus mas*

Colourful, food-producing fruit trees form a variety of groups, distributed around the living room as foodforest or as alternative agriculture, creating a seasonal landscape.



Fagus sylvatica *Pinus sylvestris* *Fagus sylvatica*

Trees suitable for timber production form tree nurseries and serve as nurse trees that further form rich woodlands.

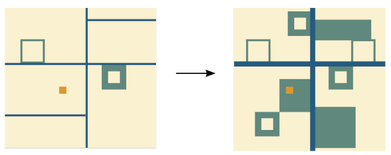


Room of dense volumn

Betula pendula *Quercus robur*

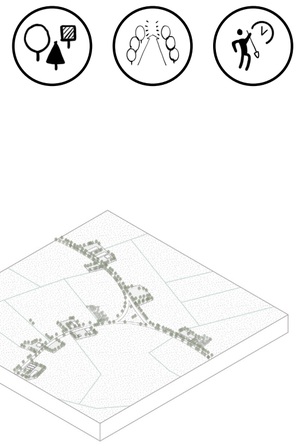
New housing or workplaces are embedded in forest living rooms made up mainly of oak or birch trees.

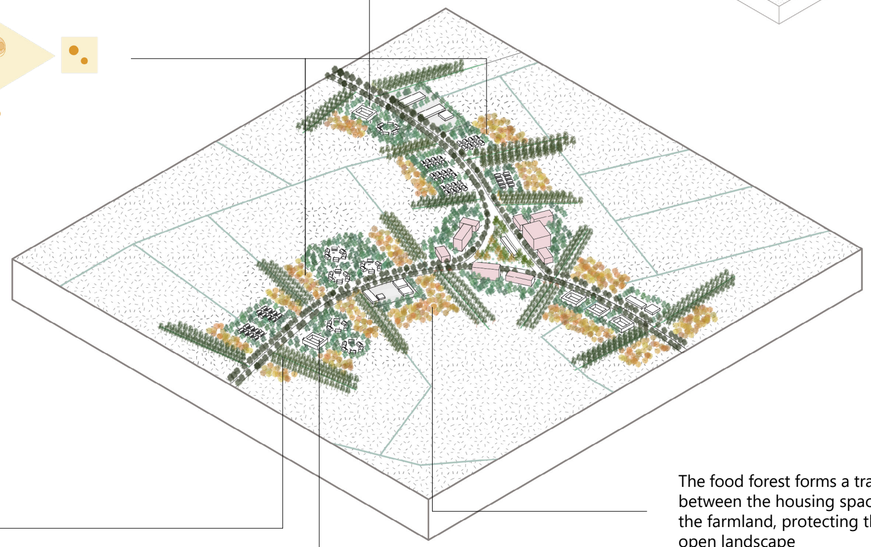




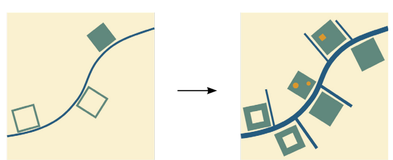
Transformation of forest pattern

Strategies for the Reclaimed arable field(kampen-hoeven)





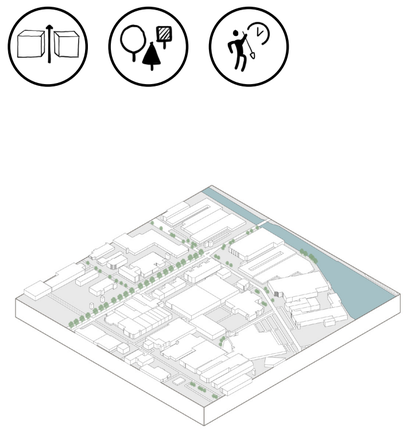
The food forest forms a transition between the housing space and the farmland, protecting the open landscape



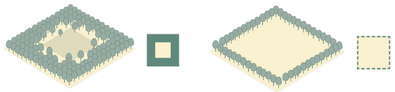
Transformation of forest pattern

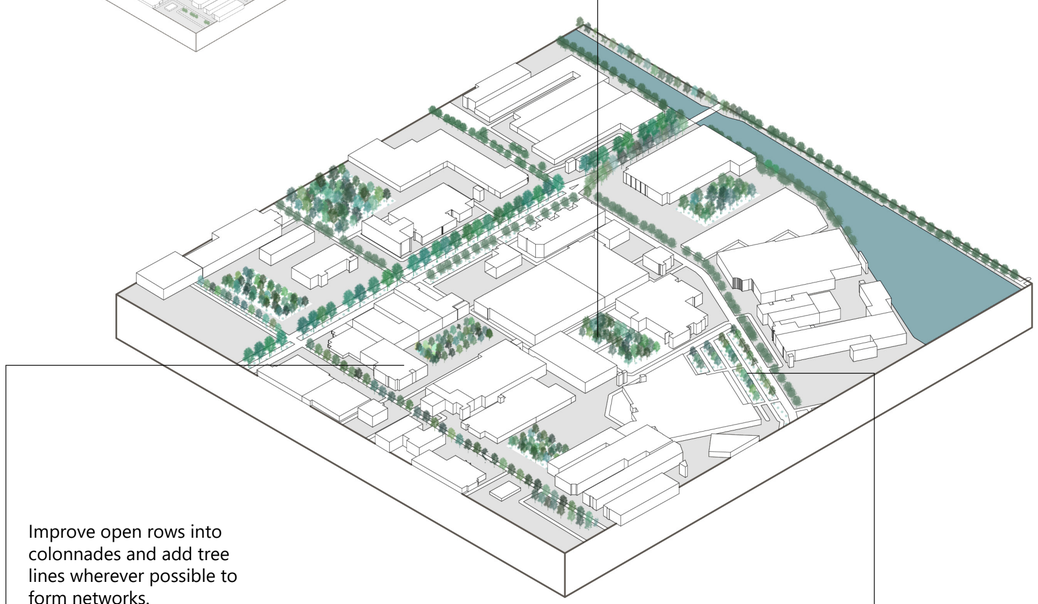


Strategies for Urban patches as scattered forest

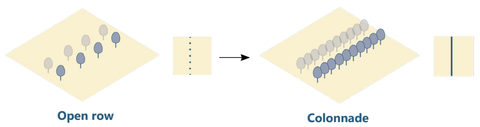


In industrial areas, the use of frames to replace vacant or abandoned industrial land serves as ecological restoration, cooling and air purification, and as a basis for further forestation.

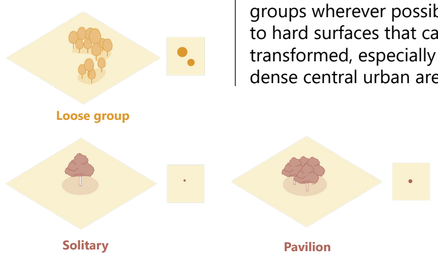


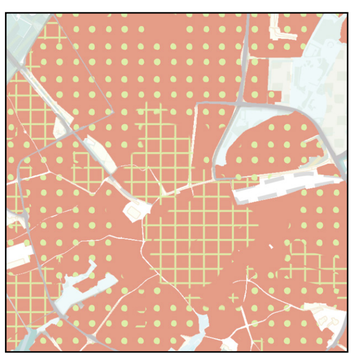


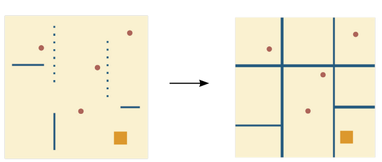
Improve open rows into colonnades and add tree lines wherever possible to form networks.



Add points and small groups wherever possible to hard surfaces that can be transformed, especially in dense central urban areas.



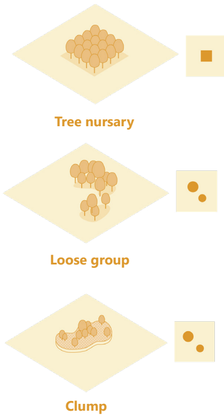




Transformation of forest pattern

Strategies for Urban patches as raster forest

The newly formed tree groups act as communal woodland, hosting a variety of recreational and productive functions, such as children's play woodland, community gardens or urban farming, encouraging deeper participation by residents.

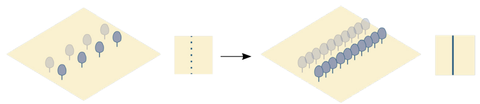


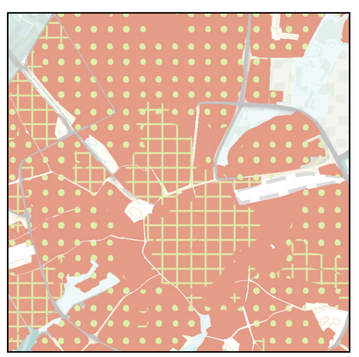


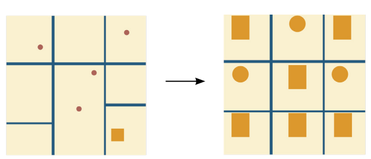


Improve open rows into colonnades and add tree lines wherever possible to form networks.

Make space for new tree groups by demolishing older houses to create a stamp-like layout.

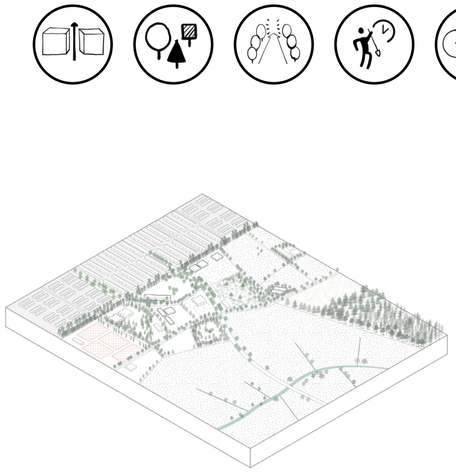


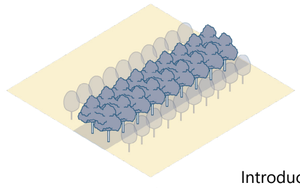




Transformation of forest pattern

Strategies for the Fringe landscape





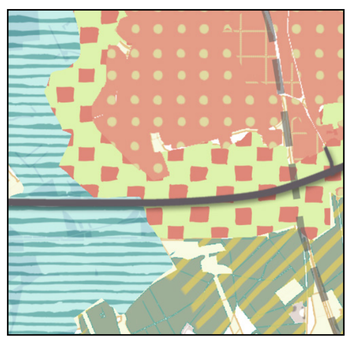
Colonnade

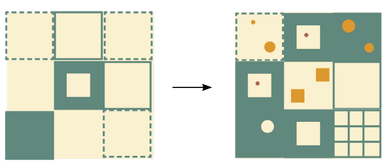
Introducing diverse tree groups in high-ceilinged dense volumes, these forested spaces carry various functions such as socialising, resting, nature education, food forests, etc. They also imply different modes of management. They also imply different management modes.



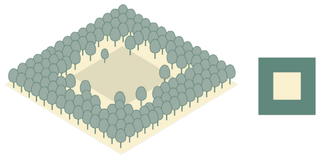
By removing and making transparent the current barriers, the space at the edge becomes more porous and accessible.

Extensive secondary roads and hedgerow paths provide a fine-grained recreational network.

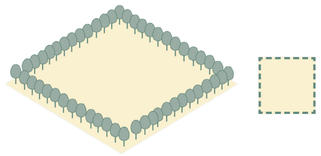




Transformation of forest pattern



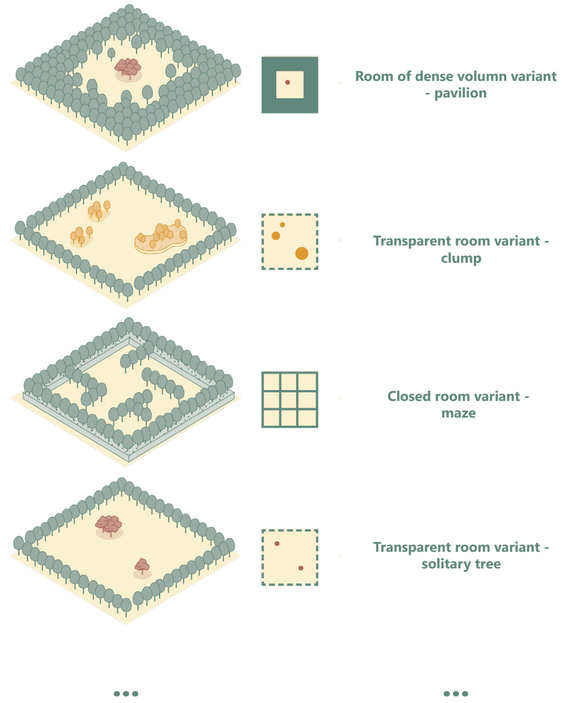
Room of dense volumn



Transparent room

Colourful 'forest rooms'

By integrating and adapting the existing forest frames, a wide variety of forest rooms are created, accommodating new housing, sports facilities, natural development areas, (community) agricultural production, water storage areas, new and old workplaces, and spaces for recreation and holidays. Together with the boulevards they provide a rich spatial experience and ensure that new developments are carefully integrated.



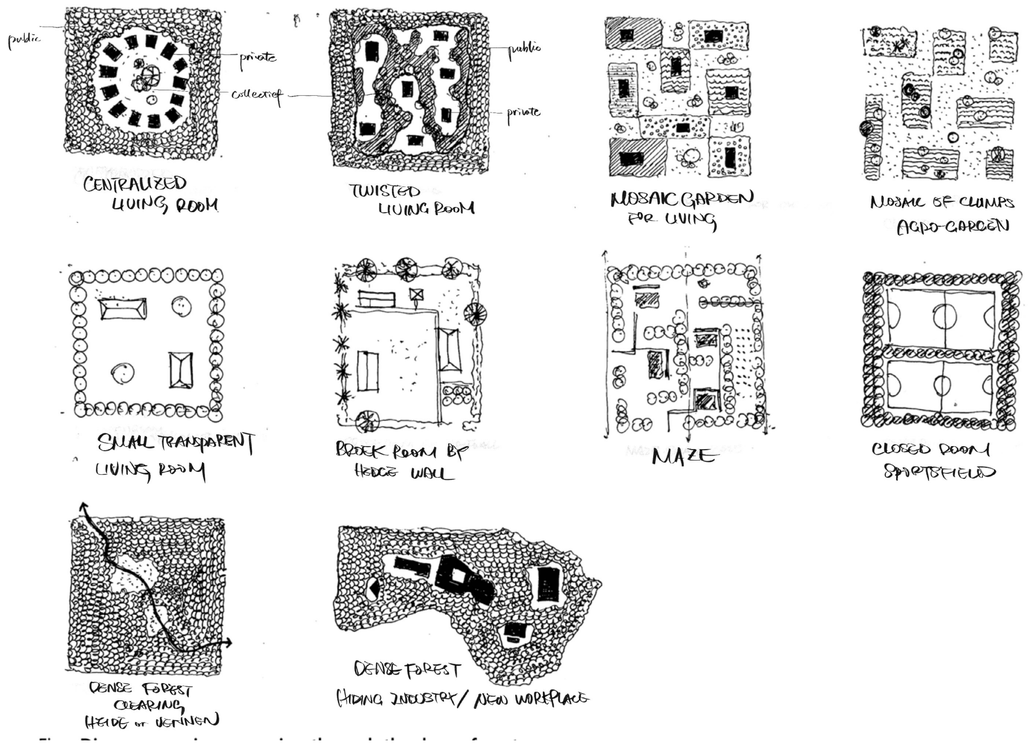
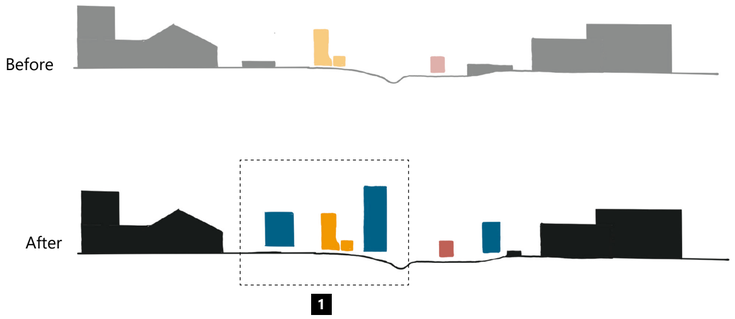
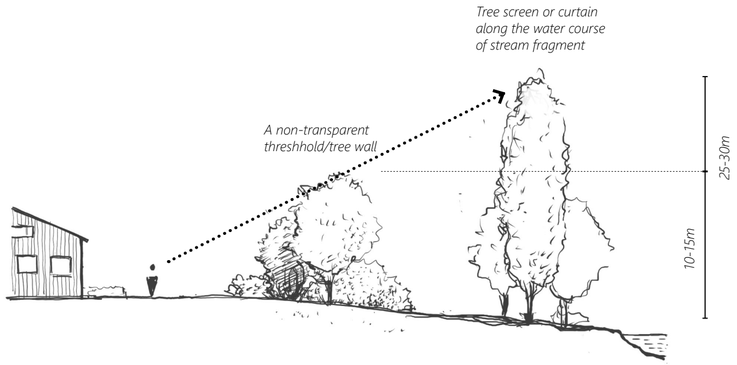


