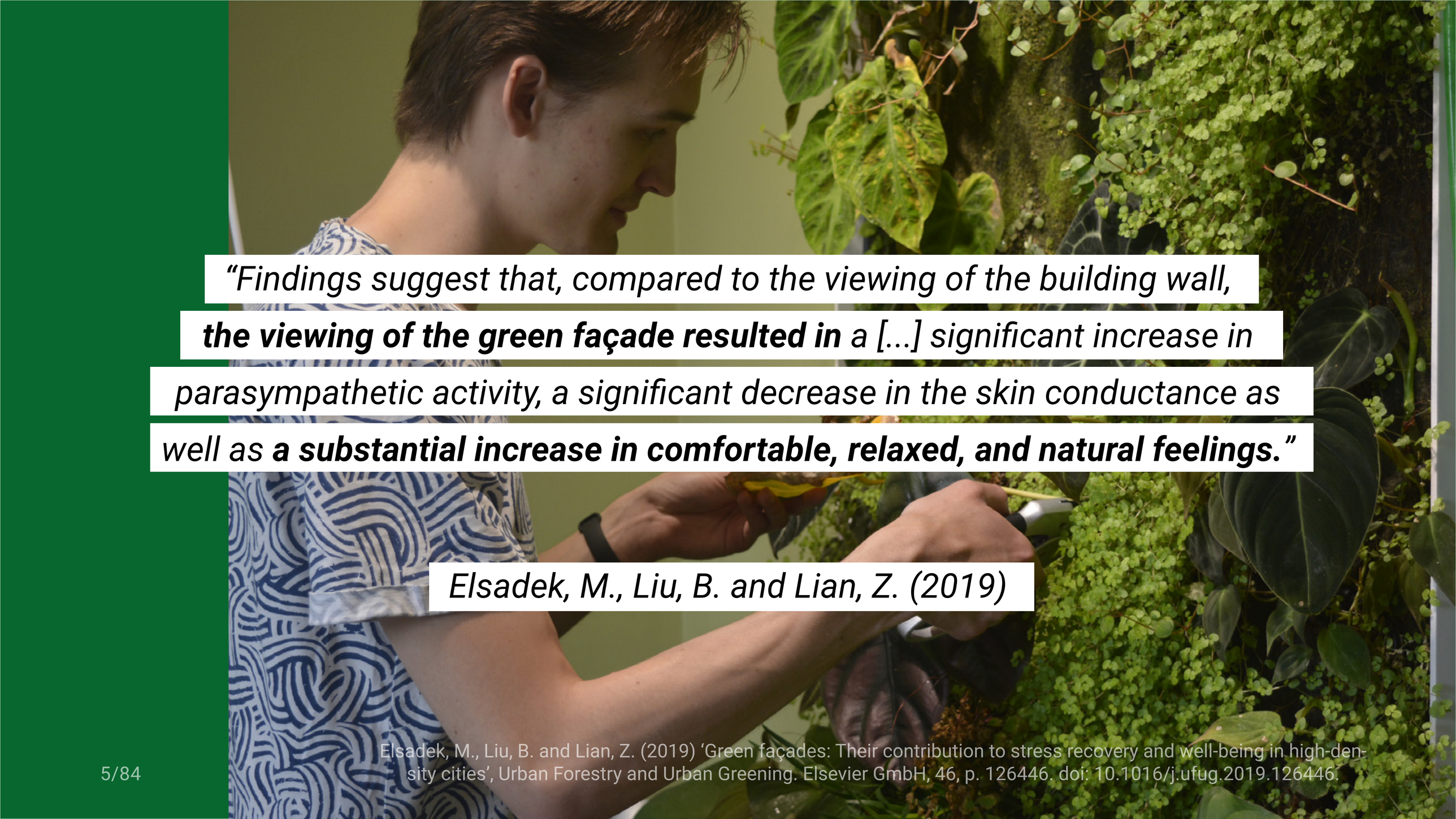
Compact nature for Compact cities

Menno de Roode

P5 Graduation presentation July 2nd 2021

1st mentor: Dr. Ir. N.M.J.D. (Nico) Tillie | 2nd mentor: Dr. Ir. R.M. (Remon) Rooij | 3rd mentor: Dr.Ir. M. (Marc) Ottele



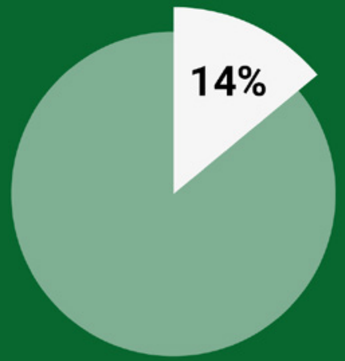
“Findings suggest that, compared to the viewing of the building wall, ***the viewing of the green façade resulted in*** *a [...] significant increase in parasympathetic activity, a significant decrease in the skin conductance as well as* ***a substantial increase in comfortable, relaxed, and natural feelings.***”

Elsadek, M., Liu, B. and Lian, Z. (2019)

Elsadek, M., Liu, B. and Lian, Z. (2019) ‘Green façades: Their contribution to stress recovery and well-being in high-density cities’, Urban Forestry and Urban Greening. Elsevier GmbH, 46, p. 126446. doi: 10.1016/j.ufug.2019.126446.

Why include green space in cities?

Biophilia



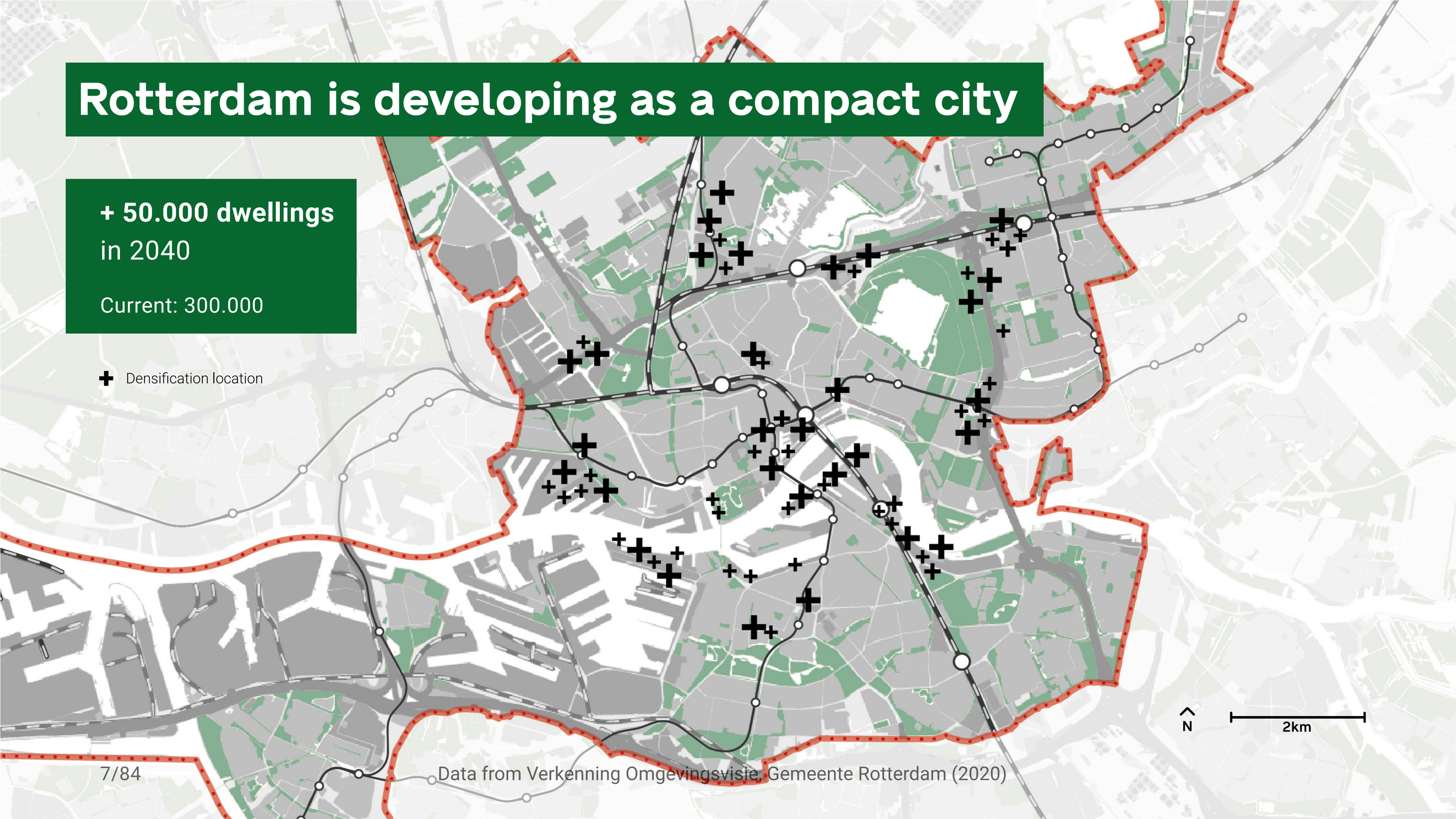
Ecological crisis

CLO (2005); Beatley (2017)

Rotterdam is developing as a compact city

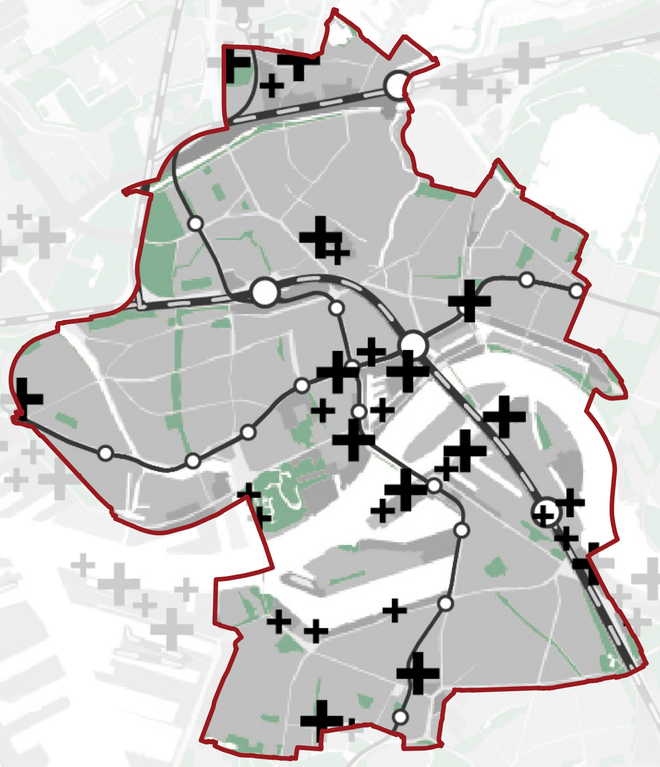
+ 50.000 dwellings
in 2040

Current: 300.000



Data from Verkenning Omgevingsvisie, Gemeente Rotterdam (2020)

Rotterdam is developing as a compact city



Densification location

Compact centre

N

2km

Cluster analysis by Van der Hoeven and Wandl (2015)

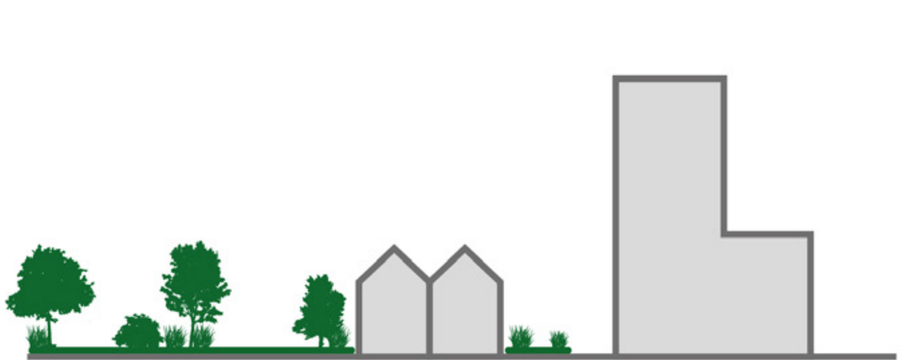
N
1km

Need for true integration of built structures and green space

Urban green space

Compact urban green space (CUGS)

Need for true integration of built structures and green space



Urban green space

Compact urban green space (CUGS)

*Why should one have to **walk to** the park, shouldn't the city **be** the park?*
(Beatley, 2017, p. 49)

Main research question

What **framework** can be used to guide the development of **compact urban green space** in Rotterdam that adresses both the quality, in terms of **well-being** and **ecology**, as well as the **spatial-ecological structure**?

This presentation

1. **Ecological resilience**

2. **Well-being** related to urban green space

3. **Compact urban green space patterns** that contribute to ecological resilience and well-being

4. **Spatial vision and strategy** to guide the development of the compact urban green space patterns in Rotterdam

5. Conclusion

1

“How can compact urban green space improve **ecological resilience** in Rotterdam?”

Ecological resilience

Fitness

Carrying capacity

Biodiversity

Adapted from Neuman (2009) and Peterson, Allen and Holling (1998)

Biotopes

- Dunes
- Sea clay polders
- Peat meadows
- River landscape
- Urban

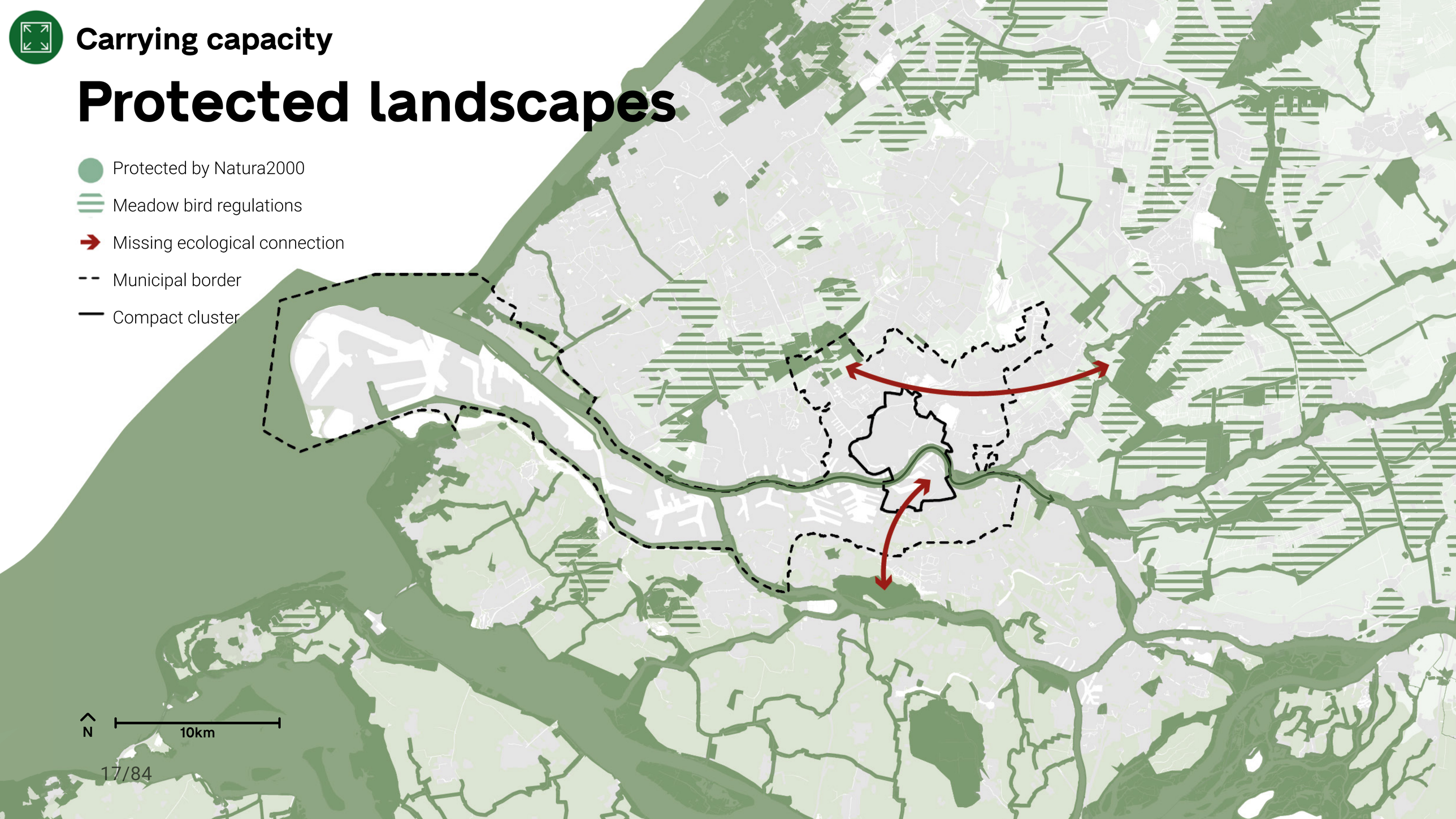
- Municipality of Rotterdam
- Compact cluster

N

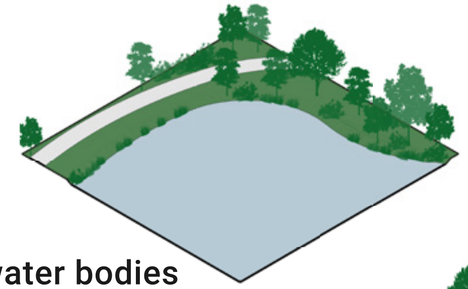
10km

Carrying capacity

Protected landscapes

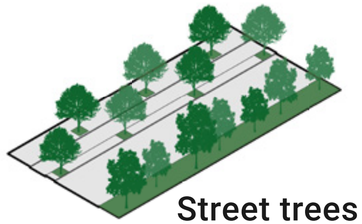


Urban habitats

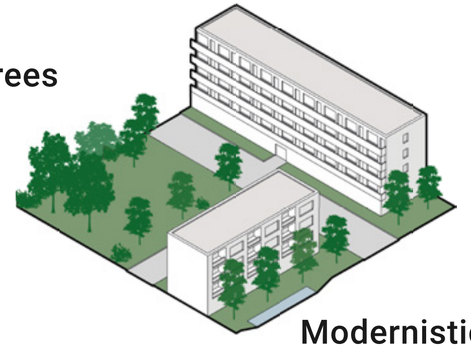


Fresh water bodies

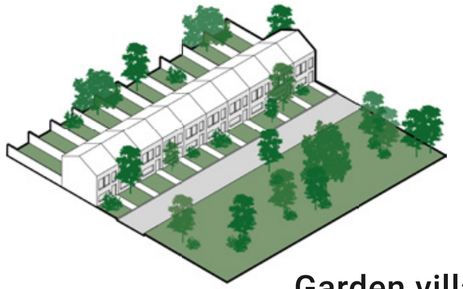
Parks



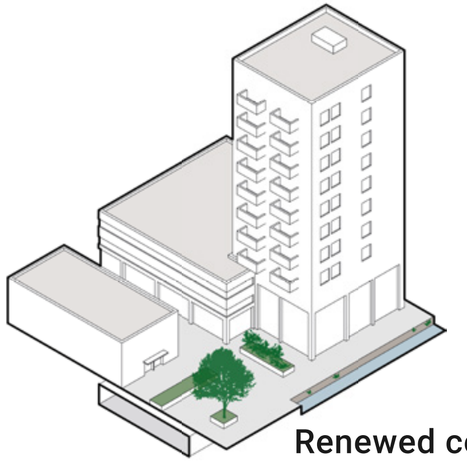
Street trees



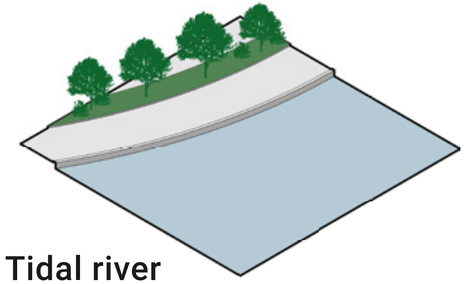
Modernistic apartments



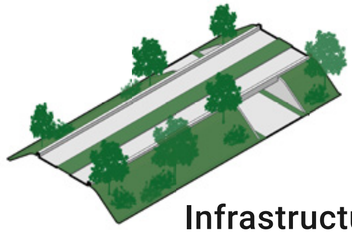
Garden village



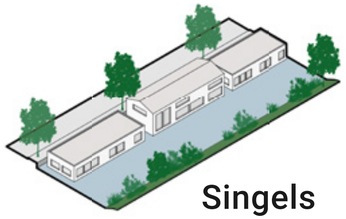
Renewed centre



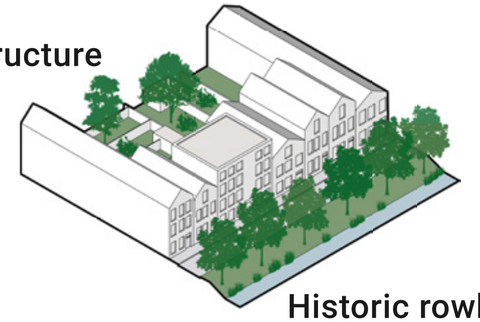
Tidal river



Infrastructure

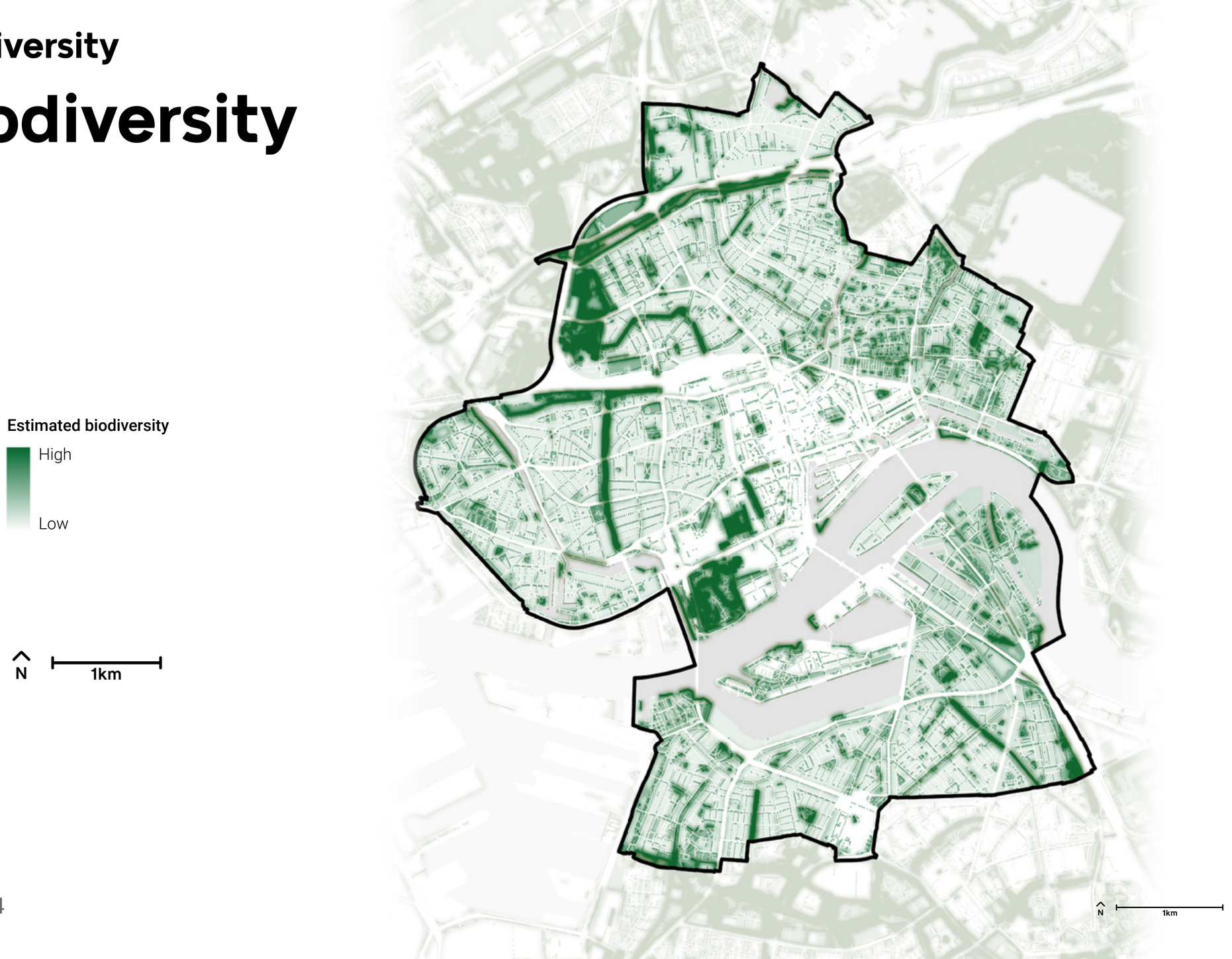


Singels



Historic rowhouses

Biodiversity



Carrying capacity

Biodiversity

Compact urban green space can improve **ecological resilience** in Rotterdam by:

- **Increasing fitness** by connecting to the natural biotopes and by providing space for natural processes

- **Increasing the carrying capacity** by forming ecological networks

- **Increasing the biodiversity** by providing diverse (and preferably large)habitats

2

“How can compact urban green space improve **well-being** in Rotterdam?”

