EARLY ADAPTATION OF WATER IN URBAN PLANS

IMPROVING WATER INCLUSIVITY IN EARLY DEVELOPMENT PLANS, LIKE SCHIEOEVERS NOORD IN DELFT, BY BRIDGING THE GAP IN DISCOURSE BETWEEN URBAN DESIGNERS AND CIVIL ENGINEERS IN URBAN WATER MANAGEMENT.

28-01-2021 - P5 PRESENTATION, INGRID STAPS

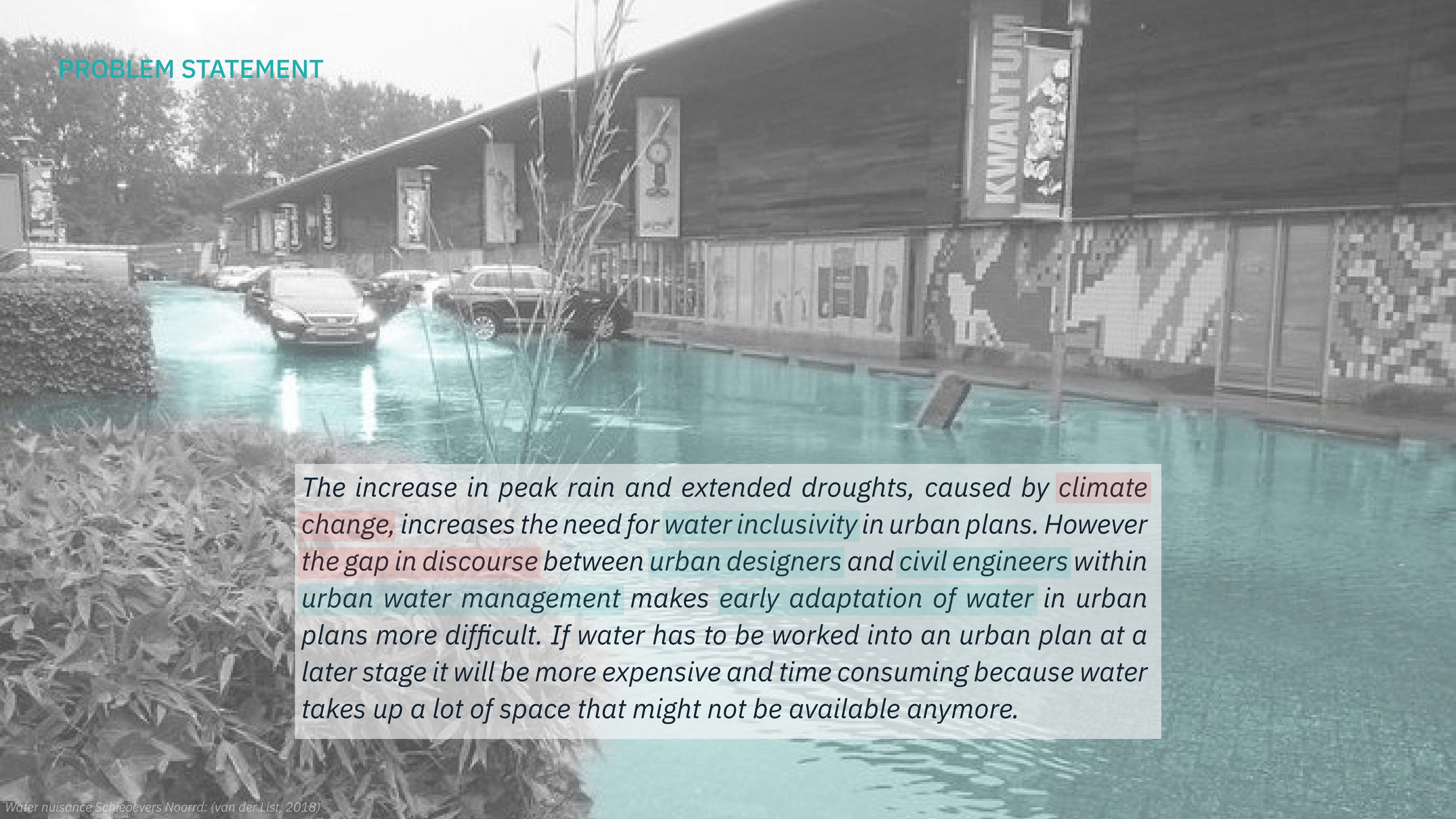
“ ENDLESS ROWS OF BRICK BOXES . . . ARE NOT REALLY HOMES FOR PEOPLE, AND CAN NEVER BECOME SUCH, HOWEVER COMPLETE MAY BE THE DRAINAGE SYSTEM, HOWEVER PURE THE WATER SUPPLY ”

- RAYMOND UNWIN

Quote (Unwin, 1909)

PRESENTATION STRUCTURE

PROBLEM STATEMENT



The increase in peak rain and extended droughts, caused by climate change, increases the need for water inclusivity in urban plans. However the gap in discourse between urban designers and civil engineers within urban water management makes early adaptation of water in urban plans more difficult. If water has to be worked into an urban plan at a later stage it will be more expensive and time consuming because water takes up a lot of space that might not be available anymore.

Water nuisance Schieoevers Noorrd: (van der List, 2018)

RESEARCH QUESTION

What lessons can be learned on water inclusivity in urban regeneration plans from Schieoevers Noord in Delft, by studying the gap in discourse between urban designers and civil engineers?

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DEFINITION OF THE RESEARCH GAP

ANALYSIS

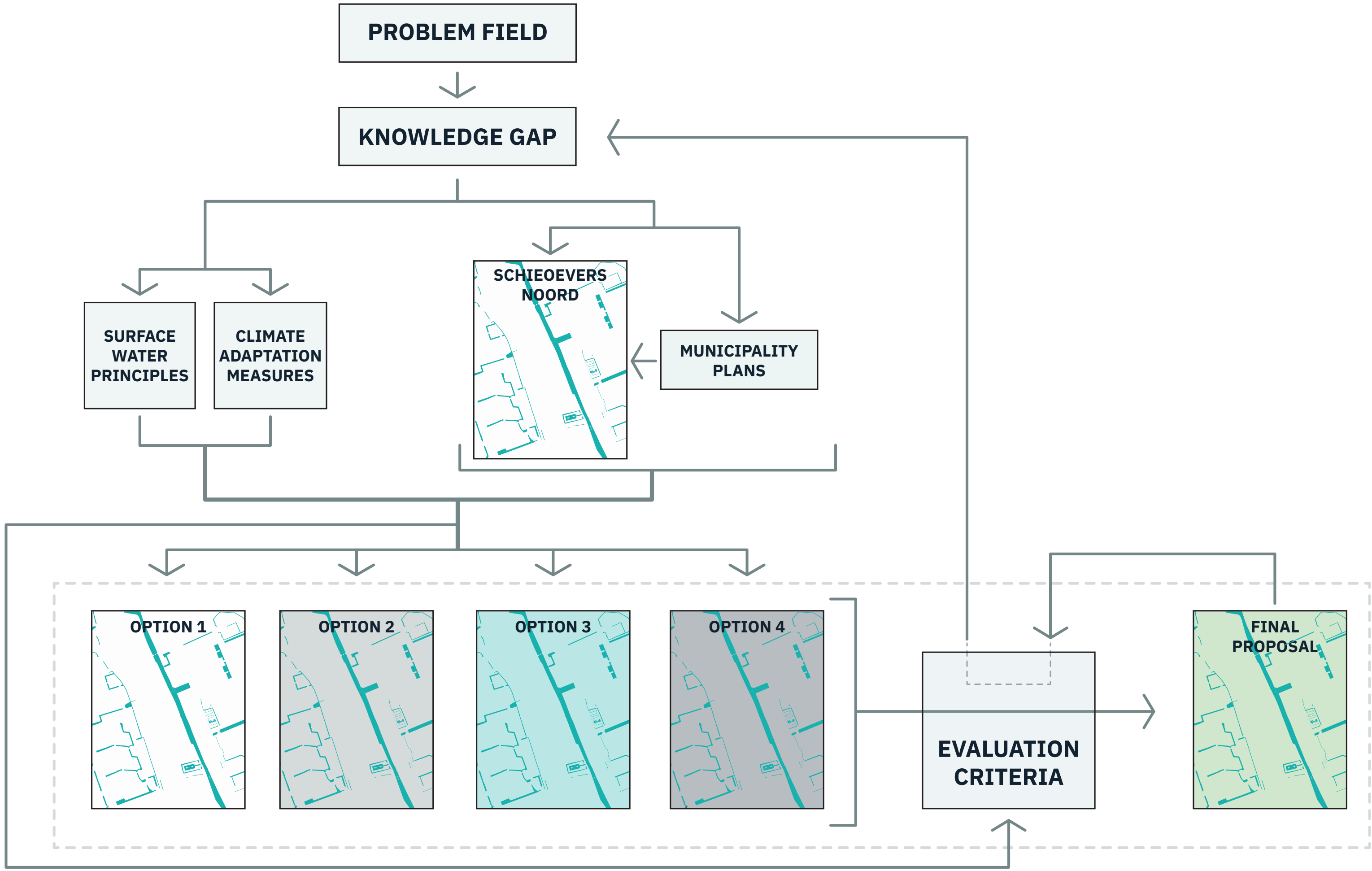
GUIDING PRINCIPLES

STRATEGIES AND PROPOSAL

TRANSFERABILITY

METHODOLOGICAL FRAMEWORK

Project structure

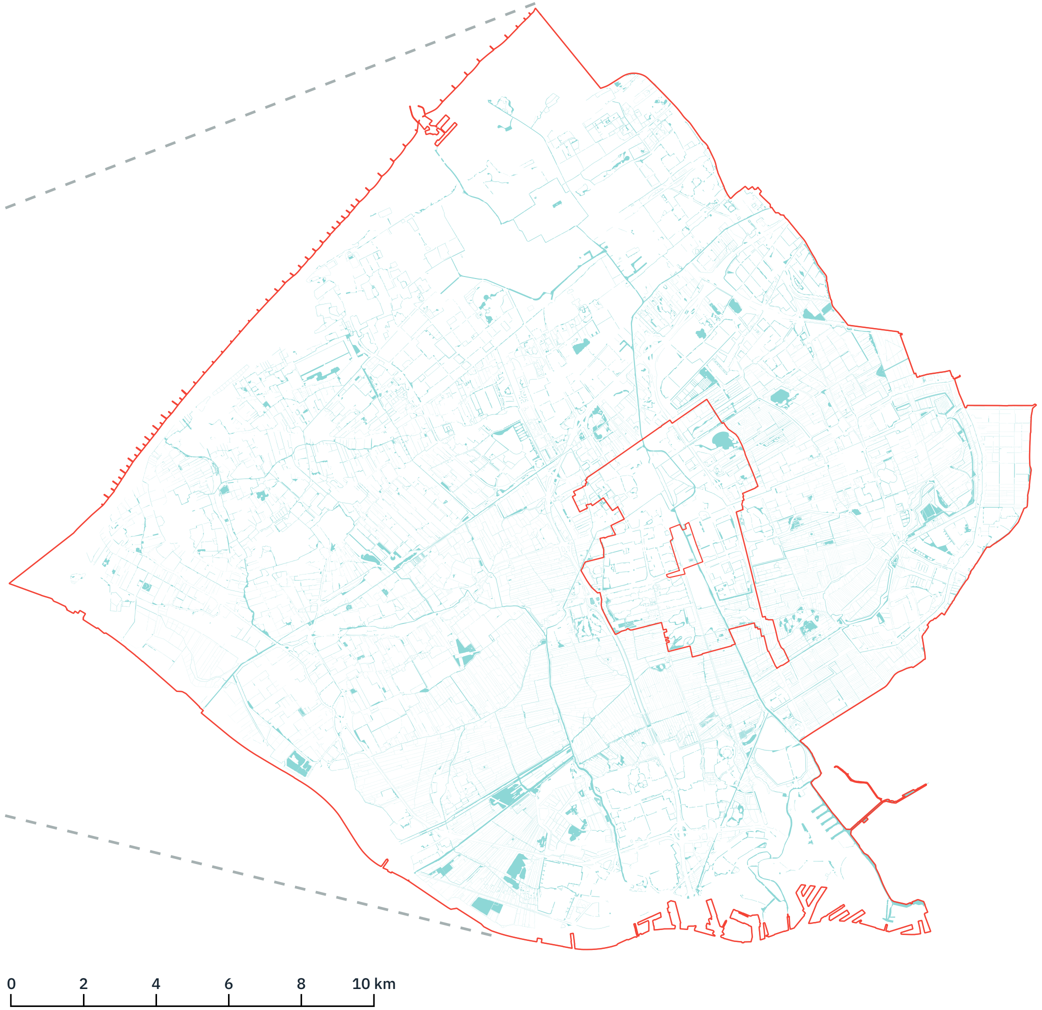


SCHIEOEVERS NOORD

INTRODUCTION OF THE CASE STUDY LOCATION

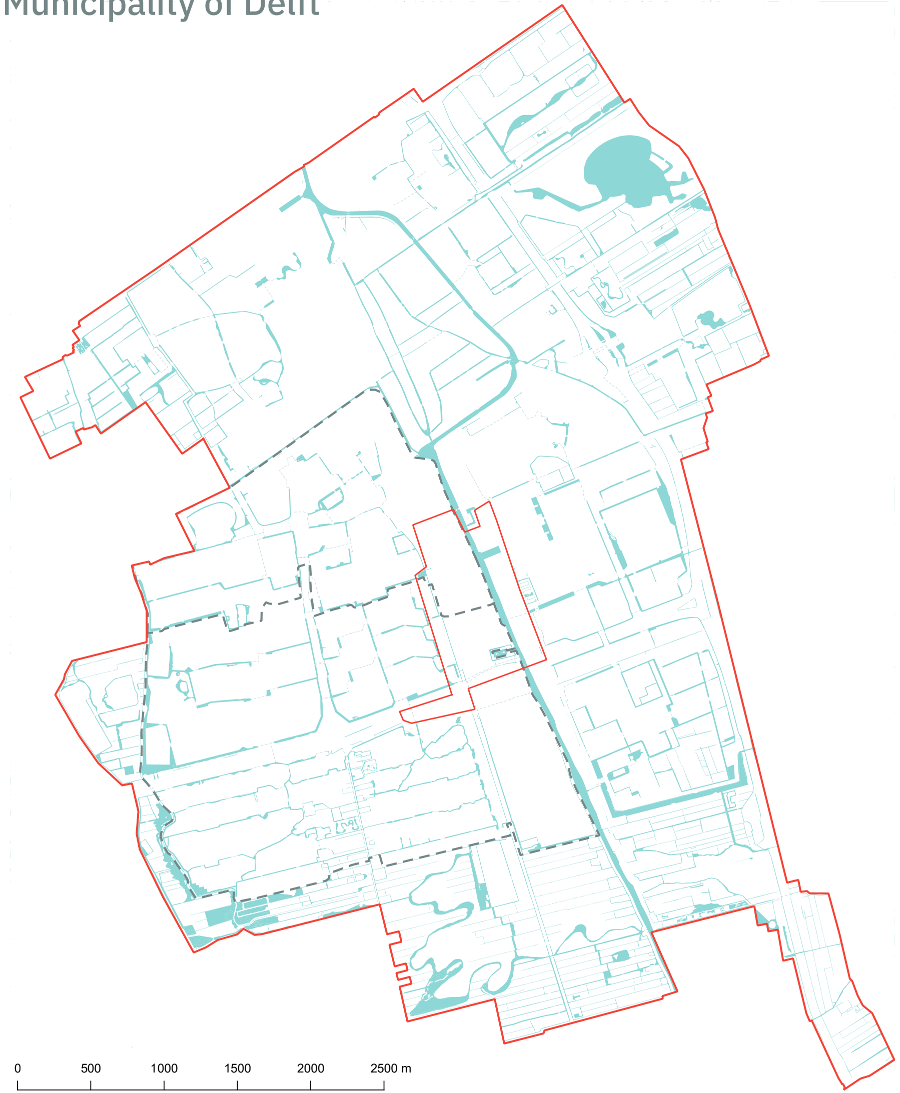
SCALES

Management area of the Delfland Water Authority



SCALES

Municipality of Delft



Higher and Lower Abtwoudse polder

SCHIEOEVERS NOORD

Photo: Delft Schieoevers (Minderhoud, 2006)

SCHIEOEVERS NOORD VISUAL IDENTITY

Large industrial buildings

Photo: (Google Earth, 2020)

SCHIEOEVERS NOORD VISUAL IDENTITY

Pavement

Photo: (Google Earth, 2020)

SCHIEOEVERS NOORD VISUAL IDENTITY

Cars and trucks

Photo: (Google Earth, 2020)

SCHIEOEVERS NOORD VISUAL IDENTITY

Lijm en Cultuur

Photo: (Google Earth, 2021)

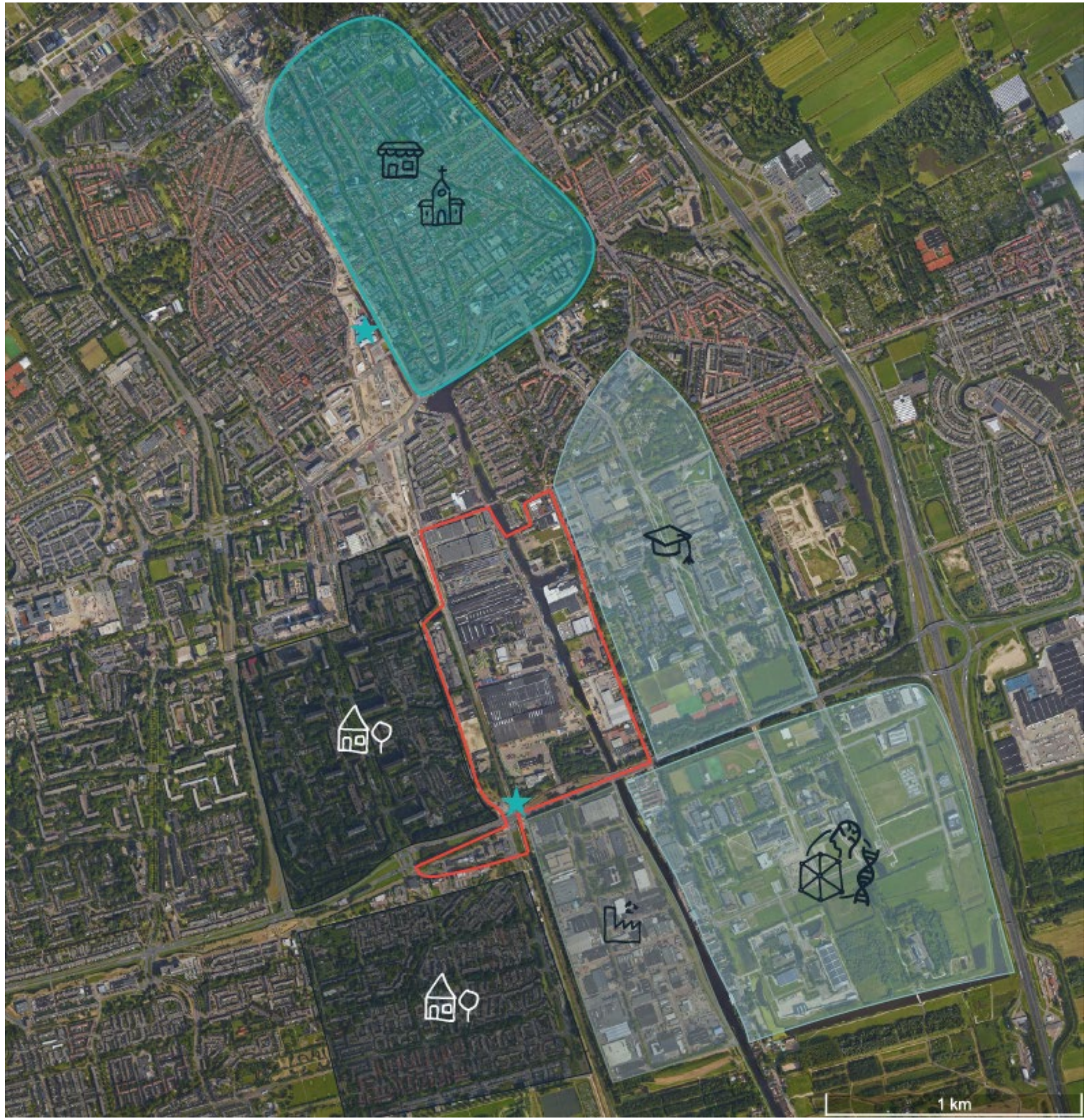
Schiehallen

SCHIEOEVERS NOORD VISUAL IDENTITY

Kruithuis

Photo: (Mastenbroek, 2016)

SCHIEOEVERS NOORD SURROUNDING AREA AND SUBDIVISION



Both images: Adapted from google earth (Google Earth, 2020)

CASE STUDY LOCTATION: SCHIEOEVERS NOORD

Goals for Delft by 2040

10.000 Additional workplaces
15.000 Additional residences

Schieoevers Noord At completion
55% of workplaces
50% of residences

Photo: Delft Schieoevers (Minderhoud, 2006)

MUNICIPAL REDEVELOPMENT PLAN FOR SCHIEOEVERS NOORD

INTRODUCING THE IMPORTANT ASPECTS OF THE MUNICIPAL PLAN

MUNICIPAL PLANS

Existing plans

Goals for Schieoevers Noord
(Municipality of Delft & Marco.Broekman, 2019)

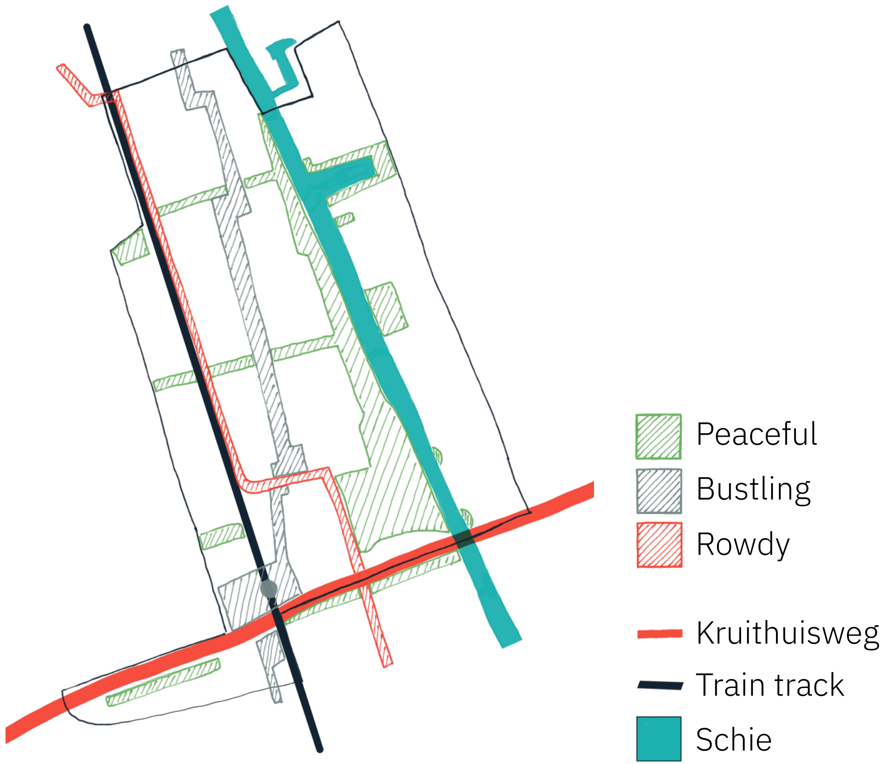
Lively and mixed urban area | Room for innovative manufacturing | Socially inclusive and culturally diverse | Sustainable and healthy environment | Mobility and connectivity

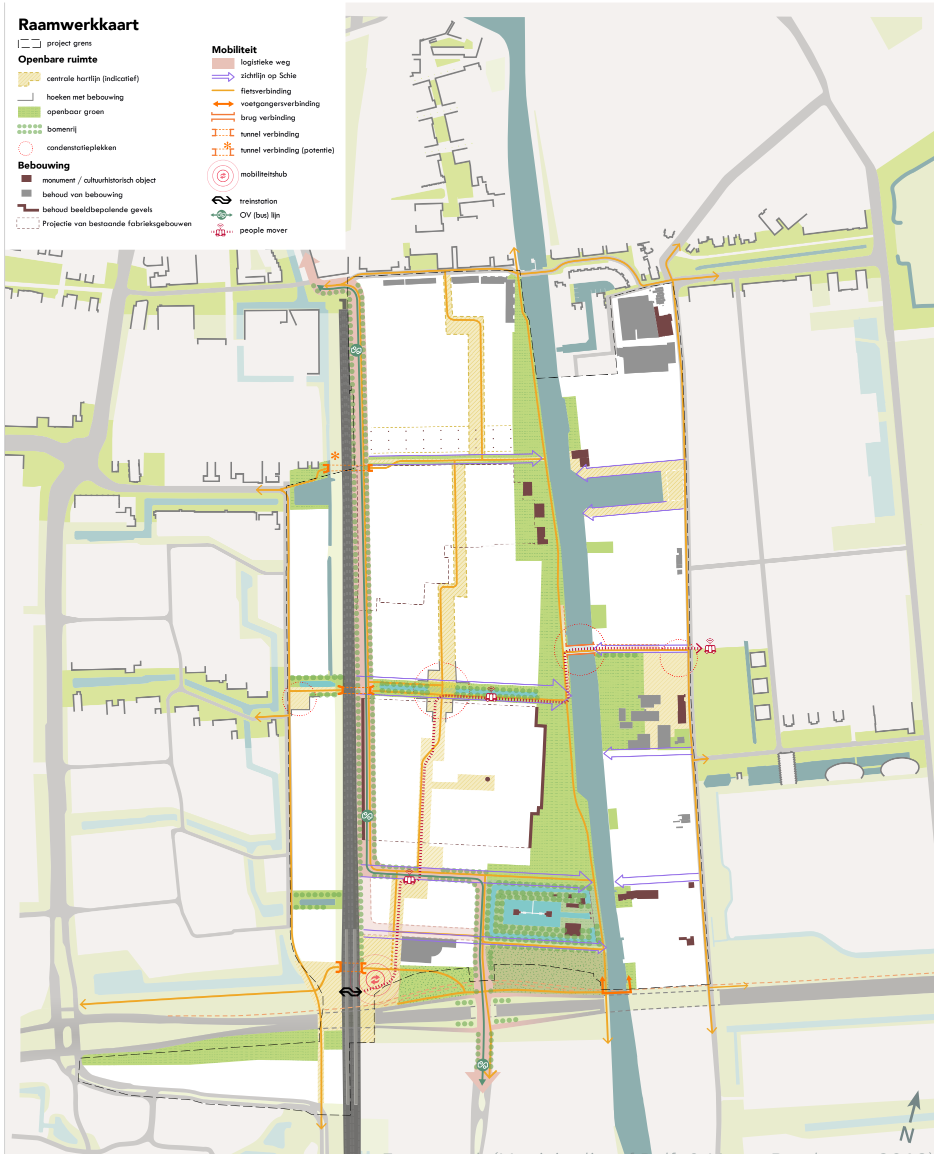
MUNICIPAL PLANS

Main framework map

Three distinctive zones

Main road (Schieweg) gets flipped to the traintracks





Framework (Municipality of Delft & Marco.Broekman, 2019)

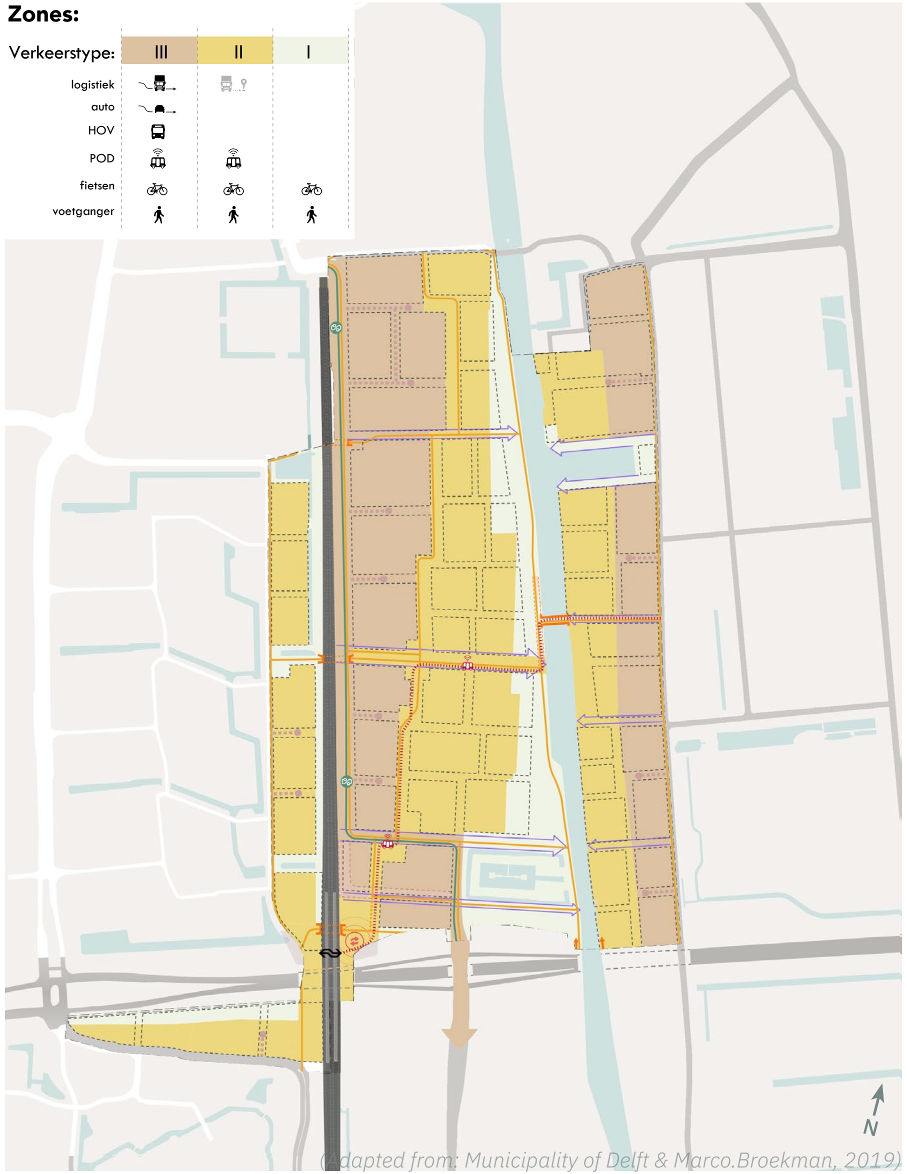
MUNICIPAL PLANS

Infrastructure framework

Mobility infrastructure prioritises public transport and cycling.

