

Re-Peating Nature

Ruralities in Transition

2022-2023 Anna Gorokhova 5517915

P5 PRESENTATION



Fascination
Friesland Pastures, 2022.
Photo: Xinjian Jiang.



Friesland Pastures, 2022.
Photo: Xinjian Jiang.



Friesland Pastures, 2022.
Photo: Xinjian Jiang.



Friesland Pastures, 2022.
Photo: Xinjian Jiang.



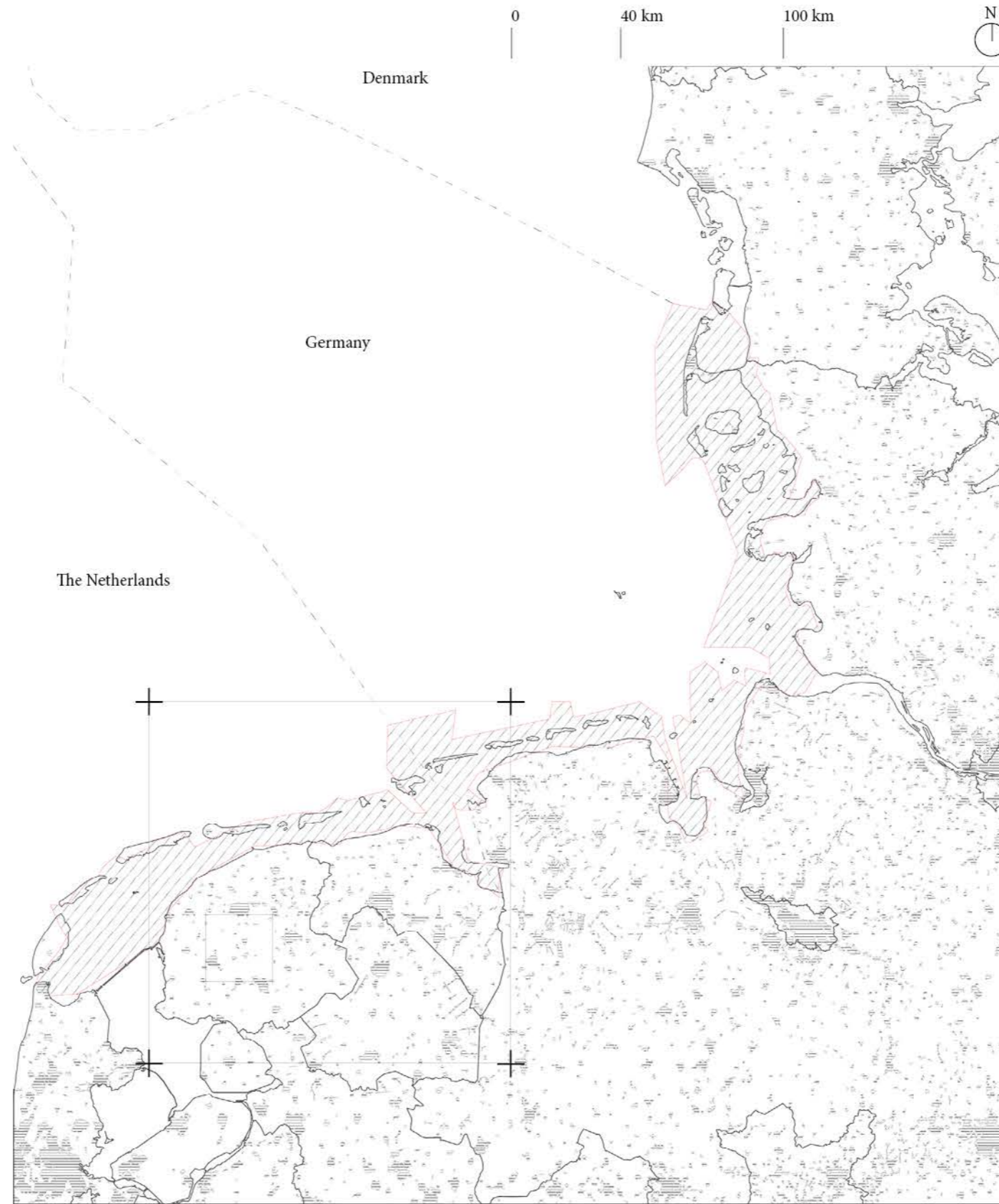
Friesland Pastures, 2022.
Photo: Xinjian Jiang.



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Friesland Pastures, 2022.
Photo: Xinjian Jiang.

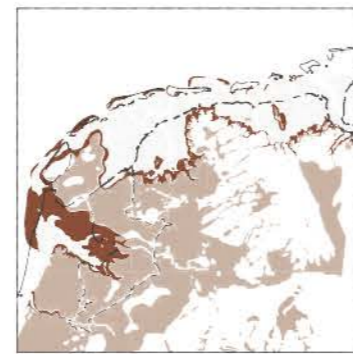


National Border
 Municipality Border
 Trilateral Agreement
 Urban Area

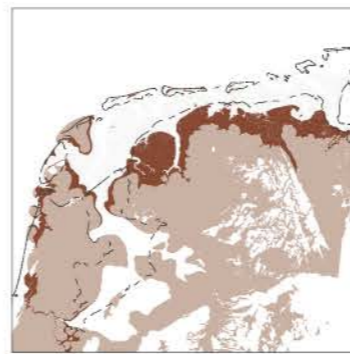


Wadden Sea Unesco Heritage
 Data: www.pdok.nl, www.openstreetmap.org, 2022.

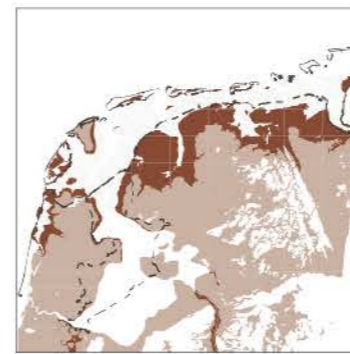
Timeline



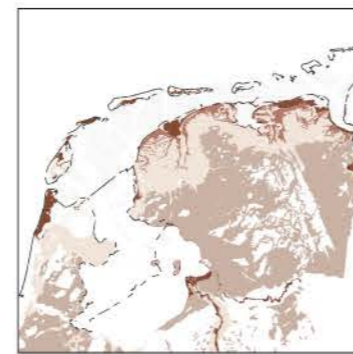
3500 BC



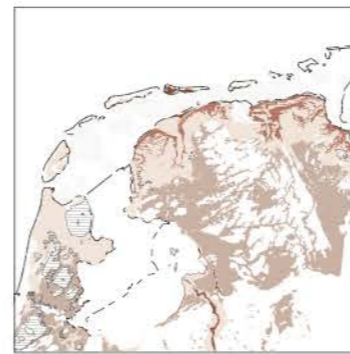
100 AD



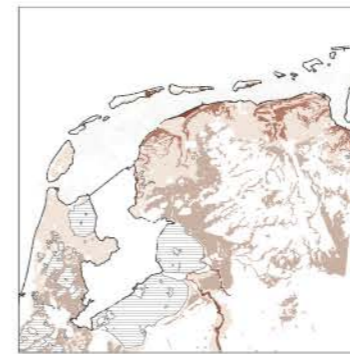
800 AD



1500



1850

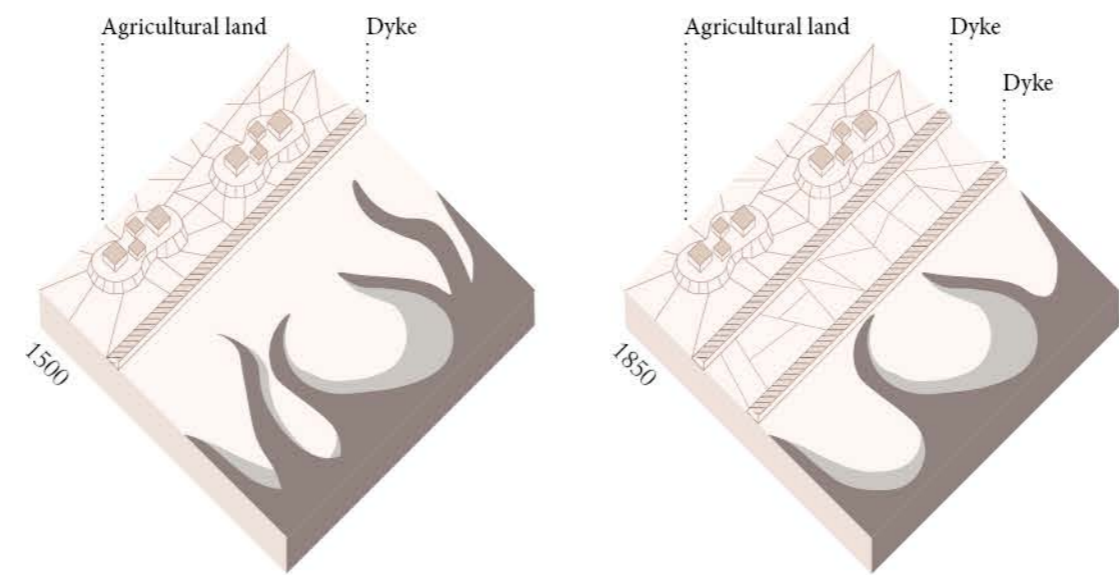
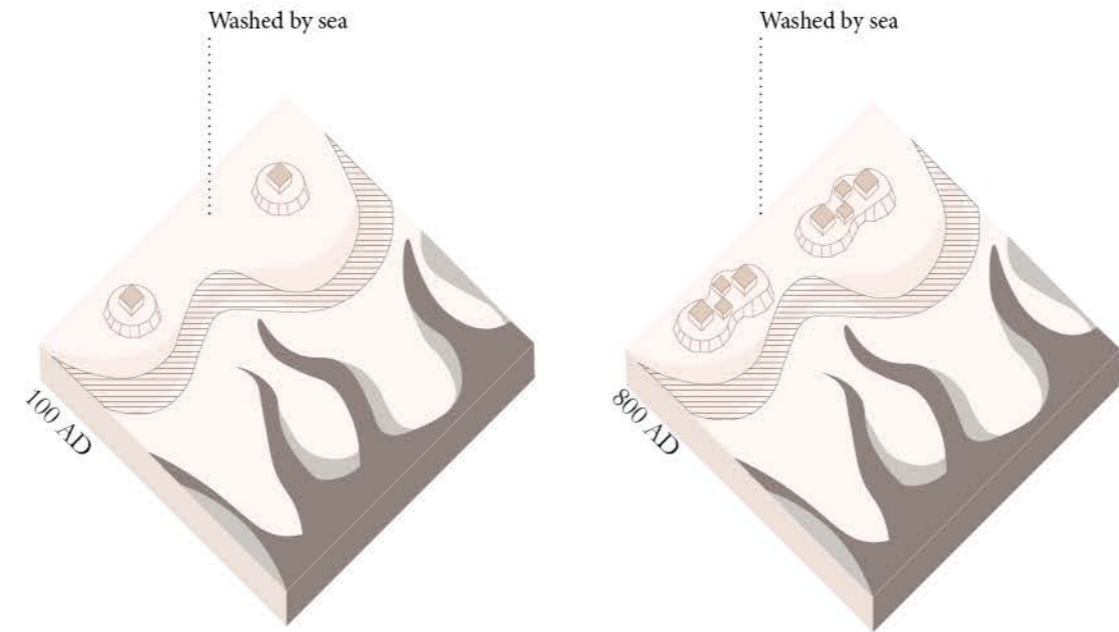


2000

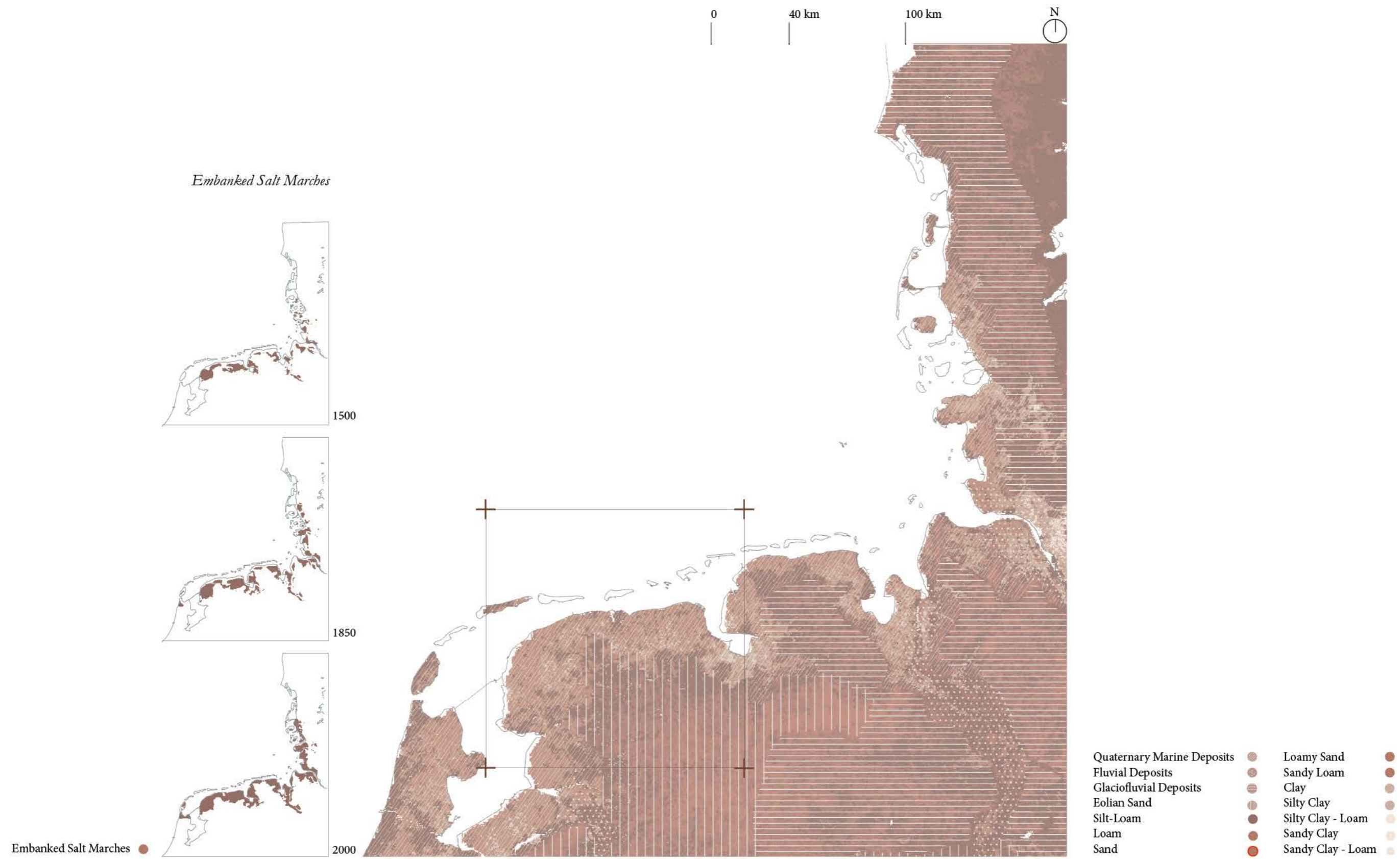
- Peat ●
- Inland Salt Marsh ●
- Salt Marsh ●
- Embanked Land ●
- Tidal Deposits ●
- Reclaimed Land ●
- Coastal Line ●
- Pioneer Settlements ●

Geomorphological Development

Data: www.fryske-academy.nl, 2022.

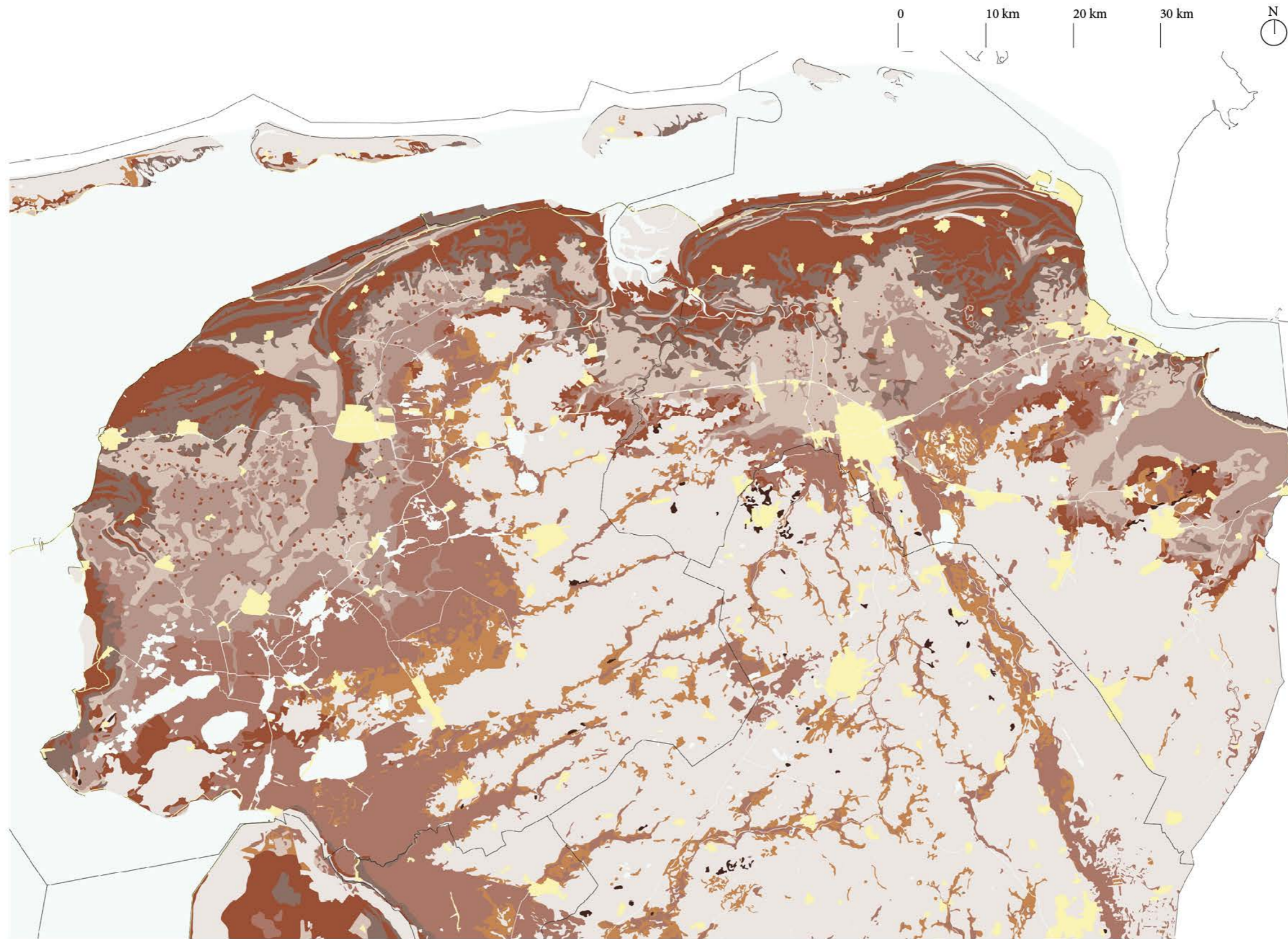


Historical Agricultural Land Expansion and Loss of Dynamic Landscape
Data: www.fryske-academy.nl, 2022.



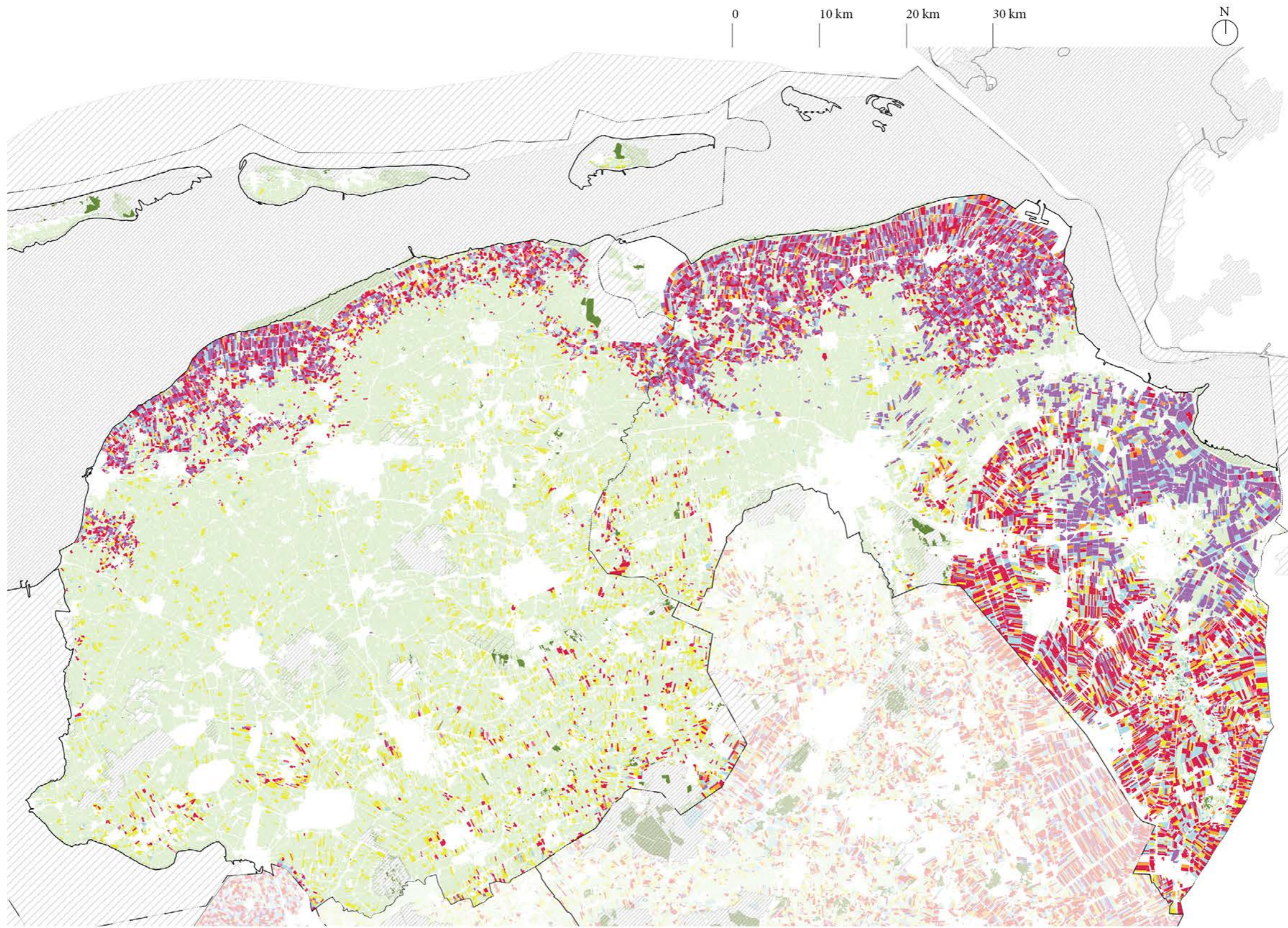
Soil Types and Soil Regions

Data: www.pdok.nl, www.openstreetmap.org, www.eea.europa.eu, 2022.

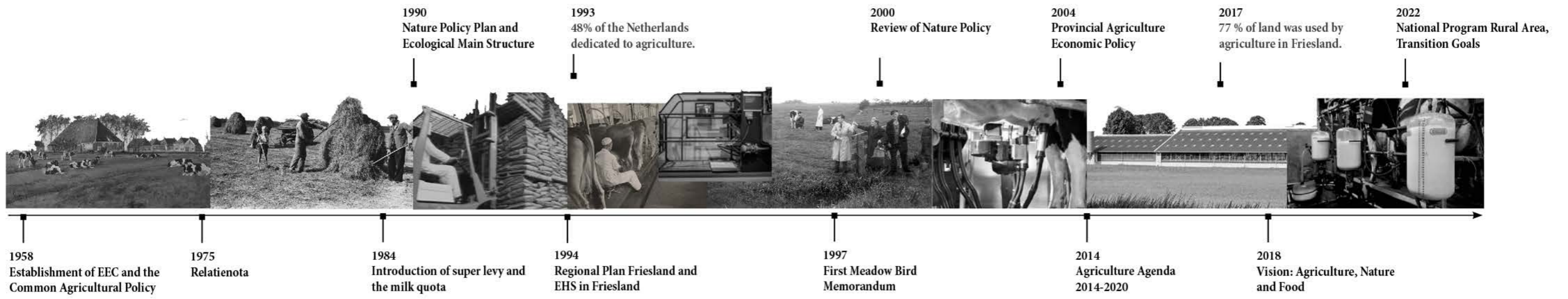


Soil Structure

Data: www.wur.nl, www.pdok.nl, www.openstreetmap.org, 2022.



Agricultural Land Use
 Data: www.cbs.nl, 2022.



Recent Timeline

Data: www.fryske-academy.nl 2022, Agri&Foodscan Fryslân, 2018.

“In 2017, 77% of Friesland was dedicated to agriculture.”

www.statistica.com

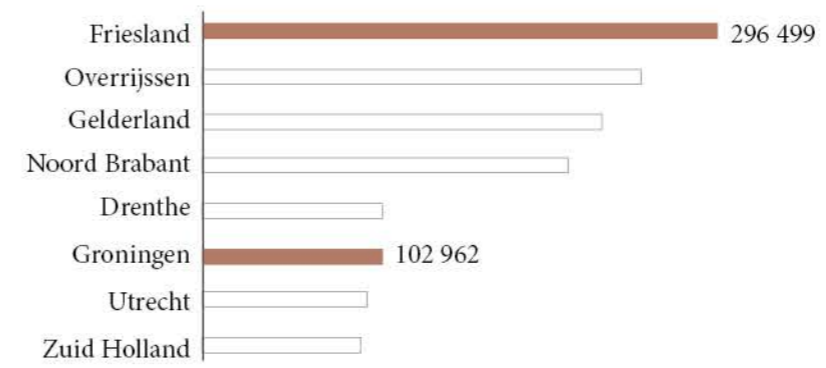


Agricultural Land Use

Data: www.cbs.nl, 2022.

“In 2021, Friesland was the province with the largest number of dairy cows in the Netherlands.”

www.statistica.com

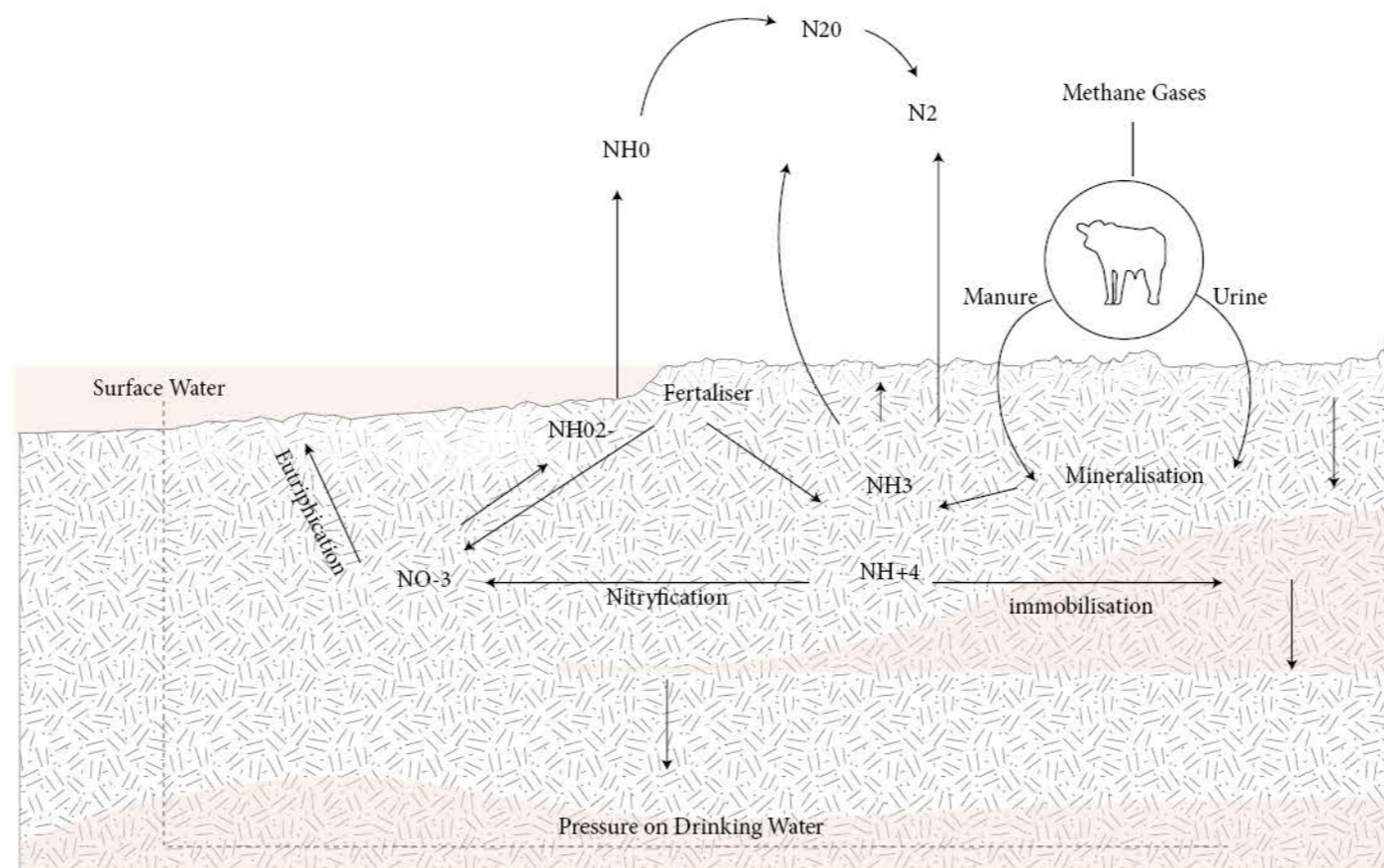


Agriculture vs Nature



Agriculture vs Nature

Data: www.pdok.nl, www.openstreetmap.org, 2022.



