

Holistic Water Management in Aarhus: How to



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Section for Climate adaptaion and Wastewater management



Summary

Talk home message:

It is essential to maintain a clear focus on the distribution of responsibilities.

“Water planning” is regulated by multiple pieces of legislation and is therefore legally complex. As a result, it is a “wicked problem”

— and success can only be achieved if all stakeholders contribute to a joint effort.

Agenda

- Why it is important for the utilities and municipality to do “co-creation”
- Landscape based spatial planning

Spatial planning hierarchy



Cities creates integrated solutions!



**Water
supply**

**Ground
water
protection**



**Wastewater
planning**



**Land
use**

**Nature
based
solutions**



**Climate
adaptation**

**Stormwater
planning**



Organization structure of Water sector in Aarhus: Areas of responsibilities



City of Aarhus

- Town planning
- Authority
- Water management plan
 - Groundwater
 - river
 - drinking water
 - wastewater
 - etc.
- Permits
- Inspections
- Enforcement

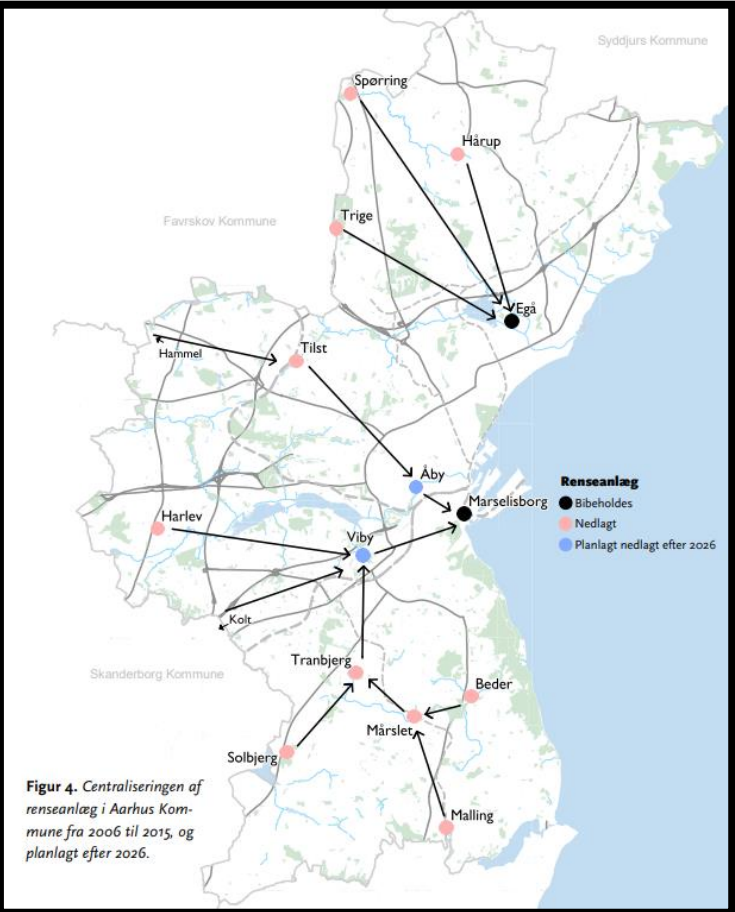
- Utility company
- **Owned by the municipality**
- Water supply
- Wastewater treatment
- Operation and Maintenance (O&M)

aarhusvand

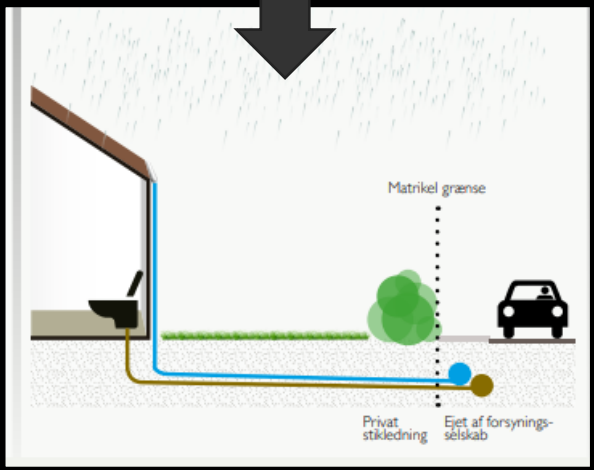
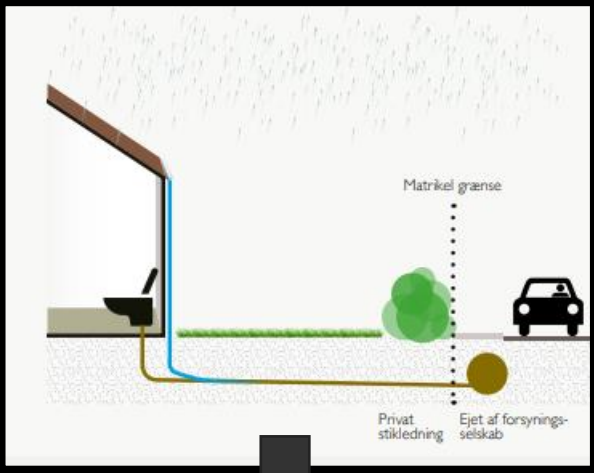


Stormwater & Wastewater management plan

Stepwise centralization of WWTP
- Improved wastewater treatment

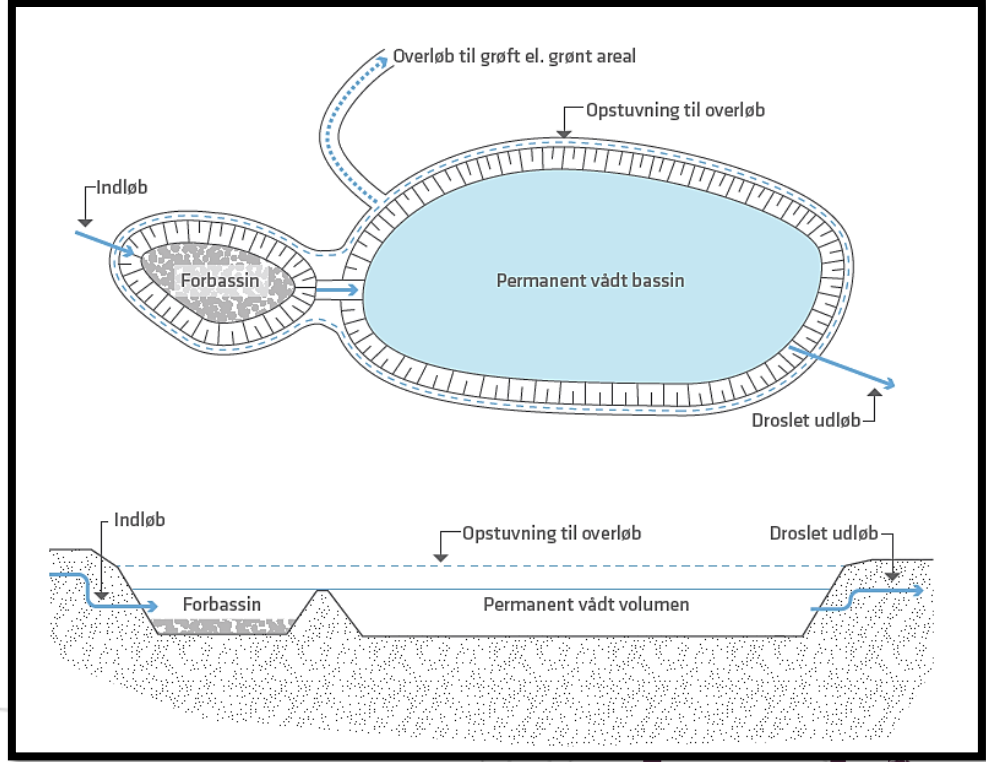


100 %
Separation of Sewer
system



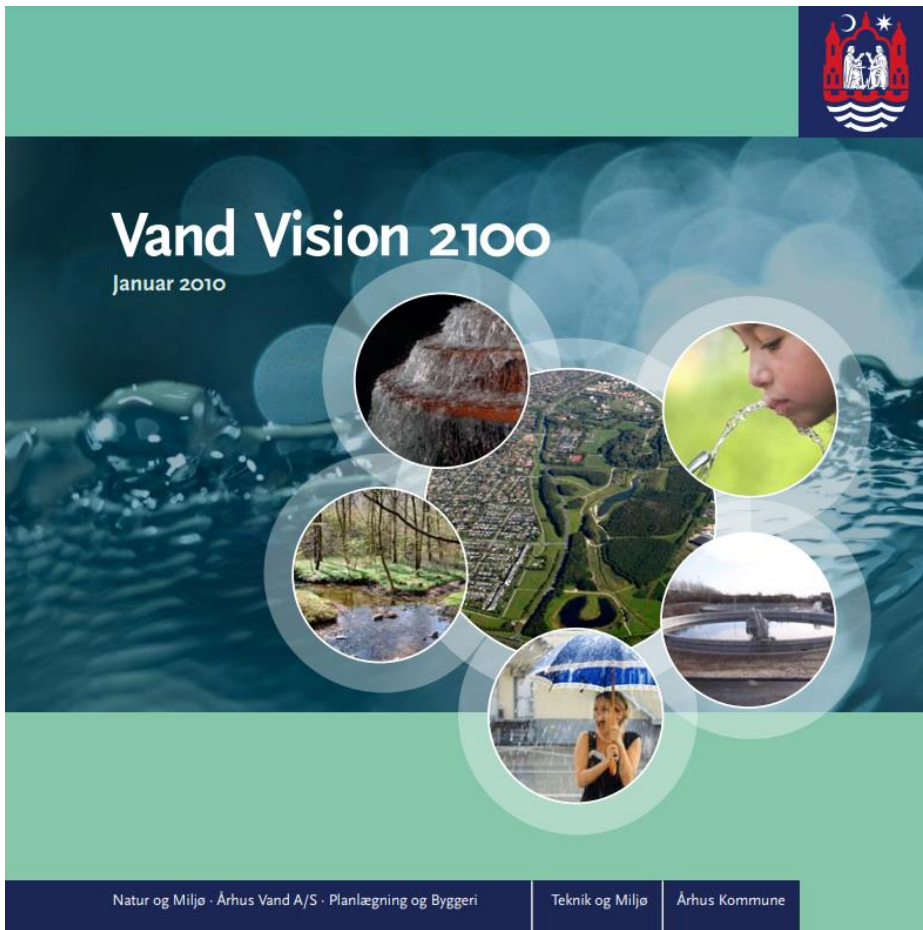
TOP PRIORITY

Stormwater
management



"The Water Vision"

The cooperation between the utility and municipality



The strategy sets the direction for how water is delayed to create space for the increasing volumes of water.'

The strategy contains six principles:

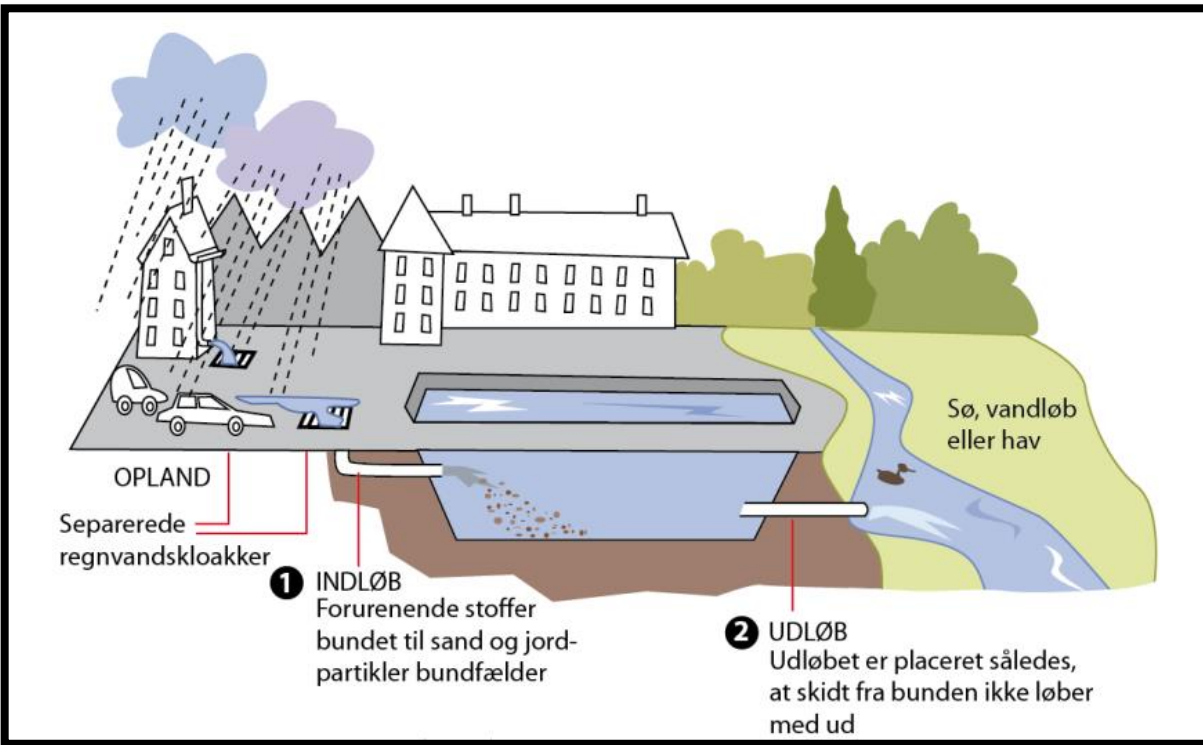
- We create space for water
- We create added value
- We implement climate adaptation where it is cost-effective
- We are proactive
- We act through broad collaboration
- We use the newest knowledge

The efforts to create space for water must take place both in the existing city, in new urban developments, in the open landscape, and along the coast.

Stormwater management – Principles

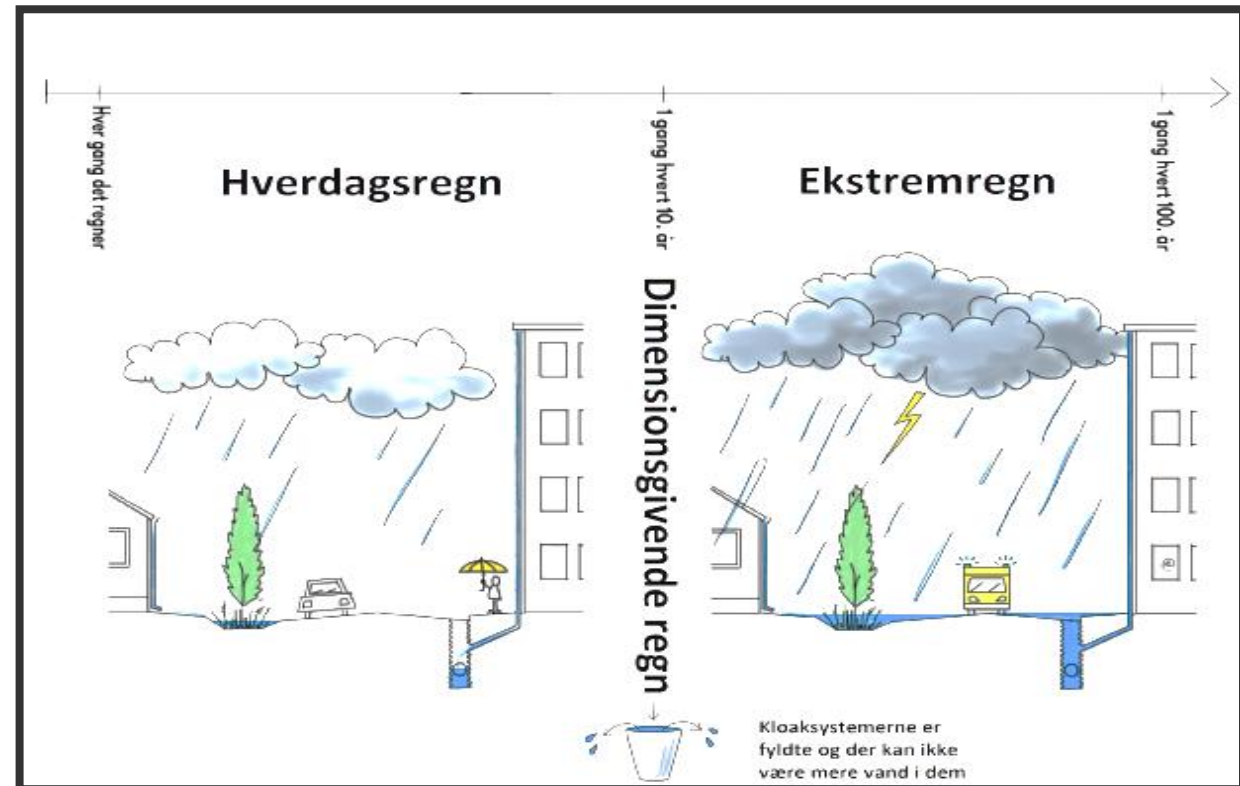
Environmental "Must does"

- Desilting the Stormwater
- "Store, delay before you discharge"



Utility

Municipality

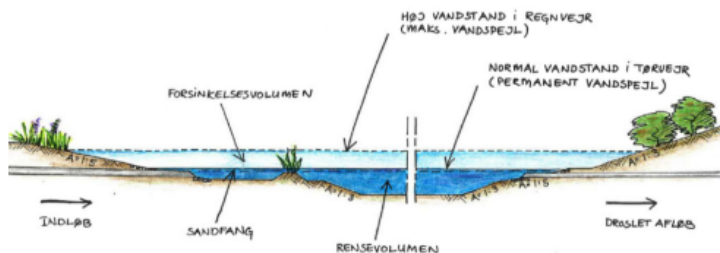


"If the everyday system doesn't work, then what's the point—what's the madness—of doing climate adaptation???"

Aarhus Kommune – Gældende design og dimensioneringskrav

TEKNIK OG MILJØ
Plan, Byggeri og Miljø
Aarhus Kommune

Grundvand og Spildevand
Karen Blixens Boulevard 7
8220 Brabrand



<https://www.aarhusvand.dk/media/n4ao511c/bassinmanual-for-aarhus-vand.pdf>

Regnvandshåndtering - Spildevandsplan 2027-2032 - Aarhus Kommune

Design guide:

Made together
with the utility

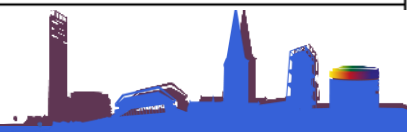
Tabel 5-2. Dimensionsgivende middelintensiteter for 10 minutter, uden sikkerhedsfaktor

	T=1 år, l/s/ha	T=2 år, l/s/ha	T=5 år, l/s/ha	T=10 år, l/s/ha
10 min	111	137	177	212

De anførte middelintensiteter svarer til landsregnrækkens regnskyl med en varighed på 10 minutter jf. Spildevandskomiteens skrift nr. 30 for lokation af Viby Renseanlæg med en årsmiddelnedbør 707 mm.