Buildings higher than five stories have an offset.

Intricate building blocks



(Adapted from: Municipality of Delft & Marco.Broekman, 2019)

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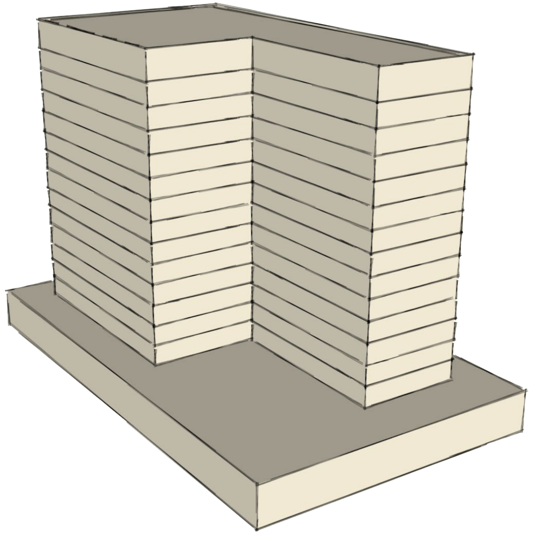

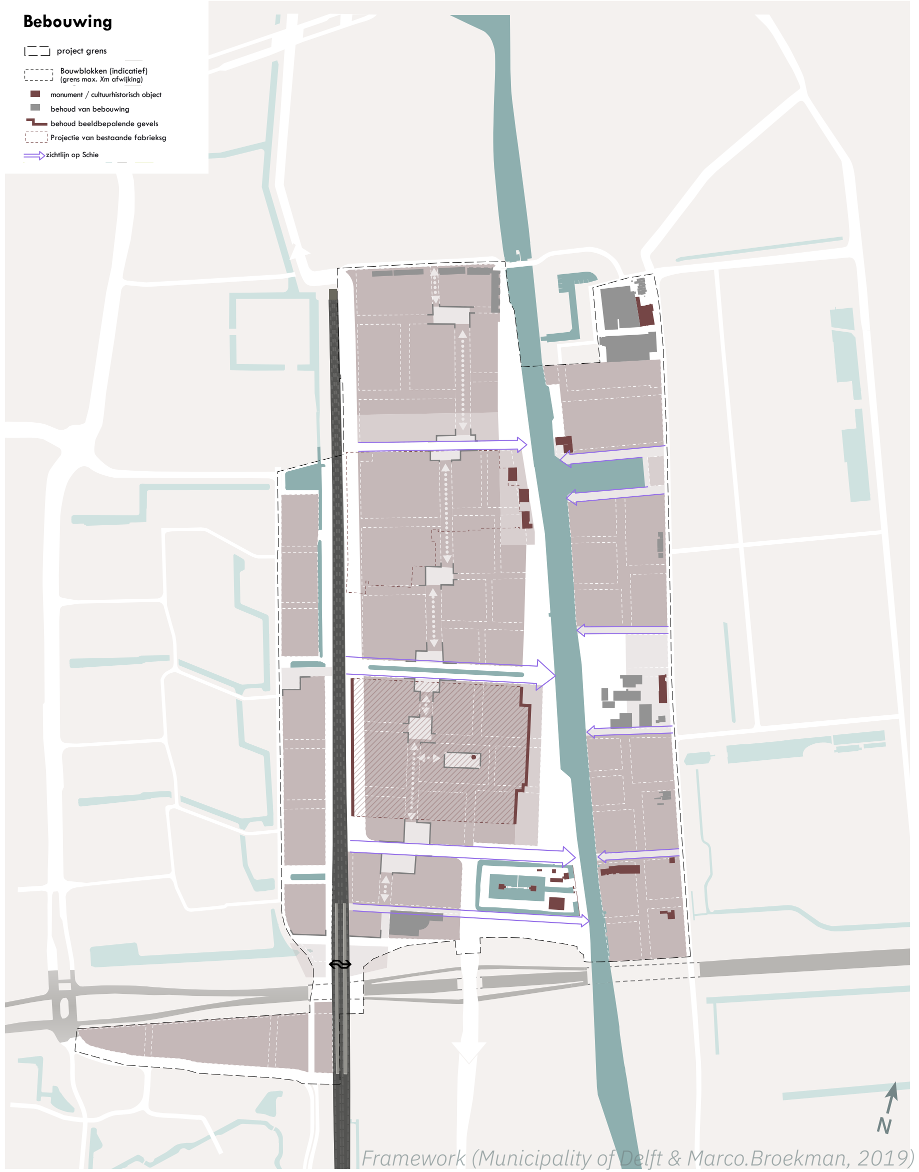

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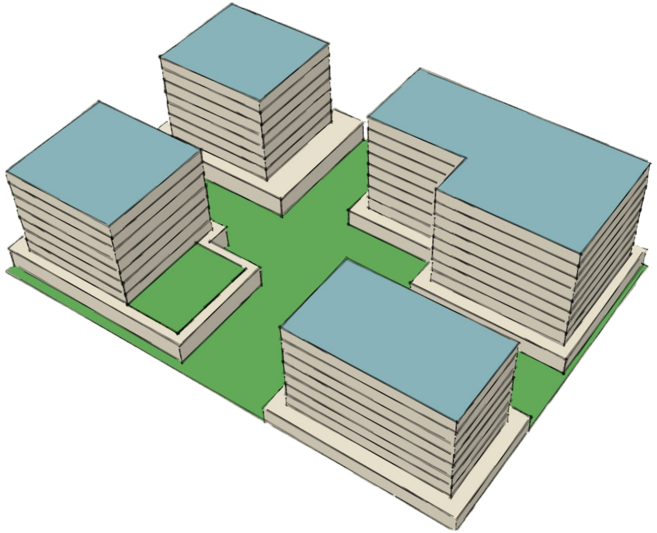
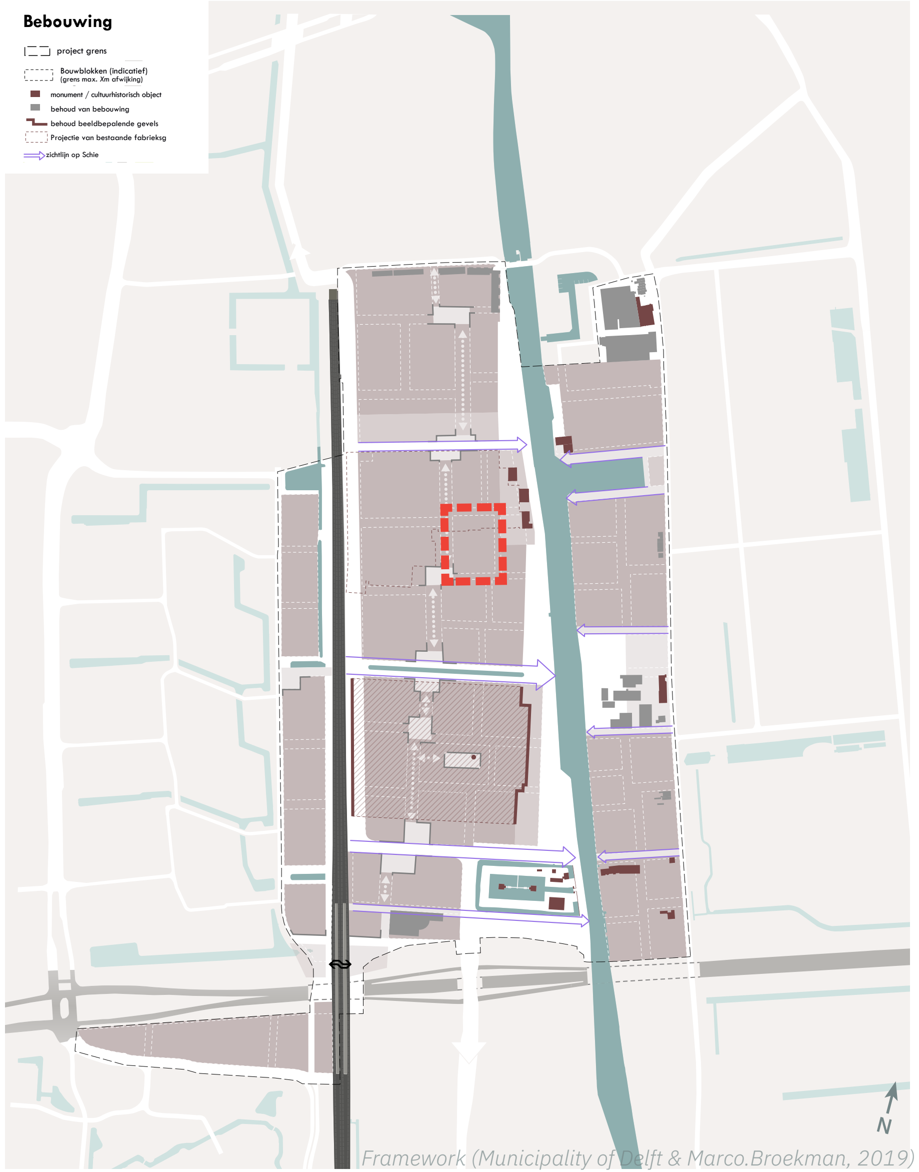




Framework (Municipality of Delft & Marco.Broekman, 2019)

MUNICIPAL PLANS

Green and blue framework

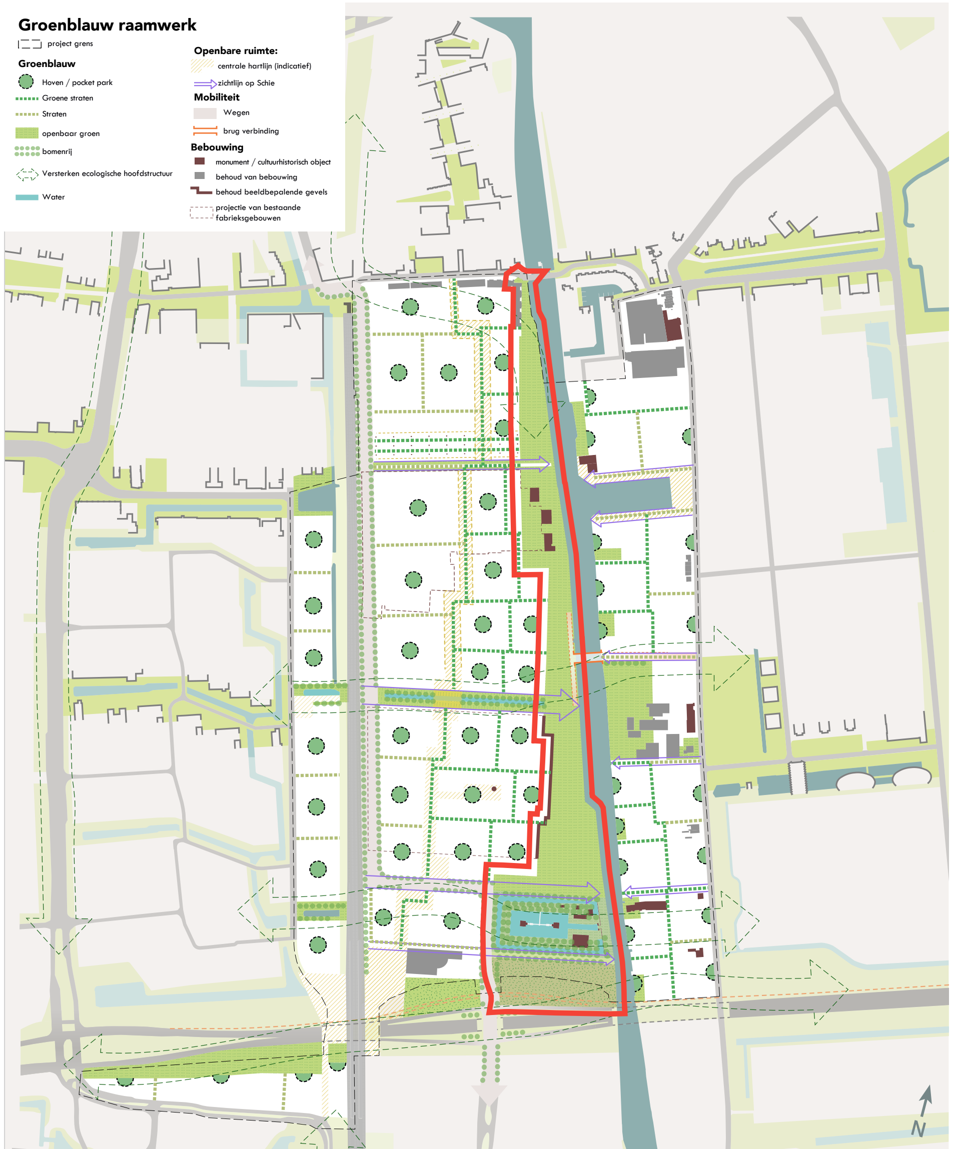
Schiepark along the Schie

Pocket parks in the whole area

All roofs need to store water and have at least one other function

Nature inclusive buildings

Schieoevers Noord shows promise for adding surface water, circularity is an issue



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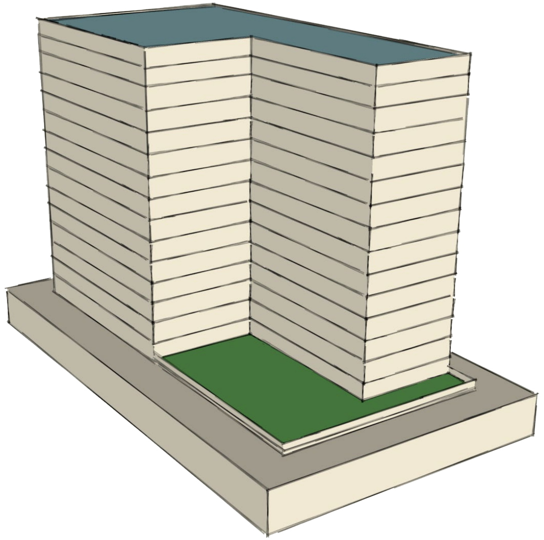

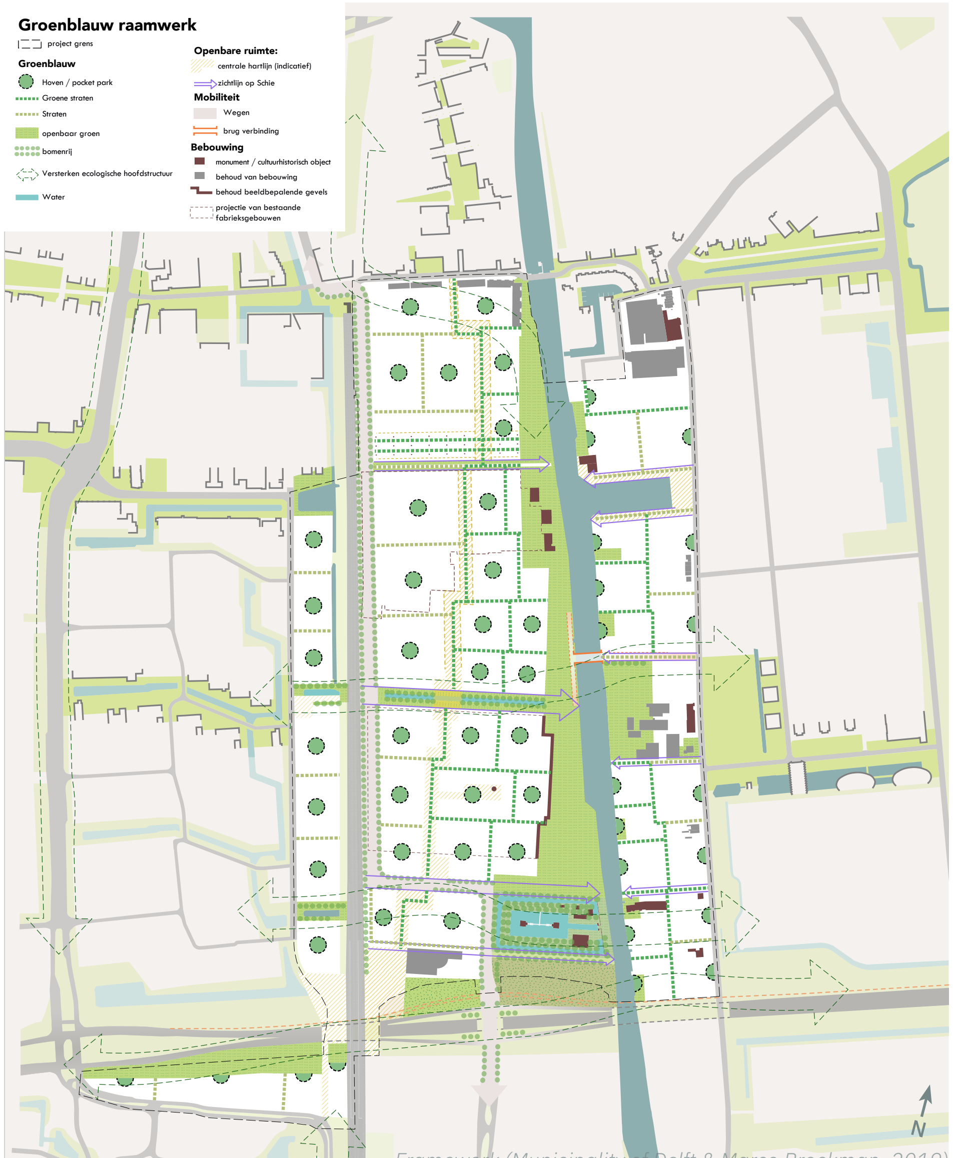

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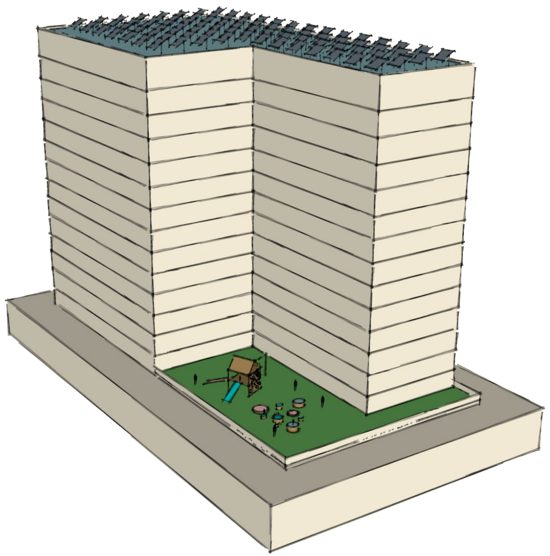

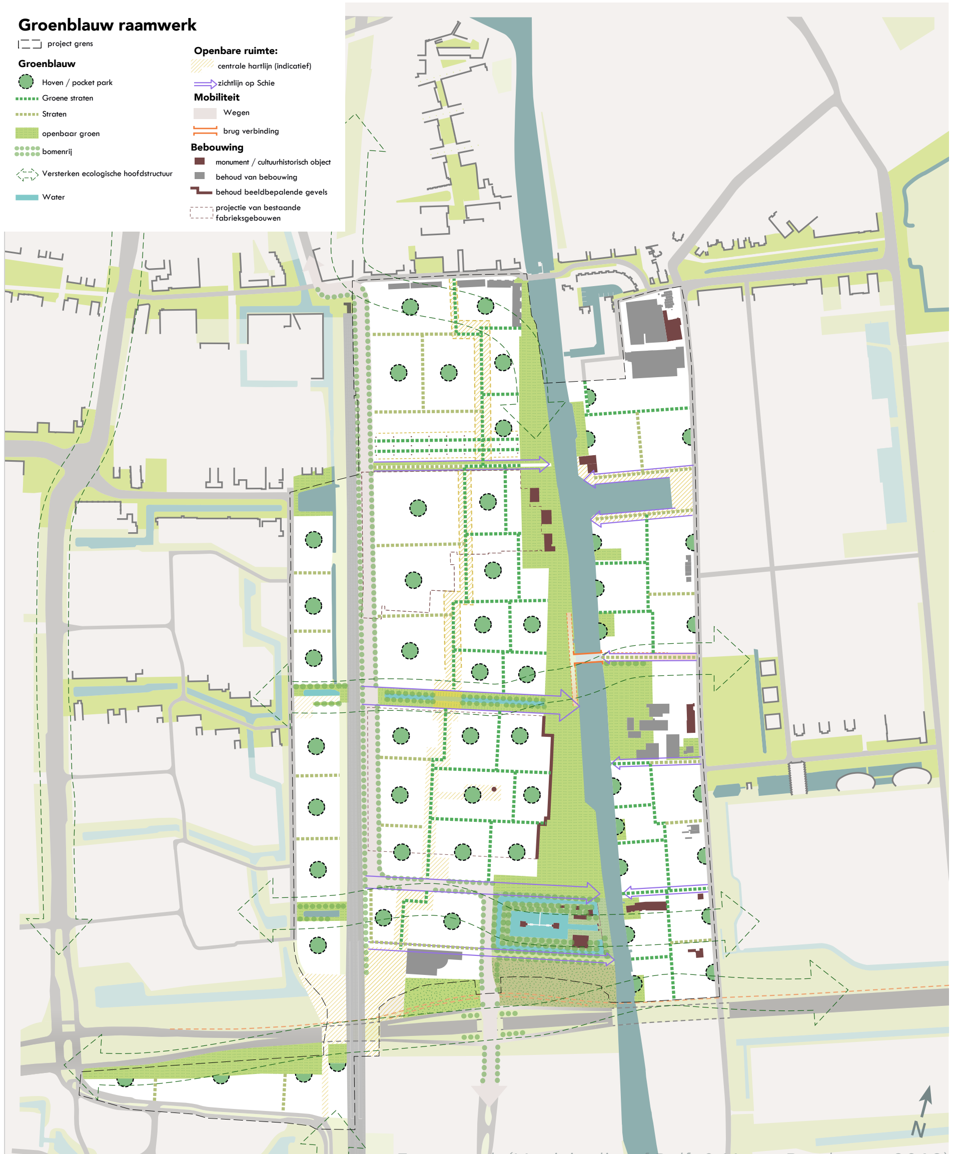

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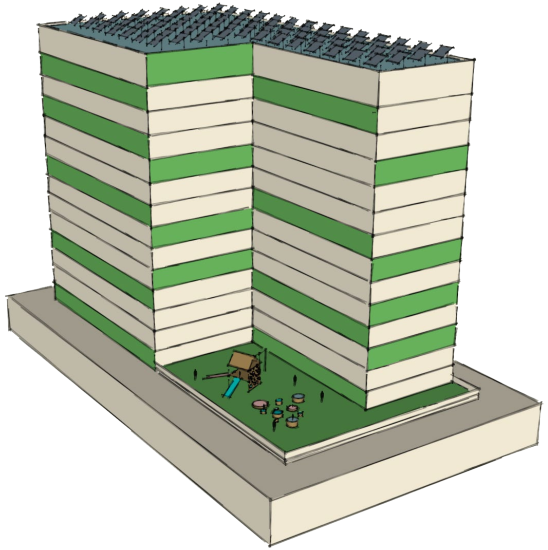

