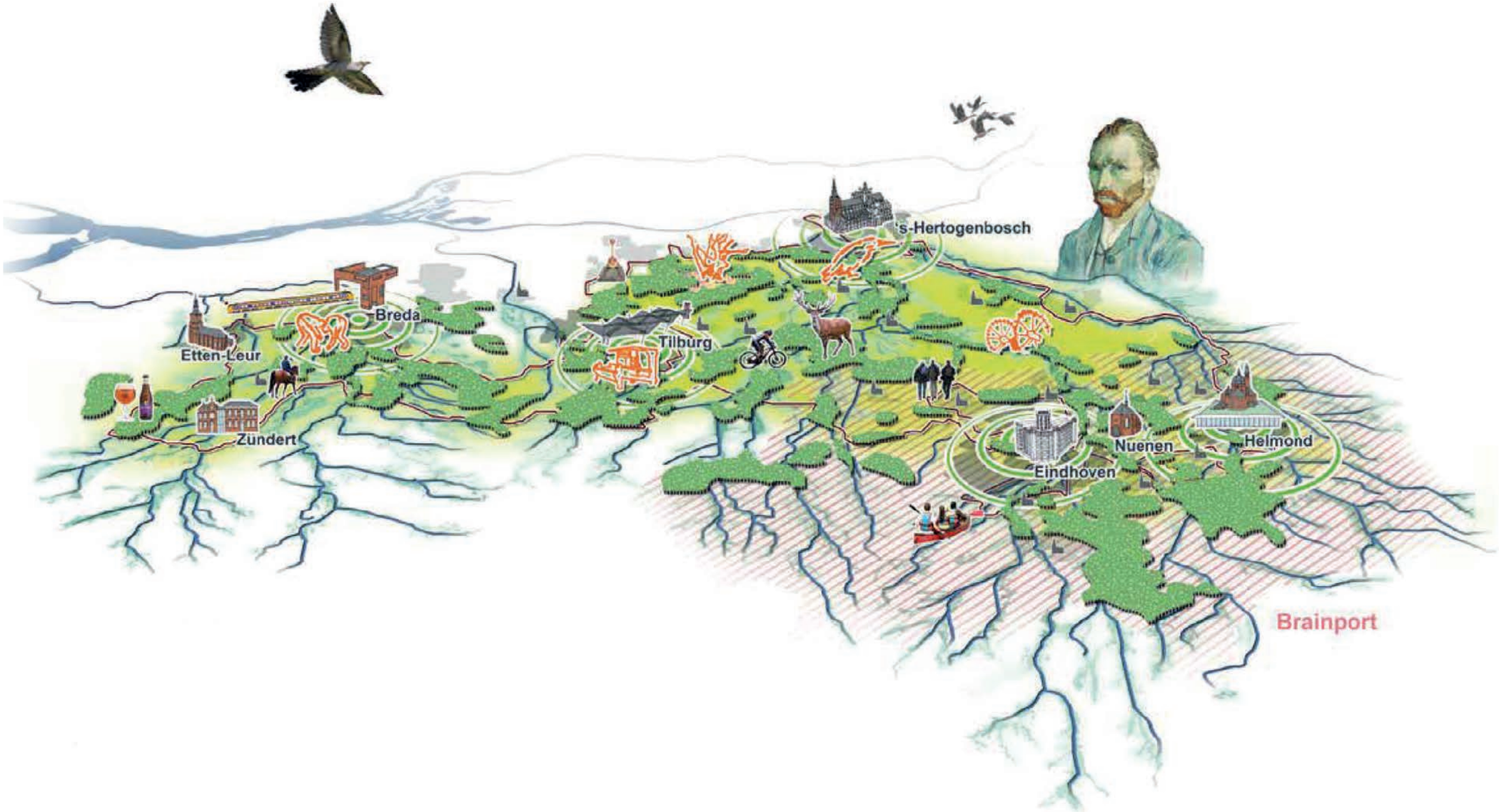
Development of the river Aa catchment area to contribute to Mid-Brabant as a National Landscape Park.

Wessel Koolhaas
Landscape architecture
mastertrack Tu Delft
Presentation Peiling 5 (P5)

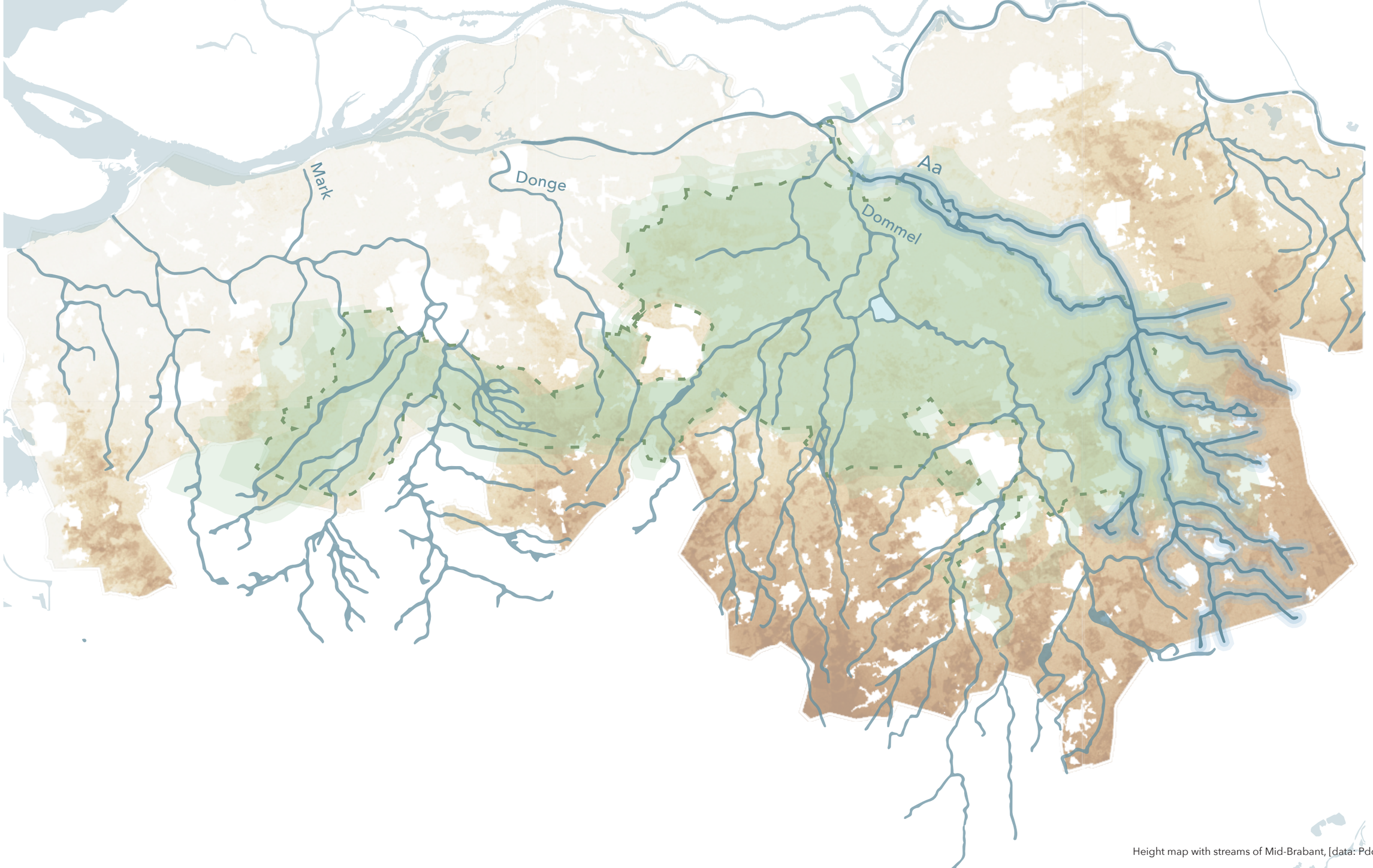
First mentor: Eric Luiten
Second mentor: Marco Lub
examination committee: Herman van de Putte

21 / 6 / 2024

Van Gogh National Park



Illistration form the masterplan for Van Gogh National Park (West 8 & Overland, 2020)



Height map with streams of Mid-Brabant, [data: Pdok, AHN 2024]



A view towards the Aa
Image by author


4764 Pigs
7230 Pigs
320 Cattle
1634 Pigs
289 Cattle
180 Cattle
159 Cattle
340 Cattle



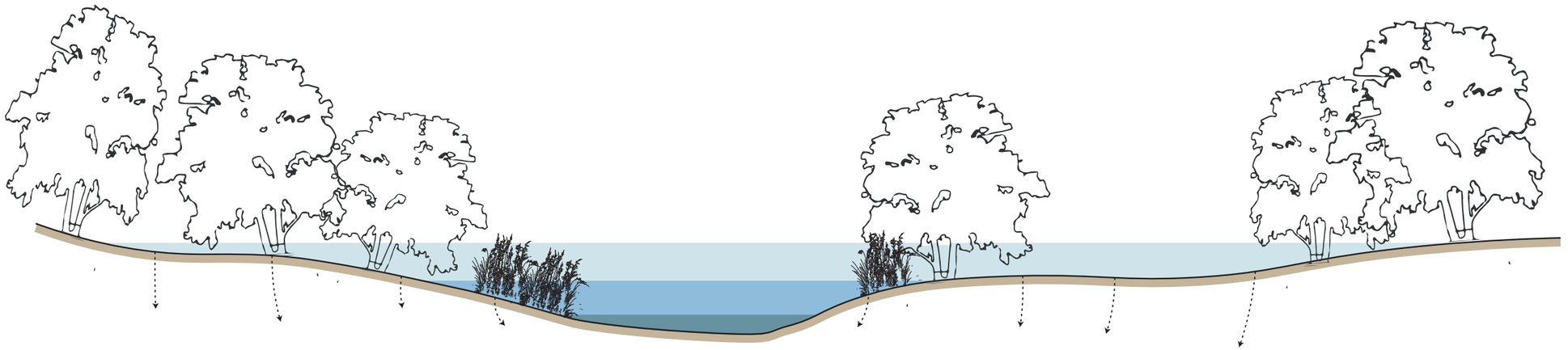
The Aa near Koks with only a strip of grass separating the Aa from agriculteral land. Image by author

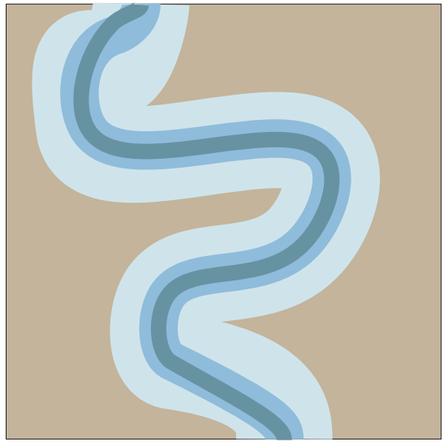


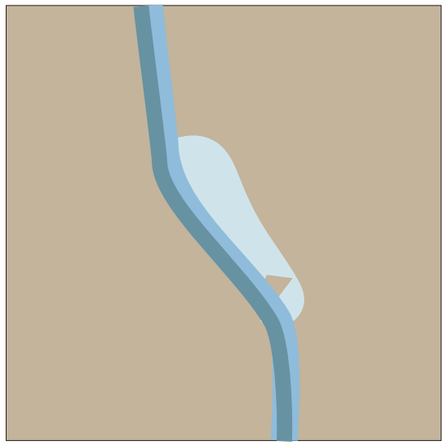
The Aa near Beek en donk
Image by author

Water

Stream normalization







Canalized

Limited nature

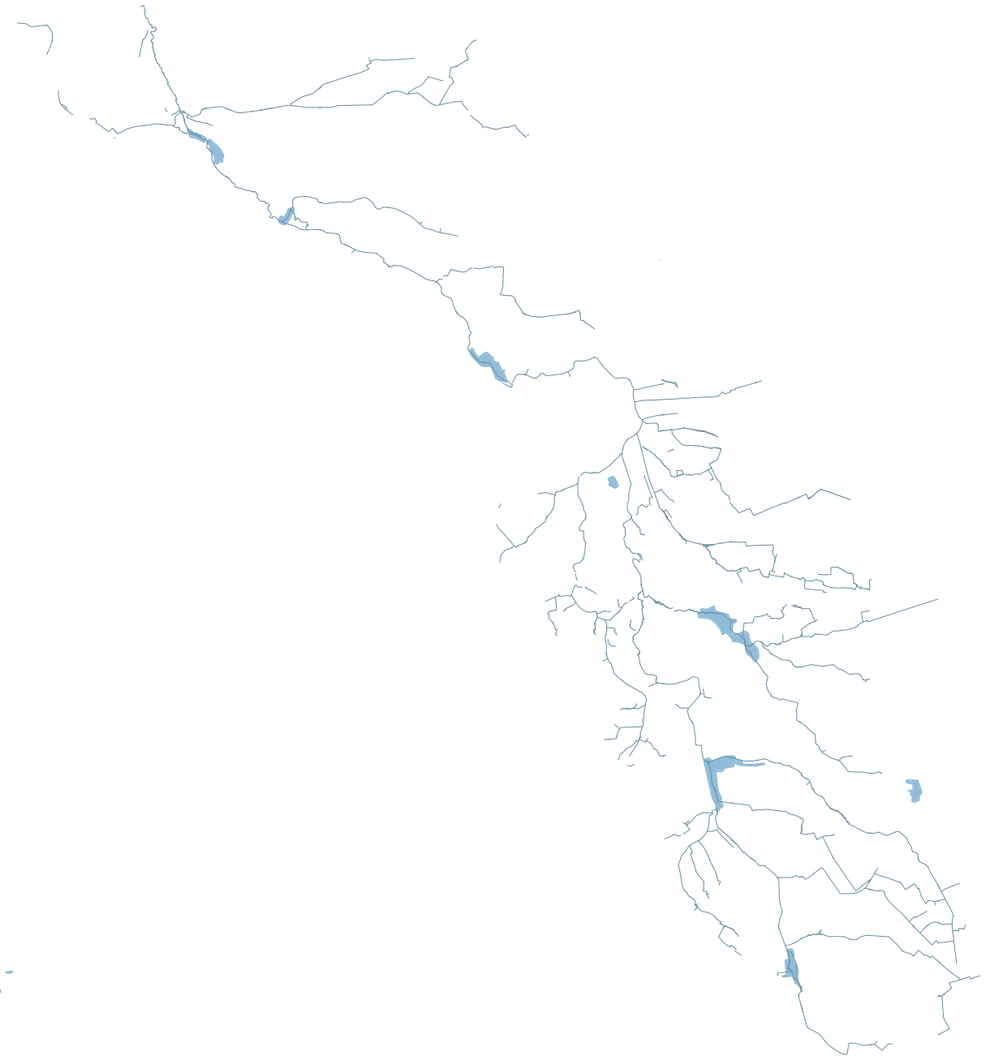
No buffer
(flooding)

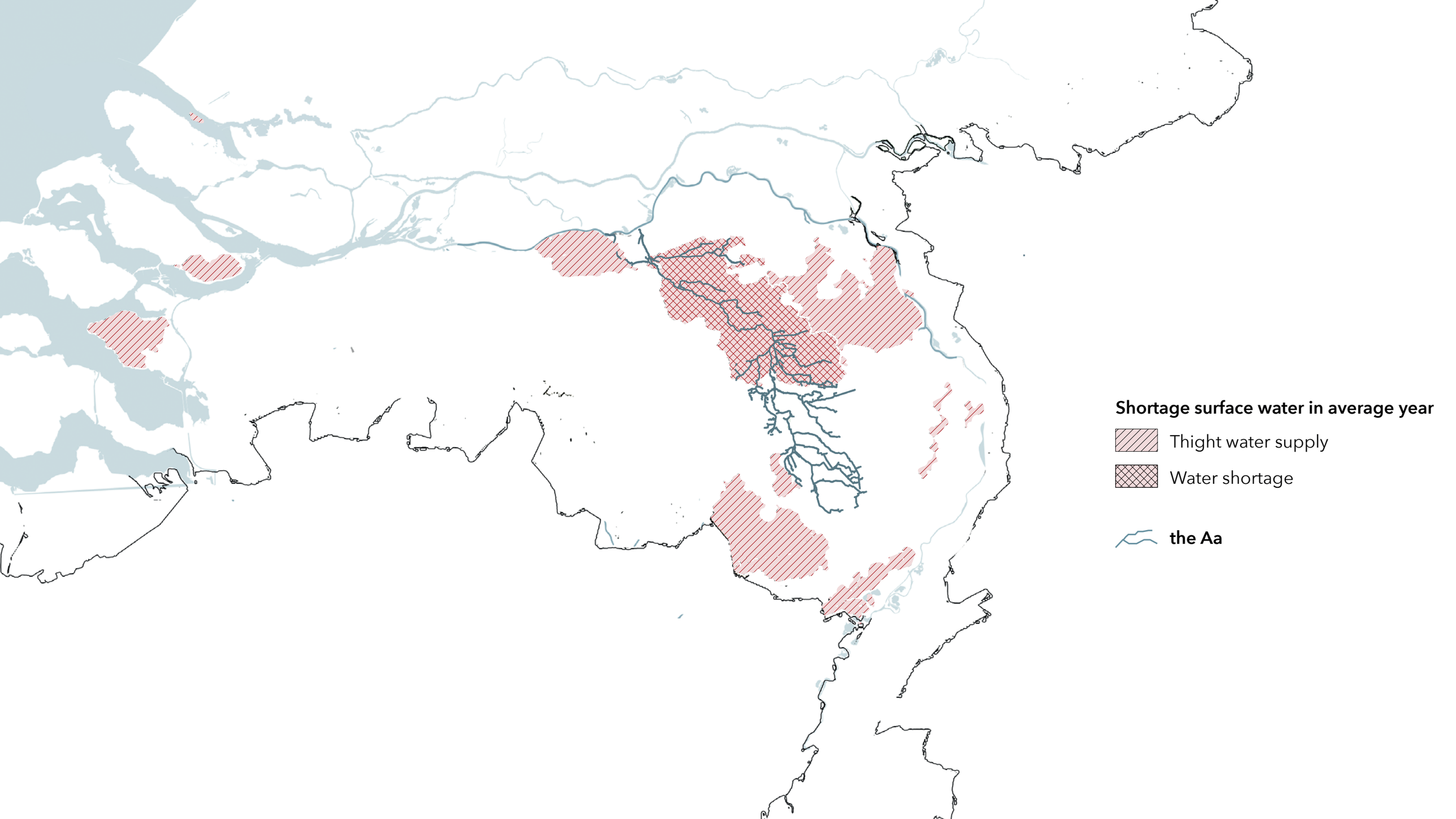
Extract groundwater
(drought)

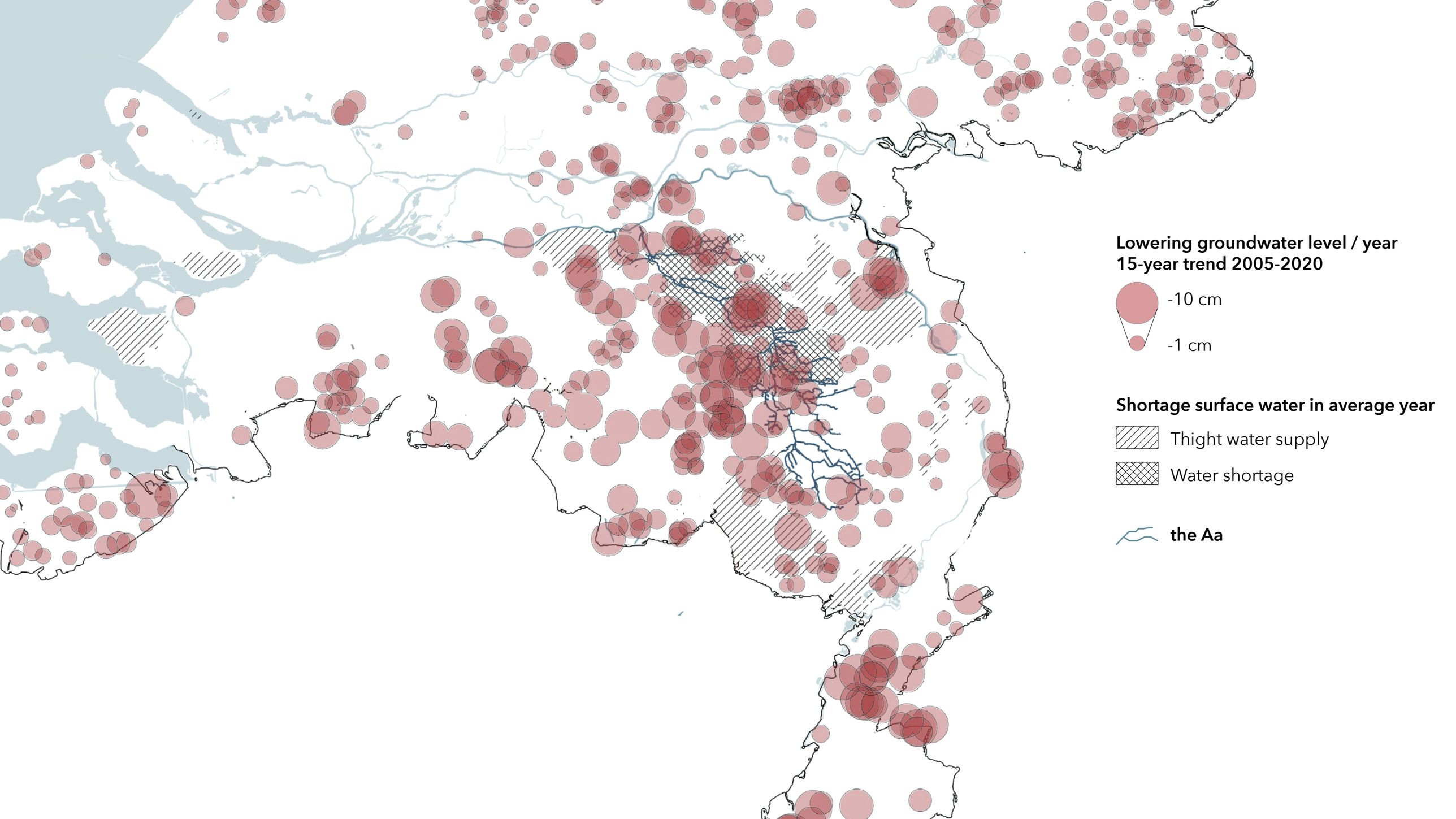
Dommel



Aa

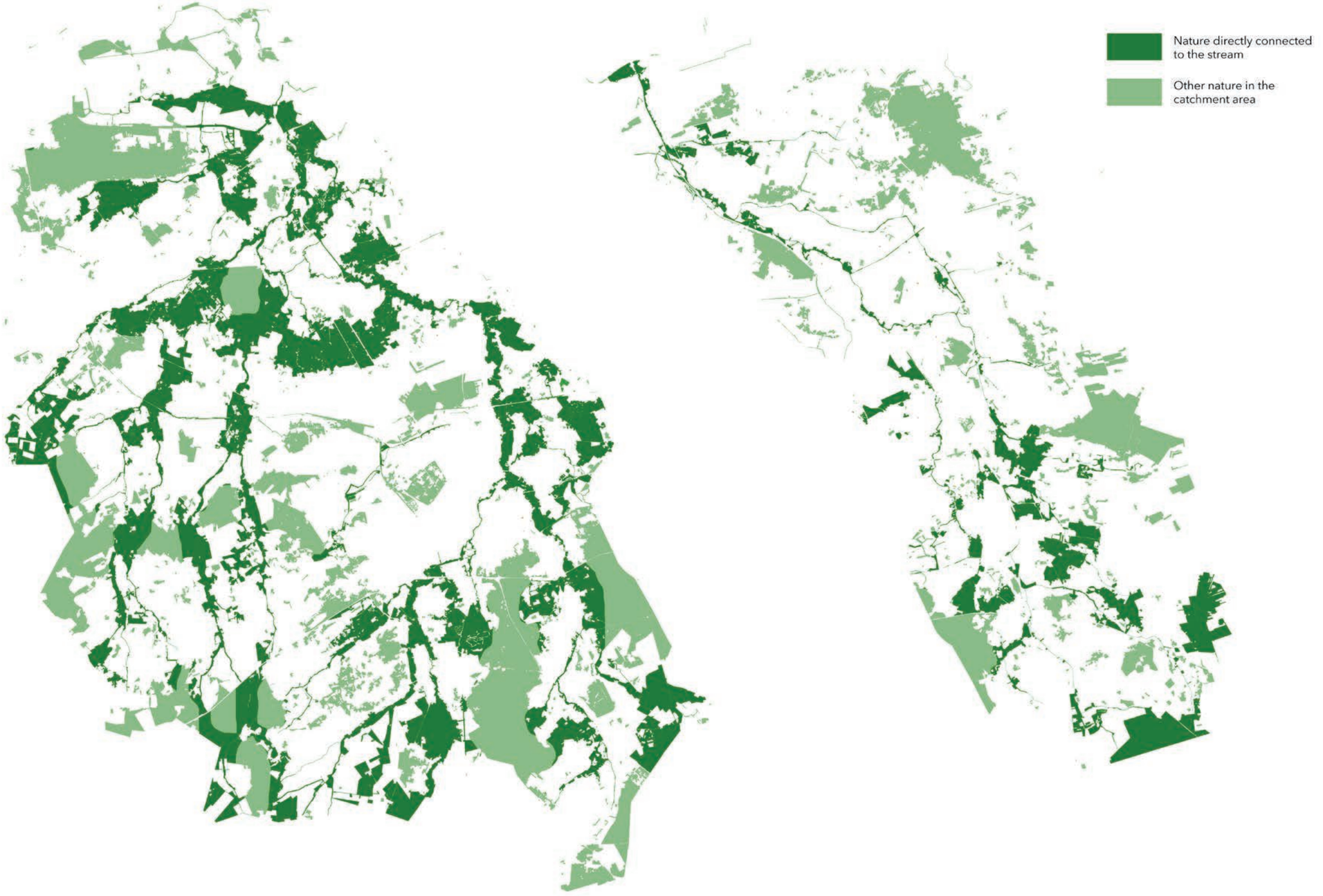



Shortage surface water in average year
Thight water supply
Water shortage
the Aa


Lowering groundwater level / year
15-year trend 2005-2020
-10 cm
-1 cm
Shortage surface water in average year
Thight water supply
Water shortage
the Aa

Dommel

Aa


Nature directly connected to the stream
Other nature in the catchment area

Ecology

Dommel

Aa



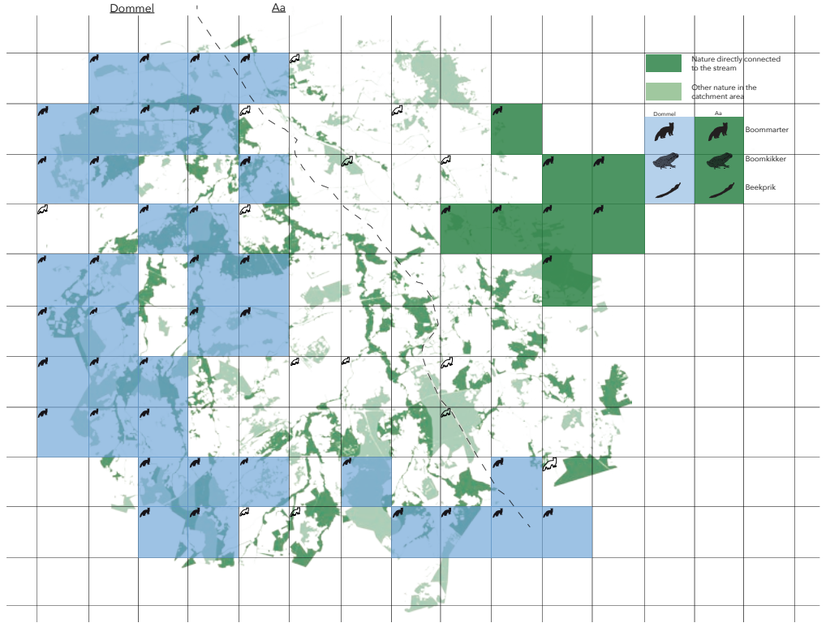
Boommarter
(Pine marten)

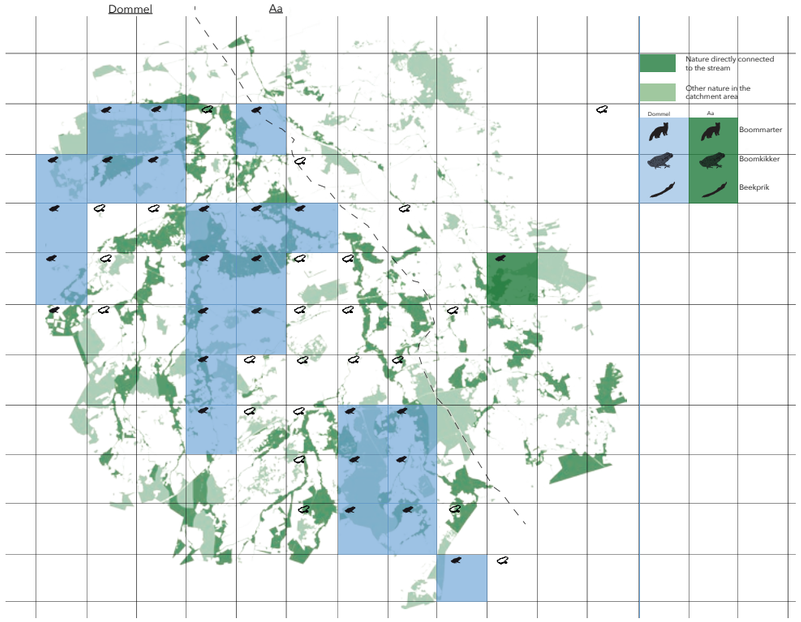


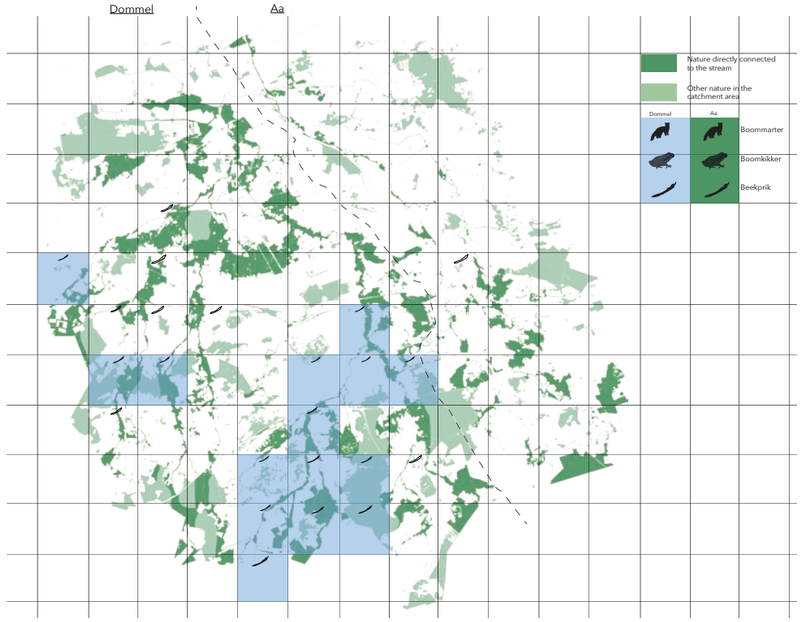
Boomkikker
(European tree frog)



Beekprik
(Brooklamprey)



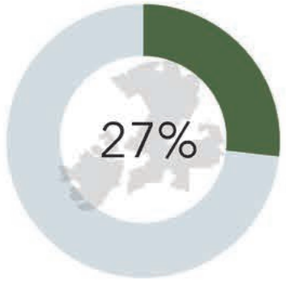




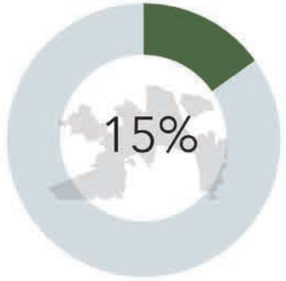
Access to nature from urban cores

percentage of land in the urban vicinity (1km form city edge) which is part of the Brabant Nature Network

Average Dommel cities

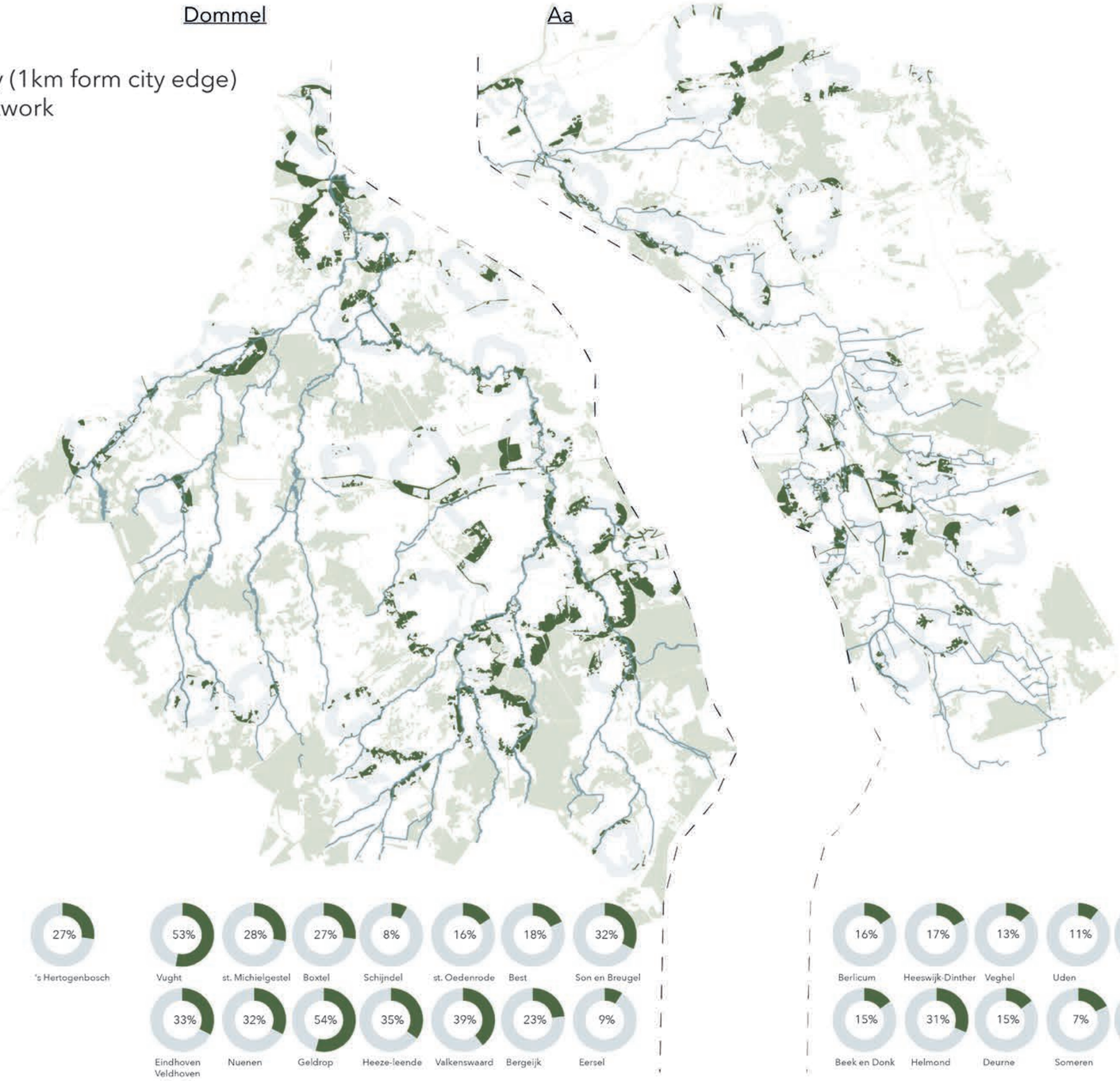


Average Aa cities

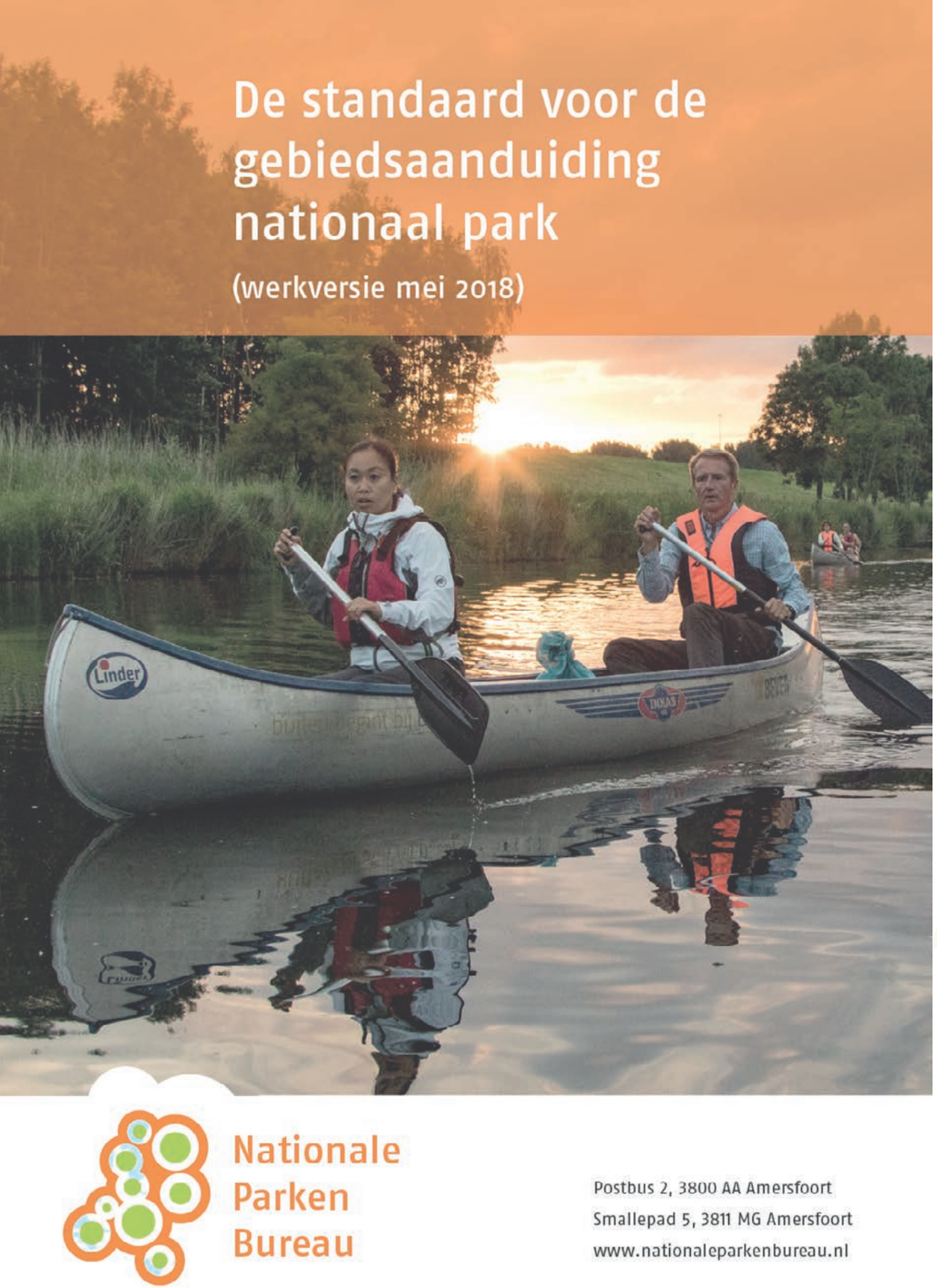


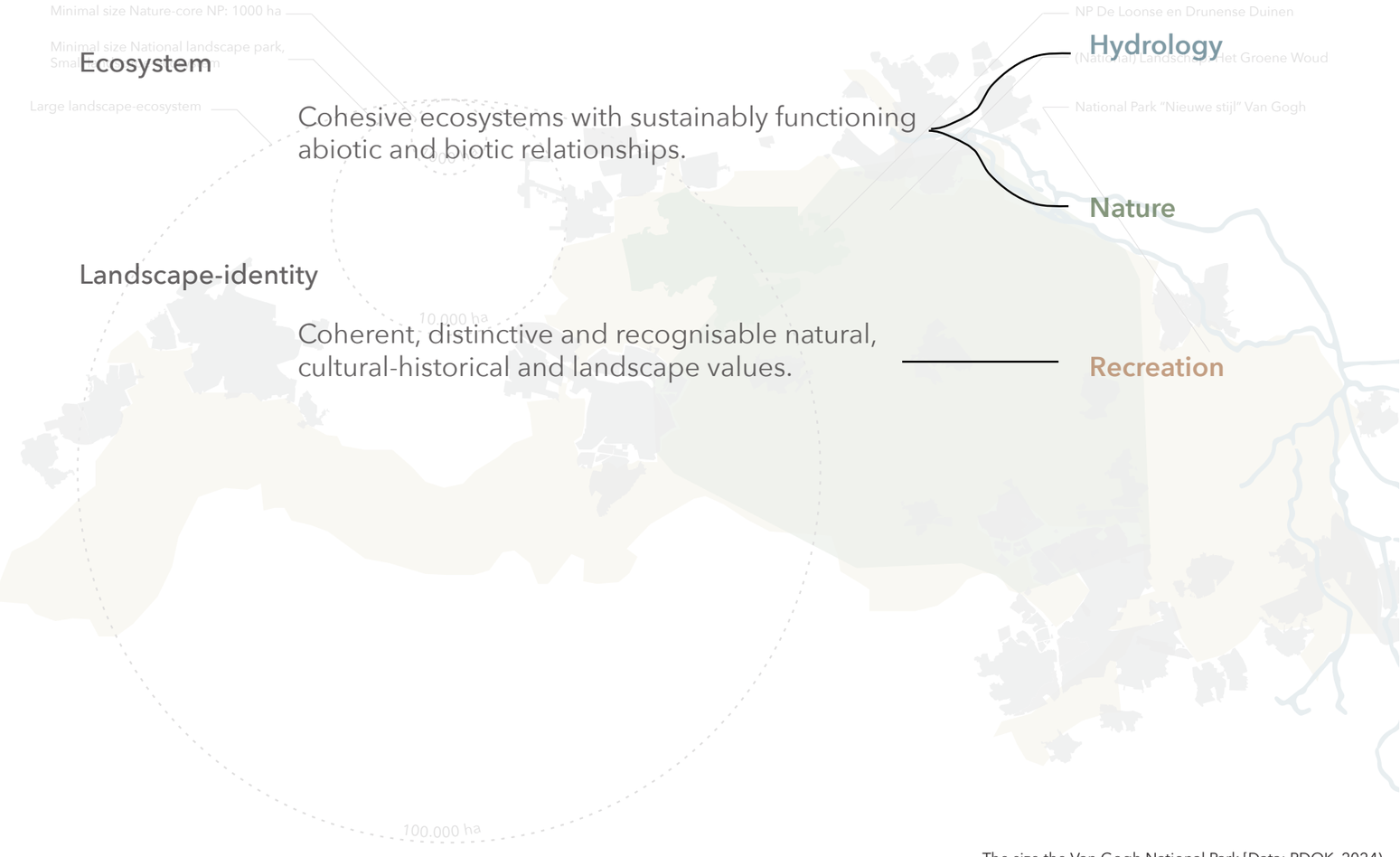
Dommel

Aa



National Park 'Nieuwe Stijl'





The size the Van Gogh National Park [Data: PDOK, 2024)

Research question

Main Research Question:

How can the landscape of the river Aa be revitalized to become a resilient and attractive component of the Van Gogh National Park?