Well-being

Health

Physical

Mental

Social development

Education

Safety

Recreation

Belonging

Social

Spatial

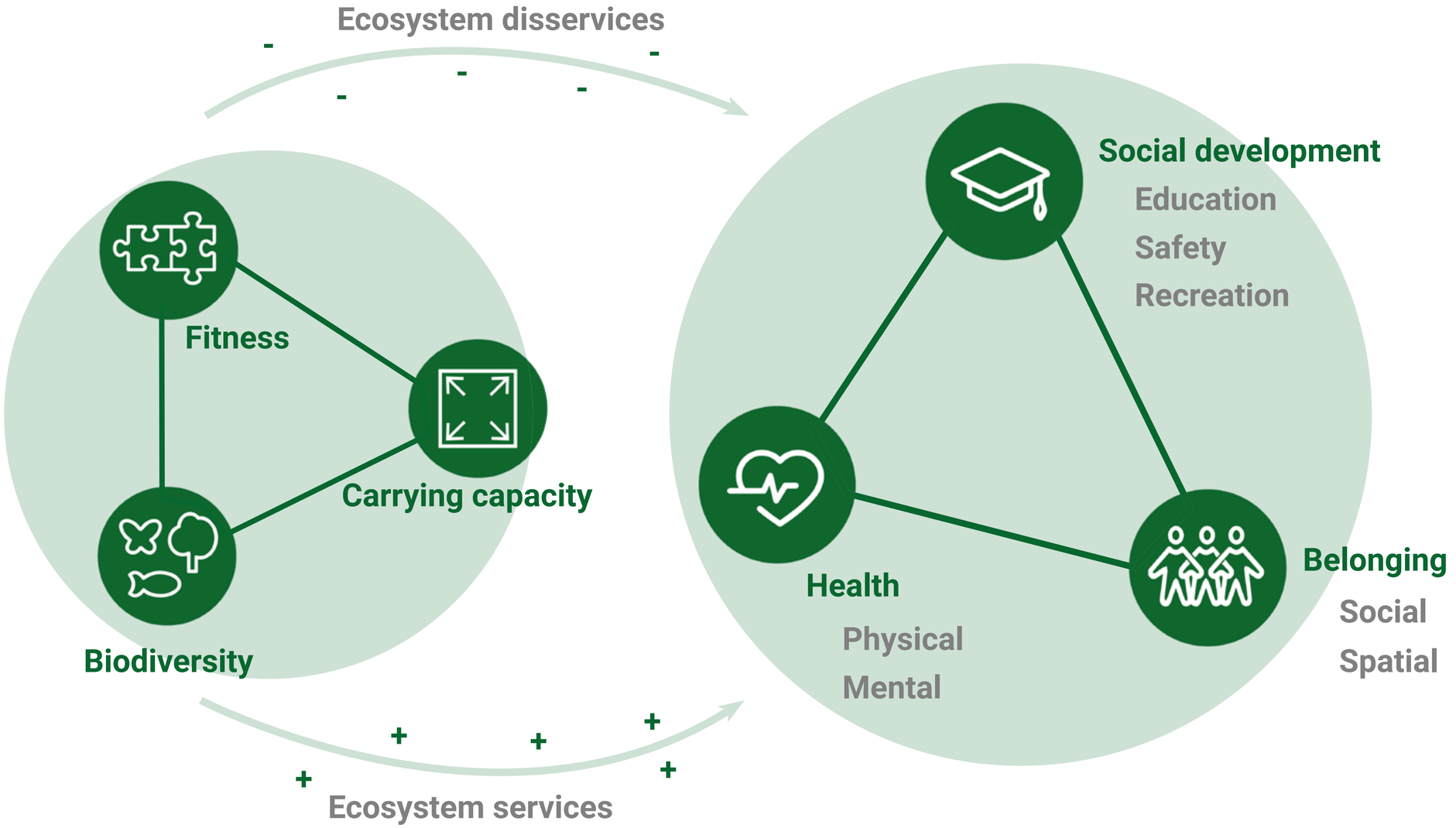
Adapted from Ecocity Builders (2020)

**“Careful!
stone-throwing magpies
Park at your own risk”**

Image courtesey of Soap_Mctavish101 https://i.imgur.com/H3wktYE.jpg

Ecological resilience

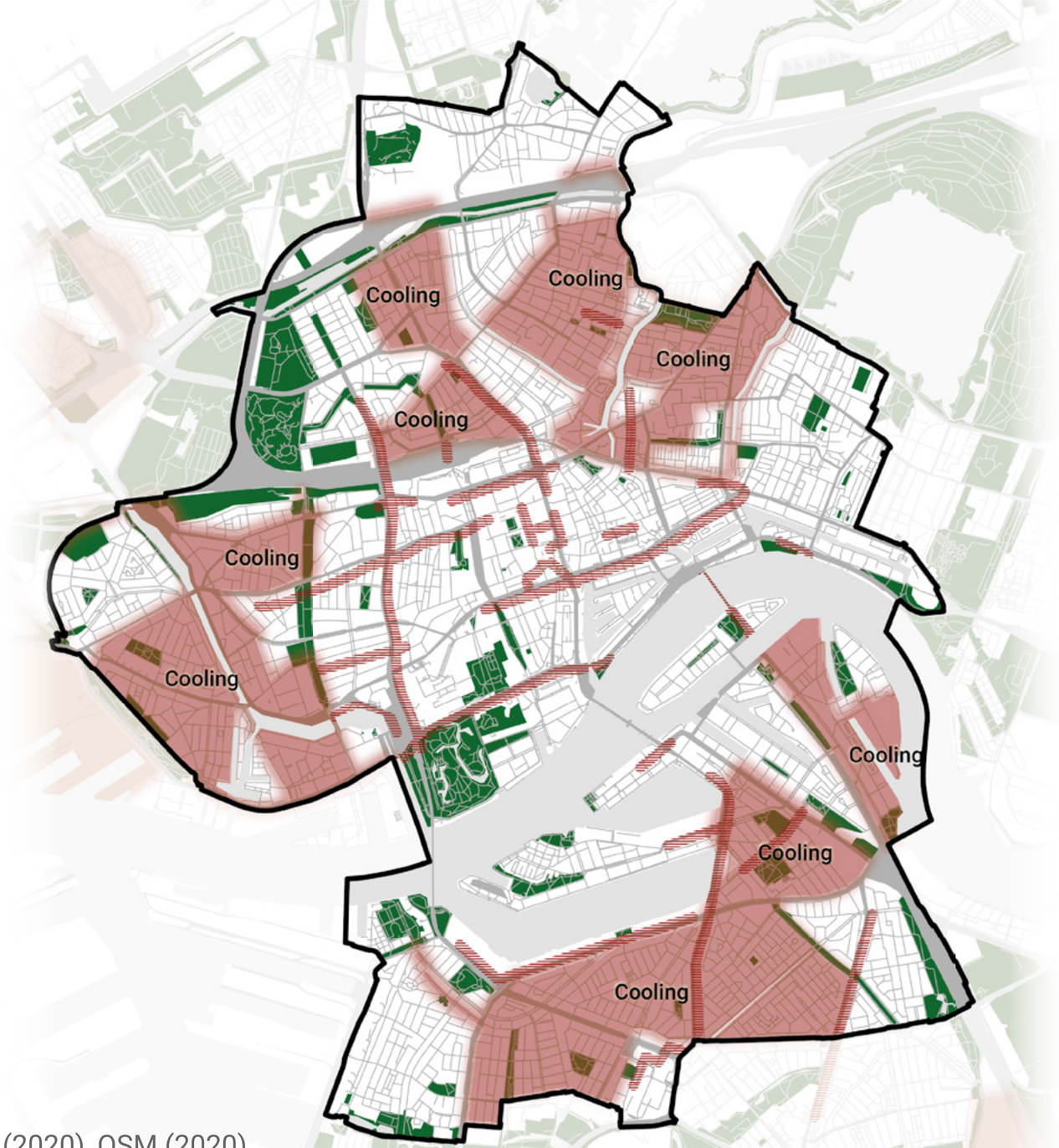
Well-being



Well-being indicators adapted from Ecocity Builders (2020)

Health

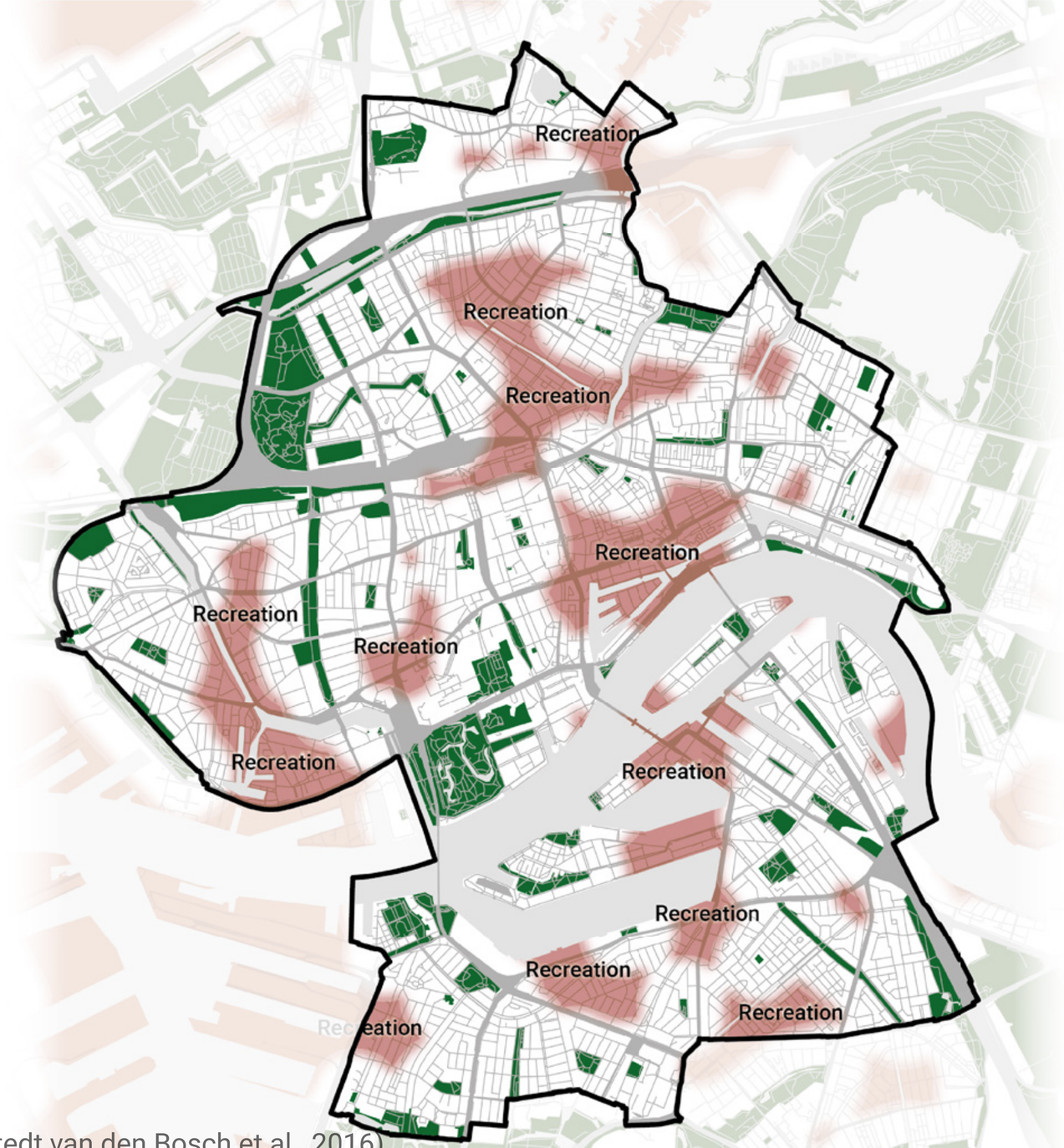
Over 30% of the inhabitants do not have a cool space close to home during a heatwave
(Gemeente Rotterdam, 2020. p. 10)



 Data by Gemeente Rotterdam (2020), CBS (2020), OSM (2020)

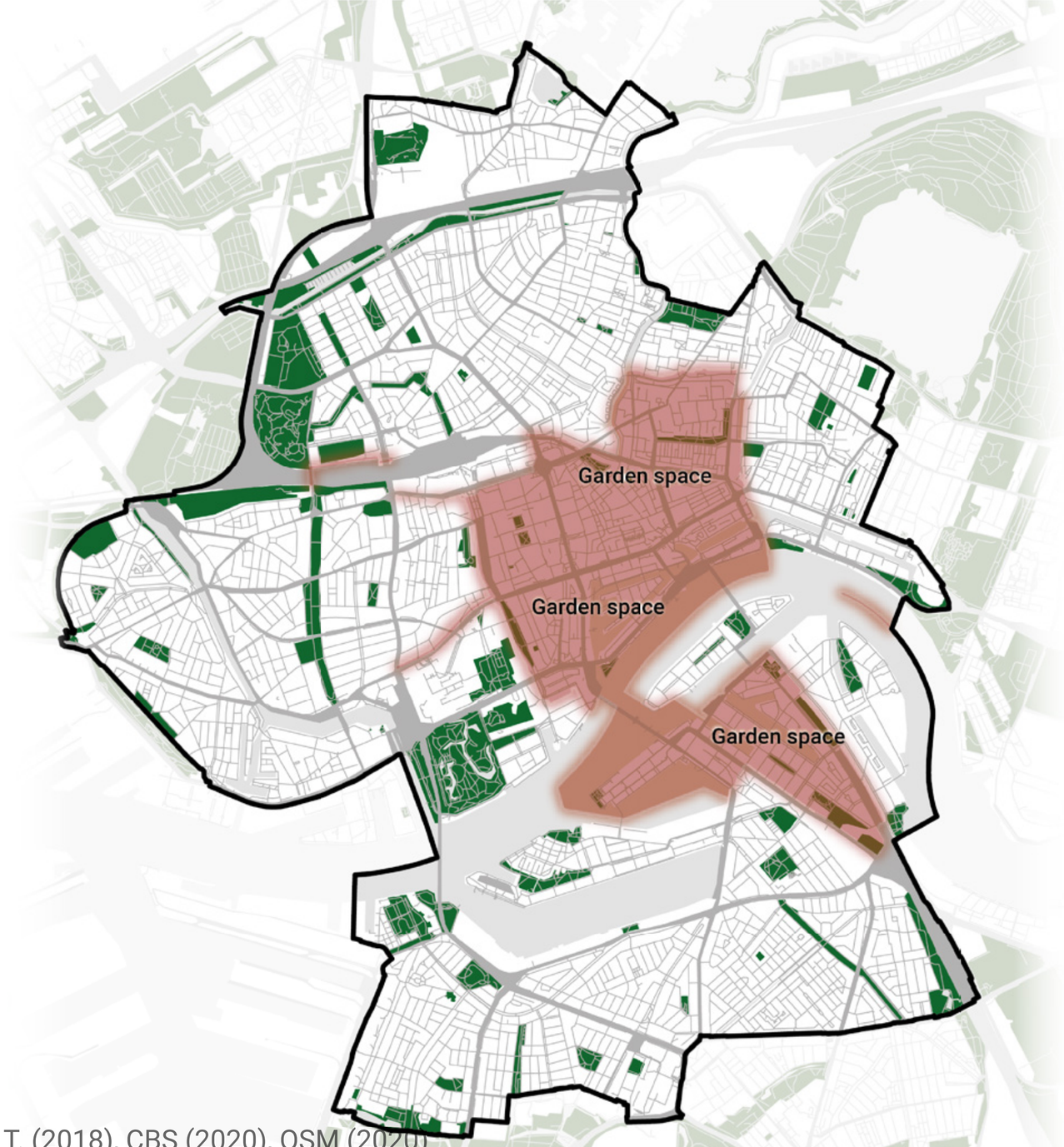
Social development

“[...] a 300 m maximum linear distance to the boundary of urban green spaces of a minimum size of 1 hectare are recommended [...]” (WHO, 2016. p. 159).


