Welfare economic & social impacts of nature-restoration – the case of Aarhus River Valley Water & Nature Park

Blue City Conference, Aarhus

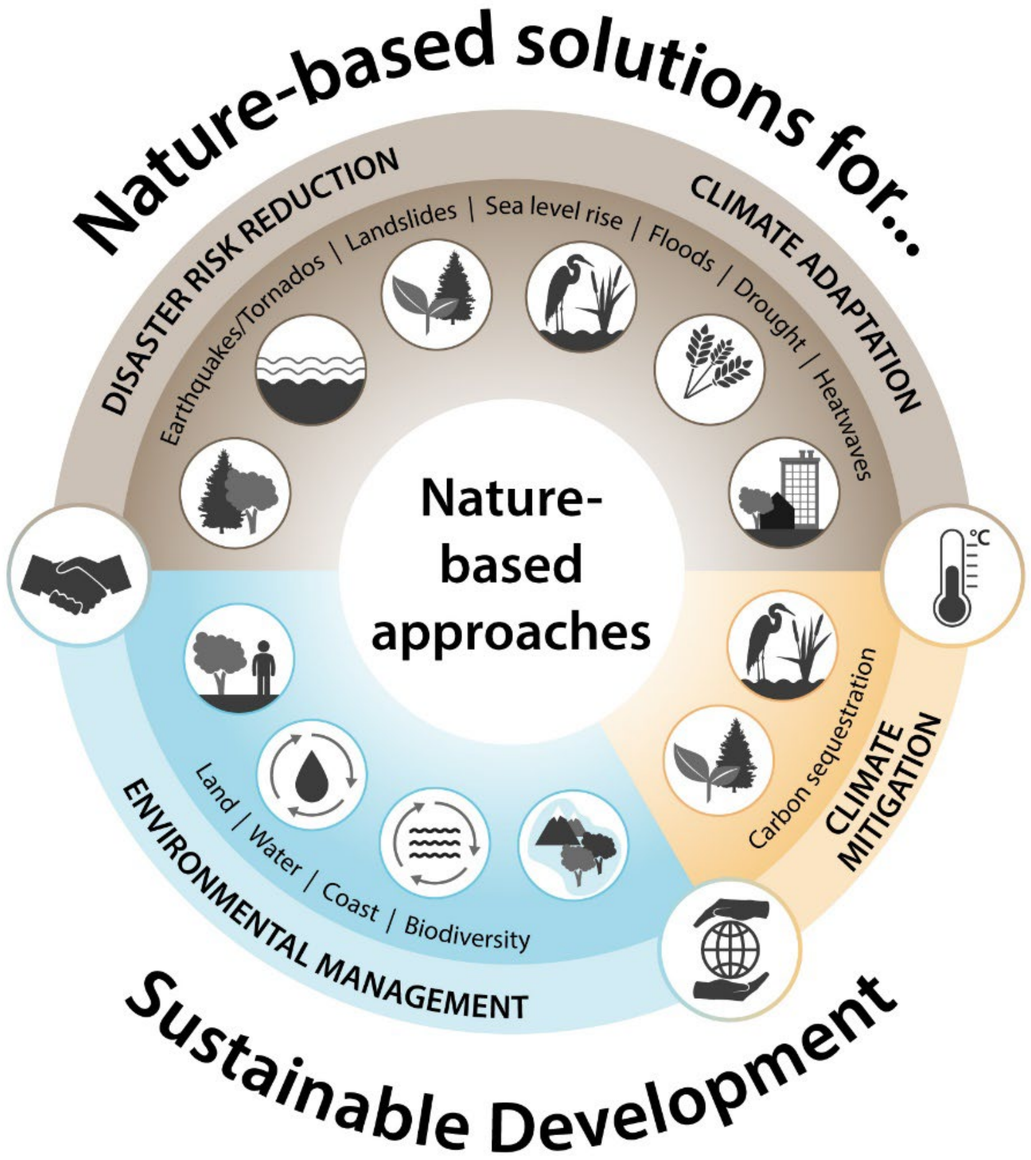
26. September 2025

Marianne Zandersen
Professor
Department of Environmental Science
Aarhus University

invest4nature
Funded by the European Union
iCLIMATE
AARHUS UNIVERSITY INTERDISCIPLINARY CENTRE FOR CLIMATE CHANGE
AARHUS UNIVERSITY

Nature-based solutions

Actions to **protect**, **conserve**, **restore**, **sustainably use** and **manage** natural or modified terrestrial, freshwater, coastal and marine ecosystems which address **social**, **economic** and **environmental** challenges effectively and adaptively, while simultaneously providing **human well-being**, **ecosystem services**, **resilience** and **biodiversity benefits** [UNEA, 2022]





Economic benefits of Nature-based Solutions…

What are they?
Who benefits?

NbS Benefits – from an economic perspective…

Direct economic benefits

Indirect economic benefits – knock-on effects

Cost savings & welfare economic benefits

Insurance-based and disaster related gains



Direct economic gains

Revenue generation

Government

- Improved tax-basis from more robust businesses, and increased property values.

Private sector

- Immediate/short term increase in **turnover** (e.g. tourism).
- Long-term **resilience of resource base** sustains future revenue streams (e.g. forestry, agriculture, fisheries, soil, hydrology).

Households

- Increased **job opportunities**, stable job possibilities.
- Supports **stable food prices** and production of **high-quality food**.

Direct economic gains

Property value generation

Government

- Immediate one-time increase in public property value.

Private sector

- Immediate one-time increase in private sector **property value**.
- **Price premiums** for developments close to green areas.

Households

- Immediate one-time increase in home-owner property value.

Direct economic gains

Job creation

Government

- **Additional job** creation opportunities.
- **Inclusion** for people who are typically excluded from the labour market.

Private sector

- **Nature-based Enterprise (NbE)** growth and job creation, requiring both specialised and low-skilled people.

Households

- **New opportunities for jobs**, also for those outside the labour market.

Cost savings & welfare economic gains

Recreation & amenity values

Government

- Improves **liveability** locally/regionally, increasing **wellbeing and attractiveness of a region or local area.**

Private sector

- Improves branding & increased **customer loyalty** and market shares.
- - Improves the **attractiveness** of **workplaces** and retention capacity of employees.

Households

- Enhances opportunities for **recreation** and improved **amenity** values.

Cost savings & welfare economic gains

Pollution prevention & high environmental quality

Government

- **Reduced pollution**.
- Cost savings to maintain **regulatory requirements** of environmental quality.
- **High quality environment** through ecosystem restoration.

Private sector

- Reduced **water treatment** costs in production.
- Reduced **storm water** utility charges.
- Reduced costs to **environmental treatment.**
- Reduced costs for **office cooling**.

Households

- Improved **surface water** quality, **drinking water** quality, **air** quality, urban **heat** and **social** connections.
- Reduced **cooling** costs at home.
- Reduced costs of **water utility** bills.

Cost savings & welfare economic gains

Improved physical & environmental health

Government

- Optimised **grey infrastructure**
- Reduced long-term **fiscal burden**
- Reduced risks to **infrastructure** & **economic assets**
- Resilience of ecosystems maintaining **ecosystem services**

Private sector

- Reduces **sick leave** rates.
- Maintains or improves **employee productivity**.
- **Lower absenteeism** due to improved work environments.
- Increases **resilience** in the workforce.

Households

- Reduced **mental and physical illness** & costs.
- Secured **salary** levels & **social inclusion**.
- **Children's cognitive development** & learning benefits.
- Reduced **local crime** rates.

Insurance-based & disaster related gains

Government

- Optimised **grey infrastructure**
- Reduced long-term **fiscal burden**
- Reduced risks to **infrastructure** & **economic assets**
- Resilience of ecosystems maintaining **ecosystem services**

Private sector

- Resilience towards risks of **production failure**, **supply chain disruption, resource scarcity**
- Reduced risks on **private infrastructure**
- Lower **insurance premiums**
- Lower **claim payouts** & maintained **insurability**

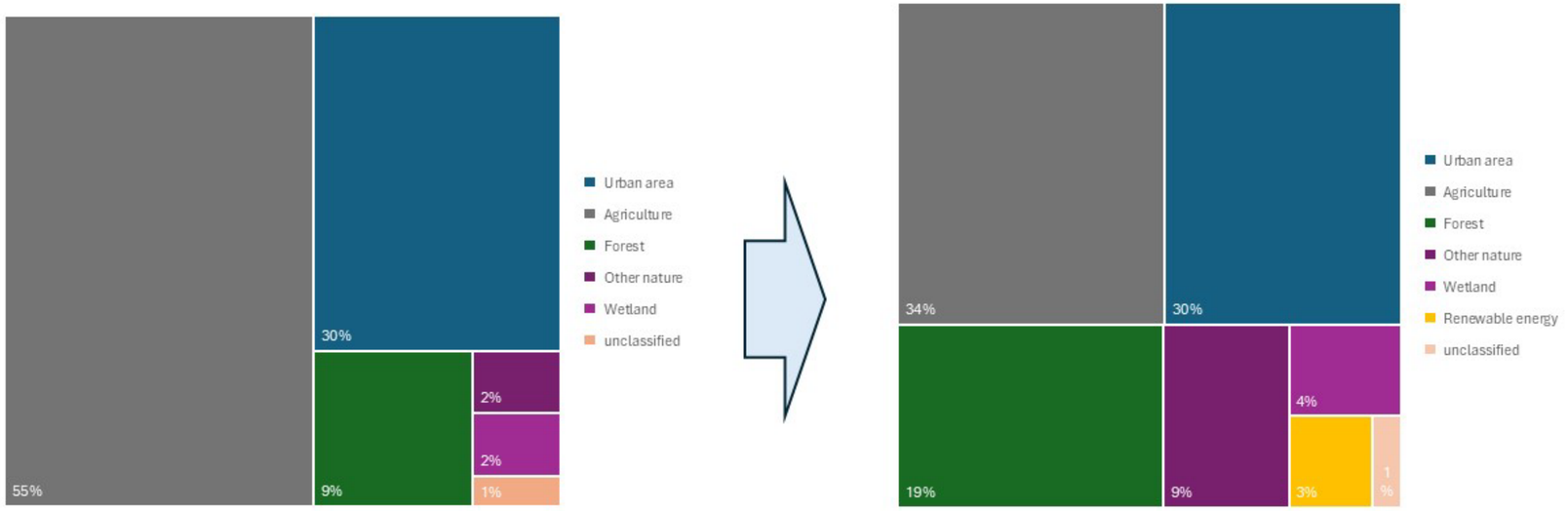
Households

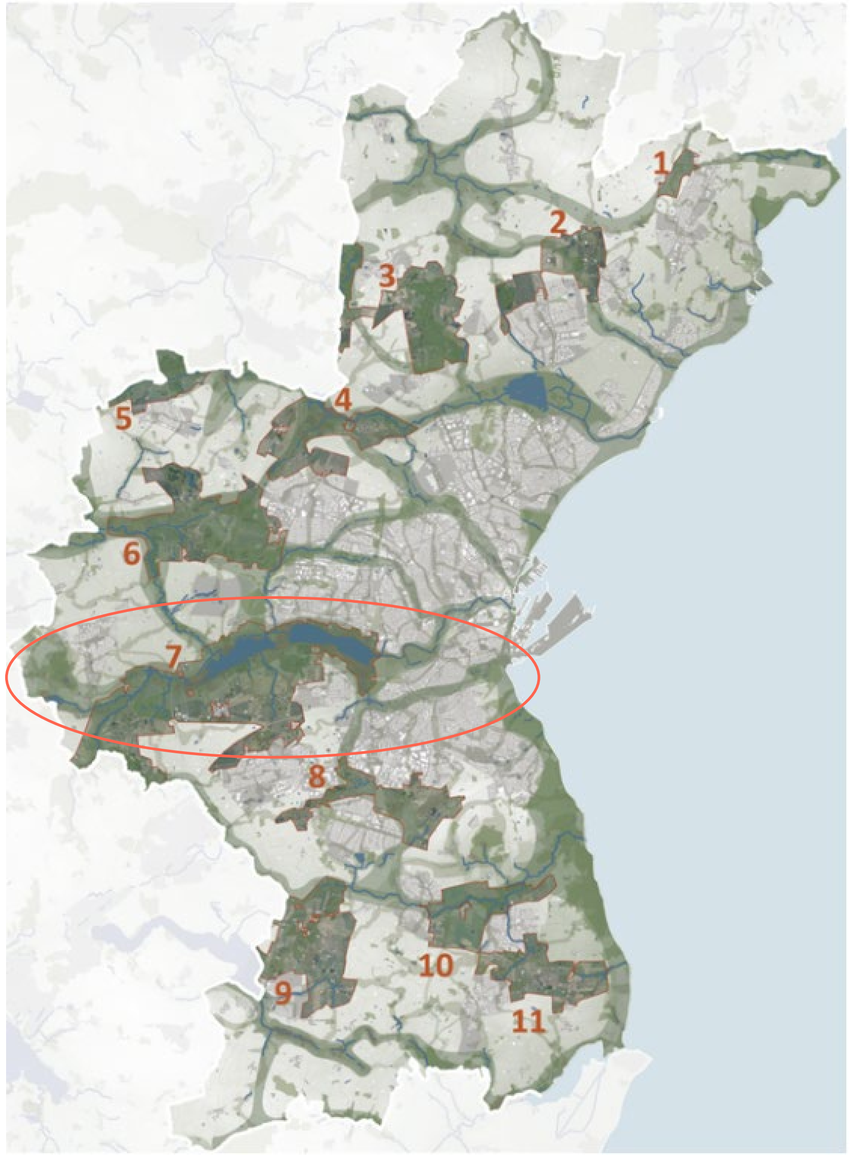
- Avoided **home-damages**
- Lower **insurance premiums**
- Avoided **health-related sickness & stress**



Economic assessment of large-scale nature restoration
- the case of Aarhus River Valley Water & Nature Park

Rebalancing landscapes – Aarhus





Large-scale NbS

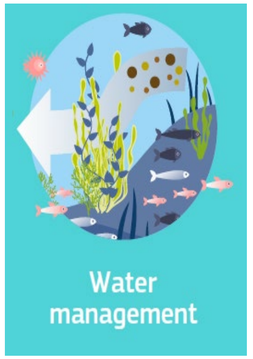
Total area: 2,368 ha

Renaturation of 1,076 ha agricultural land



NbS actions: afforestation, restoration of natural hydrology, protection and restoration of blue infrastructure; extensive grazing.

Insurance values of nature at play









Protect groundwater resources -> protection OF nature

Improve biodiversity -> protection OF Nature

Improve surface water -> protection OF nature

Sequester carbon -> Protection BY Nature

Retain & slow water flows -> Protection BY Nature

Enhance recreational opportunities -> Social resilience

Benefit assessment

- ✓ Market-based assessment (costs, carbon sequestration)
- ✓ Travel cost functional value transfer (recreation)
- ✓ Hedonic pricing functional value transfer (amenity value)
- ✓ Meta-analytical functional value transfer (surface water)
- ✓ Point-value benefit transfer (groundwater)

Cost assessment

- ✓ **Capital costs** – acquiring land, preparing soils, livestock fencing, planting and fencing of trees/bushes, restoration of streams, creation of ponds, cut drainage, gravel path establishment, gravel parking area, adjustments, biodiversity elements

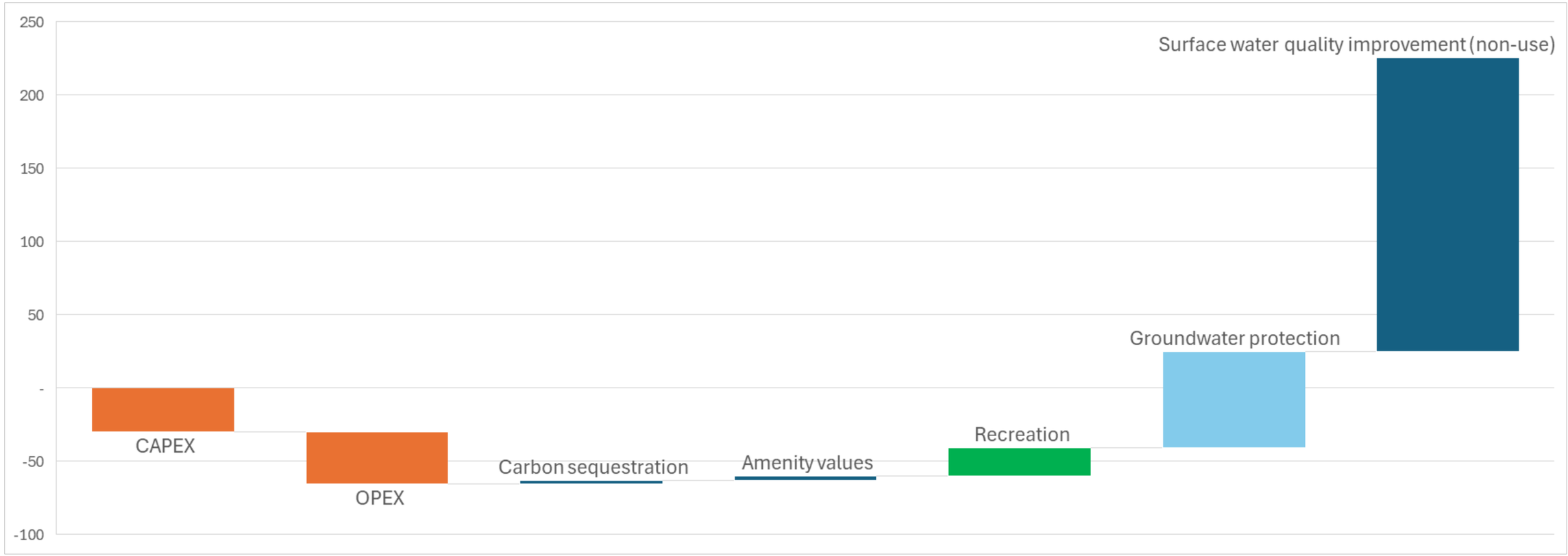
- ✓ **Operational costs** – 3-yr forest maintenance, regular maintenance of infrastructure, fundraising, planning & design, project management, citizens involvement, monitoring, opportunity costs

Benefit value results

	Benefit (eur/ yr)	Present values (eur)*
Surface water quality	10,235,959	197,751,621
Amenity value (one-off)	3,415,388	3,332,086
Drinking water quality	2,412,964	65,381,084
Recreation	966,463	18,671,401
Carbon sequestration (annualised)	81,572	2,210,266

*Present values over 50 years, 2.5% discount rate

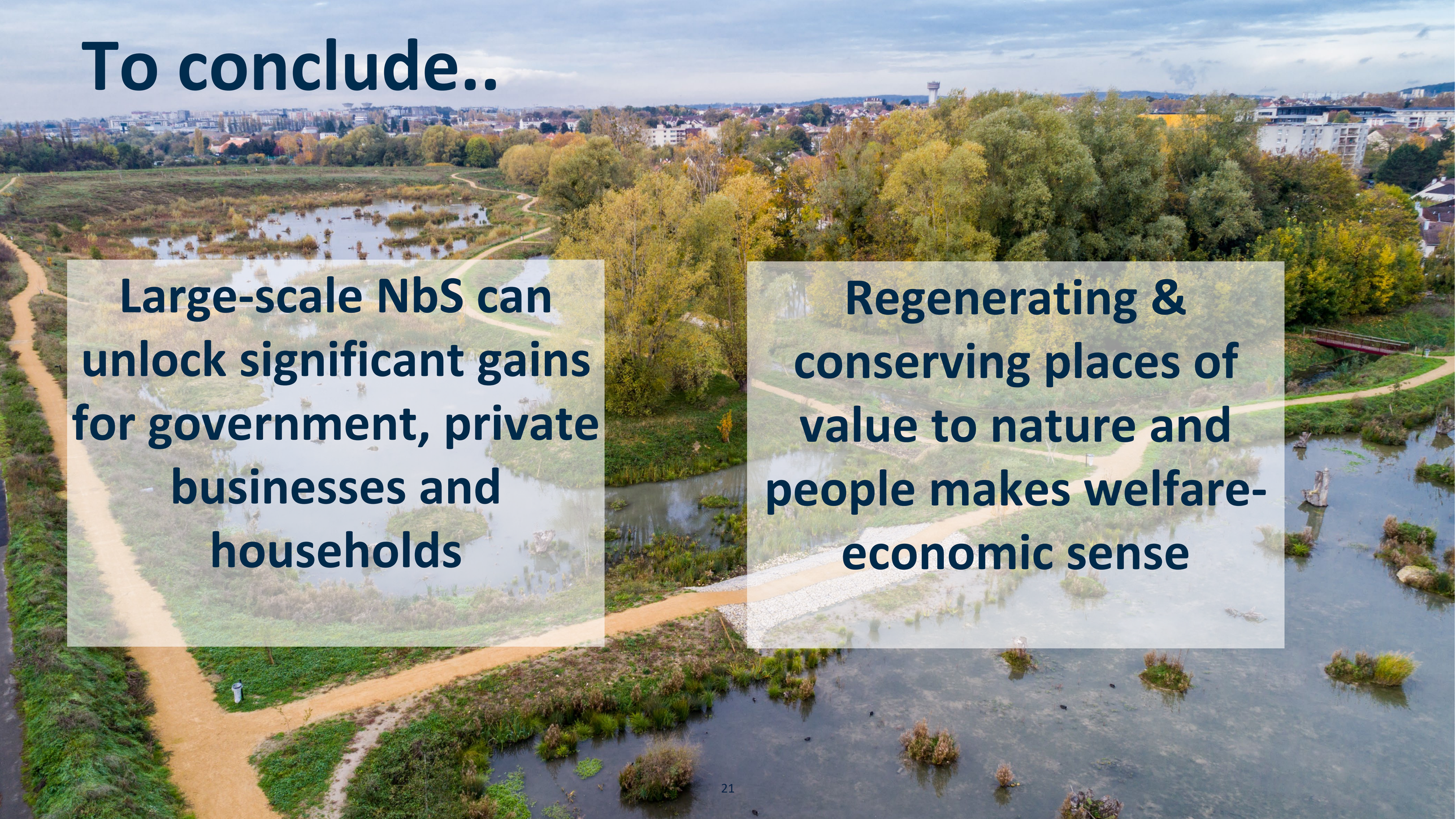
Cost-benefit analysis results



Present values in mio. eur (2024) | 50 year period | 2.5% discount rate

Cost benefit ratio: 4.4 | Society gains 224.8 mio. eur over 50 years

To conclude..



Large-scale NbS can unlock significant gains for government, private businesses and households

Regenerating & conserving places of value to nature and people makes welfare-economic sense

Acknowledgements:
Aarhus Municipality – Lone Nørgaard Telling, Peter Søgaard & more
Aarhus Water Utility Company – Bo Vægter, Niels Claes
Klima-Skov Fonden



Thank you for your attention

https://invest4nature.eu/

Source (coming soon): Zandersen, M., Nørgaard Telling, L., Panduro, T. E., & Levin, G. Welfare-economic assessment of nature restoration of agricultural land in Aarhus, Denmark. Invest4Nature Case study documentation. Invest4Nature. Horizon Europe Grant No. 101061083. https://doi.org/10.5281/zenodo.17158510

INSIGHT TO WHEN AND WHY NBS FAIL

Prof. Ivar Annus

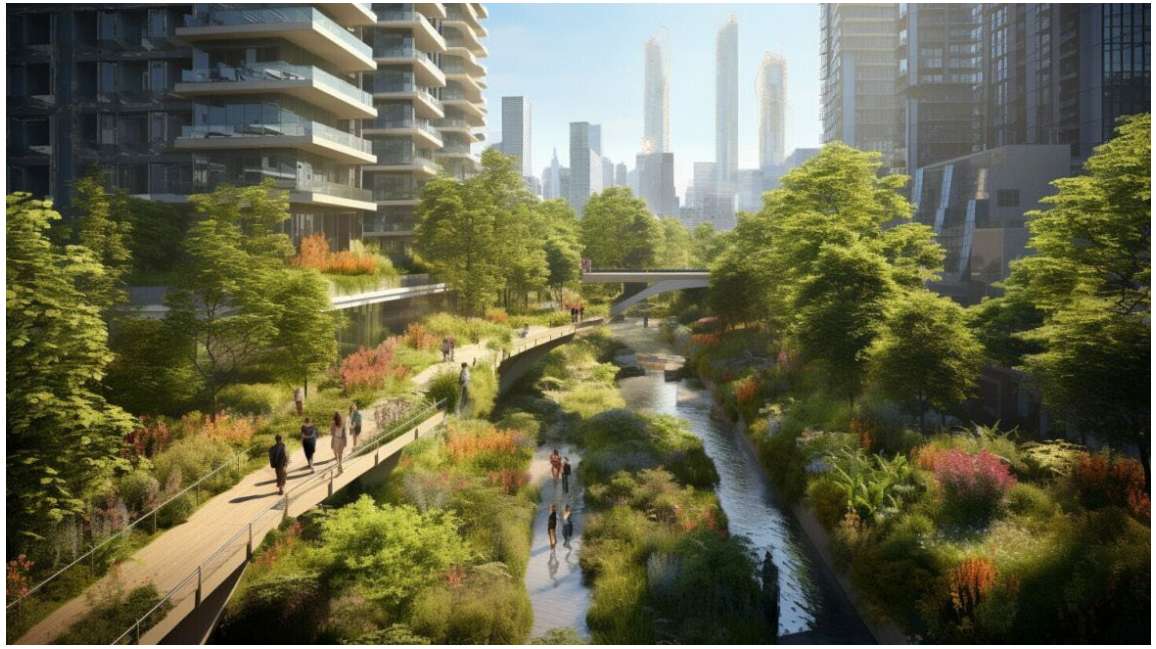
K. Kaur, N. Caradot, P. Schütz, A. K. M. Tarigan, C. Tosa, M. Truu

URBAN WATER SYSTEMS

Interreg Baltic Sea Region
Co-funded by the European Union
SUSTAINABLE WATERS City Blues

IS THERE A CHANCE FOR NBS TO FAIL?