Sub Research Questions:

Hydrology: **Which hydrological measures have to be taken to restore the natural balance of flows?**

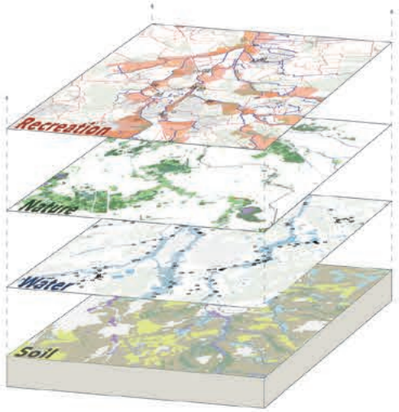
Nature: **Which ecological measures have to be taken to enhance plant and animal life?**

Recreation: **Which recreational measures have to be taken to support an attractive area for visitors and residents?**

Analysis

Design modules & Concepts

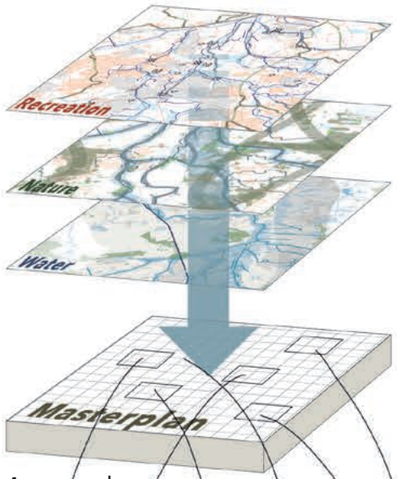
Masterplan & Zoom-ins



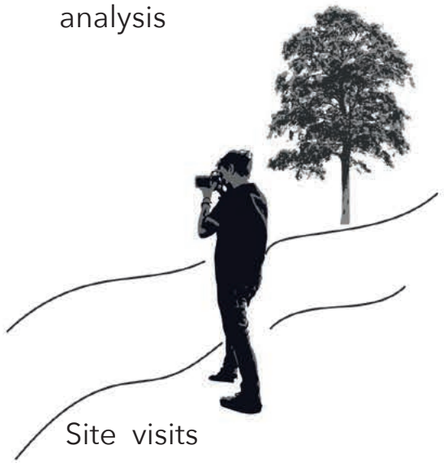
Layerd landscape analysis



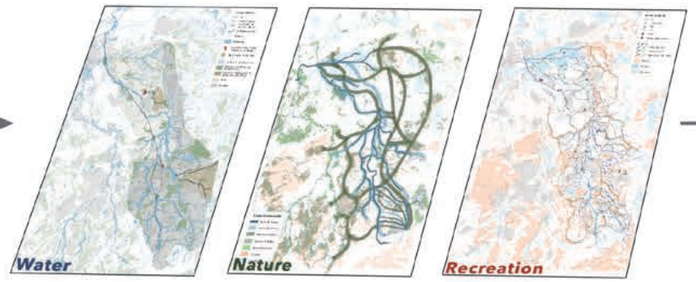
Design modules



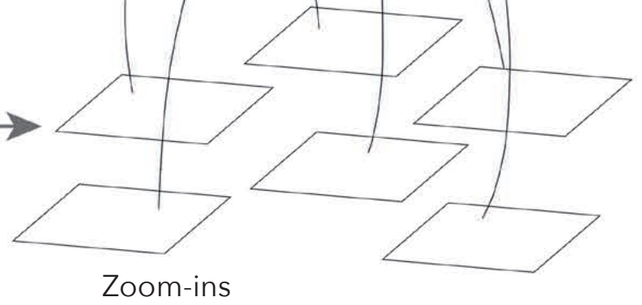
Masterplan



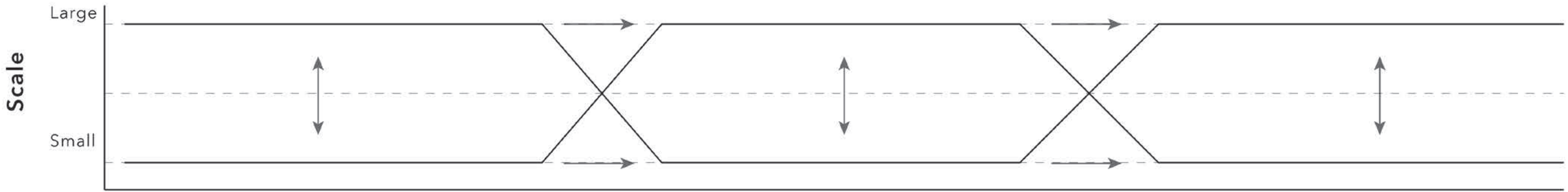
Site visits



Large scale concept mapping

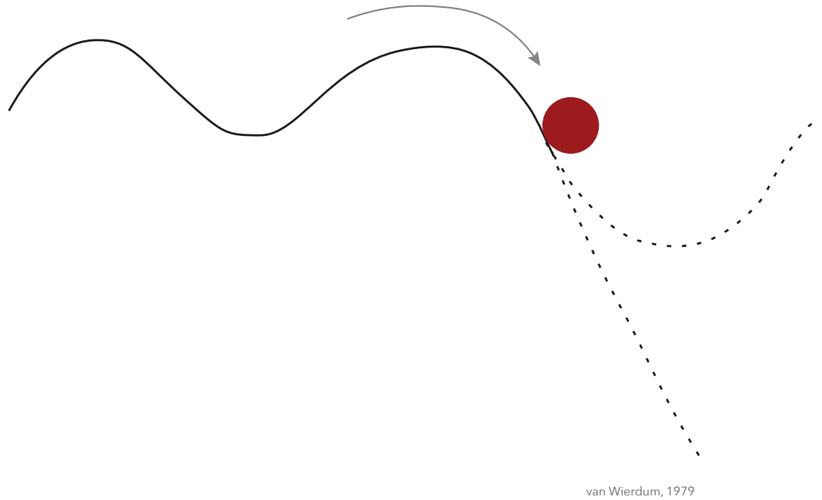


Zoom-ins



~~Ecolgical resilient~~

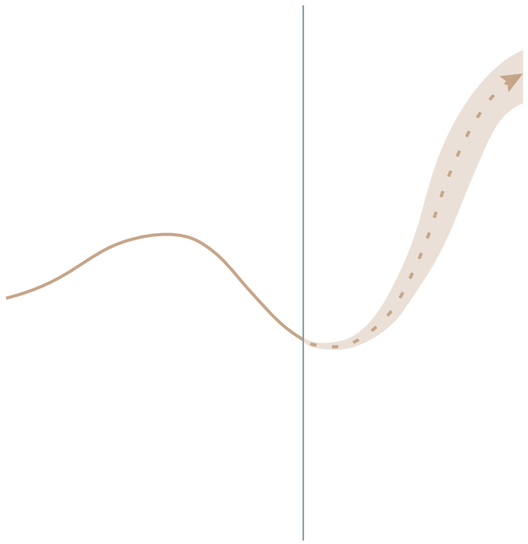
Tippingpoints



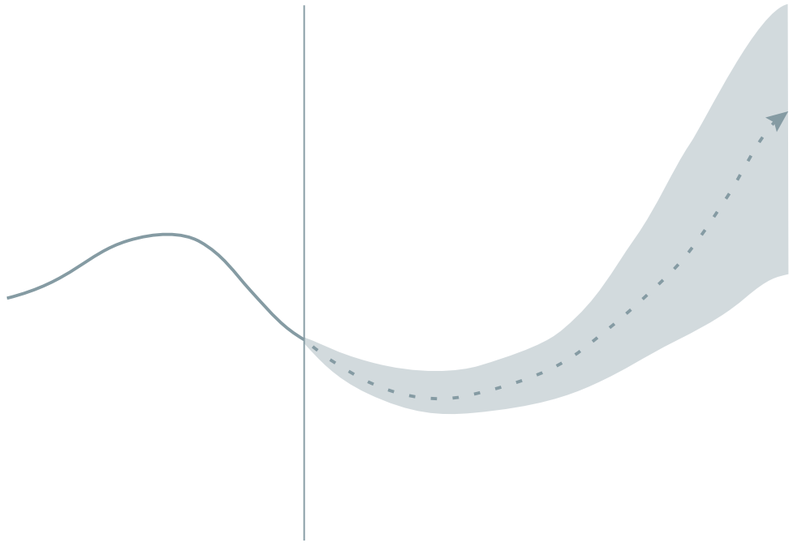
van Wierdum, 1979

Design uncertainty

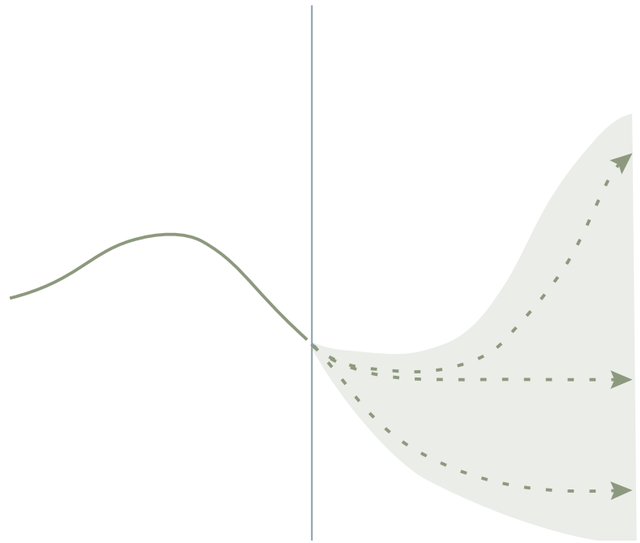
Recreation



Hydrology



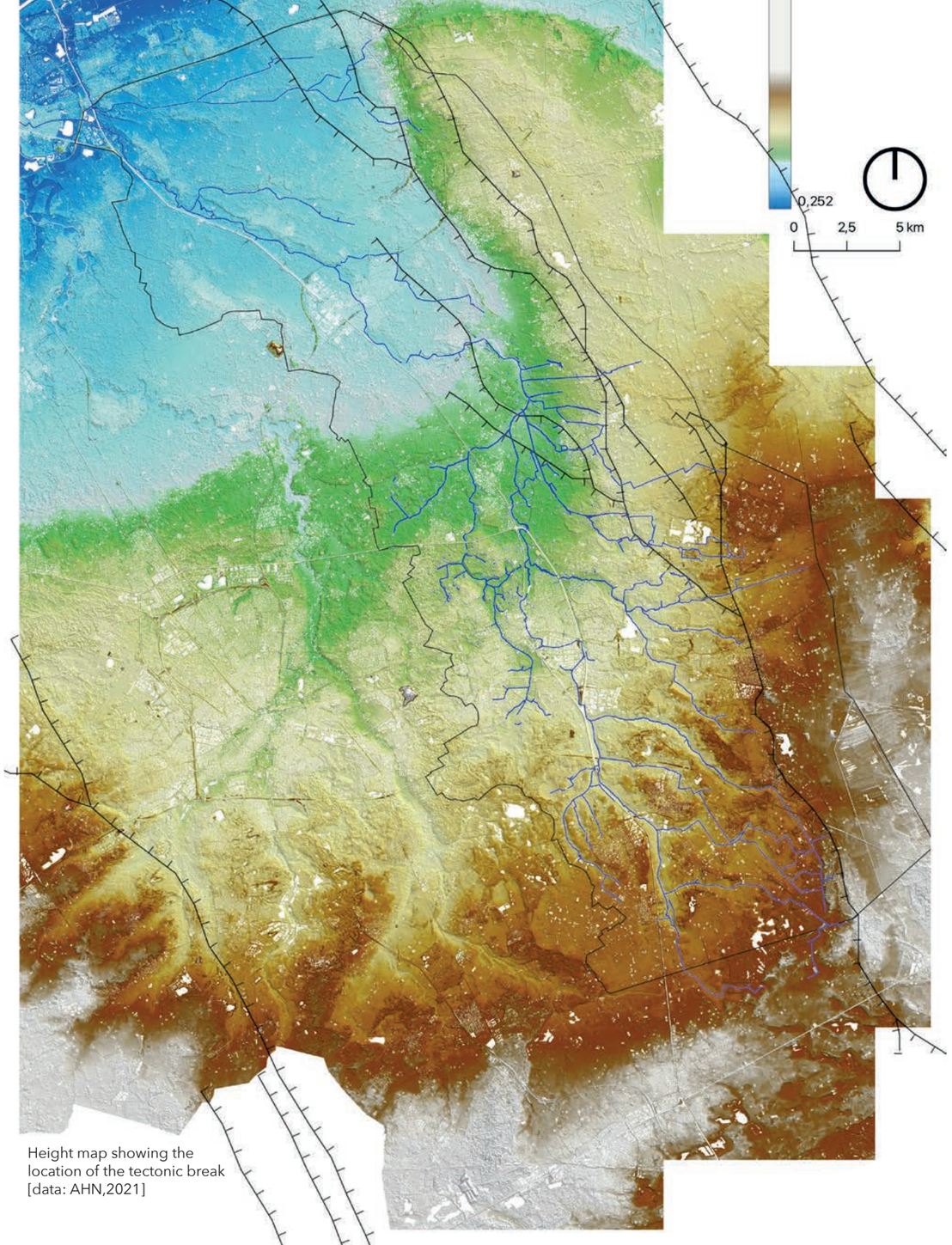
Biodiversity



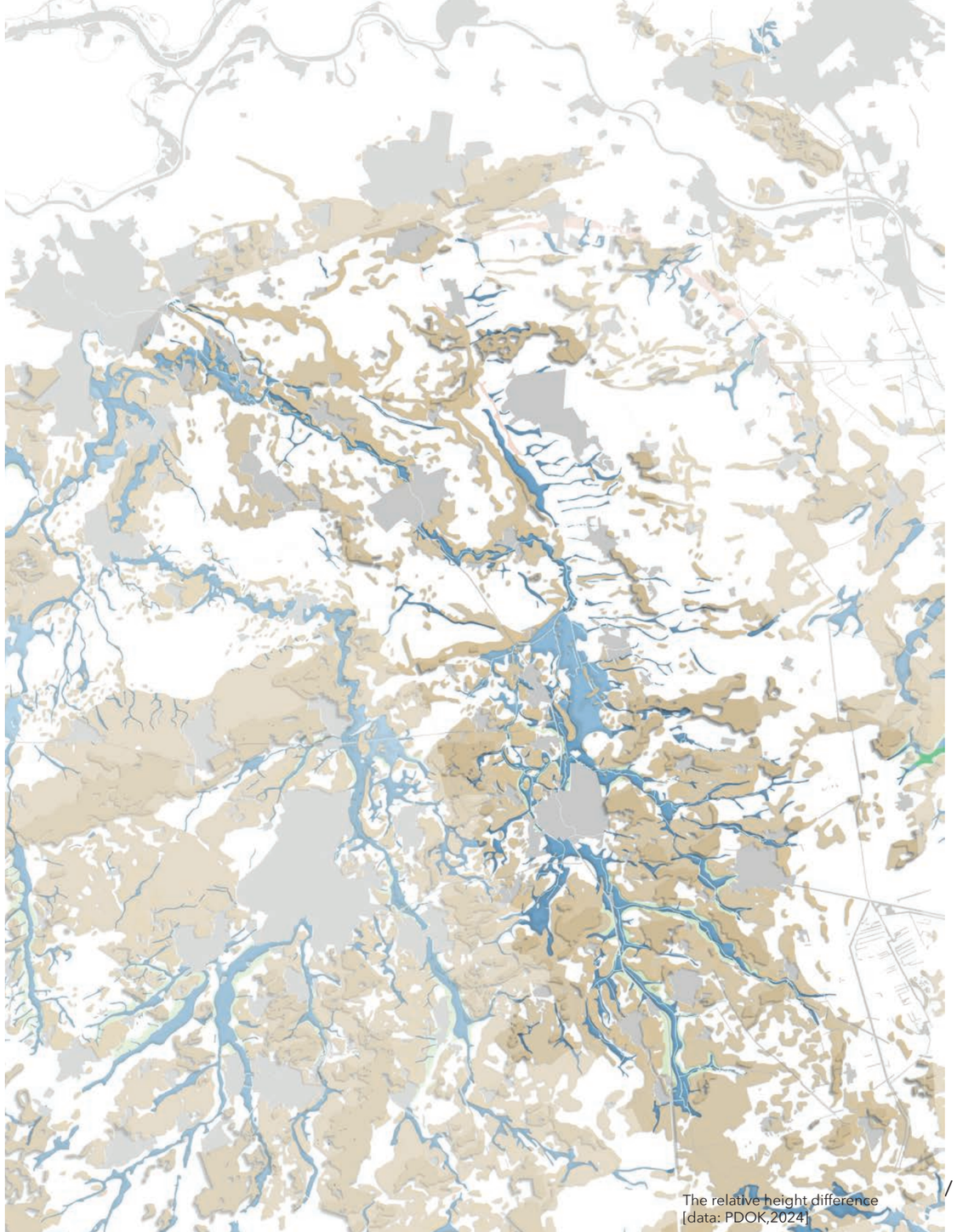
Landscape formation



A tributary of the Aa near the Peelrandbreuk
Image by author



Height map showing the location of the tectonic break [data: AHN,2021]



The relative height difference [data: PDOK,2024]

Stream landscape

Wet landscape

Slope landscape

Higher landscape

2020

2000

1950

1900

1850

1820

Culteral landscape



Natural landscape

Landscape development from 1820-2020. Form a diverse to a mostly monotonous landscape.
With a schematic section depicting the landscape of 1900. [Data: Kadaster, 2004]

Stream
landscape

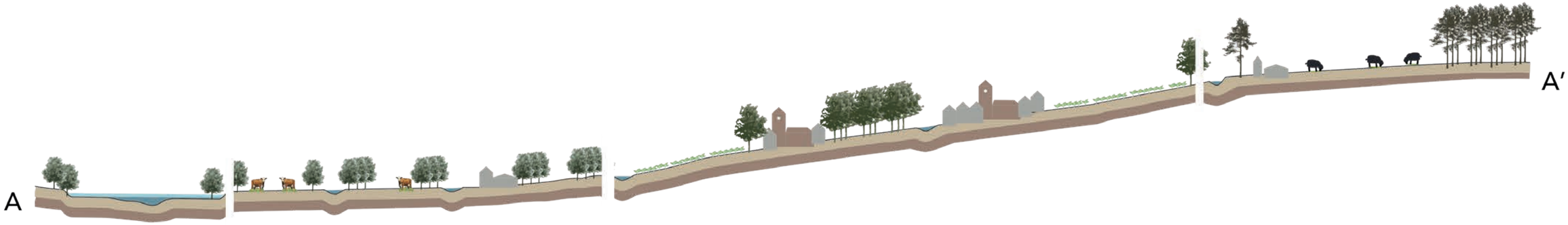
Wet
landscape

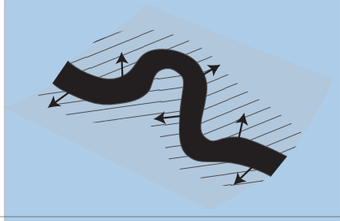
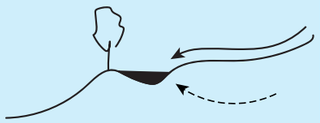
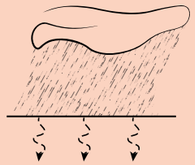
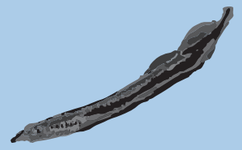
Slope
landscape

Higher
landscape

1900



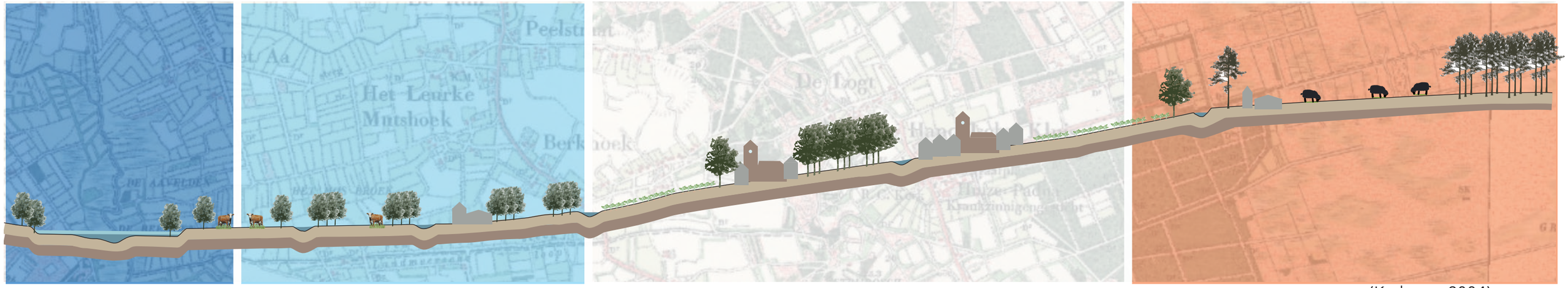


	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Stream

Wet areas

Higher areas



(Kadaster, 2004)

Design modules

Landscape types:

Sub- research questions:

Hydrology:

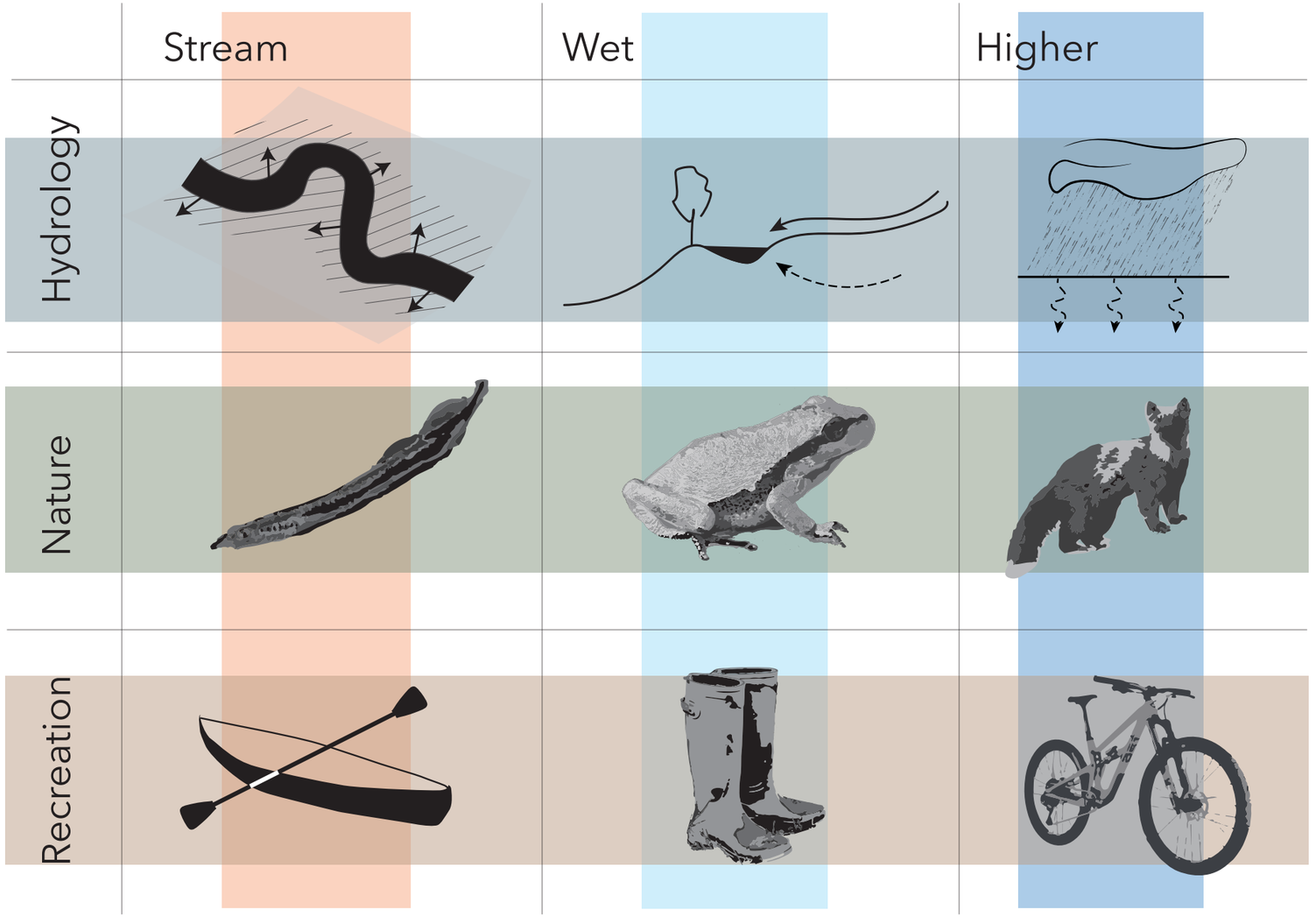
Which hydrological measures have to be taken to restore the natural balance of flows?

Nature:

Which ecological measures have to be taken to enhance plant and animal life?

Recreation:

Which recreational measures have to be taken to support an attractive area for visitors and residents?

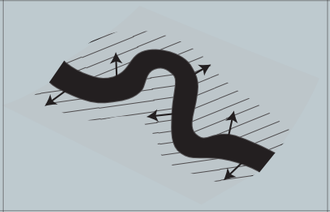
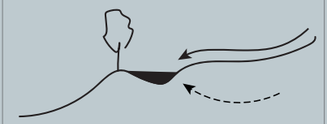
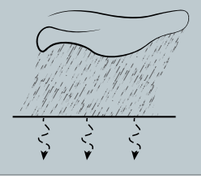


Landscape understanding to design interventions



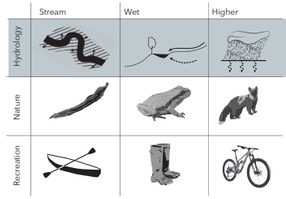
The Aa near Koks with only a strip of grass separating the Aa from agricultural land, image by author

Hydrology

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Hydrology

Problems

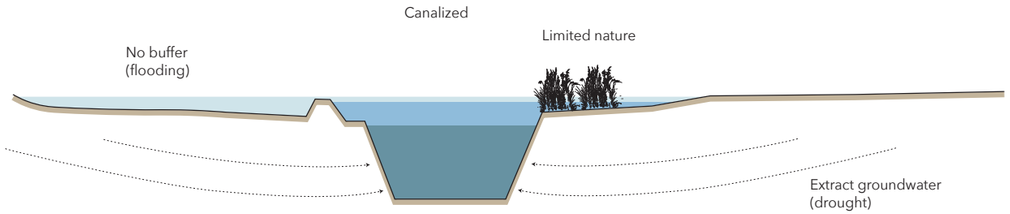


Lacking room for water

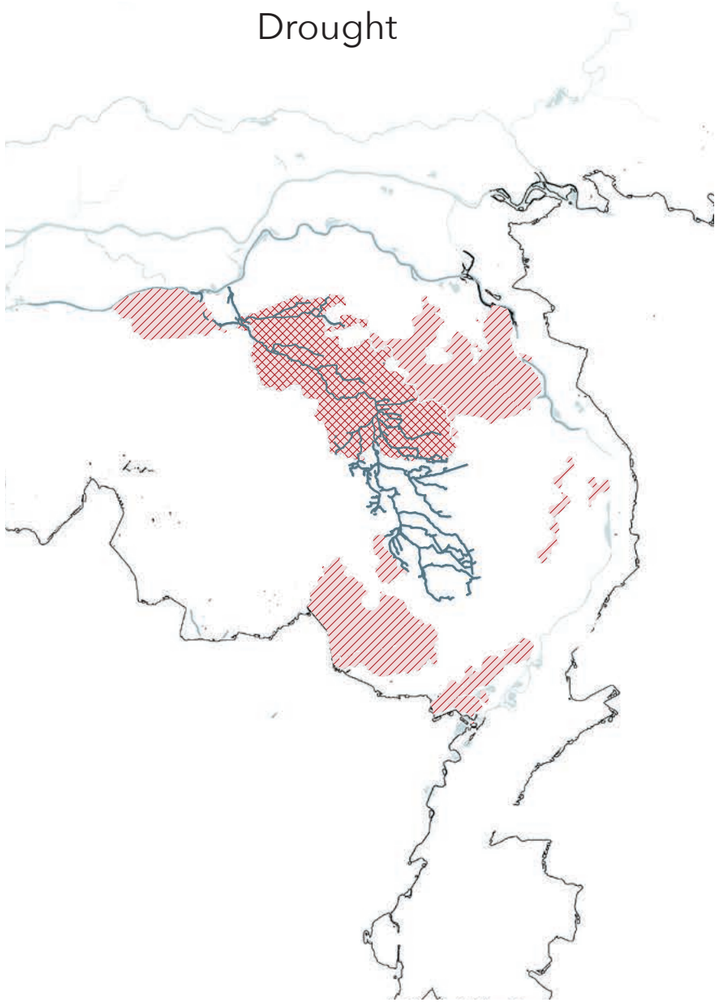
Aa



No natural dynamics in stream



Drought



Hydrology

Problem

Surface water shortage

Dropping groundwater level

To much drainage
causing floods downstream

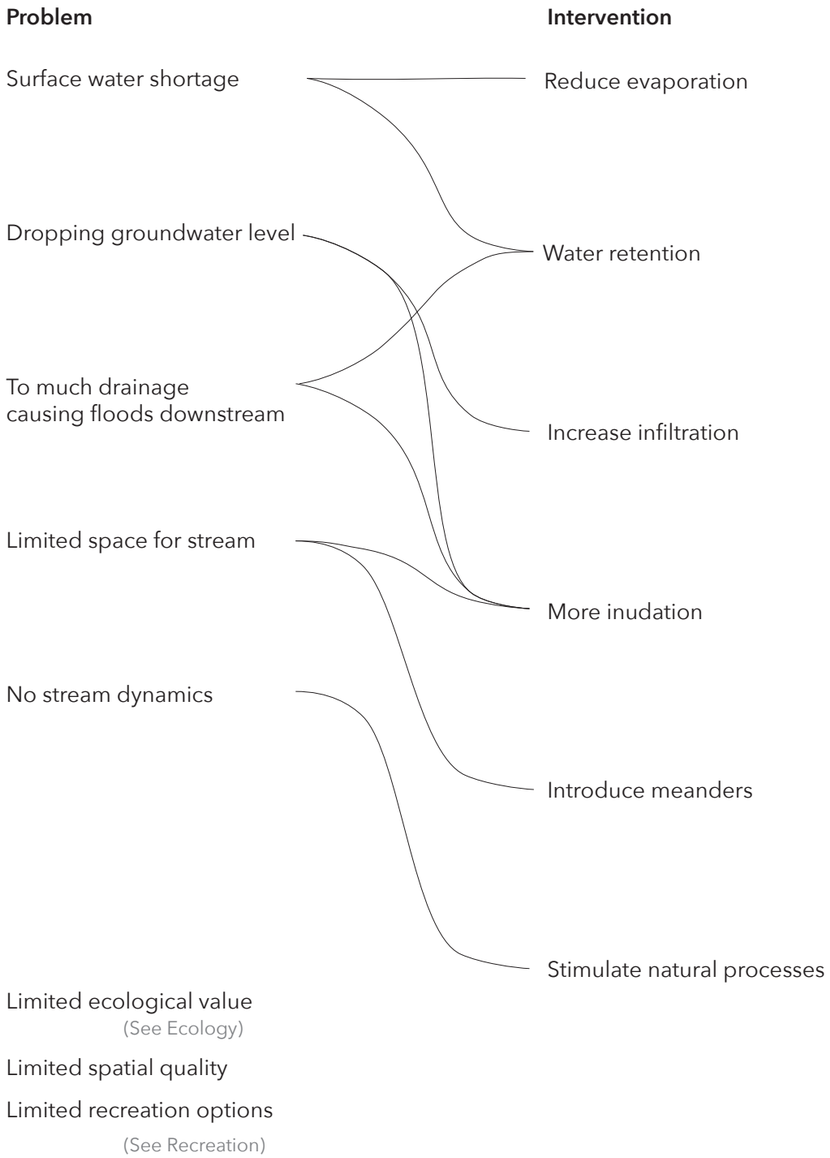
Limited space for stream

No stream dynamics

Limited ecological value
(See Ecology)

Limited spatial quality

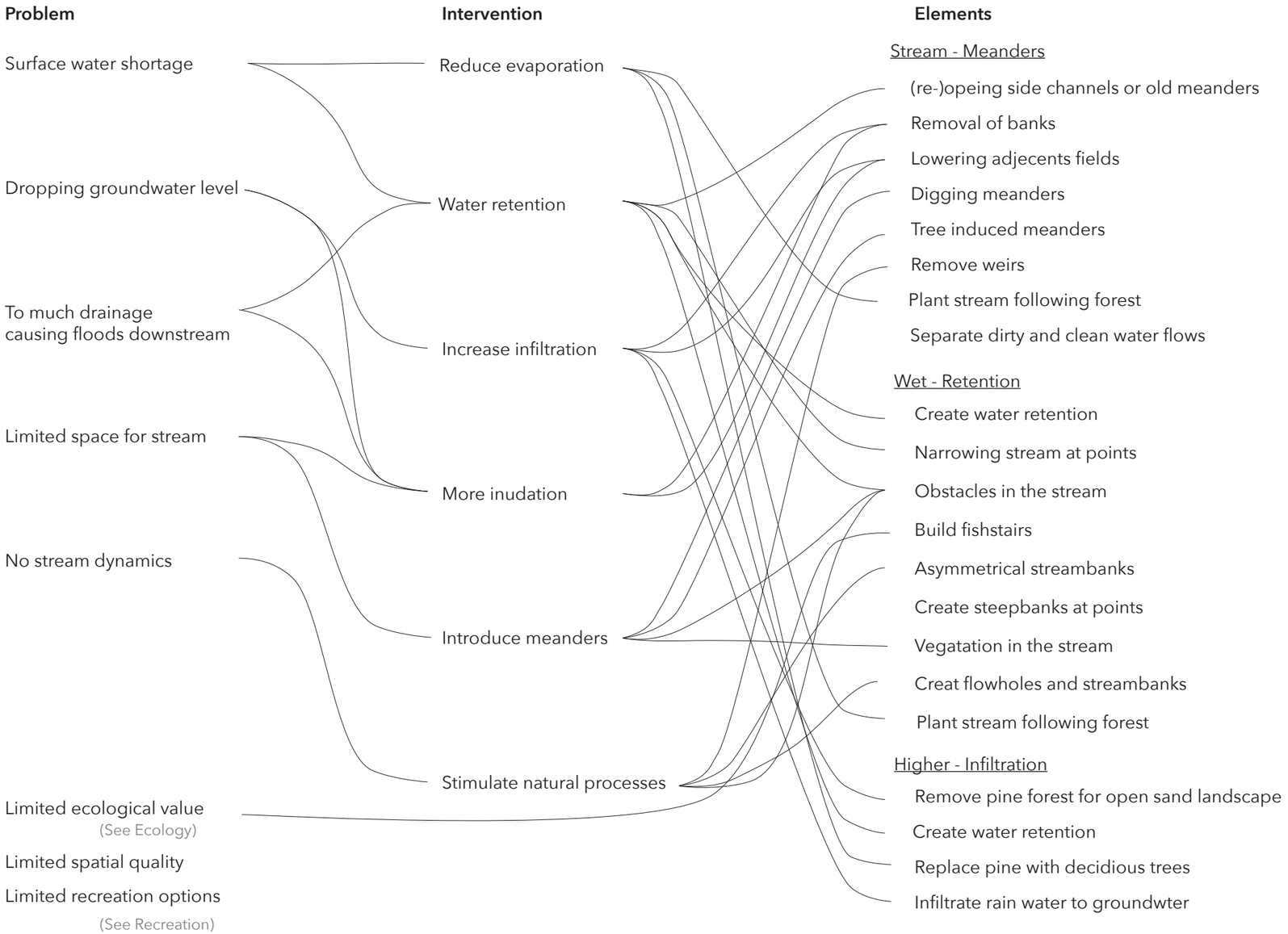
Limited recreation options
(See Recreation)



Limited ecological value
(See Ecology)

Limited spatial quality

Limited recreation options
(See Recreation)


Problem
Intervention
Elements
Surface water shortage
Dropping groundwater level
To much drainage causing floods downstream
Limited space for stream
No stream dynamics
Limited ecological value
(See Ecology)
Limited spatial quality
Limited recreation options
(See Recreation)
Reduce evaporation
Water retention
Increase infiltration
More inudation
Introduce meanders
Stimulate natural processes
Stream - Meanders
(re-)opeing side channels or old meanders
Removal of banks
Lowering adjecents fields
Digging meanders
Tree induced meanders
Remove weirs
Plant stream following forest
Separate dirty and clean water flows
Wet - Retention
Create water retention
Narrowing stream at points
Obstacles in the stream
Build fishstairs
Asymmetrical streambanks
Create steepbanks at points
Vegatation in the stream
Creat flowholes and streambanks
Plant stream following forest
Higher - Infiltration
Remove pine forest for open sand landscape
Create water retention
Replace pine with decidious trees
Infiltrate rain water to groundwter

Problem

Surface water shortage

Dropping groundwater level

To much drainage causing floods downstream

Limited space for stream

No stream dynamics

Limited ecological value (See Ecology)

Limited spatial quality

Limited recreation options (See Recreation)

Intervention

Reduce evaporation

Water retention

Increase infiltration

More inudation

Introduce meanders

Stimulate natural processes

Elements

Stream - Meanders

- (re-)opeing side channels or old meanders
- Removal of banks
- Lowering adjecents fields
- Digging meanders
- Tree induced meanders
- Remove weirs
- Plant stream following forest
- Separate dirty and clean water flows

Wet - Retention

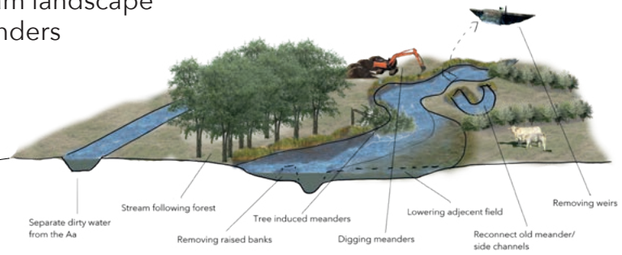
- Create water retention
- Narrowing stream at points
- Obstacles in the stream
- Build fishstairs
- Asymmetrical streambanks
- Create steepbanks at points
- Vegatation in the stream
- Creat flowholes and streambanks
- Plant stream following forest

Higher - Infiltration

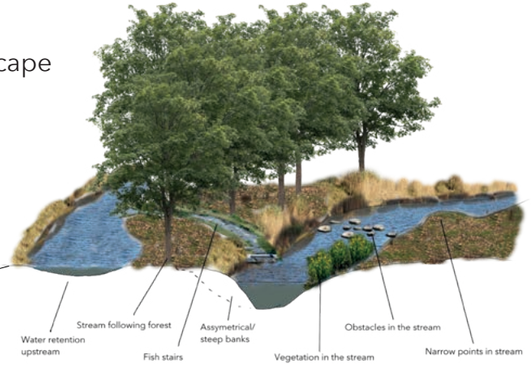
- Remove pine forest for open sand landscape
- Create water retention
- Replace pine with decidious trees
- Infiltrate rain water to groundwter

Design modules:

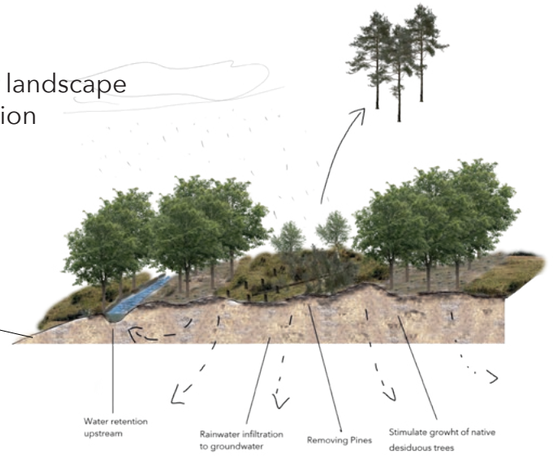
Stream landscape
Meanders

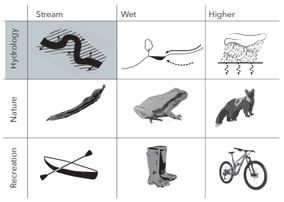


Wet landscape
Retention

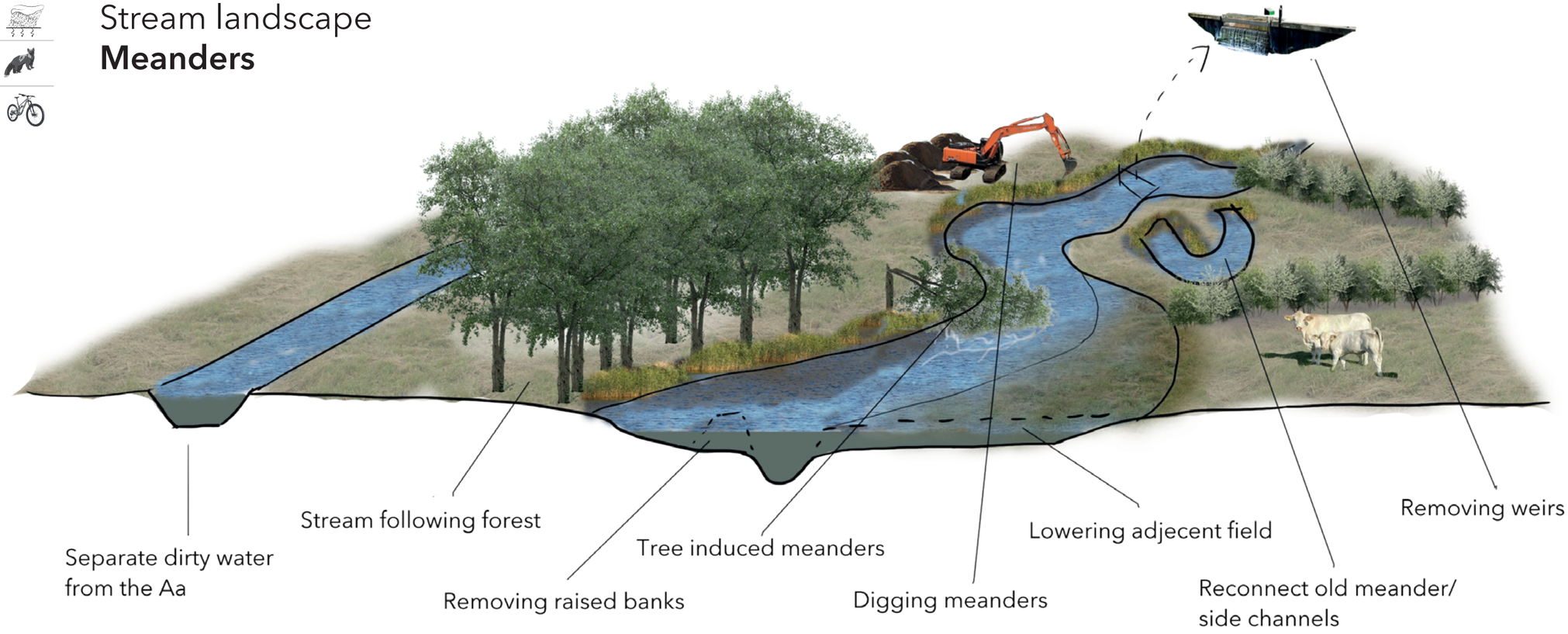


Higher landscape
Infiltration

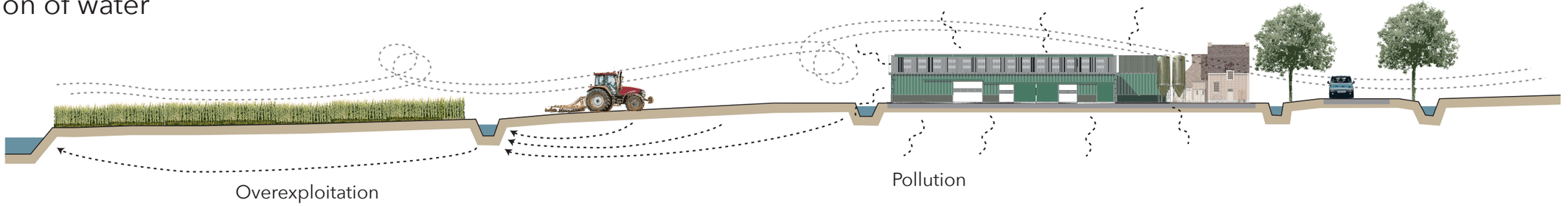


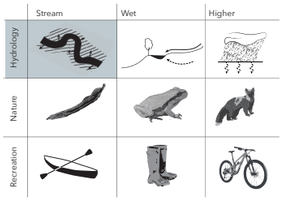


Stream landscape
Meanders

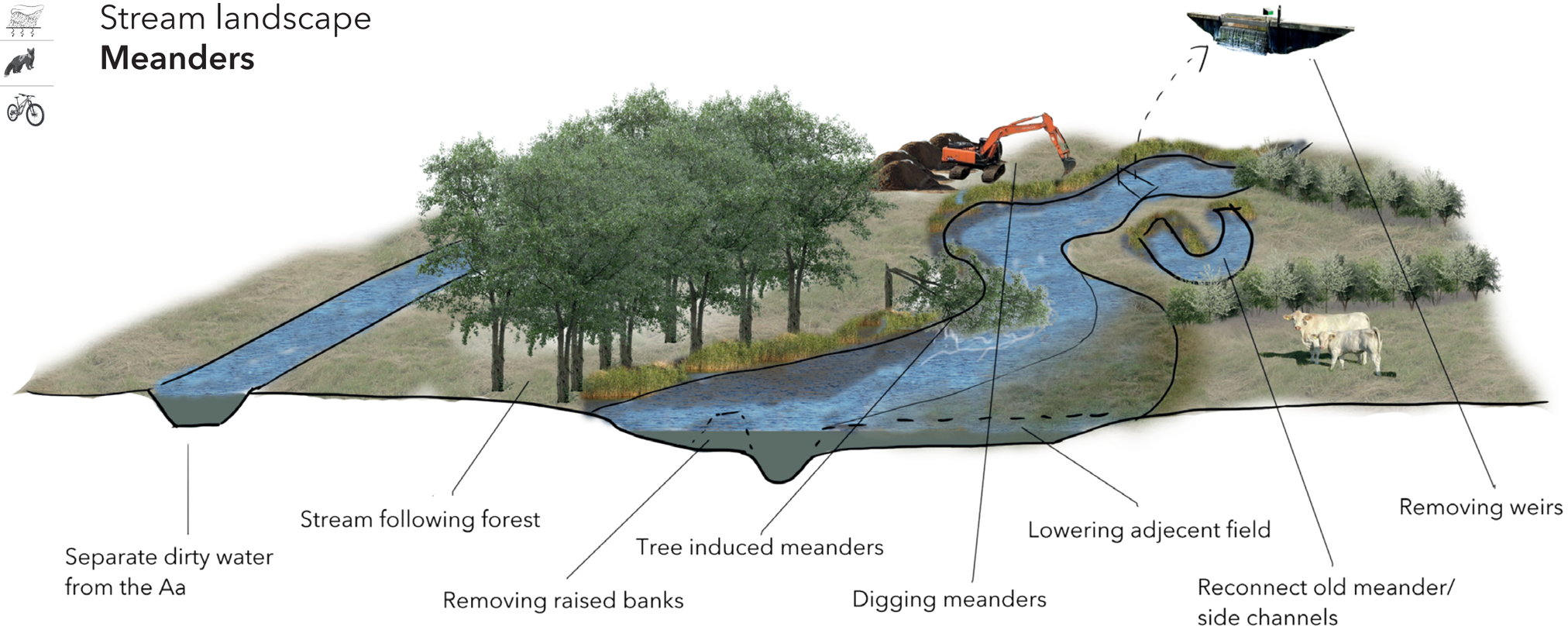


Pollution of water

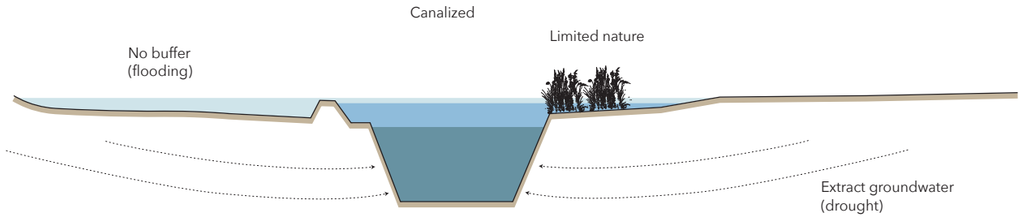


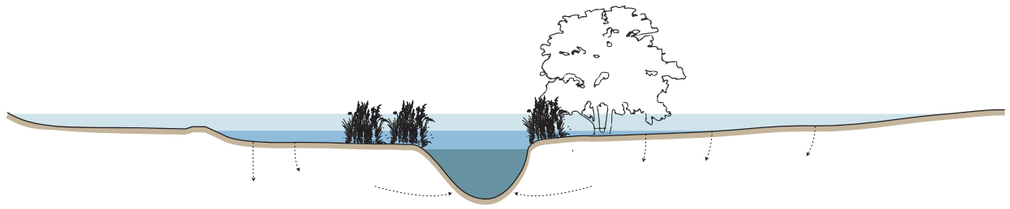


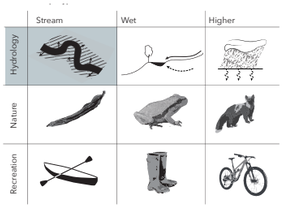
Stream landscape
Meanders



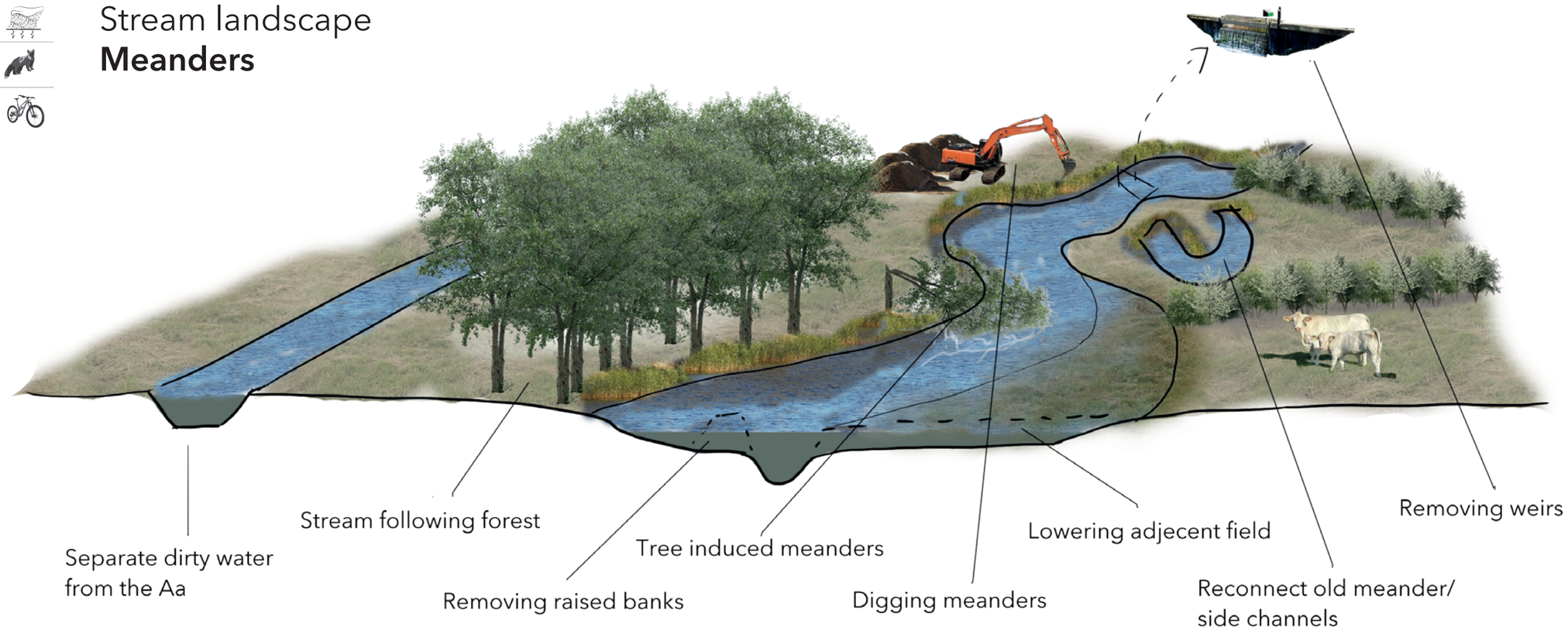
Streambed restoration



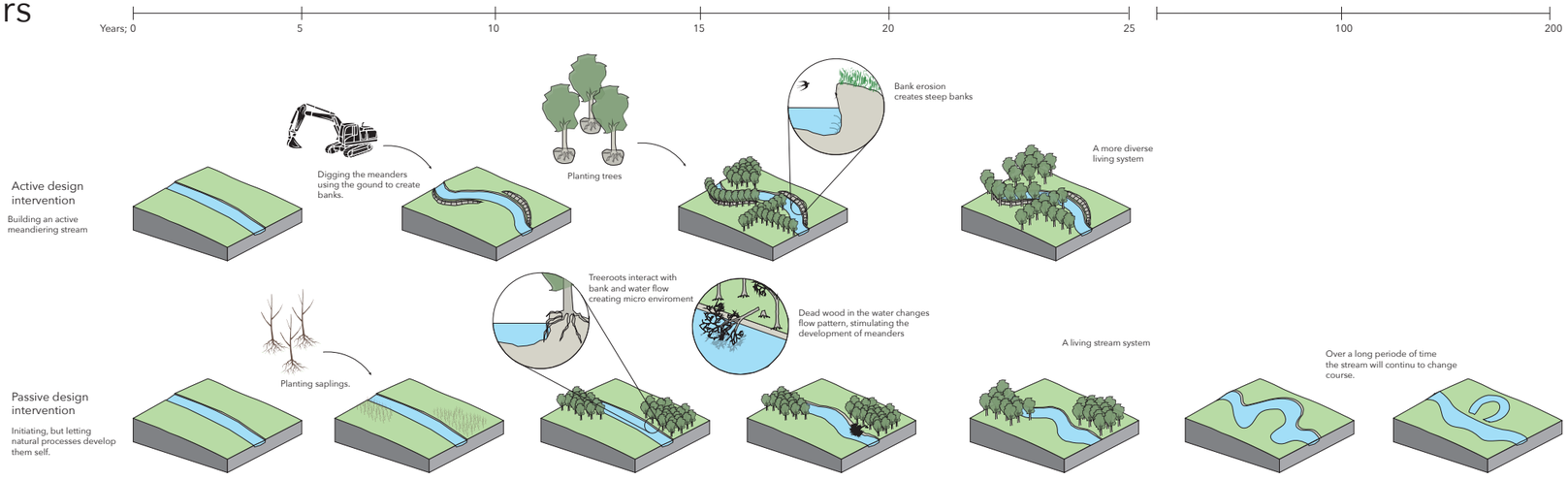




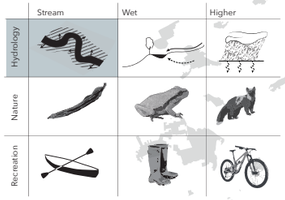
Stream landscape
Meanders



Inducing meanders



Current landscape



Hydrology analysis map

Judgement of physical chemical water quality of the Aa 2021 (KRW)

- Bad
- Inadequate
- Mediocre
- Zuid-Willemsvaart (ZW)
- Aa-water pumped into ZW
- ZW water let into the Aa
- Siphon for Aa underneath ZW
- Water buffer
- Urban areas

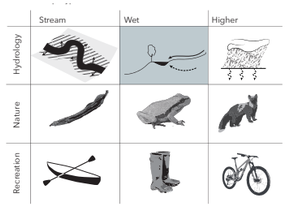
0 1 5 km

Schematic intervention map

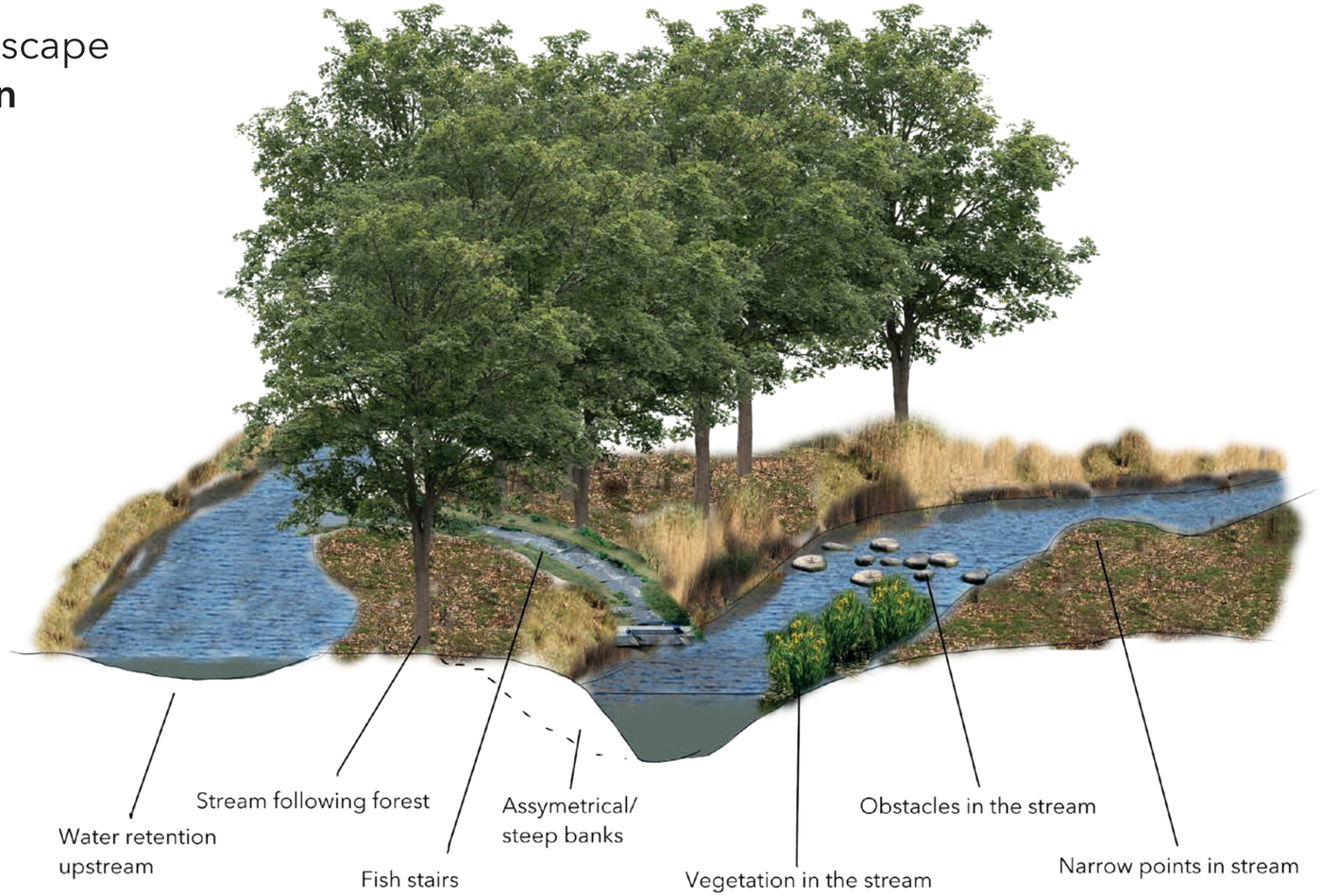
Hydrology concept map

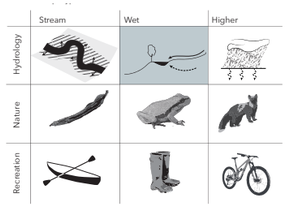
- Aa
- New Aa waterways
- Aa water still under agriculteral influence
- Zuid-Willemsvaart (ZW)
- Aa-water pumped out of system if waterquality is inaduquate
- Siphon for Aa underneath ZW
- Water buffer / space for stream
- Area where intensive agriculteral use can be maintained longer
- Urban areas

0 1 5 km

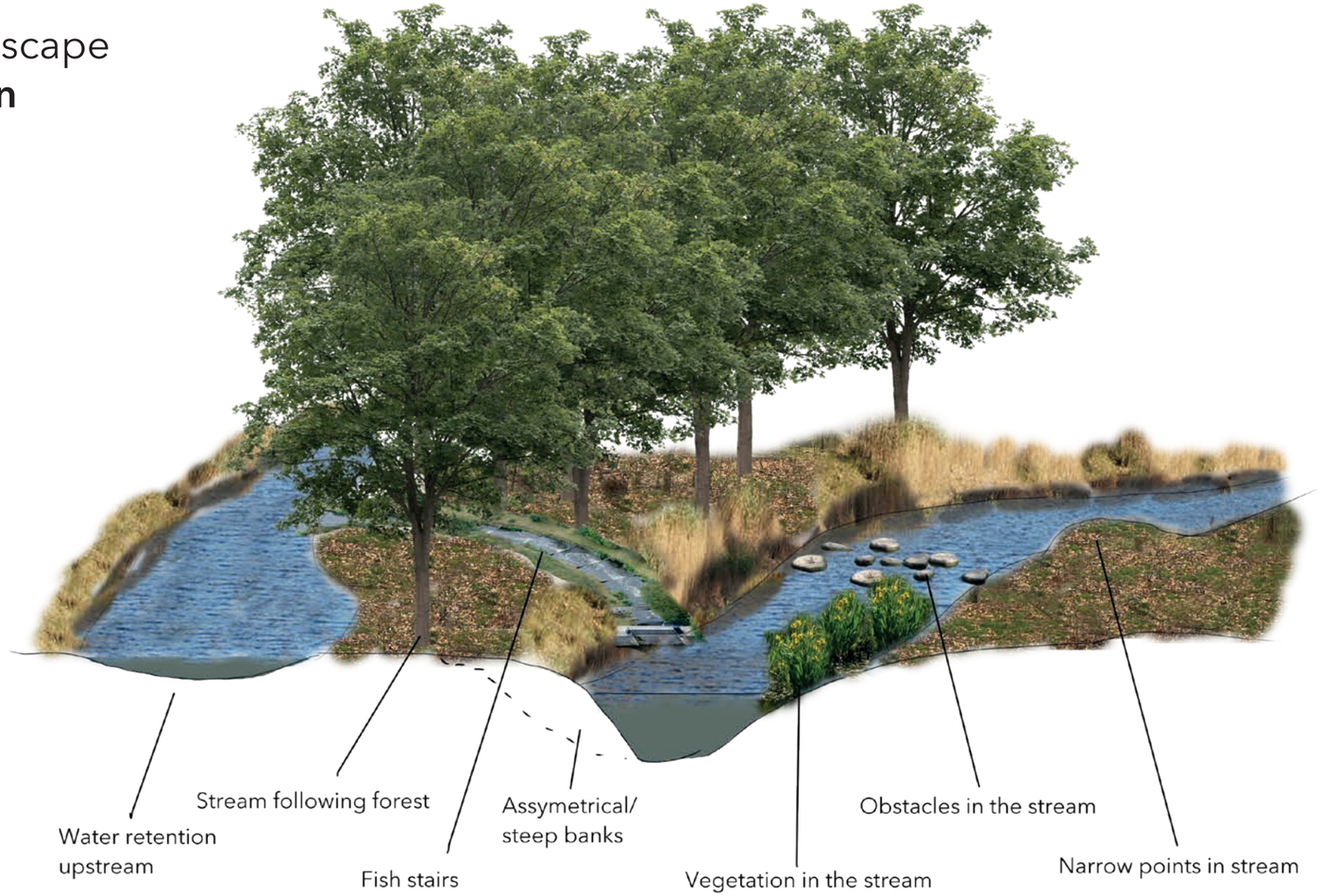


Wet landscape
Retention

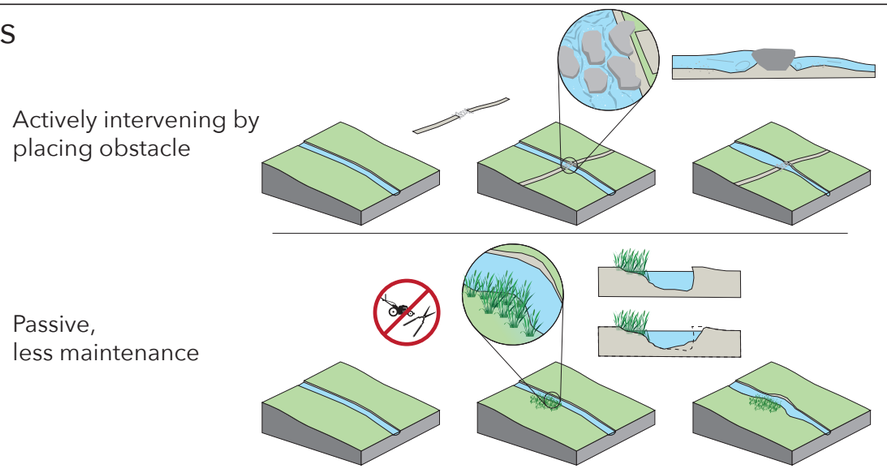


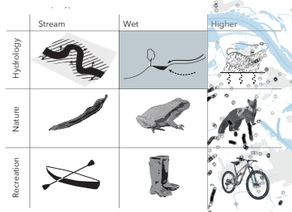


Wet landscape
Retention



Inducing stream dynamics





Current landscape

Hydrology analysis map

Judgement of physical chemical water quality of the Aa 2021 (KRW)

- Bad
- Inadequate
- Mediocre
- Zuid-Willemsvaart (ZW)
- Waterways
- Waterbodies
- High water closing gate
- Weir
- Water buffer
- Urban areas

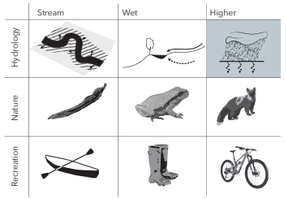
0 1 5 km

Schematic intervention map

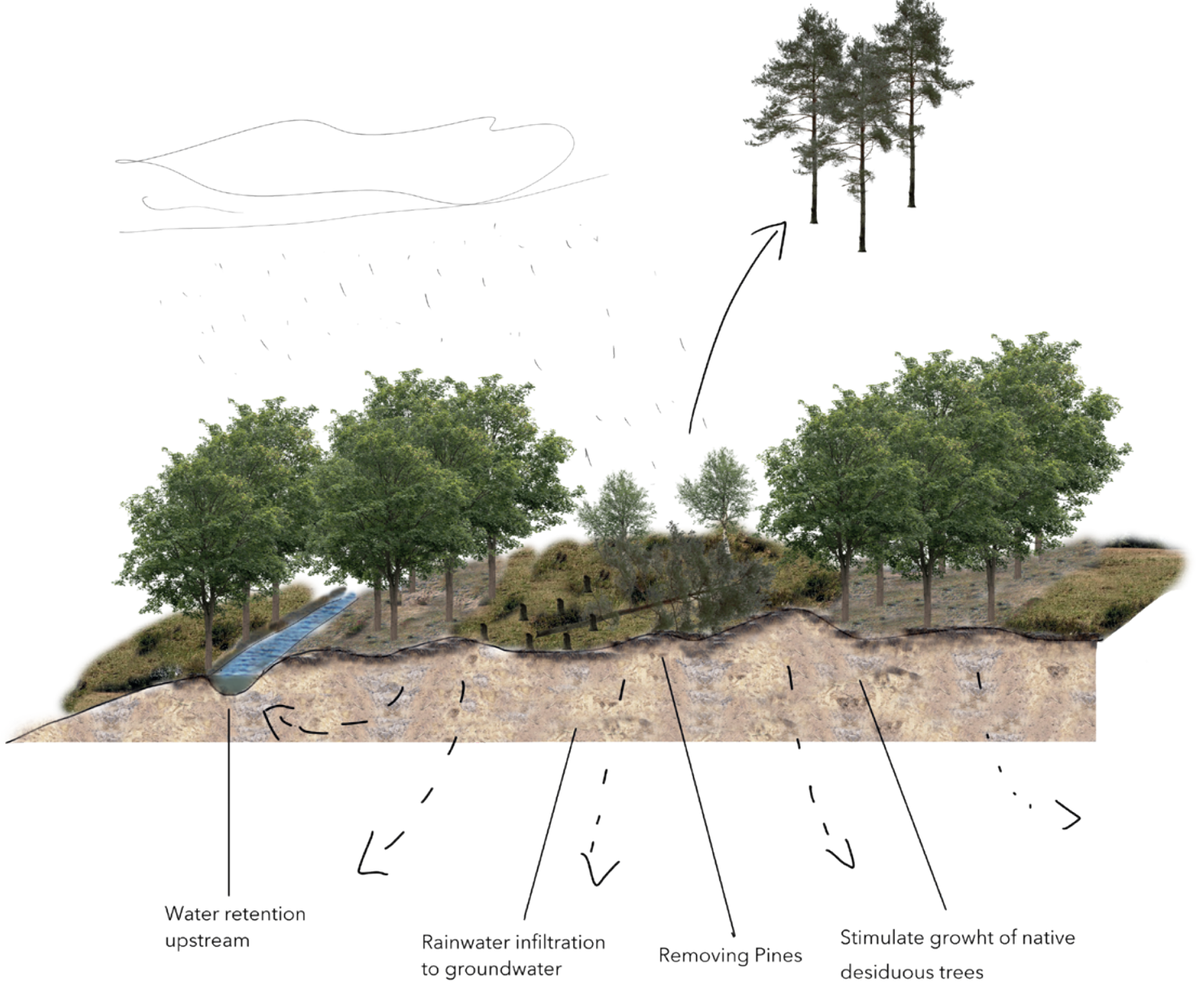
Hydrology concept map

- Aa
- Zuid-Willemsvaart (ZW)
- Waterways
- Waterbodies
- Water buffer / space for stream Aa
- Water buffer / space for stream
- Urban areas

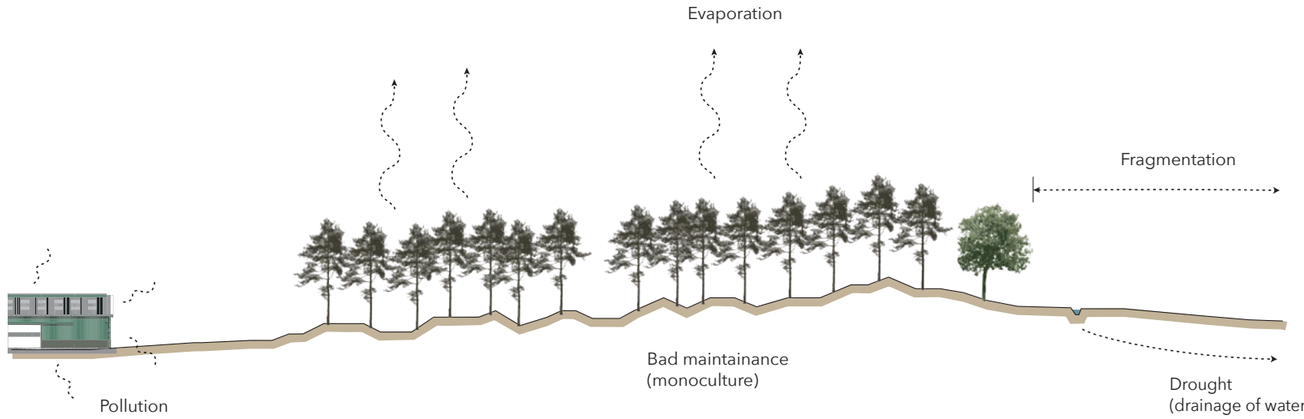
0 1 5 km

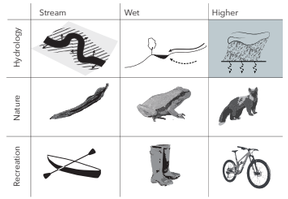


Higher landscape
Infiltration

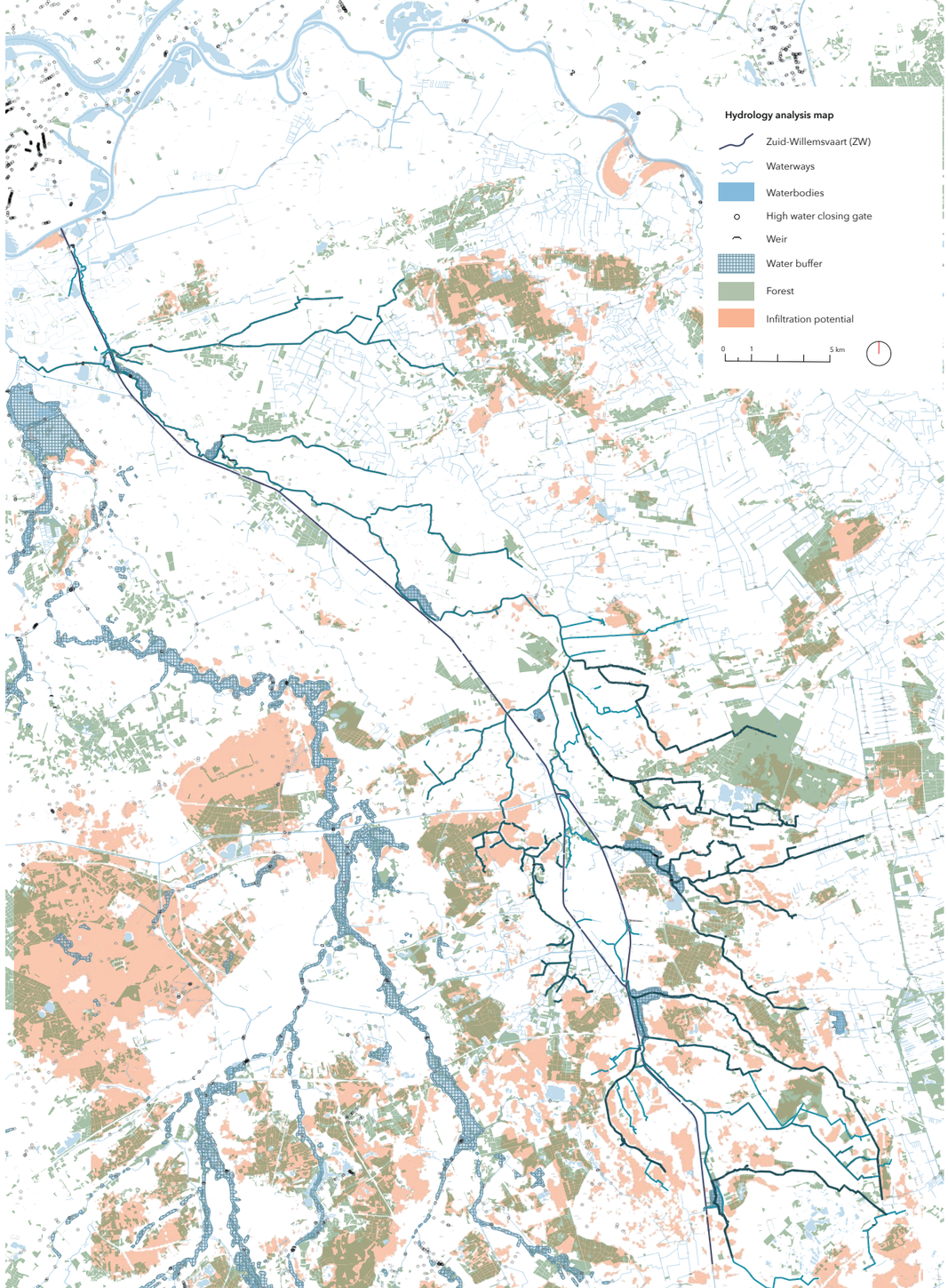


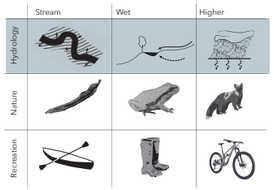
Evaporation due to conifers





Potential landscape for infiltartion and current forests

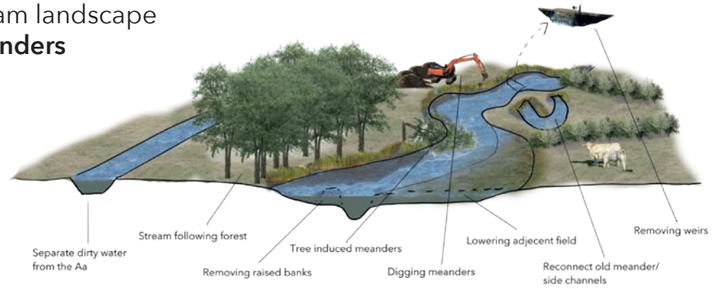




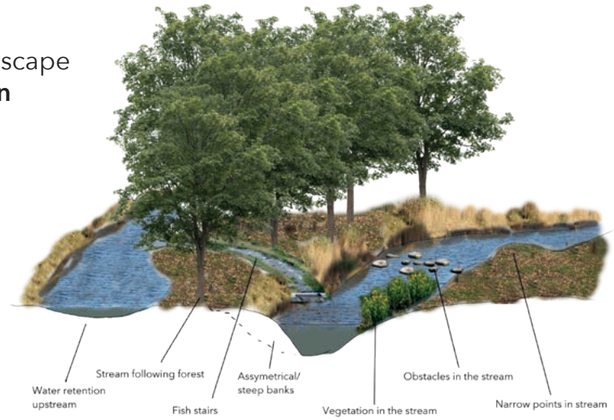
Design modules:

Hydrology

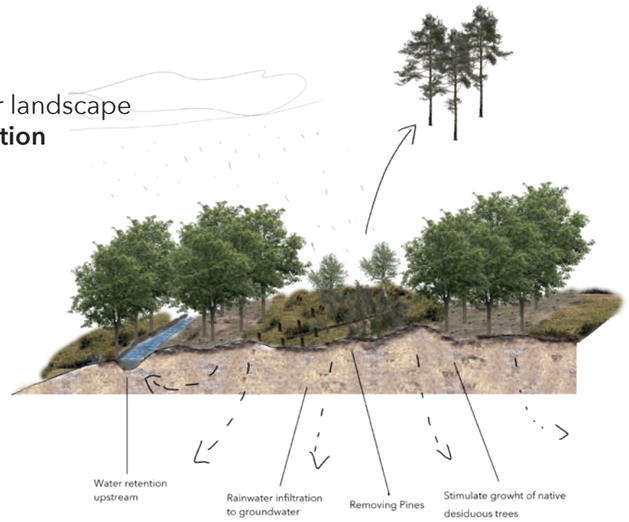
Stream landscape
Meanders

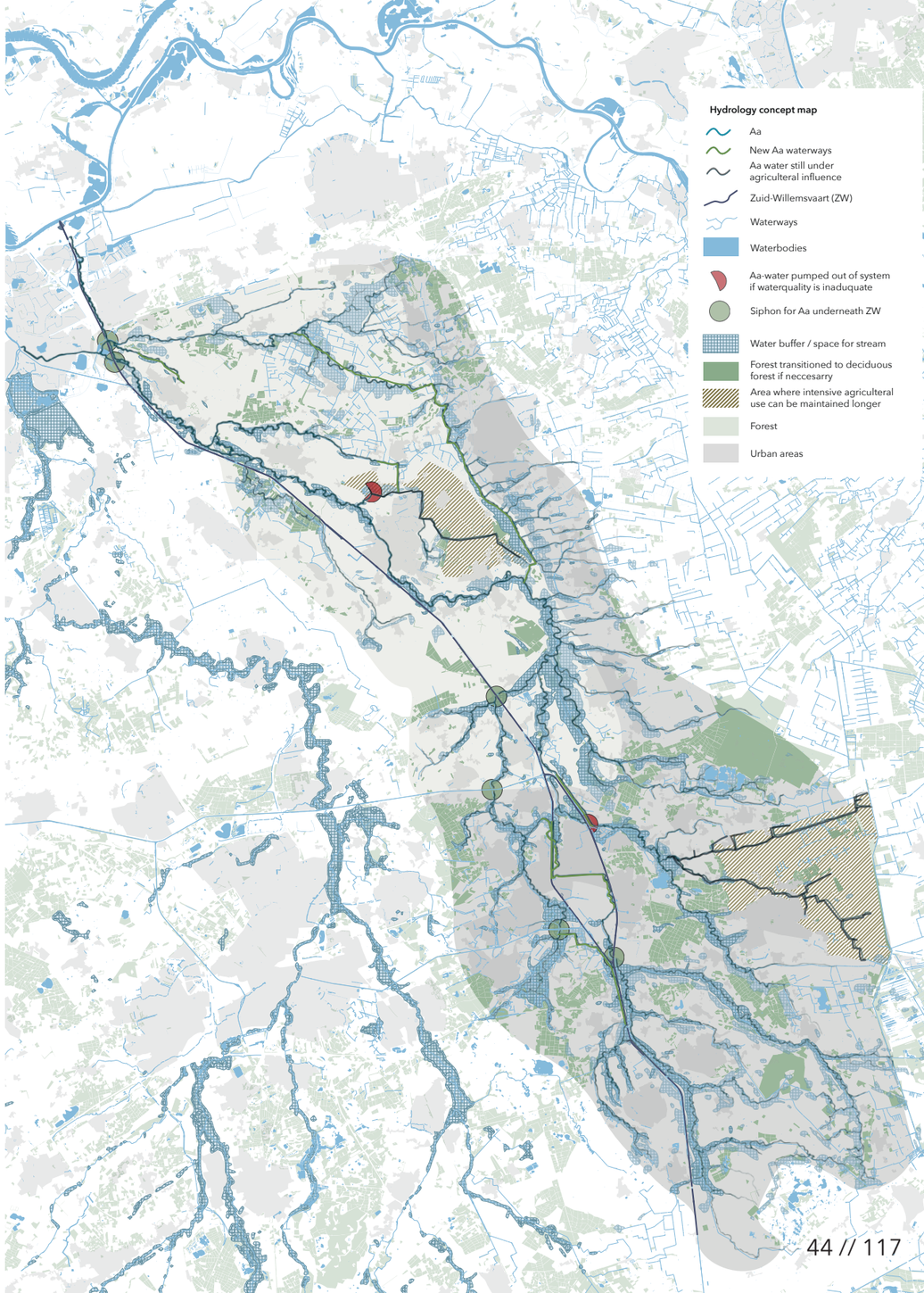


Wet landscape
Retention



Higher landscape
Infiltration



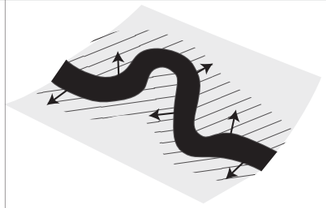
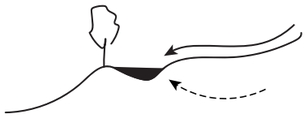
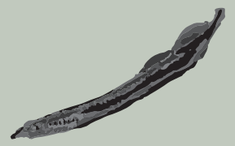