Tabel 5-6. Dimensioneringskrav for ledninger

Parameter	Gældende krav/ vilkår	Bemærkninger
Dimensionsgivende regnintensitet – Separatsystem - fuldt løbende rør	173 l/s/ha	1 års regnintensitet 111 l/s/ha Klimafaktor = 1,30 Modelusikkerhed = 1,20 Samlet faktor = 1,56 $111 \cdot 1,56 = 173$ l/s/ha
Dimensionsgivende regnintensitet – Fællessystem - fuldt løbende rør	214 l/s/ha	2 års regnintensitet 137 l/s/ha Klimafaktor = 1,30 Modelusikkerhed = 1,20 Samlet faktor = 1,56 $137 \cdot 1,56 = 214$ l/s/ha



Separation of Sewer system & Stormwater management





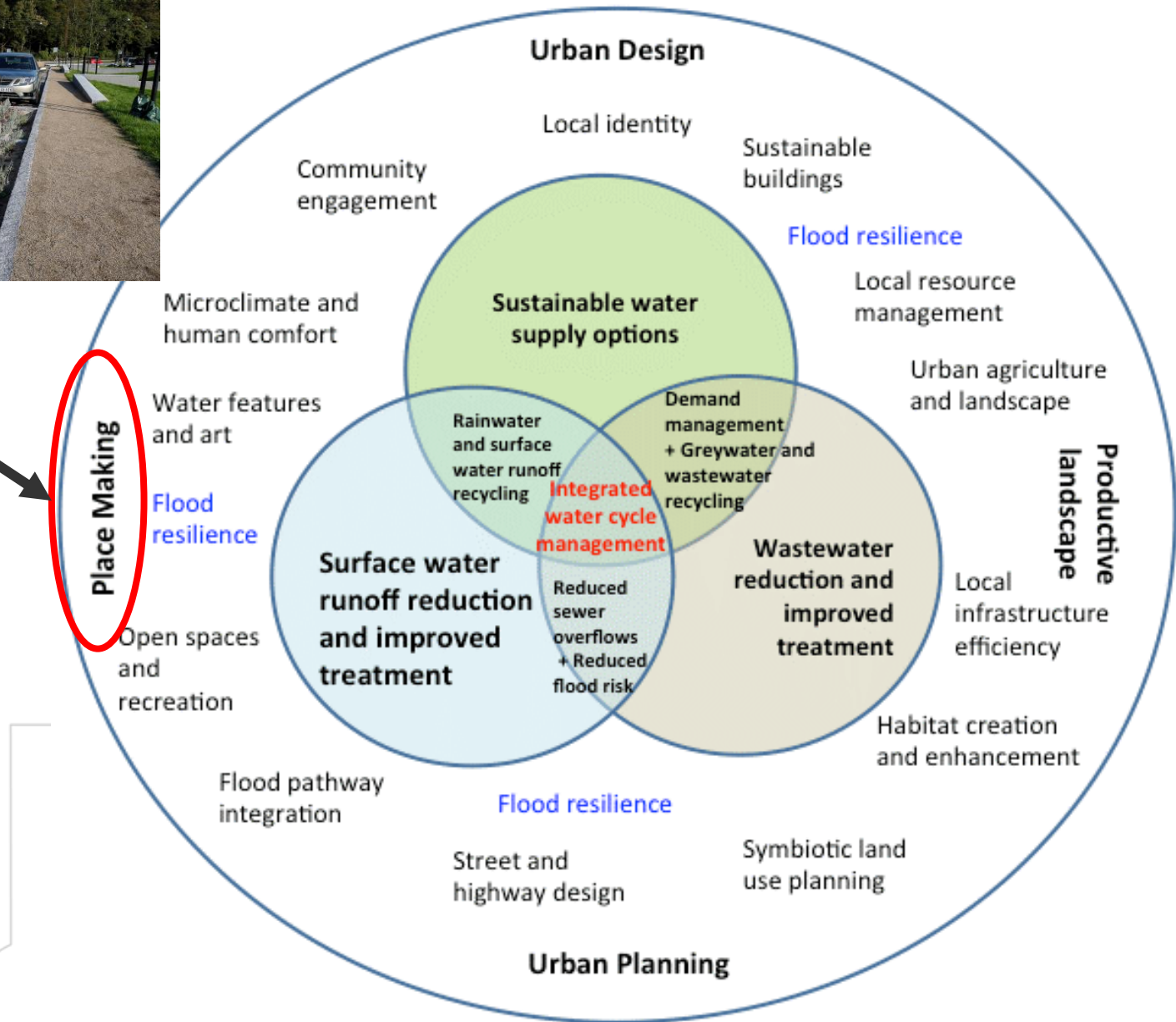
ADDED VALUE IN CLIMATE ADAPTATION AND CITY PLANNING



Our main challenge!!!

Place Making

WSUD – Water Sensitive Urban Design

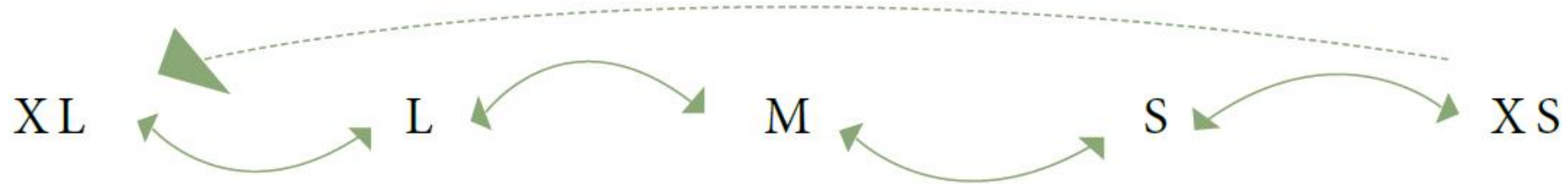


Co-Creation



LANDSCAPE BASED URBAN PLANNING

Spatial planning hierarchy



Shared vision
Aarhus Municipality



condensed city
vs
open areas
1 : 100.000

Holistic interdisciplinary
strategic plan
for a smaller
area



theme plans
1 : 10.000

Guidelines for communal
living
- priorities of programs



what and where?
1 : 2.000

By-law spacial plan for
specific housing
or business area e.g.



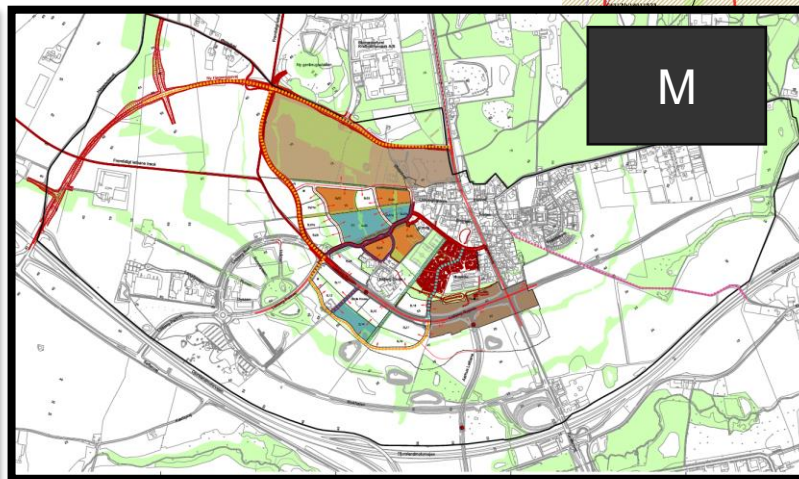
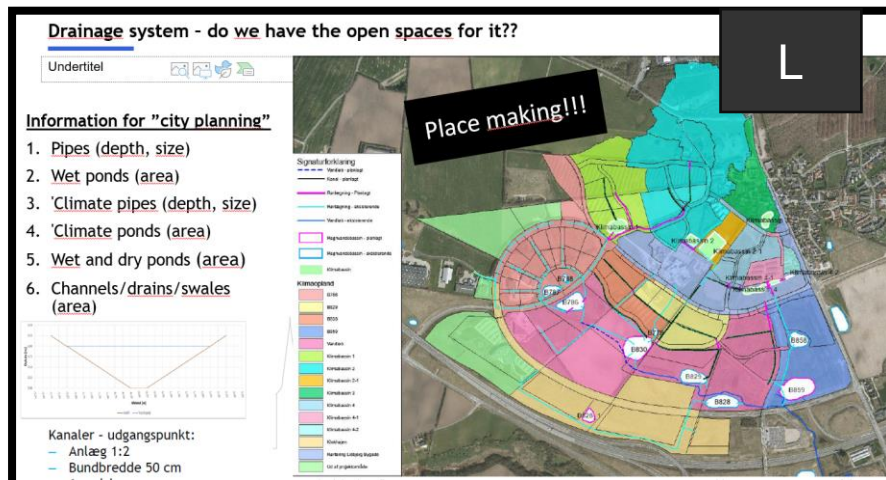
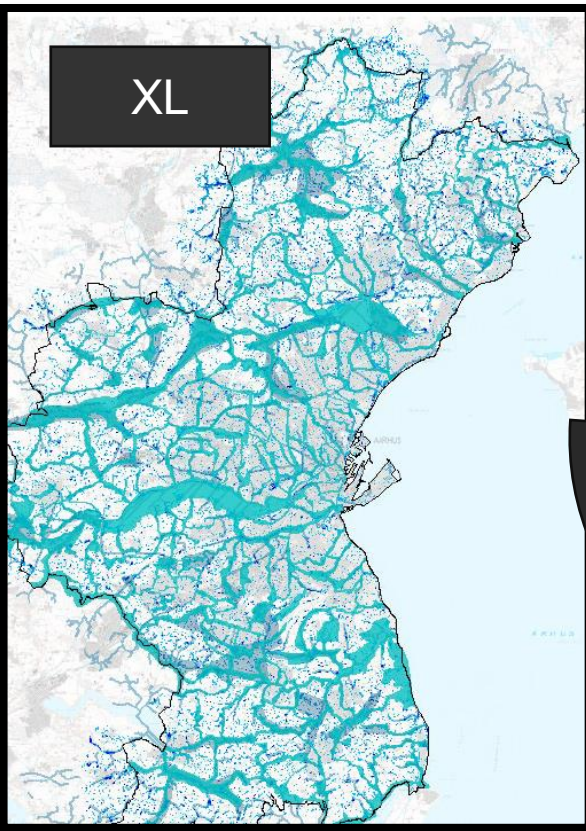
how
1:500 / 1:200

Building permission



"Time and space for water"

How?
"place making"
(at all planning levels)



Place making – how to

Permits required to connect properties to public sewer systems, often with conditions related to capacity and environmental impact.



“XL-scale & S-scale” Governance Tool - “The Danish Planning Act”

Local Development Plans in Denmark – Legal Basis and Requirements

1. Regulate Land Use

These plans regulate the **use of land**, including zoning, building design, infrastructure, and environmental considerations

2. Must Comply with the Municipal Plan

A local plan must be consistent with the municipal plan, which outlines broader development strategies for the municipality

3. Cannot Conflict with Other Legislation or Plans

Local plans must not contradict other laws or planning instruments, such as environmental protection laws or national planning directives

4. All Provisions Must Be Based on Section 15 of the Planning Act

Every regulation in a local plan must have a legal basis in Section 15 of the Planning Act, which contains a detailed catalogue of permissible planning topics (known as the "local plan catalogue")

Planloven



Kommenteret af
Helle Tegner Anker

med bistand af
Jens Flensburg

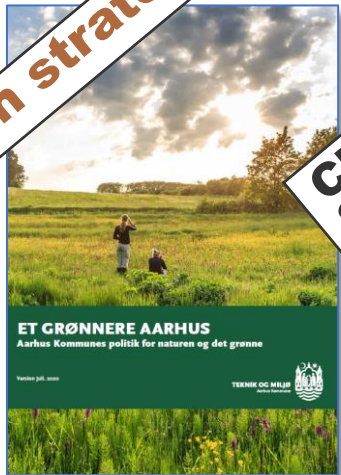
Jurist- og Økonomforbundets Forlag

Umbrella Plan

2020

A Greener Aarhus with more Blue

Green strategy



Climate adaption Strategy



Policy strategies

Nature Quality Plan



Climate adaption plan



Action plans

Parks & Recreation Plans



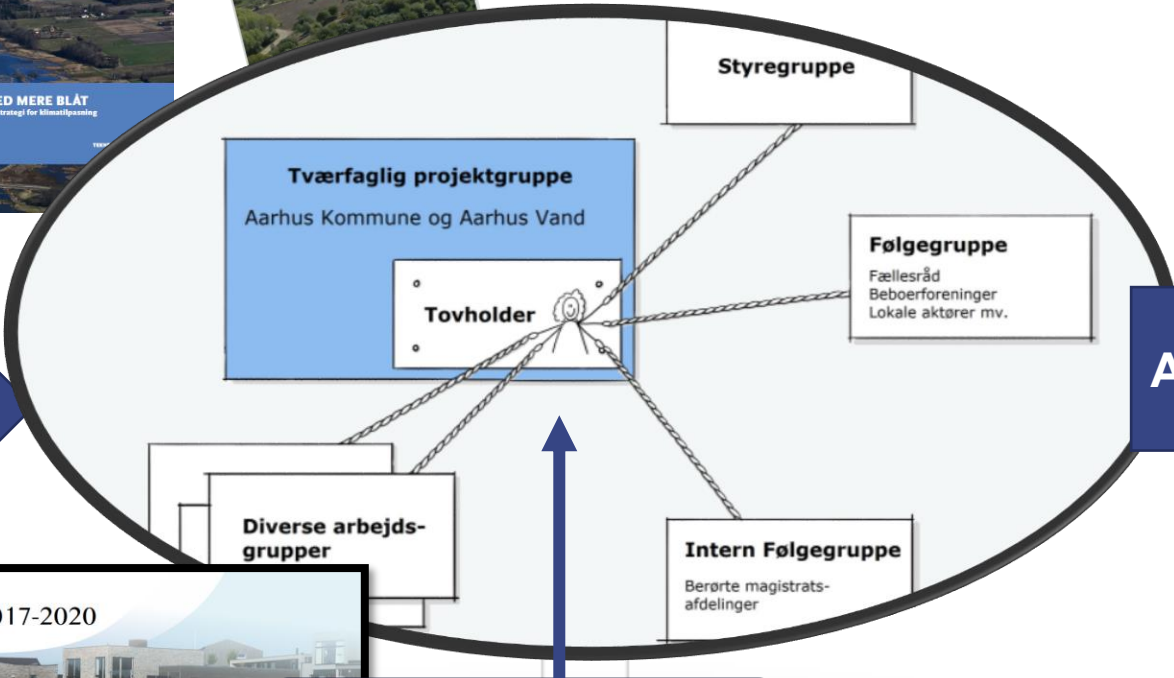
CITY OF AARHUS



Coordinating the "Blue and Green"