Fig.64 **Some experiments - forest rooms that carry different functions**

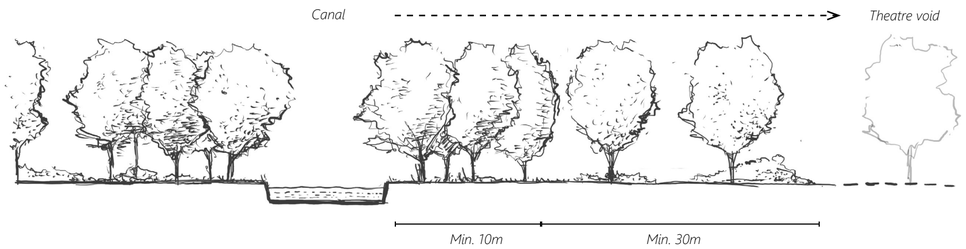
Spatial strategies for Void landscape

Transformation of a stream fragment



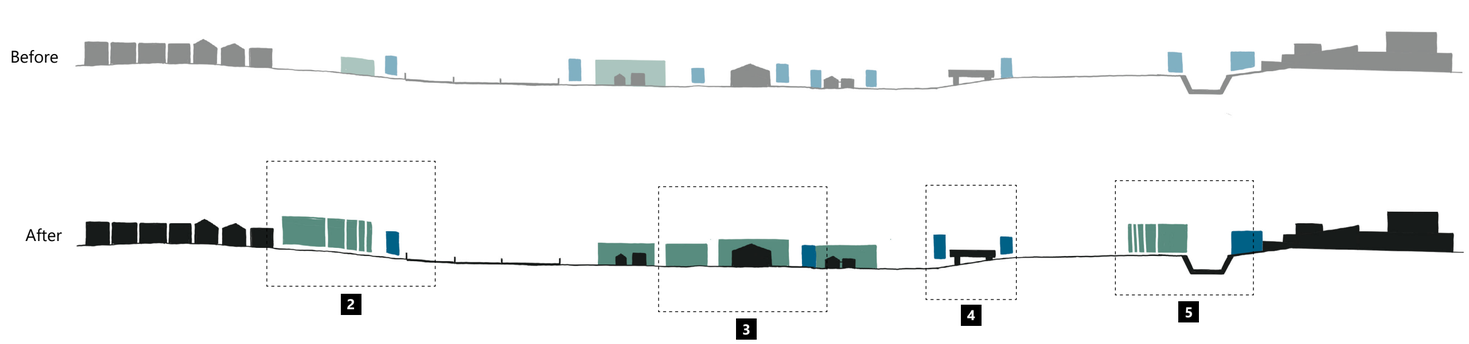


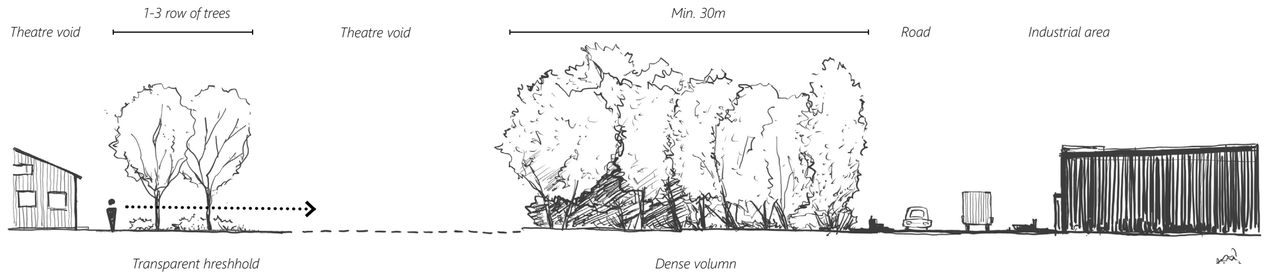
1 Provide impermeable tree thresholds between stream segments and urban patch boundaries to emphasise contrast and create visual delay. The height of the threshold should be high enough to allow people on the boundary of the patch to see the SCREEN along the watercourse and to draw people through the opening into the fragment.



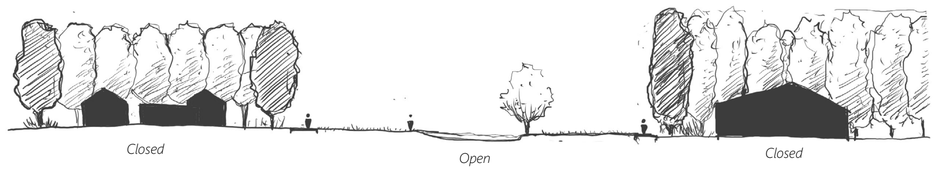
5 To enhance the character of the canal as a mobile experiential installation, the boulevard along the waterway should be reinforced with a width of 15m. less dense woodland strips as a transition from the canal to the theatre void should be provided with a width of at least 30m in order to shape the sense of gradual entry into the void.

Transformation of a theatre void

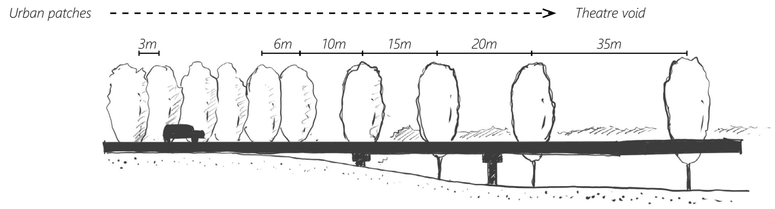




2 In order to enhance the heterogeneity of the theatre void as a narrative site, it is necessary to have tree thresholds of a certain width at its borders to enhance the sense of enclosure as a theatre. A more transparent barrier consisting of a few rows of trees could be placed at the boundaries of residential areas, while a sufficiently wide and impermeable volume is necessary at the boundaries of infrastructural and industrial areas.



3 Inside the void, the confined and open spaces should be strongly contrasted in order to emphasise the qualities of the theatre as a viewpoint to the sky. Some of the tree lines need to be removed and replaced by closed forest rooms with architectural fragments and open spaces with scattered tree points.



4 The transport infrastructure, as a linear corridor connecting the void, needs to be reinforced with tree lines on both sides, and in order to create the feeling of entering the theatre void rather than walking straight through it, the spacing of the trees on both sides can be gradually increased to create a decelerating experience as one enters the void.

9.2 Design strategies and regional vision for drought adaptation

The ridge

Enhanced infiltration and interception of runoff in coniferous forests

Retention of water in urban areas as infiltration zones

The middleground

Disconnection of stormwater and sewerage systems at the urban fringe

Precision/alternative agriculture with water storage space

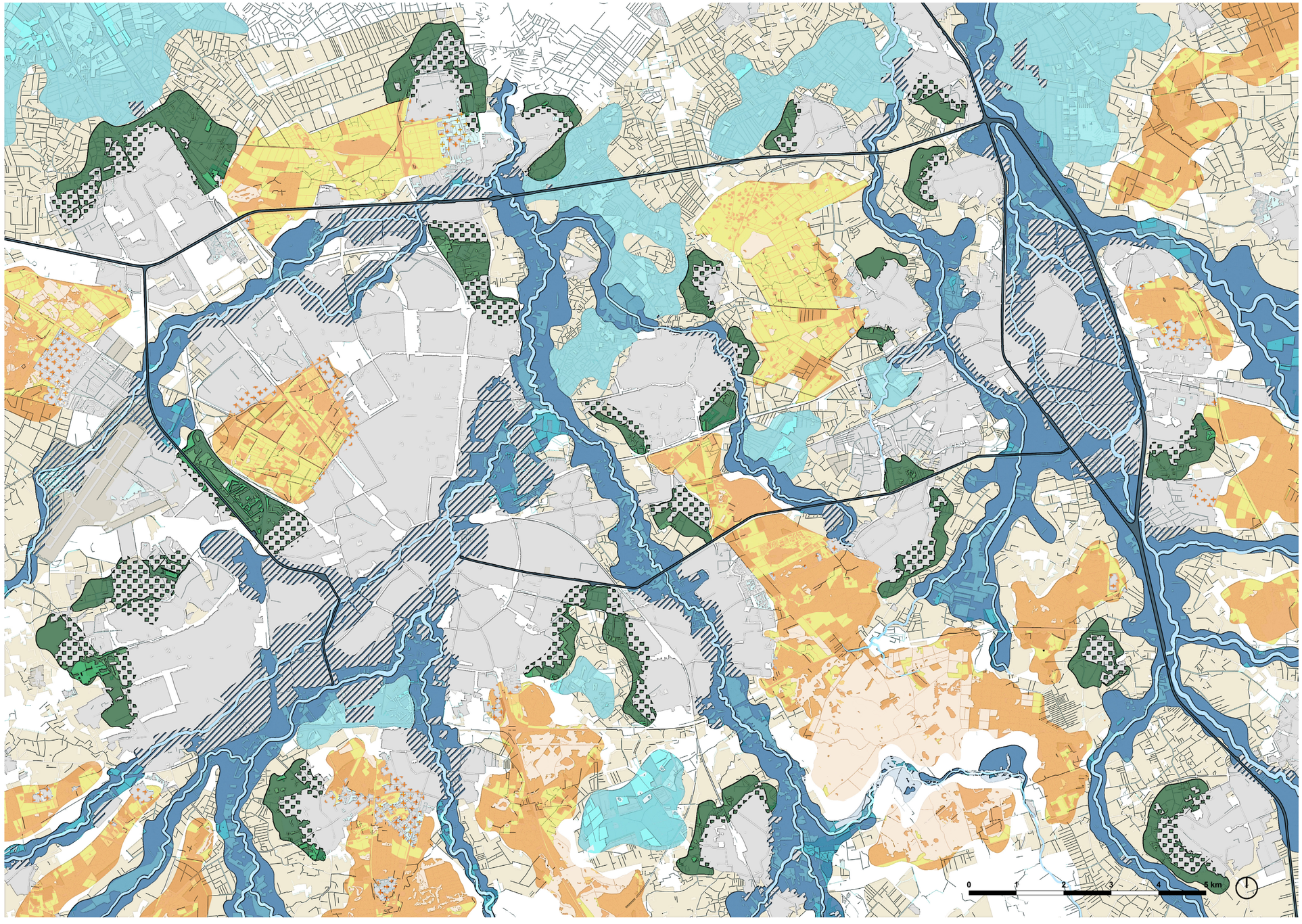
Forest reservoirs on the urban fringe for water purification and delivery

Canals as a source of dry-season water recharge

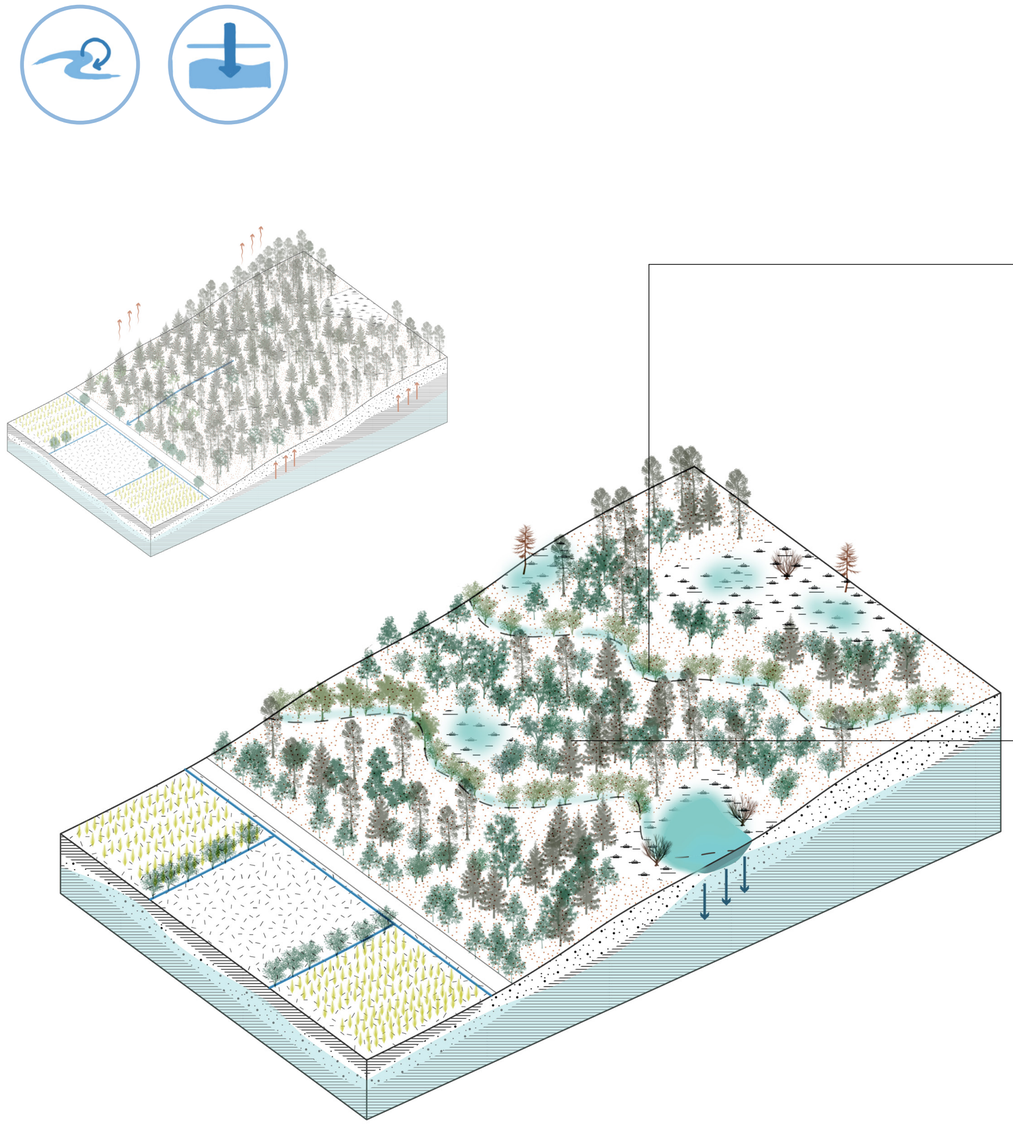
The valley

Restoration of seepages and floodable forests in stream valleys and broeks

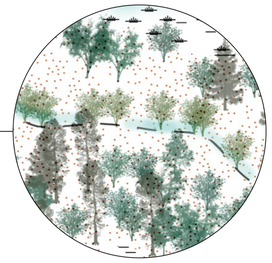
Floodable measures to restore seepage in urban area

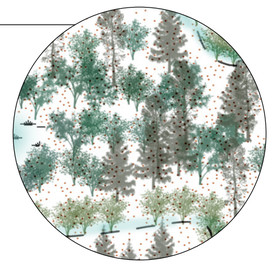


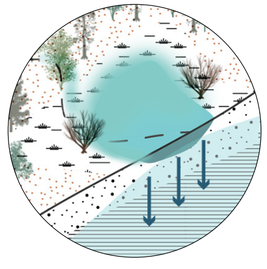
Strategies for the Ridge



Hydrologically protection zone setting and limited visiting



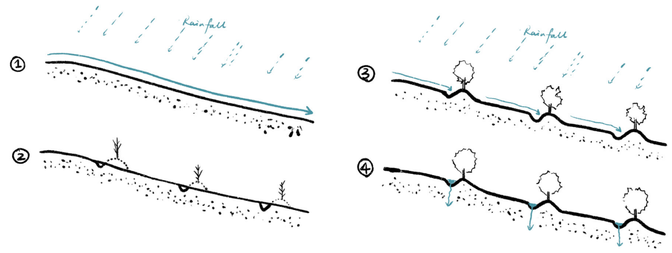




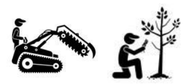
Wooded banks

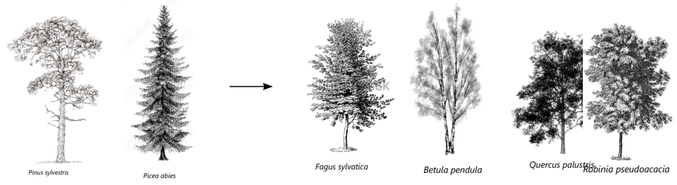


In conjunction with the thinning of coniferous forests, wooded banks have been introduced to capture runoff. wooded banks are located on slopes and extend along the contour lines, with a width of approximately 10 m. They consist of raised soils together with ditches, and the species usually chosen are Crataegus, Prunus spinosa and Sambucus nigra. The area on either side of the wooded bank needs to be kept open and this requires regular pruning and maintenance.