Nature



Astense Aa between Asten and Deurne
Image by author

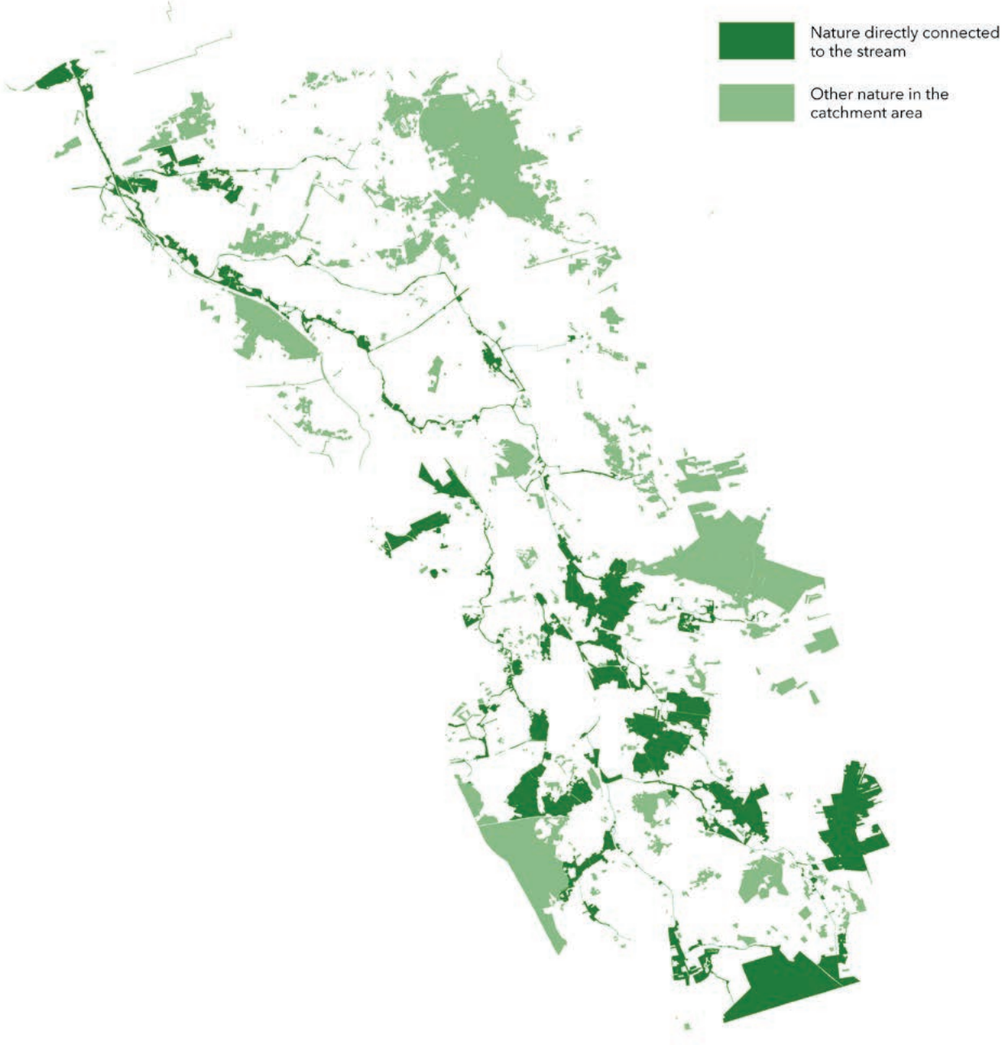
Nature

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Nature

Problems

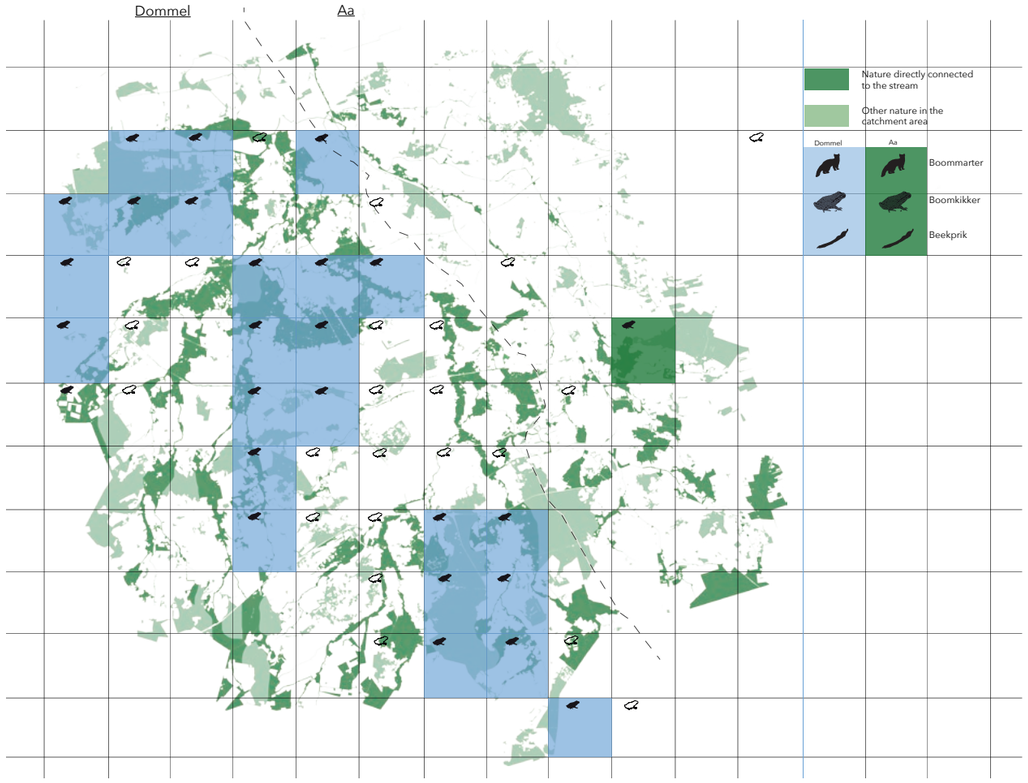
Limited and fragmented nature



Low biodiversity



Boomkikker
(European tree frog)



Problem

Fragmentation

Bad maintainance

Invasive species

Drought
(See Water management)

Nature

Problem	Intervention
Fragmentation	Bigger nature areas
	Connect nature areas
Bad maintainance	Better intergation of nature and other land-uses
Invasive species	Use native species

Drought

(See Water management)

Problem

Fragmentation

Bad maintainance

Invasive species

Drought
(See Water management)

Intervention

Bigger nature areas

Connect nature areas

Better intergation of nature and other land-uses

Use native species

Elements

Stream - Beekprik

Continius navigable stream

Vegetation in stream

Partly shaded stream

Meanders in stream

Dynamic streambed

Wet - Boomkikker

Wet roughs (living habitats)

Connecting corridors

- Bushes
- Roughs
- Shallow banks
- Wood edges
- Wooded banks
- Eco-tunnels under roads and rail

Less intensive use of agricuteral land

Higher - Boommarter

Forested living habitat

Replace pine with native species

Connecting corridors

- Wooded banks
- Tree lanes
- Ecoducts over larger roads, rail and water

Problem

Fragmentation

Bad maintainance

Invasive species

Drought
(See Water management)

Intervention

Bigger nature areas

Connect nature areas

Better intergation of nature and other land-uses

Use native species

Elements

Stream - Beekprik

- Continius navigable stream
- Vegetation in stream
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Higher - Boommarter

- Forested living habitat
- Replace pine with native species
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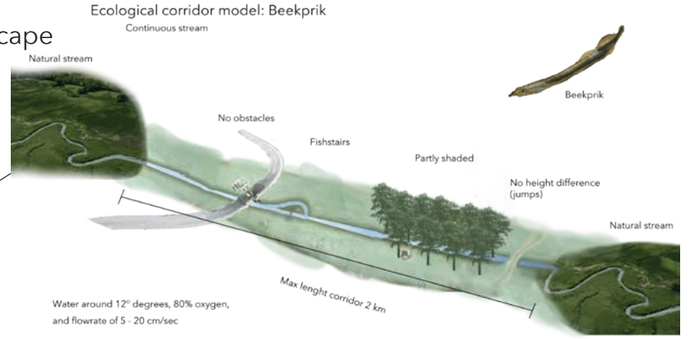
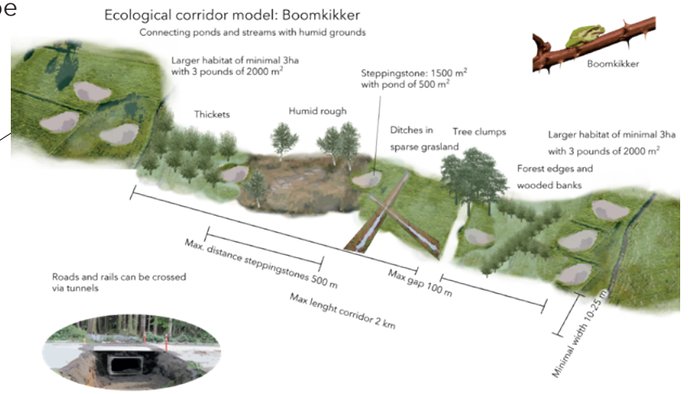
  - Wooded banks
  - Tree lanes
  - Ecoducts over larger roads, rail and water

Design modules:

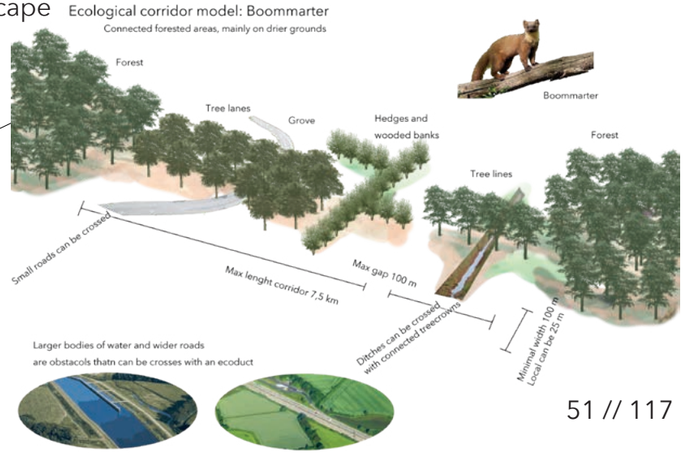
Stream landscape

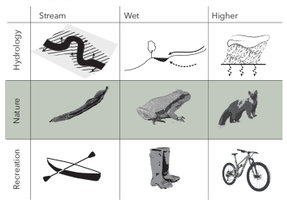


Wet landscape



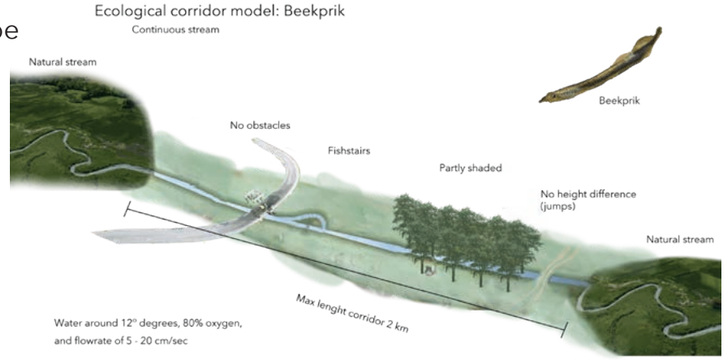
Higher landscape





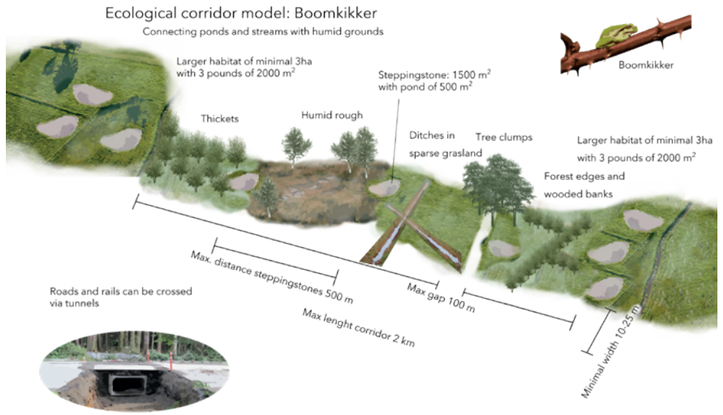
Design modules:

Stream landscape



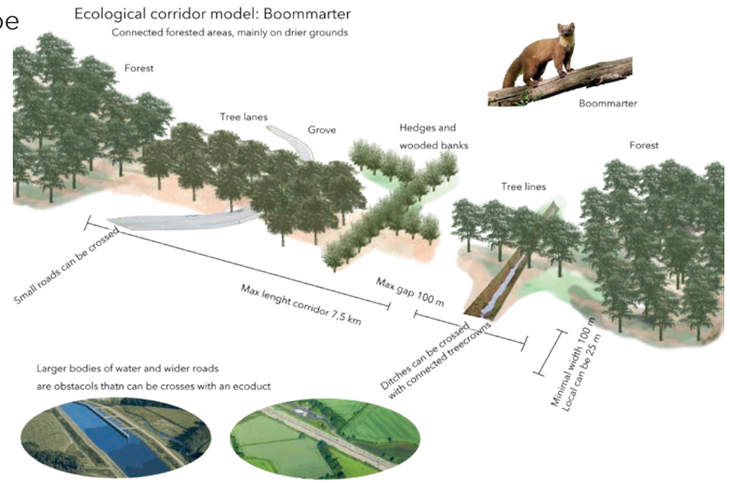


Wet landscape

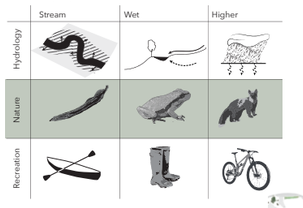




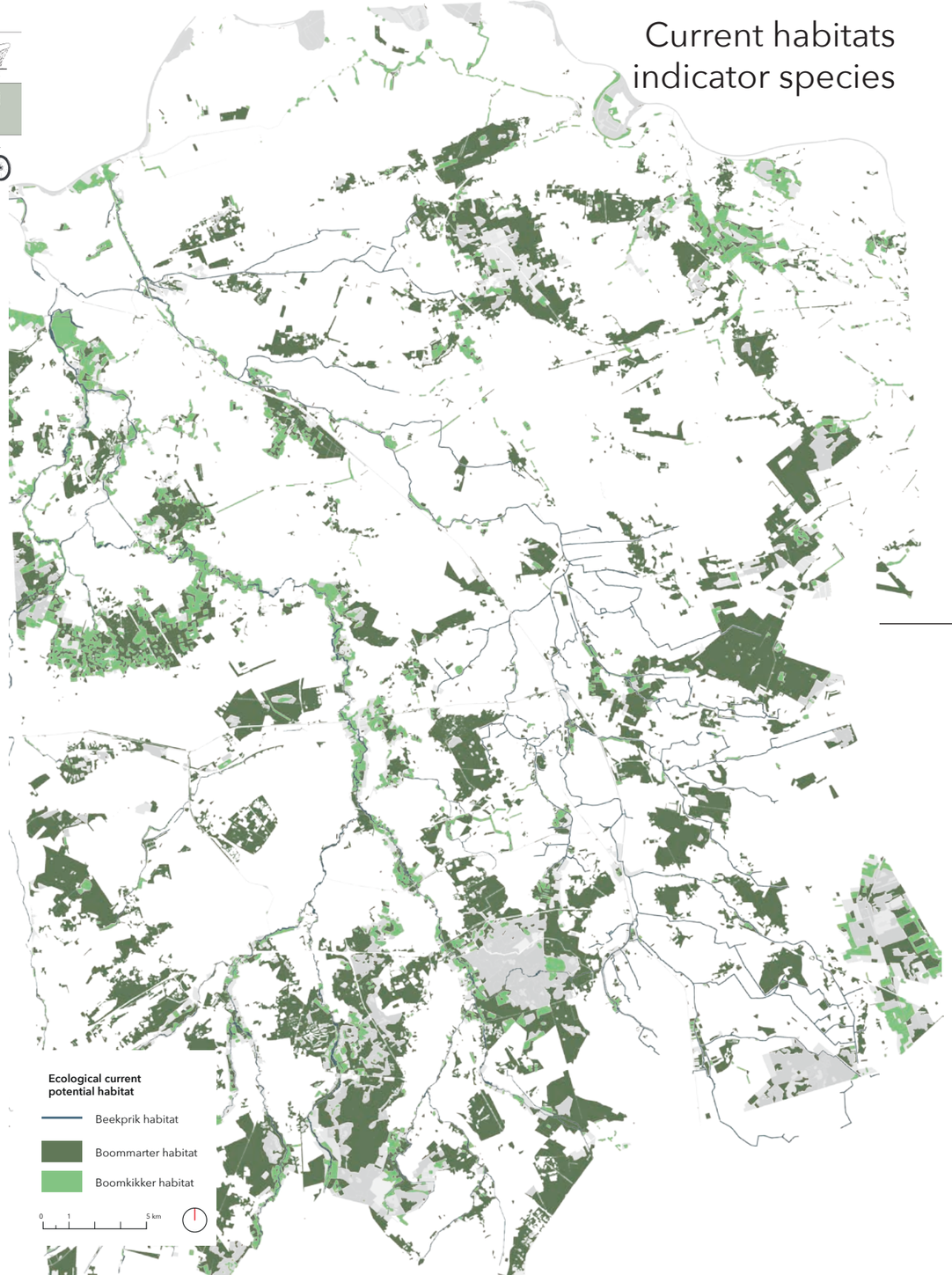
Higher landscape



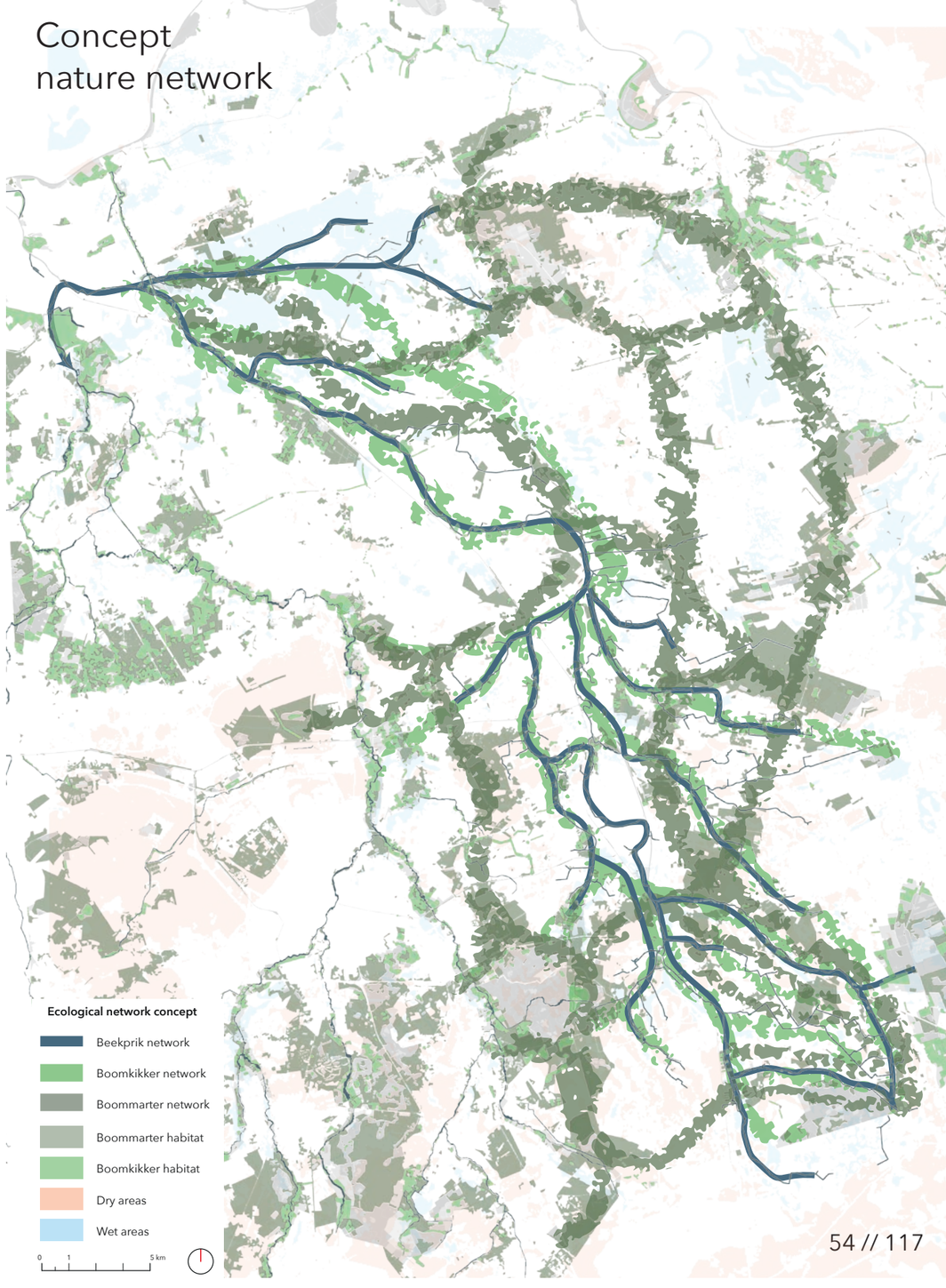




Current habitats indicator species

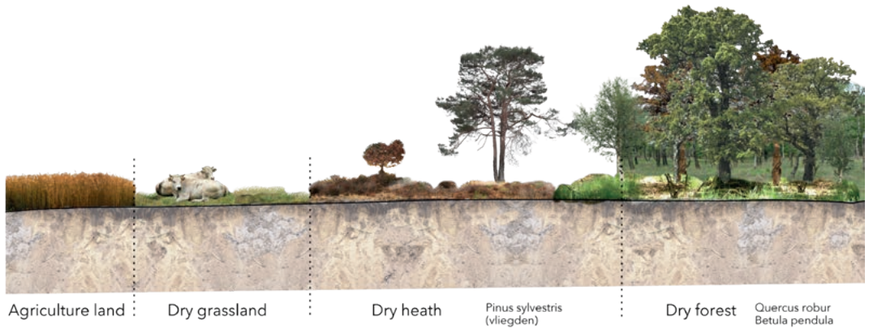


Concept nature network

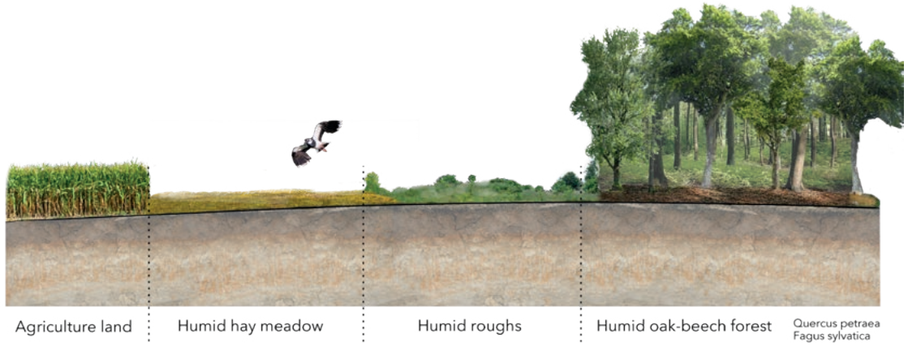


Natural succesion
landscape types

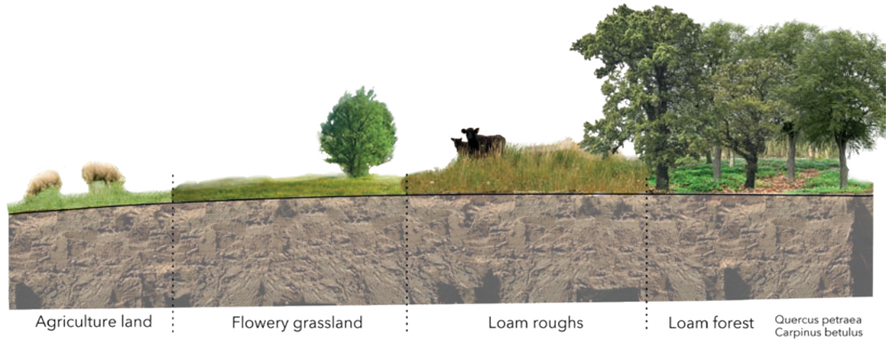
Dry sand landscape



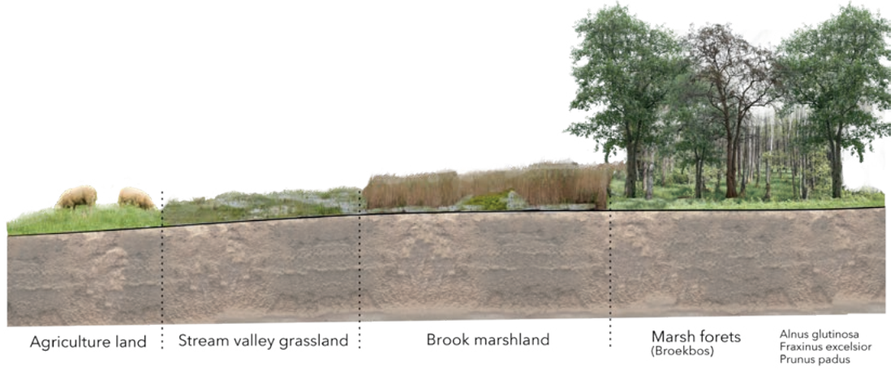
Sand landscape



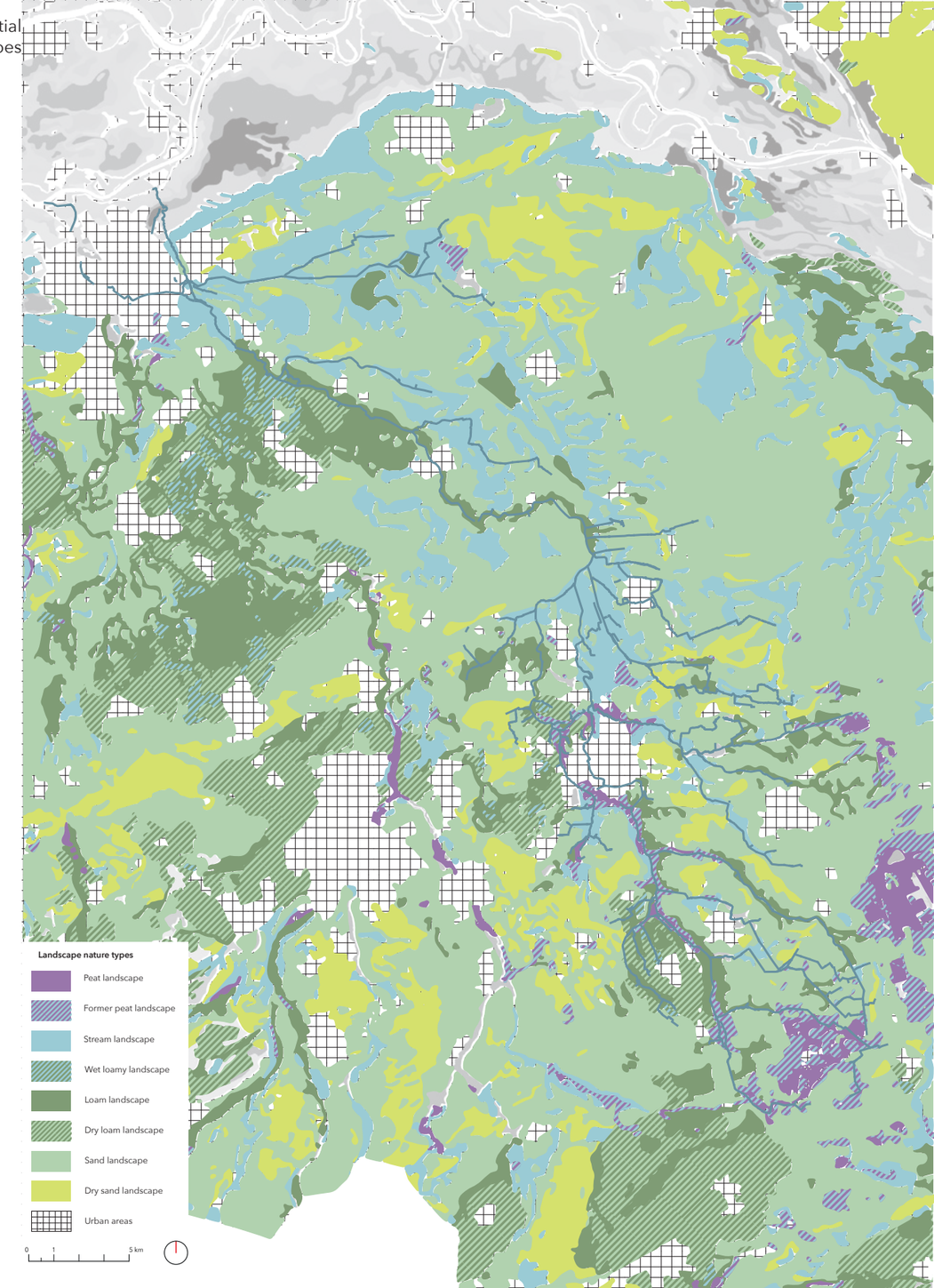
Loam landscape



Stream landscape



Potential
landscape types

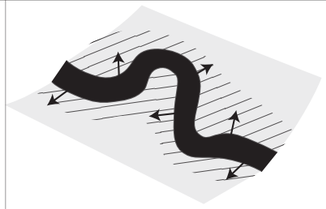
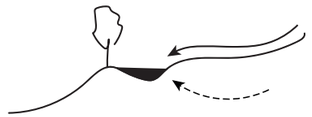
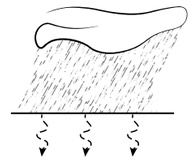


Recreation



A cold, wet, uncomertable bench in the middle of agriculteral field near Veghel. Image by author

Recreation

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Recreation

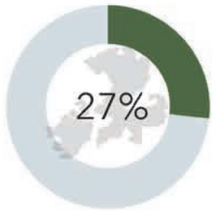
Problems

Lacking access to nature

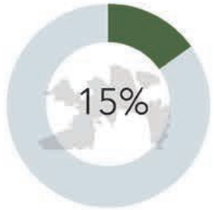
Access to nature from urban cores

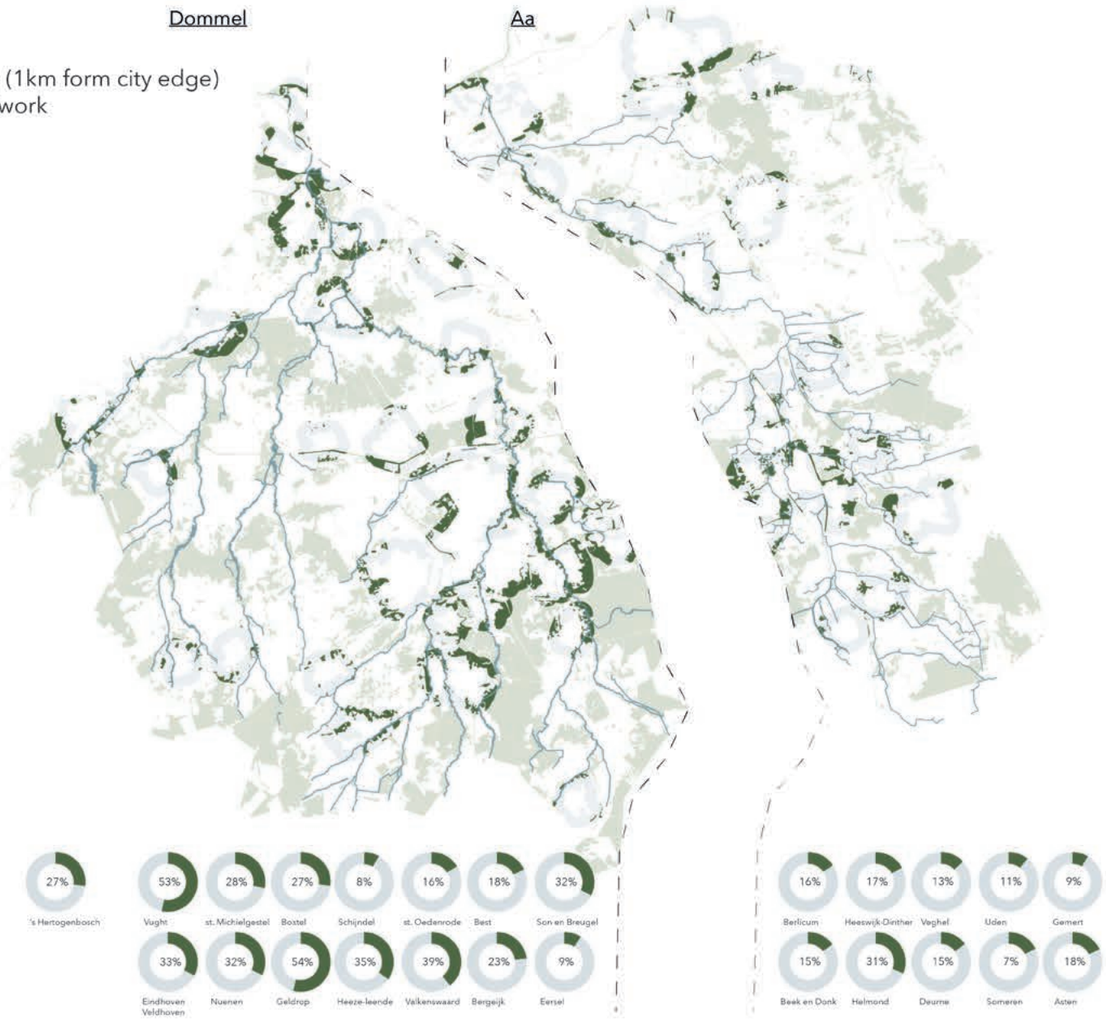
percentage of land in the urban vicinity (1km form city edge) which is part of the Brabant Nature Network

Average Dommel cities



Average Aa cities





Recreation

Problem

Limited access to nature

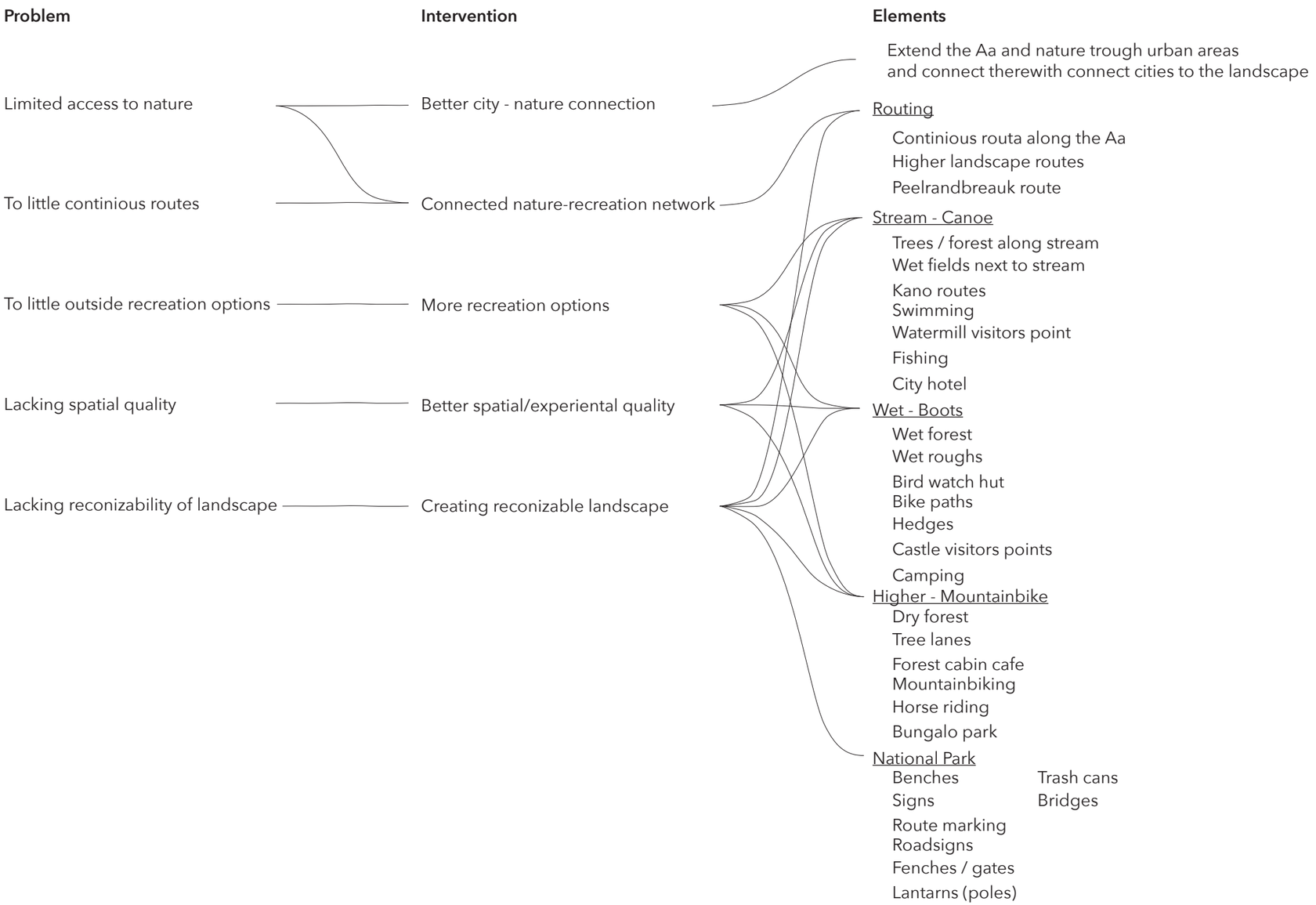
To little continious routes

To little outside recreation options

Lacking spatial quality

Lacking reconizability of landscape

Problem	Intervention
Limited access to nature	Better city - nature connection
To little continious routes	Connected nature-recreation network
To little outside recreation options	More recreation options
Lacking spatial quality	Better spatial/experiental quality
Lacking reconizability of landscape	Creating reconizable landscape


Problem
Intervention
Elements
Limited access to nature
To little continious routes
To little outside recreation options
Lacking spatial quality
Lacking reconizability of landscape
Better city - nature connection
Connected nature-recreation network
More recreation options
Better spatial/experiental quality
Creating reconizable landscape
Extend the Aa and nature trough urban areas
and connect therewith connect cities to the landscape
Routing
Continious routa along the Aa
Higher landscape routes
Peelrandbreauk route
Stream - Canoe
Trees / forest along stream
Wet fields next to stream
Kano routes
Swimming
Watermill visitors point
Fishing
City hotel
Wet - Boots
Wet forest
Wet roughs
Bird watch hut
Bike paths
Hedges
Castle visitors points
Camping
Higher - Mountainbike
Dry forest
Tree lanes
Forest cabin cafe
Mountainbiking
Horse riding
Bungalo park
National Park
Benches
Signs
Route marking
Roadsigns
Fenches / gates
Lantarns (poles)
Trash cans
Bridges

Recreation

Problem	Intervention
Limited access to nature	Better city - nature connection
To little continious routes	Connected nature-recreation network
To little outside recreation options	More recreation options
Lacking spatial quality	Better spatial/experiental quality
Lacking reconizability of landscape	Creating reconizable landscape

Elements

Extend the Aa and nature trough urban areas
and connect therewith connect cities to the landscape

Routing
- Continious routa along the Aa
- Higher landscape routes
- Peelrandbreauk route

Stream - Canoe
- Trees / forest along stream
- Wet fields next to stream
- Kano routes
- Swimming
- Watermill visitors point
- Fishing
- City hotel

