The Shape of Healthy Lowland Metropolis

Urban Forestry as Landscape Architectural Approach to a
Healthy Environment in Rotterdam- Den Haag Metropolis

Graduation Project
Landscape Architecture - Urban Forestry

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Owing to the unique landscape characteristics of Dutch lowland, forests in Randstad region are found being the result of the interaction between historical development and natural conditions. As cultural influences are genetically embedded in forest formation, the landscape approach to urban forestry provides a novel and wholistic lens looking at the interrelationship between trees and the cities, which enables deeper understandings of analysis and is possible to function as an integrated design tool.

South-west Randstad is facing the pressure of population growth and loss of natural landscape due to projected urban expansion in the following decades. Countermeasures of creating 52,000 new dwellings plus 5,000 hectors of forest by the year of 2040 are proposed in the development vision by the province Zuid-Holland. Therefore, this project aims at providing a spatial scheme that integrates future urban development and forest network that is rich and healthy.

The project starts with urban forest typological analysis, which concludes the interrelationships between underlayers and the urban forest pattens. By the typological analysis, health qualities are evaluated and compared between types that stand for different spatial qualities. The conclusion and comparison of the analysis enable further instrumental function of urban forest typology in landscape design.

The design part of this project envisions a regional urban forest network that consists of existing forest in urban context and an interurban forest which integrates the polycentricity and fragmented forest patches of the region. By the design approaches of structural experiential and dynamic program planning, a throughout design scheme is proposed, leading to desired spatial qualities which are carried out by utilisation of urban forest typology.

Keywords:
Urban Forestry, Green Infrastructure, Ecosystem Service, Randstad, Polycentric metropolis, Urban Forest Typology

Part 1. Introduction

1.1 Problem statement

Southwest Randstad area is facing the growing population in the coming decades. Urbanization brings challenges to health of the environment and to human, including loss of rural landscape to build environment, fragmentation of natural habitats, increasing need for housing and for attention on health of urban population.

As health benefits bring from ecosystem services being proven, there is a rising awareness on the importance of green space in urban settings. Projects and studies were practiced at multiple scales around the globe, including the Netherlands. However, it is still unclear on the measure which approach to an integrated cross-scale forest system that not only reflects the natural characteristics of sit but also projects landscape in the future world.

There are already numerous precedent studies on green infrastructure, however the concept on urban forestry is still relatively vague. Moreover, Spatial qualities of urban forest which support sustainable urban environment and optimized ecosystem services have not been recognized.

An urban Forest is the result of interaction between geomorphology, cultural-history, and function of one site. The understandings of the interrelationship between trees and the city provides a potential entry to reconstruct a healthy environment.

Similarly, as culture and nature are tightly intertwined in the modern world, designing urban forest should not be solely meeting social health from human's perspective, but also meeting ecological and environmental health from tree's point of view. Therefore, a design method for more inclusive and sustainable world is explored and proposed in this project.

1.2 Aim and contribution

This project aims at linking the two major fields of knowledge: Landscape design and Urban forestry. Looking at urban forestry through the lenses of landscape design methods provides possibilities of spatial applicability which allows conceptual idea to be implemented on practical site design. Conversely, views from urban forestry bring in novel perspective on design which embraces forest as user of space and combines healthy forest and human community.

Another aim of this project is to design with the philosophy of multi-species world, which value non-human as equally important existence as human-beings. Needs of fauna and flora should be included in landscape design. This project design for healthy environments not only from social perspective but also ecological and environmental perspectives. In this way, sustainability of a landscape is holistically considered and designed.

1.3 Research question

To approach to the interrelationships between landscape design and urban forestry, two questions sets are proposed focusing particularly on analysis and design phases:

1. What is the potential of urban forestry in southwest Randstad region to realize a healthy urban environment?

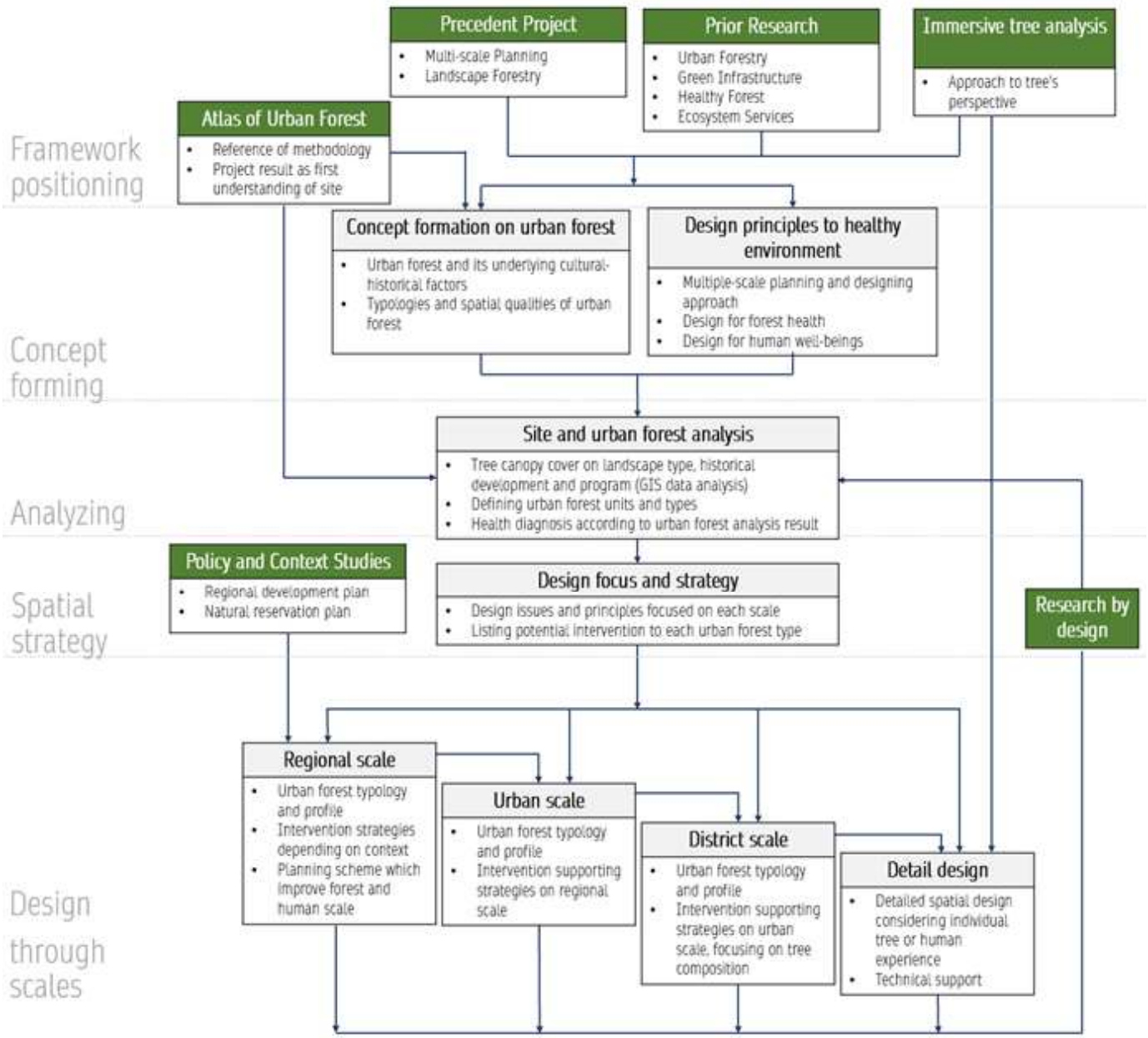
→ How to define an urban forest by its typology and spatial qualities?
→ How to understand an urban forest by recognizing its relationship with the underlying cultural backgrounds?
→ What is the value of underlying cultural and natural landscape in developing a healthy urban forest?
→ What is the relationship between forest's typologies, health conditions, and its potential for a healthy environment?

2. How to design a healthy environment with urban forest?

→ How to optimize the forest configuration and environmental conditions for health of existing forest in urban settings?
→ How to create new forest which meets the conditions environmental and social demands on health with urban forest typologies?
→ How to define and tackle with different issues on an urban forest at different scale?

1.4 Methodological structure

The project consists of five parts: Framework positioning, Concept forming, Analyzing, Spatial strategy, and Design through scales



Part 2. Theoretical Framework

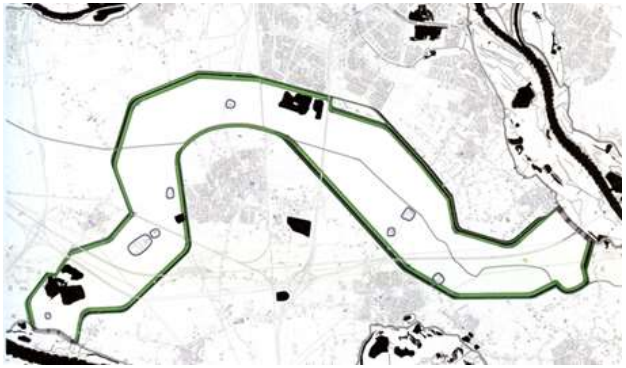
2.1 Concept formation

The project is based on the project of urban forest atlas on Den Haag city. The experience on atlas project is used as reference for research method on urban forest typology categorization and understanding of natural and cultural backgrounds underlying urban forest. Moreover, the study result of Den Haag urban forest provides understanding on site at a smaller scale.

2.2 Precedent projects

This project deals with two challenges in landscape design: integrating urban forestry and multi-scales planning. To understand the practicality and difficulty in the design process, precedent projects are collected as references and inspirations. First reference project is Park Maxima at the city of Utrecht designed by West 8 urban design & landscape architecture. Park Maxima provides a valuable example for landscape being an urban scale approach to integrate fragmented pattern, diverse urban programs, and infrastructure. 4 landscape elements are designed as uniting objects while different zonings are designed differently to meet local characteristics and requirements.

Another reference is project: Een Dijk Van Een Park by Ronald Rietveld, which demonstrate how landscape could play the priority role in regional scale planning and the approach to design with “landscape DNA”. Moreover, the philosophy of designing with flexibility from scenario thinking provides inspiration for further design experiment.



2.3 Prior research

Genius loci in landscape design

As landscape being a result of transformational process by the interrelation between culture and nature, which is fundamentally represent the palimpsest of a place: the genius loci, the character of the place, is generated by geography, aesthetics, historical and social characters of the location (de Wit and Bobbink, 2020).

Elizabeth Meyer also mentioned in her discussion on defining expanded field of landscape architecture: "The site—and land—speaks prior to the act of design." (1997, p. 168) Therefore, site-specific qualities, genius loci or landscape DNA, provide a sound basis for sustainable landscape design which capable of facing both natural and social transformations.

UF v.s. GI

Urban forestry and green infrastructure are both theories evolving from concepts regarding designing with natural components in urban context. In research by Escobedo et al (2019), use of relevant terms in academic publish, including urban forestry, green infrastructure, ecosystem services, and nature-based solutions, are reviewed, compared and discussed.

Urban Forestry

Urban forest is a network comprising woodlands, groups of trees and individual trees in the context of urban and peri-urban areas. The formation of an urban forest is deeply cultural influenced. The typicle example is the relationship between boulevard trees and European culture of "walks and avenues". There is an arboricultural side of urban forestry which relates to maintenance and care of individual trees. Moreover, social, economic and engineering aspects are crucial as well as arboriculture in the of the knowledge field.

Konijnendijk et al. (2005) listed the key spatial characteristics of a optimal urban forest network as the following:

- Integrative: an urban forest should incorporate different elements of urban green structure.
- Strategic: the design sould aimed at long-term plans for urban tree resources
- Multiple benefits:an urban forest should account for ecological, environmental, social-cultural, and economic benefits of the area.
- Participatory: social engagement and partnership is crucial in the design process of an urban forest.

Green Infrastructure

On the other hand, green infrastructure focuses on strategically planned network of natural, semi-natural, and cultivated areas. These areas are designed and managed for the purpose of socially delivering ecosystem service and ecologically protecting biodiversity. Although similarly setting in urban and peri-urban contexts, green infrastructure is more purpose oriented
and includes more diverse forms of natural components.

Spatial design principles for green infrastructure can be concluded as the following (Dramstad, Olson, & Forman, 1996; Rouse and Bunster-Ossa, 2013; Coutts, 2016):

- Connectivity: the configuration of green spaces follows principles of landscape ecology, which systematically structures patch, corridor, mosaic and aims at interconnection between components.
- Accessibility: for sake of functionality and effectiveness of ecosystem services, green infrastructure should be accessible with for example pedestrian network or providing passive exposure to vegetation.
- Habitability: green infrastructure should be potentially supportive to recreational and communal activities
- Multifunctionality: green infrastructure should provide solution to issues regarding ecological, environmental, and human health.
- Resiliency: green infrastructure should be abele to continue delivering benefits under challenges from environmental variability.

Comparasion and conclusion

There is a major intersection between concepts of urban forestry and green infrastructure. Both are relevant to human settlements that manage, maintain, conserve, or use woody plants. Both concepts are to address the capability of woody plants to socio-ecological, political, and environmental issues that influence human well-beings.

As Escobedo et al (2019) suggest, the terms and metaphors although function as precision that enable community and provide criteria guiding design guide, inherent messages is anyhow the most important of all.

Landscape ecology

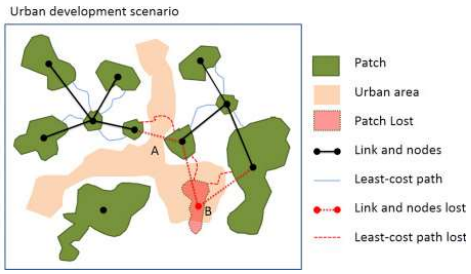
The theory of landscape ecology is based on spatial structure of landscape elements, which are classified as patches, corridors, and mosaic. Functionality being the aim of discussion on arrangement, movement and flows of animals, plants, and materials through the structure are regarded the crucial criteria of landscape quality.

Although there is no definite scale regarding patch, corridor and mosaic, the relative size, shape, arrangement, and other spatial characteristics are applied in ecological evaluation.

In terms of patches, larger size is preferred for species diversity and prevention of extinction. Round shape benefits interior species while elongated shape benefits edge species due to higher interaction with the surroundings. Therefore, an ecologically optimum patch has a round core which protects resources and several curvy fingers for species dispersal.

As main causes of ecological deterioration are loss ne isolation of habitats (patches), linear connections are urged to be created to provide efficient enhancement of biodiversity. While corridors could function as habitat, conduit, filter, source, and sink, gap and discontinue of corridor are possible depending on species. Therefore, a sequence of steppingstones may function as a corridor. Anyhow, corridors are preferred with similar vegetation to patches to be connected.

Mosaic is the overall structural integrity of a landscape. While connectivity to the natural systems being a crucial assessment of ecological health of a landscape, connectivity and circularity of a network indicates the linkage of habitats and movement of species. Moreover, intersections between corridors or between corridors and patches are generally richer in species diversity, while islands or smaller patches should be provided for certain individual pause or breed (Dramstad et. al., 1996).



Tree physiology in urban settings

Urban environment tends to challenge tree's growing physiology by air and soil qualities. Problematic conditions of urban air include elevated temperature, low moisture, reduced solar radiation, and high level of pollutants. The combined effect may lead to longer growing season, reduced stomatal conductance and photosynthesis rates, reduced wax layer on needles, and increased stem diameter. On the side of underground, urban soil qualities such as elevated temperature, intermittent low or high moisture, and shallow organic layer, may altogether lead to shallow or rotten tree roots. To keep the health level of urban forest without mitigating negative impacts from urban environments, high intensity maintenance must be practiced, which is not sustainable (Calfapietra et. al., 2019).

Polycentric metropolis

A polycentric metropolis is defined as proximate cities sharing functions, services, and labor. The cities combine their complementary strengths in a collaborative way because polycentricity may reduce unnecessary duplication of services and inefficient use of land. Moreover, the integration between cities create smore opportunities for citizens in terms of employment, services, and social life (Burger et al., 2015; Meijers and Burger, 2017).

Randstad is a polycentric metropolis which consists of a cluster of middle scale cities. With the increasing importance of metropolitan in global economic competition, concentration and diversity of resources are regarded as strengths of any form of metropolis (Zonneveld and Nadin, 2021). Thus, the integration of cities to a cohesive urban system improves not only social-economic performance but well-beings of the residents as a whole (Meijers et al., 2017).

Compositional landscape design

Since this research focuses on the relationship between spatial form and health of urban forests, an understanding between formal and experiential qualities of landscape can be supported by analysis of the interrelationships of four landscape compositional layers: basic form, spatial form, image form, and program form.

While palimpsest of basic pattern and functional program indicates underlying layers of an urban forest, spatial form is embedded in the translation of vegetal configuration from 2D plan into 3D space. As for image form, which can be interpreted as narrative reading, experience of space, accumulation of meaning, or metaphoric references, is designed with the combinational result of spatial experience, historical value, and functional program (Steenbergen et. al., 2008).

2.4 Immersive analysis

Multispecies landscape

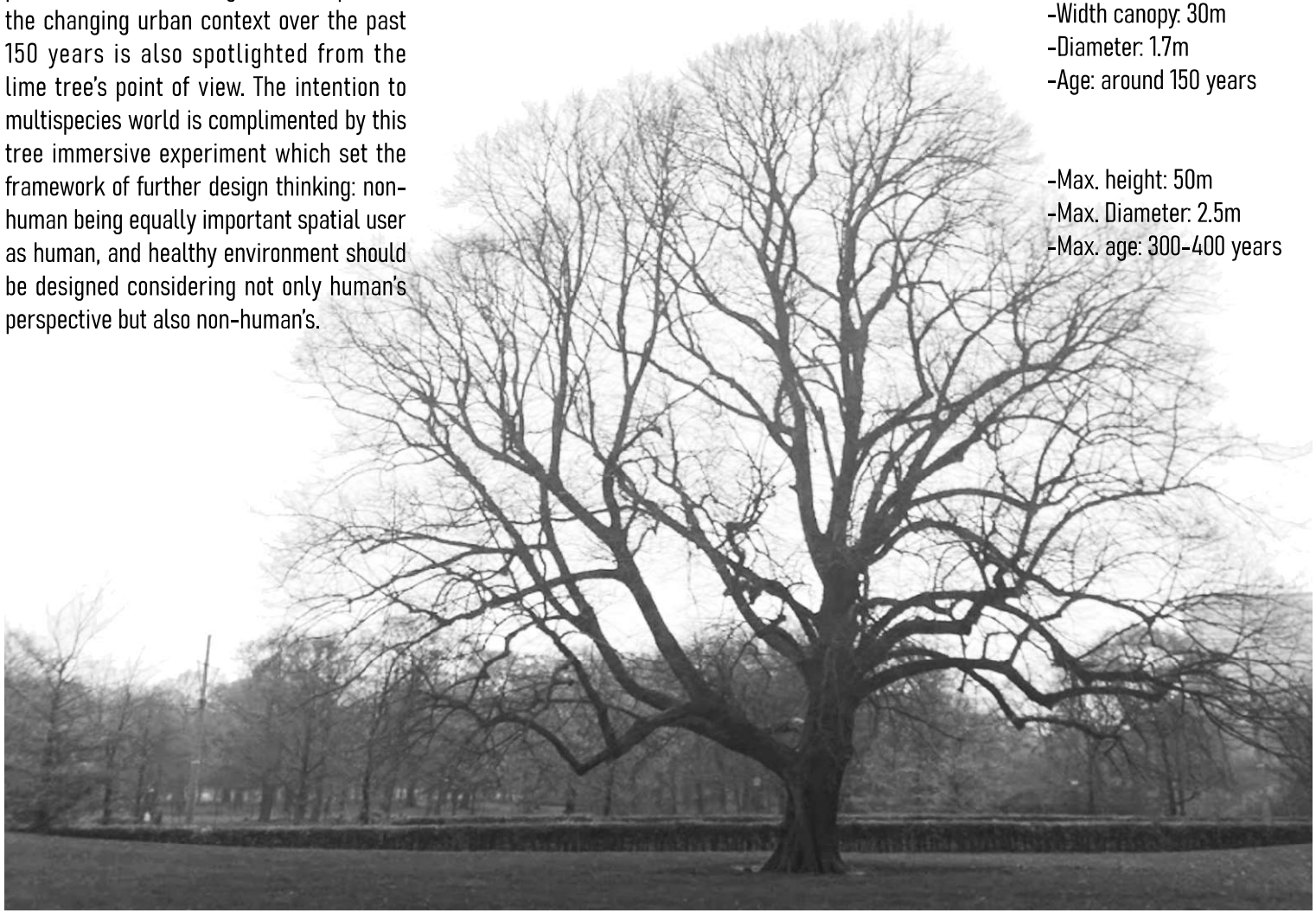
In the recent years, there are increasing discussions on seeking for new position of human in an inclusive ecosystem following the recognition and understanding of Anthropocene world. To restructure the human-nature relationship for the future generation, concept on a multispecies world is used as an entry to a more inclusive mindset, in which, the boundary between human and non-human is blurred when talking about sustainable ecosystem.
Landscape architect as spatial designer of natural elements is in the potential role to be the speaker of non-human. Although there are already numerous studies aiming to understand tree's physiology and interactions between trees and between a tree and its surrounding flora and fauna from a scientific point of view, it is challenging to be carried out in spatial design without sentimental understanding which integrate aspects regarding conditions of a healthy environment for trees and the relationship between trees and the ever-changing social context.

Therefore, a tree immersive analysis is carried out in the beginning stage of this project. A 150-year-old Dutch lime tree was chosen as the object to be observed and immersed. Despite its policy-changing value which manifests the idea of tree preservation overweighs development, the changing urban context over the past 150 years is also spotlighted from the lime tree's point of view. The intention to multispecies world is complimented by this tree immersive experiment which set the framework of further design thinking: non-human being equally important spatial user as human, and healthy environment should be designed considering not only human's perspective but also non-human's.

Tilia x europaea
Dutch lime tree

Measurement on site:
-Height: 23m
-Width canopy: 30m
-Diameter: 1.7m
-Age: around 150 years

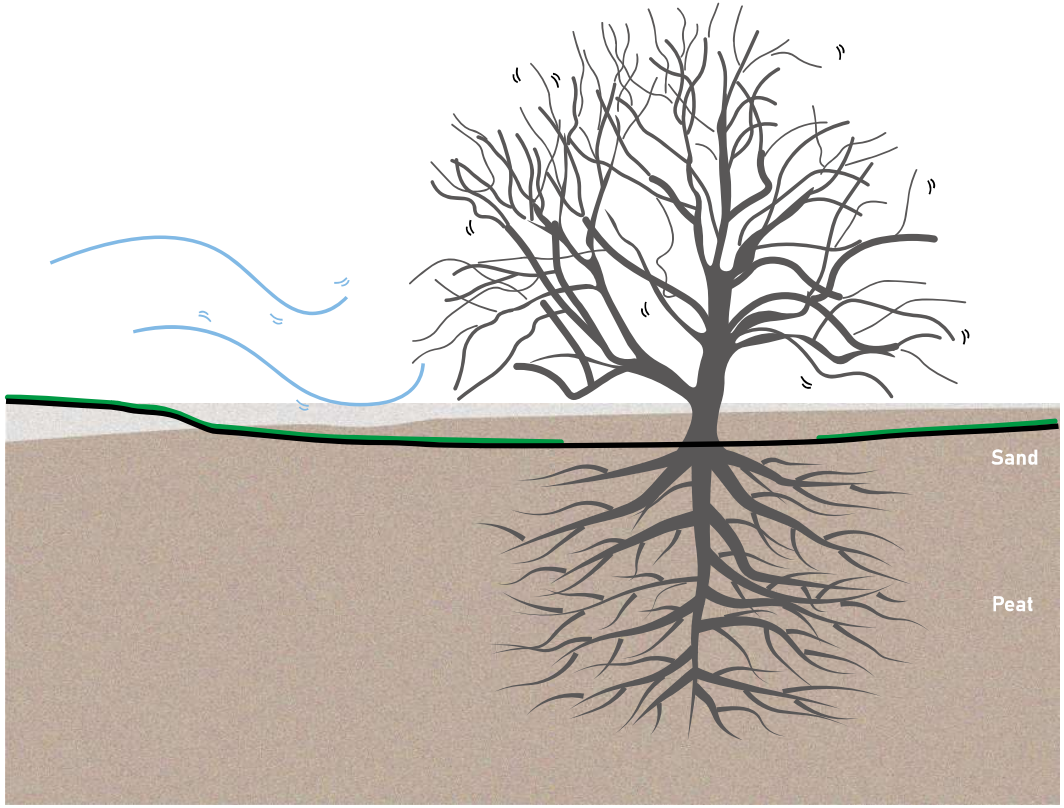
-Max. height: 50m
-Max. Diameter: 2.5m
-Max. age: 300-400 years



" The deer park has been part of the Haagse Bos. This part of the Haagse Bos was spared during the 2nd World War from the major chopping operation in the Haagse Bos. TThe Germans wanted a clear field of fire and it was nice wood to burn.

There is also a special feature associated with the lime tree next to the tram tunnel. When the tram tunnel was built in the 1990s, the route of the tunnel was changed to save this lime tree."

Only the tip of branches trembling with wind
Ready to fall leaves haning
No grass around the trunk



I enjoy being appreciated by people on the tram. They know that they are almost the main station when they see me.
Aside from that the noise often scares away my feathered frieneds, being close to tram trail is not too much a problem for now.
Maybe when I am older and bigger, the tram way will become an obstacle to my root...

Things have changed a lot since the growth of the city center. Highrise buildings block my sight and busy traffic brings air pollusion that I put a lot of energy to get rid off.
However, I am happy to feel more valuable for stress releasing. For example, office people look at me from their window as a break from work.