Species altering from coniferous to deciduous tree



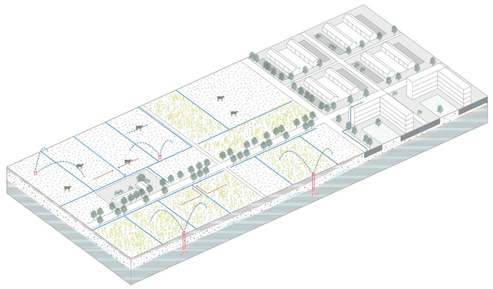


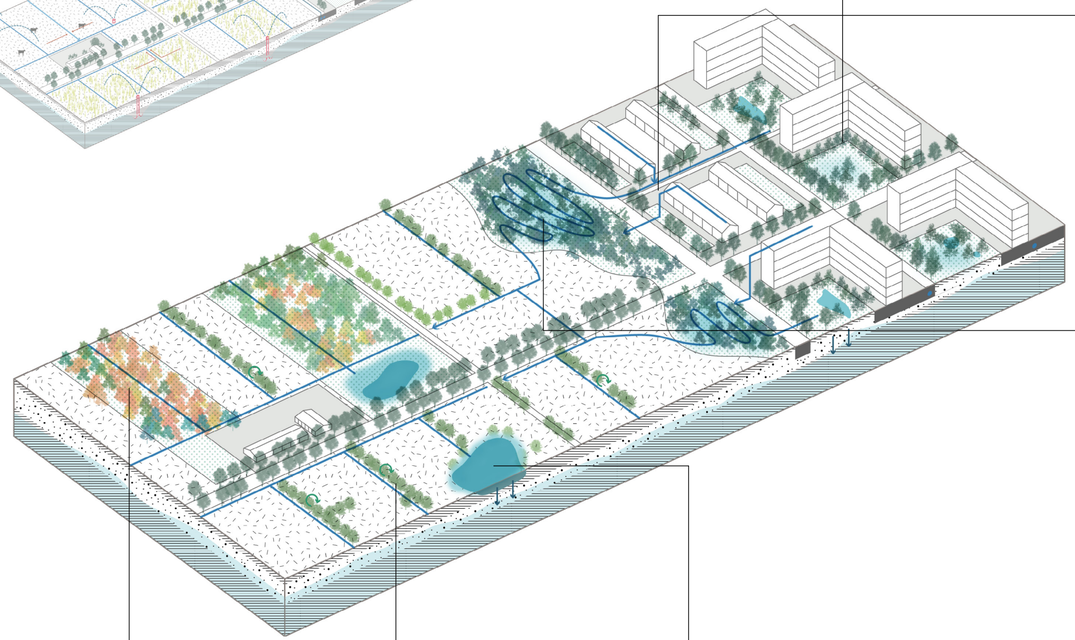
Remove the ditches where possible;
Recovery of heathland and bogs by thinning



Strategies for the Middleground



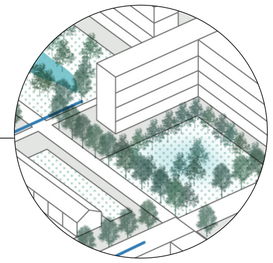




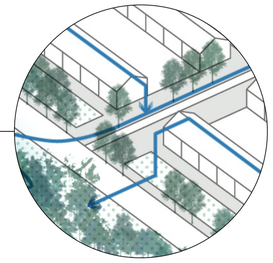
Alternative/precision agriculture to save water

Water storage in arable field

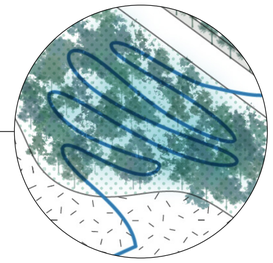
Tree bufferzone along the ditches to purify the drained water and mitigate pollution



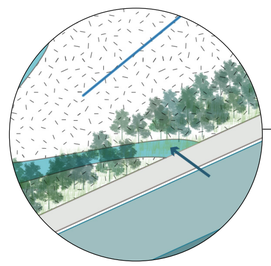
More spaces for water storage and infiltration in the urban area

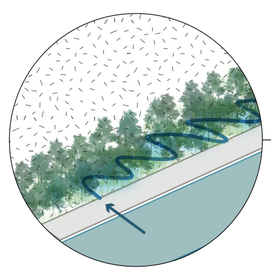


Disconnecting rainwater to sewage system on the urban fringe



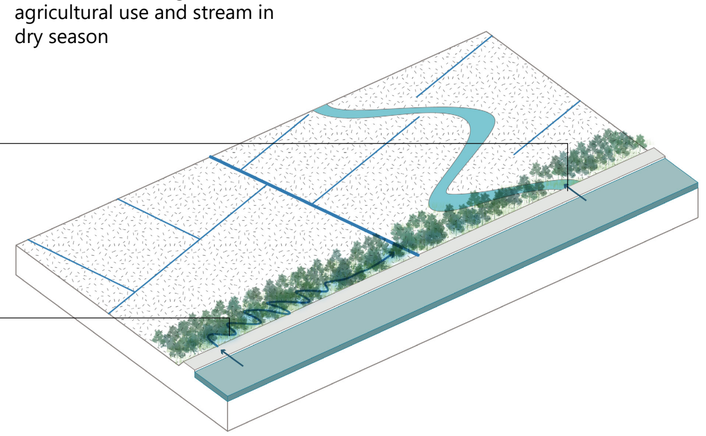
Forest resevoir on the fringe for purification and as alternative resourece



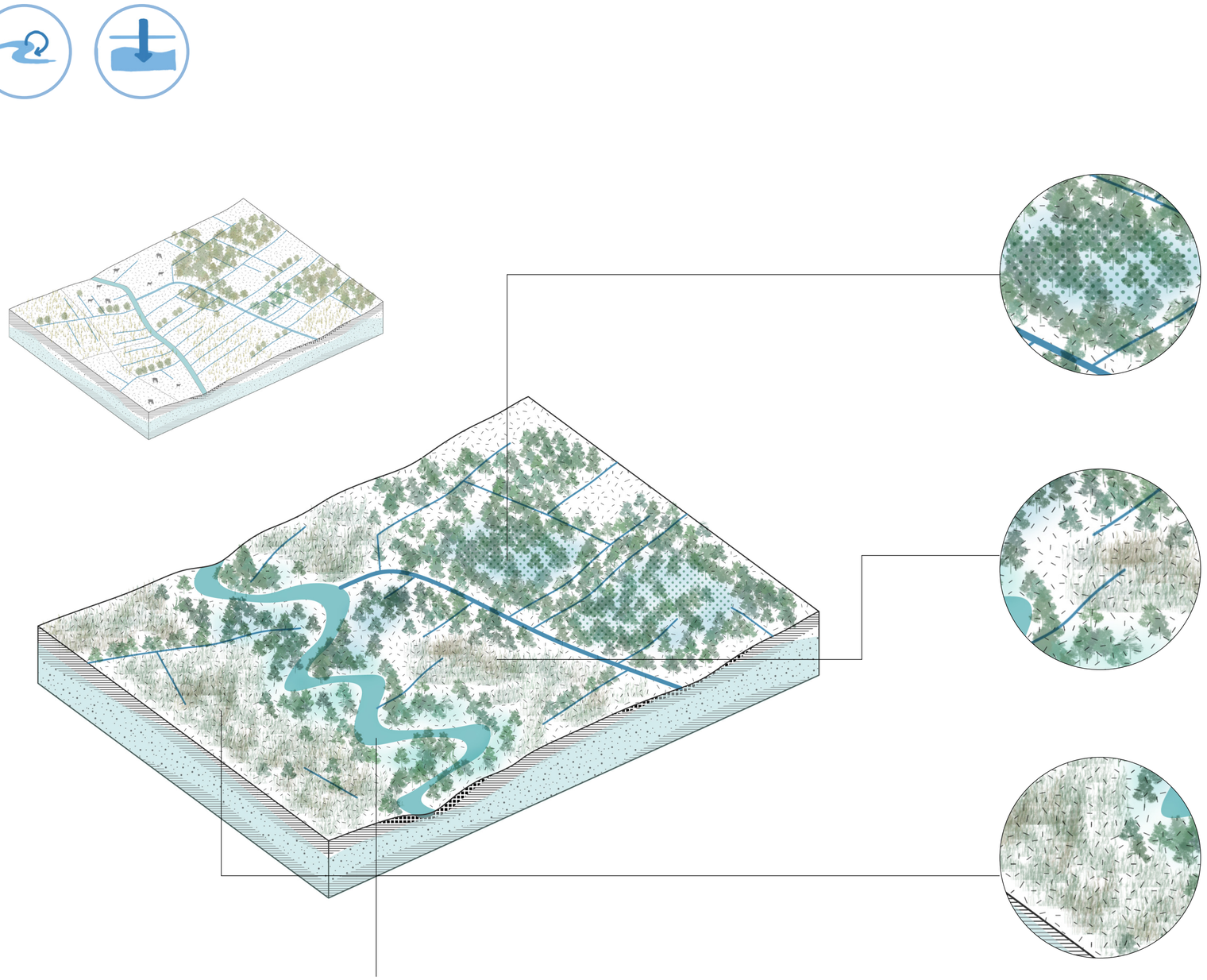


Canal as alternative resource

Canal serve recharge water for agricultural use and stream in dry season

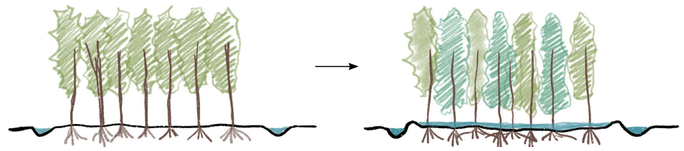


Strategies for the Valley

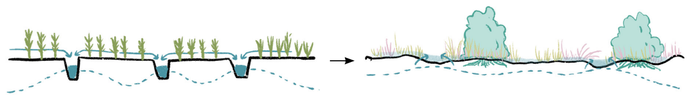


Meandering stream and flooding zone to retain water

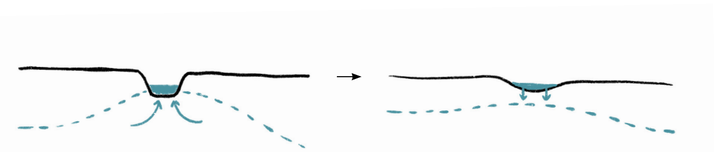
Inundble forest for recovery of seepage



Remove ditches where possible, widen and the ditches and reduced depth of ditches

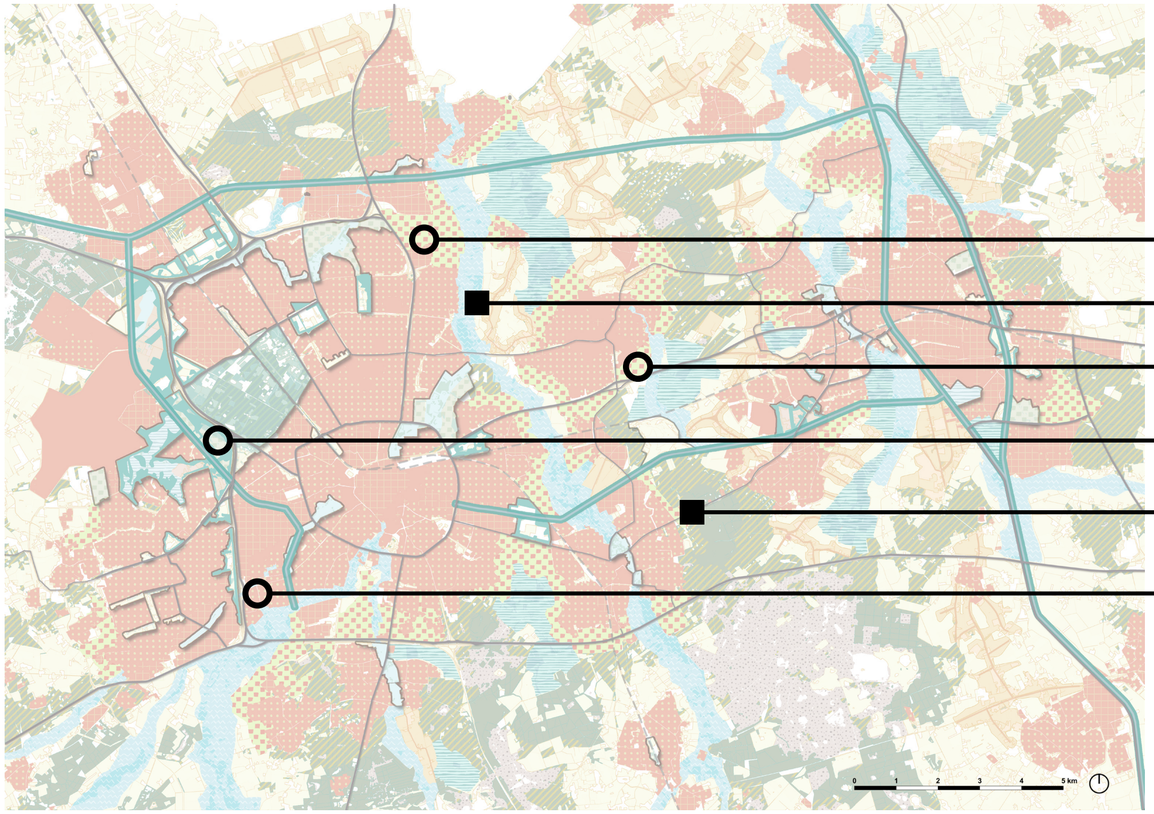


Alternative agriculture
paludiculture along the stream and in broek

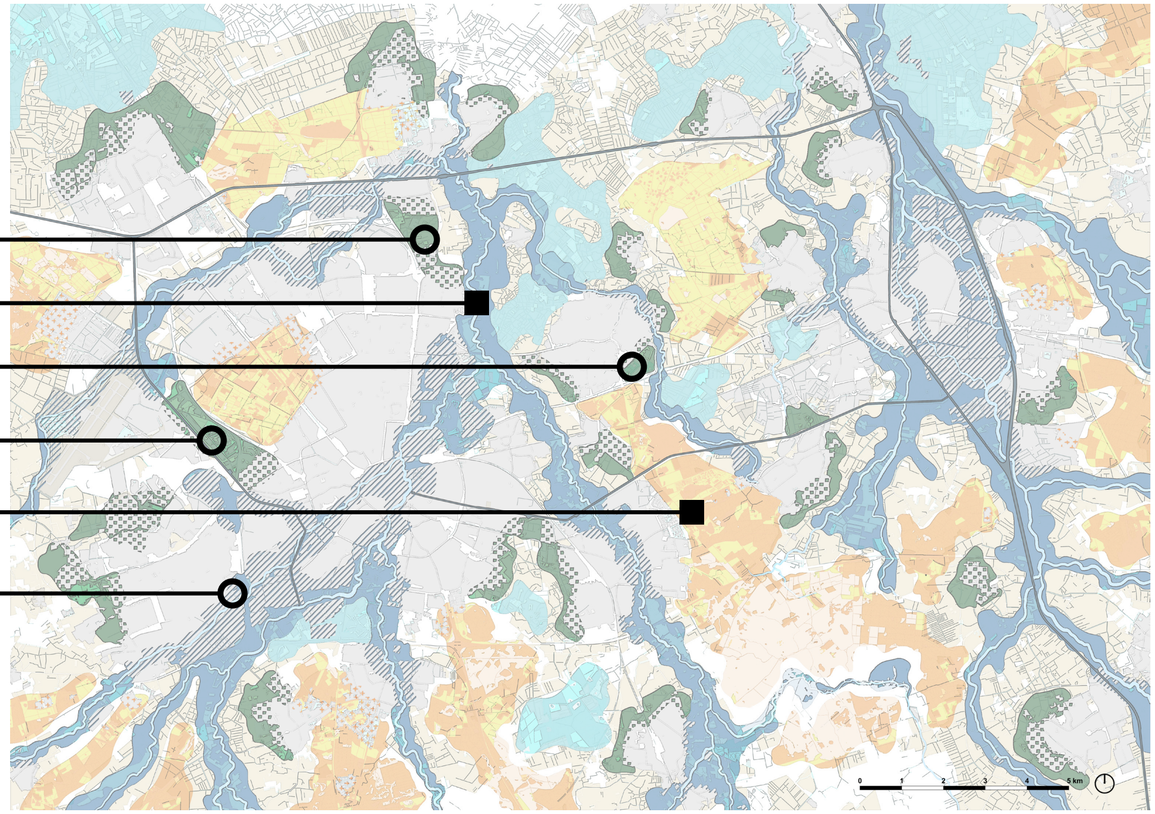


9.3 Synergies and conflicts

Afforestation vision for landscape identity enhancement



Afforestation vision for drought adaptation

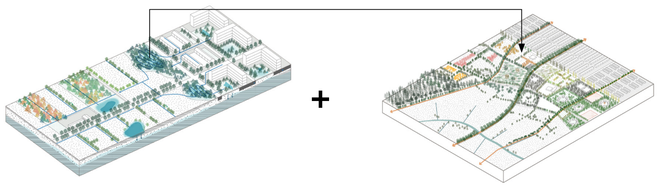


The two visions are synergistic in some places, but conflicting in others. This is also reflected in the design principles and spatial strategies. A few examples of synergy and conflict are shown here and will be the starting point for local scale transformation later.