Wet - Boots
- Wet forest
- Wet roughs
- Bird watch hut
- Bike paths
- Hedges
- Castle visitors points
- Camping

Higher - Mountainbike
- Dry forest
- Tree lanes
- Forest cabin cafe
- Mountainbiking
- Horse riding
- Bungalo park

National Park
- Benches
- Signs
- Route marking
- Roadsigns
- Fenches / gates
- Lantarns (poles)
- Trash cans
- Bridges

Design modules:

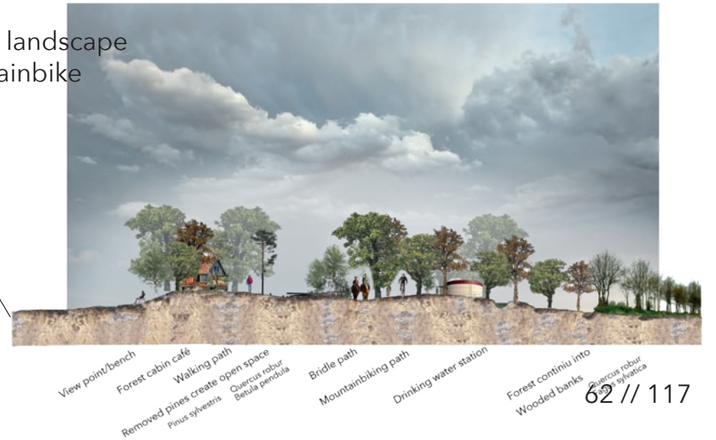
Stream landscape
Canoe

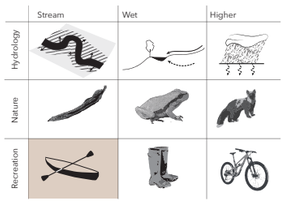


Wet landscape
Boots



Higher landscape
Mountainbike





Problems of reachability of the Aa

Stream landscape
Canoe



Stream following forest
Alnus glutinosa
Fraxinus excelsior
Prunus padus

Kanoing

Swimming

Watermill / tourists centre

Fishstairs

Coppiced willows

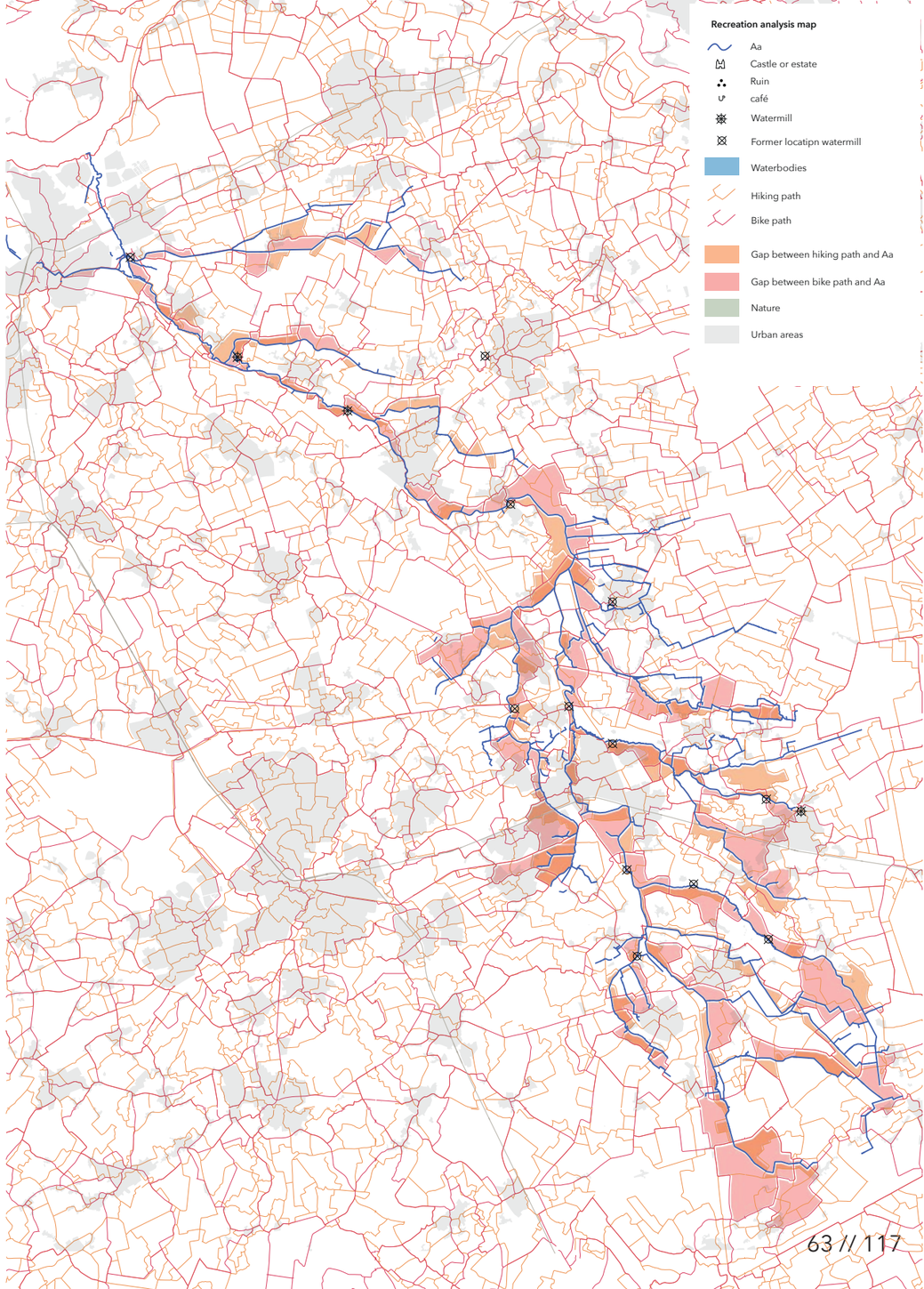
Cattle grazing

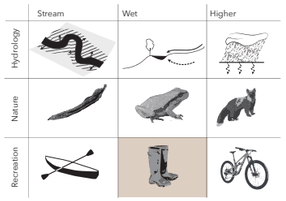
Quercus petraea



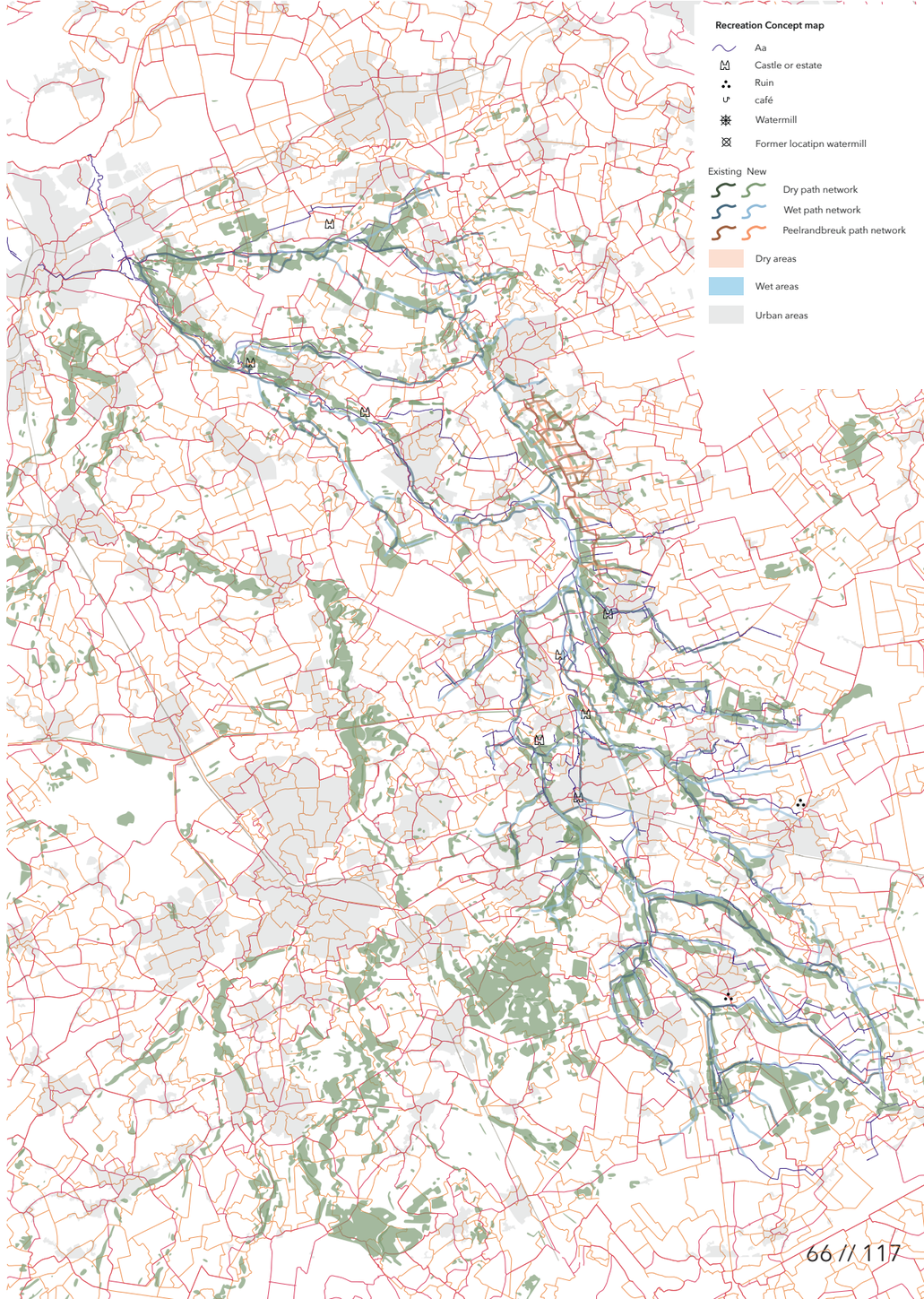


De Kilsdonkse watermill in Heeswijk-Dinther (Foto left by A. de Vries)





Schematic intervention map



Wet landscape Boots



Loamy forest
Quercus patraea
Carpinus betulus

Spares wet meadow

Birdwatching hut

waliking path

bike path

Hedge landscape
Fagus sylvatica

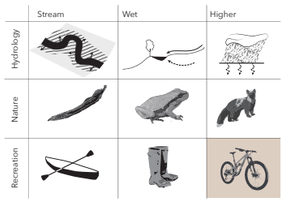
Castle / tourists centre

Salix alba

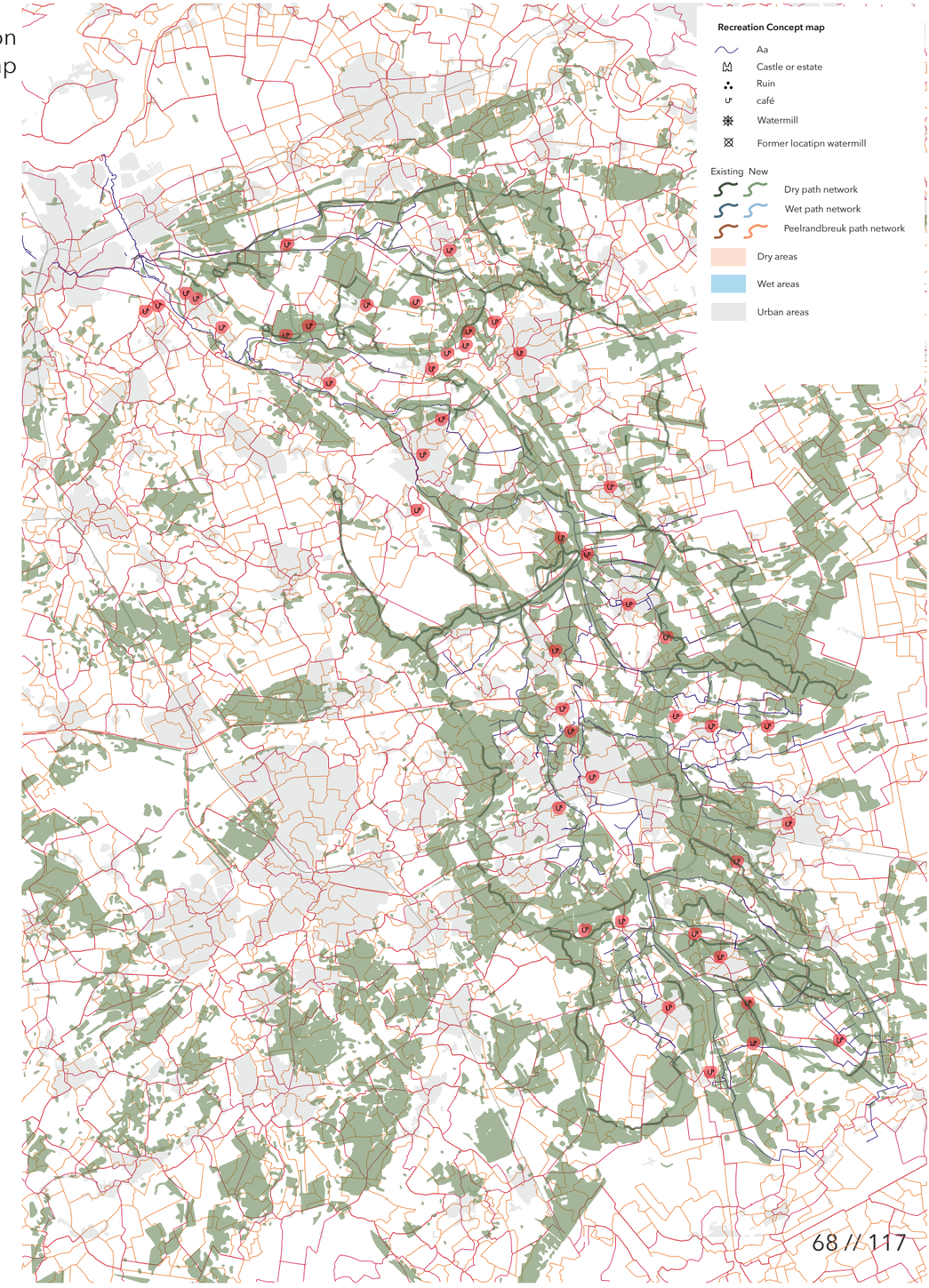
Camping at the farmer



Hedge landscape around castle of Heeswijk-Dinther



Schematic intervention map

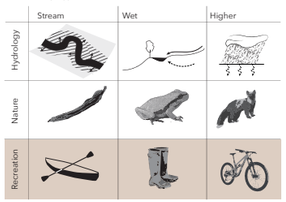


Higher landscape
Mountainbike





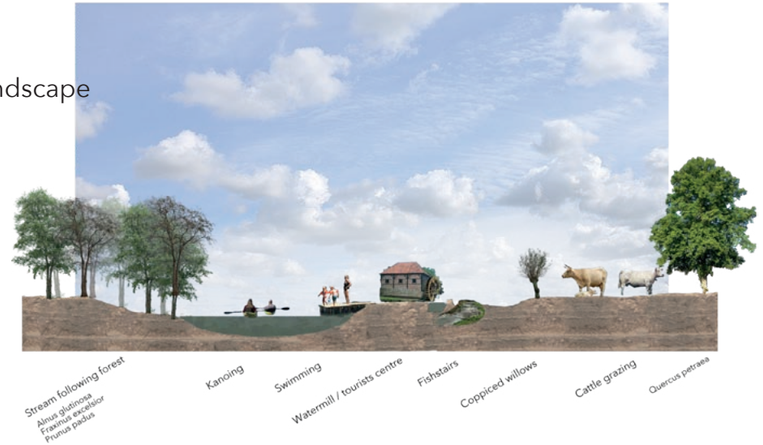
Cafe De Boswachter in het Hurkse
(Foto: H. van der Burgt)



Recreation network

Design elements:

Stream landscape
Canoe

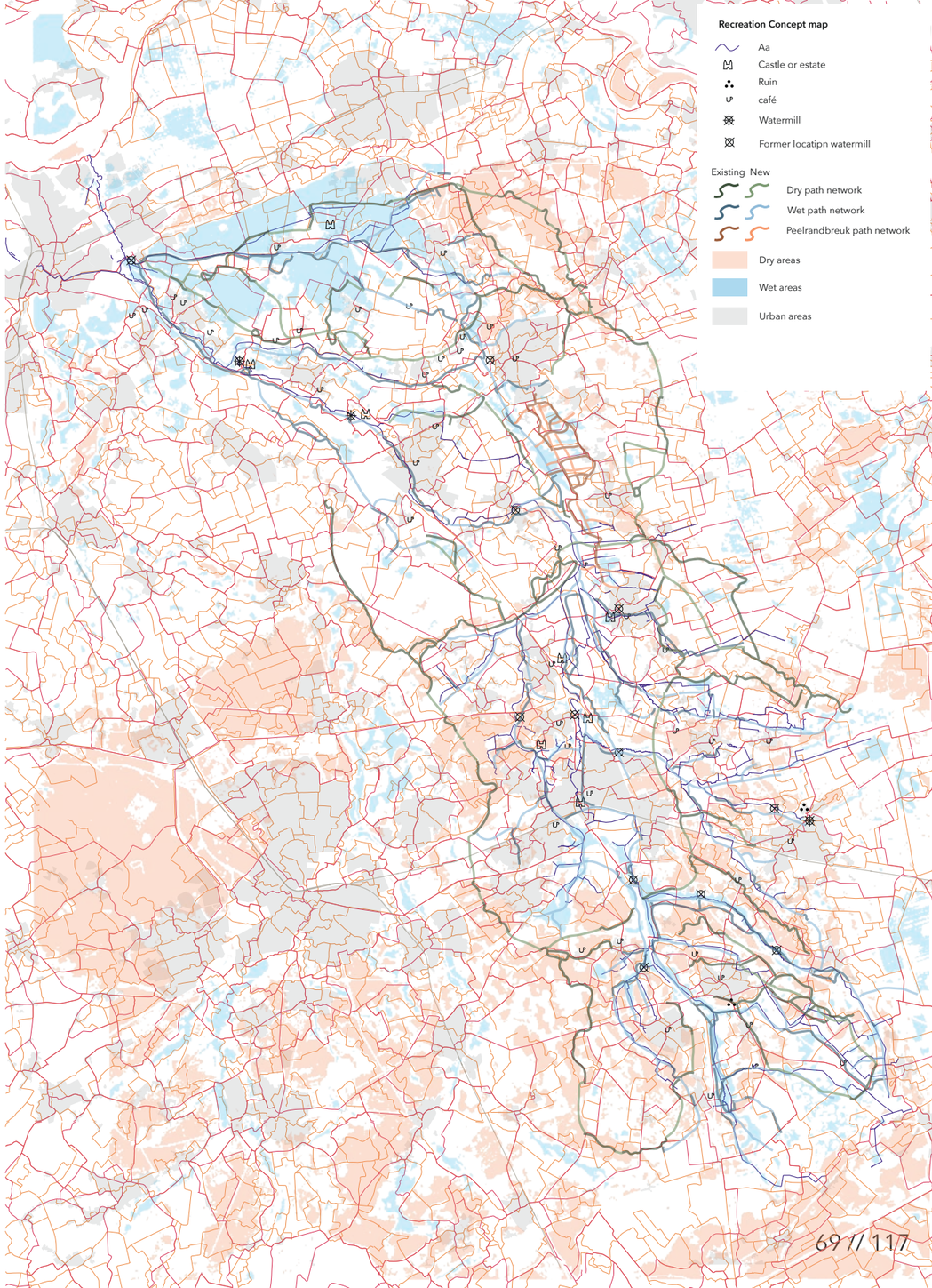


Wet landscape
Boots



Higher landscape
Mountainbike

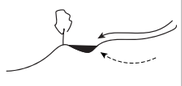
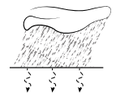




Overview

Design modules:

Landscape type

Theme	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

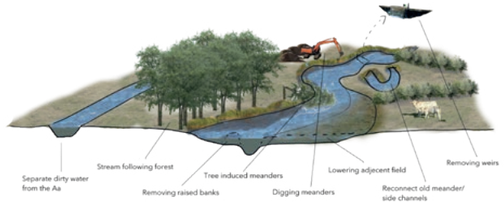
Hydrology

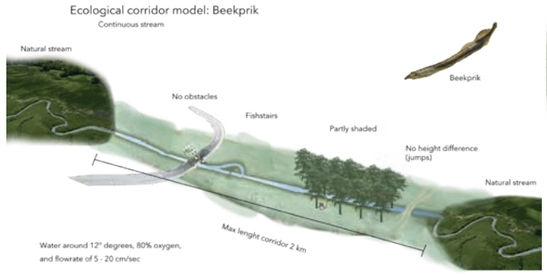
Nature

Recreation

Stream landscape

Meanders



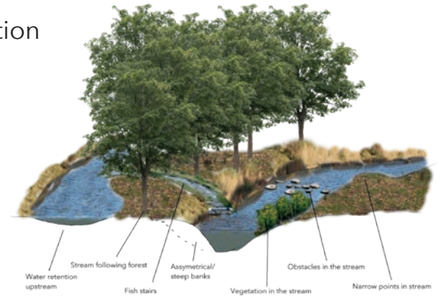


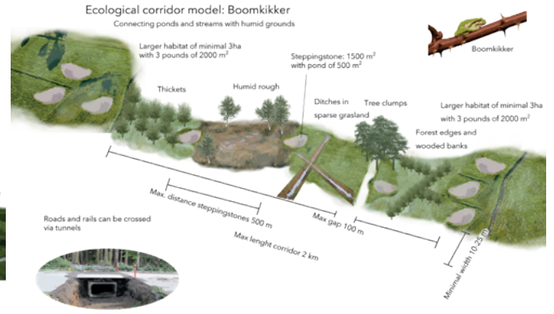
Canoe



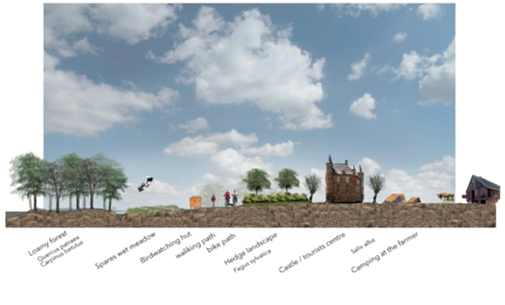
Wet landscape

Retention



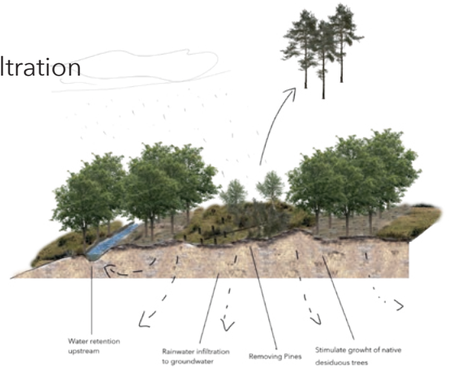


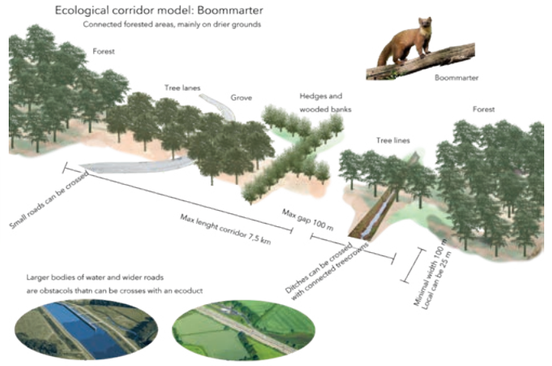
Boots



Higher landscape

Infiltration



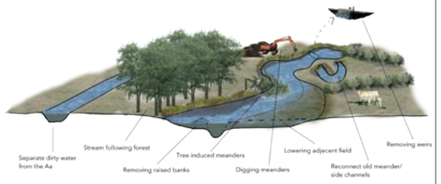


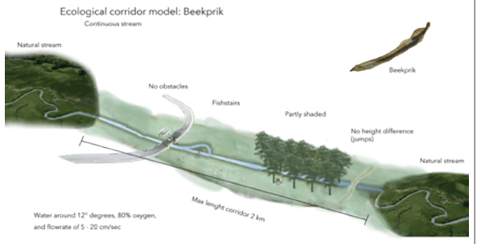
Mountainbike



The Aa
- Meander
- Beekprik
- Canoe

Meanders



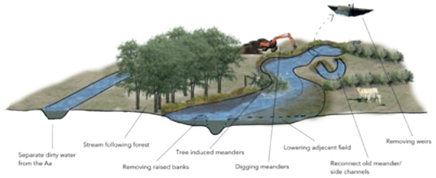


Canoe



Wet stream landscape
- Room for meandering
- Water retention
- Boomkikker
- Boots

Meanders



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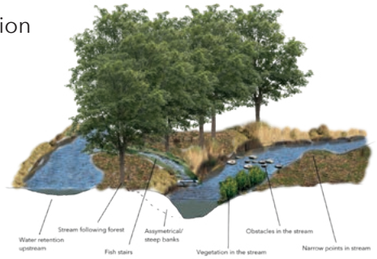
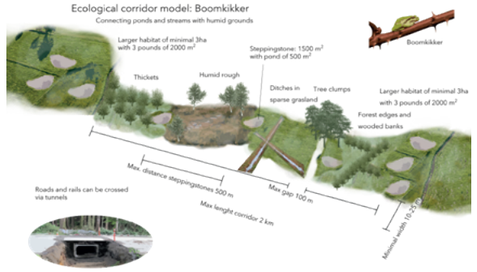


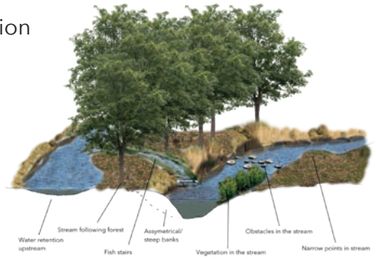


Boots

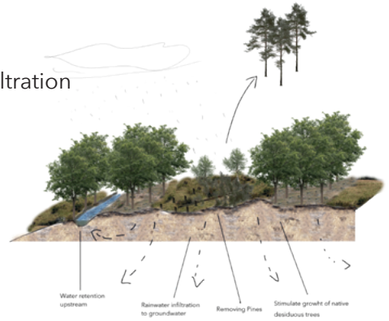


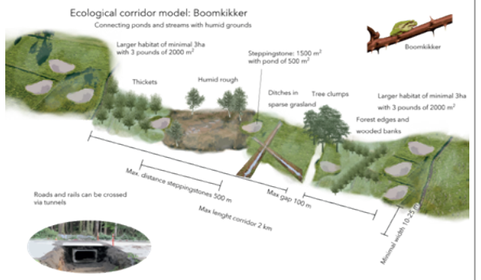
Wet roughs
- Water retention
- Infiltration
- Boomkikker
- Boots

Retention



Infiltration



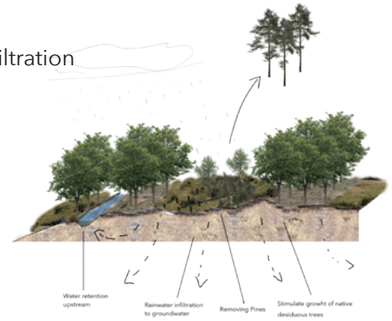


Boots



Dry sand landscape
- Infiltration
- Mountainbike

Infiltration

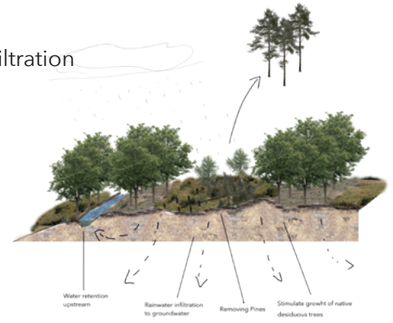


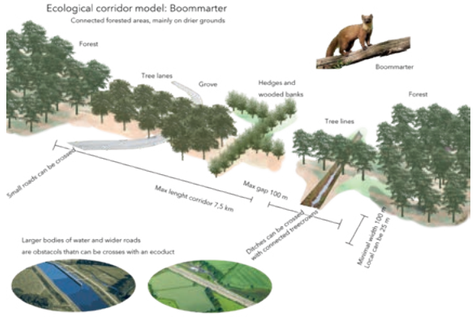
Mountainbike



Forest
- Infiltration
- Boommarter
- Mountainbike

Infiltration

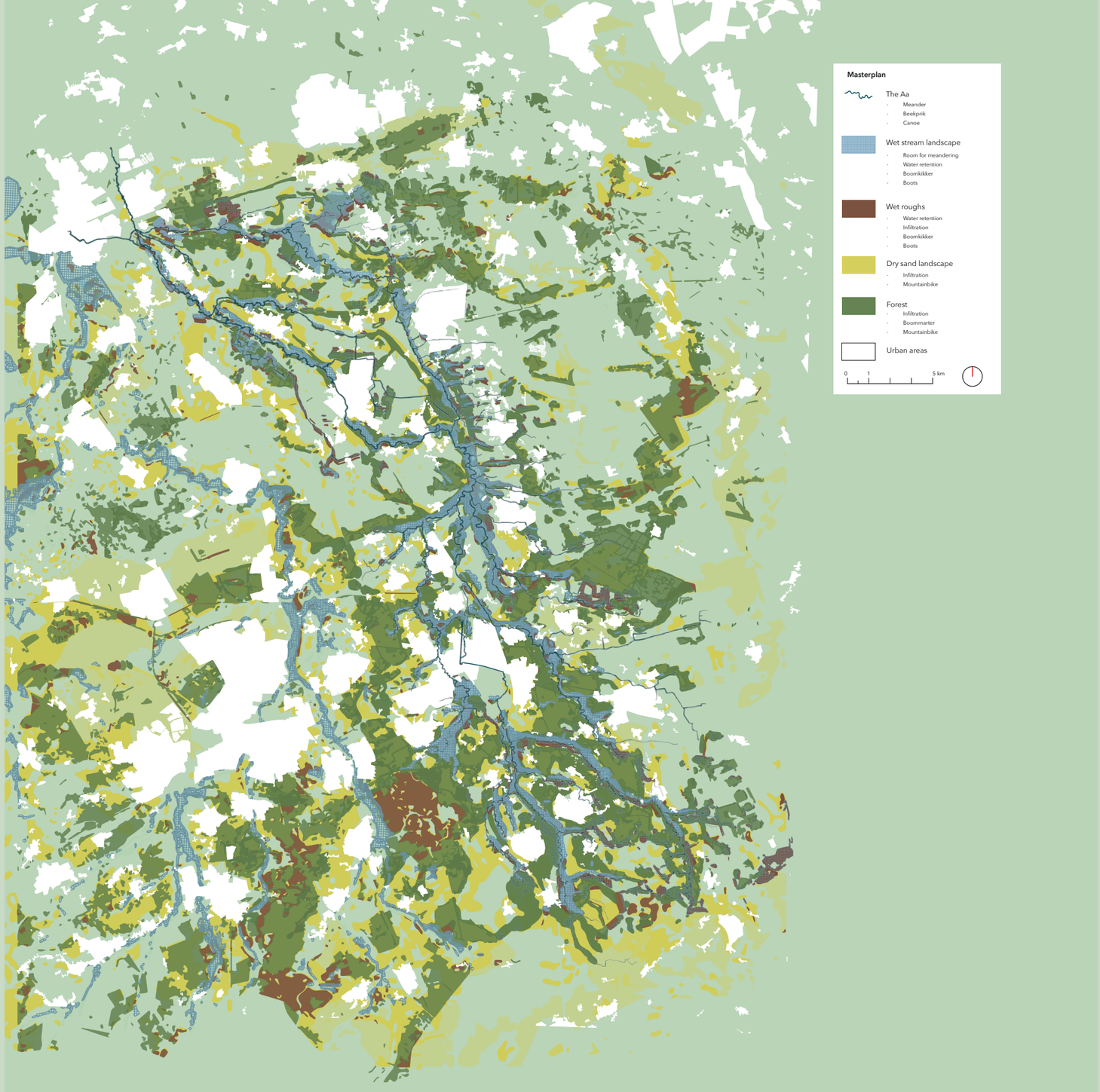




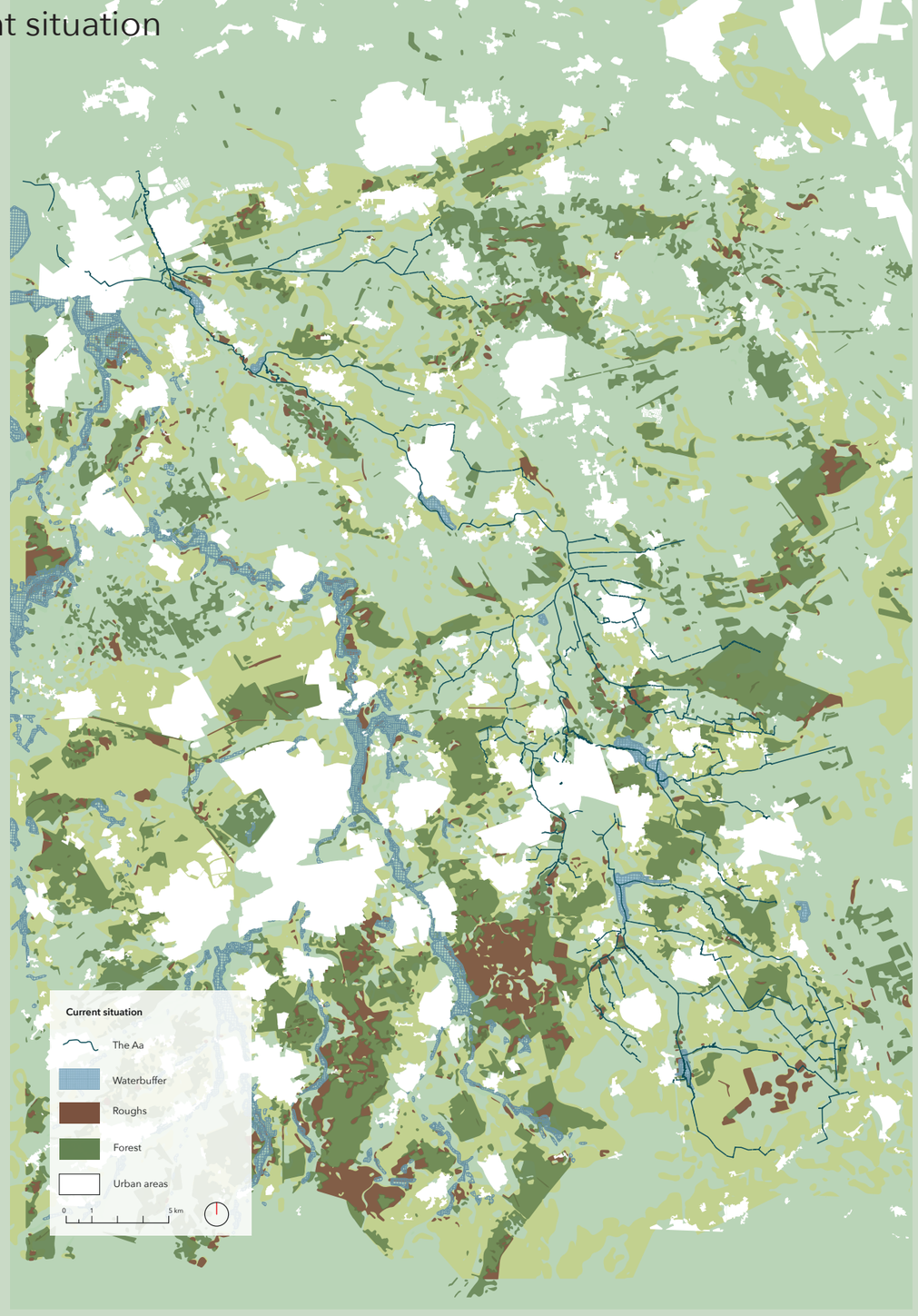
Mountainbike



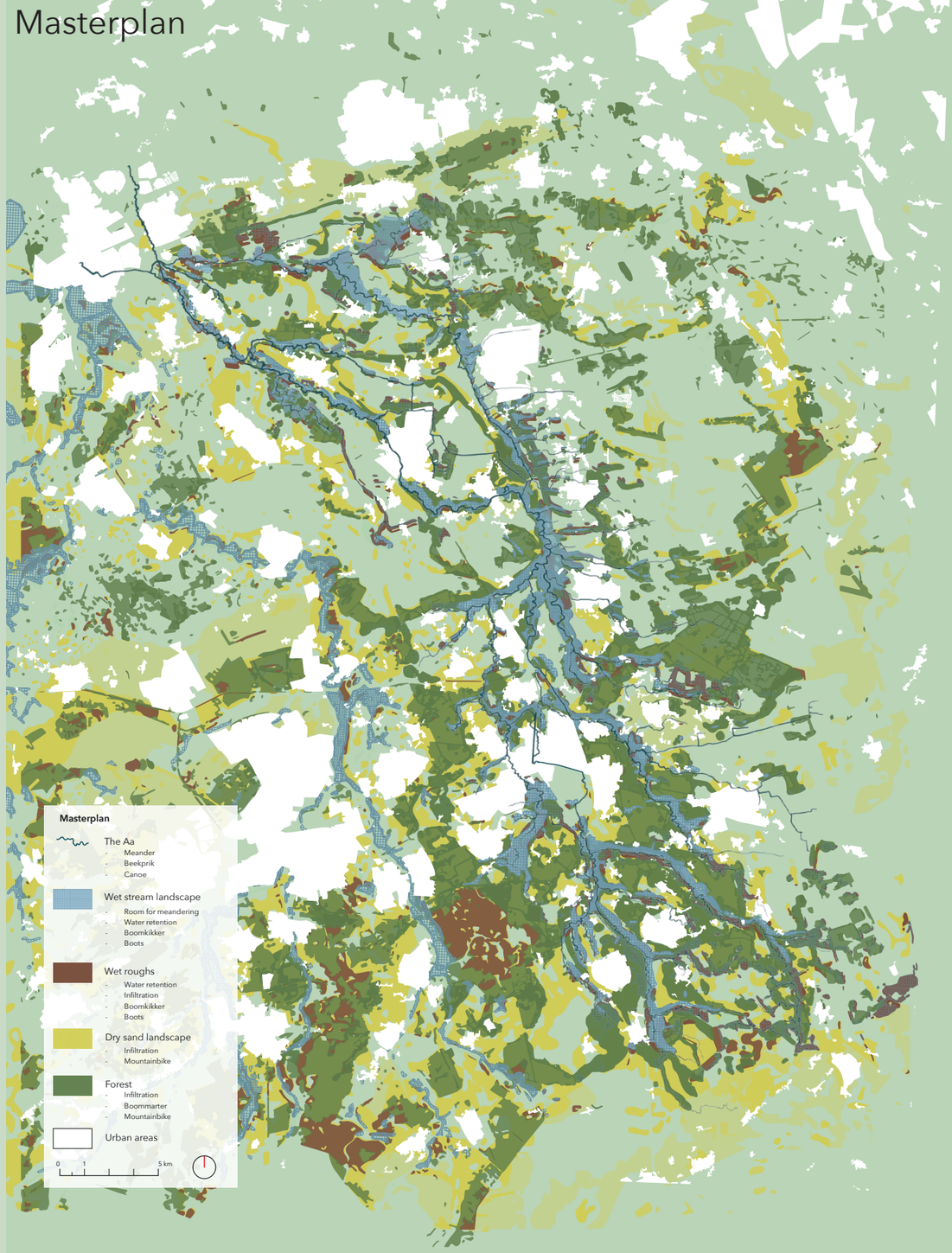
Masterplan


Masterplan
The Aa
- Meander
- Beekprik
- Canoe
Wet stream landscape
- Room for meandering
- Water retention
- Boomkikker
- Boots
Wet roughs
- Water retention
- Infiltration
- Boomkikker
- Boots
Dry sand landscape
- Infiltration
- Mountainbike
Forest
- Infiltration
- Boommarter
- Mountainbike
Urban areas
0
1
5 km