Ammonium and Nitrogen

Data: www.sciencedirect.com

Population Trends



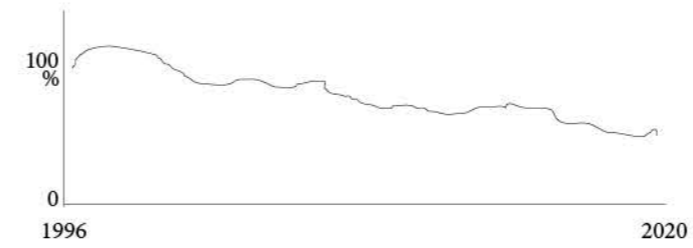
Grutto



Grutto average annual decline 3.7%



Kevit



Kevit average annual decline 2.8%



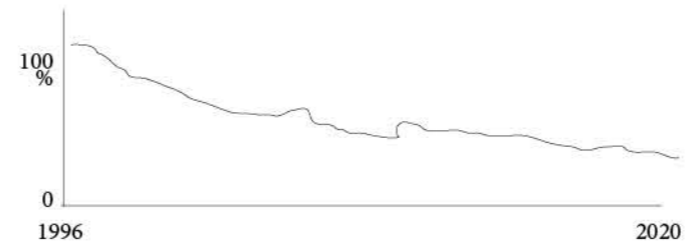
Tereluur



Tereluur average annual decline 1.4%



Scholekster



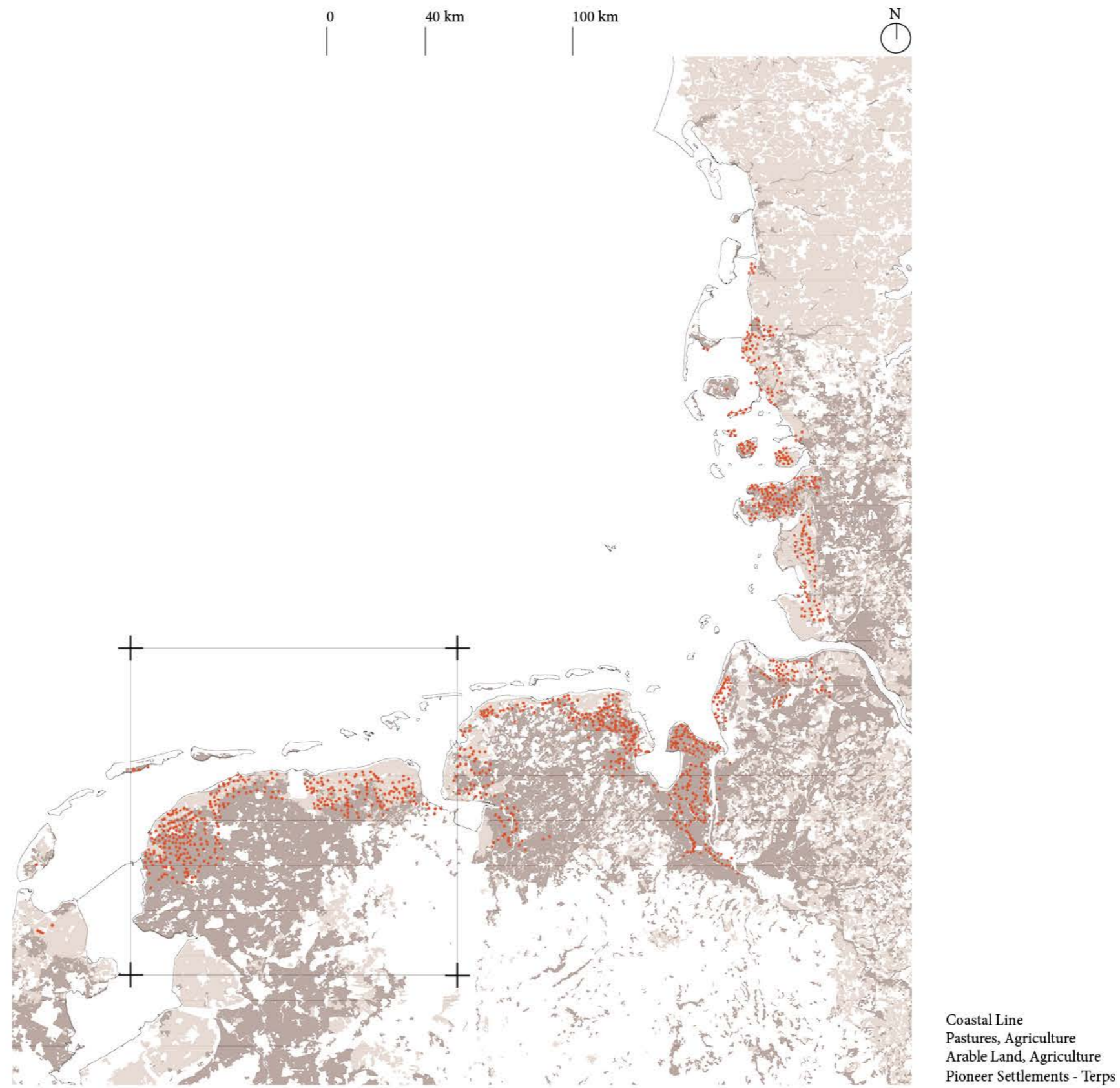
Scholekster average annual decline 4.0%

Common Meadow Bird Population Trends

Data: www.fryske-academy.nl, 2022.

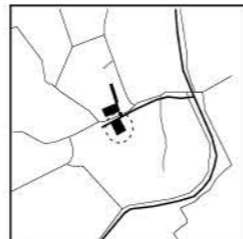
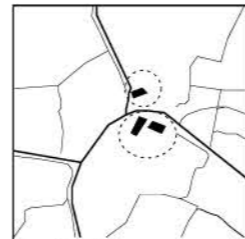
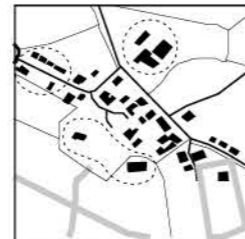
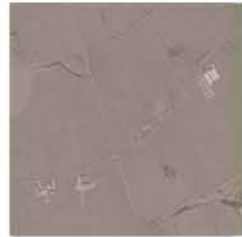


Agriculture vs Culture



Agriculture vs Cultural Heritage
 Data: www.pdok.nl, www.openstreetmap.org, 2022.

Terpscape



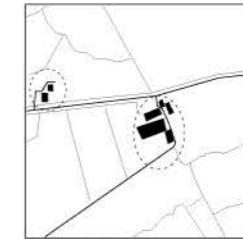
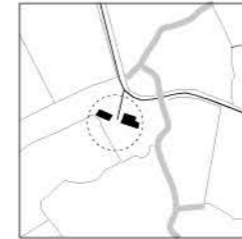
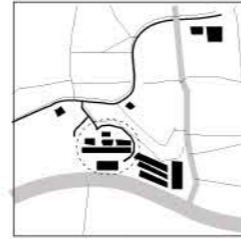
Terpichelago

Multi Isle

Double Isle

Isle

Water



Major Canal

Secondary Canal

Minor Waterway

Infrastructure



Wind Mill



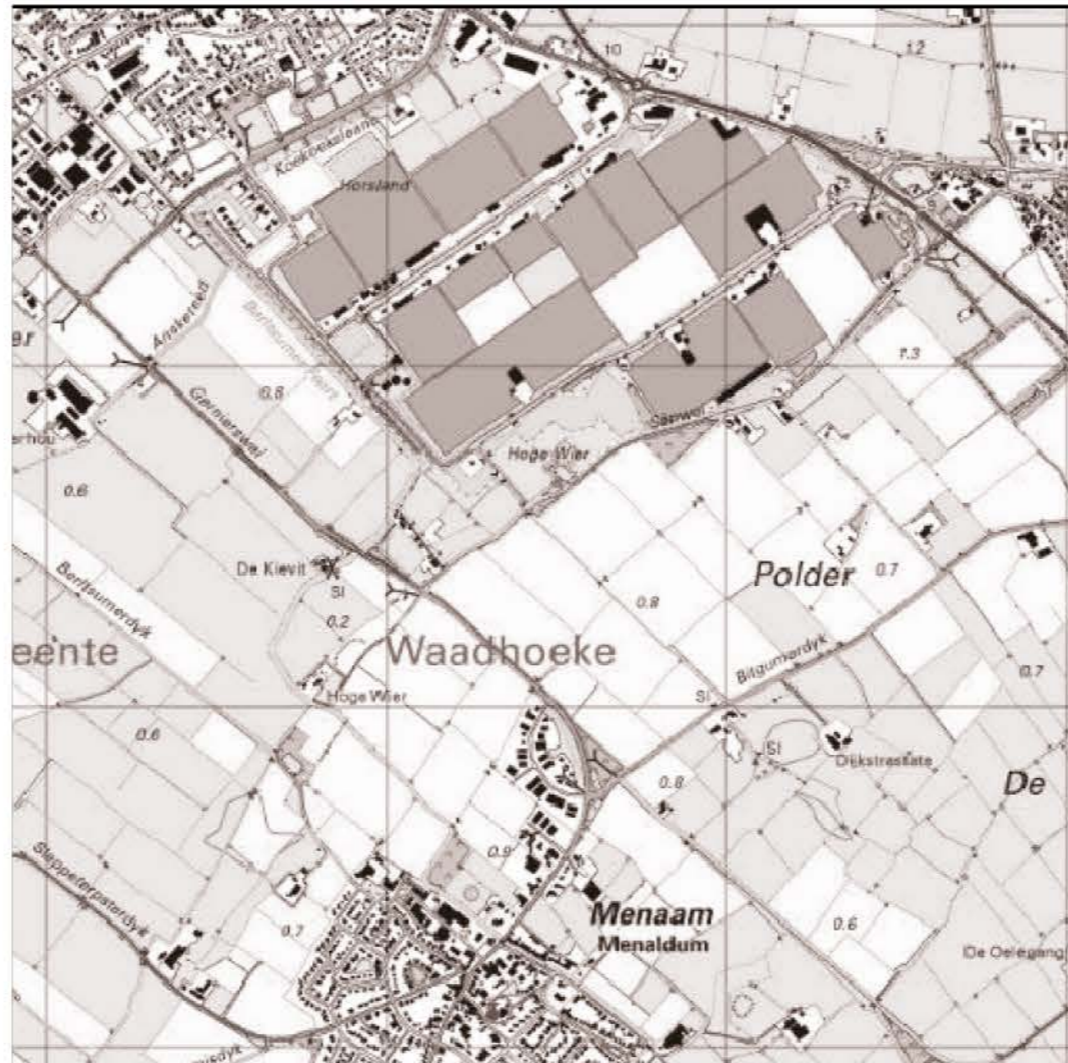
Old Sea Dike

Agricultural Cultural Heritage



Agricultural Allotment 1902

Photo: topotijdreis.nl



Agricultural Allotment 2020
Photo: topotijdreis.nl



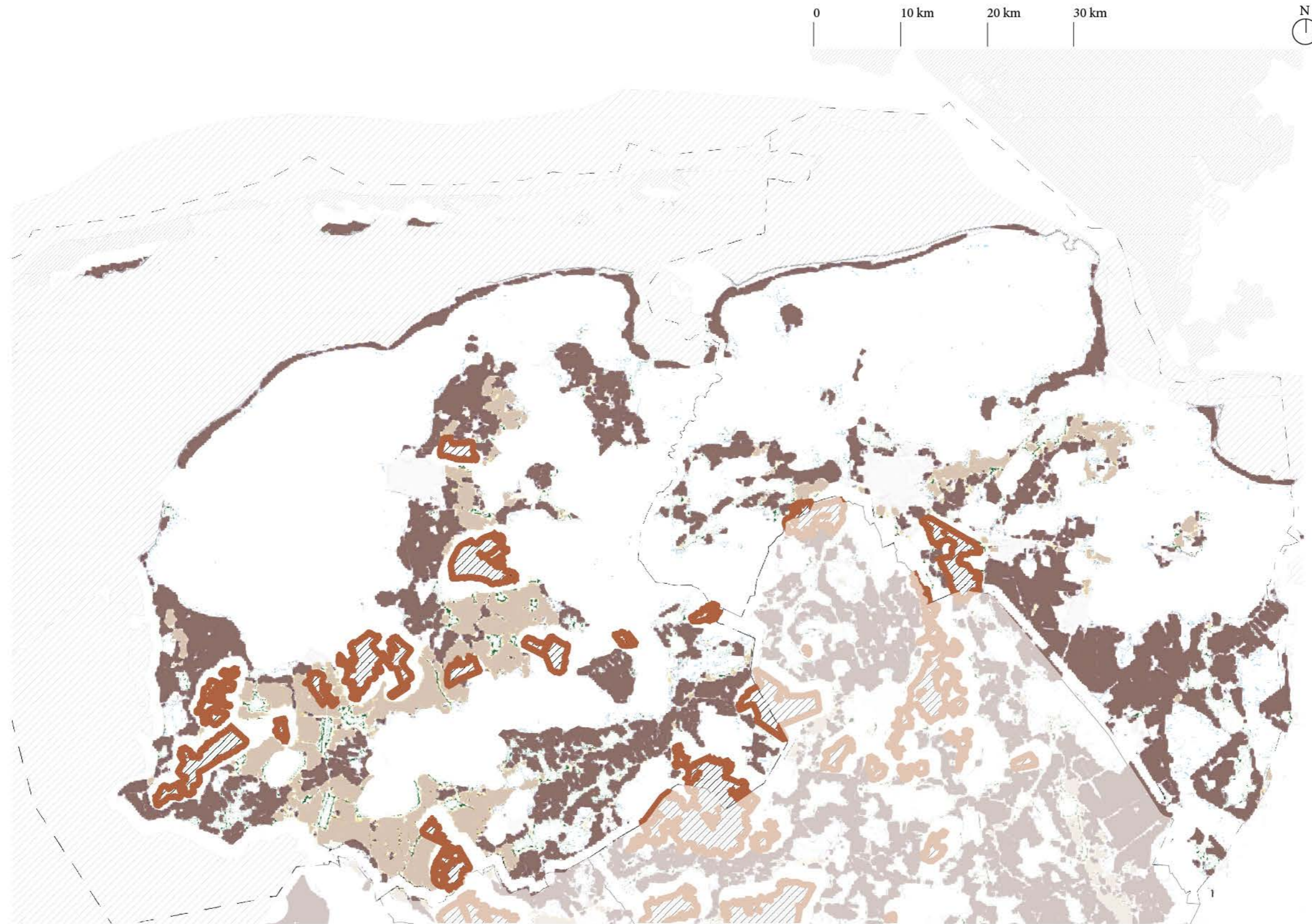
*Agriculture vs
Climate Change*

Richtinggevende emissiereductiedoelstellingen per gebied



National Government Emission Goals

Data: www.rijksoverheid.nl 2022



Transition 47% ●
 Peat Transition 47% ●
 Buffer Zone Natura 2000 ●
 Natura 2000 ●

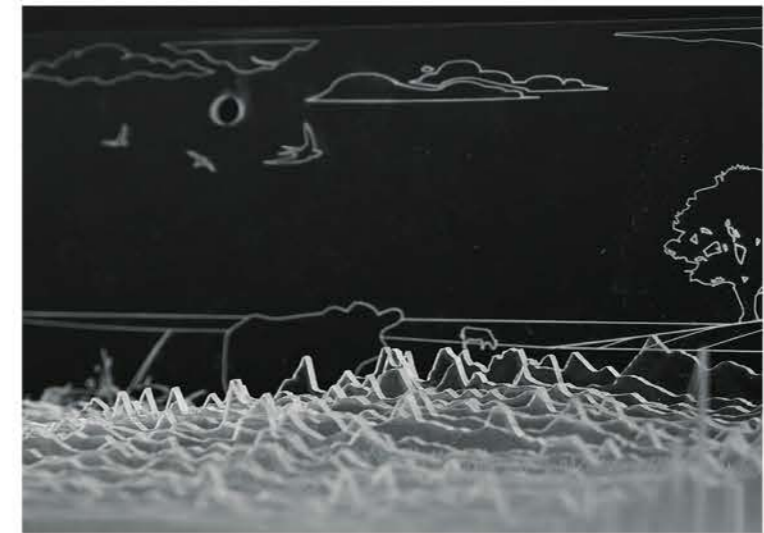
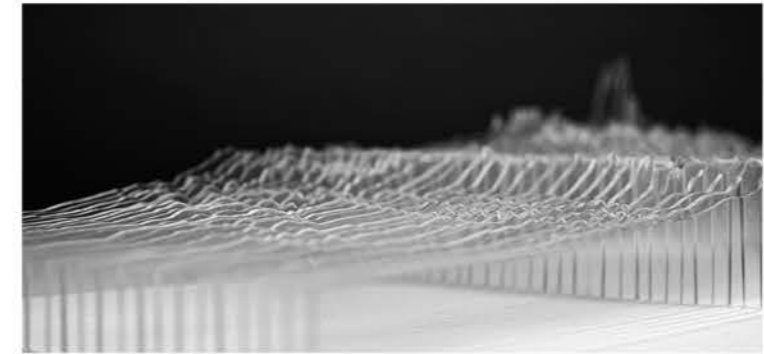
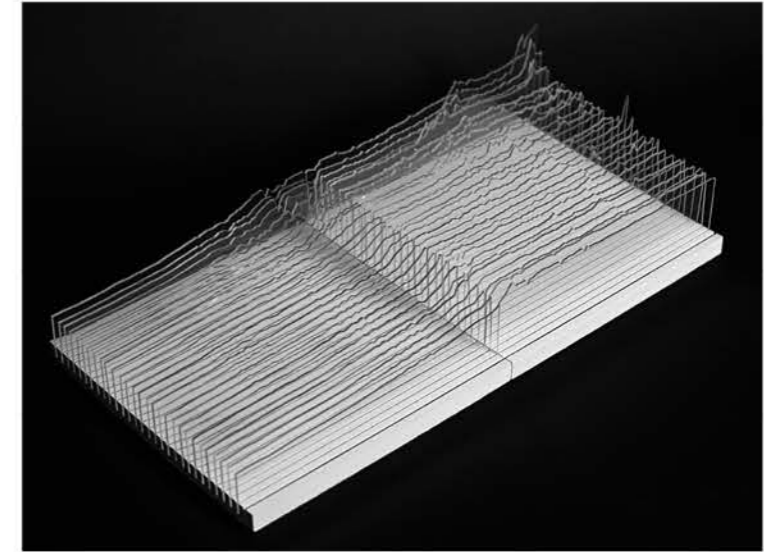
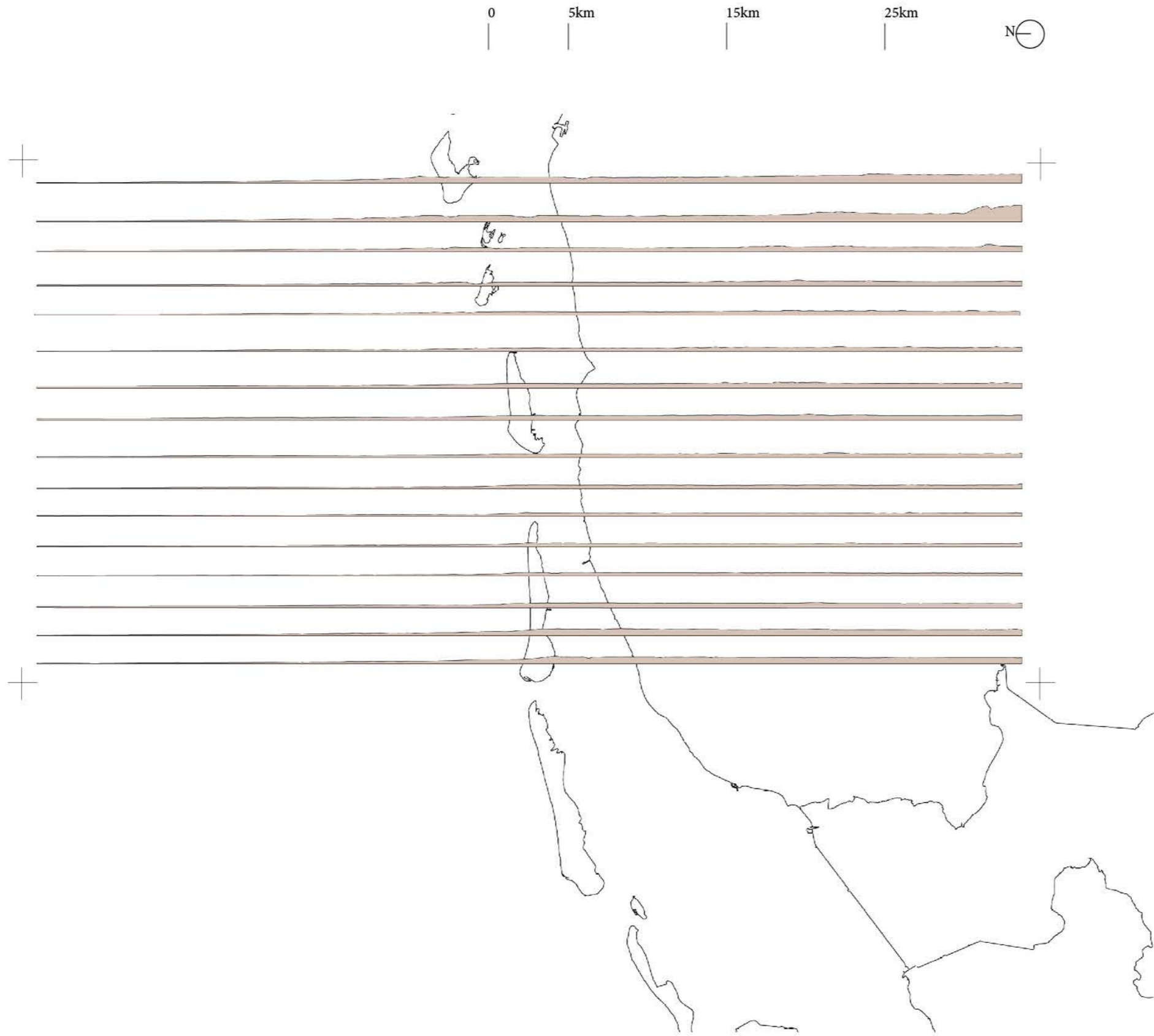
Government Transition Goals
 Data: <https://www.rijksoverheid.nl>, 2022



“Farmer Citizen Movement (BBB) was established and won many provincial electives as of March 2023”

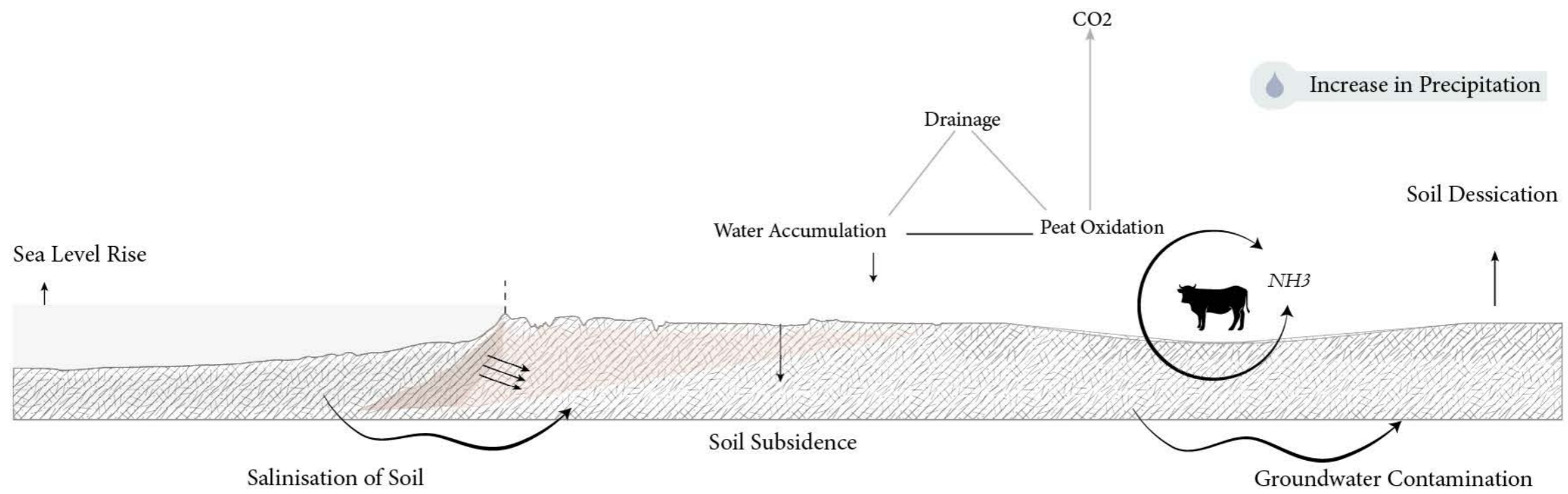
(Camut, 2023)

Farmers Protest in Drenthe, 2019.
Photo: Jurre van den Berg



Hidden Elevations

Data: www.pdok.nl, www.openstreetmap.org, 2022.

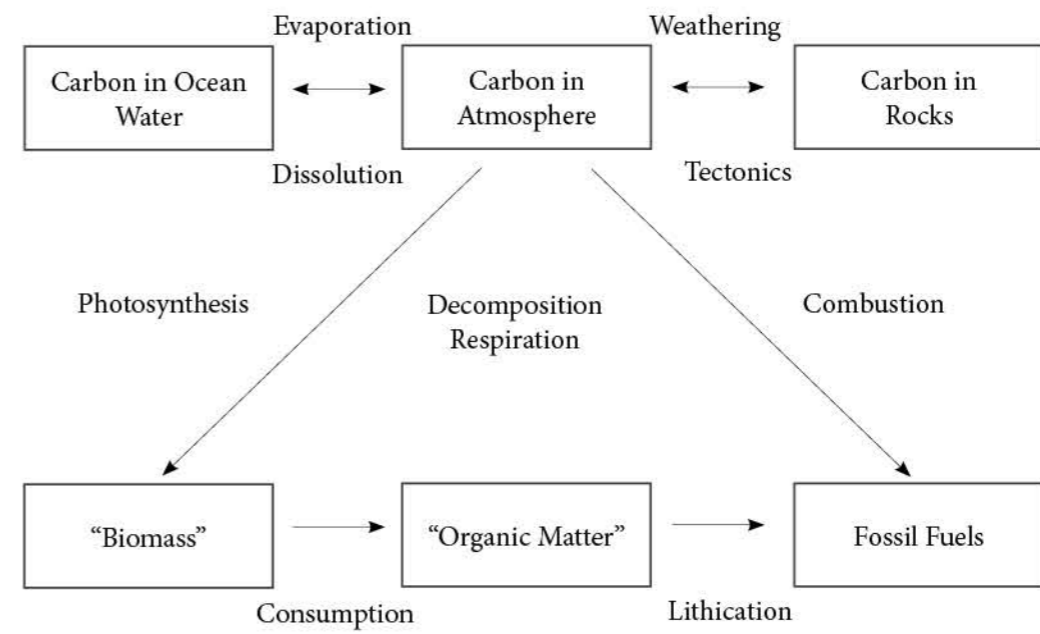
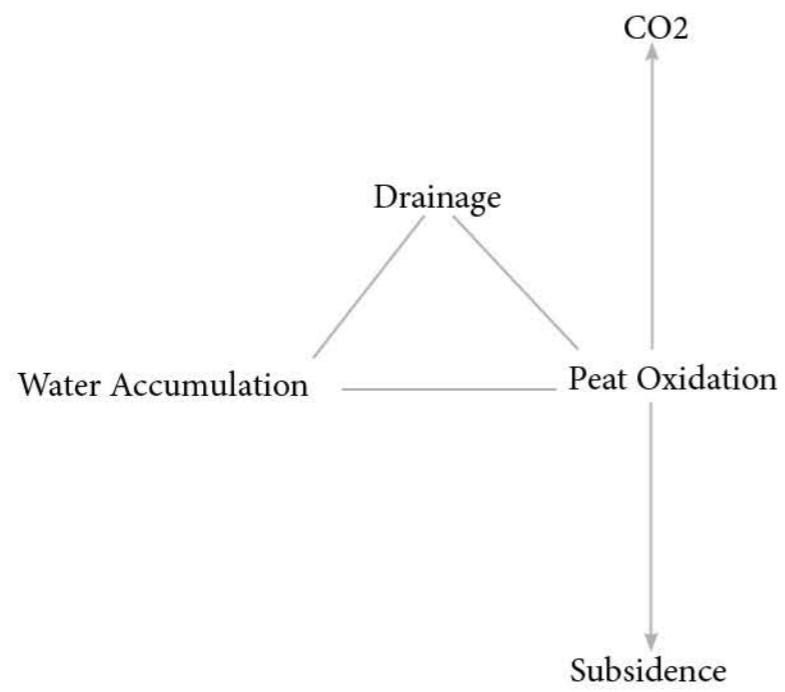