Although I am blessed with spacious surrounding, I sometimes jealous those oak trees and my old friends at the deer park. They have neighbours to look after each others, which is important especially when it is windy like today. If it wasn't my strong trunk and roots, it is a lot to take all the wind force alone.

It has its pros and cons to be beside a mount. The mount shelters me from strong wind, and preserve me warmth and humidity. However, water flows from the mount to my territory when it rains and sometimes make my legs wet.

2.5 Conclusion

Human-nature relationships

Landscape architecture as an academic field study the relationship between human and nature, which is constantly changing due to different social backgrounds of the time. There are four themes of nature by way of orientation: nature for consumption, nature for aesthetic pleasure, nature as cultural translation, and readable nature (Hunt, 1992). Although four themes of nature evolve from one to another with time and historical development, up until today, four ideas of nature do not exist exclusively but rather intertwined. This project as well search for a landscape presentation which meets the contemporary idea of nature that is functional, beautiful, and meaningful.

In the context of Randstad

Speaking of human-nature relationship in the context of Randstad, geomorphological and cultural condition really made a special perception of nature in Dutch lowland. Here, landscape is hardly "nature" since the cities are derived on top of reclaimed former lakebed or peat landscape. It is notable when one look at the map of mature tree canopy in Randstad region, forests are found matching in or around urban areas but not in-between zones. The phenomenon indicates the strong cultural influence in the making of Dutch forest landscape. Therefore, the themes of human-nature relationship are suitably applied especially in this case as a reference when studying urban forestry in Randstad.

Today's practice of landscape forestry

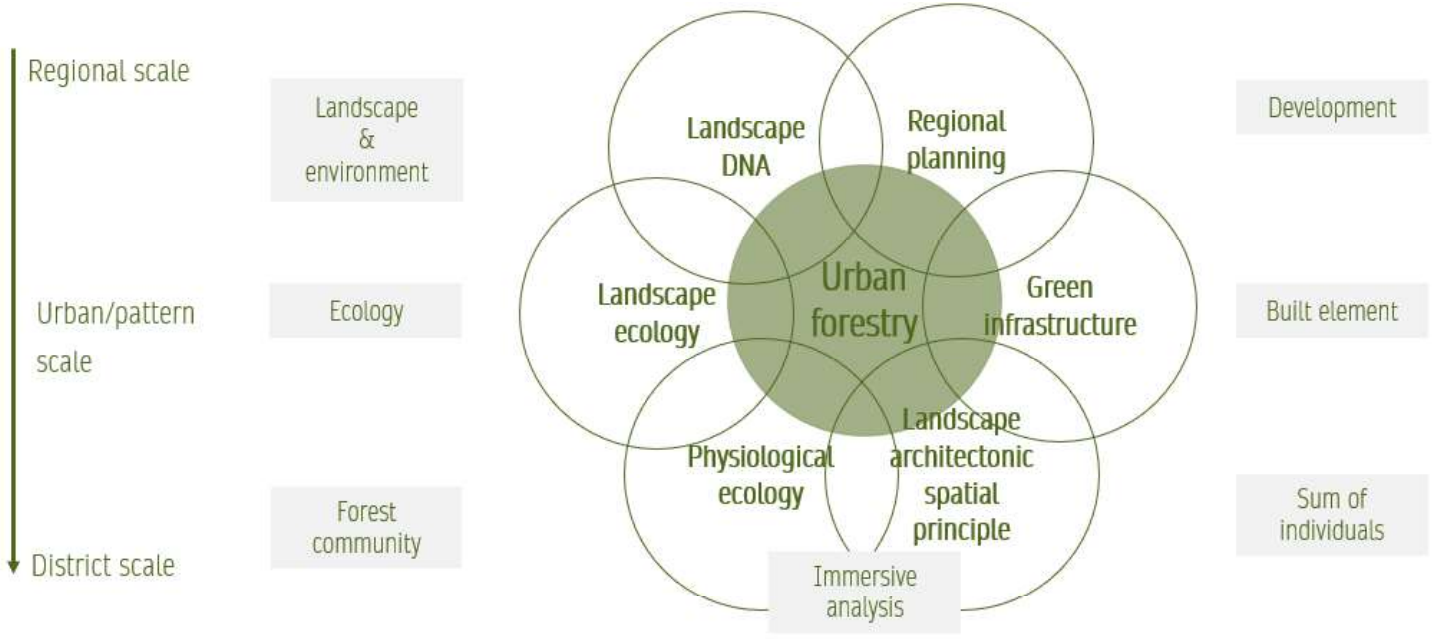
Landscape architectural approach to design of natural elements has always focused on the social-economic perspective, centering human as the main user of spaces. Even with ecology-based landscape design, quantified benefits from ecosystem services are often used as important justifications in decision making. This human-centered perspective is understandably the result of economy-driven mindset of the generation which lack in broader view of sustainability. A perfect example is a precedent project of forest creation in the Netherlands which aims at increase areas of both forest and residential housing. In that project, location of new forest is decided by the result of overlaying four maps on the national scale: current tree density map, current population density map, map of Nature Network Netherlands, and map of Natura 2000.

The use of overlayers reflects that forest and vegetation are used as instrumental roles which optimize the environment following urban development (as projected by population density and policy) and ecological network (as provided by Nature Network Netherlands and Natura2000).

However, the forest is located never according to the suitability to the trees and forest itself, leaving out considerations about geomorphology and landscape conditions, climate, and sociology of vegetation groups. The current human centered approach might result in mass creation of unhealthy and unsustainable forest which further limits the benefits on ecological or even social-economic aspects. Thus, the idea of multi-species world is experimented and exanimated as the approach to healthy and sustainable landscape.

Design with scales

As scale-continuum being one major lenses of looking at general landscape and design (de Wit and Bobbink, 2020), framing the scale of context is a crucial premise of discussion on spatial, ecological, functional, and social qualities of a landscape. For example, in ecological analysis, a fragmented habitat at a fine scale may be perceived intact at a broad scale (Dramstad et. al., 1996).


Regional scale
Urban/pattern scale
District scale
Landscape & environment
Ecology
Forest community
Landscape DNA
Regional planning
Landscape ecology
Urban forestry
Green infrastructure
Physiological ecology
Landscape architectonic spatial principle
Immersive analysis
Development
Built element
Sum of individuals

Part 3. Urban Forest Typological Analysis

3.1 Building urban forest map

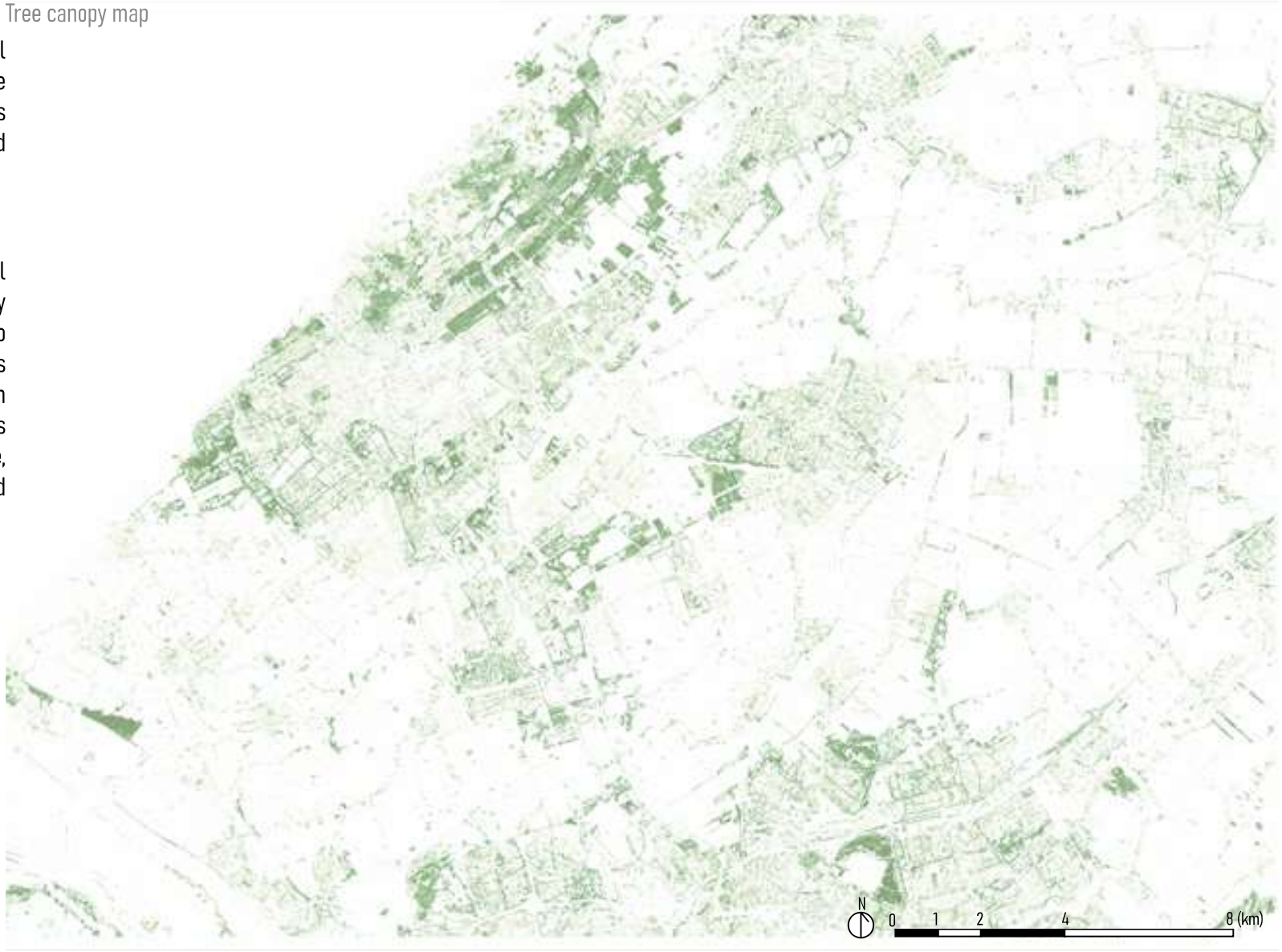
Data used for forest analysis

At the regional level of forest typological analysis, tree canopy map is used as the basis of forest pattern. The map shows only vegetation higher than 20 meters, and density of tree canopy is reflected on color.

Objectives

The purposes of this forest typological analysis are not only merely to classify forest morphological pattern, but also to further urderstand health conditions of the area from both forest and human perspectives. Moreover, with the analysis of spatial and program of each forest type, potential location for new forests and houses can be concluded.

Tree canopy map



Underlayer analysis: geomorphology

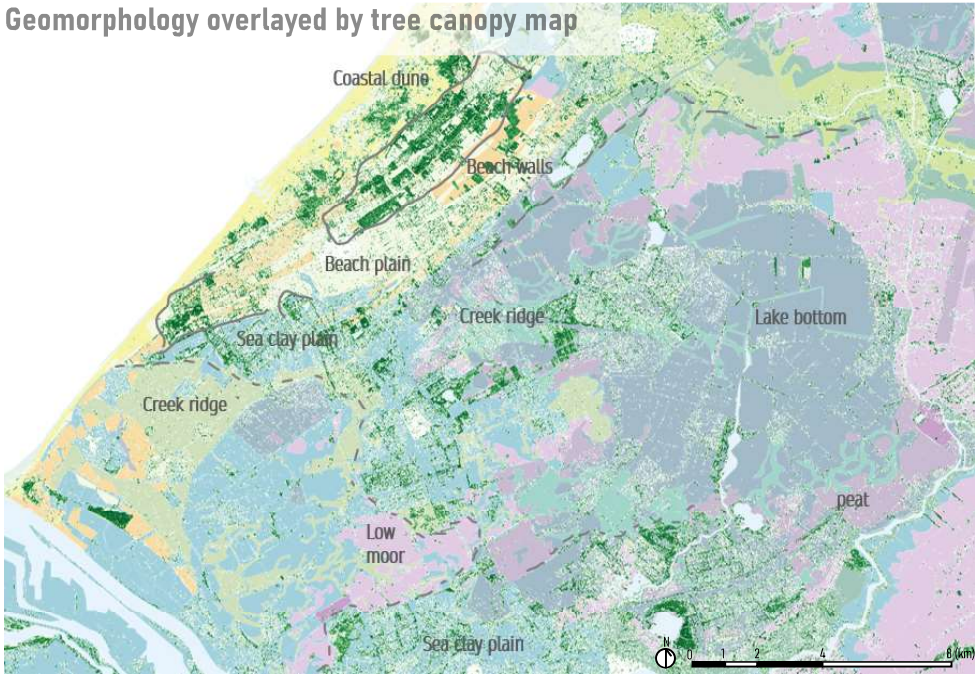
By overlaying the geomorpohlogy map and the tree canopy map, the relationship between natural landscape and forest sllocation or density is revealled.

One can find that dense forest appears mostly at dune landscape, where the direction of forest pattern matches the direction of beach plain and beach walls.

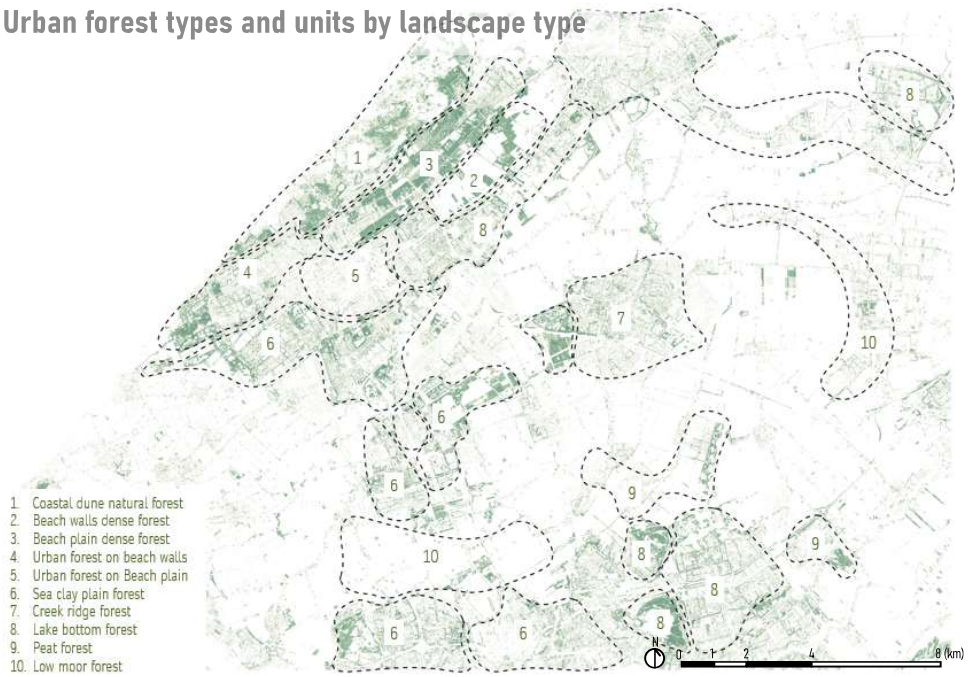
In addition, there are some scattered forests on sea clay plain. These forests are cut on the boarders to creek ridge and low moor. This could be the result of the past development of human settlement which is highly relevant to soil consumption and management.

10 types of forest patterns are therefore concluded according to the underlying geomorphology in the region.

Geomorphology overlayed by tree canopy map



Urban forest types and units by landscape type



Underlayer analysis: landscape development period

As urban forests in Dutch lowland are highly influenced by social factors, the historical analysis of the forests is done with the idea of history of green spaces in urban development. Referred to book: Atlas of Dutch Urban Landscape- A millennium of Spatial Development and common concept generic landscape styles, the historical timeline of green spaces can be roughly divided into 5 periods in the site context: before 1860, 1860-1900, 1900-WW2, WW2 - 1960, and 1960-today.

Urban forests created before 1860 are mostly located at towns developed since meddle ages with fortification and linear streets. Few forests are located at remoted parks and cemetery linked to the city

1860-1900 is the first period of which private properties expansion occurred. Estates houses were built outside town fortification, bringing urban forest to the "outskirt".

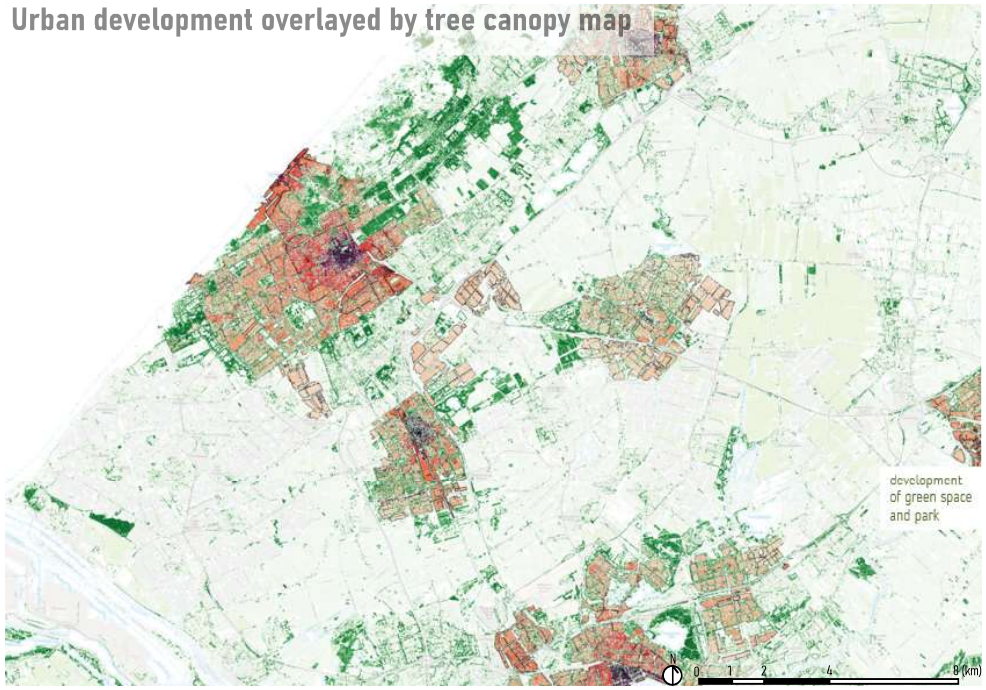
Between 1900 and 1945, location of urban forest was influenced by modern urbanization. The concept of urban green spaces and large city parks deveoped with the idea of modern cities.

Between 1945 and 1960 is the time of mass urban planning. Urban forests developed with the uniform building style and repeating neighborhood units. Moreover, the development of infrastructure enabled existence of new residential towns such as Zoetermeer.

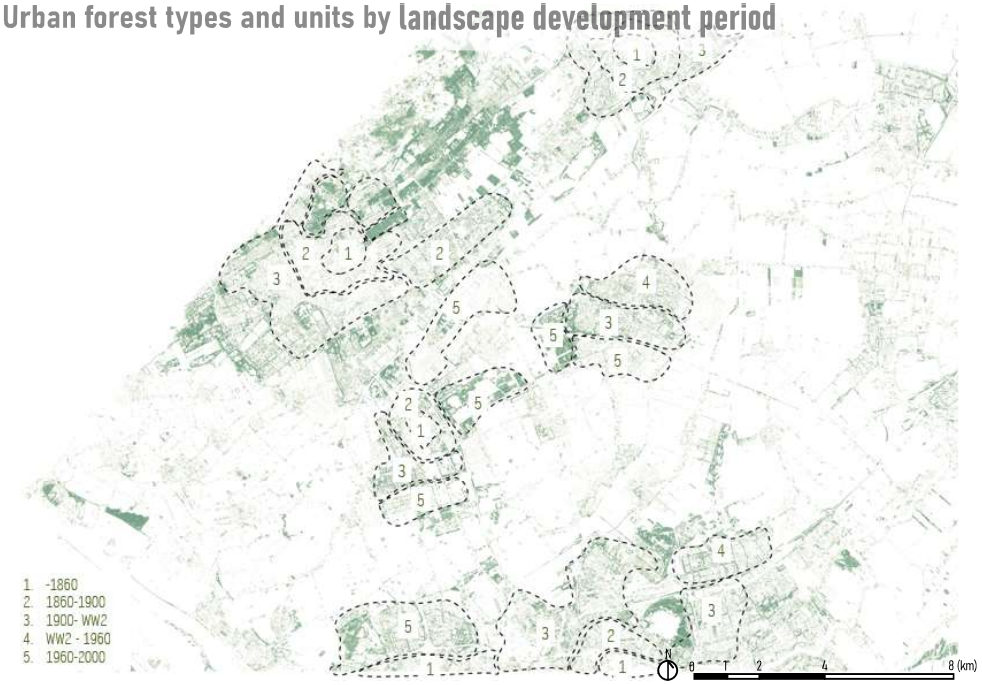
New demand of housing arose as rapid globalization, causing development of new housing areas. Buffer forest were planned at outskirts or between towns to prevent urban expansion and to ensure quality of life.

Between 1945 and 1960 is the time of mass urban planning. Urban forests developed with the uniform building style and repeating neighborhood units. Moreover, the development of infrastructure enabled existence of new residential towns such as Zoetermeer.

Urban development overlayed by tree canopy map



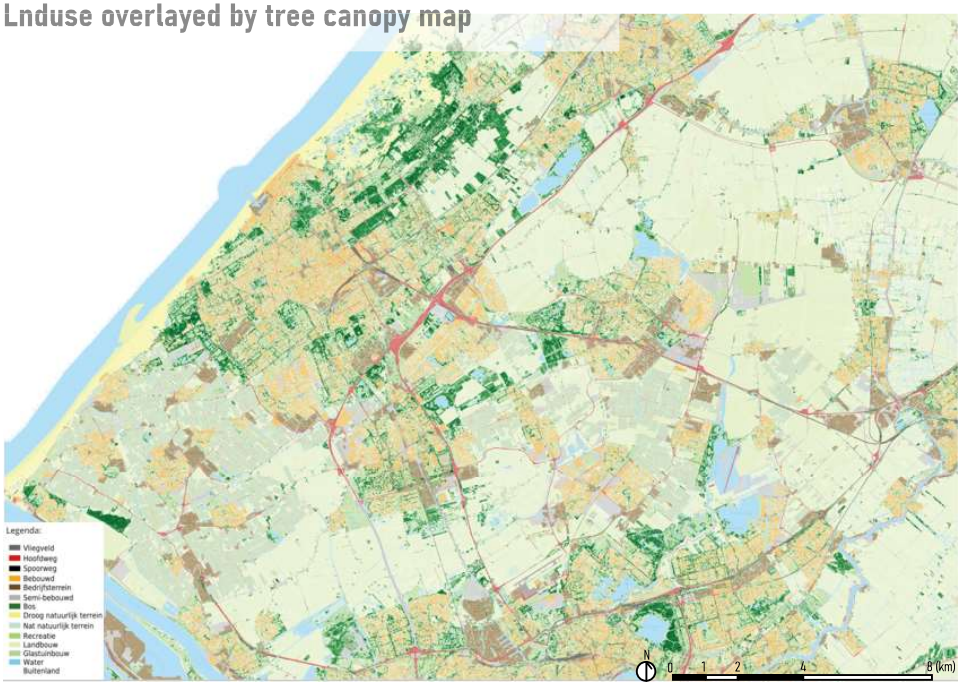
Urban forest types and units by landscape development period



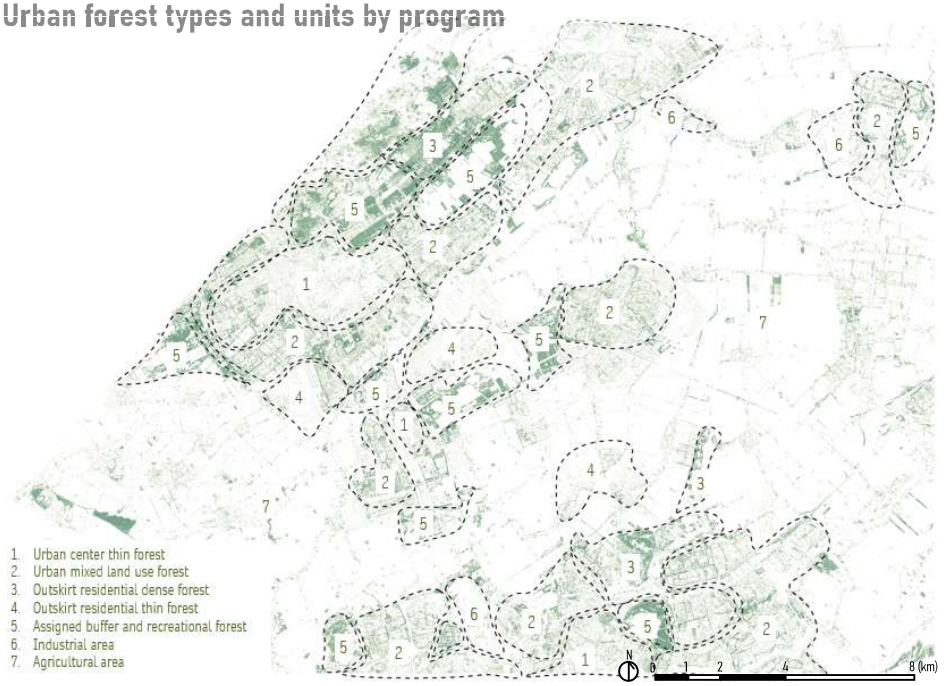
Underlayer analysis: landuse program

By overlapping the landuse map and tree canopy map, it is clear that forests are following urban area. Among urban landuse, industrial areas has thin canopy density. The denest forests function as parks and woodlands, where large water bodies often exist. Another noticible relationship between program and forest is found where transportation infrastructure on one hand cutting landscape pattern and creating boundaries, but on the other land often followed by dense forests as buffer and fringe space.

Lnduse overlayed by tree canopy map



Urban forest types and units by program



Concluding to 1 typological map

Overlaying

Overlaying unit maps of 3 different underlayer analysis.