- Nature-based solutions (NBSs), which can be **defined as actions or interventions** carried out to protect, manage and enhance the resilience of natural and modified ecosystems, **are often presented as cure-all multifunctional, no-regret mitigation measures** that are capable of addressing risks such as **floods, droughts, water quality, biodiversity, citizen well-being and more**.



https://constructive-voices.com/how-to-deliver-urban-nature-based-solutions/

HOW DO WE DEFINE AND MEASURE FAILURE?

- **Pipe based systems**
  - Monofunctional
  - Available design standards
  - Failure can be measured
  - If $Q > Q_{max}$
  - If $H > D$

- **Nature based systems**
  - Multifunctional
  - Design guidelines scattered
  - Failure of some functions can be measured
  - What are the proper KPI-s for primary and secondary objectives?



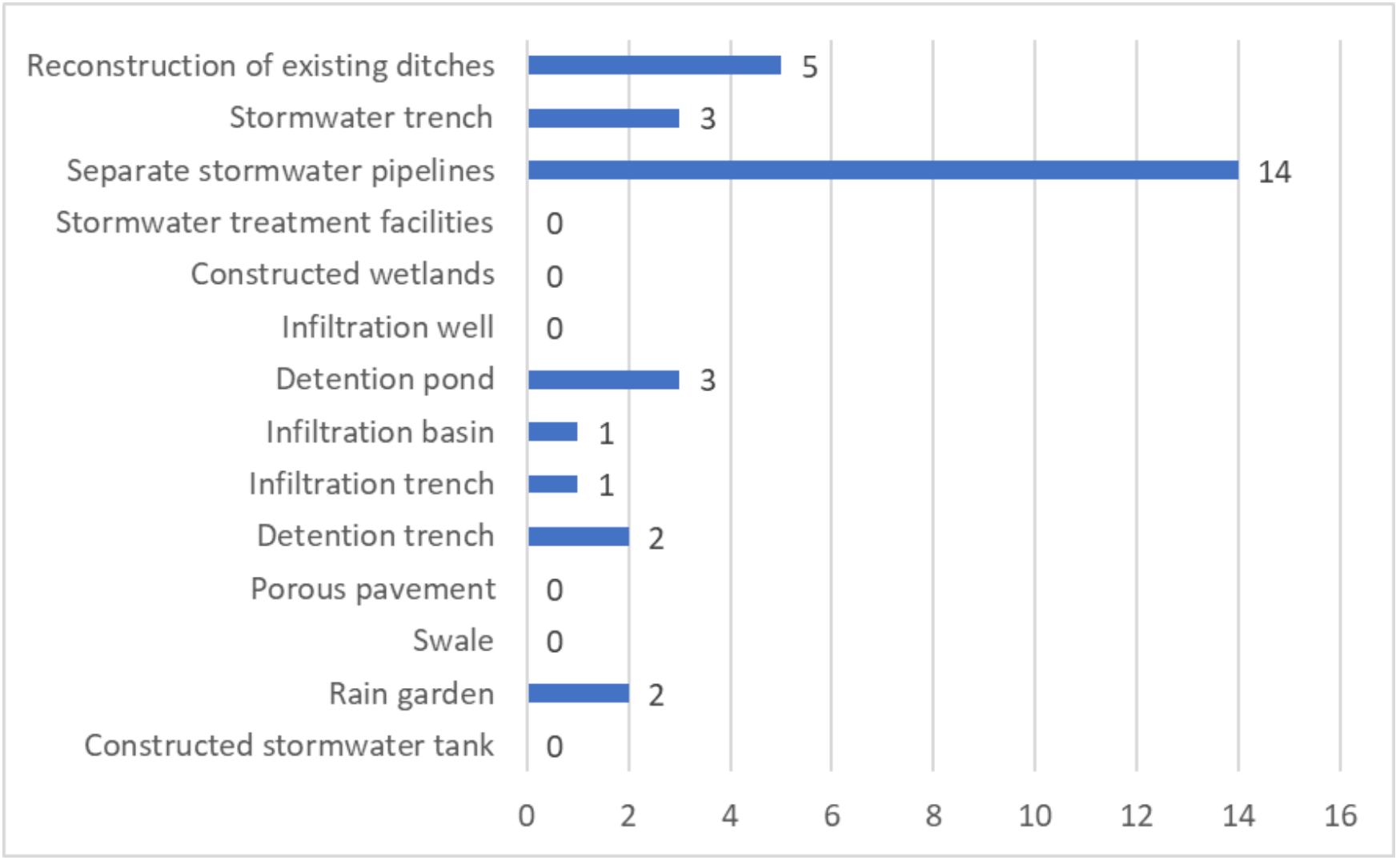
Photo: Martins Plume





Prof. Godecke Blecken Lulea University of Technology

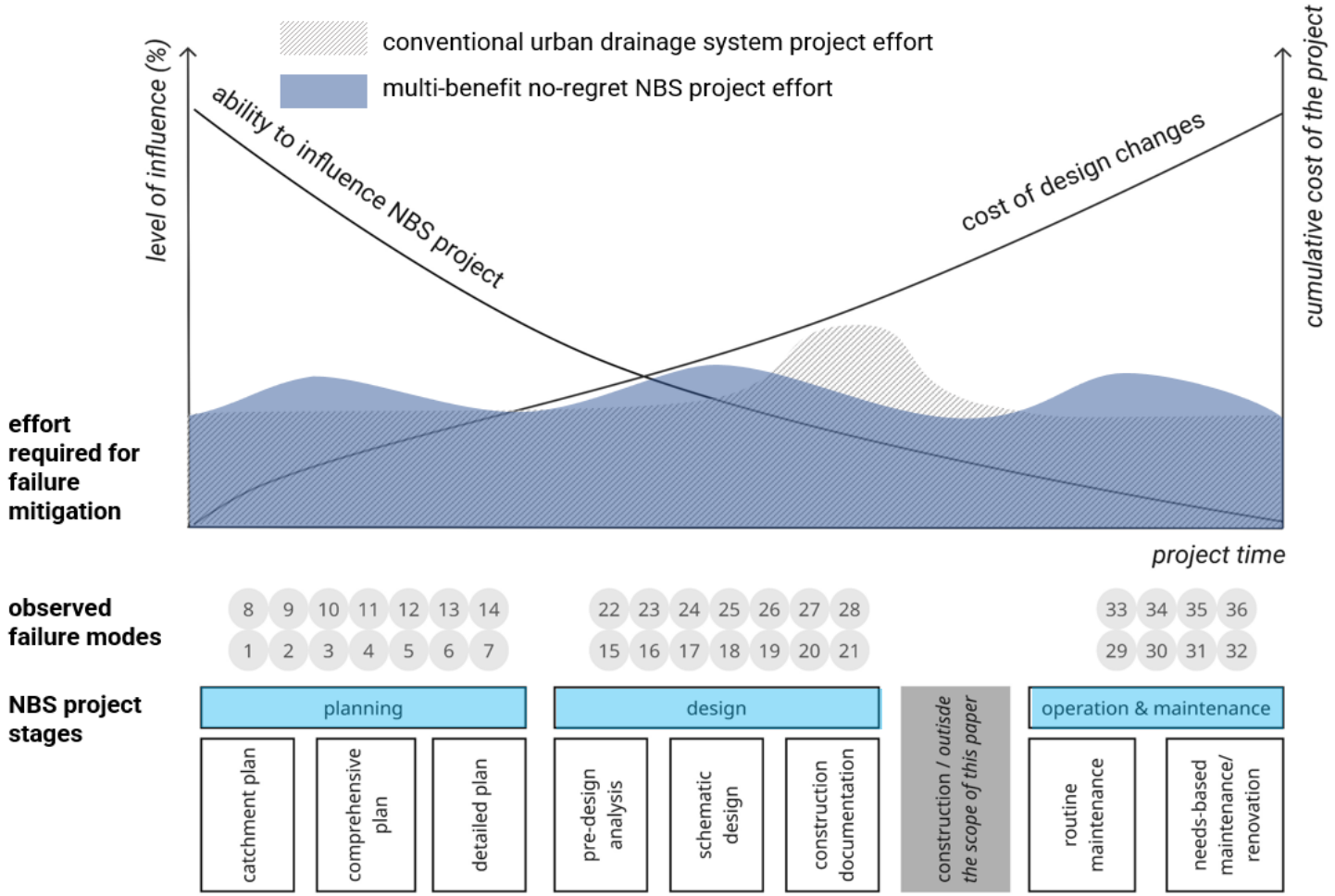
HOW SENSITIVE WE ARE TO FAILURE? INCENTIVE FOR SUSTAINABLE STORMWATER MANAGEMENT IN ESTONIA



TAL TECH

METHODOLOGY

- PRISMA methodology for systematic literature review



TYPES OF POTENTIAL FAILURES

- **System reliability perspective:**
  - **Intrinsic failures** such as flawed design assumptions, inadequate material choices, or under-dimensioned soil volumes.
  - **Extrinsic failures** occur due to external pressures, including unexpected climate variability, urban densification, or pollution inputs that exceed the intended performance envelope.
  - **Induced failures** result from human actions following implementation, including improper maintenance, repair errors, or incompatible upgrades to surrounding infrastructure.
- **Organizational reliability perspective:**
  - **Preventable failures** are related to not following best practices and executing predictable missteps in implementation.
  - **Complexity-related failures** can produce unanticipated outcomes due to interactions between components, fully unpredictable performance settings, and stakeholders expectations.
  - **Intelligent failures** emerge from the experimentation or piloting of novel NBS concepts in uncertain environments, and can represent valuable learning opportunities when adequately monitored and documented.

TAL TECH

FAILURES IN PLANNING PHASE

- **Multifunctionality:**
  - Cities struggle to evaluate success of NBS beyond primary objectives
  - Low rate of applications to assess spatial ecosystem services
- **Connectivity:**
  - Fragmentation of green spaces
  - Poor integration with existing grey infrastructure
- **Social equity:**
  - Not considering diverse needs and values of the community
  - Gentrification – greening initiatives lead to increase in property values
- **Implementation and management:**
  - Lack of specific guidelines and clear responsibilities
  - Lack of coordination and fragmented vision among government agencies



TAL TECH

Vollaers, V., Nieuwenhuis, E., Van De Ven, F., & Langeveld, J. (2021). Root causes of failures in sustainable urban drainage systems (SUDS): An exploratory study in 11 municipalities in The Netherlands. *Blue-Green Systems*, *3*(1), 31–48. https://doi.org/10.2166/bgs.2021.002

FAILURES IN DESIGN PHASE

- **General causes of failure:**
  - Lack of governance or legal and participatory frameworks
  - Lack of standardization and knowledge in technical design
  - Fragmentation of engineering standards and guidelines
  - Poor communication among different operators and stakeholders
- **Technical design failures:**
  - Clogging
  - Inaccurate estimation of flow pathways
  - Insufficient design capacity
  - Wrong materials and media
  - Not considering correctly environmental and operational fluctuations
  - Not considering catchment scale impact

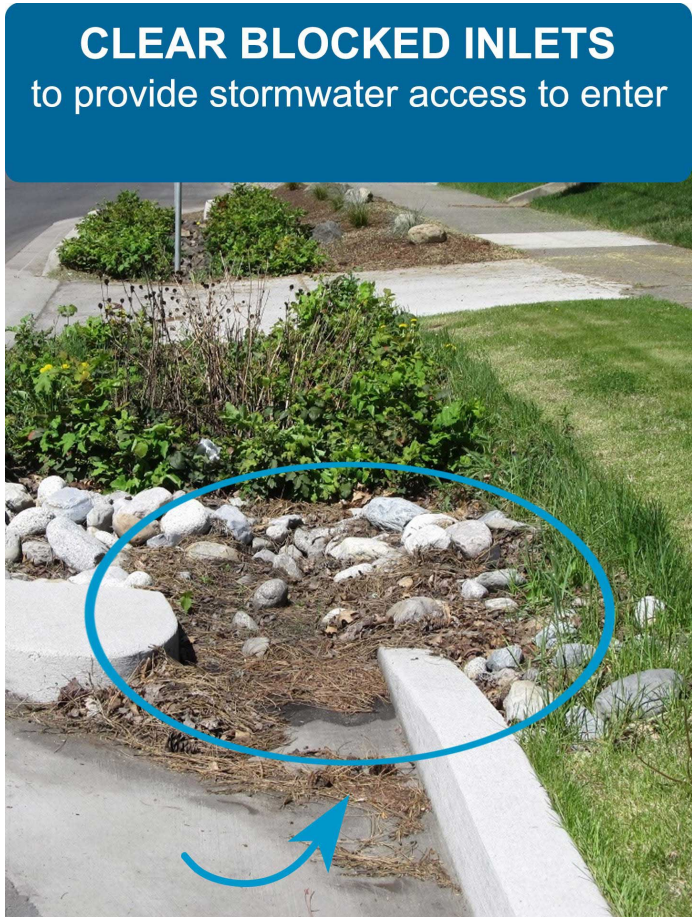


TAL TECH

Vollaers, V., Nieuwenhuis, E., Van De Ven, F., & Langeveld, J. (2021). Root causes of failures in sustainable urban drainage systems (SUDS): An exploratory study in 11 municipalities in The Netherlands. *Blue-Green Systems*, *3*(1), 31–48. https://doi.org/10.2166/bgs.2021.002

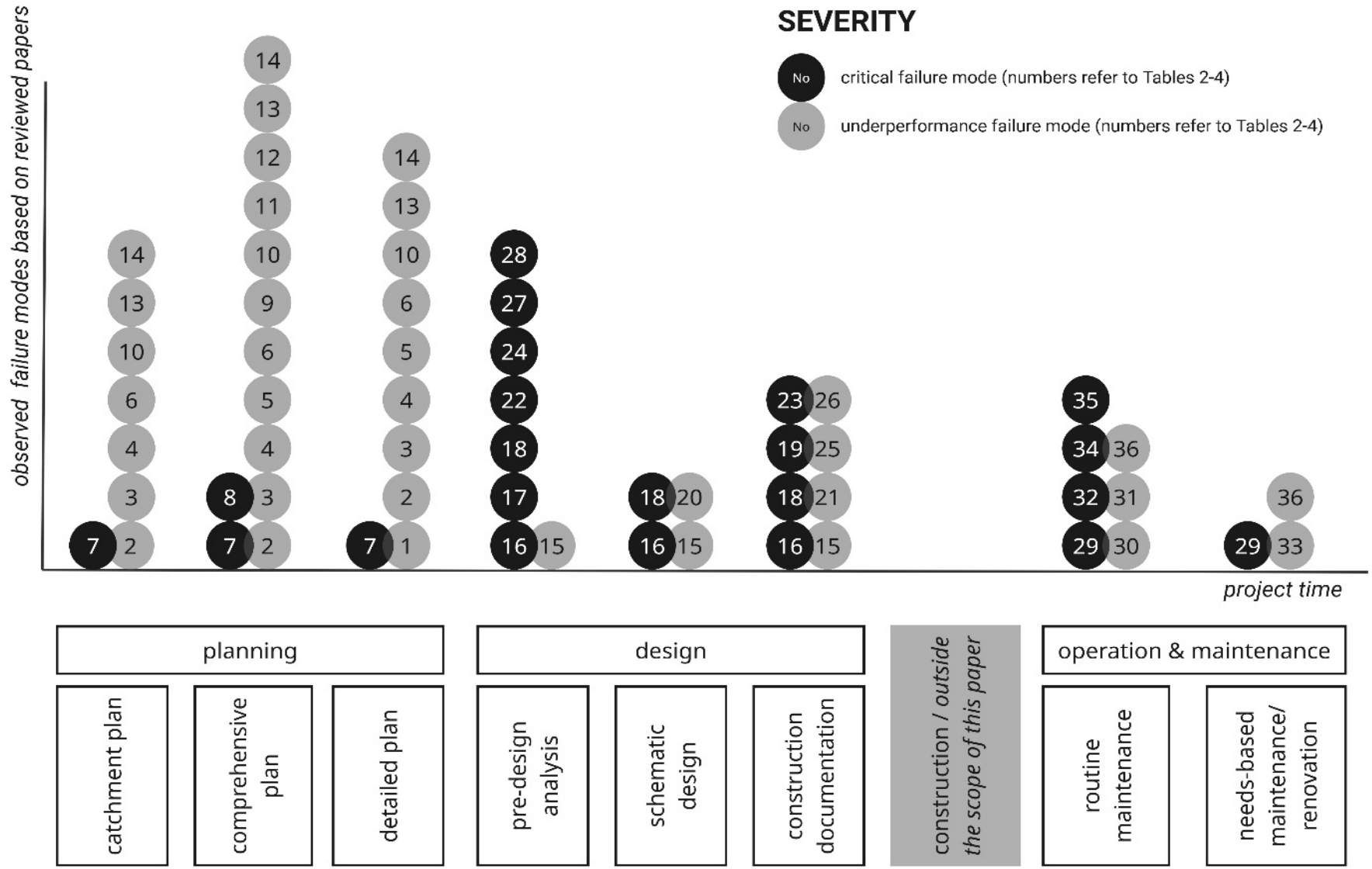
FAILURES IN OPERATION AND MAINTENANCE

- **Technical failures:**
  - Clogging
  - Soil erosion
  - Unable to maintain vital vegetation
  - Sediment accumulation
- **Process failures:**
  - Underscoring the importance of systematic maintenance planning
  - Insufficient post-construction oversight
  - Shortcomings in the design phase will be multiplied in the operation phase

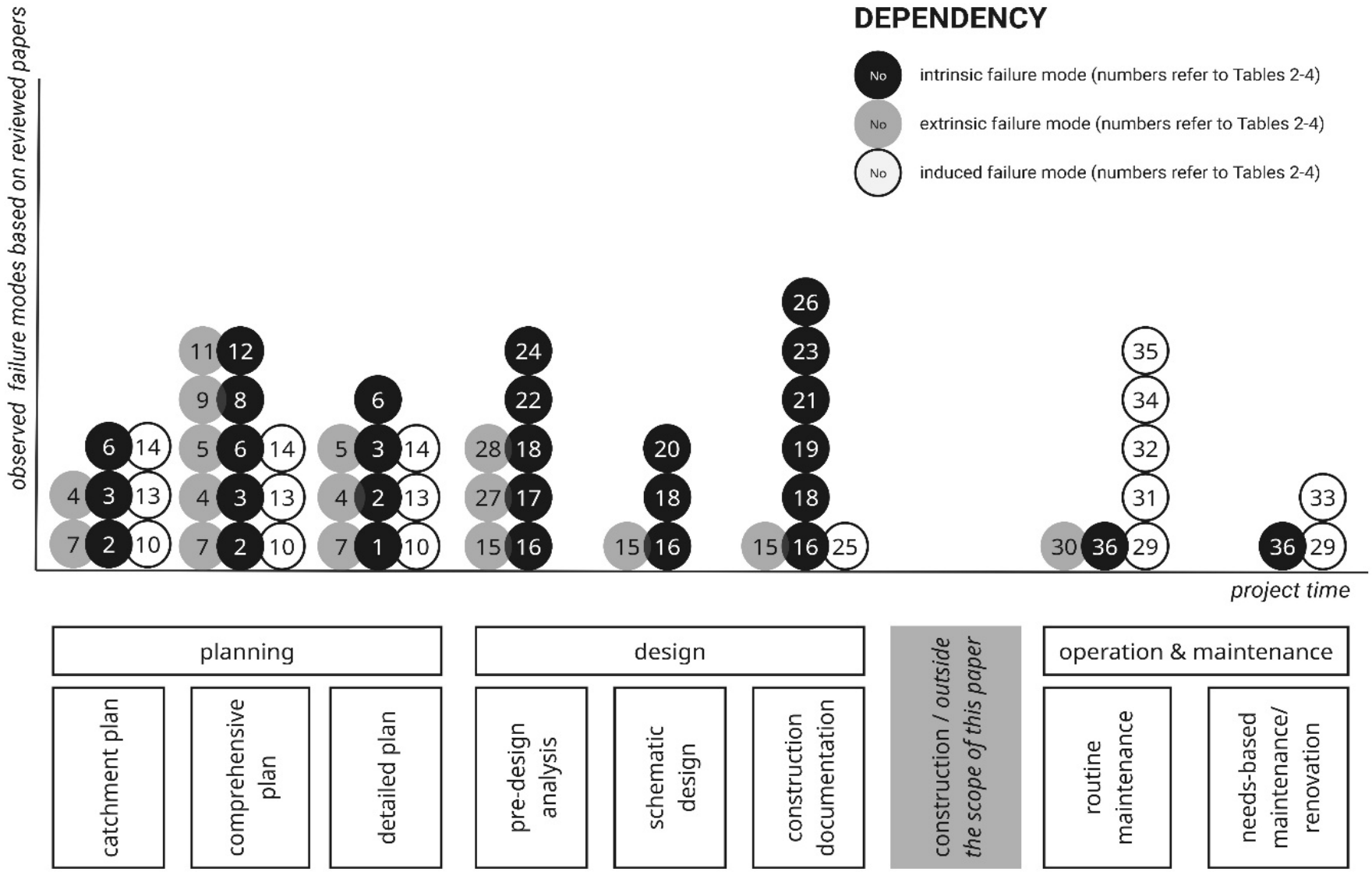


Spokanecity.org

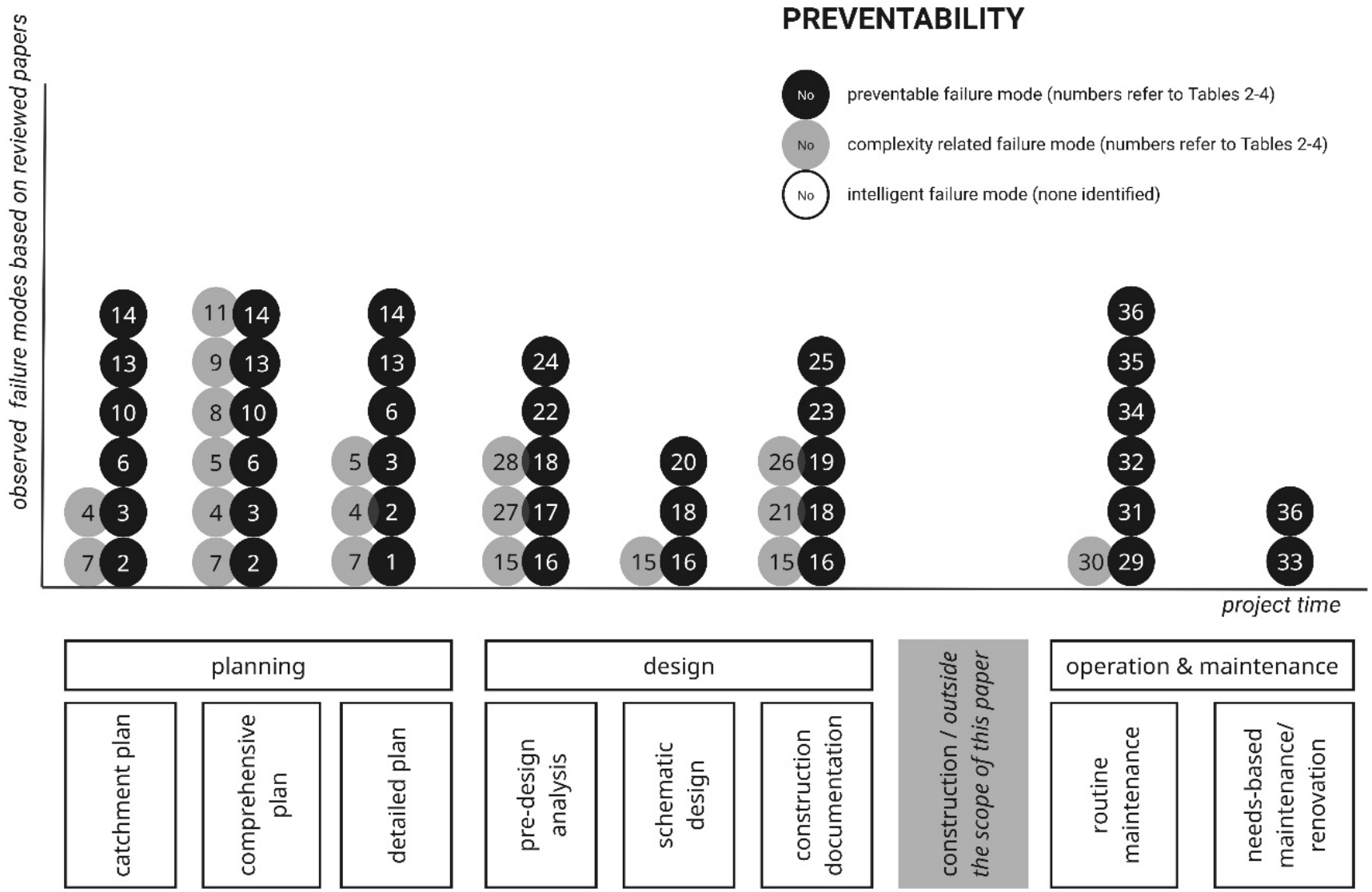
SEVERITY, DEPENDENCY AND PREVENTABILITY OF FAILURES



SEVERITY, DEPENDENCY AND PREVENTABILITY OF FAILURES



SEVERITY, DEPENDENCY AND PREVENTABILITY OF FAILURES



CONCLUSIONS

- **Timing matters:**
  - Most consequential failures originate in early-phase conclusions
- **Catchment scale thinking is key to success:**
  - A singular NBS is more likely to fail unless part of a well-connected system
- **Innovation requires tolerance for intelligent failures:**
  - The result of experimenting with novel design approaches, materials, monitoring technologies, or adaptive management strategies is an expected part of the innovation process, provided it occurs in a controlled environment, is thoroughly monitored, and generates actionable learning.
- **Data-based decision-making across the NBS life cycle:**
  - Smart, standardized data models tailored to an NBS can improve consistency, transparency, and interoperability, which are essential for tracking failure modes, functionality, and performance.