Recreation
Recreation
Recreation

Belonging

"[Community-driven greenery] provides immediate opportunities for interactions between humans and nature."
(Oh et al., 2018)



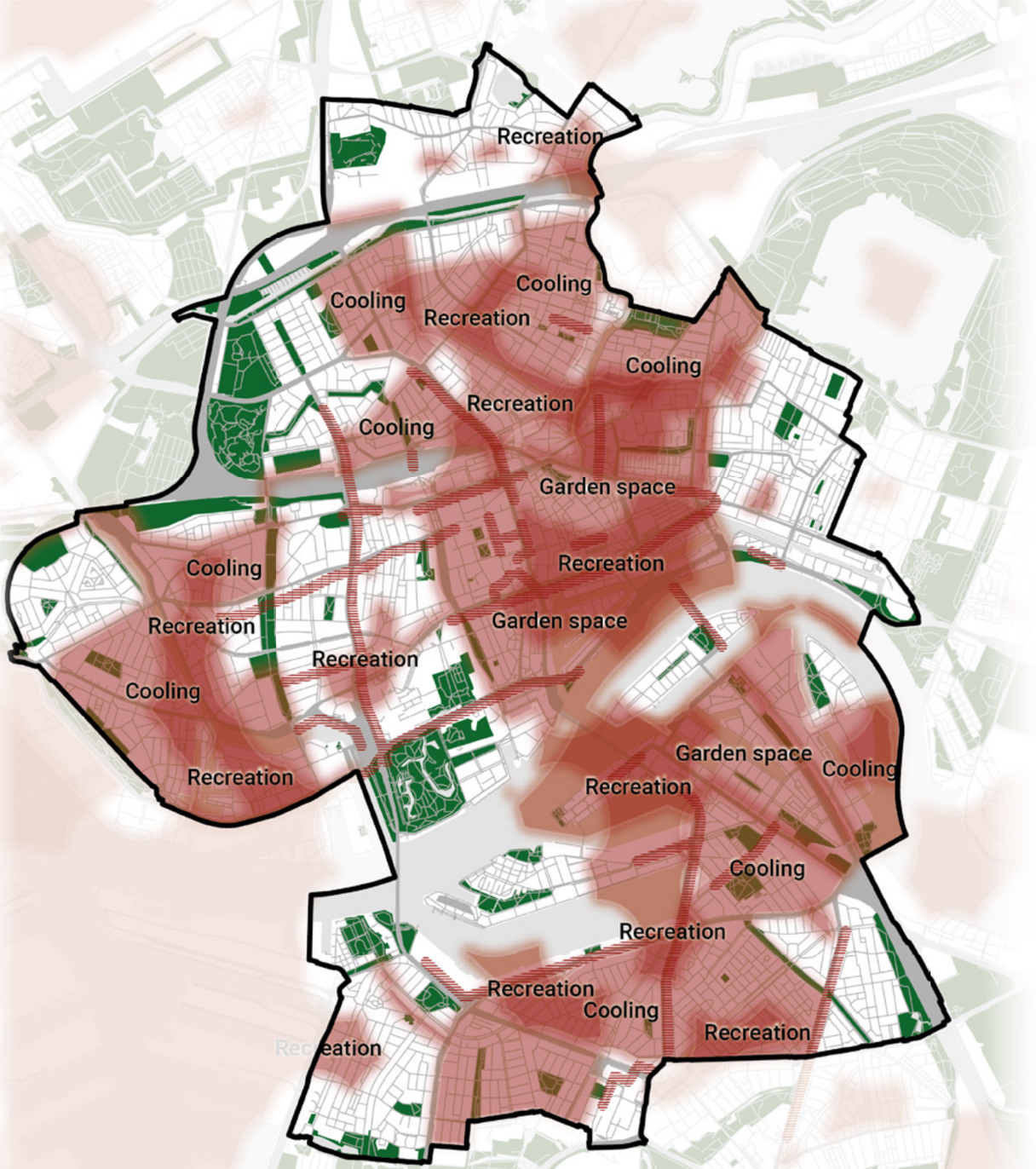
Ecosystem service that could potentially be provided by CUGS

N

1km

 Data by Oh, R. R., Richards, D. R., & Yee, A. T. (2018), CBS (2020), OSM (2020)

Required ecosystem services



Cumulative lacking ecosystem services

Many

None

Poor walkability

Aa Ecosystem service that could potentially be provided by CUGS

N

1km

Compact urban green space can improve **well-being** in Rotterdam by:

- Adressing health by **reducing heat stress** and **enhancing walkability**

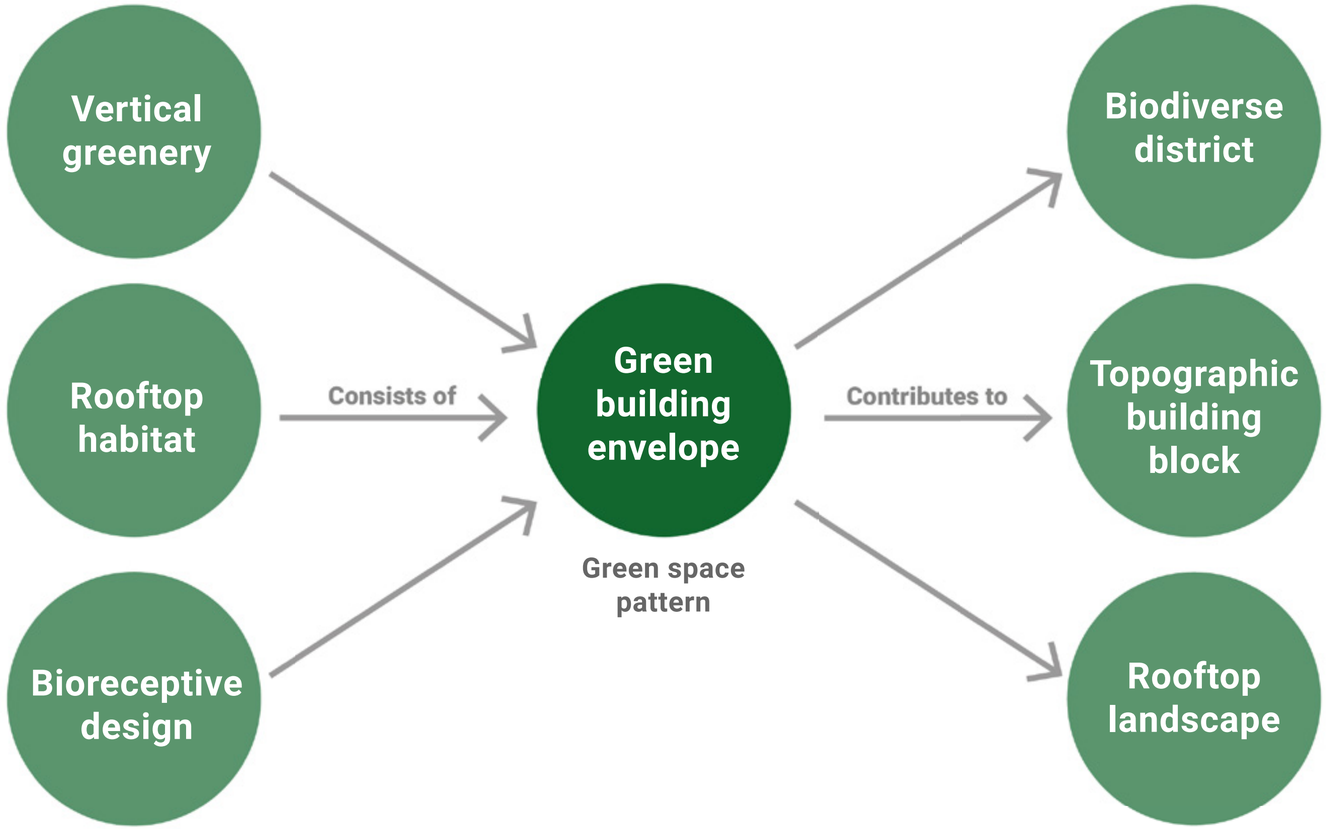
- Adressing social development by **increasing accessibility** and **providing amenities**

- Adressing belonging by **inviting citizen engagement** and **community stewardship**

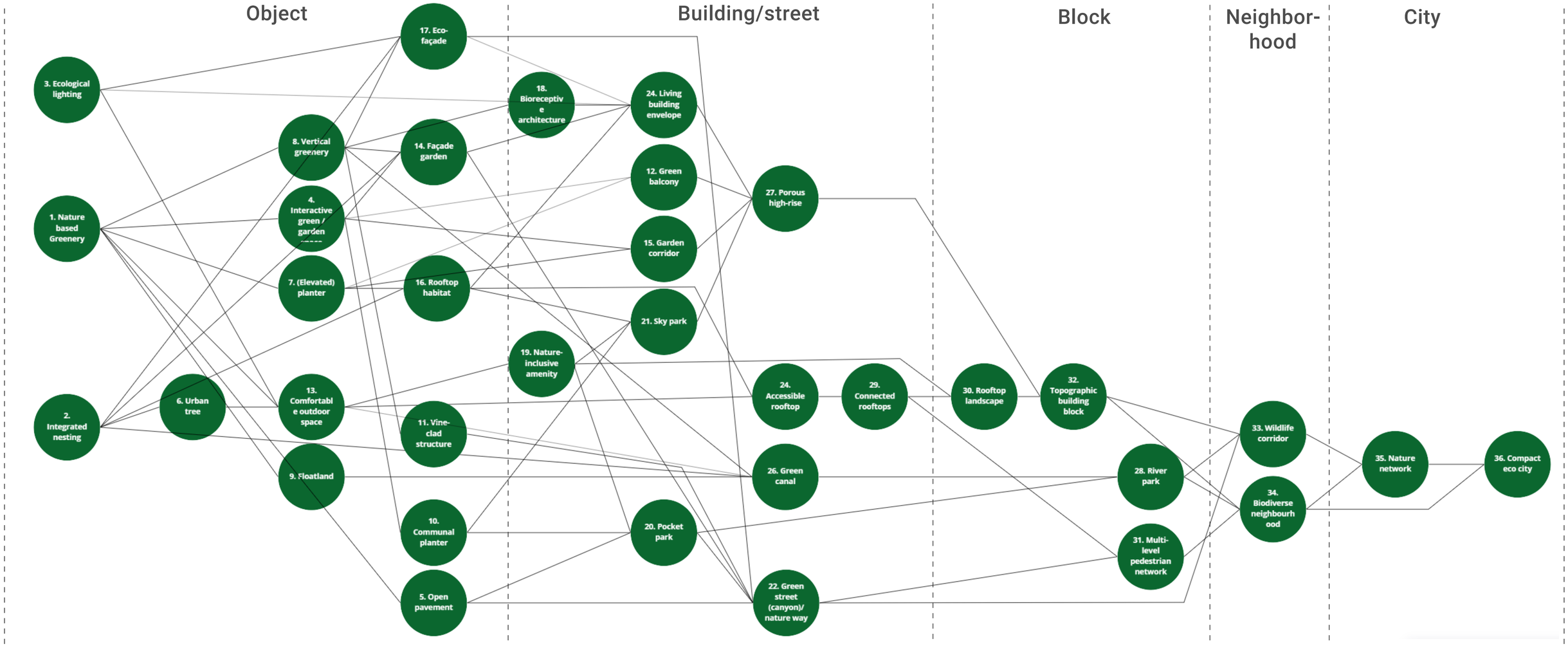
3

“Which **compact urban green space patterns** contribute to ecological resilience and well-being?”

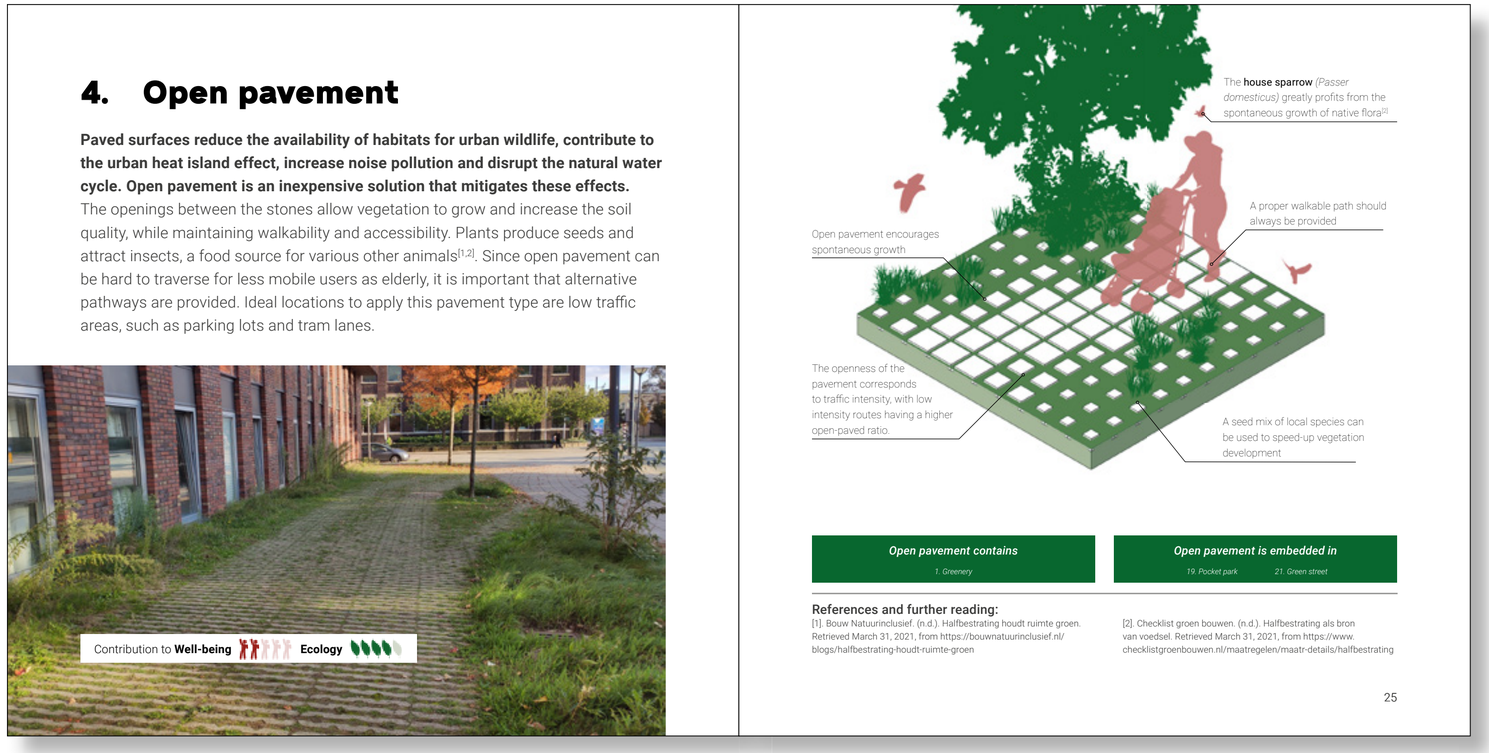
Which compact urban green space patterns contribute to ecological resilience and well-being?”



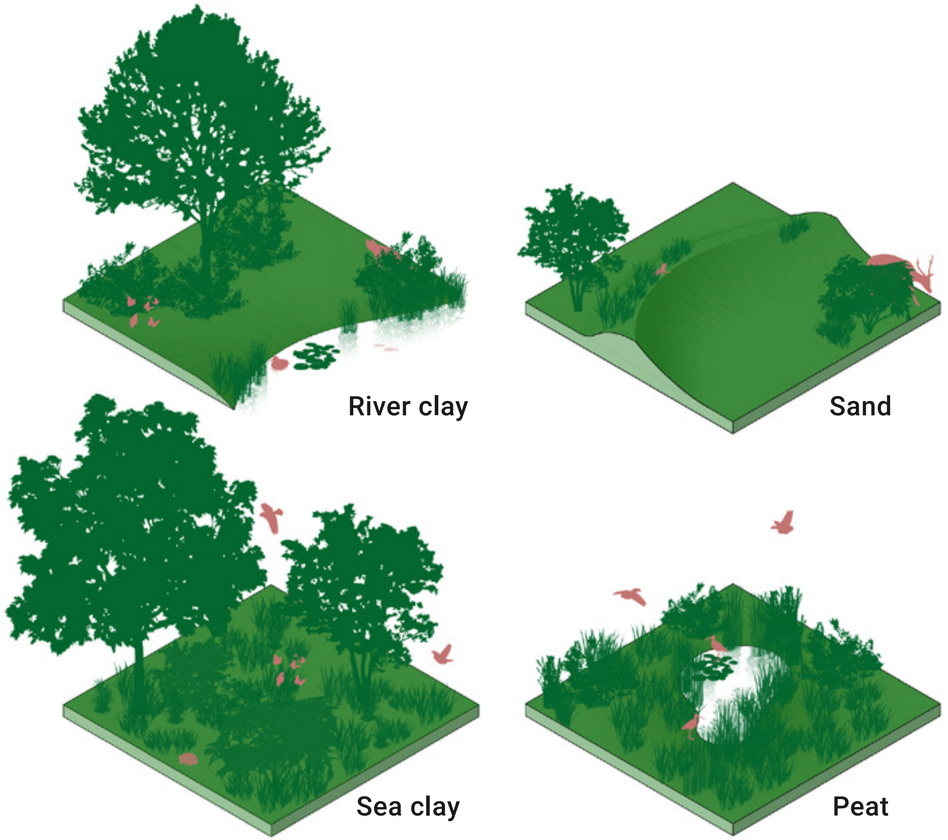
Pattern network



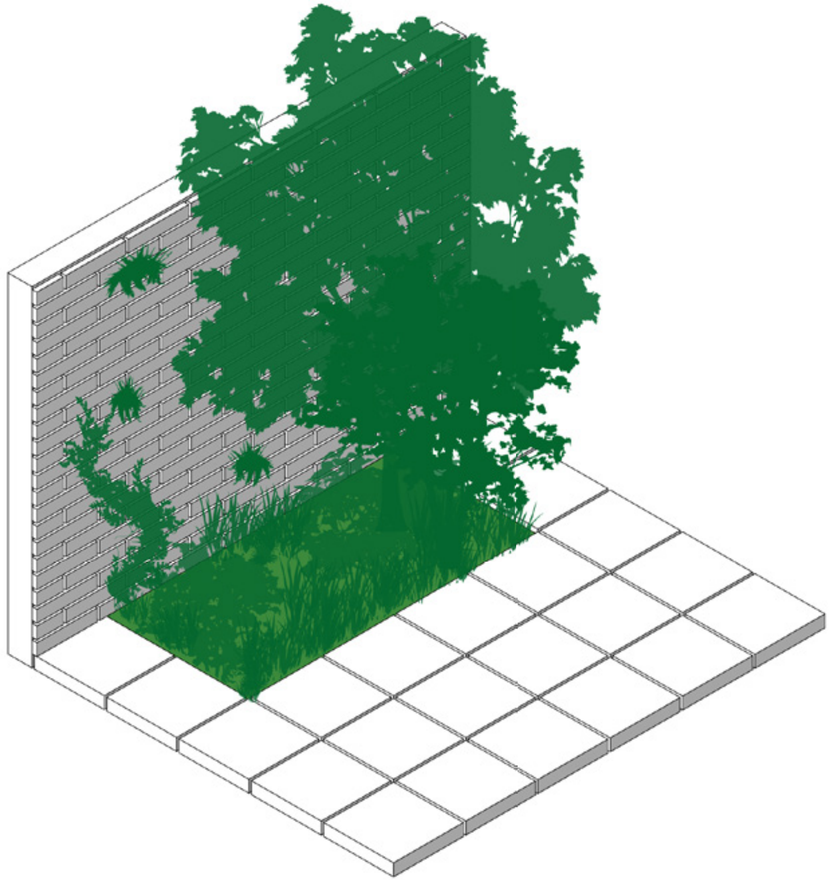
Pattern atlas



1. Greenery

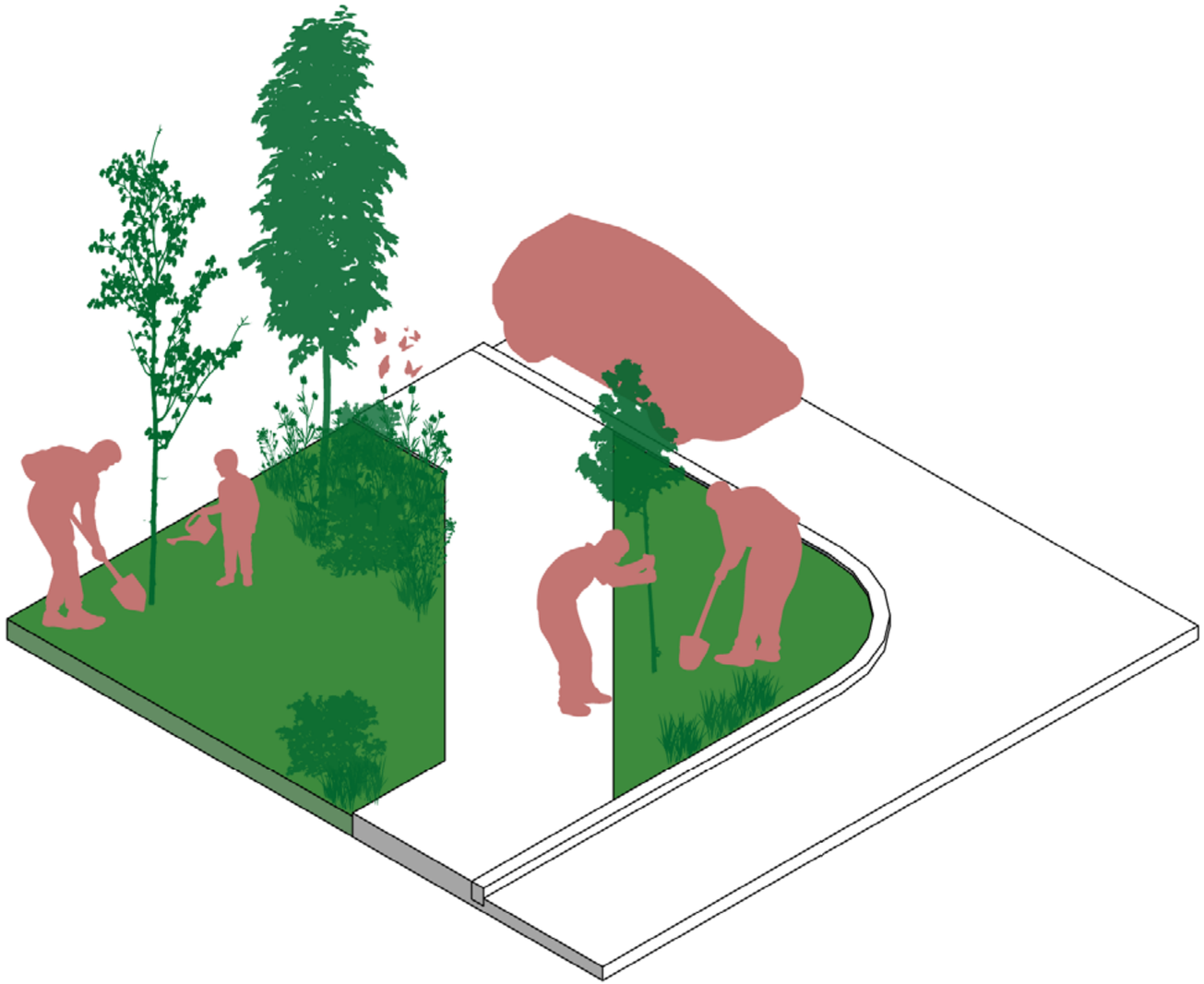


1a. Nature-based

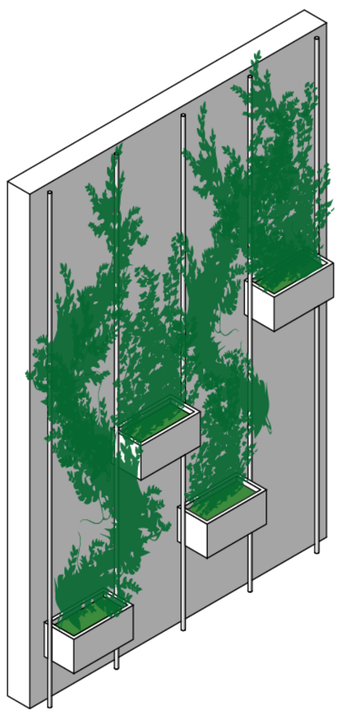


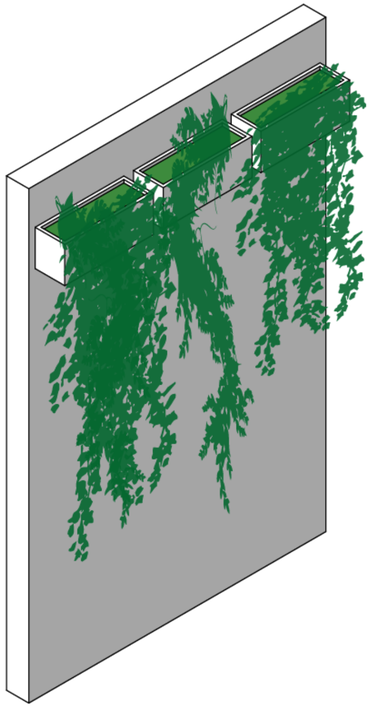
1b. Spontaneous

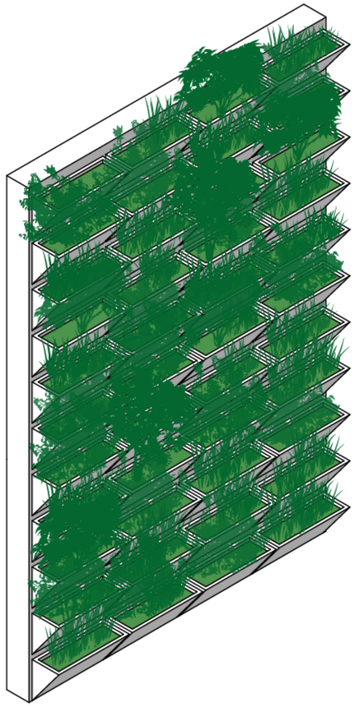
10. Adopted green space

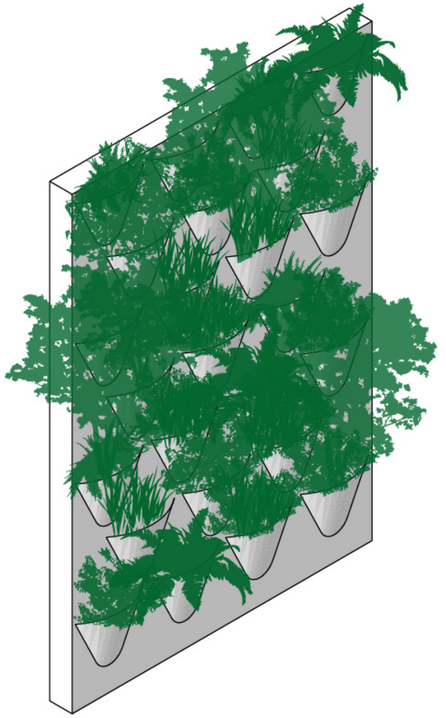


8a. Vertical greenery (living wall)