Mergeing urban forest units

To skip units tahat are too small or conbining neighboring units who have similar patterns. When units are overlaping without the exact same boundaries, landscape geomorphology is used as the dominant layer since it is the major guide at regional scale and in long term. The result should be ess than 30 units.

Defining types

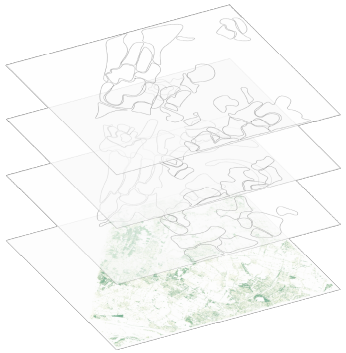
By matching the merged unit map with 3 underlaying qualities, contextual characteristics can be identified in each unit. Afterwards, units which have similar canopy pattern and are classified under same typology regardless of contextual characteristics. 8 types of urban forest pattens are concluded.

Evaluating the qualities

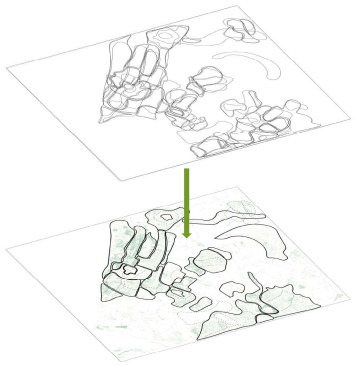
Since contextual characteristics are researched per units and patten types, they can now be elavuated for further comparison. The quantified evaluation focuses on density (quantity) and health condition (quality) of both human and forest. The set of design principles for healthy urban forest is used as criteria evaluating health condition. Therefore, radar charts indicating tree canopy density, forest health, unbuilt/unplanted space, human-forest interaction, population density, and human health, are made for each types, ranking the qualities in seven levels.

Evaluating the potential

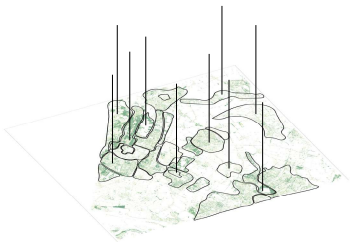
Same critira apply to evaluation of potential of types. The potential is indicated on the same rader charts with light green hatches. By overlaping the quality and potential evaluation, room for improvement and the goal of intervention of each types are clear.



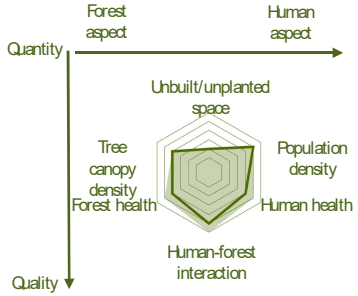
Overlapping boundaries from three layers

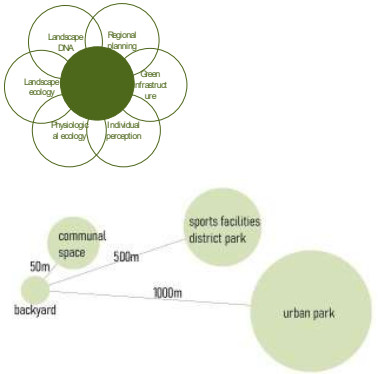


Immersing and simplifying urban forest units



Defining the types

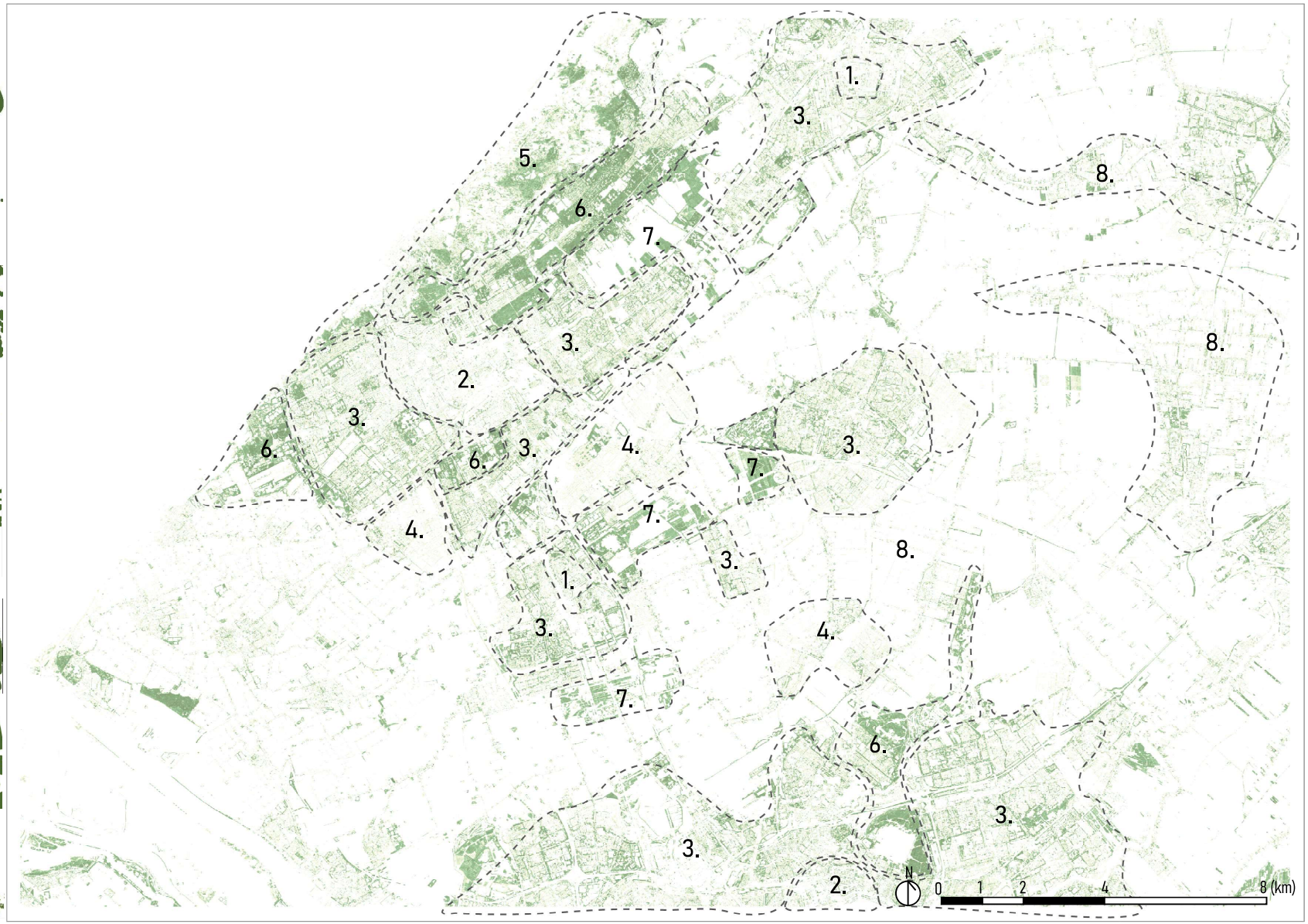




Evaluating health conditions and potentials

Urban forest typology map

1. Delicately dotted
2. Thinly dotted
3. Evenly distributed
4. Blank
5. Brushed patches
6. Organic patches
7. Geometrical patches
8. Thinly linear

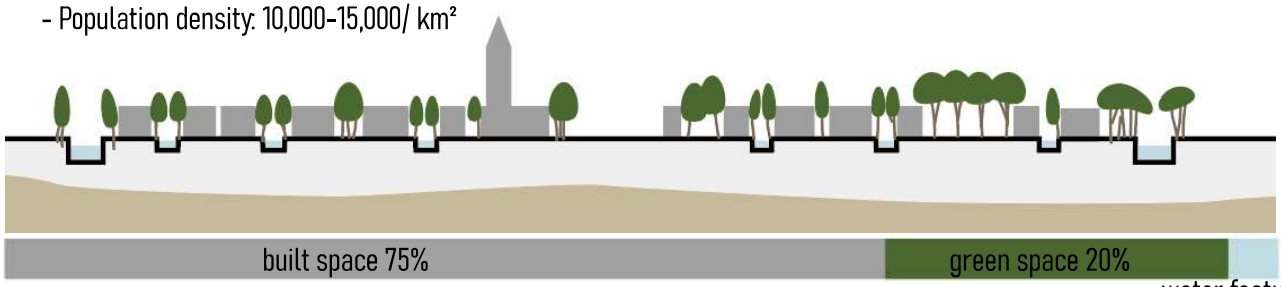


3.2 Urban forest typology profile

1. Delicately dotted urban forest

Typology background

- Landscape type: Dune/Clay/River deposit
- History: Historical city center with fortification developed before 1860
- Program: commercial/residential/ special use/ monumental
- Forest pattern: mix of linear, dotted linear, and rectangular patches.
- Tree density: 30-50 trees/ha
- - Population density: 10,000-15,000/ km²



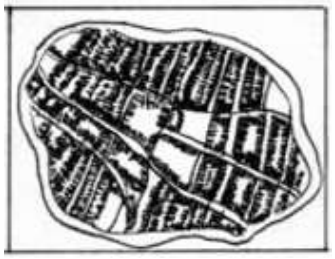
water feature 5%

Characteristics of different layers

Forest layer

- Forest Age: round 20% of public trees were planted before 1970, with the earlist be planted aound 1900
- Ownership: public forest along canals in rows and in squares in the form of ceiling. There is also high percentage of private forests which locate in backyards, taking the forms of points such as solitary and small groups. Private forests in congregate back yards can take shap as sprinkled planes.

Social layer

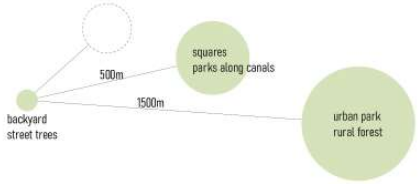


- Building type: narrow apartments in rows enclosing backyard.
- Infrastructure: canals being linear and rounded as fortification. Abundance of public spaces such as plazas and squares. Street surface being brick and street width being narrow.
- Resident group: high percentage of young population (20-64) in single or couple household.
- Pattern of life: small life ciricle with accessible shops and facilities. walking and cycling as dominant means of movement
- Accessibility to forest: lacking neighbourhood park and district park which can be replaced with easily accessible squares and canal parks

Health diagnosis

- Interconnected network with diverse patterns only with fortification.
- Monotonuous species of tree rows.
- Restrained space for root system.
- Intensive maintenance required.

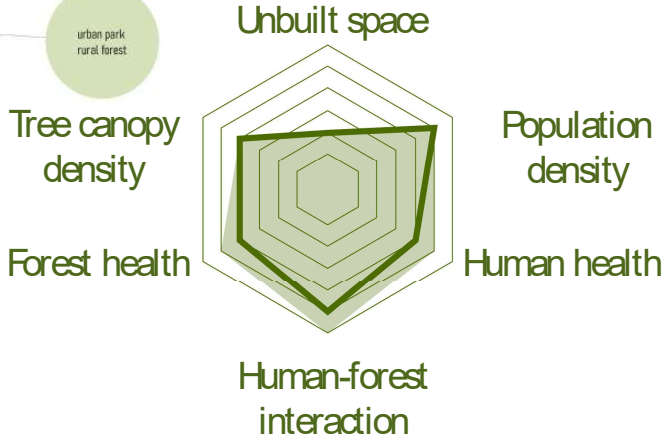
- Strong sense of identity linked to historical value.
- Forests are enriched with multifunctionality such as social gathering events and cafe terraces.



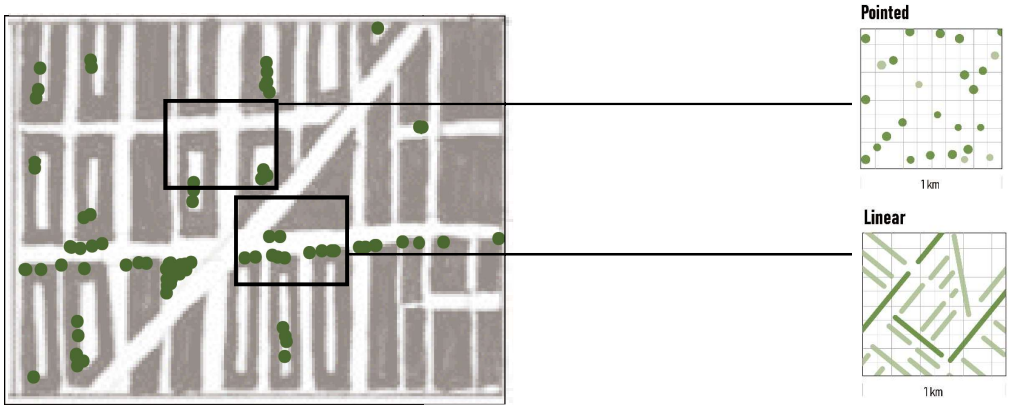
Health potential

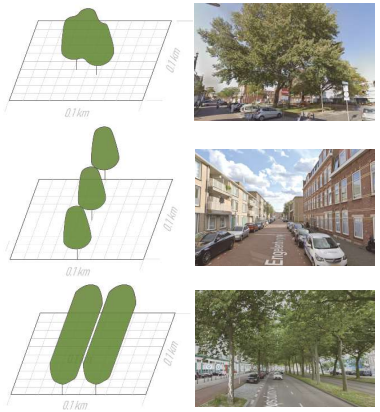
- Combining with canal system.
- Strengthening linkage to exterior forests.
- Diversifying tree species.

- Raising people's care to public trees, which can potentialy serve as neighbourhood parks.
- Strengthening accessibility to urban parks and rural forests.



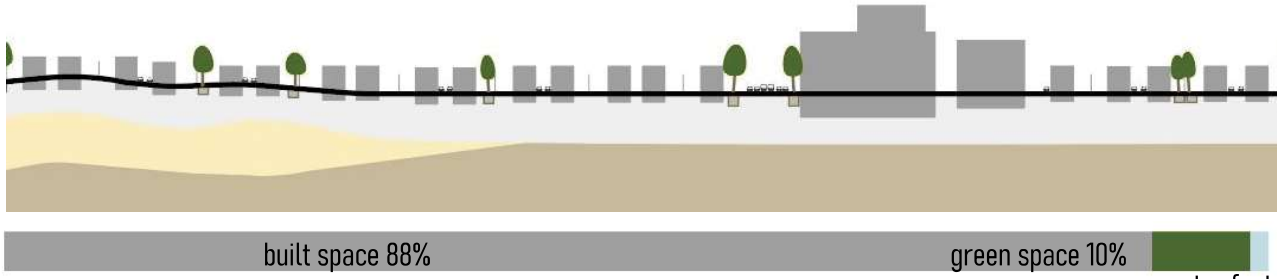
2. Thinly dotted urban forest

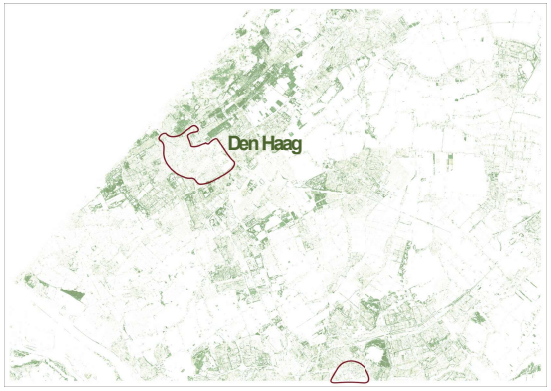




Typology background

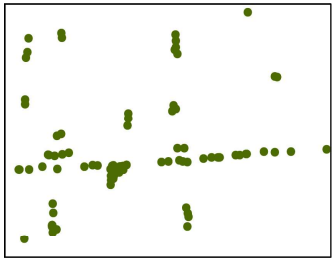
- Landscape type: Dune/River deposit
- History: Densely built extended city developed between 1860 and WW2
- Program: mix of commercial and residential use, Public transport and street network dominated
- Forest pattern: fading dots in linear configuration in linear building blocks or along streets
- Tree density: 20-40 trees/ha
- Population density: 17,000-20,000/ km²





Characteristics of different layers

Forest layer



- Forest Age: most trees are under 50 years old.
- Ownership: trees detactable in the canopy map (taller than 20m) are public trees, which are arranged in linear form on the main streets. Scatter groups in pointed pattern are partially in private backyards and partially in public corner spaces.

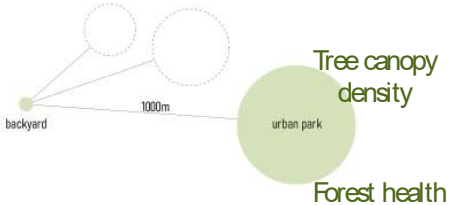
Social layer

- Building type: rows of monotonous building blocks with backyards facing each others.
- Infrastructure: grid street fabric with two-lane alleys which are car dominant. Wider streets may be four-laned with tram lanes or with small canals.
- Resident group: high percentage of young population (20-64) and high percentage of migration background (Den Haag).
- Pattern of life: car and public transport reliant due to seperation of residential district from facilities and commercial center.
- Accessibility to forest: lack of neighbourhood park and district park while there are few street trees at door.

Health diagnosis

- Main street with linear street trees are main connections of forests while scatter dots are distant and small.
- Monotonuous species of tree rows.
- Restrained space for root system.

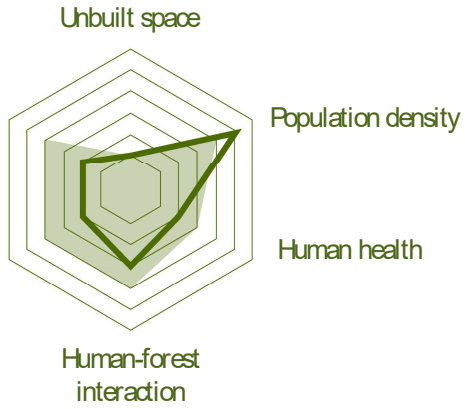
- Lack in communal identity due to monotonuous cityscape.
- There is a gap in basic level of public green spaces in the neighbourhoods and in the districts. The most accessible dense forests are urban parks more than a kilometer away, which can be discouraging from frequent visits due to the distance.



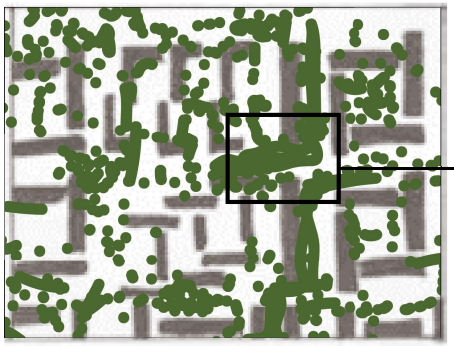
Health potential

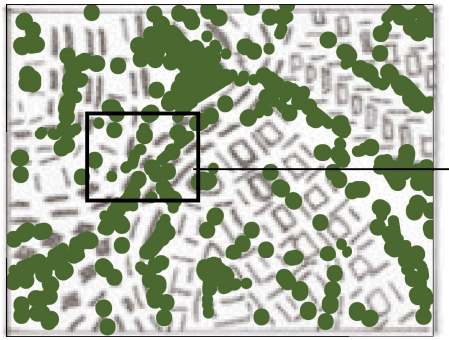
- Redesigning means of mobility can potentially release spaces for new forests and acivities.
- Densification of forests can possibly provide more interconnected networks
- Strengthening linkage to exterior forests.
- Diversifying tree species.

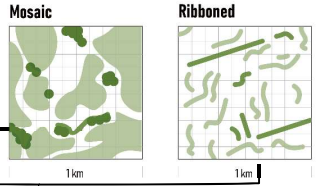
- Creating local green space as gathering points to raise the sense of community.
- Strengthen connections to urban parks and rural forests by improving the experience of travel. Linear parks or pleasant bike pathes can be applied.



3. Evenly distributed urban forest

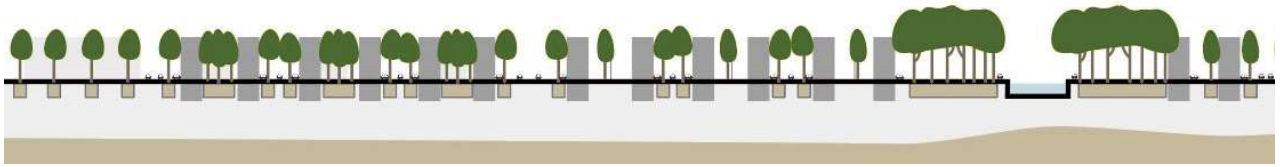


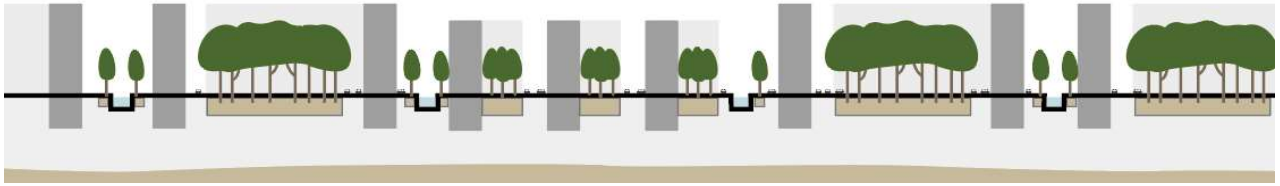




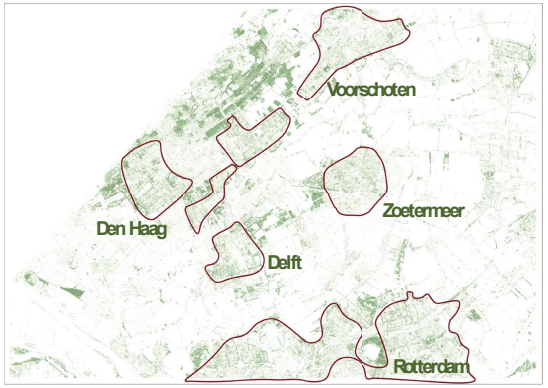
Typology background

- Landscape type: Sea clay plain /River ridge / beach walls (Voorschoten)
- History: Residential outskirt built after WW2 / estate houses
- Program: Residential area with industrial land mixed in some parcel
- Forest pattern: linear tree groups , building units dominated, buffers of infrastructure
- Tree density: 70-90 trees/ha
- Population density:5,000-10,000/ km²



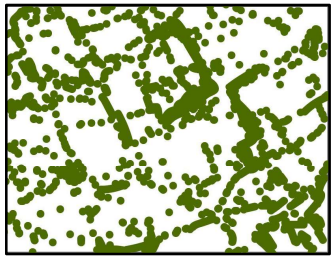


water feature 10% unassigned space 10%



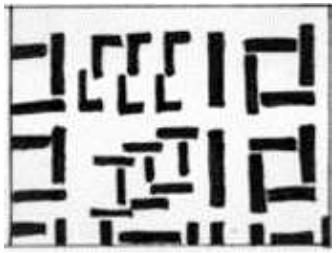
Characteristics of different layers

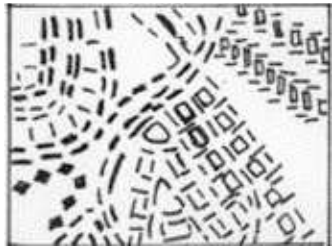
Forest layer



- Forest Age: round most of the public trees were planted between 1970-2000, while private trees in backyards planted after 2000
- Ownership: in forests of mosaic patter, tree groups are located in semi-public areas as communal spaces in highrise neighbourhoods shich do not have private yards. As for the forests of ribboned pattern, linear tree arrangements are mostly bounderies between private backyards.

Social layer



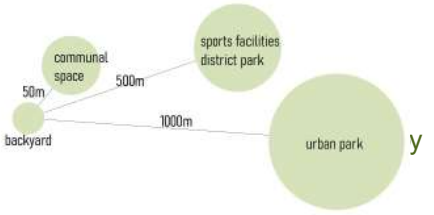


- Building type: evenly distributed forests can be found in highrise neighborhoods such as Voorhof and Buitenhof, or in single houses in neighborhoods which have cauliflower pattern.
- Infrastructure: cars are highly relied in these types of neighbourhood. In addition, water features like canals and ponds are also common and well organised in the developing plan.
- Resident group: high percentage of familites with children(<=14) and elder population (65+)
- Pattern of life: Car as dominant mean of mobility. Work places and facilities are seperated as these areas are highly residential.
- Accessibility to forest: abundant green spaces on all levels

Health diagnosis

- Highrise buildings might cause barriers on flying routes of birds and insects.
- Forest type or tree species are not matching the water features.
- Health management on private forests requires cooperation between residents.

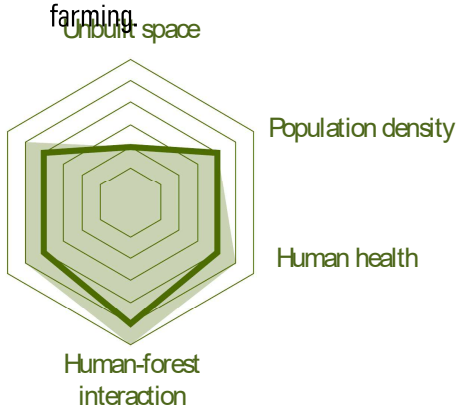
- Highly reliant on cars.
- Sense of community can be enhanced.



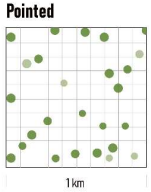
Health potential

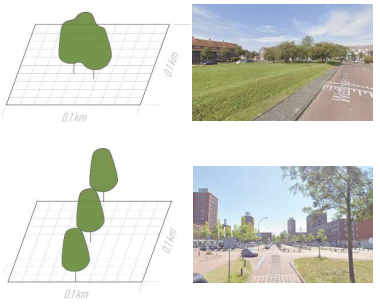
- Exploring the possibilities of vertical greening and other approach combining highrise buildings and forests.
- Adapting forests to water feature and landscape types to diversify tree species and types of habitats.
- Aiding management and densification of private forests.