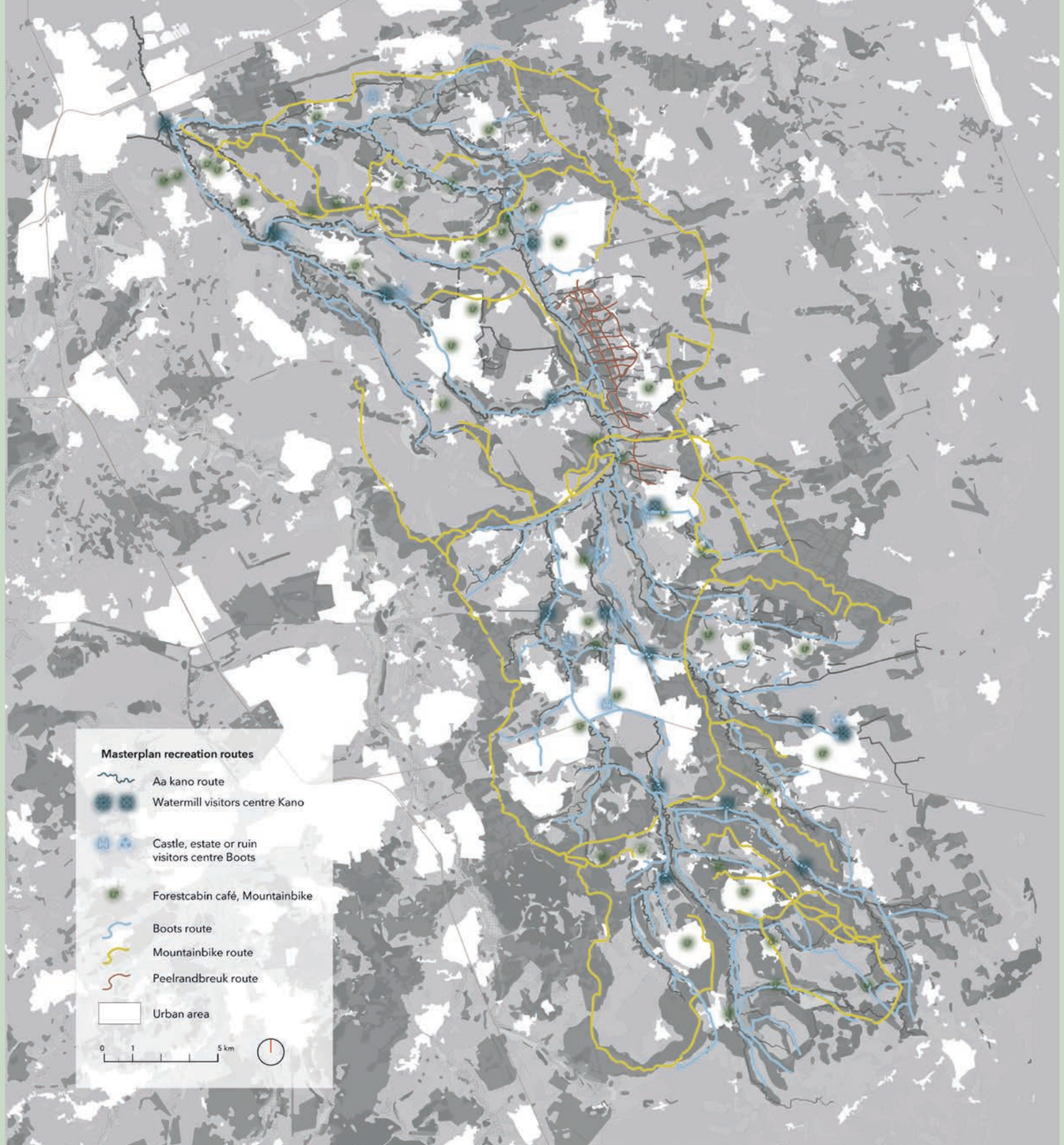
Current situation



Masterplan



Recreation routes and nodes



The Aa
- Meander
- Beekprik
- Canoe

Wet stream landscape
- Room for meandering
- Water retention
- Boomkikker
- Boots

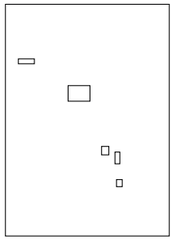
Wet roughs
- Water retention
- Infiltration
- Boomkikker
- Boots

Dry sand landscape
- Infiltration
- Mountainbike

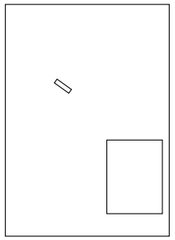
Forest
- Infiltration
- Boommarter
- Mountainbike



Inside city



Upstream



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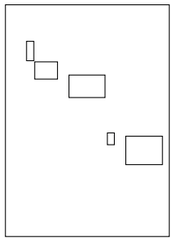
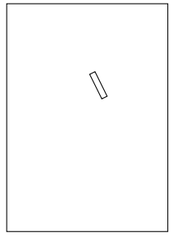
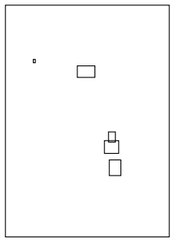


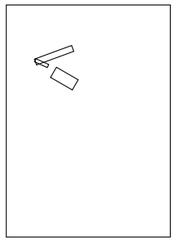
Leigraaf channel



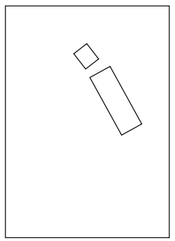
New waterways



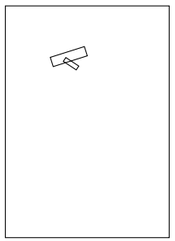
Downstream natural



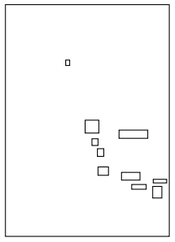
Peelrandbreuk



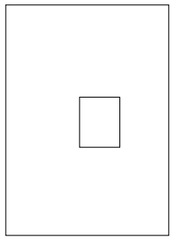
Downstream inudation



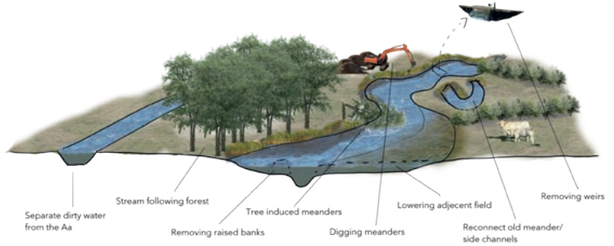
Stream spring

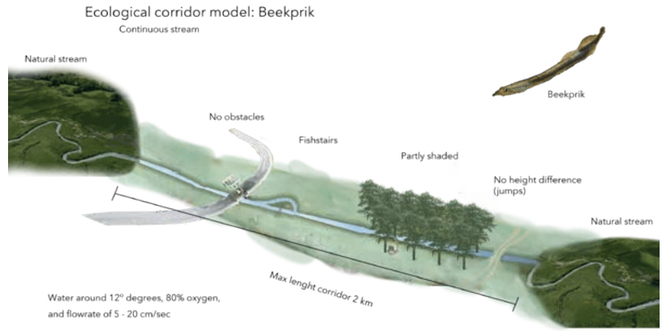


Downstream active



Meanders



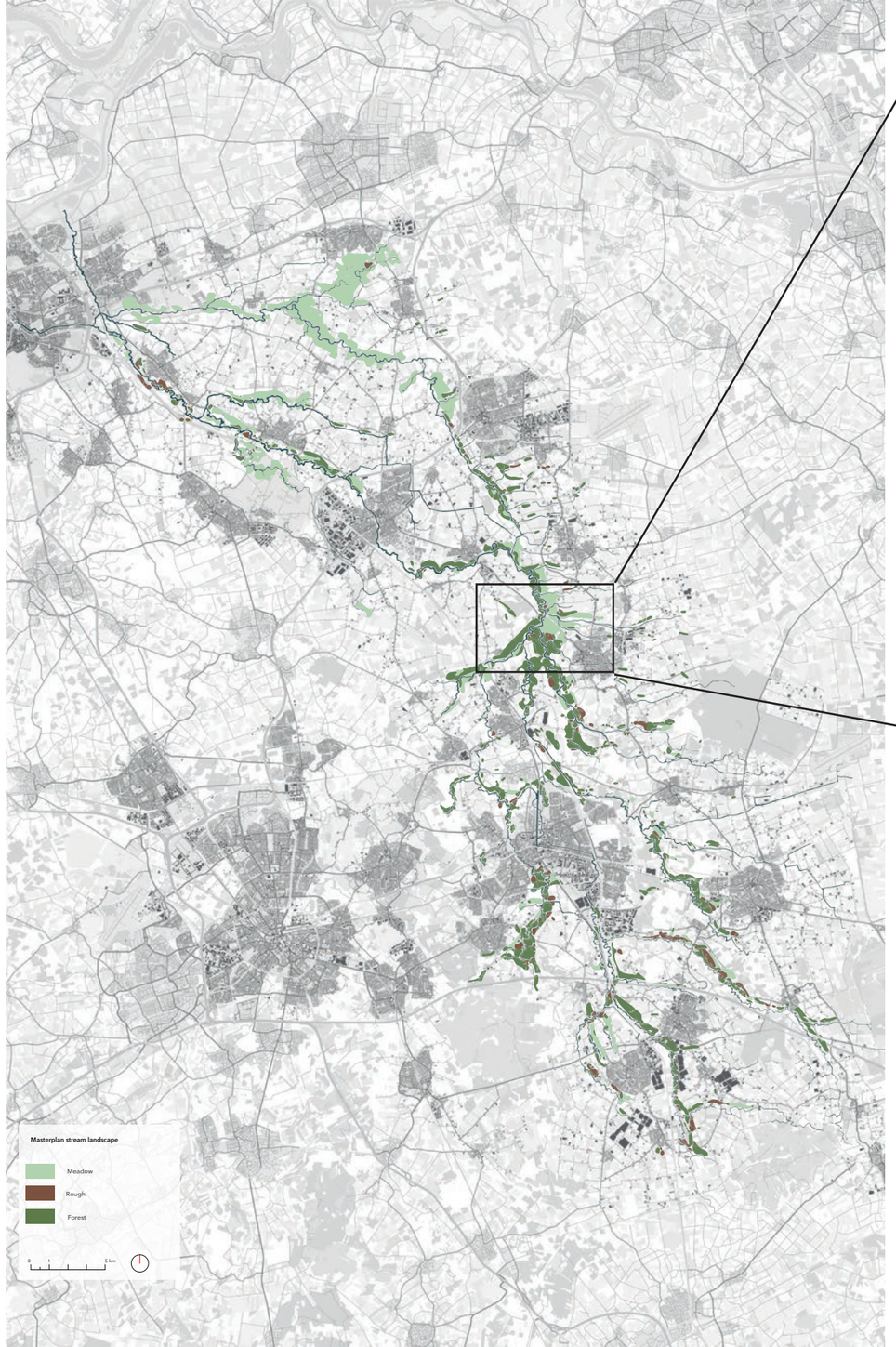


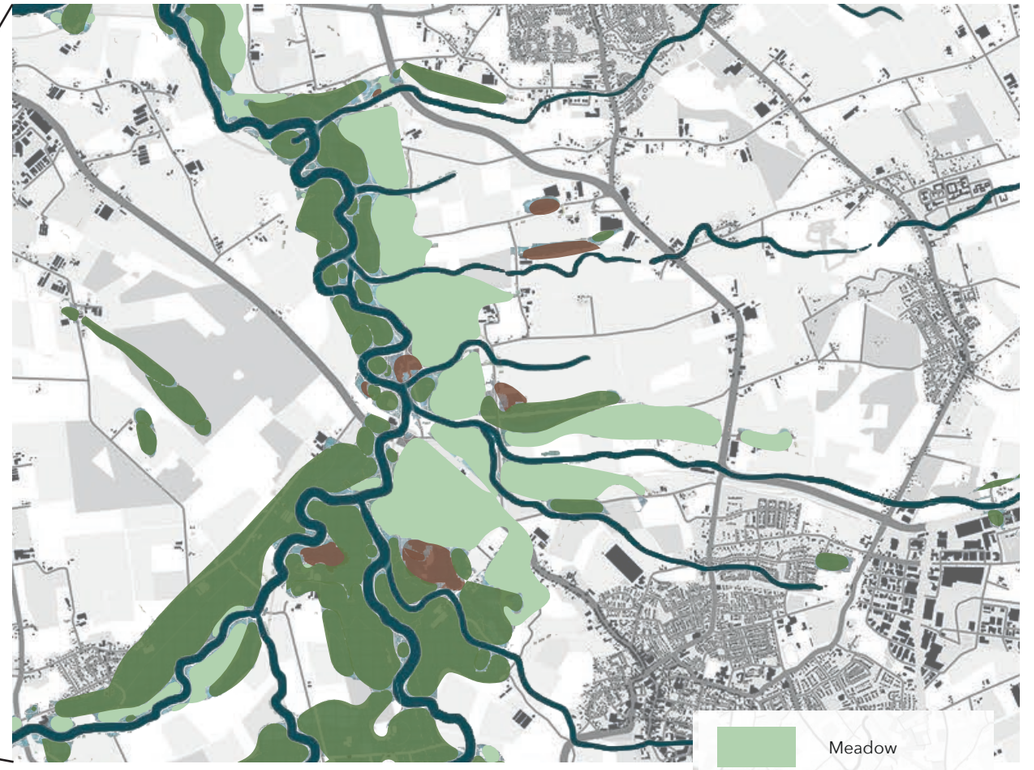
Canoe



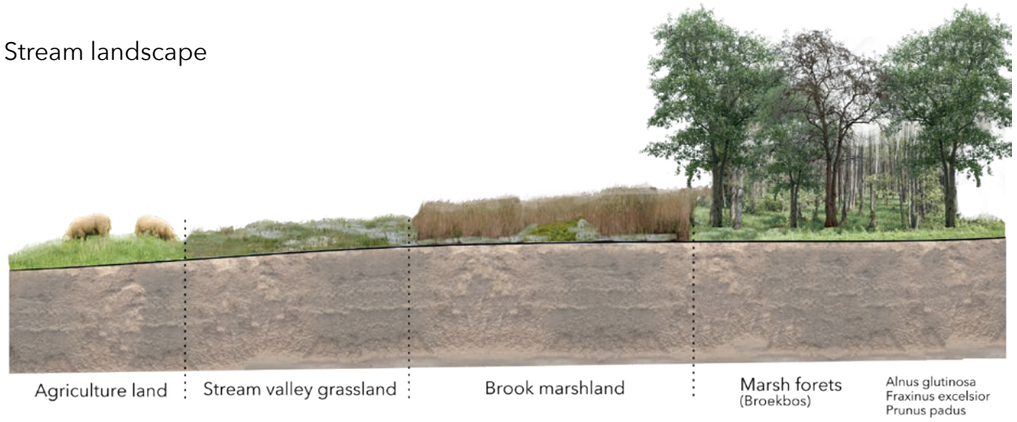
Wet stream landscape

- Room for meandering
- Water retention
- Boomkikker
- Boots





Stream landscape





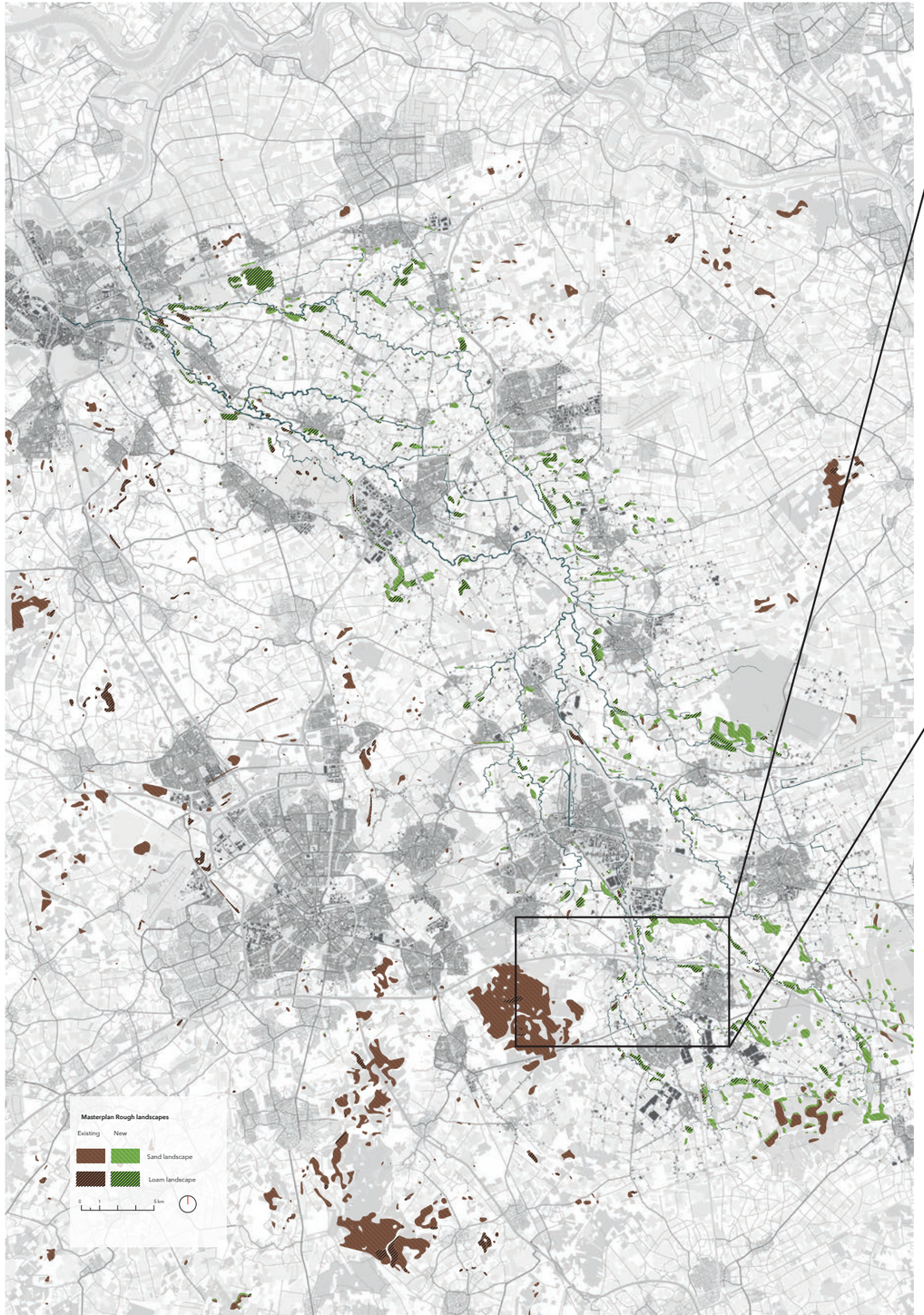
The Aa near Berlicum
Image by author



Tree canopy over the stream at castle Heeswijk
Image by author

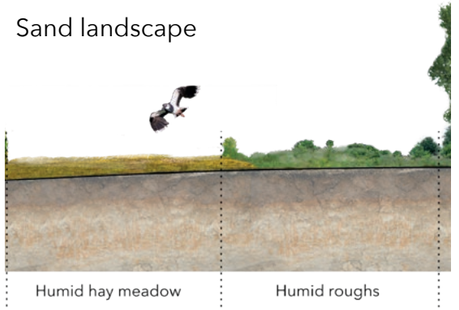
Wet roughs

- Water retention
- Infiltration
- Boomkikker
- Boots

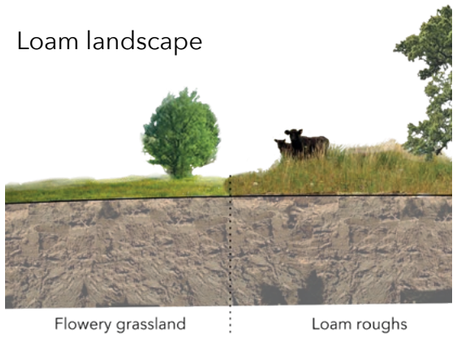




Sand landscape



Loam landscape

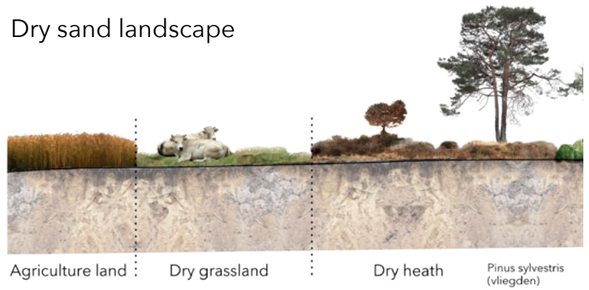


Dry sand landscape

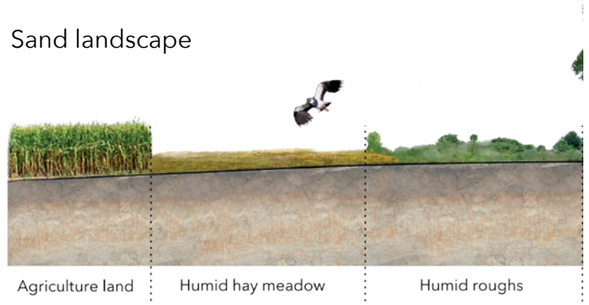
- Infiltration
- Mountainbike

Natural succesion landscape types

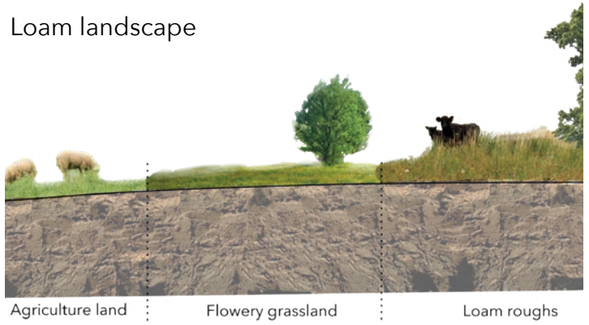
Dry sand landscape



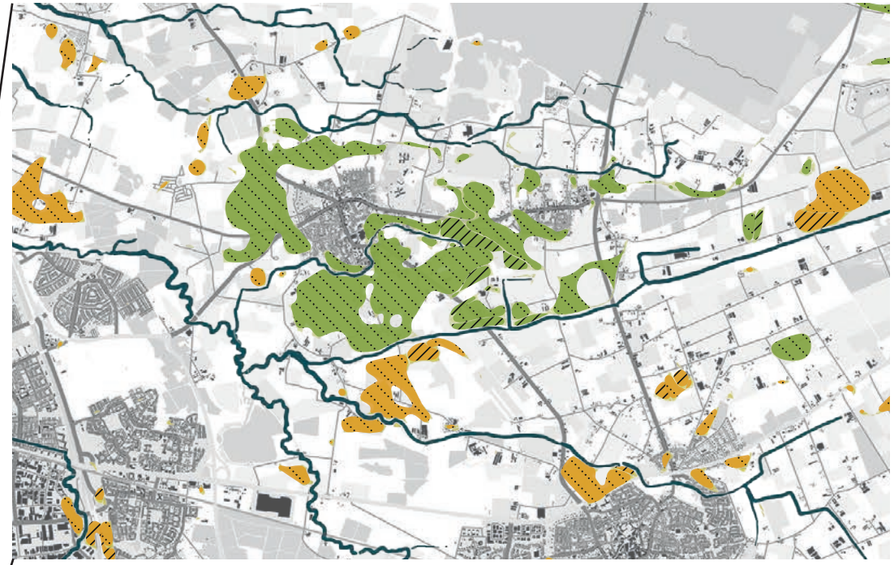
Sand landscape

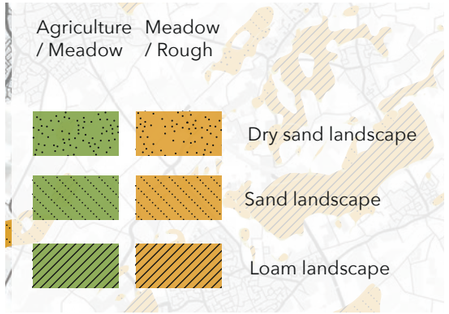


Loam landscape









Natural succesion landscape types



Dry sand landscape

Dry forest Quercus robur Betula pendula



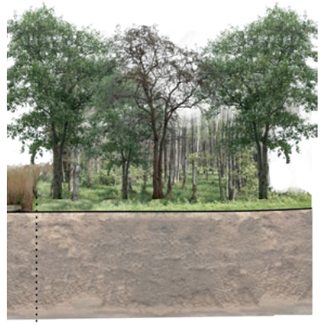
Sand l andscape

Humid oak-beech forest Quercus petraea Fagus sylvatica



Loam landscape

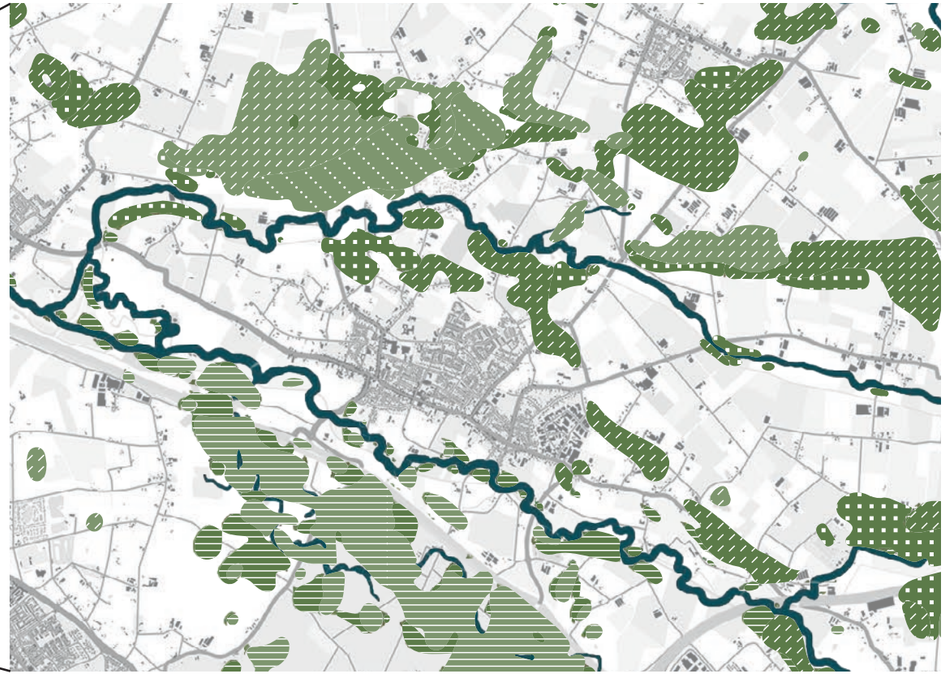
Loam forest Quercus petraea Carpinus betulus

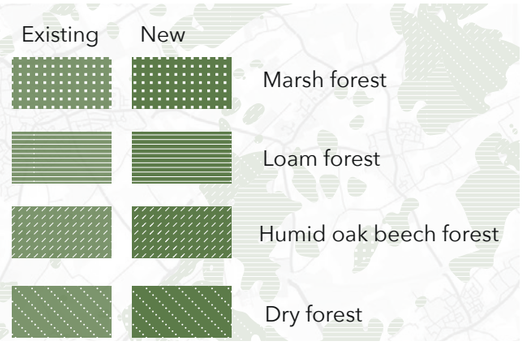


Stream landscape

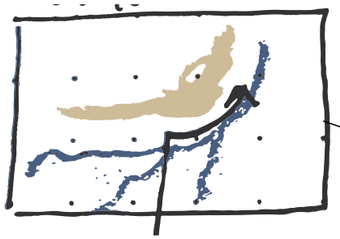
Marsh forets (Broekbos) Alnus glutinosa Fraxinus excelsior Prunus padus



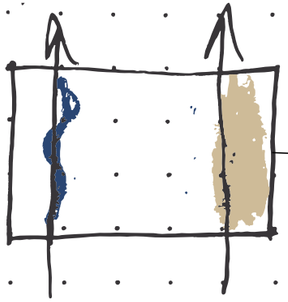




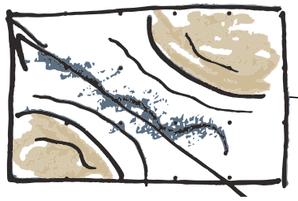
Zoom-ins



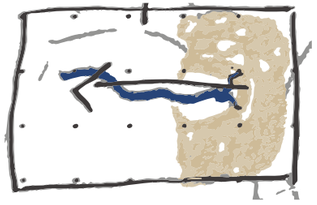
Collision



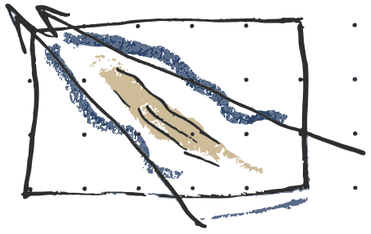
Parallel



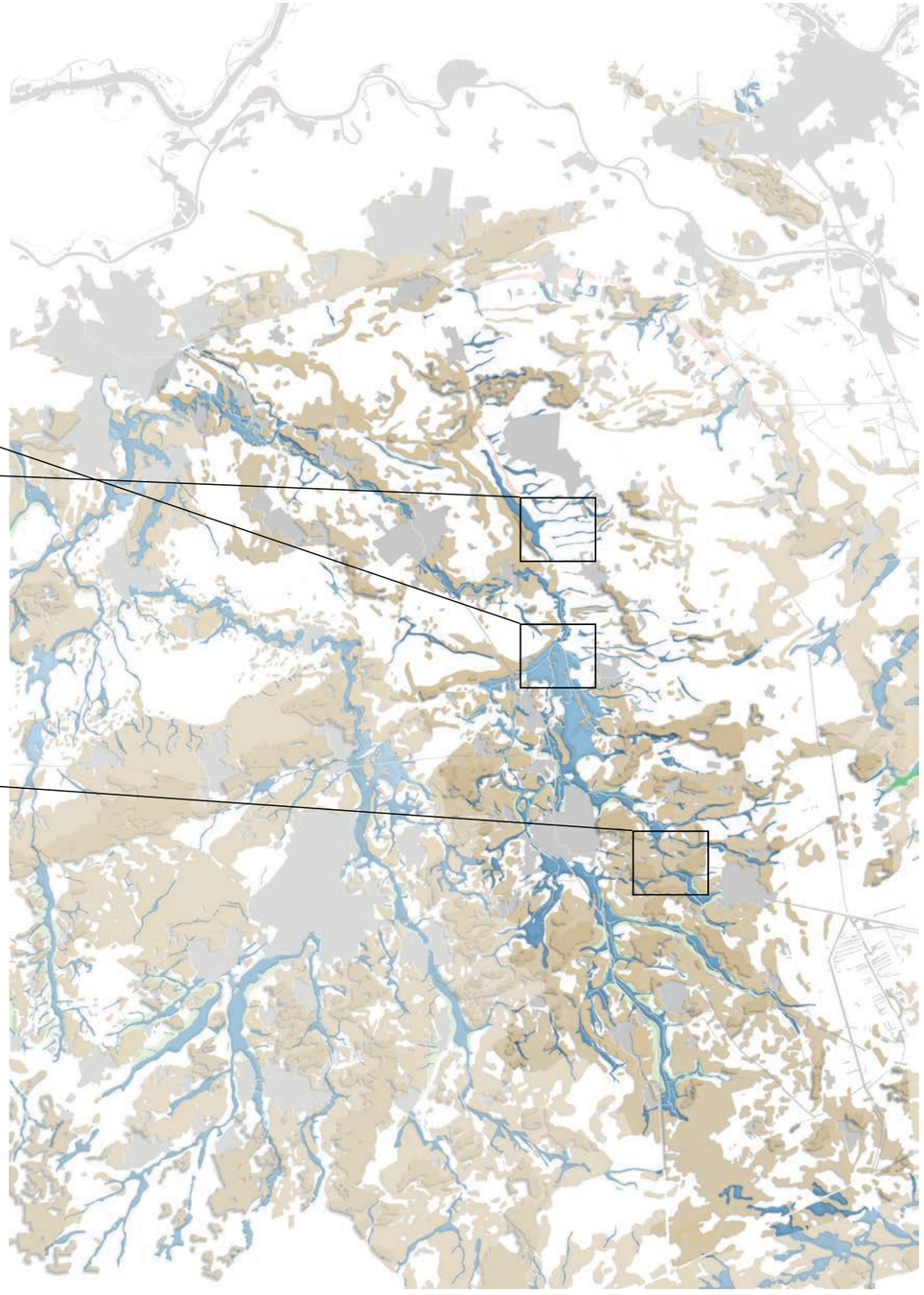
In between



Spring



Besides



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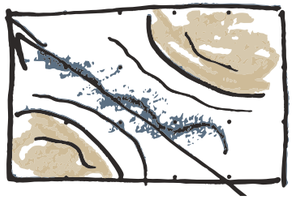
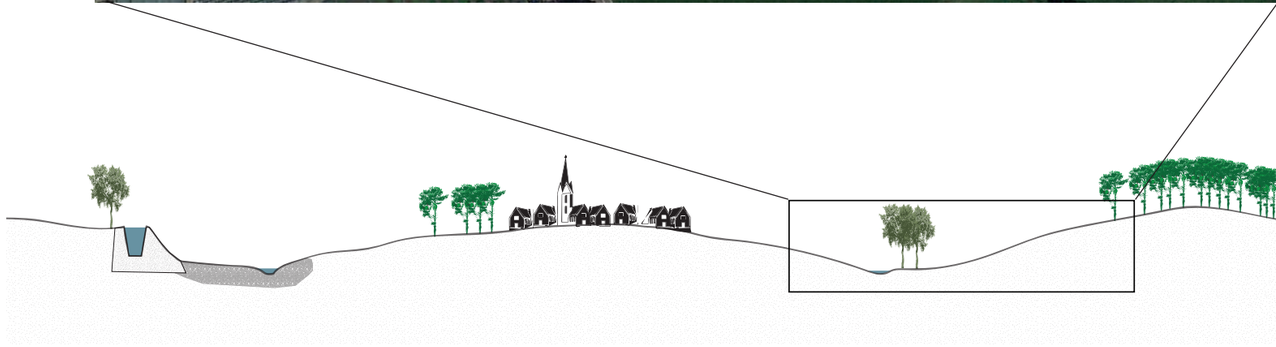
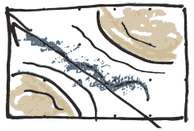




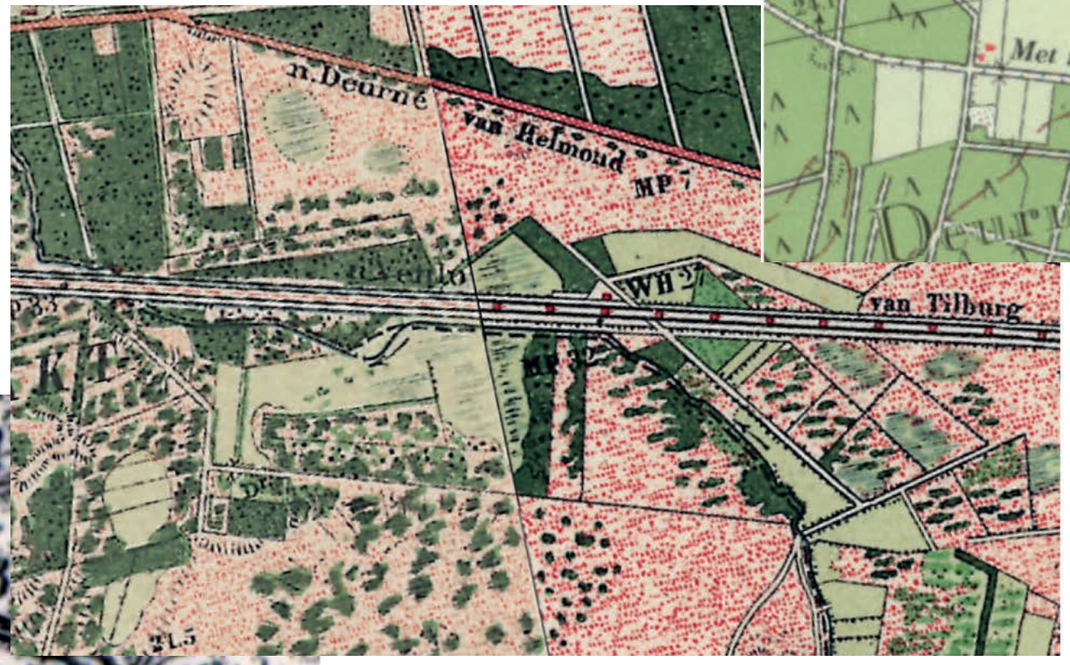




1968



1900



1868

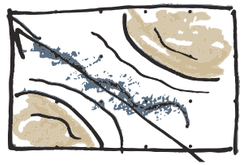


2005



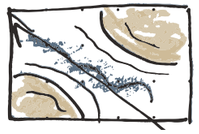






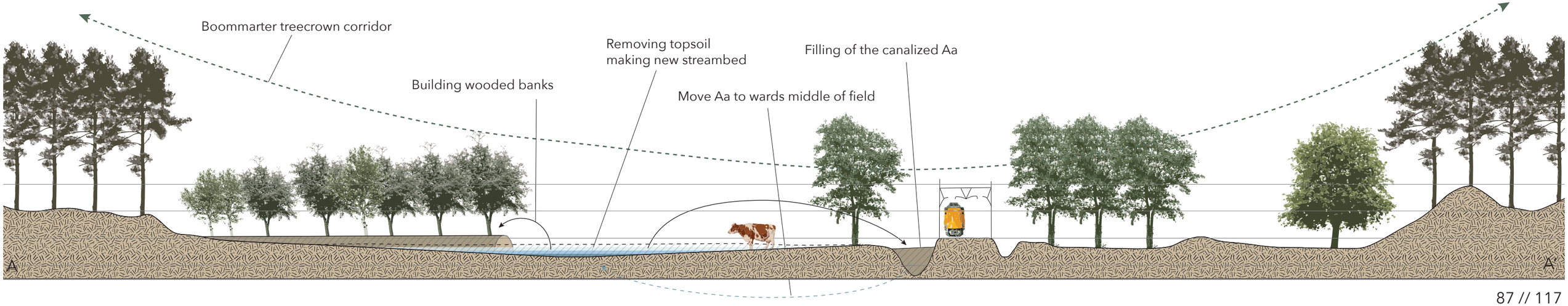
2024

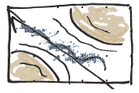




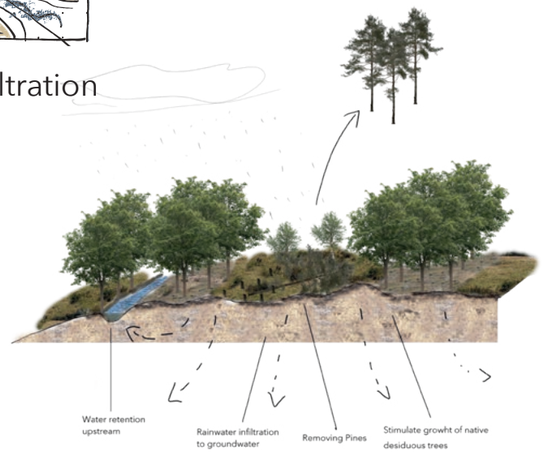

A'
A

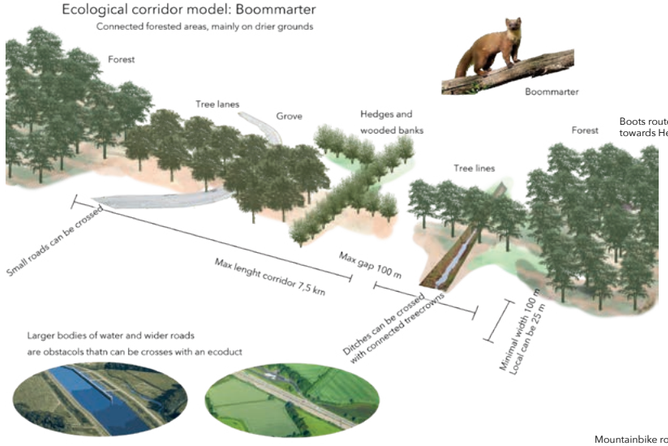
1
20


Boommarter treecrown corridor
Building wooded banks
Removing topsoil
making new streambed
Move Aa to wards middle of field
Filling of the canalized Aa
A
A'



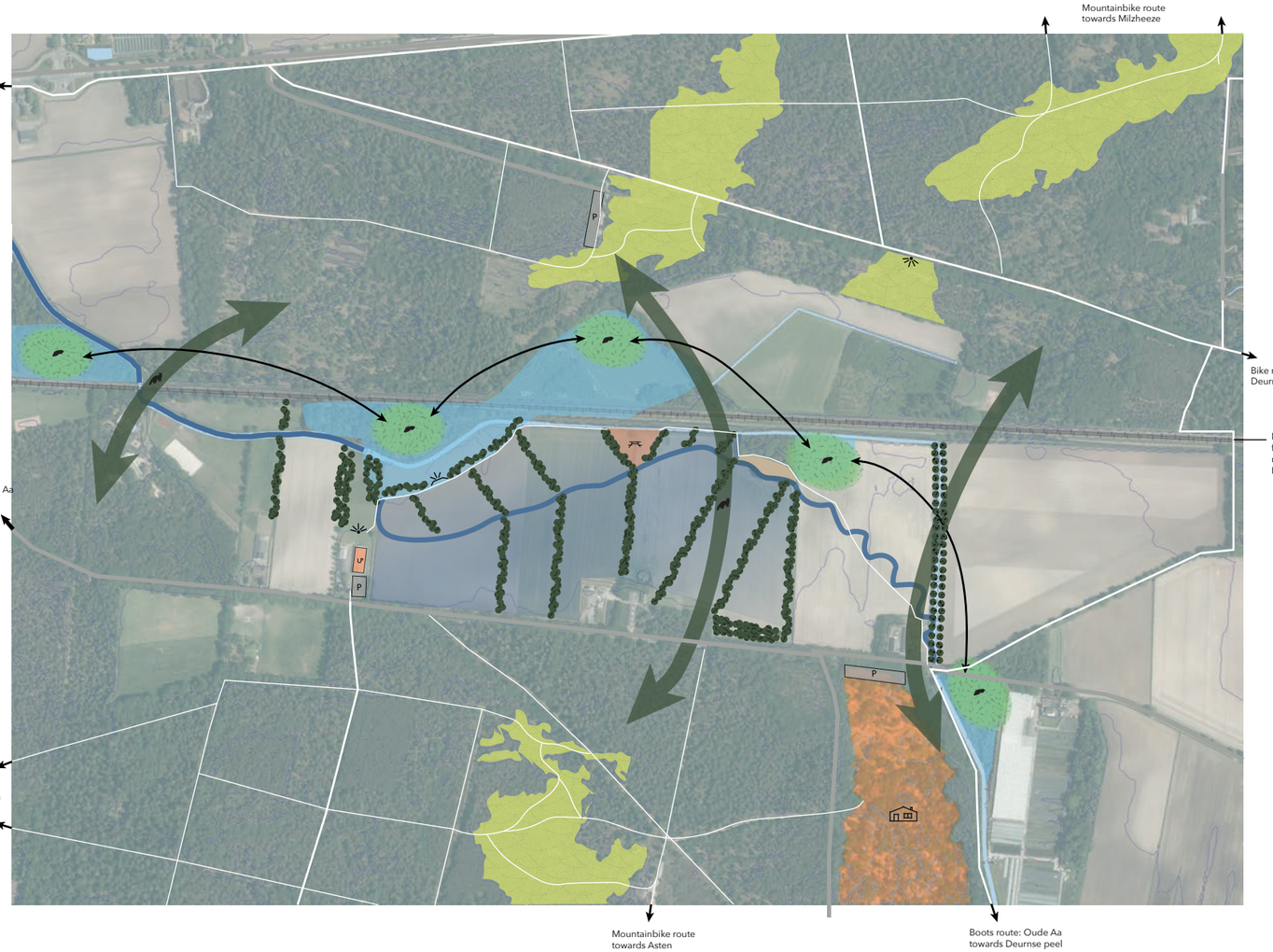
Infiltration





Mountainbike





Zoom in concept map: stream vally

Nature

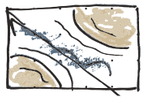
- Boomkikker stepping stone
- Wooded bank
  - Quercus robur
  - Betula pendula
  - Alnus glutinosa
- Tree lane
  - Quercus robur