Example of Synergies

Strategy for the middleground

Strategy for fringe landscape

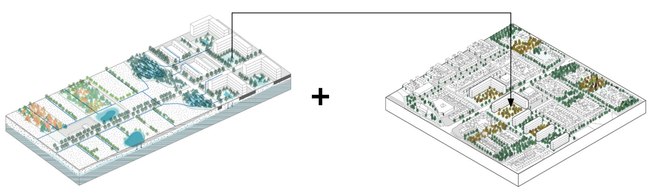


Forest rooms with integrated water storage and water purification functions; a network of recreational spaces with added ecological layers.

1 The reservoir on the interface of urban and rural can be integrate into the forest rooms in the fringe landscape

Strategy for the middleground

Strategies for Urban patches as raster forest

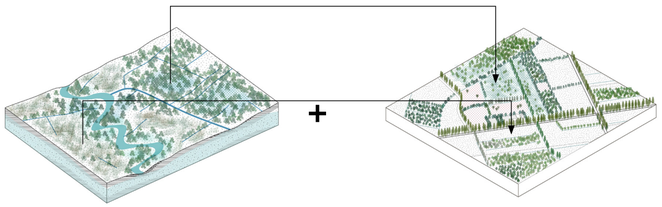


Urban forest spaces integrating water storage and infiltration, more diverse tree groups.

2 More infiltration space in the city could be combined with the creation of the communal spaces in the urban patches

Strategy for the valley

Strategy for the broek landscape

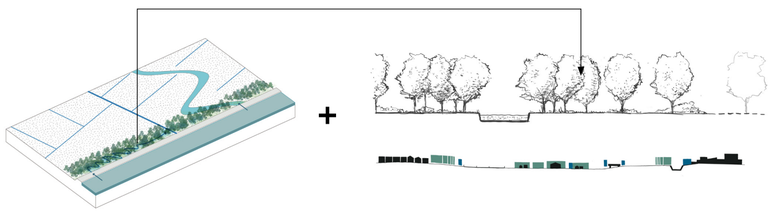


The broek landscape with participatory practices for water level management and alternative agricultural functions.

3 The recovery of seepage and paludiculture zone in the valley of the watersystem can be well integrated in the room structure preserved or created in the broek landscape, which enriches the functionality and the spatial experience.

Strategy for the middleground

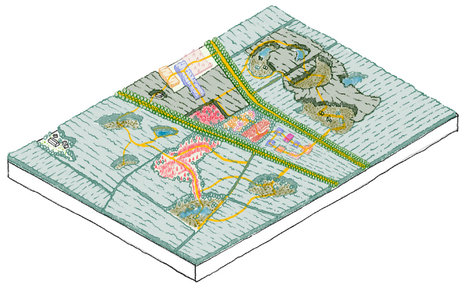
Strategy for the void landscape



The water purification function opens up more possibilities for spatial experiences in the boulevards and transitional woodlands along the canals.

4 The water purification and supplyment from the canal in the dry season, could be combined with the spatial proposal of infrastructure corridor in the Void landscape

Example of Conflicts



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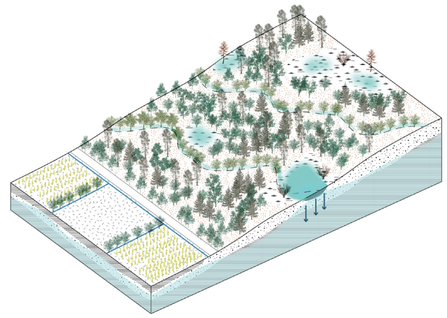
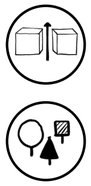
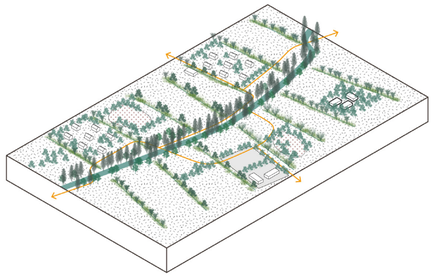


1 The strategy of landscape identity enhancement in the reclaimed forest create diverse spaces in the existing coniferous woodland, and recreation activities could be enriched by these communal spaces and the new boulevard, which make it a vital area with many visitors





However, in the drought adaptation strategy, the reclaimed forest area need to focus on recover more heathland and swamps, and limit visiting for a undisturbed infiltration process and for the better water quality.



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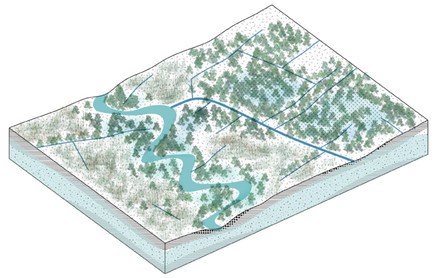
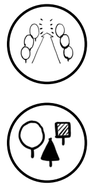
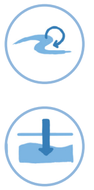


2 The strategy of landscape identity enhancement in the stream valley require the spatial structure of ditch ribbons, and the stream itself become an appealing element or the landmark to attract people's visiting through the new experience route. The functions such as housing, playground, allotment garden and other recreational spaces are settled in along the stream



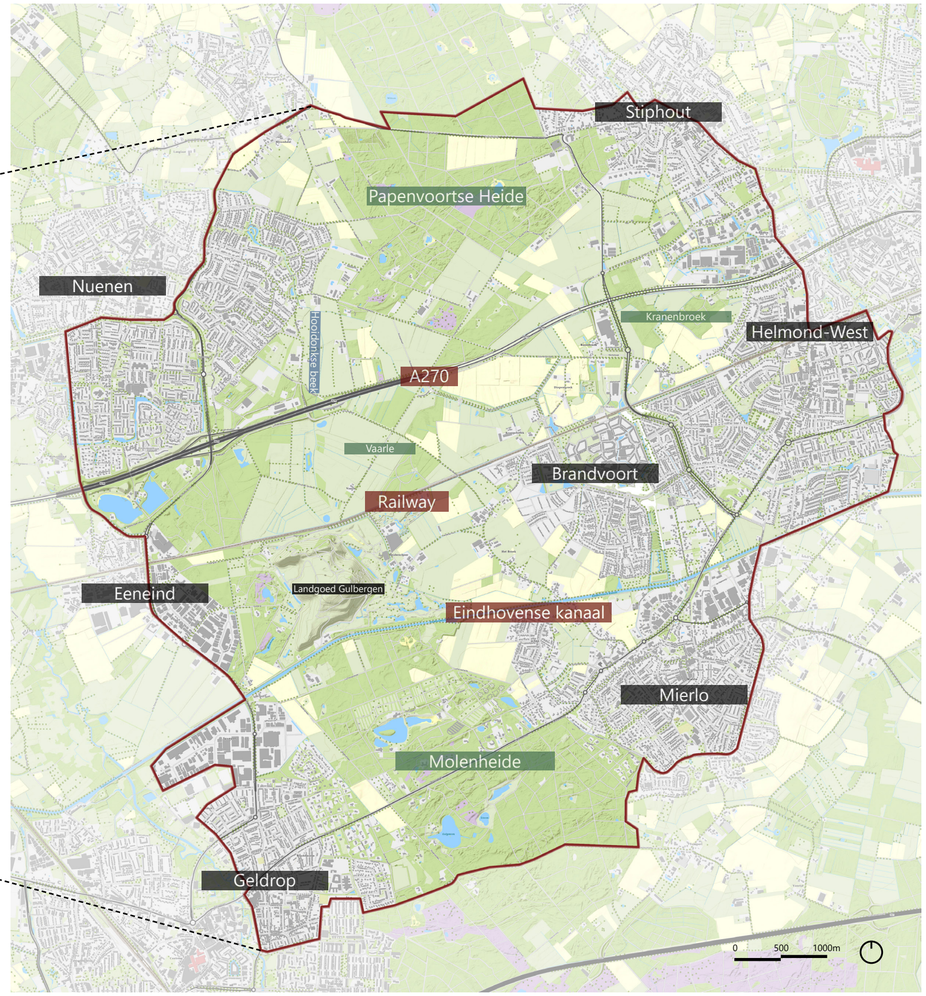


However, in the drought adaptation strategy, the stream need much more spaces for flowing and meandering. thus require less ditches, which hide its structure as a cultural landscape; and a more natural bank and flooding zone have conflicts with the function arrangement in the plots.

10 PROJECTING TO THE LOCAL DESIGN TRANSFORMATION

10.1 The choice of the case area





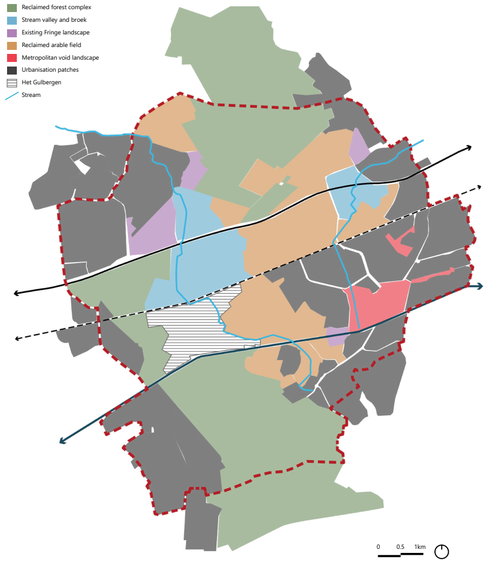
The case area is located in the heart of the region, surrounded by the urban fringes of Nuenen, Geldrop, Stiphout, the western wing of Helmond and Mierlo. It is a highly dynamic and highly diverse area, harbouring contrasts and conflicts as well as opportunities for landscape integration.

The crossing of the A270, railways and canals gives its central part a great deal of traffic, and Landgoed Gulbergen is a popular destination for sightseeing and recreation throughout the region. Easy accessibility and its location in the middle of several municipalities has led to a large housing task, with the expansion of VINEX neighbourhoods such as Brandvoort in the west wing of Helmond continuing.

In contrast to the high dynamics of the centre, its northern and southern flanks, the dry forests of Papenvoortseheide and Molenheide, respectively, require the establishment of solid climatic resilience and ecological connectivity, which is also required for the wetter, infrastructure-cut and fragmented landscape in the middle part of the site, especially the stream valleys and the broek landscapes that are dependent on the Hooidonksebeek. broek landscapes. Although the long process of urbanisation and fragmentation has made this area less of a traditional area of intensive agriculture, as the core of several historic municipalities, there are still many characterful reclaimed fields facing transformation or change of use, and the conservation and development of their landscape character is a matter of urgency.

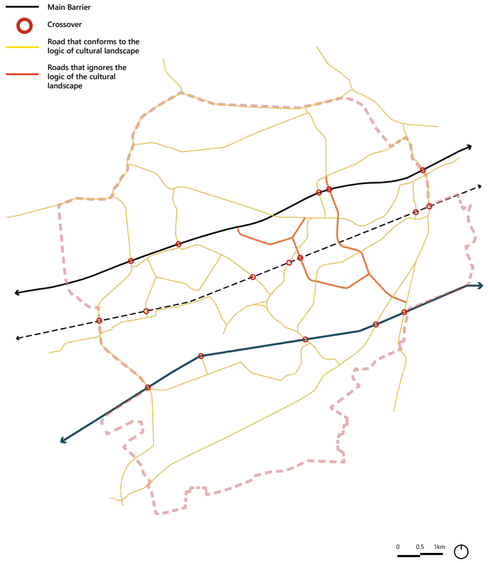
10.2 The context of the case area

Metropolitan landscape type



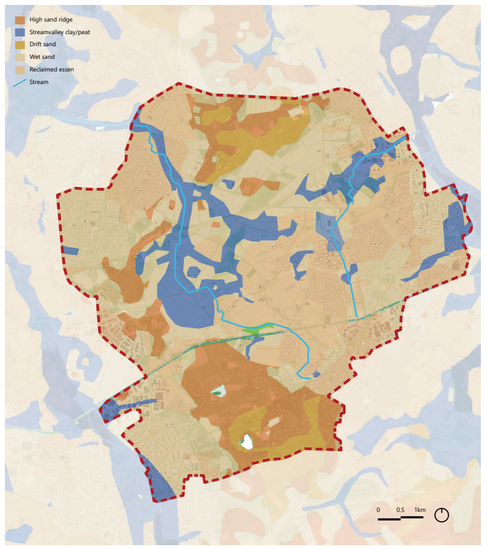
As a highly diverse area, it has all of the metropolitan landscape composition types, and this juxtaposition is even more pronounced at the edges of the city. The focus is on reinforcing each type of landscape identity and creating spatial and functional transitions.

Route analysis



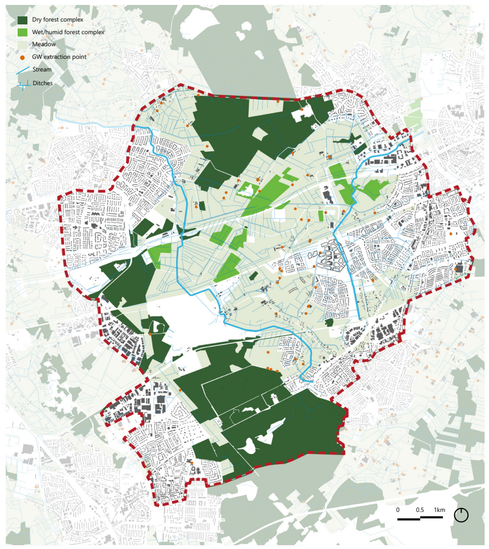
The area has a relatively complete local transport network, with regional transport infrastructure acting as a backbone for mobility. Many of the historic roads demonstrate the logic of the landscape and still exist and serve as the main local roads, but motorways and railways act as barriers interrupting the spatial and historical continuity, exacerbated by the raw thoroughfares (avenues) of the new expansion plans.

Geomorphology



The geomorphological map reveals the underlying logic of the landscape type, with dry sand ridges and wet stream valleys (Hooidonksebeek) running parallel in a north-south direction, creating a strong contrast. On the eastern side, urban expansion has taken over much of the formerly reclaimed agricultural land (essen).