- Providing pleasant bike routes linking to the city center or to larger urban or rural forests.
- Enriching a diversity of function in communal spaces such as playground, sports facilities, food garden and farming.



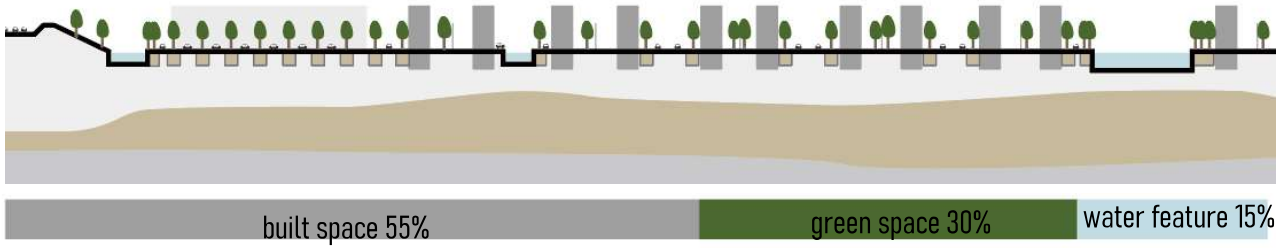
4. Blank urban forest

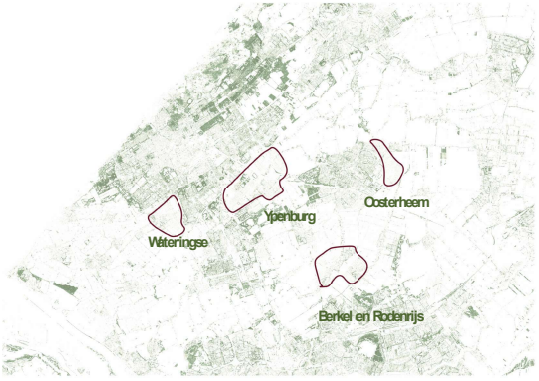




Typology background

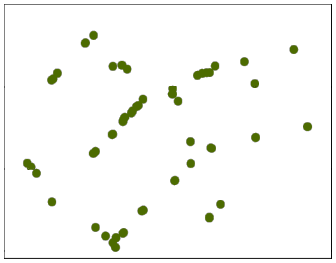
- Landscape type: Lake bottom
- History: developed after 2000
- Program: residential communities
- Forest pattern: following form of building units: backyards, water edges
- Tree density: 0-20 trees/ha
- Population density: 6,000-8,000/ km²





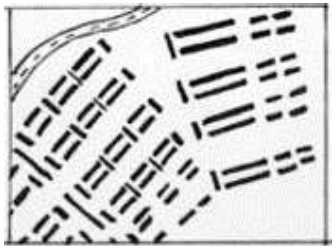
Characteristics of different layers

Forest layer



- Forest Age: most trees are planted after 1990 and under 30 years old. As the result, they are not tall enough to be detacted in canopy data.
- Ownership: trees detactable in the canopy map (taller than 20m) are public trees, which are arranged in distant linear form on the main streets.

Social layer

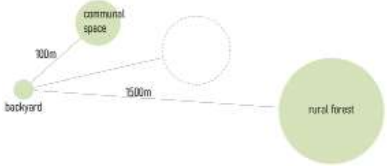


- Building type: rows of single houses with backyards and frontyards, similar to type 2 and type 3
- Infrastructure: intertwined with canals patterns, areas mostly surrounded by infrastructuresuch as highway.
- Resident group: high percentage of families with young population (20-64) and children(<=14). Some areas have high percentage of residents with migration background.
- Pattern of life: car and public transport reliant due to seperation of residential district from facilities and commercial center.
- Accessibility to forest: lack of neighbourhood park and district park while there are few street trees at door.

Health diagnosis

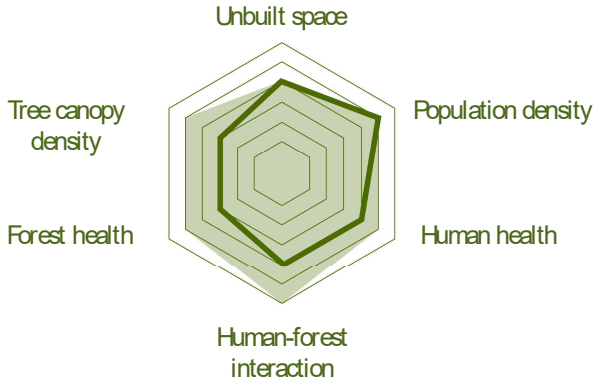
- nfrastructure could be a barrier for linking external ecological network
- Forest type or tree species are not matching the water features.
- Monotonuous species of tree rows.

- Highly reliant on cars.
- Sense of community can be enhanced.
- Lack of larger green spcae for the district.

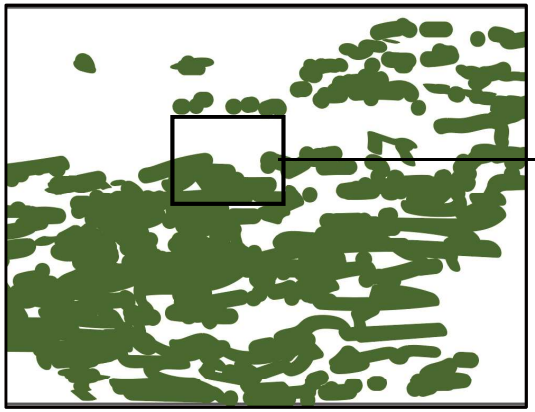


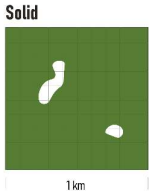
Health potential

- Young forests should be managed with care by the community possibly by breaking the boundary between private and public forests, and diversifying undergrow layers of vegetation.
- Enhancing connectivity with external forests to strengthen bigger scale ecological network.
- Densifying forests at the borders to buffer from infrastructure or agricultural fields.
- Creating local green space as gathering points to raise the sense of community.
- Strengthen connections to urban parks and rural forests by improving the experience of travel. Linear parks or pleasant bike pathes can be applied (same as type 3)



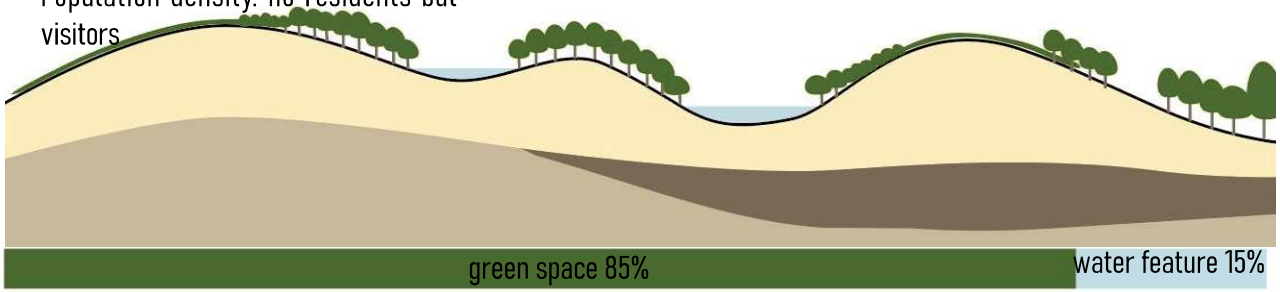
5. Brushed patches

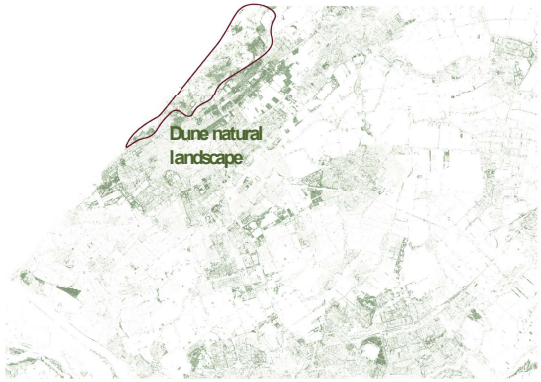




Typology background

- Landscape type: old and young dune
- History: partially former royal hunting field. There were also agricultural activities, natural reserve
- Program: ecological reserved, recreational
- Forest pattern: the natural forest in the dune area reflects the environmental conditions such as wind direction, wind force, and water accessibility
- Tree density: 80-100 trees/ha
- Population density: no residents but visitors





Characteristics of different layers

Forest layer

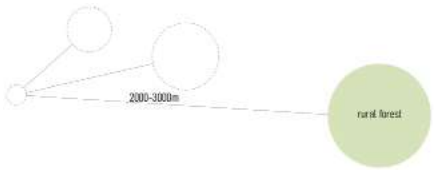
- Forest Age: the formation of dune landscape can be threw back to closing of beach wall round 7,500 years ago. The current forest is composed with trees of mixed age as natural evolving process.
- Ownership: the dune area is owned publicly, with management involving Dunea, Staatsbosbeheer, Province of South Holland, Municipality of The Hague, Delfland and Rijnland Water Board.

Social layer

- Policy and management: the whole coastal dune is discontinued by the city of Den Haag into Westduinpark-Kijkduin area and Nationaal Park Hollandse Duinen area.
- Activities: cycling, hiking, horse-riding, bird watching, and cultural monument visiting.
- Accessibility: the dune area is distant from the city. In this case, inconvenient in accessibility may become a drawback factor for frequent visit. However, the nature reserve requires absence of human.

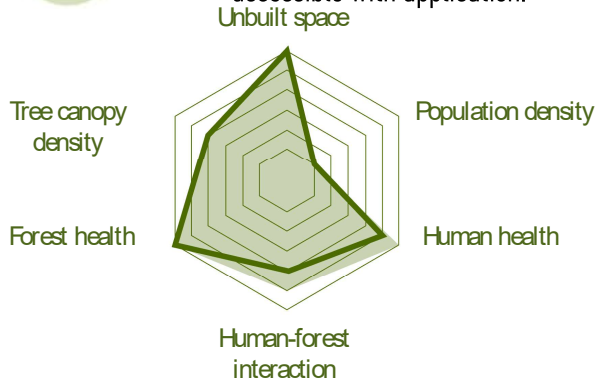
Health diagnosis

- Although tree density in the dune area is not as high as manmade rural forests, it is not necessary better to densify the area due to the nature of soil and landscape type of dune.
- Natual environment distant from urban areas with a diversity of recreational and educational functions, serving as a getaway destination.

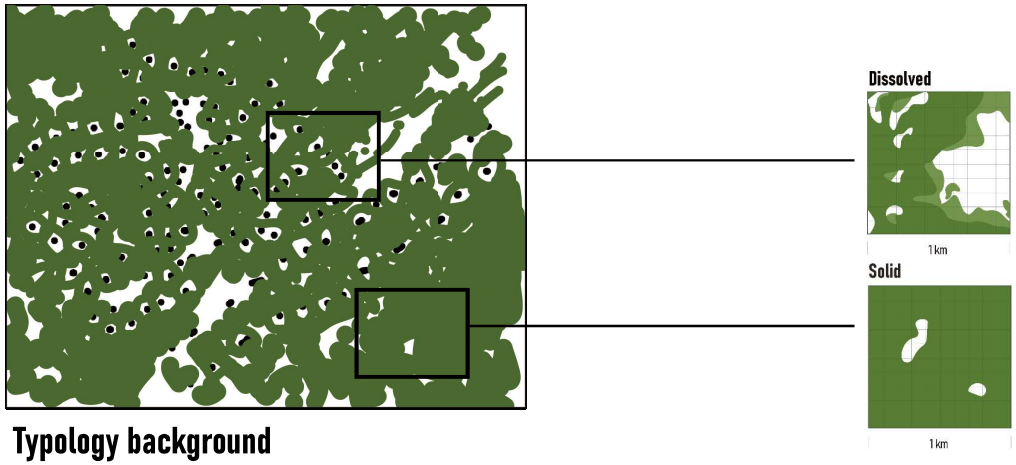


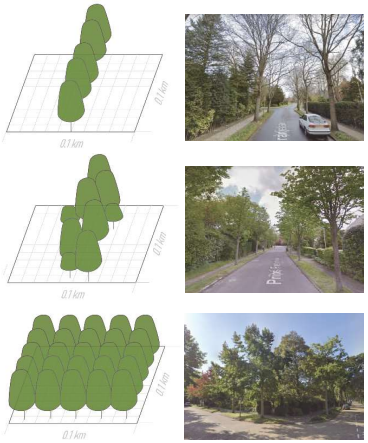
Health potential

- Conservation and restoration of the forest to reveal the natural landscape.
- Following the National Dune Park plan of development to strengthen connection and accessibility for visitors.
- Plan of different levels of utilization. For instance, easily accessible area that is connected to urban parks and conservation area which is only accessible with application.



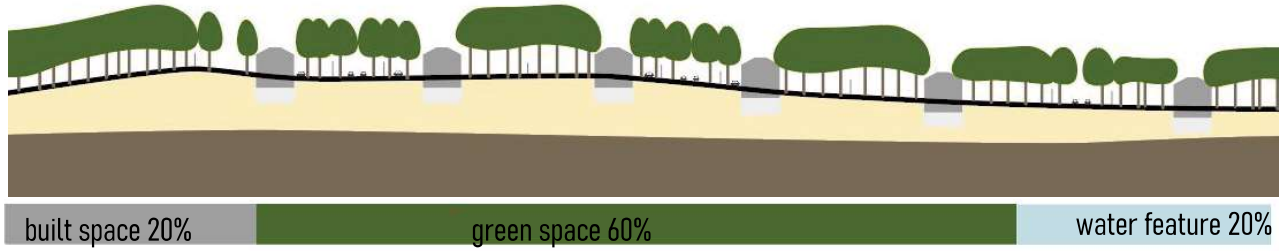
6. Organic patches

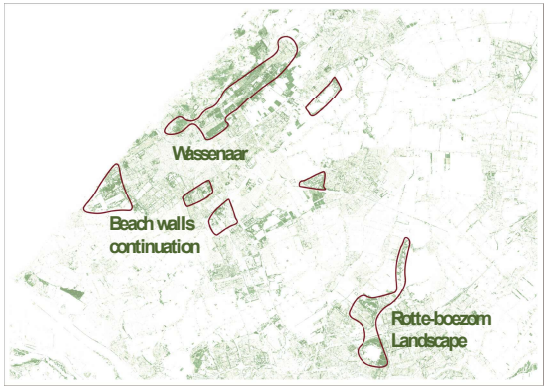




Typology background

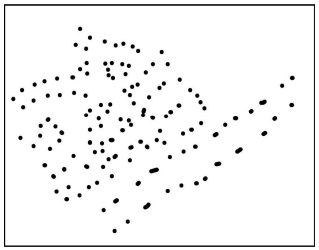
- Landscape type: old dune accumulation, river bottom and peat
- History: estate zone, Rotte-boezem cultural landscape
- Program: ecological reserved, recreational
- Forest pattern: densely planted with clearing of houses
- Tree density: 130-150 trees/ha
- Population density: 5,000-6,000/ km²





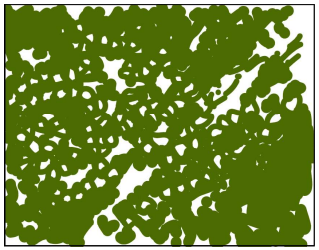
Characteristics of different layers

Forest layer



- Forest Age: the forest in Wassenaar area consists numorous monumental trees which were planted in estates at around the begining of 20th century.
- Ownership: the forest in Wassenaar area is formed with private trees in yards and old forests which naturally grown with dune beach plein. Other forests such as Rotte-boezem area, are also formed with mixed ownerships of private and public.

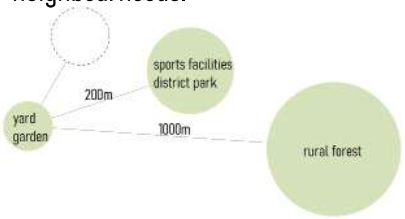
Social layer

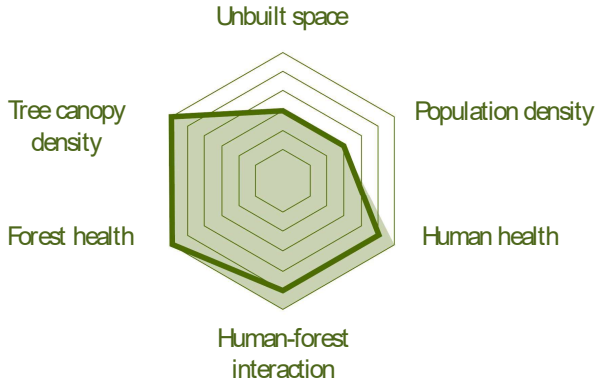


- Building type: single mansions, villas, and estates houses with garden and large private yards.
- Infrastructure: in Rotte-boezem area, the landscape is dominated by water managing infrastructure such as dikes, pumps, canals and ditches.
- Resident group: high percentage of family households with children(<=14) and elderly (>55)
- Pattern of life: cars and bikes being dominant means of transport due to the seperation of home from workplaces and facilities.
- Accessibility to forest: each households enjoys large amount of private forest in easily accessible distance. However, there is a lack of community and local playground, which may be compensated by accessible district parks.

Health diagnosis

- Large and dense patches of forest matching the underlying nagtural landscape.
- Accessible large private green spaces.
- There may be lack of interaction within neighbourhoods.

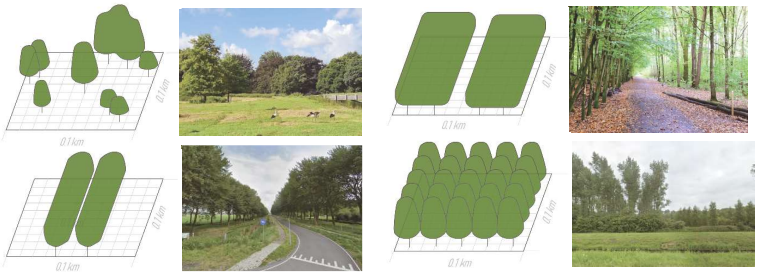




Health potential

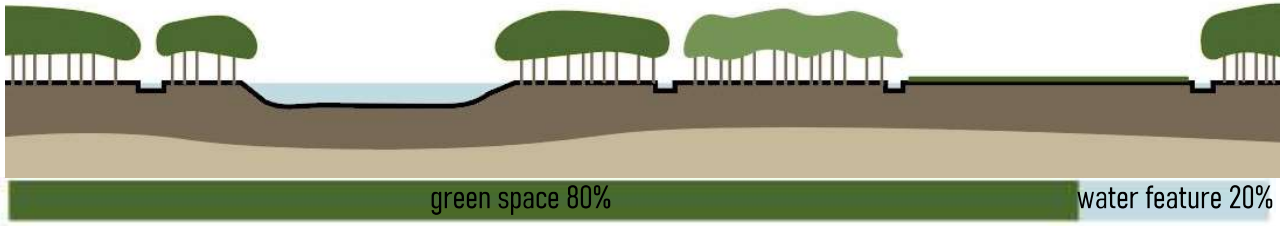
- Strengthen connectivity in between private and public forests.
- Extending the ecological benefits to the surrounding urban areas
- Strengthening connectivity within the community through events and activities in communal green spaces.

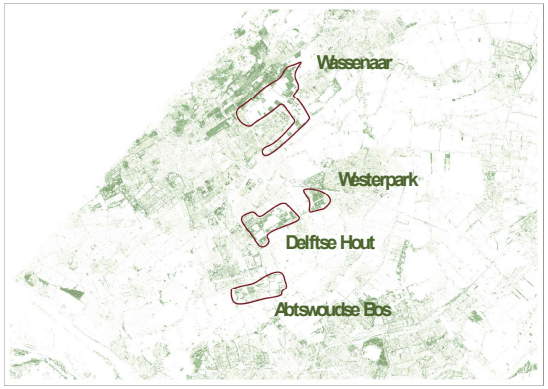
7. Geometrical patches



Typology background

- Landscape type: sea clay plain/ lake bottom/ beach walls (polder landscape)
- History: designed and developed in around 1960
- Program: Buffer forests for recreational function
- Forest pattern: matching the patterns of poler landscape, some parts are modified with designed pattern for recreational purposes
- Tree density: 100-130 trees/ha
- Population density: no residents but visitors





Characteristics of different layers

Forest layer

- Forest Age: the buffer forests are plante around 1970.
- Ownership: the forests are owned and managed by public sectors such as Staatsbosbeheer and water board.

Social layer

- Infrastructure: the forests are equipped with recreational faculties such as hiking pathes, natural playgrounds, and water features.
- Activities: Cycling, hiking, horse-riding, bird watching, camping, fishing, and water sports.
- Accessibility to forest: the forests are locates in rural areas of around two kilometers from urban areas. They can be reached by bike, car, and bus.

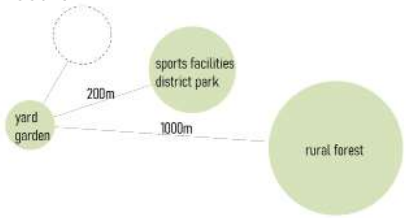
Health diagnosis

Forest layer

- Large and dense patches of forest. The trees are not as old so the forests are in the stage of evolving. Therefore, further managements are required.
- Some parts of the forests are nonotonuous with species. Moreover, densely planted trees do not allow undergrow layers like shrubs.

Social layer

- Rural forests serve as main destinations for recreation at an urban scale.



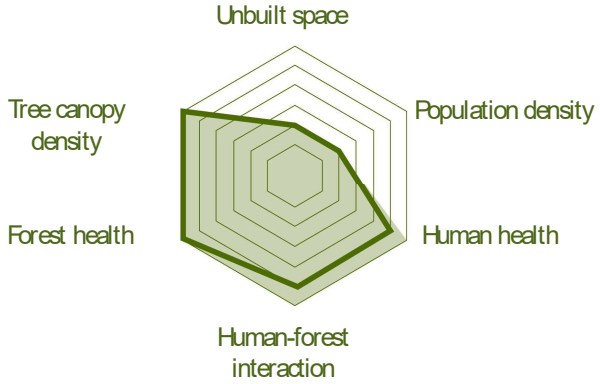
Health potential

Forest layer

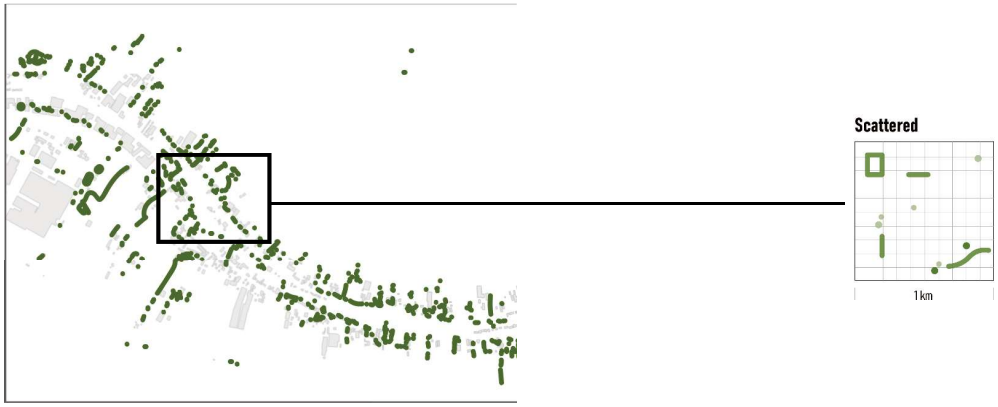
- Serving as main ecological hotspotof the region.
- More potential can be realized with Diversified tree species which reflect on natural landscape characteristics.
- Several forests can be linked by corridors to provide larger ecological benefits.

Social layer

- Potential for attracting more visitors from larger service range.
- Strengthening connectivity to the city to rise the frequency of use.

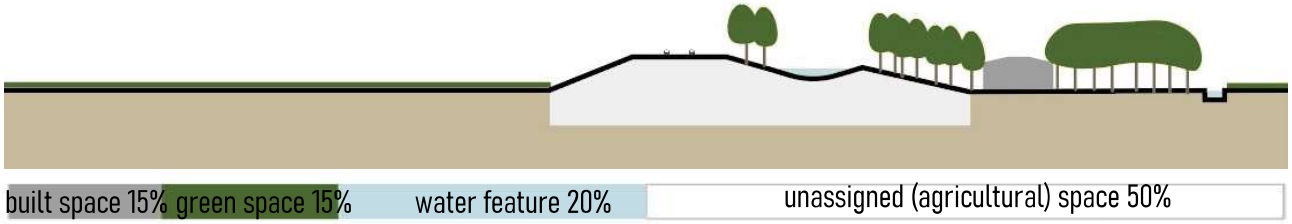


8. Thinly linear



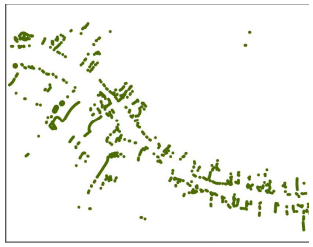
Typology background

- Landscape type: peat, lake bottom and river terrace
- History: developedn with town or infrastructure around 18, 19C
- Program: residential houses along the dike / railway and infrastructure in agricultural polder
- Forest pattern: linear linkage of blocks along river terrace and railway
- Tree density: 20-40 trees/ha



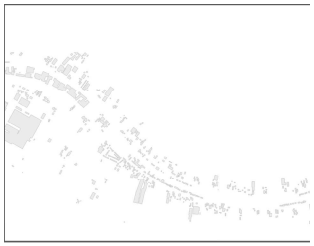
Characteristics of different layers

Forest layer



- Ownership: private owned forests by farms houses.