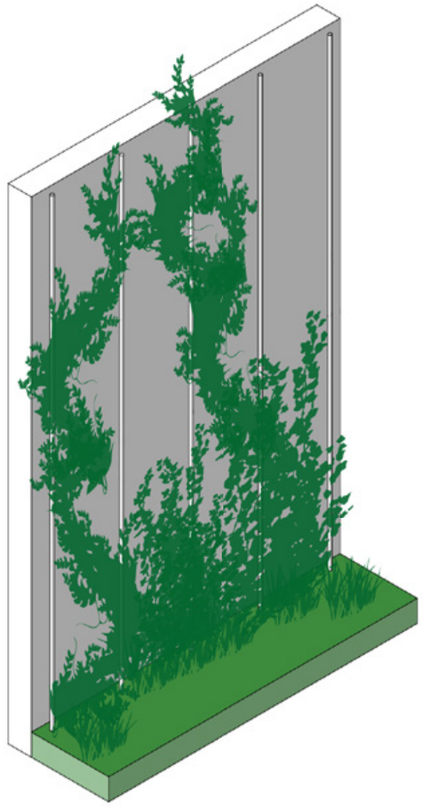




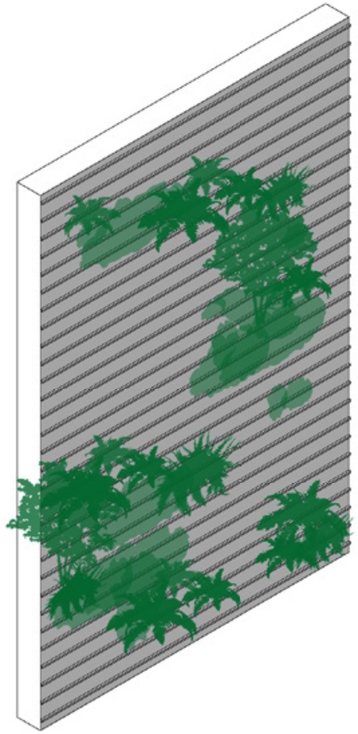




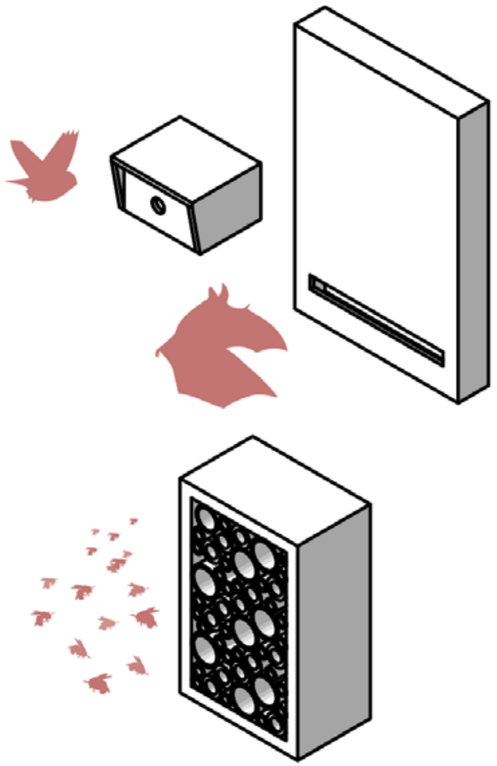
8b. Vertical greenery (green facade)



8c. Vertical greenery (bioreceptive)