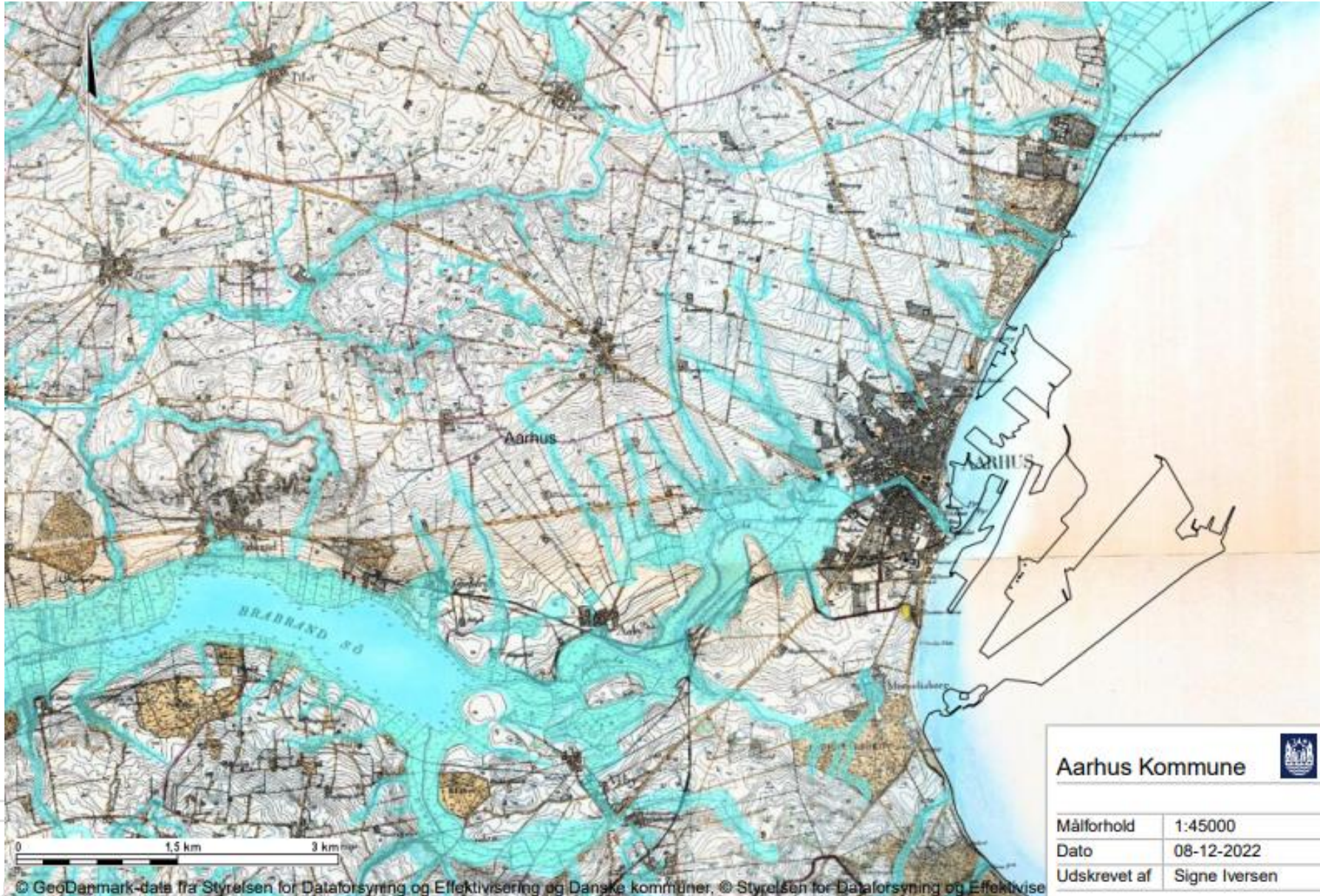
The City Council's strategic objectives



A greener city with more blue

Blue-Green facilitator/coordinator

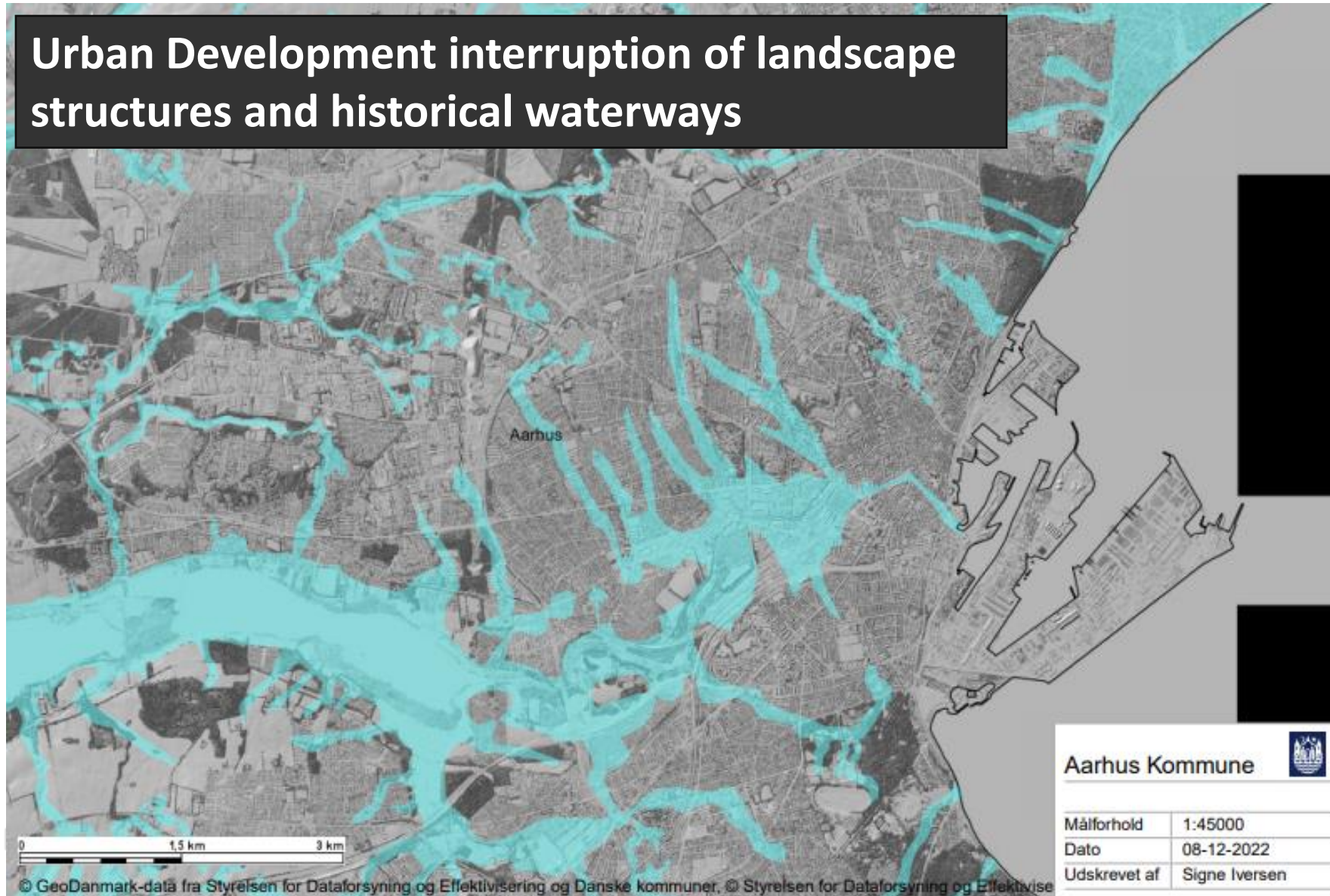




**Historical
landscape and
historical
waterways**



Urban Development interruption of landscape structures and historical waterways



Water –
from historical
times till now

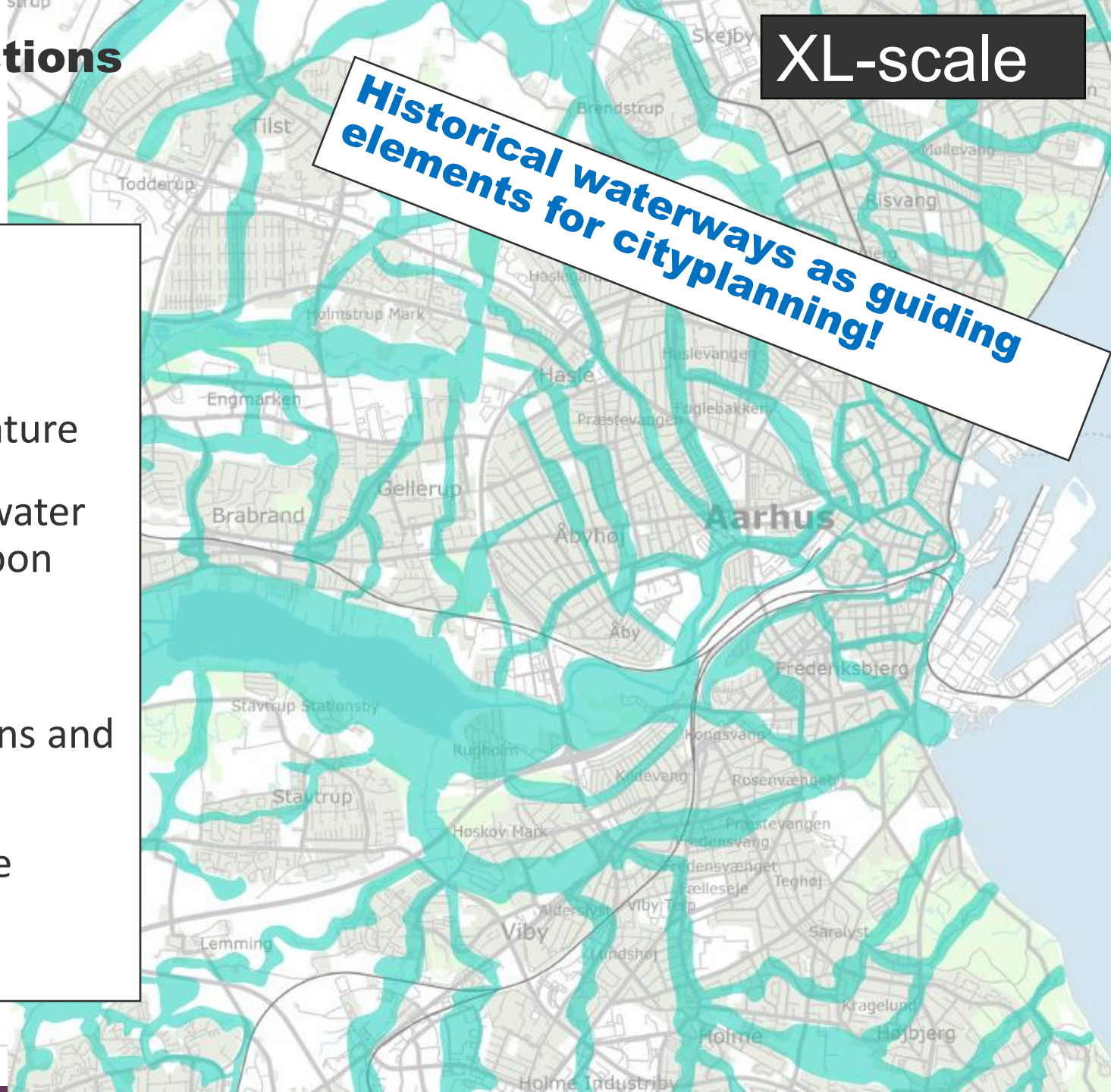


By-laws: Blue and Green Connections

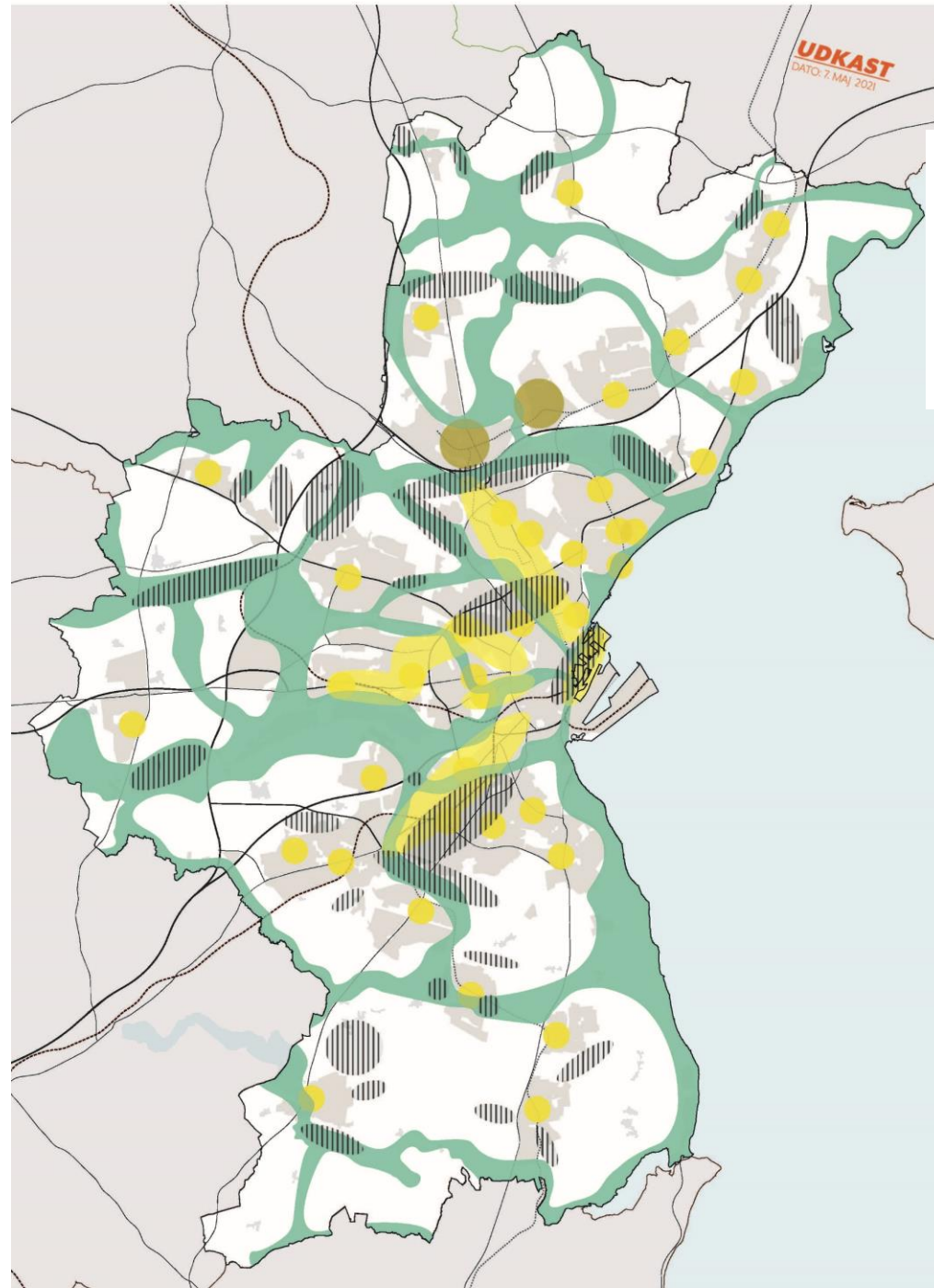
Legal Basis and Requirements in City planning

1. Support Visual and physical connectivity between nature, water, leisure areas and recreative pathways.
2. Enhance and emphasize landscape and nature
3. Emphazise Climate adaption with visible water and synergies with water, nature and Carbon reduction
4. City development, buildings and technical facilities must not be barrier for connections and accesibility to green areas.
5. Existing barriers for connectivity should be removed.

Historical waterways as guiding elements for cityplanning!

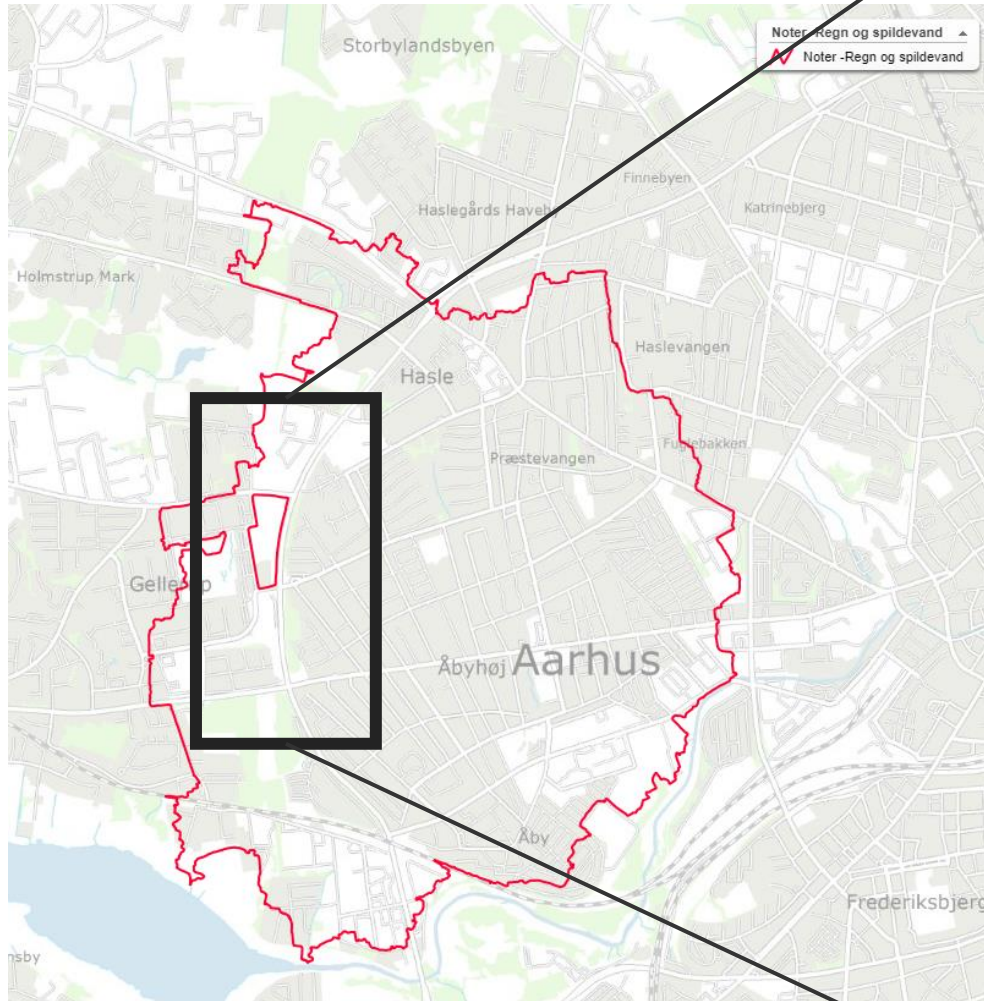


Nature, water and leisure **BALANCES** city growth



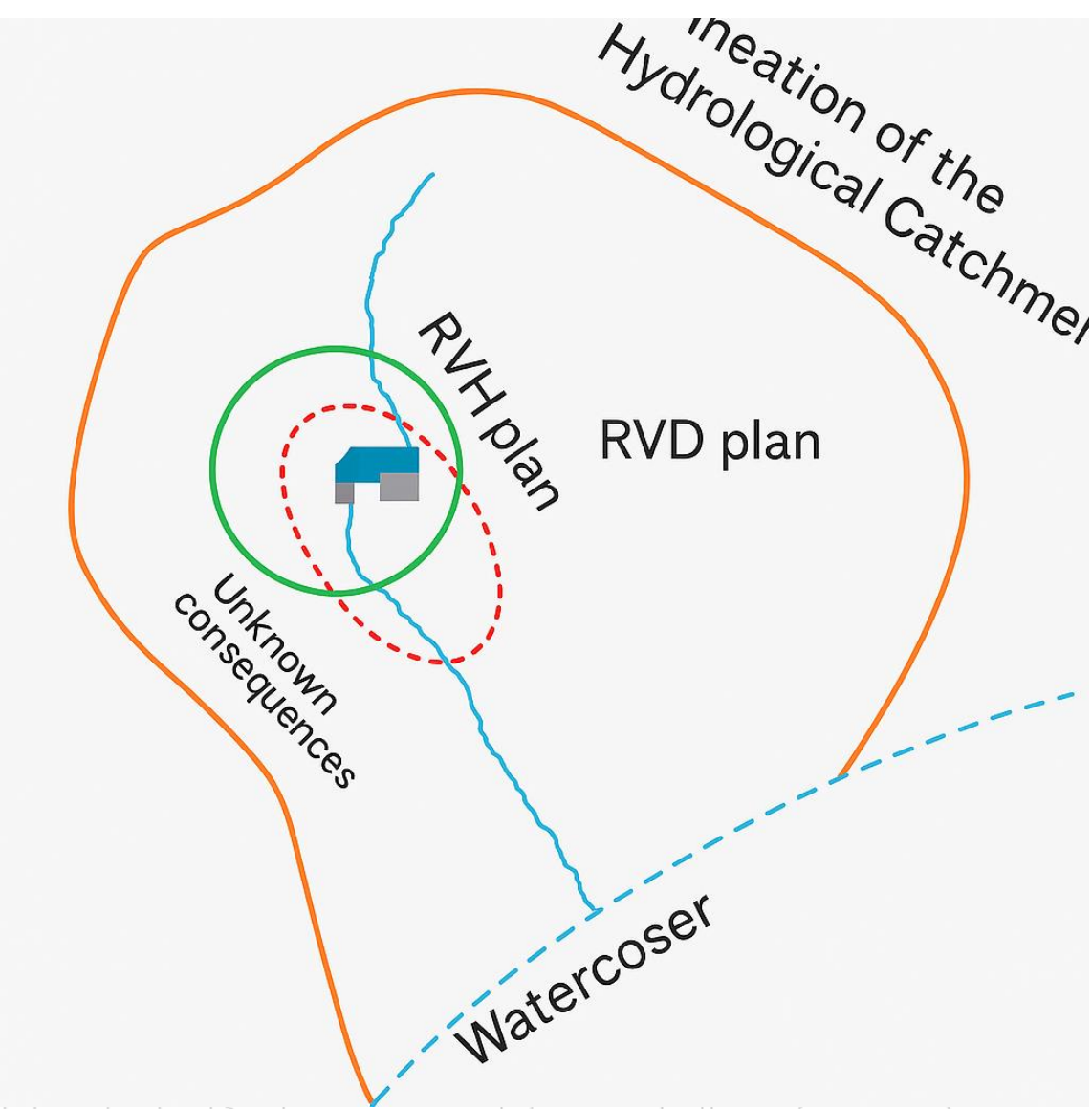
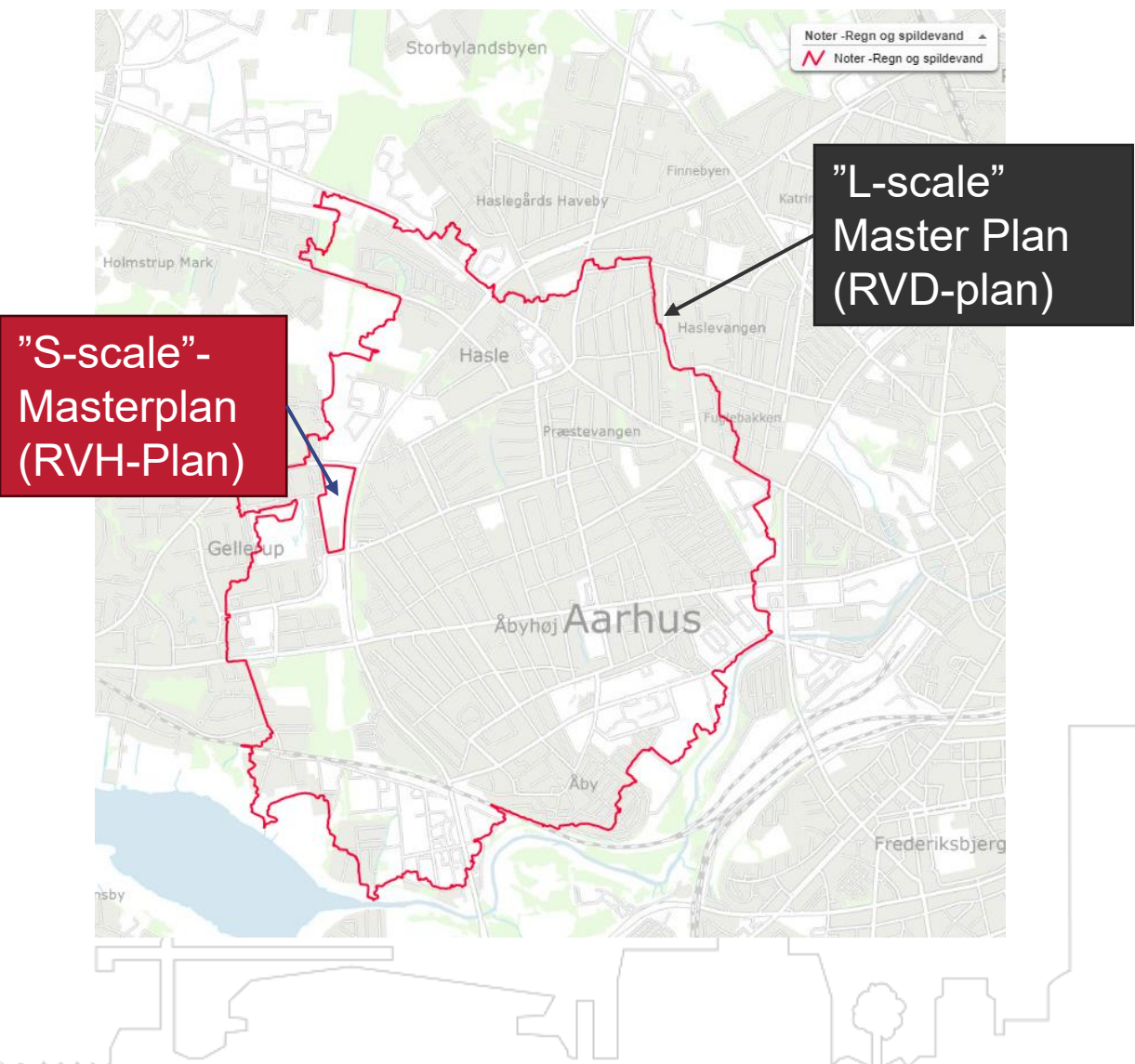
- Blue and green network
- Blue and green development areas
- City Growth – New cities
- Growth axis and densification areas