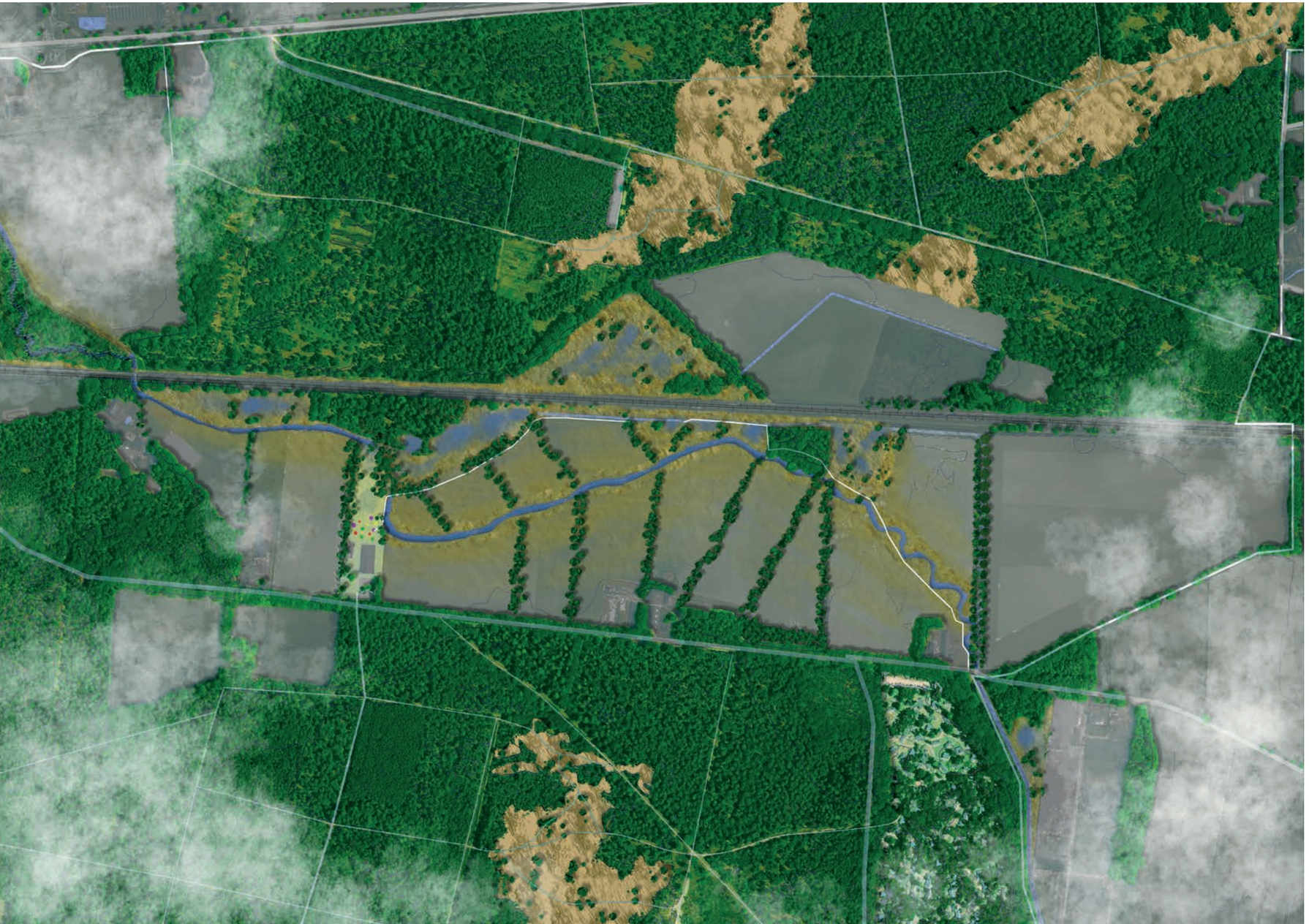
Water managment

- Aa
- Section 1 restoration meander
- Section 2 steep south facing banks
- Section 3 Top layer soil removed to create spares wet meadow. Soil used for heightend wooded banks, which form obstacles in stream thereby retaining water. Stream finds it own between gaps in wooded bank.
- Removing pines, creating open sandy water infiltration landscape

Recreation

- Bungalo park (existing)
- Forest edge café
- Picknick site
- Lookout point
- Bird watching hut
- Parking
- Road
- Bike path
- Path



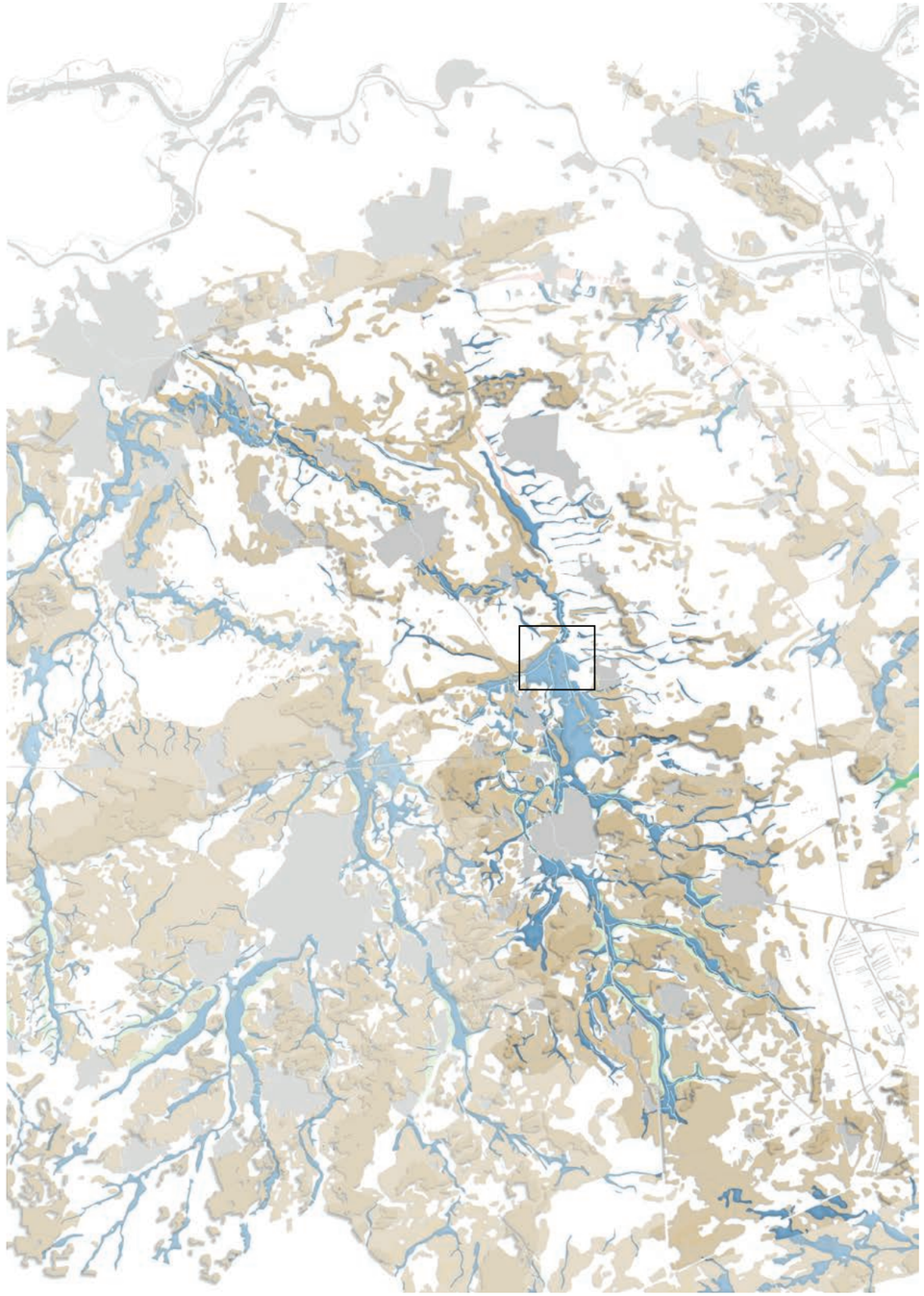


Summer

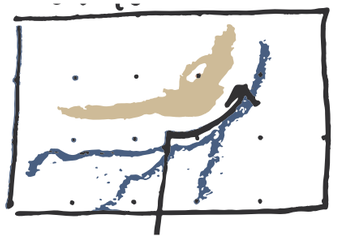


Winter

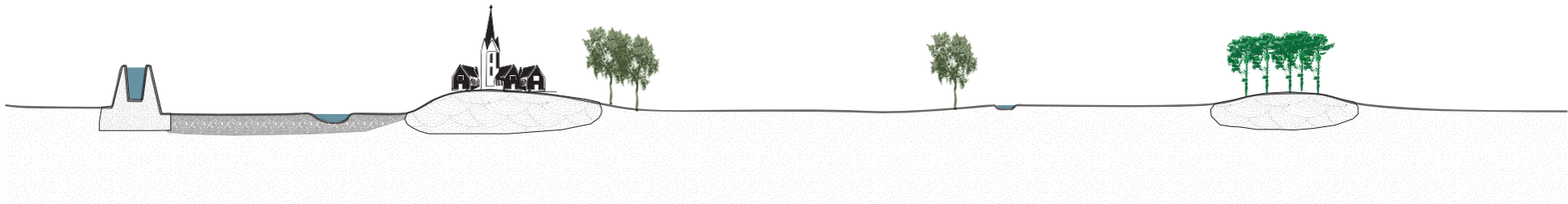


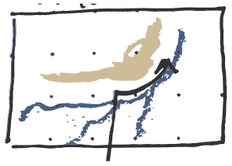


Collision



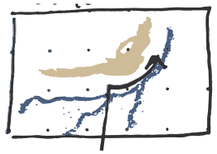






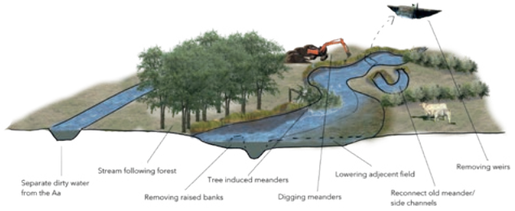
Current situation





Concept

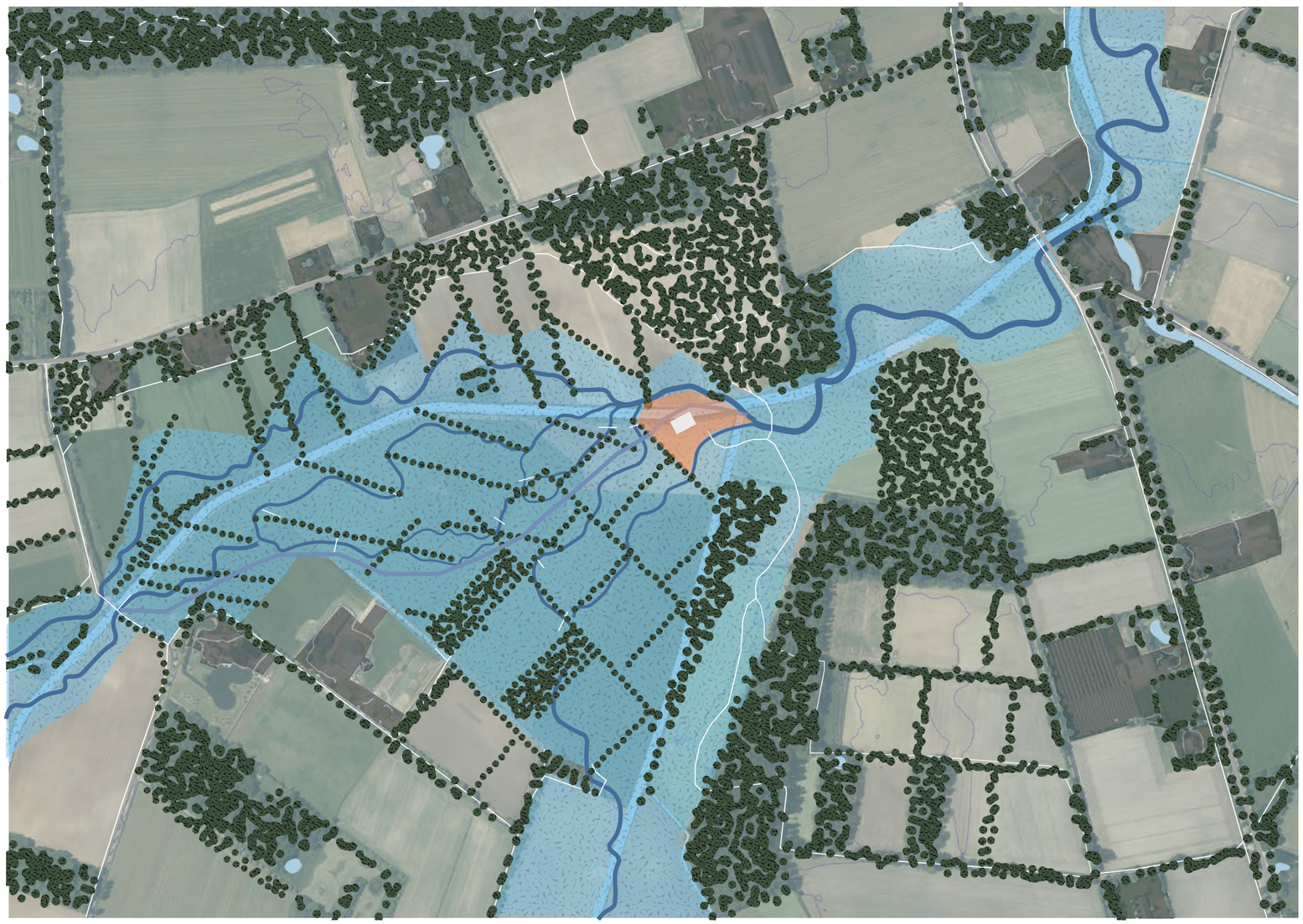
Meanders





Canoe





Zoom in concept map: Collision

Nature

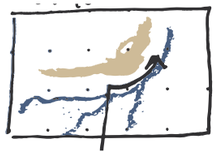
- Boomkikker habitat
- Forest
  - Querqus petraea
  - Carpinus betulus
  - Prunus padus
- Tree lane
  - Fagus sylvatuca

Water managment

- Main channel Aa
- Smaller channel, Beekprik habitat
- Canoe waterway

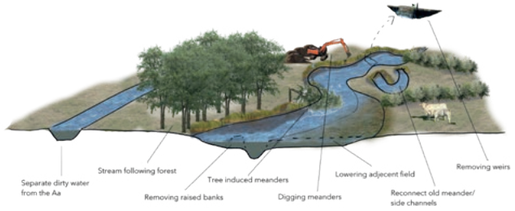
Recreation

- 'Watermill' visitors centre
- Road
- Bike path
- Path



Concept

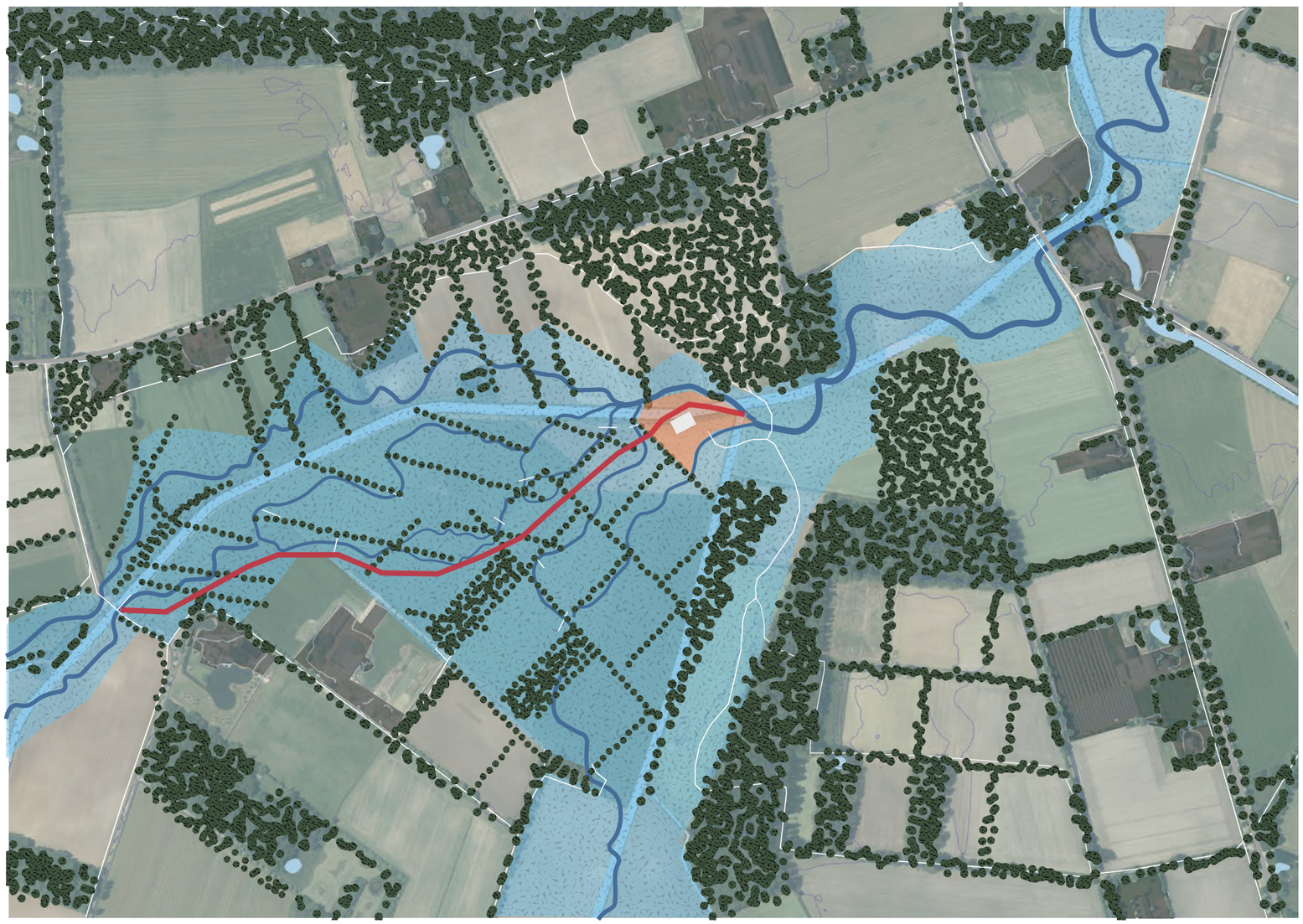
Meanders





Canoe





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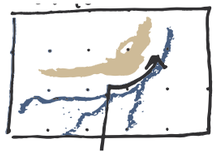
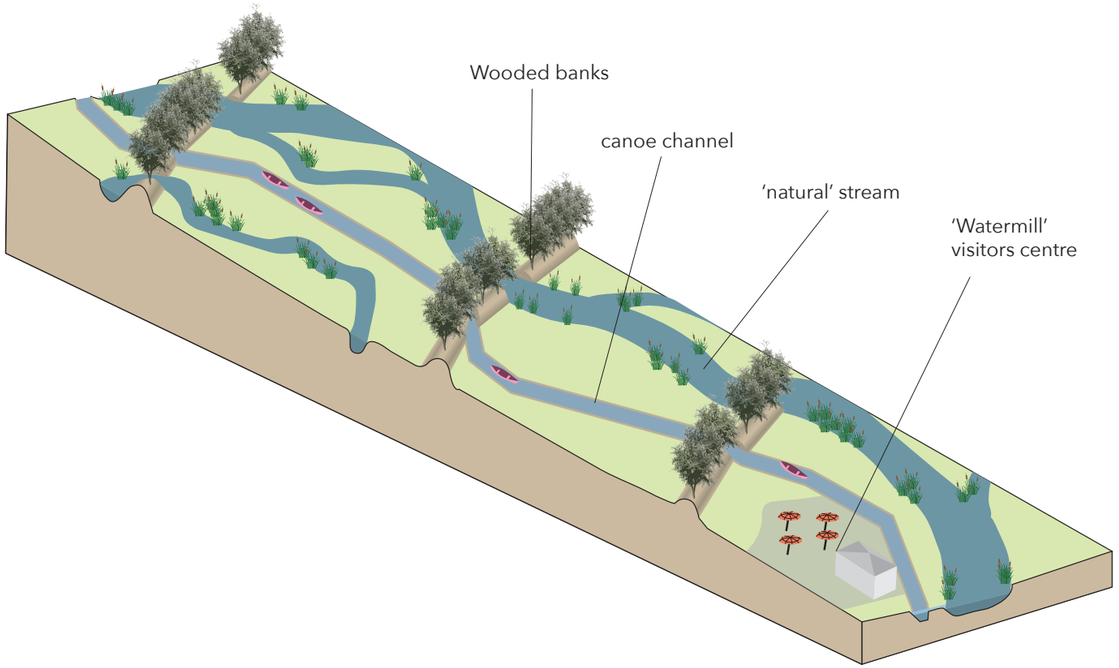


Canoe channel









Canoe channel

Crossings



Visitors centre







Created lanscape

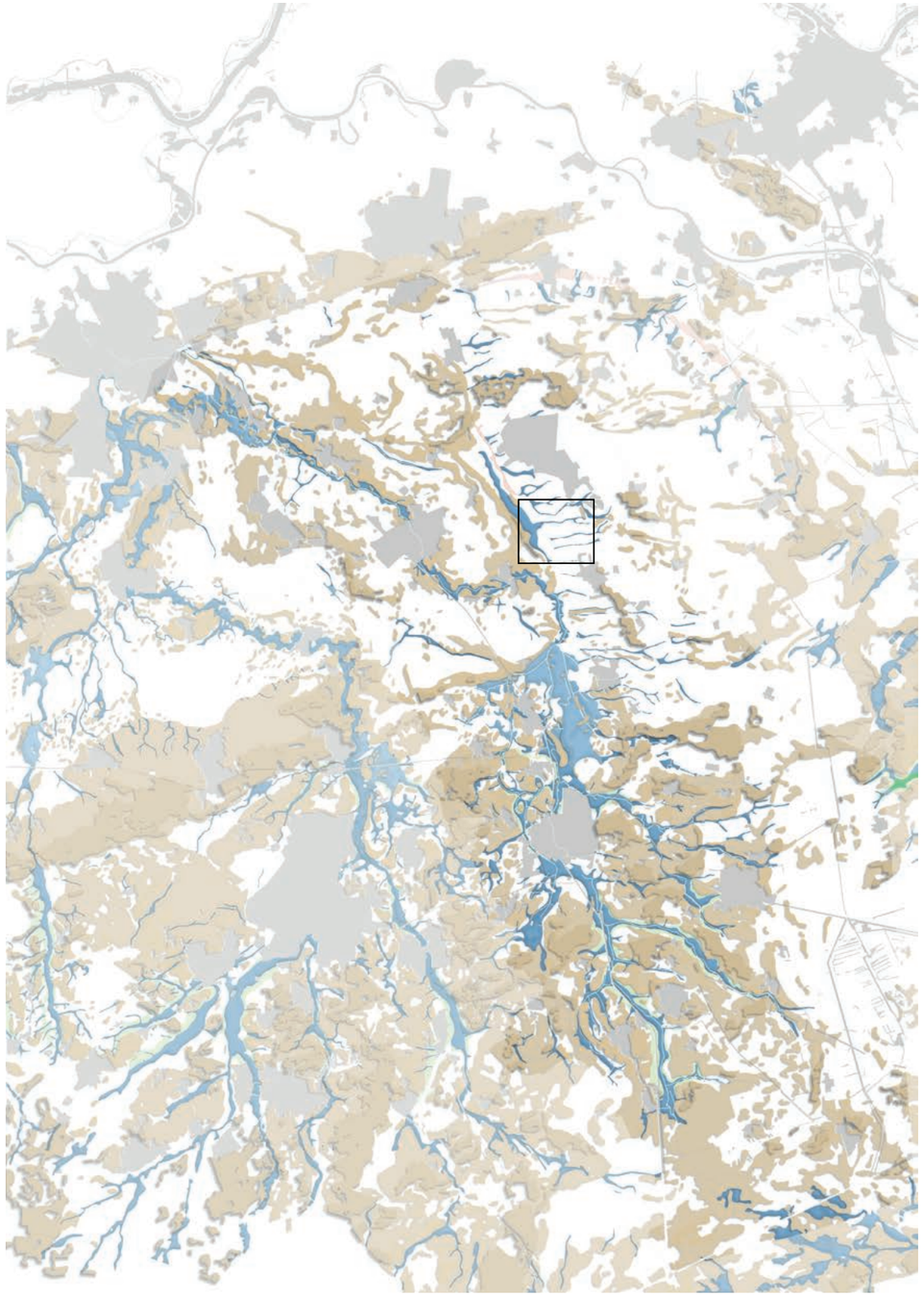


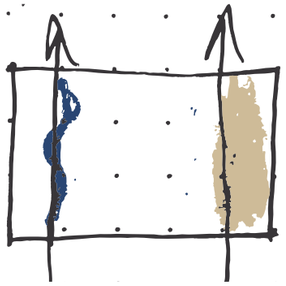
Introduced water finds its way



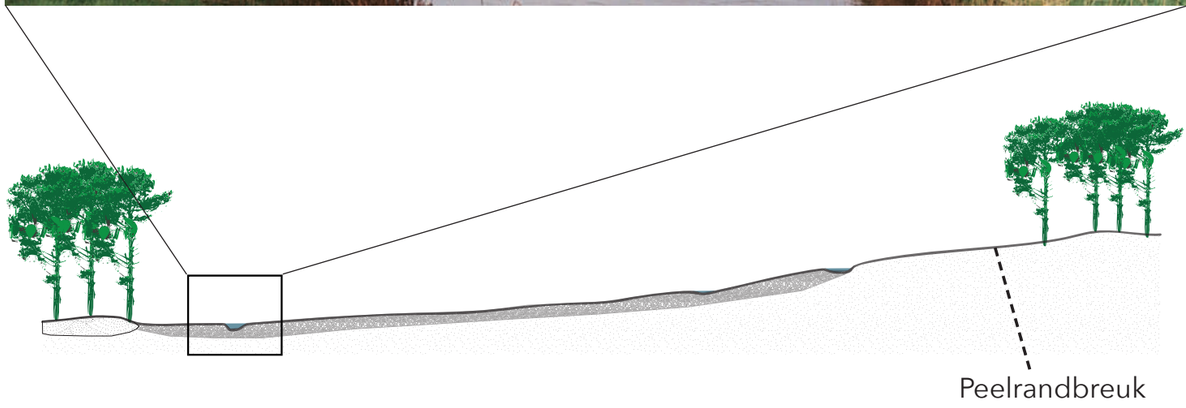
Natural stream is created

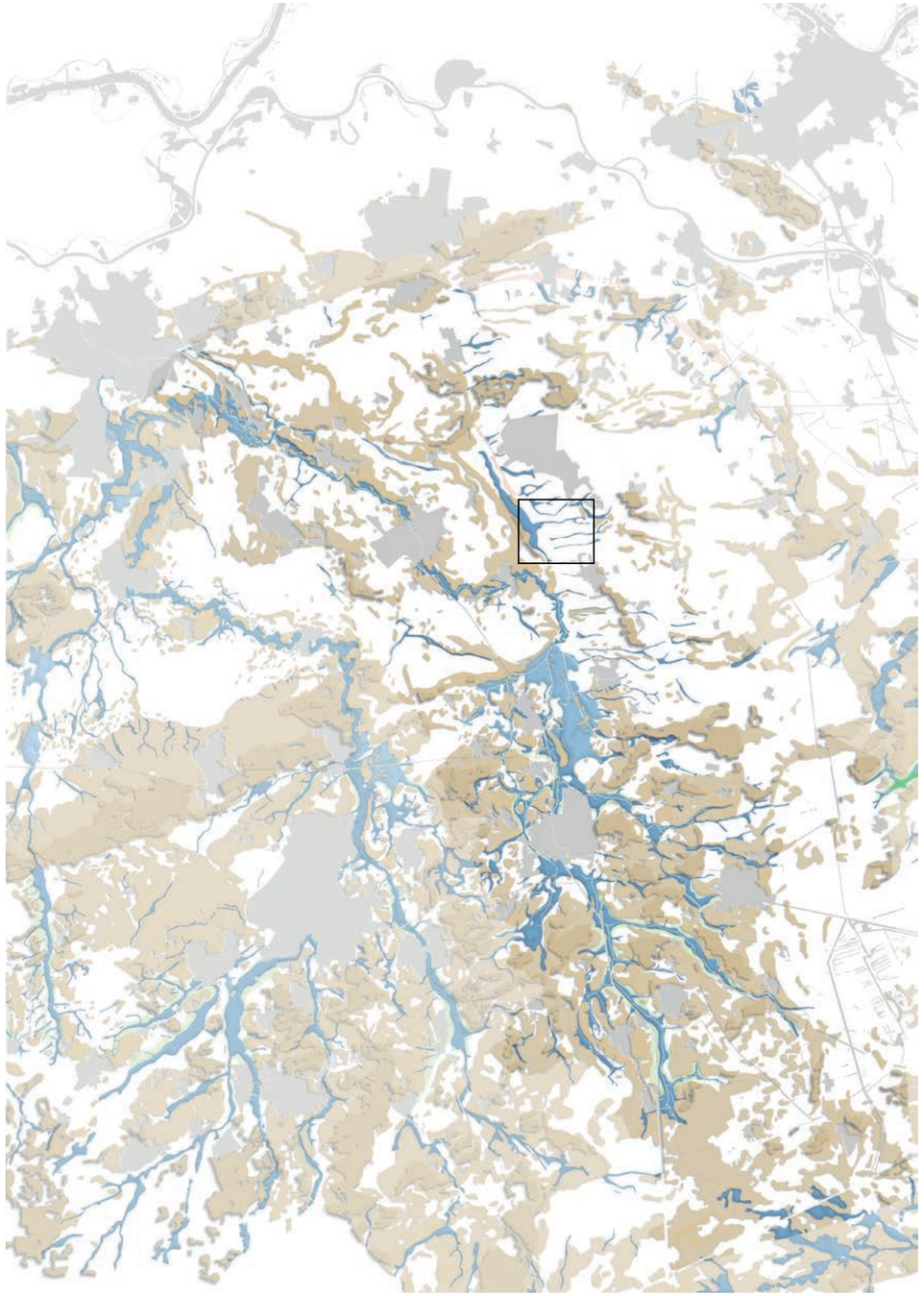
Parallel











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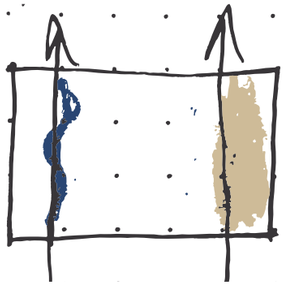
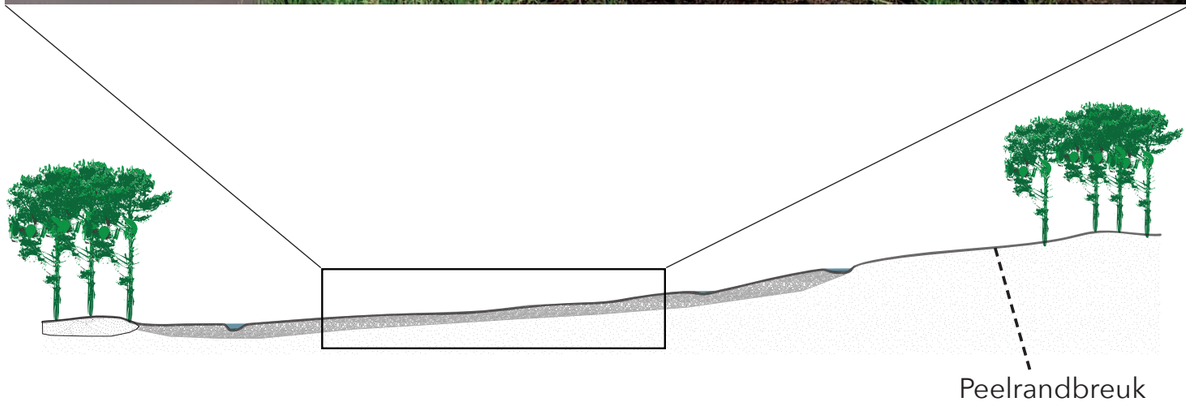
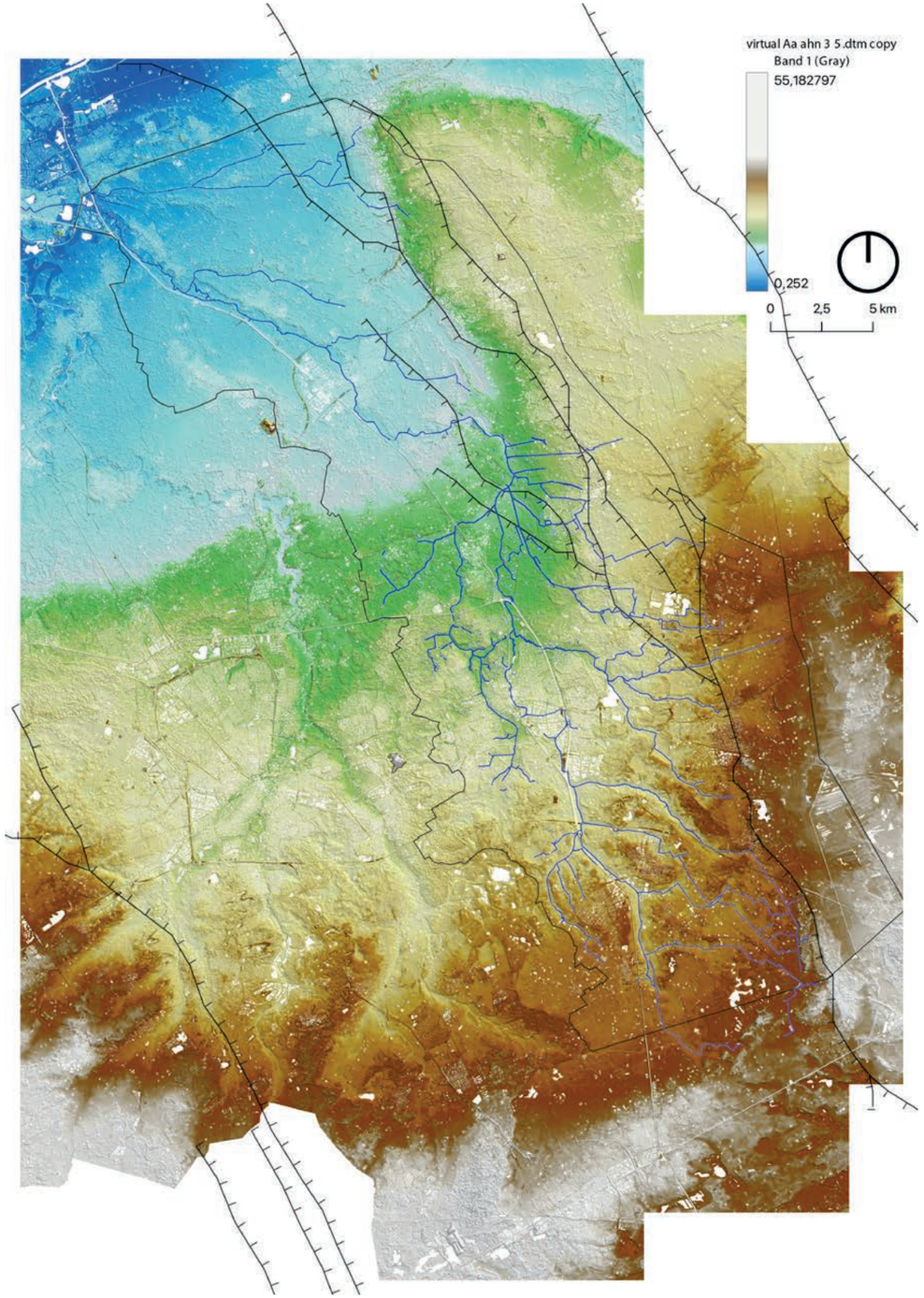
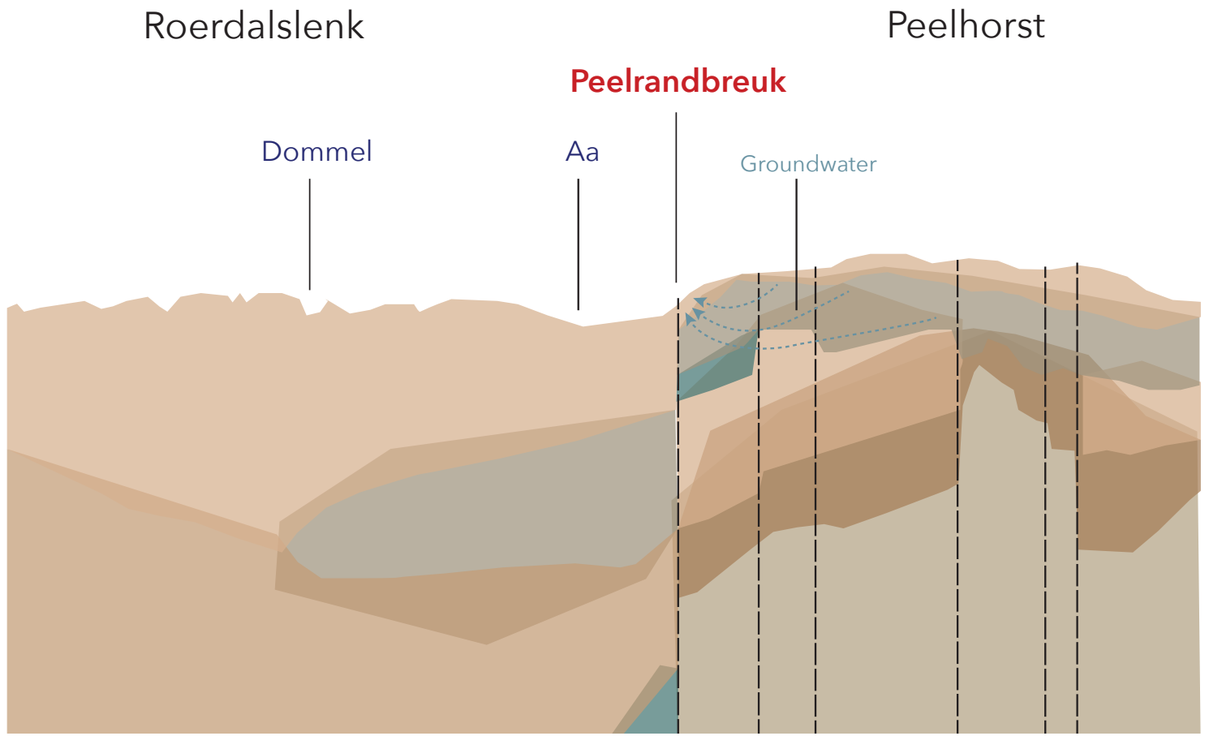
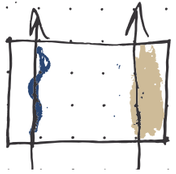






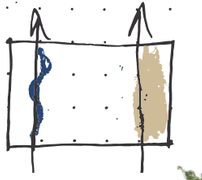

virtual Aa ahn 3 5.dtm copy
Band 1 (Gray)
55,182797
0,252
0
2,5
5 km


Roerdalslenk
Peelhorst
Peelrandbreuk
Dommel
Aa
Groundwater

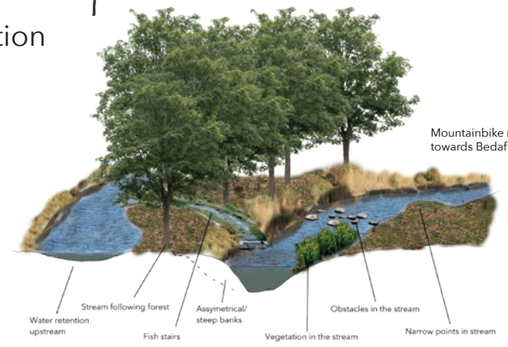


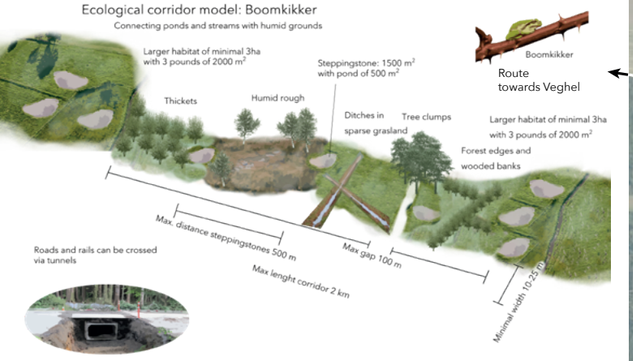

Peelrandbreuk
Ecological corridors
to nothing
Aa distrubitary
Leigraaf

Parallel



Retention





Boots





Zoom in concept map: Parallel

Nature

- Boomkikker habitat
- Wooded bank
  - Quercus petraea
  - Carpinus betulus
  - Prunus padus
- Tree lane
  - Fagus sylvatuca
- Tree lane
  - Salix alba
  - Alnus glutinosa