Climate Change. Excess Water
Waterberging in Friese polders, 2012.
Photo: Ic.nl



Climate Change. Excess Water
Waterberging in Friese polders
Photo: Ic.nl, 2012

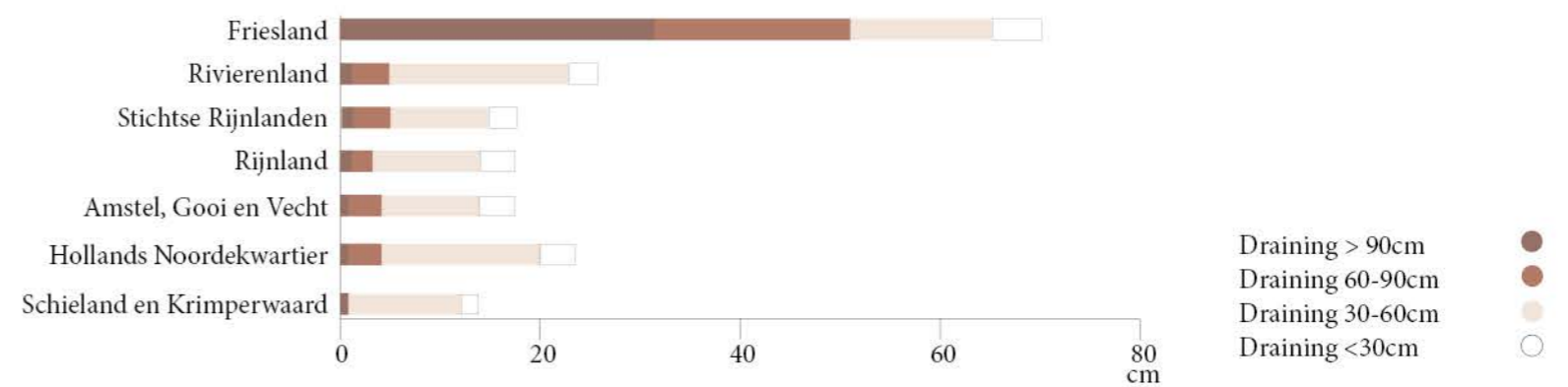


Carbon Cycle

**“1 700 000 tonnes of CO2
were released into the
atmosphere due to peat
oxidation in Friesland,
2015”**

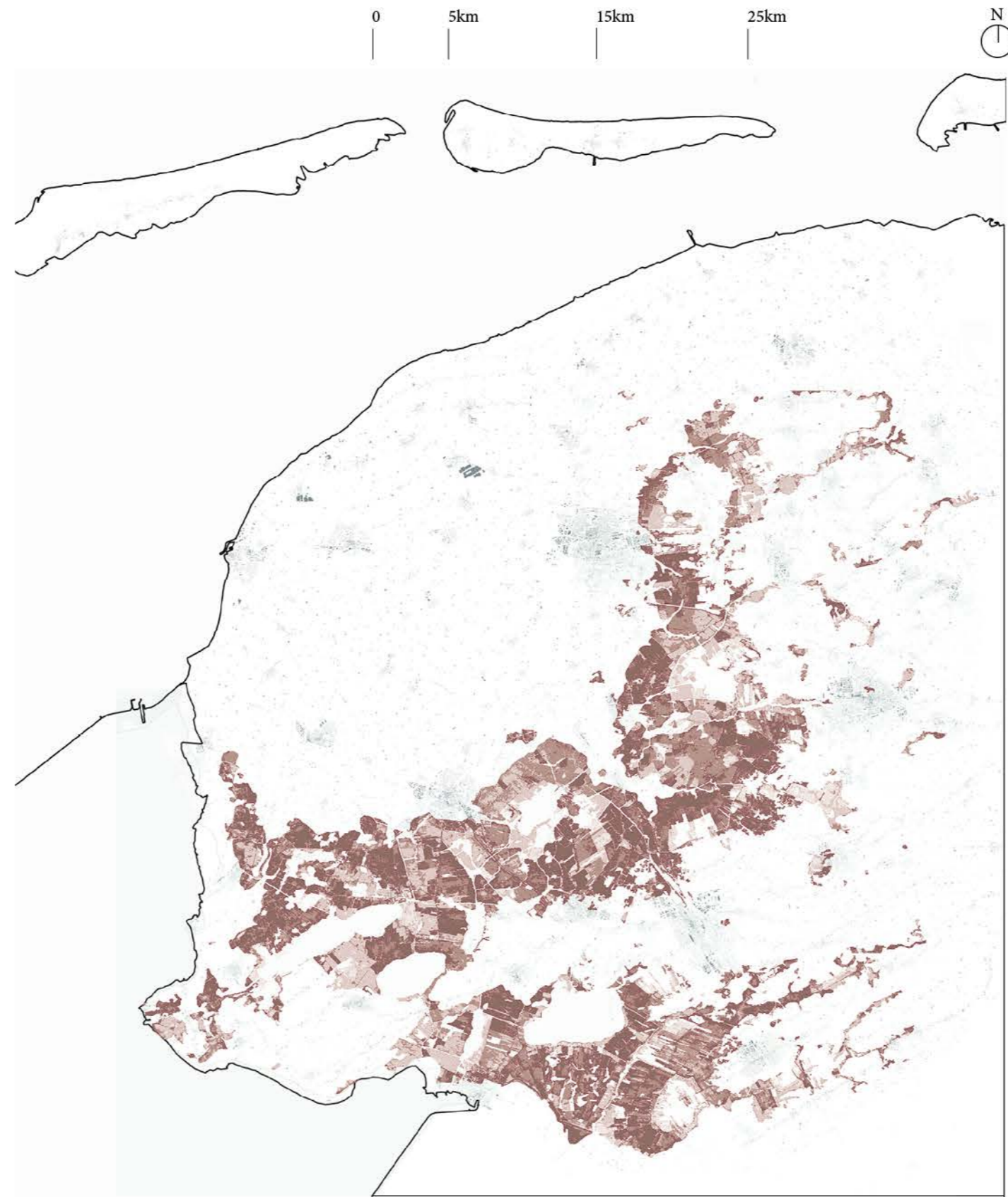
www.dsm.com

Water draining by regions



Water Draining

Data: www.pbl.nl 2022

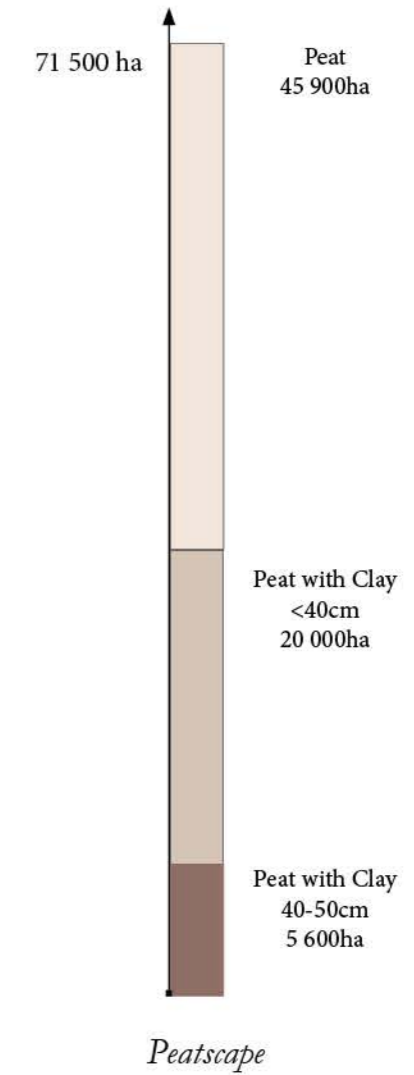
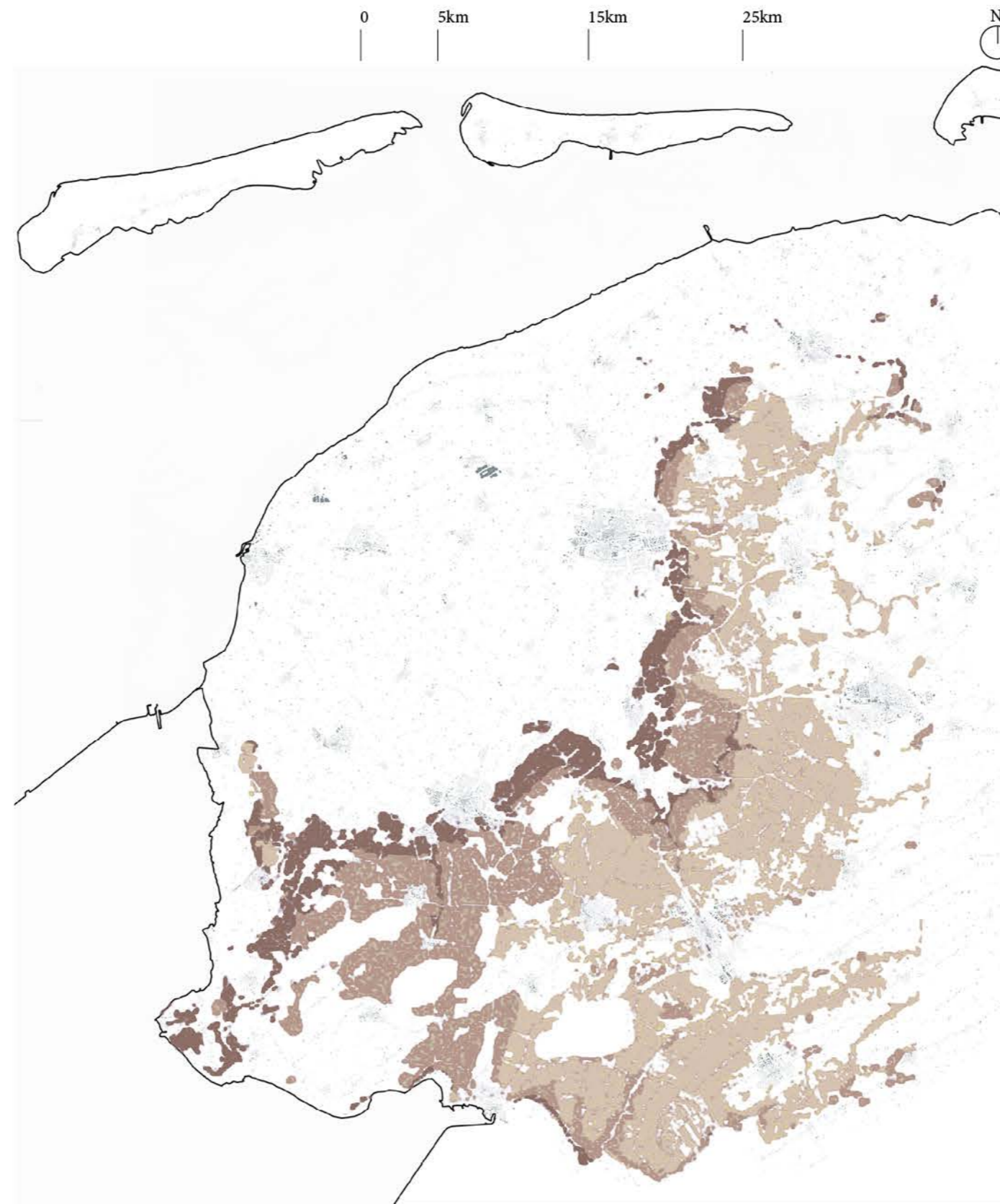


Water Draining / Pumping

Data: www.pbl.nl 2022, www.pdok.nl, www.openstreetmap.org, 2022.

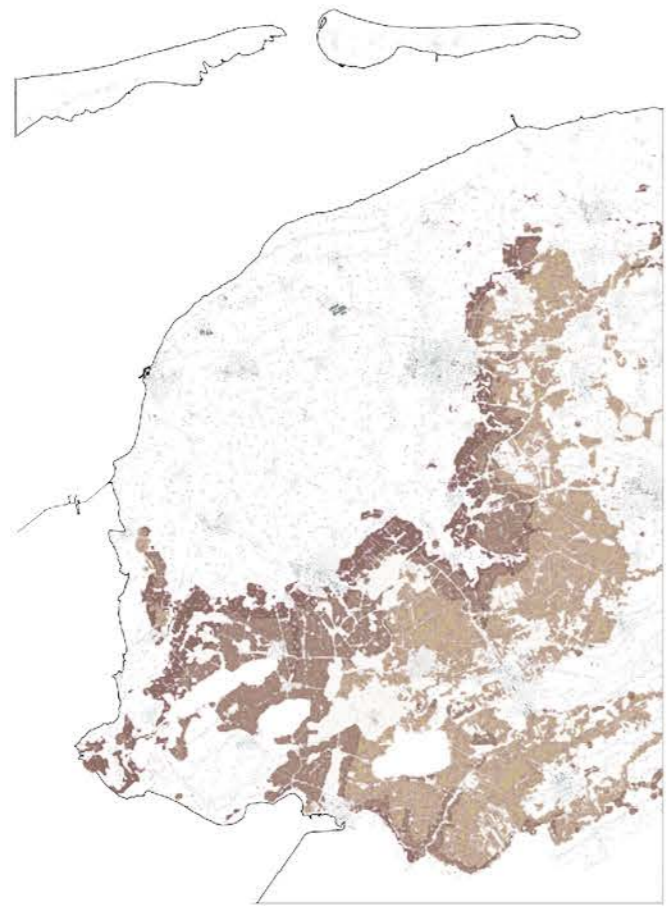
“Peatlands - wetlands with partially decomposed plant material”

(Zhong, et al., 2020)

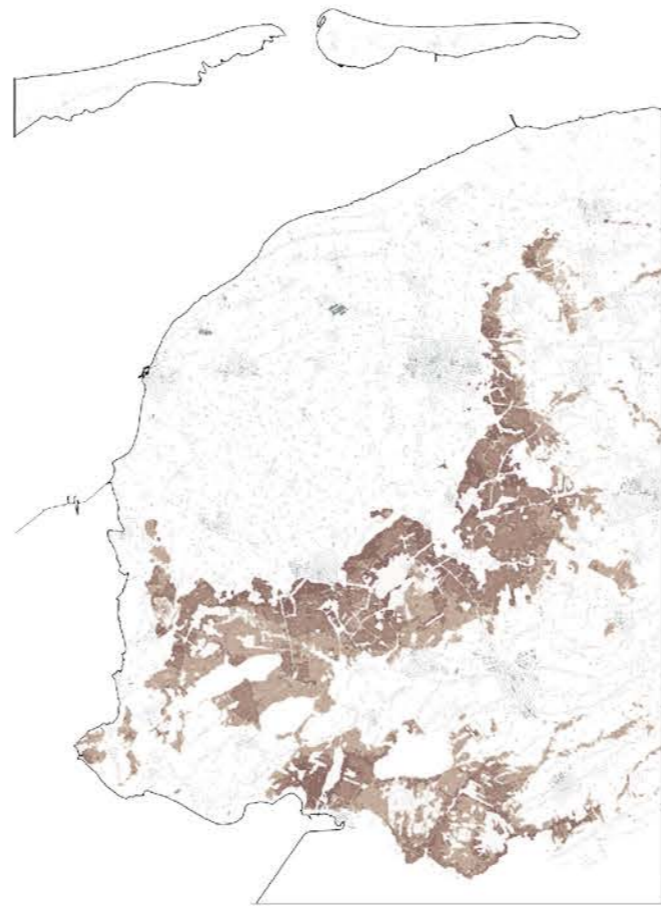


Peat Structure

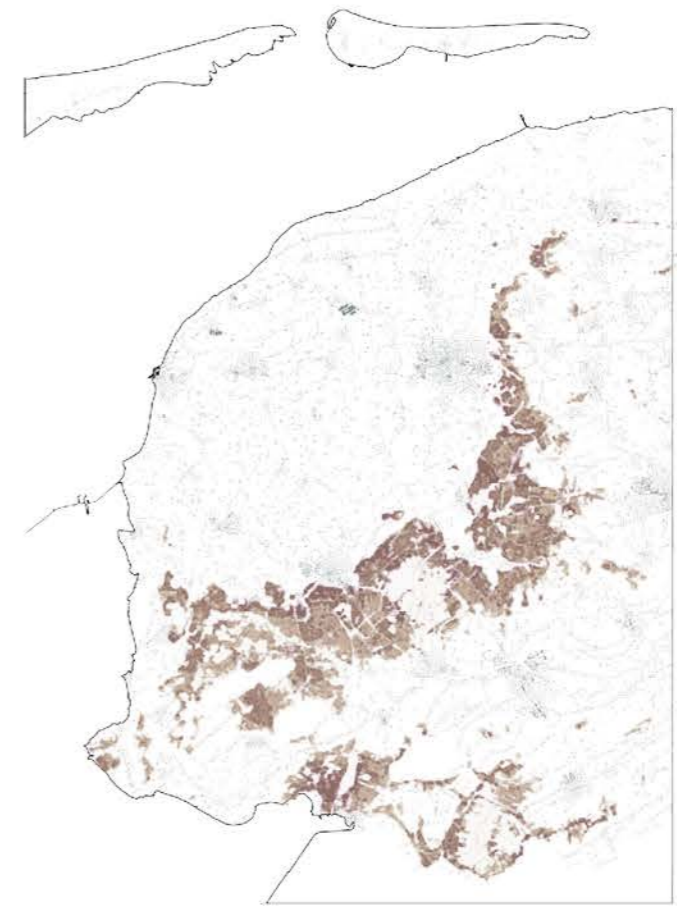
Data: www.wur.nl, www.pdok.nl, www.openstreetmap.org, 2022.



2015



2050



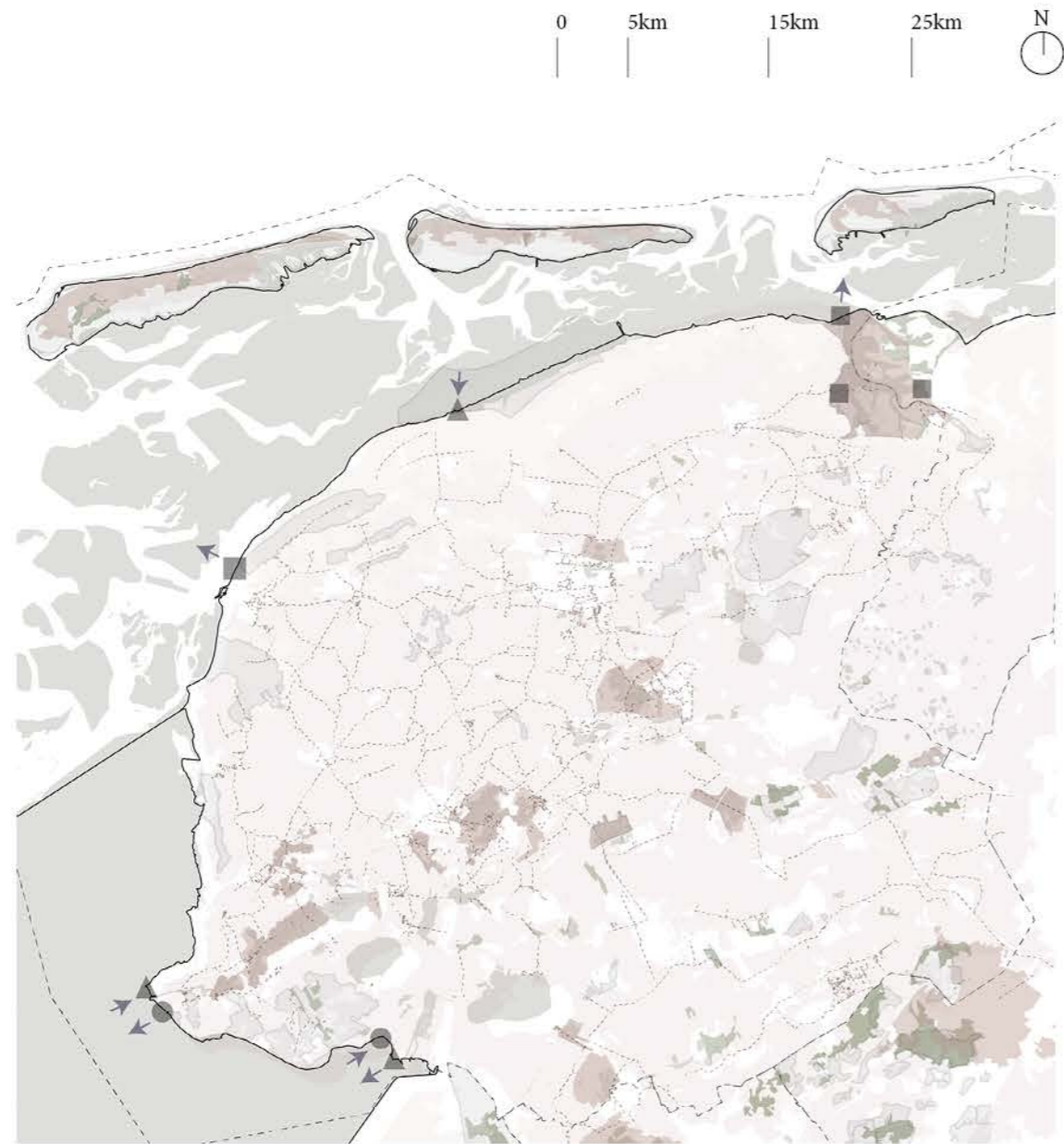
2100

- Water
- Urban
- Peat
- Peat with Clay Layer <40cm
- Peat with Clay Layer 40-50cm



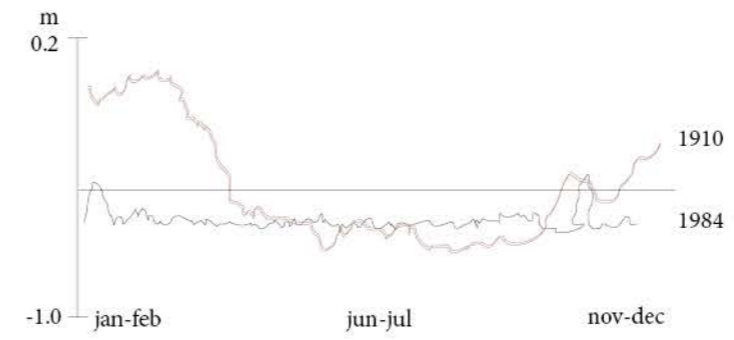
Peat Oxidation

Data: www.regiodealnatuurinclusievelandbouw.nl, www.pdok.nl, www.openstreetmap.org, 2022.

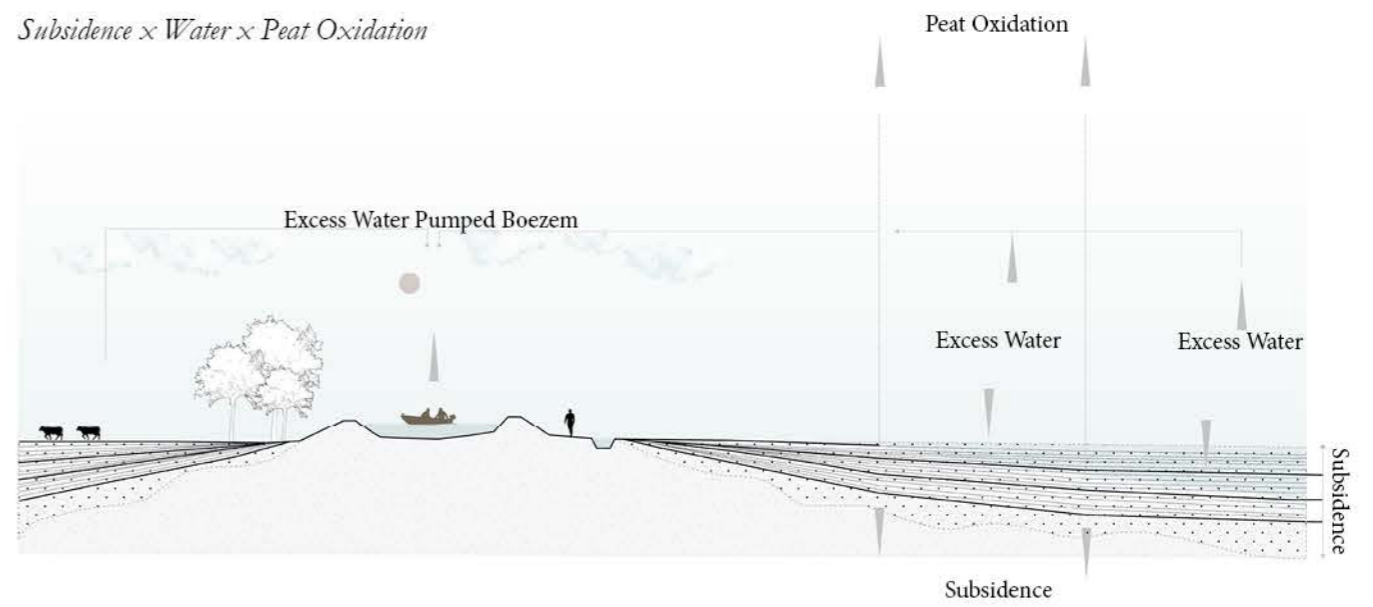


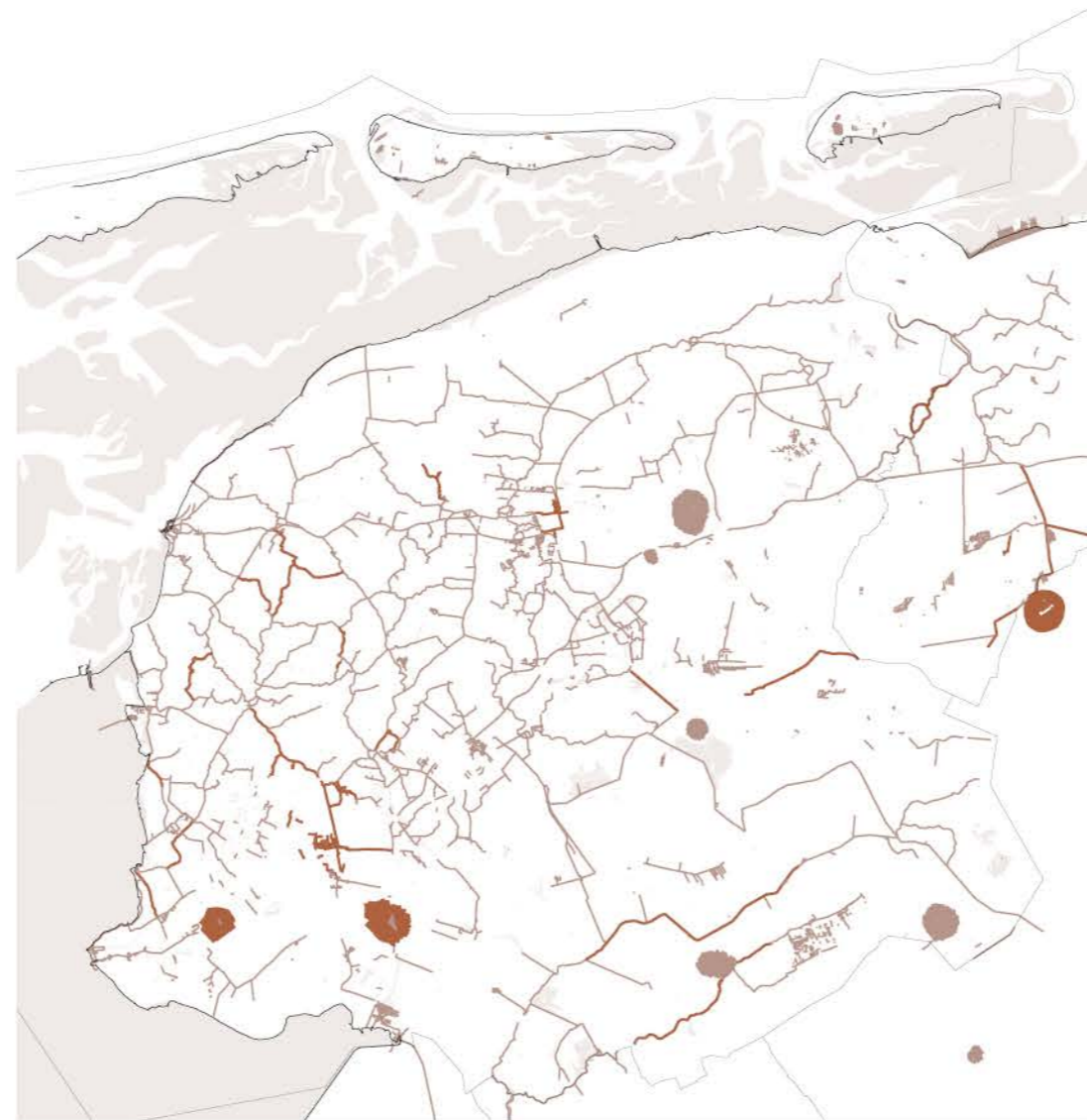
- ▲ Pumping Station
- Sluice
- Inlaat
- Nature
- Natura 2000
- Water - Boezem System

Annual Groundwater level changes



Subsidence x Water x Peat Oxidation





Ecological Surface Quality
Data: www.rijksverheid.nl, 2022



Homogenization of Biodiversity



Homogenization of Cultural Heritage



Ammonia, Nitrogen Cycle
Peat Oxidation/ Subsidence



Resilience

Landscape Resilience is the ability fo a landscape to maintain its functions under changing conditions

Research Pillars

Resilience

*Landscape Resilience is the ability fo a
landscape to maintain its functions under
changing conditions*