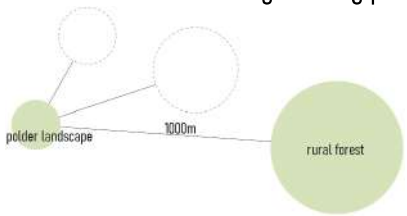
Social layer



- Building type: singel houses with barns and farm houses cluster.
- Infrastructure: dikes being the most dominant infrastructure, and mobility network like country roads, fast lanes, and railways follow
- Resident groups: high percentage of children(<=14) and elderly (>55)
- Accessibility to forest: this type usually locates in non-urban areas, which does not have much publich green spaces such as community park. However, its closeness to polder landscape provides basic ecosystem services. For more recreational function, rural forests are accessible within a kilometer.

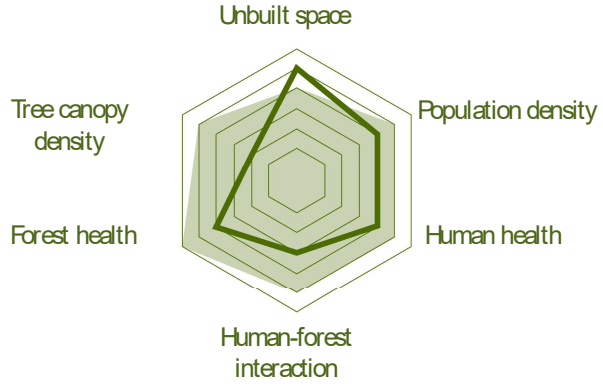
Health diagnosis

- The forest here is thin, distant, and rarely grouped. More over, there is low diversity of tree species.
- There is a lack of accessible communal green spaces as daily recreational destination and socail gathering point.



Health potential

- There is a lot of room for new forests and densification of woodland.
- To include forests of this type to the regional green network, linear corridor is the most effecient way to connect the forest habitats.
- Potential for new program on unassigned spaces such as new residential development and new forests.



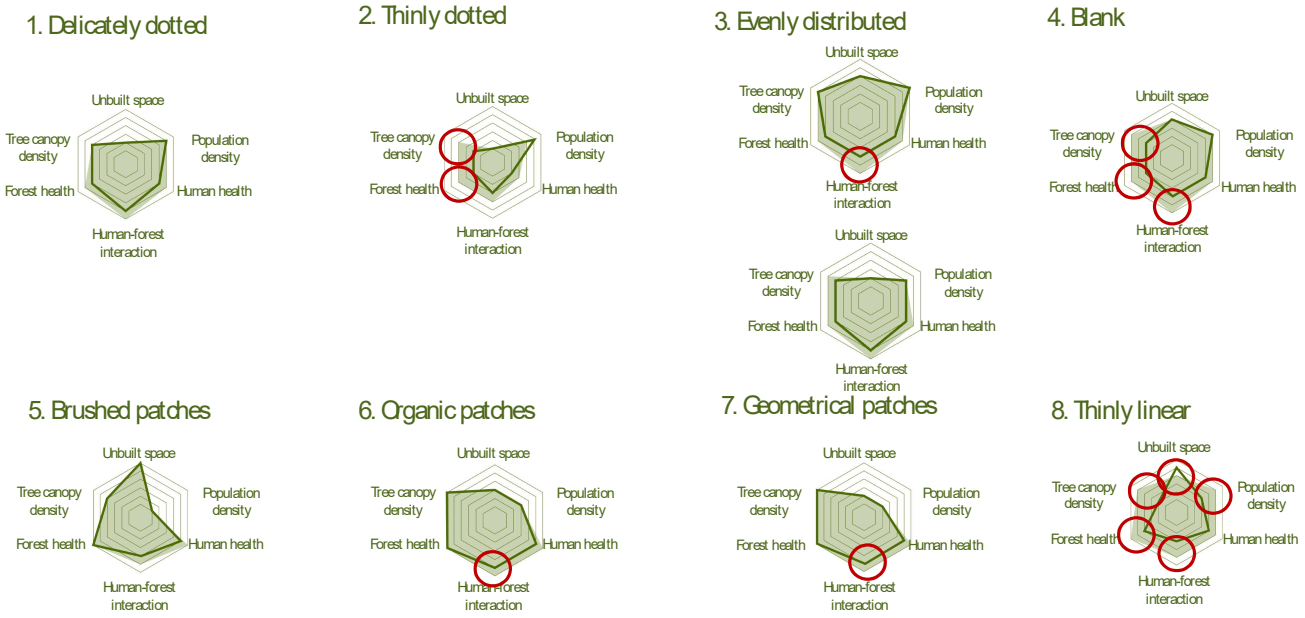
3.3 Conclusion and comparison on typology

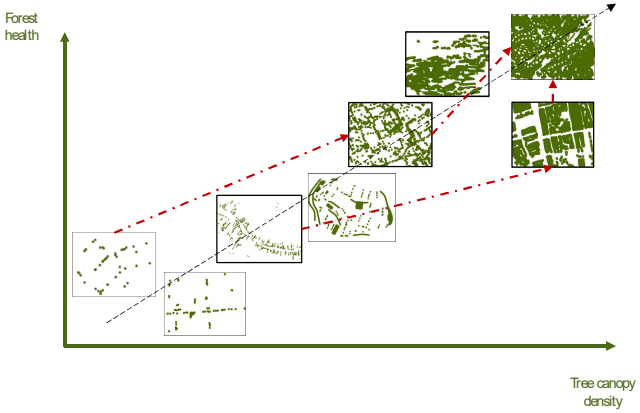
The potential types

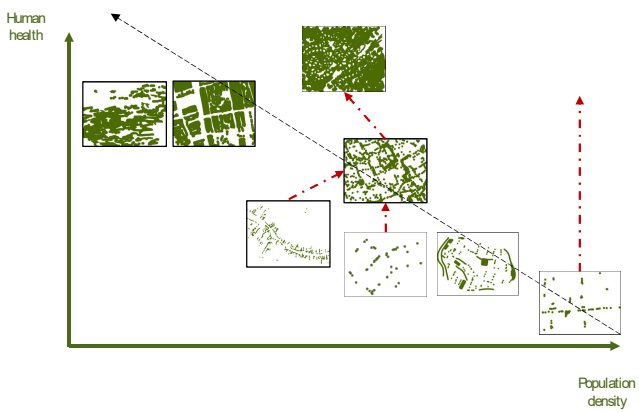
By comparing the rader charts of each types, one can tell that densifying tree density and straightening human-nature interaction are approaches maximizing potential of different types of urban forests. Among different types, type 2, 4, and 8 has the most areas which potential excesses the current quality, meaning that are the most potential types to be improve. Type 8 is particularly potential to larger, denser, and healthier urban forests as it includes a big amount of unbuilt and unvegetated polder fields for argricultural usage.

Possible transformation between types

As tree density and forest health has negative correlation, type 6, organic patches, is the ideal type of urban forest. By planting more forests in the polder broad field, type 8 can be transformed into type 7, and type 7 can be transformed into type 6 by linking to the natural landscape qualities such as water feature of soil type.

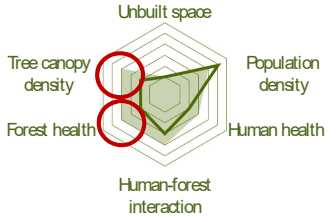


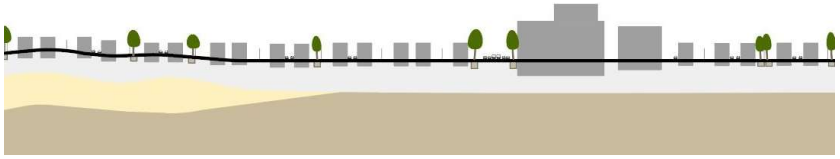


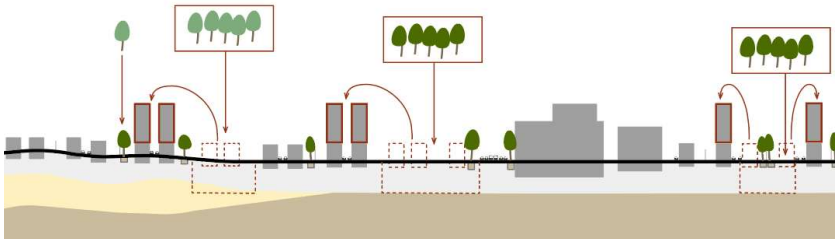


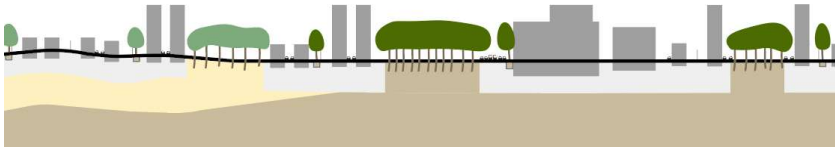
Strategy for forest densification in urban areas

2. Thinly dotted

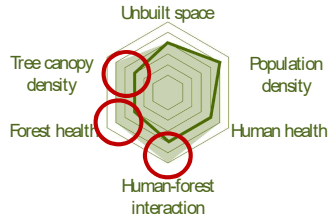


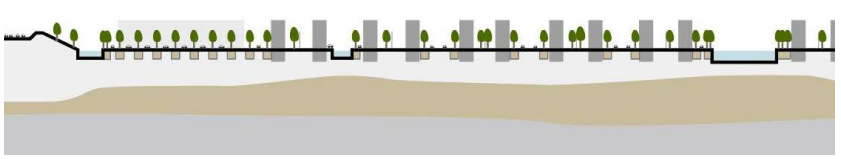


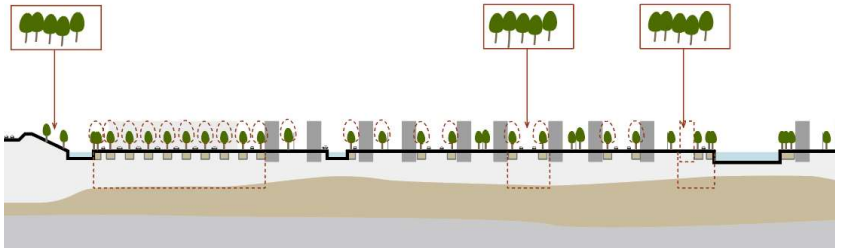


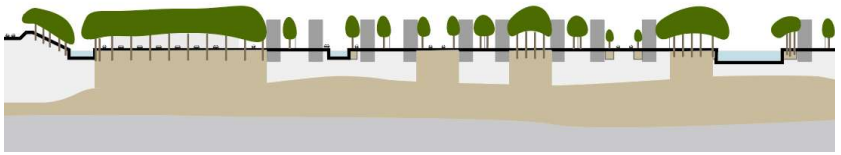


4. Blank







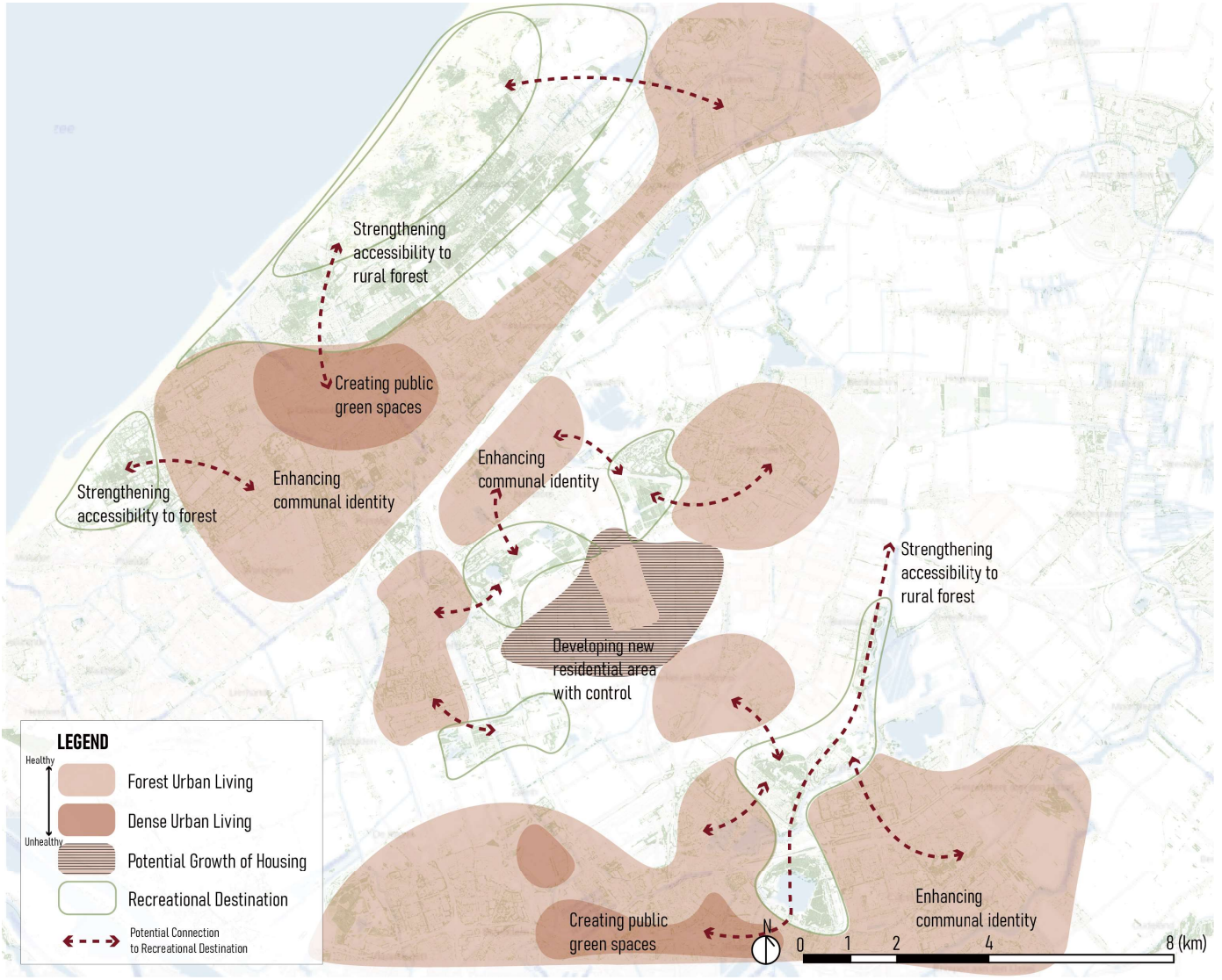


Conclusion: Forest Health

By mapping health level of each types of forest, it can be concluded that the urban forests of the area are divided into five levels of health. The healthiest forest locates at the natural dune area which should be conserved. The second healthiest forests are dense buffer forests which can be optimized by creating interconnections and connections to the urban areas. The largest part of the urban forest is forested urban area with moderate health level. Forest health of thus type can be achieved by densification and creation of conneciton. Another type of forest in urban area is young urban forest, which requires maintenance. The least healthy type of forest locates in urban areas of Den Haag and Rotterdam. Densification and linkage to rural dense forests can improve health level of this type.

Conclusion: Social Health

The social health condition of the area can be concluded into three levels according to density and accessibility to private and public forests. The most unhealthy districts loacte at the city center of Den Haag and Rotterdam, while most parts of the urban area have dense forests nearby as recreational destinations. Eventhough many residential communities are composed with houses eqipped with private yards, health level can be improved with provision of communal parks.



3.4 Regional vision in 2070

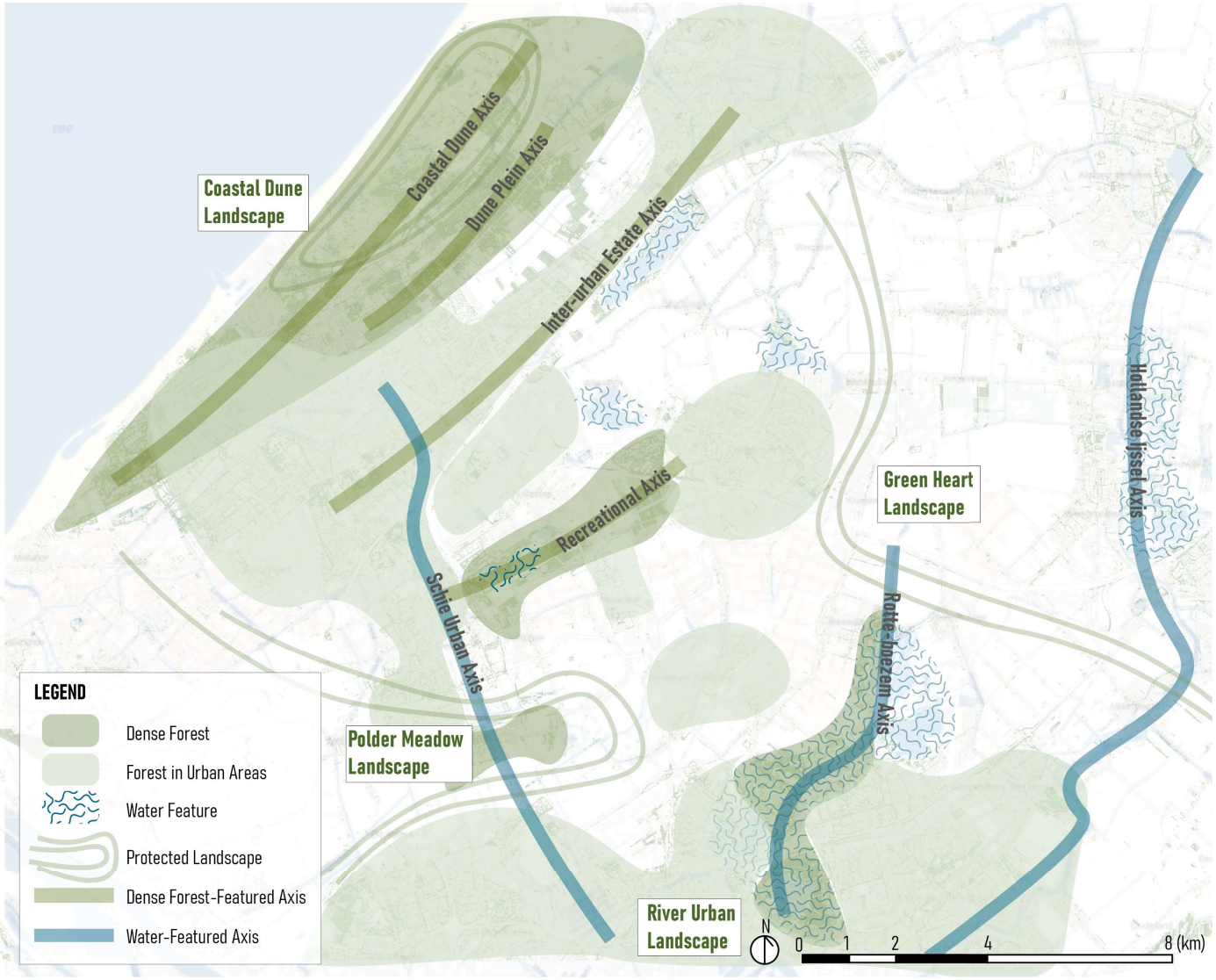
Green-Blue Infrastructure

Based on the existing urban forest types, the optimal regional green blue network is achieved with full potential of each types.

The region consists of four main types of landscape: Coastal Dune Landscape on the north-west; Green Heart Landscape on the east; Polder Meadow Landscape reaching from the west to the area between Delft and Schiedam; and River Urban Landscape locates at Rotterdam. Among four landscape types, Polder Meadow Landscape and Green Heart Landscape are not managed with clear boundaries, thus requiring more attention on their protection.

The green network is dominated by four dense forest-featured axes: Coastal Dune Axis linking the natural reserved dune area and Westduinpark; Dune Plein Axis with dense forests and villa houses; Inter-urban Estats Axis which connects Den Haag and Leiden; Recreational Axis with dense forests running from Delft and Zoetermeer.

The blue network is dominated by linear structures. Aside from that, there are more room for water required for the regional to be more sustainable.

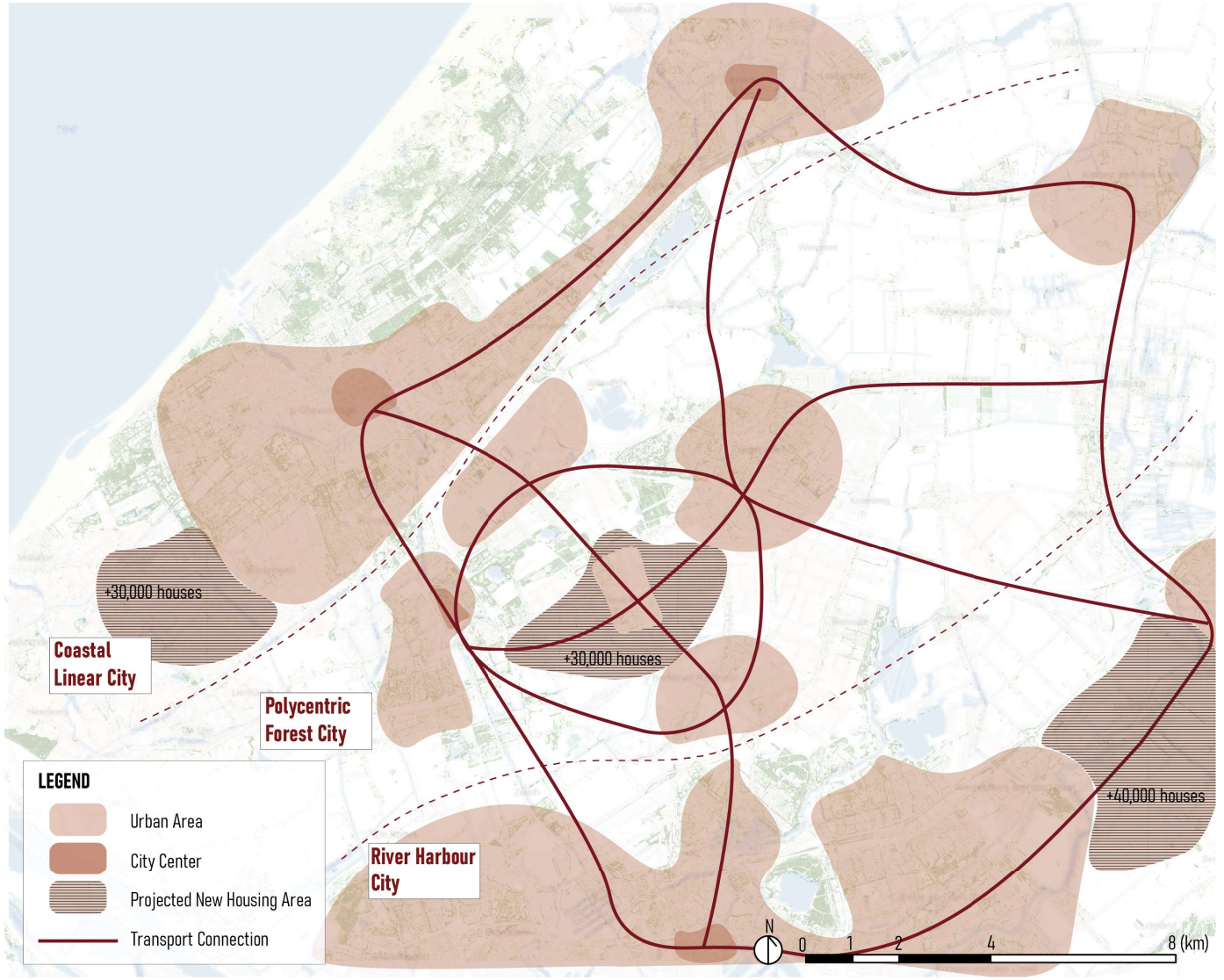


Development and Transportation

Numrous towns and urban centers in this region can be classified into three characteristics of cities: Coastal Linear City running from Den Haag to Leiden along coastal dune; Polycentric Forest City including Delft, Nootdorp, Pijnacker, Zoetermeer, Berkel en Rodenrijs, and even Alphen aan den Rijn; and River Harbour City including Schiedam, Rotterdam, and Gaoda.