Planning frameworks and regulatory constraints (From L-scale to S-scale)



Urban Area - Catchment analysis (L-scale)

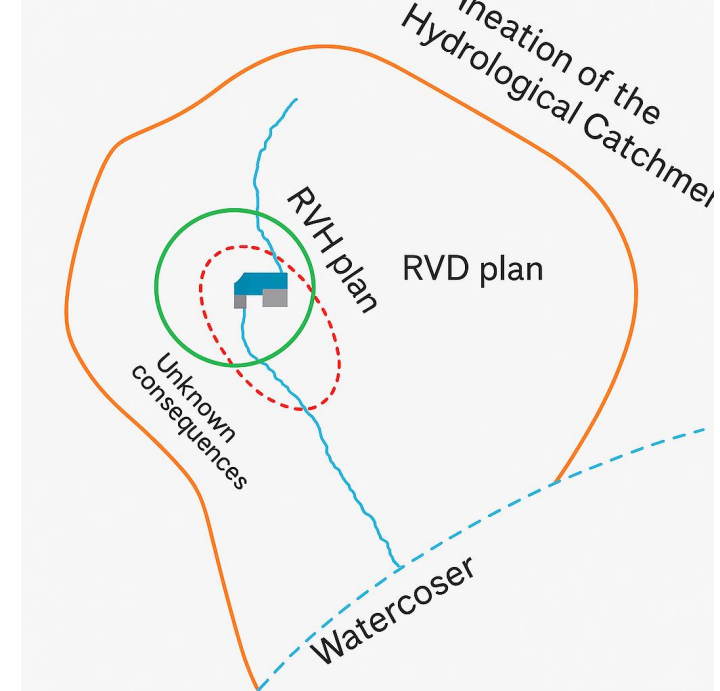
"A Matter of scale"



In Aarhus Municipality, a distinction is made between:

Stormwater Disposition Plans (SWDP),

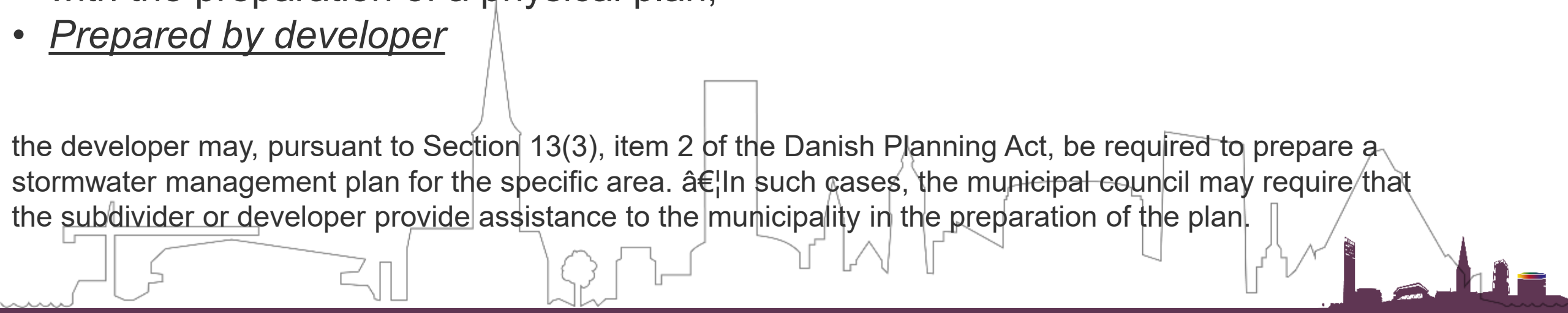
- which are prepared for an entire hydrological catchment area
- Prepared by utility/municipality



Stormwater Management Plans (SWMP),

- which are prepared at the local development plan (local plan) level In connection with the preparation of a physical plan,
- Prepared by developer

the developer may, pursuant to Section 13(3), item 2 of the Danish Planning Act, be required to prepare a stormwater management plan for the specific area. â€œIn such cases, the municipal council may require that the subdivider or developer provide assistance to the municipality in the preparation of the plan.