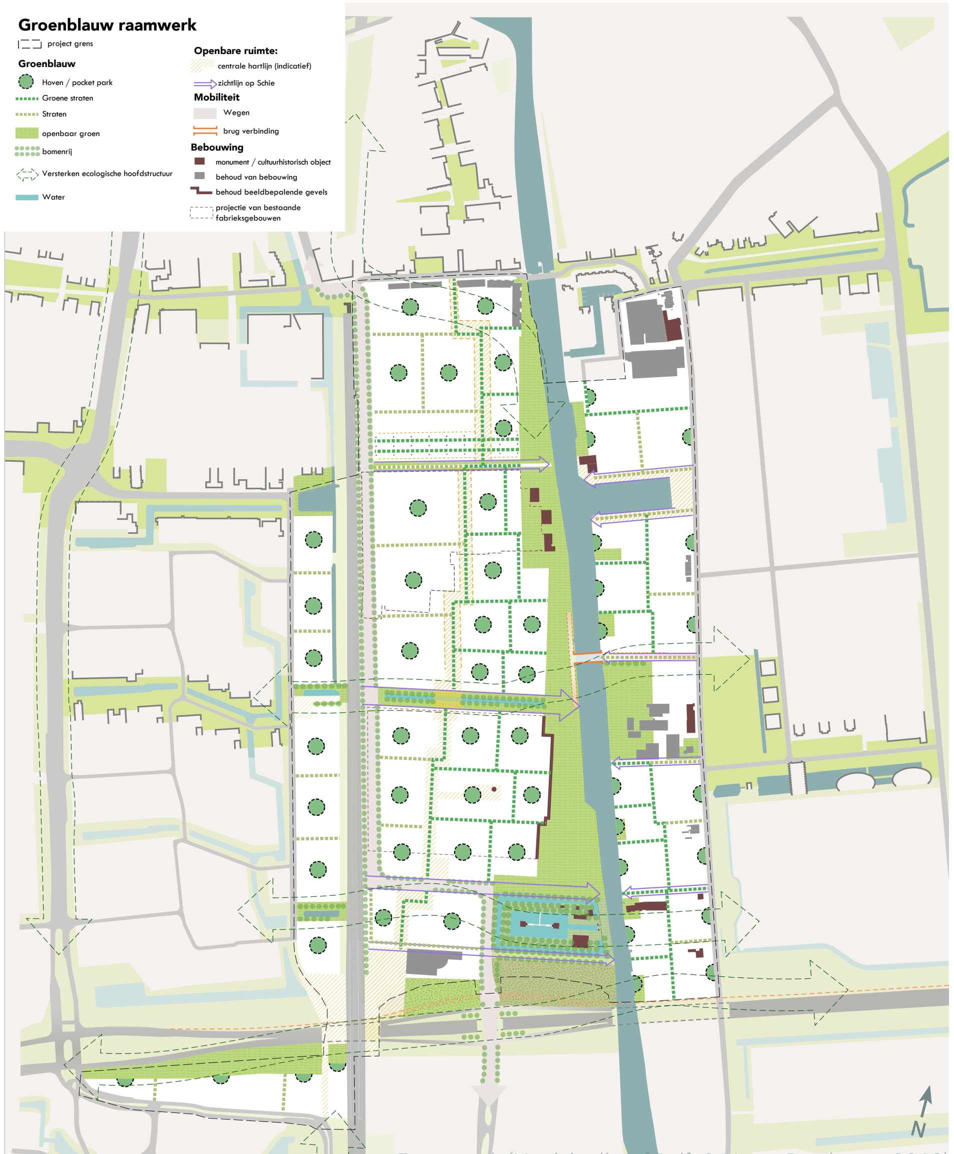

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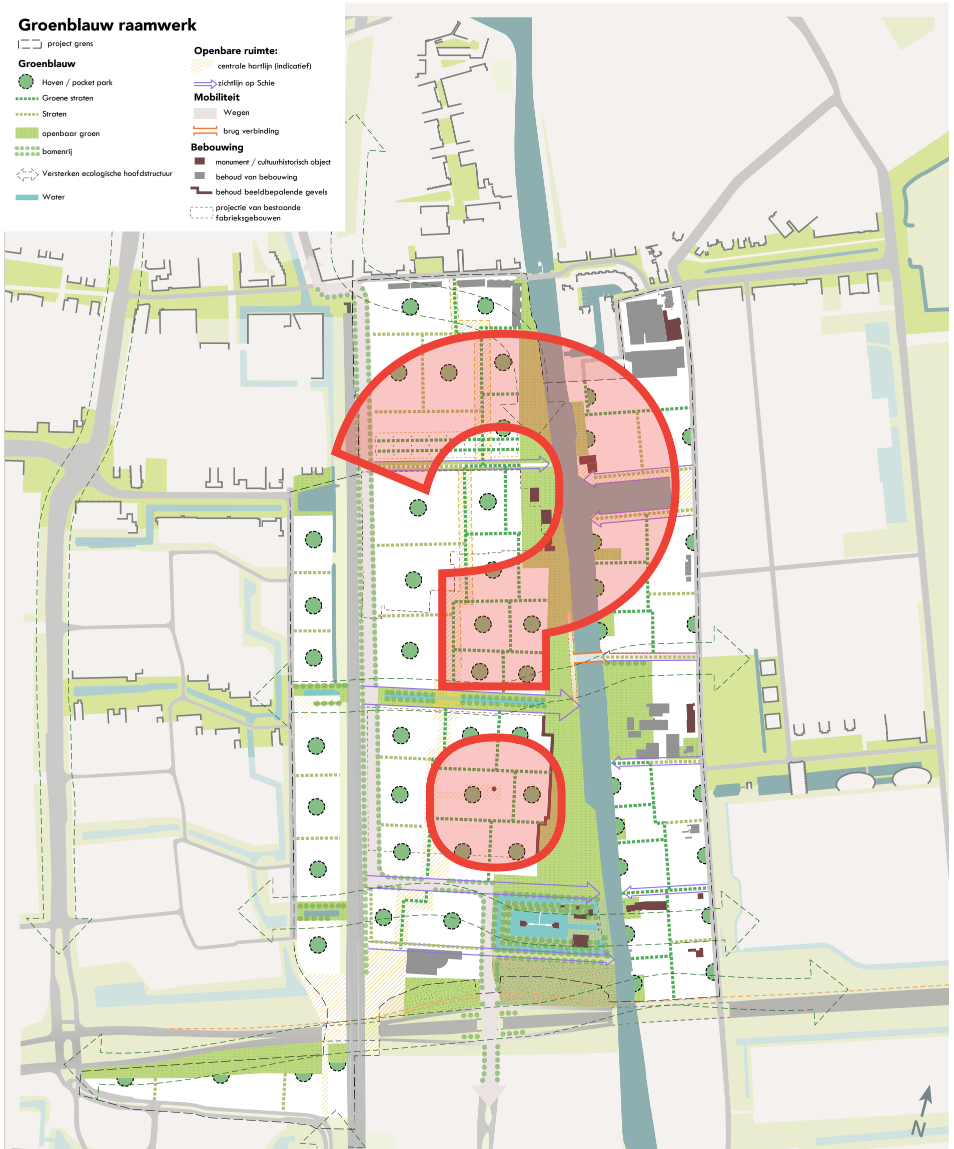


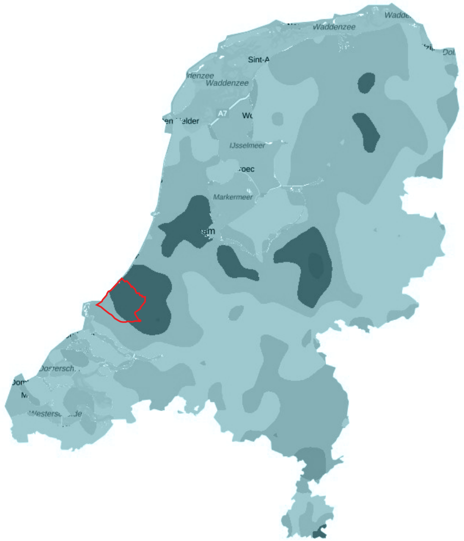
Framework (Municipality of Delft & Marco.Broekman, 2019)

WHY IS SURFACE WATER SO IMPORTANT?

WATER NUISANCE

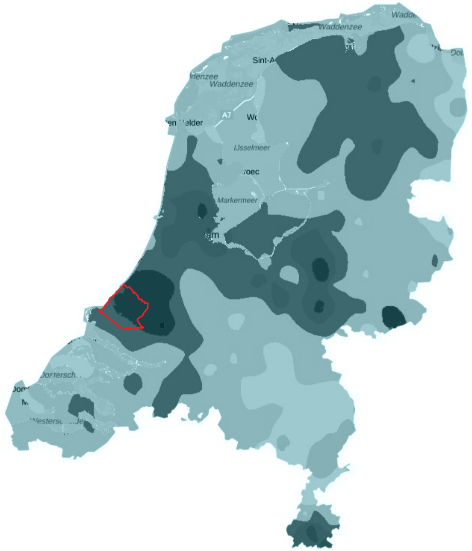
Sensitive areas in Schieoevers Noord

Yearly rainfall current climate



(Klimaateffectatlas, KNMI)

Yearly rainfall 2050



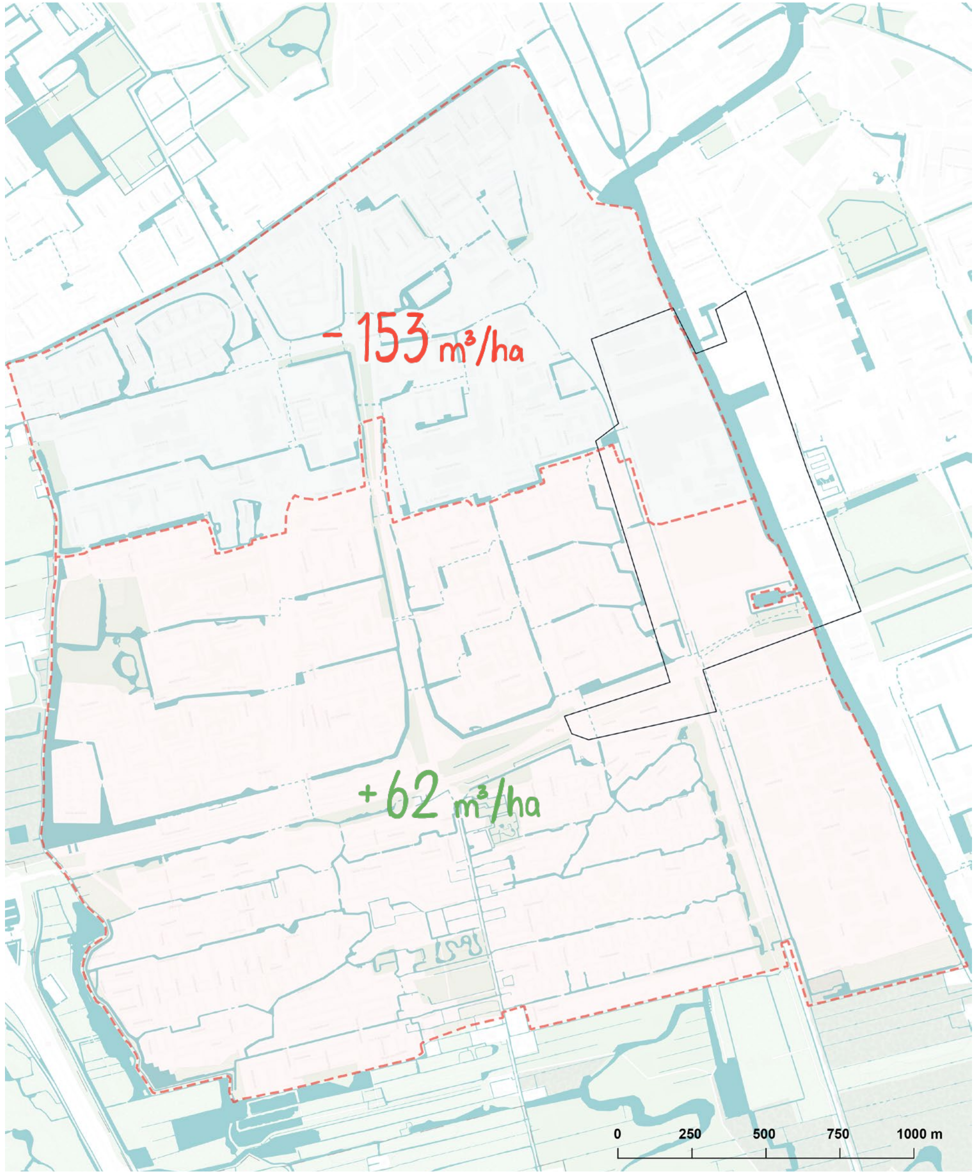
(Klimaateffectatlas, KNMI)

WATER SYSTEM

Water shortage in Higher Abtwoudse polder

Delfland Water authority static water storage norm: 325m³/ha

Shortage causes water quality decline



WATER SYSTEM

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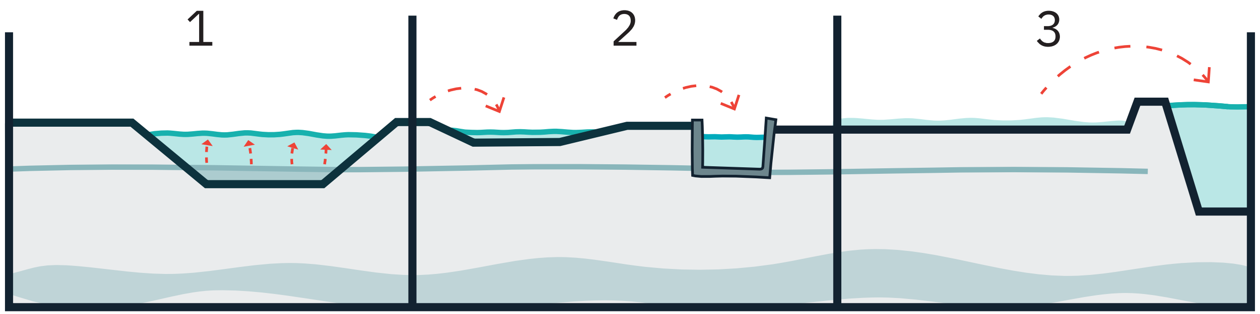
FIRST PRINCIPLE OF WATER SYSTEMS

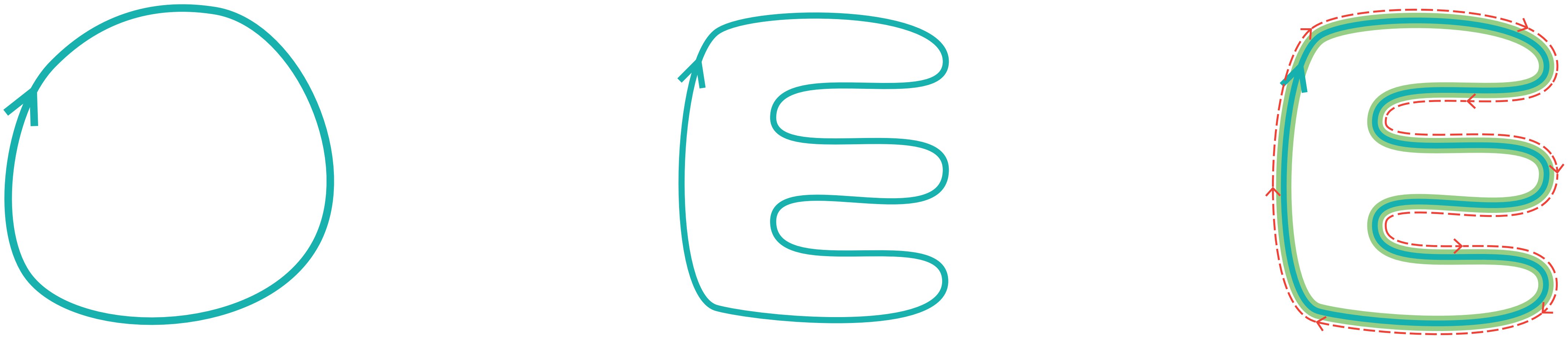
Retain, Store, Drain



CREATING A STRONG HEALTHY SURFACE WATER SYSTEM

PRINCIPLES FOR HEALTHY SURFACE WATER

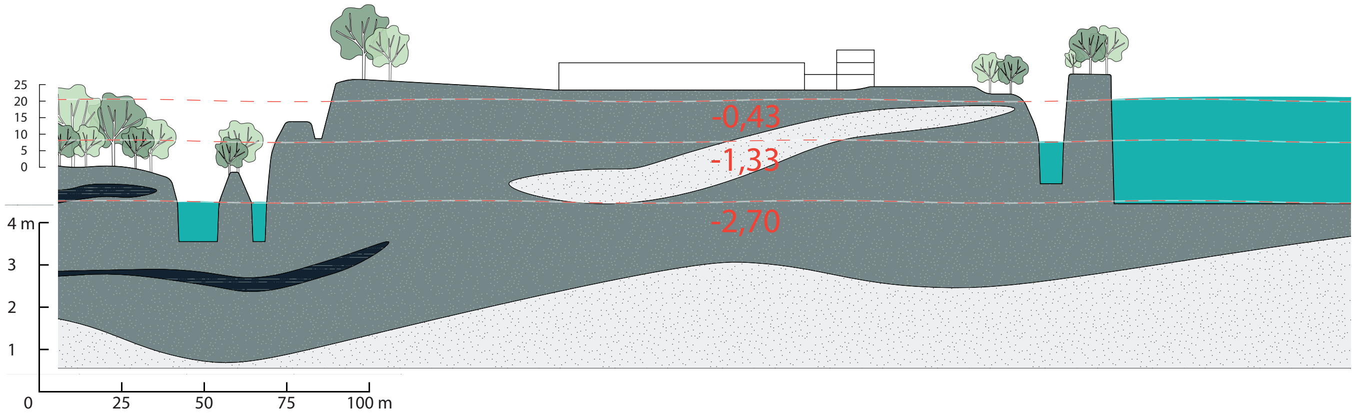
Circulation, added length and a continuous ecological structure

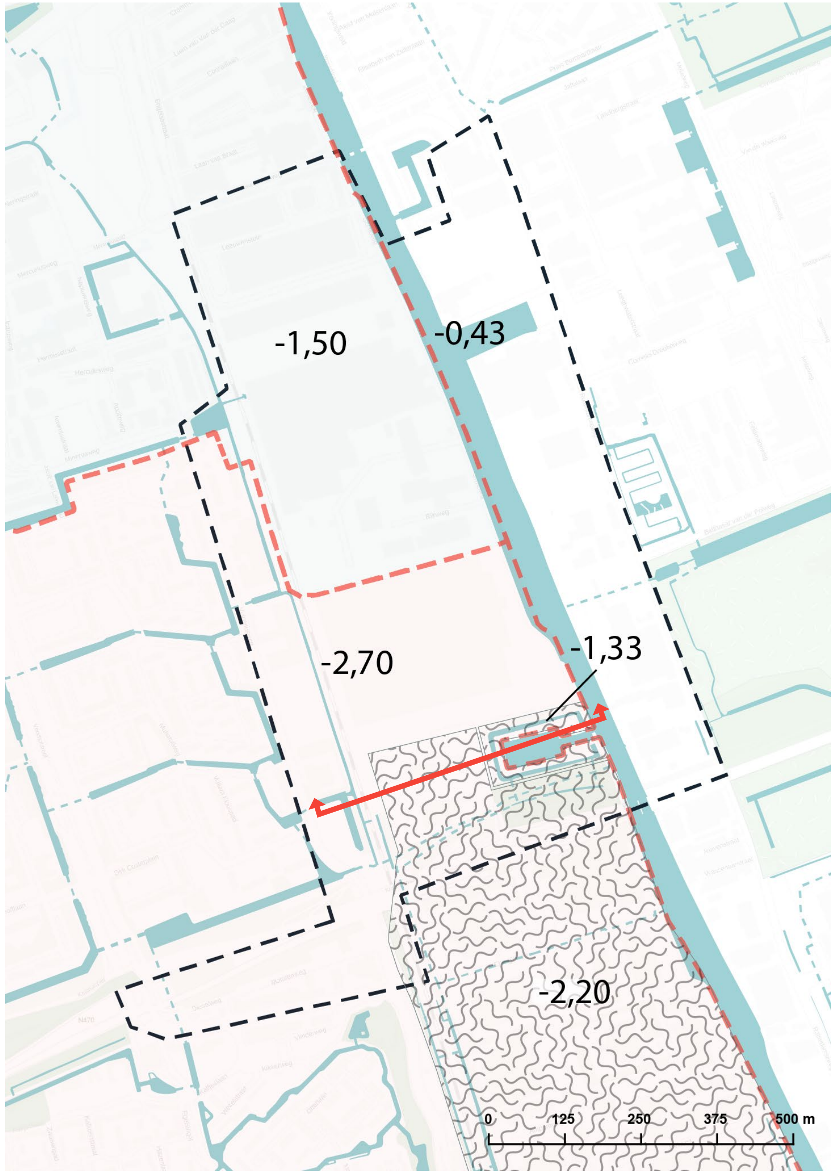


COMPLEXITY OF THE EXISTING WATER SYSTEM

Heigt differences

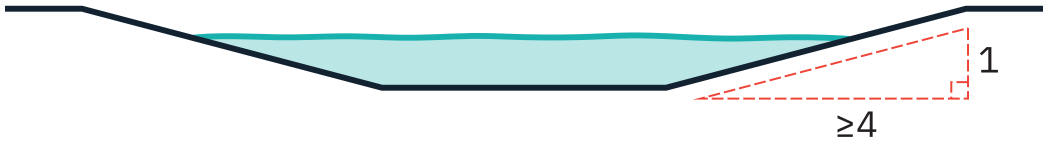
Higher Abtwoudse polder	- 1,50 m NAP
Lower Abtwoudse polder	- 2,70 m NAP
Kruithuis	- 1,33 m NAP
Schie, bosom level	- 0,43 m NAP
Adjusted level Lower Abtwoudse polder	- 2,20 m NAP



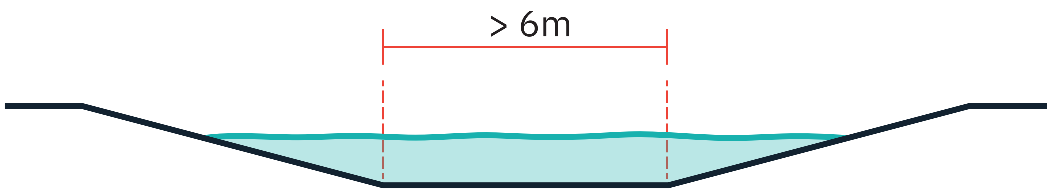


PRINCIPLES FOR HEALTHY SURFACE WATER

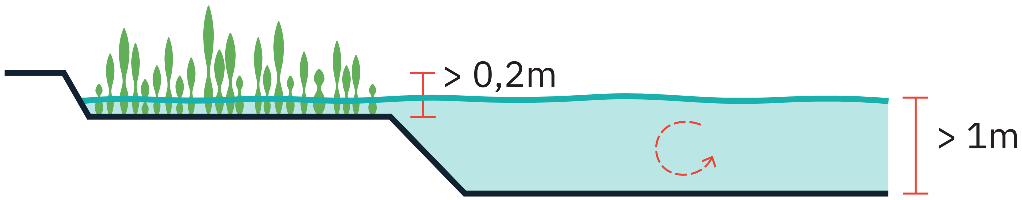
Nature friendly banks



Minimal width



Wetberms



DOWNSIDE OF THESE PRINCIPLES

Space usage

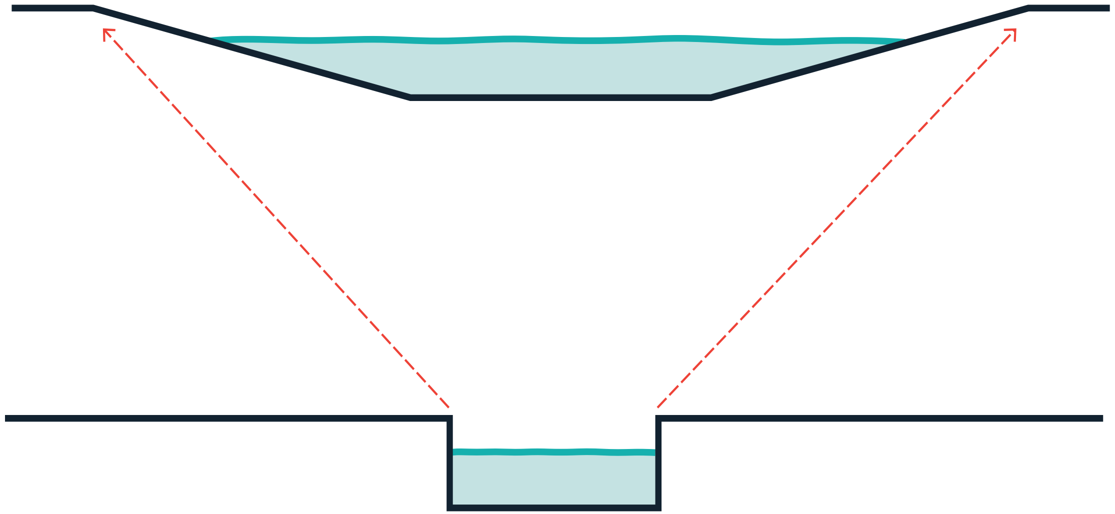


Image: (Waterschap Hollandse Delta, 2019)

Photo: (Straatbeeld, 2018)

LACK OF SPACE

Later stage of development

Building blocks

Mobility infrastructure

Green spaces

Adapted from (Municipality of Delft & Marco.Broekman, 2019)

MY SUGGESTIONS FOR SCHIEOEVERS NOORD

REDEVELOPMENT OF SLUISBUURT AMSTERDAM

BOOM Landscape and Burton Hamfelt Urban Architecture

Plan (BurtonHamfelt Urban Architecture, 2018)

High demand for housing
Mixed use
Park on a water defense structure
Similar size of plan
Located along water
High, slender towers to leave space for green and water

(Gemeente Amsterdam, BOOM Landscape, & BurtonHamfelt Urban Architecture. 2018)

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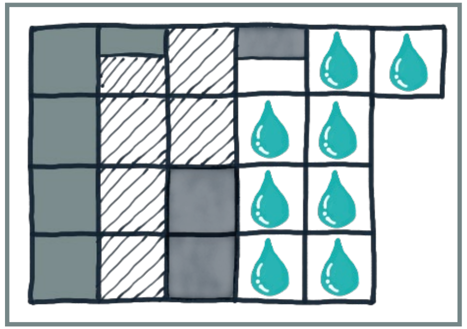
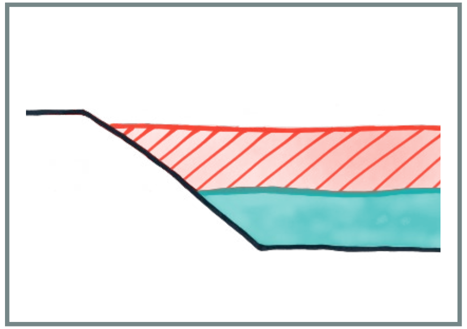
EVALUATION CRITERIA

Criterion 1 - Space matrix

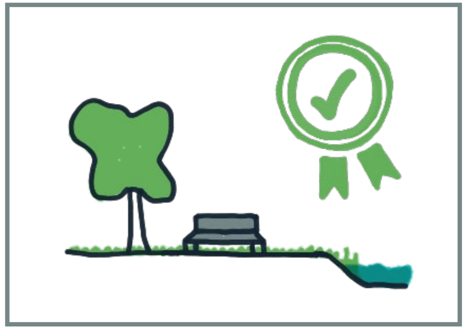


Criterion 2 - Static storage

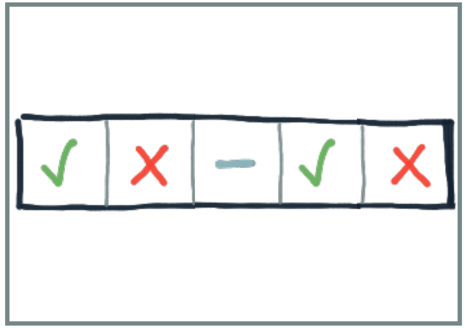


Criterion 3 - Effect on the polders

Criterion 4 - Spatial quality



Criterion 5 - Adaptive measure effects



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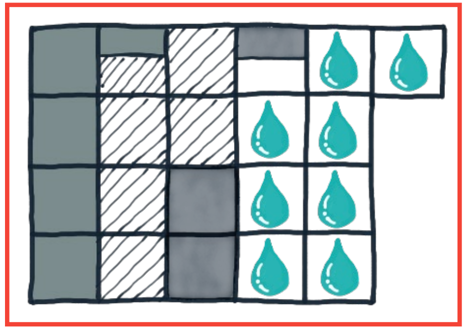
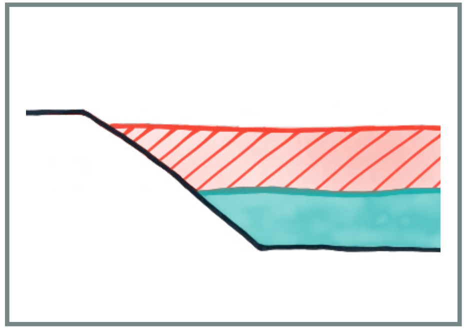


How much space does it take up?

Criterion 2 - Static storage



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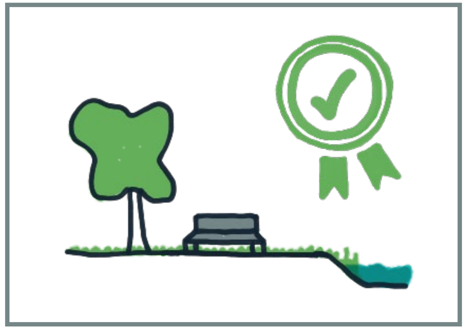

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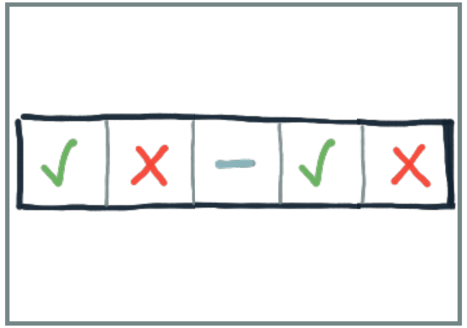

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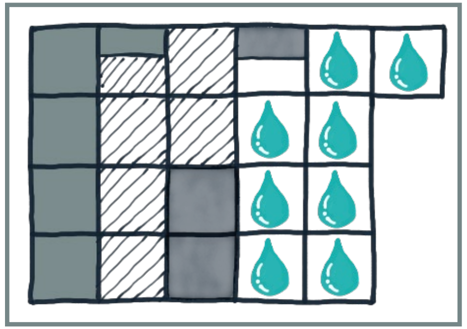
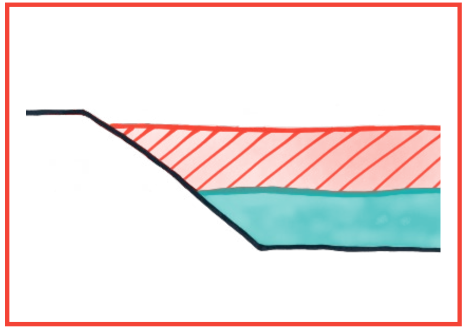


How much space does it take up?