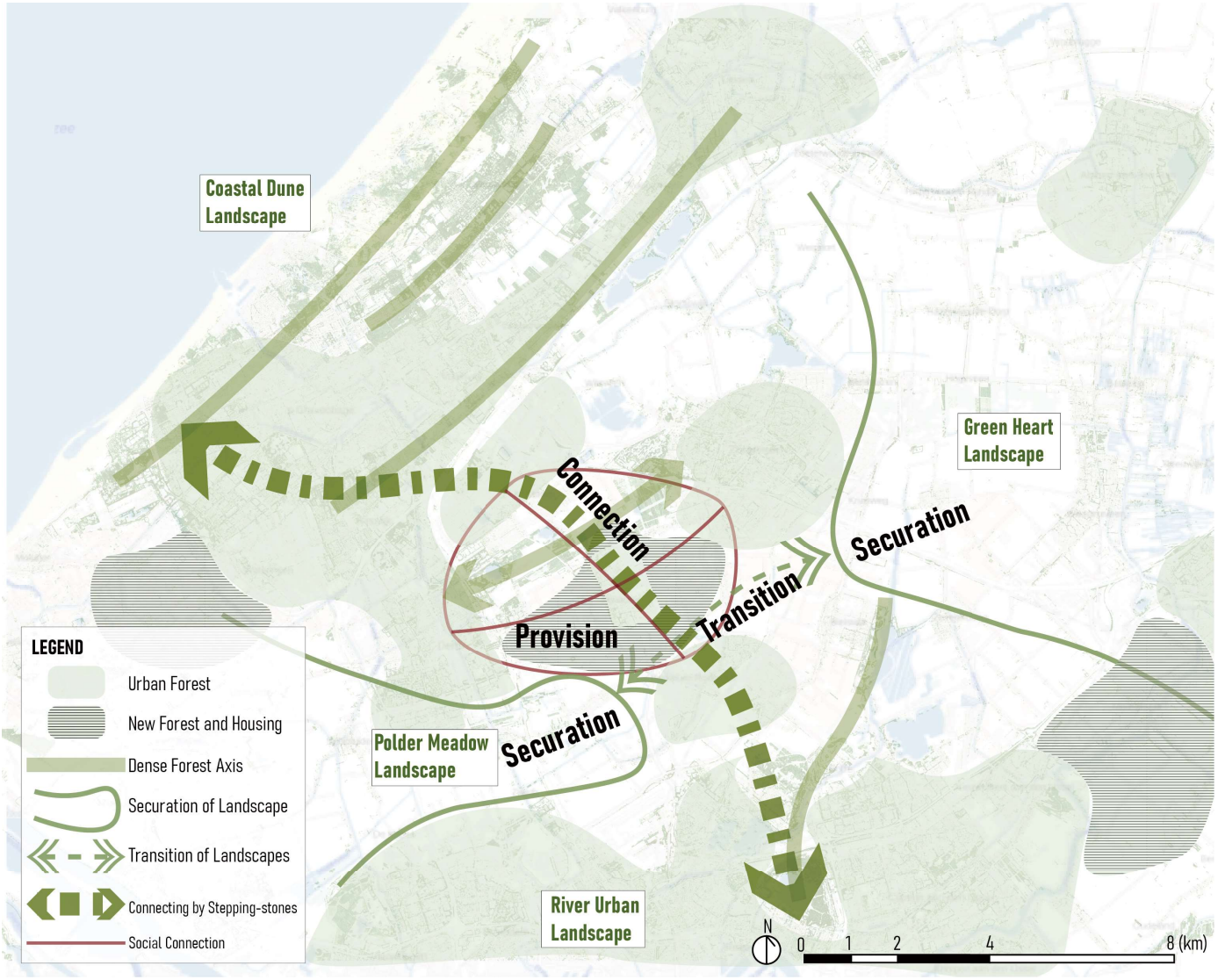
As 100,000 new housing are planned to be provided in this region, densification in current urban areas and new development from current green house areas are both contributable.

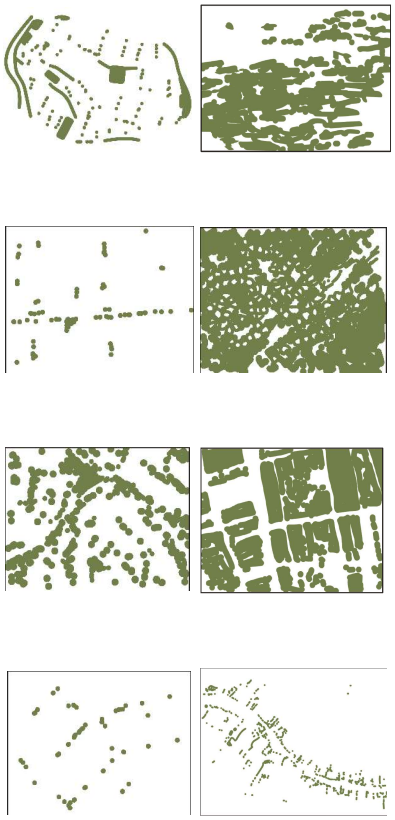
In terms of tranportation and connection, linkages are made based on existing highways and railways. It can be projected that Pijnacker will become the regional center with due to its location. A small circle and efficient interconnections should be provided between towns around Pijnacker to glue together the polycentic towns. A big circle should be provided to connect the whole region.

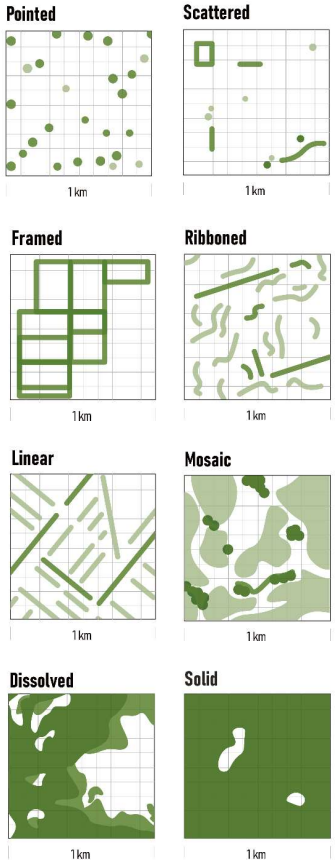


Conclusion

By overlapping the vision maps of green-blue infrastructure and development aspects, the importance of Polycentric Forest City become evident for that it takes responsibilities to the following roles: Connection, Provision, Securation, and Transition.



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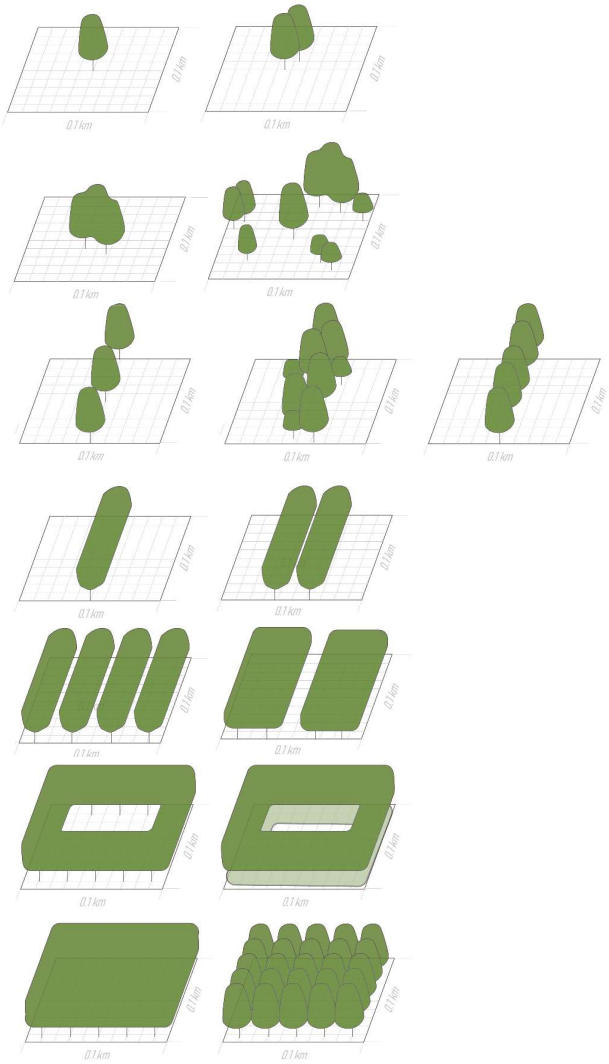


Part 4. Envisioning the inter-urban forest

4.1 Design Framework and Objectives

Designing the Inter-urban Forest

As concluded by the regional vision, the area between Delft, Zoetermeer, Noortdorp and Berkel en Rodenrijs plays a crutial role to regional forest and socail health. Therefore, a strategitic design is carried out focusing on this inter-urban area at the scale of 1:50,000 for the purpose of not only envisioning the realization of strategy but experimenting utilizing urban forest typology as a landscape architectural design tool at different scales.

Although the whole inter-urban area (framed by the dotted line on the diagram) is based on flat polder landscape, it is currently consist of several landuses like dense buffer forest, for example, Delftse Hout, Bieslandse Bos, Het Kasteel, Speelbos De Balij, and Westerpark Zoetermeer; two impoetant meaow bird areas including Stiltegoed and around Oude Leede; large areas of green houses. At the center of the area is Pijnacker, which is consist of residential houses and thin urban forest.

4.2 Probematique on site

Problematique of the Area

Apart from the problem and strategy concluded from the regional analysis, several problems on site reveal after zoming in to the inter-urban area at urban scale (1:50,000).

Land Subsidence and Urban Heat Island

Owning to the peaty and clayey geomorphological nature, land subsidence is a serious problem in this area paticularly at where green houses locate. Moreover, green houses are also the source of urban green island effect of the area, which is a threst to living quality and animal habitats. Therefore, countermeasures such as adapting building structure and water rechargement to soil should be taken in future design.

Climate resilience

Regional analysis of water structure shows clearly that there is currently limited room for water on the inter-urban site, which may lead to incapability to react against extereme climate events such as sudden and heavy precipitation and drought seaseons.

Hierarchy Among Forests

As 30,000 new houses are required in this area in the following 50 years, there is need for reorganizing the allocation of private and green spaces at different lelvels. For exmaple, not only new urban parks but new communal spaces should be taken into consideration in the plan.

Landuse after Green Houses

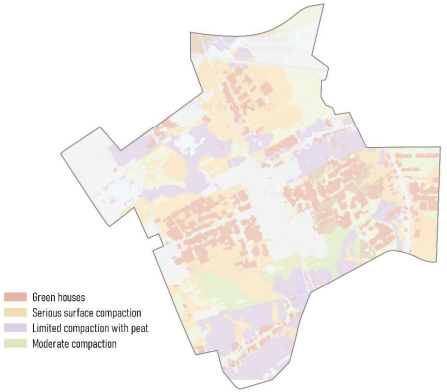
The area is currently highly oppucpied by green houses, which are projected to be moved to elsewhere in the following 50 years. Therefore, there is a high potential for new plan of landuse in the future.

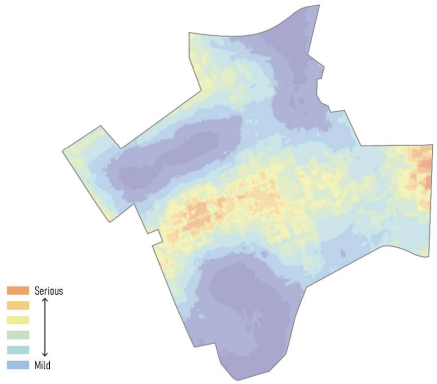
Complex Landscape, Monotonous Experience

Even with a diverse underlying landscape nature, the travel experience in theis area is currently dominated by monotonous townscape

Lack of Integral Identity

Due to the polycentricity inconvenience of the area, in addition to the inconvenient and unpleasant experience moving from one twon to another, this area has not formed a life circle, resulting lack of integral identity.





4.3 Design Strategies and Principles

Concluding from regional vision and problematique on site, the inter-urban forest is designed following the principles of Provision, Connection, Diversification, Sercuration, and Transition.

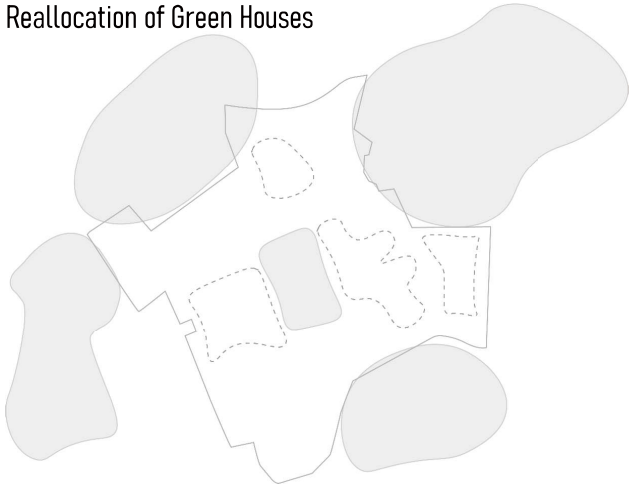
Provision

The provision principles includes relocating green houses and creating new forest and housing.

Reallocating green houses not only allow more spaces for new landuses, but solving the problem of land subsidence and urban heat island effect.

The area is responsibile for creating 30,000 new houses and 5,00 ha of new of forest. The development of urban area should be designed with control and forest is also designed by the tool of typology with health as the main objective.

Reallocation of Green Houses



Provision of New Houses and Forests

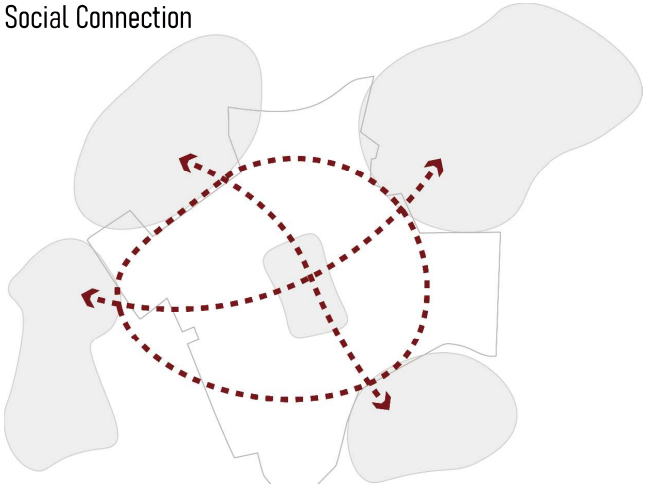
Connection

The idea of connection applied to both social aspect and landscape ecological aspect.

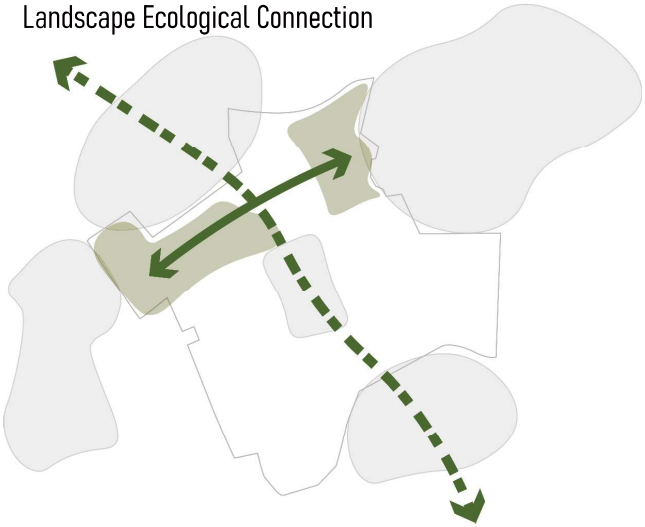
Connection between towns are created by a circular route and a cross route intersecting at Pijnacker. The connections aim at strenghtening identity by unifying five towns as one life circle.

Landscape ecological connection focuses on between dense forests of Delftse Hout and Het Kasteel, Speelbos De Balij. Another connection is created by scattered green spaces in urban areas as stepping-stones between coastal dune landscape and river landscape.

Social Connection



Landscape Ecological Connection



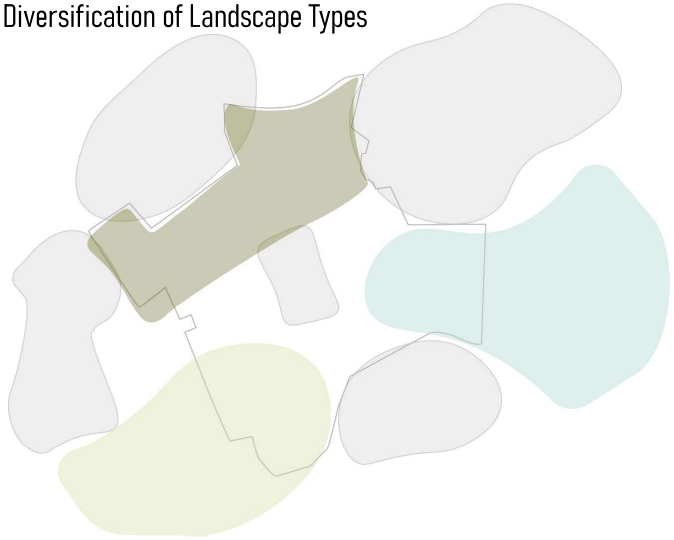
Diversification

To diversify monotonous current landscape on site, it is crutial to first identify the variety of underlaying landscape. Futhermore, to revitalize the natural landscape, participation of water feature is indispensable.

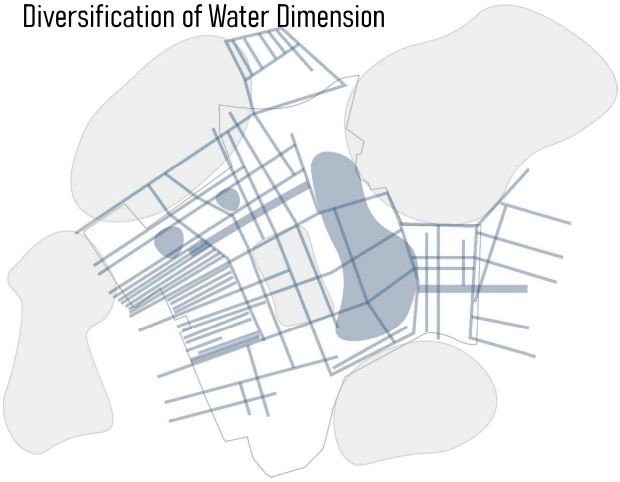
Natural(cultural) landscapes of the site includes polder meadow landscape and Rotte-boezem landscape and green heart. Each together with their soiltypes is potential to develope different biotopes of forests.

Diversifying water dimension by polder system, wetlands and ponds not only enriches recreational experience, reveals historical memories, but also enhances resiliency to extreme climate events

Diversification of Landscape Types



Diversification of Water Dimension



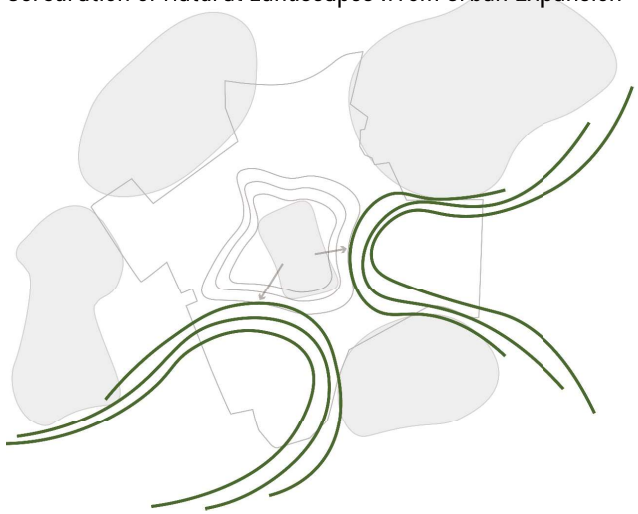
Sercuration and Transition

The area between Pijnacker and Berkel en Rodenrijs plays an important role in the landscape context as it is the meeting point of polder meadow landscape and Rotte-boezem landscape. Moreover, it is facing the pressure of urban expension, thus securation and transition of landscape is the principle applicable here.

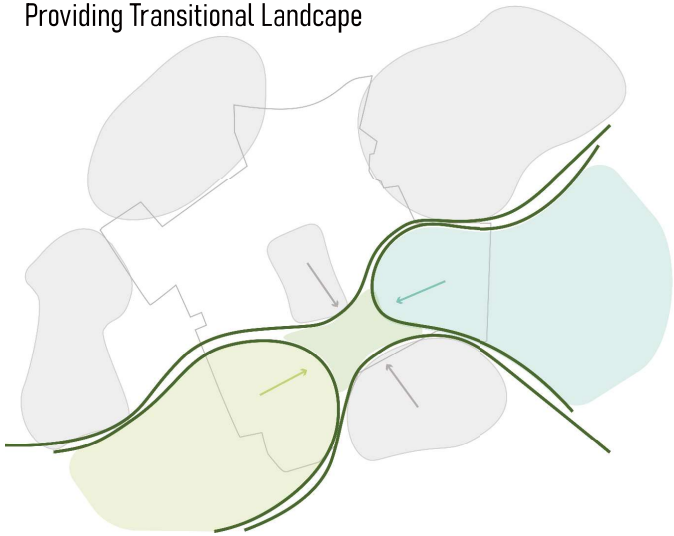
Securing the protected landscape against urban development means new residential development are located within boundaries, which may become the focus of intervention of highlighting and stregthening.

Transition between polder meadow and Rotte-boezem landscape is provided by intersecting characteristics from two landscapes and biotopes.

Sercuration of Natural Landscapes frrom Urban Expansion



Providing Transitional Landcape



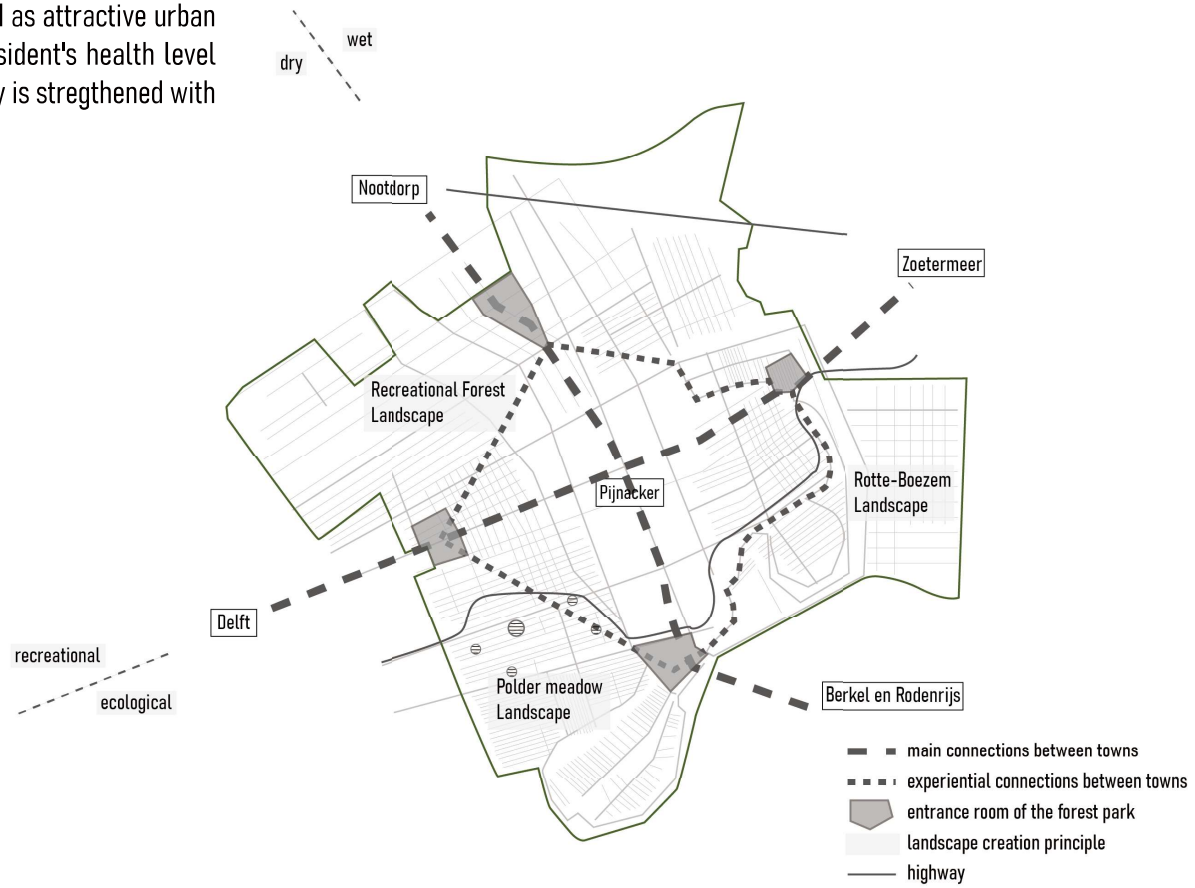
Conclusion: Basic Principles

The design principles can be concluded to the diagram on the righ.

The inter-urban area is divided by two main connections: Delft-Zoetermeer and Nootdorp-Berkel en Rodenrijs. The northern part of the forest focuses on connection of recreational function and the southern part focuses on landscape and ecological securation and transition. The contrary also exists from weat to east. The western part of the forest is suitable for mutural polder water level, while the eastern part allows more room for water retention, rechargement, and wet land condition.

The circular connection linking four towns on the other hand represents the boundary of urban expension from Pijnacker outword. The circular route itself functions as experiential highlight, of which the design is approached by forest typology of tree arrangement. This will be further elaborated in the following chapters.

The intersections of main connections and circular route are entrance to the inter-urban forest from towns. The goal of these rooms is to be designed as attractive urban livingrooms so that resident's health level is improved and identity is stregthened with frequent visit to forest.

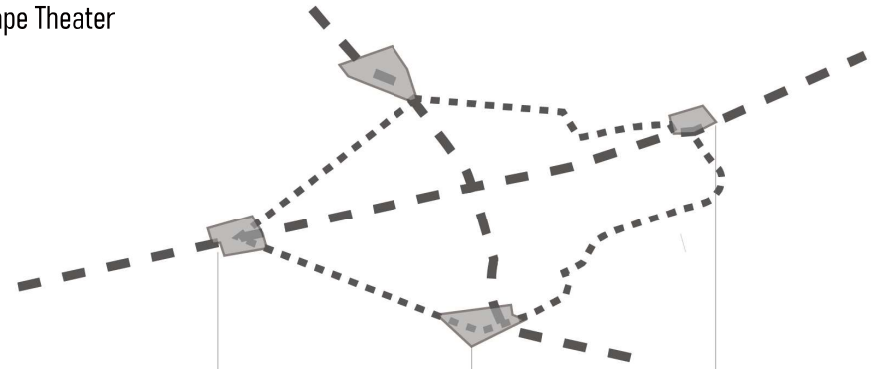


Two Scales and Time Frams of Design

The inter-urban area is envisioned with multifuntionality which should be carried out with wholistic approach including a long-term plan considering changes of social context and time taken for forest and biotope to grow. Therefore, this project proposes a scheme for dynamic programs in 50-year time frame. Due its large scale, the design is approached by tool of district pattern forest typology (at scale of 1: 5,000).

However, the four entrance rooms, main connections, the circular experiential route are aimed at attracting nearby residents and creating integral identity. The objectives are carried out from structural experiential design which focuses on spatial experience and program on human scale. Tree arrangement (at scale of 1: 1,000) is therfore reffered to as design tool. The goal of this part of design is to create a landscape theater in which visitors experience different forest arrangement, spatial atmospheres, and micorlimates echoing the complix and diverse landscape on site.