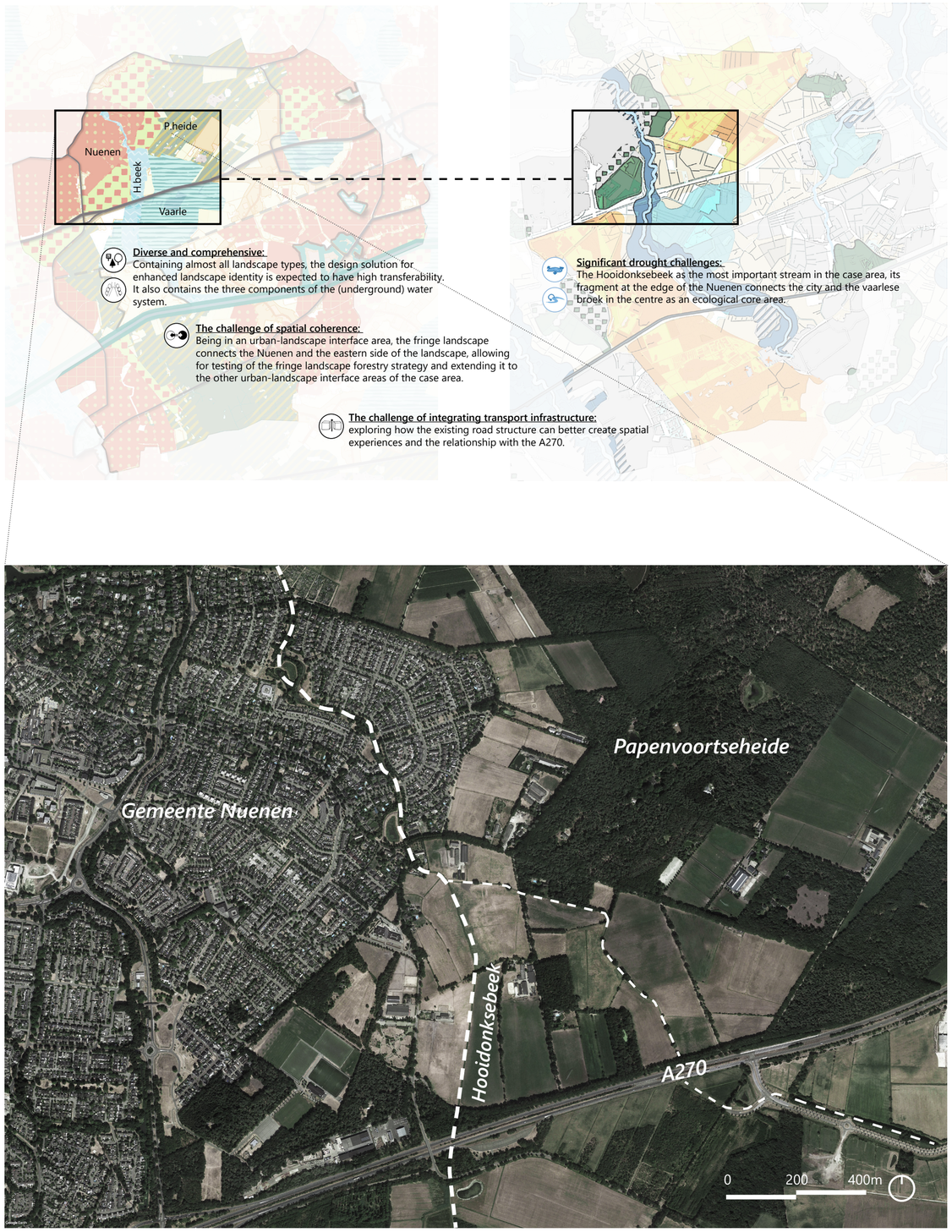
Hydrological analysis



The north-south orientated sand ridges and stream valleys shown in the geomorphological maps are represented as fractured forests, especially in the middle section, where the originally coherent wet landscape has been interrupted by agricultural land and gulbergen, and where vegetation is missing and needs to be protected and restored. The formerly reclaimed landscape corresponding to the urban fringe and intensive agricultural land needs to contain the effects of drought and act as a middleground to form a healthy water cycle with the stream valleys and sand ridges. A coherent hydrological/ecological core needs to be established to recreate the north-south connection.

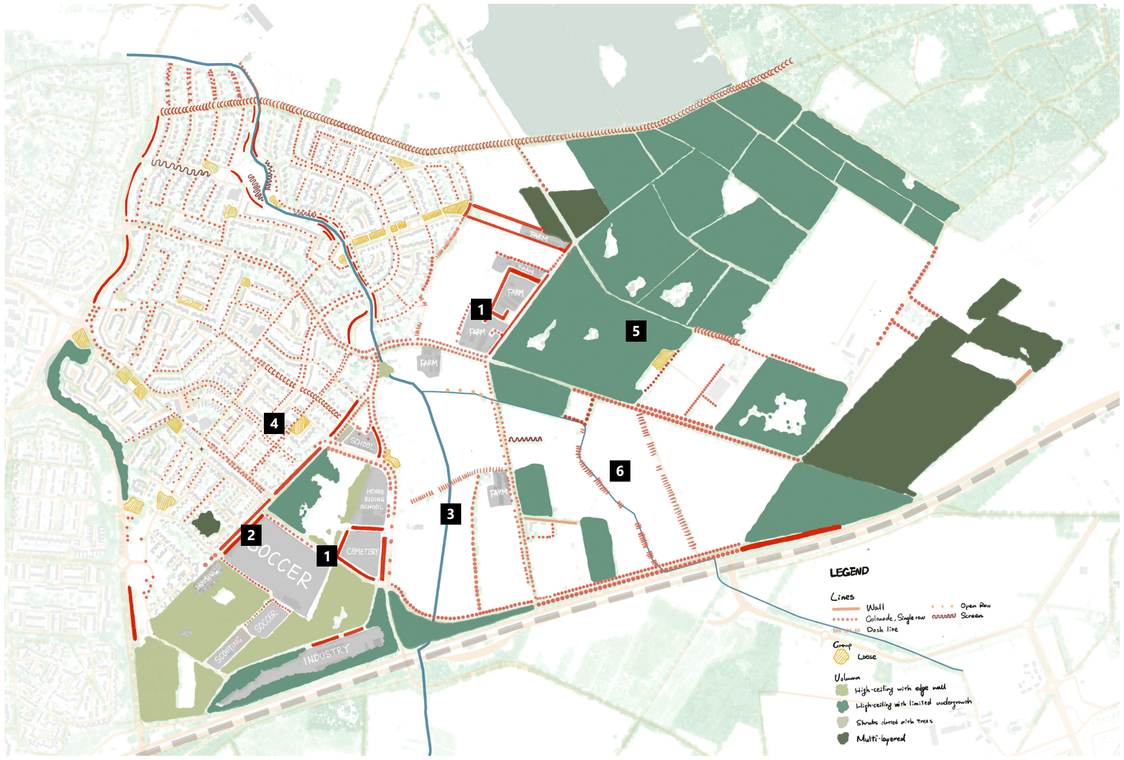
10.3 Local design explorations on <u>the fringe of Nuenen</u>

Regional vision projecting: Why Nuenen's fringe?



10.3.1 Design analysis

Spatial analysis based on tree syntax



0 200 400m

LEGEND

Lines

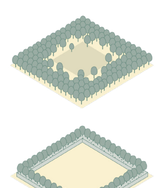
- Tree wall
- Colonnade
- Open row
- Dash line
- Screen/curtain
- Arcade

Groups

Frames

- Multilayered volumn
- High-ceiling with limited
- High-ceiling with edge wall
- Shrubscape with scattered trees





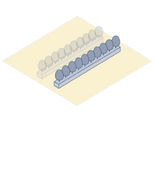
1 Fringe tree 'rooms' with various function





4 Nuenen-Oost as raster forest





2 Tree wall as barrier on the fringe



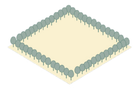
5 Papenvoortse Heide as monogenous high dense forest





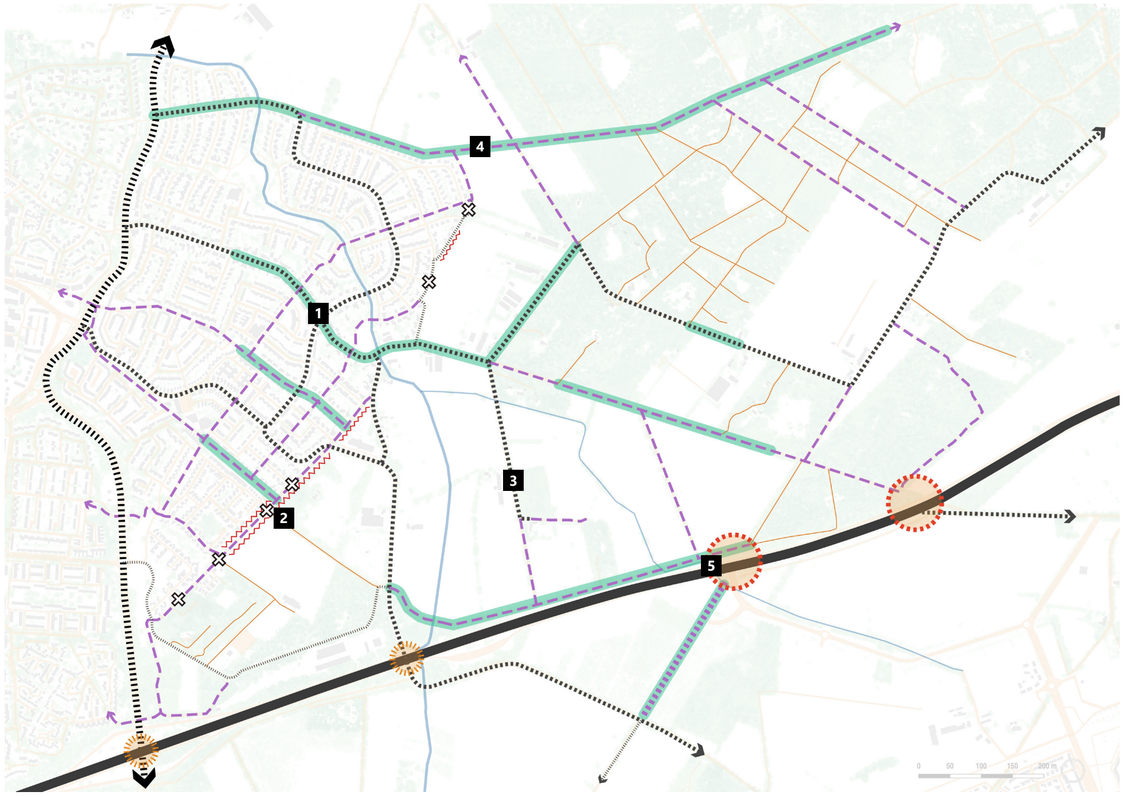
3 Consolidated land and hidden Hooidonkse beek





6 Normalised former broek rooms as farmland

Route analysis



LEGEND

- A270
- Main traffic lane (car)
- Secondary traffic lanes (car)
- Cycle path (including walking)
- Internal walkways
- Route with high spatial quality
- Disappeared historic route
- Main barriers along the road
- Lost/historical connections
- Connection across barriers
- Barricaded junctions/missing connections



1 The boulevard (Beekstraat) from the city intersects the stream and leads to the broek after passing through the rooms of the fringe landscape.



2 The path to the forest room at the edge is blocked.



3 In the forest and in the broek, some important historical roads (Prinsenweier) with the function of carrying recreation are unpaved or too narrow.

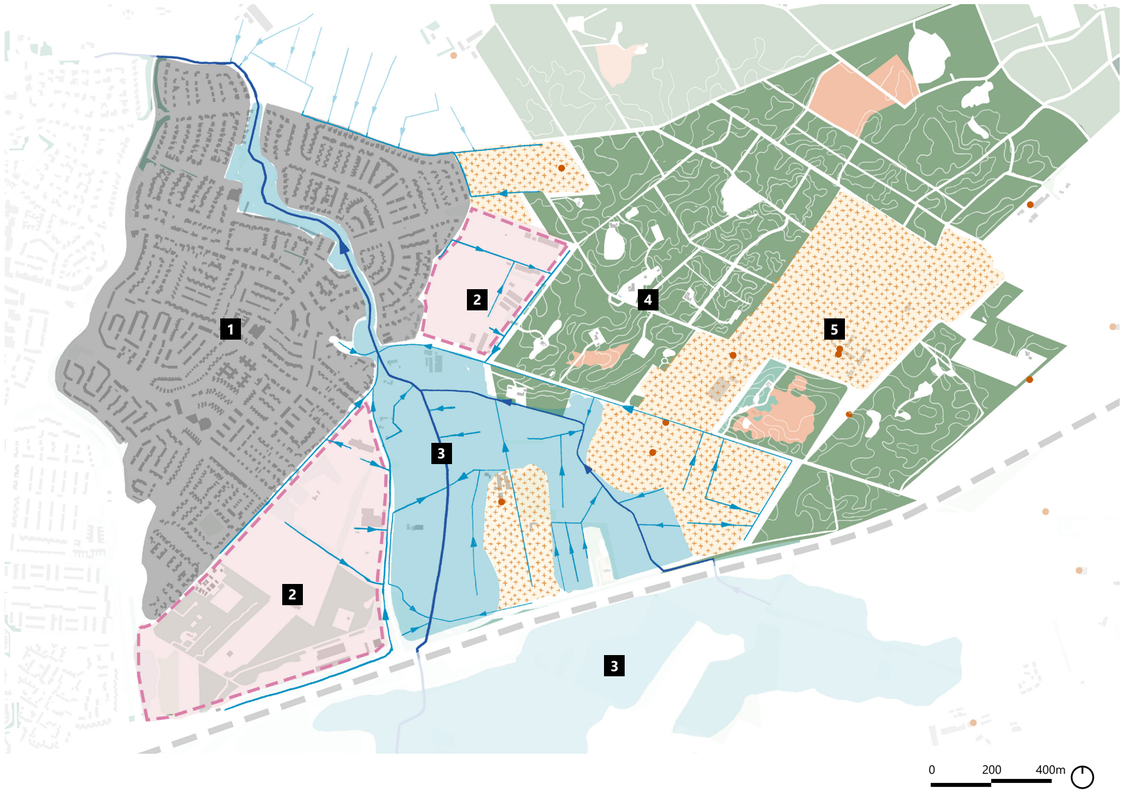


4 The high-quality boulevard (Papenvootsedijk) to the north leads into the dense forests.



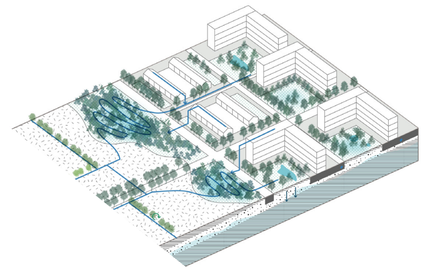
5 The link road (Ricksedreef), which used to fulfil the logic of the cultural landscape, has been interrupted by the A270.