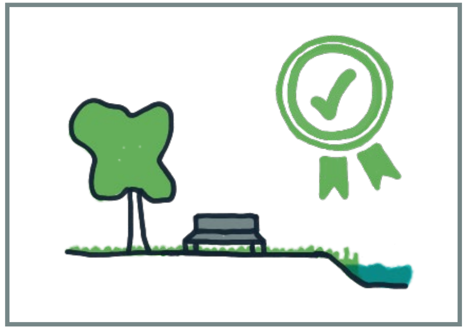
Criterion 2 - Static storage



Norm: At least 325 m^3 water per hectare.

Criterion 3 - Effect on the polders

Criterion 4 - Spatial quality



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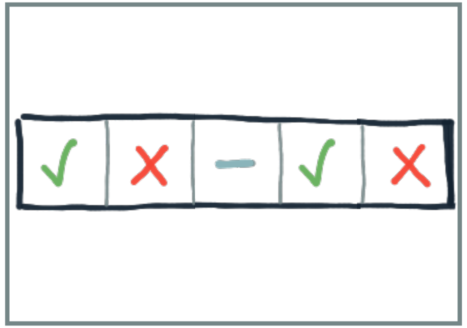
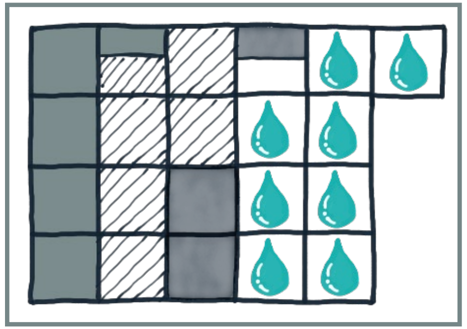


EVALUATION CRITERIA

Criterion 3 - Effect on the polders

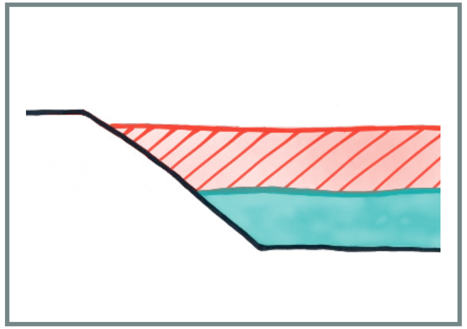
How does it affect the surrounding water system? (Higher and Lower Abtwoudse polders)

Criterion 1 - Space matrix



How much space does it take up?

Criterion 2 - Static storage



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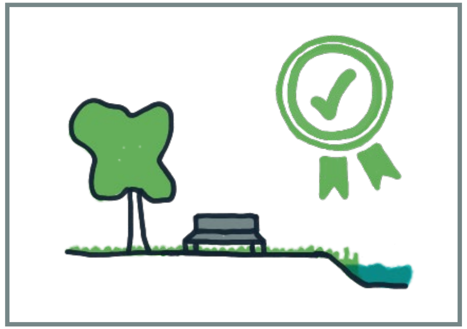
Criterion 4 - Spatial quality



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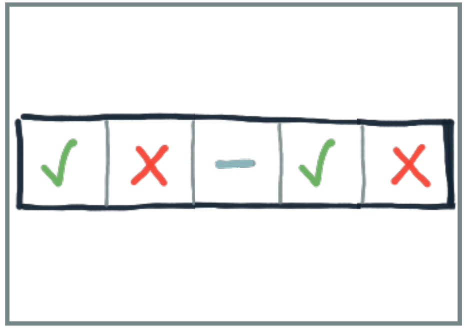

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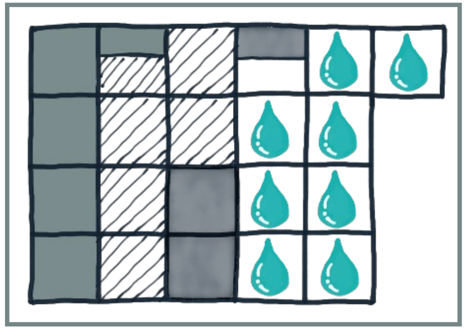
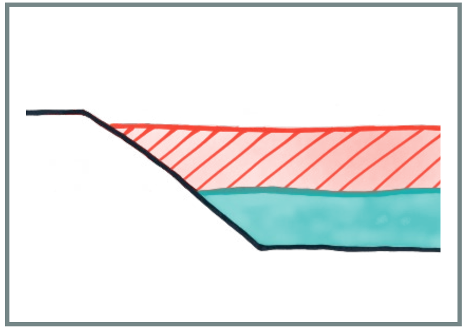


How much space does it take up?

Criterion 2 - Static storage



Norm: At least 325 m^3 water per hectare.

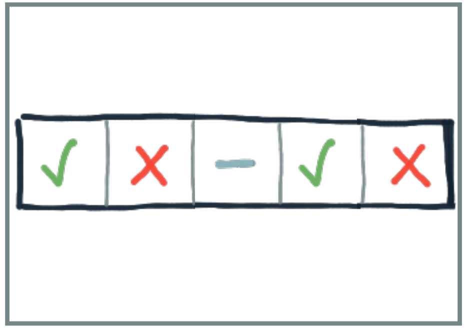
Criterion 3 - Effect on the polders

How does it affect the surrounding water system? (Higher and Lower Abtwoudse polders)

Criterion 4 - Spatial quality

Does it provide a balanced mix of different types of natural spaces?

Criterion 5 - Adaptive measure effects



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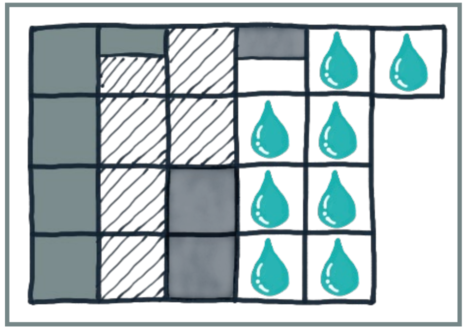
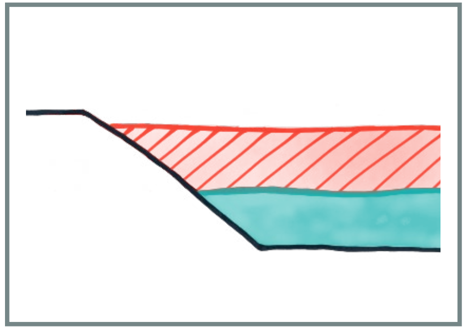


How much space does it take up?

Criterion 2 - Static storage

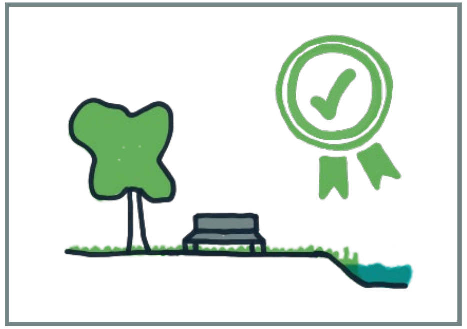


Norm: At least 325 m^3 water per hectare.

Criterion 3 - Effect on the polders

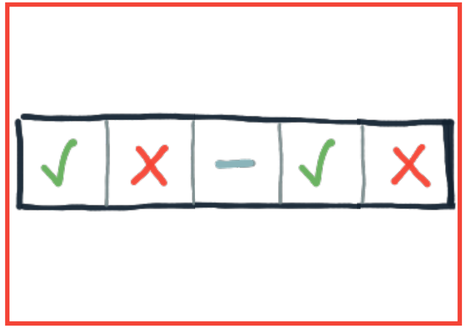
How does it affect the surrounding water system? (Higher and Lower Abtwoudse polders)

Criterion 4 - Spatial quality



Does it provide a balanced mix of different types of natural spaces?

Criterion 5 - Adaptive measure effects

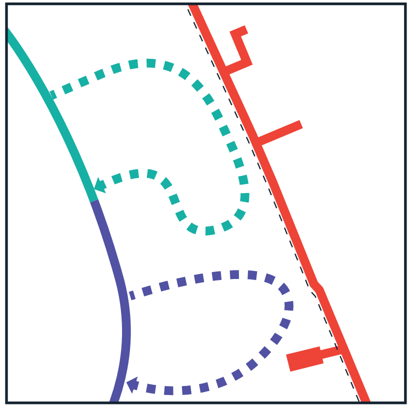


Effect on:
Biodiversity,
Heat reduction,
Multifunctionality,
Water awareness,
Costs.

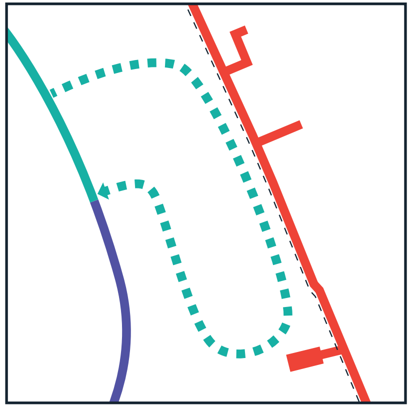
STRATEGY COMPARISON

Scoring according to the evaluation criteria

Strategy 1 - Status quo

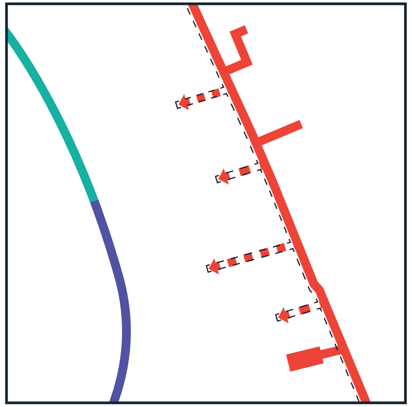


Strategy 2 - Improved status quo

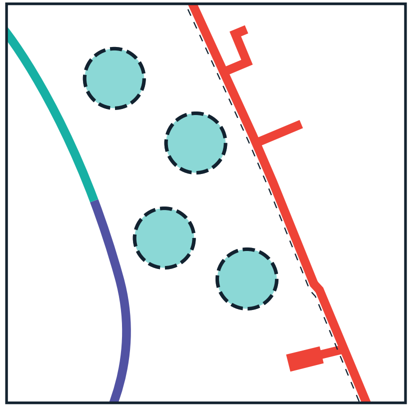


Criterion	Strategy 1 - Status quo	Strategy 2 - Improved status quo
Criterion 1	– –	–
Criterion 2	+ +	+
Criterion 3	+	+
Criterion 4	– –	+
Criterion 5	0	+

Strategy 3 - Schie



Strategy 4 - Pocket parks



Criterion	Strategy 3 - Schie	Strategy 4 - Pocket parks
Criterion 1	– –	+ +
Criterion 2	–	– –
Criterion 3	0	0
Criterion 4	– –	–
Criterion 5	–	+ +

FINAL PROPOSAL

A HEALTHY SURFACE WATER SYSTEM FOR SCHIEOEVERS NOORD

WATER SYSTEM PROPOSAL

Sub-polder with variable water level

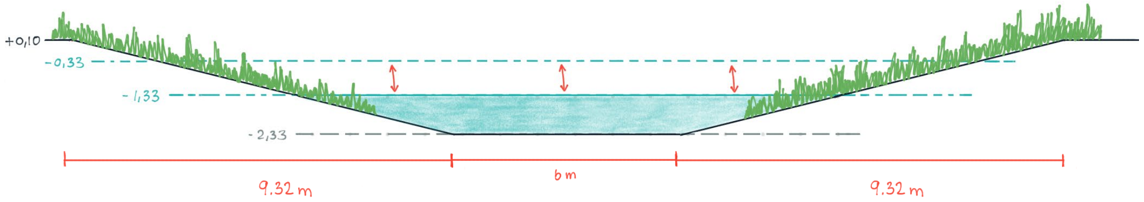
Base water level is -1,33 m NAP

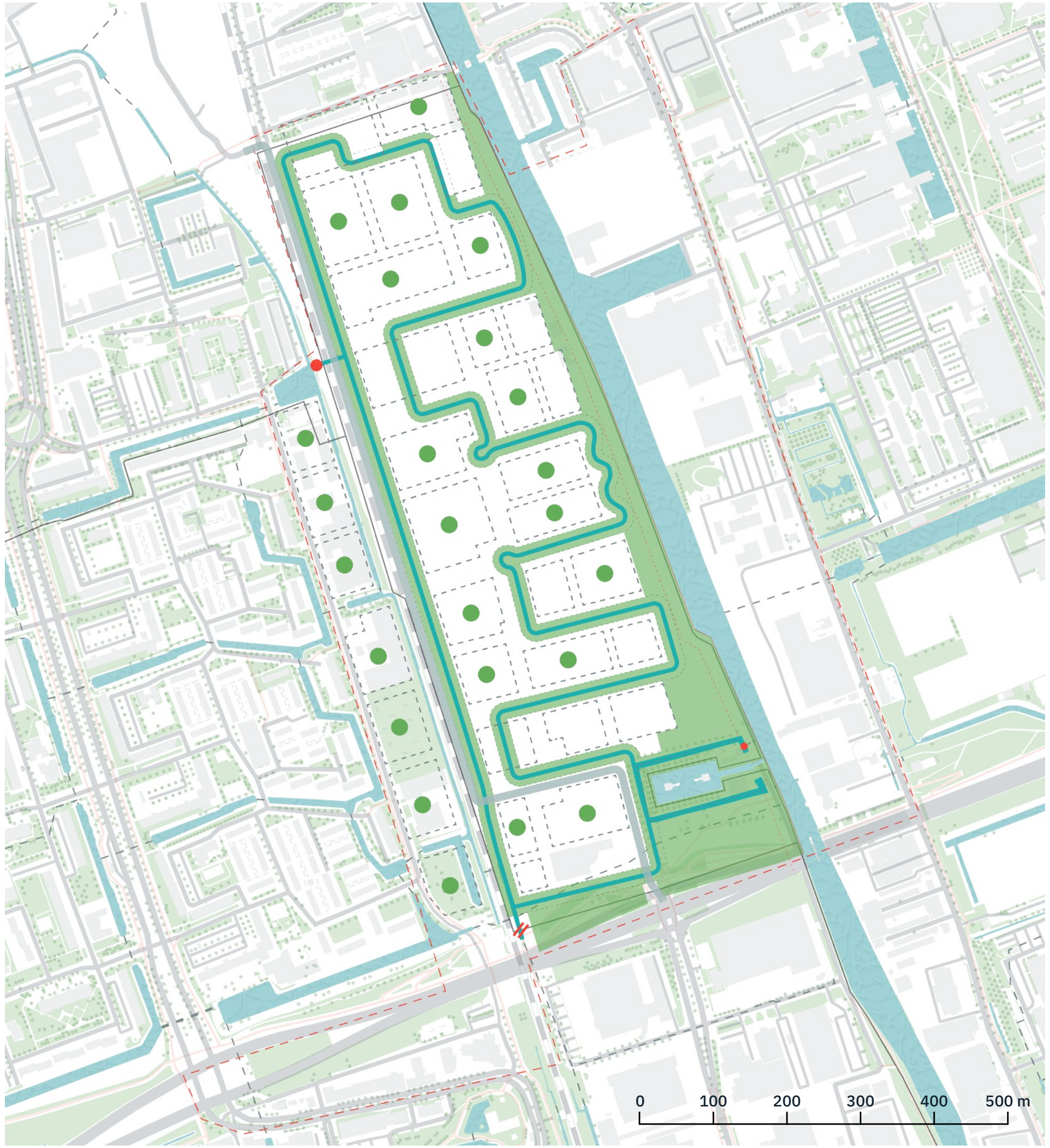
Allowable height fluctuation is 1 metre (-1,33 m to -0,33 m NAP)

Self-sufficient, circulating system

Separated from Lower Abtwoudse polder
Connected to higher Abtwoudse polder

Space remains for several pocket parks and the Schiepark





WATER SYSTEM PROPOSAL

Technical details

1. Minimal width of the water and the Nature friendly banks

2. The new building block borders

3. Regional water defence, protection zone.

4. Pumping station with two pumps:
   Circulation pump - Capacity: 2,5 m³/min
   Evacuation pump - Capacity: 11,6 m³/min

5. Second pumping station with one pump:
   Emergency exchange pump - Capacity: 4,5 m³/min

WATER SYSTEM PROPOSAL

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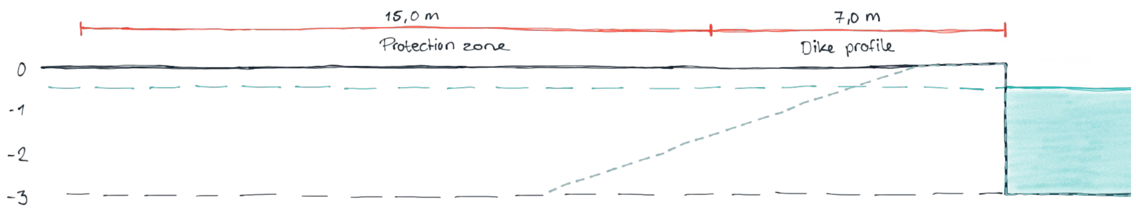

WATER SYSTEM PROPOSAL

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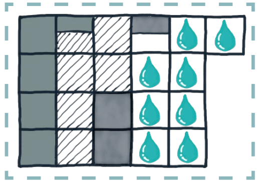
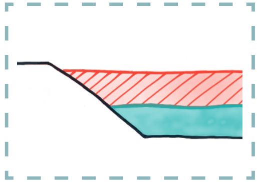
WATER SYSTEM PROPOSAL

Sub-polder with variable water level

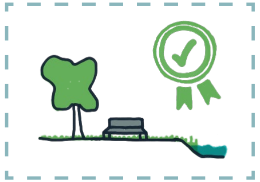


+ Even with 2 N.F.B's fits in all but area 5

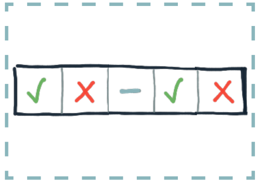


++ Static storage: 1100 m³ / hectare

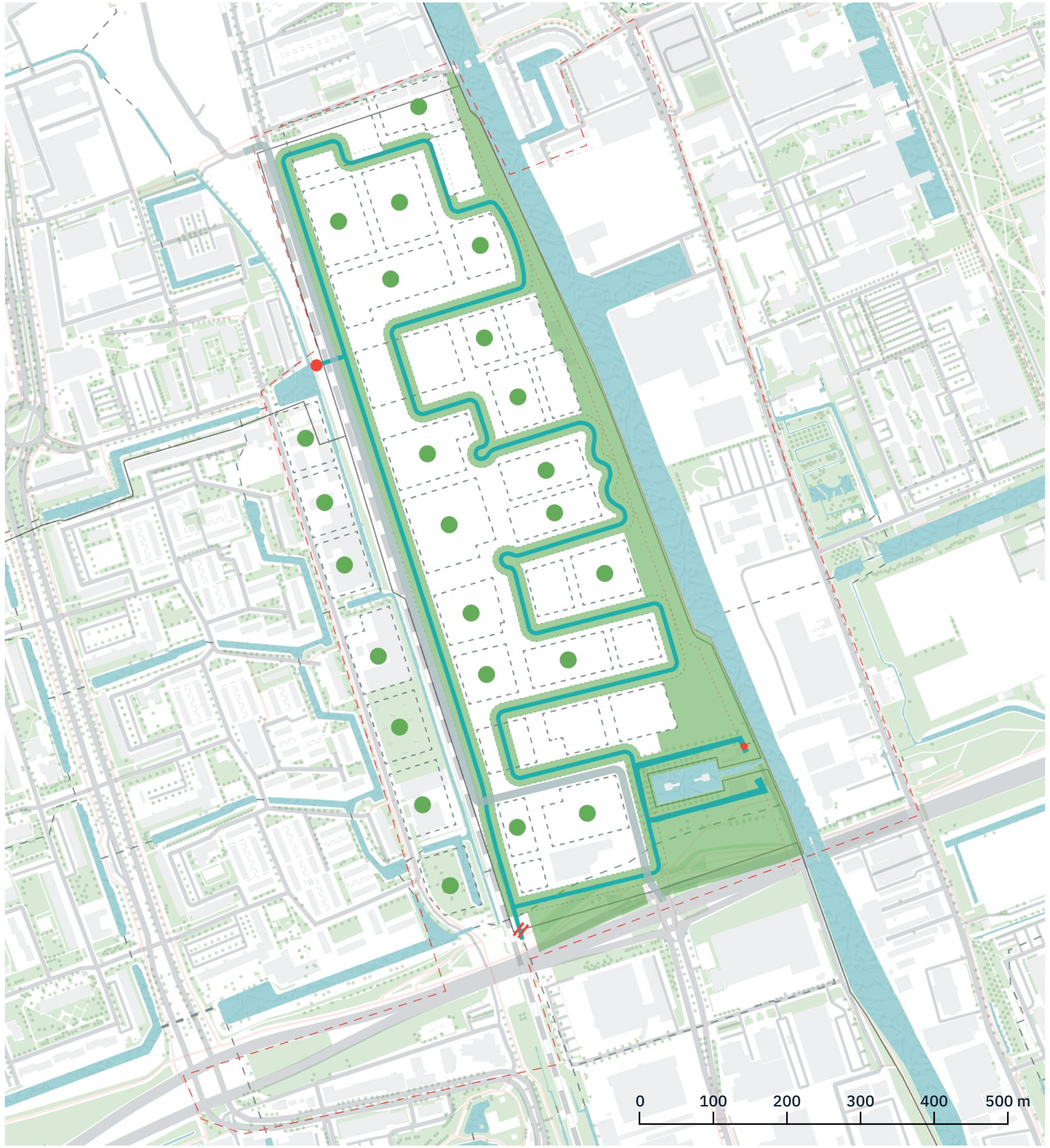
+ Can retain for, and exchange with H.A.P.