**How can the agricultural
landscape transition into becoming
more resilient in the province
of Friesland ?**

Research by Design

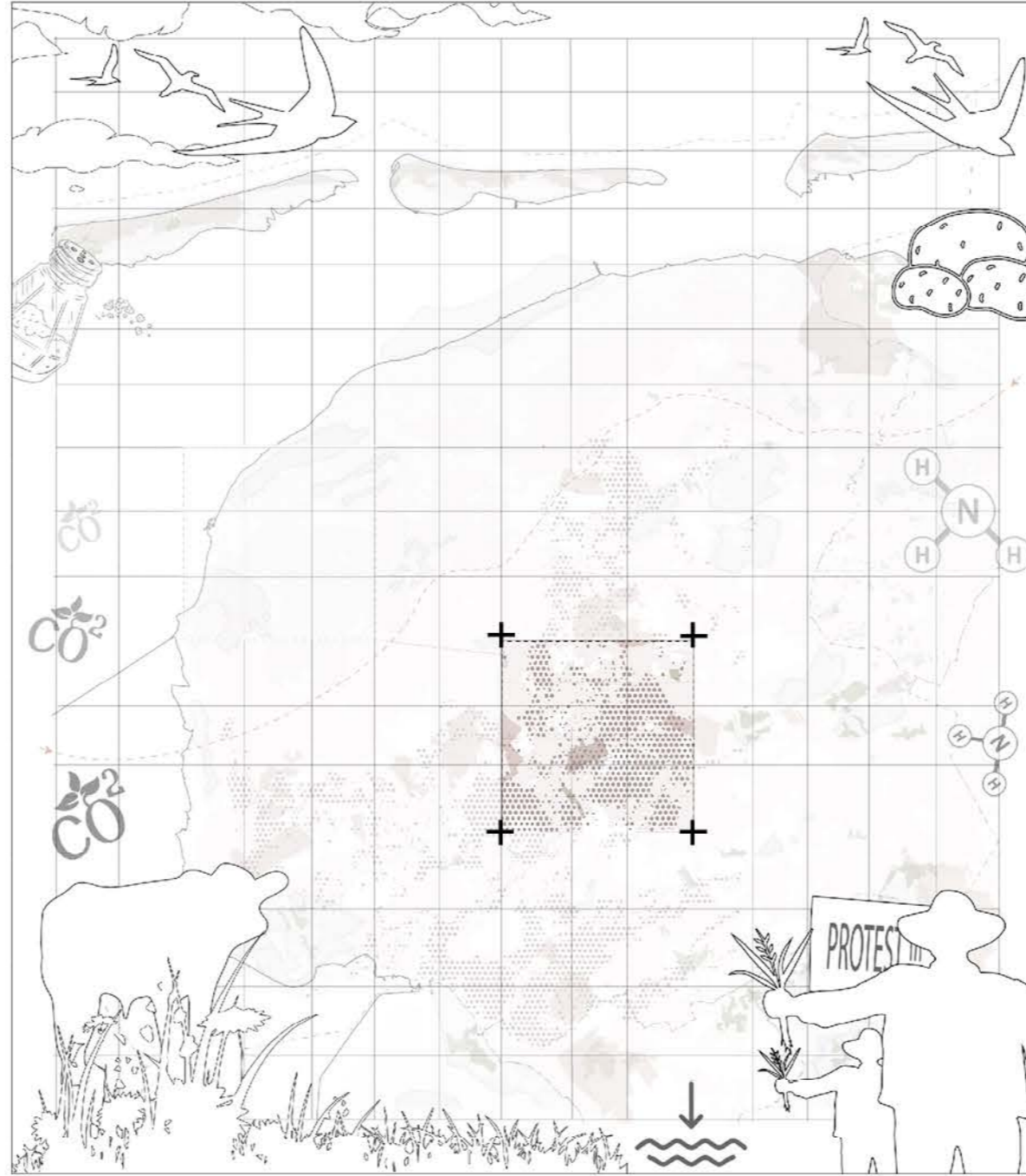
Engaging Stakeholders

*What if we do nothing?
No Peat Scenario*

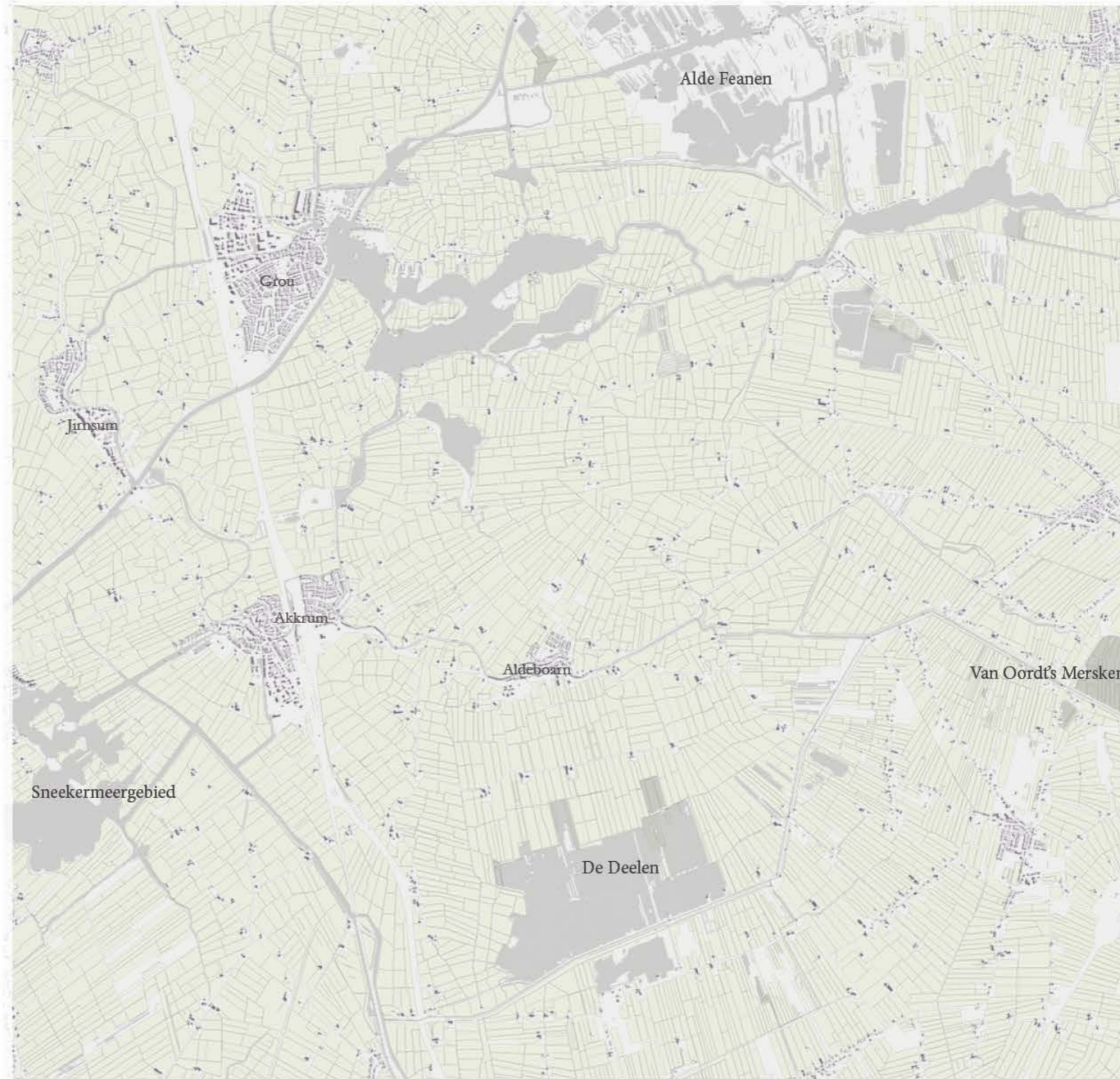
*What if we stop draining excess
water?
Water Acceptance Scenario*

*What if we manage the water
cycle and develop nature for carbon
sequestration?
Developing Nature Scenario*

Scenarios



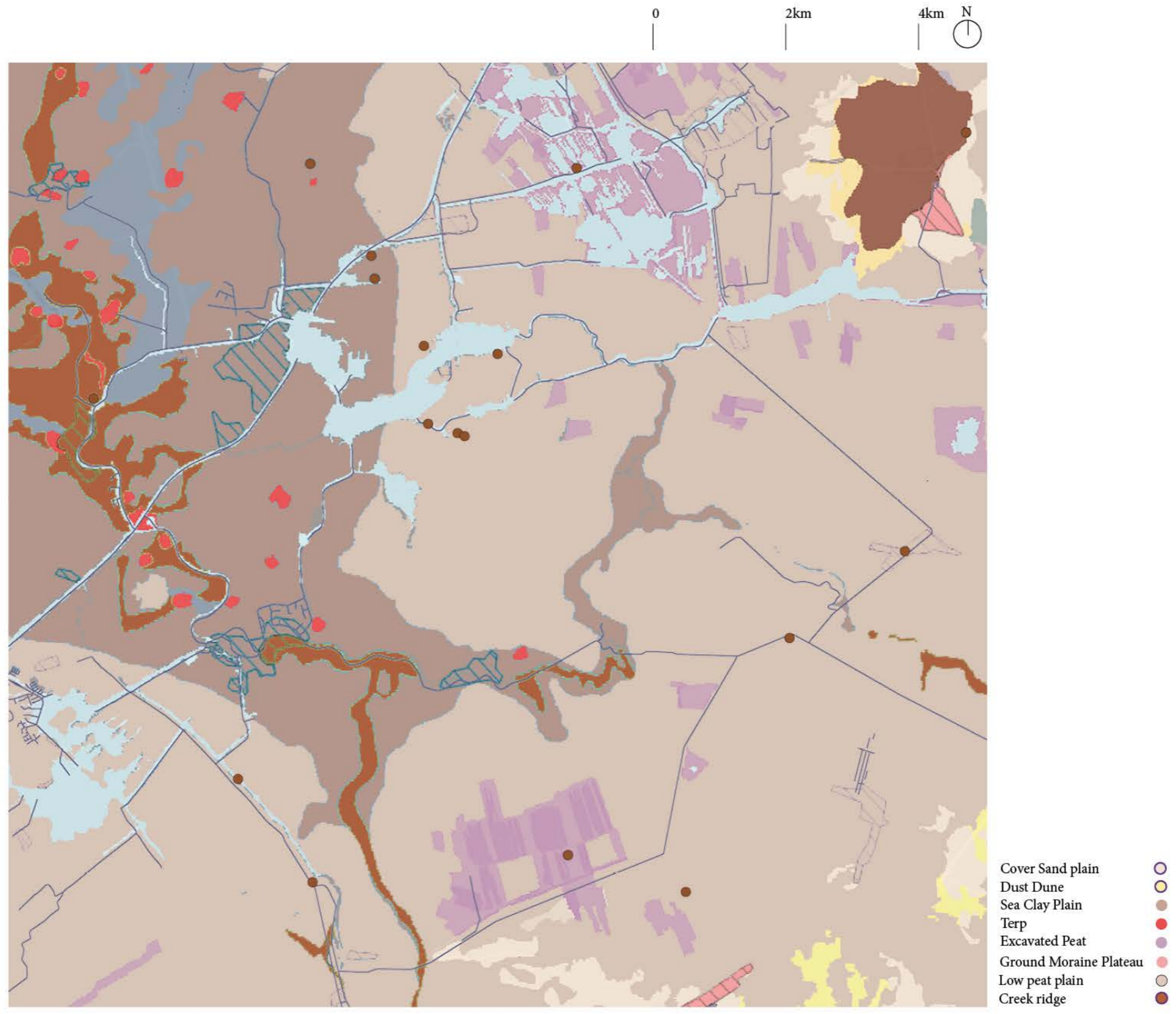
Site



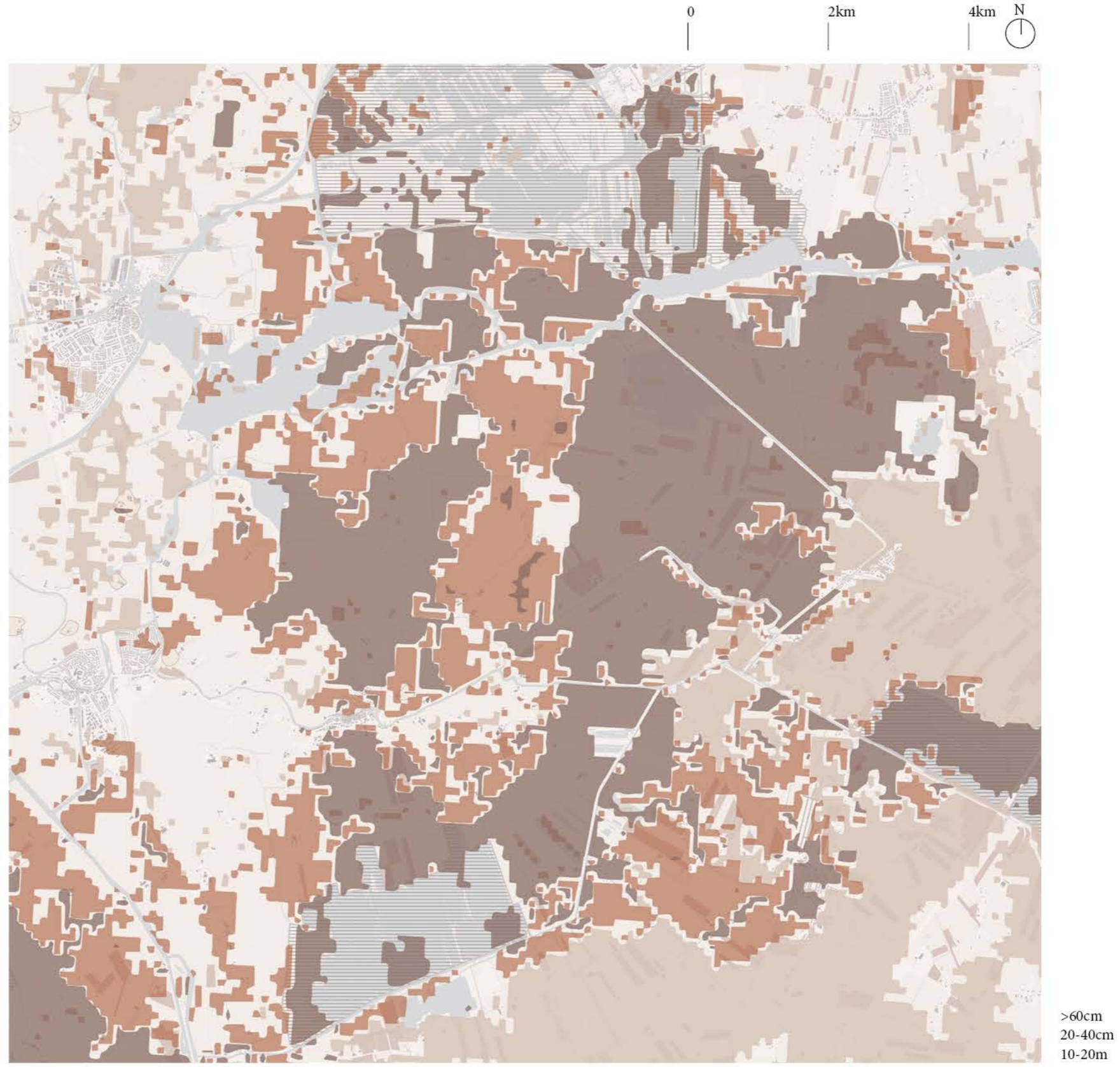
*Site
Current Situation*



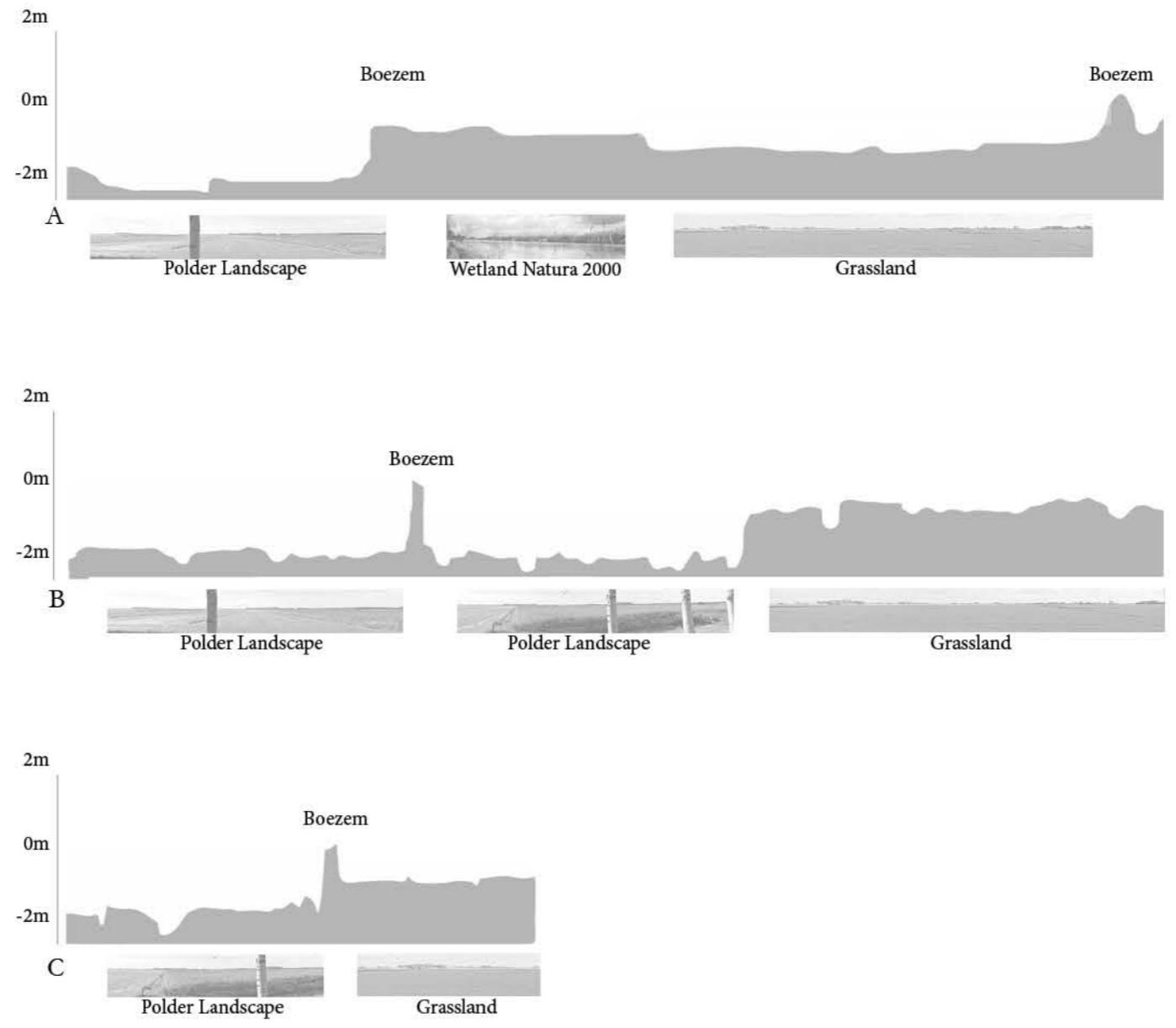
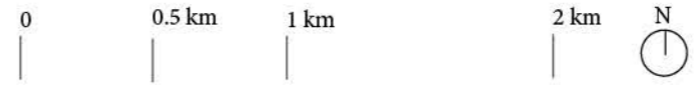
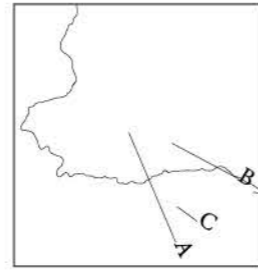
Site Land Use



Site Soil Structure



Site Soil Subsidence



Ground Water Elevations

Data: www.pdok.nl, www.ahn.arcgisonline.nl, www.openstreetmap.org, 2022.



Friesland Peatscapes, 2023.
Photo: Anna Gorokhova.



Friesland Peatscapes, 2023.
Photo: Anna Gorokhova.



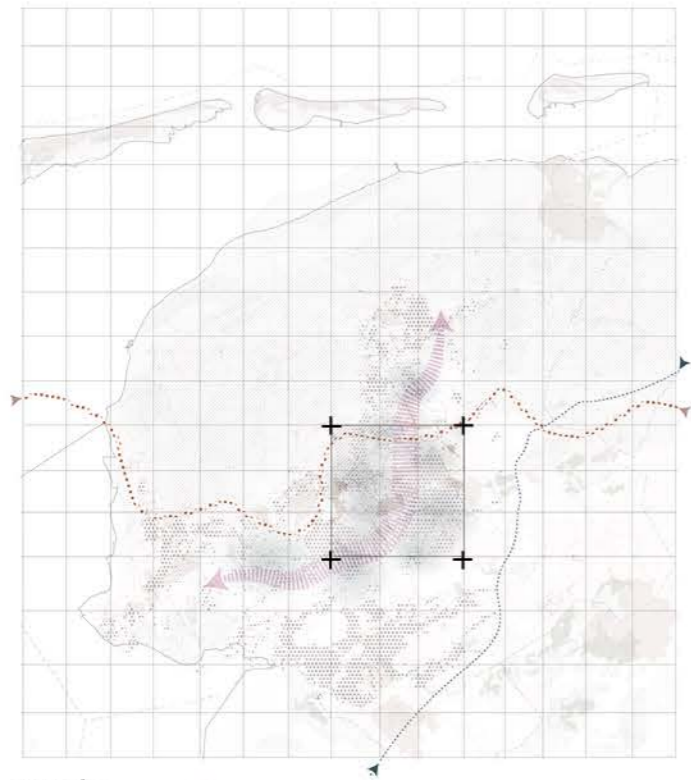
Friesland Peatscapes, 2023.
Photo: Anna Gorokhova.



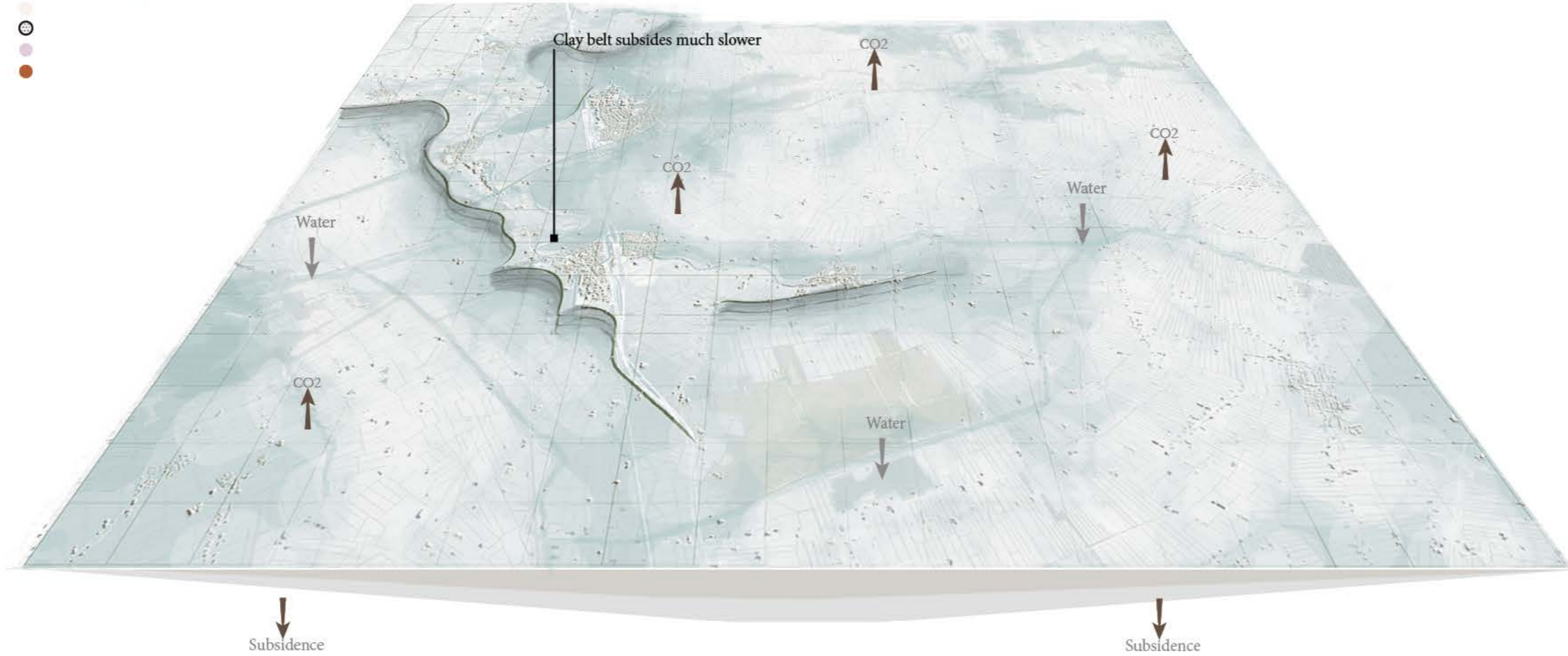
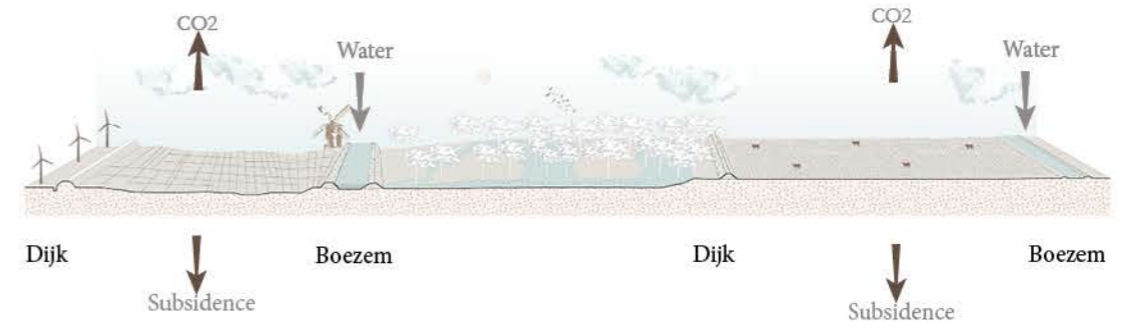
Friesland Peatscapes, 2023.
Photo: Anna Gorokhova.



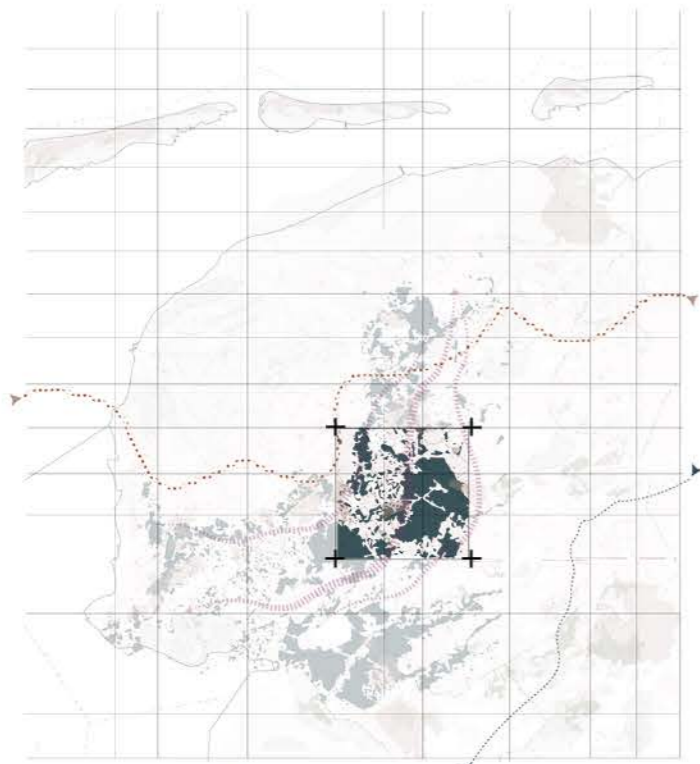
Friesland Peatscapes, 2023.
Photo: Anna Gorokhova.



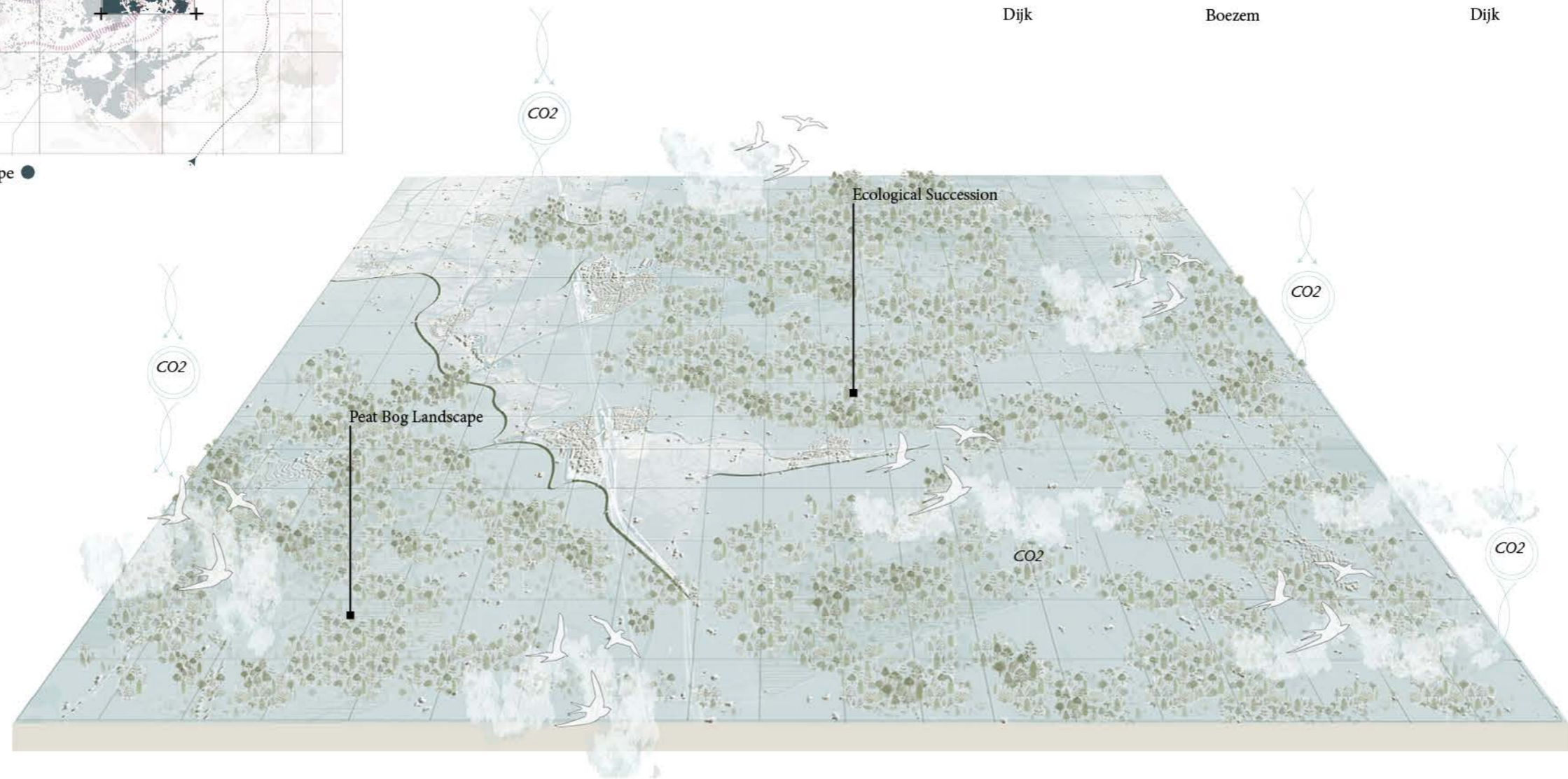
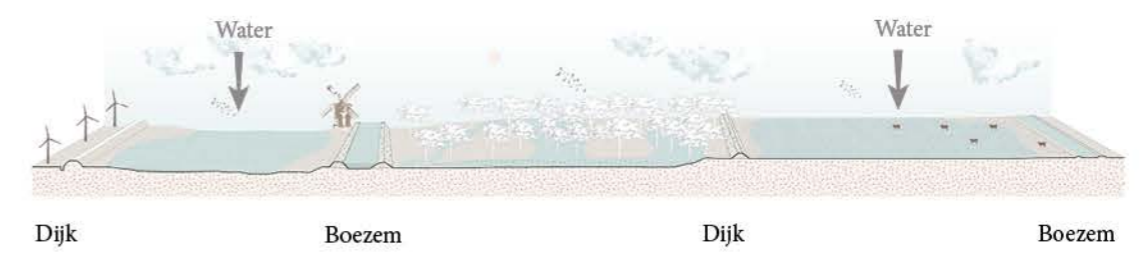
- Droughts
- Peat Oxidation
- Subsidence
- Salinisation



