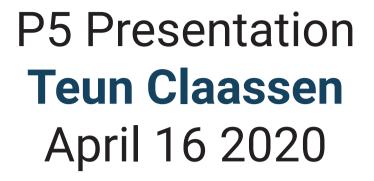
DROWNING DELTAS A STRATEGICAL SPATIAL APPROACH TO SOIL SUBSIDENCE IN DELFLAND



MSc Urbanism Urban metabolism

Mentors: Dr.ir. Marjolein Pijpers-van Esch & Dr. Arie Romein

TUDELFT Delft University of Technology

PROBLEM FIELD **RESEARCH SETUP** ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS

CONTENT

PROBLEM FIELD **RESEARCH SETUP** ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS



•

•

New Orleans
8 mm /year

•



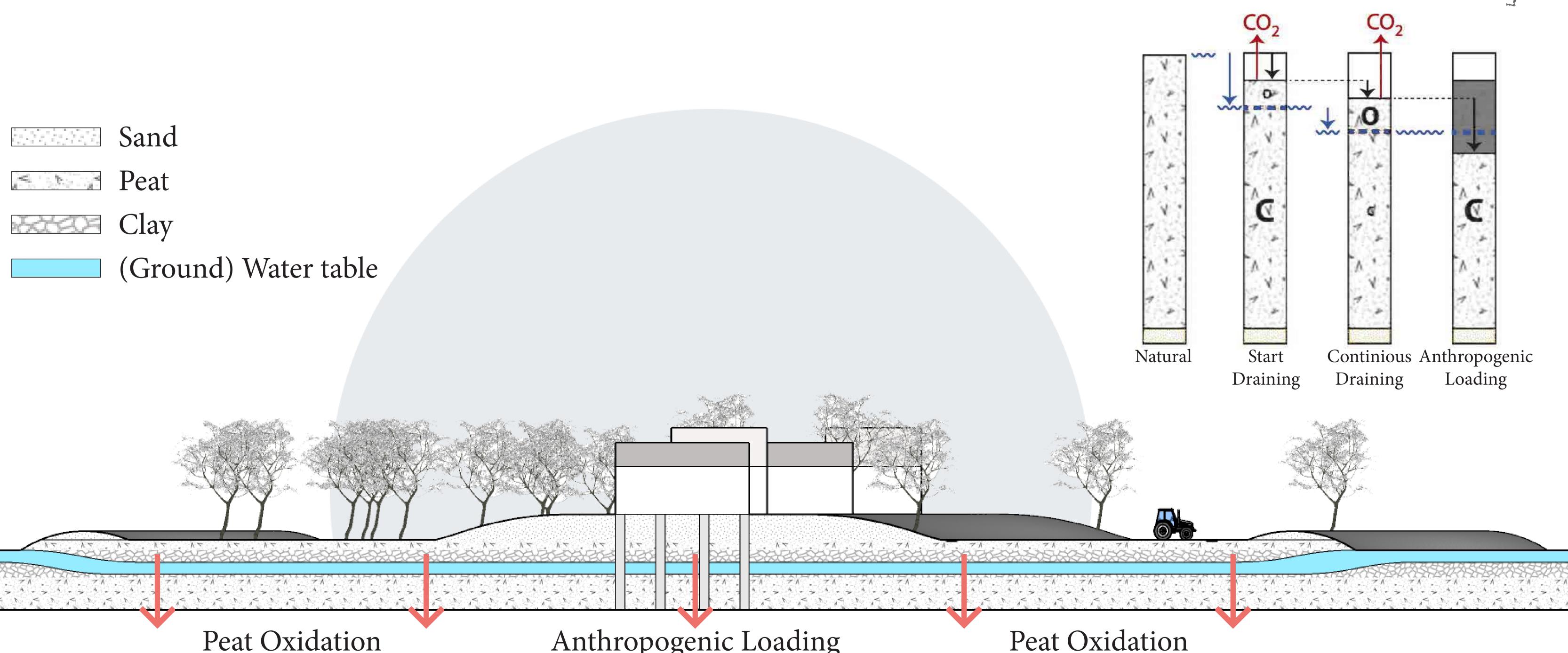
PROBLEM FIELD

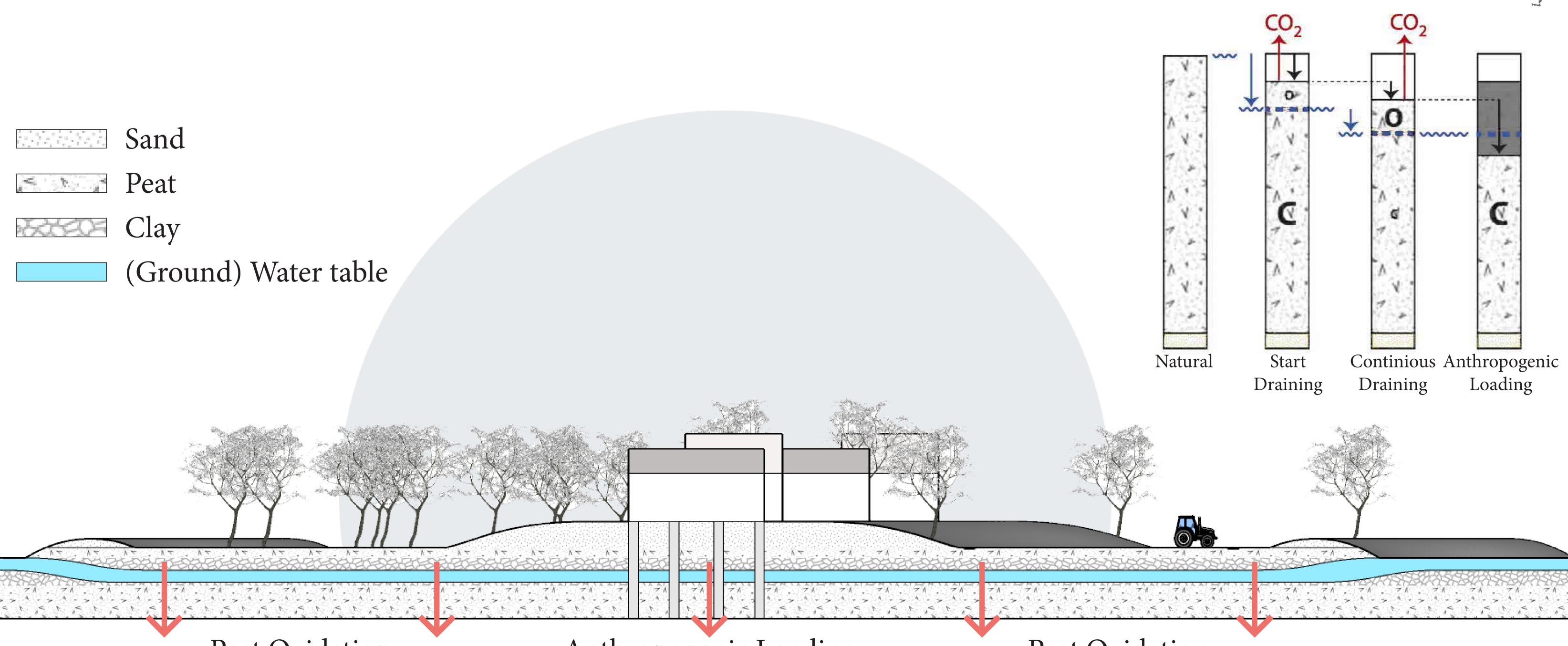
Manila /year • 45 mm /year

Ho Chi Minh City 80 mm /year

•Jakarta 20-30 mm /year

Source: Deltares, 2013

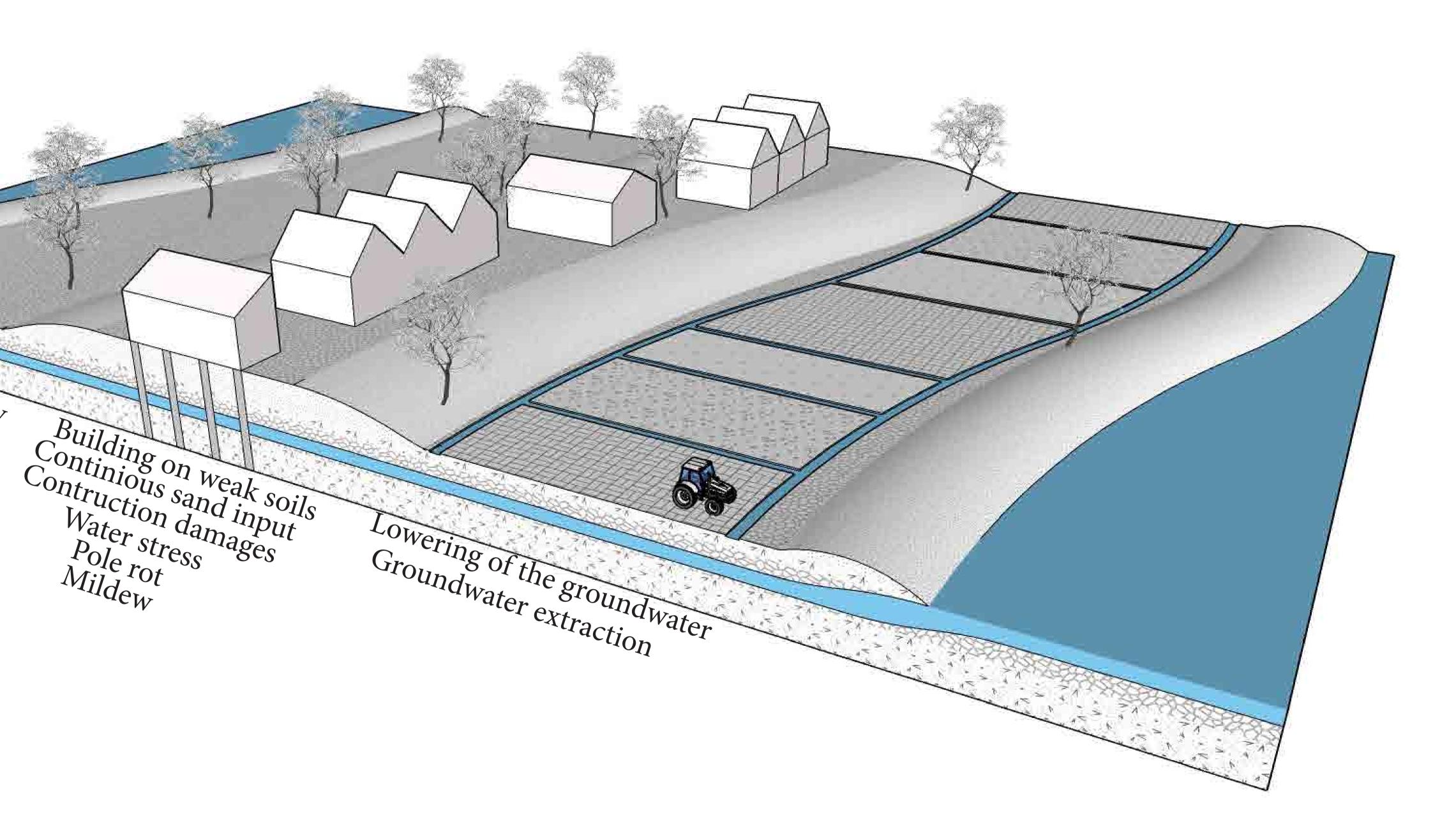


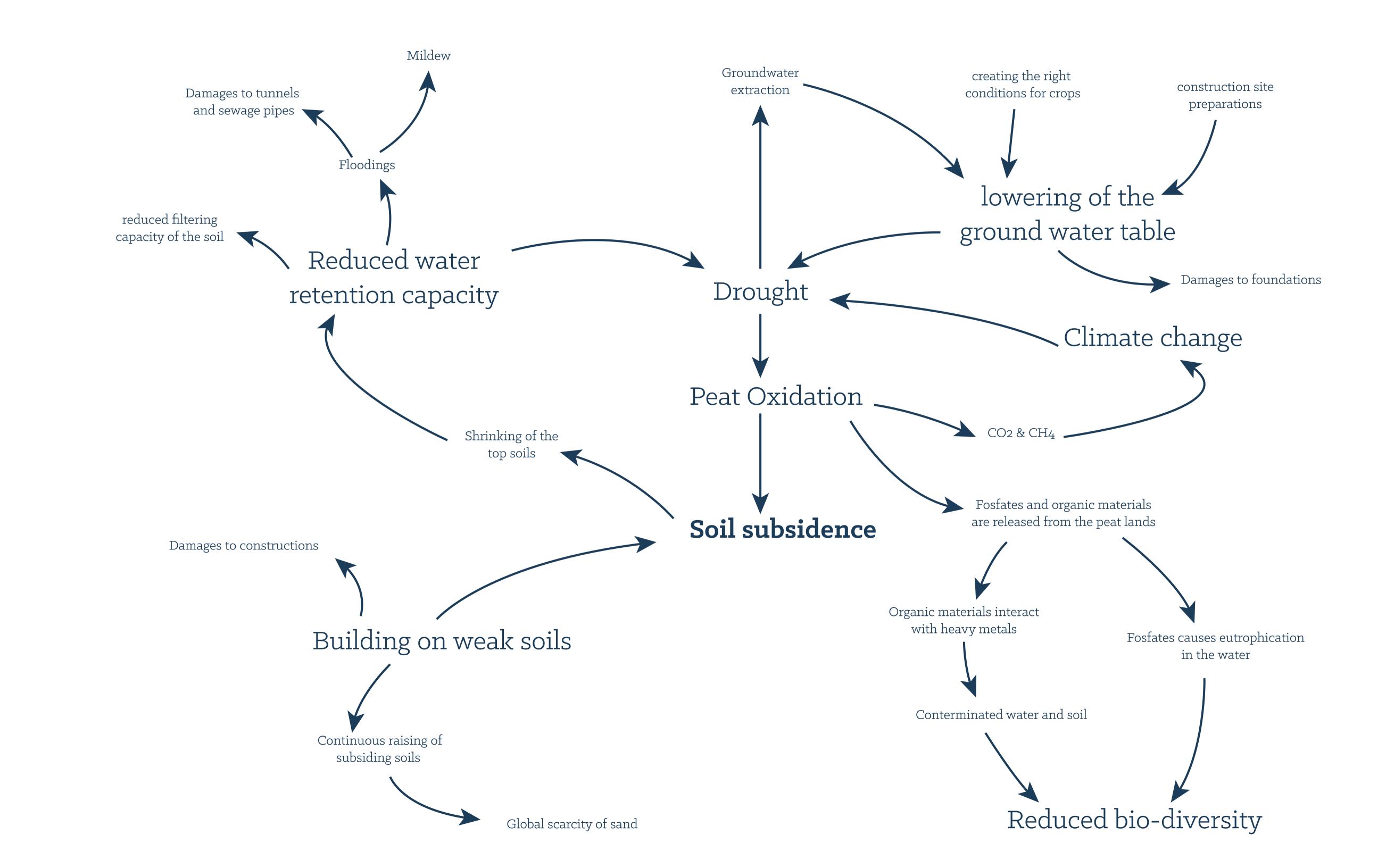


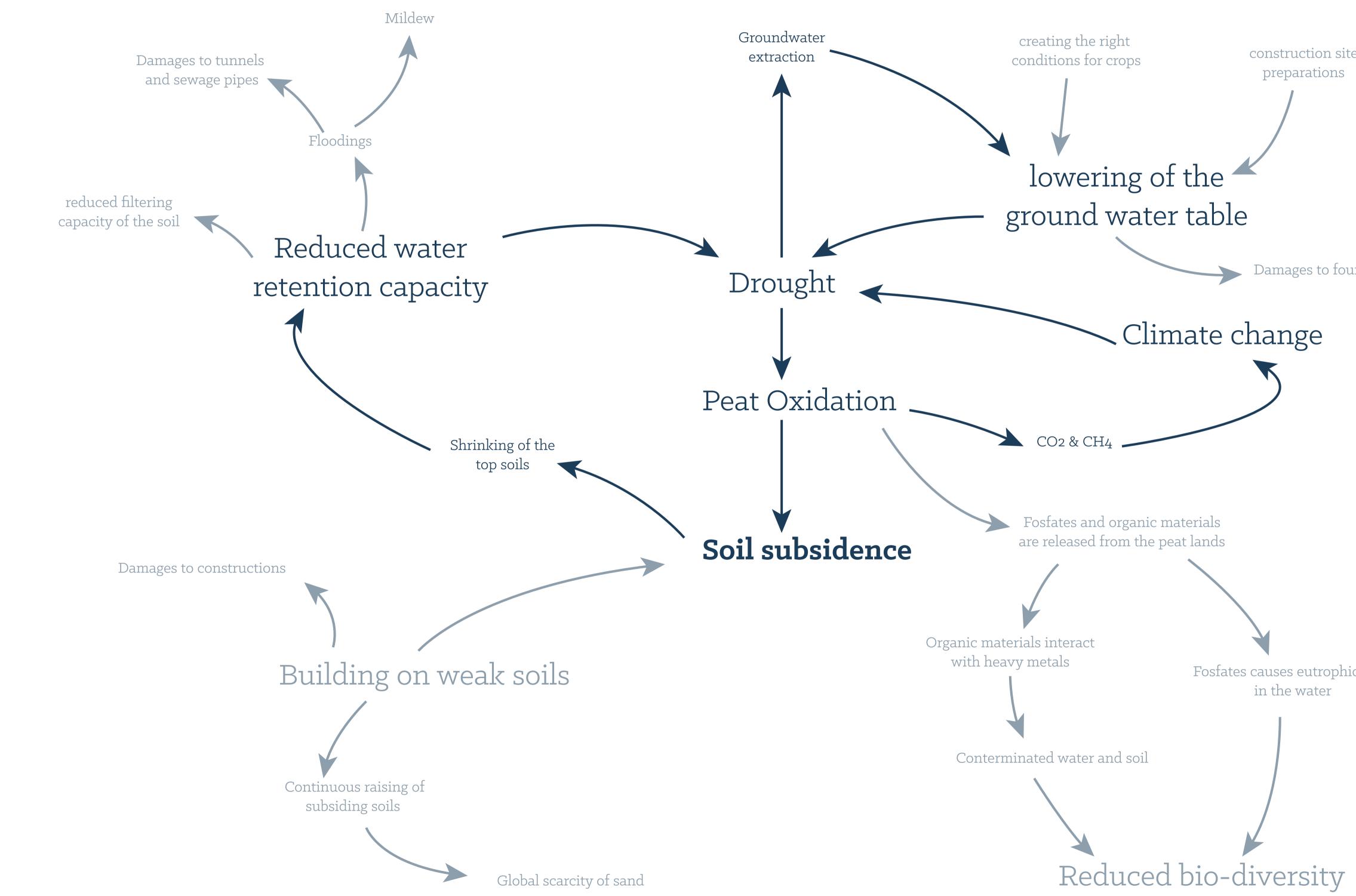


Anthropogenic Loading

Peat oxidation Shrinking of top soils Reduced water retention capacity Drought Reduced bio-diversity Eutrophication