Water system analysis



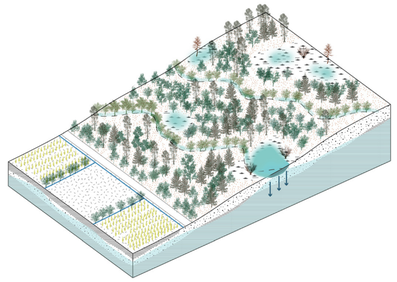
LEGEND

- Stream course
- Main ditches
- Groundwater Extraction
- Middleground - urbanization area
- Middleground - urban fringe
- The valley
- Middleground - Agriculture
- The ridge - Dry forest
- The ridge - Heathland

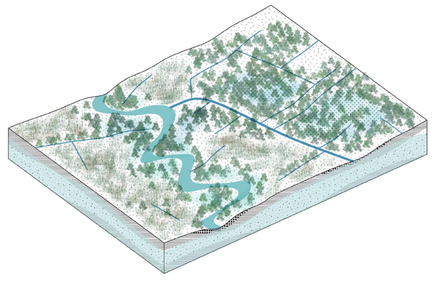


1 **Nuenen-East (Middleground)**
Drainage to urban sewage system

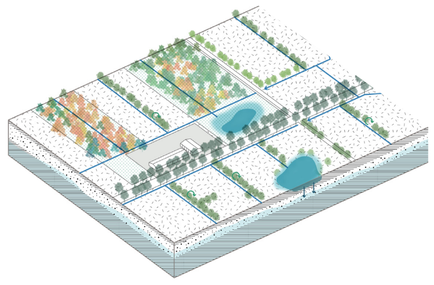
2 **East Fringe (Middleground)**
Opportunity of forest resevoir



4 **Papenvoortse Heide (Ridge)**
Catch the runoff
Strengthen infiltration

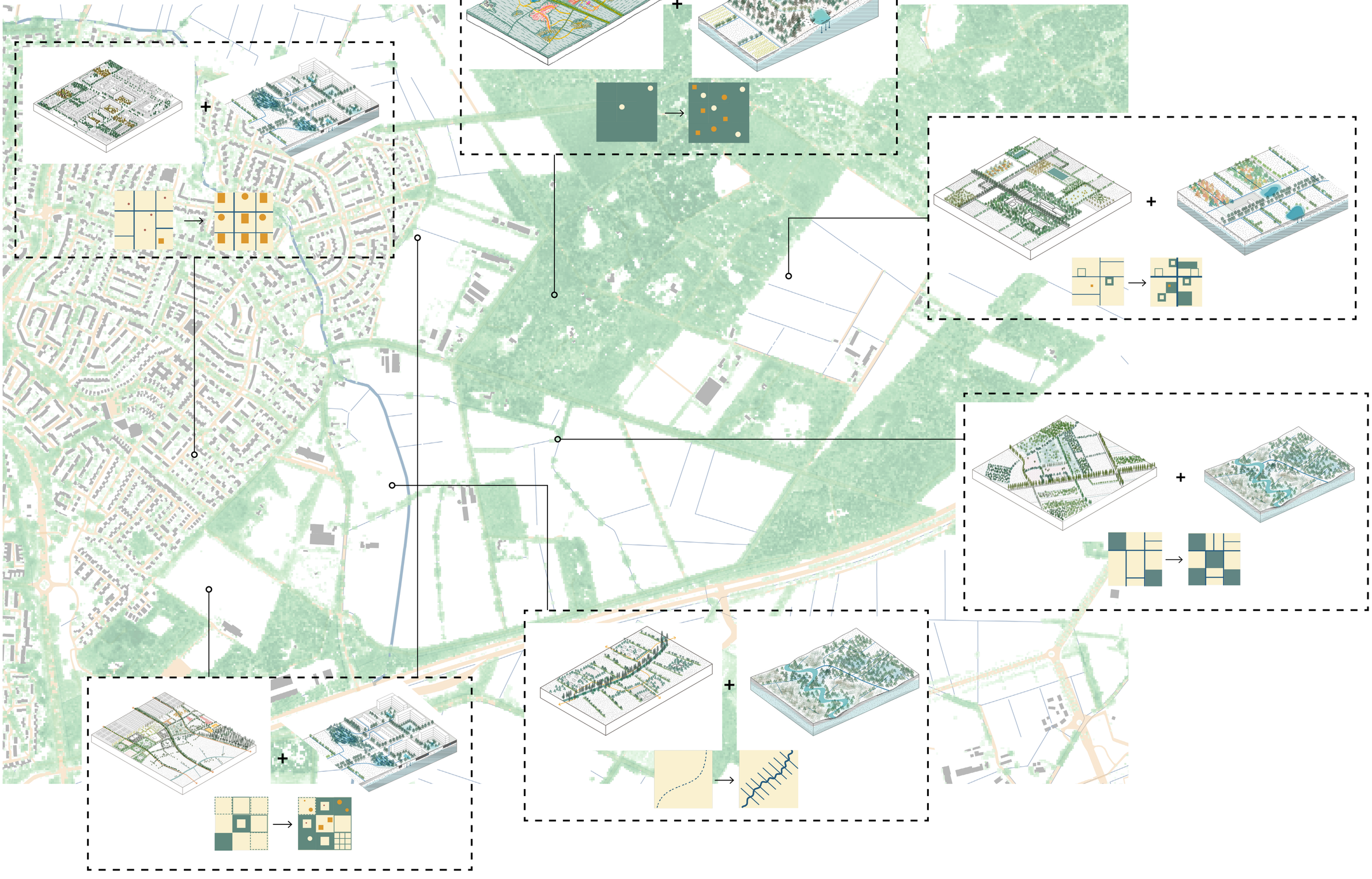


3 **Hooidonkse beek (Valley)**
Stream buffer forest
Strengthen seepage



5 **Farms and meadows (Middleground)**
Reduce extraction
Alternative resource

Integrated application of strategies and transformation of forest patterns



10.3.2 Design proposal



Masterplan 1:3000 (in ±35 years)

Stemp forest in urban patch

Collectively managed forest in residential area as communal space and rainwater storage

Stream valley

A legible and meandering stream zone and new scheme of forest-living

Broek landscape

Seasonal Inundable dense forest with water level management

Broek landscape

Vacation house in the broek as recreational destination

Colissen agriculture landscape

Wooded bank and hedge walls in the arable field

Fringe landscape

Allotment garden, food-forest and firework site in the tree rooms

Fringe landscape

Carr forest as resevoir for rainwater storage and purification

Fringe landscape

Prepared dense forest rooms for industry and new workplace

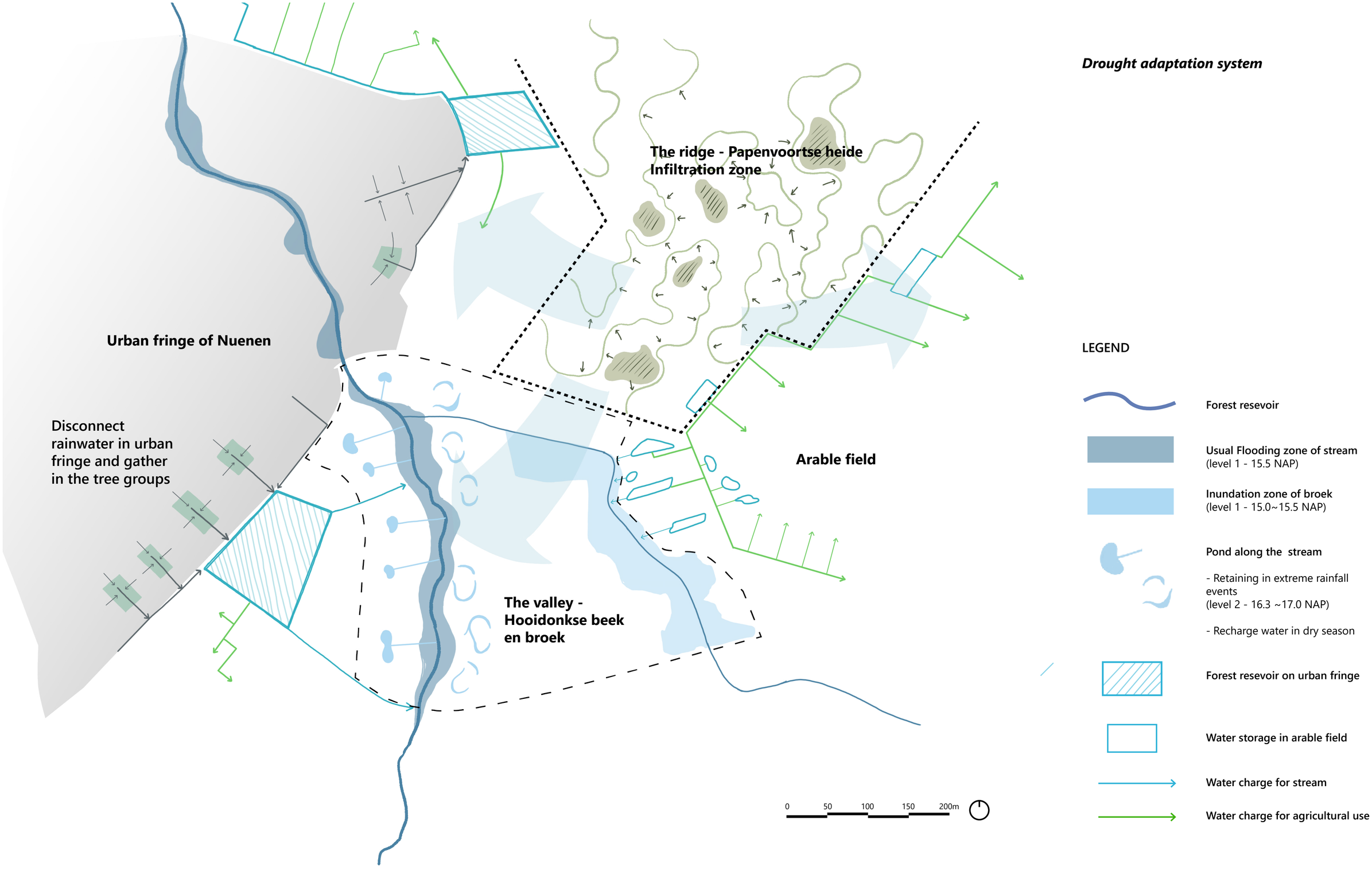
Reclaimed forest complex

Recovery of heathland and fen in coniferous forest, with wooded banks and woodwalk

Reclaimed forest complex

Agro-forest lab and camping site in the coniferous forest

1 *Forest resevoir Manege*
2 *RKSV sportspark living Nuenen*
3 *Forest campus Nuenen-East*
4 *General public cemetery*
5 *Beekwoonkamer Hooidonk*
6 *Hooidonksepark*
7 *Beekfortwoning Hooidonk*
8 *Visitor center Prinscheweide*
9 *Vacation houses*
10 *Nature education center Papenvoortseheide*
11 *Agroforest lab Papenvoortseheide*
12 *Camping center Papenvoortseheide*
13 *Forest resevoir*
14 *Urban farming center*



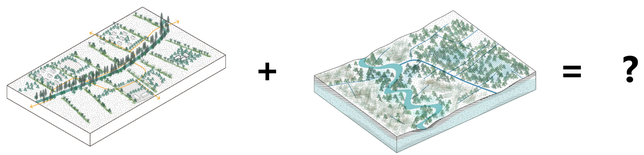
Drought adaptation system

LEGEND

- Forest resevoir
- Usual Flooding zone of stream (level 1 - 15.5 NAP)
- Inundation zone of broek (level 1 - 15.0~15.5 NAP)
- Pond along the stream
  - Retaining in extreme rainfall events (level 2 - 16.3 ~17.0 NAP)
  - Recharge water in dry season
- Forest resevoir on urban fringe
- Water storage in arable field
- Water charge for stream
- Water charge for agricultural use

10.3.3 Zoom-in design transformation: *Stream valley of Hooidonksebeek*

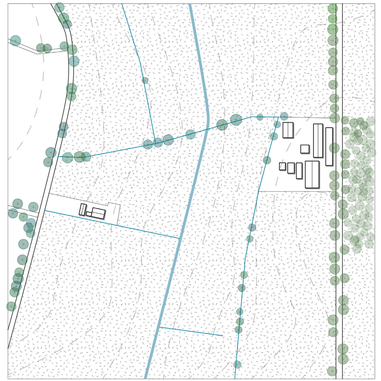




147

0 50 100m

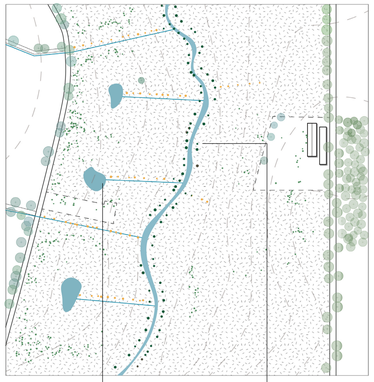
Phase 1: Improve water retention ability, recovery of meanering stream



Remove ditches



Phase 2: Establish forest framework and retention system, housing project starts

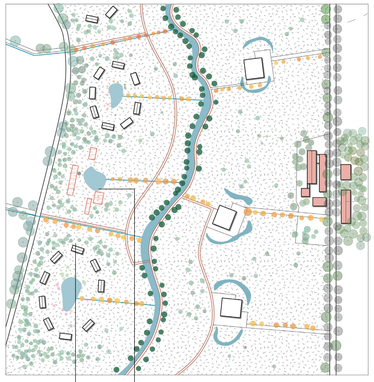


Create water retention areas, restore seepage

Pioneer stand plant in



Phase 3: Cultivation and maintanence of new stream forest, develop recreational functions and routes



5/year
Pioneer stand maturity

ongoing
Collective water yard and paludiculture food garden

1/5year
1/year



Phase 4: For ongoing participatory management and maintenance of the forest as an attractive recreational and residential area.



1/10year
Stream poplar tree and ditch hedge

1/10year
Trees in riparian zone



Water Board

The boulevard (Beekstraat) from the city intersects the stream and leads to the broek after passing through the rooms of the fringe landscape.

Province

Farmers

In the framework of the ***ruimte voor ruimte*** policy, agricultural land is converted by converting farmers' property rights into the right to build a new house on the corresponding site. Farmers can also continue more sustainable agribusiness activities in the agroforest areas of the new kampen landscape.

ruimte voor ruimte

Staatsbosbeheer

The Forestry Department will lead the establishment of the forest framework, including the cultivation of forests and riparian forests at housing sites.

Water Board

Waterschap leads the construction of the retention system.

Municipality

The Municipality of Nuenen is involved in the development of a new housing agenda.

Farmers

Staatsbosbeheer

Volunteers

SBB and volunteer organisations with specialist knowledge will continue to provide maintenance for the high ecological value forests in the stream valleys

Municipality

The Municipality of Nuenen is involved in the development of a new housing agenda.

Residents

In the newly created housing areas, the new residents will take the lead in the management and maintenance of the forest rooms and collective woodland.

Residents

Tourists

0-3 years

5-10 years

15 years

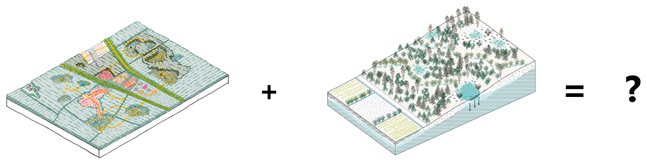
25 years

148

149

10.3.4 Zoom-in design transformation: *Reclaimed forest complex of Papenvoortseheide*





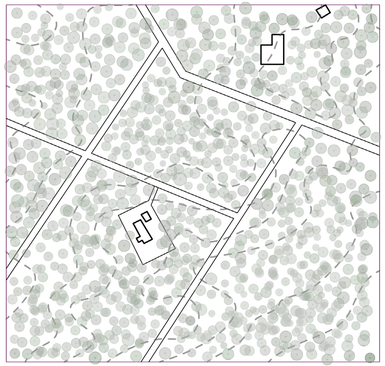
+ = ?

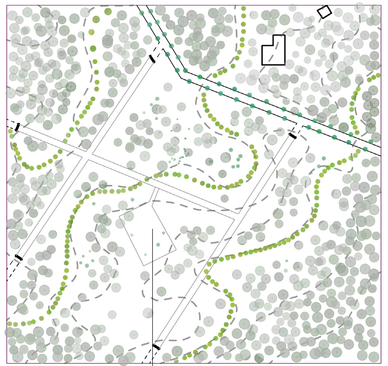
Current situation: Monotenous coniferous forest

Phase 1: Thinning of exisiting coniferous forest, establish wooded banks, remove of some property

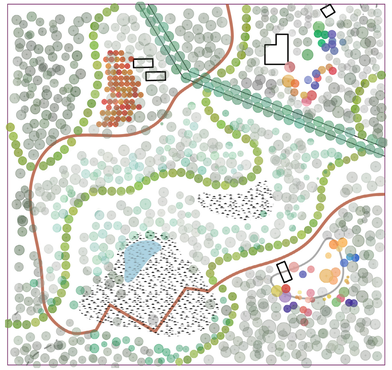
Phase 2: Species altering, new communal forest places established, recovery of heathland and bogs

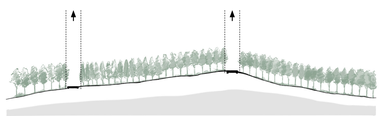
Phase 3: Ongoing participatory management of collective food-forest and camping site, new wood walkway for experience.