Urban water management plan - Åbyhøj

Aarhus Vand arbejde



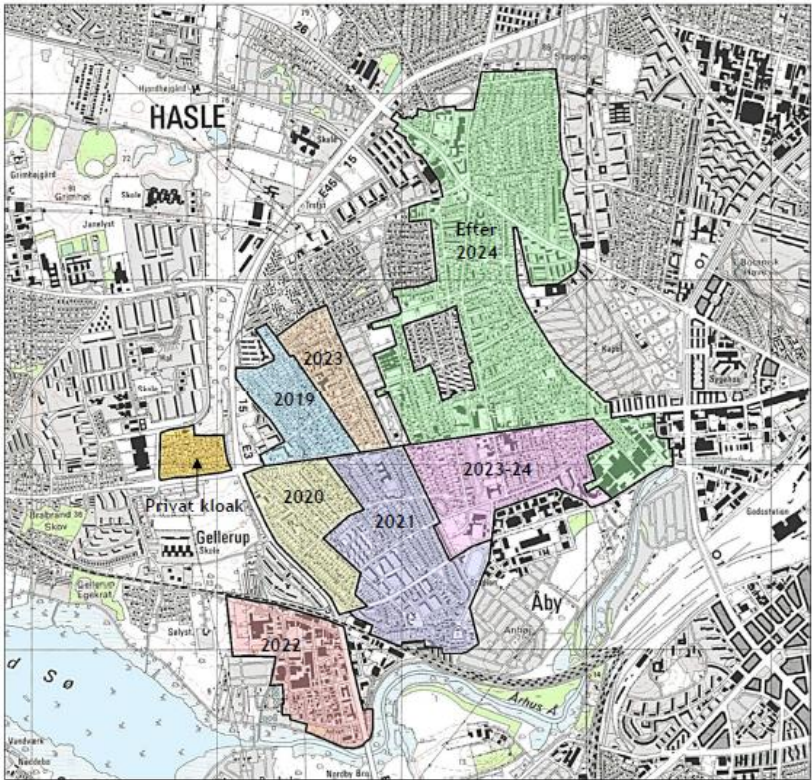
PLAN FOR SEWER SEPARATION



Flood Risk analysis



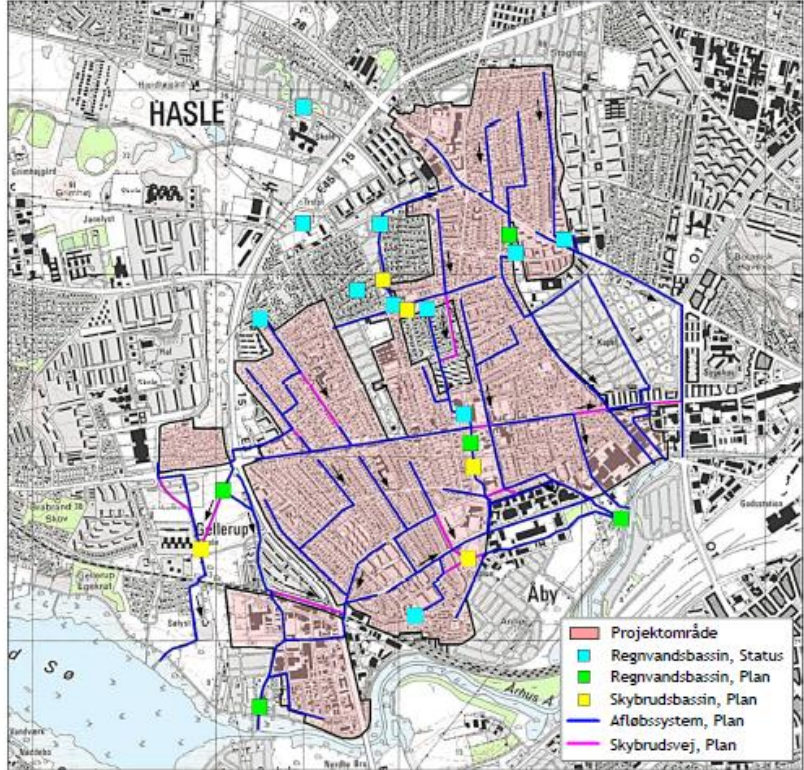
Strategic Masterplan



Ref: Aarhus Vand



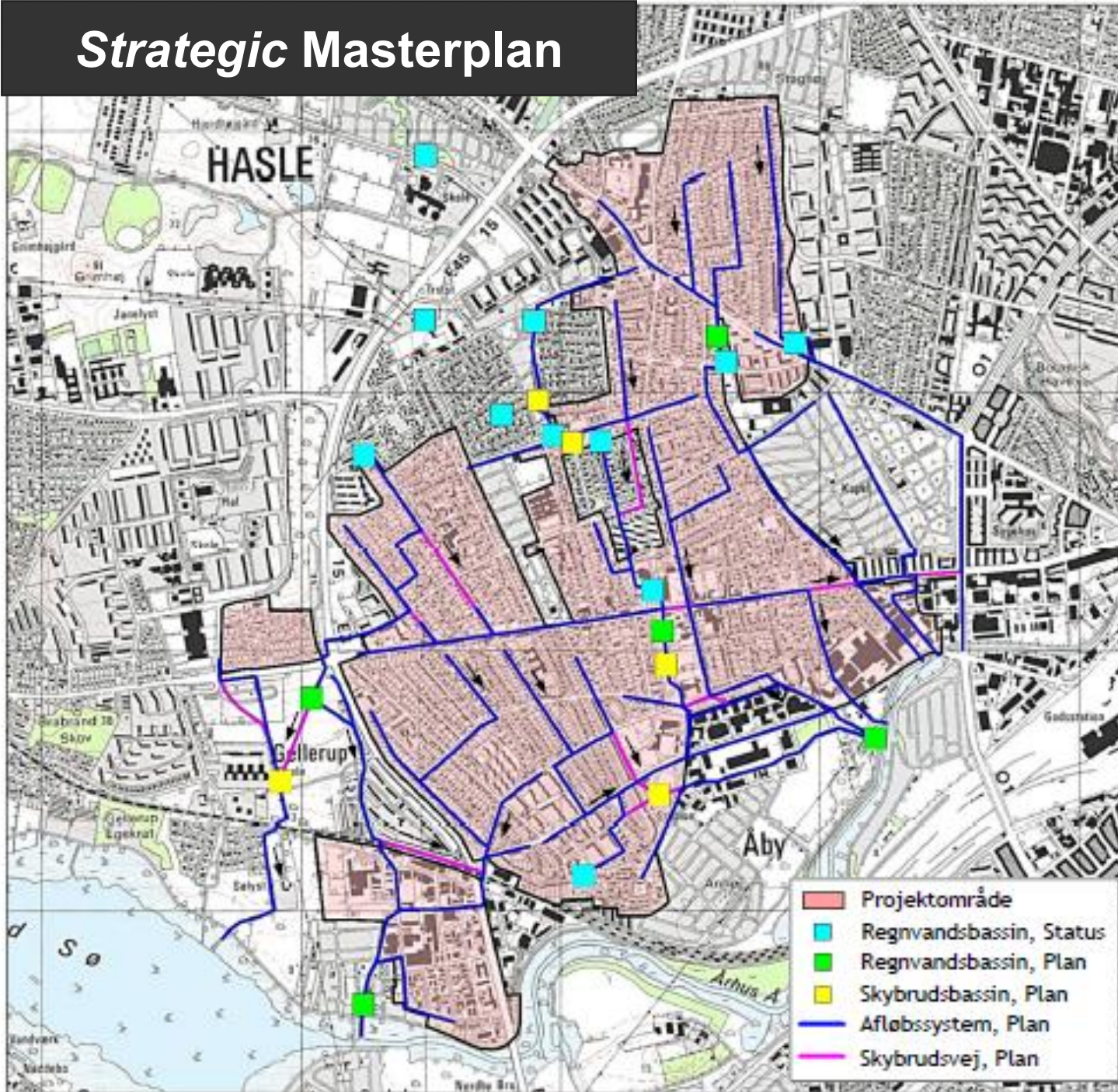
Ref: Aarhus Vand



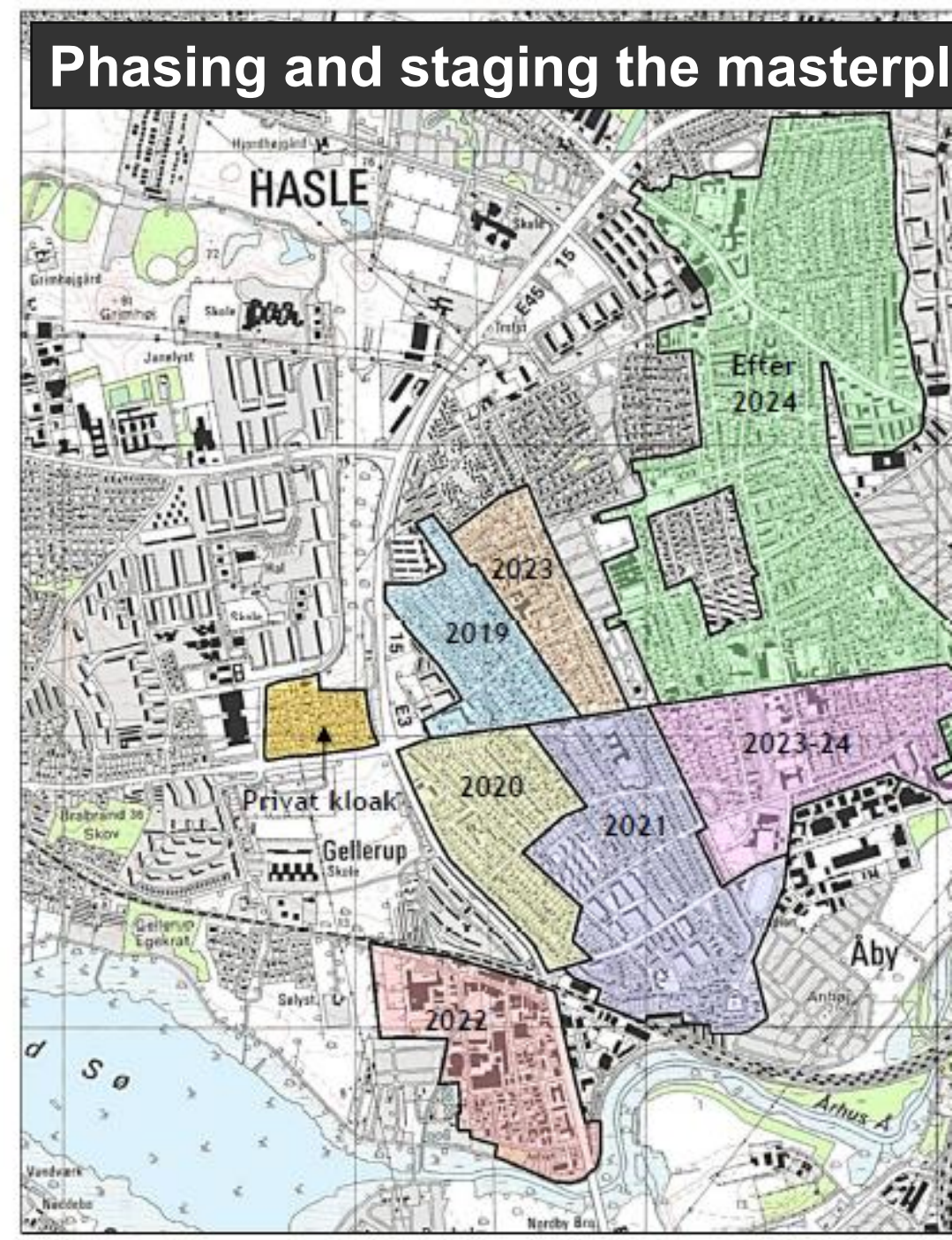
Ref: Aarhus Vand



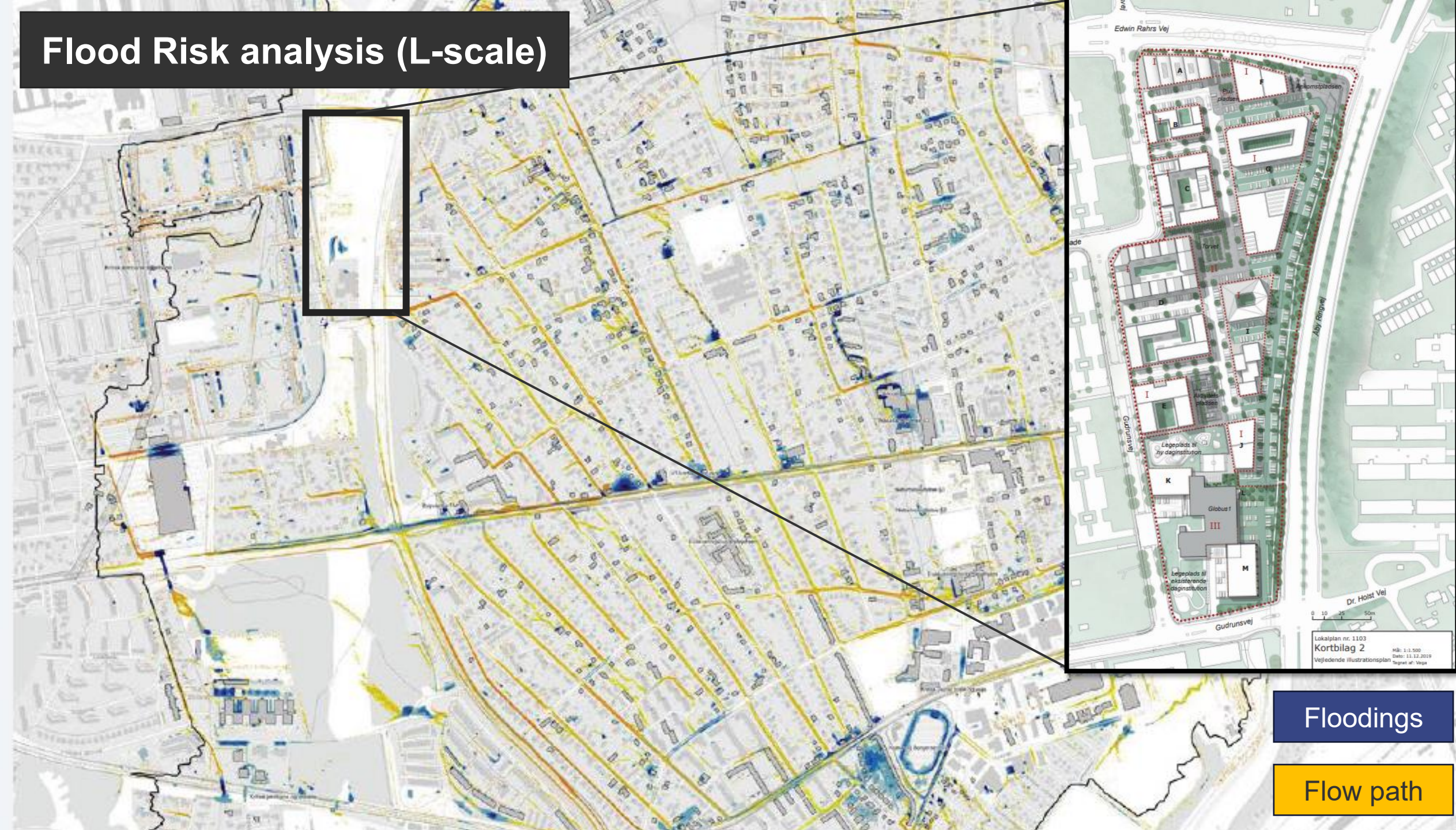
Strategic Masterplan



Phasing and staging the masterplan

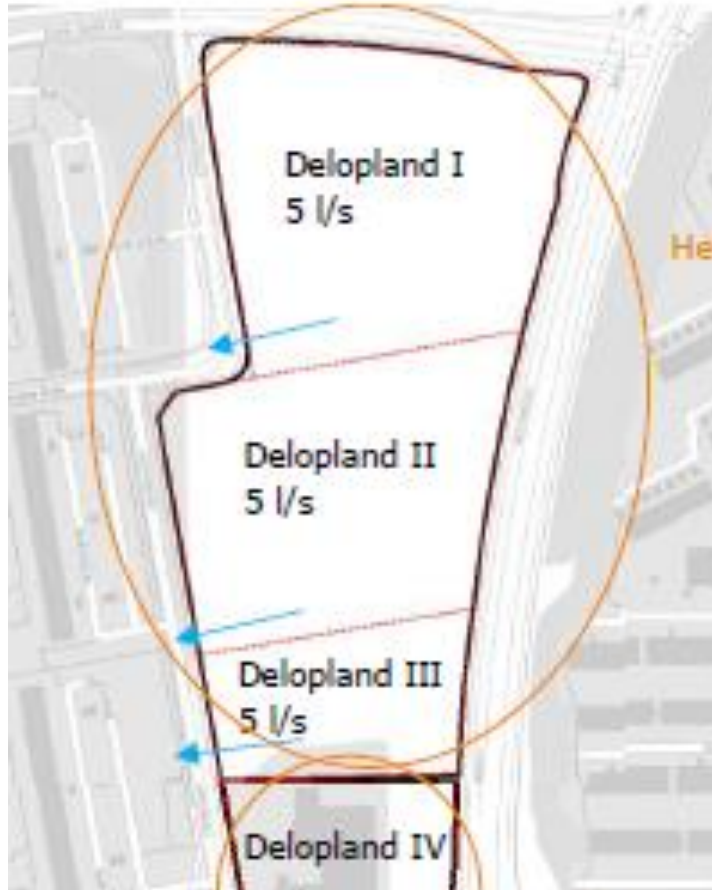


Flood Risk analysis (L-scale)



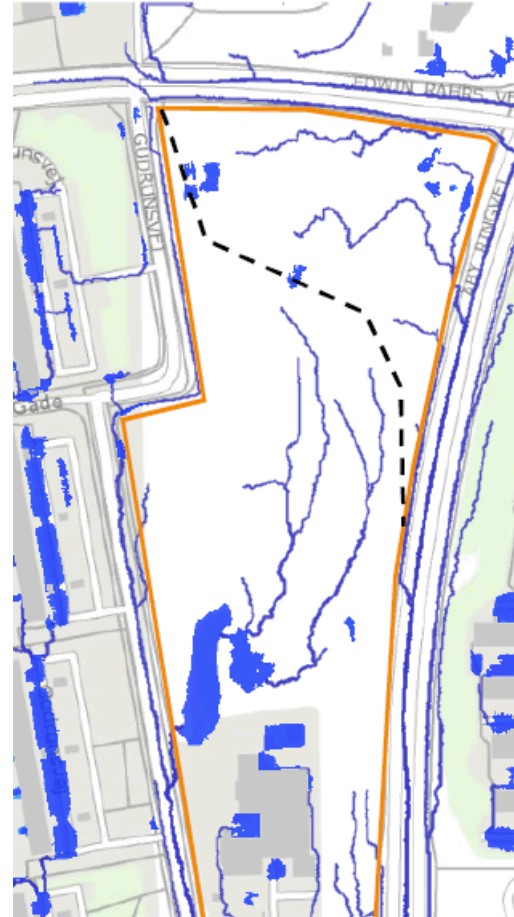
Local Development Planning/Land Use Planning (S-Scale)

Responsability – private developer



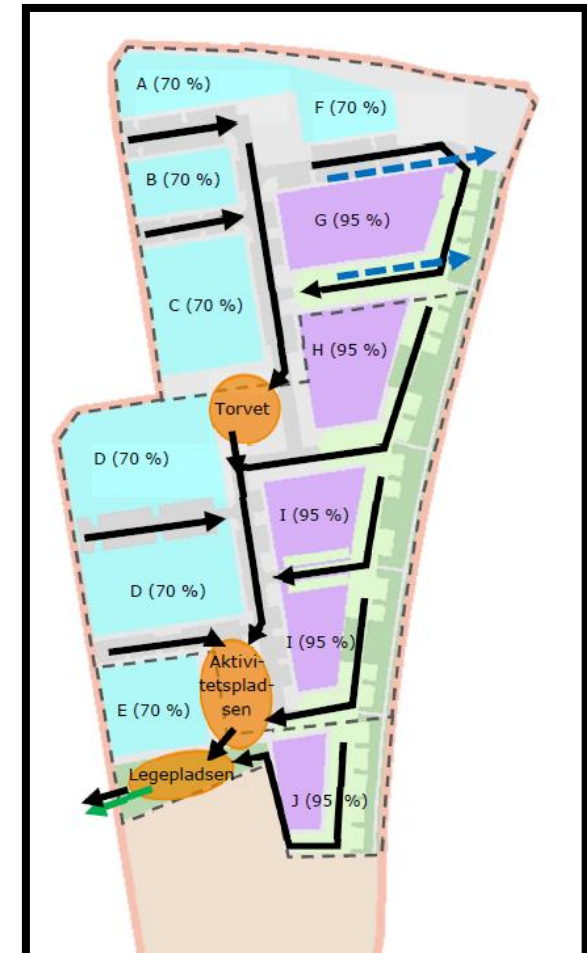
**Planning frameworks and
regulatory constraints**

Kilde: NIRAS



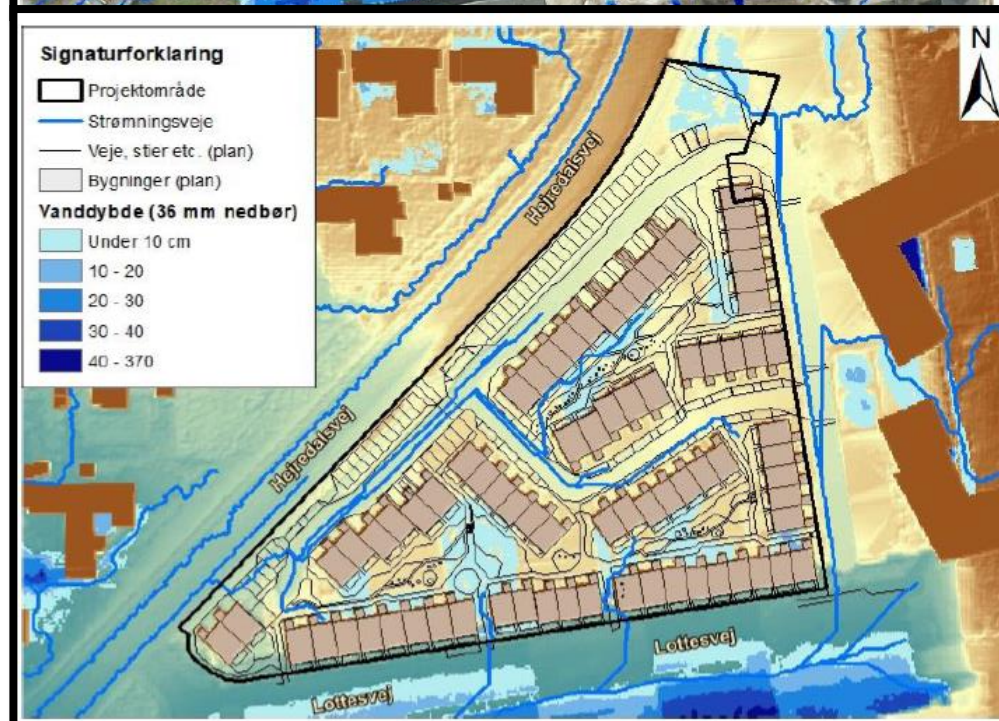
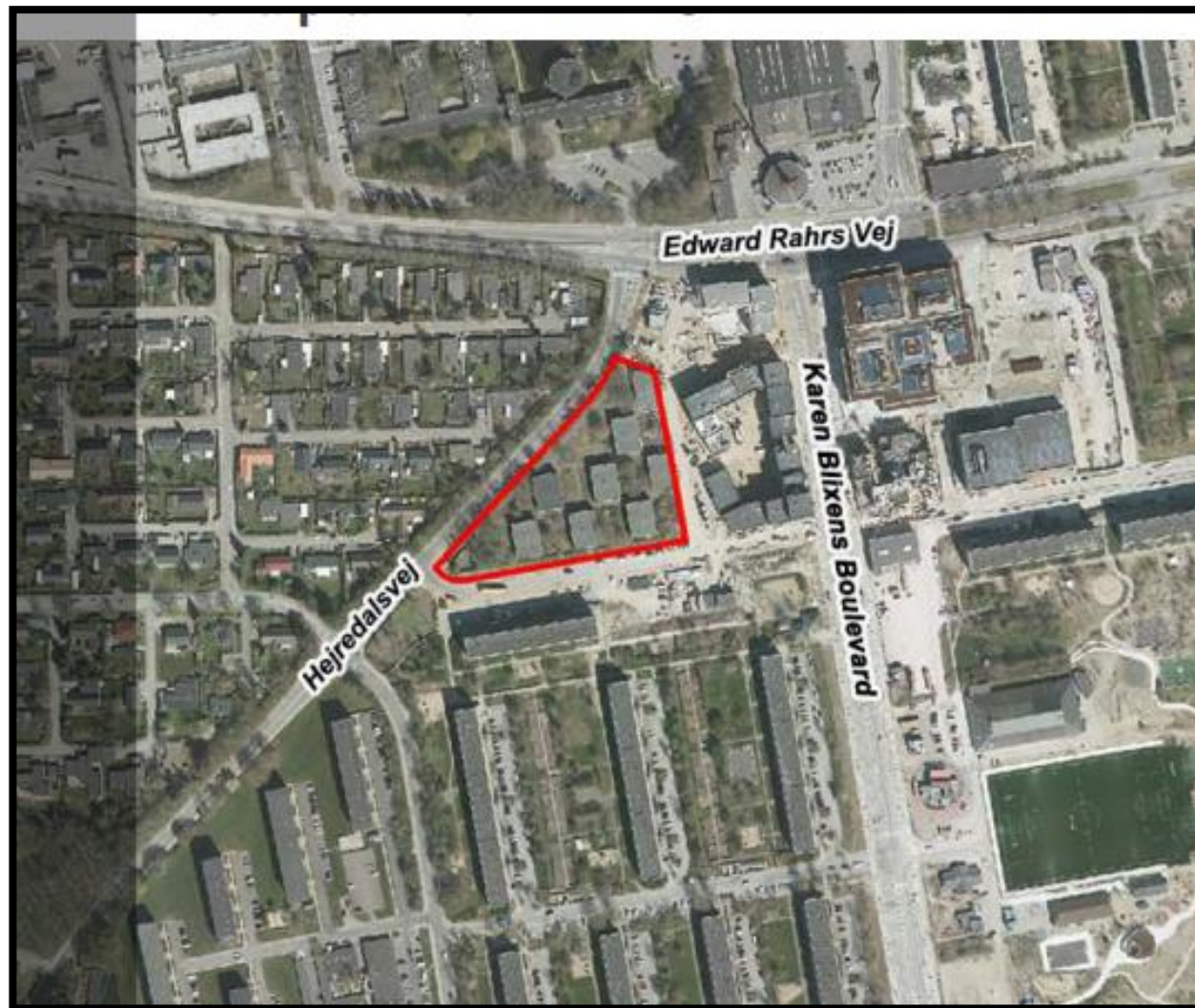
Flood analysis

Kilde: SCALGO



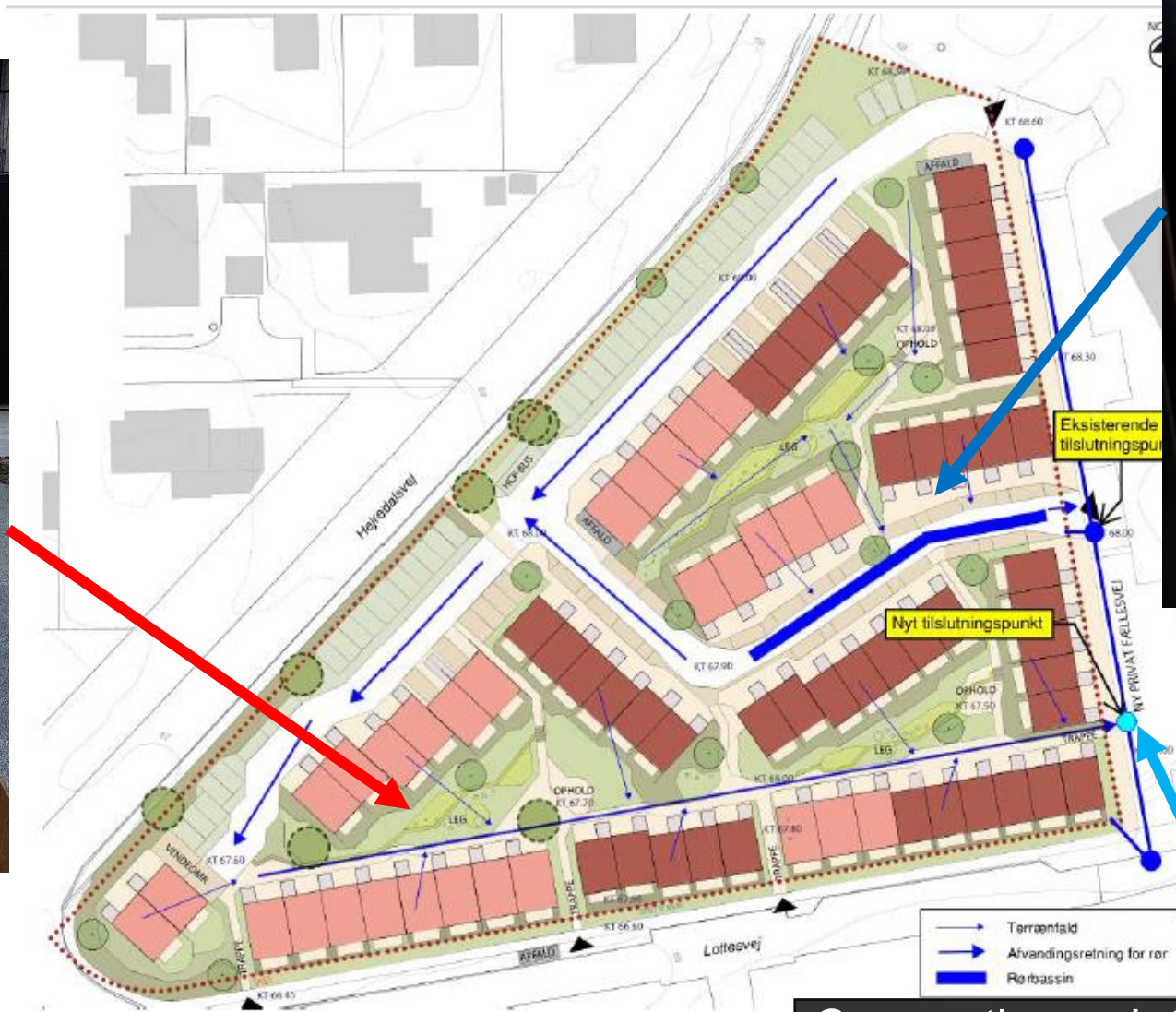
**Layout plan +
Blue-Green solutions**

Kilde: NIRAS





Private storage



27.09.2023

Private storage

Connection point to the drain system
Responsibility: Utility

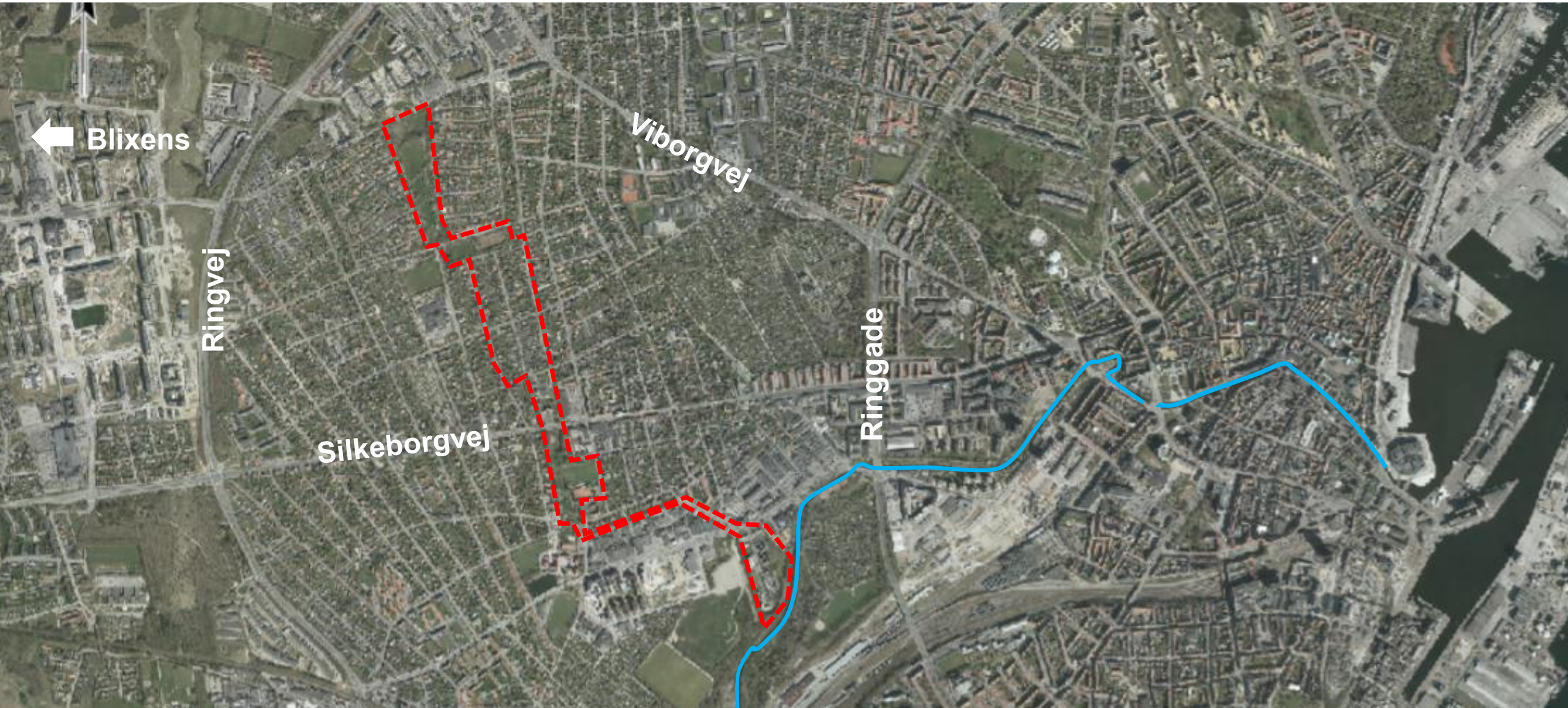
PART OF THE LANDSCAPE – AARHUS RIVER VALLEY