TAL TECH

PROF. IVAR ANNUS

ivar.annus@taltech.ee

TAL TECH SCHOOL OF ENGINEERING

URBAN WATER SYSTEMS



Biodiversity at the Core of NBS: Ensuring Impact Through Ecological Follow Up

Tessa Bargmann
Jóna Ólavsdóttir
Isabel Seiffert-Dähnn
Line Barkved
Jon Museth

Leonard Sandin

Aarhus

2025-09-26

Visions project nature-based solutions



Funded by the Nordic Council of Ministers

Nordicsituation.com



…Traditional solutions and management





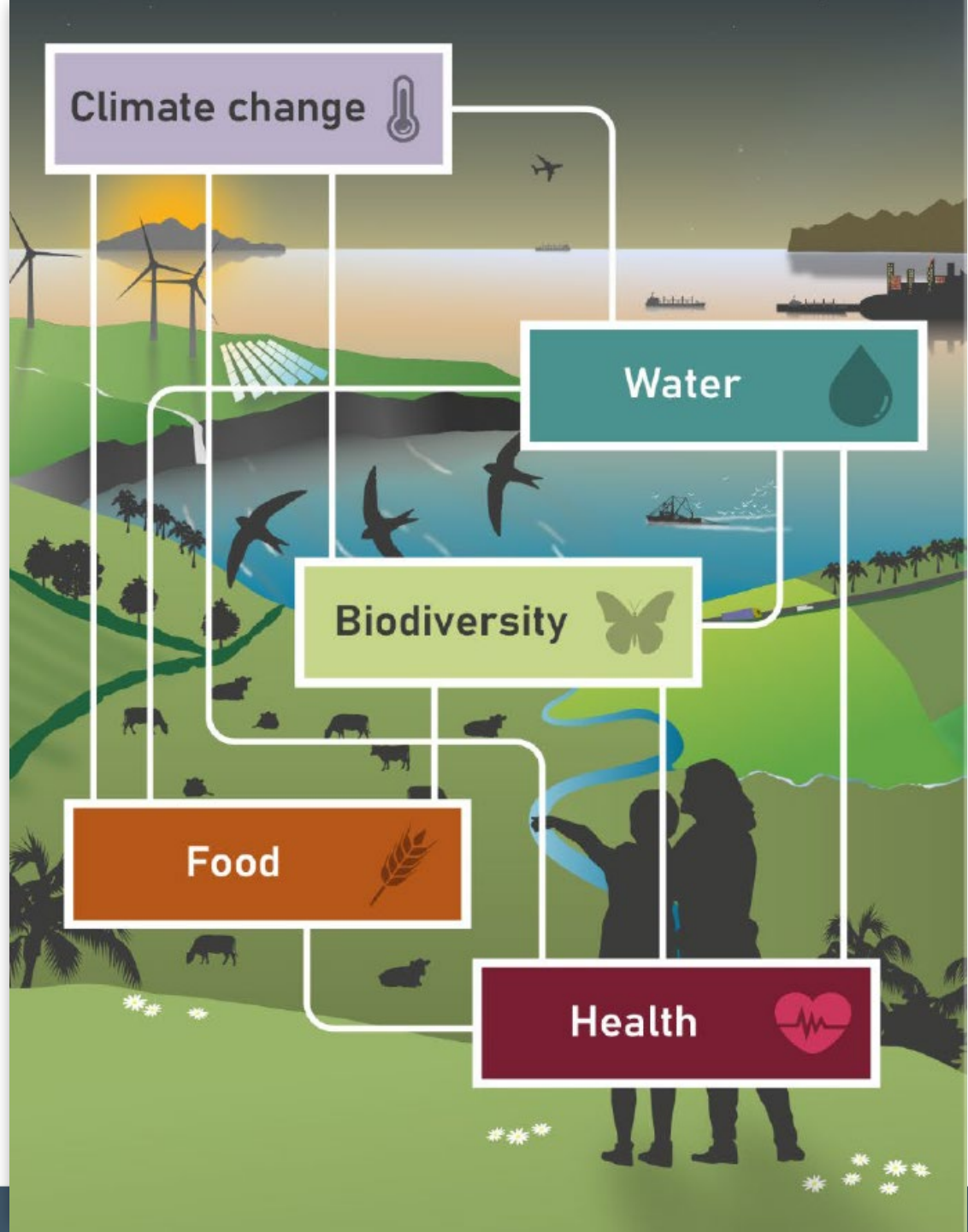


…[3] are no longer enough to solve these challenges

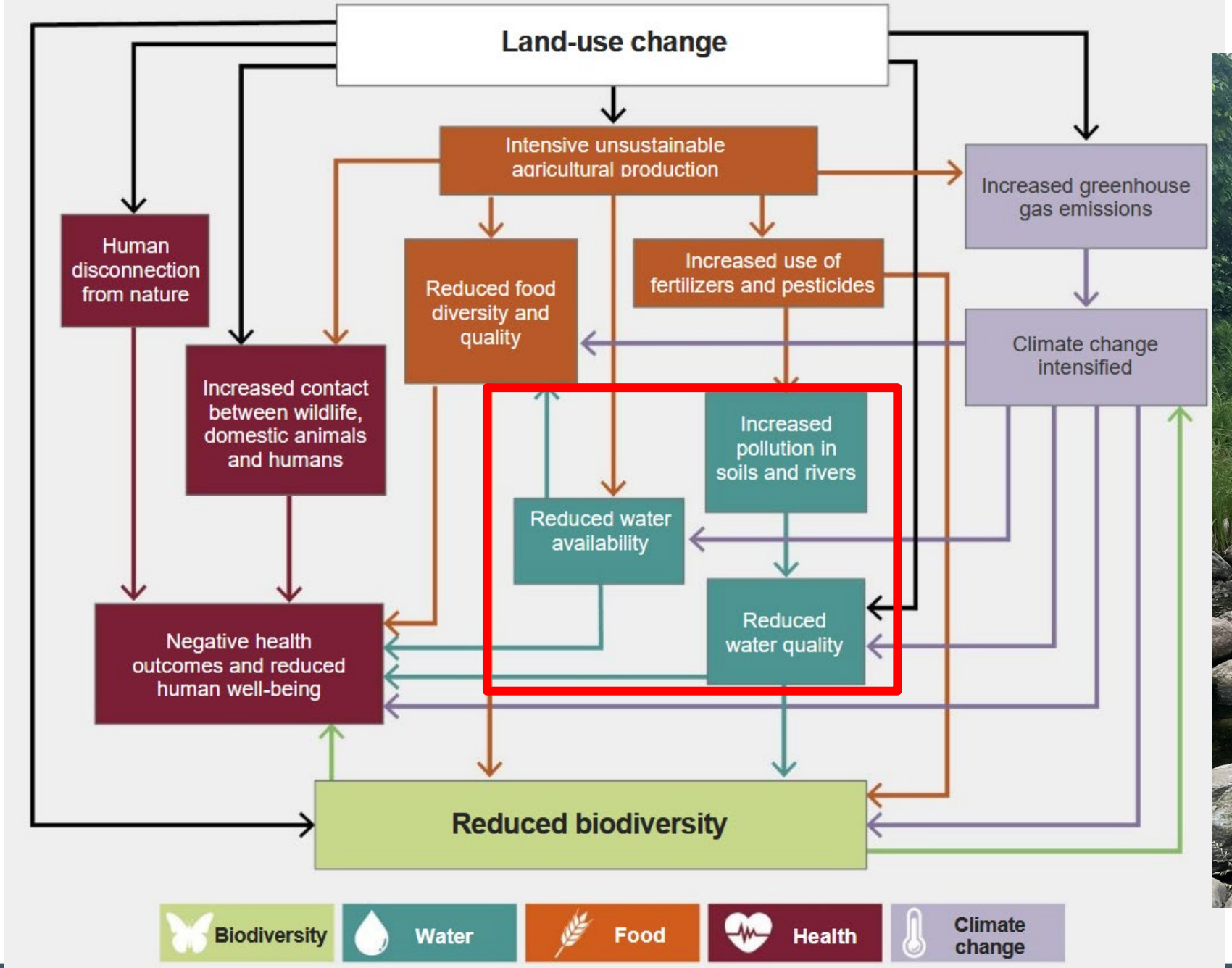
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The Nexus Challenges

- **Nexus** – The link between two or more elements, sectors, or systems
- **Nexus approach** – Understanding the links and interactions between sectors and systems in a holistic way, to develop integrated and adaptive decisions that maximize synergies and minimize trade-offs
- **Silo approach** – Addressing problems in isolation without considering interconnections, which may result in misalignment, unintended consequences, or overlooked trade-offs

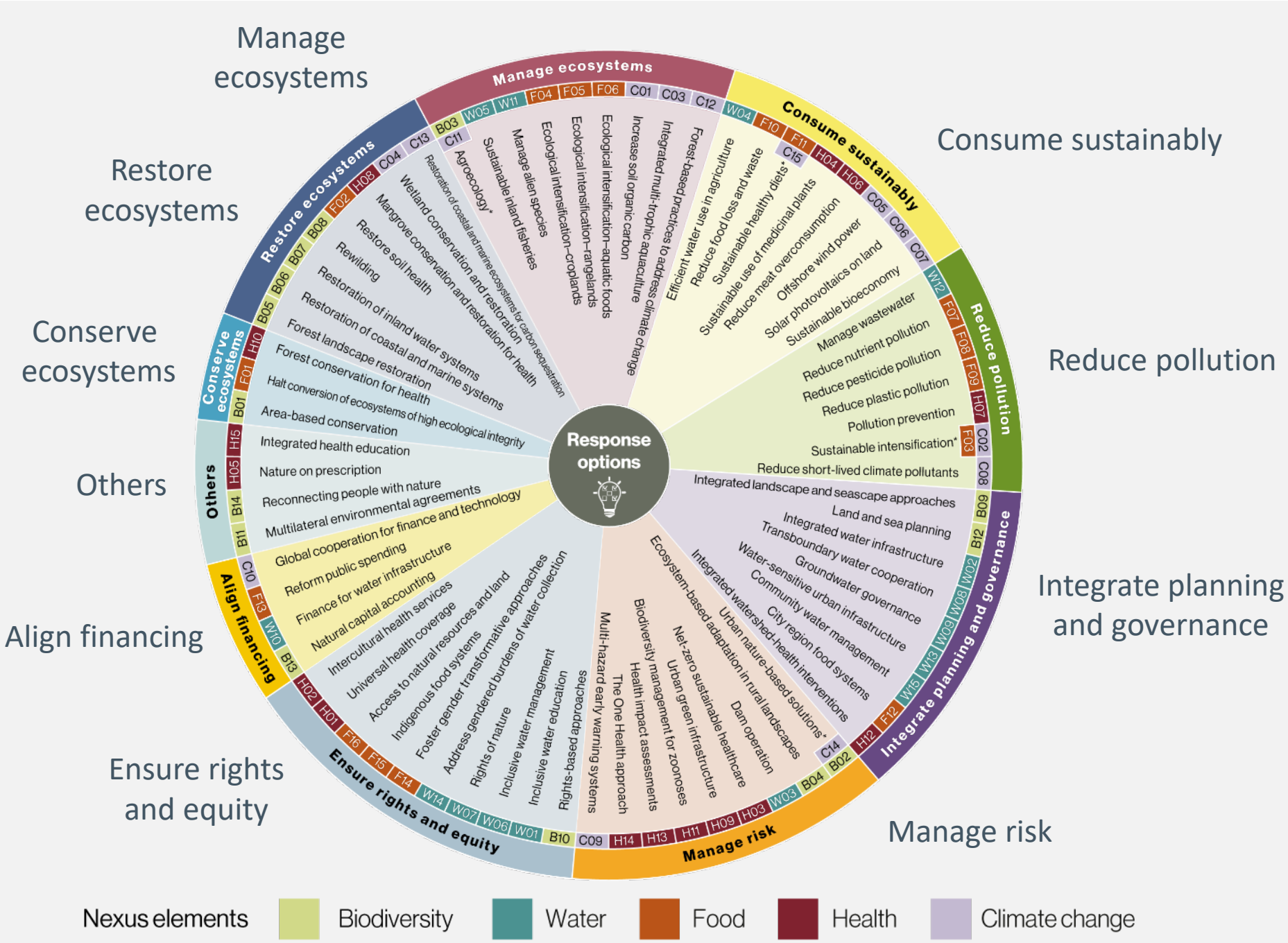


EXAMPLE OF CASCADING NEGATIVE EFFECTS ON NEXUS ELEMENTS





Norsk institutt for naturforskning



IPBES Nexus Assessment reviews and synthesis

- 71 response of in
- 10 broad categories

Source: IPBES Nexus Assessment, (2024) Figure SPM.7

November 2022

Restoration or Nature-based Solutions: What's the difference and why does it matter?

Authors: Kerry Waylen, Kirsty Blackstock, Alhassan Ibrahim, Esther Carmen, Keith Marshall, James Hutton Institute, Aberdeen, Scotland

«Societal needs and goals»

A restoration project that aims to improve the extent and quality of wetland habitats will focus on ecological connectivity and include a range of activities to improve water quality, biology, morphology and hydrology

An NbS project would instead start with a societally defined problem, such as flood risk management, and intervene in nature accordingly

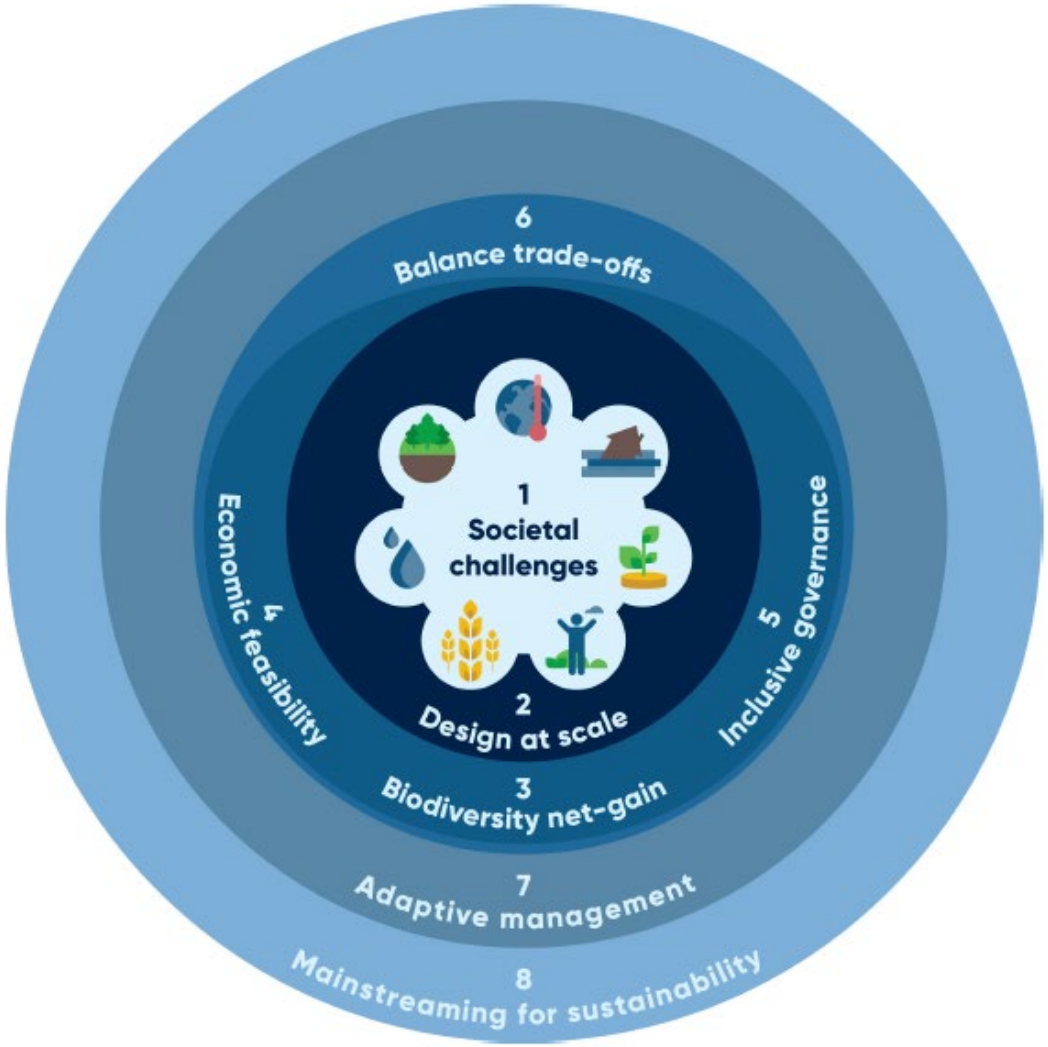


Figure 2. Eight assessment criteria of the IUCN Global Standard for NBS.
Source: IUCN, 2020.

The Biodiversity Gap in NBS Implementation

- Policies support NBS, but often not under that name
- Lack of a clear definition of biodiversity net gain
- Lack of long-term monitoring and evaluation of NBS
- Indicators often focus on co-benefits (flood risk, recreation) but neglect ecology



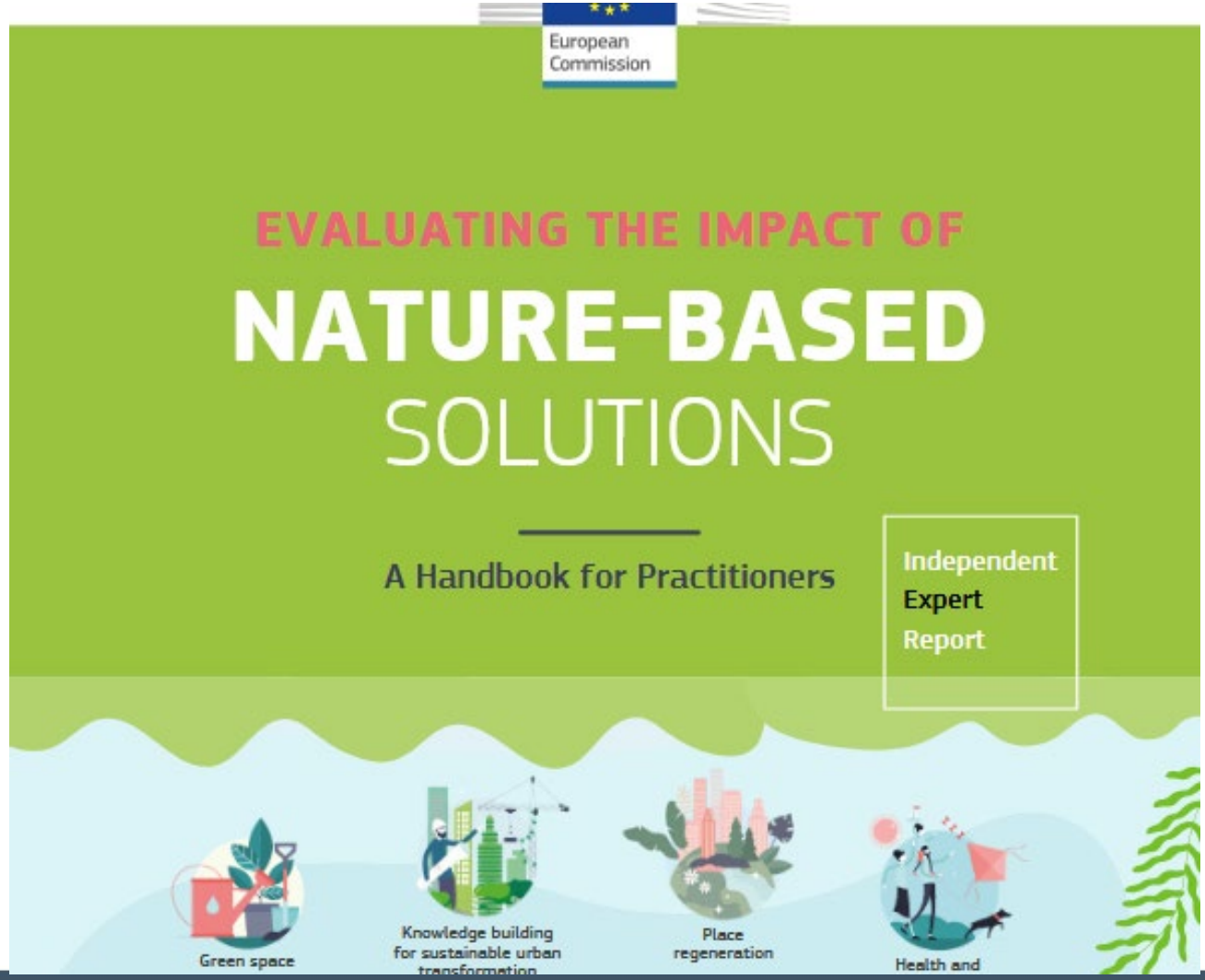
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What makes NBS evaluations impactful?