Structural Experiential Design:
Landscape Theater



Dynamic Program in Long-term

Part 5. Long-term Dynamic Program

5.1 Forest and Landscape Scheme

Geomorphology

As suggested in the theoretical framework, landscape which represent the geomorphological nature and genius loci on site is the most essential quality for forest health at a big scale. Therefore, the scheme of landscape type proposed is firest based on the soil type and micro-climate.

Water System

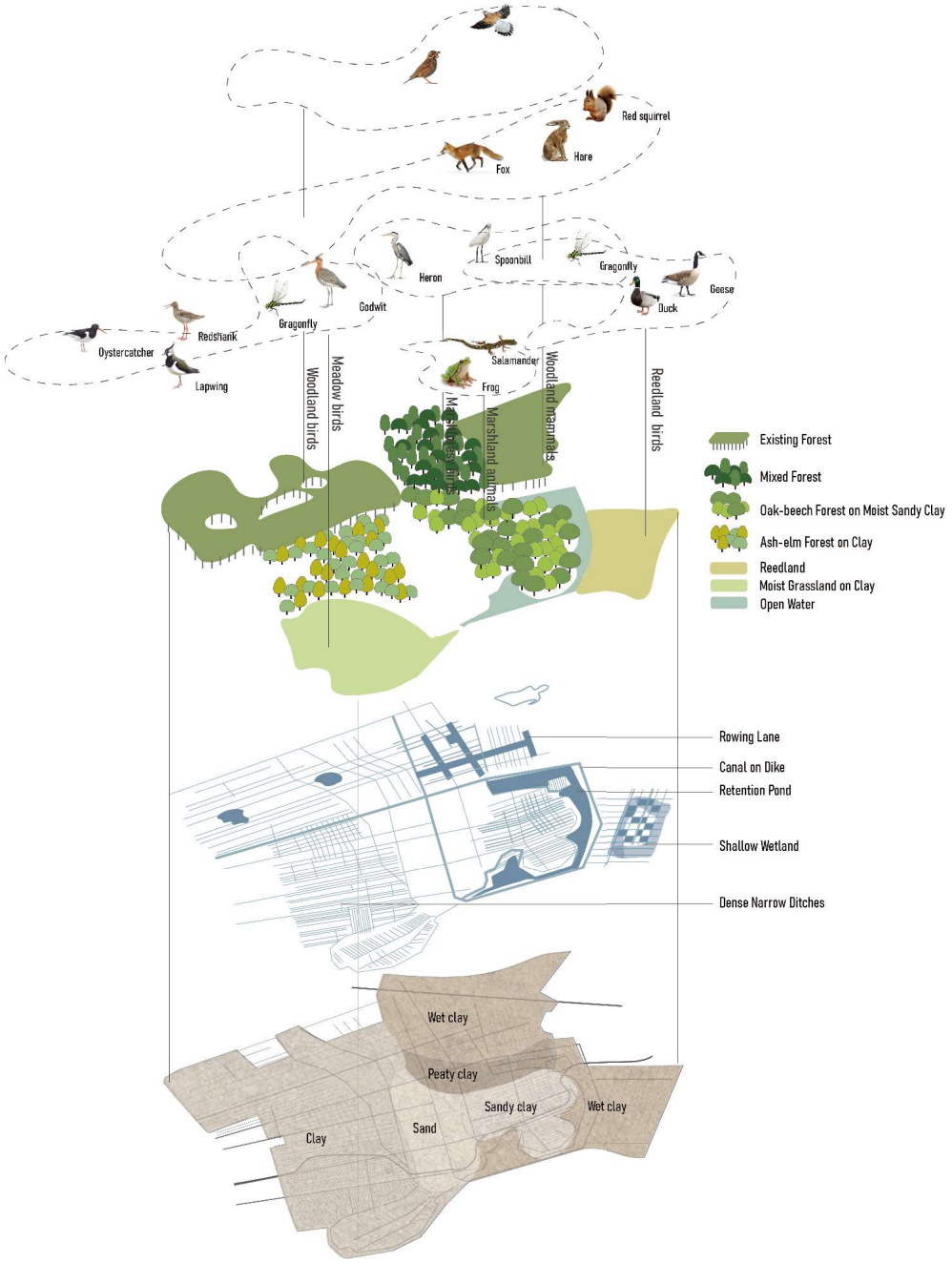
The scheme of water system follows the design principle of diversification, thus not only polder are revealed, ditches are also intensified and more water bodies are created to moisterize micro-climate. Water retention is carried out by a large size retention pond. Moreover, wide canals are designed for creational perposes.

Vegetation Type

To densify and diversify the forest in the inter-urban area, different types of vegetation types are proposed in the scheme: Ash-elm forest on clay, oak-beech forest on moist sandy clay, most grassland on protected meadow area and reedland as transition from Roote-boezem landscape to dense forest.

Ecosystem

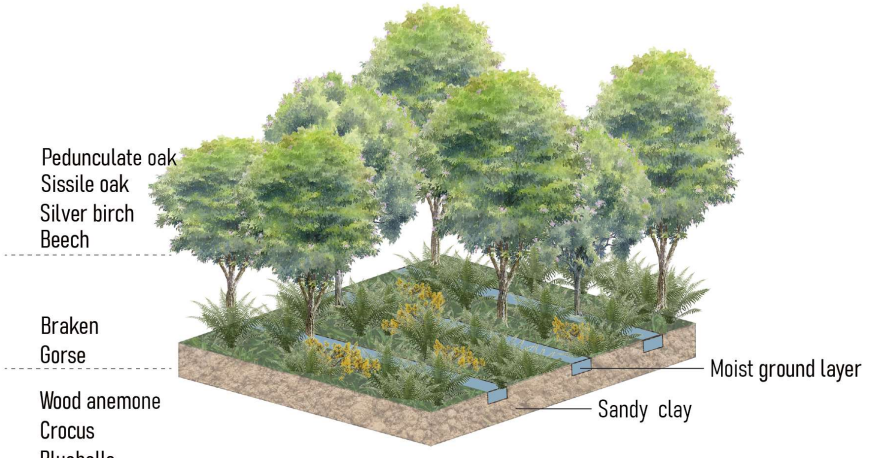
Each forest and vegetation type is attractive to certain types of fuana. As birds being the most common habitants, different types of bird are attracted to different areas. For instance, meadow birds can be found on grassland, duck and goose can be found in reedlnad, and woodland birds in the dense forest. Other animals such as small mammals are also attracted to dense forest, while amphibian and insects habit in open water area and reedland. With the diverse habitats, the inter-urban forest becomes the ecological hotspot of the region.



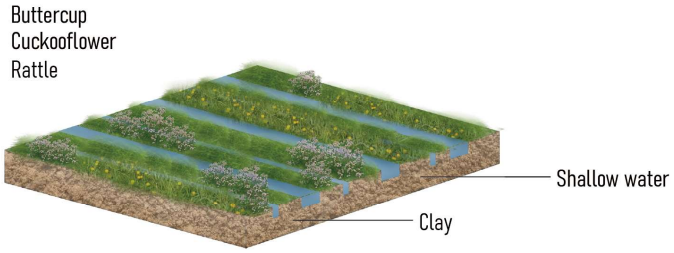
Forest Flora and Fuana

Ash-elm forest on clay

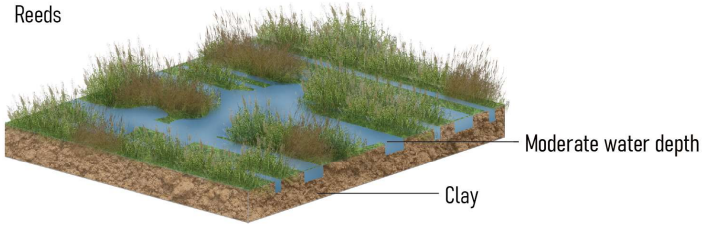
Oak-beech Forest on Moist Sandy Clay



Moist grassland on clay



Reedland



5.2 Social and Recreational Scheme

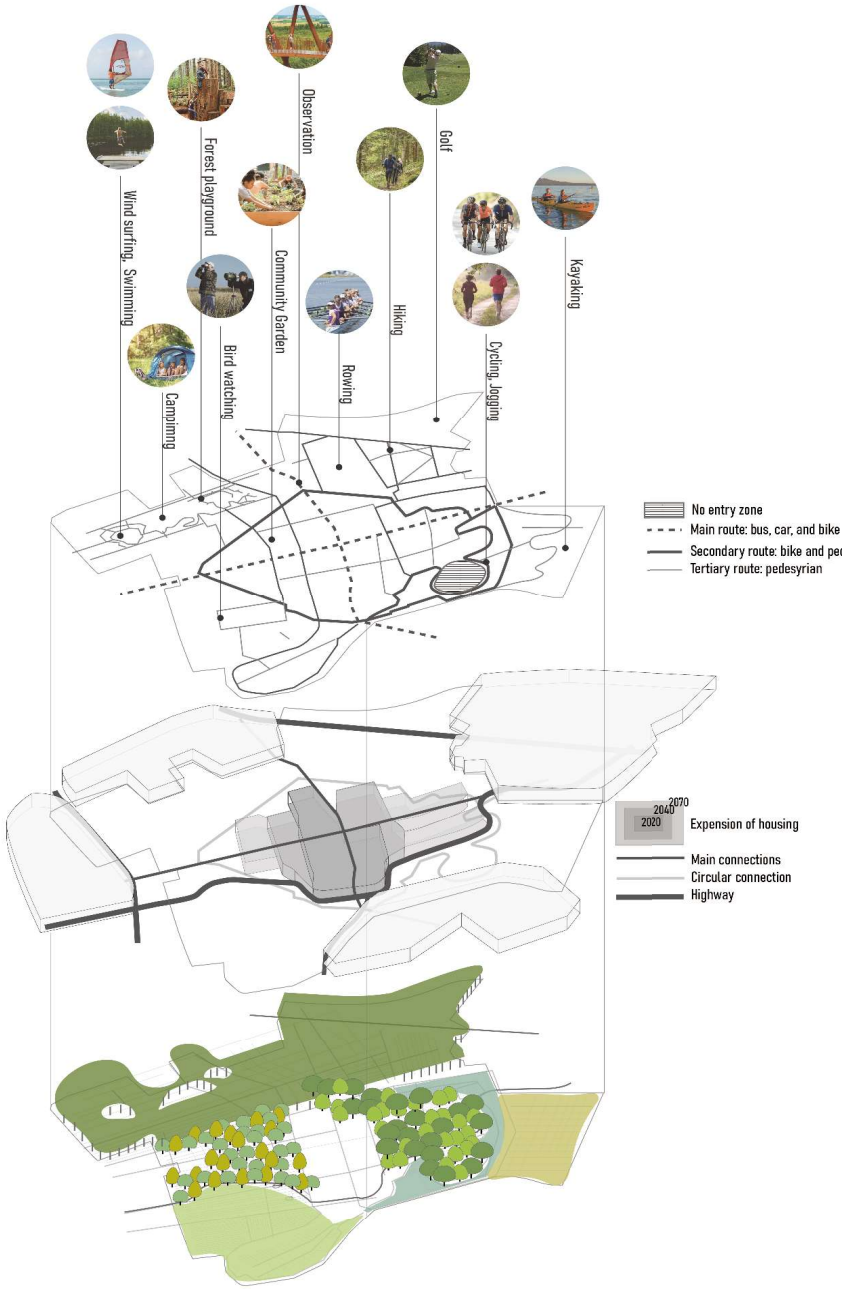
Expansion of Urban Area

New houses are provided expanding from existing urban area of Pijnacker.

The building of new urban area is realized in two phases as current green houses being relocated gradually. Up until 2040, 12,000 new houses are completed, and 38,000 more houses can be provided from 2040-2070. By 2070, Pijnacker is grown to the size of its nearby towns and the five towns are interconnected into one close life circle.

Recreational Program

Althought there are abundance of recreational program design along the main experiential route and four entry rooms, more recreational activities are allowed in the inter-urban forest as landscape forms by time. For example, water sports like rowing and kayaking are possible at the new canals and wetland. The existing hiking routes in Bieslandse Bos and Balijbos are connected with the new forest hiking trail in between. People are invited to interact with nature by bird watching, camping and playing in forest playground. The inter-urban forest is therefore becming a huge amusement park for everyone in the region.



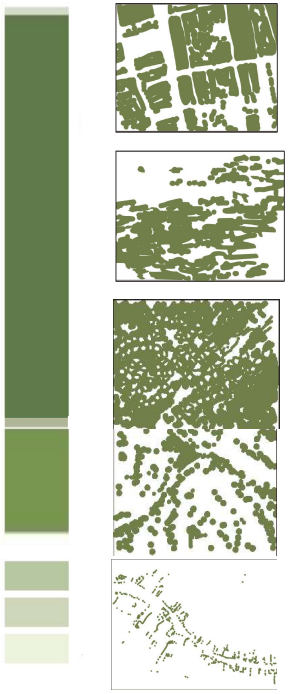
5.3 Spatial Scheme

Spatial Encloseness

In terms of spatial encloseness, the schem concludes landscape ecological and social program, showing the contrast between dense forest on the northern side of the main asis, and broad meadow and water on the southern side. Insede the circular route between four towns, whichi is also the border of urban expansion, it is designed with moderate spatial encloseness.

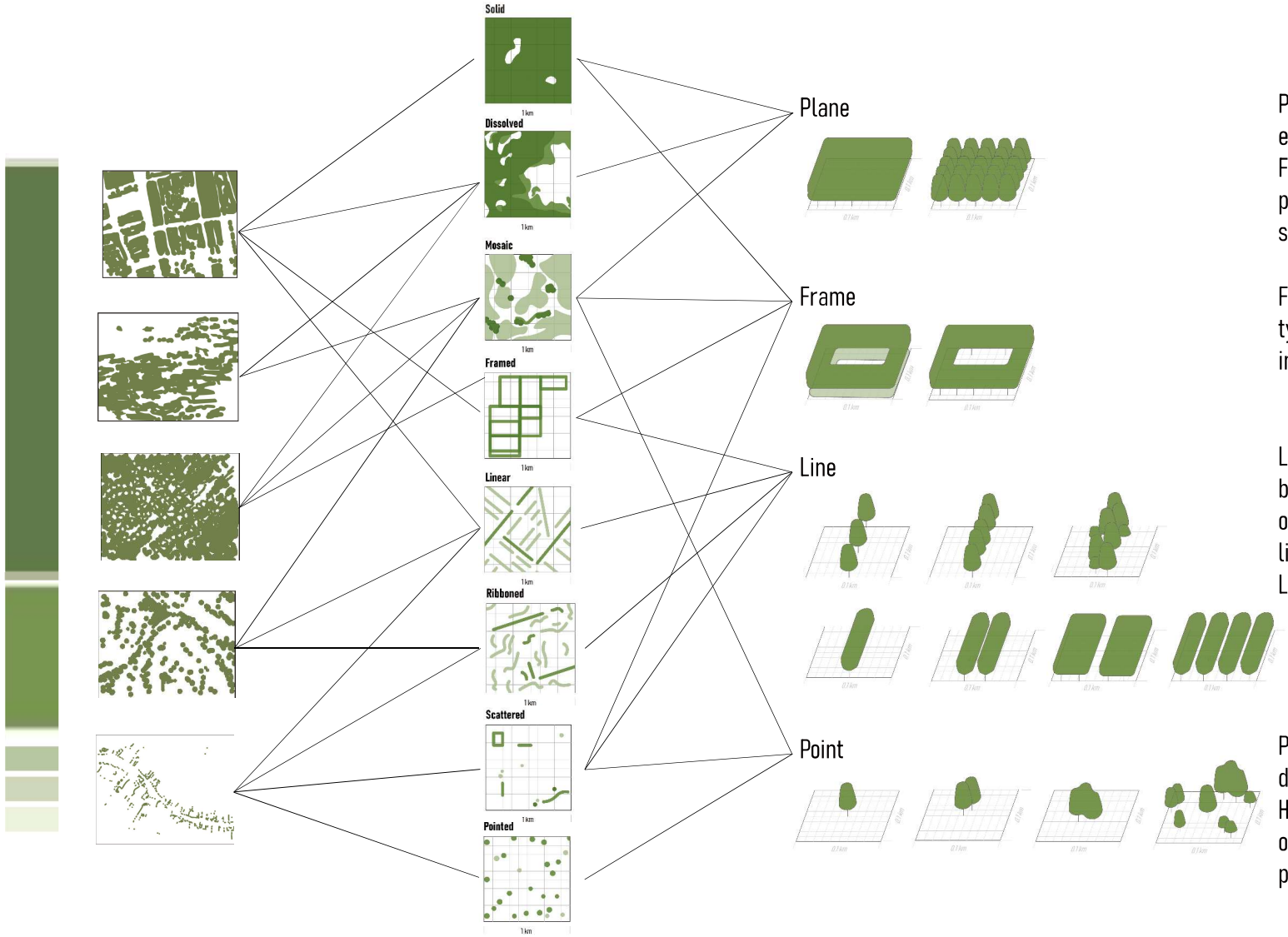
Typological reference

To envision the forest pattern of different encloseness, typology are referred to, especially the types with igh health level.
For the densest recreation woodland, 5-Brushed patches and 7-Geometrical patches are possible forms.
For expended residential area in forest, which is designed with moderate encloseness, typologies such as 3-Evenly distributed and 6-Organic patches are suggested.
For broad landscape of meadow land, retention pond and reedland, the health conditions of are not enhanced with densely planted forests but with less green houses and more water. Therefore, the forest typology remains to be 8-Thinly linear.



5.4 Design Principles

Typology through scale as a strategic tool



Plans are the most beneficial approach to ecological and environmental health.
From landscape ecological perspective, plans function as patches or stepping-stones depending on the scale.

Frames are program-wise the most flexible type, thus function as a protective approach in transition periods.

Lines are the most efficient connection between habitats. Lines can be composed of single to several rows of trees, or even linear patches of forest depending on scale. Lines function as ecological corridors.

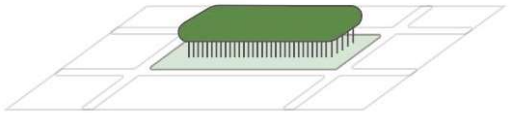
Points are thin and disconnected, thus do not provide mych ecological benefits. However, a point of trees is standing out from flat surounding, which make it possible to function as eye-catcher.

Typology and Polder Landscape

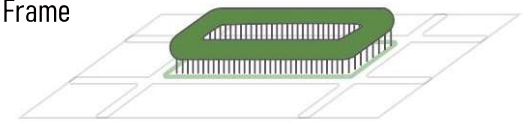
As forest typologies and types of tree arrangement are generic spatial design tool, landscpae characteristic of site should be extracted and applied in design to enforce genius loci.

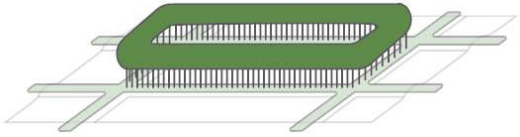
Polder landscape is dominated by water infrastructure such as ditches, canals and dikes. The elongated gridded land slot is also a characteristic spatial element of polder. Therefore, to integrate site soecificity to typological design tool box, the arragement of trees should follow polder slot in flat and dry condition, and to follow dike ay areas with dynamic ground level.

Plane

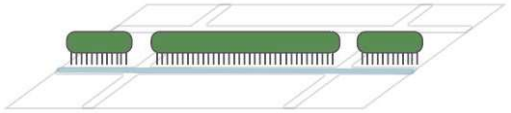


Frame

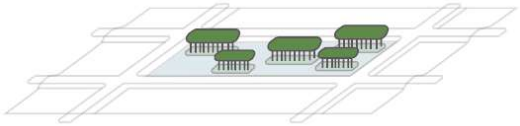




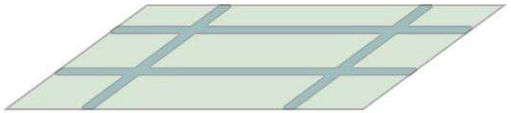
Line



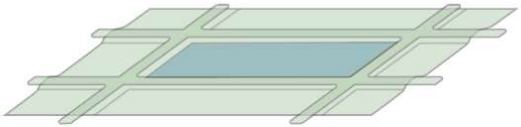
Point



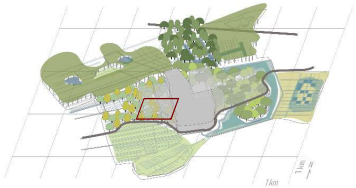
Following polder slots



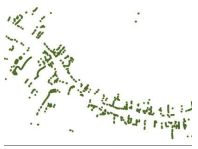
Following Dikes



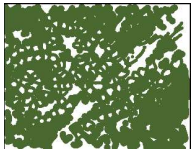
Housing and Ash-elm Forest



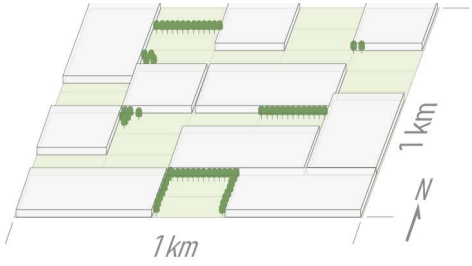
Before



After

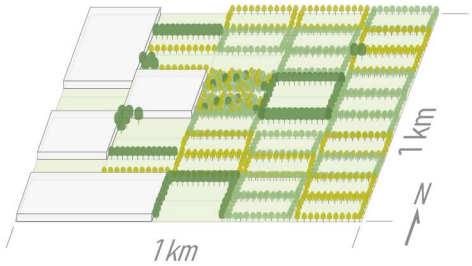


2022



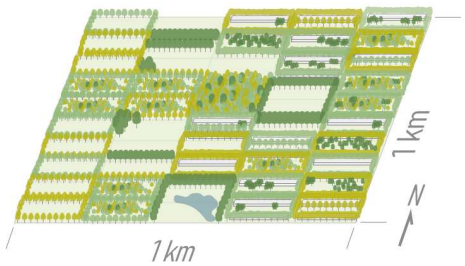
The area is currently occupied by green houses. Although there are some scattered groups of trees, the forests are not interconnected.

2030



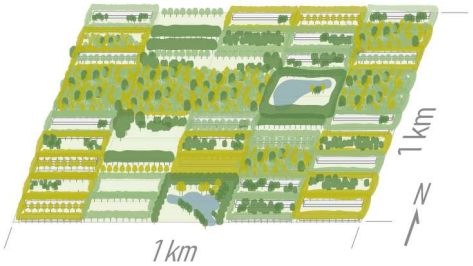
The east half of the green houses are relocated in the first phase. The empty polder slots are first secured with tree lines framing the fields to prevent infrastructure dominated development and to provide ecological connection while leaving flexible program. Few slots of polder are planted densely planted with trees as future ecological hotspot.

2050



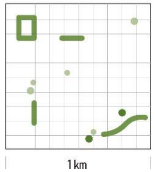
The west half of the green houses are relocated and similarly replaced with tree line frames. On the east half, building of first 3,500 houses are completed while framed forests have grown to interconnect. Forests are connected as growth of canopies. Dense forest are planted on more slots, and communal green spaces are also allocated inbetween houses.

2070

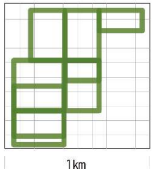


2,000 new houses on the west half are completed. Existing forests and new back yard forests are interconnected, and a new green network is formed.
Recreational destinations are provided at different scales, including 24 ha of urban scale woodlands, district parks and commumal green spaces.

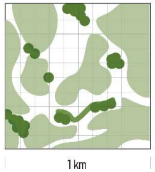
Scattered



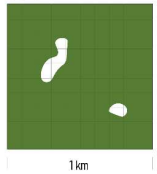
Framed



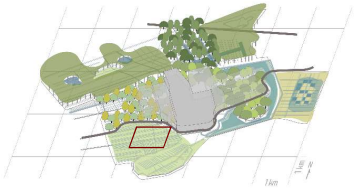
Mosaic



Solid



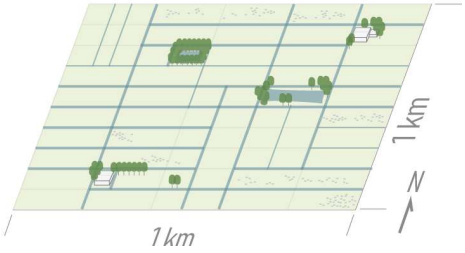
Pasture and Meadow Bird Grassland



Before

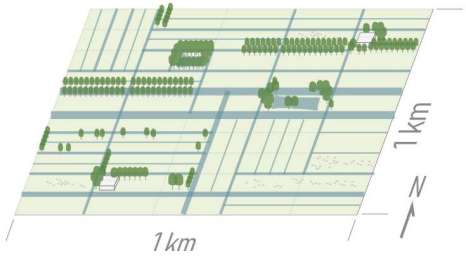
After

2022



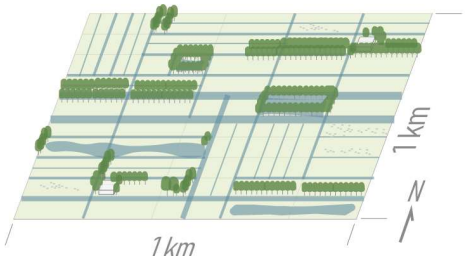
The area is now meadow bird grassland and pasture for cattle grazing. There are currently a historical duck decoy which is a framed forest. Asie from the duck decoy, there are only few scattered tree groups and short tree lines.