Blue-green recreational path



Urban water management plan in ÅBYHØJ ("L-scale")

Blue-green recreational path



Added Value projects + Urban water management plan

Water Projects

Aarhus Vand

Regnvandsdispositionsplan

Adskillelse af regnvand og spildevand i Åby, Åbyhøj og Hasle

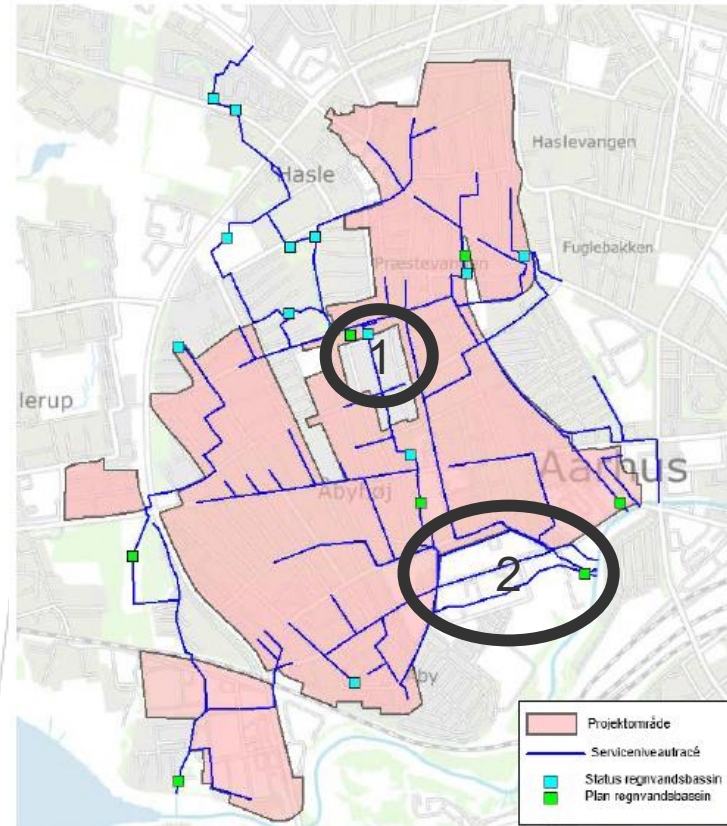
Opdatering 2021

2. december 2021

Udarbejdet til:
Aarhus Vand
Gunnar Clausens Vej 34
8260 Viby

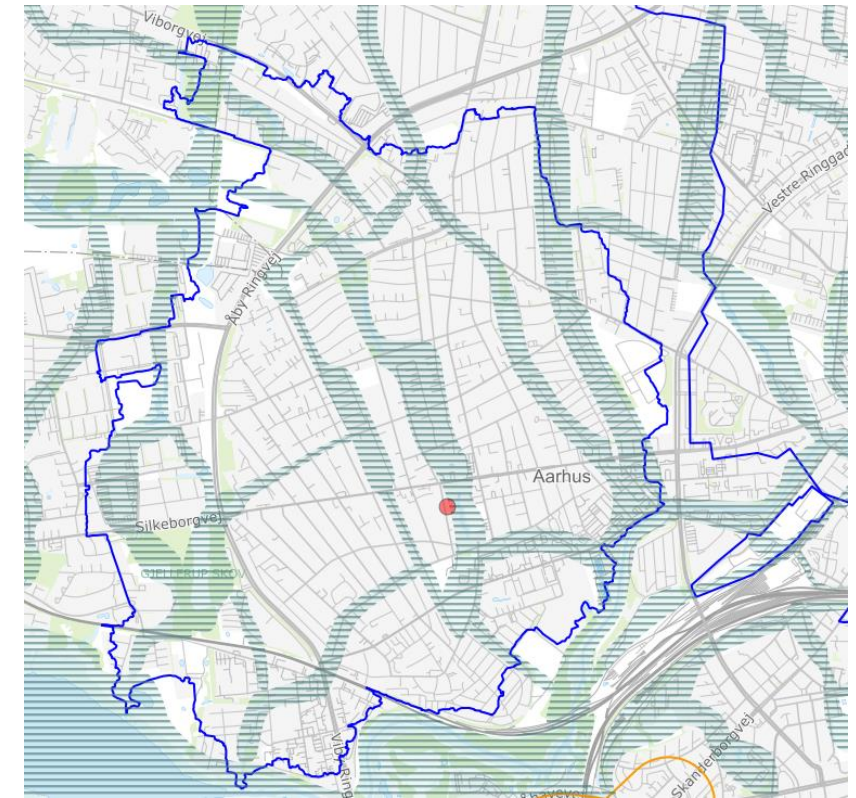
Udarbejdet af:
EnviDan A/S
Martin Hyllegaard Madsen
E-mail: mhm@envidan.dk
Direkte tlf.: 53 29 77 53
Projekt navn: Regnvandsdispositionsplan
Projektnr.: 1202469
Kvalitetssikring: Michael Møller
Side 1 af 37

EnviDan



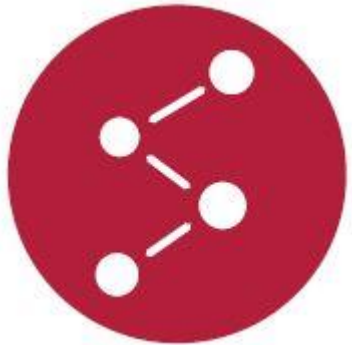
- 1) Klokkeparken
- 2) Fragtmadscentralen

Add Value + Blue/Green plan



VISION FOR ADDED VALUE

6 QUALITIES – DEFINED IN THE VISION



IMPROVE
CONNECTIONS



NEW MEETING
POINTS



GREENER
DISTRICTS



ENHANCE THE
CHARACTER/
DISTINCTIVE/
NATURE/
ATTRIBUTES
OF THE
DISTRICTS



MORE
PEACEFUL
ROAD STREETS



INVOLVE
CITIZENS



Added Value & RVD-plan

How to put Things together

RVD-PLAN



Added Value



Combined Plan

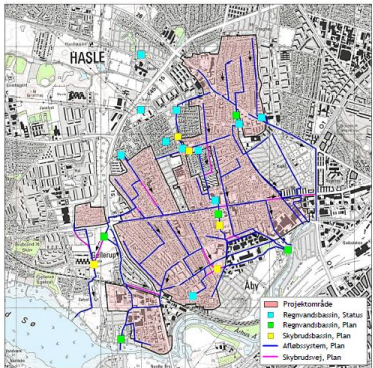
Aarhus Vand

Regnvandsdispositionsplan
Adskillelse af regnvand og spildevand i Åby,
Åbyhøj og Hasle

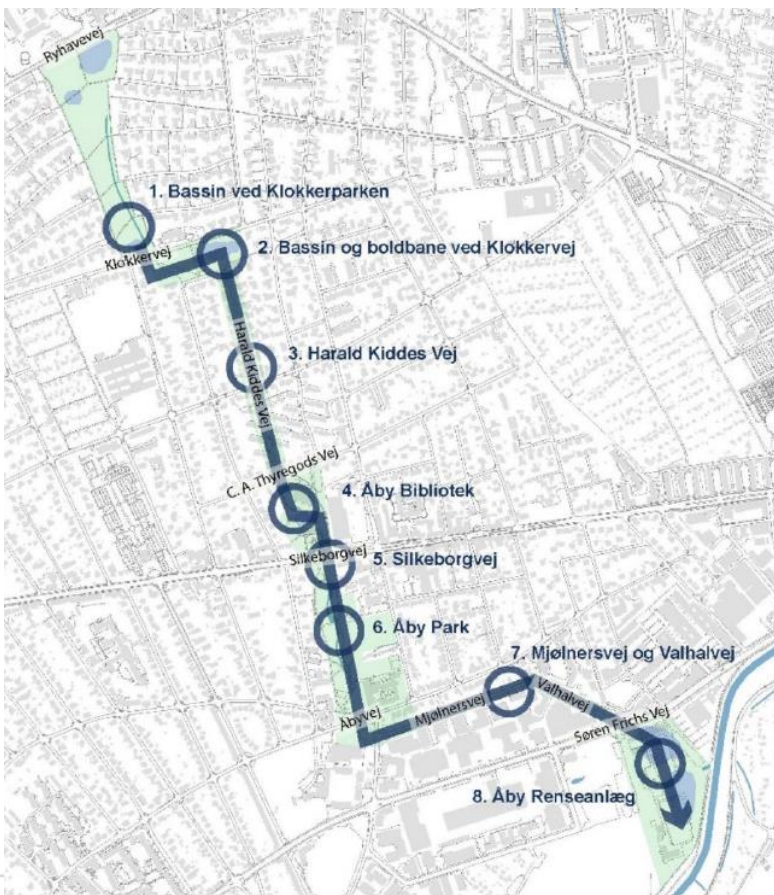
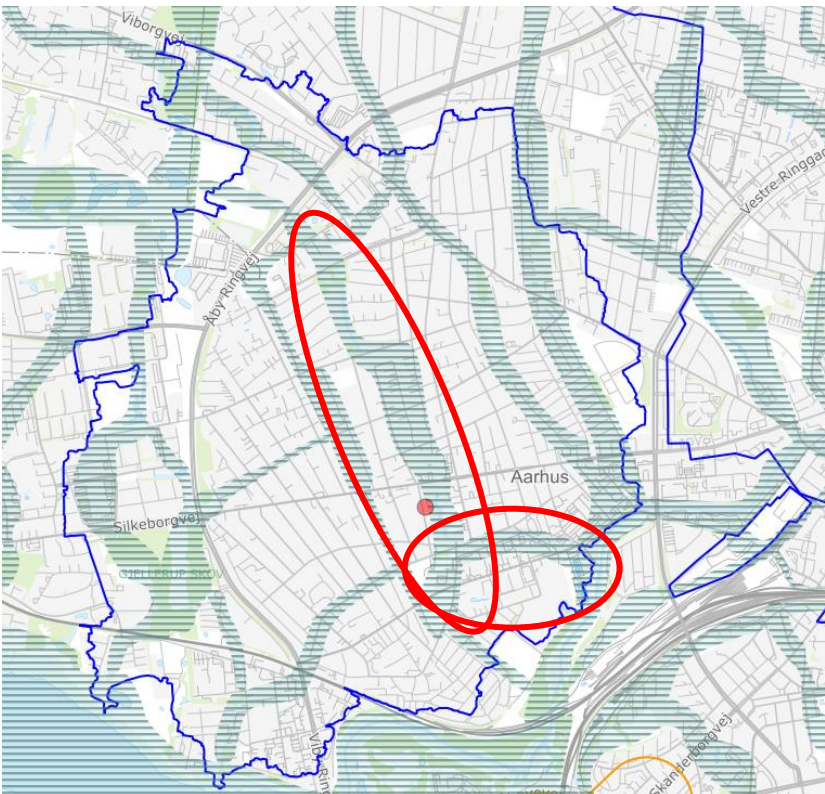
Opdatering 2021

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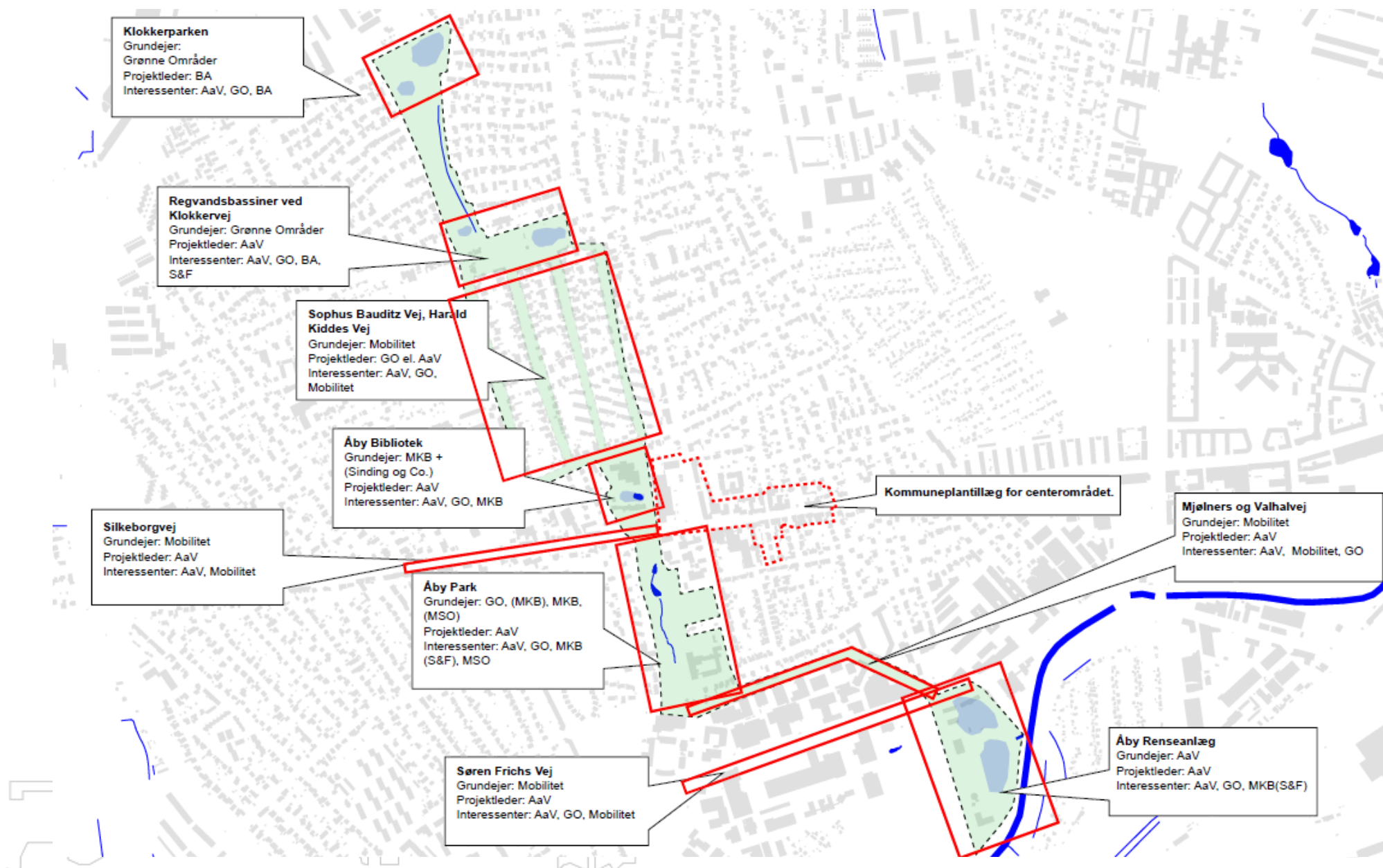
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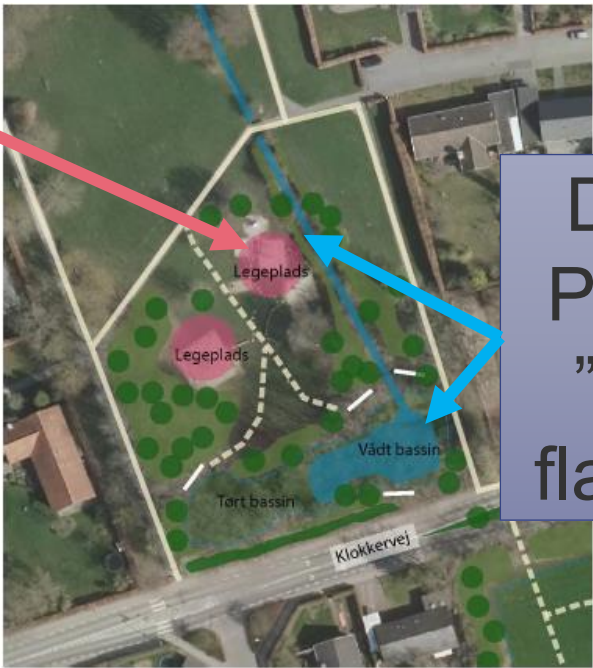


RECREATIONAL PATH – CLIMATE ADAPTATION – 9 PROJECTS



"LOCAL"-MASTER PLAN" for CLIMATE ADAPTATION & ADDED VALUE

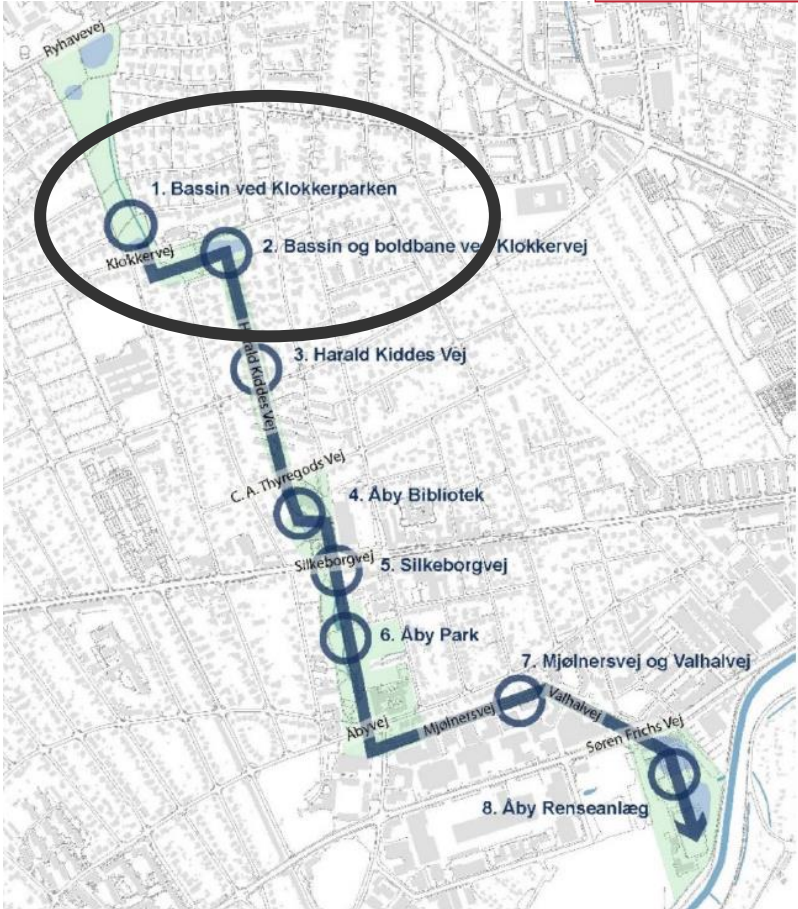
Playground & Park



28. juni 2021
Side 4 af 18

Detention Ponds and "path" for flash-floods

SIDE 3 AF 10





Den blå-grønne kile i Åbyhøj – klimatilpasning med merværdi

Notat om designmanual for kilen

Formål
Aarhus Vand er i gang med at adskille regnvand og spildevand samt klimatilpasse Åbyhøj jf. Spildevandsplanen 2017-2020 og er nu kommet til den blå-grønne kile i Åbyhøj. En række offentlige arealer, der samlet set strækker sig fra Klokkerparken mod nord til Åby Renseanlæg og Aarhus Å mod syd. Aarhus Kommune ønsker i den forbindelse at anvende klimatilpasningen i kilen som løftegang til at styrke områdets nuværende kvaliteter og skabe merværdi for borgerne i Åbyhøj.