Evaluation must answer *real policy questions* that affect daily life

Well-designed NBS evaluation:

- **Concrete questions** – clear link to outcomes (biodiversity, climate adaptation, well-being)
- **Robust methodology** – balance complexity, trade-offs, and feasibility
- **Transdisciplinary team** – public + private + civil society + science



Practical lessons from NN+ projects

- **Start small and simple**: manageable indicators build credibility and capacity
- **Tailor monitoring & evaluation** to the local context
- **Engage both local practitioners and disciplinary experts** → ensures ecological, social, and unintended effects are captured
- **Share results back with participants** → maintains trust and motivation for future evaluations



Example - evaluation

- Sunflower plantations
- Flower strips as NBS
- Insect counting using cameras traps
- Pollinators



- BIOSENSE Institute – Novi Sad
- *Tijana Nikolić Lugonja and Maja Knežević (BIOS), Markus Sydenham (NINA)*

SONATA - Monitoring of nature infrastructure - Skill acquisition fOr NATure-bAsed solutions

Funded by the European Union

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Take home messages

- Biodiversity is the foundation of NBS
- Ecological follow-up ensures impact
- Monitoring must be embedded in NBS governance at all levels



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Nordic Guidance on Nature-based solutions



Figure 2. Mockup of the online handbook site and best-practice toolbox.

Advice for Nordic NBS policy development



Policy overview structure in the digital handbook.

GuideNbS

A-DVICE

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Network Nature

› Home › Nature-based Solutions Hubs

NetworkNature Nordic hub



The NetworkNature Nordic hub is a gathering place for all those who work with nature-based solutions in the Nordic region. It is a platform where we exchange contacts and share the knowledge, we gain about implementing nature-based solutions in our part of the world. Also, we post Nordic cases on the Case Study Finder page, so you can see different examples of nature-based solutions in the Nordic region. Occasionally, the Nordic hub will also facilitate events and webinars. The Nordic hub is administered by Jóna Ólavsdóttir, coordinator of the Nordic Council of Ministers' Nature-based solutions programme in the Nordic region.

Leonard Sandin – leonard.sandin@nina.no

https://networknature.eu/networknature-nordic-hub

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Cultural Heritage as a Vital Pillar for Successful Development of Nature -Based Solutions: Insights from India to Denmark

Gaurav S. Singhvi

Interior Architecture Designer & Scientific Vastu Consultant

Convener, INTACH Udaipur Chapter &

By Gaurav S Singhvi
9414343181,9461625303

Blessed to Belong from Aravali Hill Ranges
the Oldest Mountain Ranges of the World



To remind all of us that why cultural heritage must be at the heart of every Nature-Based Solution including the Architecture Development



Cultural heritage is not just about the past …
it is about how we design the future for our upcoming Generations – without being selfish

So today, I want to share with you why in India,



These traditions are not just about faith, but they are powerful, community - driven, Nature - Based Solutions that have preserved ecological balance for centuries.

Let’s begin this journey together.”

Not just as professionals,
but as partners —





to make every NBS a story
of nature and heritage
working hand in hand.”



For money, power, attention, and greed, we have wounded our own mother —Mother Earth.
And now we are looking for its healing & treatments.

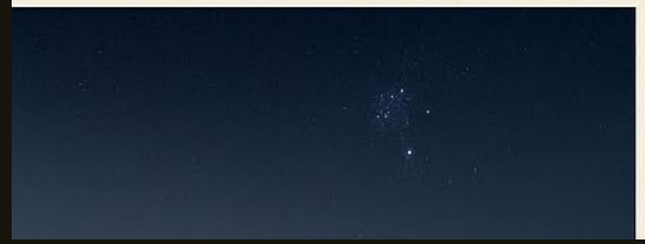


During COVID, when humans were forced indoors, we saw the truth:

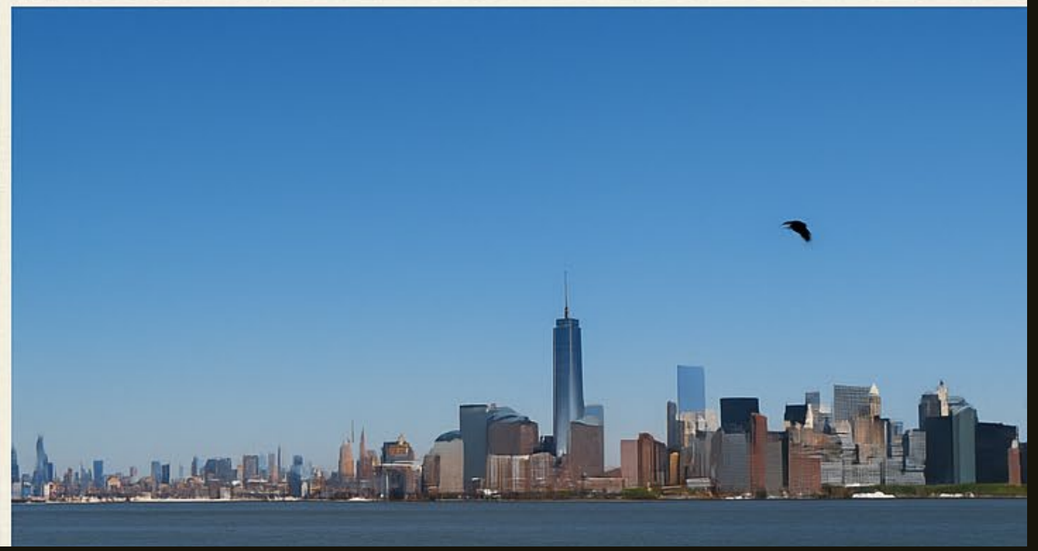
- Nature healed on its own.
- Rivers cleared, skies became blue, stars were visible again, birds returned to cities.
- Pollution levels dropped dramatically.

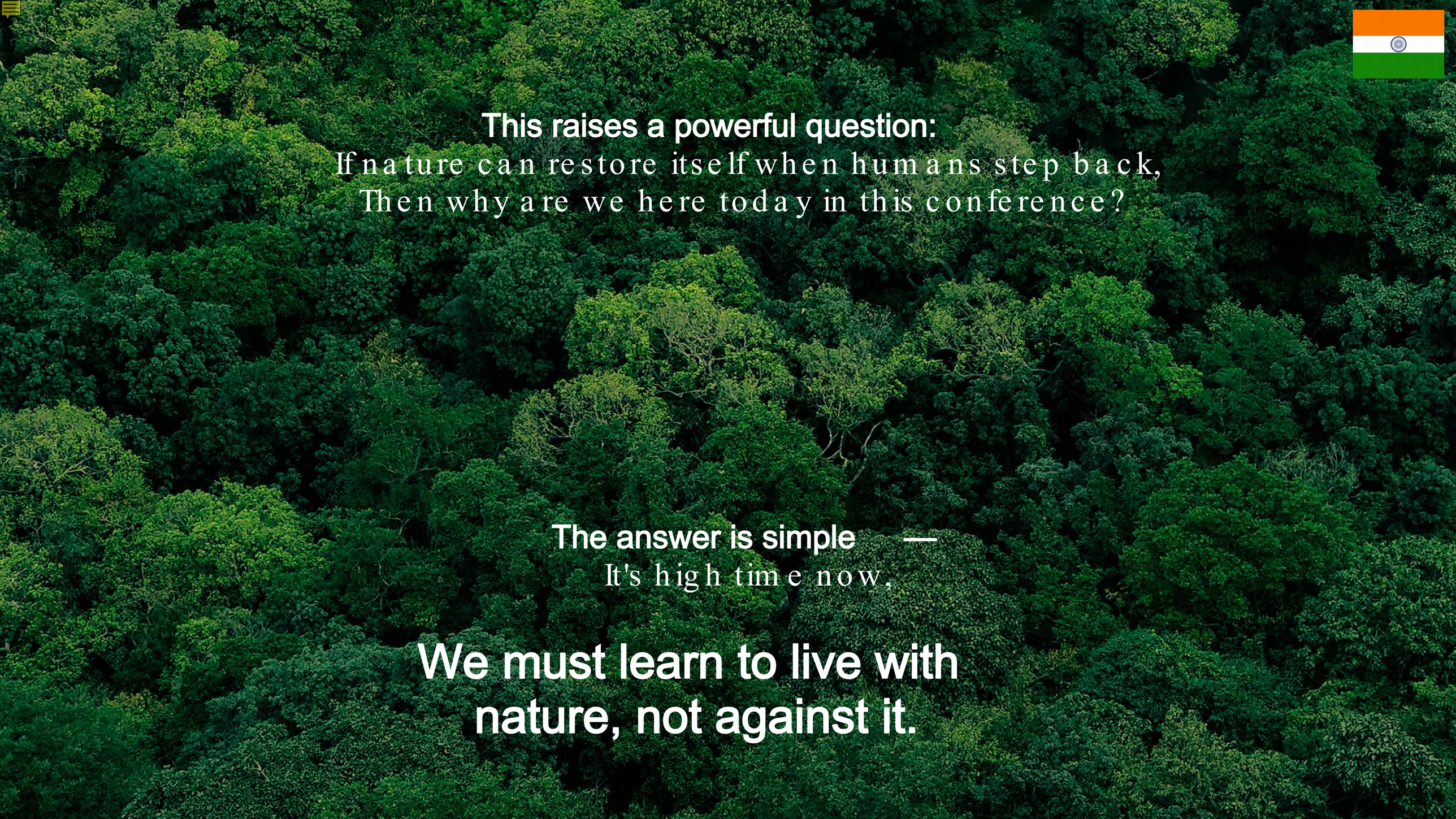











This raises a powerful question:
If nature can restore itself when humans step back,
Then why are we here today in this conference?
The answer is simple —
It's high time now,
We must learn to live with
nature, not against it.



We built concrete forests



Cut down real forests



We mined mountains



Dried rivers.







We pushed birds and animals out of their spaces, some to extinction.

India's Heritage and Nature are inseparable & Nature - Based Solutions Rooted in as Traditions



Sacred Rivers:
Ganga, Yamuna, Narmada, Kaveri – worshipped as goddesses → motivates people to preserve water sources.

Sacred Trees:
Banyan tree (Vat Vriksha) – symbolizes longevity, worshipped during rituals.
Peepal tree – produces oxygen 24x7, protected due to its sacred status.
Neem tree – worshipped for its healing qualities.

Sacred Animals & Birds:
Cow – worshipped, ensures conservation of cattle.
Tiger – associated with Goddess Durga.
Peacock – national bird, protected by law & culture.







Our ancestors knew the value and importance of each and every organism like:



Trees → Oxygen & Shade



Animals → Predator Balance



Birds → Seed Dispersal



Bees → Pollination



Fish → Clean Water



Forests/Mountains → Rain Cycle

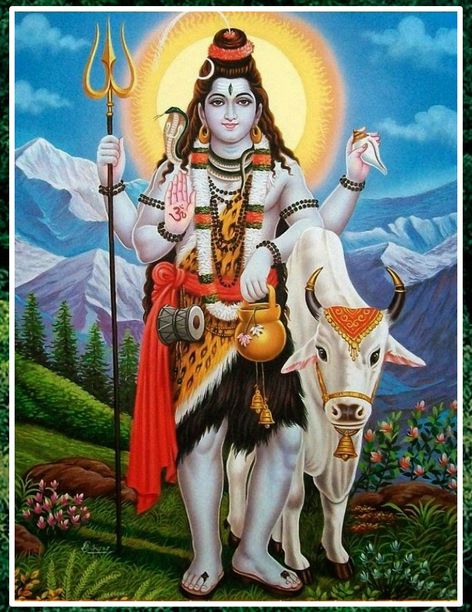
rooted in ecological wisdom. These associations remind us that humans, nature, and the divine are inseparable.
Protecting these beings means protecting the balance of nature itself.



ord Vishnu – Garuda (Eagle)
ymbolism: Garuda
presents speed, strength,
nd the sky element.
cological Role: Eagles and
ptors are apex predators,
ntrolling rodent and snake
opulations.
rotection Relevance: If
ptors decline, rodent
festations rise, affecting
ops and spreading diseases.



Goddess Lakshmi – Owl
•**Symbolism**: Wisdom, patience, ability to see in darkness (hidden wealth).
•**Ecological Role**: Owls control rat and pest populations in farms, silently protecting grains.
•**Protection Relevance**: Loss of owls leads to pest imbalance and crop loss.



Lord Shiva – Nandi (Bull)
•**Symbolism**: Strength, purity, dharma (righteousness).
•**Ecological Role**: Bulls were historically essential for ploughing and seed dispersal. Cattle dung enriches soil and supports biodiversity.
•**Protection Relevance**: With the decline of indigenous cattle, soil fertility and sustainable farming are at risk.



Goddess Saraswati – Swan or Peacock
•**Swan Symbolism**: Discrimination (ability to separate milk from water = wisdom).
•**Ecological Role (Swans/Geese)**: Aquatic ecosystem balance, seed dispersal, wetland health.
•**Peacock Symbolism**: Beauty, pride, dance of nature.
•**Ecological Role**: Peacocks eat snakes, insects, and pests.
•**Protection Relevance**: Losing them affects pest control and cultural identity.



Lord Kartikeya (Murugan) – Peacock
•**Symbolism**: Victory, power, beauty.
•**Ecological Role**: Natural pest controllers, keeping snake populations in check

rooted in ecological wisdom. These associations remind us that humans, nature, and the divine are inseparable. Protecting these beings means protecting the balance of nature itself.



d Ganesha – Mouse
mbolism: Desire & ego (tiny destructive if uncontrolled). esha rides it to show mastery r desires.
ological Role: Mice and ents are part of the food n, feeding snakes, owls, and ors.
otection Relevance: rpopulation of rodents urs when predators decline, alance is needed.



Goddess Durga – Lion or Tiger
•**Symbolism**: Courage, ferocity, mother's power to protect her children.
•**Ecological Role**: Tigers and lions are apex predators, maintaining the balance of herbivore populations.
•**Protection Relevance**: Without them, herbivores overgraze forests, leading to desertification.



Lord Vishnu (Varaha Avatar) – Boar
•**Symbolism**: Lifting Earth out of cosmic waters, protector of land.
•**Ecological Role**: Wild boars aerate soil, disperse seeds, and maintain forest ecology.
•**Protection Relevance**: Overhunting disturbs soil cycles and predator-prey relationships.



Goddess Kali – Jackal
•**Symbolism**: Death, time, destruction of ego.
•**Ecological Role**: Jackals are scavengers, cleaning ecosystems by eating carrion and waste.
•**Protection Relevance**: Without scavengers, disease spreads through decaying remains.



Lord Yama – Buffalo
•**Symbolism**: Death, dharma, justice.
•**Ecological Role**: Buffaloes maintain wetlands, their grazing prevents overgrowth, and dung supports aquatic ecosystems.
•**Protection Relevance**: Decline affects wetlands and traditional agriculture.

rooted in ecological wisdom. These associations remind us that humans, nature, and the divine are inseparable. Protecting these beings means protecting the balance of nature itself.



Goddess Ganga – Crocodile (Makara)
•**Symbolism**: Purity, flow of life, fierce protector of rivers.
•**Ecological Role**: Crocodiles are keystone species, controlling fish populations, maintaining river ecology.
•**Protection Relevance**: Healthy crocodile populations mean healthy rivers.



Lord Vishnu (Matsya Avatar) – Fish
•**Symbolism**: First life, savior of creation.
•**Ecological Role**: Fish maintain aquatic ecosystems, cycle nutrients, and provide food for many species.
•**Protection Relevance**: Overfishing disrupts marine balance and food security.



Lord Vishnu (Kurma Avatar) – Tortoise
•**Symbolism**: Patience, stability, balance of creation.
•**Ecological Role**: Turtles and tortoises clean rivers, eat algae, and disperse seeds.
•**Protection Relevance**: They are indicators of clean water ecosystems.



Goddess Shitala Mata – Donkey
•**Symbolism**: Humility, endurance, acceptance of suffering.
•**Ecological Role**: Donkeys are beasts of burden, historically supporting agriculture and transport.
•**Protection Relevance**: Losing them erases a sustainable and low-energy transport system.



Lord Dattatreya – Four Dogs
•**Symbolism**: Four Vedas, loyalty, guardianship.
•**Ecological Role**: Dogs (wild & domestic) maintain scavenger balance, protect human settlements.
•**Protection Relevance**: Stray dog mismanagement leads to rabies; conservation requires balance with sterilization.

The Larger Message:

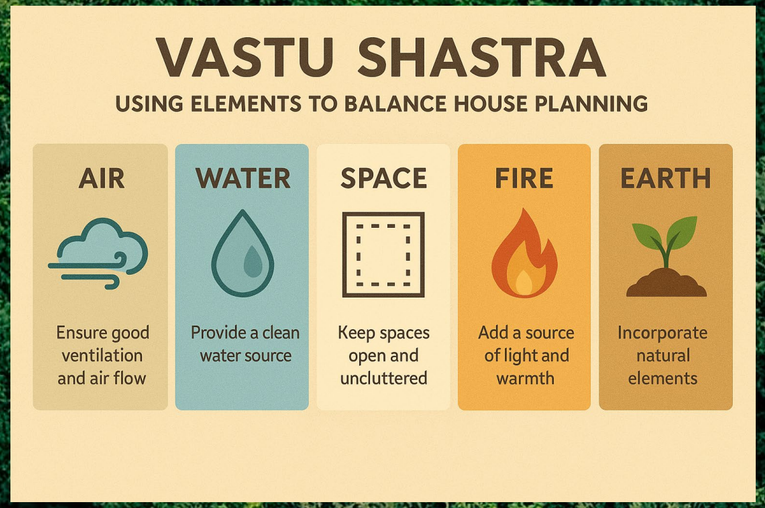
•These vāhanas were not chosen randomly — they are an *ecological code*.
•Gods remind us that animals, birds, and humans are one family (*Vasudhaiva Kutumbakam*).
•Protecting them ensures food security, healthy ecosystems, and survival of humanity.


Because,
When we get emotionally connected
we care.

Vastu Shastra parallel: Ancient Indian architecture/science designed homes, towns, and cities in harmony with sun, wind, water, and soil—a form of embedded NBS that sutained life for centuries



Importance of Nature for Humans Dwellings is Explained in Vastu Shastra Sciences



Air (Vayu)
or Nature: Plants need air O_2 for photosynthesis, O_2 respiration). Animals d humans need oxygen. carries pollens, seeds, d maintains climate cles.
or Body: Breath (Prana) is e itself. Poor air quality = or health. Balanced air = ergy & vitality.
Vastu: Proper ntilation, open windows, d greenery keep energy w balanced and prevent gnation.

2. Water (Jal)
•**For Nature:** Essential for rivers, oceans, rainfall, soil fertility, and all forms of life. Maintains Earth's temperature.
•**For Body:** 70% of our body is water. It regulates temperature, digestion, and circulation.
•**In Vastu:** Water bodies in the right direction (like northeast) bring prosperity, purity, and health. Clean water in the home = healthy family.

3. Space (Aakash)
•**For Nature:** The universe exists because of space. Birds fly, sound travels, planets move only in space.
•**For Body:** Space in our body = cavities (mouth, nostrils, stomach, lungs, cells). Without space, life cannot exist.
•**In Vastu:** Open courtyards, uncluttered rooms, and high ceilings bring positive energy and reduce stress. Space connects the house to cosmic energy.

4. Fire (Agni)
•**For Nature:** Sunlight supports photosynthesis, seasons, and warmth. Fire regulates day-night cycles and provides energy.
•**For Body:** Fire = metabolism (digestive fire/Agni). Without it, we cannot digest or transform food into energy.
•**In Vastu:** Fire (kitchen, lamps, sunlight) is placed in the southeast direction. It keeps health, energy, and positivity strong.

5. Earth (Prithvi)
•**For Nature:** Soil provides food, minerals, forests, and holds all life together. Gravity keeps balance.
•**For Body:** Our body is built of minerals and nutrients from Earth. It gives stability, strength, and immunity.
•**In Vastu:** Strong foundation, use of natural materials, and connection with soil/greenery give stability to life and home.

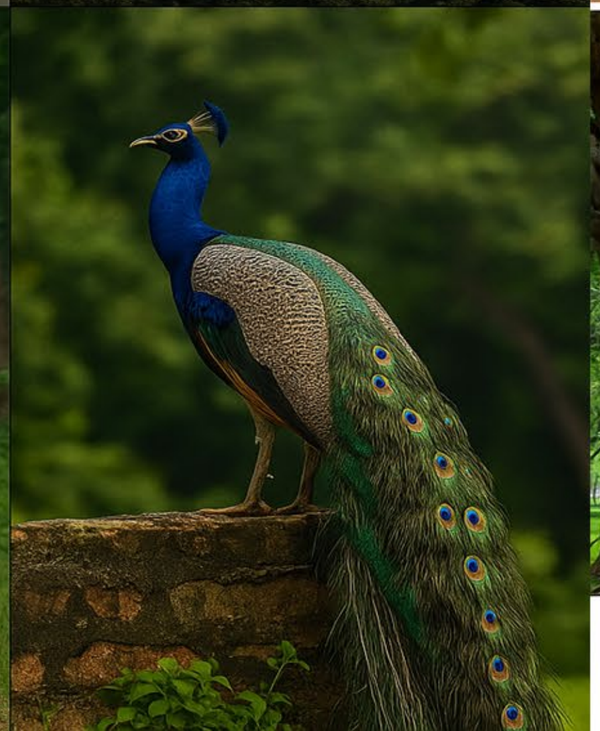
















Why Integrate Cultural Heritage with NBS in India?

Heritage gives identity & continuity

- **Impact:** When NBS respects heritage, people feel it is *their* solution, not an imposed one.



Long-term acceptance through emotional value

- **Impact:** Embedding rituals in NBS means *community guards solutions for generations.*





Avoiding conflicts through early heritage inclusion

- **Failure Case:** Many Indian riverfront projects (e.g., Sabarmati, Kota) neglected heritage ghats, temples, and trees → led to cultural disconnection & criticism.
- **Lesson:** If heritage experts, Vastu consultants, and archaeologists are included early, **projects avoid opposition** and gain legitimacy.



Inter-generational responsibility

- **Past Wisdom:** Sacred groves in Rajasthan or Kerala → preserved for centuries because elders taught children “this is God’s forest.”
- **Future Impact:** If today’s children grow up learning about sacred lakes, trees, and rituals, tomorrow they’ll inherit **living ecosystems, not concrete ruins**.



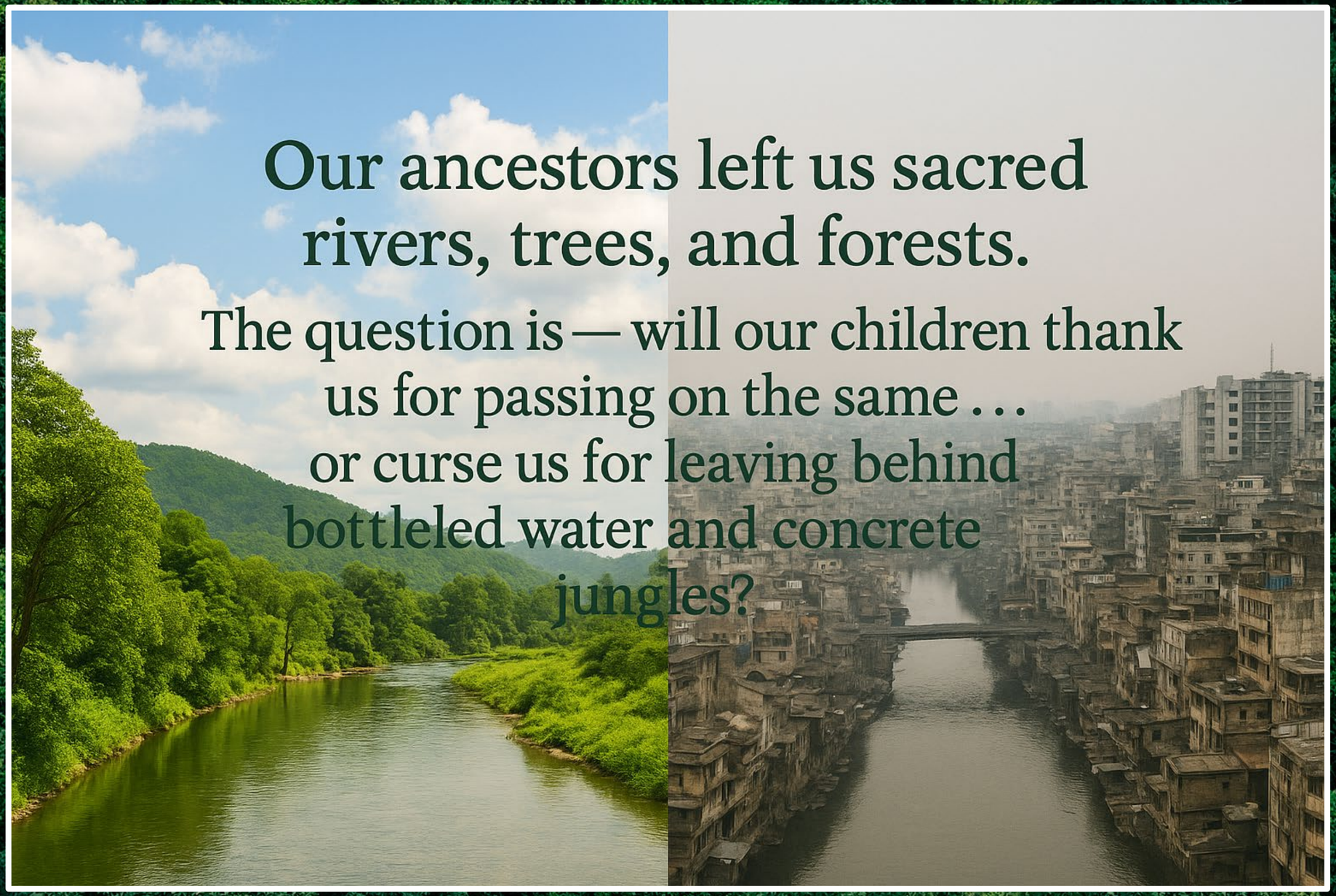
Vision for the Future:

Children should breathe clean air, not depend on oxygen cylinders.