++ Has a balanced and diverse green-blue system



++ Shows promise in most categories



ZOOM-IN MAPS AND VISUALISATIONS

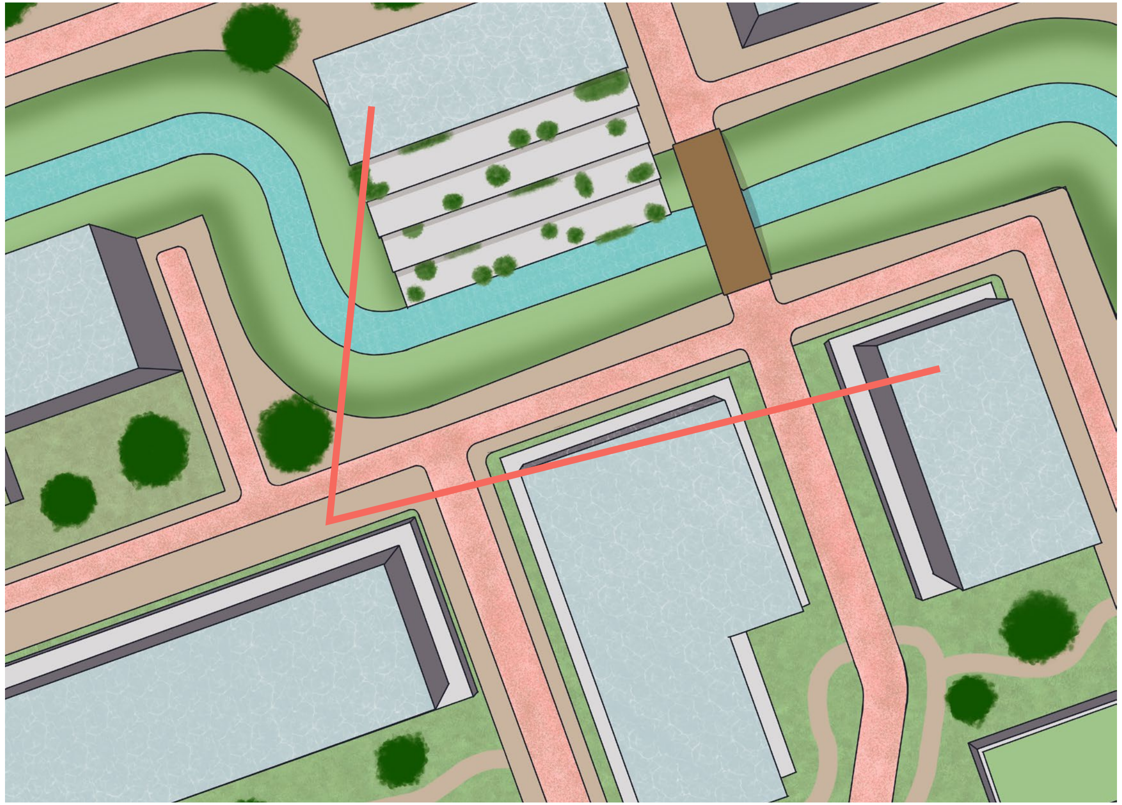
Building on water

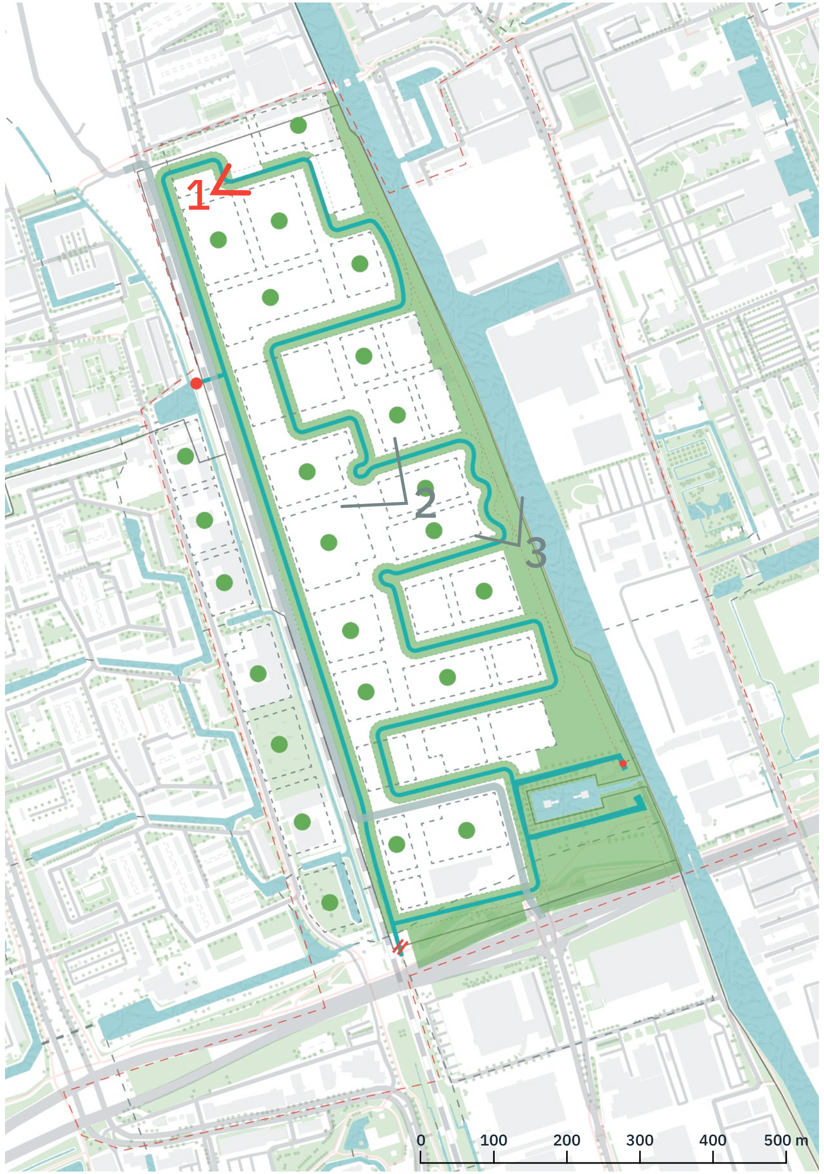
Urban square with water

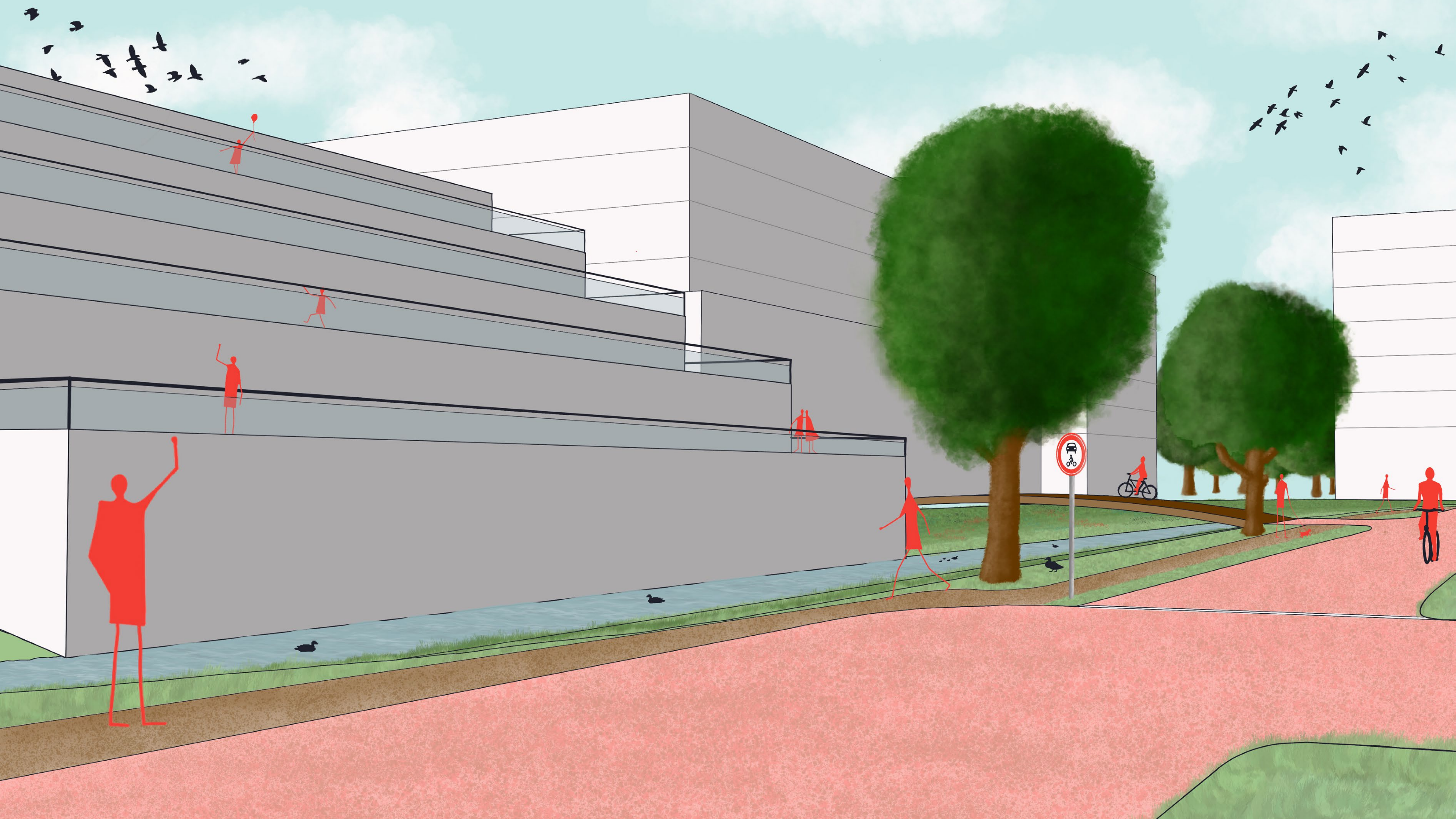
Urban wetland

BUILDING ON WATER

Zoom-in map

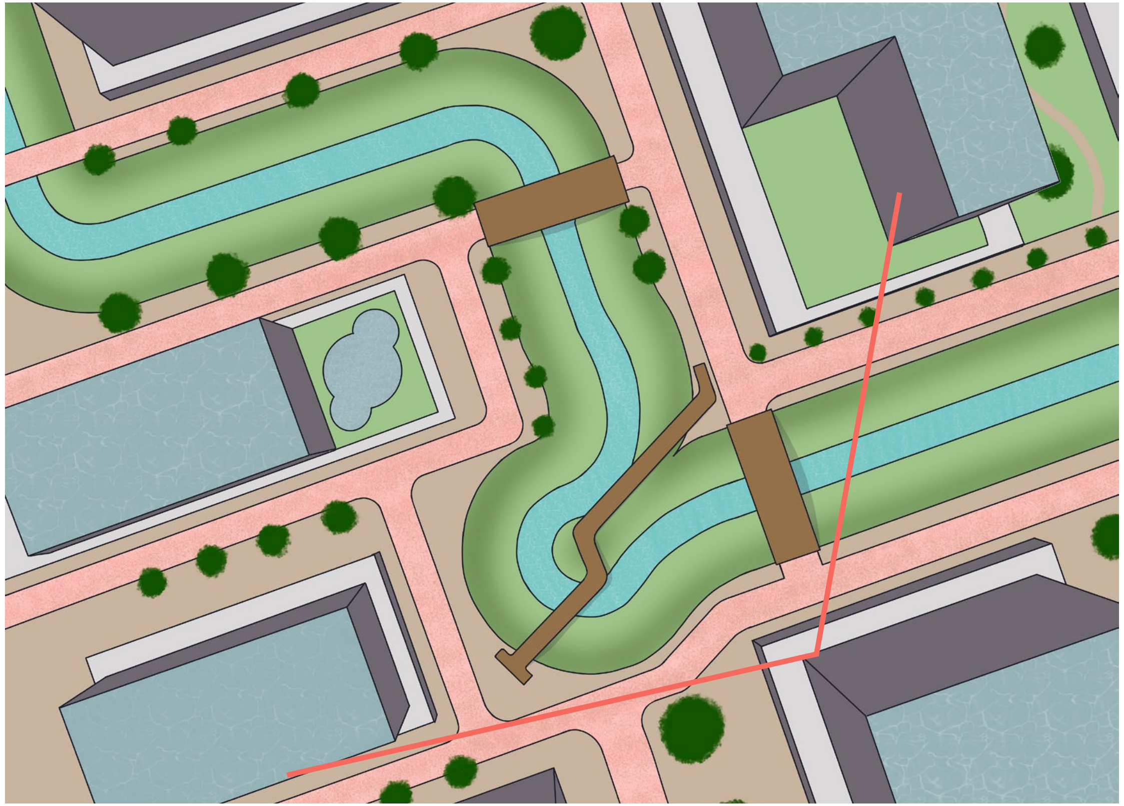


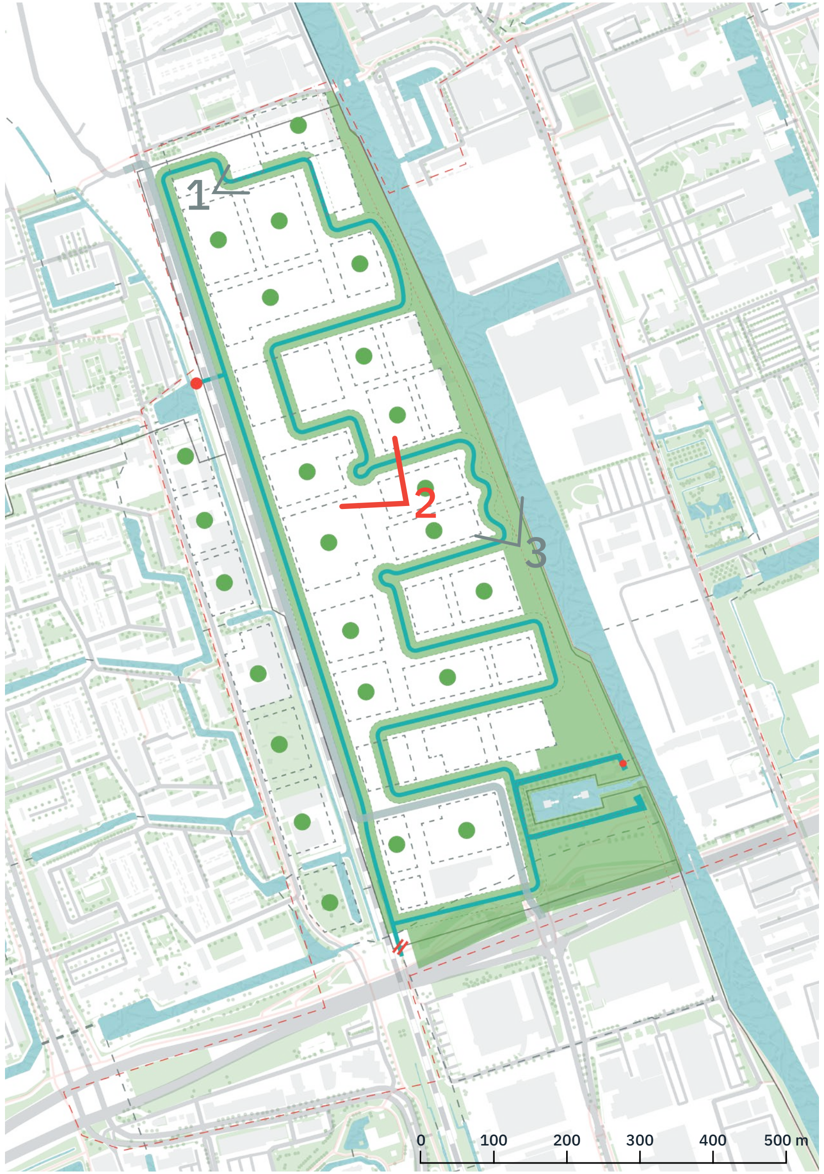


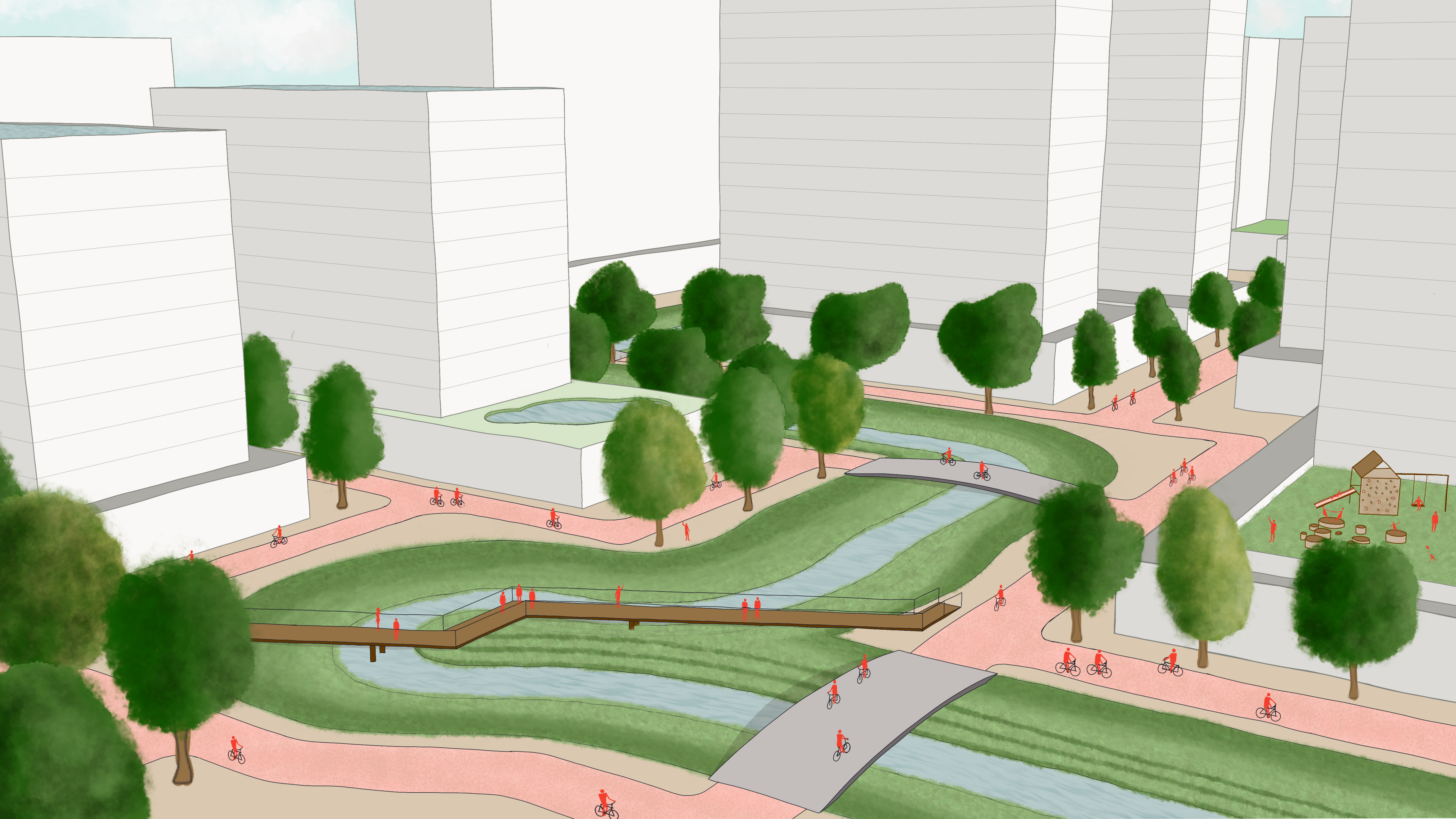


URBAN SQUARE WITH WATER

Zoom-in map

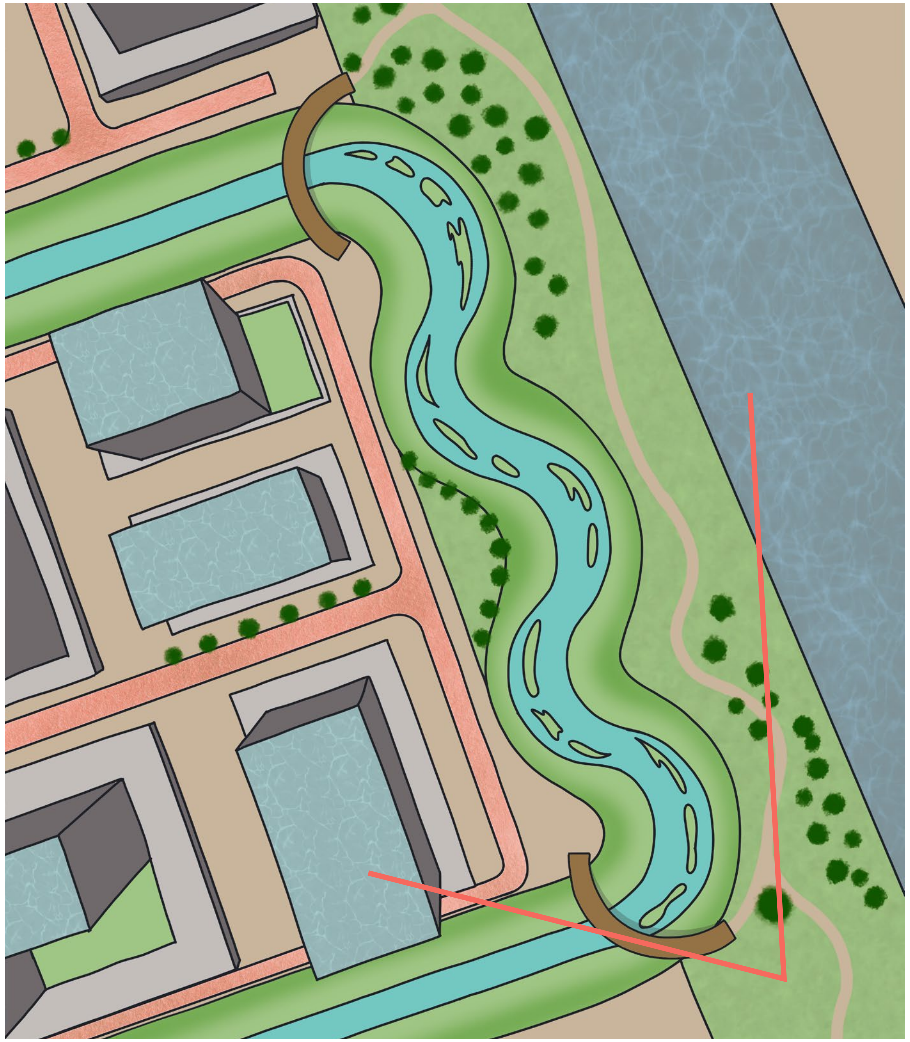


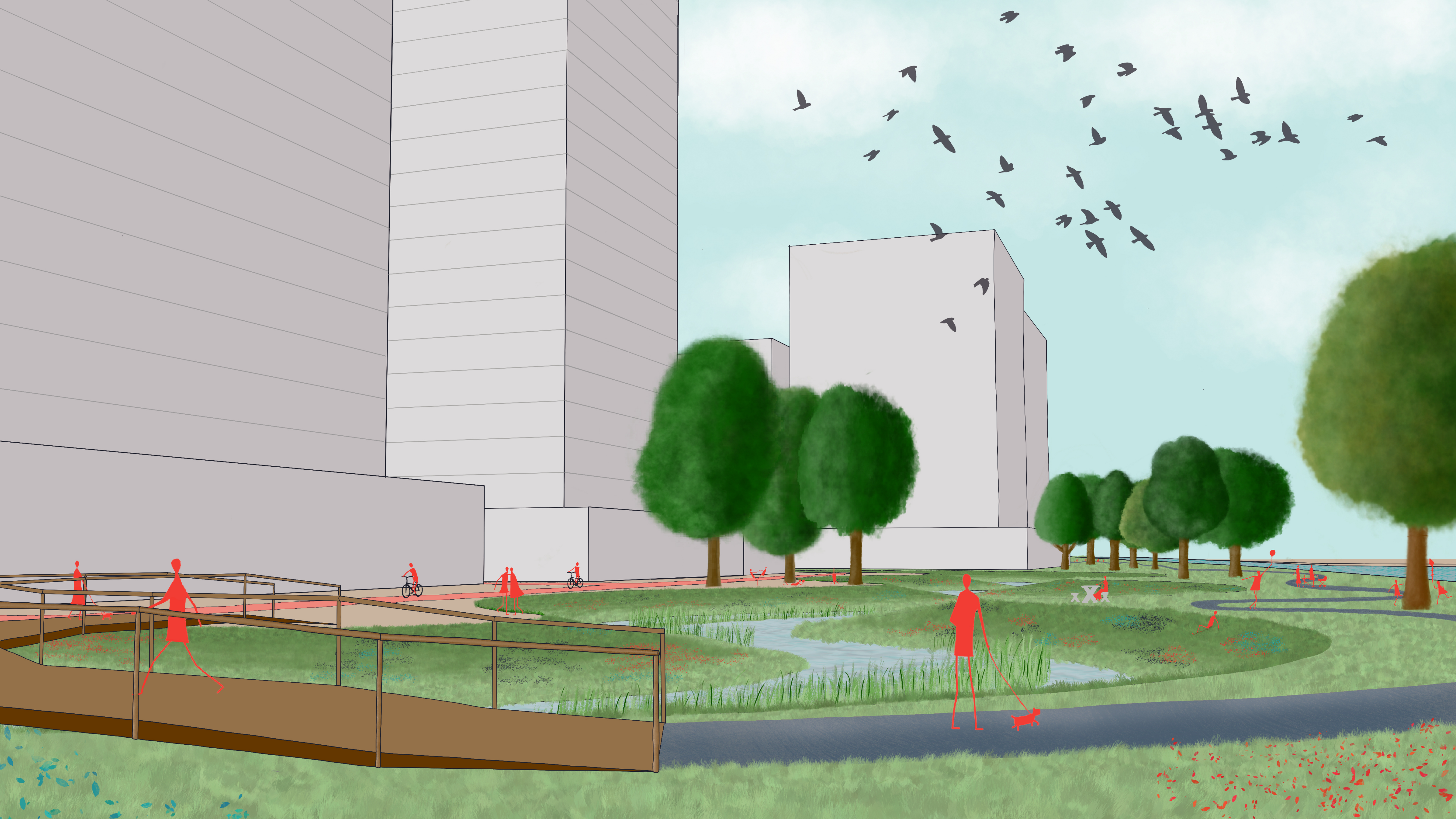




URBAN WETLAND

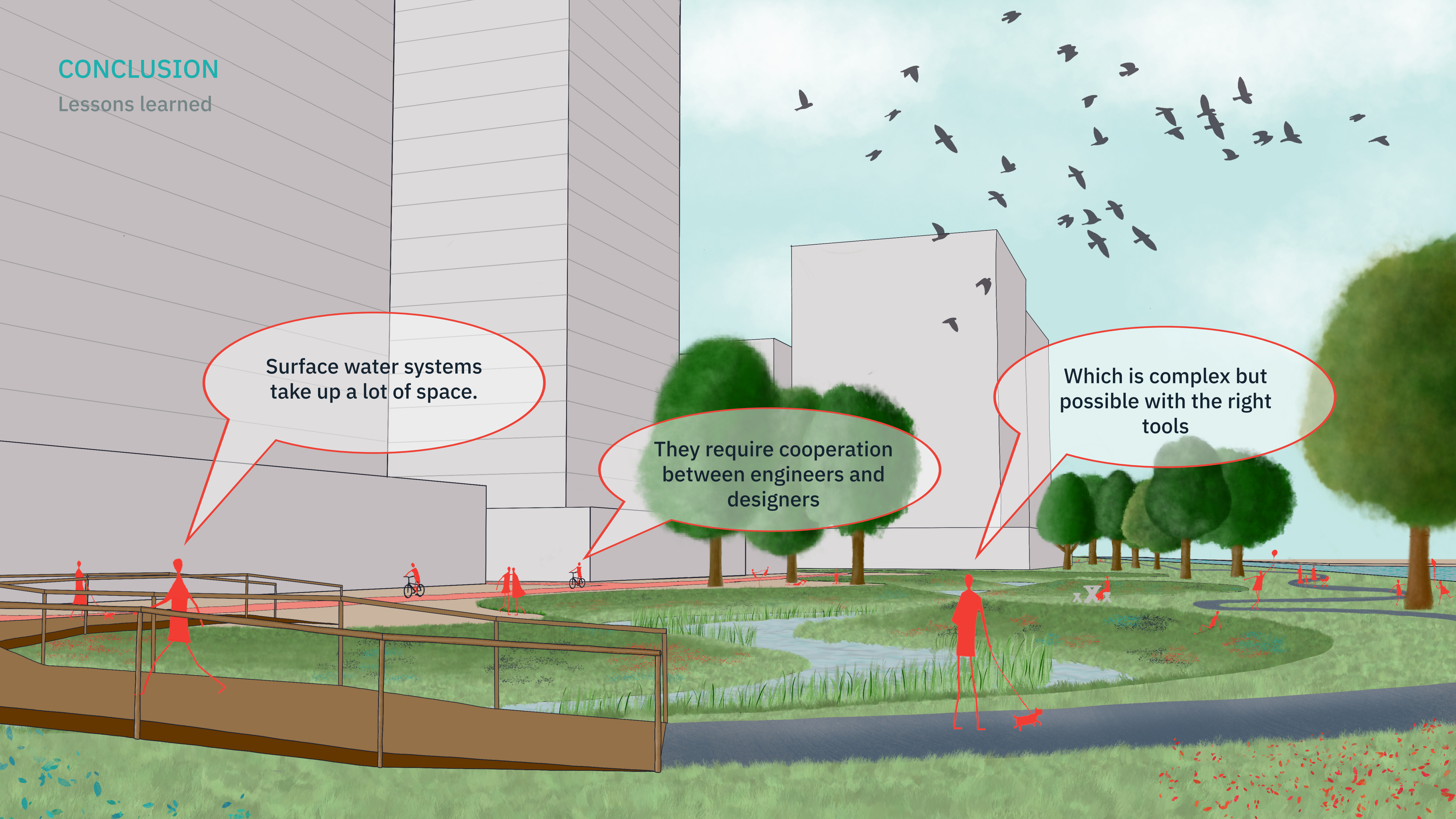
Zoom-in map





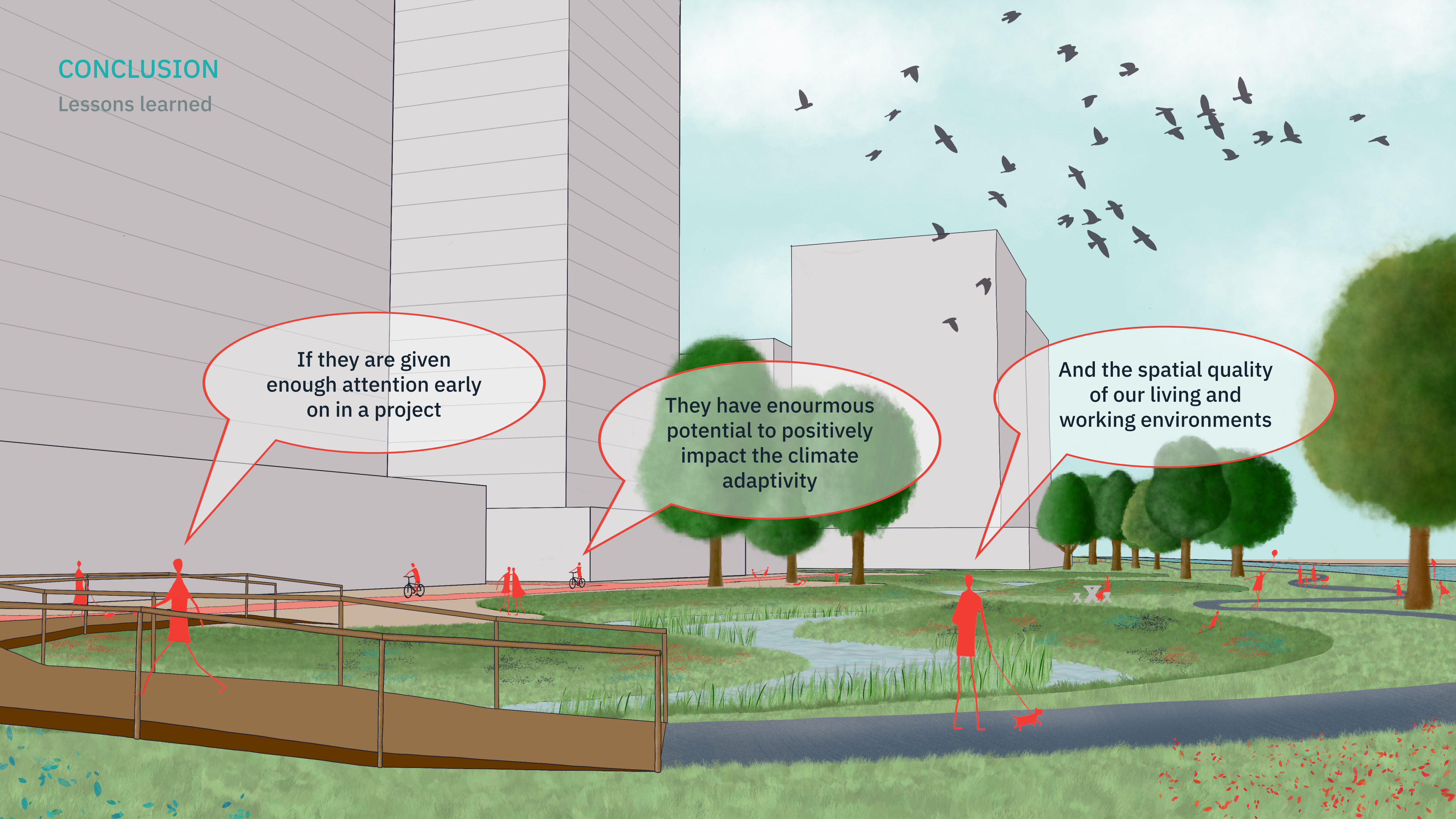
CONCLUSION

Lessons learned



CONCLUSION

Lessons learned

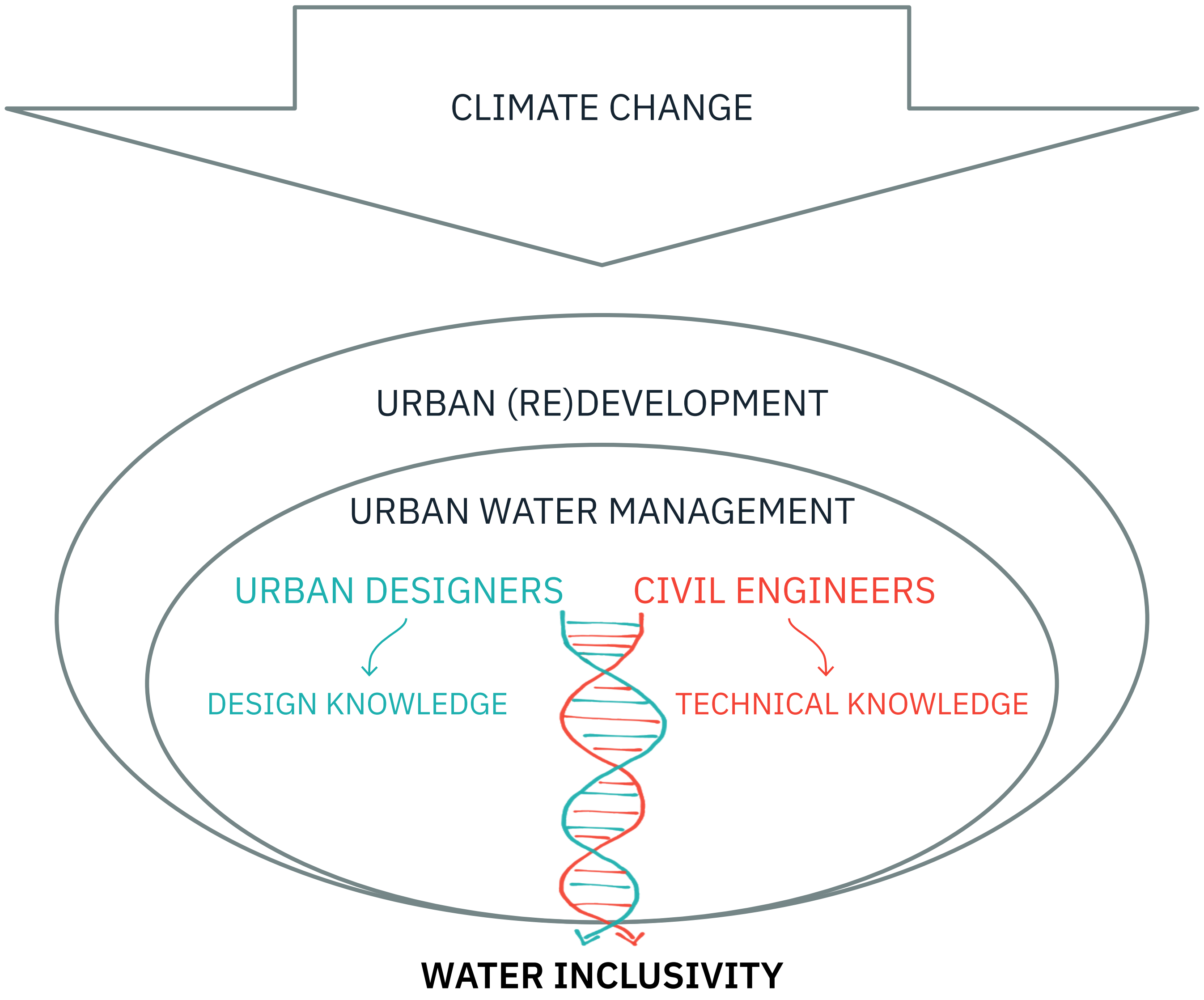



THANK YOU!

EARLY ADAPTATION OF WATER IN URBAN PLANS

IMPROVING WATER INCLUSIVITY IN EARLY DEVELOPMENT PLANS, LIKE SCHIEOEVERS NOORD IN DELFT, BY BRIDGING THE GAP IN DISCOURSE BETWEEN URBAN DESIGNERS AND CIVIL ENGINEERS IN URBAN WATER MANAGEMENT.

28-01-2021 - P5 PRESENTATION, INGRID STAPS


CLIMATE CHANGE
URBAN (RE)DEVELOPMENT
URBAN WATER MANAGEMENT
URBAN DESIGNERS
CIVIL ENGINEERS
DESIGN KNOWLEDGE
TECHNICAL KNOWLEDGE
WATER INCLUSIVITY

EARLY ADAPTATION OF WATER IN URBAN PLANS

SUBREGIONS

SUBREGION 3

Part of first development

12.200 m^2 FSI = 2,25 Height = 90 m

Existing green and water

Pumping station

Station Delft Campus

Existing green and water

SUBREGION 5

50.480 m² FSI = 1,70 Height = 30 m

Very little existing green

Abtwoudse bridge

Existing residential buildings

Collection of hardware and furniture stores

Quay of the Schie

SUBREGION 8

Part of first development

124.340 m² FSI = 2.75   Height = 55-90 m

No existing green

Schiehallen - culturally and historically important

Kabeldistrict, Kondor Wessels