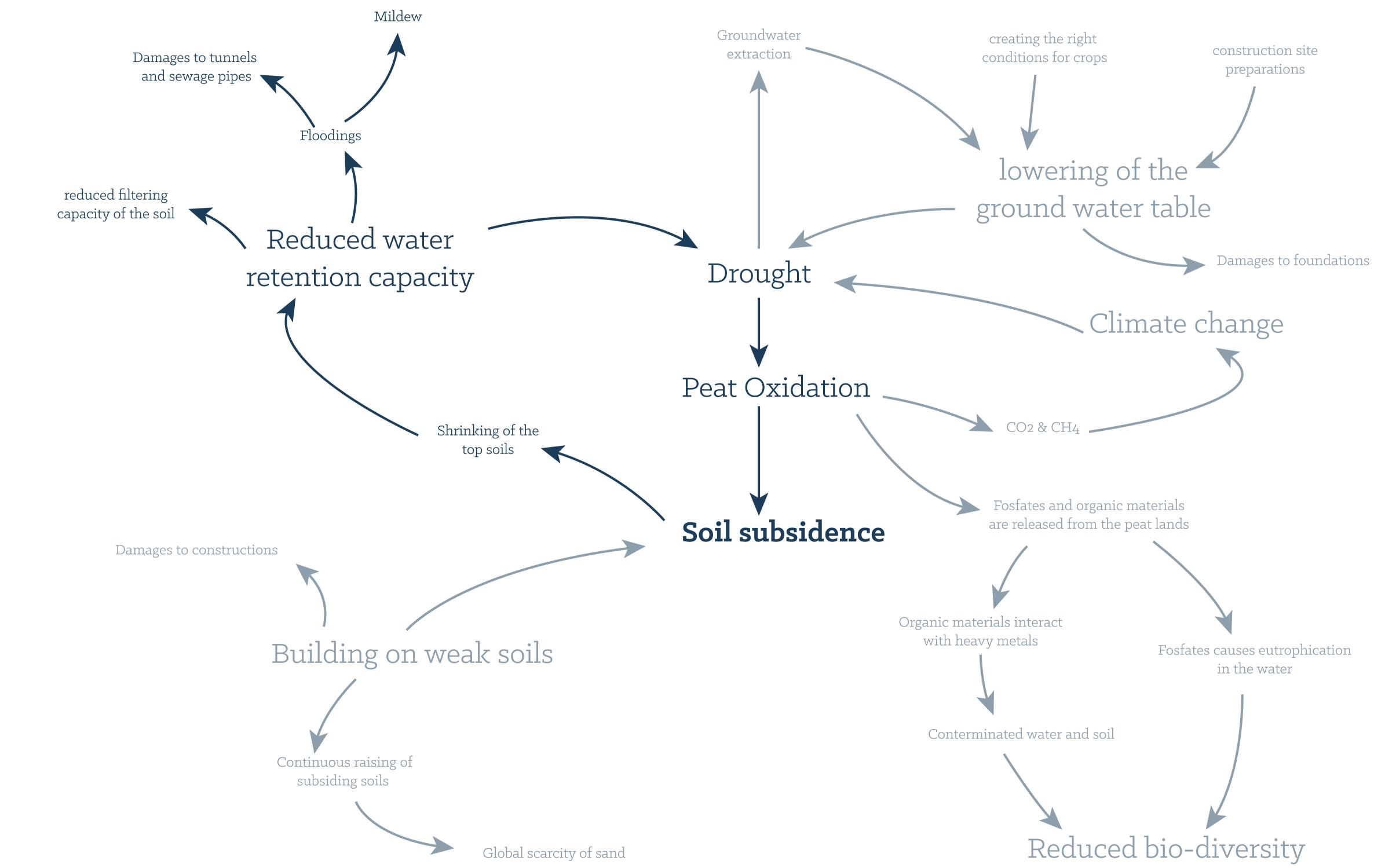


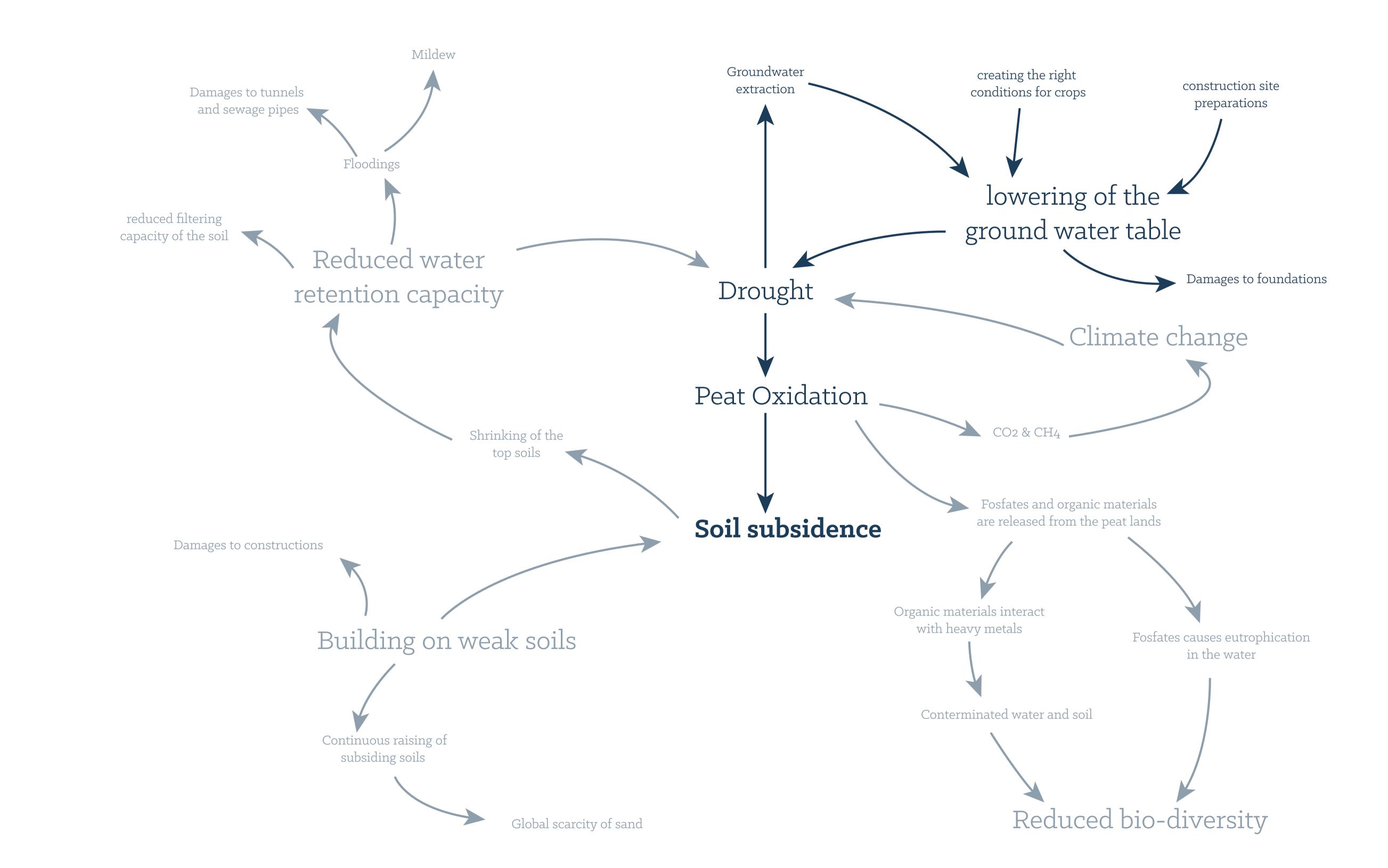


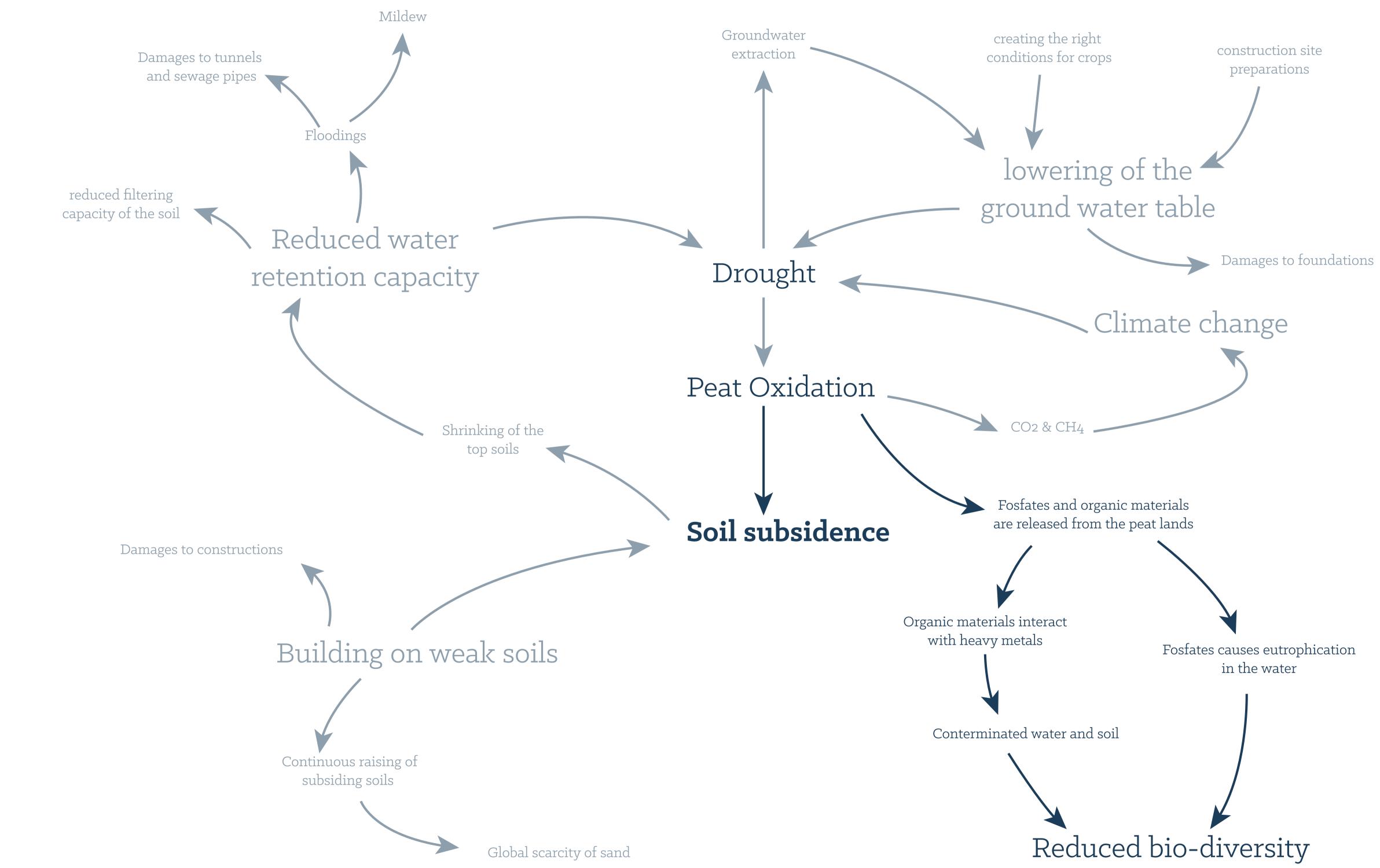
PROBLEM FIELD

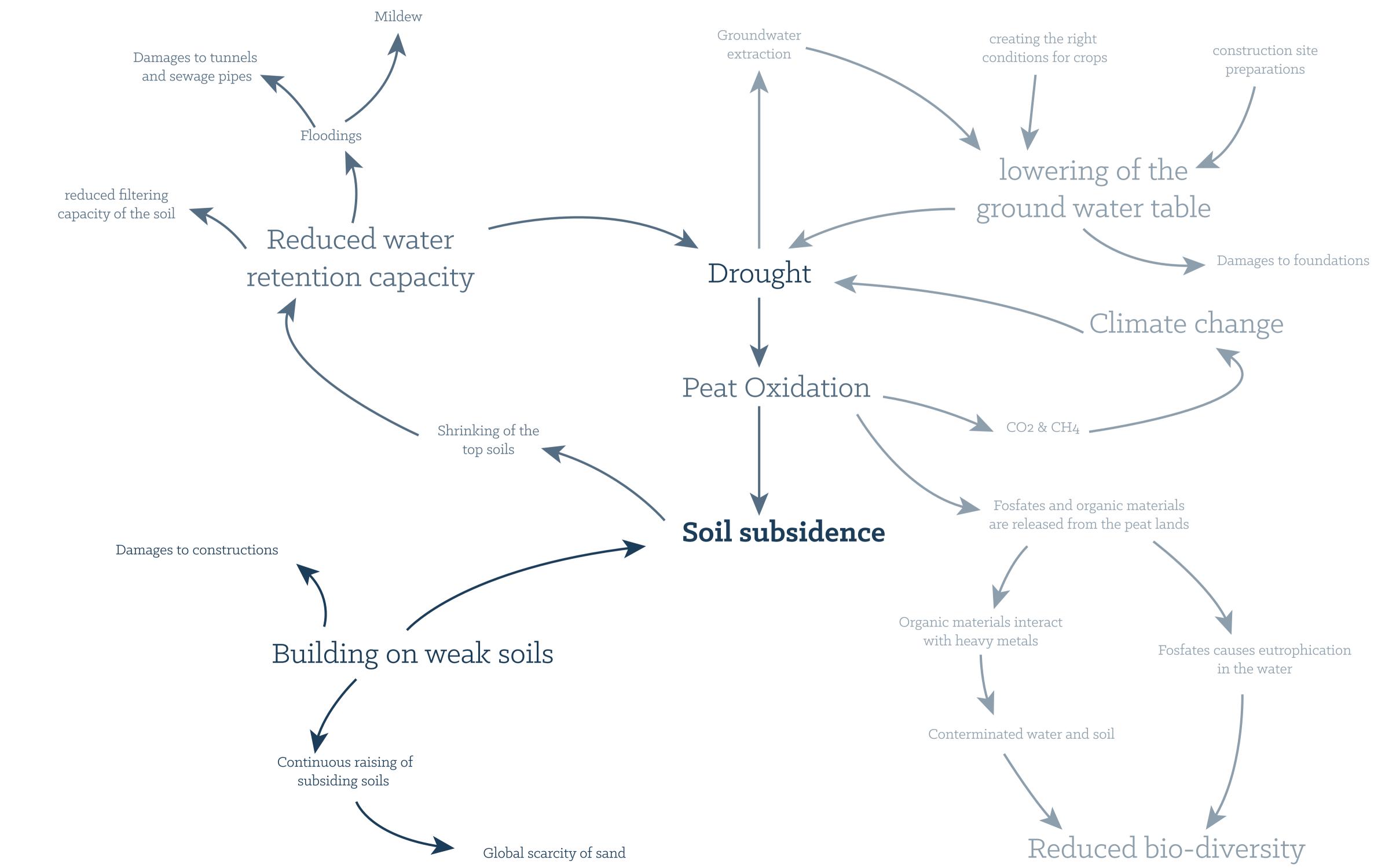


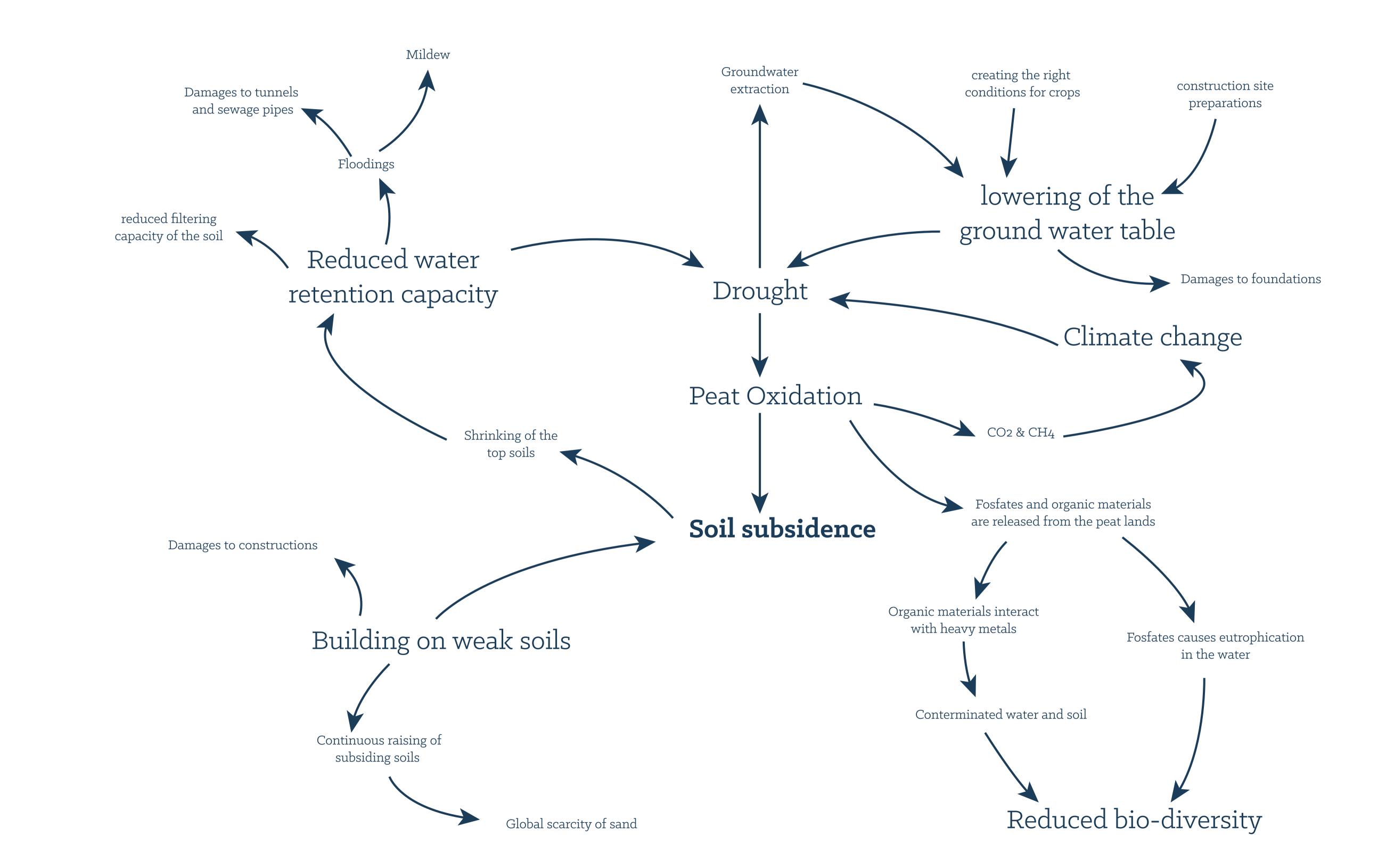
Fosfates causes eutrophication













DELFLAND



SPATIAL URBAN & ENVIRONMENTAL

PROBLEM FIELD

STRATEGICAL UNCERTAINTY & STAKEHOLDERS

PROBLEM FIELD RESEARCH SETUP ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS

RESEARCH SETUP

Monitor



Plan implementation

Specify a dyanamic adapative plan

Determine contingency actions and triggers

Describe current situation, objectives & uncertainties

Development of dynamic adaptive policy pathways

Analyze the problem, vulnerabilities & Oppertunities

Assess Efficacy and Sell by date of the different actions

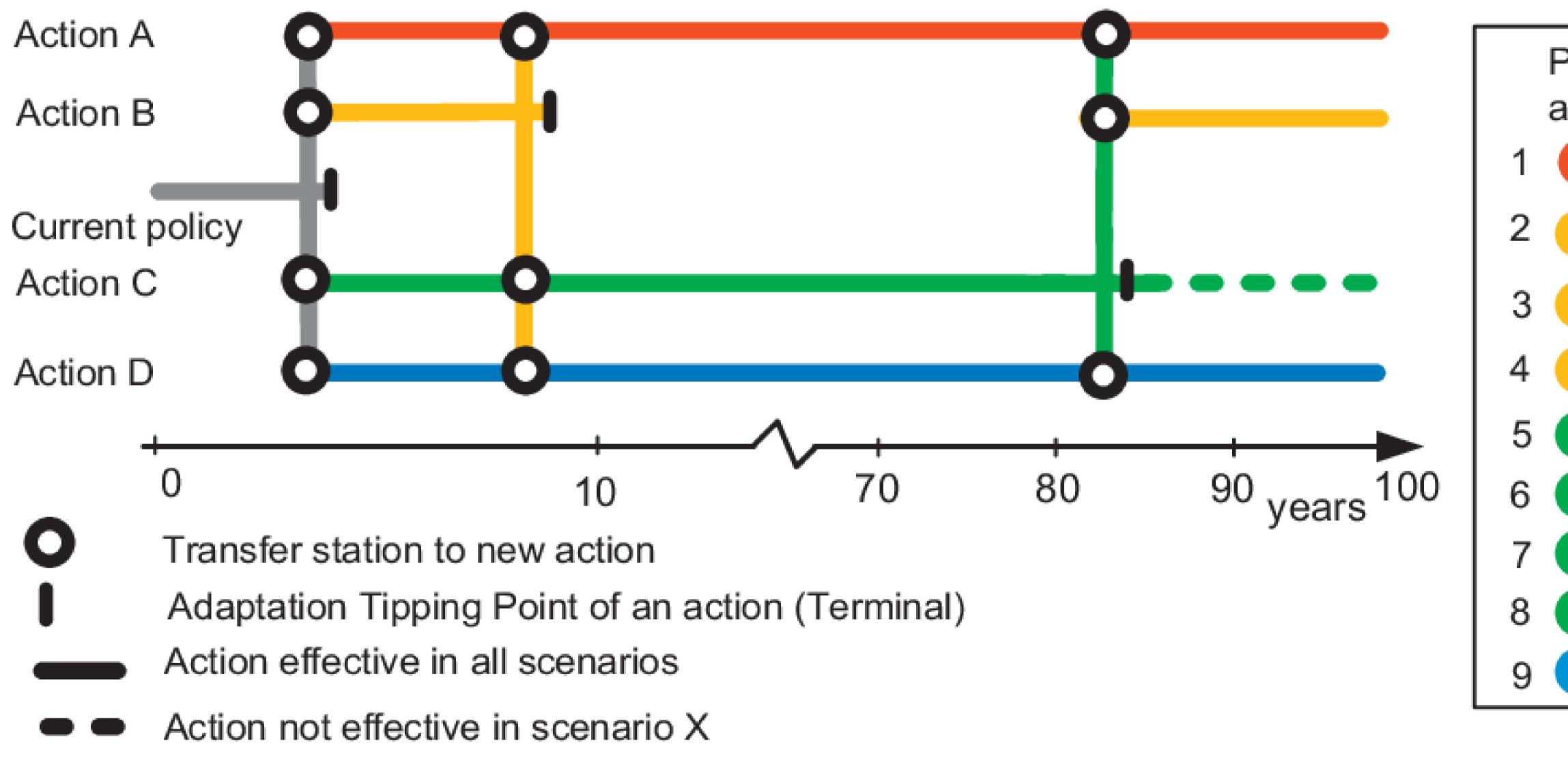
Develop adaptation pathways and pathway map

Select preferred pathway(s)

RESEARCH SETUP

Identify actions

Reassess vulnerabilities & oppertunities



Adaptation Pathways Map

RESEARCH SETUP

	Relative Costs	Target effects				
0	+++	+	0			
00	+++++	0	0			
00	+++	0	0			
00	+++	0	0			
0	0	0	-			
00	++++	0	-			
00	+++	0	-			
00	+	+				
0	++	+				

Scorecard pathways



within the Delfland region?