*What if we do nothing? No Peat, Beyond 2100 Scenario
System Limits*



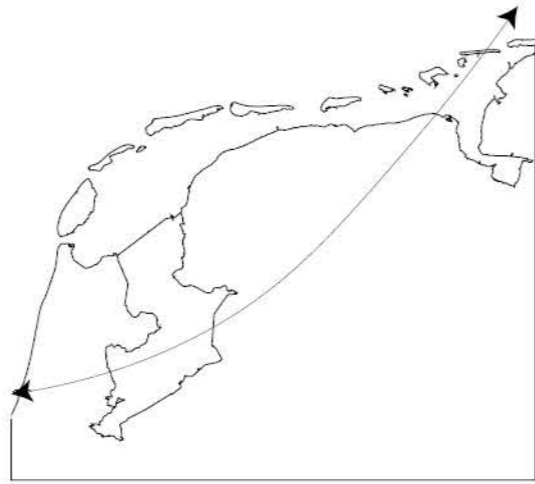
Peat Bog Landscape ●



*What if we stop draining ? Beyond 2100 Scenario
System Limits*

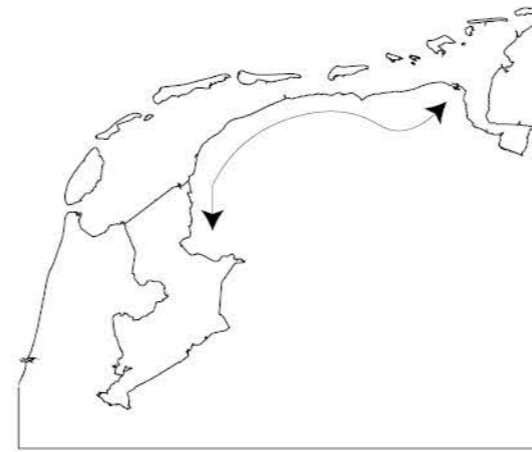


*Design Workshop
Engaging Stakeholders*



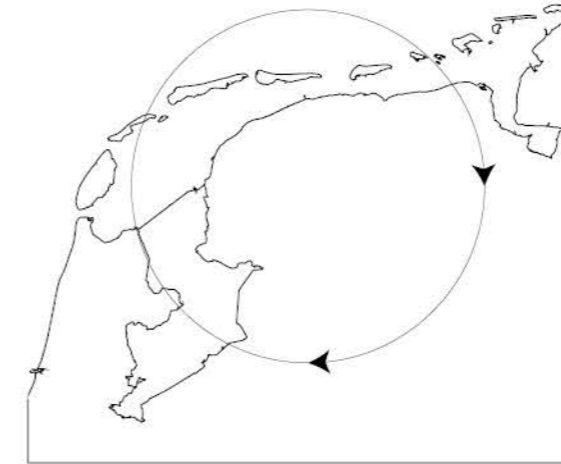
Stronger Eco Corridors

- Strengthening ecological connections in the hinterland by ensuring quality and provision of habitat



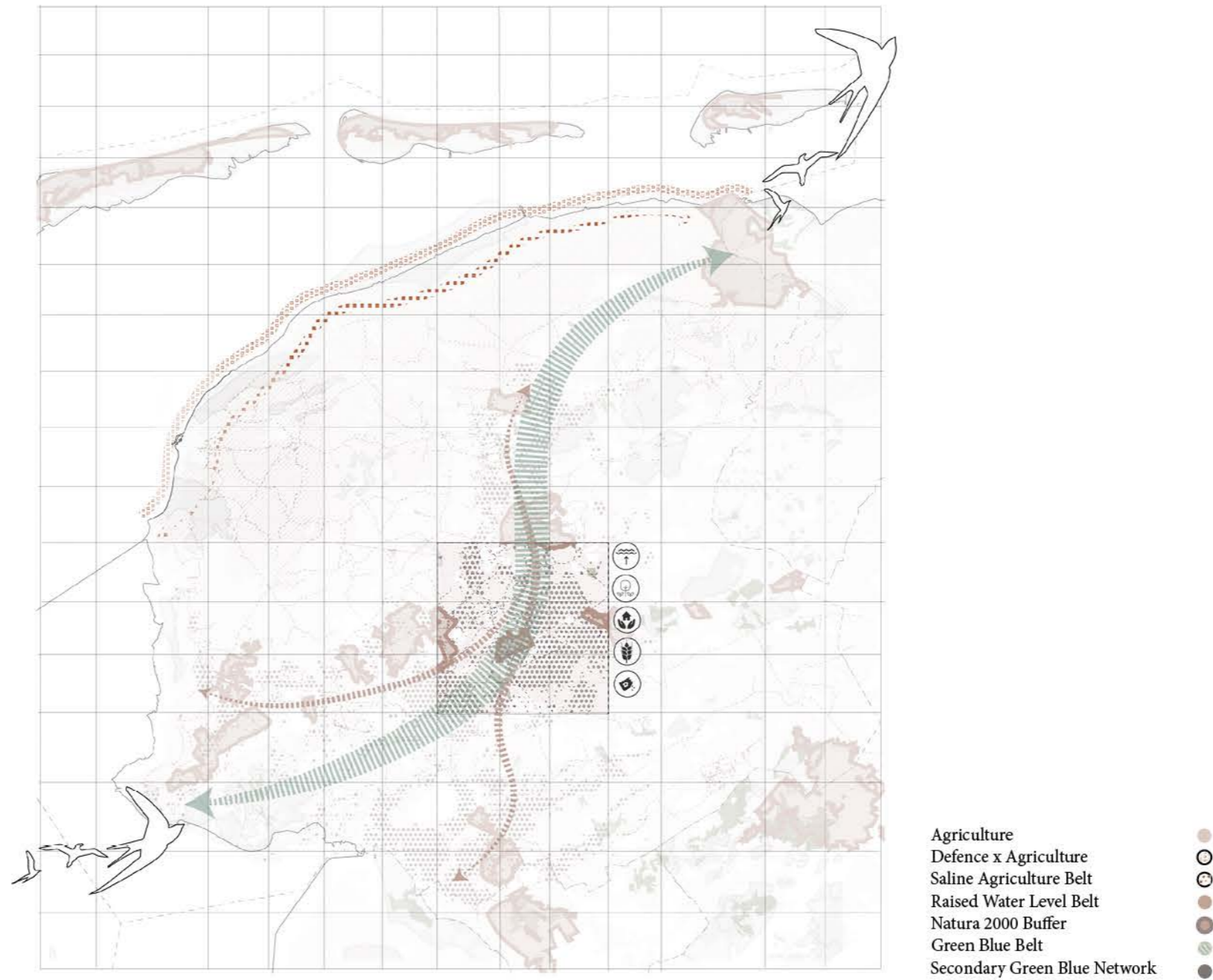
Stronger Cultural Heritage

- Honoring agricultural cultural heritage by increasing accessibility and (re) envisioning its integration



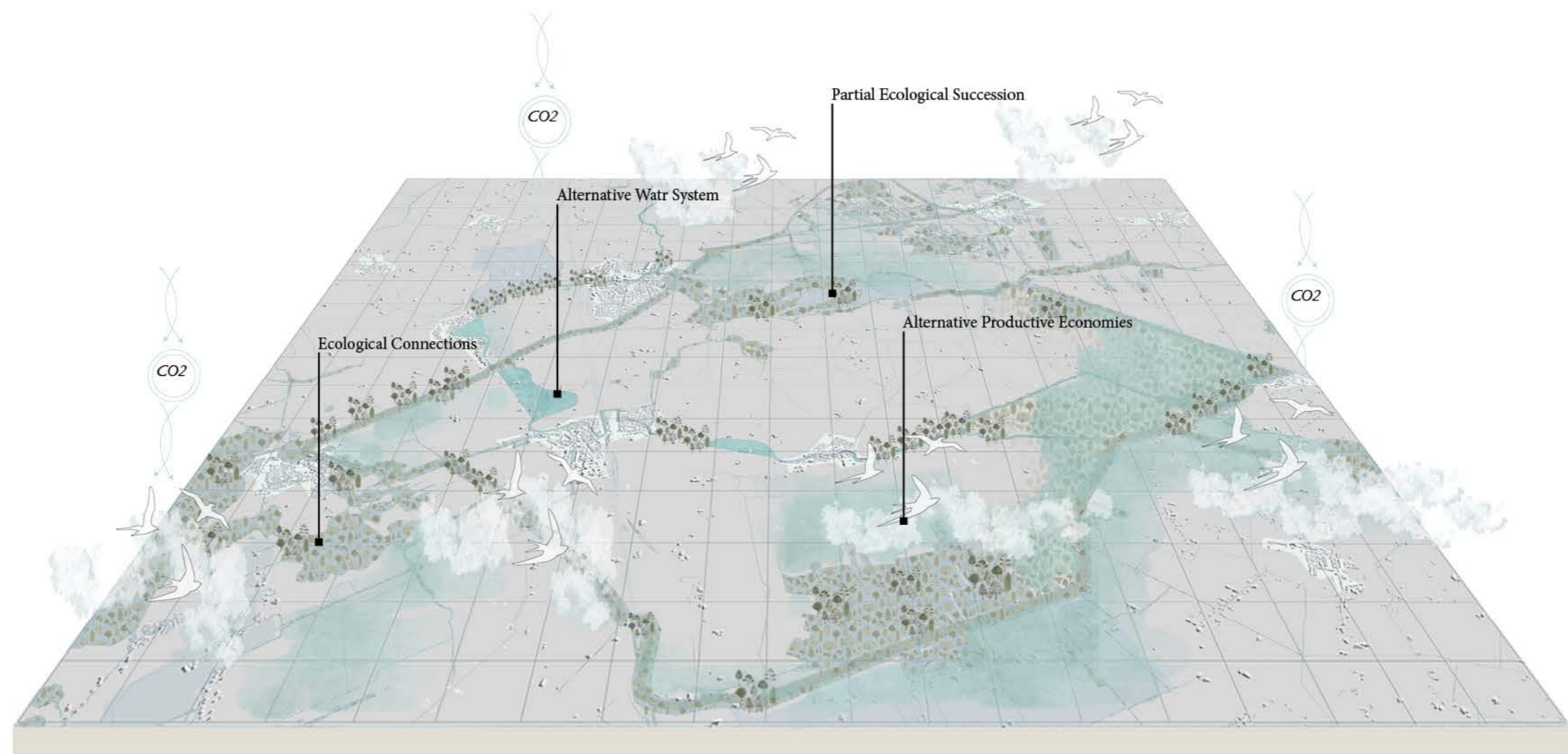
Mitigation and Climate Adaptation

- Developing new agricultural landscape for climate adaptation and mitigation



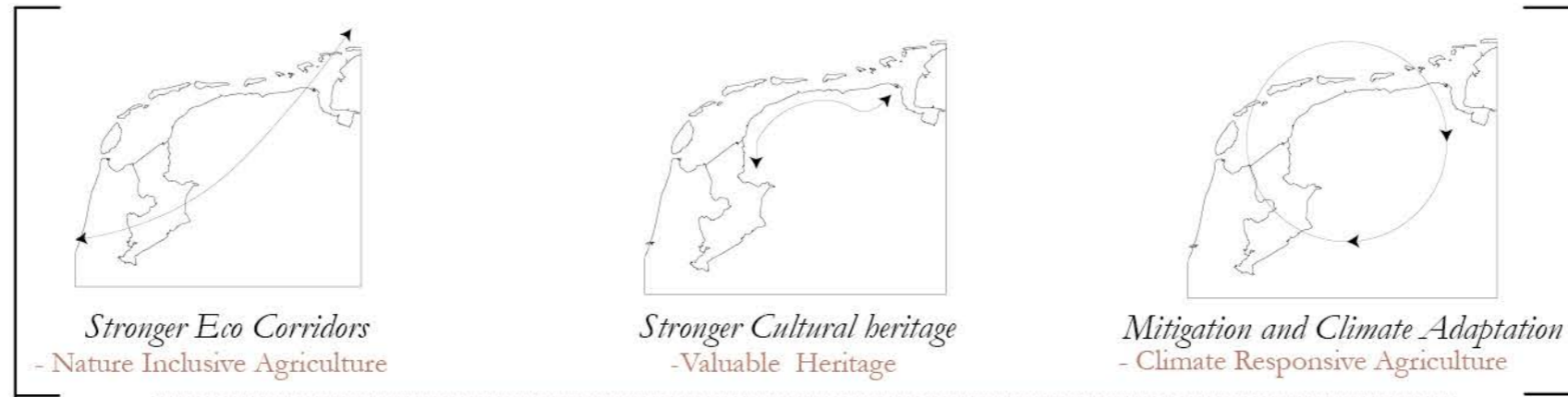
What if we manage the water cycle and develop nature for carbon sequestration? 2100 Scenario

Developing Nature Scenario beyond 2100



What if we manage the water cycle and develop nature for carbon sequestration? 2100 Scenario
Developing Nature Scenario beyond 2100

Design Principles



Goals

EU National Gov Regional Gov

Sub - Goals

Strategies

- Strengthening ecological connections in the hinterland
- Honoring agricultural cultural heritage
- Developing new agricultural landscape for climate adaptation and mitigation

Sub - Strategies

Regional Local Site

Time
Regional Scale
Local Scale
Farm Scale Design



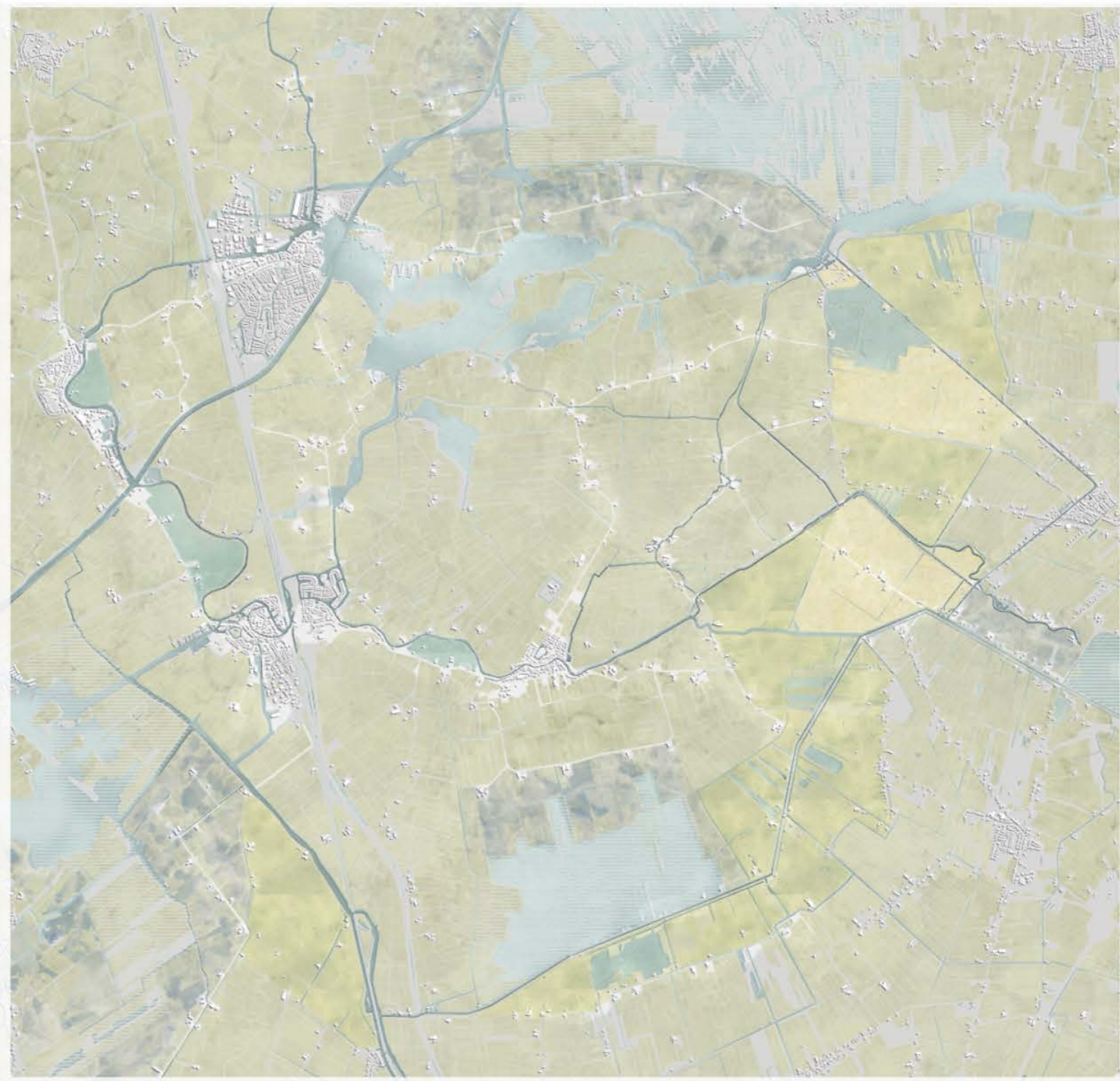
Goals and Strategies

Stakeholders	EU	National Gov	Regional Gov	Scale	Regional	Local	Farm		
Goals	Sub - Goals			Strategies					
Establish Natura 2000 Buffer Zones	Reduce Nitrogen by 47% in Peat Areas	Improve Water Quality / Quantity	Increase Ground Water Quality Increase Surface Water Quality Increase Fresh Water Storage Reduce Risk of Inland Salinisation Manage Excess Water Flow	}	Green Blue Infrastructure Backbone	Water Storage Wetland Establishment and Enhancement Raising of Water Levels Blocking of Drainage Channels	}	Peat Restoration Paludiculture	
		Improve Soil Quality	Minimise Soil Subsidence Minimise Peat Oxidation Increase and Maintain Soil Quality Strengthen Manure Treatment Cycle			Nature Bank Stabilisation Natura 2000 Buffer Zone Primary, Secondary, Tertiary Green Blue Network			
		Improve Biodiversity/ Habitat	Increase Habitat Provision and Distribution Increase Habitat Quality						
		Improve Cultural Heritage	Increase Accessibility of Cultural Heritage Increase Value of Cultural Heritage			Reconnected Cultural Heritage Network Valuable Cultural Heritage Routing Local Agro Heritage Network			Small Scale Leisure Agrotourism
		Improve Socio - Economic	Encourage New Business Models Increase Recreational Opportunities			New Economies			Green Blue Recreation Network New Job Opportunities



Grassland ●
Water ●

*What if we develop nature ?
Current Situation*

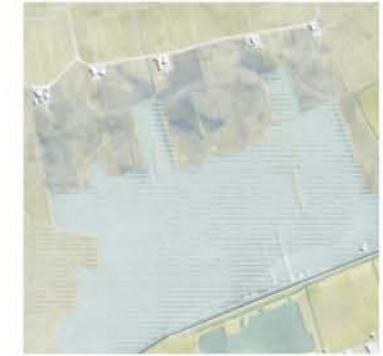


- Natura 2000 Polder Paludiculture
- Grassland Grassland Paludiculture
- Water Purification Wetlands
- Buildings (Re) Peat Buffer
- Cultural Network

What if we develop nature ? 2035 vision
Alternative Future / Long Term Carbon Storage



3 Natures



Carbon Bank



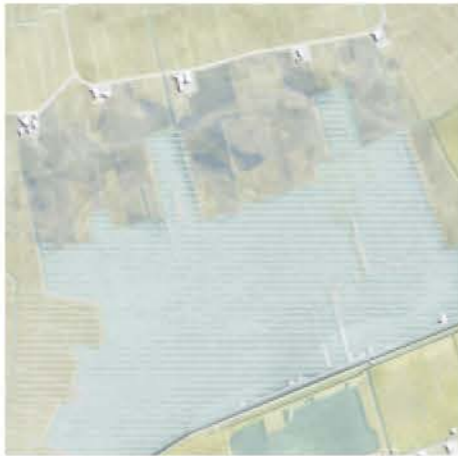
Paludiculture



People Nature

- | | | |
|-------------|---|-------------------------|
| Natura 2000 | ● | Polder Paludiculture |
| Grassland | ● | Grassland Paludiculture |
| Water | ● | Purification Wetlands |
| Buildings | ● | (Re) Peat Buffer |
| | ● | Cultural Network |

What if we develop nature ? 2035
Nature Types



Carbon Bank



High Biodiversity Value
Long Term Carbon Storage Development
Natura 2000 Buffer Zone
Peat Restoration



Paludiculture



Medium Biodiversity Value
Long Term Carbon Storage Development
Peat Restoration

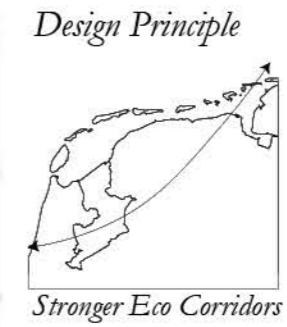


People Nature



Less Biodiversity Value
Water Purification
Experience

What if we develop nature ? 2035
Nature Types



Water Ecological Corridors ●
Natura 2000 ●

Establishing Carbon Bank Ecological Connectivity 2035



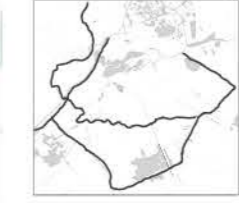
Design Principle



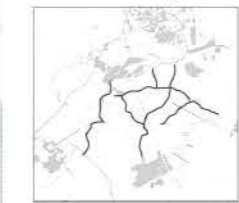
Stronger Eco Corridors

Strategies

- A. Primary Ecological Corridors



- B. Secondary Ecological Corridors

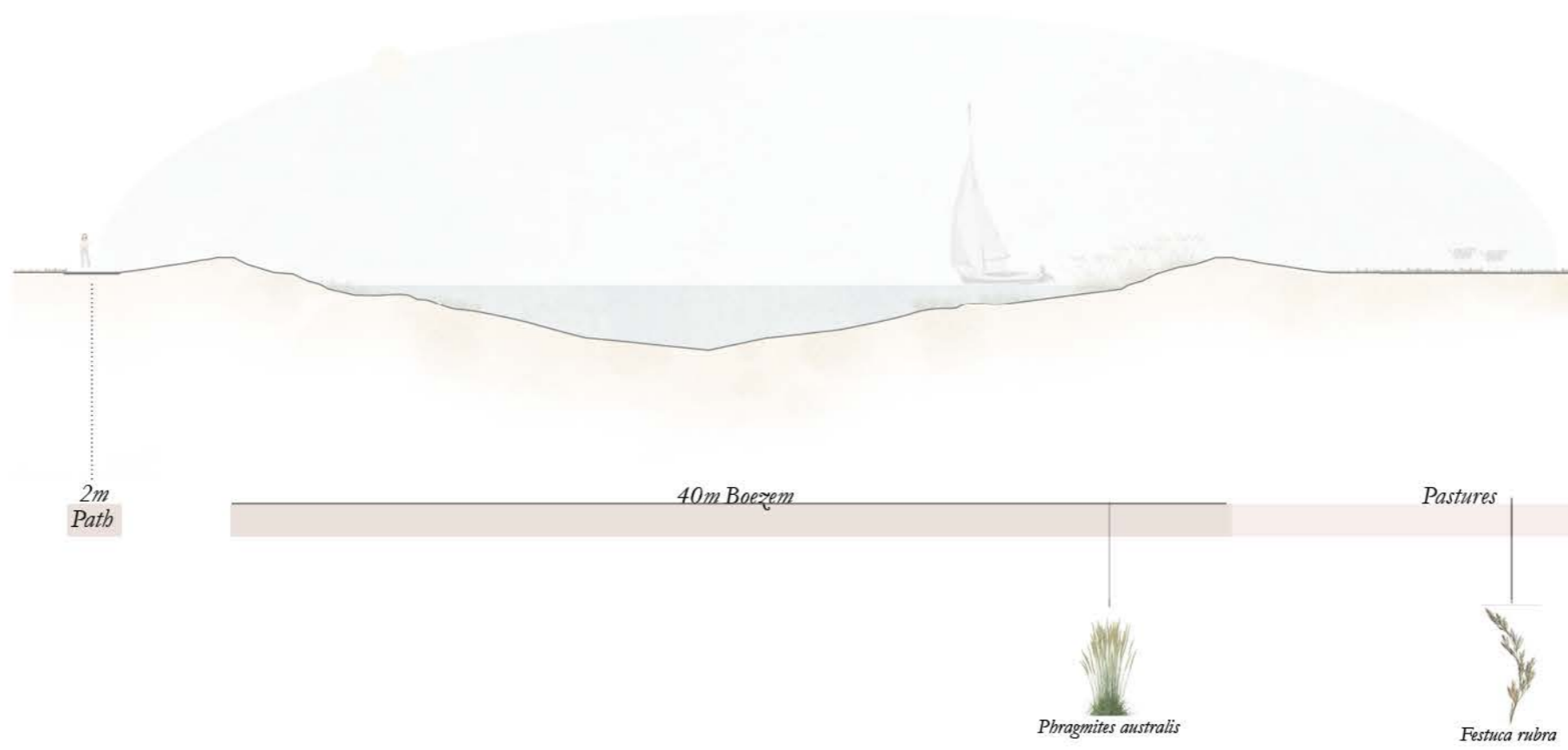


- C. Tertiary Ecological Corridors

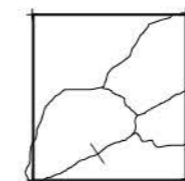


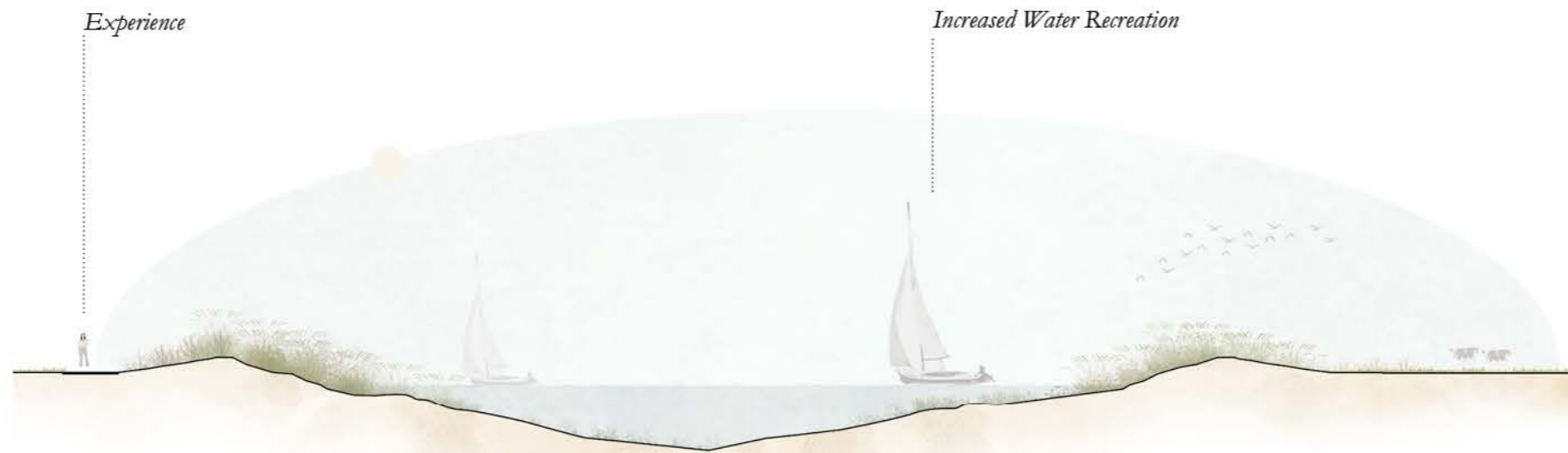
Water Ecological Corridors ●
Natura 2000 ●








Establishing Carbon Bank Ecological Connectivity 2035



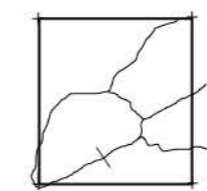
Carbon Bank Ecological Connectivity
Primary Ecological Corridor 2023

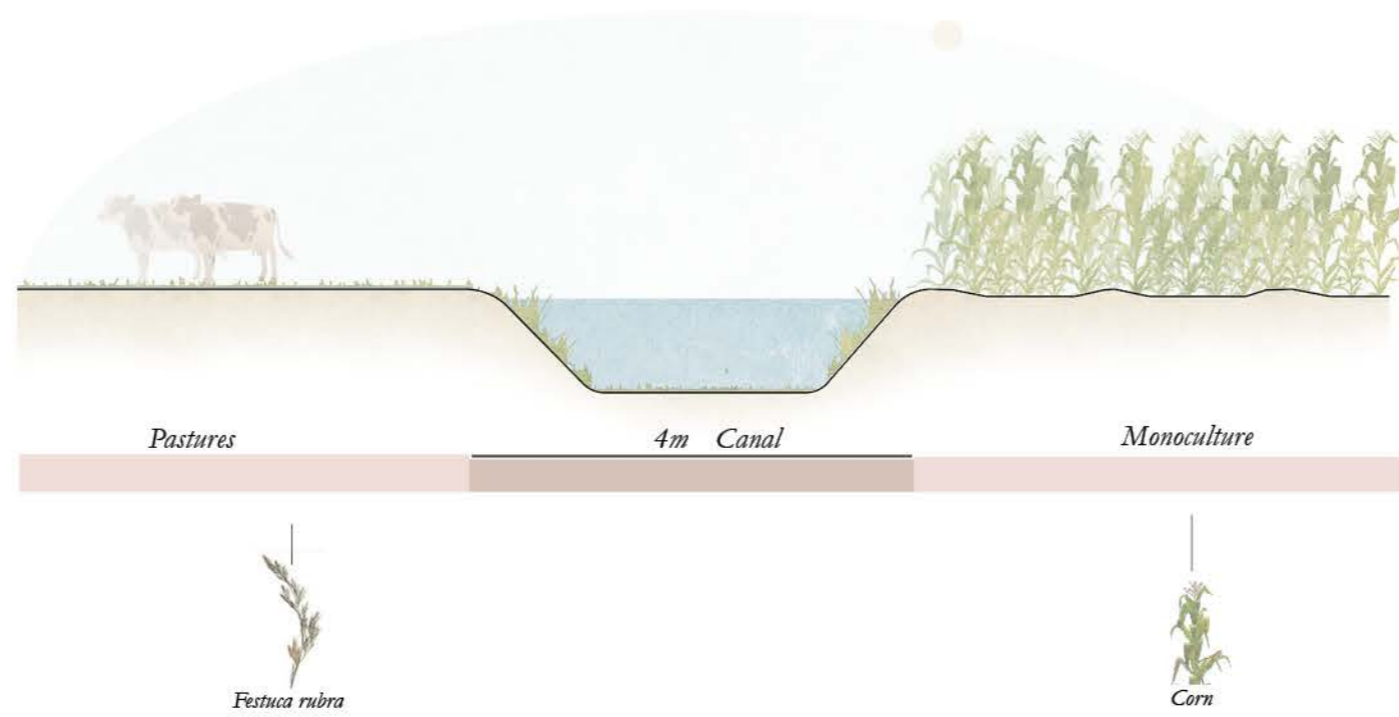




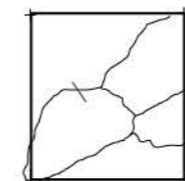
Flowers	Shrubs	Aquatic	Reeds	Grasses
 <i>Rhinanthus angustifolius</i>	 <i>Cornus sericea</i>	 <i>Iris pseudocaris</i>	 <i>Phragmites australis</i>	 <i>Festuca rubra</i>
 <i>Myosotis scorpioides</i> <i>subsp. scorpioides</i>	 <i>Sambucus nigra</i>	 <i>Nasturtium officinale</i>	 <i>Schoenoplectus lacustris</i>	 <i>Cynosurus cristatus</i>
 <i>Purple loosestrife</i>		 <i>Mentha aquatica</i>	 <i>Typha latifolia</i>	
 <i>Lysimachia nummularia</i>				