Schiehallen

Parking for cars and waste collection trucks

SUBREGION 10

39.880 m² FSI = - Height = -

Existing green and water

Kruithuis, monumental building from 1660

Two different water levels (-0.43 m and -1.33 m NAP)

Inside Kruithuis

Kruithuis entrance

EARLY ADAPTATION OF WATER IN URBAN PLANS

CLIMATE ANALYSIS

CLIMATE ANALYSIS

Water quality and quantity issues

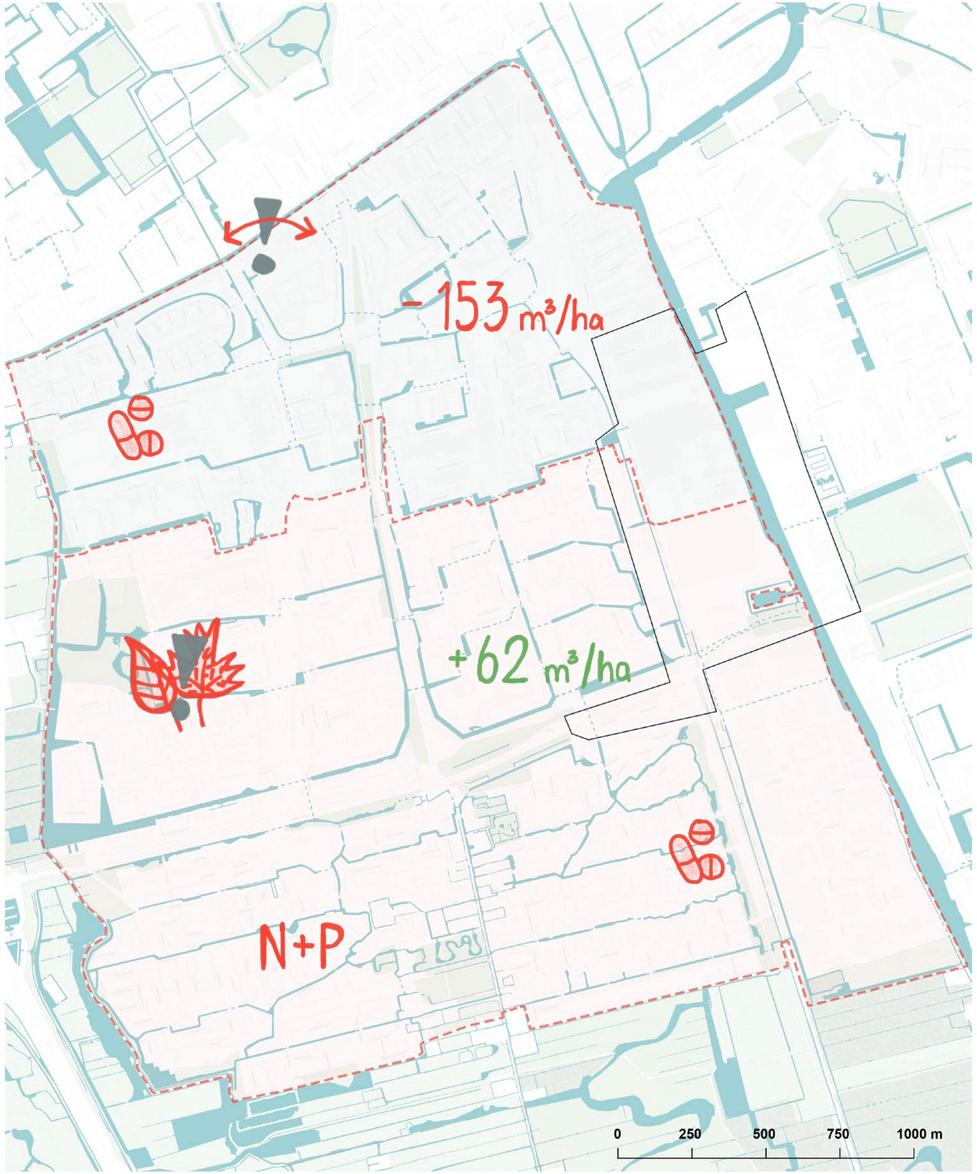
Micro pollutants (e.g. from medication)

Pollution from fallen foliage

N+P Excess of nutrients (Nitrogen and Phosphorus)

Exchange of water with Bosom

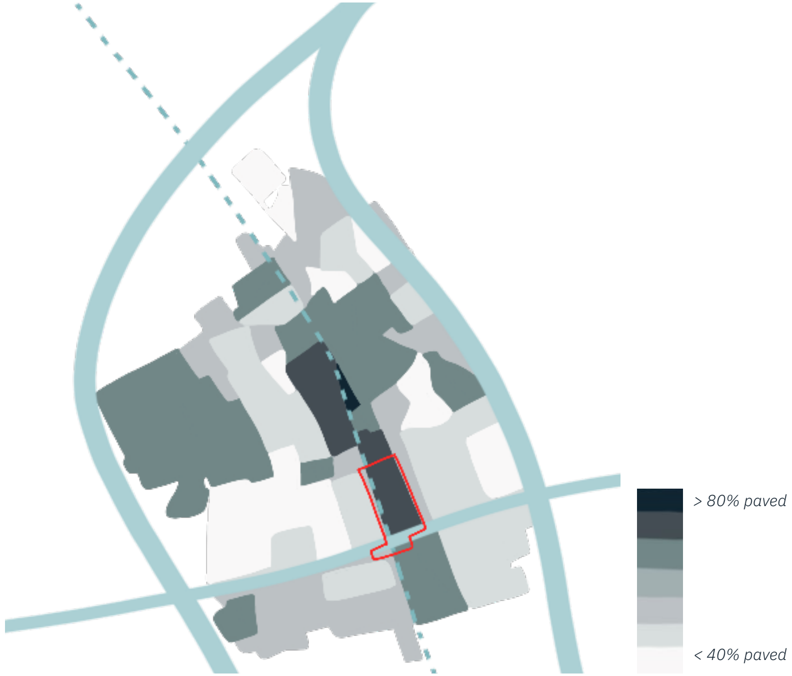
Most significant pollutant for the polder

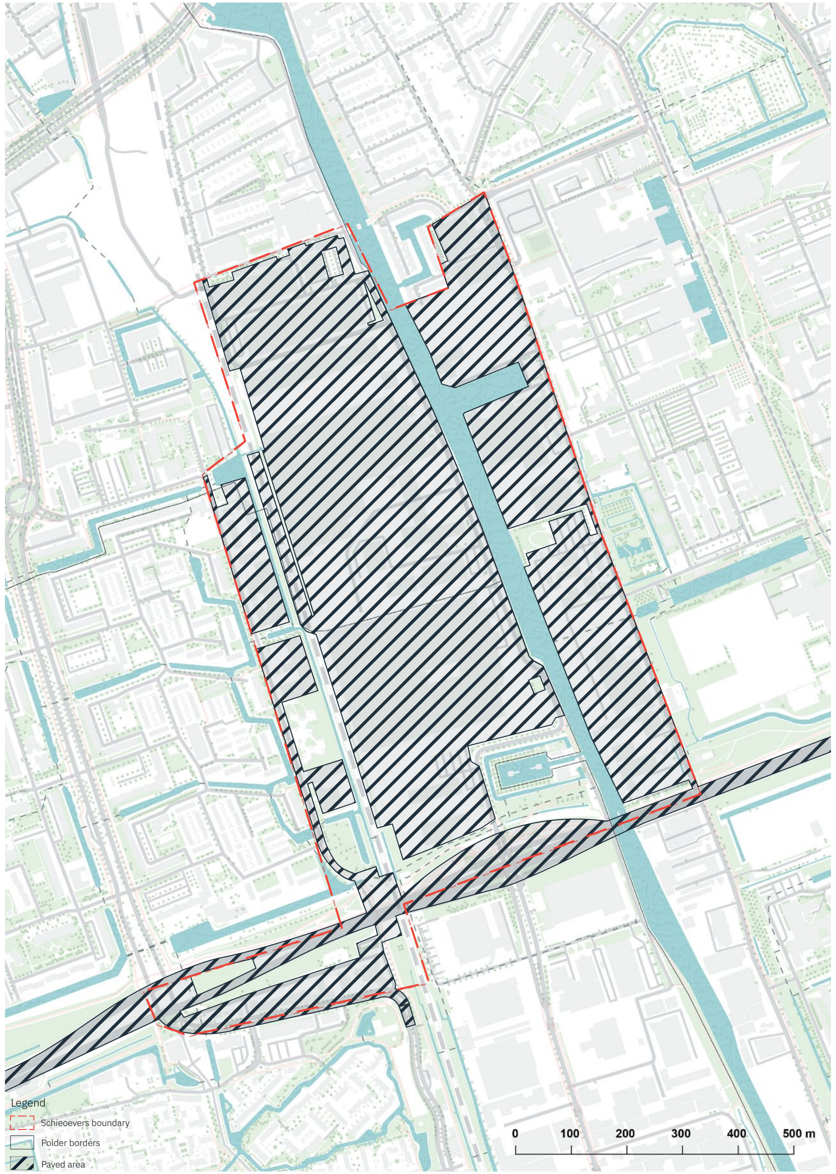


CLIMATE ANALYSIS

Paved surface

Percentage of paved area





CLIMATE ANALYSIS

Urban heat island effect

Longest string of days with >= 25 C

Current climate

Situation 2050

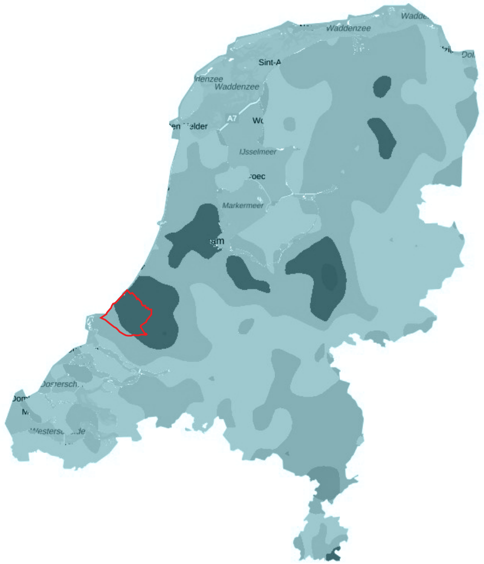
Klimaateffectatlas, KNMI

CLIMATE ANALYSIS

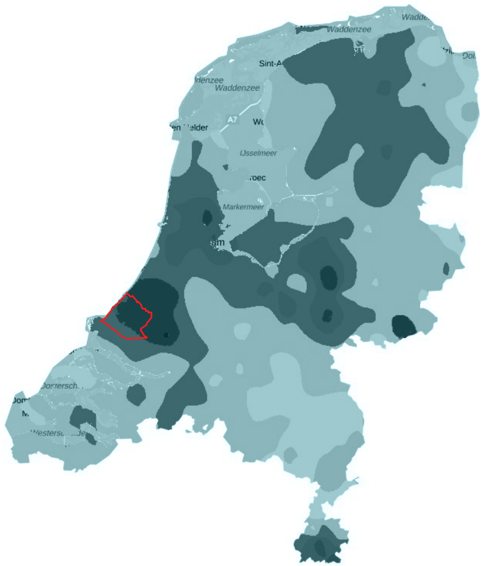
Water nuisance

Yearly rainfall

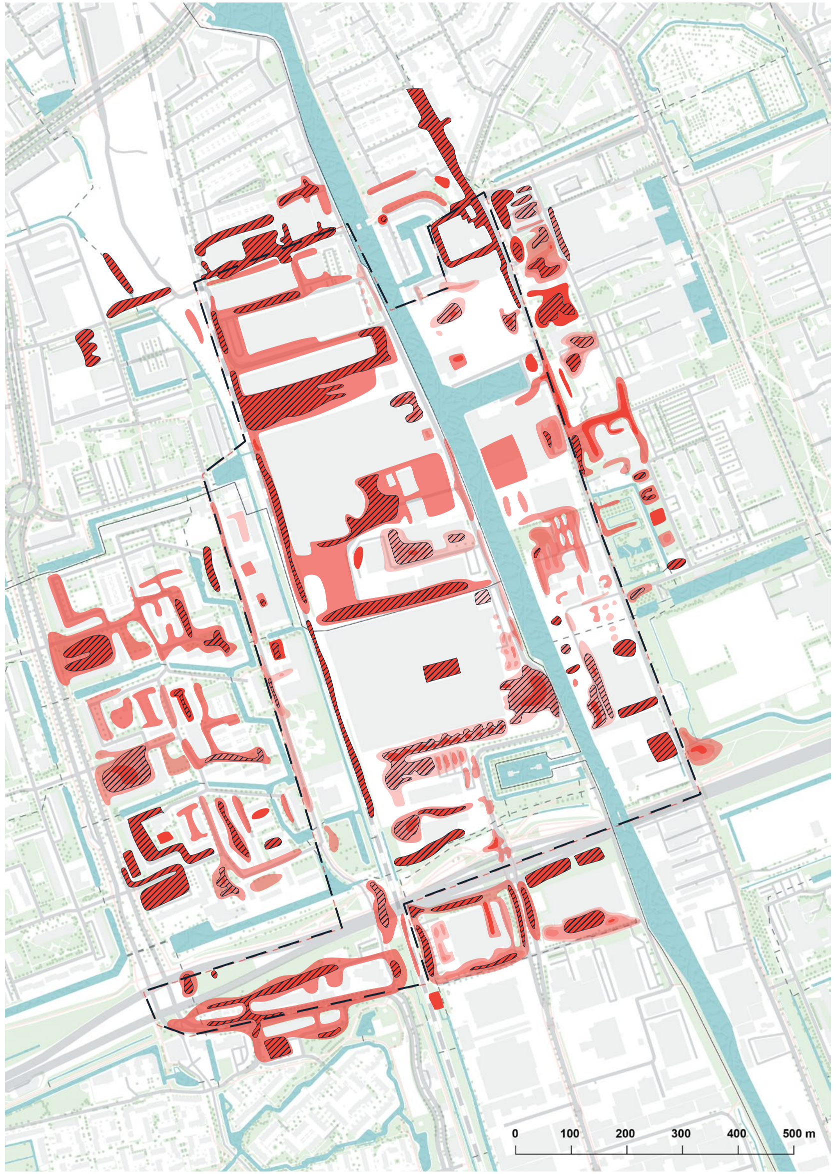
Current climate



Situation 2050



Klimaateffectatlas, KNMI



EARLY ADAPTATION OF WATER IN URBAN PLANS

WATER SYSTEM

WATER SYSTEM

Polder and Bosom water

WATER SYSTEM
High- and low Abtwoudse polders

WATER SYSTEM

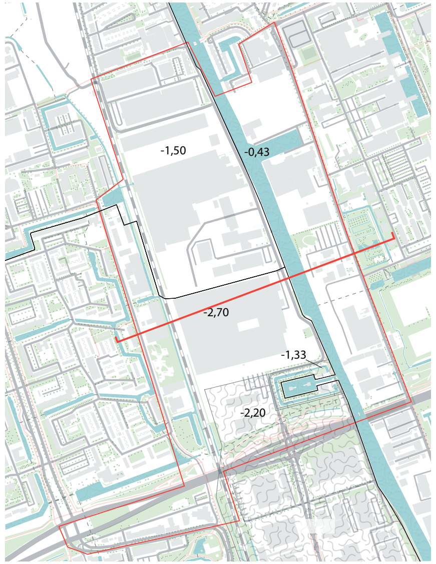
Water levels

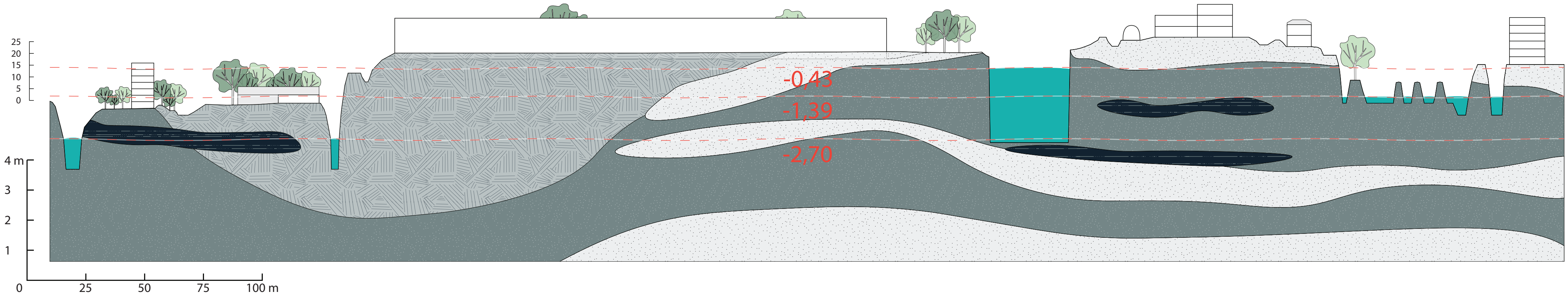
WATER SYSTEM

Pumps, weirs and direction of flow

WATER SYSTEM

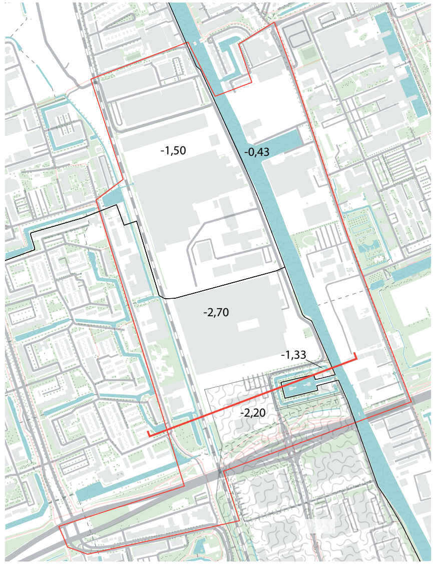
Technical section through Schiehallen

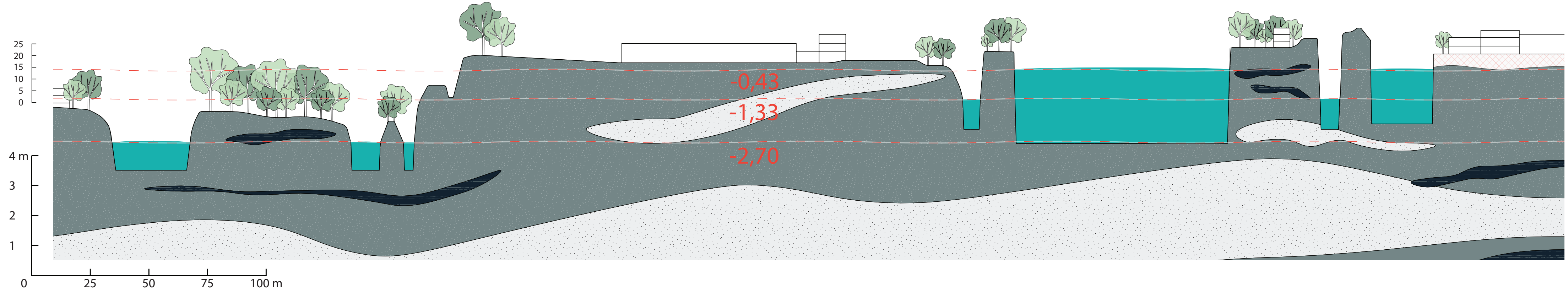




WATER SYSTEM

Technical section through Kruithuis



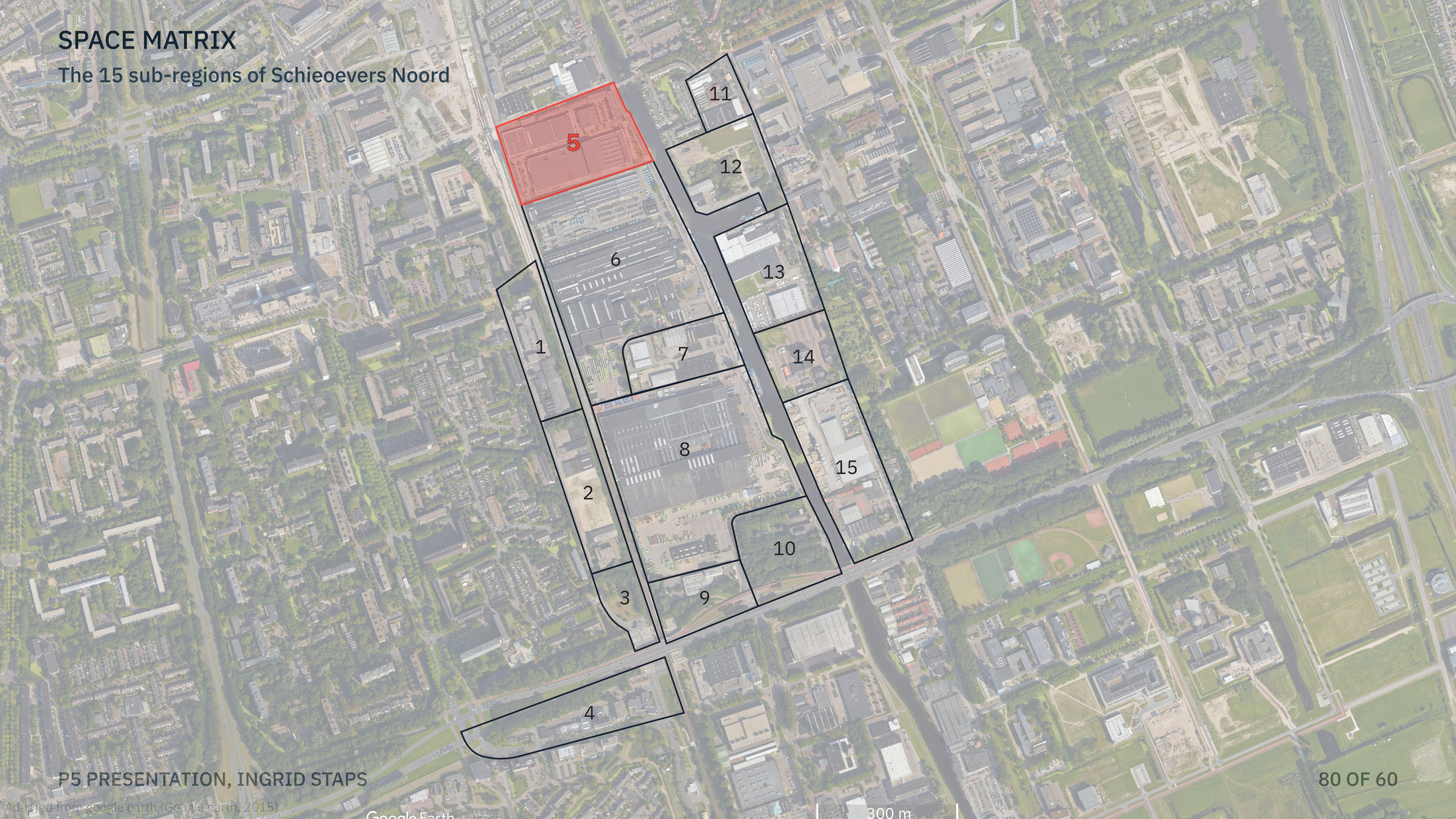


EARLY ADAPTATION OF WATER IN URBAN PLANS

SPACE MATRIX CALCULATION

SPACE MATRIX

The 15 sub-regions of Schieoevers Noord



Adapted from google earth (Google earth, 2015)