What are the spatial consequences and decision-making requirements of dealing with soil subsidence, its effects, and the uncertainties that come with them,



RESEARCH SETUP

Let a start of the start of the

Asses the spatial and strategical impact of dealing with soil subsidence and its effects in Delfland

> Create a spatial projection of the preferred pathway(s)

Describe current situation, objectives & uncertainties



Identify actions

Assess Efficacy and Sell by date of the different actions

Develop adaptation pathways and pathway map

Analysis of stakeholders and their involvement

DAPP based research framework and steps

Select preferred pathway(s)

RESEARCH SETUP

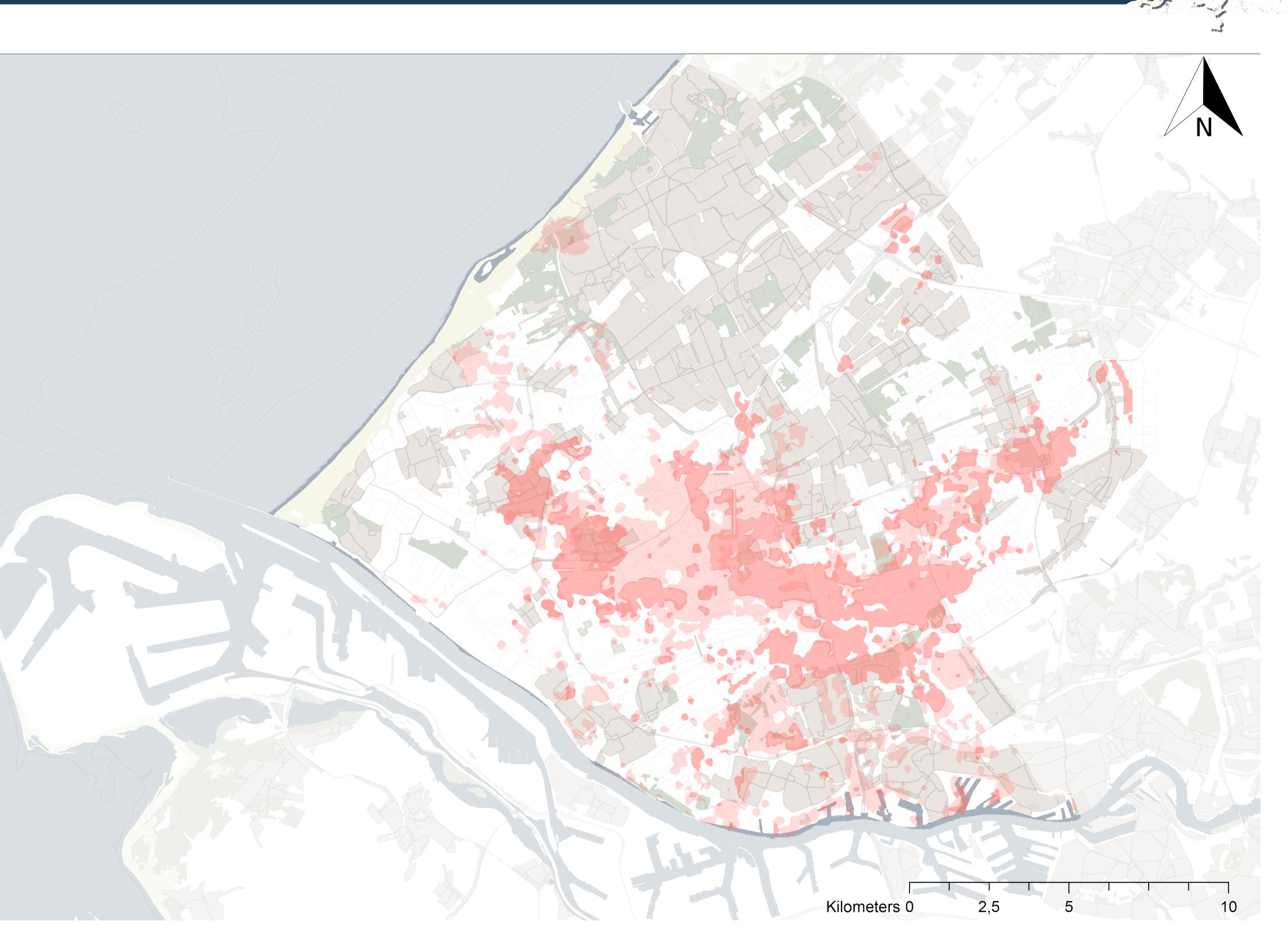
PROBLEM FIELD RESEARCH SETUP ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS





5-10 mm subsidence per year

1-5 mm subsidence per year

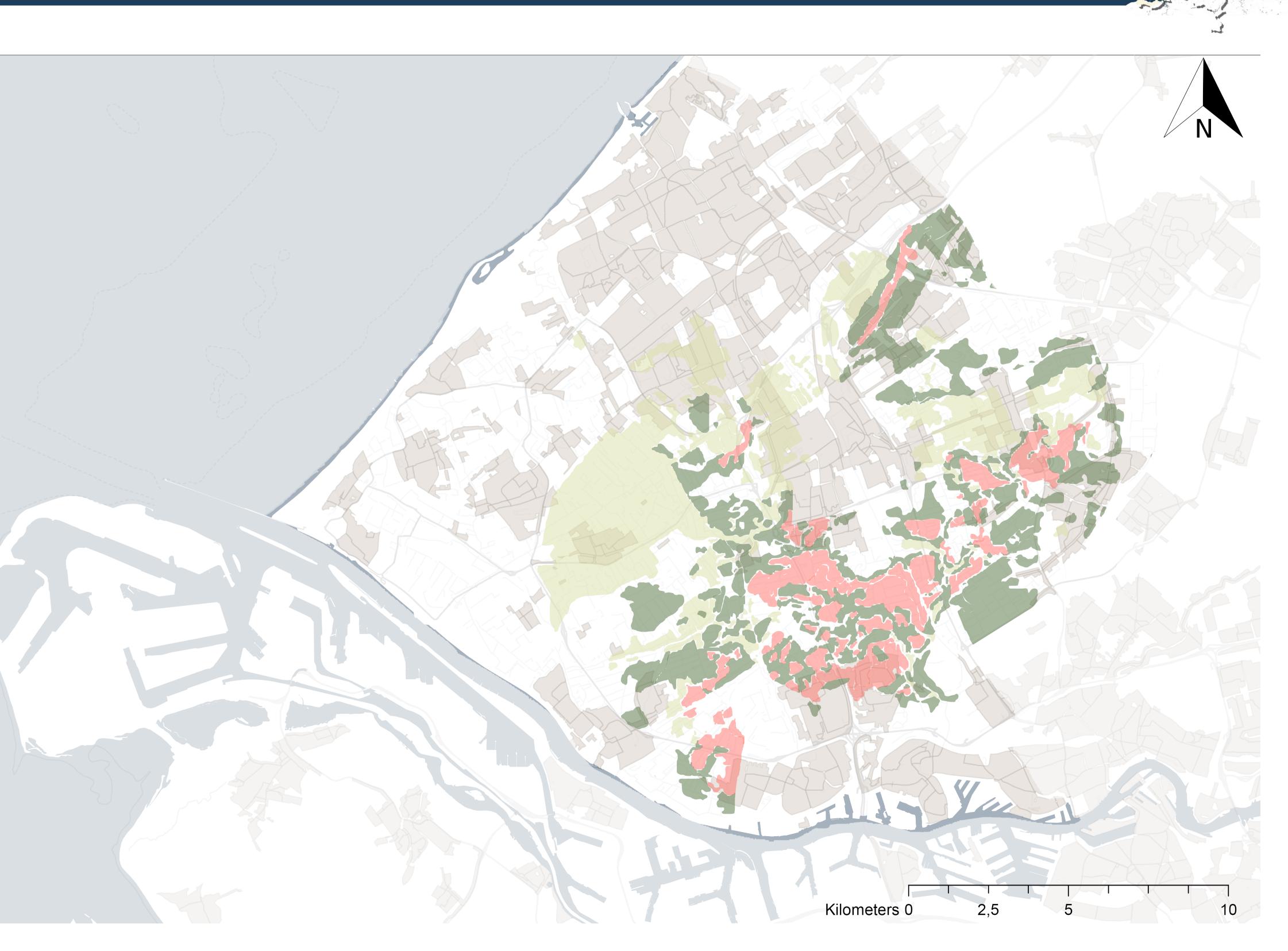




Peat on clay soils

Clay on peat soils

Mixture of peat, clay and other soils

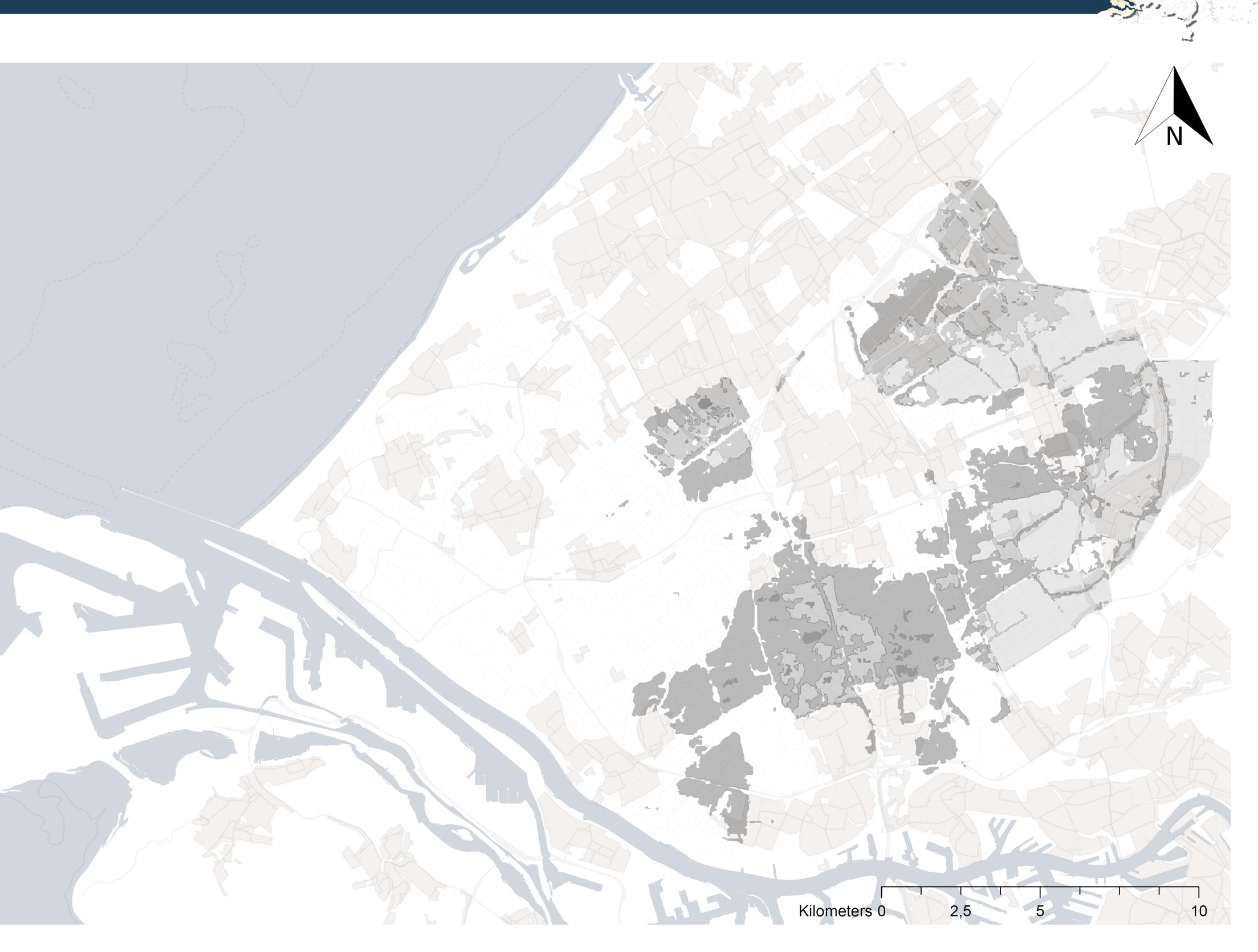




-3m below sea level

-4m below sea level

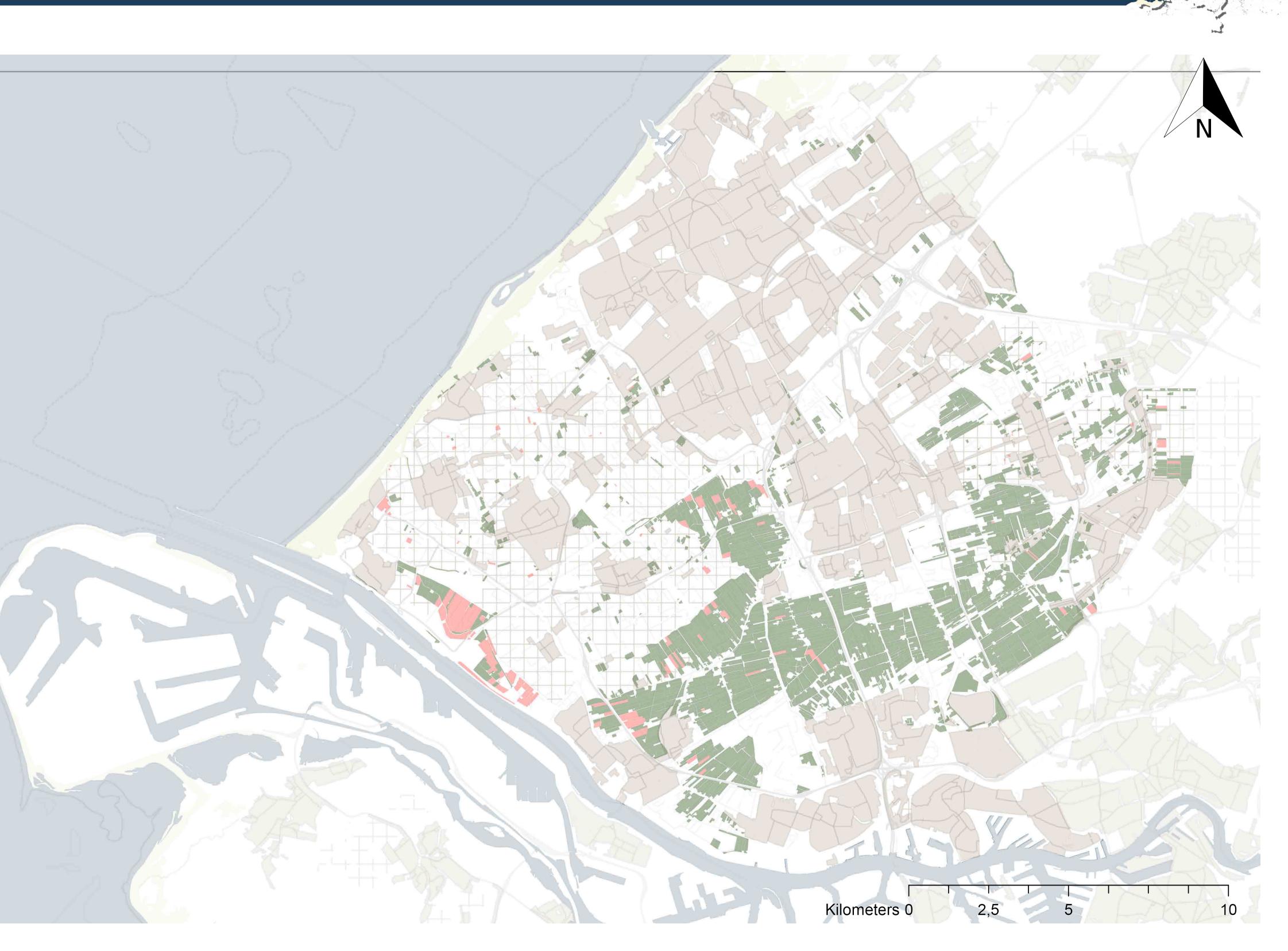
-5m below sea level





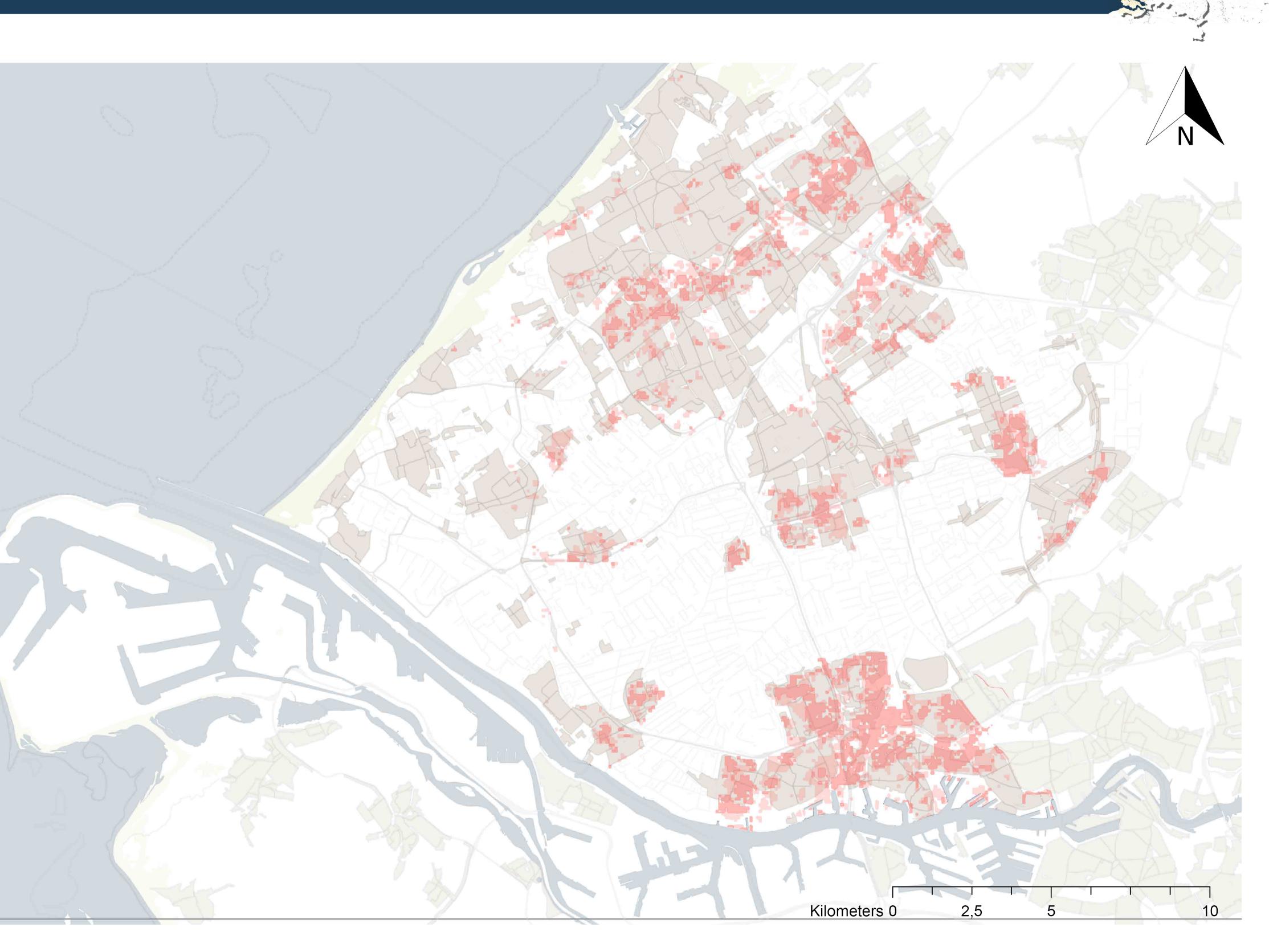
Agricultural grass lands







Subsidence as a result of anthropogenic loading

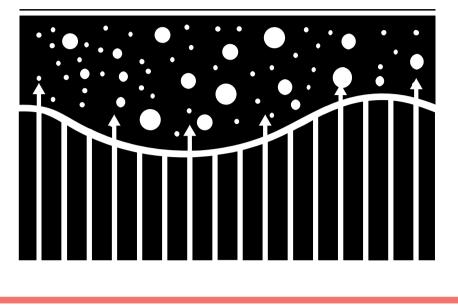


PROBLEM FIELD RESEARCH SETUP ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS & RECOMMENDATIONS

ACTION ASSESSMENT

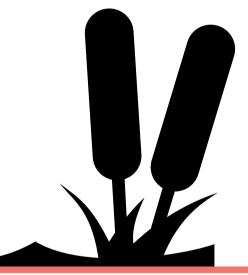
passive waterlogging





Paludiculture

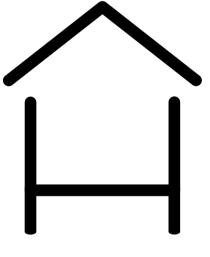
Agricultural



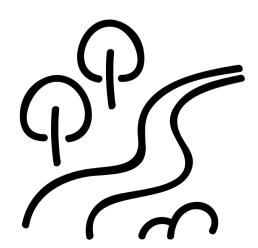
Lifted buildings

Constructional

Ecological



Unrefined watercourses



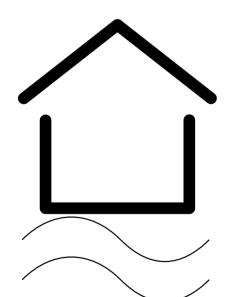
Broaden watercourses



Sphagnum tillage



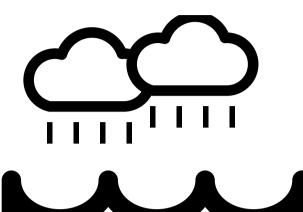
Floating constructions



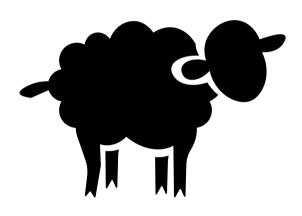
Decentralized water treatment



Peak storage



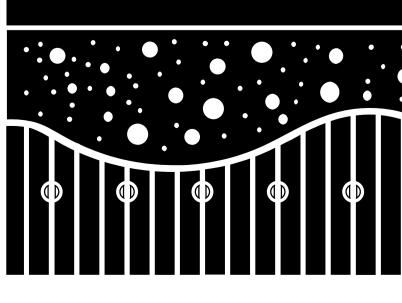
Low weight land cultivation



Low pressure (re)construction

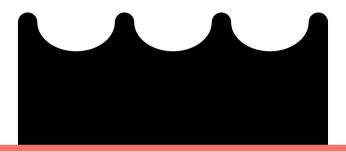


Underwater drainage



ACTION ASSESSMENT

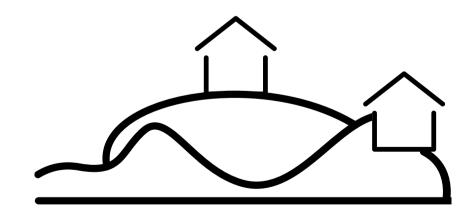
Seasonal storage



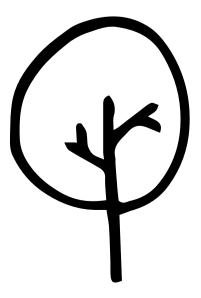
Permaculture



Soil and height orientated planning

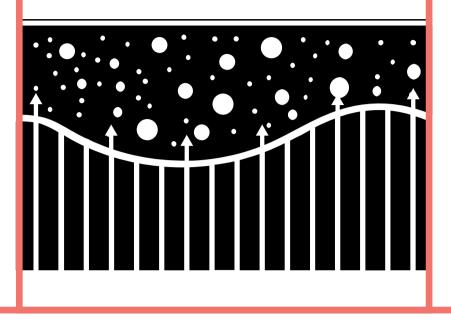






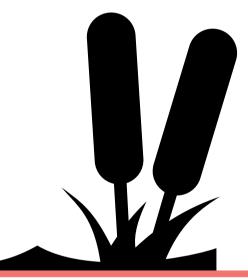
Water Management

passive waterlogging



Paludiculture

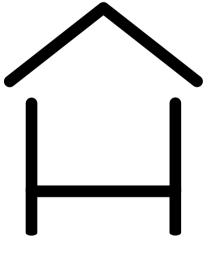
Agricultural



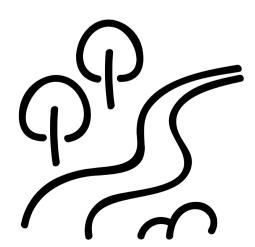
Lifted buildings

Constructional

Ecological



Unrefined watercourses



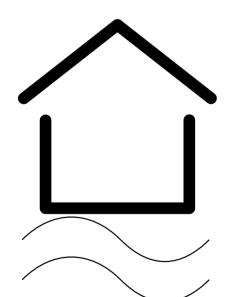
Broaden watercourses



Sphagnum tillage



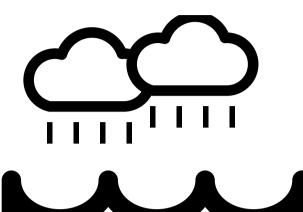
Floating constructions



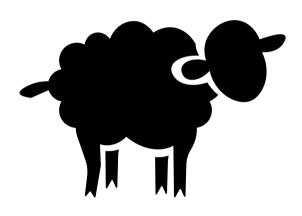
Decentralized water treatment



Peak storage



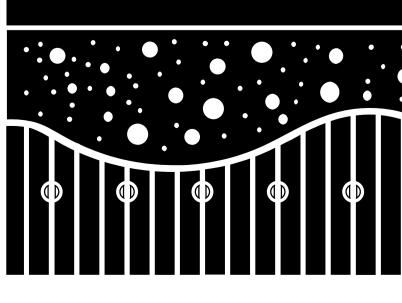
Low weight land cultivation



Low pressure (re)construction

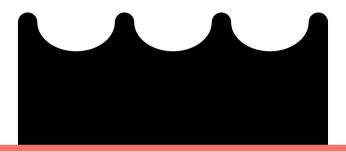


Underwater drainage



ACTION ASSESSMENT

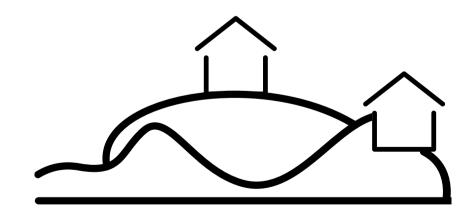
Seasonal storage



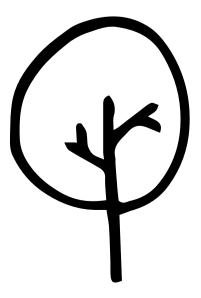
Permaculture



Soil and height orientated planning

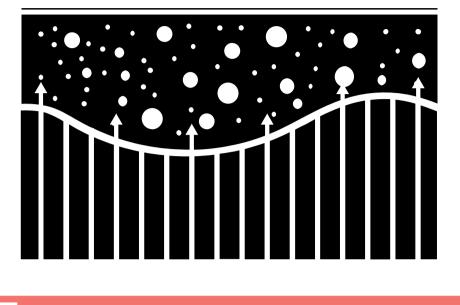






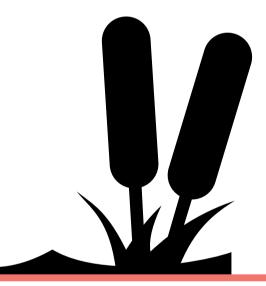
passive waterlogging

Water Management



Paludiculture

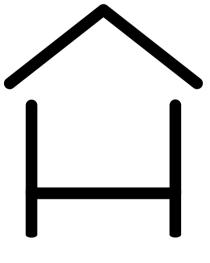
Agricultural



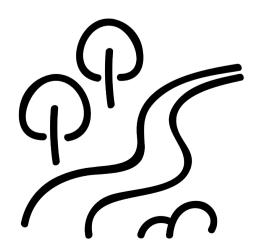
Lifted buildings

Constructional

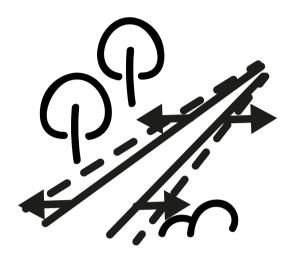
Ecological



Unrefined watercourses



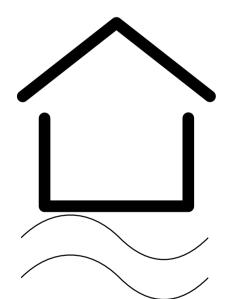
Broaden watercourses



Sphagnum tillage



Floating constructions

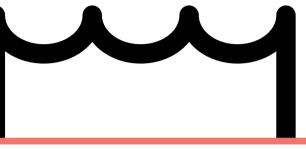


Decentralized water treatment

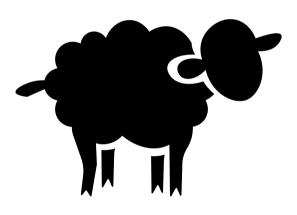


Peak storage





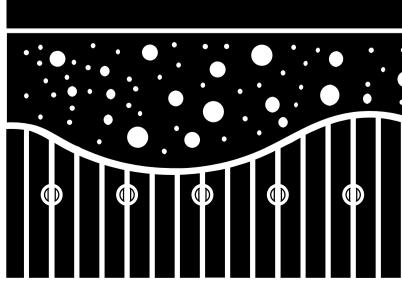
Low weight land cultivation



Low pressure (re)construction

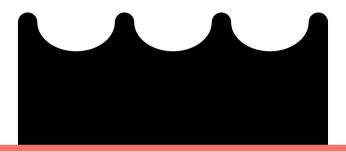


Underwater drainage



ACTION ASSESSMENT

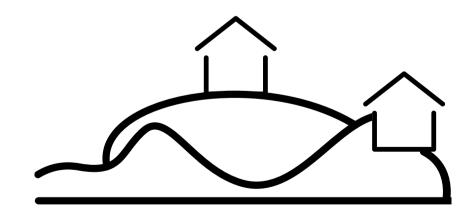
Seasonal storage



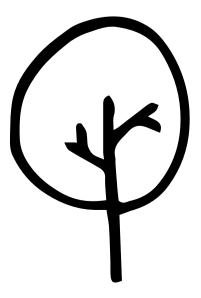
Permaculture



Soil and height orientated planning

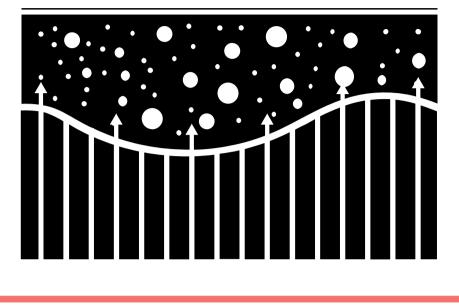




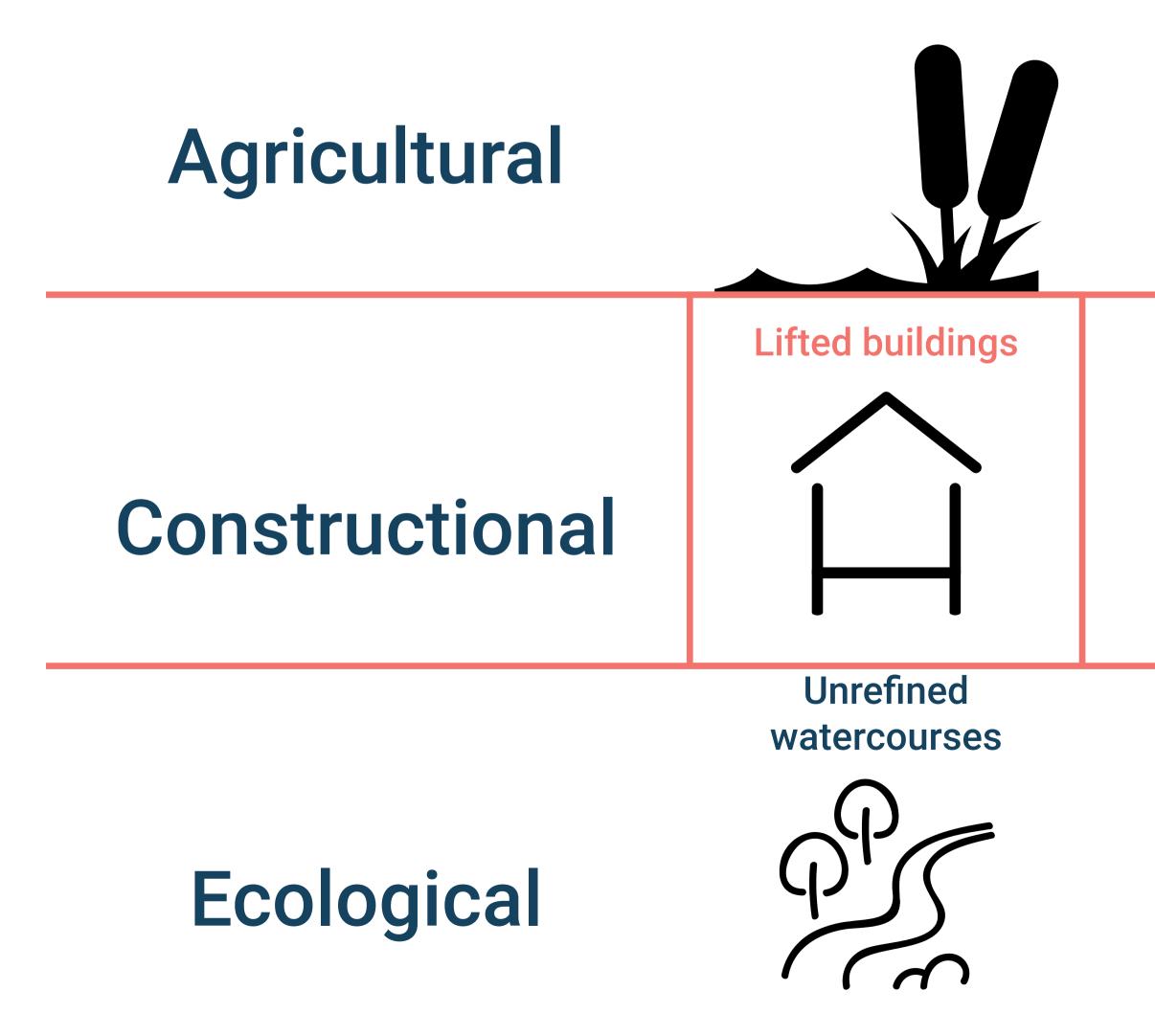


passive waterlogging





Paludiculture



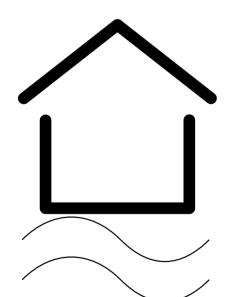
Broaden watercourses



Sphagnum tillage



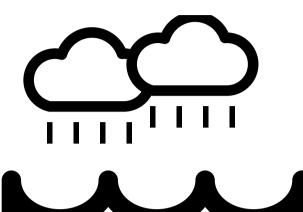
Floating constructions



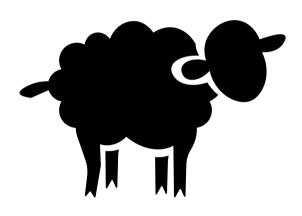
Decentralized water treatment



Peak storage



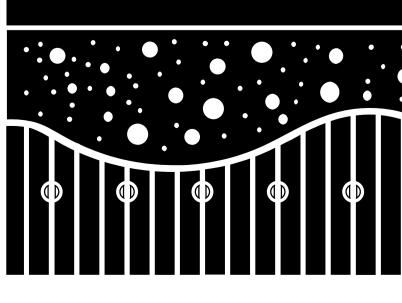
Low weight land cultivation



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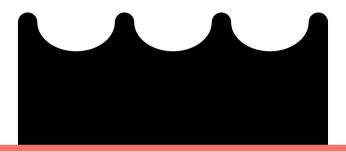