Dette notat indeholder en række skitser og beskrivelser med principper om hvorledes hvert enkelt område skal indrettes og udlignes, når Aarhus Vand skal klimatilpasse kilen. Principperne skal sikre, at man opnår en fælles identitet for kilen med genkendelige elementer som f.eks. bænke og træer samt sikre at de kommunale interesser på arealerne tilgodeses. Notatet skal således anvendes af Aarhus Vand som rettesnor for de kommende projekter i kilen.

Baggrund
Merværdi i klimatilpasningen i Åbyhøj
Aarhus Kommune har i samarbejde med lokale aktører og borgere i Åbyhøj udsendt en vision for udpeget seks kvaliteter for merværdi. Kvaliteterne bygger videre på bydelens eksisterende kvaliteter og Åbyhøjs DNA som en grøn bydel med engagerede borgere.

Principperne for indretning og udformning af de enkelte områder i den blå-grønne kile tager udgangspunkt i visionens seks kvaliteter.

Proces
Der har forud for dette notat været afholdt en række arbejdsmeder med de forskellige kommunale interessenter, der enten som grundreger eller brugere af arealerne i den blå-grønne kile har krav eller ønsker til hvorledes kilen skal klimatilpasses og indrettes. Arbejdsmederne har haft til formål at afklare evt. konflikter og indsamle input omkring de enkelte områder, som er blevet medtaget i dette notat. Der er afslutningsvis blevet opstillet på de mange arbejdsmeder via en samlet mail med alle arbejdsmedereferaterne.

28. juni 2021
Side 1 af 18

TEKNIK OG MILJØ
Plan, Byggeri og Miljø
Aarhus Kommune

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Direkte e-mail:
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Sagsbehandler:
Karina Kracht
Sophie Langkjær Jensen



ET BÆLT MED GRØNNE RUMMELIGE OMÅDER
EN GRØNNE RUMMELIGE OMÅDER
EN GRØNNE RUMMELIGE OMÅDER
EN GRØNNE RUMMELIGE OMÅDER
EN GRØNNE RUMMELIGE OMÅDER
EN GRØNNE RUMMELIGE OMÅDER

"When we carry out drainage projects, we collaborate with residents and Aarhus Municipality to define shared ambitions for each area. As part of the projects, we also focus on creating added value to give something back to the local community. This can – as seen here in Klokkeparken – take the form of new gathering places, more pathways, green areas, and increased biodiversity."

Aarhus Vand - Utility





Den blå-grønne kile i Åbyhøj – klimatilpasning med merværdi Notat om designmanual for kilen

Formål
28. juni 2021
Side 1 af 18

Aarhus Vand er i gang med at adskille regnvand og spildevand samt klimatilpasse Åbyhøj jf. Spildevandsplanen 2017-2020 og er nu kommet til den blå-grønne kile i Åbyhøj. En række offentlige arealer, der samlet set strækker sig fra Klokkeparken mod nord til Åby Renseanlæg og Aarhus Å mod syd. Aarhus Kommune ønsker i den forbindelse at anvende klimatilpasningen i kilen som lejlighed til at styrke områdets nuværende kvaliteter og skabe merværdi for borgerne i Åbyhøj.

Dette notat indeholder en række skitser og beskrivelser med principper om hvorledes hvert enkelt område skal indrettes og udformes, når Aarhus Vand skal klimatilpasse kilen. Principperne skal sikre, at man opstår en fælles identitet for kilen med genkendelige elementer som f.eks. bæltre og træer samt sikre at de kommunale interesser på arealerne tilgodeses. Notatet skal således anvendes af Aarhus Vand som retningslinje for de kommende projekter i kilen.

Baggrund
Merværdi i klimatilpasningen i Åbyhøj
Aarhus Kommune har i samarbejde med lokale aktører og borgere i Åbyhøj udarbejdet en vision for udpeget søkvaliteter for merværdi. Kvaliteterne bygger videre på byens eksisterende kvaliteter og Åbyhøjs DNA som en grøn bydel med engagerede borgere.



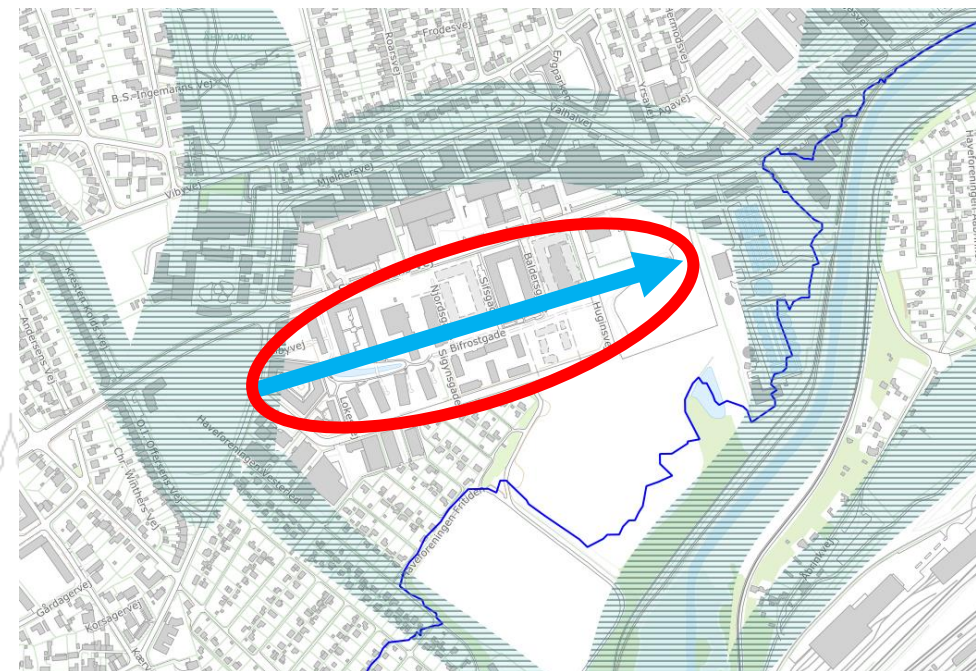
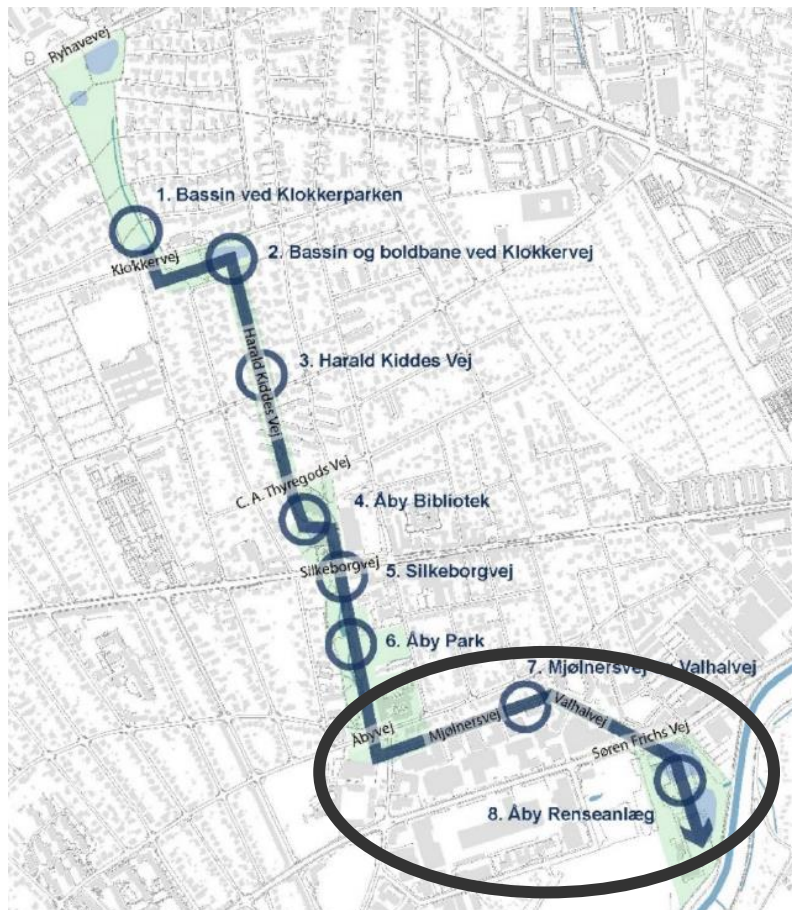
Principperne for indretning og udformning af de enkelte områder i den blå-grønne kile tager udgangspunkt i visionens seks kvaliteter:

Processen
Der har forud for dette notat været afholdt en række arbejdsmeder med de forskellige kommunale interessenter, der enten som grundejere eller brugere af arealerne i den blå-grønne kile har krav eller ønsker til hvorledes kilen skal klimatilpasse og indrettes. Arbejdsmederne har haft til formål at afdække evt. konflikter og indsamle input omkring de enkelte områder, som er blevet medtaget i dette notat. Der er afslutningsvis blevet opsumeret på de mange arbejdsmeder via en samlet mail med alle arbejdsmederreferencerne.

TEKNIK OG MILJØ
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Aarhus Kommune

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Urban Transformation ("S-scale")

Exampel of:

Climate adaptation + Greenfactor + Courtyard + Vertical development



Before



Physical planning



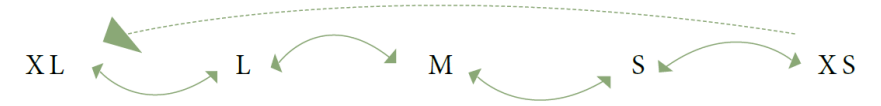
Today



Summary

Implantation of NBS

Spatial planning hierarchy



City Planning

Blue-Green planning

Place making

Urban transformation

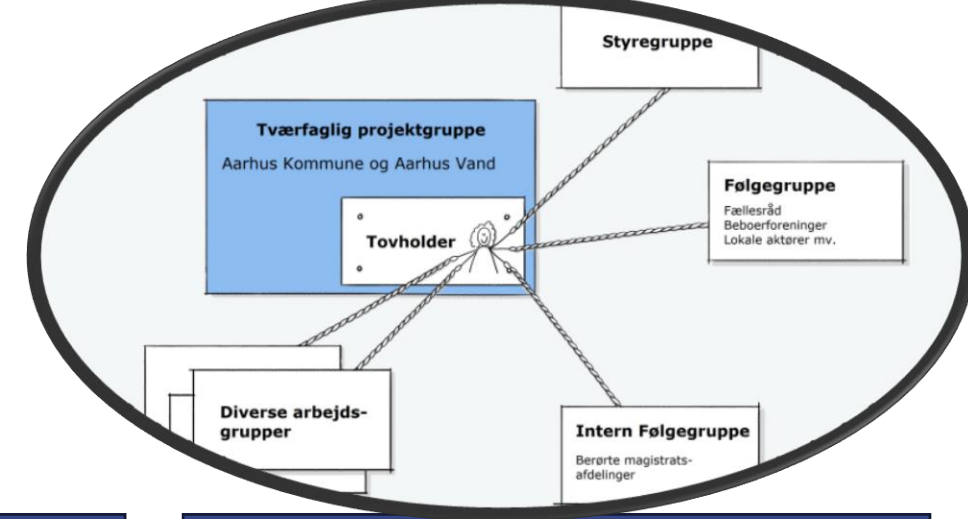
Projects

Co-creation

Place making



Summary



Legislation

Municipal plan, sector plans, etc.

Planning and Environment
“Complaint Board Decisions”

Talk home message:

It is essential to maintain a clear focus on the distribution of responsibilities.

“Water planning” is regulated by multiple pieces of legislation and is therefore legally complex. As a result, it is a “wicked problem”

— and success can only be achieved if all stakeholders contribute to a joint effort.

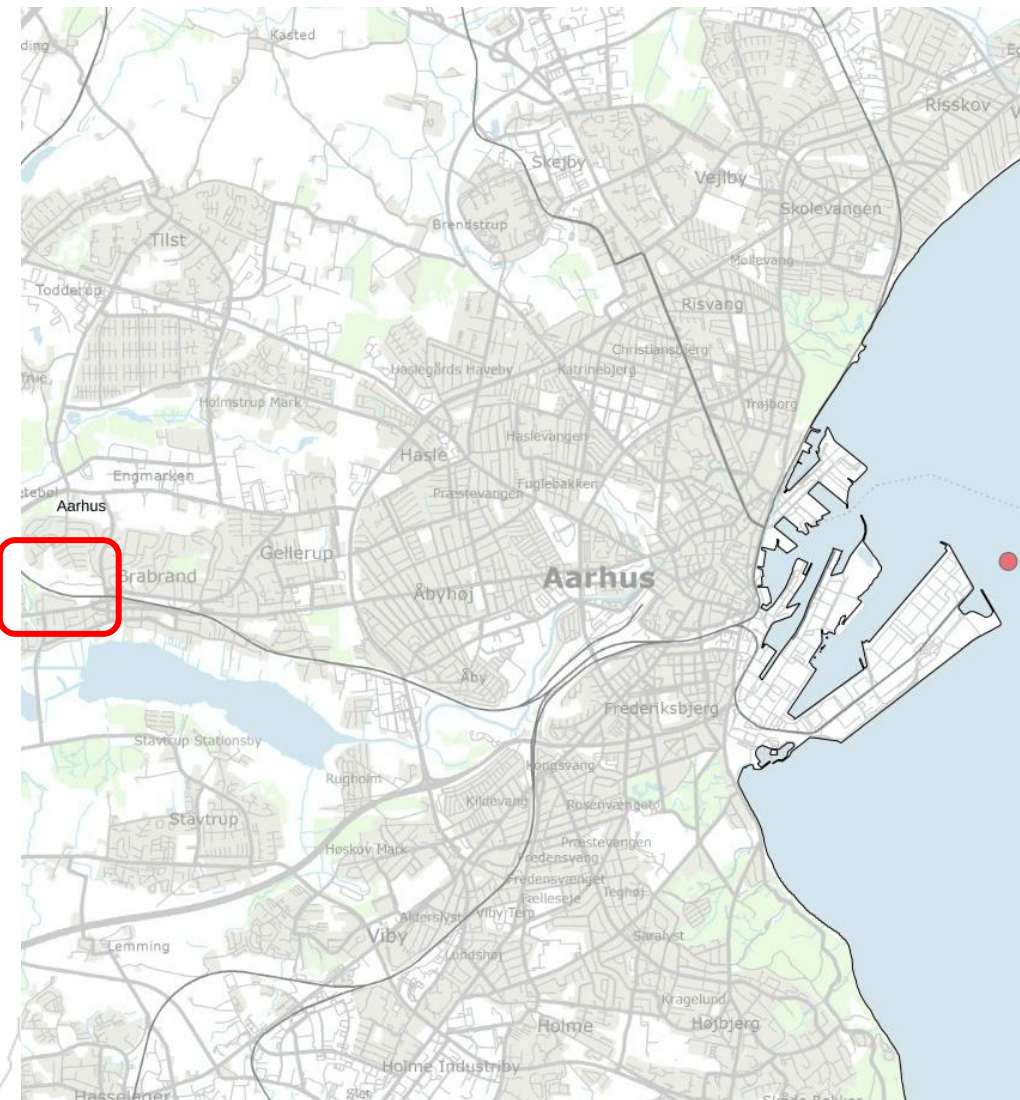


TULIP – Regnvandshåndteringsplan

Aarhus Vand & Private bygherre

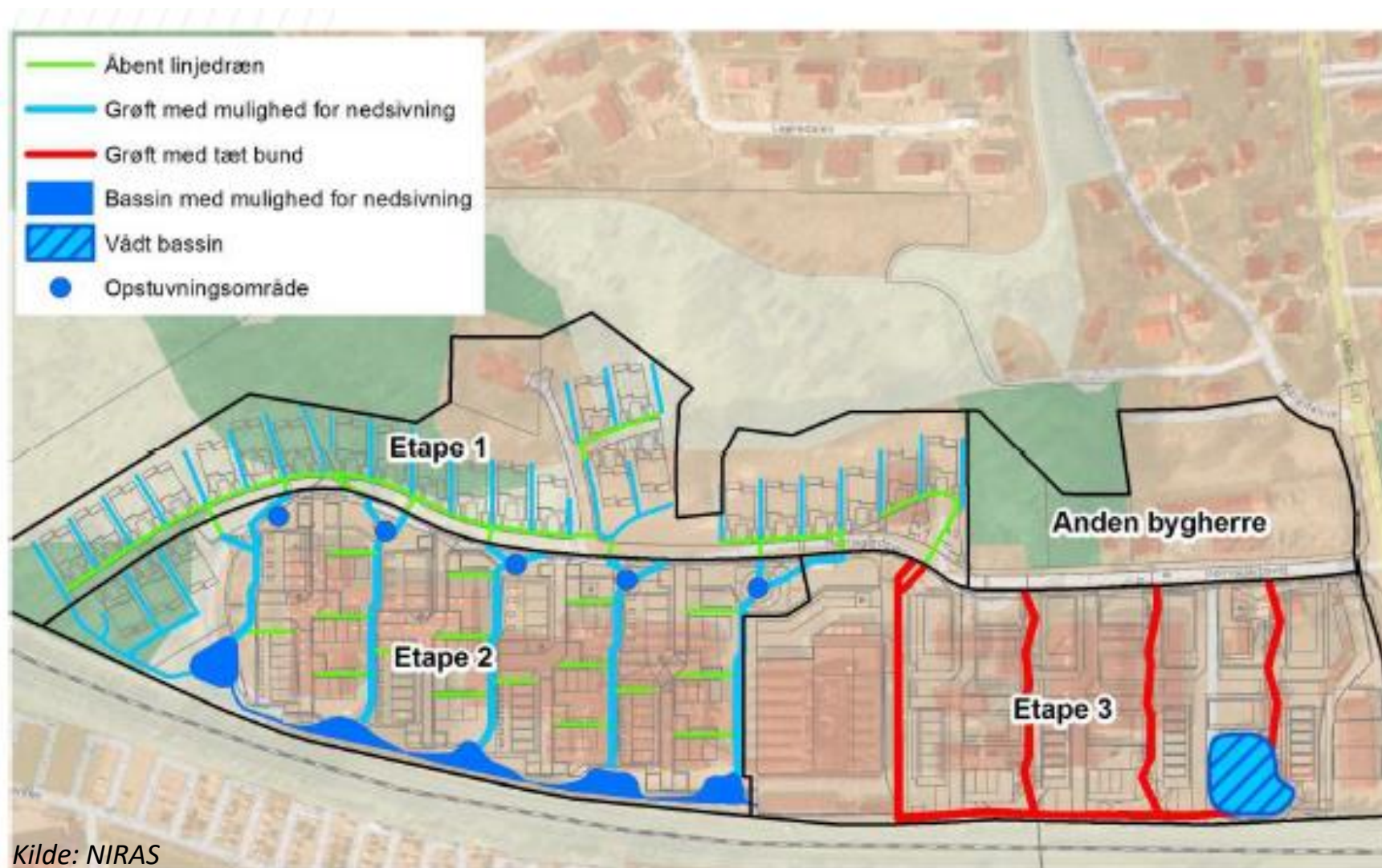


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TULIP – Regnvandshåndteringsplan