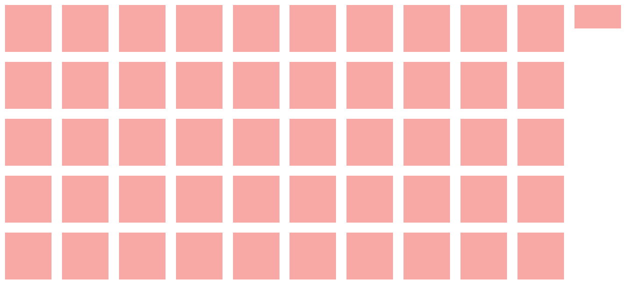
SPACE MATRIX

Sub-region 5 - Requirements for buildings

Total surface area of region
A_{reg} = 50.480 m² -> 50,5 Squares

FSI = 1,70

Maximum building height
H_{max} = 30 m



Airial view of Schieoevers Noord (Google earth, 2015)

SPACE MATRIX

Sub-region 5 - Minimal footprint of buildings

Total surface area of region
$A_{reg} = 50.480\ m^2$ -> 50,5 squares

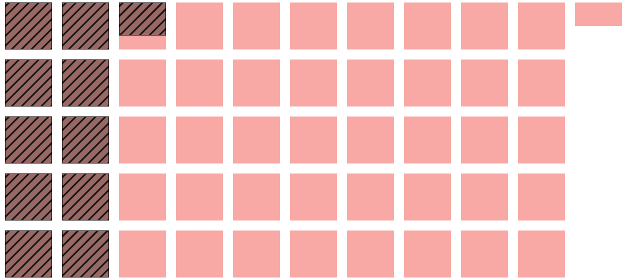
FSI = 1,70

Maximum building height
$H_{max} = 30\ m$

Number of floors
$N_v = 1 + ((H_{max} - 7) / 3$
$N_v = 8$

Total area of builings
$A_b = FSI \times A_{reg}$
$A_b = 85.816\ m^2$

Minimal footprint new buildings
$A_{foot} = A_b / N_v$
$A_{floor} = 10.727\ m^2$ -> 10,7 Squares

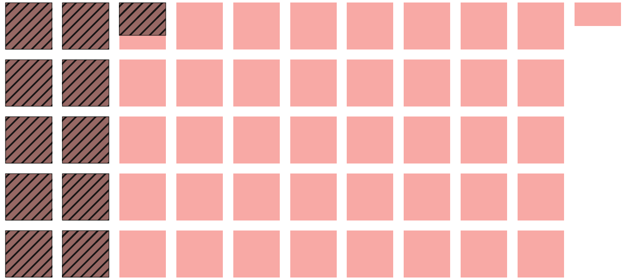


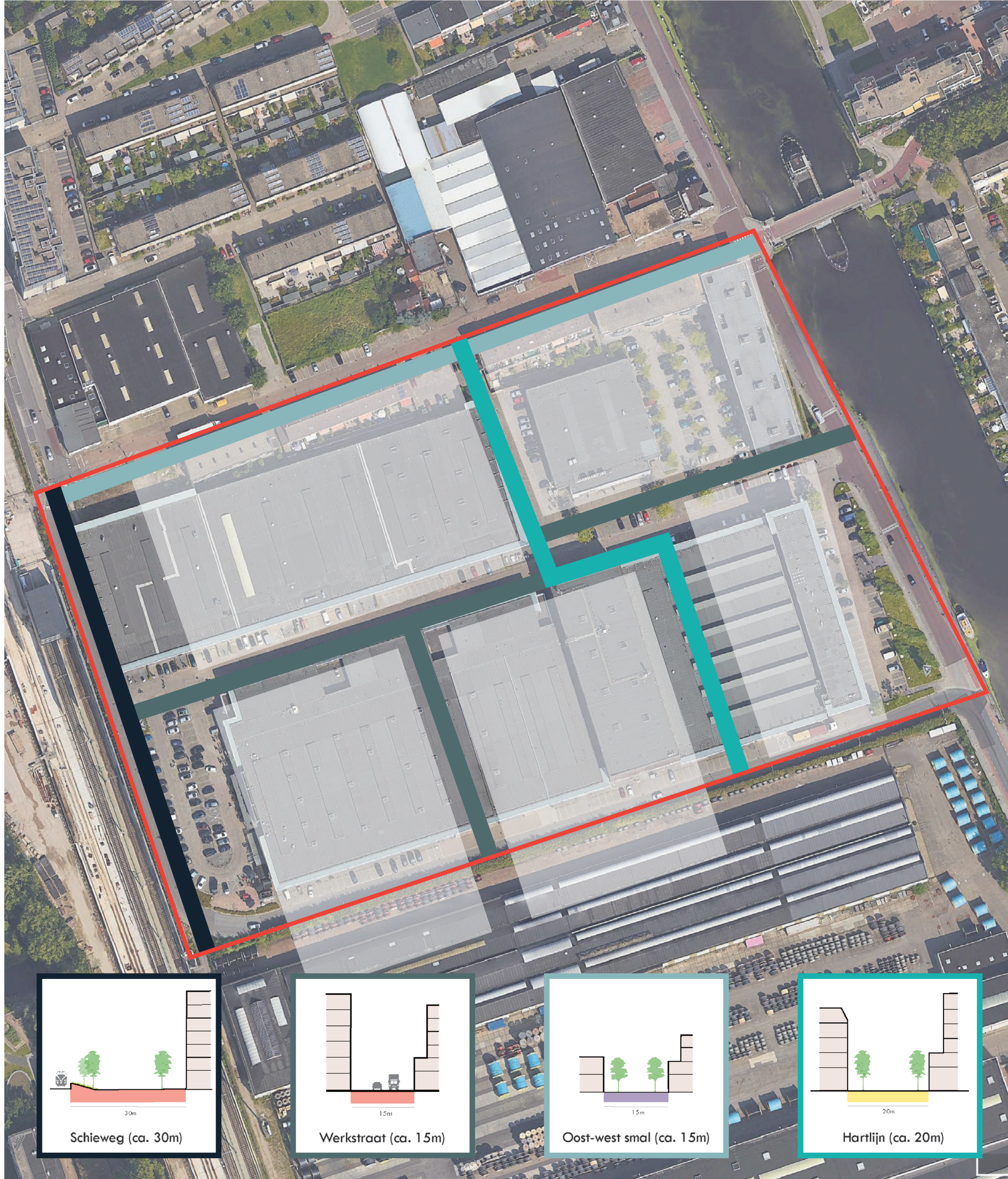
SPACE MATRIX

Sub-region 5 - Requirements for mobility infrastructure

Total surface area of region
A_{reg} = 50.480 m² -> 50,5 Squares

Minimal footprint new buildings
A_{floor} = 10.727 m² -> 10,7 Squares





SPACE MATRIX

Sub-region 5 - Footprint of mobility infrastructure

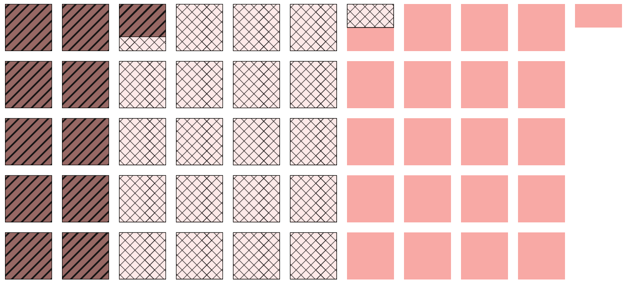
Total surface area of region
A_{reg} = 50.480 m² -> 50,5 Squares

Minimal footprint new buildings
A_{floor} = 10.727 m² -> 10,7 Squares

Footprint mobility infrastructure
1. Schieweg - 30 m wide
2. Working street - 15 m wide
3. East-West Narrow - 15 m wide
4. Heart street - 20 m wide

[30 m] x [175 m long] = 5250 m²
[15 m] x [380 m long] = 5700 m²
[15 m] x [295 m long] = 4425 m²
[20 m] x [215 m long] = 4300 m²

A_{mob} = 19.675 m² -> 19.7 Squares



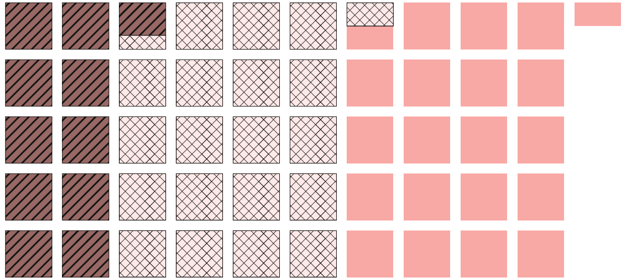
SPACE MATRIX

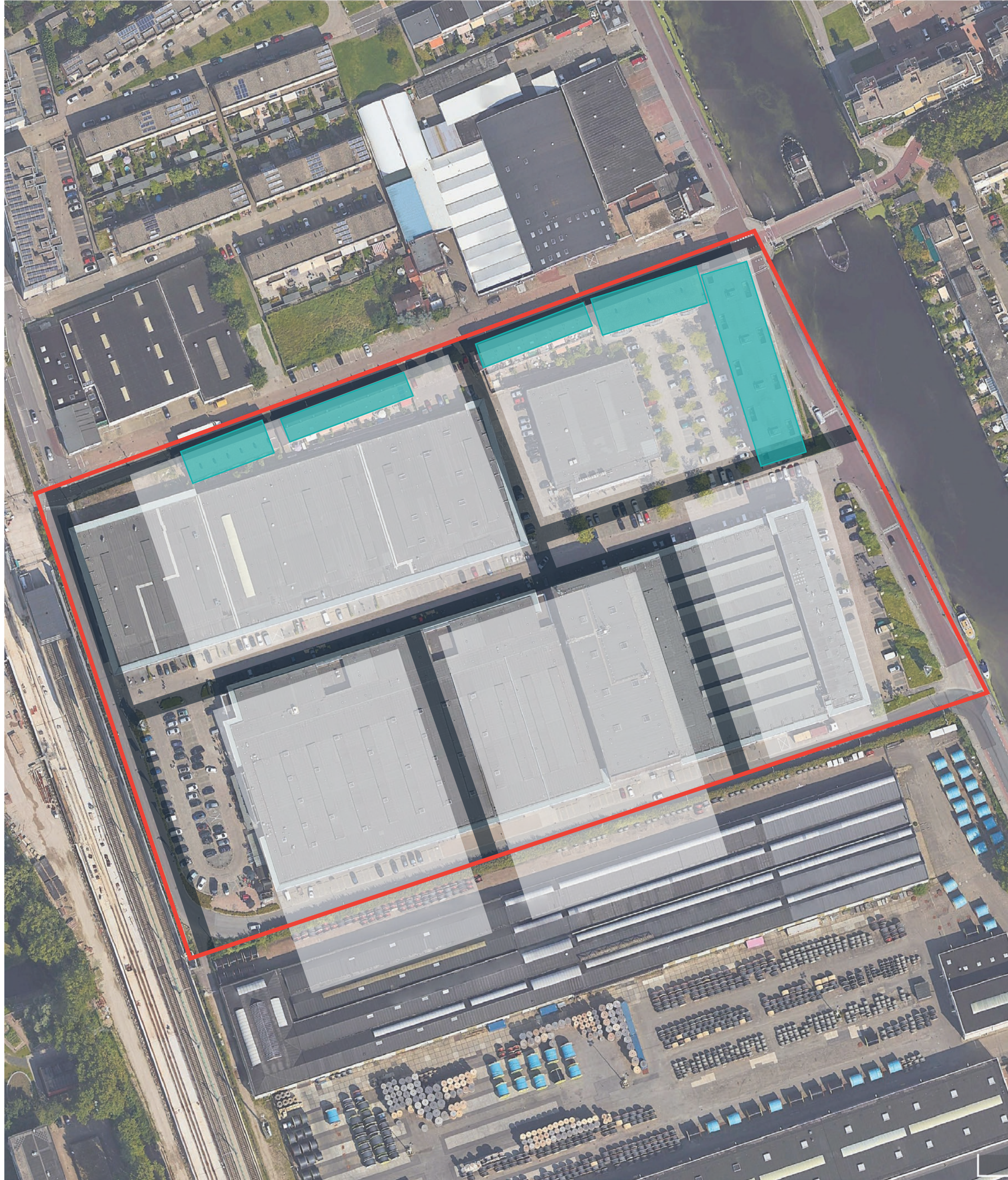
Sub-region 5 - Existing / Monumental structures

Total surface area of region
A_{reg} = 50.480 m² -> 50,5 Squares

Minimal footprint buildings
A_{floor} = 10.727 m² -> 10,7 Squares

Total footprint mobility infrastructure
A_{mob} = 19.675 m² -> 19.7 Squares





SPACE MATRIX

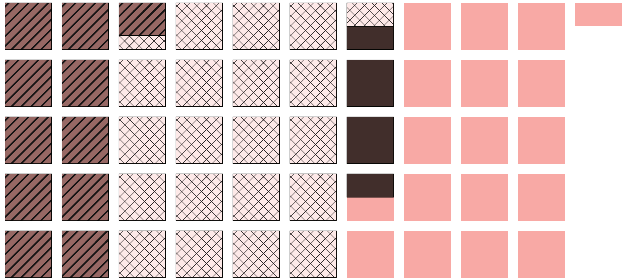
Sub-region 5 - Footprint of existing / monumental structures

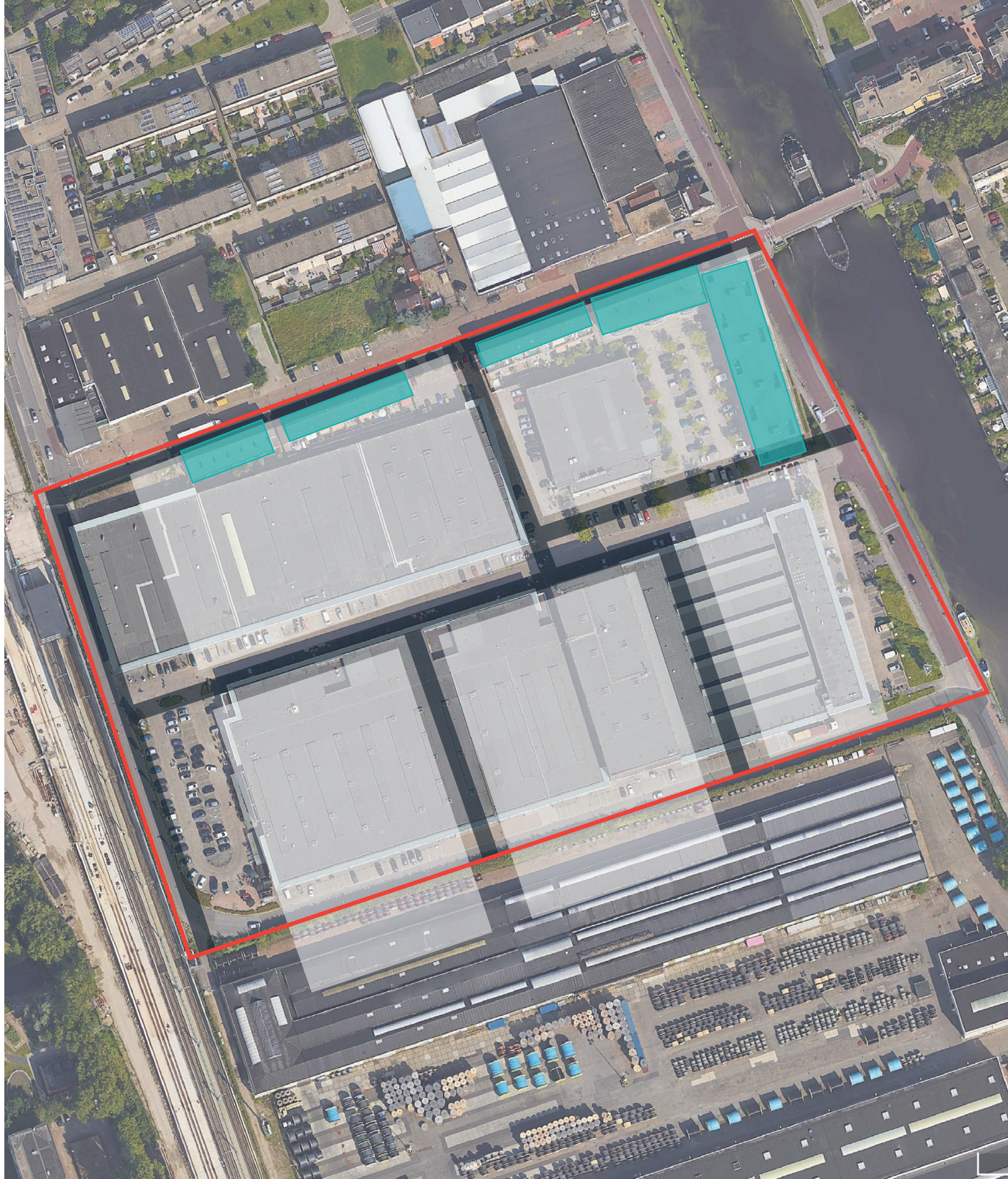
Total surface area of region
A_{reg} = 50.480 m² -> 50,5 Squares

Minimal footprint buildings
A_{floor} = 10.727 m² -> 10,7 Squares

Total footprint mobility infrastructure
A_{mob} = 19.675 m² -> 19,7 Squares

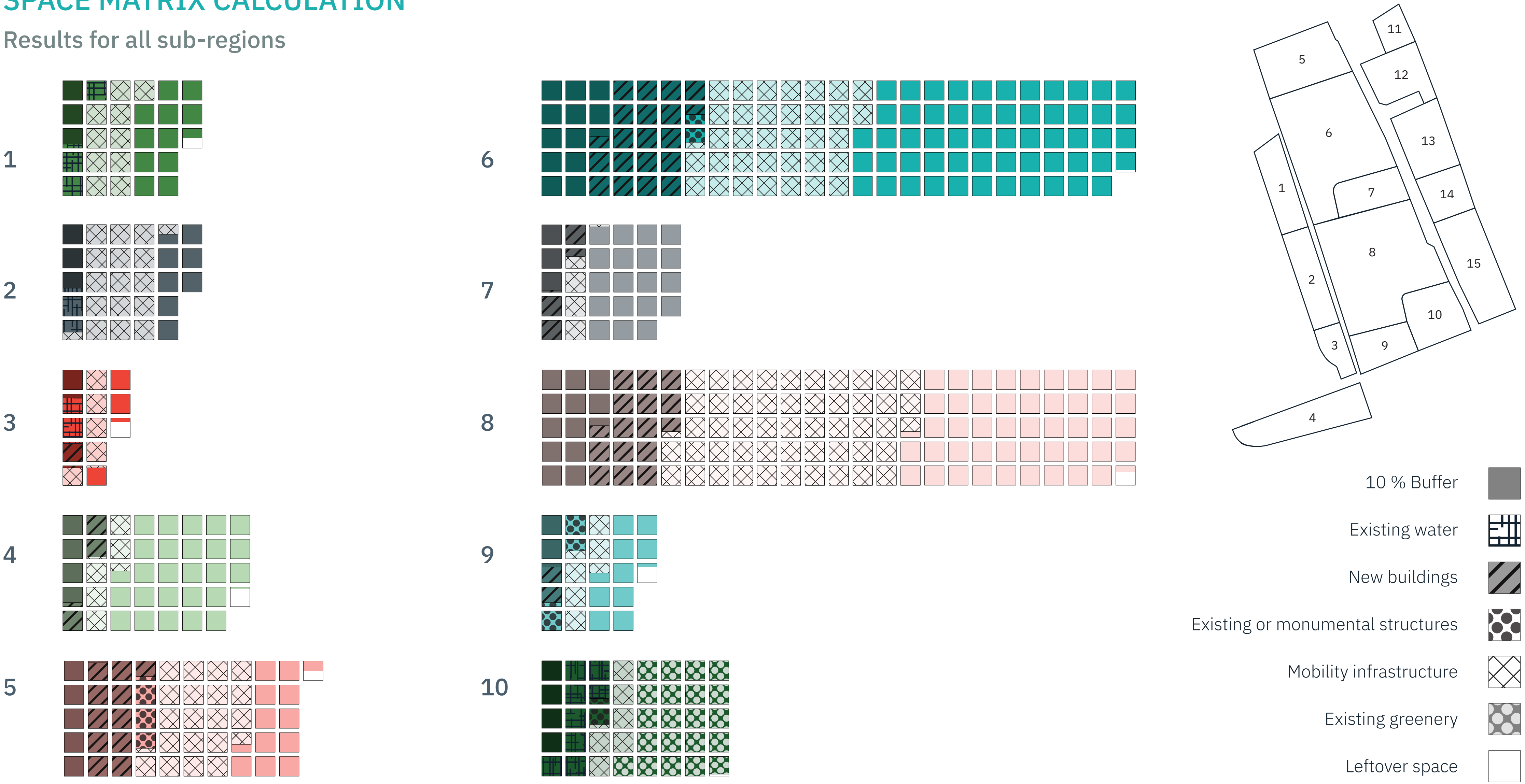
Total footprint existing structures
A_{built} = 2.957 m² -> 3,0 Squares





SPACE MATRIX CALCULATION

Results for all sub-regions

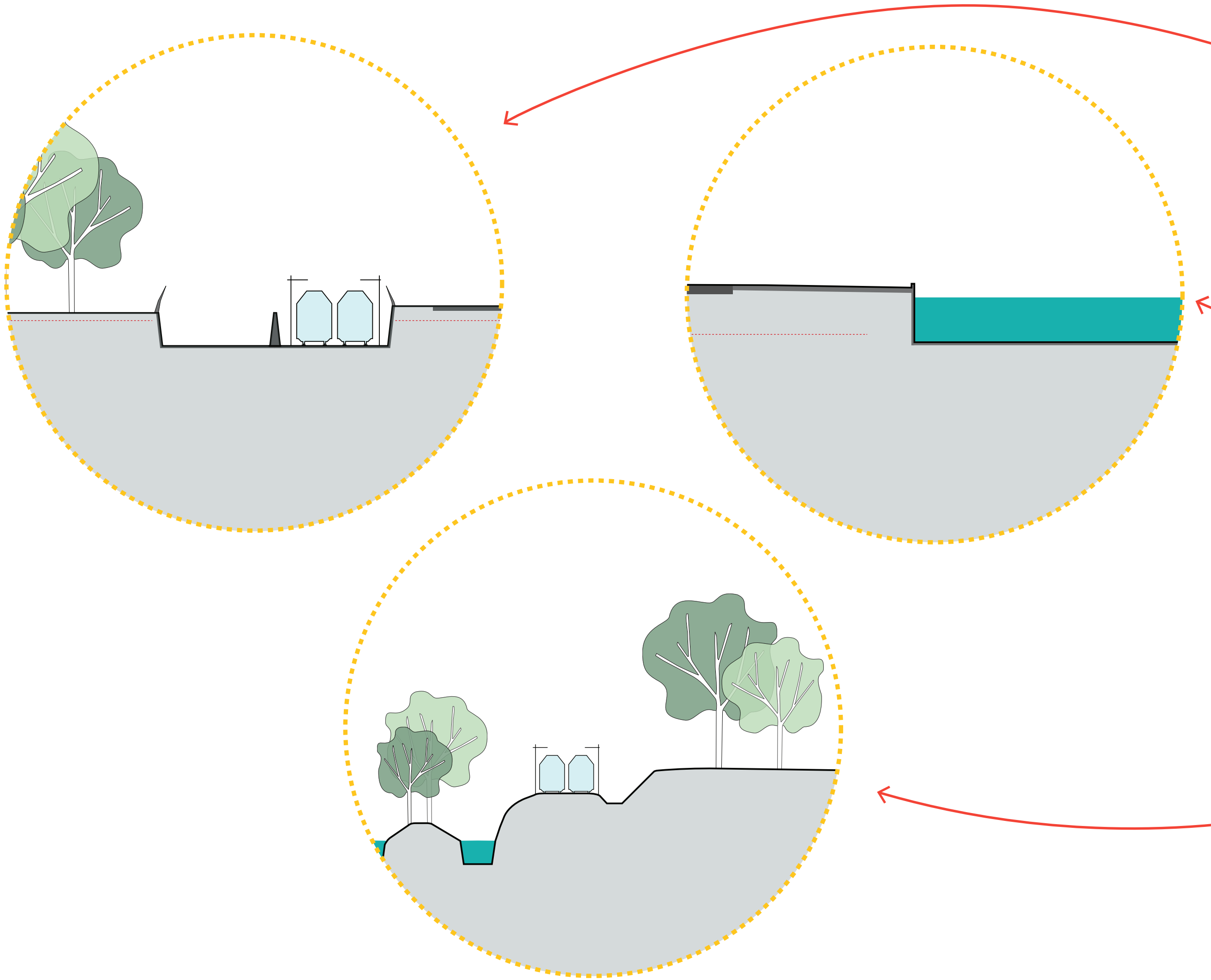


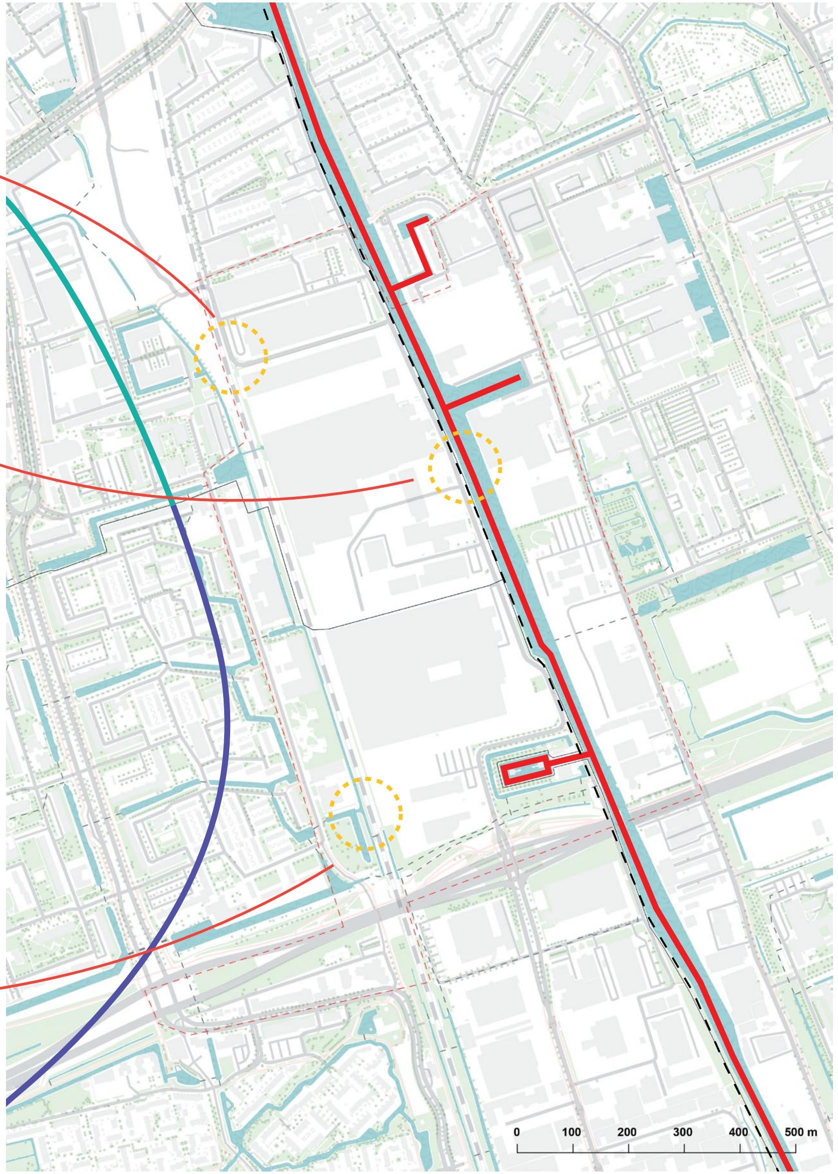
EARLY ADAPTATION OF WATER IN URBAN PLANS