Underwater drainage



ACTION ASSESSMENT

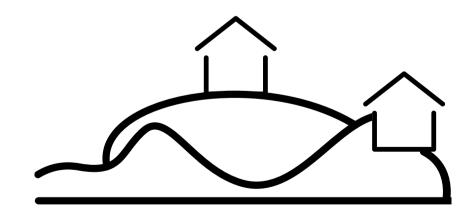
Seasonal storage



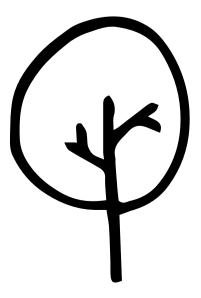
Permaculture



Soil and height orientated planning

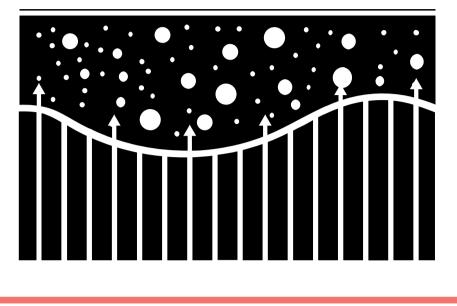






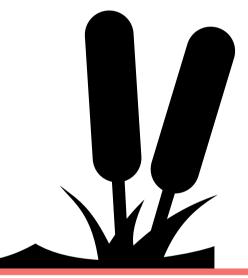
passive waterlogging





Paludiculture

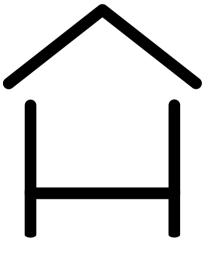
Agricultural



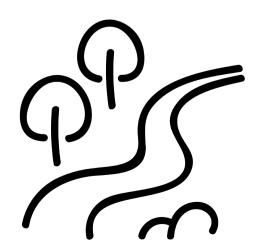
Lifted buildings

Constructional

Ecological



Unrefined watercourses



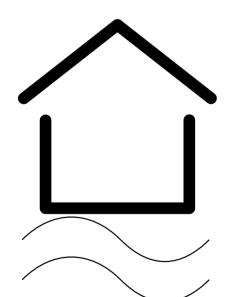
Broaden watercourses



Sphagnum tillage



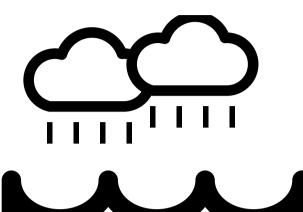
Floating constructions



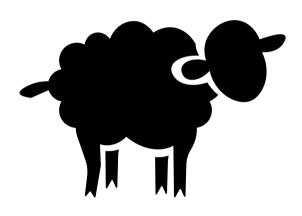
Decentralized water treatment



Peak storage

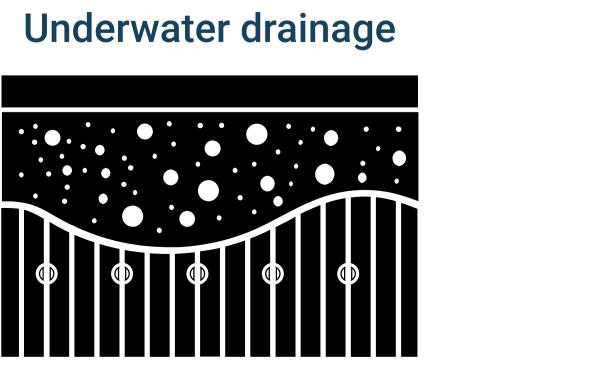


Low weight land cultivation



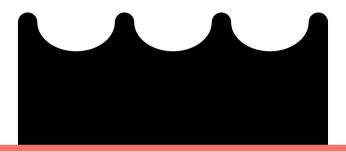
Low pressure (re)construction



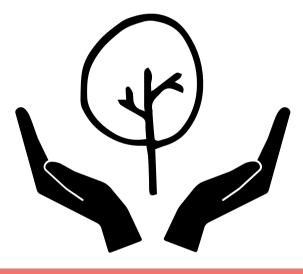


ACTION ASSESSMENT

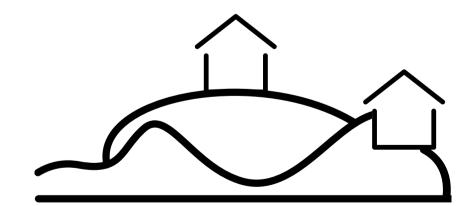
Seasonal storage



Permaculture

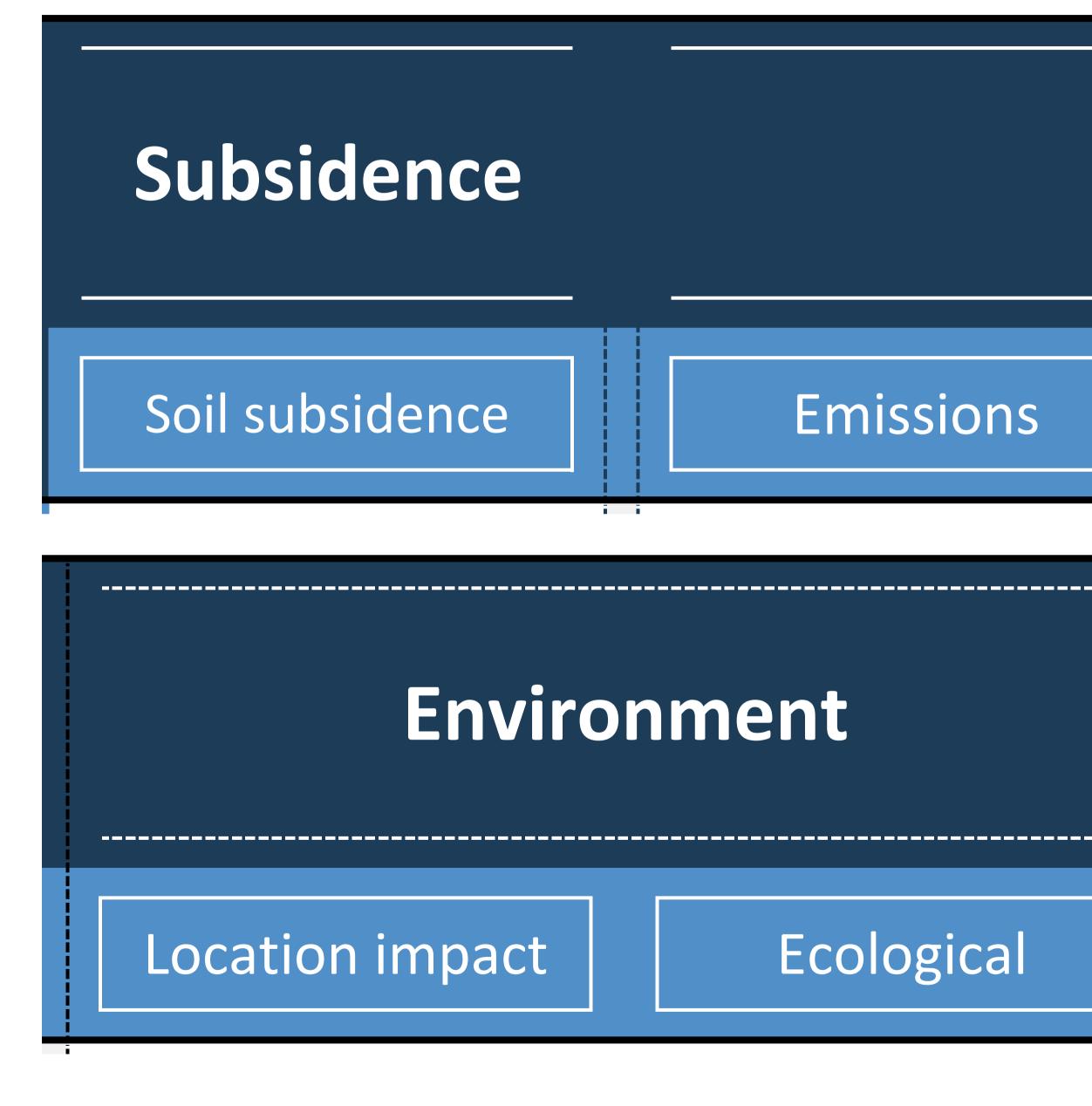


Soil and height orientated planning



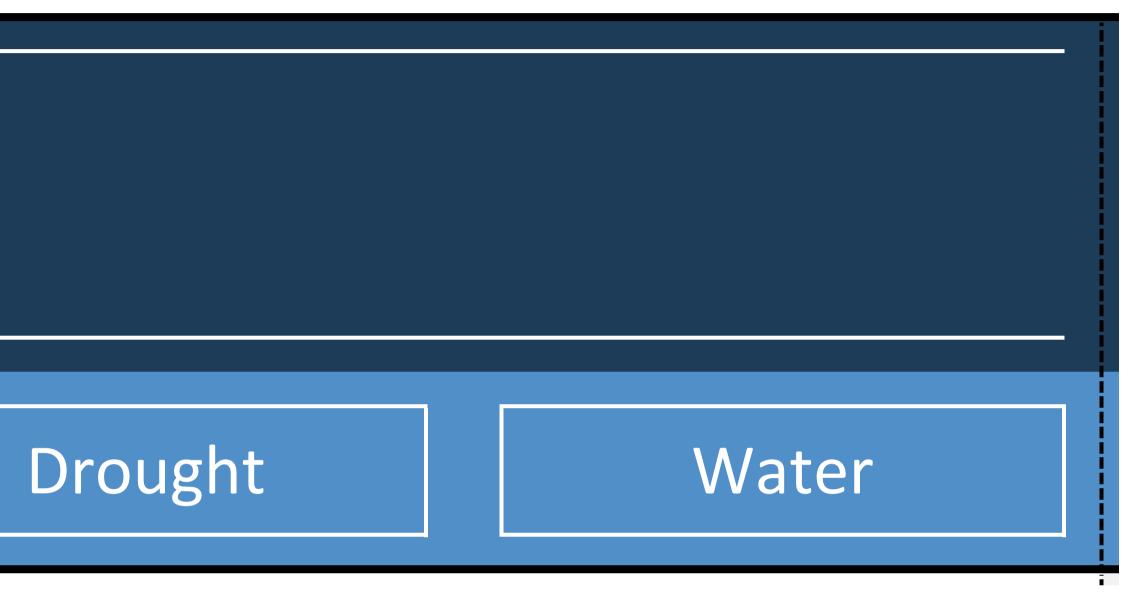












Heat



Financial

i i

ACTION ASSESSMENT

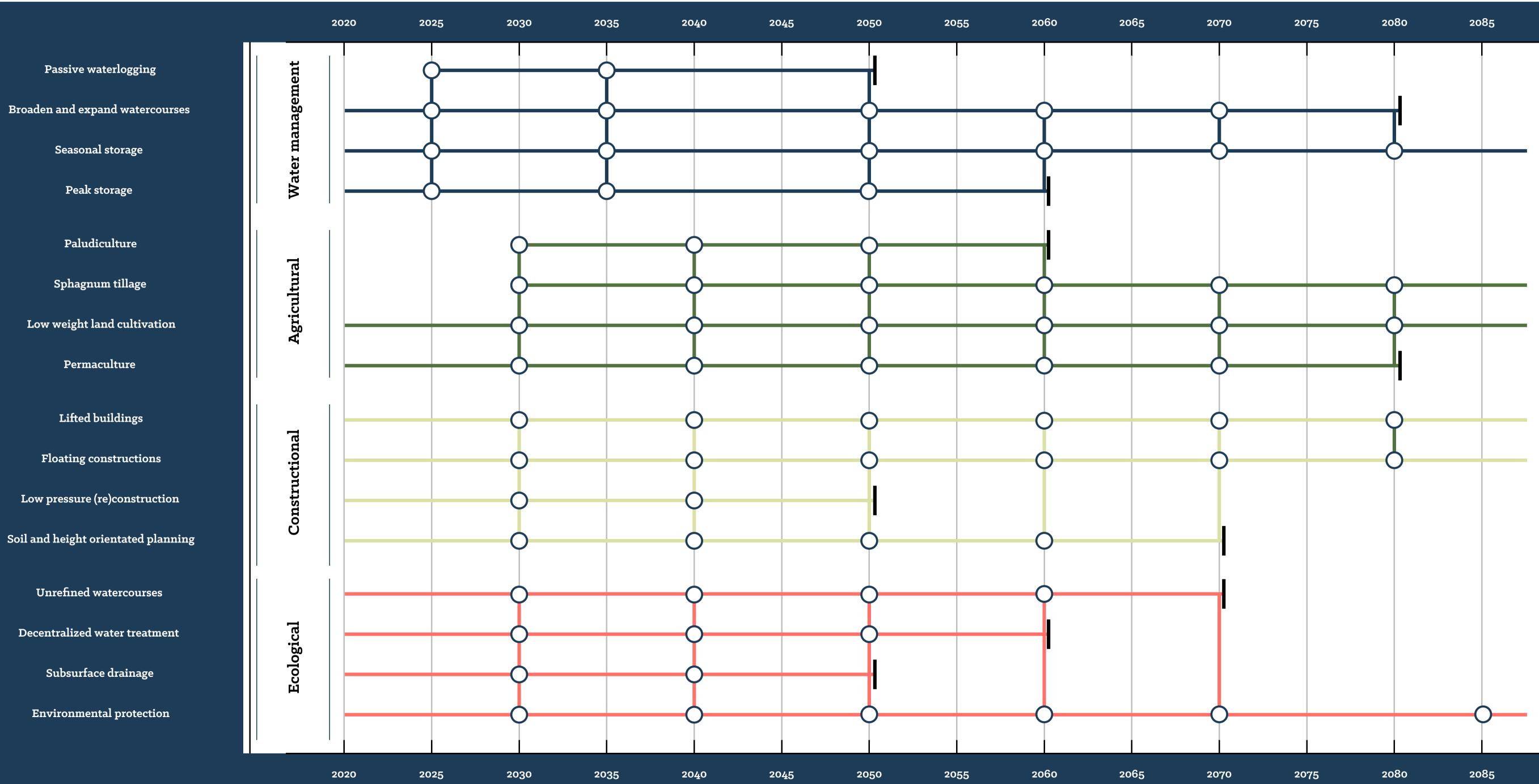
Effect Action		Subsidence Climate			Environment		Expediency				
		Soil subsidence	Emissions	Heat	Drought	Water	Location impact	Ecological	Financial	Start date	End date
Water management	Passive waterlogging	++	0	+	+ +	0		+	0	2025	2050
	broaden and expand watercourses	+	0	+ +	+ +	+ +	-	+		2020	2080
	Seasonal storage	0	0	+ +	+	+		+		2020	~
	Peak storage	0	0	+	+	+ +	-	0	-	2020	2060
Agricultural	Paludiculture	+	+	+ +	+ +	+ +	0	+		2030	2060
	Sphagnum tillage	++	++	+	+ +	+	0	+ +		2030	~
	Low weight land cultivation	+	+	0	0	0	0	0	-	2020	~
	Permaculture	0	0	+	+	+	-	+ +	-	2020	2080
Constructional	Lifted buildings	++	0	+ +	+	+ +	-	+	-	2020	~
	Floating constructions	+	+	+ +	+ +	+ +	0	+	0	2020	~
	Low pressure (re)construction	+	0	0	0	0	0	-	-	2020	2050
	Soil and height orientated planning and development	+	0	+	+	+	-	0	0	2020	2070
Ecological	Unrefined watercourses	0	0	+ +	+	+	-	+ +		2030	2070
	Decentralized water treatment	0	0	0	0	0	0	+ +	-	2020	2060
	Underwater drainage	+	0	0	+	+	0	+	-	2020	2050
	Environmental protection and conservation	0	+	+	+	0		+ +		2040	~
	Environmental protection and conservation	0	+	+	+	0		++		2040	~