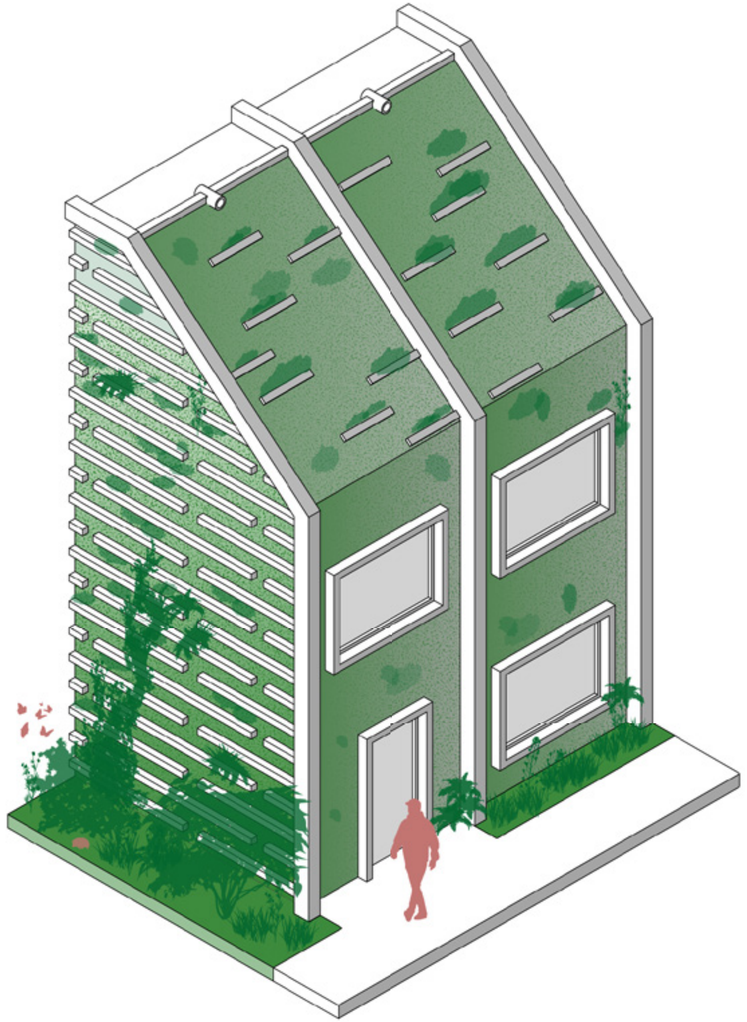


2. Integrated nesting

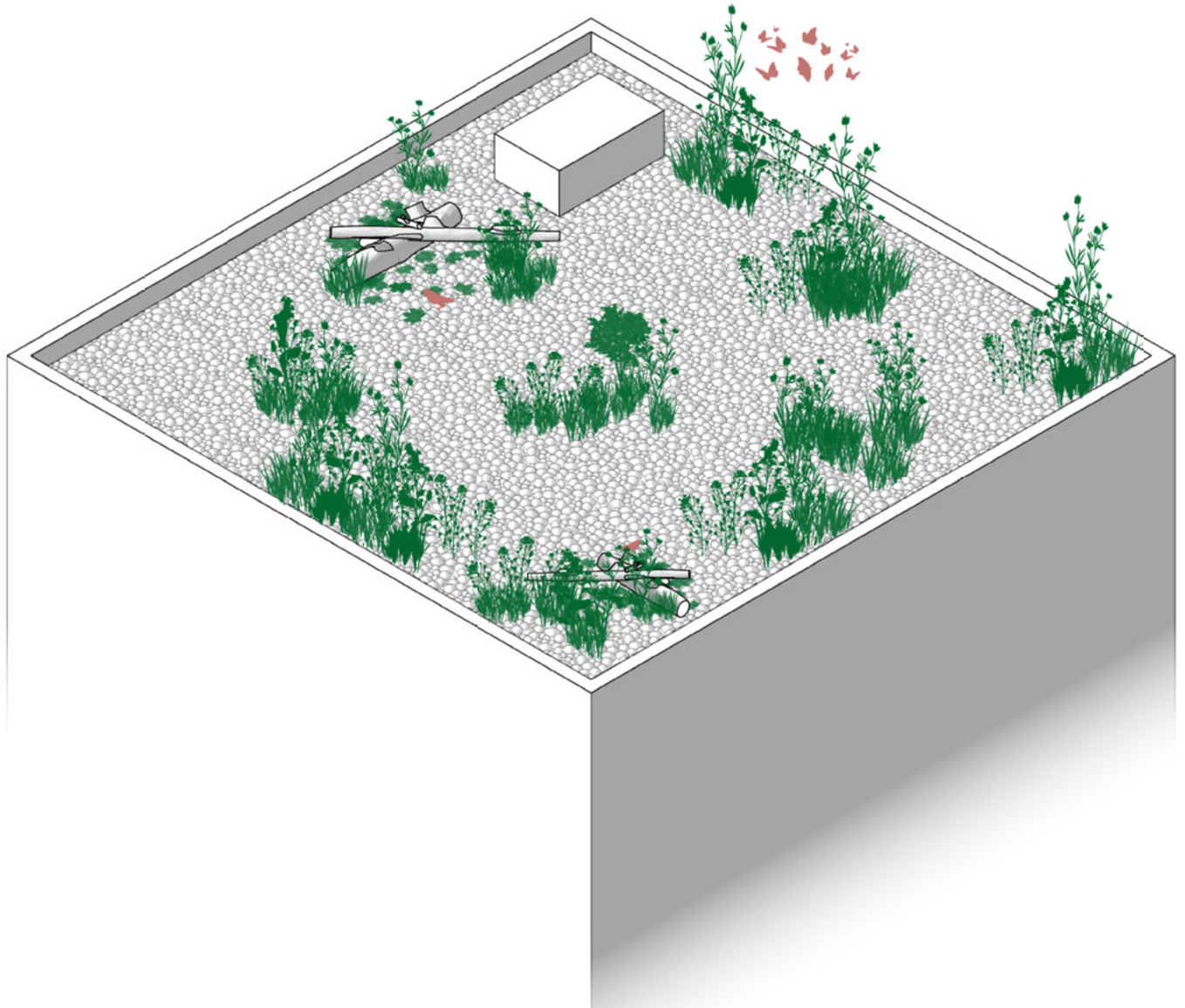


16. Bio-facade

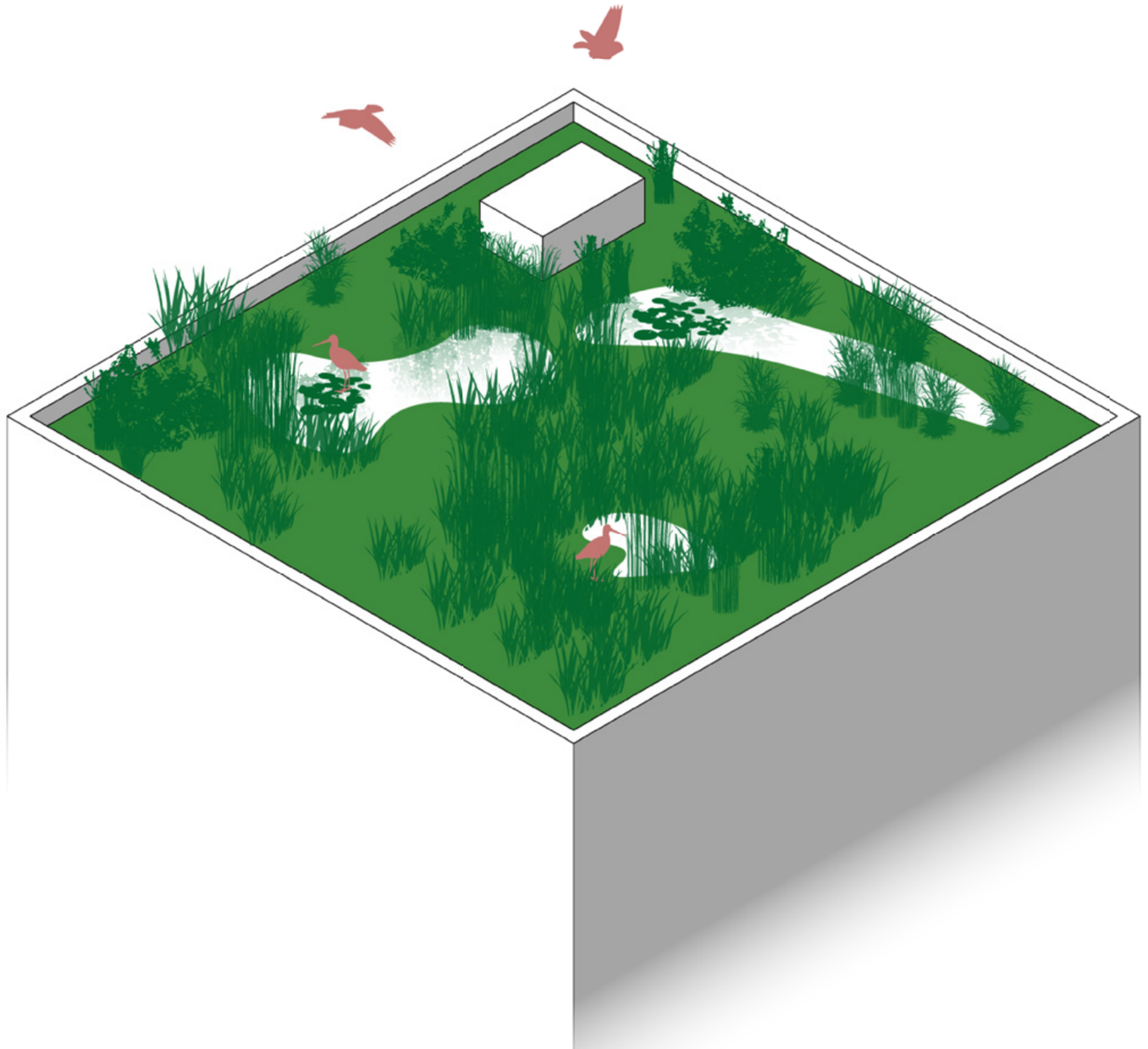
17. Bioreceptive architecture



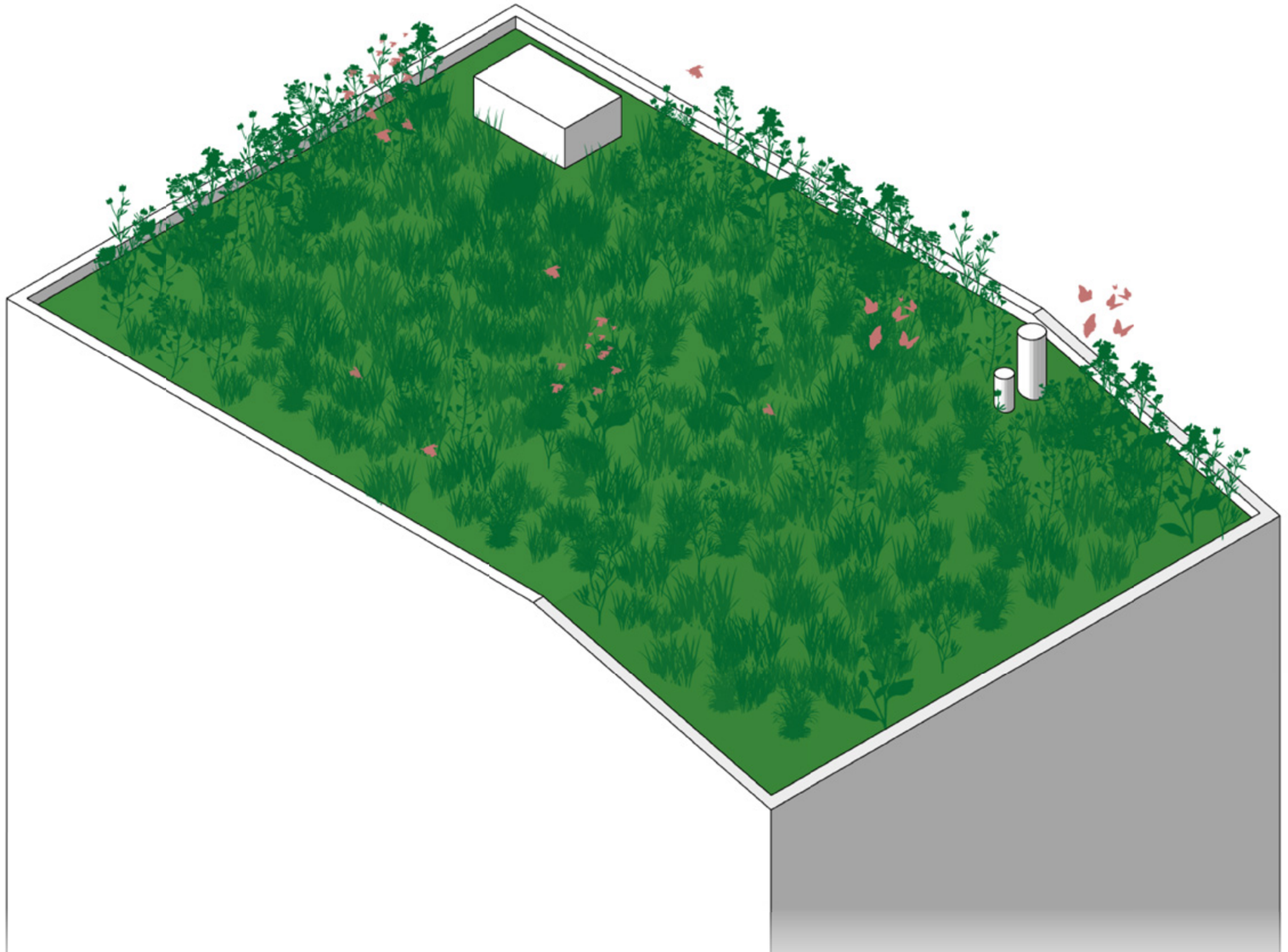
15a. Rooftop habitat



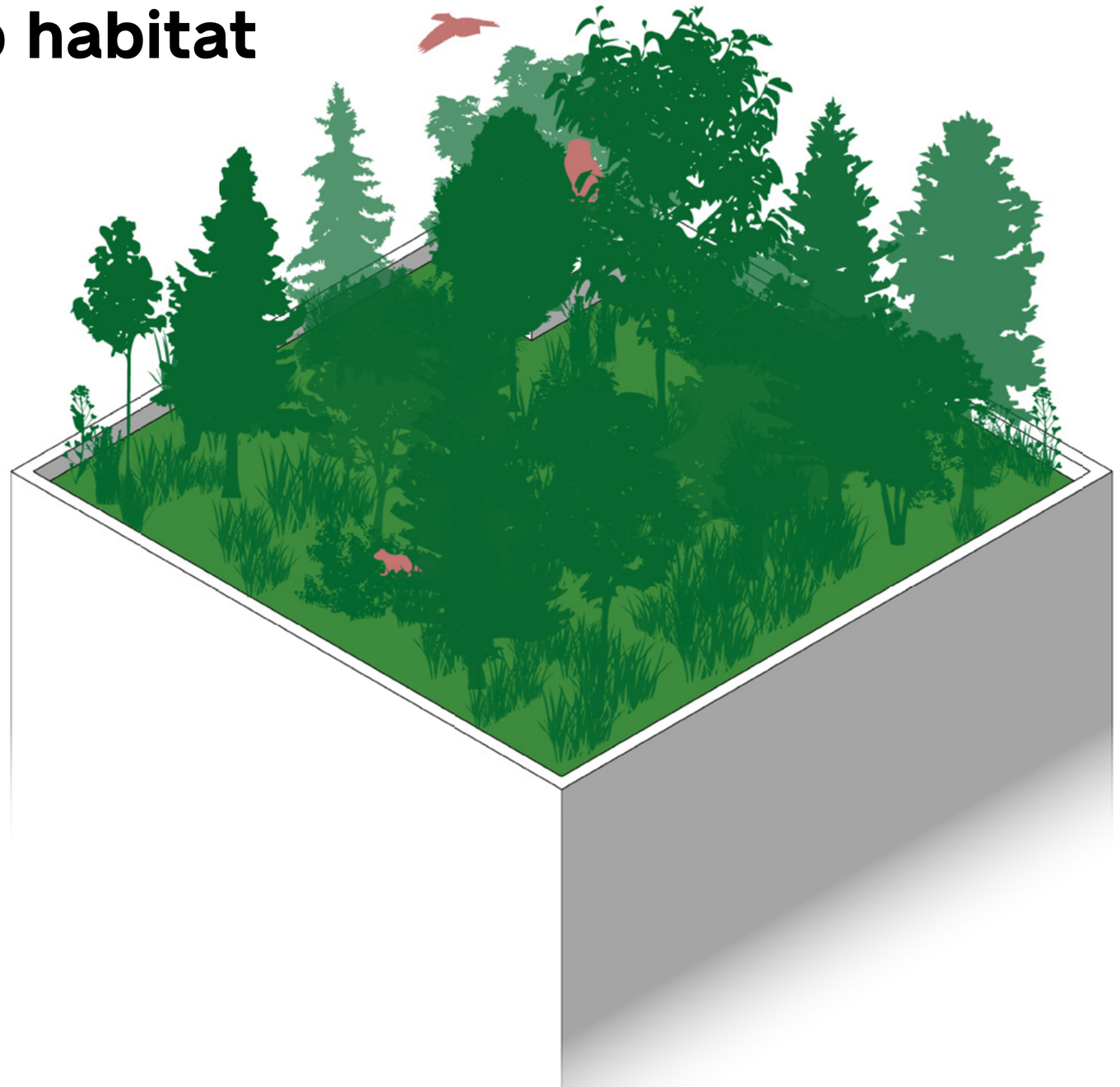
15b. Rooftop habitat



15c. Rooftop habitat



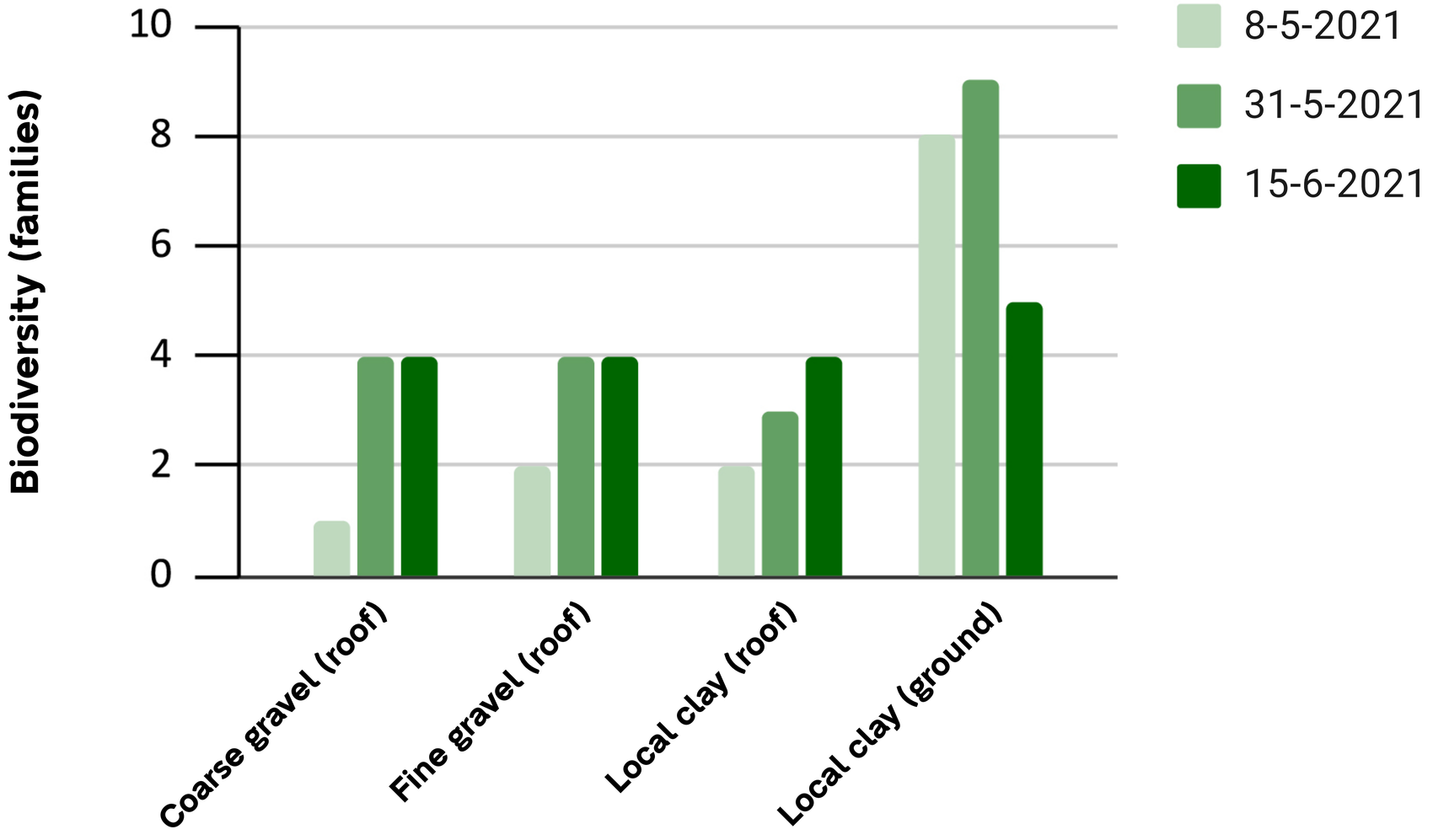
15d. Rooftop habitat



Rooftop habitat: Ebben Tree Nurseries

Rooftop habitat: Ebben Tree Nurseries

Rooftop habitat: Ebben Tree Nurseries



Rooftop habitat: Ebben Tree Nurseries

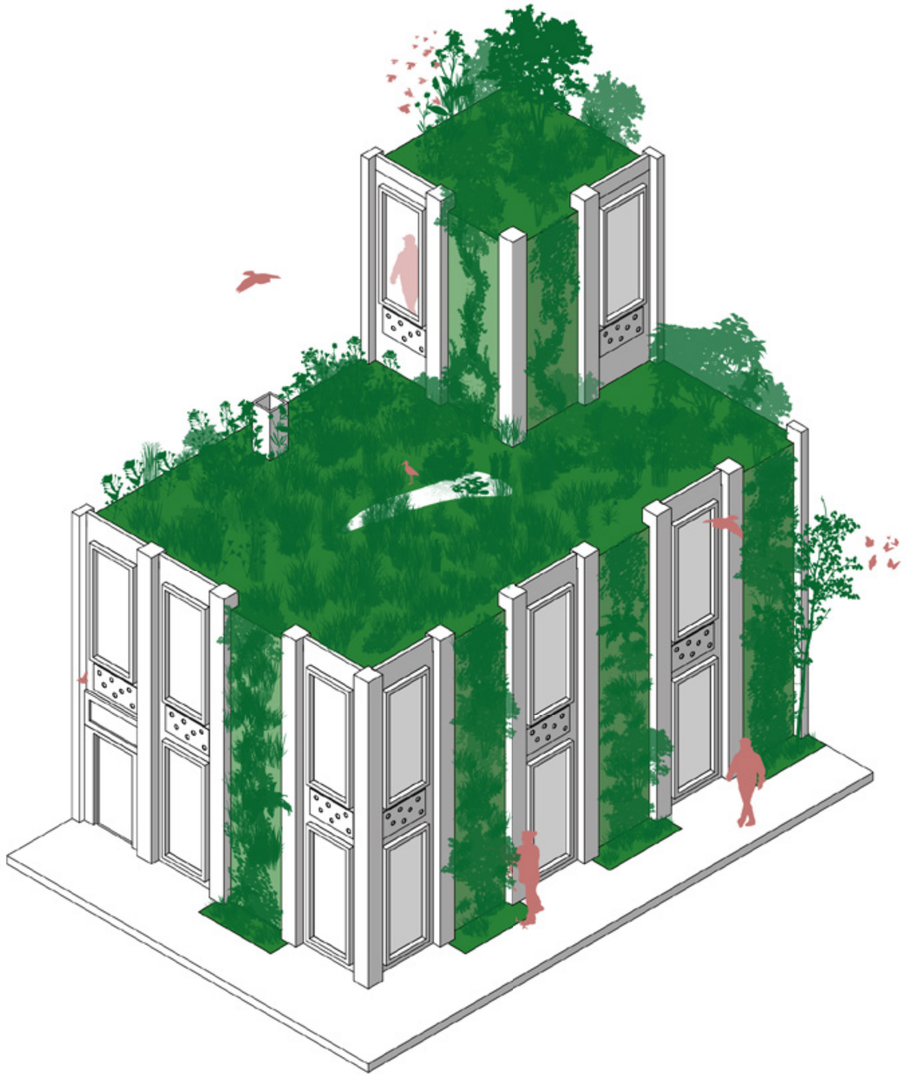
Coarse gravel:
~5%

Fine gravel:
~15%

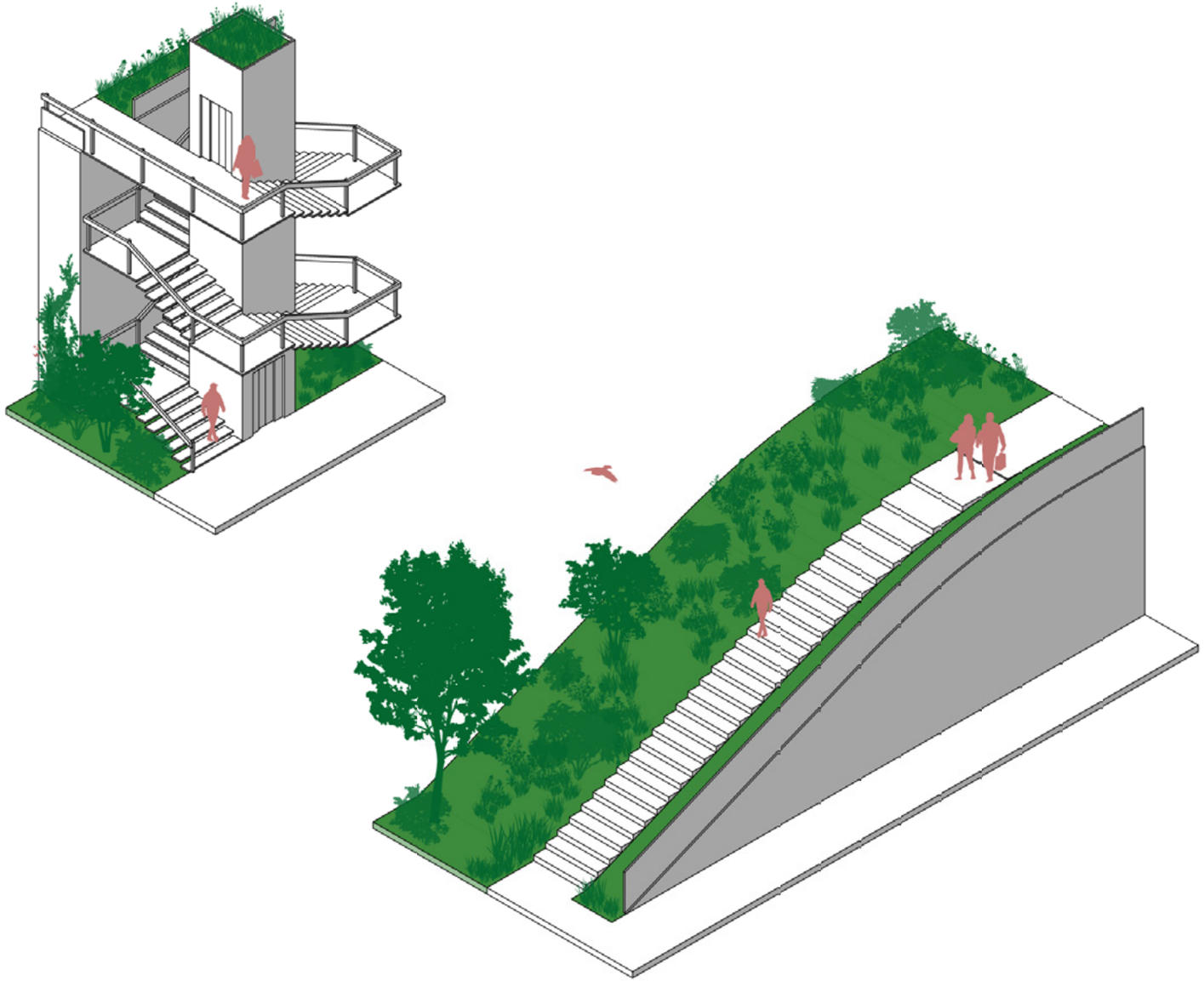
Local clay:
~85%

Local clay:
~20%

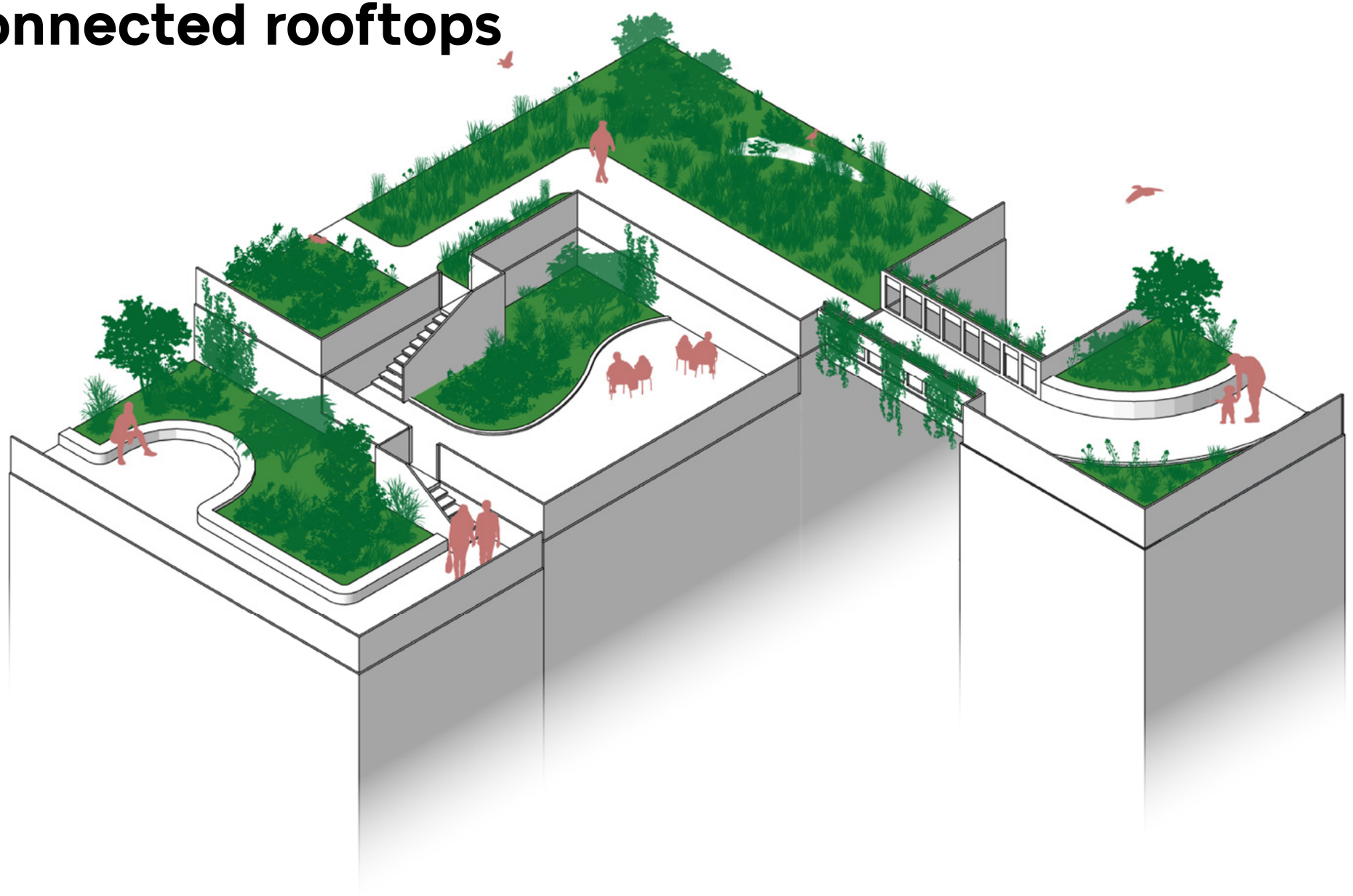
23. Living building envelope



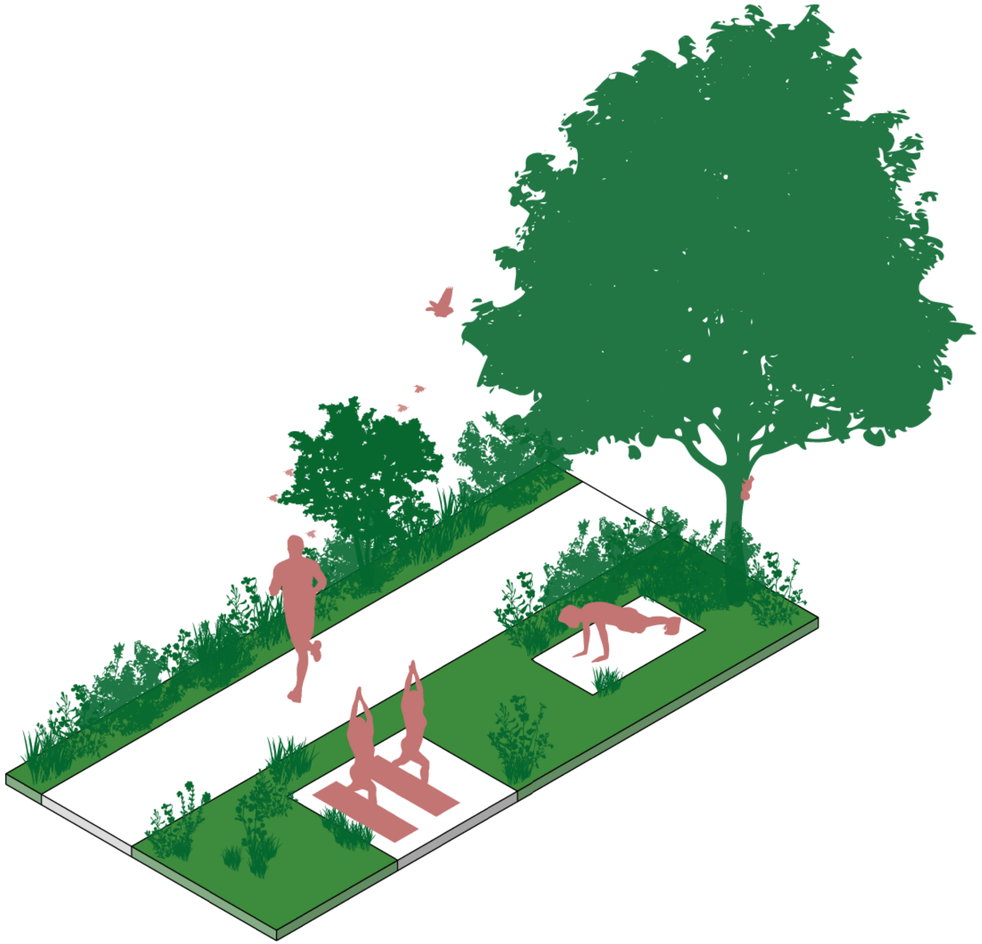
22. Accessible rooftop



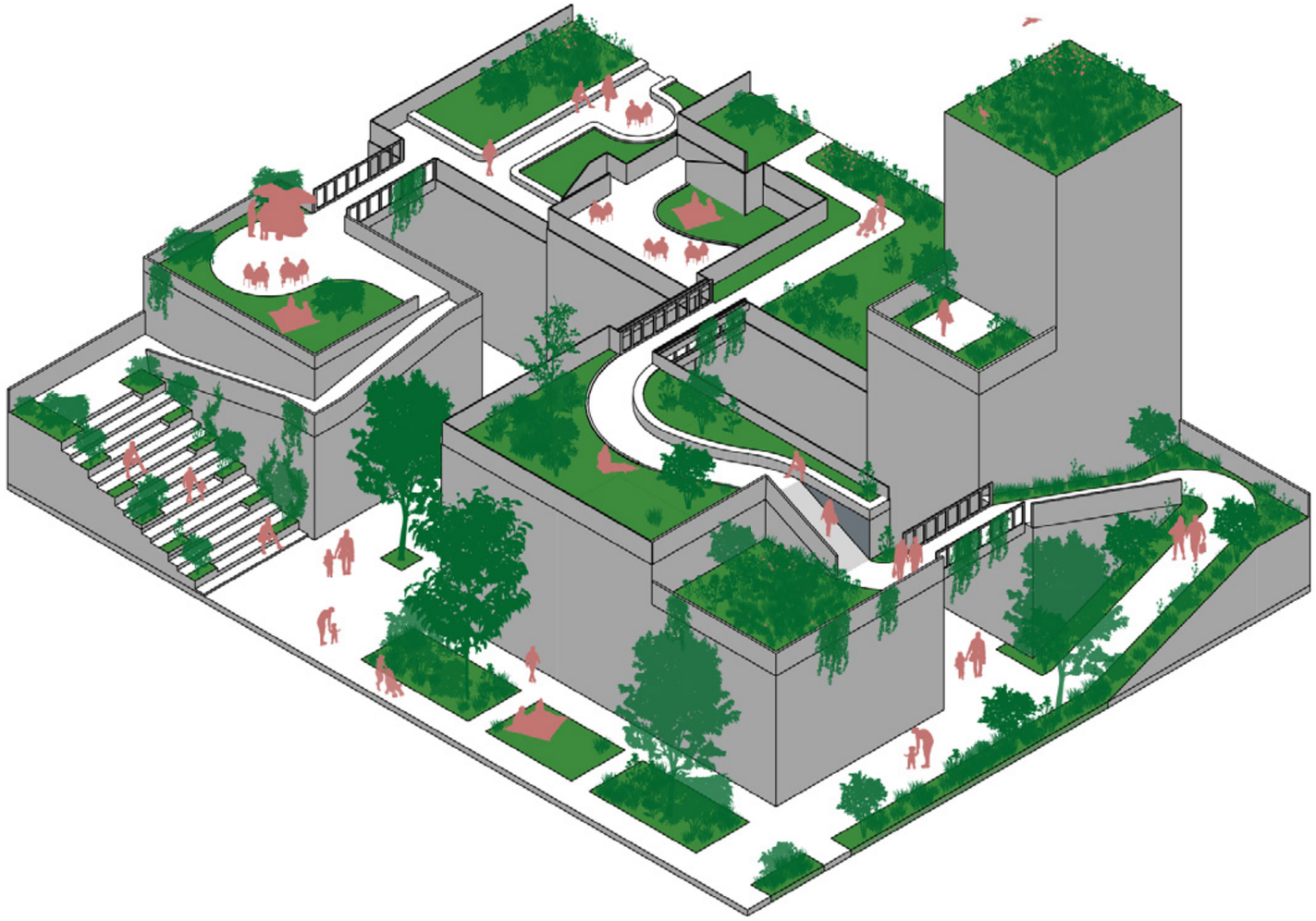
27. Connected rooftops



18. Nature-based amenity

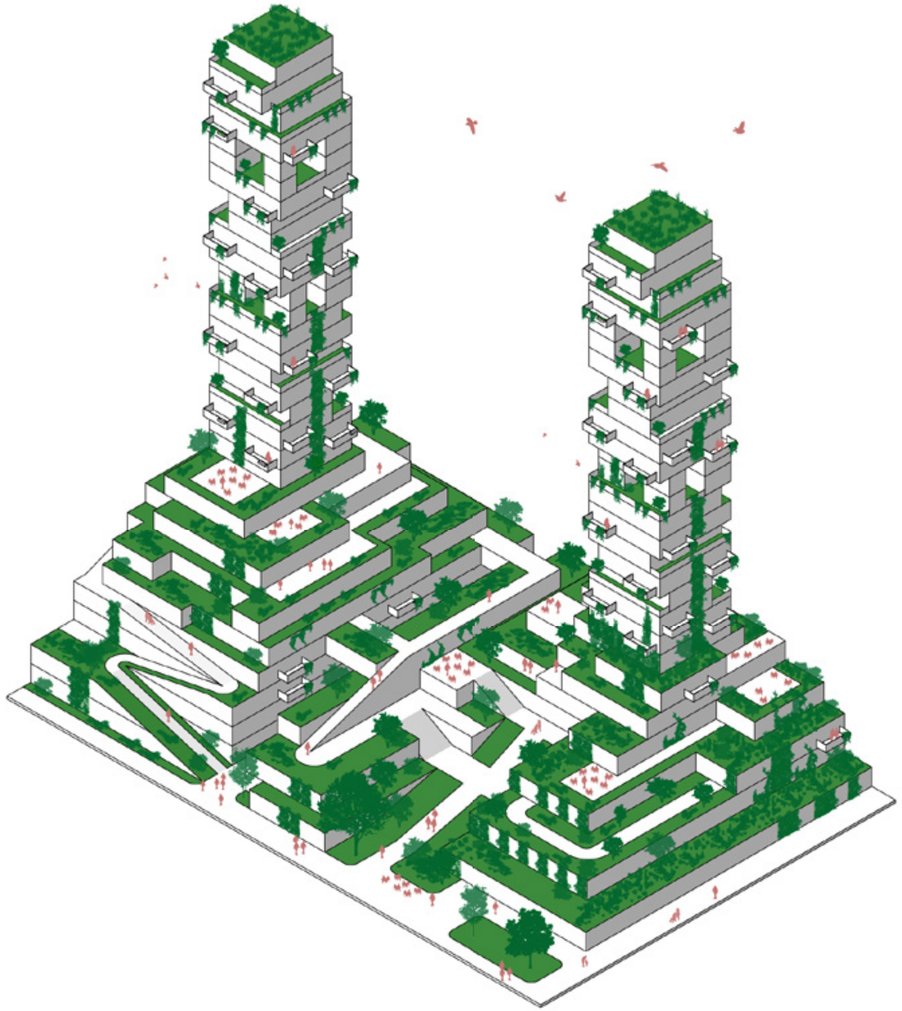


28. Rooftop landscape

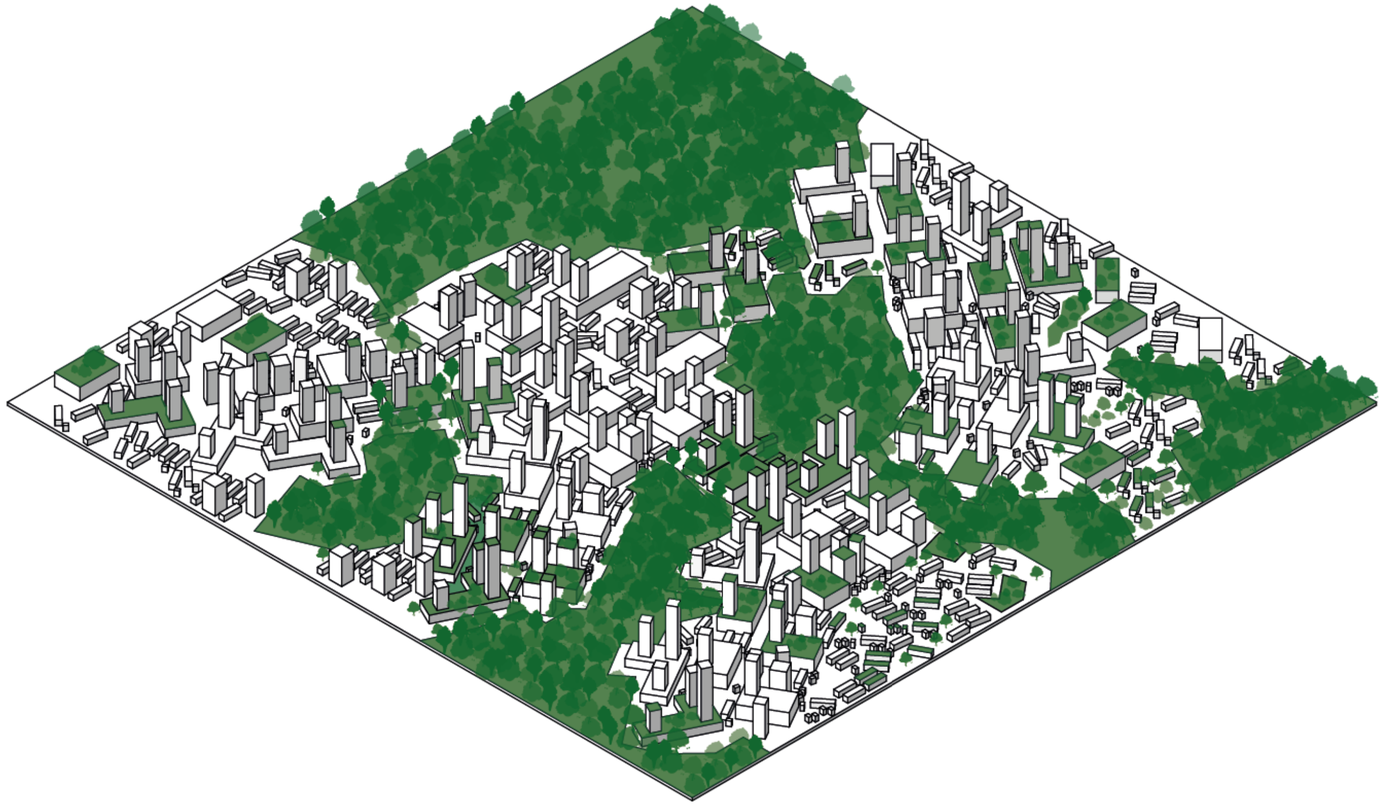


25. Porous high-rise

30. Topographic building block



34. Compact eco city



3

Compact urban green space patterns that contribute to ecological resilience and well-being:

- Offer value at different scales, by including smaller patterns and contributing to larger patterns
- Are fundamentally integrated into urban and architectural design

4

“What **spatial vision and strategy** could be used to guide the development of the compact urban green space patterns in Rotterdam?”

Framework for Rotterdam

1. An ecological network connects and creates high biodiversity areas

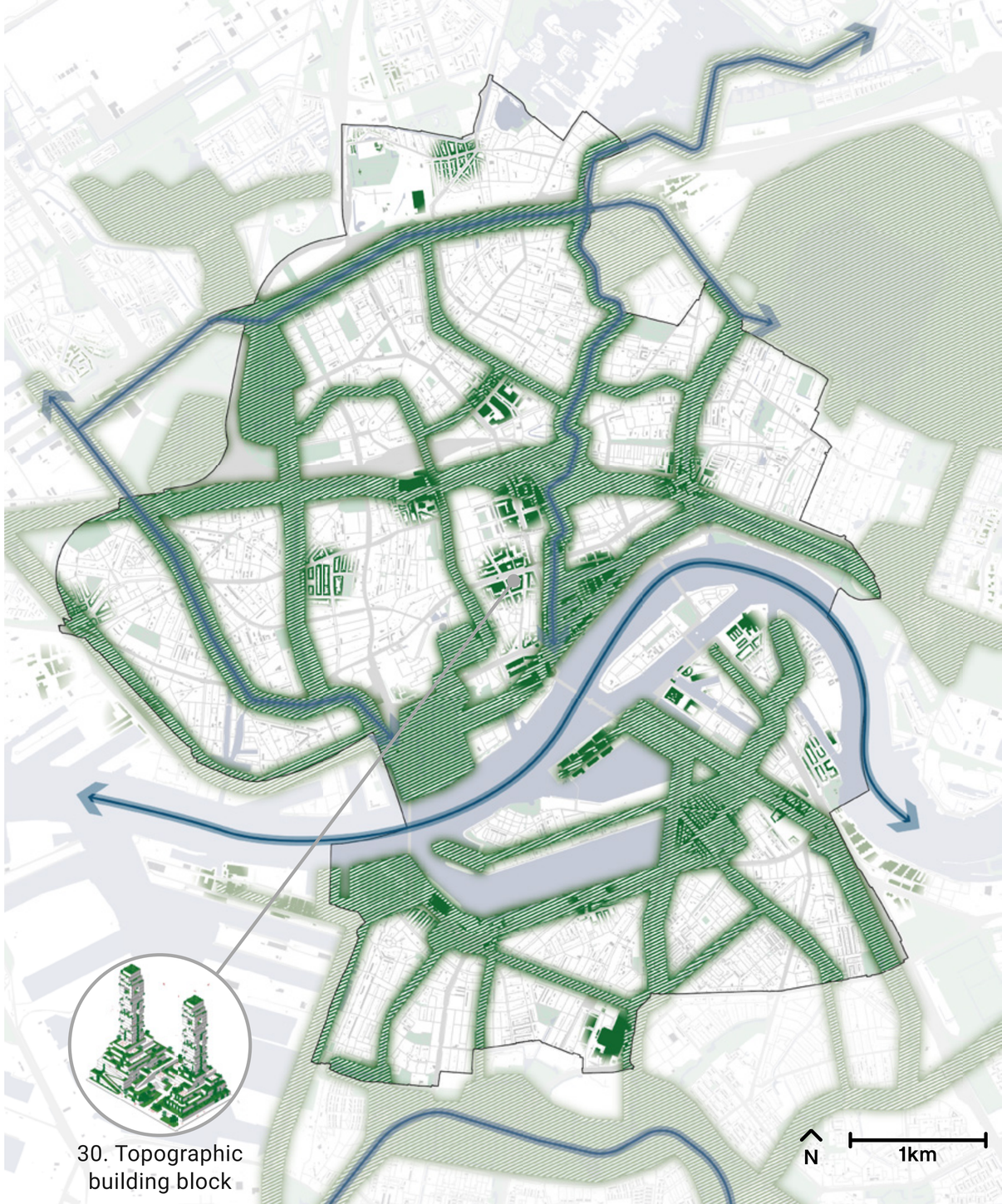
- Existing ecological corridor and high biodiversity areas