Water managment

- Leigraaf, tributary of the Aa
- Small streams from the Peelrandbreuk

Recreation

- Camping site
- Picknick site
- Road
- Bike path
- Path

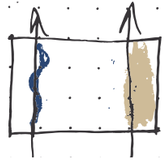


Peelrandbreuk



Wet landscape, water retention







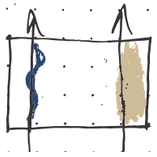
Current situation



After:

Ecological corridors connecting Aa with Peelranbreuk

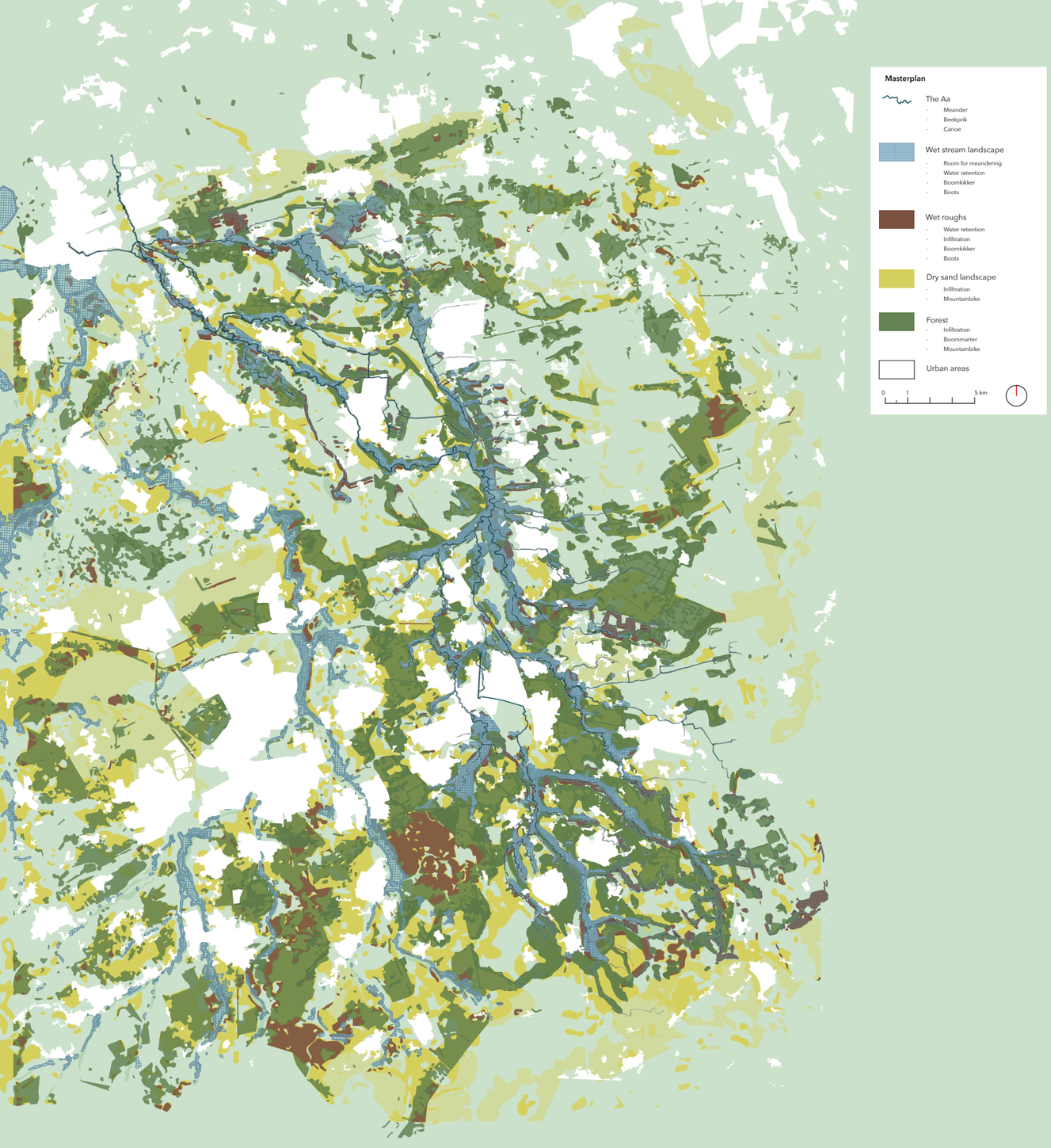


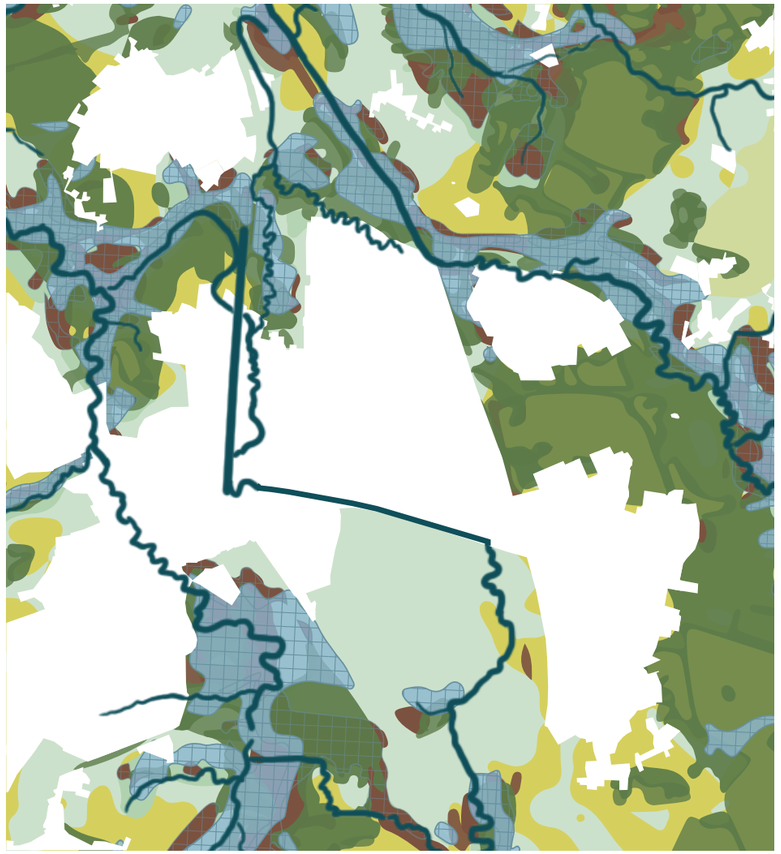


Parallel

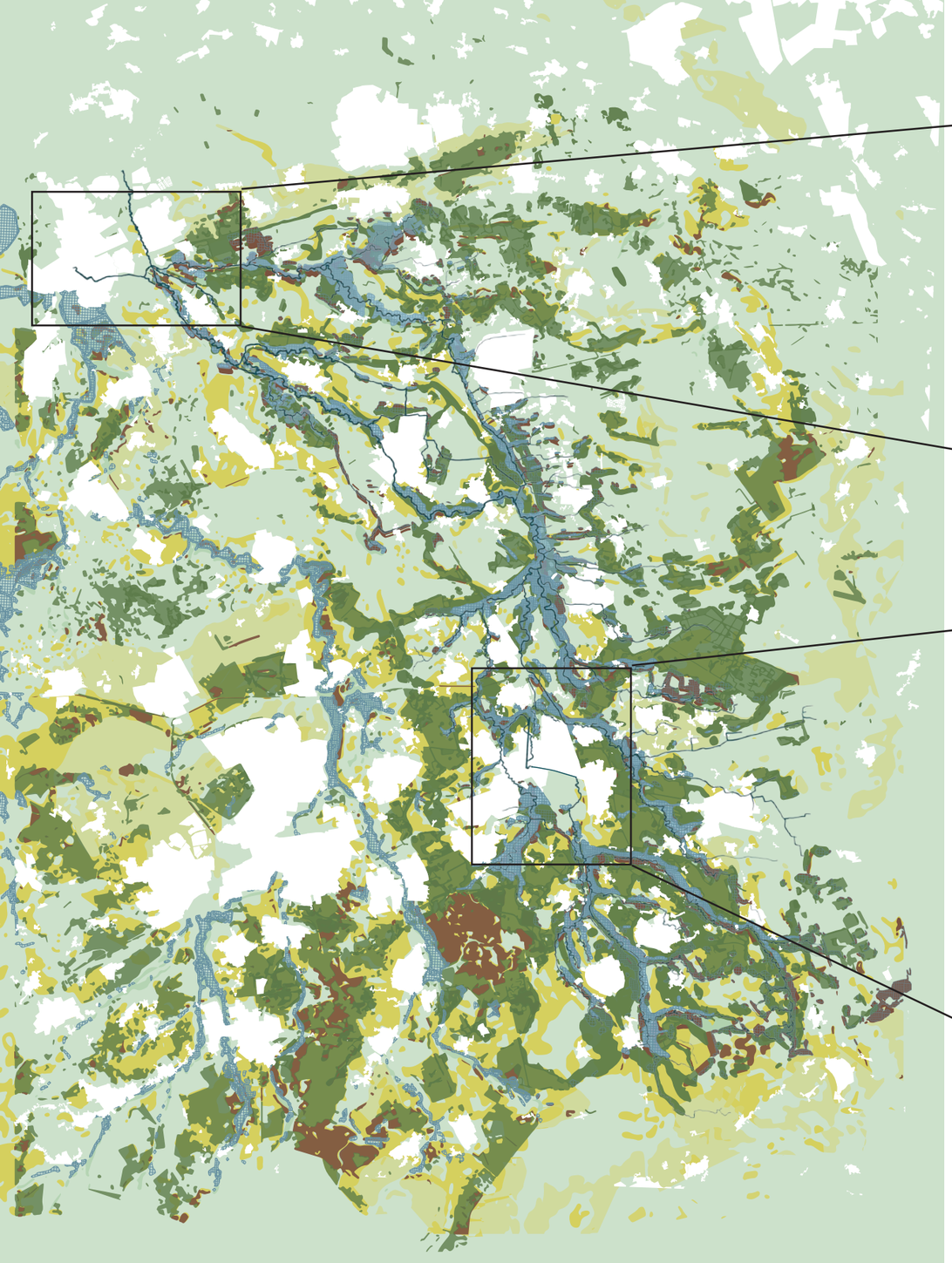


Urban areas


Masterplan
The Aa
- Meander
- Beekprik
- Canoe
Wet stream landscape
- Room for meandering
- Water retention
- Boomkikker
- Boots
Wet roughs
- Water retention
- Infiltration
- Boomkikker
- Boots
Dry sand landscape
- Infiltration
- Mountainbike
Forest
- Infiltration
- Boommarter
- Mountainbike
Urban areas
0
1
5 km



Urban areas



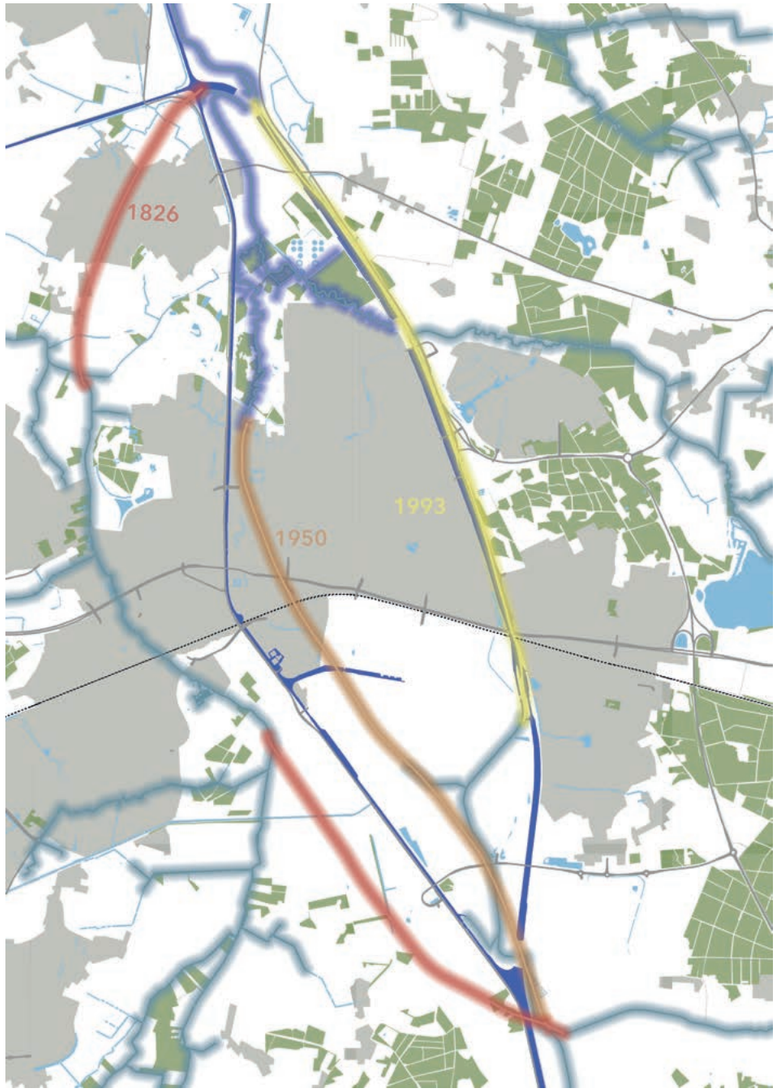
's-Hertogenbosch

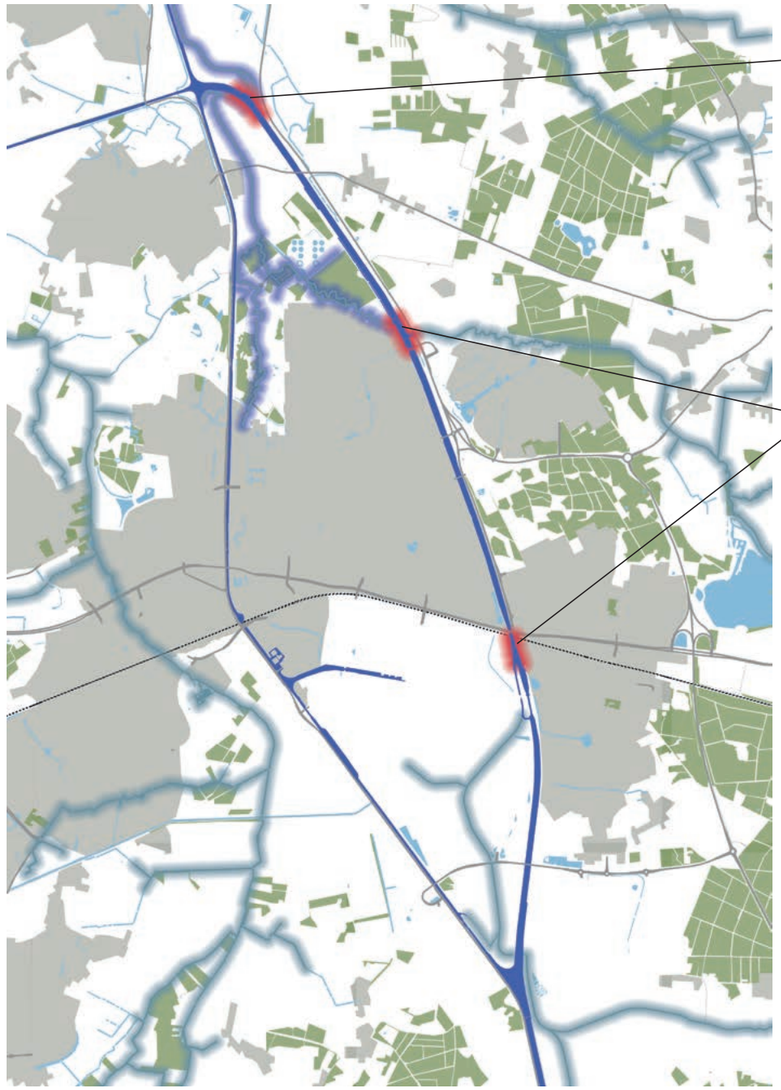


Helmond



Helmond



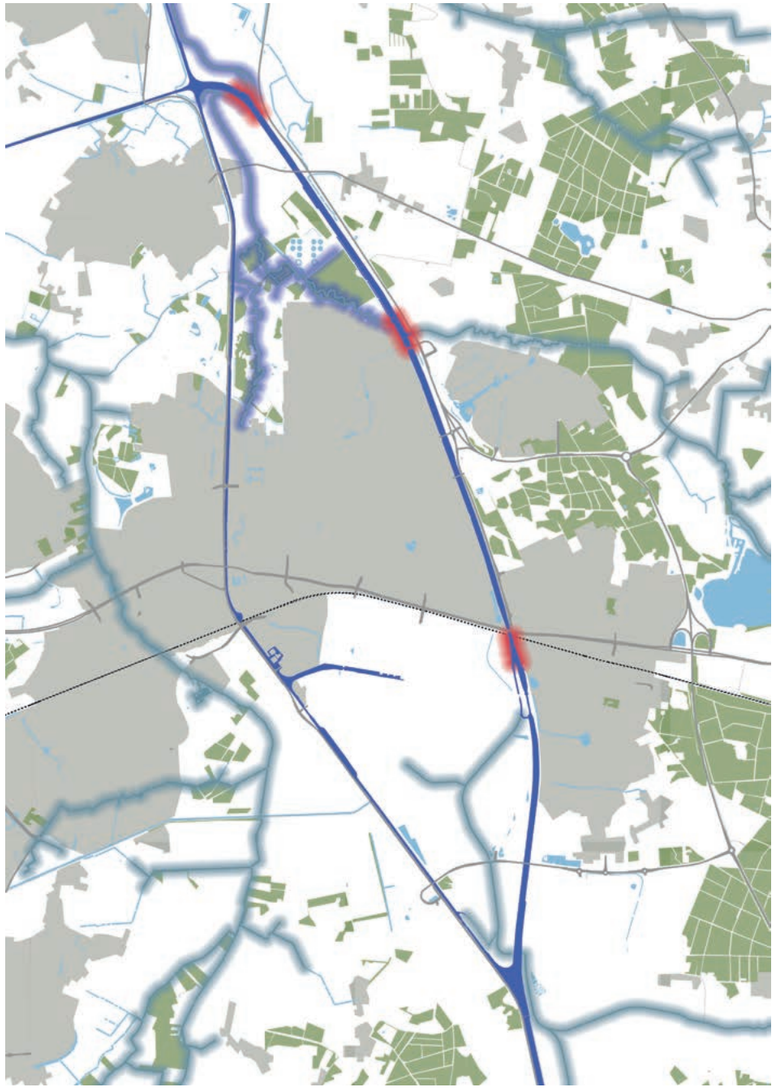


Water out of shipping channel into Aa

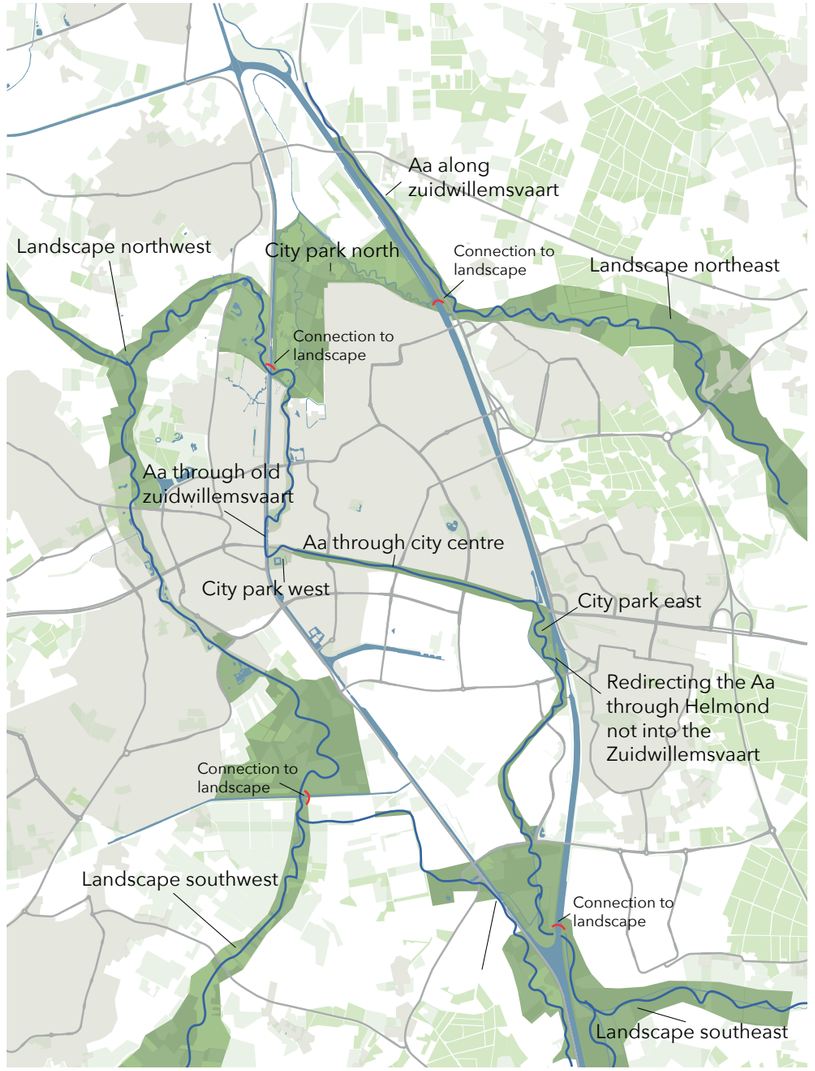
Loss of Aa water into shipping channel

Helmond

Current situation

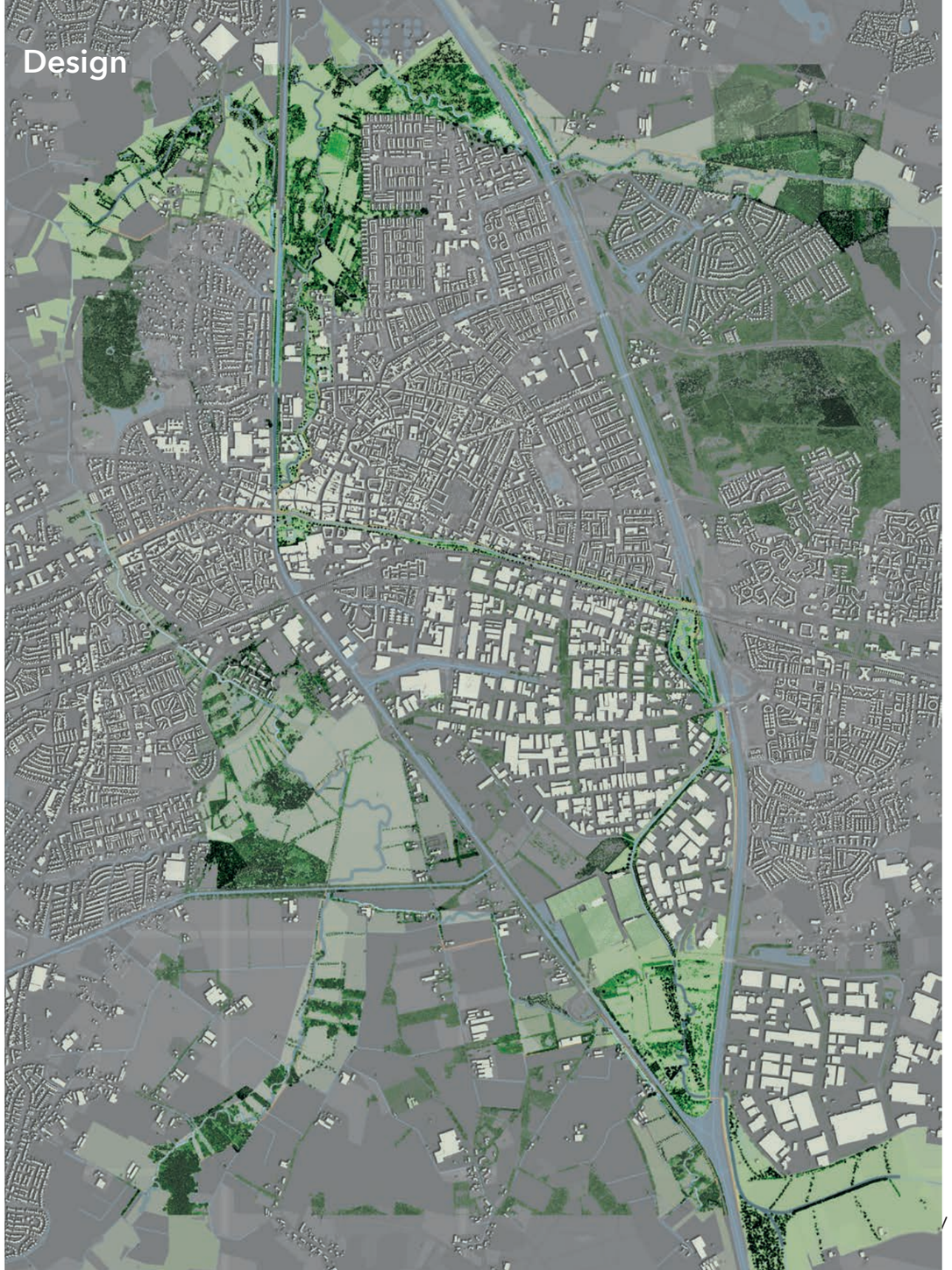


Concept



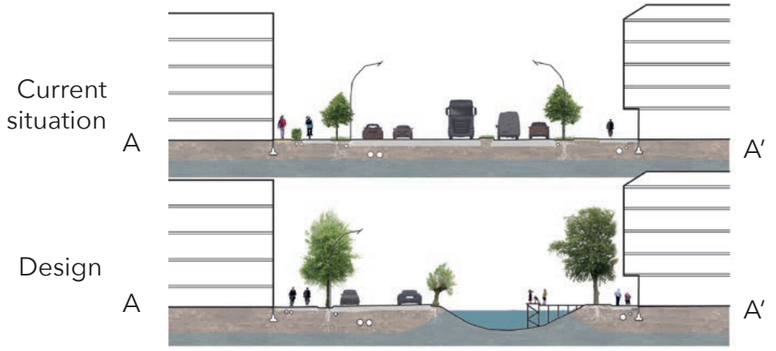
Helmond

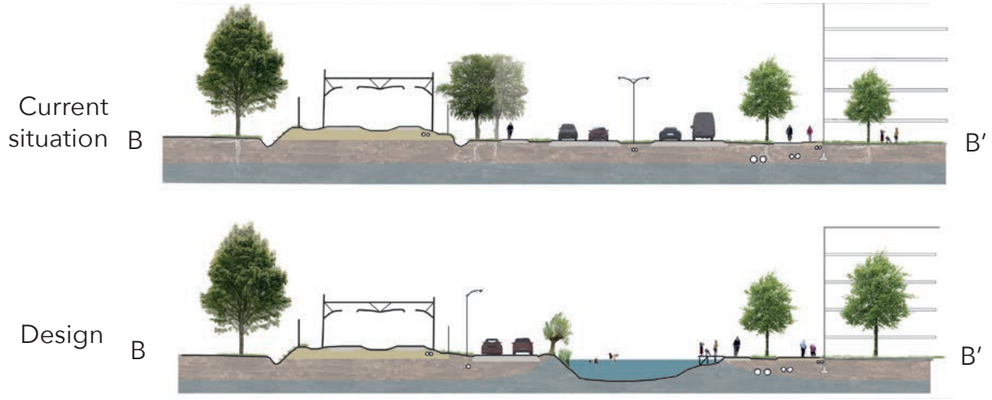


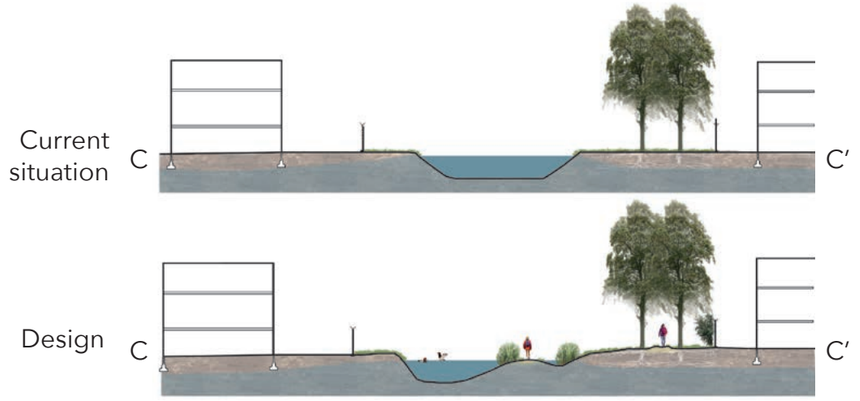


Helmond


A
A'
B
B'
C
C'


Current situation
A
A'
Design
A
A'

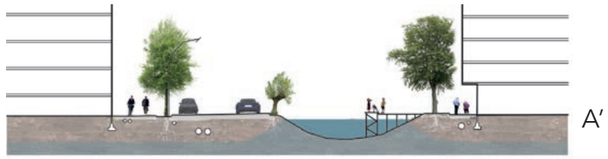

Current situation
B
B'
Design
B
B'


Current situation
C
C'
Design
C
C'

Current situation



Design



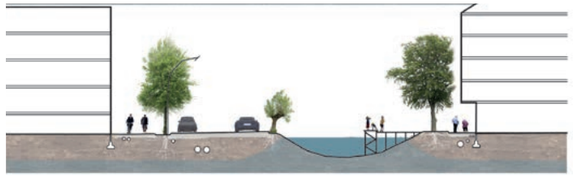


Current situation



A A′

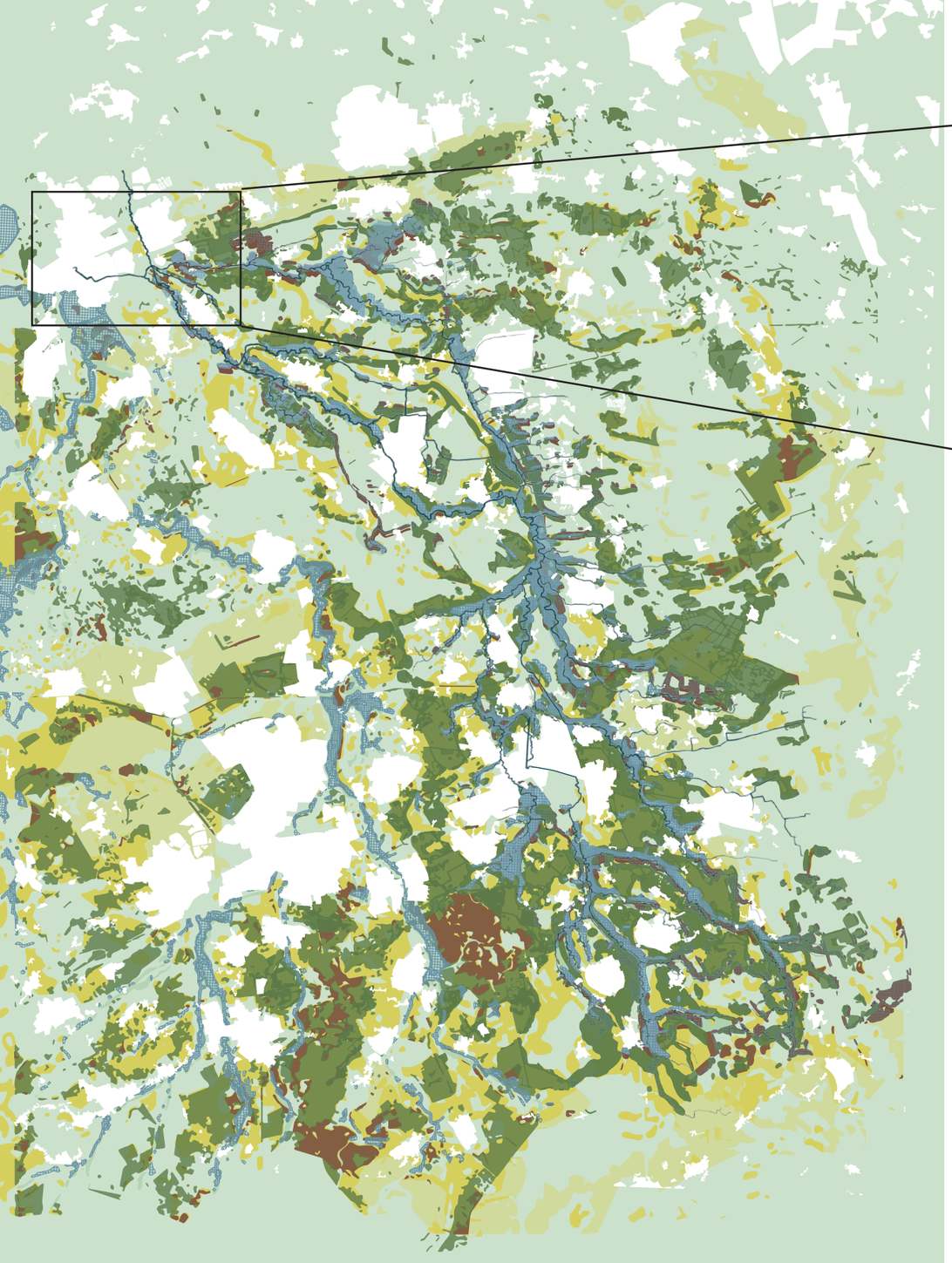
Design



A A′



‘s Hertogenbosch



‘s-Hertogenbosch



‘s Hertogenbosch

Current situation



Dommel at the city centre

Highways



Business parks



Industerialised livestock farming



‘s Hertogenbosch

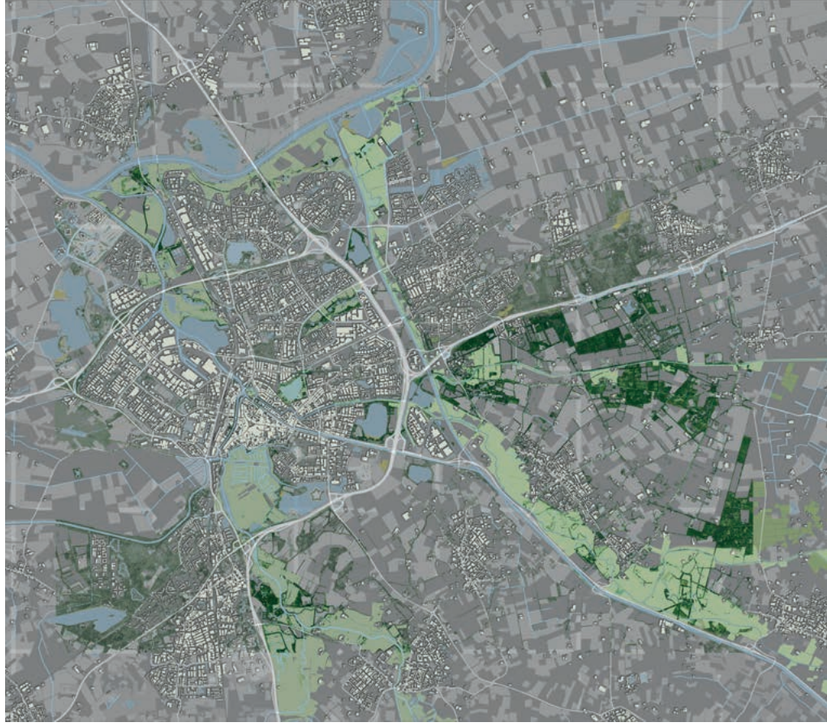
Current situation



Concept



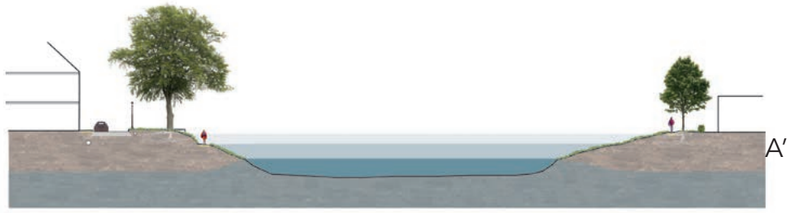
Design



Current situation

Current situation

A



A′

Design

A

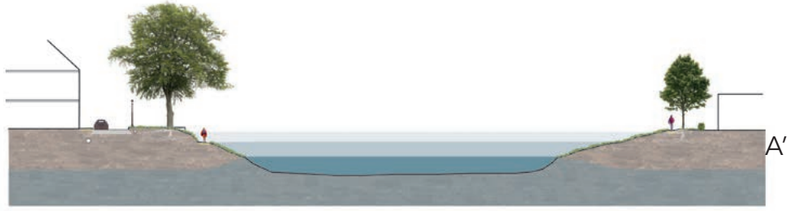


A′



Current situation

A



A'

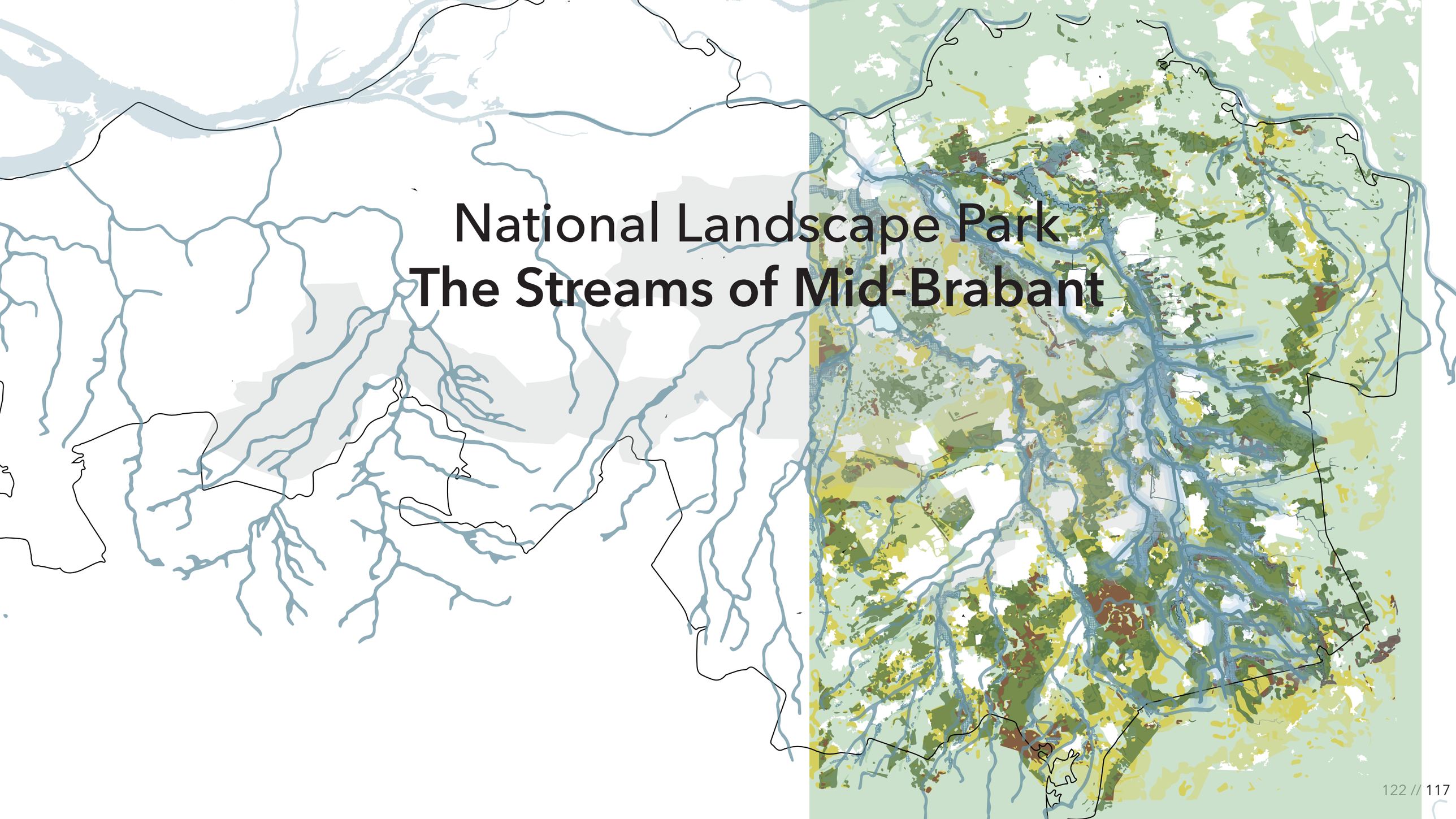
Design

A



A'





National Landscape Park
The Streams of Mid-Brabant



Overflown banks at the Dommel near Eindhoven
Image by author

Overview

Design elements:

	Stream landscape	Wet landscape	Higher landscape
Hydrology	Meanders	Retention	Infiltration
Nature	Ecological corridor model: Beekprik	Ecological corridor model: Boomkikker	Ecological corridor model: Boommarter
Recreation	Canoe	Boots	Mountainbike