Mitigating

Adaptating

Mitigating and Adaptating

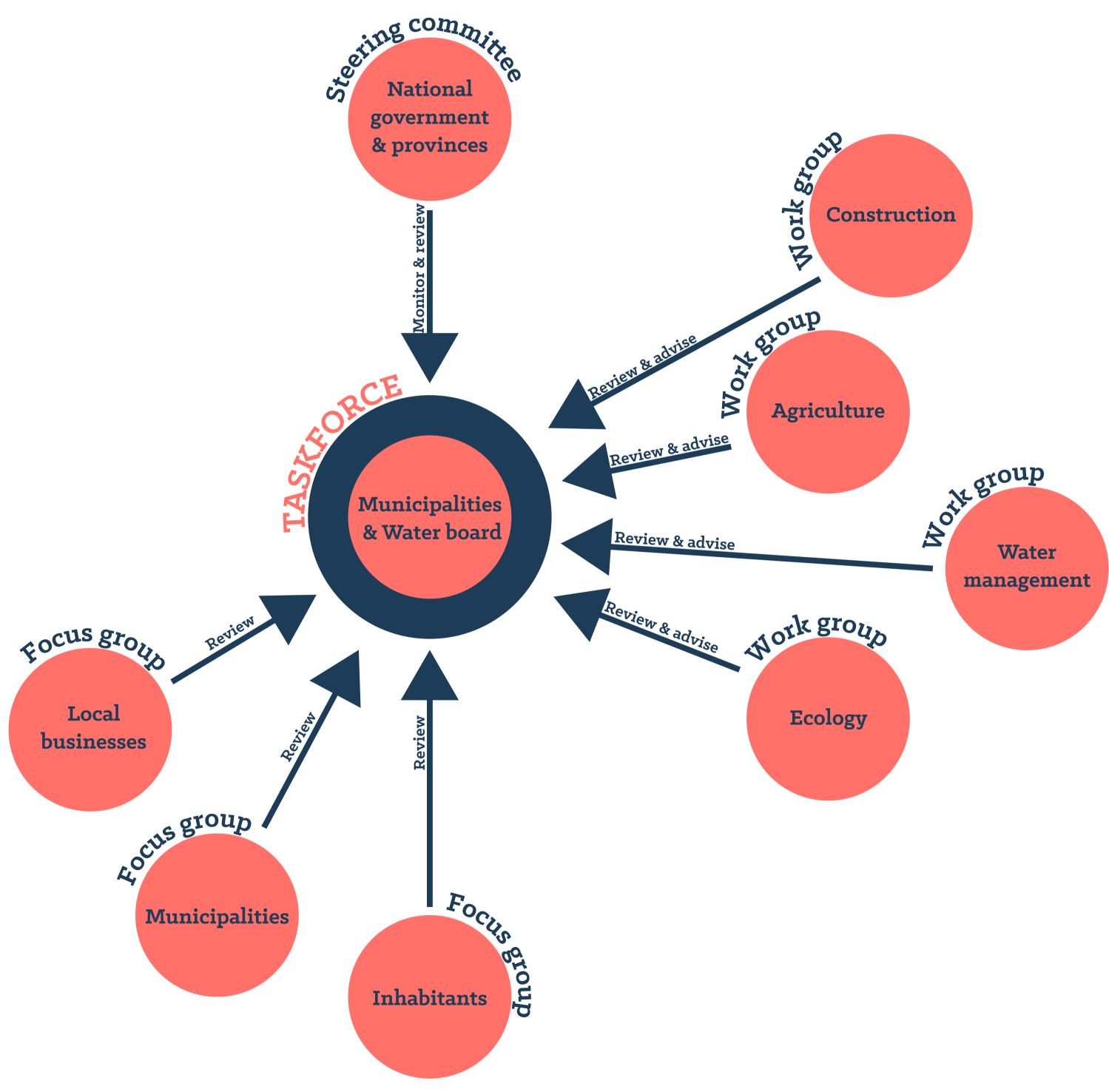
ACTION ASSESSMENT



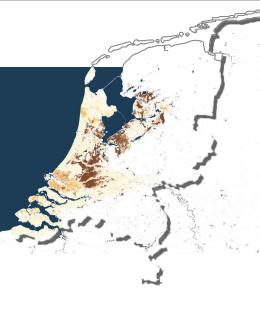
ACTION ASSESSMENT

PROBLEM FIELD RESEARCH SETUP ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS & RECOMMENDATIONS

DECISION-MAKING



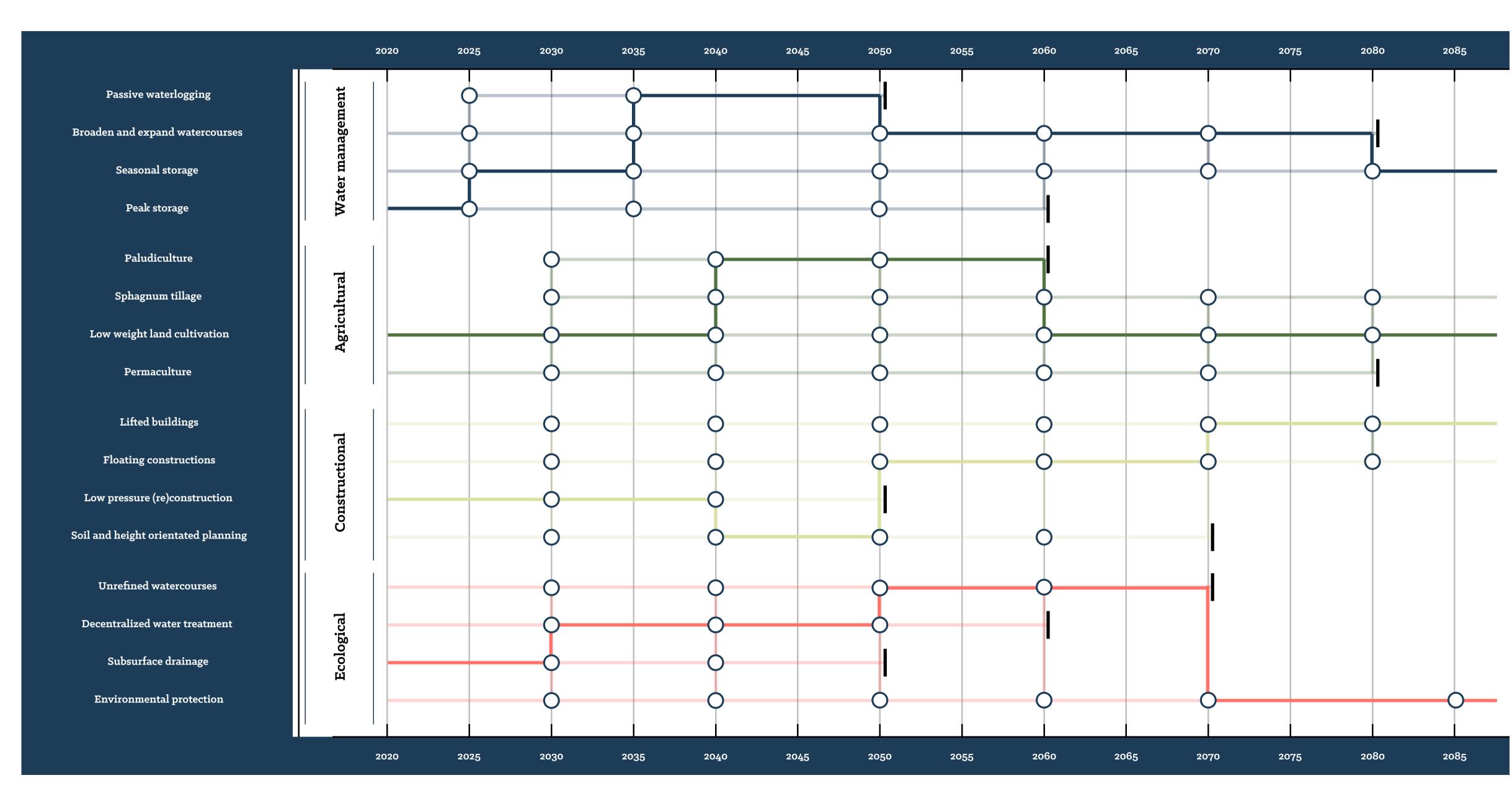
DECISION-MAKING



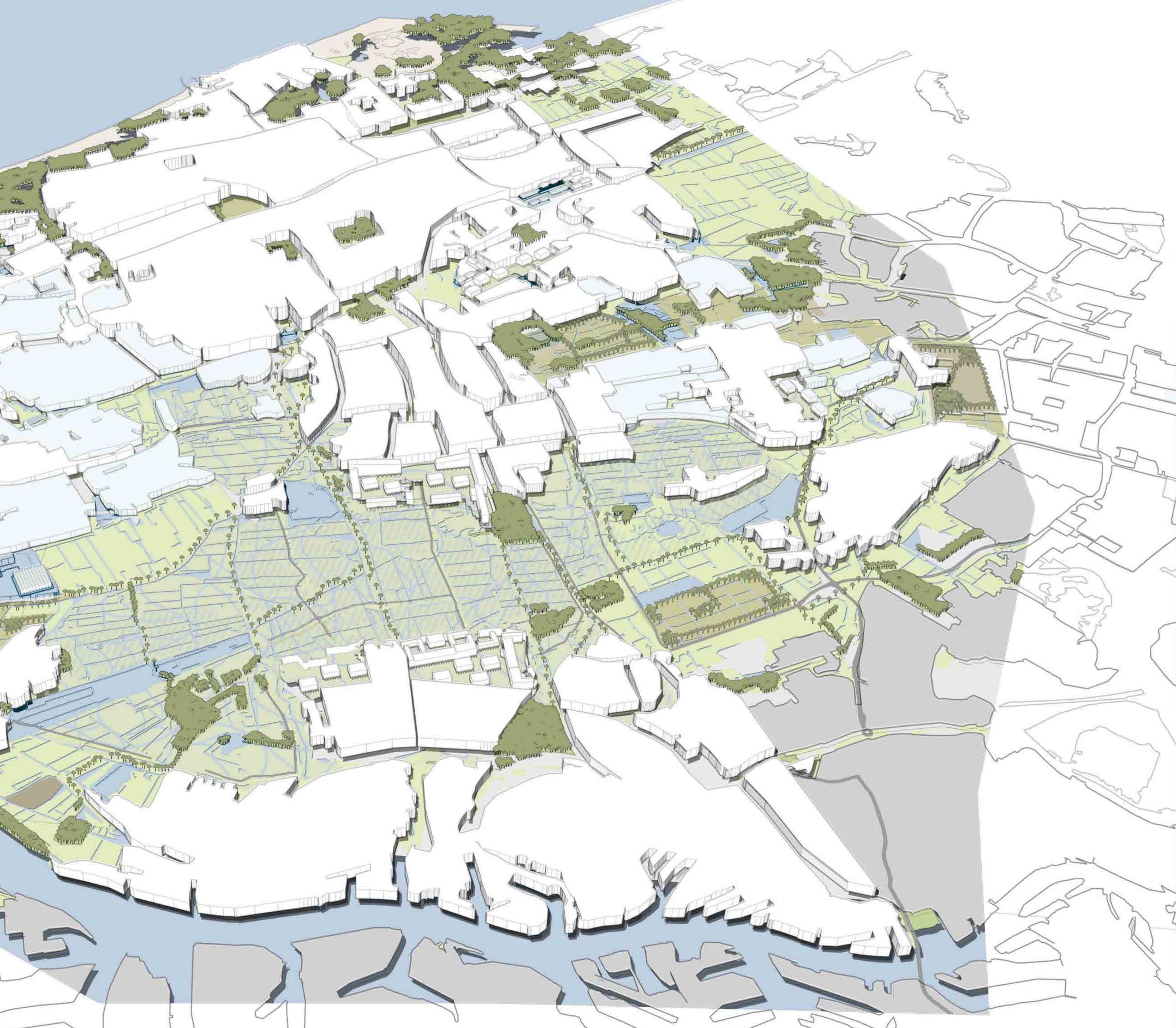
PROBLEM FIELD RESEARCH SETUP ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS & RECOMMENDATIONS