- Existing natural structure
- Main proposed corridors
- Ecological network
- Ecological improvement of current green spaces

Framework for Rotterdam

1. An ecological network connects and creates high biodiversity areas

2. Densification projects serve as green injections for the neighbourhood

Green densification location



30. Topographic building block

Framework for Rotterdam

1. An ecological network connects and creates high biodiversity areas

2. Densification projects serve as green injections for the neighbourhood

3. New parks make innovative use of under-used spaces

- Water-based park
- Rooftop park
- Pocket park

26. Water front park

Framework for Rotterdam

1. An ecological network connects and creates high biodiversity areas

2. Densification projects serve as green injections for the neighbourhood

3. New parks make innovative use of under-used spaces

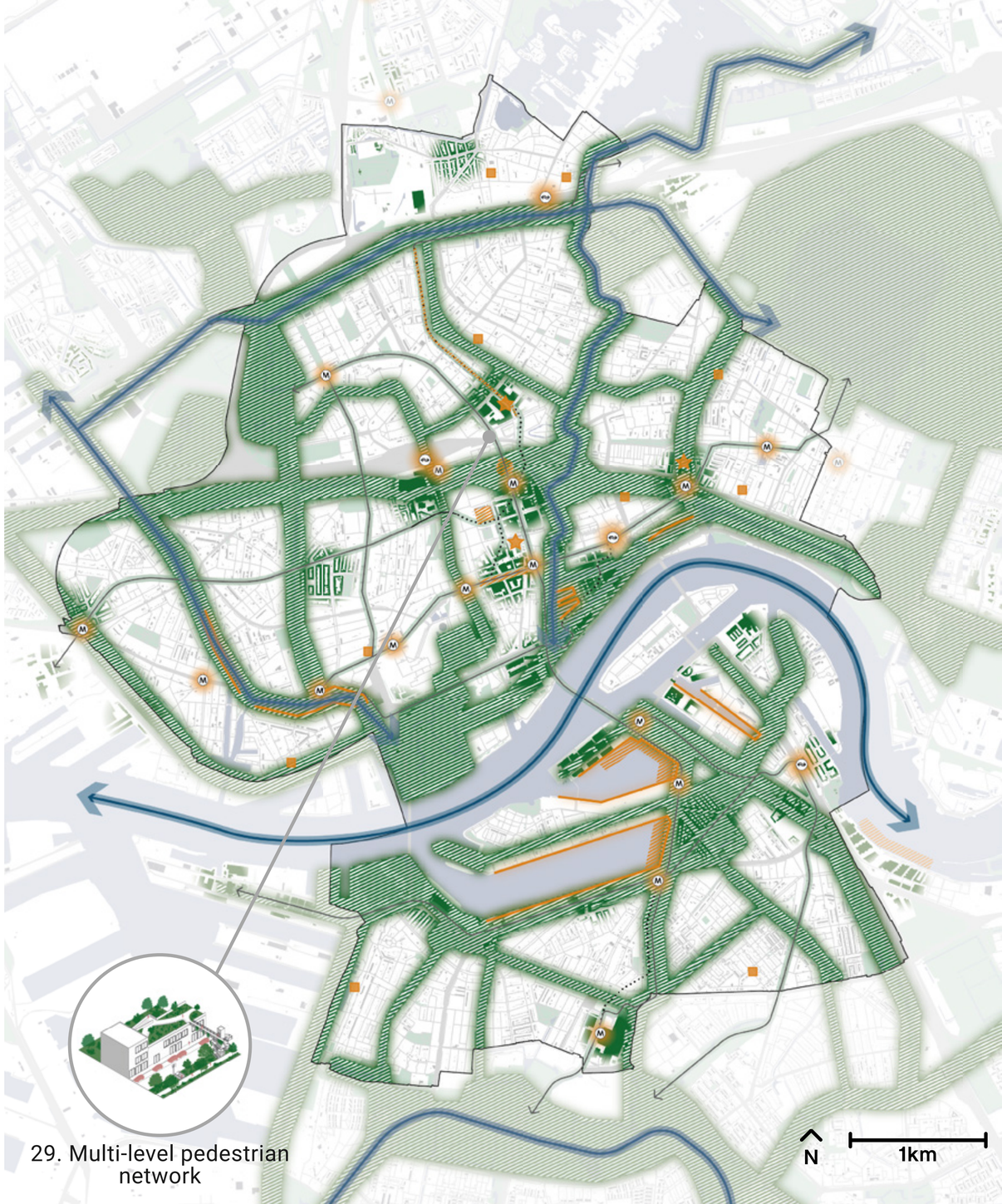
4. Pedestrian networks connect parks with public transportation and improve walkability

Green improves walkability

Elevated route

Metro station

Train station



29. Multi-level pedestrian network

Framework for Rotterdam

1. An ecological network connects and creates high biodiversity areas

2. Densification projects serve as green injections for the neighbourhood

3. New parks make innovative use of under-used spaces

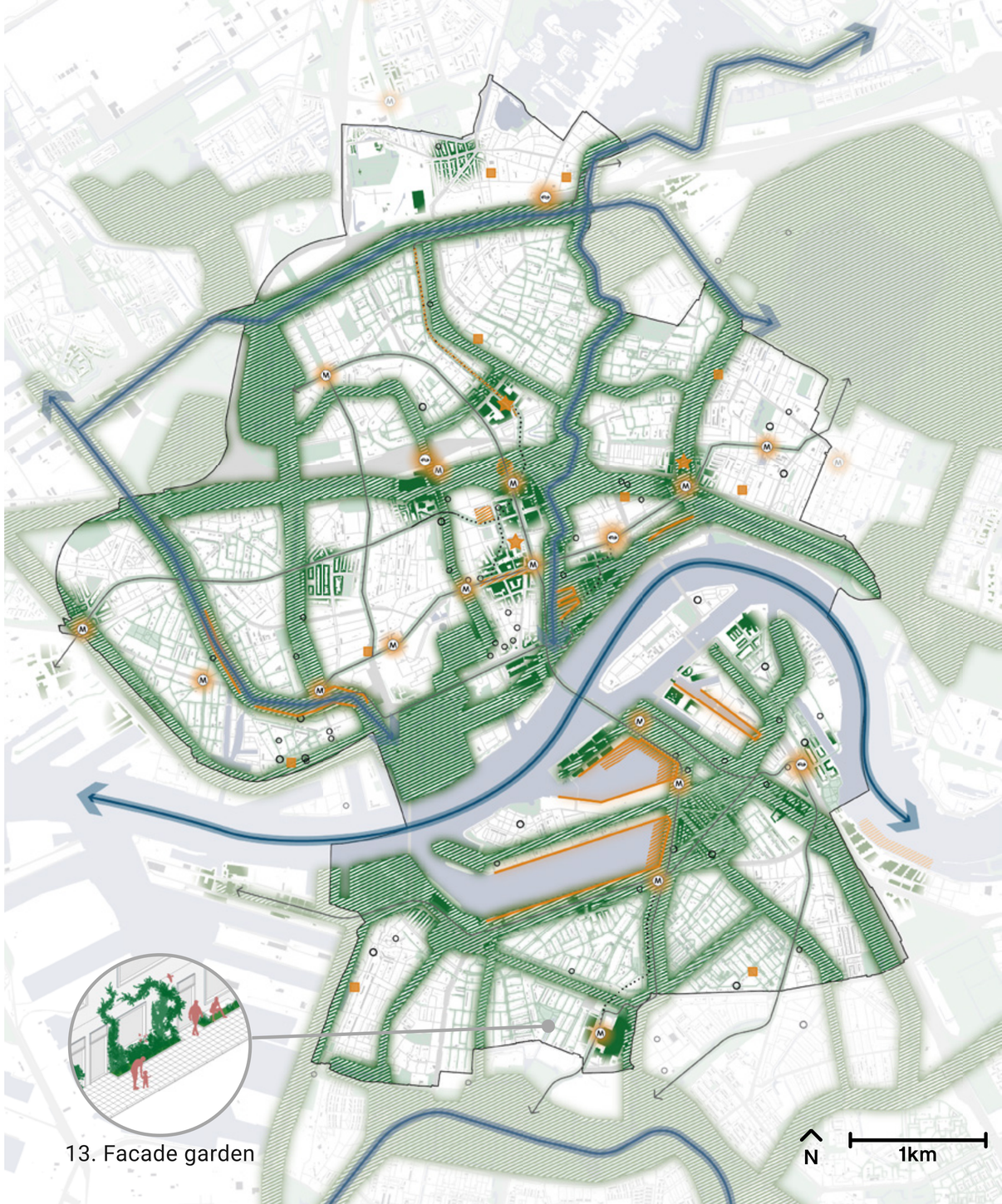
4. Pedestrian networks connect parks with public transportation and improve walkability

5. Invite community to be stewards of greenery and bring green space close to home

Local projects encourage green streets

Activation of flat rooftops

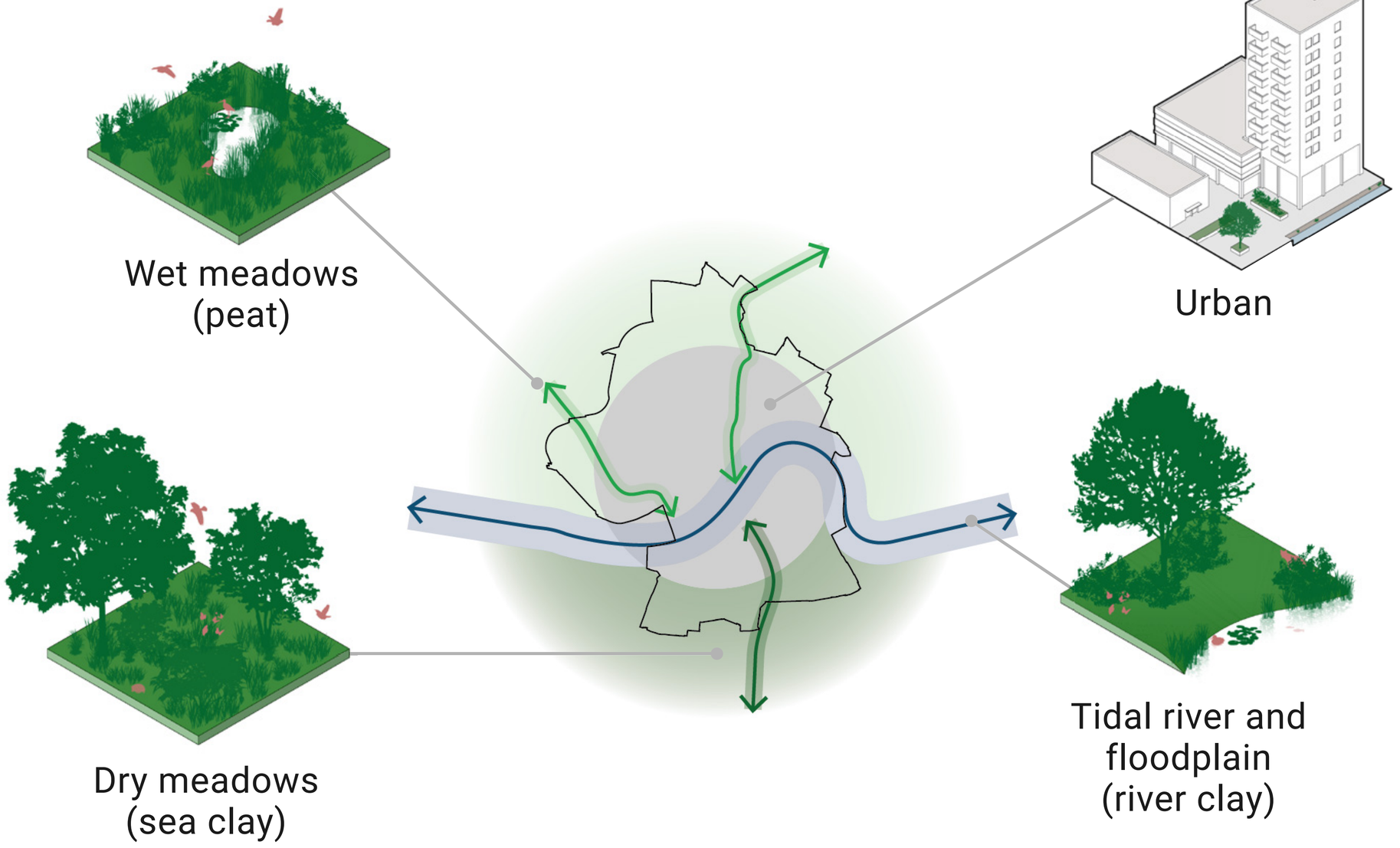
Educational facilities and community centres catalyse green initiatives