They should eat natural food, not chemical-processed meals at ten times the cost.

They should inherit flowing rivers, not dead canals; living forests, not barren deserts.

Heritage-linked NBS ensures this by weaving cultural respect into ecological design.



“We don’t inherit the Earth from our ancestors, we borrow it from our children.”

“If we humans cannot rise above greed and selfishness,

then let me Remind you all:

Our Ancient India Nature-Based Customs, Rituals, and

Traditions not only preserved life for centuries,

but also developed and sustained livelihoods.

The choice is ours: to honour them or to lose everything.”

And be in all types of Losses.

Support Sustainable Livelihoods & Cultural Identity

Few Examples from India are:





Chilika Lake (Odisha):
Seasonal fishing bans & lake-worship rituals protect fish and bird life.

Apatani Agro -ecology (Arunachal Pradesh):
Fish–paddy integration creates a self-regulating, pesticide-free ecosystem sustaining biodiversity & community.







Sacred Stepwells (Rajasthan , Gujrat)
sustained water for centuries → identity of communities + practical water security.

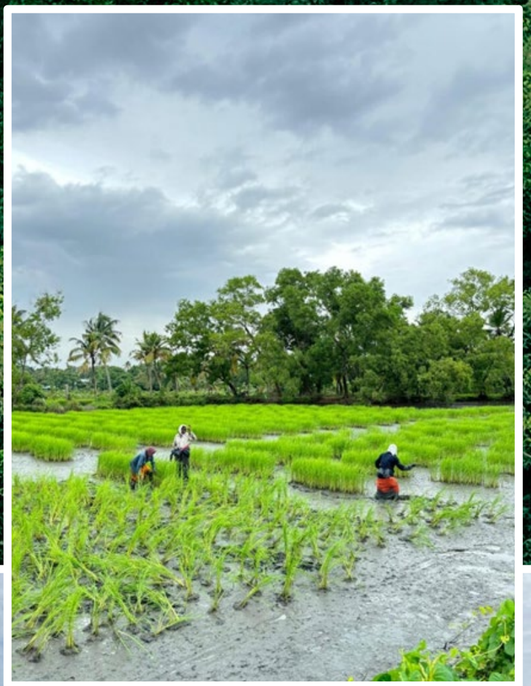
Sacred Groves (Meghalaya, Maharashtra, Himachal): Forest patches protected as abodes of deities preserve biodiversity & water sources.





- **Ladakh Ice Stupas (Modern-traditional hybrid):** Inspired by ancient glacial water storage → NBS for water security. Secure farming livelihoods in summer.









Pokkali Rice Farming (Kerala):
Saline-resistant rice + prawn rotation sustains wetlands & livelihoods.





Tank Irrigation (Tamil Nadu, Karnataka):
.

Pastoralism (Rajasthan, Gujarat): Rabari & Maldhari grazing traditions maintain grassland ecology.





Bamboo Culture (Nagaland, Mizoram): Sustainable bamboo harvesting sustains housing, crafts, and ecology.

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Mangrove Worship (Sundarbans, West Bengal): Bonbibi rituals → mangrove protection & flood safety.







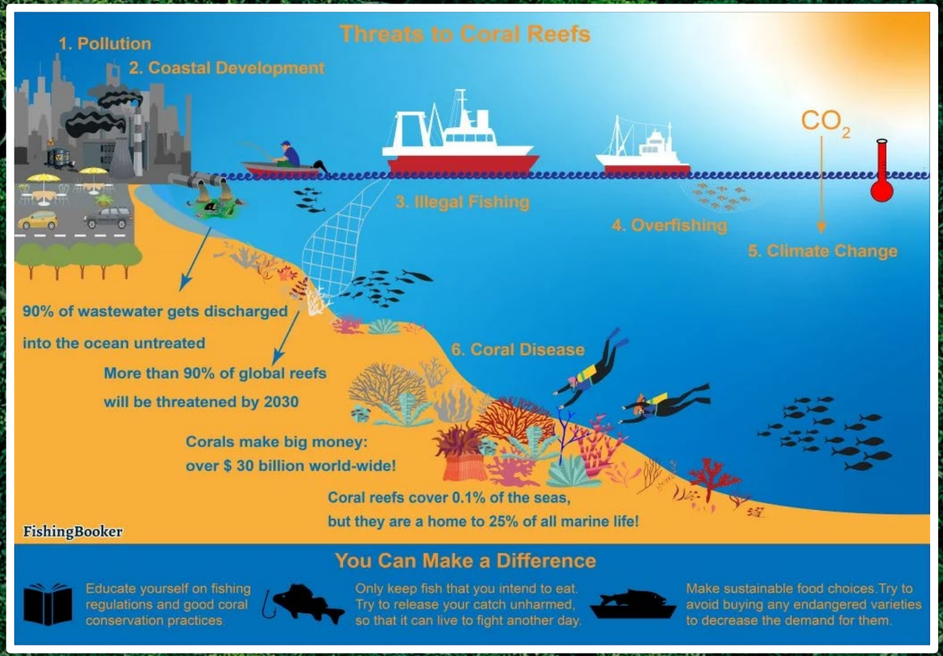
Kutiyattam Coconut Offerings (Kerala):
Coconut groves preserved → soil & coastal protection.





Coral & Marine Worship (Gujarat): Coastal temples → reef & fish conservation.

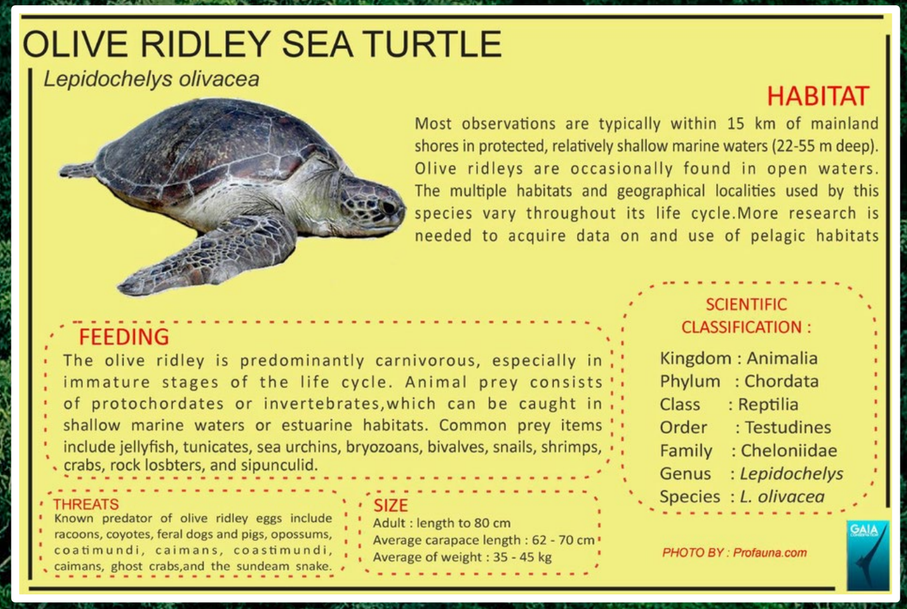
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Monsoon Fishing Bans (Kerala, Odisha, Bengal): Religious restrictions → fish breeding ensured. ensures fisherfolk's income stability year -round.



Sea Turtle Myths (Odisha, Tamil Nadu): Turtles linked with gods → survival of Olive Ridleys. healthy marine ecosystem → supports coastal fishing livelihoods.







· Sacred Rivers (Pan -India):
Rituals in Ganga, Yamuna,
Narmada → Ensure Water Care.





· Orans (Rajasthan): Sacred groves dedicated to local deities → grazing + biodiversity balance. Supply fodder, timber, and grazing → essential for rural survival.







Pushkar Lake (Rajasthan): Pilgrimage rituals ensure community involvement in lake upkeep. Pilgrimage economy supports priests, boatmen, and vendors → rituals maintain the lake.



Bishnoi Community - Rajasthan’s Bishnoi village: Where nature meets tradition

Strict faith -based rules → tree & wildlife protection (esp. blackbuck, khejri trees). provide fodder, shade, and eco -tourism potential.

Khejarli massacre:

In the 18th century, led by Amrita Devi, the Bishnoi community sacrificed their lives to protect a grove of khejri trees from being felled for the Maharaja's palace. This event is a testament to their commitment to environmental protection.





Modern advocacy:

The community continues to advocate for conservation, famously taking action against movie star Salman Khan for poaching blackbucks in the 1990s.

Bishnoi Community & Biodiversity Conservation in Rajasthan

Living with Nature as Religion

- The Bishnoi community, founded by Guru Jambheshwar in the 15th century, follows 29 principles where protection of animals, trees, and all life forms is central.
- Cutting green trees and killing animals is strictly prohibited.

Sacred Bond with Wildlife

- Blackbucks (Antilope cervicapra) and chinkaras (Indian gazelles) roam freely in Bishnoi villages without fear.
- These animals are treated as family members and are often buried with rituals if they die.

Unique Human –Animal Interaction

- Bishnoi women are known to breastfeed orphaned blackbuck and deer fawns, ensuring their survival when mothers die.
- This extraordinary compassion shows their deep emotional and cultural commitment to biodiversity.

Community -Driven Conservation

- Bishnois have historically fought poachers to protect blackbucks and chinkaras.
- The community is considered the “first eco -warriors” of India for their sacrifices, including the famous Khejarli Massacre (1730) where over 300 Bishnois gave their lives to save sacred Khejri trees.

Sustainable Desert Ecosystem Management

- Through protection of trees like the Khejri , they maintain soil fertility and provide fodder in the harsh Thar Desert.
- Their practices support a balance of desert ecology, benefiting both humans and wildlife for centuries.







Johad Movement (Alwar, Rajasthan):

Traditional johads revived → groundwater levels restored. Farmers regain crop income.





. **Sacred Tanks in Temples (South India):**
Ritual purity → water storage & ecosystem function.









Camel Breeding (Rajasthan): Raika traditions sustainable desert livelihood + ecosystem grazing balance.

- **Living Root Bridges (Meghalaya):** Sacred + practical → bridges made from ficus roots, climate-resilient NBS. Community-built bridges improve connectivity → enable trade, tourism, and farming access.







Salt Pan Cultivation (Gujarat, Tamil Nadu): Traditional rituals + sustainable salt farming → coastal community





- **Terrace Farming (Himalayas & NE India):** Prevents soil loss → secures food crops & farmer incomes.



So the Lesson is : When heritage, rituals, and livelihoods guide nature-based planning, conservation becomes community-driven and self-sustaining.

Policy Integration & Challenges (India) & Reasons for Non - Implementation

• Rapid urbanization neglecting heritage in metros & housing.



Decadal change in per capita forest cover in Indian mega cities

Green space and nature-based solutions are an essential component for the development of sustainable, resilient and inclusive cities

Decadal Change in Per Capita Forest Cover in Indian Mega Cities

City	Population (Million)		Forest Cover Sq.Km***		% change	Per Capita Forest Cover Sq.Met	
	2011 *	2020 Est**	2011	2020		2011	2020
Ahmedabad	6.35	8.05	18	9	-48	2.8	1.2
Bengaluru	8.50	12.32	94	89	-5	11.1	7.2
Chennai	8.70	10.97	18	23	26	2.1	2.1
Delhi	16.31	20.18	174	194	11	10.7	9.6
Hyderabad	7.75	10.00	33	82	147	4.3	8.2
Kolkata	14.11	14.85	3	2	-30	0.2	0.1
Mumbai	18.41	20.41	102	111	9	5.5	5.4

***Forest Cover ISFR 2021 pertains to the year 2019-20 hence population year 2020
Source:* Indian Census **UN World Pop. Prospects Table: @pargaien

• Between 2001–2021, India's urban land area doubled; tree cover fell by ~30% in expanding metros (Delhi, Gurugram, Hyderabad).
• Metro construction in Delhi, Bangalore cut thousands of old trees; compensatory plantation either not done or survival rate below 15%. Example: Delhi Metro construction led to relocation of dozens of small temples and loss of 16,000+ trees
• In many masterplans, green/open lands exist only on paper — later converted to residential/commercial plots because Animals, Birds, Trees cannot speak or oppose.
• Cities expand without considering heritage → metros, highways, and housing projects often bulldoze ancient trees, ghats, or stepwells.

• Lack of awareness – heritage seen as an obstacle.



• Engineers/Town Planners prioritize speed, not sustainability. They see ancient systems (stepwells, kunds, temple tanks) as "obstacles," filling them for malls or colonies.

• Example: Traditional water systems (baolis, temple tanks) ignored in favor of pipelines and concrete water storage, leading to groundwater depletion.

• Example: Hyderabad lost dozens of temple tanks between 1990–2020, worsening floods.

• Traditional knowledge (like planting Peepal & Neem near settlements for oxygen & medicine) dismissed as "superstition," though proven scientifically.

• No mandatory heritage consultation policies.



• No law mandates heritage consultation in Smart Cities/AMRUT projects.

• Forest & commons shrinking: FAO data shows India lost 2.33 million ha of natural forest (2000–2020).

• EIA (Environmental Impact Assessment) often diluted or bypassed under political pressure.

• Funding hurdles – heritage projects seen as costly.

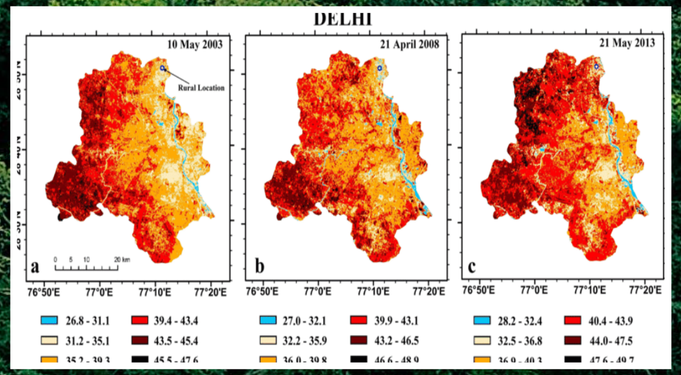




• Heritage - sensitive NBS (like stepwell restoration) cost less long - term, but upfront costs seen as “burden.”
• Politicians prefer flashy, short - term projects (LED - lit riverfronts, concrete parks) to show quick results before elections.
• Example: Sabarmati Riverfront cost ₹1,200+ crore but displaced 20,000 families & destroyed heritage ghats.

• Climate change pressures – floods, heat stress, biodiversity loss.





• Urban flooding: Bengaluru 2022 floods happened because 180+ lakes vanished in 40 years.
• Mumbai floods worsened by the destruction of mangroves.
• Urban Heat Island: Delhi records 4 – 6 °C hotter than nearby rural areas due to loss of tree cover.
• Biodiversity collapse: Sparrow population in Delhi dropped by 80% in 2 decades; wetlands for migratory birds were reduced.

• Community opposition – short - term encroachments.





• In many cities, locals encroach lakebeds for housing/shops → resist eviction citing livelihood short-term motives: villagers cut sacred groves for firewood despite ecological damage.

• Example: Encroachments on Udaipur’s lakes (Pichola, Fatehsagar) reduce water holding capacity

• Builders & mafias – illegal Aravalli clearances.





• Builders and resorts illegally acquire green zones, with official collusion.
• Aravallis: rampant illegal construction of farm houses, Hotels, resorts, banquet halls in Gurgaon, Faridabad despite SC bans. 60% of green cover lost to real estate, farmhouses, and hotels. 100 + Resorts have been made in Kumbhalgarh area on the hills, we can see the resorts from the resort and not the hills anymore.
• Flora & fauna: Leopards, nilgai, peacocks, and many species losing habitat → rise in man-animal conflict.
• Nexus of politicians, land dealers, and officials allows approvals of illegal projects. Example: Supreme Court in 2018 ordered demolition of 10,000+ illegal constructions in Aravalli forest zone, yet violations continue.

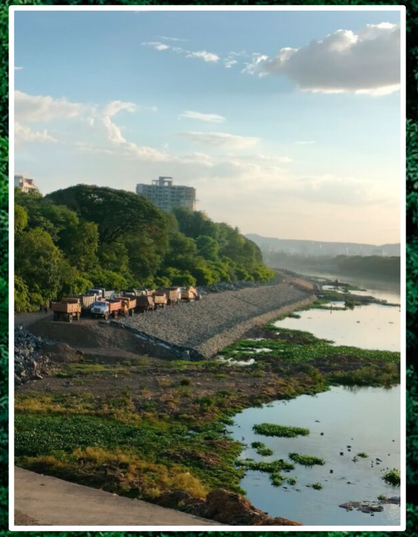
• Mining – 1,000 km+ of world's oldest hills degraded.





• The oldest mountain range (3.2 billion years) is being blasted and hollowed for marble, granite, and stone.
• Illegal mining in Rajasthan & Haryana continues despite the Supreme Court ban since 2002. Yet reports show 31% of the Aravallis were destroyed in Rajasthan & Haryana itself.
• Studies show 31 mining hotspots in a 1,000+ km stretch destroying aquifers, accelerating desertification towards Delhi.

• Riverfront projects are destroying old ghats, temples, trees.






The Only Only Threat & Challenge to
the Nature
are the Humans,
Can you relate ?

Policy Integration & Challenges (India)

& their Solutions

Policy Level:

- Make heritage assessment mandatory in all NBS/EIA (Environmental Impact Assessment) reports.
- Merge HRIDAY-type heritage guidelines into Smart Cities / AMRUT projects.
- Create joint task forces (heritage + environment + engineering + Vastu experts).

Community Engagement:

- Schools & Colleges: Heritage-NBS modules, competitions, river-cleanup + storytelling events.
- Storytelling & Rituals: Utilize traditional narratives, festivals, and rituals (such as Ganga Aarti, Jal Poojan, and Van Mahotsav) to connect people emotionally.
- Local Participation: Empower citizens' groups to monitor projects, adopt stepwells, and maintain ghats.

International Models:

- Denmark: Aarhus & Copenhagen involve museums, historians, and communities in every waterway/greenway planning. Heritage isn't "extra"; it's core.
- Singapore: Restored river culture + mangroves alongside modern flood management.







Individual Action

Daily Lifestyle Choices
Save water & electricity – switch off taps, lights, fans, and appliances when not needed.
Reduce plastic use – carry cloth bags, steel bottles, avoid disposables.
Adopt minimalism – buy only what is needed, focus on *need-based* living rather than *greed-based*.

Eco-Friendly Habits
Plant & nurture trees – even a single tree can provide oxygen, shade, and shelter.
Segregate & recycle waste – compost kitchen waste, recycle paper, glass, and e-waste responsibly.
Use sustainable transport – walk, cycle, or carpool to reduce emissions.

Protecting Biodiversity
Feed birds & animals ethically – place water bowls for birds, protect stray animals, avoid harming insects.
Support native species – grow local plants in gardens, which support bees, butterflies, and birds.
Say no to wildlife exploitation – avoid buying products made from animal skins, horns, feathers.

Community & Awareness
Educate family & friends – spread awareness of traditions, rituals, and modern eco-friendly practices.
Support local eco-friendly products – artisans, organic farmers, and craftspeople.
Participate in clean-up drives – lakes, rivers, streets, and forests.
One-line message:



Protecting nature doesn't need big actions, it needs small conscious choices — made daily, by all of us."

Collective Action

From Denmark (for India to learn):

1. **Aarhus River Restoration** – restored a buried river, revived fish population, improved air quality, and boosted civic identity → model for Indian urban riverfronts (without losing heritage).
2. **Holystic Approach** – Use of different knowledge groups to make the project -
3. **Copenhagen Green Connections** – links parks, heritage sites, and waterways into a connected eco-network → India can adapt this to reconnect lakes, stepwells, and temple tanks.



From India (for Denmark to learn):

1. **Udaipur Lake System** – centuries-old catchment management (lakes–stepwells–wetlands) sustains a desert city → low-cost, resilient model against droughts.
2. **Sacred Groves (Orans of Rajasthan, Kerala's Kaavu)** – community-protected forests ensuring biodiversity → shows how faith & culture create lasting stewardship.
3. **Havelis & Heritage Tourism (Nawalgarh, Shekhawati) –** conservation linked with local livelihoods → Denmark can draw from this to connect heritage with sustainable tourism.

Opportunity: Mutual Collaboration

- **Denmark → India:** Technical expertise, policy frameworks, climate-smart urban design as per Indian Climate, Way of Quick & Coordinated Implementations.
- **India → Denmark:** Futuristic planning in accordance to Nature, Cultural anchoring, community-driven conservation, heritage-linked stewardship.
- **Together:** A holistic NBS model blending **science + tradition + community**, exportable globally.

1. Policy Shift

“No heritage, no approval.”

Just like no one builds a house without an architect, no NBS should be approved without heritage experts, knowledge groups Involved at the table.

2. Cross-Sector Collaboration

“Engineers, planners, heritage experts — not three teams, but one cricket team.”

When they play together, the city wins.

3. Education & Awareness

“Teach planners that Peepal trees give more oxygen than air conditioners.”

Future professionals must learn that culture is not decoration, it is survival.

4. International Exchange

“Denmark has the planning, India has the prayers — together, we can build miracles.”

Cross-pollination makes solutions stronger and more universal.

5. Community Rituals as Tools

“If people can gather to play Holi with colors, they can gather to clean a lake with the same enthusiasm.”

Festivals and rituals are the most natural way to involve communities in conservation.

Closing Reminder:



“Policies may be written in offices, but heritage lives in people’s hearts. If we connect both, Nature-Based Solutions won’t just succeed — they will flourish for generations.”


ITS YOUR'S CHOICE
"If we forget our rivers, our trees, our traditions — we are not developing solutions, we are digging our own graves."
"But if we listen to heritage, respect nature, and act together — we are not just building projects, we are gifting life itself to our children."



So, Lets Stop Making Our Mother Cry

Make this Earth -Loving & Beautiful Again with her Blessings





So, Start Loving Our Mother Again



“So, my humble request to all of you :
from today, let no Nature Based Solution in the world be approved without heritage at its heart.

Only then can our Earth breathe free again.”

Jai Hind, Jai Bharat

Thank You



If you think, Our Colloborations can do Miracles: Scan this QR to keep the connection on.