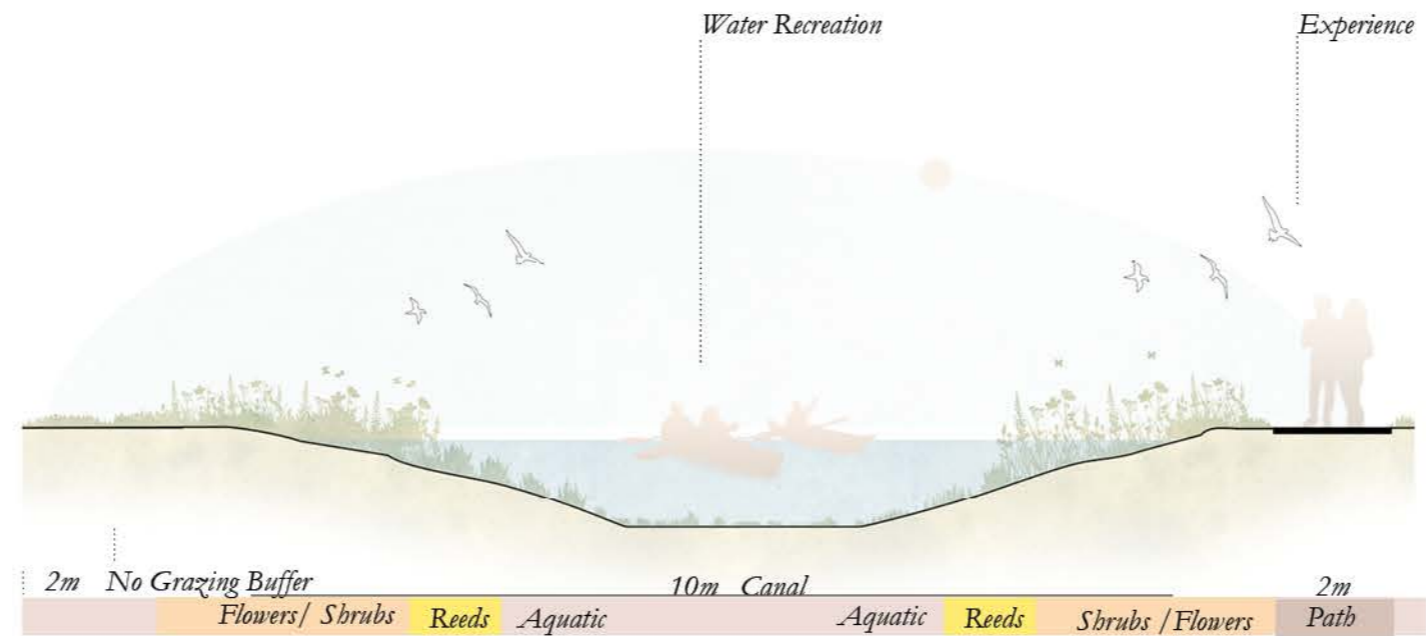
Carbon Bank Ecological Connectivity
Primary Ecological Corridor 2035



















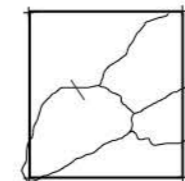
Carbon Bank Ecological Connectivity
Secondary Ecological Corridor 2023

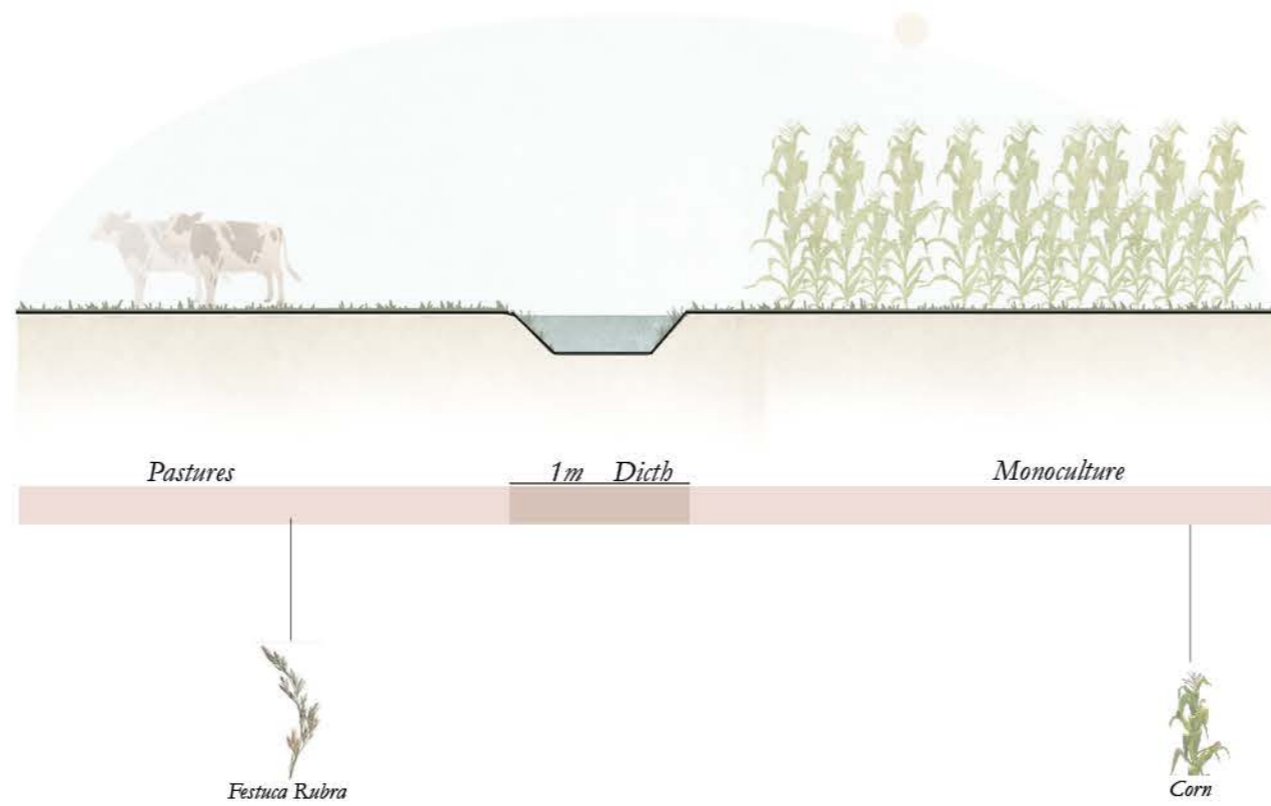




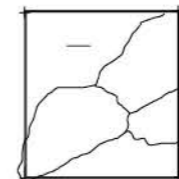
- | Grasses | Reeds | Aquatic | Flowers | Shrubs |
|---|--|---|---|--|
| 
<i>Festuca rubra</i> | 
<i>Phragmites australis</i> | 
<i>Iris pseudocaris</i> | 
<i>Rhinanthus angustifolius</i> | 
<i>Cornus sericea</i> |
| 
<i>Cynosurus cristatus</i> | 
<i>Schoenoplectus lacustris</i> | 
<i>Nasturtium officinale</i> | 
<i>Myosotis scorpioides</i>
<i>subsp. scorpioides</i> | 
<i>Sambucus nigra</i> |
| | 
<i>Typha latifolia</i> | 
<i>Mentha aquatica</i> | 
<i>Purple loosestrife</i> | |
| | | | 
<i>Lysimachia nummularia</i> | |

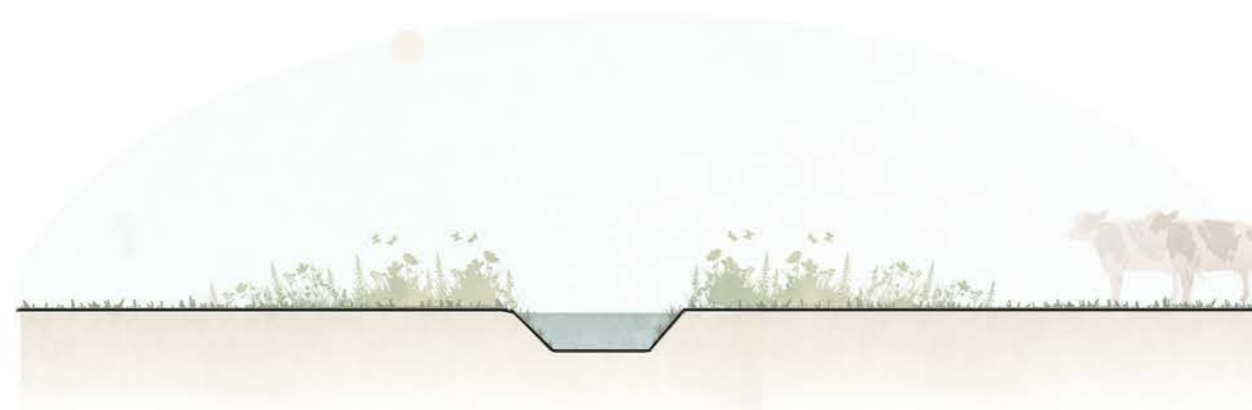
Carbon Bank Ecological Connectivity
Secondary Ecological Corridor 2035





Carbon Bank Ecological Connectivity
Tertiary Ecological Corridor 2023





Diverse Pastures
2m No Grazing Buffer
1m Ditch
2m No Grazing Buffer
Diverse Pastures

Grasses

Flowers

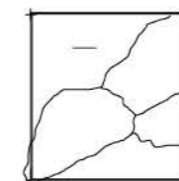
Shrubs

- 
Plantago lanceolata L.
- 
Melilotus officinalis
- 
Festuca rubra
- 
Cynosurus cristatus

- 
Rhinanthus angustifolius
- 
Myosotis scorpioides
subsp. *scorpioides*
- 
Lysimachia nummularia

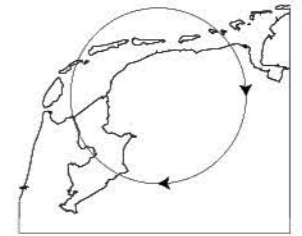
- 
Cornus Ssricea
- 
Sambucus nigra

Carbon Bank Ecological Connectivity
Tertiary Ecological Corridor 2035







Design Principle



Mitigation and Climate Adaptation

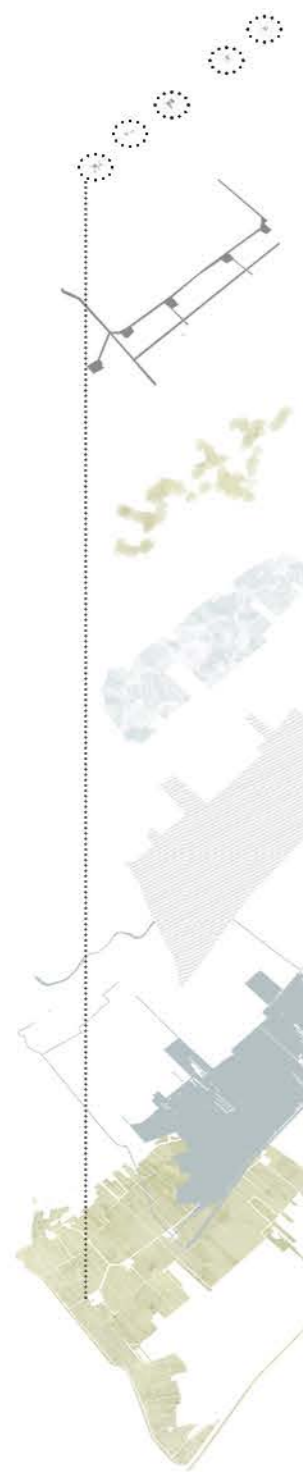
Natura 2000 Buffer Zone 
Natura 2000 

Establishing Carbon Banks 2035

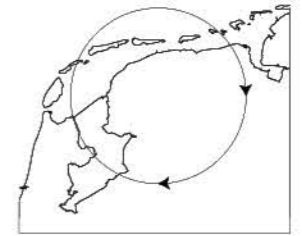


Structure

- Agrotourism*
- Carbon Trade*
- Recreation*
- Increased Connectivity with Nature*
- Biomass Production*
- Natura 2000 Buffer Zone*
- Peat Restoration*
- De Carbonisation*
- Natura 2000*
- Water Seepage Prevention*
- Blocking Drainage Channels*
- Diverse Landscape/ Grassland*



Design Principle



Mitigation and Climate Adaptation



Natura 2000 Buffer Zone ●
 Natura 2000 ●

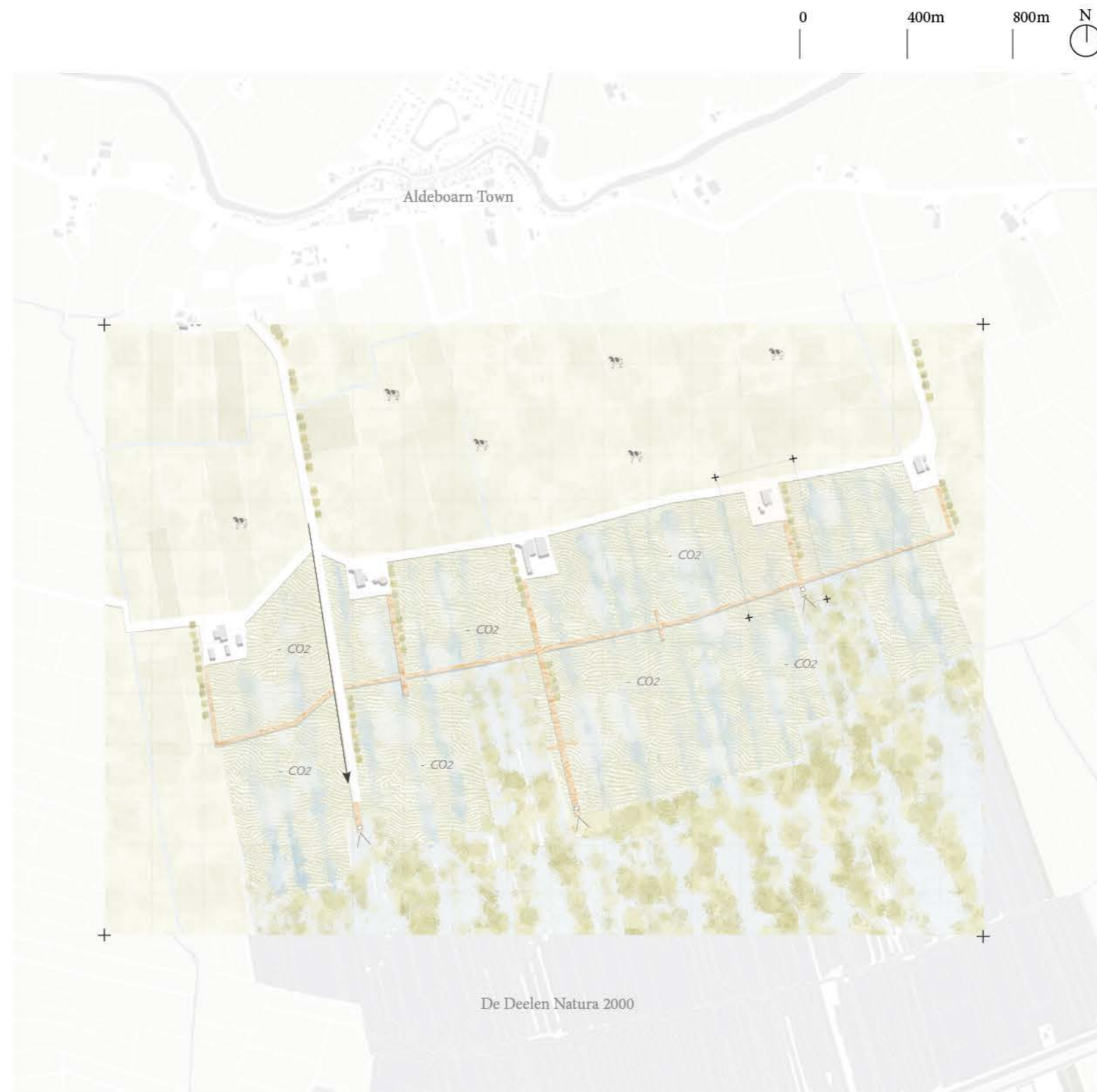
Establishing Carbon Banks 2035



Aldeboarn Town

Clay Belt

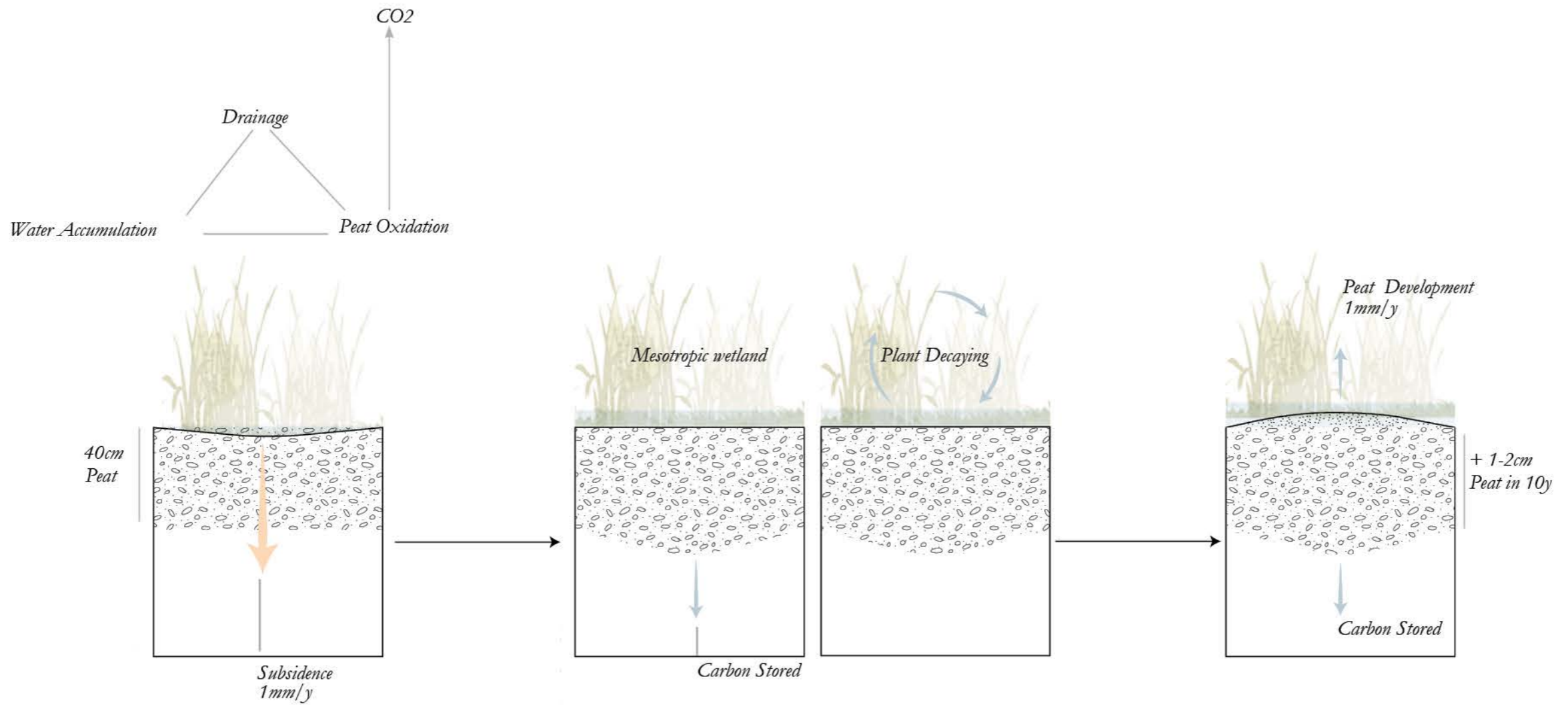
De Deelen Natura 2000
Peat Bog



De Deelen Carbon Bank 2035



De Deelen Carbon Bank



Peat Restoration Process



Peatlands

<https://www.bohinj.si/en/aktivnost/gorejke-peat-bog/>



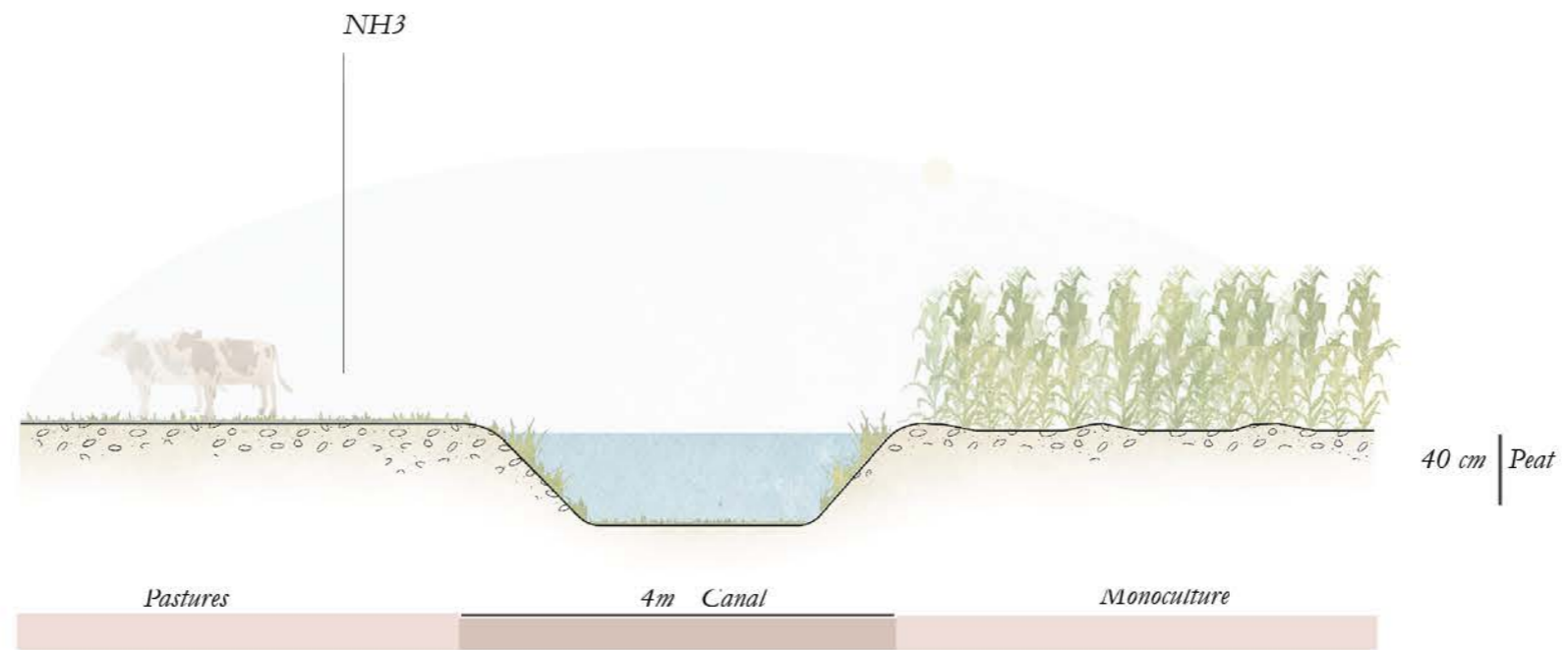
Peatlands

<https://www.bohinj.si/en/aktivnost/gorejke-peat-bog/>

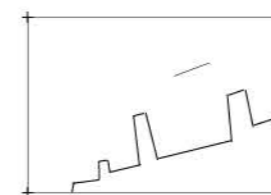


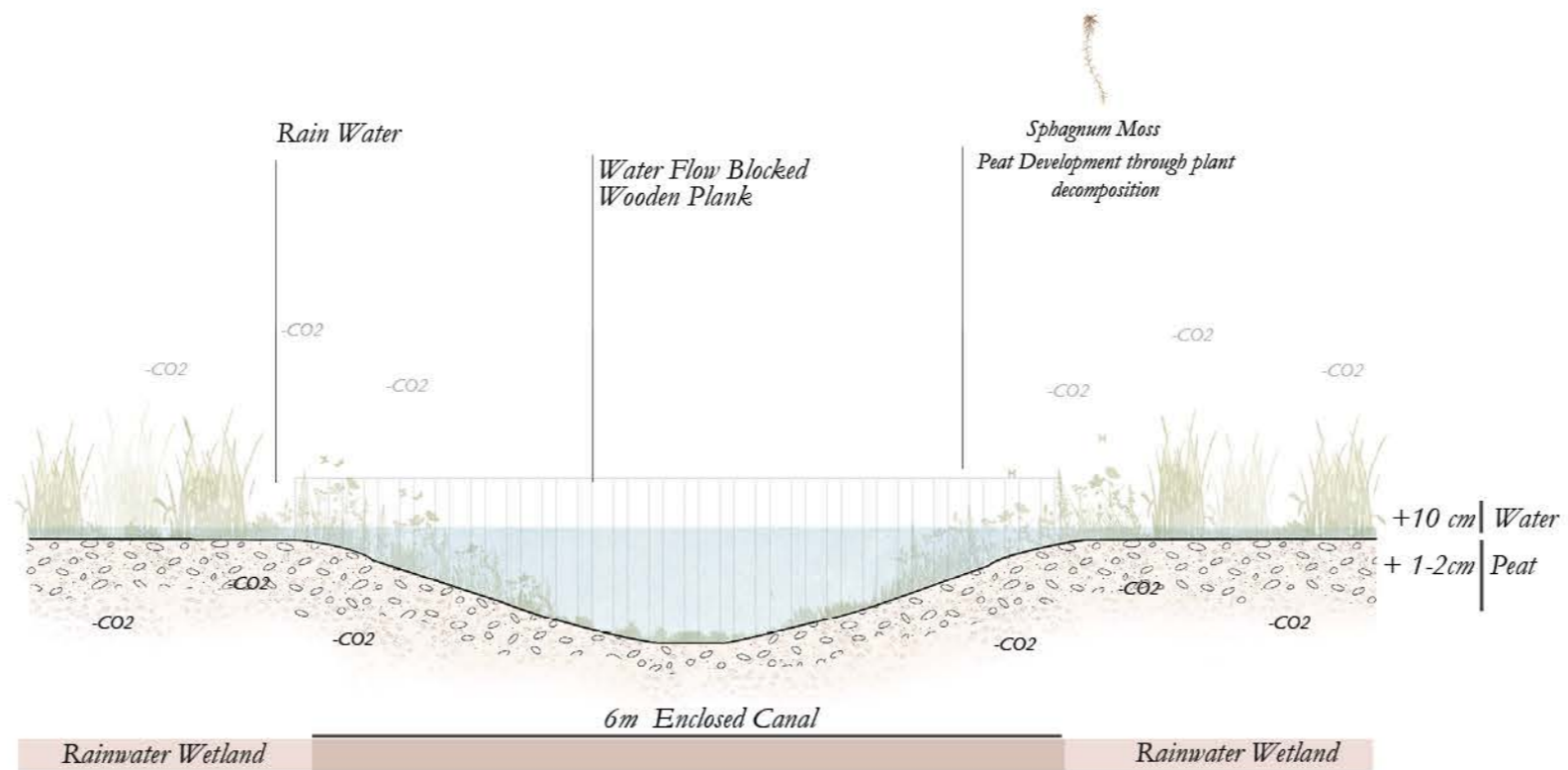
*Peat Restoration Technique
Blocking Drainage Channels*

Images: <https://www.forestofbowland.com/peatland-restoration>

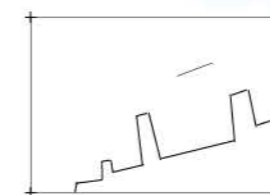
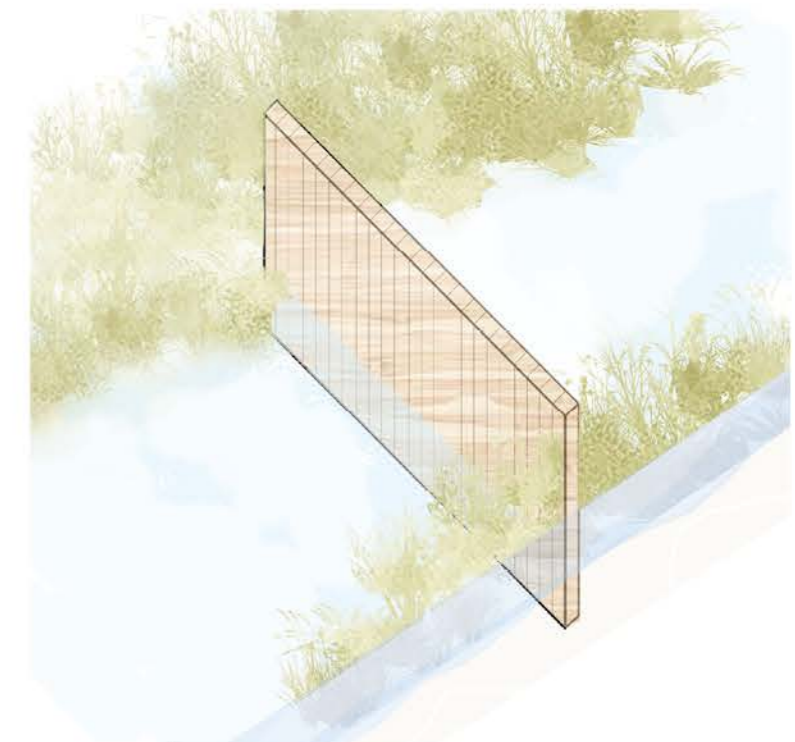