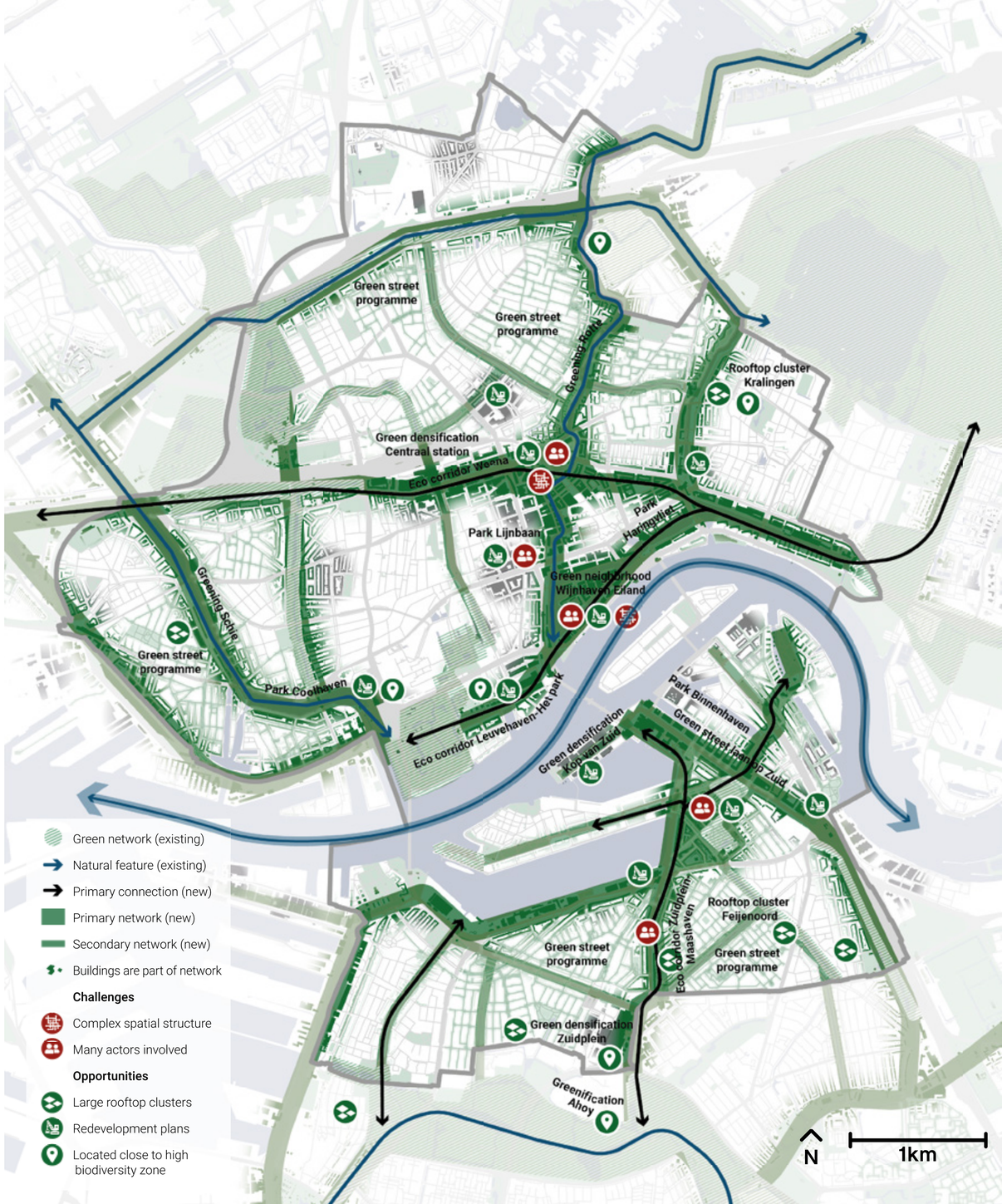
13. Facade garden

Connection to surrounding landscape

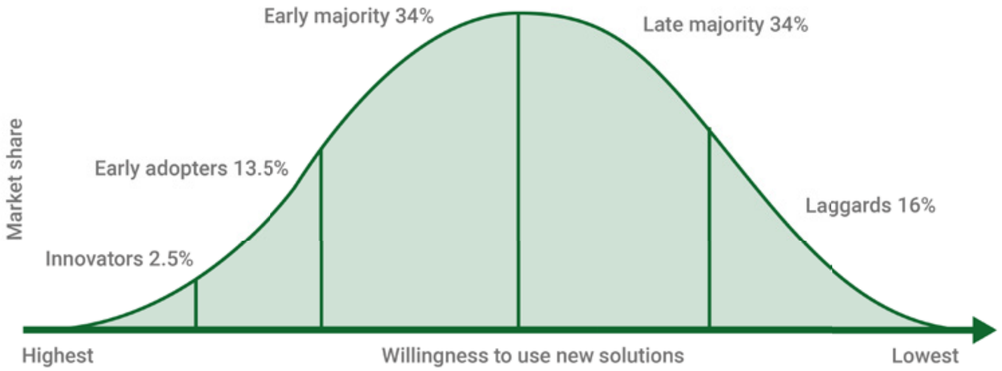
Connection to surrounding landscape



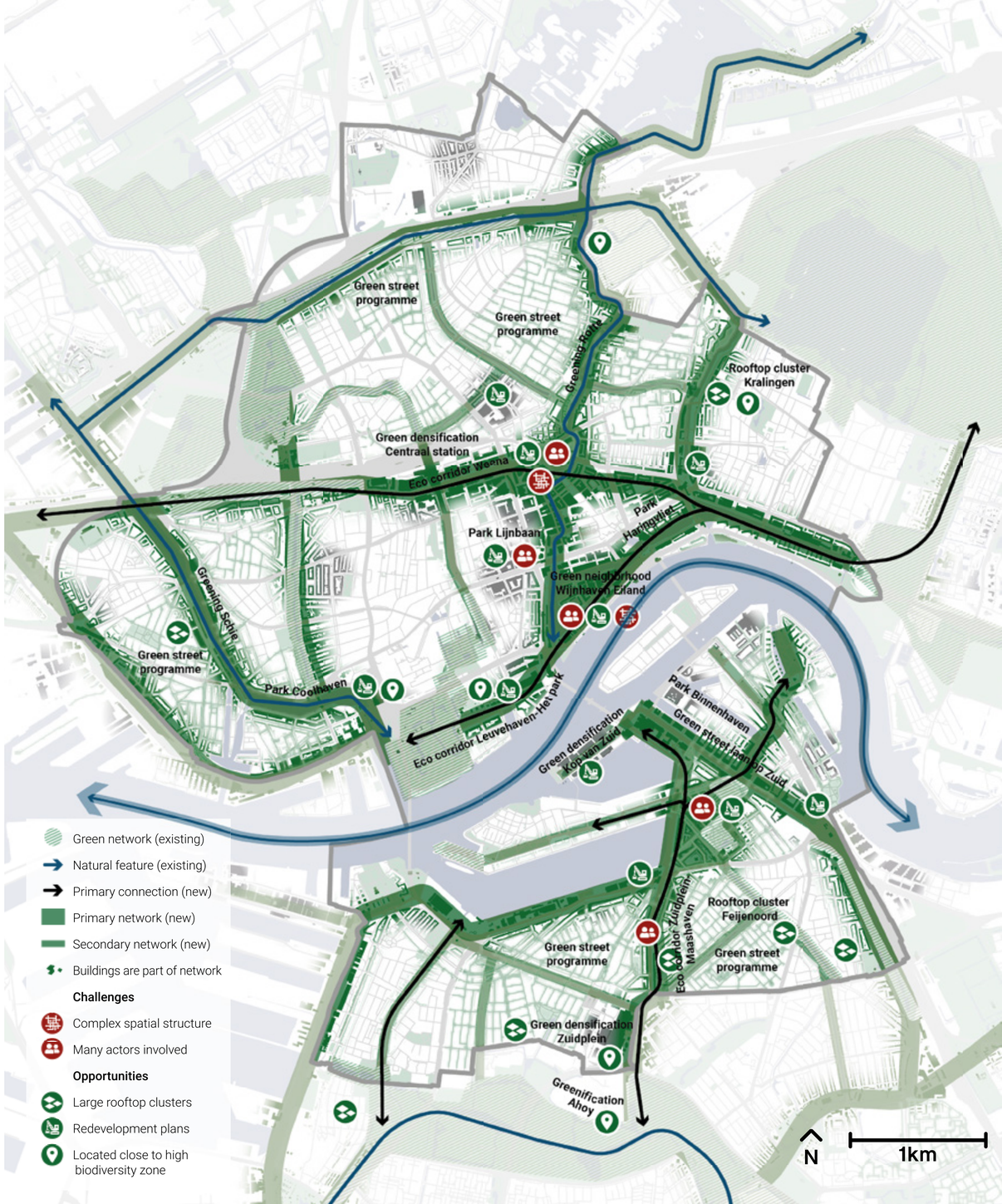
Implementation



Implementation

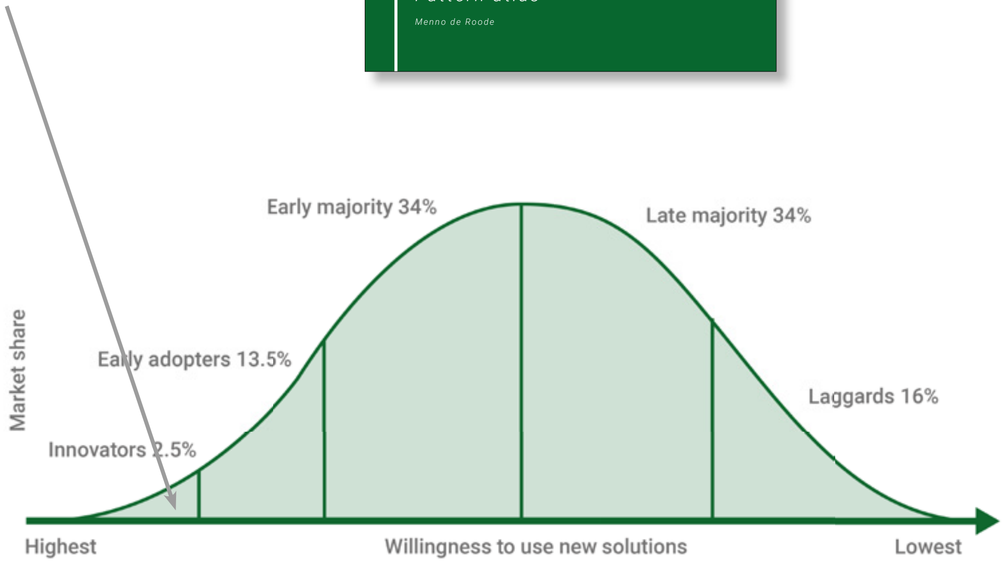


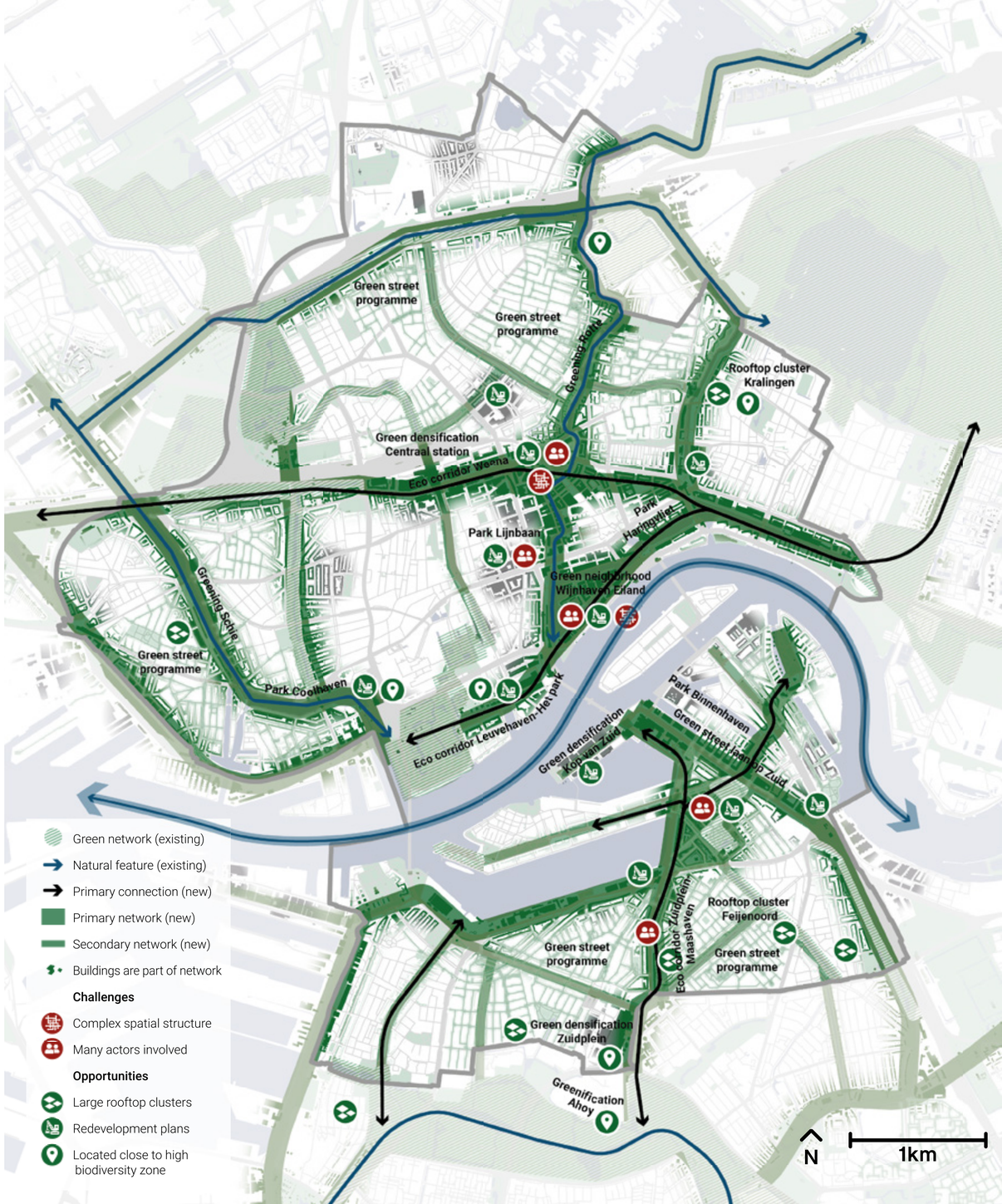
Rogers, E. M. (1995). Diffusion of Innovations: modifications of a model for telecommunications. In Die diffusion von innovationen in der telekommunikation (pp. 25-38). Springer, Berlin, Heidelberg.



Implementation

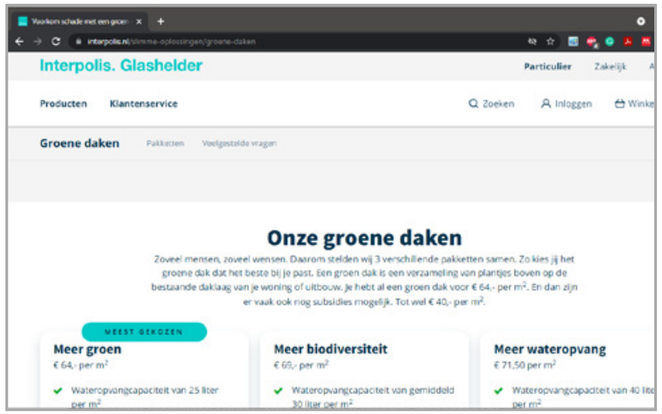
1. Information



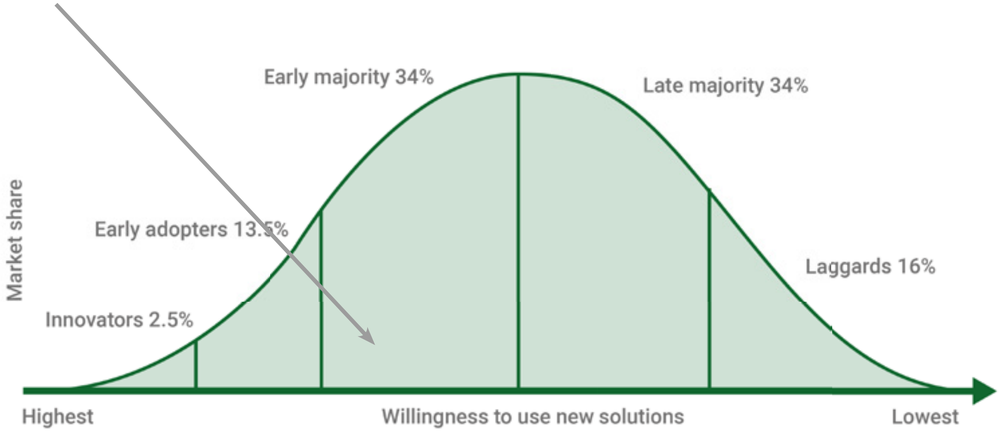


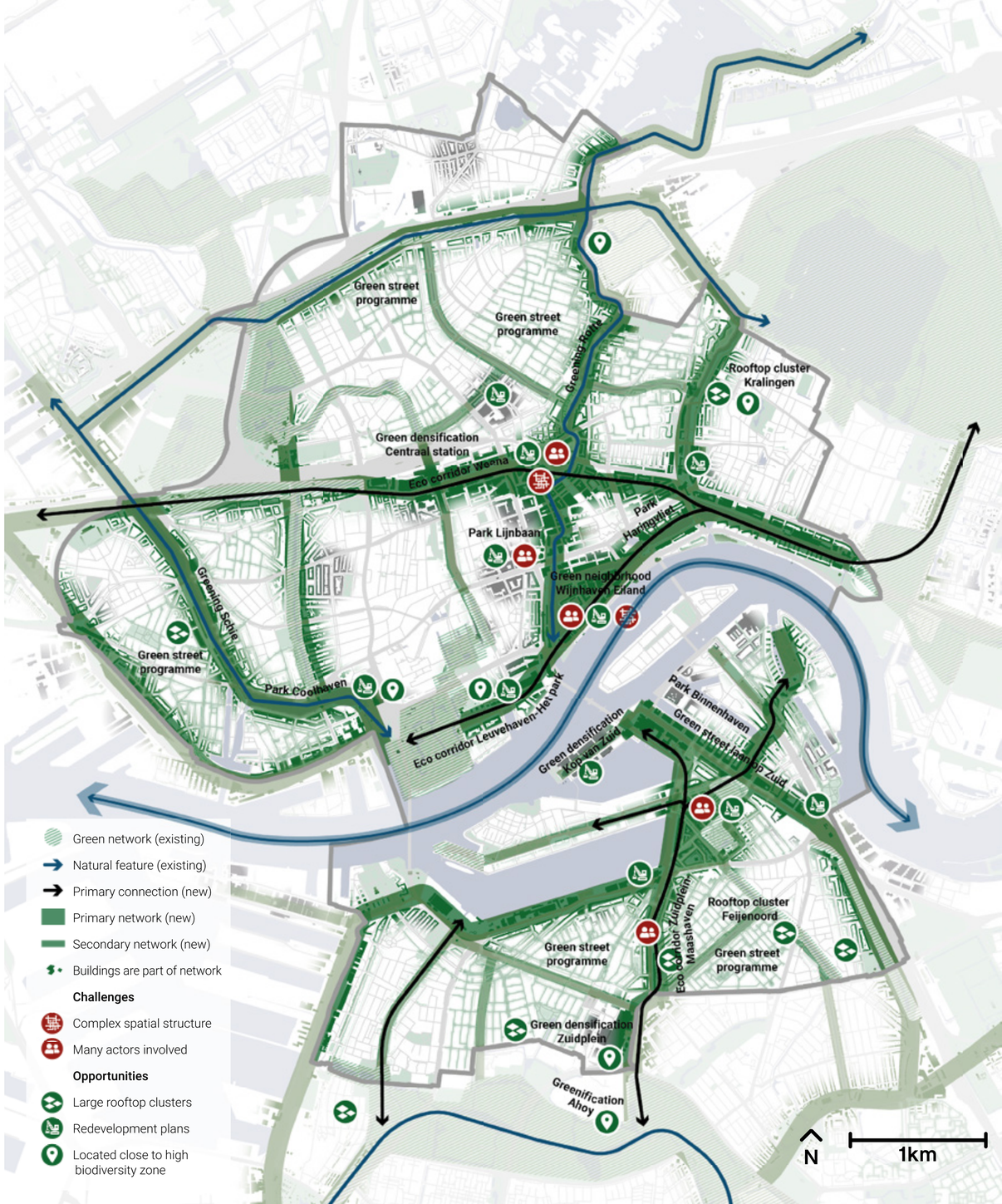
Rogers, E. M. (1995). Diffusion of Innovations: modifications of a model for telecommunications. In Die diffusion von innovationen in der telekommunikation (pp. 25-38). Springer, Berlin, Heidelberg.