Aarhus Vand & Private bygherre

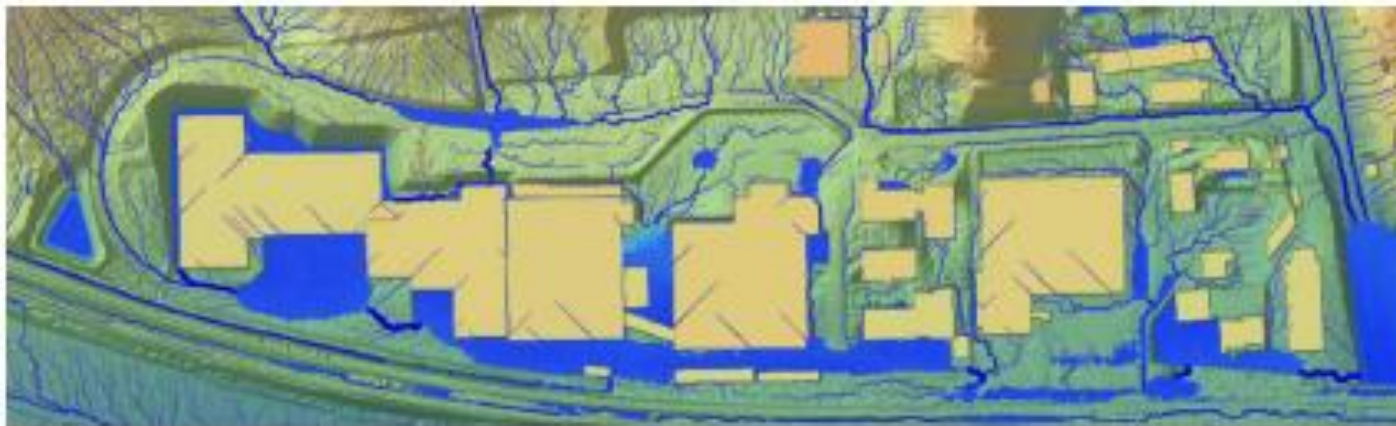


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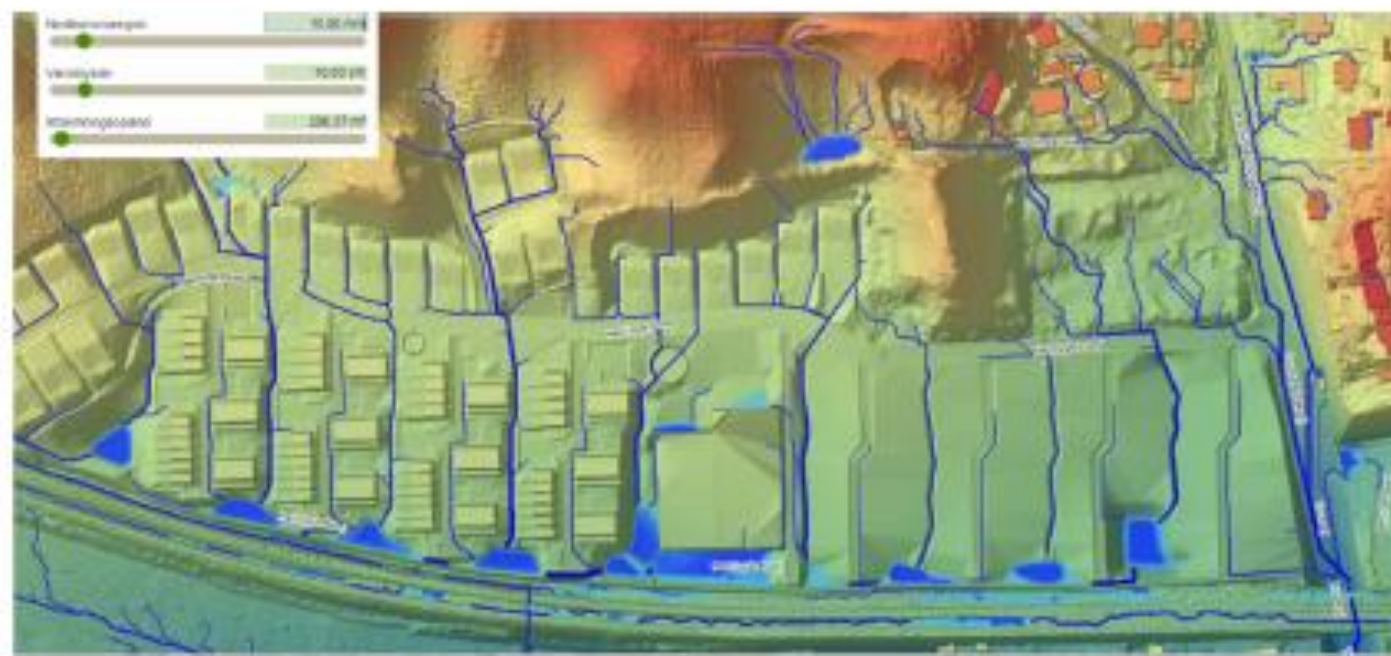
TULIP – Regnvandshåndteringsplan

Aarhus Vand & Private bygherre

*Før -
situationen*

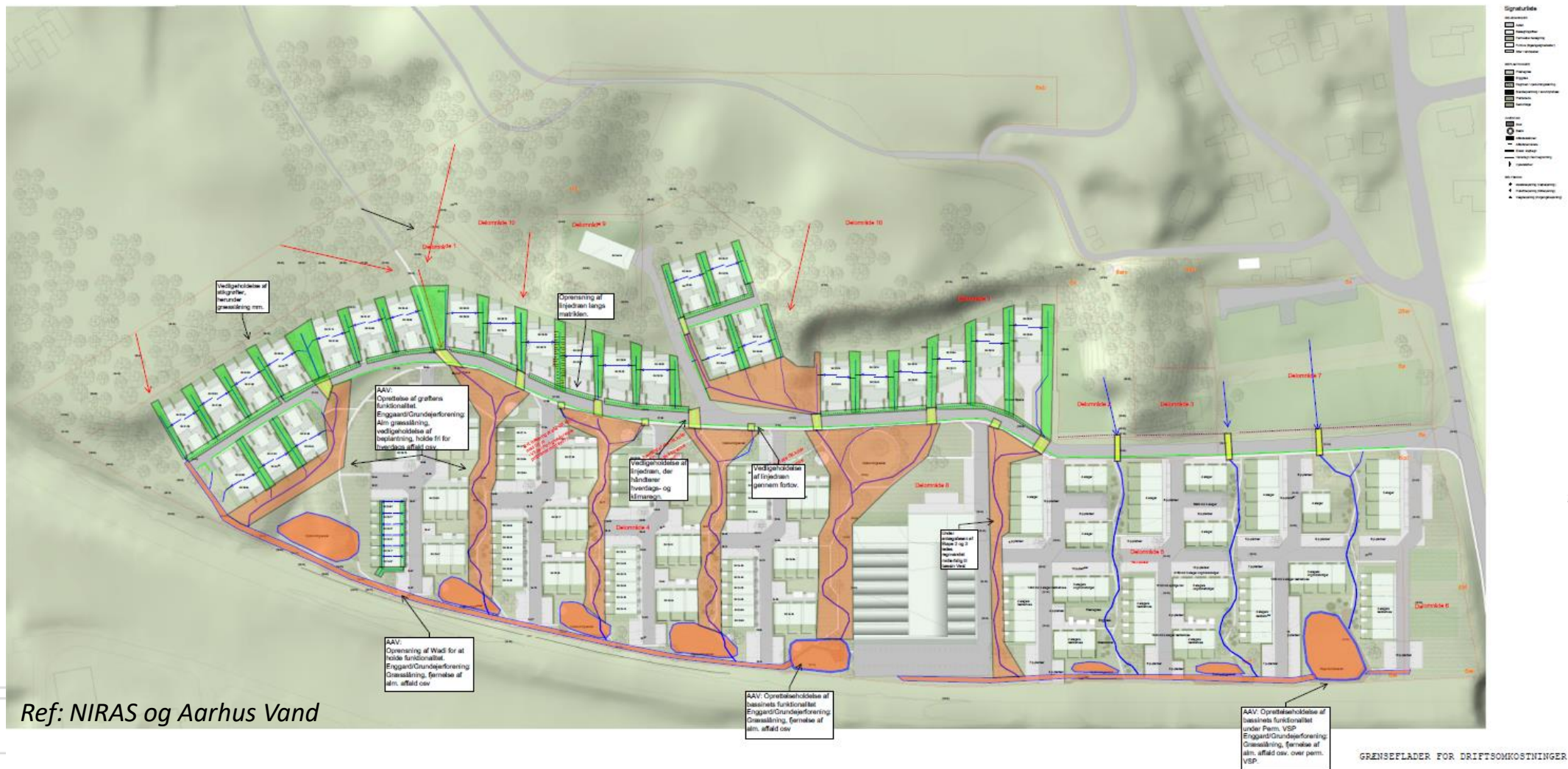


*Efter -
situationen*



Ref: NIRAS

Aarhus Vand & Private bygherre



O&M of swales/NBS

6.1 Skema med forventede frekvens af vedligehold og tilsyns opgaver

Aarhus Vand skal udføre løbende opsyn af regnvandsanlæggene, som følger:

Anlægstype	Driftspunkt	Interval	Udførelse
Overfladeløsning	Regnvandsgrøfter	Hver 52. uge	Tilsyn
Overfladeløsning	Linjedræn	Hver 52. uge	Tilsyn
Overfladeløsning	Tørre lavninger	Hver 52. uge	Tilsyn
Overfladeløsning	Filterjord	Hver 10 år. Årstal?	Prøvetagning, analyse og orientering af Aarhus Kommune. Evt. udskiftning af filterjord ved overskridelse af kriterier.
Tekniske anlæg	Åbne sandfang	Hver 4-6 måned	Tilsyn og tømning med slamsuger
Tekniske anlæg	Sandfangsbrønde	Hver 4-6 måned	Tilsyn og tømning med slamsuger
Tekniske anlæg	Ind- og udløb	Hver 4-6 måned	Tilsyn
Tekniske anlæg	Reguleringsbrønde	Hver 12. uge	Tilsyn
Vådt bassin	Sediment i sandfangsbygværk	Hver. 24. uge	Tilsyn og evt. tømning med grab
Vådt bassin	Sediment i hovedbassin	Min. hvert 5. år	Tilsyn og evt. oprensning af bassin
Overfladeløsning	Adgangsveje i gartnermakadam	Hver 52. uge.	Tilsyn



LEGENDE
- Sted
- Grøfter
- Linjedræn
- Regnvandsbassin
- Sandfangsbrønde
- Filterjord

AAV Byggemodning 8200526_LP1029, H Tulipgrunden, Brabrand
Anlægsbeskrivelse – Overfladeløsninger, linjedræn bassiner
Aarhus Vand A/S

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3.1.1 Service

Aarhus Vand har ansvar for service på følgende elementer:

- Sandfangsbrønde – tilsyn og tømning
- Sandfangsbrønde med kuppelrist og dræn – tilsyn og tømning
- Åbne sandfang – tilsyn og tømning
- Reguleringsbrønde
- Ledninger og brønde
- Drænligninger og prøvetagningsbrønde til monitoringsprogram (udviklingsprojekt) – tilsyn og tømning
- Filterjord i grøfter og tørre lavninger/forsinkelses- og nedslivningsbassiner – prøvetagning og udskiftning

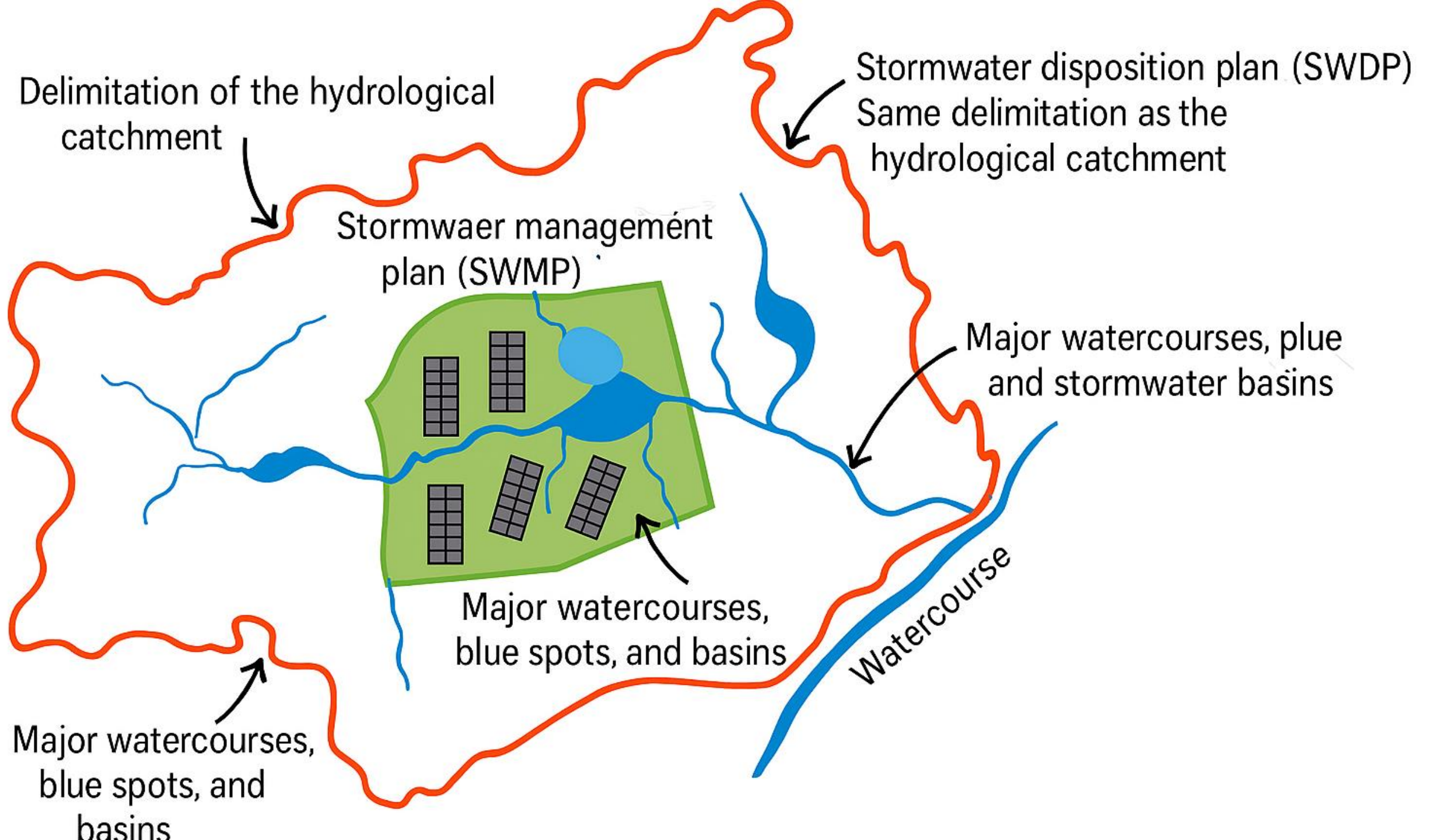
3.1.2 Drift (Overvågning/sikring af funktion)

Aarhus Vand har ansvar for overvågning/sikring af funktion for følgende elementer:

- Grøfter:
 - o Ind- og udløb
 - o Stentræpper
 - o Vegetation og erosion
- Linjedræn
- Tørre lavninger/forsinkelses- og nedslivningsbassiner
 - o Ind- og udløb
 - o Stensætninger
 - o Vegetation og erosion
- Vådt regnvandsbassin
 - o Ind- og udløb
 - o Vegetation og erosion
- Adgangsveje til hhv. vådt regnvandsbassin og tørre lavninger/forsinkelses- og nedslivningsbassiner

3.2 Grundejerforening

Regnvandslauget (identisk med grundejerforeningen) har følgende ansvarsområder, jf. "Deklaration om regnvandslaug og forbud mod pesticider":



REVISION OF THE MUNICIPAL PLAN

GUIDELINES

Identification of areas that may be exposed to erosion or flooding.

Guidelines on mitigation measures against flooding and erosion in the planning of urban development, etc.

FRAMEWORK

SHALL

It must be stated whether existing and new frameworks lie wholly or partly within a designated area.

SHALL

When preparing a local plan in a designated area, it must be assessed whether the associated framework should be supplemented with a description of the handling of mitigation

STATEMENT/ EXPLANATORY REPORT

SHALL

Account for the basis for designating areas in the mapping.

SHALL

Preconditions for requirements regarding the establishment of mitigation measures.

SHALL

Account for coherence with adjacent municipalities.

PROJECT

No requirements for establishing mitigation measures shall be incorporated into the local plan.

LOCAL PLANNING FOLLOWING THE MUNICIPAL PLAN DESIGNATING AREAS FOR FLOODING AND EROSION

NO

Is the local plan for urban development, specific technical installations, changed land use, etc.?

JA

Does the framework contain a description of the mitigation measures?

NO

YES

Municipal decisions

1. Are mitigation measures needed for this area?
 - If no, a standard local plan process is followed.
 - If yes, the following question shall be addressed.

Are mitigation measures needed for this area?

- If no, a standard local plan process is followed.

Framework provisions incorporated into the local plan as local plan provisions.