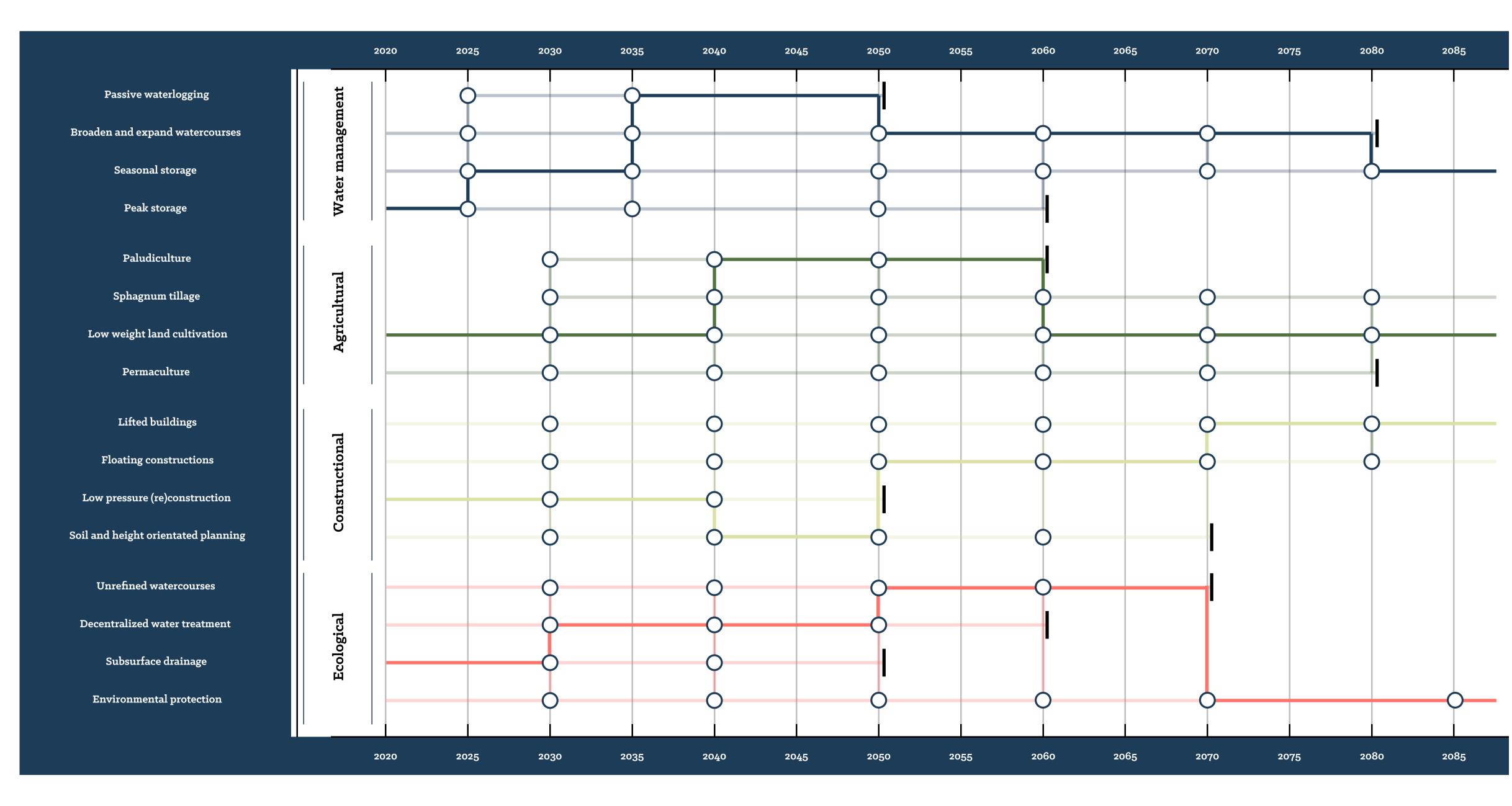
ADAPTATION PATHWAY



ADAPTATION PATHWAY 2085 4002 1-----3.1. A REAL

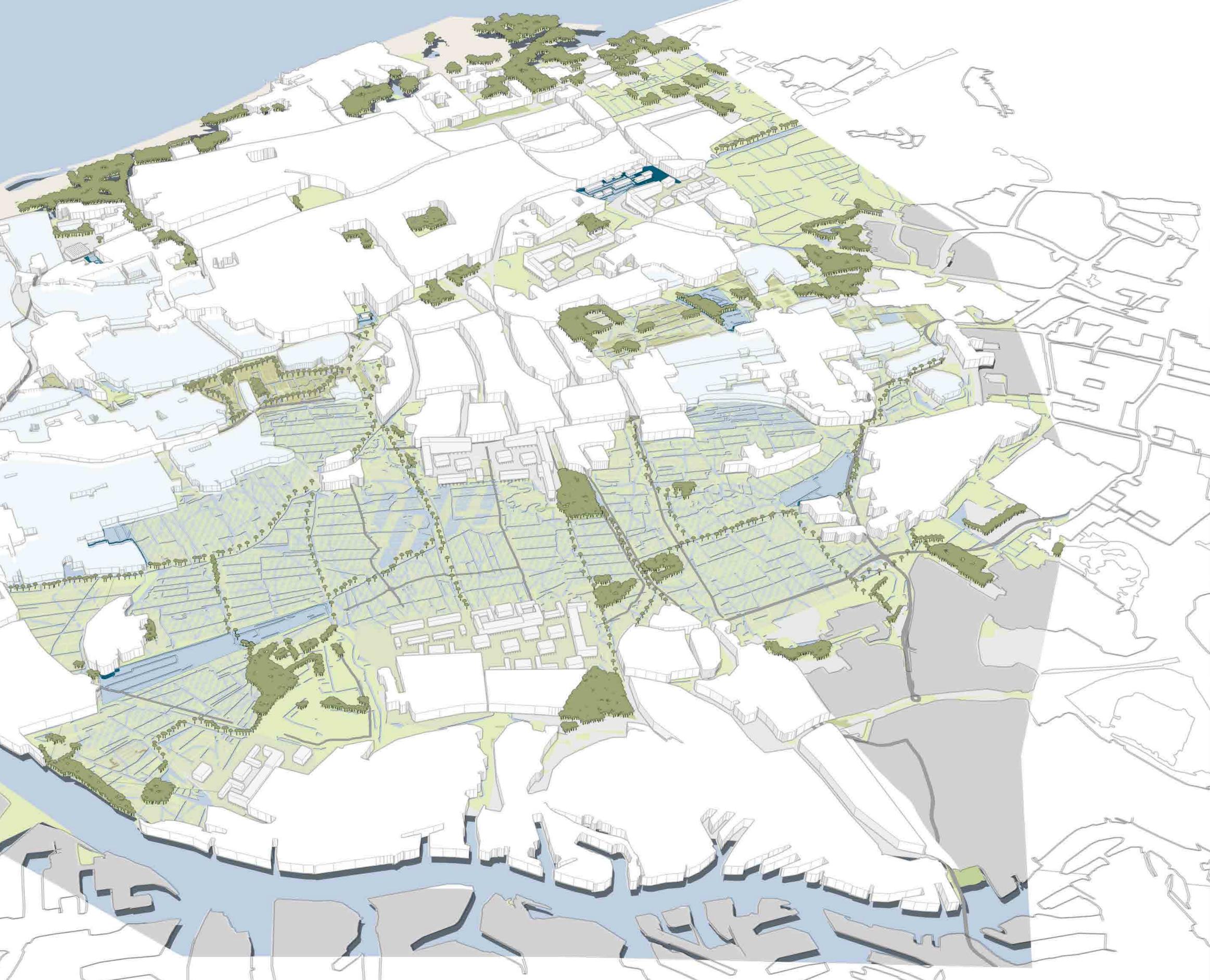


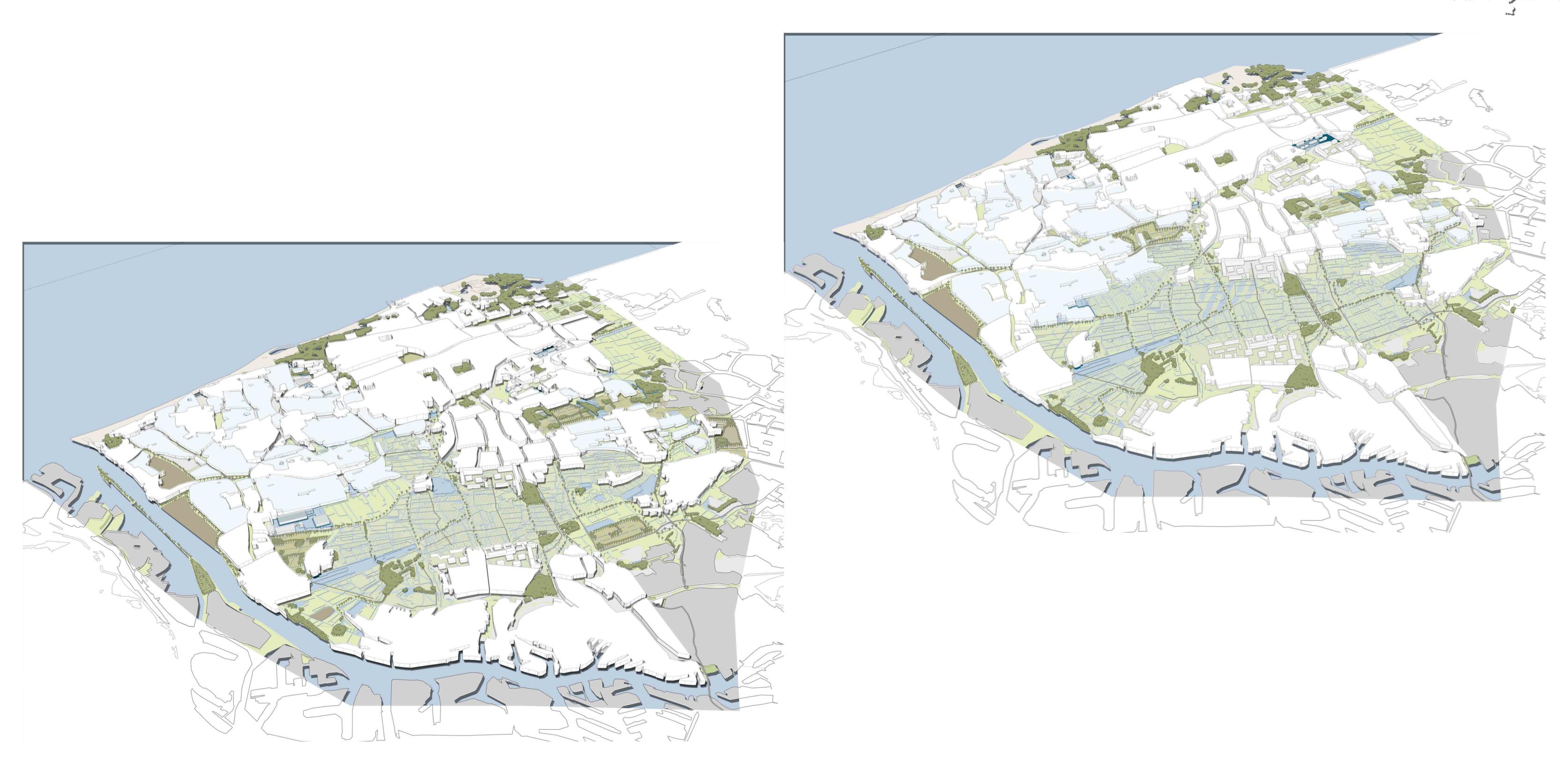
MITIGATION PATHWAY

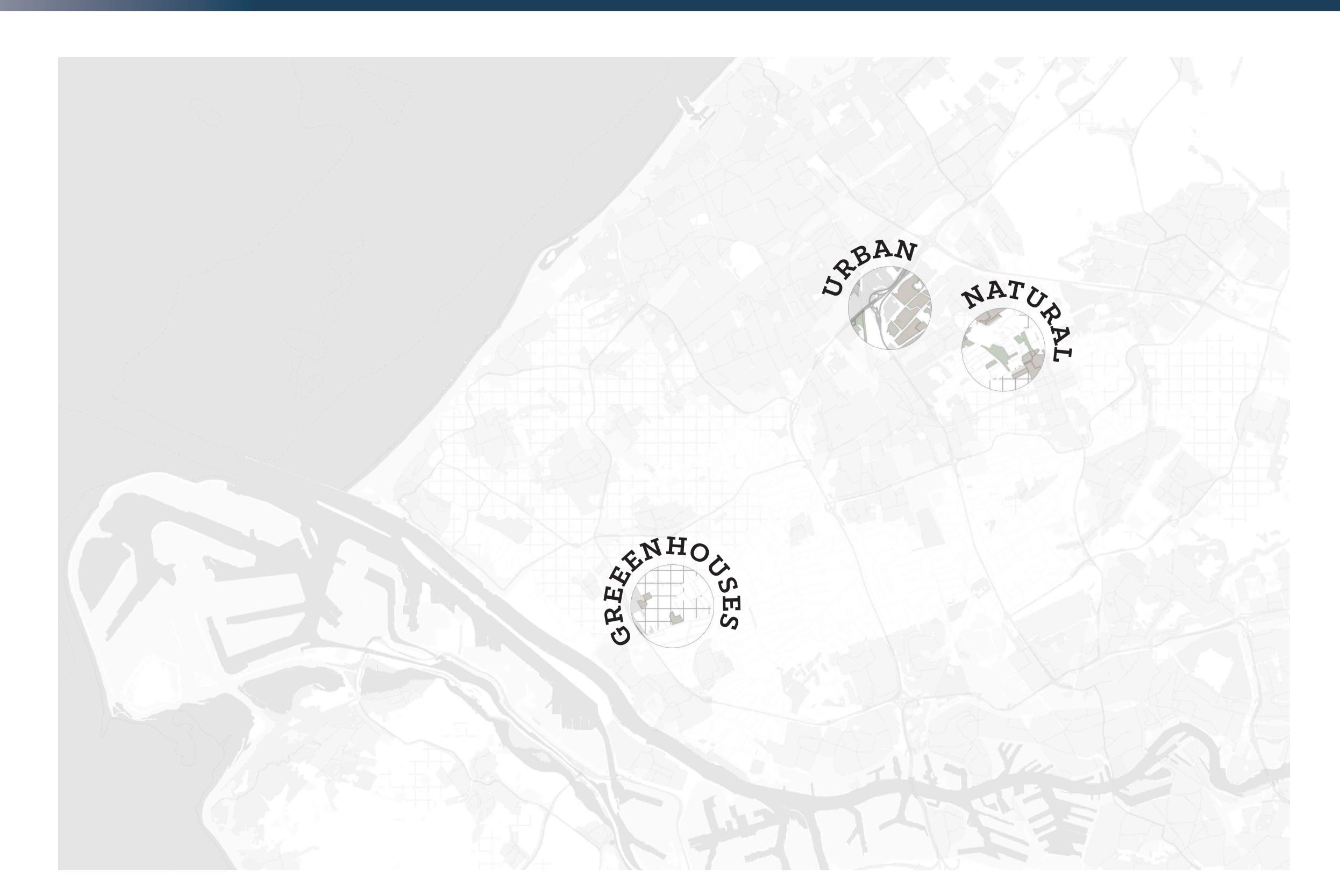


MITIGATION PATHWAY

2085

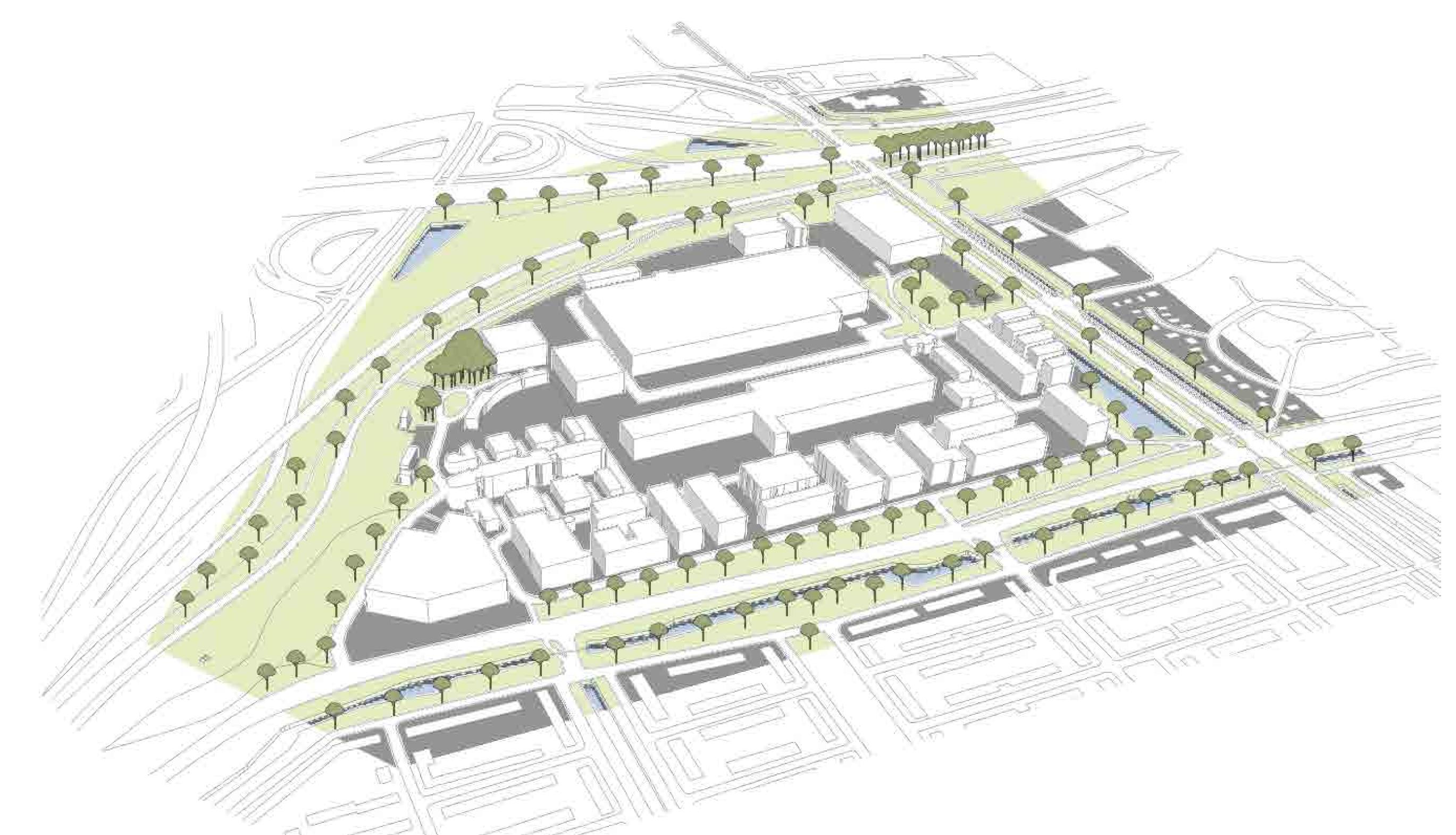






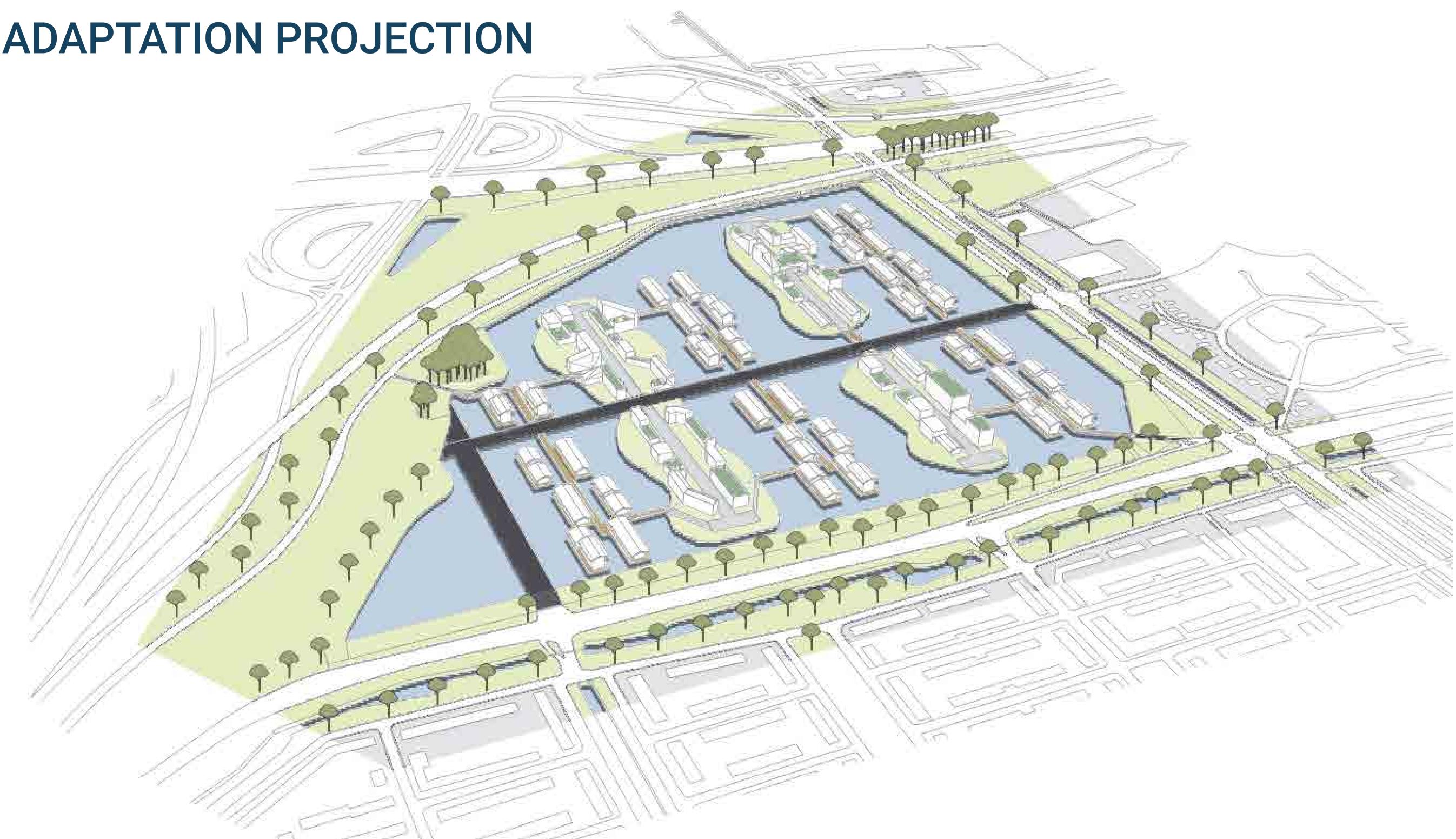


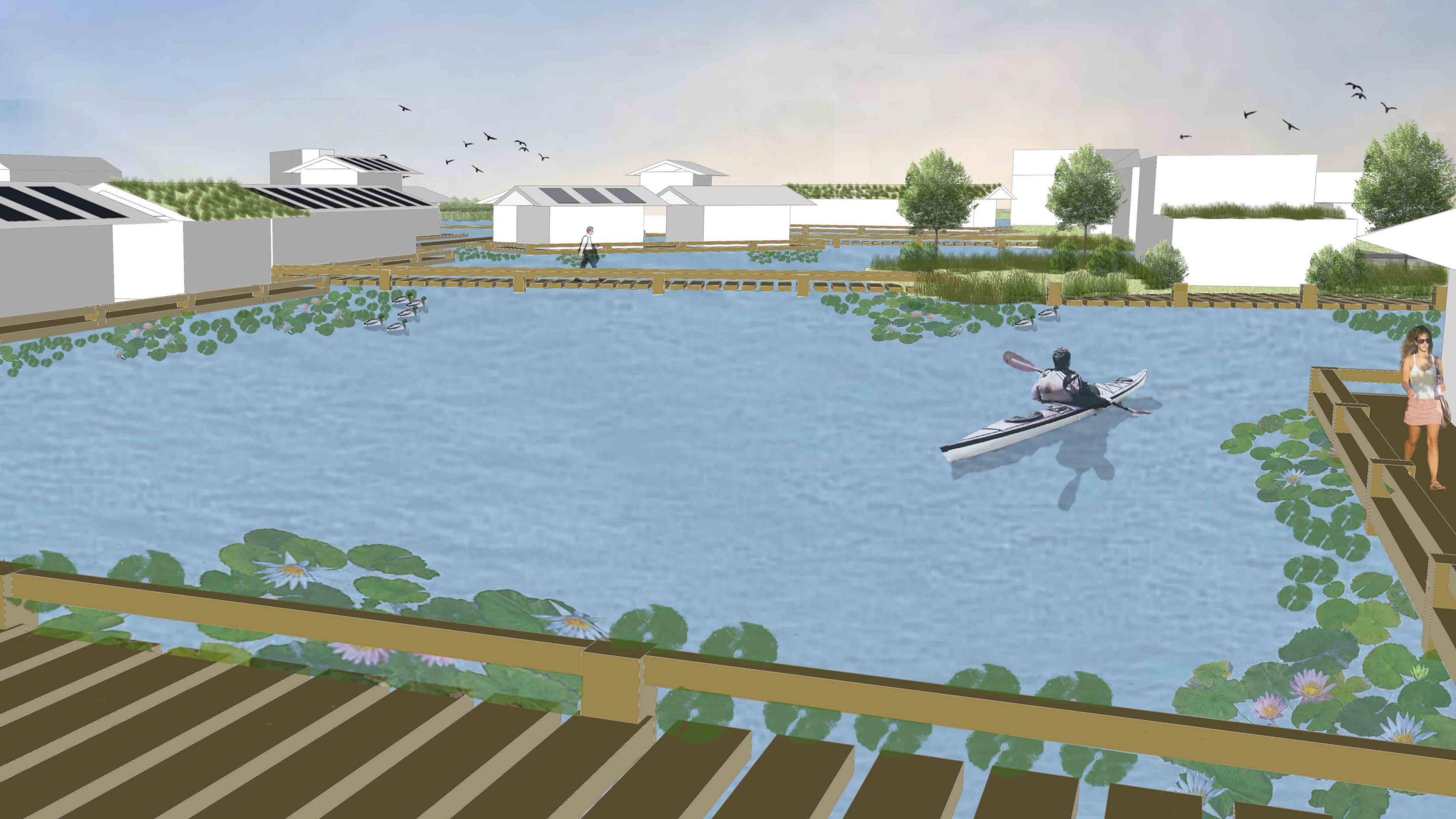
URBAN





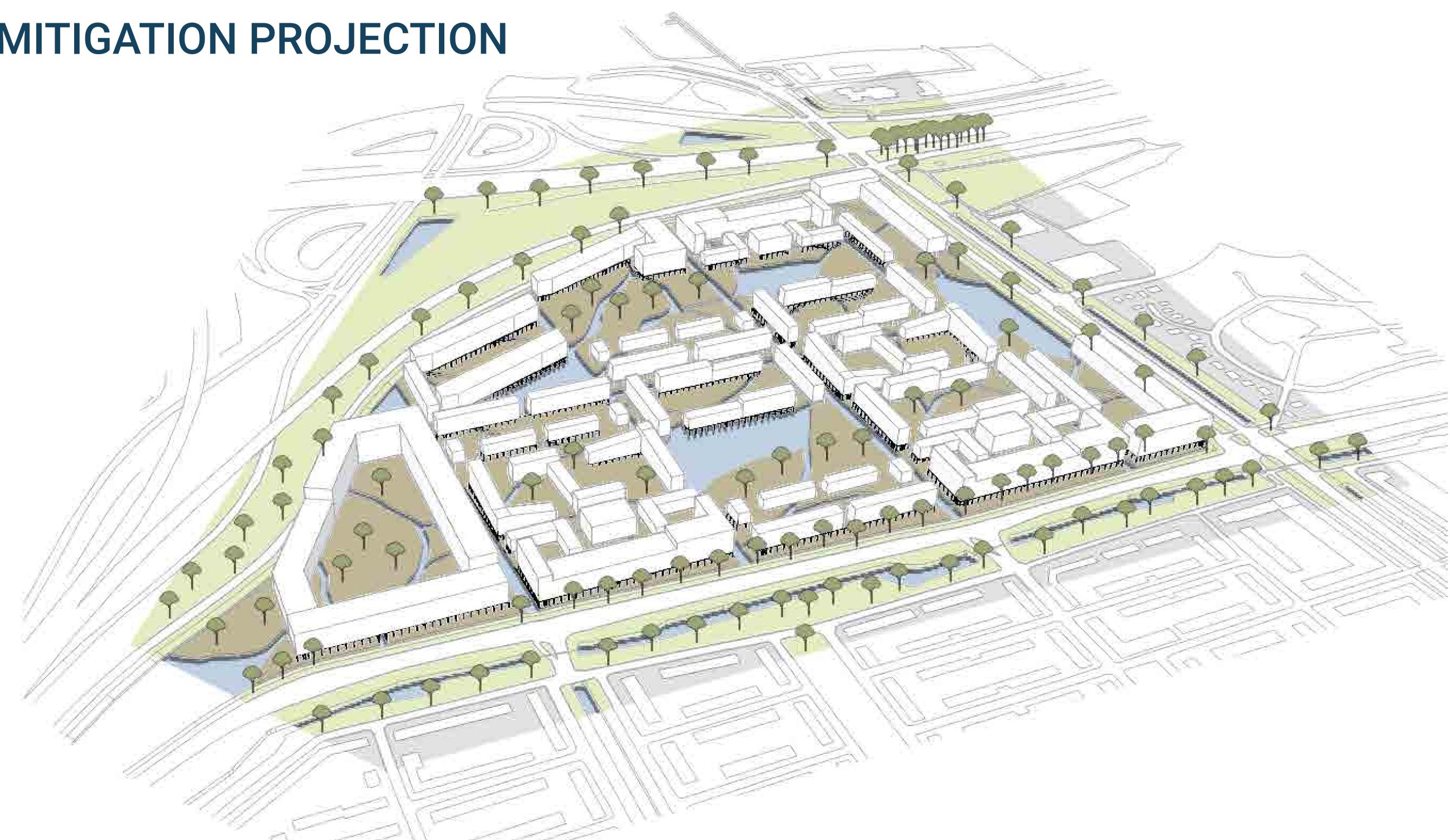
URBAN ADAPTATION PROJECTION







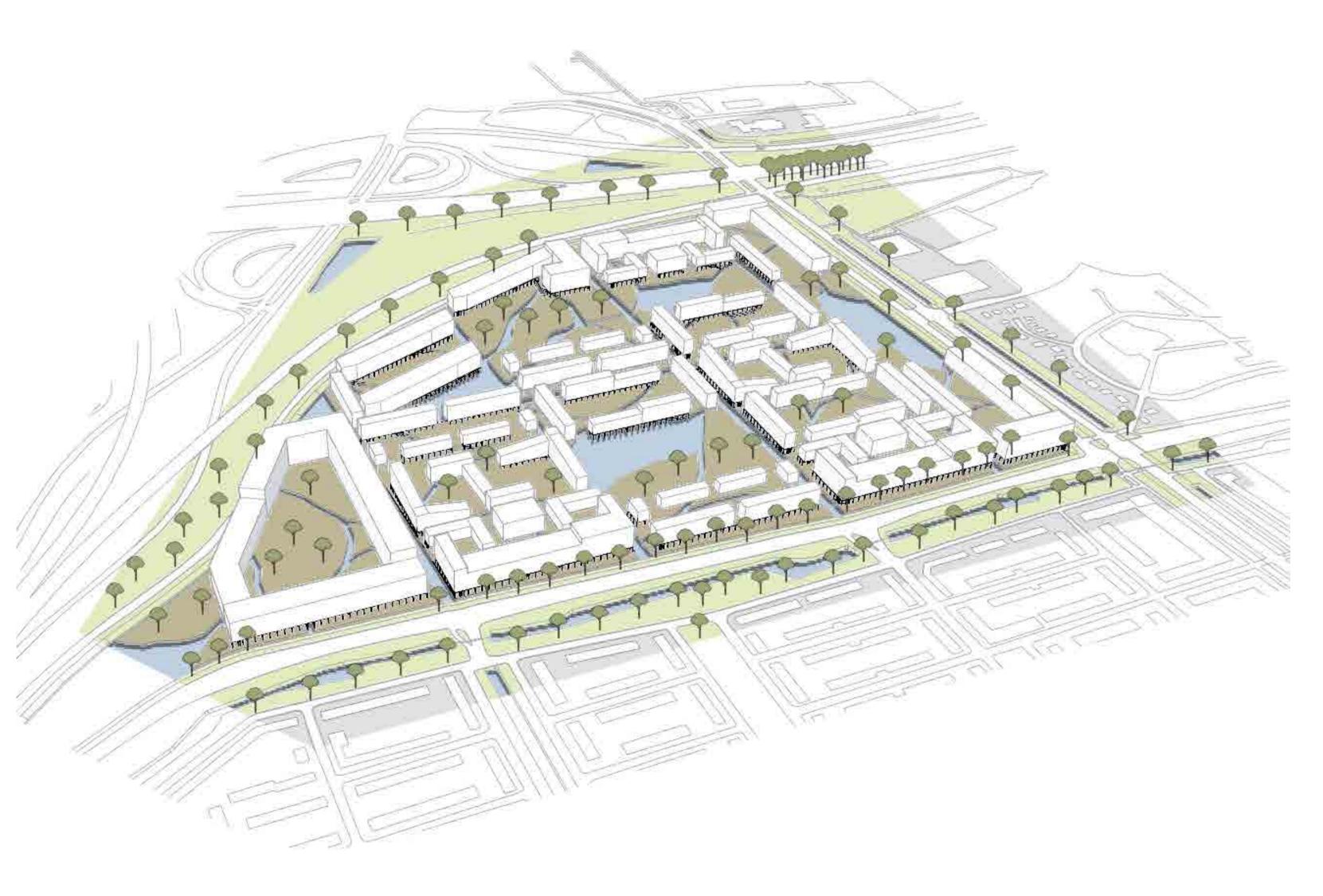
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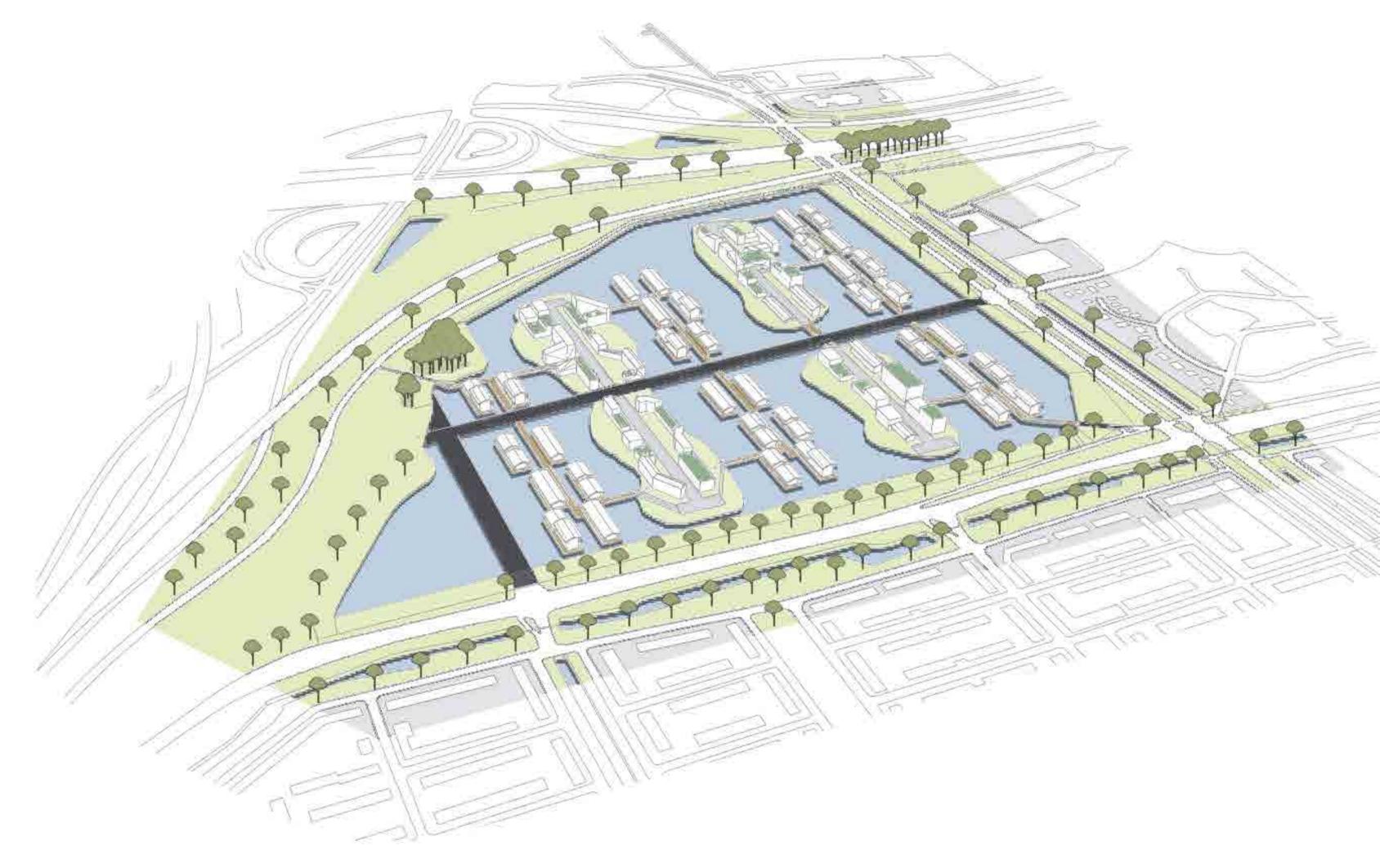