*Peat Restoration Technique
Blocking Drainage Channels 2023*



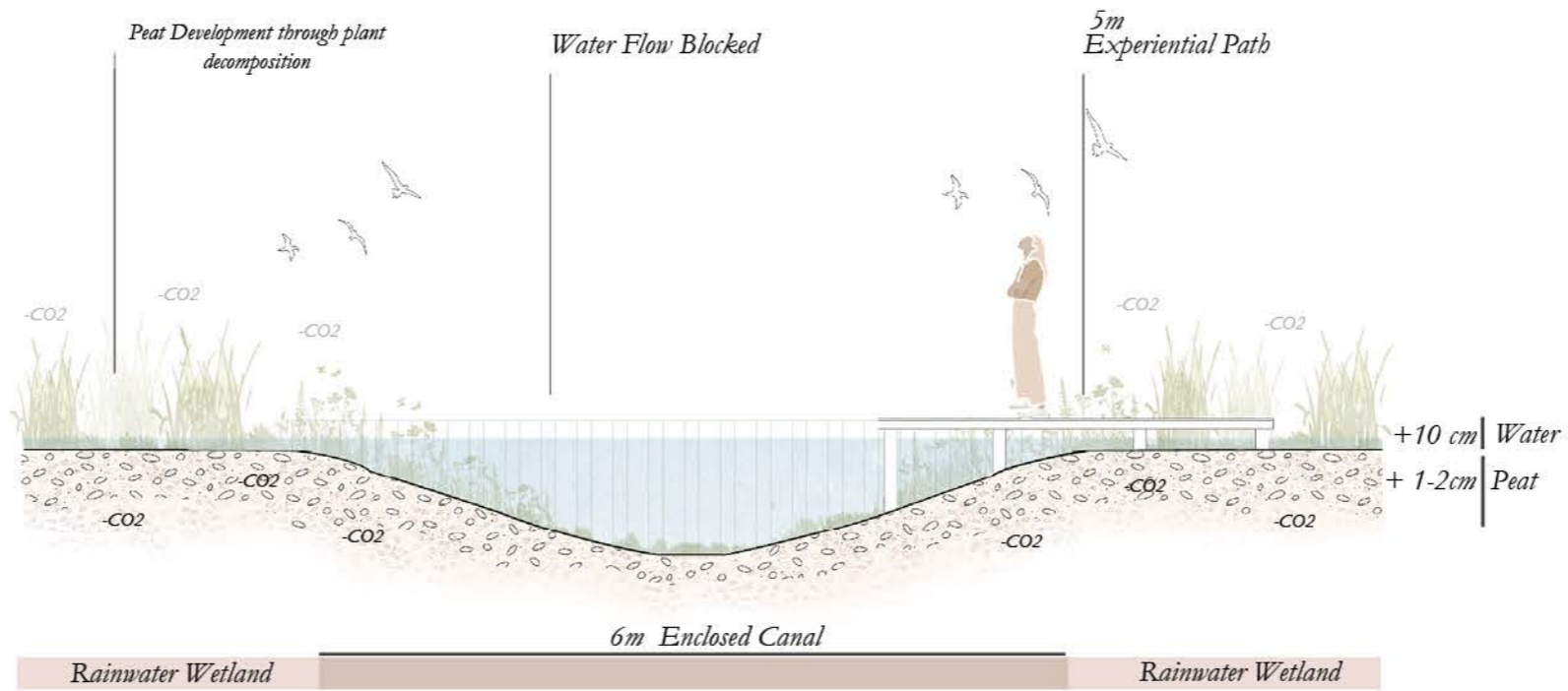


Peat Species



Peat Restoration Technique
Blocking Drainage Channels 2035

Images: <https://www.forestofbowland.com/peatland-restoration>



Reptiles



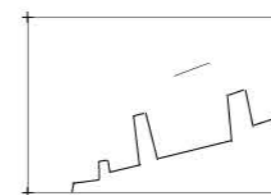
Invertebrates

Birds

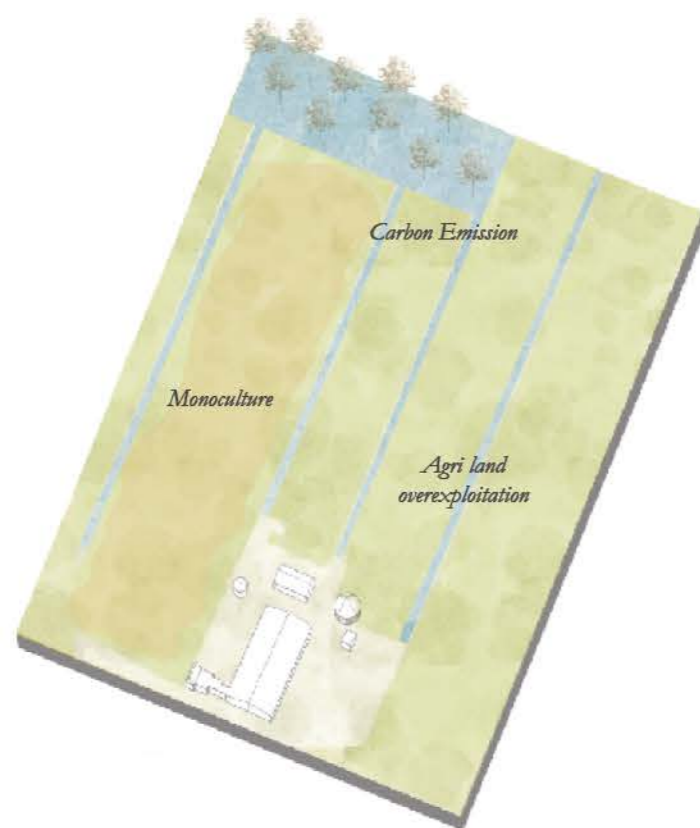


Peat Restoration Technique
Blocking Drainage Channels 2035

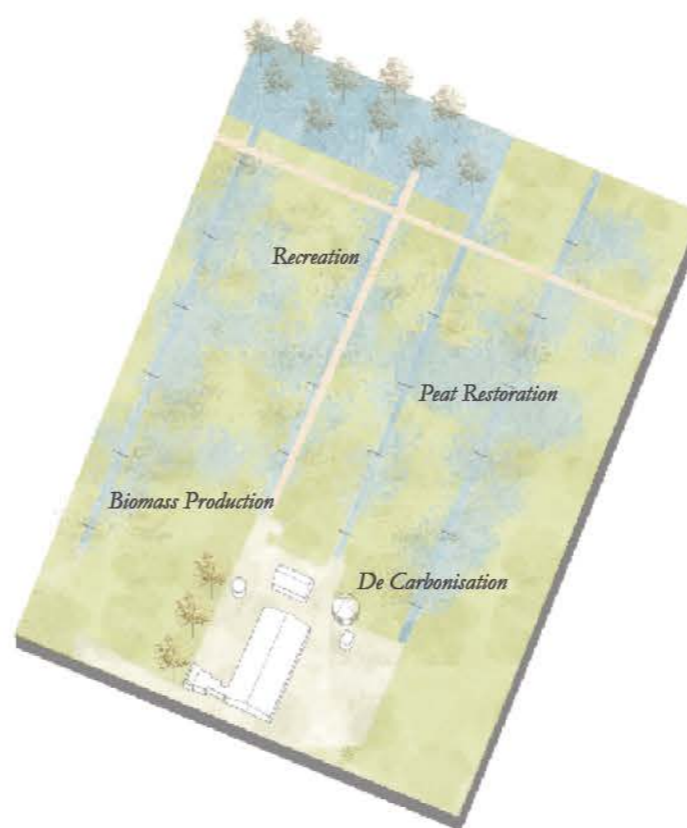
Images: <https://www.forestofbowland.com/peatland-restoration>



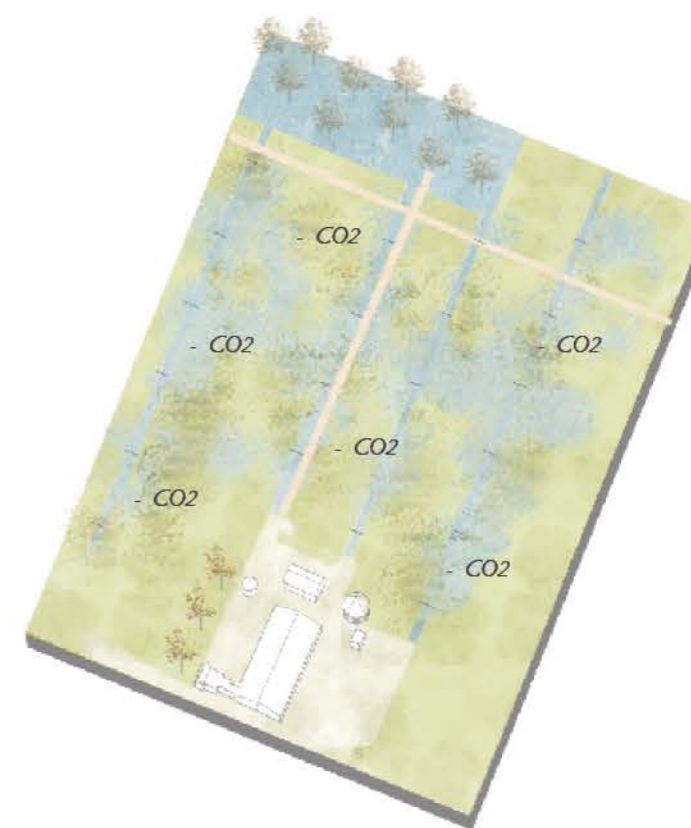
2023



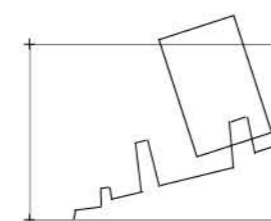
2025



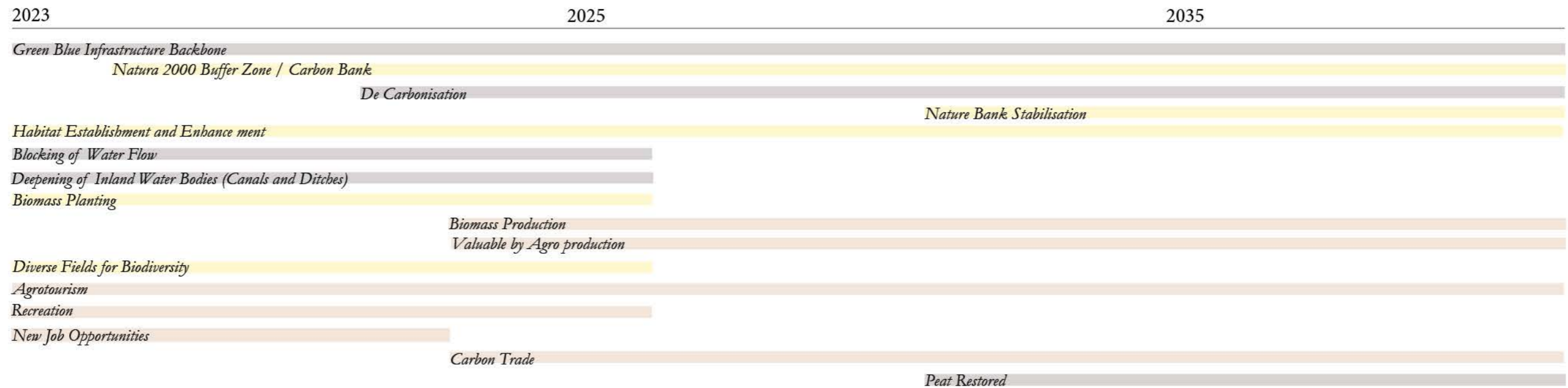
2035



*De Deelen Carbon Bank Farm
Carbon and Biomass Farming
Alternative Future*



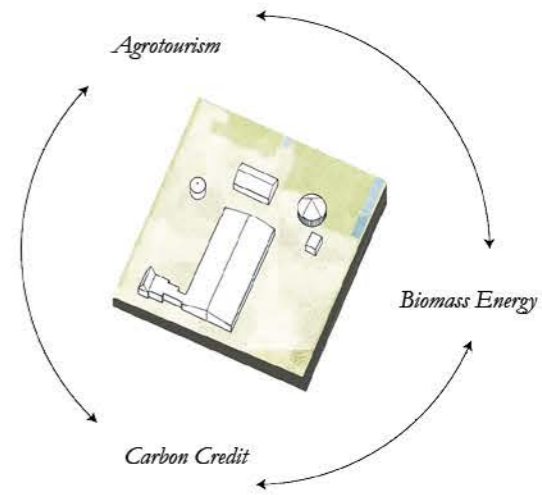
Timeline



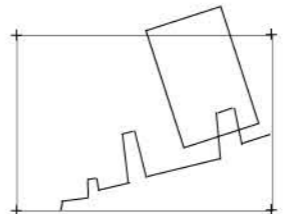
- Culture, Socio-Economy ●
- Habitat ●
- Water / Soil ●



Alternative Economy



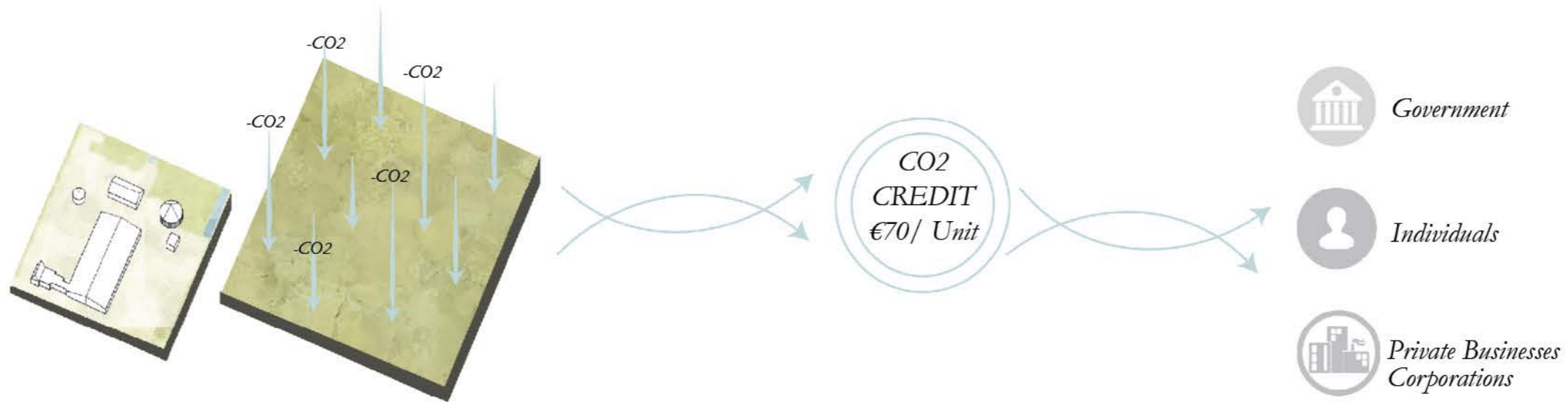
*De Deelen Carbon Bank Farm
Carbon and Biomass Farming
Alternative Future*

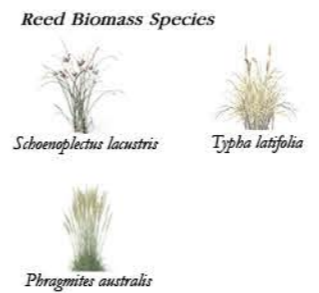
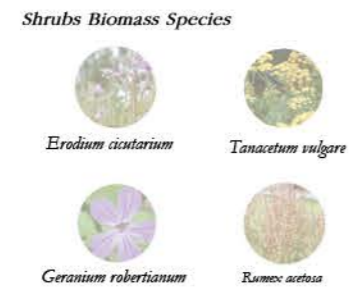
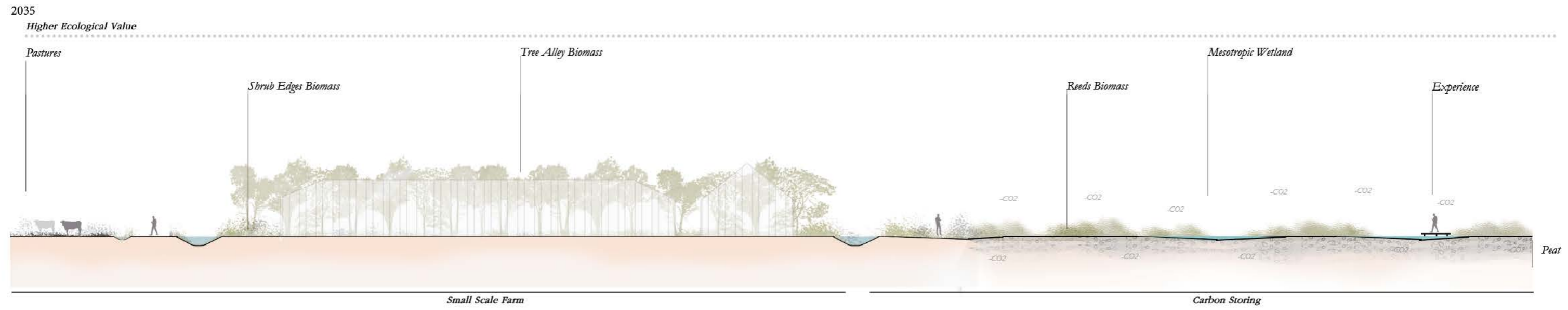




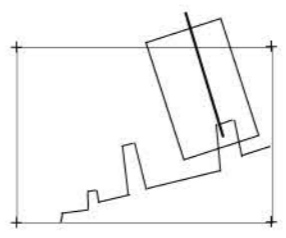
"Lytse Deelen" experimental carbon farm

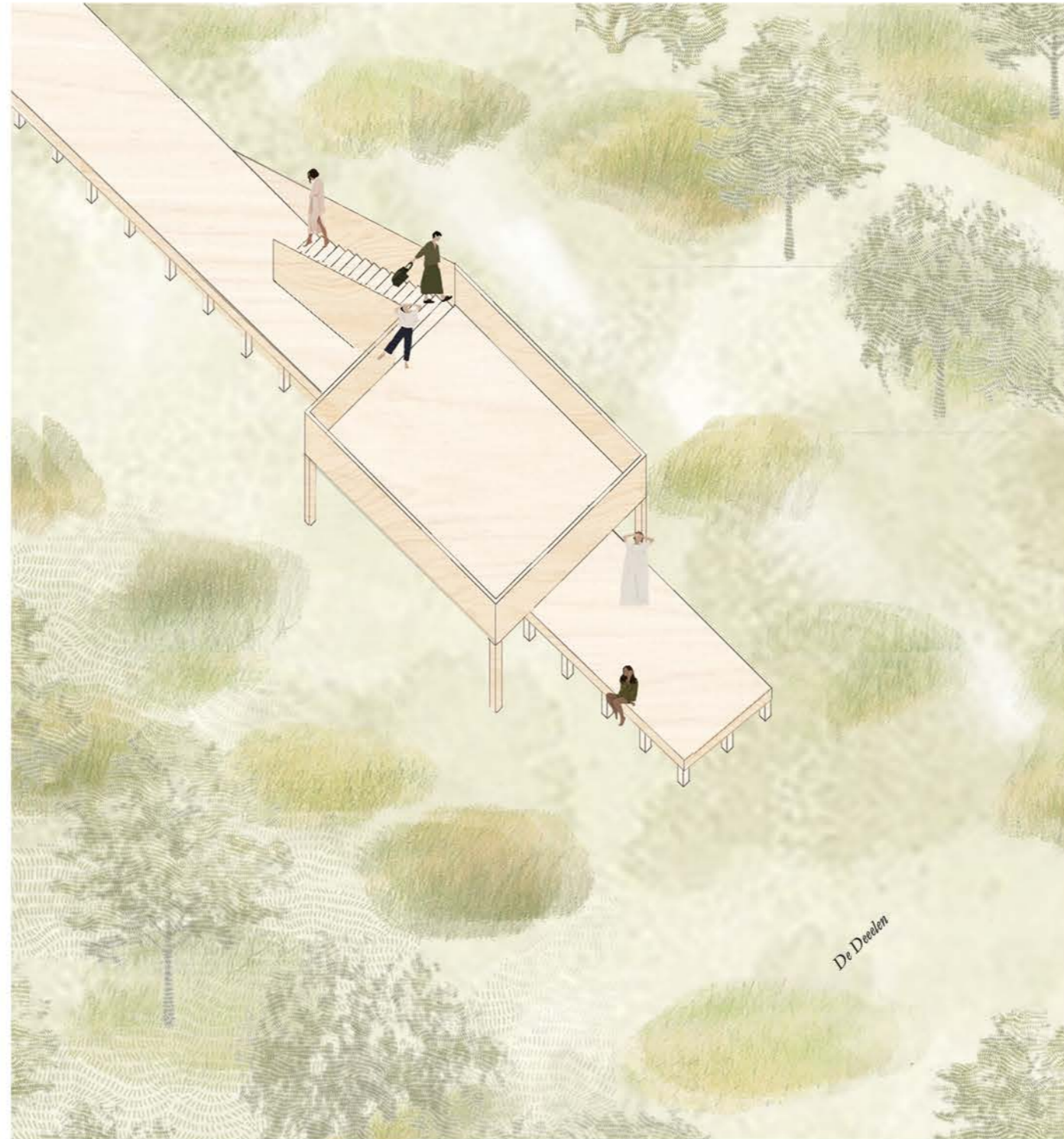
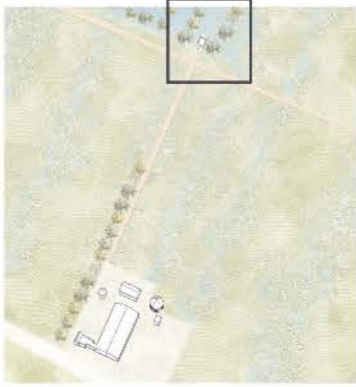
- Successful carbon credit farm model



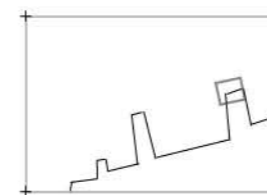


De Deelen Carbon Bank
Carbon and Biomass Farming
Alternative Economy



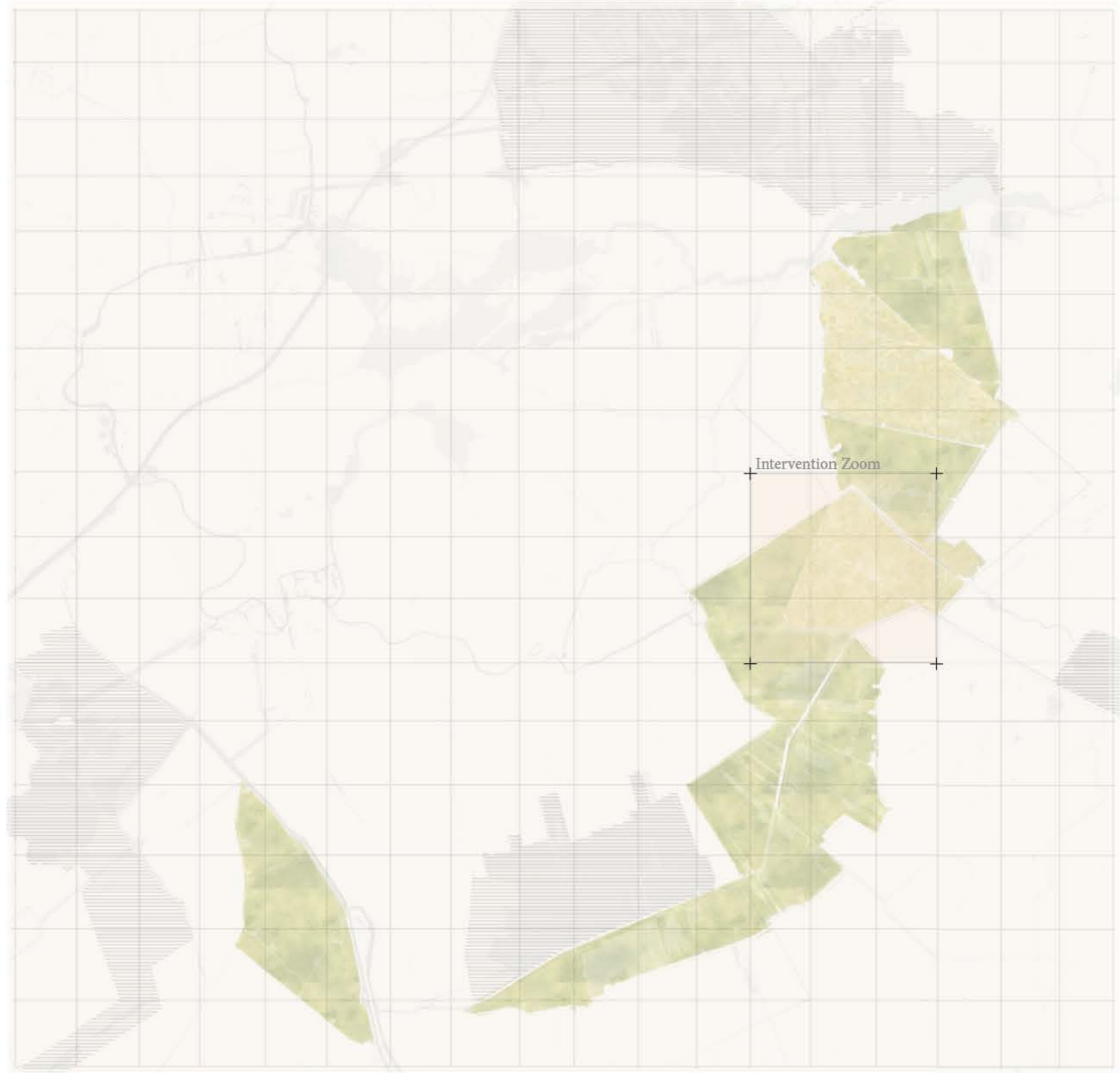


*De Deelen Carbon Bank
Experience*

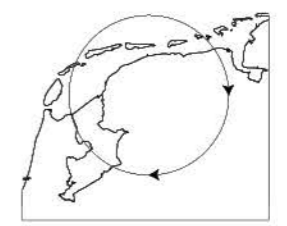




*De Deelen Carbon Bank
Experience*



Design Principle



Mitigation and Climate Adaptation

- Rice Paludiculture ●
- Cranberry Paludiculture ●

Paludiculture 2035



Dijk

Polder

Boezem



Paludiculture

“Paludiculture is the practice of crop production on wet soils, predominantly occurring on peatlands”

Radbound University



“Better Wetter” experimental farm
- Successful wet crops in Friesland



Oryza sativa



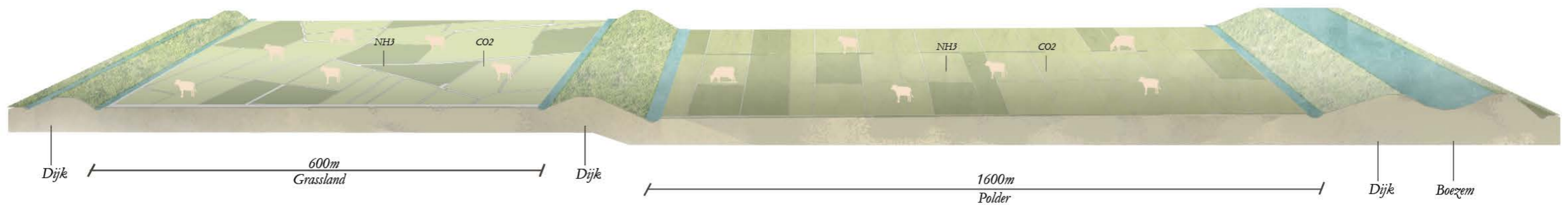
Vaccinium macrocarpon Ait.