2030



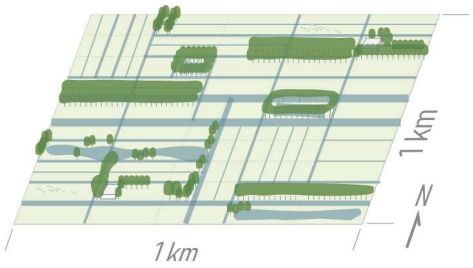
The firsr phase of intervention includes planting new forests are in linear form which leads sighline to highlight the broadness of polde rlandscape and simultaneously providing ecological connections.

2050



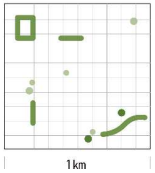
The following phase focuses on widening main polder ditches and creating more water features to regulate grazing field and saperate it from grassland for ecological purposes.

2070

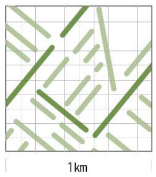


The tree lines have grown to become linear forests which is important as ecological corridor of the area. The broad spatial characteristic of polder landscape is preserved and highlighted.

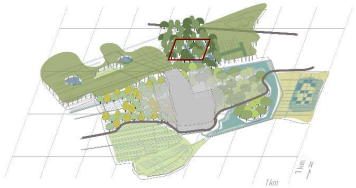
Scattered



Linear



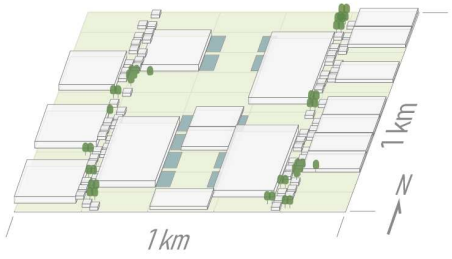
Rowing Canals in Dense Forest



Before

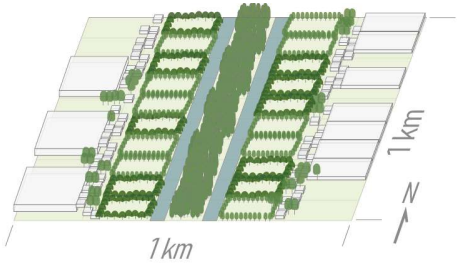
After

2022



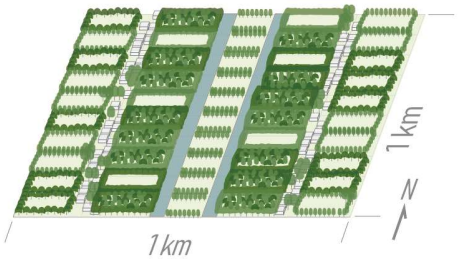
The area is dominated by two dikes with houses on each sides and green houses behind. There are some ponds by the green houses for agricultural purposes. Only few tree groups are currently here0.

2030



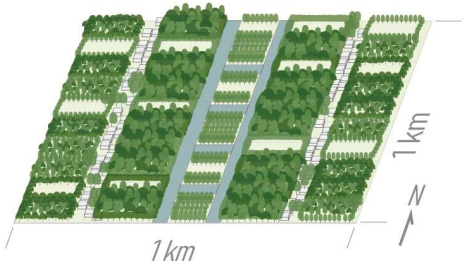
Green houses in this area are partially relocated, and the ponds are connected and widen as canals for rowing sport.
Forests are planted in this phase, including dense planting of fast growing species such as Poplar and mixed species forest in the form of poder frame to secure provide connection and to leave flexibility to the landuse.

2050



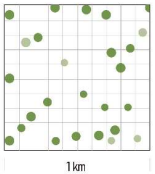
More green houses are relocated and more room are possible for new forests. There is more densification in this phase such as new framed forests and dense forests. Poplar forest is harvested after 20 years of growing is replaced by new tree lines.

2070

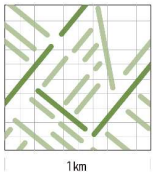


The area becomes a large dense forest which characteristic water recreational program, while dikes and houses from before 2022 standing still and coexisting with the changing context.

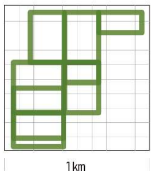
Pointed



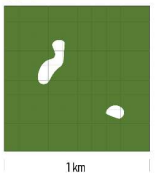
Linear



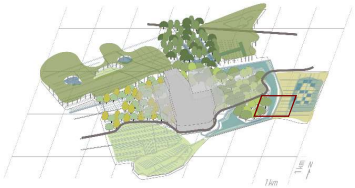
Framed



Solid

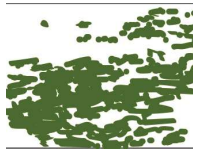


Retention Pond and Reedland

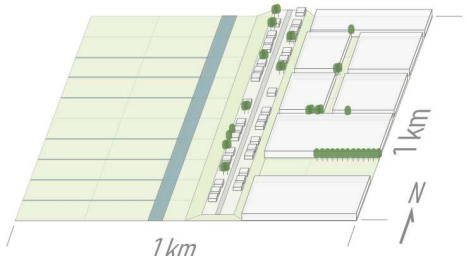


Before

After

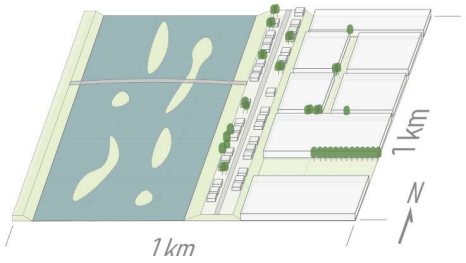


2022



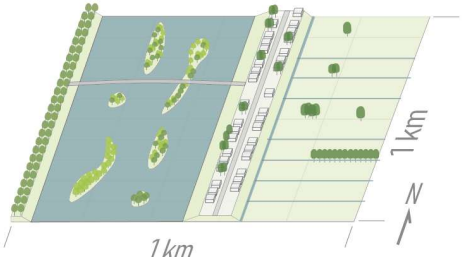
The area is currently divided by a dike with houses into two parts: polder and green house. There are currently scattered tree groups by houses or between green houses.

2030



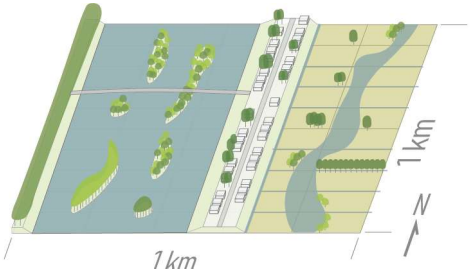
In 2030, a retention pond is built by earth excavation and reused on site for a dike. A connection bridge is built across two sides of the pond in this phase.

2050



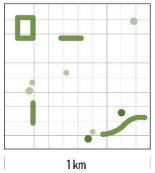
More forests are planted as islands in the retwntion pond and along the dike.
On the other side, green houses are relocated and polder ditches are revealed to create more moist microclimate for growing reedland.

2070

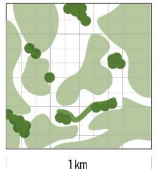


As forests along the dike and in the retention pond grew, reedland is also formed in this phase with more room for water created. Recreational programs like kayaking and bird watching are introduced in this area.

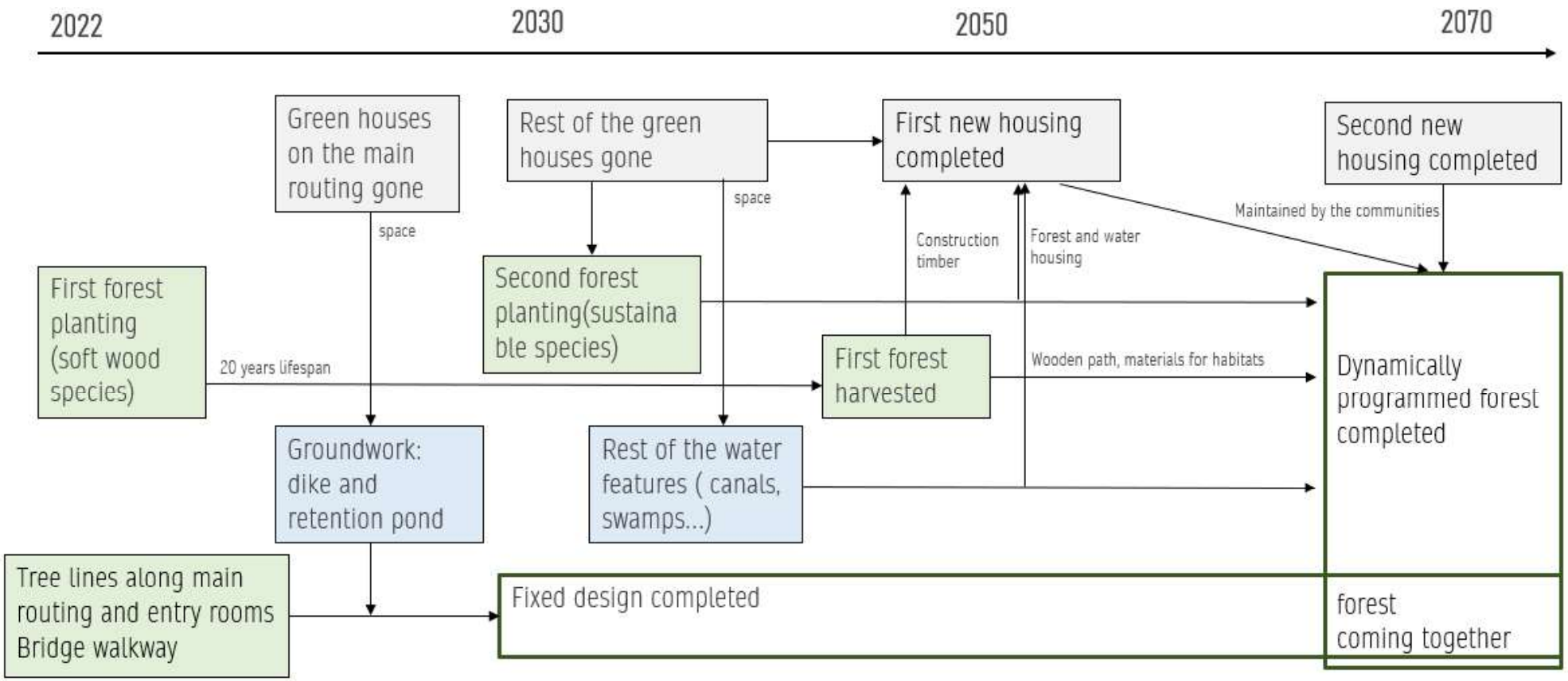
Scattered



Mosaic



5.5 Phase and intervention



Part 6. Structural Experiential Design: The Landscape Theater

6.1 Program and Spatial Scheme

The designed route not only aims at providing connections bentween five towns, but creating a diverse and pleasant moving experience. The experience is designed by different topology levels, moisture, spatial encloseness, and sound.

Typology level

Typology levels created by walkway on dikes, on flat wooden pathway in polder lands, and on a elevated walkway in the forest. There are four nodes of intersection on four sides of the walkway, functioning as main gathering points and where programs are provided.

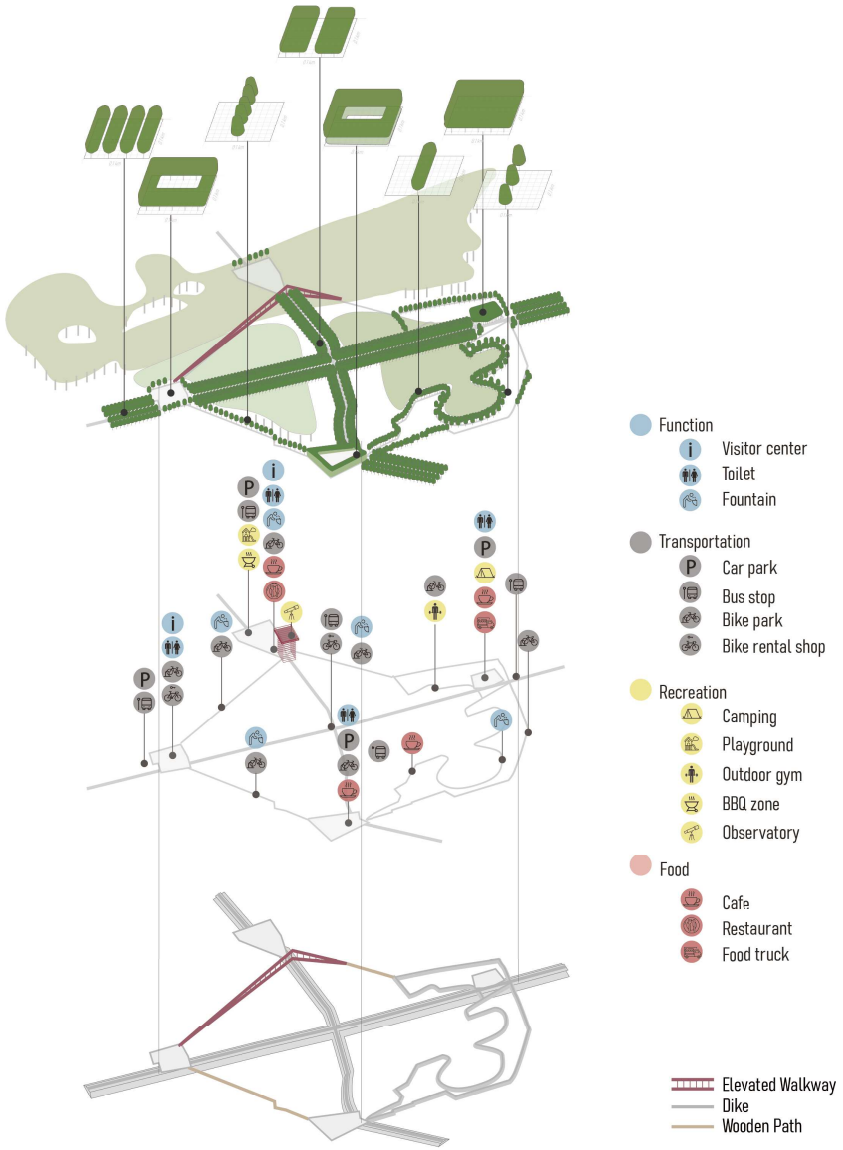
Program and Image

On the west side where the inter-urban forest connects with Delft, the entrance is a room on dike where visitor center and bike rent are provided. The node on the northe side is marked by the highest point in the area: an observatory above forest canopies. Other facilities like cafe and restaurant can also be found there. The node connecting the forest and Zoetermeer is an island with pavilion in the retention pond, where camping and foodtruck are allows in an enclosed atmosphere.

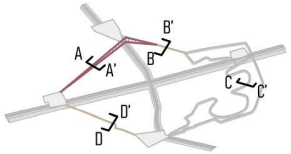
Spatial atmosphere and tree arrangement

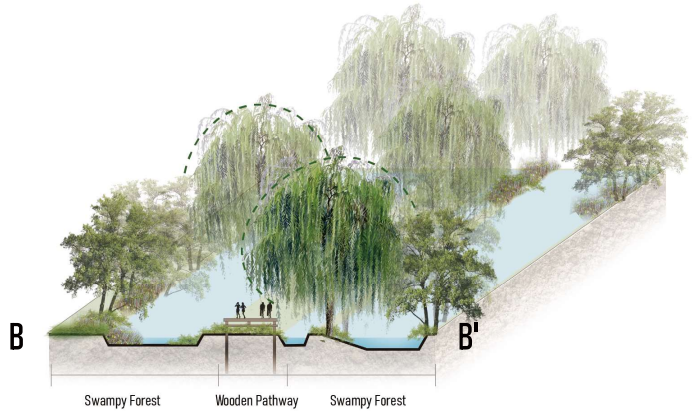
To create diverse experience and to highlight clear way finding of the area, different arrangement of tree lines are planted along the routes. On the main corss of routing, eight rows of trees are planted beside the dike, creating a semienclosed atmosphere of avenue. The tree lines are more diverse along the circular route. Distance between trees varies and in some parts there is only single line and in some parts tree lines double.

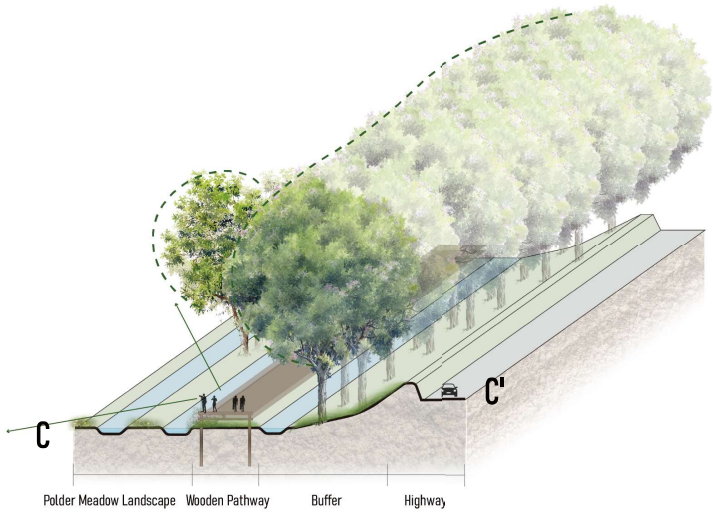
Interms of the space of node spaces, there are frame of tree and frame of tree plue undergrow vegetation, which creates even more enclosed walls. The plvilion connecting Zoetermeer is made by densely planted wood to form a plane of ceiling, leaving no undergrow vegetation and allowing more activities happen.

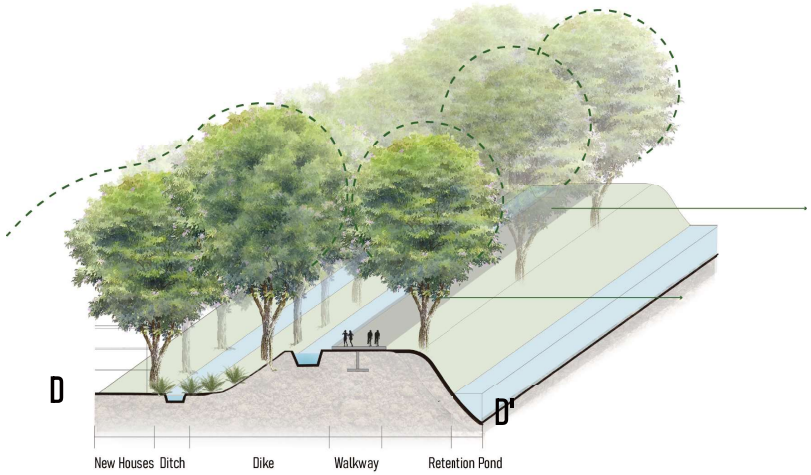


6.2 Four Levels of Walkway

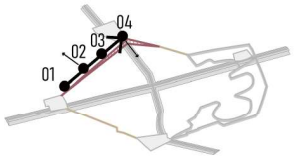


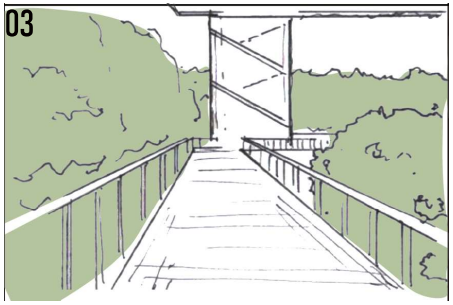


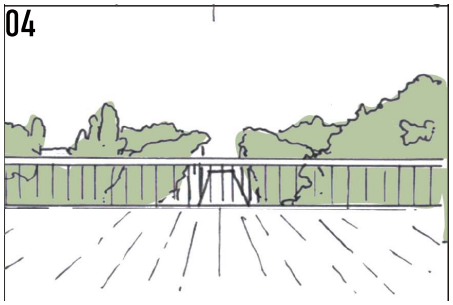


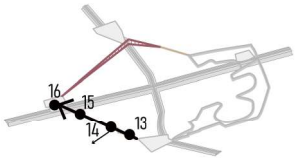


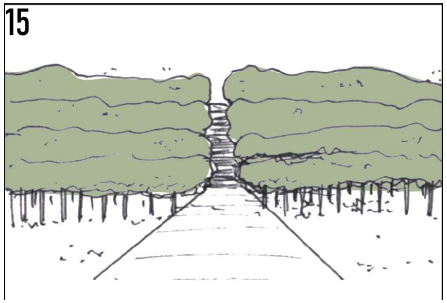
6.3 Experience Along the Route

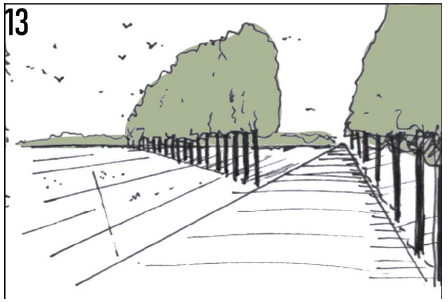


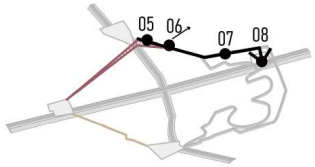








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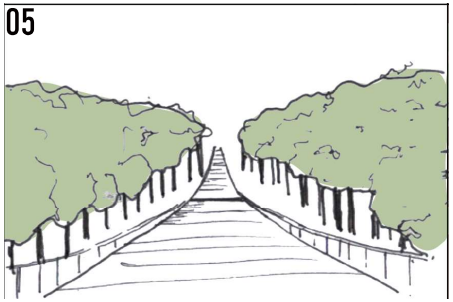
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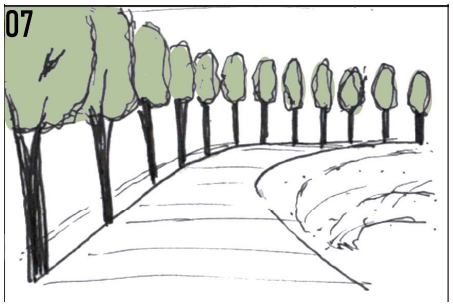
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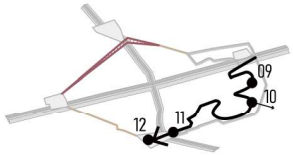
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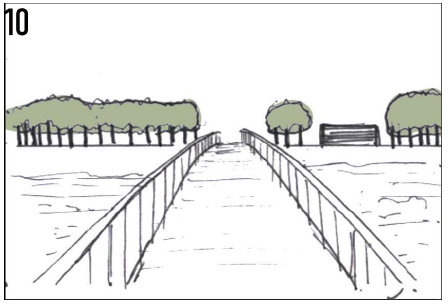
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09

Part 7. Conclusion and Appendix

7.1 Conclusion and reflection

Project conclusion

The project caries out an experimentation utilizing pattern and morphology studies of urban forest as tools of landscape analysis and design. The conclusion from reginal analysis indicates that densification in existing urban context is possible and beneficial from both perspectives of building more interconnected green network and enhancing physical, mental and social health of urban population. It is also concluded that it is not enough merely to densify forest in urban area. More potential from polder landscape, which is currently occupied by green houses, can be maximize. This idea also leads to the planning of inter-urban forest.

From the inter-urban forest design, it is evident that planning for such large scale, long-term projection is important. Society need and potential change should first be defined, and phaseing is the main approach to construct the long+term thinking. Interestingly, forest typology is found to be changing from one to another in different phases of time. This finding proves and strengthens the potential of "unhealthy types".

The last part of experiential routing design concludes the spatiality of tree arrangement at human scale and how it is carried out from decomposing district pattern. This part demonstrates the retationship of forest typologies through scales. The result of this part also proposed the answer to how can landscape meet forest health and human experience: linking typology at urban and district scale, which focus on forest and ecological health, and arrangement on human experiential scale.

Reflection

To examinate if the project approach led to the desired outcome, there is need to look back at the aim and contribution written in the beginning phase of the project: to apply the spatial design method of landscape architecture to urban forestry, and conversely to look at landscape design with the novel perspective of urban forestry.

As aims and objectives being fulfilled, the approach was proved to work well in this project. I would say the objective targeted site analysis is the key to a working project approach. The health conditions of forest in south-east Randstad area were thoroughly evaluated according to theoretical principles of healthy spaces. First by typological analysis on urban forests, generic quality profiles were built with regarding theoretical criteria. At this stage, theory basis for forest health includes landscape ecological perspective and physiological ecology, and the one for human health includes accessibility to programs and spatial experiences. The result from mapping the typologies and units on the site clearly indicates the healthy parts and weak points of the site. Moreover, generic typologies could be used instrumentally as toolbox of design intervention.

Assumption and Limitation

During to time and resource limites, a lot of consideration regarding social and technical facters are disregarded in this project. For instance, it is projected to be major mobility change in the next decades. In 2070, infrastructure like highway and railway may disappear or be relocated underground. However, this factor is regards large amount of studying and social knowledge, which is not possible in my one year timeframe. Other assumption includes mainly relocation of green houses is, on the other hand, requiring more evidences to be validated.

Suggestion for further research

For future project working on the same topic of urban forest typology and health, I would suggest a stronger definition on health from human perspective and for what extent can population health enhanced by forests. In this project, only accessibility and experience are taken into consideration, which are indicated at smaller scale. However, it is absant on regional and urban scale. Therefore, grenn-blue infrasture planning and ecosystem services should be more emphasized in future research.

Another suggestion would be more research on vegetation under 20 meters. Although the framework of urban "forest" fouses on grown trees, I believe that other vegetations also provide ecofyftem services and are crucial for ecosystem health. In addition,as broad polder landscape being the characteristic nature of Dutch lowland, it requires deeper thinking on how to define the "healthy forest" for polder landscape incorporating the broad spatialitty.

7.2 Appendix 1: Glossary

Forest
Group of trees, regardless of group size
Always relates to cultural background.
Forest can be quantified as >0.5 ha, > 30 m width, and canopy over >60%

Urban
Area where is populated, constructed, or visited by human

Health
A status of high live quality, which includes free from illness, restriction, or destruction.
A status of abled to interact and develop relationship with fellow specie and other creations.

7.3 Appendix 2: Bibliography

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