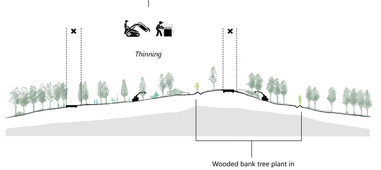


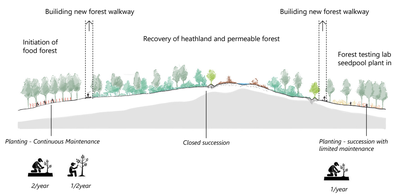


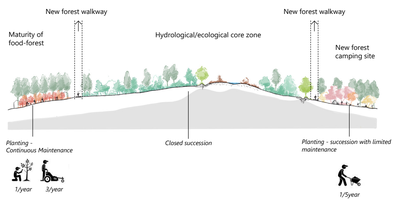












Staatsbosbeheer

Interventions such as thinning on existing forests are led by SBB

Municipality

Complementary measures such as road closures require municipal intervention

Municipality

SBB and volunteer organisations with specialist knowledge will continue to provide maintenance for the high ecological value forests in the stream valleys

Residents

Volunteers

Creation of new food-forest and recreational woodland open spaces led by local residents and volunteer organisations.

Staatsbosbeheer

SBB continuously monitors the restoration of the ecological/hydrological core area.

Residents

Volunteers

0 year

5-10 years

15 years

30 years

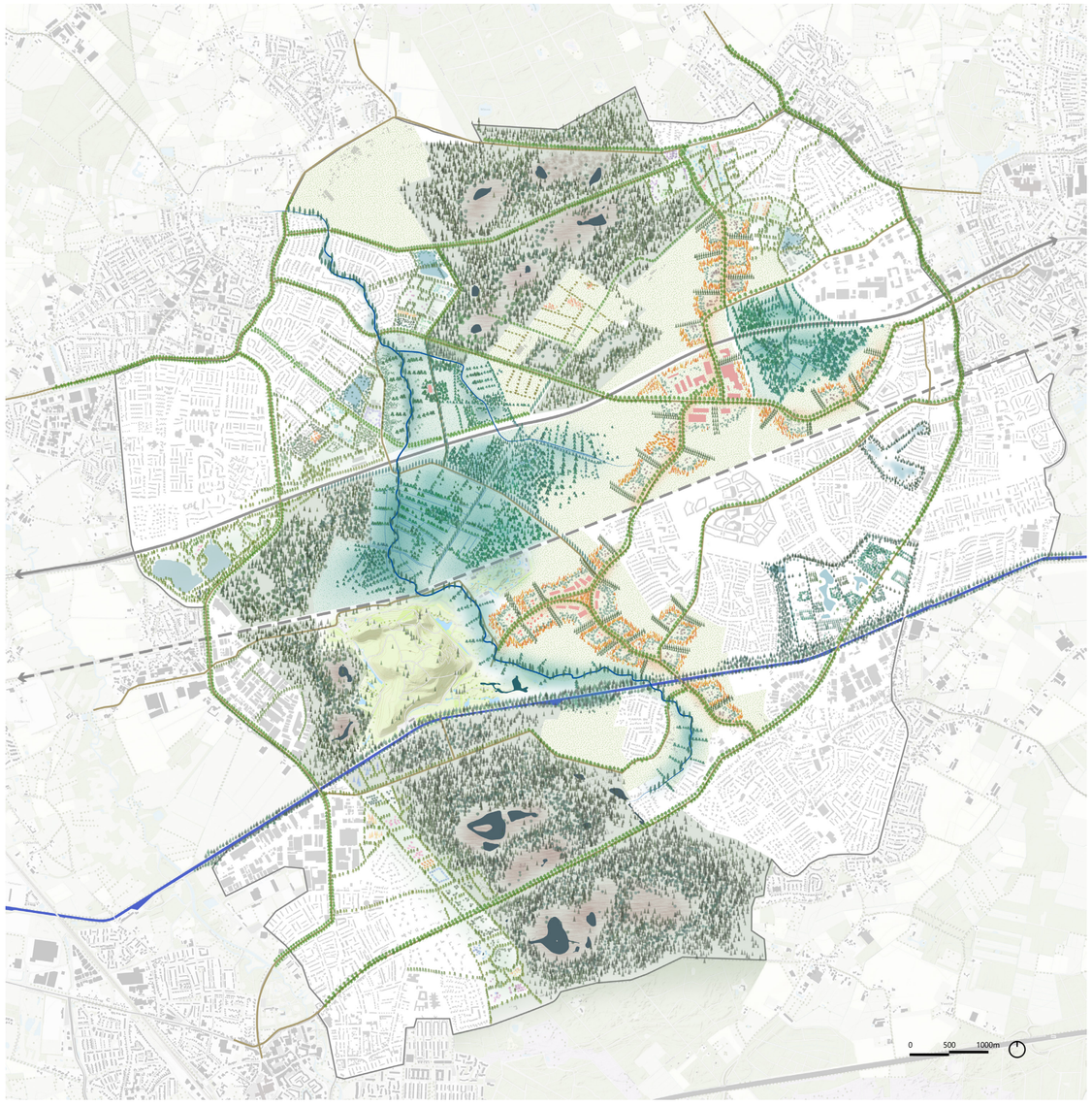
Residents of Nuenen
Volunteer organisations

Residents of Nuenen
Volunteer organisations

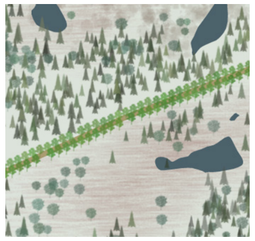
Residents of Nuenen
Volunteer organisations
Tourists

10.4 The overall spatial vision of the case area

Strategic plan 1:50000

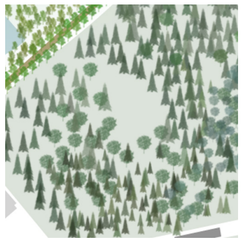


LEGEND



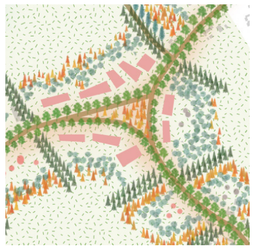
Reclaimed forest

Hydrological/ecological core zone



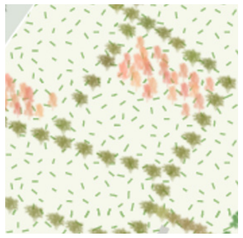
Reclaimed forest

Recreation/participation zone



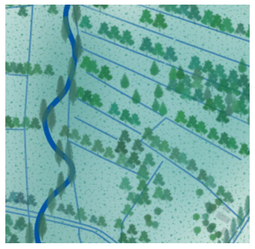
Arable field - New kampen forest

Housing
Agro/food-forest
New workplace
Water storage



Arable field - Coulissen forest

Alternative agriculture
Hedgerow landscape restoration
Water storage



Stream-broek forest

Hydrological/ecological zore zone

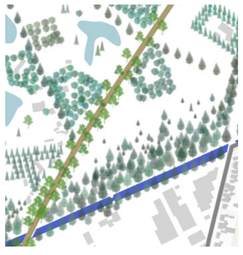


Stream-broek forest

Recreation/participation zone
Housing

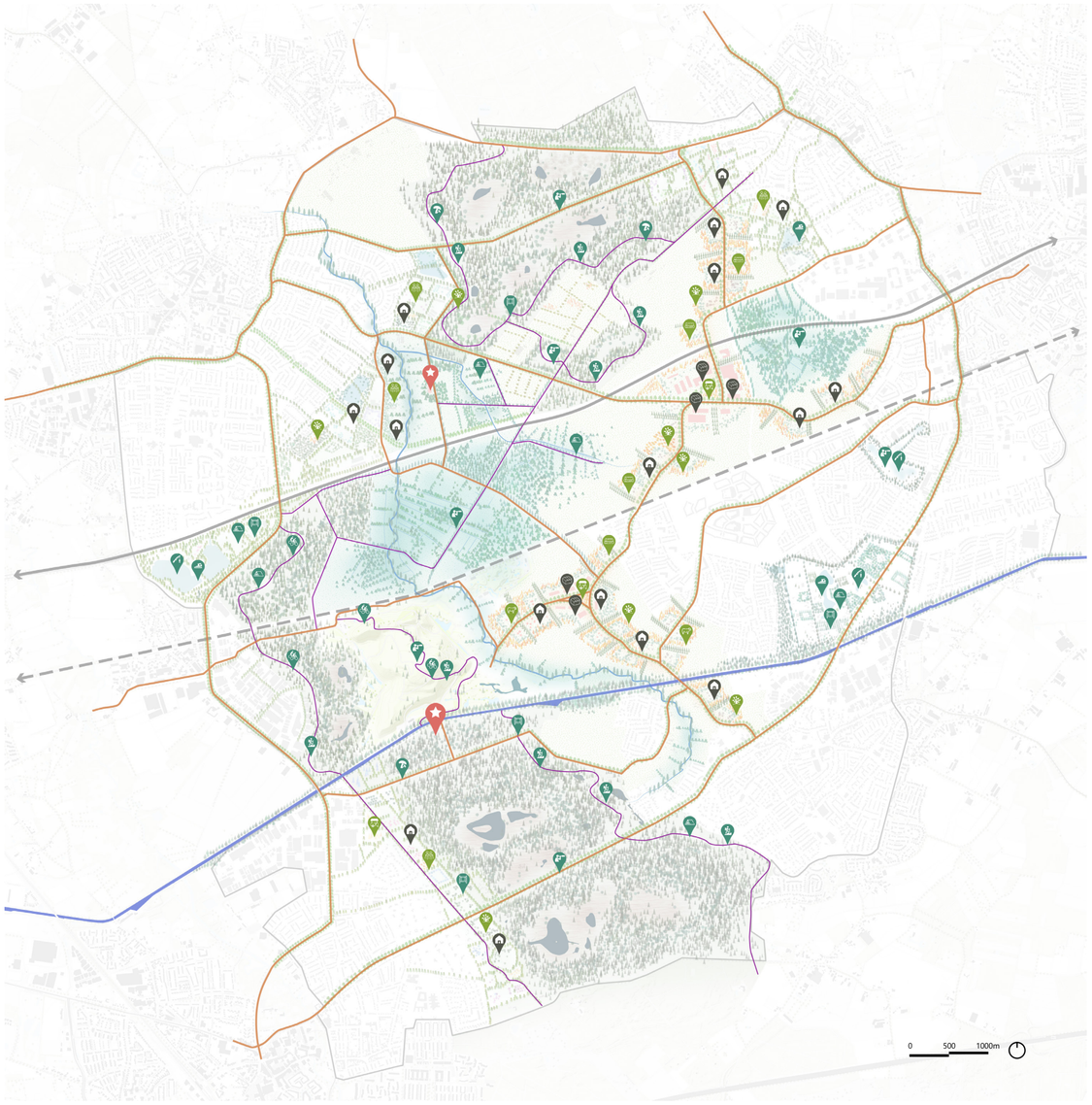


Fringe landscape - forest rooms



Forest theatre and canal forest

Structure of programmes 1:50000



Main roads

Major Recreational Paths/Bikeways

New visitor center

Production and co-management in forest

Timber forest

Food forest

Allotment garden

Livestocking forest

Outdoor food market

Recreation in forest

Bird watching

Camping

Organic fishing

Hiking

Cycling

Mushroom picking

Forest playground

Swimming

Observation point

Living in forest

New collective housing

New workplace

Structure of programmes 1:50000





Static - Dry natural core zone

Ecological / water functions prioritised, government institutions leading



Static - Wet natural core zone
Ecological / water functions prioritised, government institutions leading



Active forest belt on arable field/kampen landscape



Dynamic - Active fringe or edge



Forest theatre - regional forest hub

SECTION 5
CONCLUSION

11 Conclusion

This chapter will answer the (sub)research questions posed in chapter4. the main research question answered through this thesis is:

How can Forest based strategy strengthen drought adaptation and enhance landscape identity within SGE?

This main research question is actually twofold. Firstly, the study aims to explore what forest based (spatial) strategies and the research and design methods they represent are like; secondly, the study aims to explore how these strategies can strengthen landscape identity and drought adaptation within SGE.

With regard to the first aspect, the study seeks to understand how forests and trees have been transformed from a traditional perspective of a land type or 'natural capital' into objects and methods of landscape design. This relates to the ecosystem services provided by forests and trees in the two topics of concern. On the topic of drought adaptation, 'forest-based' refers to linking drought-related hydrological challenges to the regulating services that trees can provide, and seeking to use trees and forests as additional assets in conventional hydrological strategies. On the topic of landscape identity, 'forest-based' refers to the fact that while there are many spatial intervention strategies that could theoretically improve landscape identity from a landscape architecture perspective, this study seeks to focus on the relationship between trees - a specific landscape element - and a spatial, tree-based design approach - called tree language - as the basis for interpretation and intervention in the landscape. The idea behind it is to view the metropolitan landscape of SGE from the perspective of the forest, or to rethink the territory as a forest.

Regarding the second aspect, the study clarifies and legitimises landscape identity and drought adaptation as two parallel issues, responding to the challenges associated with them through the spatial, cultural, social and environmental dimensions of forests and trees and developing typological forestry strategies (design toolbox) and design principles, respectively. The challenges and opportunities analysed were translated into design objectives at three scales. At the regional scale, these forestry strategies were used where appropriate and each resulted in a vision that enhances overall diversity, narrative, and promotes a healthy regional groundwater system.

Several key sites at the local scale explored how these strategies were spatially integrated to respond to conflicts or achieve synergies in the visions, and were transformed in stages over the time process. The exploration at this scale reflects on the design principles obtained earlier and results in a coherent (blue-green) spatial structure, experiential network and hydrological function at an intermediate scale, reflecting the forest-based intertwining of city and landscape in the metropolis. To this point, forests and trees can respond to the various challenges obtained in these literature reviews and analyses from various spatial, cultural, social and environmental perspectives.

Next paragraphs provide more elaborate insight in the research findings by answering of the sub research questions

SRQ1:
What theories and concepts respond to SGE's context, concretise its problems and provide a basis for further analysis?

The question is posed based on the historical development and problematic description of the site in CHAPTER 2 and 3, and answered primarily by the literature review in CHAPTER 5. In response to the lack of landscape identity in SGE, the study firstly situates SGE within the theoretical context of dispersed territory (5.1), with studies on patchwork metropolis (Neutelings, 1989; Pisano, 2013) and landscape form of metropolis (De Wit & Van der Velde, 2009) are seen as very illuminating and summarise some of the insights - diversity and narrative place at regional scales and coherence at meso-scales.
Chapter 5.2 uses Ramos et al.'s (2006) transactional model of landscape identity as a basis for clarifying the concept of landscape identity, dividing it into spatial-physical and social-existential aspects that interact with each other in the time process. The relevant theories are reviewed separately to make them operational. On the spatial-physical side, theories related to spatial guidance and environmental preferences (Lynch, 1960; Kaplan & Kaplan, 1989; Erwing et al., 2006) were incorporated, and principles of legibility (including spatial form, sensory perception, and historical continuity) and complexity were made explicit. On the social-existential side, drawing on theories about landscape stewardship (García-Martín et al, 2018; Fisher et al. ,2017; Eiter, 2010), the principles of multifunctionality and participatory management are made explicit. Chapter 5.3 defines the influences that are critical for drought in the SGE, based on Van den Eertwegh et al.'s (2021) mechanistic approach to drought in sandy soil areas, and clarifies the importance of the groundwater table in drought adaptation and how it relates to water use and drainage activities.
Chapter 5.4 identifies the 'forest approach' to be used in this study, building on the ecosystem services (cultural, provisioning, regulating) that forests and trees can provide, linking it theoretically to landscape identity and drought adaptation, and developing a theoretical synthesis. In terms of landscape identity, drawing on De Wit & Van der Velde's (2024) work on Delft's tree language, the spatial configuration of trees is used as a basis for enhanced spatial character and a bearer of stewardship in the time process, so that the cultural and provisioning ecosystem services provided by forests are anchored in the spatiality of the trees; in terms of drought adaptation aspect, the role of trees as regulators with a sponge effect is emphasised, responding to various aspects of drought in sandy soils in 5.3.

SRQ2:
What are the challenges and opportunities of enhancing landscape identity within SGE from the lens of forest and forestry?