SURFACE WATER PRINCIPLES

IMPORTANT IN SCHIEOEVERS NOORD

Train track/tunnel, water defense structure, height differences

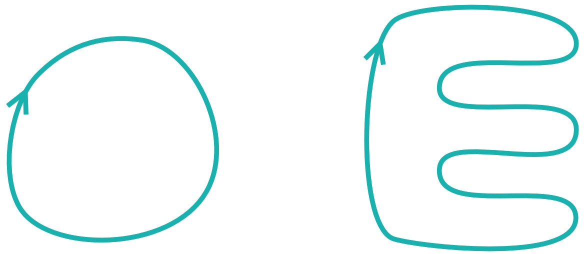




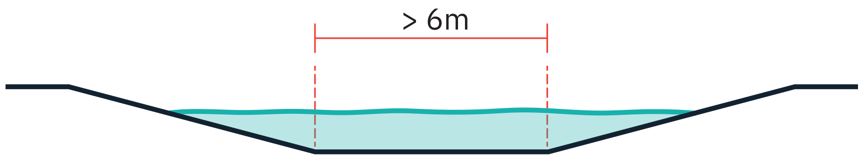
SURFACE WATER SYSTEM

Principles for a healthy surface water system

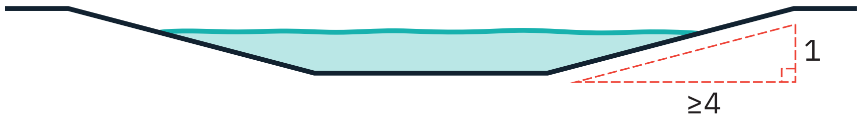
Circulation and length



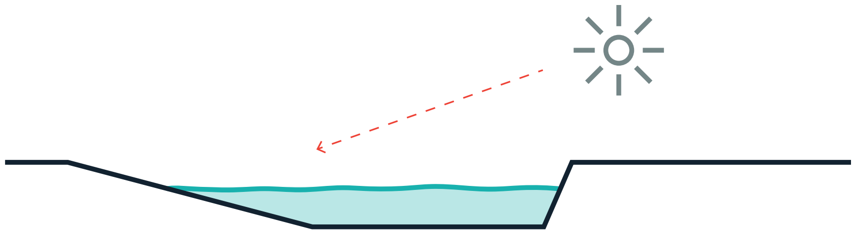
Minimal freeboard



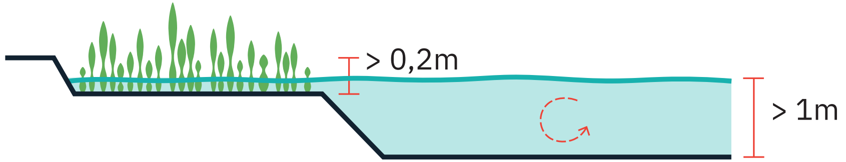
Nature friendly banks



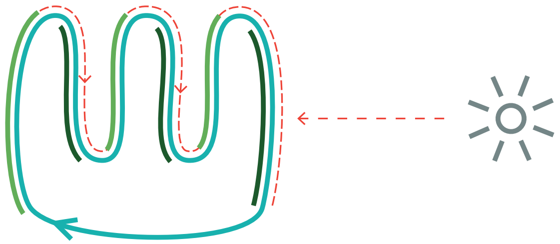
Sun facing



Wet berms



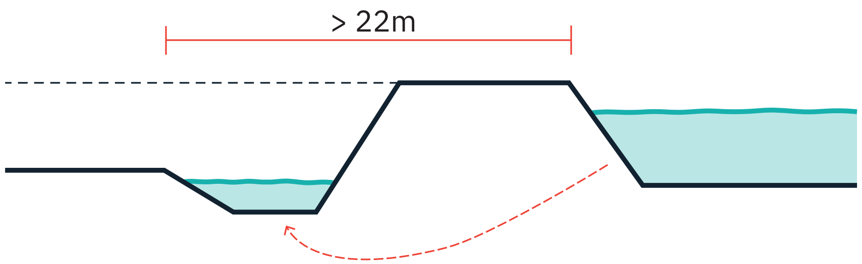
Connected ecosystems



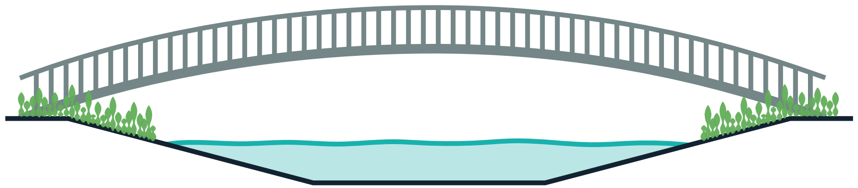
SURFACE WATER SYSTEM

Principles for a healthy surface water system

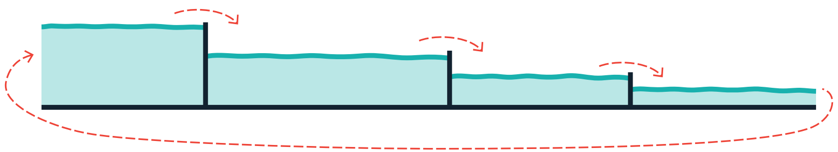
Levee protection zone



High bridges



Connect to the system

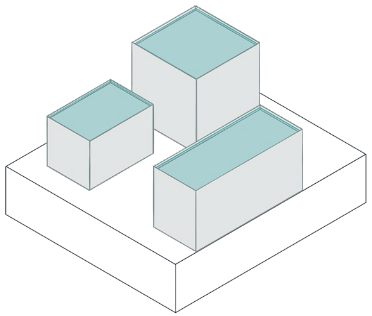


EARLY ADAPTATION OF WATER IN URBAN PLANS

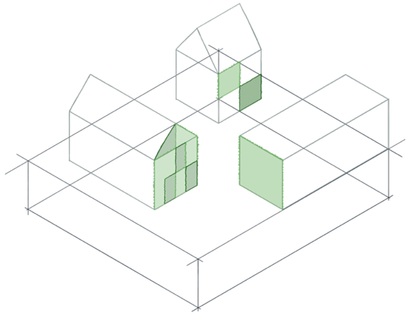
CLIMATE ADAPTATION MEASURES

CLIMATE ADAPTATION MEASURES

Blue roofs

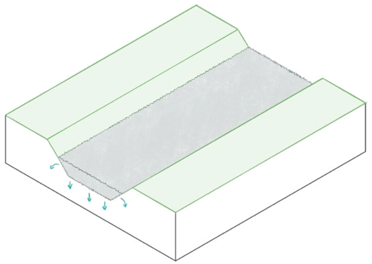


Green facades

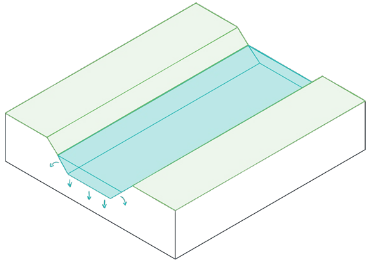


Bioswale

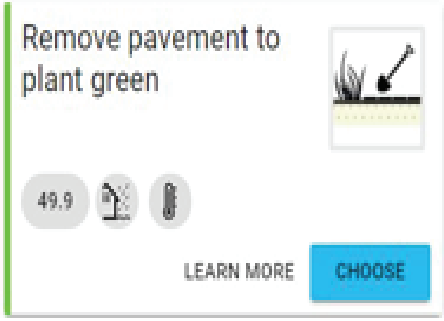
Gravel layers



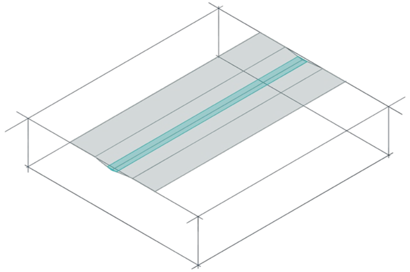
Ditches



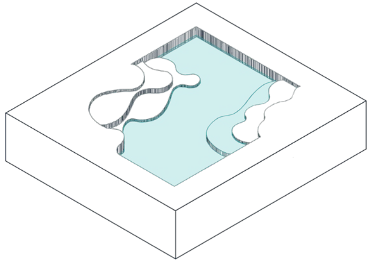
Removing pavement



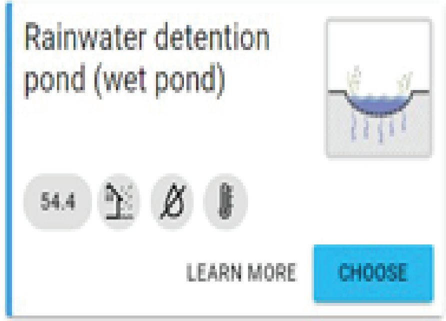
Hollow roads



Water square

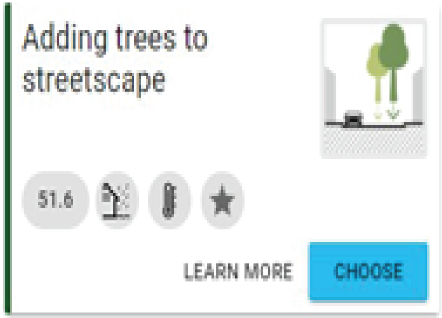


Rainwater detention pomd



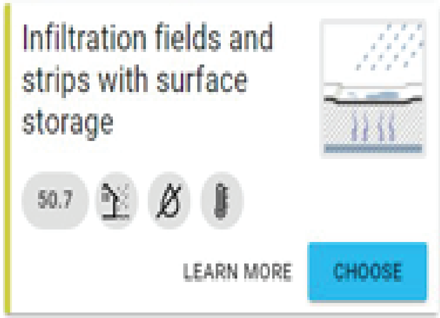
CLIMATE ADAPTATION MEASURES

Adding trees



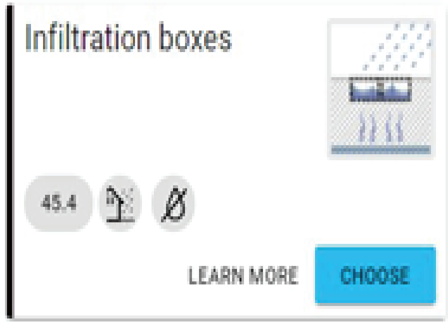
Urban forest

Infiltration field

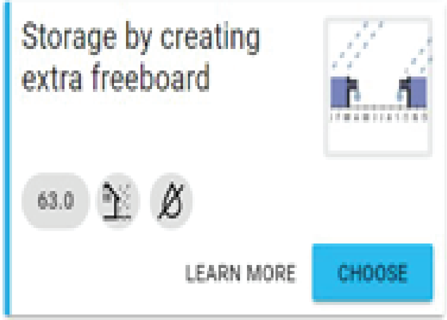


Urban wetlands

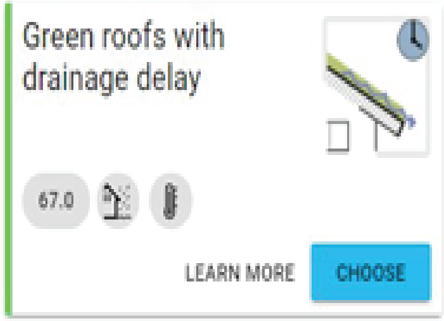
Infiltration boxes



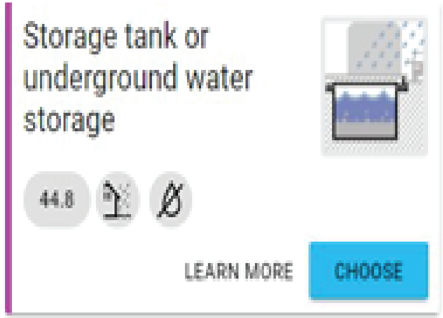
Storage by freeboard



Green roofs with drainage delay



Storage tanks, underground storage



Rain barrels

MEASURE COMPARISON MATRIX

Measures	Effect on water	Multifunctionality	Biodiversity	Storage capacity	Evapotranspiration	Water quality effect	Water awareness	Heat stress reduction		Costs		Maintenance	
Source	Green blue grids	Green blue grids	Green blue grids	Climate resilient cities	Climate resilient cities	Climate resilient cities	Created by author	Green blue grids	Climate resilient cities	Green blue grids	Climate resilient cities	Green blue grids	Climate resilient cities
Scale	0 - 3 no effect - large effect	0 - 3 no effect - large effect	0 - 3 no effect - large effect	0 - 4 very small to no result - large result	0 - 4 very small to no result - large result	0 - 4 very small to no result - large result	0 - 4 completely invisible - experience difference	0 - 3 no effect - large effect	0 - 1 no difference - 0,05 C difference	1 - 3 neutral - high cost	0 - 4 very small to no result - large result	0 - 3 no effect - large effect	0 - 4 very small to no result - large result
Blue roofs	3	2	0	2	2	0	1	1	1	2	3	1	-
Gravel layers - maybe remove	3	2	0	2	0	4	0	0	0	2	3	1	3
Hollow roads	1	1	0	2	2	0	3	0	0	1	2	1	2
Green facades	1	2	3	1	0	0	2	3	0	2	3	?	4
Ditches	1	1	2	1	0	1	3	1	0	1	1	1	1
Water squares	3	3	1	3	0	0	4	1	1	3	4	3	2
Bioswale with drainage	3	2	3	2	0	4	4	2	1	2	2	2	1
Remove pavement to plant green	2	2	2	1	4	4	2	2	1	1	1	1	2
Rainwater detention pond (wet pond)	3	3	3	2	0	2	3	2	1	3	1	3	1
Adding trees to the streetscape	2	1	3	1	4	1	1	3	1	2	1	2	1
Urban wetland	3	3	3	2	1	3	2	3	0	1	2	2	2
Green roofs with drainage delay	2	2	2	1	2	4	1	2	1	2	2	1	3
Urban forest	3	3	3	1	3	1	1	3	1	2	1	2	1
Infiltration boxes	3	3	0	2	0	4	0	0	0	3	3	2	4
Storage tank or underground water storage	2	1	0	4	0	3	0	0	0	3	3	2	4
Infiltration fields and strips with surface storage	2	2	1	2	0	4	3	1	1	2	2	2	1
Drainage infiltration transport drains / Gravel layer	3	2	0	1	0	1	0	0	0	2	1	2	1
Rain barrel	1	1	0	1	0	1	1	0	0	1	2	1	-
Surface water	3	1	1	3	3	2	2	1	0	2	3	2	1
Supplemental water retention by flexible water level management	3	2	2	3	3	2	4	1	0	3	-	2	-

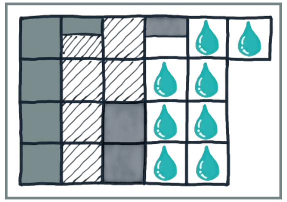
EARLY ADAPTATION OF WATER IN URBAN PLANS

EVALUATION CRITERIA FOR STRATEGIES

EVALUATION CRITERIA

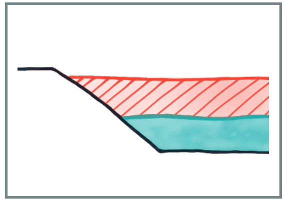
Amount of space used

Per m water with 1 NVO -> Empty space left - (length * (avg width + NVO))
Per m water with 2 NVO's -> Empty space left - (length * (avg width + 2(NVO)))
Per m water with Protection zone -> Empty space left - (length * (avg width + 2(PZ)))
Per park -> Empty space left - $n_{parks} * A_{park}$



Static storage capacity

Static storage:
Per m water without NVO -> $\Delta h_{water\ level} * l_{width\ bottom}$
Per m water with 1 NVO -> $(\Delta h_{water\ level} * l_{width\ bottom}) + (2 + (4 * \Delta h_{water\ level}))$
Per m water with 2 NVO's -> $(\Delta h_{water\ level} * l_{width\ bottom}) + (2(2 + (4 * \Delta h_{water\ level})))$

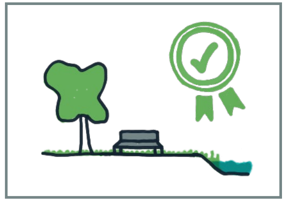


Effect on the polders

Effect on: [++, +, 0, -, --]
Quality of water in H.A.P. AND L.A.P.
Quantitiy of water in H.A.P. AND L.A.P.

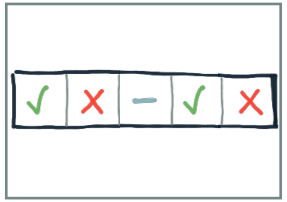
Spatial quality

Design goals
Experience of the water and green
Interaction with water and green .....



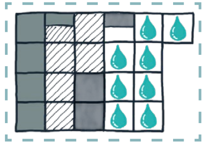
Adaptive measure effects

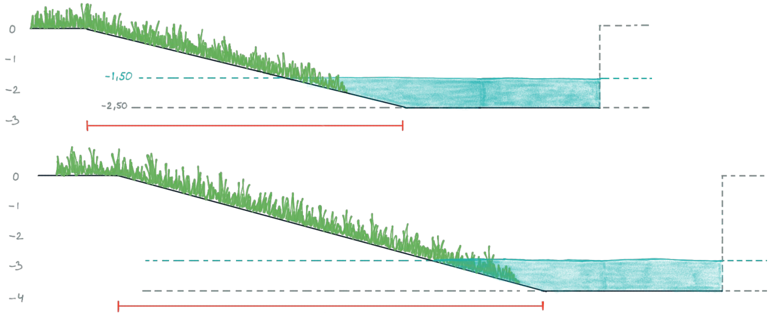
Effects on: [++, +, 0, -, --]
Biodiversity, Heat reduction, Multifunctional space usage, water awereness and costs



STRATEGY OPTIONS

Strategy 1 - Connecting both polders



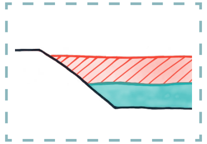


	Space left [m2]	Space left with one NFB [m2]	Space left with two NFB [m2]
Area 5	7800	223	-4582
Area 6	49900	22584	8659
Area 7	17400	9974	6189
Area 8	39100	13688	-401
Area 9	9400	4790	1789

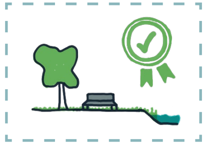
Static storage: [m^3]
$l_{\text{width bottom}}$ = x, HAP -> $\Delta h_{\text{water level}}$ = 1m, LAP -> $\Delta h_{\text{water level}}$ = 2m

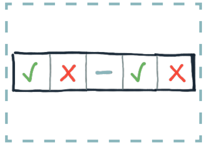
HAP
Per m water with 1 NVO = 1x + 6 - 2NVO's = 1x + 12

LAP
Per m water with 1 NVO = 2x + 10 - 2NVO's = 2x + 20

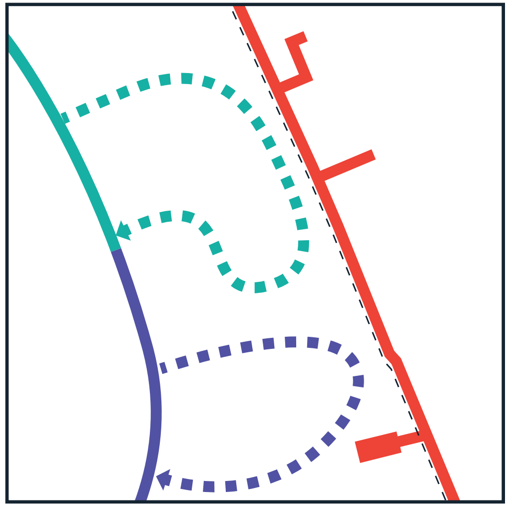


	Quality	Quantity
H.A.P. -	+	++
L.A.P. -	+/-	+





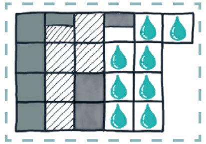
Biodiversity	++
Heat reduction	0
Multifunctional space	+
Water awereness	++
Costs	-

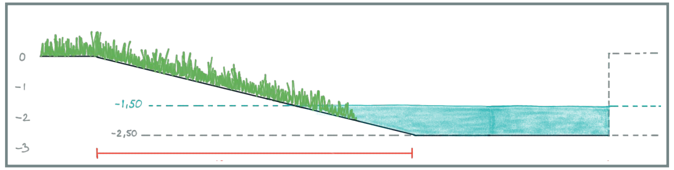


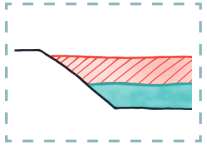
STRATEGY OPTIONS

Strategy 2 - Using only Higher Abtwoudse polder

	Space left [m2]	Space left with one NFB [m2]	Space left with two NFB [m2]
Area 5	7800	223	-4582
Area 6	49900	22584	8659
Area 7	17400	9974	6189
Area 8	39100	14695	1612
Area 9	9400	5005	2218



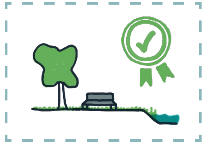


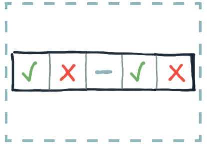


Static storage: [m^3]
$l_{width\ bottom}$ = x, HAP -> $\Delta h_{water\ level}$ = 1 m

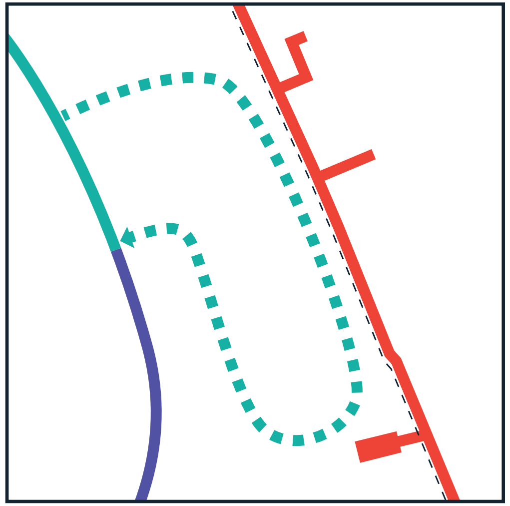
HAP
Per m water with 1 NVO = 1x + 6 - 2NVO's = 1x + 12

	Quality	Quantity
H.A.P. -	+/-	+
L.A.P. -	+/-	+



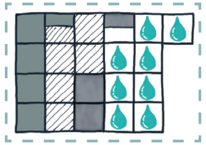


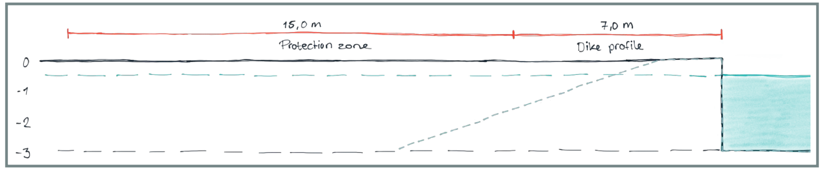
Biodiversity	++
Heat reduction	0
Multifunctional space	+
Water awereness	++
Costs	-



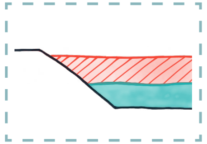
STRATEGY OPTIONS

Strategy 3 - Inlet from the Schie





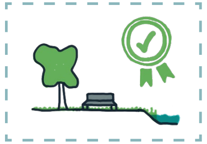
	Space left	Length of water	Space left
	[m2]	[m]	[m2]
Area 5	7800	80	2520
Area 6	49900	300	30100
Area 7	17400	230	2220
Area 8	39100	300	19300
Area 9	9400	0	9400

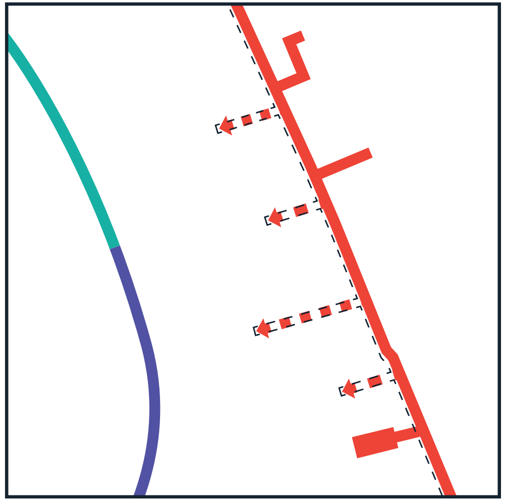


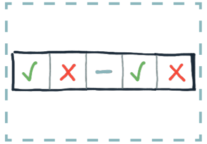
Static storage: (no NVO's)
$l_{\text{width bottom}}$ = x, SCHIE -> $\Delta h_{\text{water level}}$=0,2m

SCHIE
Per m water = 0,2x

		Quality	Quantity
H.A.P.	-	0	+
L.A.P.	-	0	+



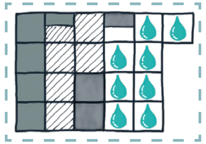


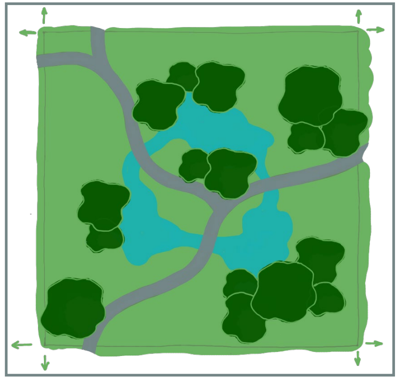


Biodiversity	0
Heat reduction	+
Multifunctional space	-
Water awereness	0
Costs	--

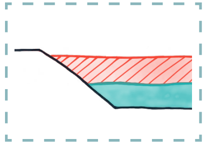
STRATEGY OPTIONS

Strategy 4 - Pocket parks and climate adaptation measures



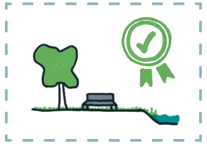


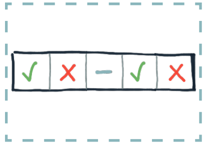
	Space left [m2]	Space left with parks [m2]
Area 5	7800	5800
Area 6	49900	46700
Area 7	17400	16600
Area 8	39100	35500
Area 9	9400	8600



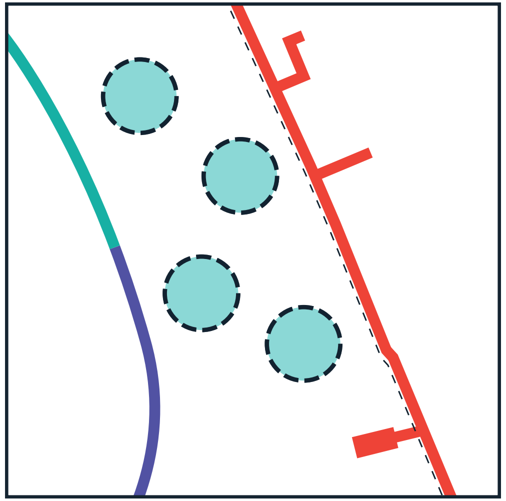
Irrelevant for this strategy because no static storage is added.

		Quality	Quantity
H.A.P.	-	+	0
L.A.P.	-	+	0





Biodiversity	+
Heat reduction	++
Multifunctional space	++
Water awereness	++
Costs	-



EARLY ADAPTATION OF WATER IN URBAN PLANS

REFERENCES

(Gemeente Amsterdam, BOOM Landscape, & BurtonHamfelt Urban Architecture. 2018)


ILLUSTRATIE: K