Gaurav S Singhvi

LUXURIOUS LIFESTYLE DESIGN CONSULTANT

INTERIOR DESIGNER & VASTU CONSULTANT





Latest Example from



चिंताजनक: 102 मीटर चौड़ी नदी को पहले किया 50-55 मीटर, मौके पर 37 मीटर तक छोटी

देखो किसने घोंटा आयड़ का गला

आयड़ चमकाने के बजाय रसूखदारों के कब्जे पर चलाओ बुलडोजर, पानी फिर बरपाएगा कहर

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मोहम्मद इलियास
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उदयपुर: देखो हाकम और विधायक जी, किसे कैसे किस-किस ने आयड़ नदी का गला घोंटा। वर्ष 1990 में 102 मीटर चौड़ी आयड़ नदी सरकारी कागजों में मात्र 50-55 मीटर रह गई और अब कई जगह 35-40 मीटर में सिमट गई। जहां छोटी हुई वो सब इलाका पॉश व रसूखदारों नवरतन कॉम्पलेक्स व भूपालपुरा का है। इन रसूखदारों ने आयड़ नदी किनारे पेटे में कब्जा कर किसी ने रिटर्निंग वॉल बना दी तो किसी ने निर्माण कर इमारत खड़ी कर दी।

नदी में इतना अतिक्रमण होने के बावजूद वोट की राजनीति में किसी ने इन पर बुलडोजर नहीं चलाया। अधिकारियों ने कार्रवाई की बजाय उन्हें नदी पेटे में पट्टा दे दिया। यही कारण प्रशासन व स्मार्ट सिटी ने पूरी कर दी। अतिक्रमण उजागर होने के बावजूद कार्रवाई के बजाय आगे से निर्माण कर अतिक्रमियों को शह दे दी। अब जब आयड़ नदी ने अपनी प्राकृतिक सीमा में बहते हुए रौद्र रूप दिखाया तो सबकी आंखें खुलकर बाहर आ गईं।

60-70 मकान डूब क्षेत्र में, सिर्फ गरीबों पर चलाया डंडा

स्माई सिटी की ओर से 5 किलोमीटर क्षेत्र में नदी को संवारने पर 75 करोड़ रुपए खर्च किए गए। इस बार भारी बारिश के कारण अर्ली बाद आयड़ के पूरी वेग में बहने पर इस क्षेत्र में करीब 60 से 70 मकानों में पानी में भर गया तो कई क्षेत्रों को भारी नुकसान हो गया। सर्वाधिक गड़बड़ी नदी के छोटे वाले स्थान नवरत्न कॉम्प्लेक्स पुलिया के आगे व भूपालपुरा क्षेत्र में की गई। हैरत की बात यह है कि इन गड़बड़ियों वाले इलाके को प्रशासन और जनप्रतिनिधियों ने नजर अंदाज कर सुभाषनगर क्षेत्र में गरीबों पर डंडा चल दिया। यह क्षेत्र तो सुरक्षित है, नुकसान सिर्फ रसूखदारों के कब्जे वाले इलाकों में हुआ।



नवरत्न कॉम्पलेक्स पुलिया के समीप नदी पेटे में ही निर्माण, यहां पर पानी के बहाव के कारण दोनों तरफ मकानों में पानी घुसा। पत्रिका



नवरत्न कॉम्पलेक्स पुलिया अतिक्रमण हटाने के बजाए उसके आगे से बना दी गई के यहां नदी पेटे में बनाई रिटर्निंग वॉल। पत्रिका

देखिए, कहां कितनी छोटी हुई नदी

शहर में आयड़ नदी का उद्गम स्थल मदार विकलवास फीडर से उदयसागर तक

सरकारी कागजों में 102 मीटर थी, उसे अभी 50-55 मीटर बताई

यहां इतनी कम हुई

- पुला- 49 मीटर
- कृष्णपुरा कॉजवे - 37 मीटर
- भूपालपुरा - 47 मीटर
- अशोक नगर श्मशान- 40 मीटर
- अशोक नगर एनिकट - 52 मीटर
- सेक्रसिटी मॉल - 59 मीटर
- पुराना पासपोर्ट ऑफिस - 59 मीटर
- सुभाष नगर - 54 मीटर



करजाली हाउस के पास आयड़ नदी पेटे में निर्माण। पत्रिका



भूपालपुरा क्षेत्र के नदी पेटे में मिट्टी डालकर चौड़ाई ही कम कर दी। पत्रिका

नदी का इतिहास और लेखा-जोखा

26 किलोमीटर उदयपुर क्षेत्र में है आयड़ नदी की लम्बाई

05 किलोमीटर क्षेत्र नदी को स्माई सिटी ने संवारा

75 करोड़ रुपए खर्च किए नदी को संवारने में

05 किलोमीटर क्षेत्र में जहां नदी संवरी वहीं छोटी हुई

1990 में औसत 102 मीटर चौड़ी थी नदी

50-55 मीटर औसत रह गई कई जगह पर

37 मीटर सबसे कम चौड़ी वाली जगह है अभी

60-70 मकान 5 किमी. के दायरे में आए डूब क्षेत्र में

09 गांव को उदयसागर के बैकवाटर ने कर दिया तरबतर

साढ़े चार-पांच हजार साल पुरानी सभ्यता की साक्षी आयड़ नदी बेड़च, बनास और चंबल होते हुए गंगा तक पहुंचती है, आज वह खुद अस्तित्व की लड़ाई लड़ रही है। उत्तर, दक्षिण और पश्चिम के पहाड़ों से आने वाला बरसाती पानी इस नदी में मिलता है और यही नदी उदयपुर के भूजल और झीलों की रीढ़ रही है। लेकिन कांक्रीट विकास, अतिक्रमण और लापरवाही ने इसी एक नाले में बदल दिया है।

जिज्ञासा परमार, आयड़ नदी पर शोधार्थी

साढ़े नदी को उसके मूल स्वरूप में वापस नहीं लाया गया, अतिक्रमण नहीं हटा तो आयड़ स्वयं अपने अस्तित्व को पाने के लिए हमें गंभीर दंड देगी। अभी नदी की चौड़ाई असल क्षमता से आधी से भी कम है। आयड़ का तल भी कृत्रिम रूप से समतल कर पत्थर की फर्शी डाल दी गई है, जिससे पानी की रफ्तार तेज हो गई और किनारों पर कटाव बढ़ गया। अतिक्रमण ने भी भारी नुकसान पहुंचाया है।

डॉ. अनिल मेहता, झील विशेषज्ञ

Udaipur in 2025 - Flood









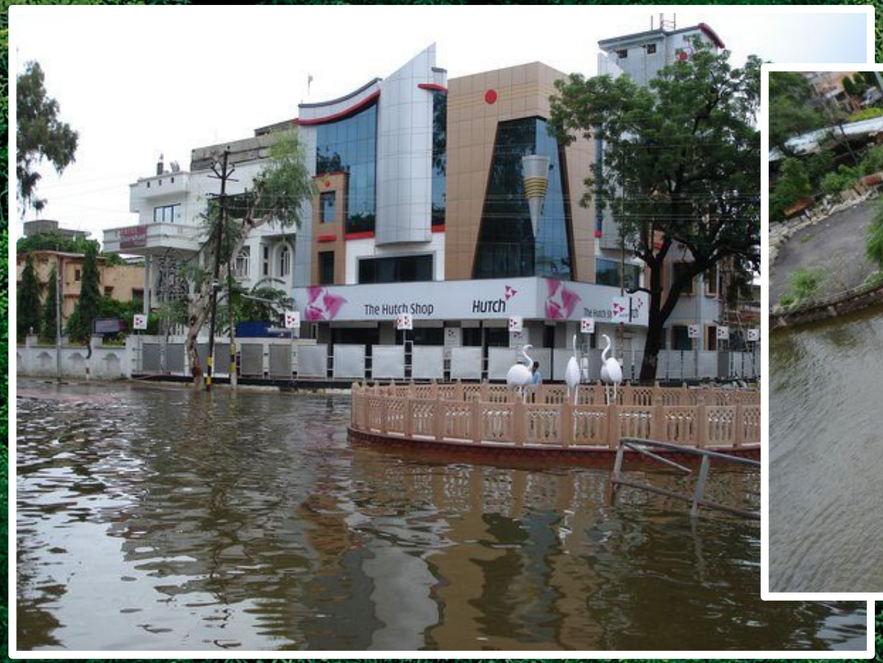
Udaipur in 2025 - Flood









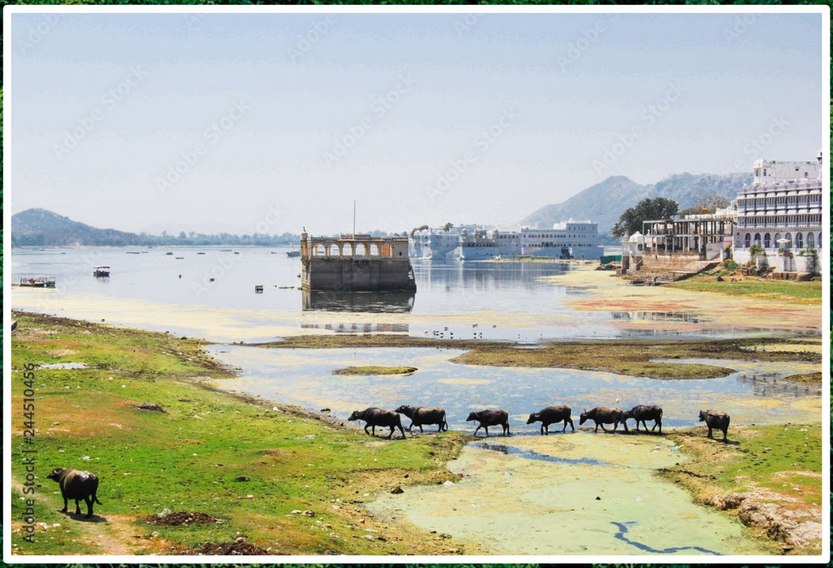






Udaipur in 2009 - Drought









Summary:

- Cultural heritage is **not separate from NBS** – it is its backbone. Actually we are doing wrong – first we are creating the problem and now we are looking for the solutions. It should have be vice versa.
- India & Denmark both prove heritage can drive sustainable development for long term projects.

Recommendations :



1. Policy Shift

"**No heritage, no** approval."

Just like no one builds a house without an architect, no NBS should be approved without heritage experts, knowledge groups involved at the tabe



2. Cross-Sector Collaboration

"Engineers, planners, heritage experts — not three teams, but one cricket team."

When they play together, the city wins.



3. Education & Awareness

"Teach planners that Peepal trees give more oxygen than air conditioners."

Future professionals must learn that culture Is not decoration, it is survival.



4. International Exchange

"Denmark has the planning, India has the prayers – together, we can build miracles."

Cross-pollination makes solutions stronger and more universal.



5. Community Rituals as Tools

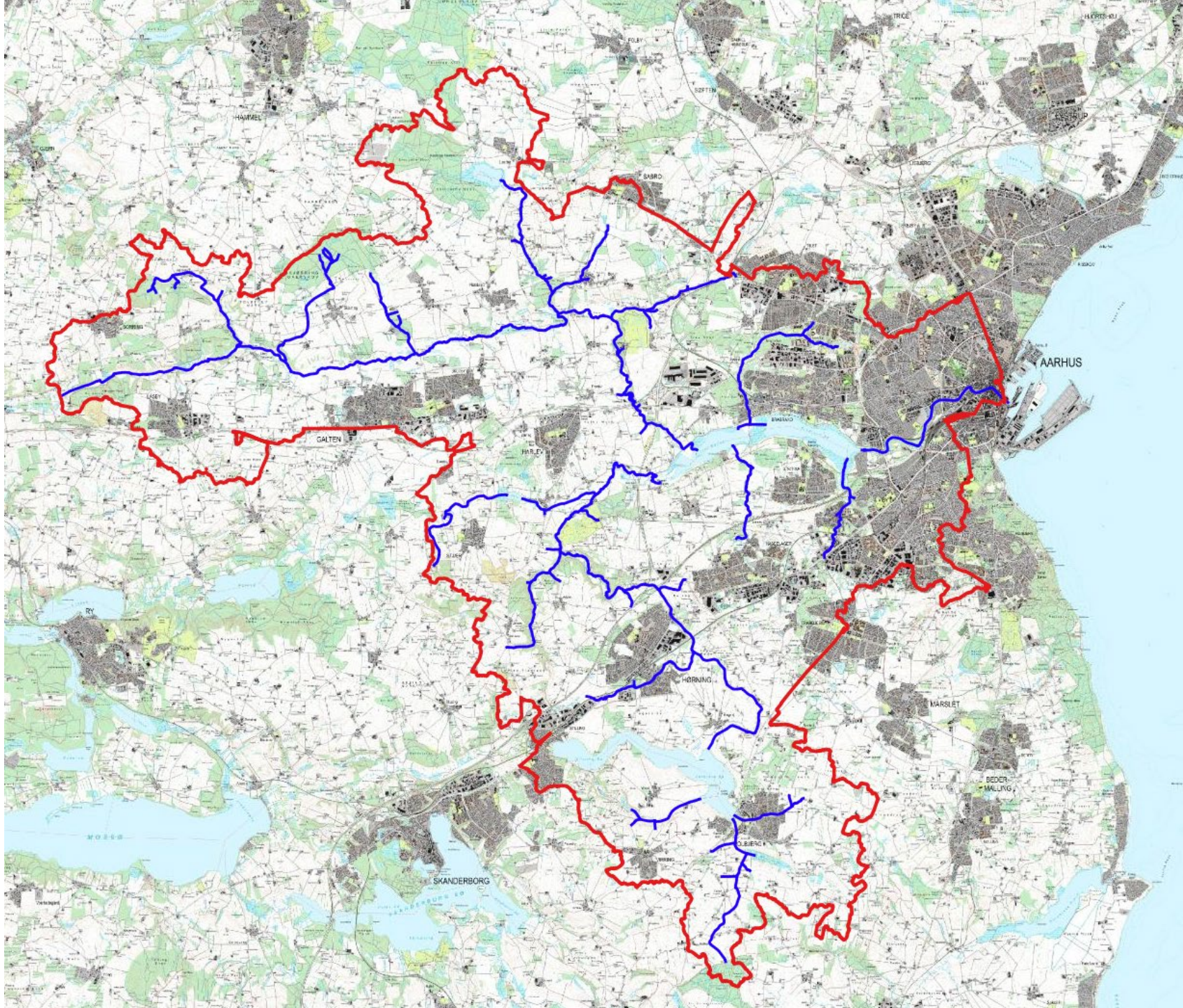
"If people can gather to play Holi with colors, they can gather to clean a lake with the same enthuslasm.

Århus River Catchment

Analysis and Challenges

From a water balance perspective

Rasmus Nielsen

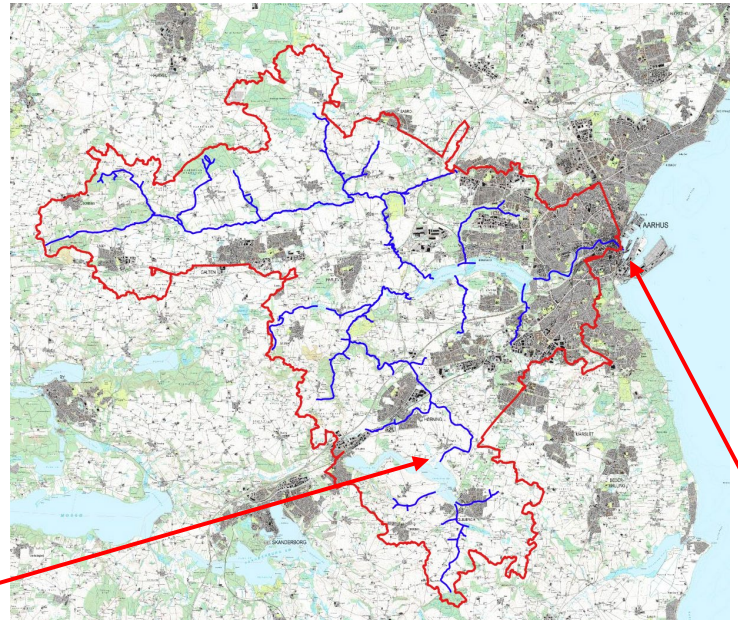


Århus Å – Catchment

330 km^2

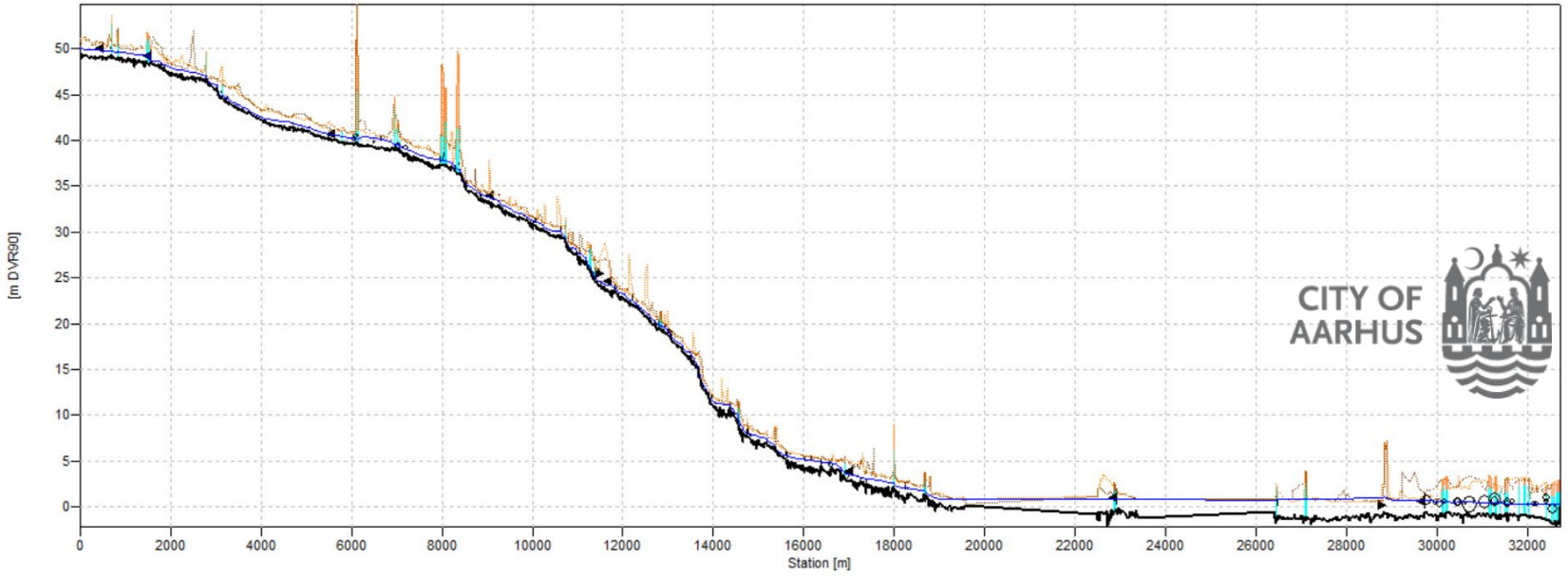
- 13 % urban
- 87 % rural

135 km river



Problems:

- Flooding
- Ecological state



Bay of Aarhu

Flooding

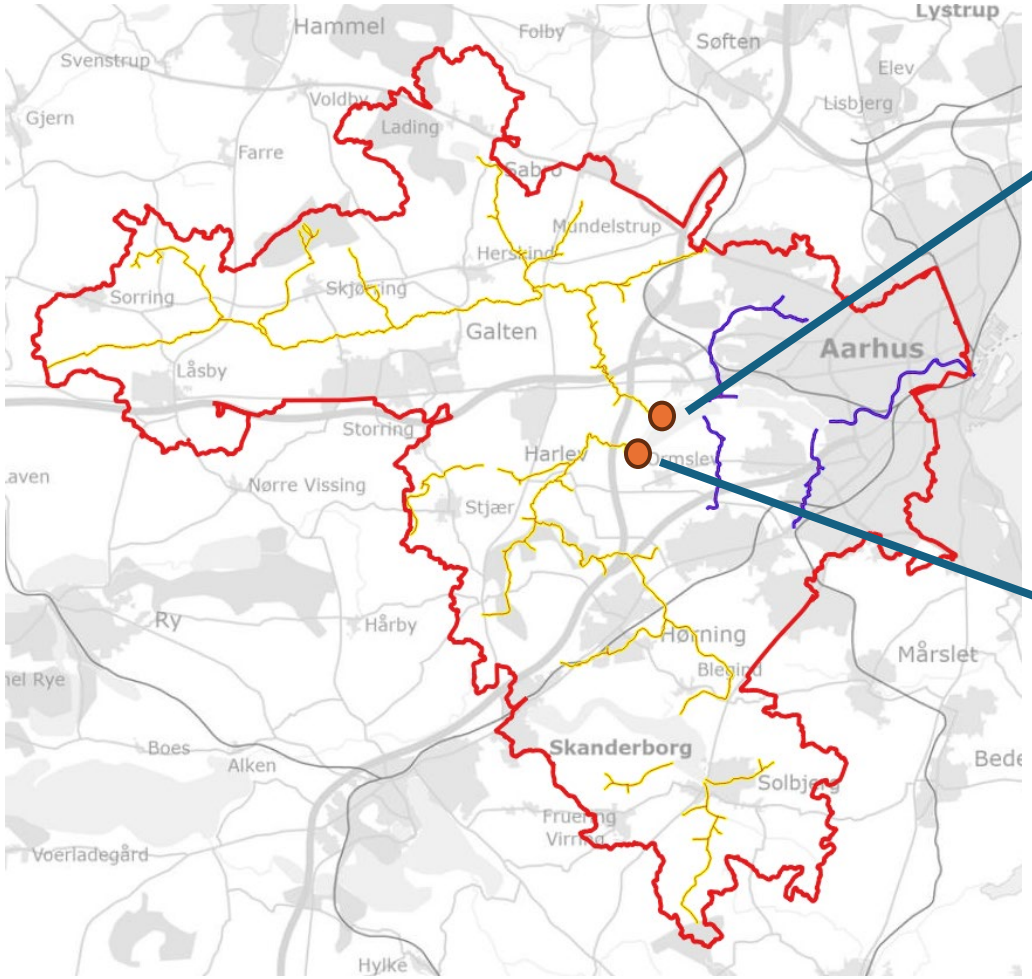
100 year climate projected flood event

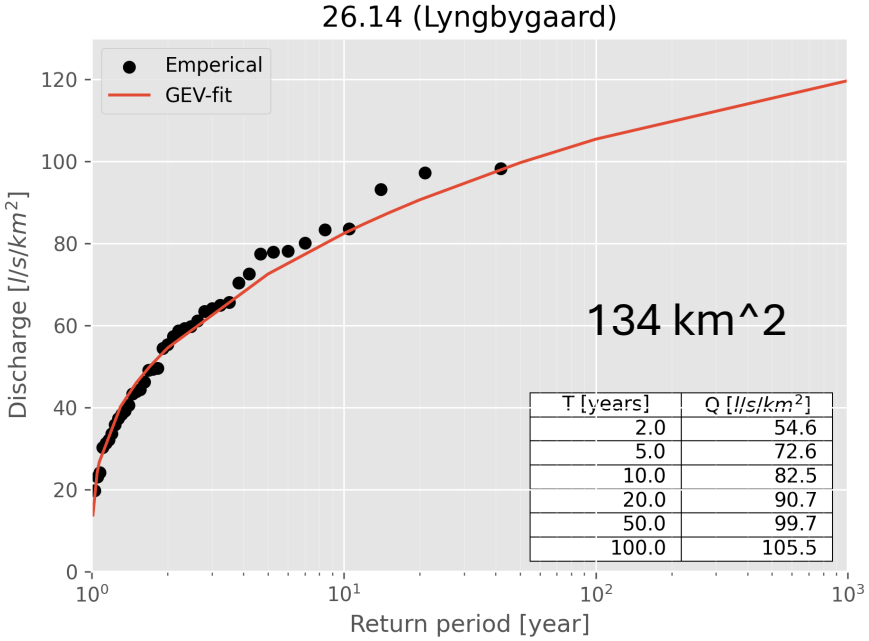


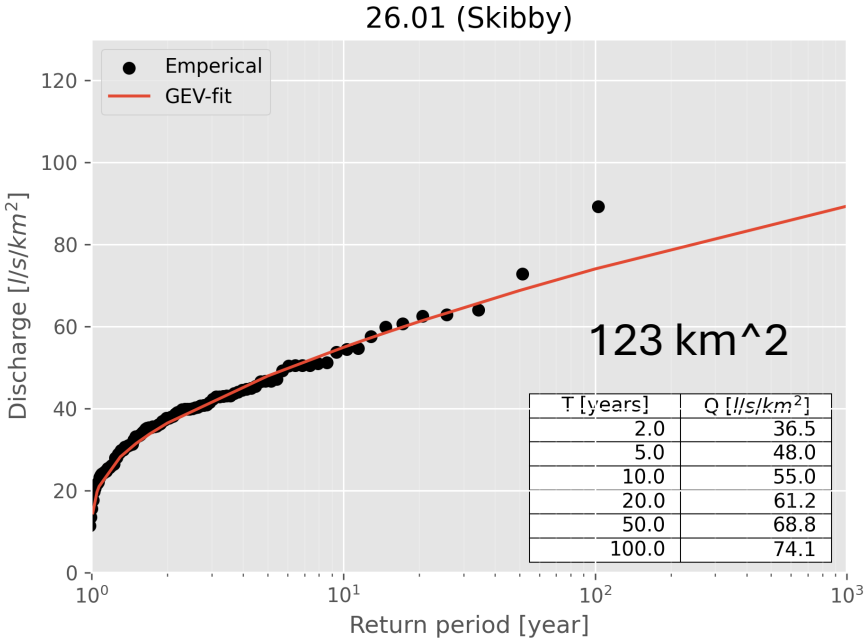


100 year flood event

Investigate!