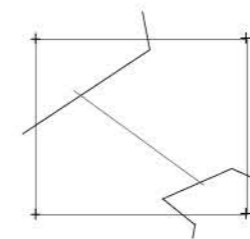
Typha Latifolia

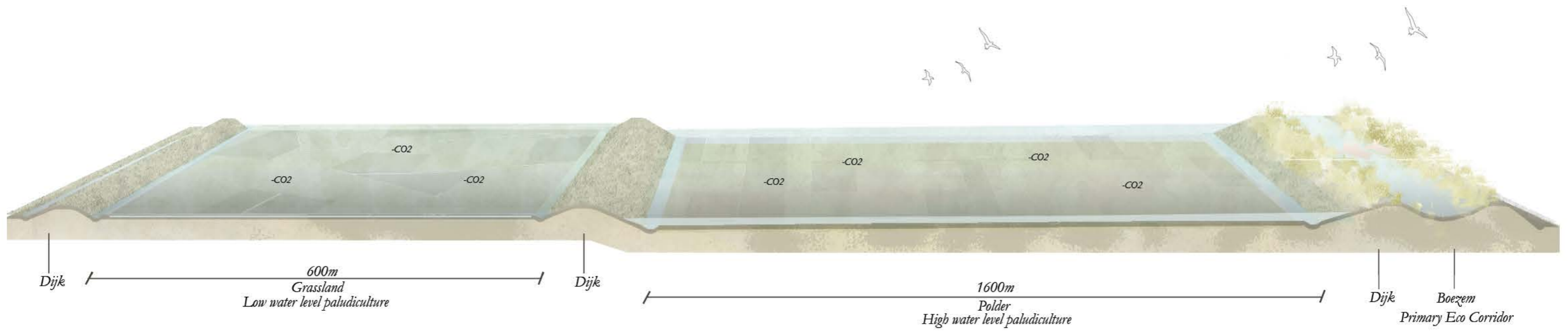


Phragmites australis

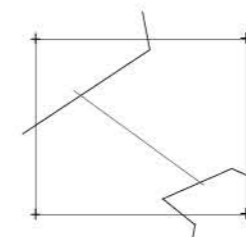


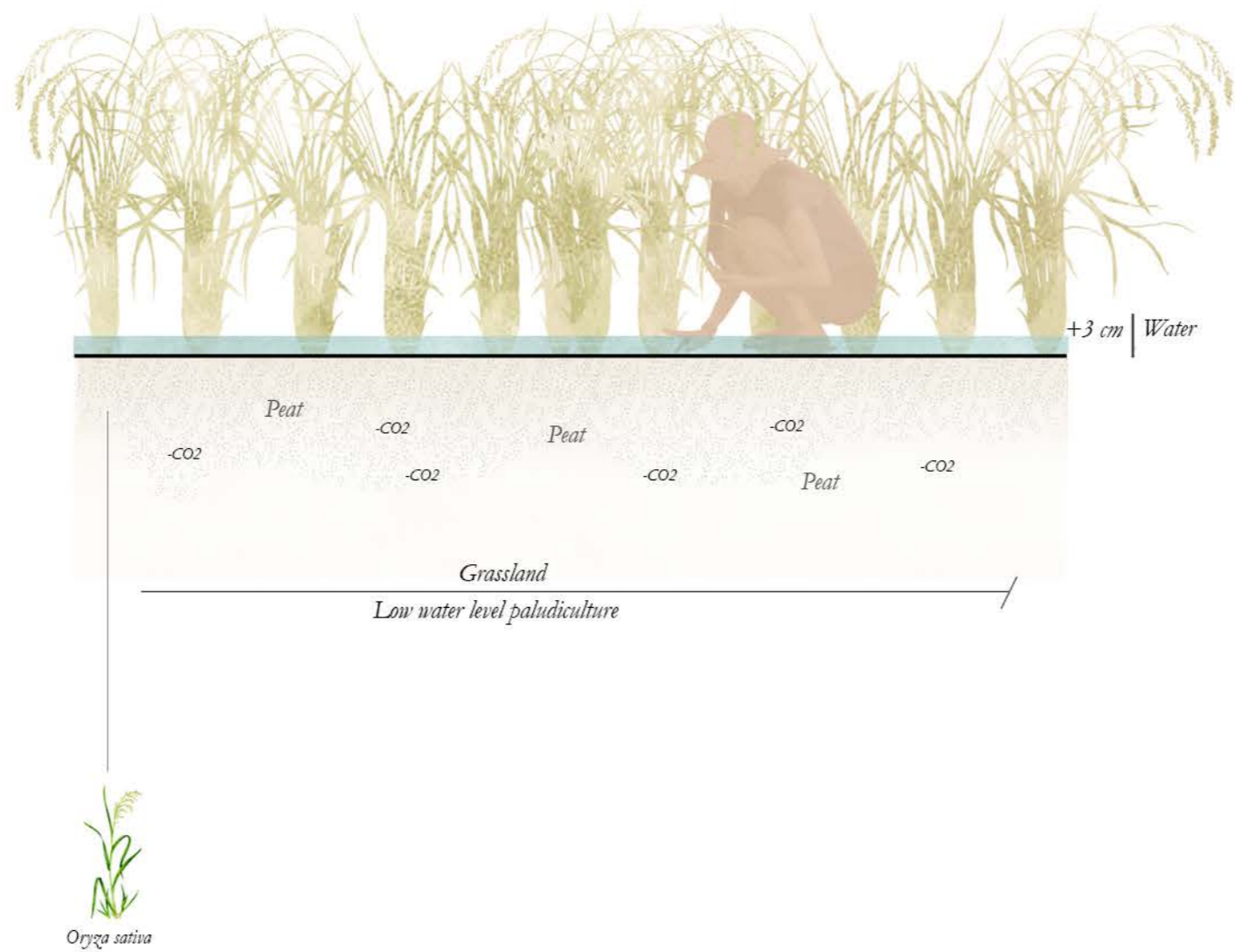
Paludiculture 2023



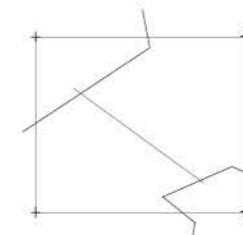


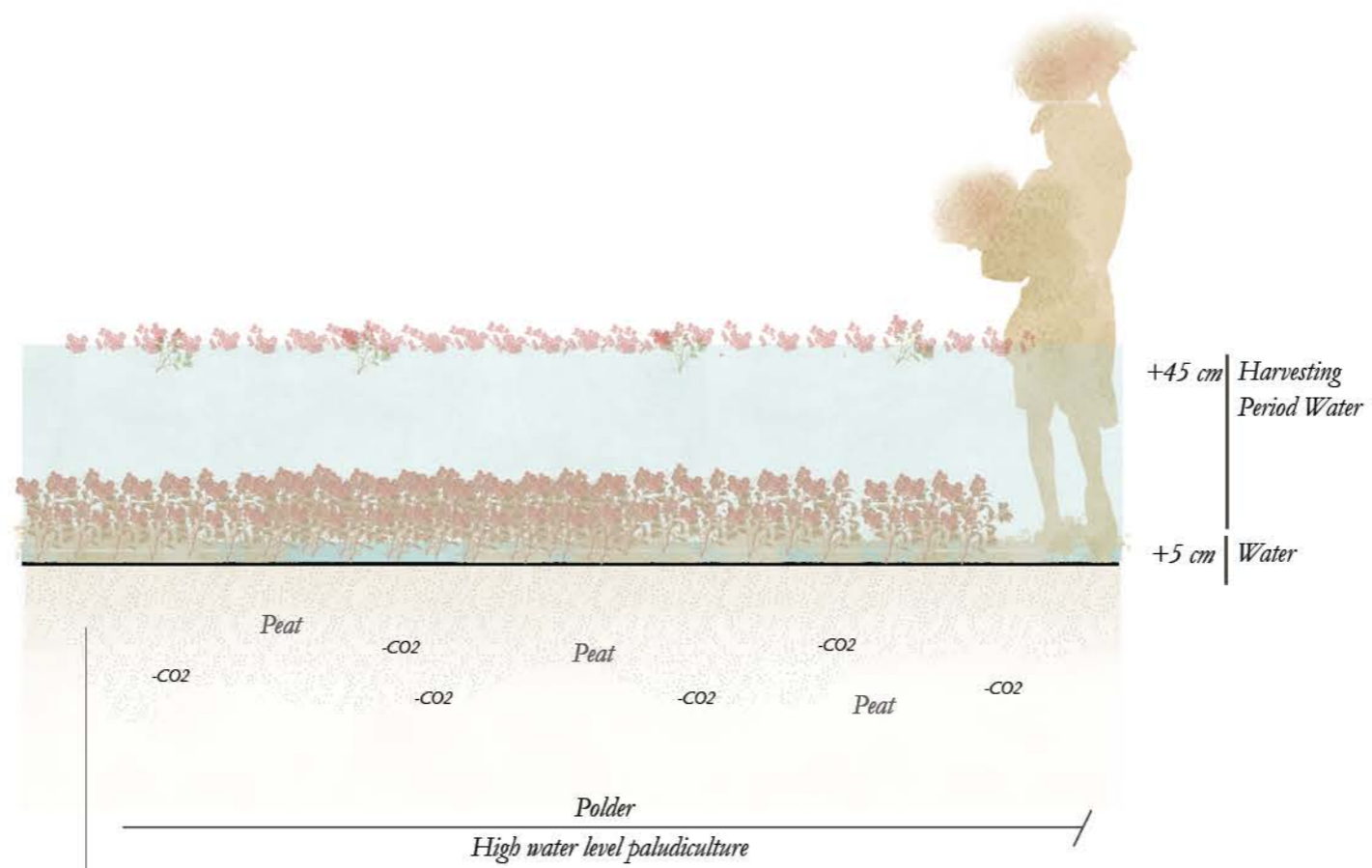
Paludiculture 2035



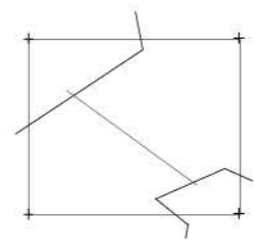


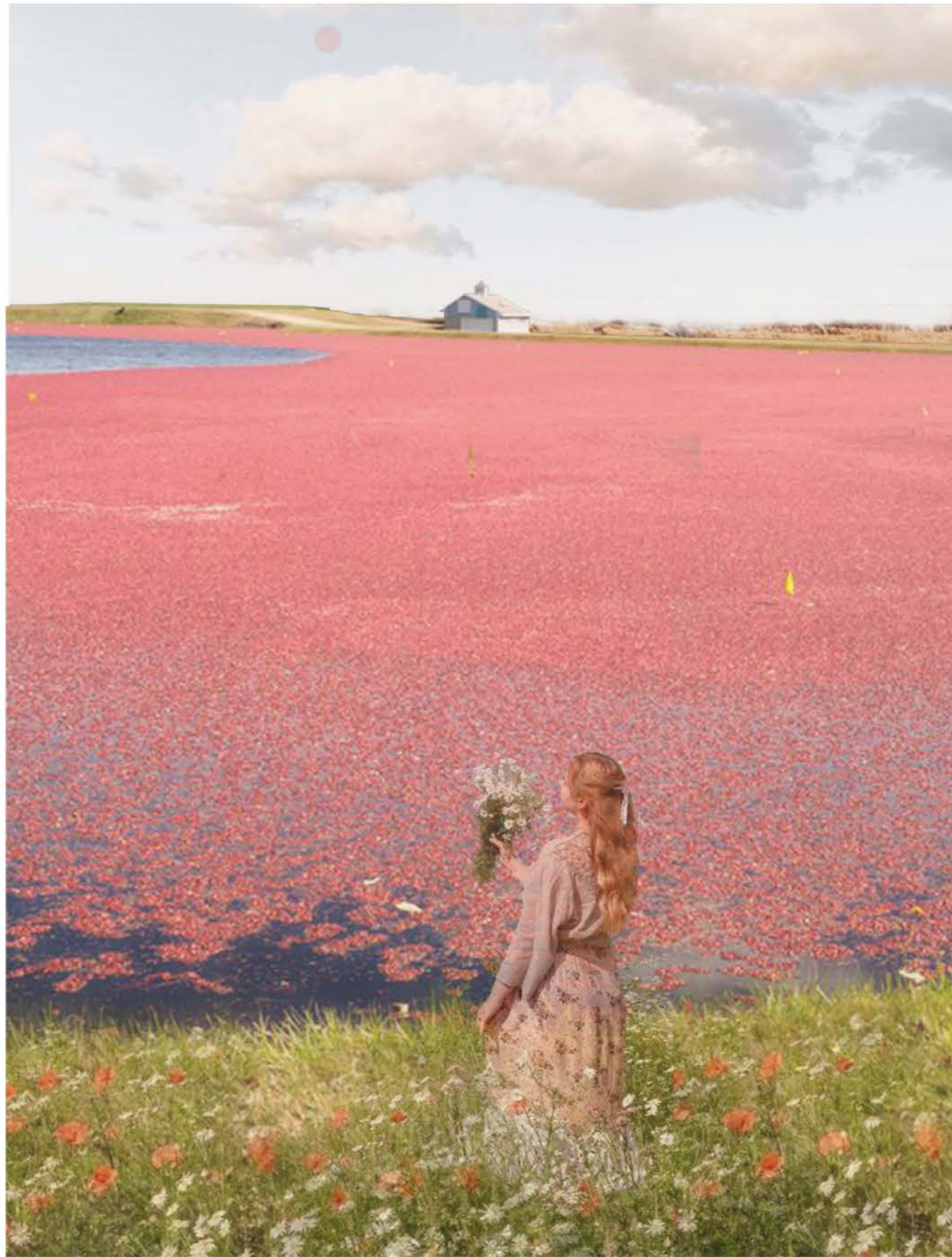
Paludiculture 2035



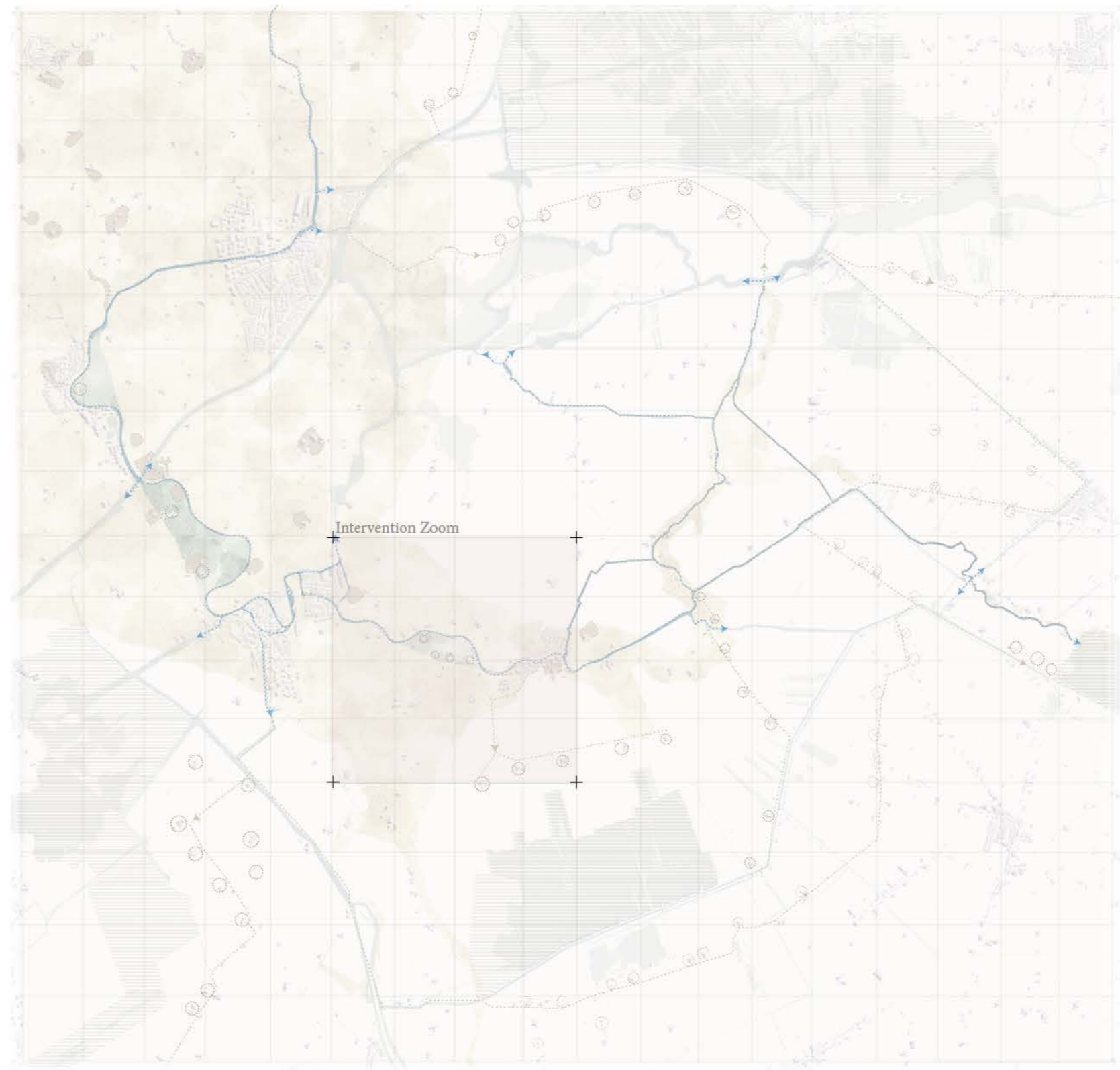


Paludiculture 2035

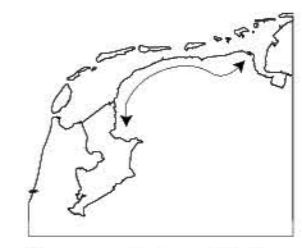




*Paludiculture
Experience*



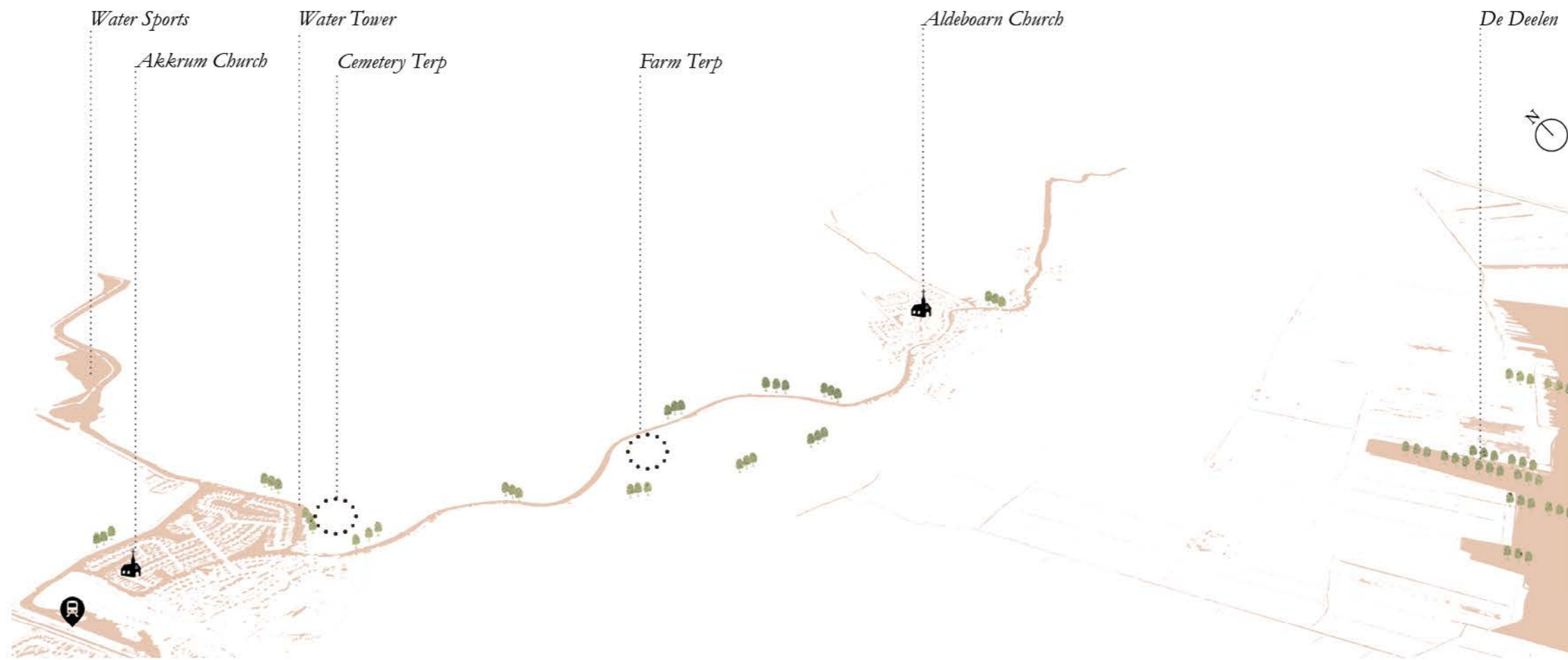
Design Principle



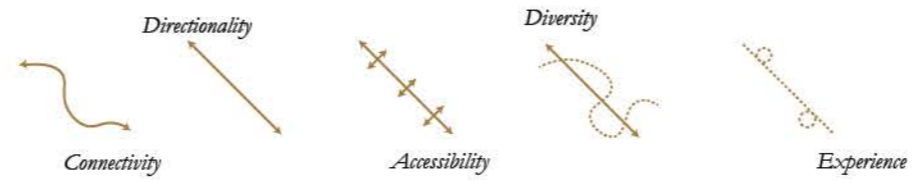
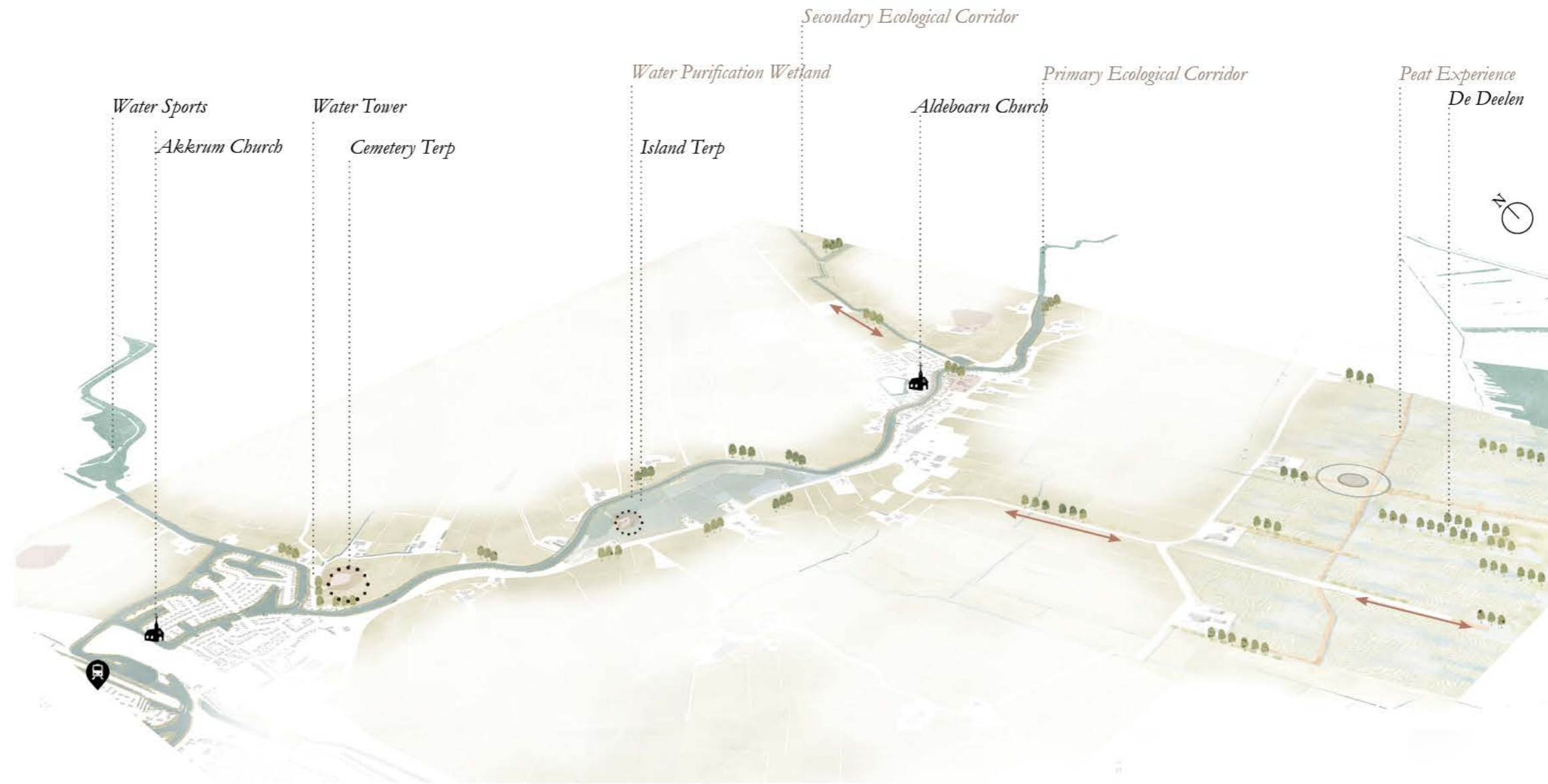
Stronger Cultural heritage

- Terps
- Backbone Cultural Route
- Secondary Cultural Routes
- Clay Soil
- Water Purification Wetlands
- Dairy Agriculture

Cultural Routing 2035



Routing 2023



Routing 2035



Views



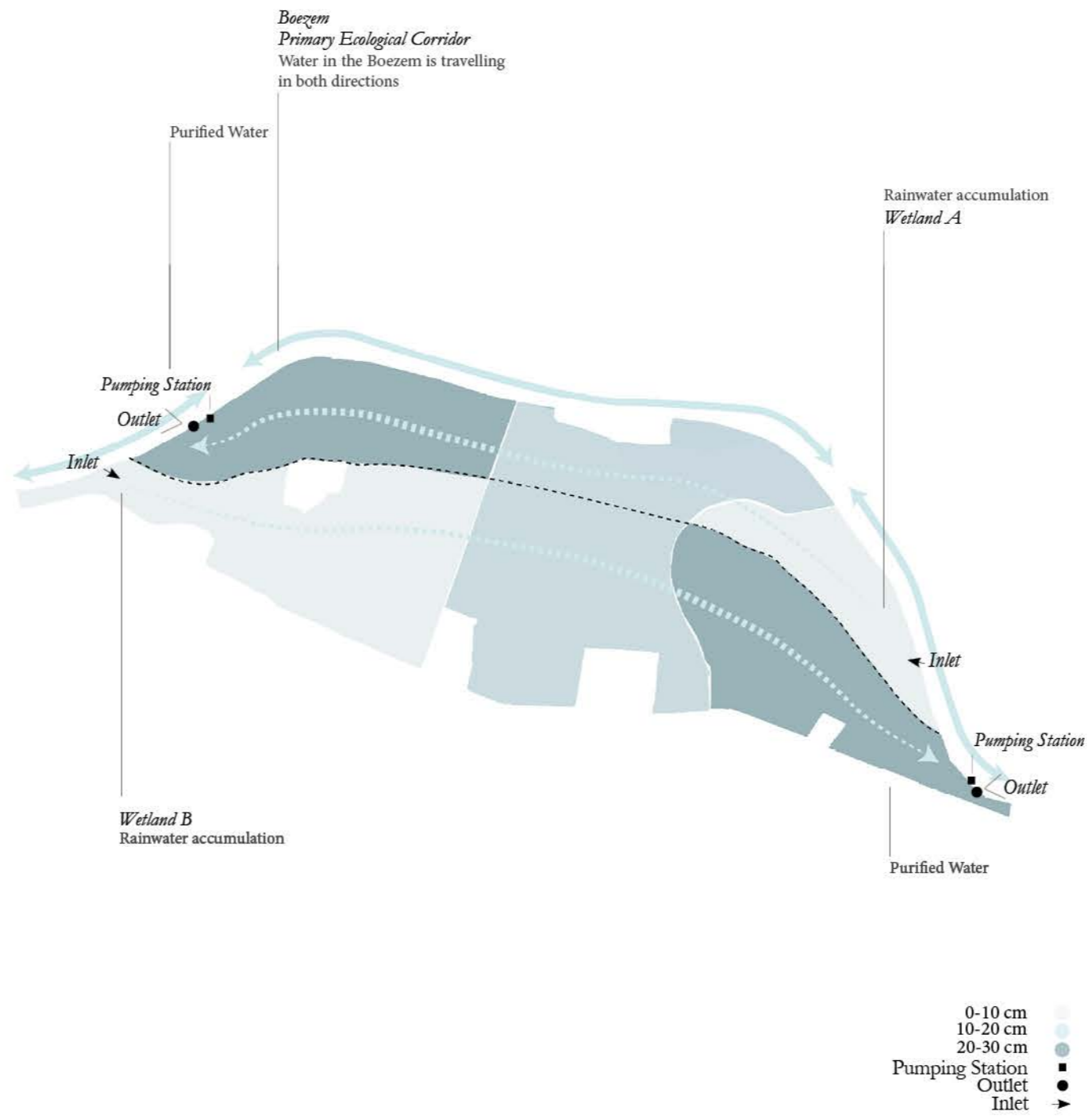
Private Water Access



Terp Farm

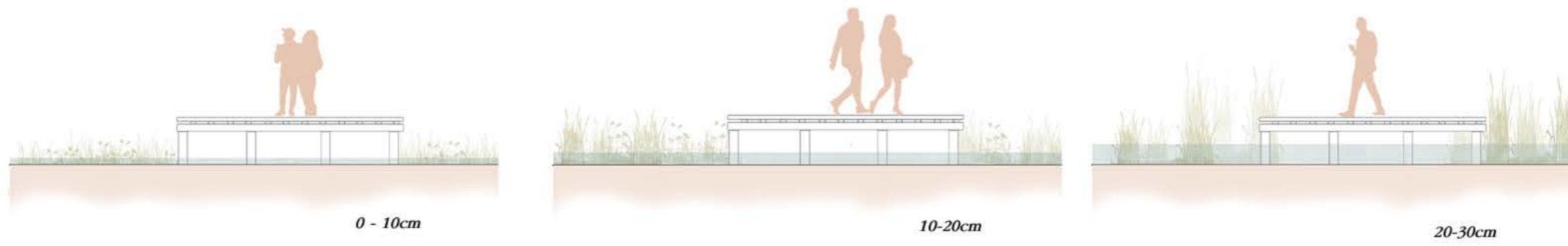


People Nature 2035



People Nature Constructed Wetland 2035

Water Depths



Callitriche spp



Veronica beccabunga



Equisetum fluviatile



Iris pseudocaris



Nasturtium officinale



Mentha aquatica



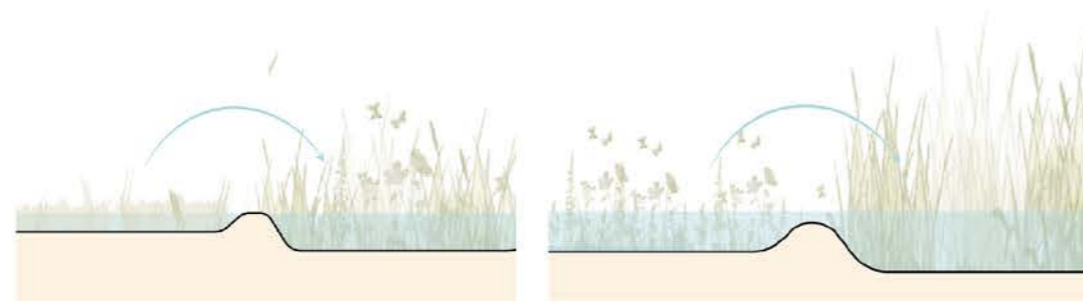
Phragmites australis



Schoenoplectus lacustris



Typha latifolia



Schematic Diagram