This question is systematically answered in chapter 7.The SGE metropolitan landscape is interpreted as a 'Nevelstad' consisting of four components. In cultural landscape, the focus is on enhancing the historical coherence of the landscape and protecting spatial cultural heritage under pressure, as well as maintaining and enhancing diversity in the landscape. In urbanisation patches the focus is on creating diversity of spatial experiences in homogeneous urban landscapes based on the urban forest pattern obtained from the analysis. Fringe landscapes are transitional spaces in metropolitan landscapes, important for continuity at intermediate scales in the territory, with a focus on enhancing landscape integration and maintaining its complexity. Void landscapes are narrative places in metropolitan landscapes, with the main challenge being that they are not sufficiently highlighted as fragments of cultural landscapes in the metropolis, with a focus on enhancing their spatial heterogeneity as well as combining with infrastructural corridors to become a system to be experienced. In each of the metropolitan landscape types, tree language serves as a formal method of interpretation.

SRQ3:
What are the challenges and opportunities of strengthen drought-adaptation within SGE from the lens of forest and forestry?

This question is systematically answered in chapter 8. the SGE is viewed as a hydrological system consisting of the ridge, the middleground, and the valley. the challenge of the ridge is too little infiltration and too rapid drainage due to inappropriate land use and tree selection. the challenge of the valley is too rapid drainage and restricted seepage due to inappropriate land use, with a focus on restoring its ecological vitality through nature-based design; the middleground serves as the part that takes over the main infiltration and seepage zones. The challenges of the valley are excessive infiltration and restricted seepage due to inappropriate land use, with a focus on restoring its ecological vitality through nature-based design. the middleground combines the challenges of both as part of the main infiltration and seepage areas, and faces excessive groundwater abstraction, with a focus on creating a resilient water storage and use system.

SRQ4:
How can forest based strategy enhance and reinvent the landscape identity in SGE?

This question is answered by the spatial design toolbox and overarching vision generated in chapter 10, which also reflect the 6-point design principles of chapter 9 on enhancing landscape identity.
By editing the tree language - in particular the introduction, modification and invention of tree syntax and the transformation of the forest pattern - forestry strategies based on the interpretation of each landscape type were formed. They enhance the readability and diversity of the SGE as a whole, and each has its own focus. Forestry strategies in cultural landscapes focus on enhancing historical continuity and the recognisability of cultural heritage through the introduction of significant tree syntax, and try to build on existing forest patterns to add spaces for people to engage in land practices and interact with the landscape. Forestry strategies in the urbanised patches focus on the transformation of the existing forest pattern, establishing the transformation pathway 'The scattered-the raster-the stamps' and enhancing liveability through a combination of line

and group syntax. In the fringe landscape, the focus is on the modification and invention of the frame syntax to create an extremely varied and clearly spatially structured complex of forest rooms. For the void landscape, which does not have a fixed forest pattern, a series of experiential devices based on tree planting are established as components of the design, with the aim of enhancing the contrast with the surrounding urban environment and creating a sense of 'entering the theatre' of the experience.

SRQ5:
How can forest based strategy strengthen the drought-adaptation in SGE?

This question is answered by the spatial design toolbox and overarching vision generated in Chapter 10, which also reflect the 4-point design principles for enhancing drought adaptation in chapter 9.
In the ridge, effective capture of runoff and increased infiltration can be achieved through the forestry system phasing in coniferous woodland replacement and restoration of moorland/marsh, and the installation of wooded banks. In the middleground, the creation of water storage and infiltration spaces through a combination of afforestation in the city, on the urban fringe, on agricultural land, and along canals, and linking them into a system, can be an alternative source of water for irrigation during dry seasons and effectively replenish streams and groundwater. In the valley, strategies to remove ditches, modify water level management and floodable forests on agricultural land and in the city allow more time and space for water to flow and restore seepage to occur, promoting ecological habitats that are dependent on moisture.

SRQ6:
How can forest strategies spatially integrate in design transformation for cases of local scale?

This question is related to the synergies and conflicts arising from the visions and strategies corresponding to the two parallel topics (10.3, 11.1, 11.2), and is answered by the conclusions obtained from their locally transformed design experiments (11.3).

In the case of 'On the fringe of Nuenen', the conflict between the functional practice of creating diversity in the reclaimed forest complex and the strategy of restoring the moorland bog and replacing species in the ridge was resolved by the spatial compartmentalisation that Recreational activities for visitors are bound to the edge of the forest through wooded banks and avenues, creating dynamic and restricted zones in the reclaimed forest complex. The strategy of the fringe landscape is combined with the hydrological strategy of the middleground to realise synergetic effects, where spaces for the collection and purification of rainwater from the urban fringe are integrated into the structure of the integrated rooms as part of a fine recreational network in the fringe transition zone. The emphasis on cultural landscape characters and making them experienceable in the valley conflicts with the strategy of restoring the floodplain of meandering streams in the valley, a conflict that is resolved by the installation of water storage areas in forested rooms used for Housing assignments in the valley as well as multilevel, seasonal floodability measures. On the whole, the forest and broek landscape from the urban centre of Nuenen to the eastern and southern sides of the site is connected by several main roads with modified tree syntax, and dynamic and restricted zones, both recreation oriented and nature conservation oriented, are set up to enhance coherence in general.

12 Reflection

12.1 Relationship between graduation topic master track and graduation lab

The Urban Forest Lab's expertise in Urban Forestry aligns with the practical implementation and exploration of sustainable solutions for urban environments, providing a specific lens through which to view and address the issues identified in SGE. The Forest-based Strategy, as the core of my thesis, serves as a bridge between the theoretical foundations of Flowscape which related to landscape as infrstructure, and the applied methodologies of the Urban Forest Lab. It integrates landscape planning, ecological principles, and community engagement to propose a holistic approach to enhance landscape identity, mitigate drought challenges, and contribute to the larger goal of creating resilient and sustainable metropolitan landscapes.

12.2 Academic relevance

12.2.1 Reflections on the 'forest approach' - validity and limitations

'The forest approach' is the central approach in this study. In this approach, forests and trees are used in this project more as a systematic method of analysis and design than as a design element in traditional landscape design, or as a vague image of an 'ecosystem service provider'. 'Tree language' is at the heart of this approach, consisting of a vocabulary of trees (tree species), tree syntax (spatial configuration) and forest pattern, which emphasises the spatiality of trees as a starting point for analysis and design. It transforms/reduces/sifts analyses of spatial, social, cultural, ecological, etc. aspects of SGE into problems related to forests and trees and seeks to address them through designing forests. The temporal dimension of trees as living landscapes is also emphasised, with the aim of introducing time process-based forestry tools, including planting, maintenance and management, as a new design methodology.

This approach responds to the desire to see the territory as a forest, giving trees and forests an infrastructural status and reflecting the idea of a forest urbanism - an integrated development of the city and the forest, where the values associated with trees become the anchor point of a way of life that fosters a stewardship of the environment represented by the forest.

In retrospect, this approach led to limitations in at least two ways.

The first is that while the study attempts to encapsulate the territory as a forest through tree language, and in particular tree syntax, as a descriptive approach with limited quantitative and reductionist flavours, it inevitably fails to paint a full picture of the complexity and diversity of reality, particularly where the landscape is more chaotic and layered. If the type of fringe landscape can still be systematically described and designed innovatively through Frame, a tree syntax that contains many variants, then in the void landscape, because its core spatial character is the contrast with the surrounding urban environment (more abstract), it cannot be summarised by a specific forest pattern, and the corresponding forestry strategies cannot be presented through a unified archetype, but rather concrete context of some fragmented principles of shaping experience. It is undeniable that the few profiles given in the thesis as principles for designing void landscapes do not generalise to all landscapes of this type, they are only applicable to a part of the stream fragments and fragments of the broek-kampen reclaimed landscapes, and when the site is shifted to e.g. a void as a reclaimed forest, they are no longer applicable and still need to be shaped into new principles based on specific design experiments.

The second aspect is that the approach to tree language dictates that it is used primarily in situations where trees make up a proportion of the landscape. Although, as the analysis consistently points out, the SGE is an area very rich in forests and in forested spatial capital, this situation is still spatially uneven. For example, to a certain extent, interpretations of landscape identity based on tree language for high-density urban centre areas (urban patches as scattered forest) and a part of residential areas (urban patches as raster forest) are unconvincing, as their primary perception is based on spatiality shaped by architectural and its history and culture. While targeting urban woodlands can increase livability and possibilities for interaction with the landscape, the extent to which parameters such as complexity and legibility in urban environments are determined by trees remains a question worth exploring. This aspect is also related to scale, which is discussed further in 12.2.3.

12.2.2 Reflections on landscape identity - boundaries and operationalisation of concepts

Landscape identity is one of the central concepts in this study and a major issue that SGE faces as a decentralised landscape metropolis.
This study's grip on the concept of landscape identity is based on Ramos' (2006) transactional model of landscape identity. In his study, this model is used to facilitate macro-level policy making rather than more specific design and planning, and its innovation is to theoretically establish the dynamic interaction between landscape character and human identity in the time process. However, he also addressed the issue of 'dimensions' and 'content' of landscape identity and in a subsequent study (Ramos et al., 2019) expressed the inability to identify universal 'content' ' or parameters.

Several of the parameters identified in this paper at different scales are derived from a review of studies in different fields and for different scales. This makes the concept of landscape identity broad (not limited to literally 'identifying landscapes') and easy to apply in analysis and design (parameters can be used for specific evaluations and are applicable to forest approaches).

One problem is that these parameters, which come from different studies and which I connect to landscape identity, are transferred with a change in context, which leads to an appropriation that may not be amenable to logical academic scrutiny. For example, the 'compatibility' of patches was emphasised in patchwork metropolis-related research, an insight that was translated into the 'coherence' of landscapes at intermediate scales in my research and directly guided the analysis and design of fringe landscapes as a type of analysis and design. Pisano's (2013) and Neutelings' (1989) insights into this compatibility are based on a view of the territory as a random patchwork of patches, with a strong emphasis on the role of the transport infrastructure, which is seen merely as a device for moving at high speed between clusters of patches. This context is not entirely compatible with SGE, where some transport infrastructure (e.g. the A2 highway) still exists as barriers in the cultural landscape.

Another problem lies in the fact that the concretisation of this vague notion of upper landscape identity on a spatial-social level may limit the means of design intervention. When factors in the site that may influence landscape identity are beyond the control of these parameters, corresponding design strategies may be missing. For example, in stream valleys and broek landscapes, as specialised habitats where seepage occurs, natural values such as biodiversity will inevitably also influence landscape identity, but forestry strategies for them do not take into account the possible manifestation of these non-human factors in participatory management. This relates to the two parallel perspectives of the research approach taken in this paper, which will be discussed further in 12.2.5.

12.2.3 Reflection on urbanisation and dispersed territory - a question of scale

One of the central concerns of this study is urbanisation, the characterisation of SGE as dispersed territory.The view of SGE as 'nevelstad' contributed to the emergence of four metropolitan landscape components. The result of the research is that the metropolitan landscape of the SGE presents a state somewhere between radical fragmentation and radical concentration, with more complete and coherent urbanscapes (e.g. the city centre area of the radial development of the Eindhoven) and

landscapes (e.g. the belt area from Stiphoutse bos to Molenheide), and fragmented, mixed patchworks co-existing.

An important conclusion of the project is therefore that SGE is unable to create coherence at the macro-scale, replacing it with coherence at the meso-scale. It can be seen that in regional spatial visions about landscape identity, no regional structure is actually deliberately created, except for the void landscape. This means that a forest-based strategy or forest approach cannot actually solve some spatial problems regionally, such as the problem of regional transport infrastructure as a barrier. All it can do is to create a diverse forested landscape at the regional scale as much as possible.

The ability of the forest approach to enhance legibility and complexity in terms of landscape identity is primarily at the local or micro scale because it is an approach based on spatial perception, and there is a limit to the extent to which people can perceive space. It cannot form an overall image beyond this limit. Therefore, the intermediate-scale coherence mentioned earlier is also not a coherence based on the spatial form of the forest, but rather on the fact that 1) the patchwork of forest types at the intermediate scale can be effective in forming functional connections; 2) the dimensions of the fringe landscape as a transition zone can be used to full effect as an articulation at this scale; and 3) this coherence still relies heavily on the modification of the mobility or pathway system to be realisation.

12.2.4 Reflections on drought adaptation - forests as a means or an end?

The project's research on drought adaptation can be summarised as 'Strengthening territorial drought adaptation through forestry strategies', i.e. it focuses on the most pressing hydrological problems in the SGE (groundwater-soil drought), and forests and trees are seen as a means of solving these problems. Indeed, there is an implicit but probably overlooked objective, 'Enhancing drought adaptation in forests', which focuses on forests and trees themselves as organisms whose habitat and ecological values are compromised by drought.

These two objectives overlap in places, such as in the ridge and the valley, which are more tree-rich, have more pronounced tree-dominated habitat qualities, and a significant portion of which is designated as part of the natura 2000 or Brabant nature network. Forestry strategies here naturally improve the habitat for trees and other organisms while mitigating groundwater-soil drought, such as the installation of floodable forests and replacement tree species, among others. But the ecological qualities of the agricultural land and the urban fringe are not specifically emphasised in the middleground, where trees exist more as biological devices for drought mitigation or as additional assets in a conventional hydrological strategy.

This made me aware of an anthropocentric tendency that may have been retained in the course of the research. In addressing environmental issues such as drought through trees and forests, I have not formalised considerations of their own, and indeed the well-being of all non-human organisms, as a way of thinking. Although the two parallel perspectives approach adopted in this study implicitly concerns humans and non-humans separately, in analyses and designs concerned with drought adaptation, the scales still seem to be tipped on the side of human needs for the environment.

12.2.5 Reflections on the two parallel perspectives

Two parallel perspectives were used in this study, a spatial-morphological perspective and a bio-physiological perspective, which implies that landscape identity and drought adaptation are treated as two separate topics.
The bio-physiological perspective represents a 'vertical' interpretation of the site, where the biological/habitat attributes of the landscape become the basis for the multiple layers of land use on top of it, while the spatial-morphological perspective represents a 'horizontal' interpretation. A spatial-moephological perspective, on the other hand, represents a 'horizontal' reading, which focuses on the landscape as a surface and the spatial relationships of various equally important landscape elements.
Logically, an in-depth consideration of each of these two perspectives would lead to different design priorities, synergies and conflicts. In practice, this did occur and became the basis for subsequent design transformations in smaller scale sites.
However, during the actual research process, I was uncontrollably tempted to integrate bio-physiological concerns directly into spatial design strategies related to landscape identity, and more than once questioned the necessity of such a parallel approach. In hindsight, this impulse and questioning was justified. On the one hand, analyses that are spatial in nature are naturally more actionable, whereas hydrologically related strategies require spatial anchors when mapped. On the other hand, as discussed in 13.2.4, nature-based design or consideration of the ecological well-being of non-human species may also be new starting points for enhancing landscape identity.
Regardless, this parallel perspective remains a valid way of thinking that facilitates insightful and integrative critical thinking about site-related issues.

12.2.6 Transferability

In terms of urbanisation and urbanity, the specific analysis of the SGE as nevelstad and the resulting four metropolitan landscape components are transferable to the rest of the brabantstad, e.g. the decentralised urban agglomeration of Breda-Tilburg-Den Bosch.

The transferability of the catalogue of tree languages (tree syntax) established in the study and the forestry strategies for enhancing landscape identity generated on the basis of it is limited because they are generated on the basis of local landscape character and historical culture. The conservative conclusion is that their transferability is limited to the specific historical landscape area of Brabantse Kempen (which also includes parts of the Flemish provinces of Antwerp and Brabant), the more confident conclusion is that they can be transferred northwards and westwards to a broader area that includes the Brabantse Meijrij and the surrounding area of Tilburg. Forestry strategies to enhance drought adaptation were established based on soil and hydrological conditions in high sand areas, and they could be transferred to other high sand areas in the Netherlands, including the province of Helderland.

12.3 Societal and moral relevance

One of the most obvious contradictions is that landscape identity is defined as " . . the unique psychosociological perception of a place defined in a spatial-cultural space" (Stobbelaar & Pedroli, 2011). The subject of the perception carried out here should be the inhabitants who live in the place, or at least those who are familiar with it. This points to the ethical problems in the process of identifying influences, or their 'content', in measuring landscape identity - these criteria were not developed with the participation or testing of local people, but rather by me, as an outsider, grounded in limited observation, taking the widely accepted conclusions from the literature review grafted onto the land through my own understanding. Theoretically, this should have been done in a more participatory way, for example through questionnaires, interviews, etc. However, due to practical factors, such as language constraints, these were not realised.

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