Solutions / flood mitigation strategies?

Challenge
More water – increasing flow and floodings



Fix
Store and delay

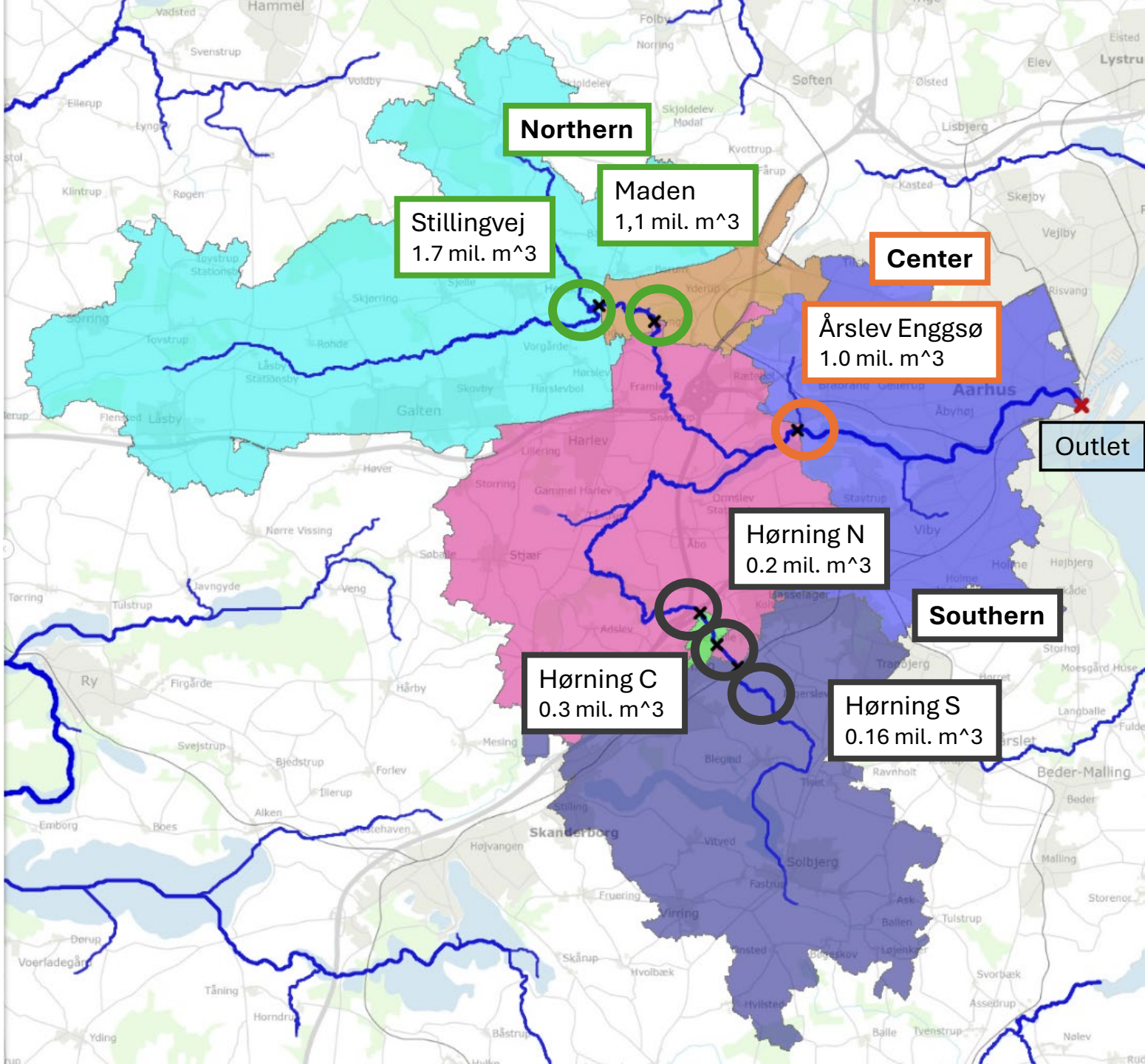


Fix: Store and delay

Overview of potential area for water storage

Fix
Store and delay

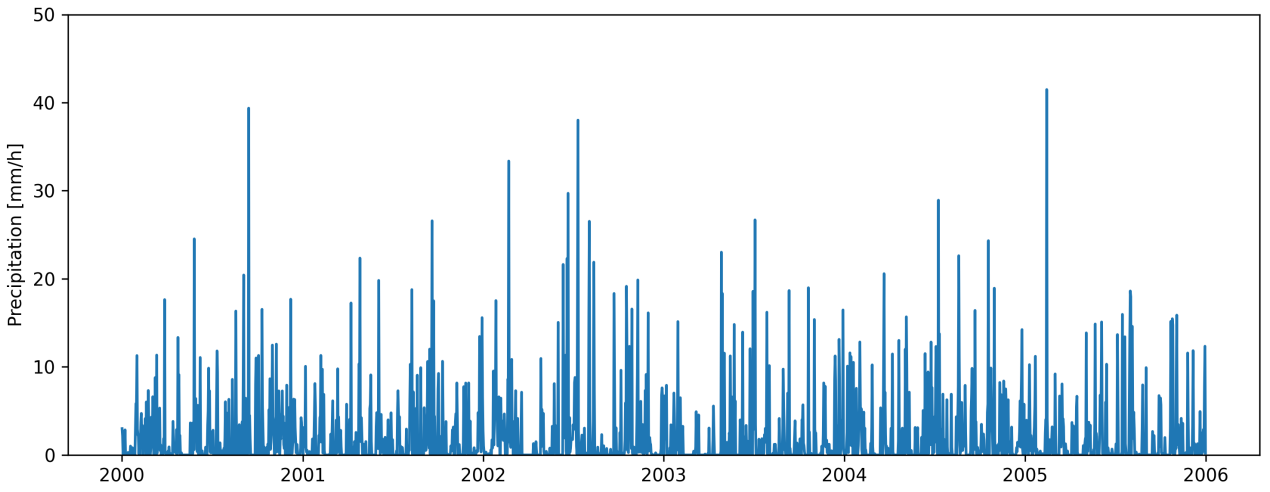


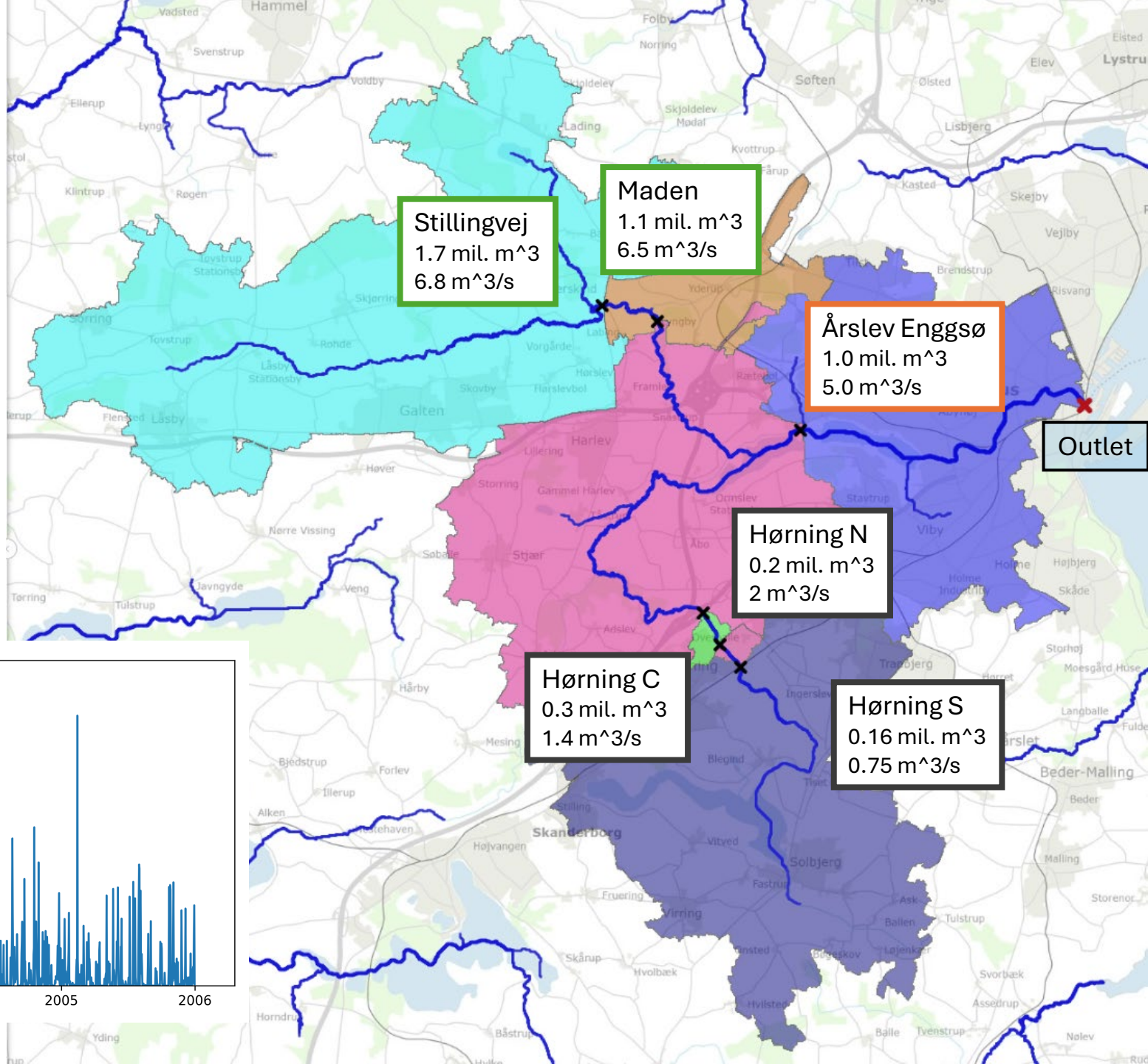


Effects?

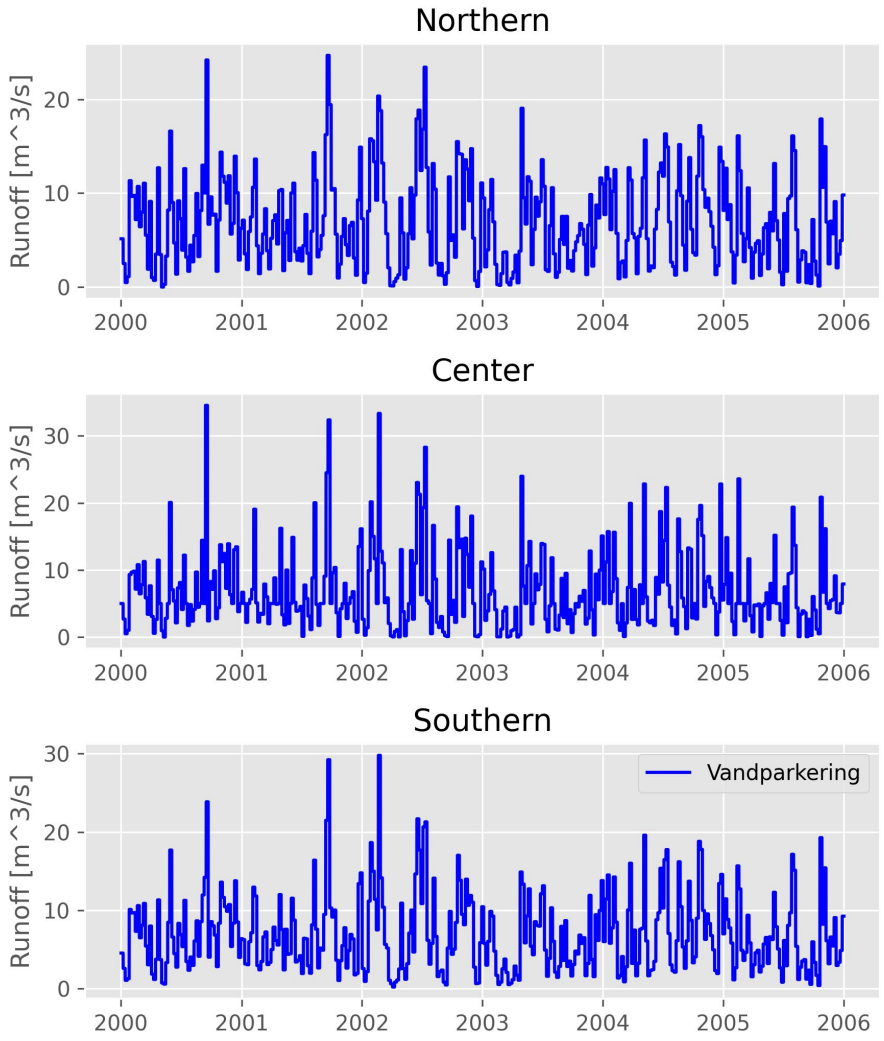
Dynamical simulation of the water balance

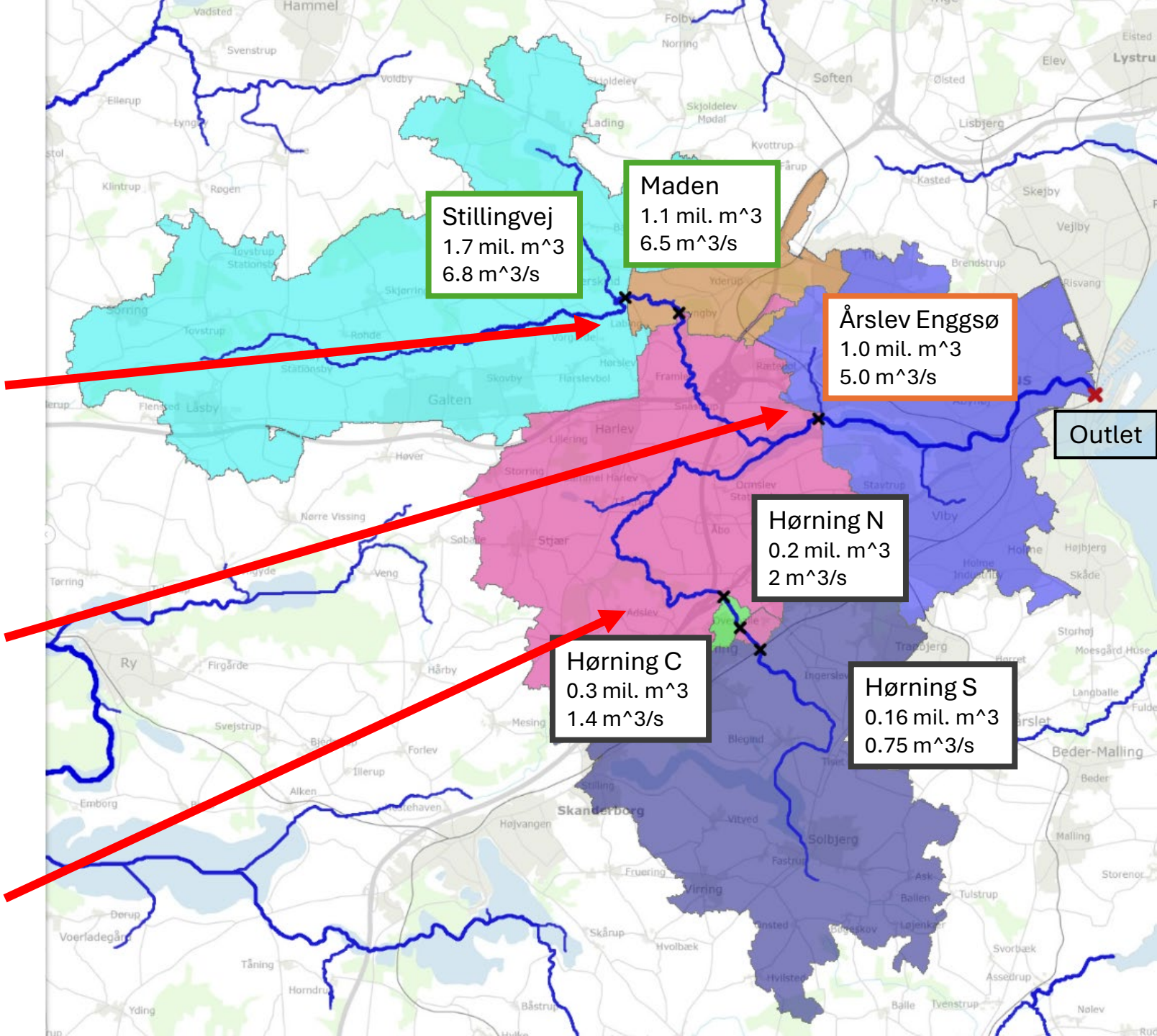
- Variables (simple basins):
  - Volume and flow from outlet
  - Total: 4.4 mil. storage volume
  - Infiltration: Glass model
- Forcing
  - DMI's gridded corrected precipitation (Temporal: daily, spatial: 10 x 10 km)



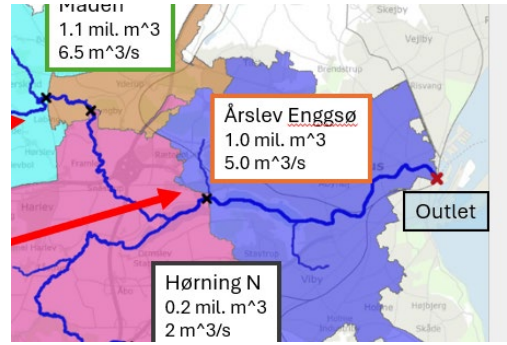


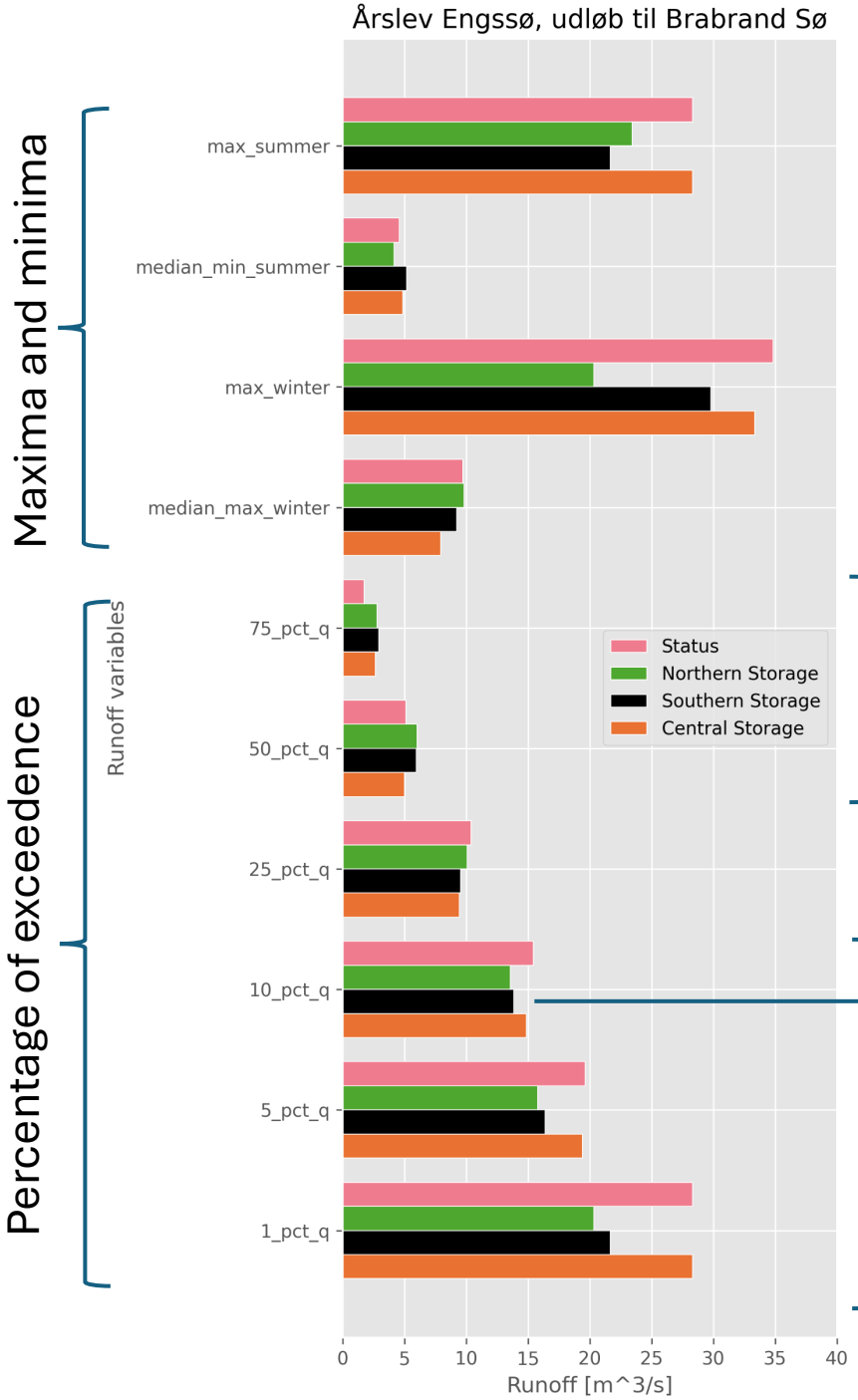
Time series analysis of local effects





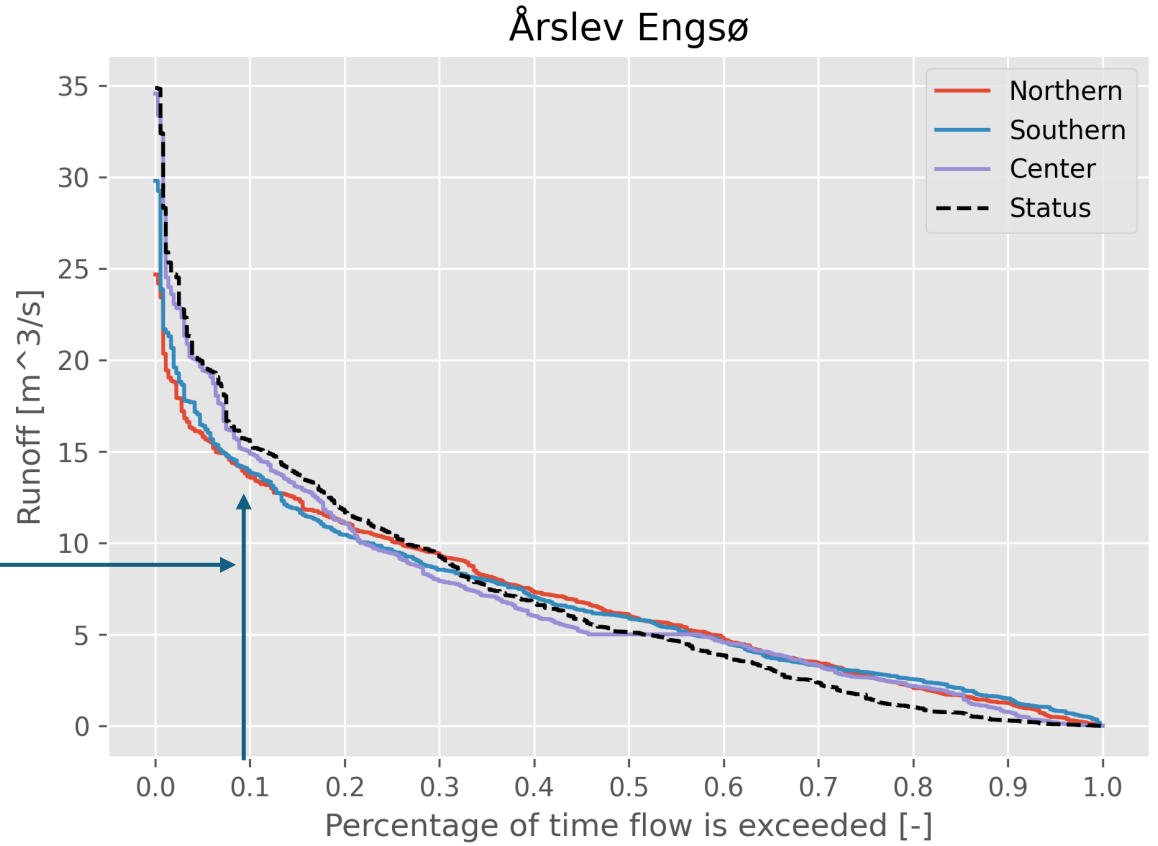
Interpretation of statistical runoff parameters