Implementation



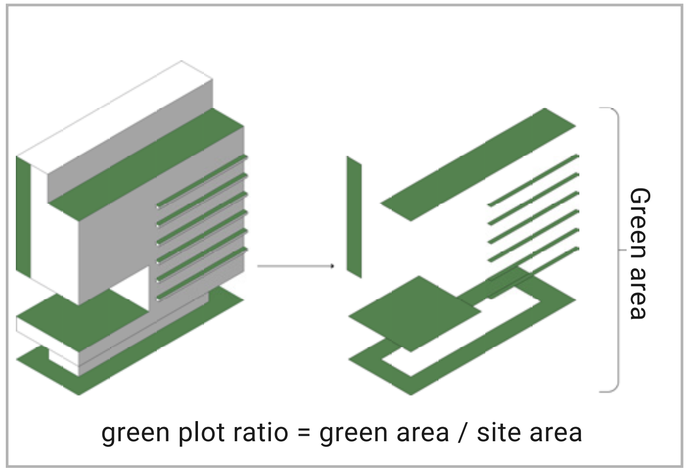
2. Financial incentive



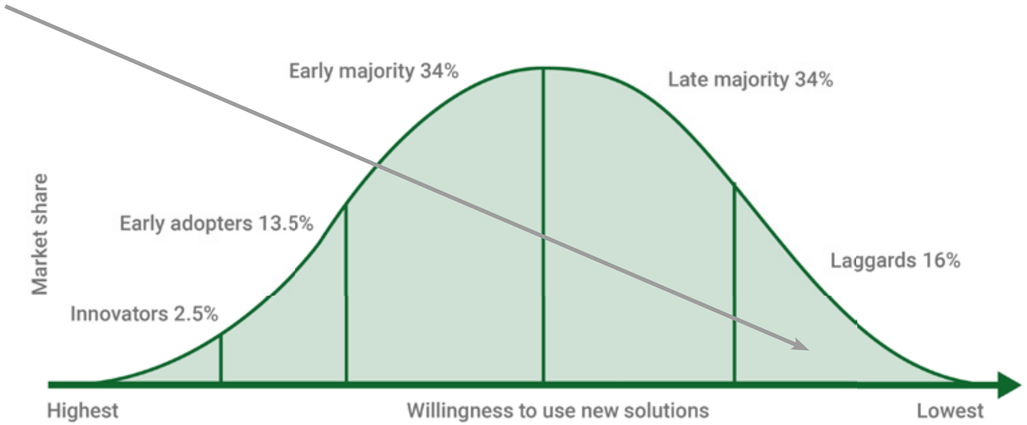


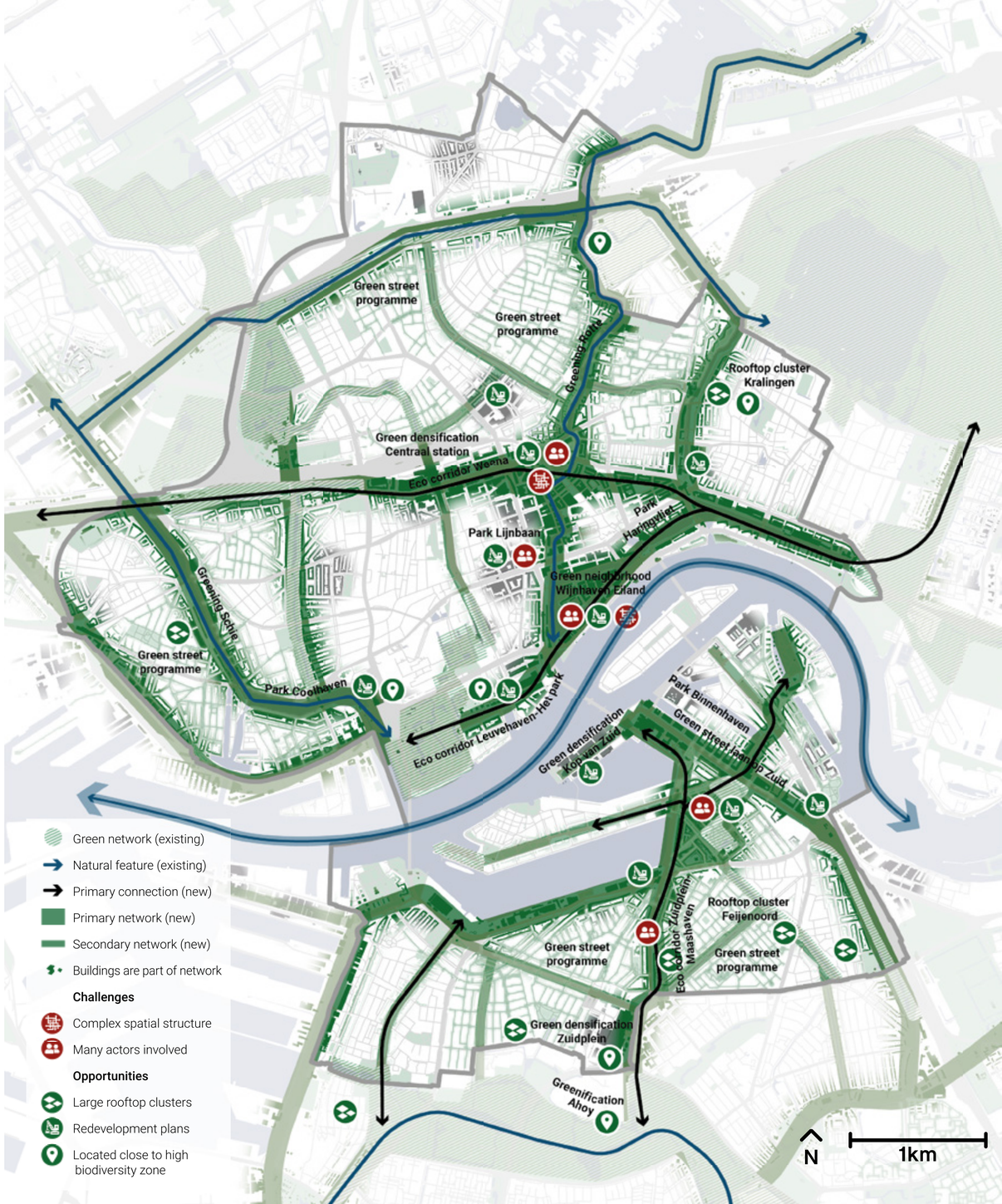
Rogers, E. M. (1995). Diffusion of Innovations: modifications of a model for telecommunications. In Die diffusion von innovationen in der telekommunikation (pp. 25-38). Springer, Berlin, Heidelberg.

Implementation



3. Regulations





Rogers, E. M. (1995). Diffusion of Innovations: modifications of a model for telecommunications. In Die diffusion von innovationen in der telekommunikation (pp. 25-38). Springer, Berlin, Heidelberg.
Green plot ratio adapted from Urban Redevelopment Authority, Singapore

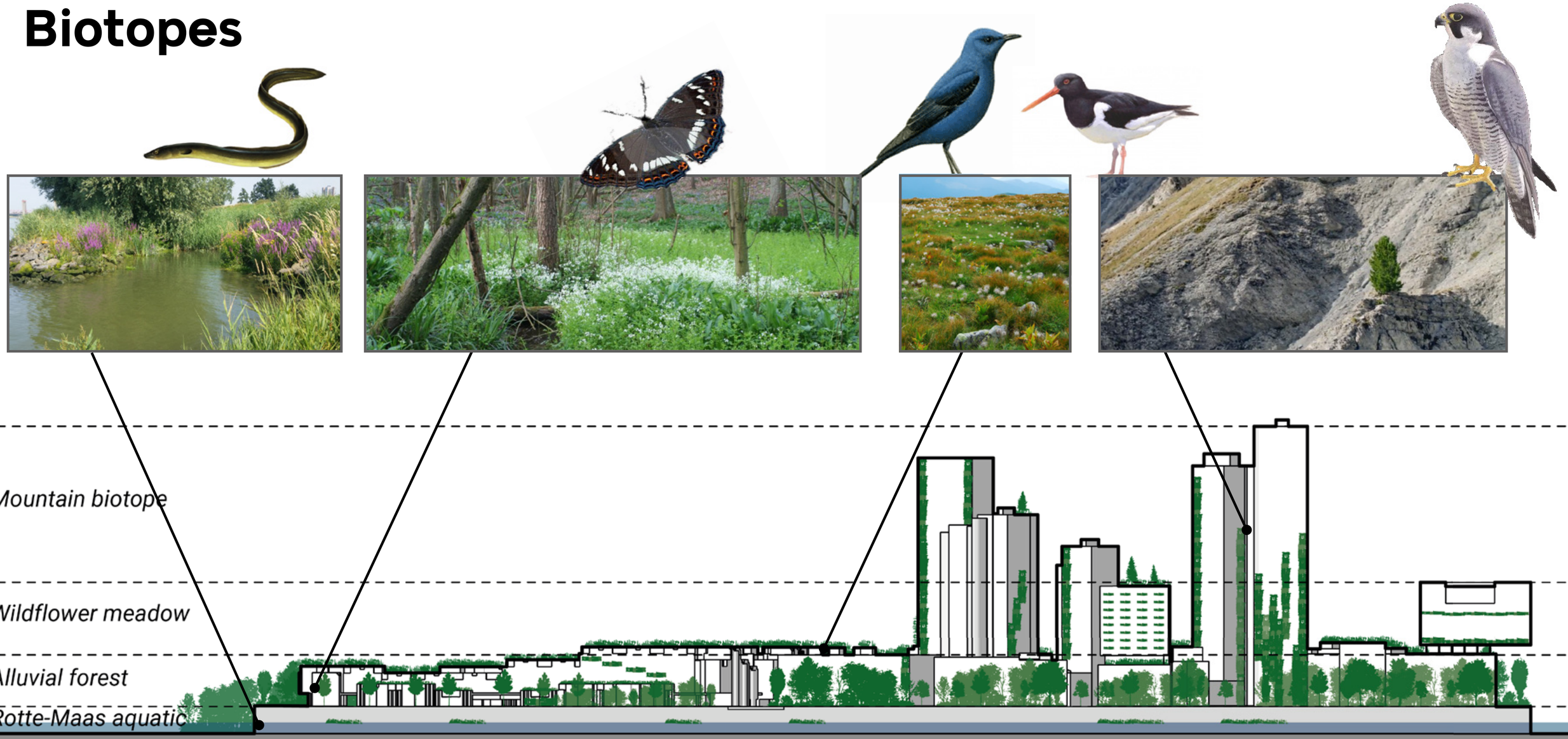
Implications

Wijnhaven Eiland

Wijnhaven Eiland

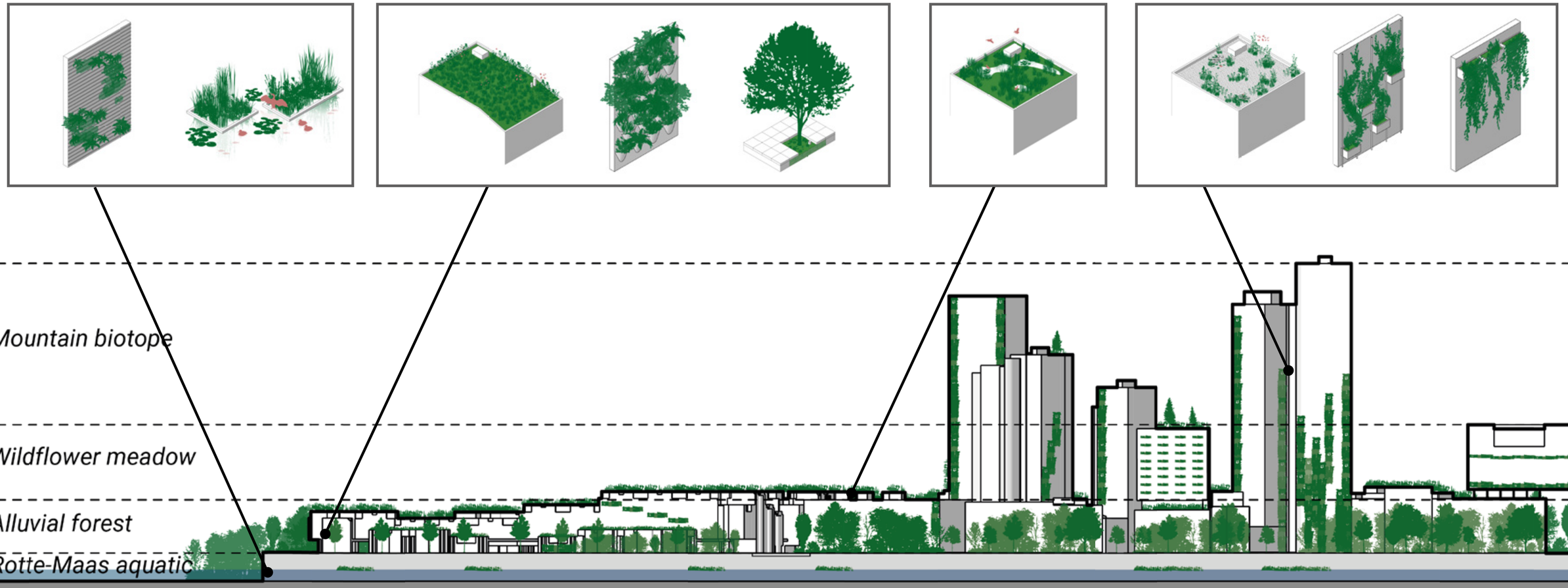
Biodiverse neighborhood: district as a park

Biotopes

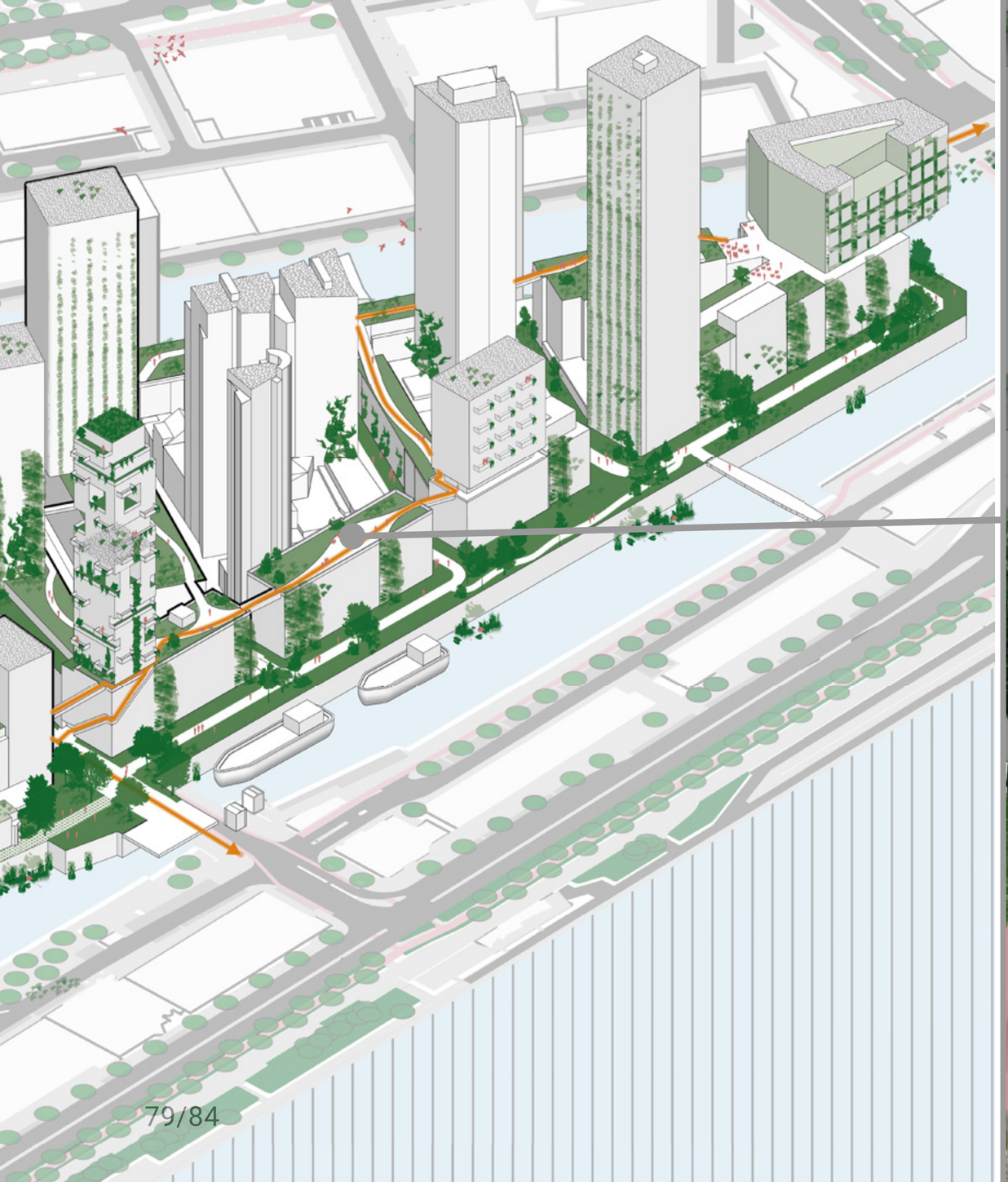


Images from: Vogelbescherming, Natura2000, https://freebigpictures.com/mountain-pictures/, https://www.agami.nl/search.pp?showpicture=163959, RTL, Sancuary: Survival Stories of the Alps.

Biotopes


120m
Mountain biotope
70m
Wildflower meadow
20m
Alluvial forest
0m
Rotte-Maas aquatic

“During my lunch break I take a rest on my balcony. I like to draw the people and animals I can see from here.”



“We have noticed that more guests visit our bar since we have opened our rooftop terrace.”

4

A **spatial vision and strategy** that guides the development of the compact urban green space patterns in Rotterdam:

- Is connected to existing spatial qualities
- Includes a combination of patterns suitable for renovation projects and patterns that require new development
- Is not a blueprint but consists of tools to foster cooperation between governmental, private and civil organizations

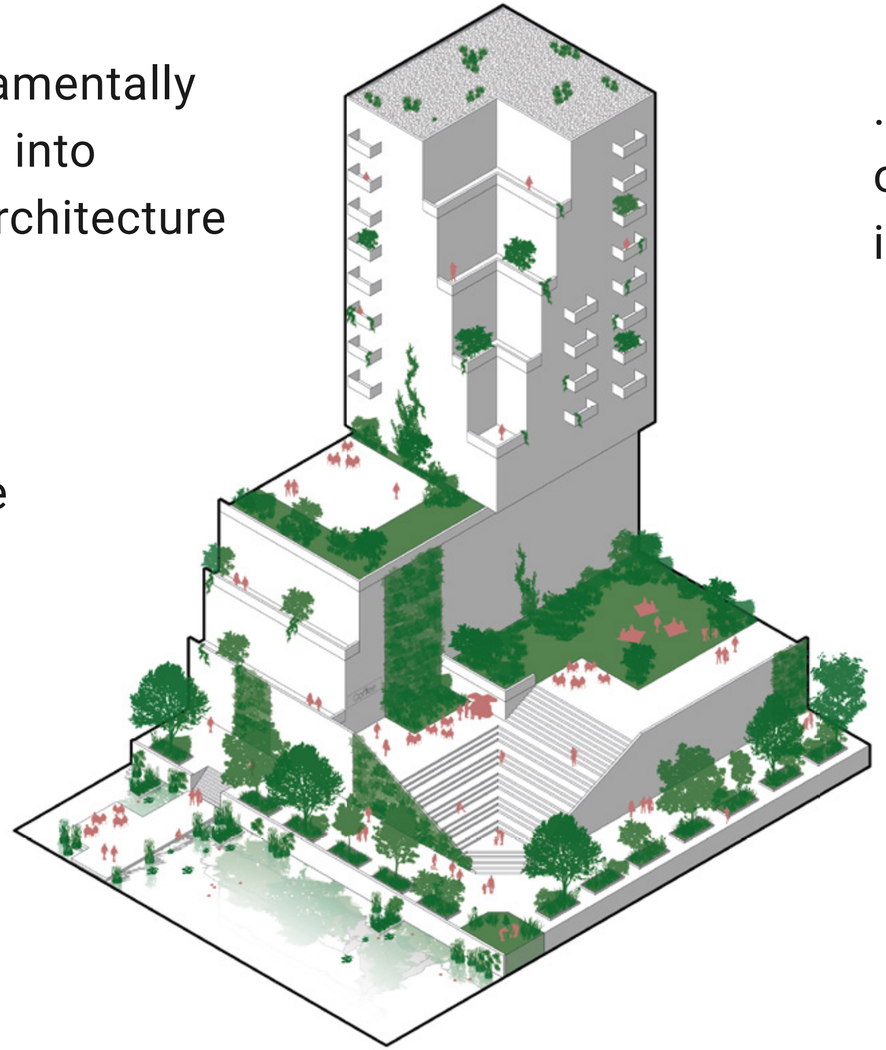
A **framework** that guides the development of **compact urban green space** in Rotterdam which addresses both the quality, in terms of **well-being** and **ecology** as well as the **spatial-ecological structure**:

- Is formed by the combination of conceptual patterns and a spatial structure and strategy.
- Provides space for bottom-up processes that address the uncontrollable aspects of well-being and ecology.
- Consists of proper spatial design and management (from an anthropocentric point of view) to achieve spatial quality and limit the negative effects of ecological resilience.

Design conclusions: Compact Urban Green Space should:

...be fundamentally integrated into building architecture

... provide accessible outdoor space even in tall buildings



... provide habitats compatible with existing environmental characteristics

...encourage green initiatives by the local community

...add value at different scales

...connect to public space at the ground level.

Let’s take green space to the next level!

Menno de Roode

P5 Graduation presentation July 2nd 2021

1st mentor: Dr. Ir. N.M.J.D. (Nico) Tillie | 2nd mentor: Dr. Ir. R.M. (Remon) Rooij | 3rd mentor: Dr.Ir. M. (Marc) Ottele