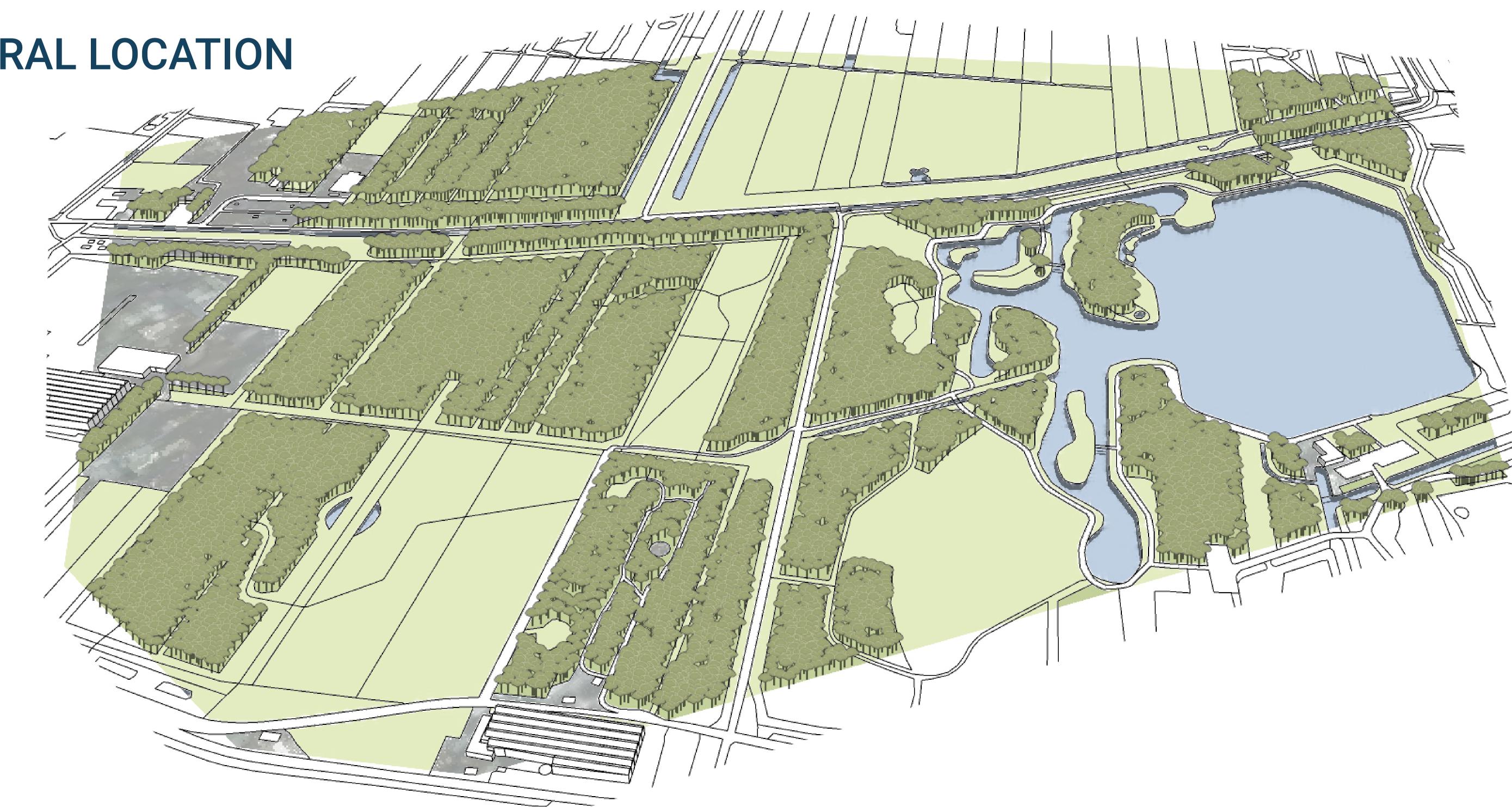
URBAN PROJECTIONS



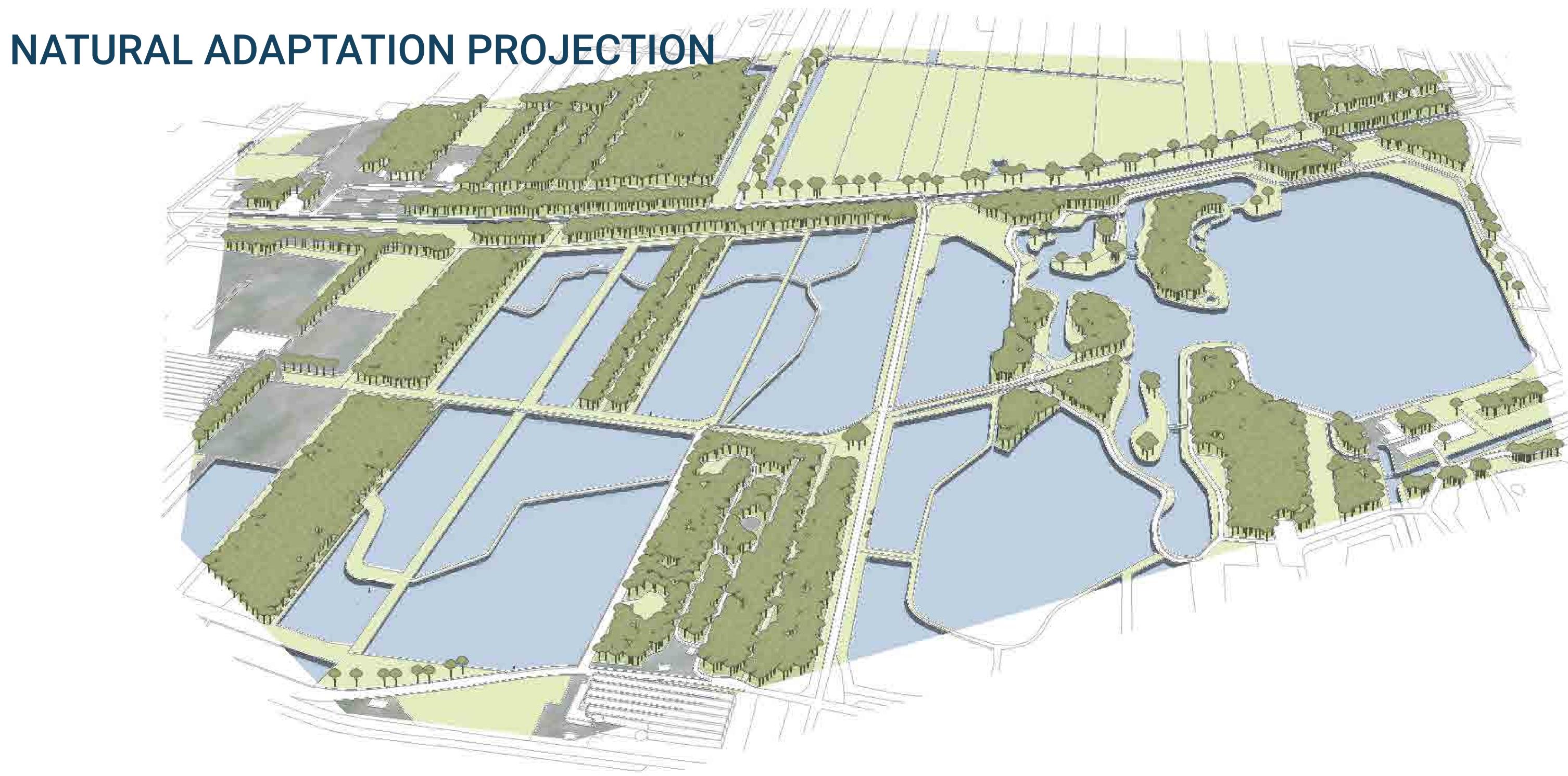




NATURAL LOCATION











NATURAL MITIGATION PROJECTION







NATURAL PROJECTIONS



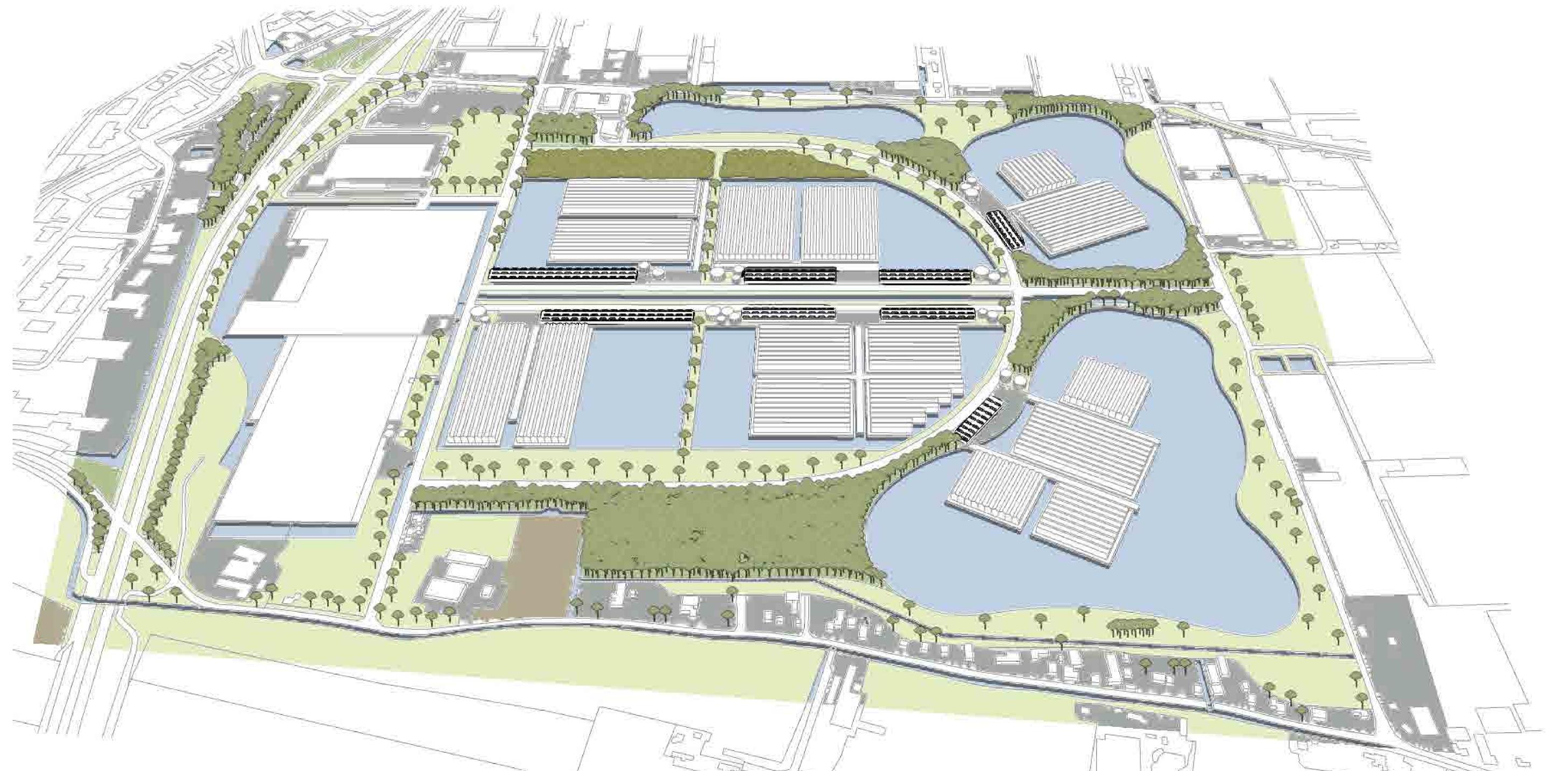


GREENHOUSES





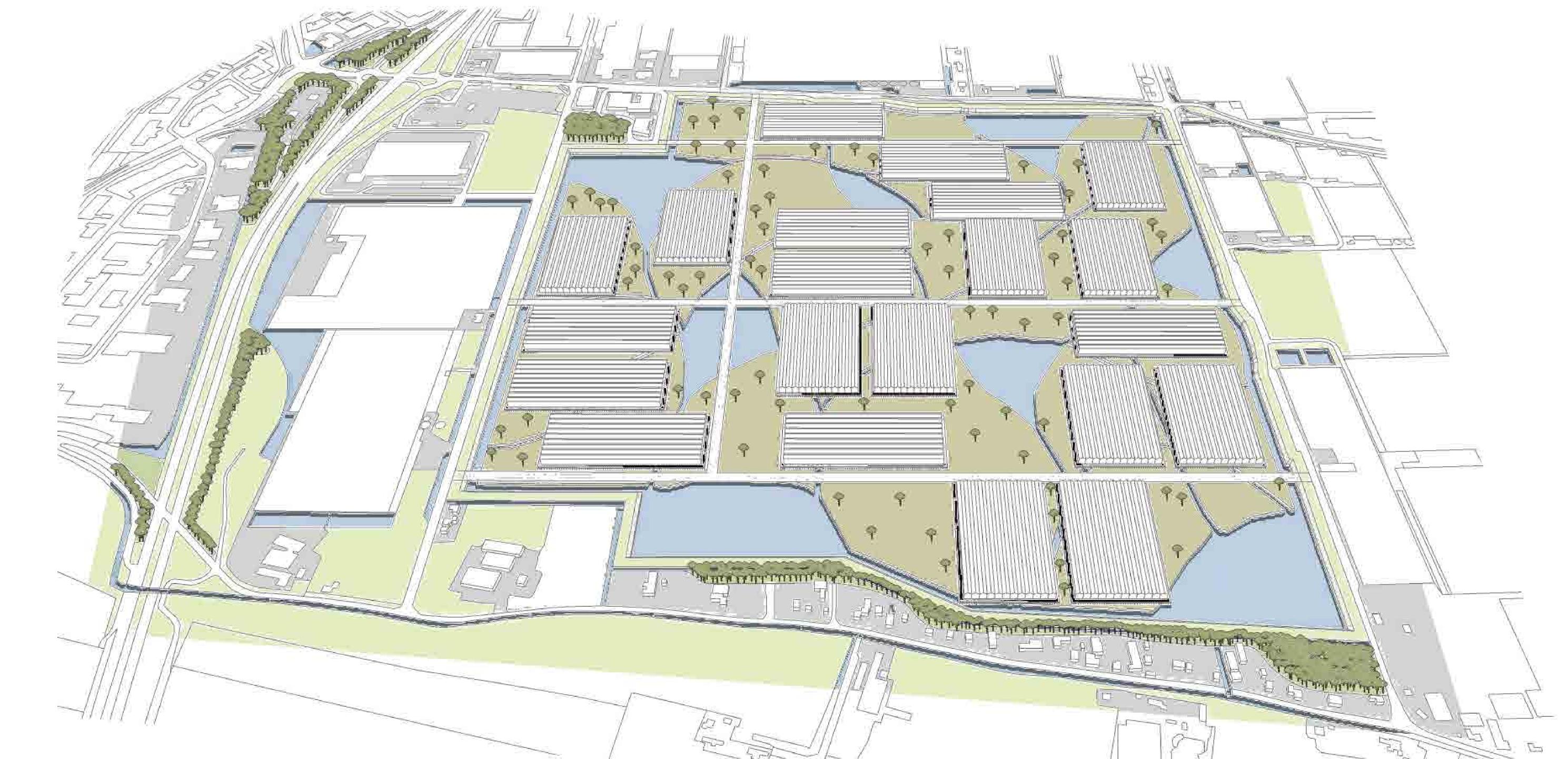
GREENHOUSE ADAPTATION PROJECTION







GREENHOUSE MITIGATION PROJECTION

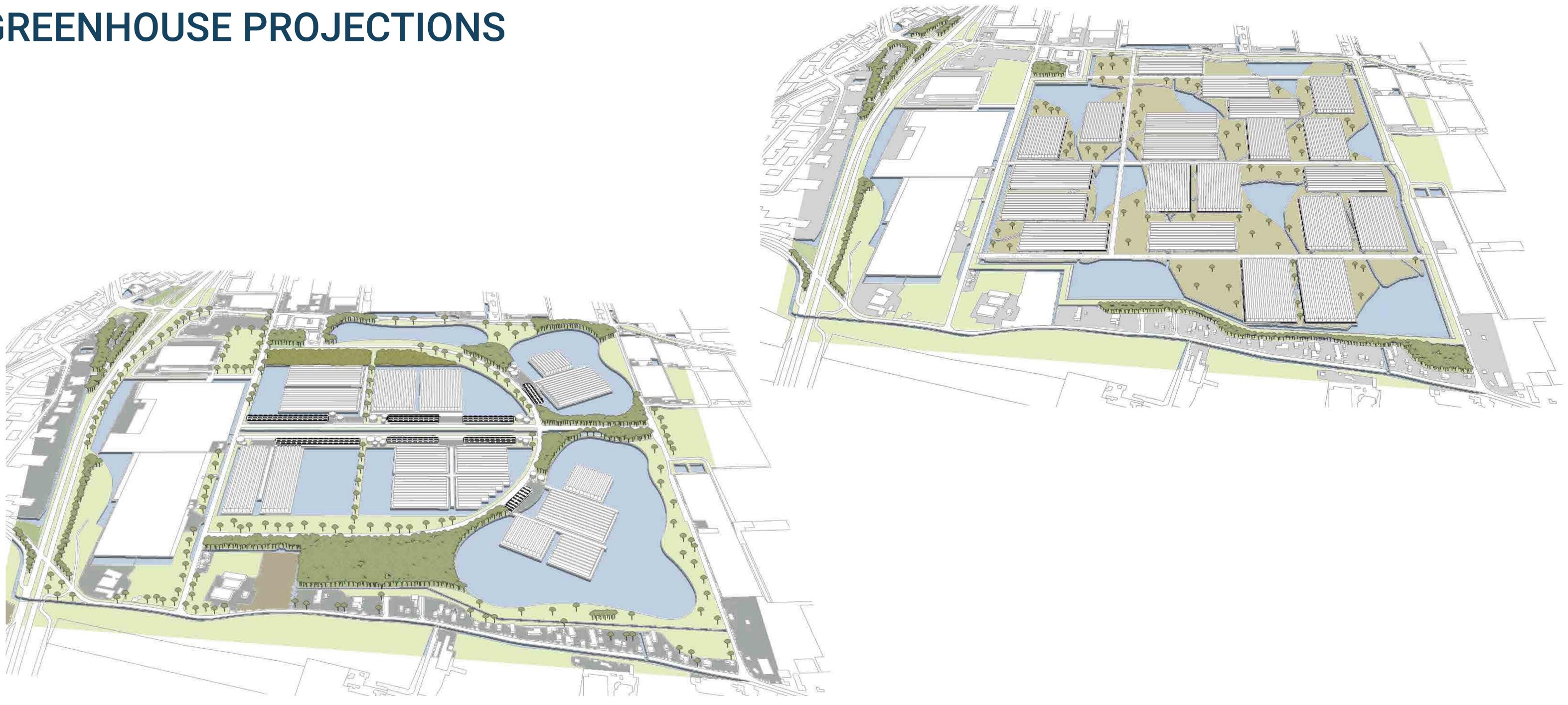








GREENHOUSE PROJECTIONS



PROBLEM FIELD RESEARCH SETUP ANALYSIS ACTION ASSESSMENT DECISION-MAKING PATHWAY PROJECTIONS CONCLUSIONS & RECOMMENDATIONS

CONCLUSIONS & RECOMMENDATIONS

Monitor



Plan implementation

Specify a dyanamic adapative plan Determine

contingency actions and triggers

> Create a spatial projection of the preferred pathway(s) Select preferred pathway(s)

Describe current situation, objectives & uncertainties

Development of dynamic adaptive policy pathways

Analyze the problem, vulnerabilities & Oppertunities

Identify actions

Assess Efficacy and Sell by date of the different actions

Develop adaptation pathways and pathway map

Analysis of stakeholders and their involvement

CONCLUSIONS

Reassess vulnerabilities & oppertunities

DROWNING DELTAS A STRATEGICAL SPATIAL APPROACH TO SOIL SUBSIDENCE IN DELTA REGIONS