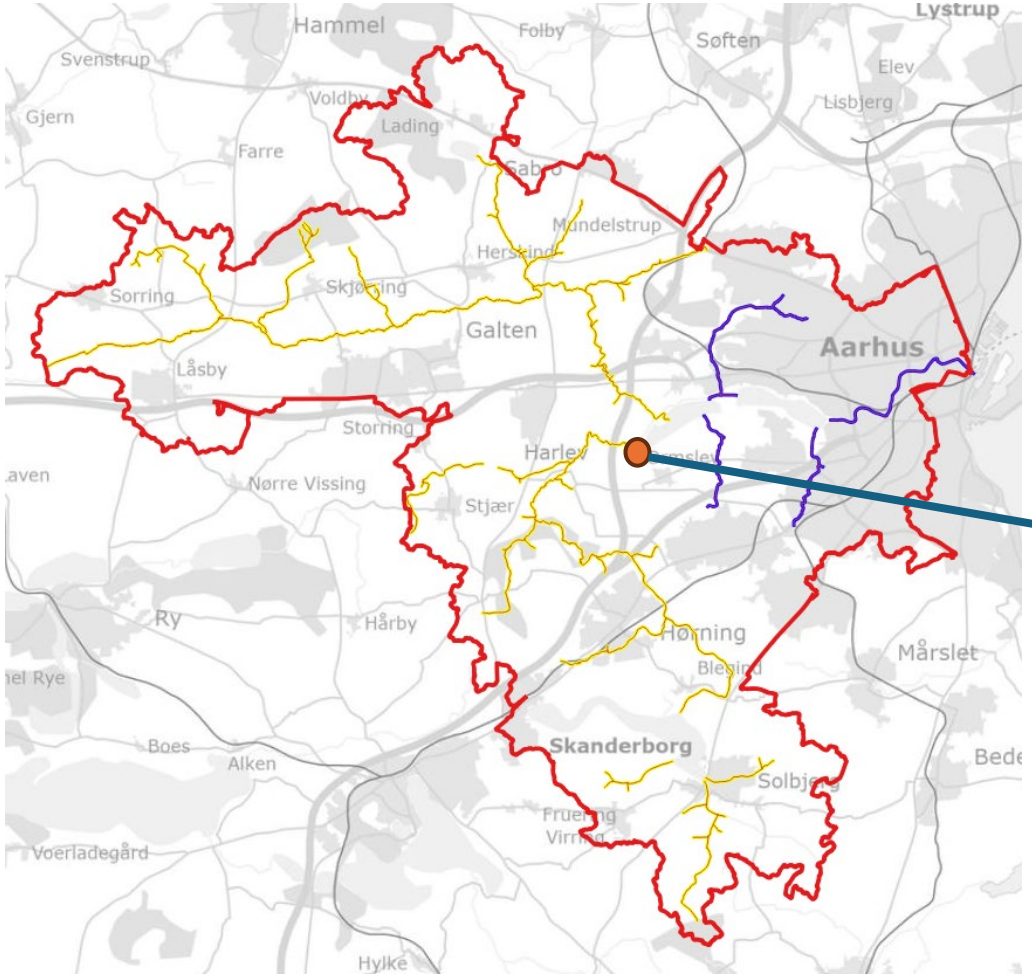


High values indicate better ecological state in vunerable streams

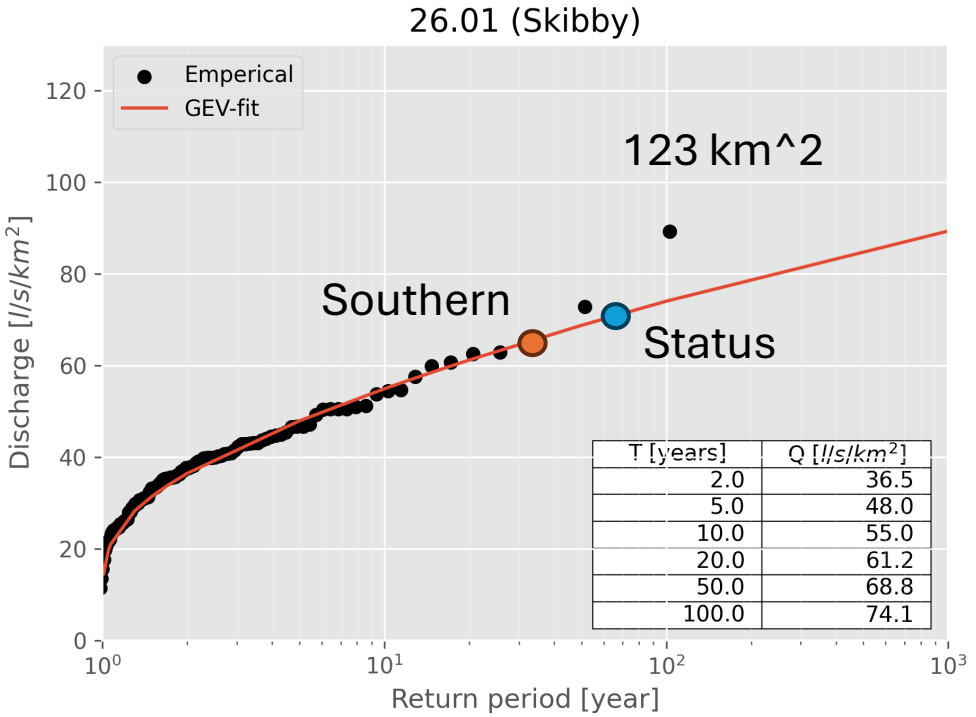
High values indicate greater risk of flood and erosion



Reduced flood risk?



From a 75 year event to a 30 year event?



Fix: Store and delay

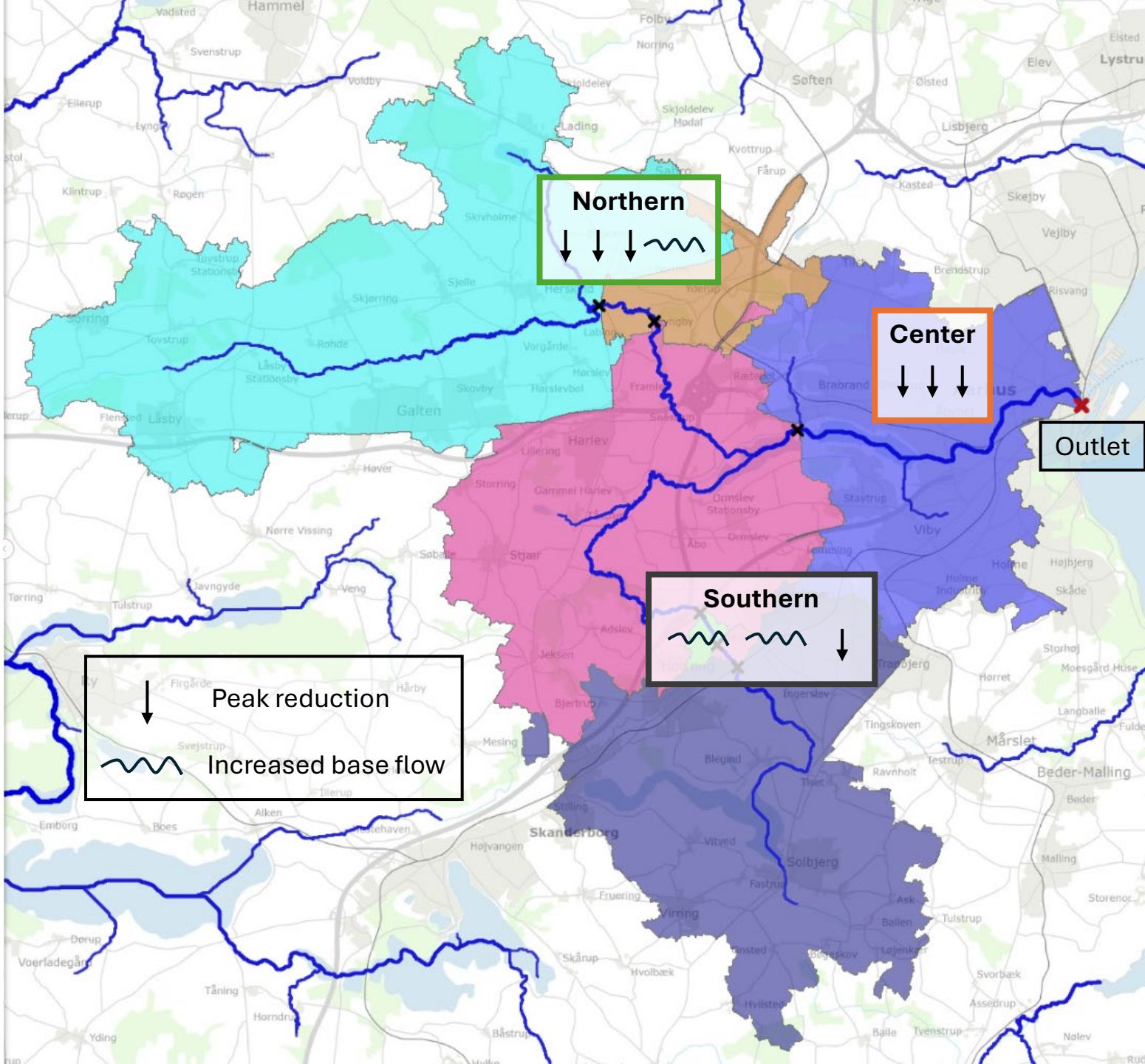
Conclusions

Results indicate:

- Increased base flow to vunerable streams
- Global reduction of flood risk and erosion
  - Northern and center are promising

- Flood risk is significiantly reduced at critical points

- Increased base flow indicates better ecological conditions at vunerable locations



Fix: Store and delay

Ranking of projects:

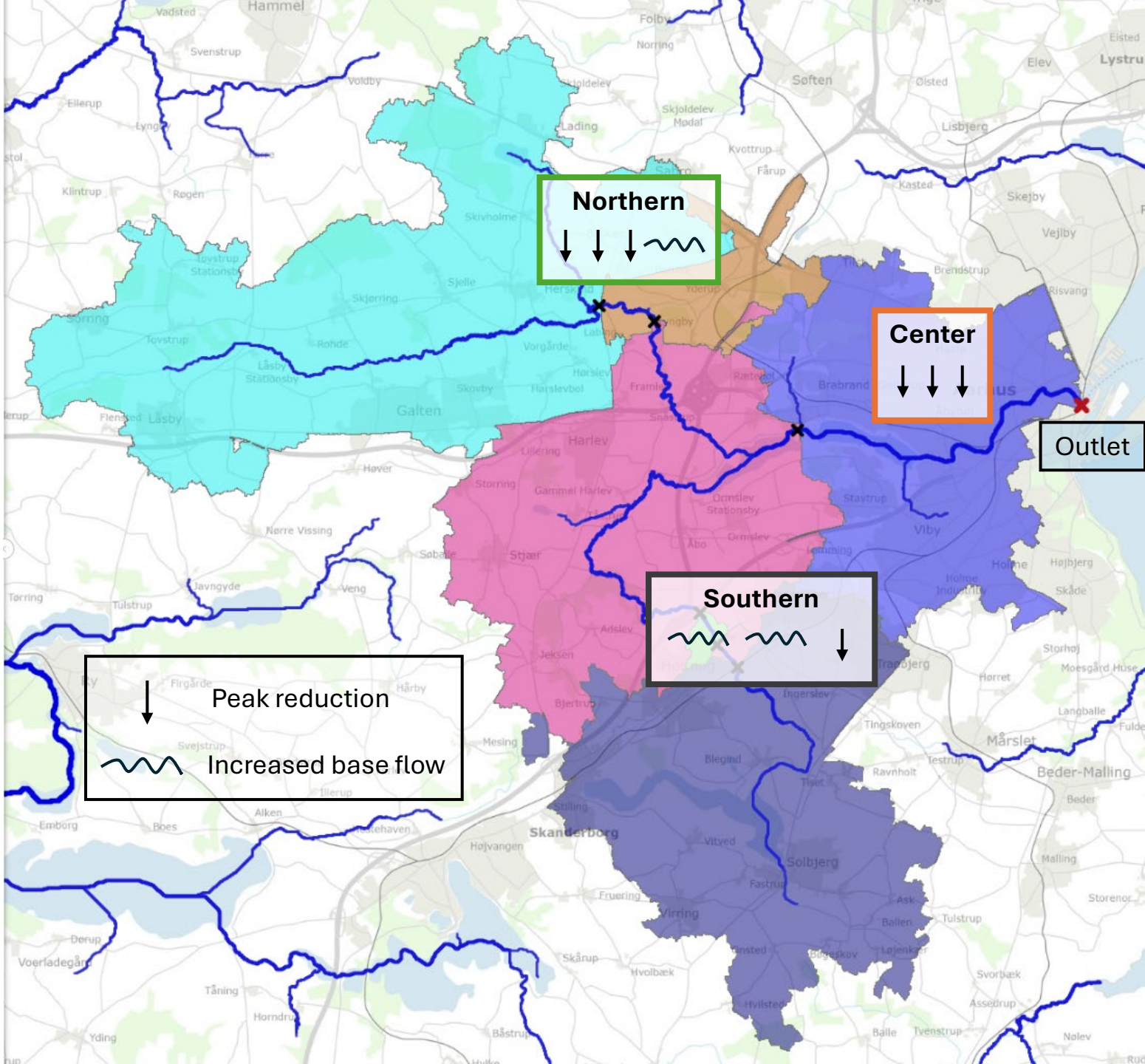
1: Northern

2: Center

3: Southern?

Planning?

External consultancy?



Interreg Baltic Sea Region

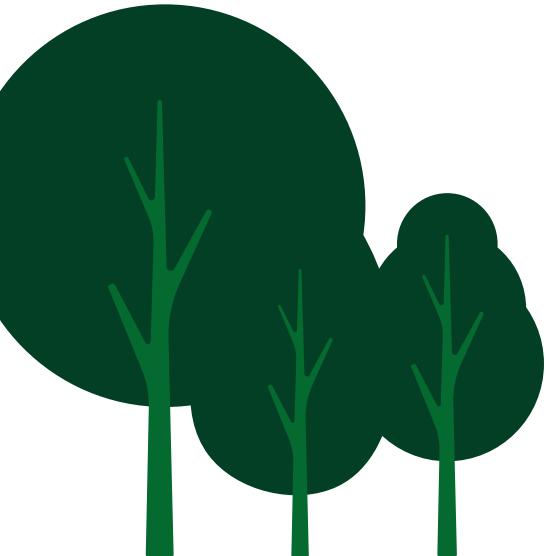
Co-funded by the European Union

SUSTAINABLE WATERS City Blues

Blue and green Malmö

Nature-based solutions in the city

Therése Ehrnstén, City of Malmö





6 The range of and access to green and blue areas has increased in Malmö

8 Malmö's resilience to climate change has increased

A GREEN CITY THAT LEADS THE CLIMATE TRANSITION:

The city of Malmö is committed to enhancing biodiversity and expanding the range of green environments in Malmö

3-30-300 i översiktsplanen

Modellen 3-30-300 är antagen i Malmö stads översiktsplan som vägleder hur Malmös mark- och vattenområden ska användas och utvecklas.

Översiktsplan för Malmö →




1960


2022


1998






2022





Sea level rise by 2125





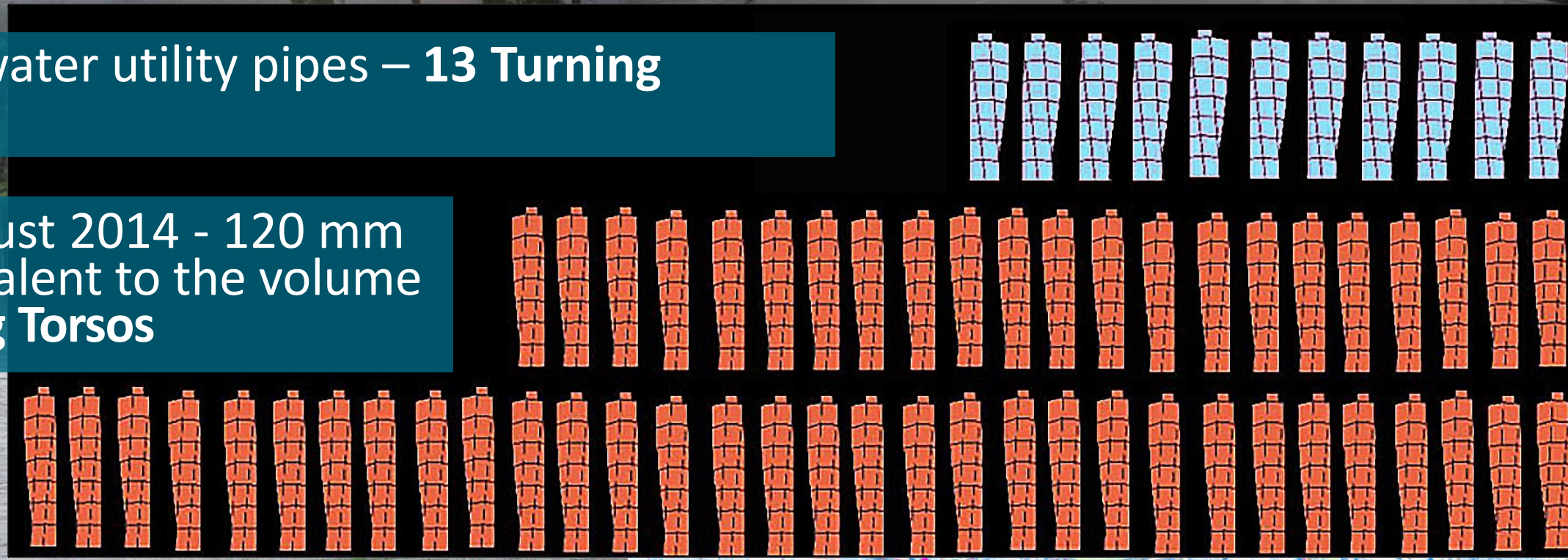
Malmö stad



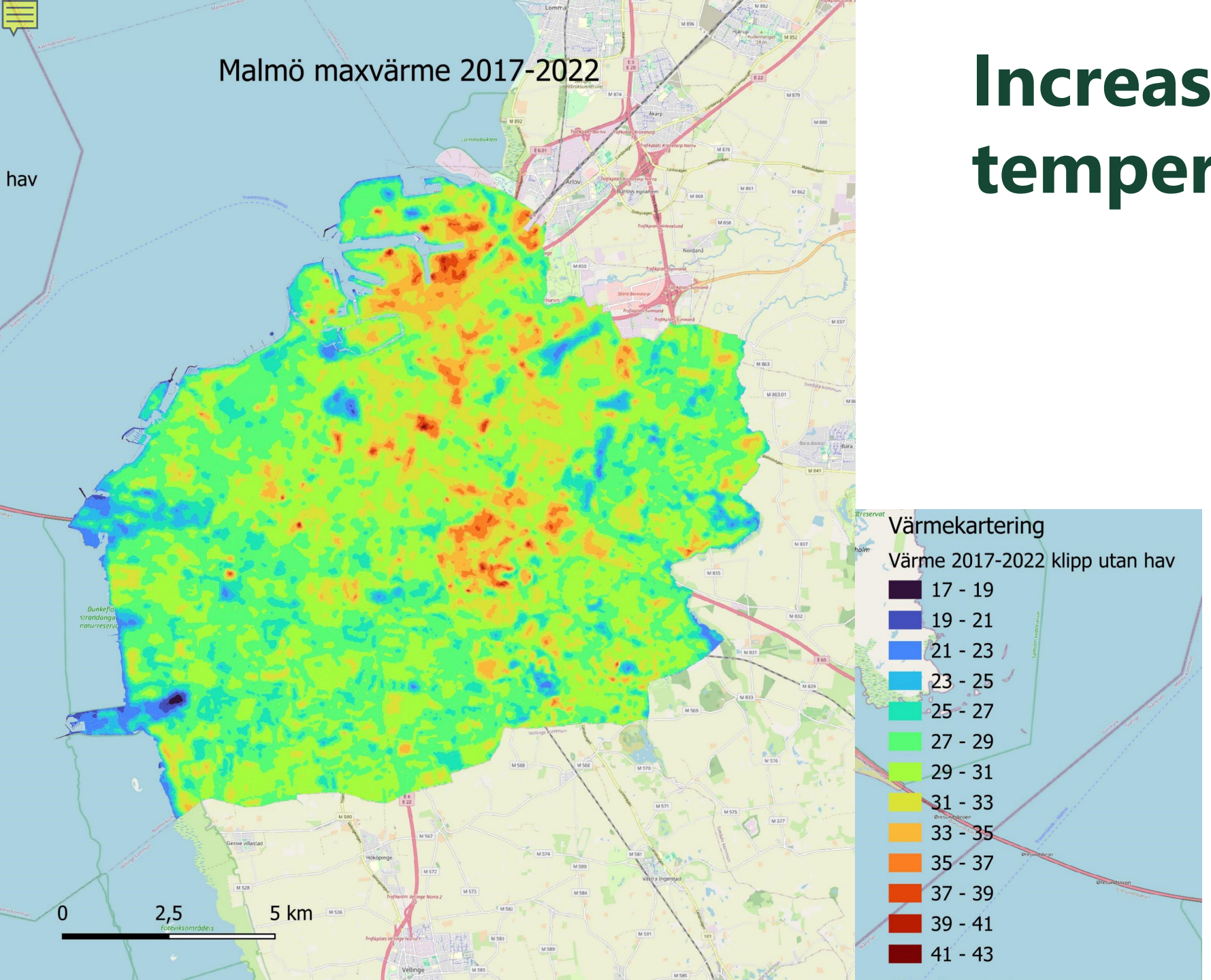


Capacity of water utility pipes – **13 Turning Torsos**

Arvid 31 august 2014 - 120 mm in 6h – equivalent to the volume of **65 Turning Torsos**



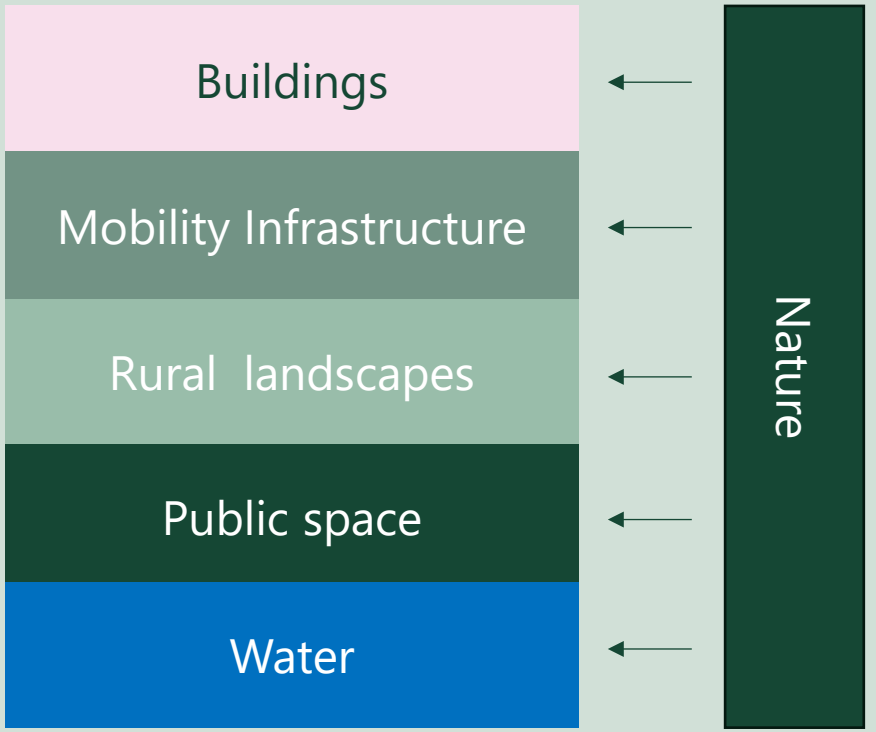
Increasing temperatures



Why nature-based solutions?

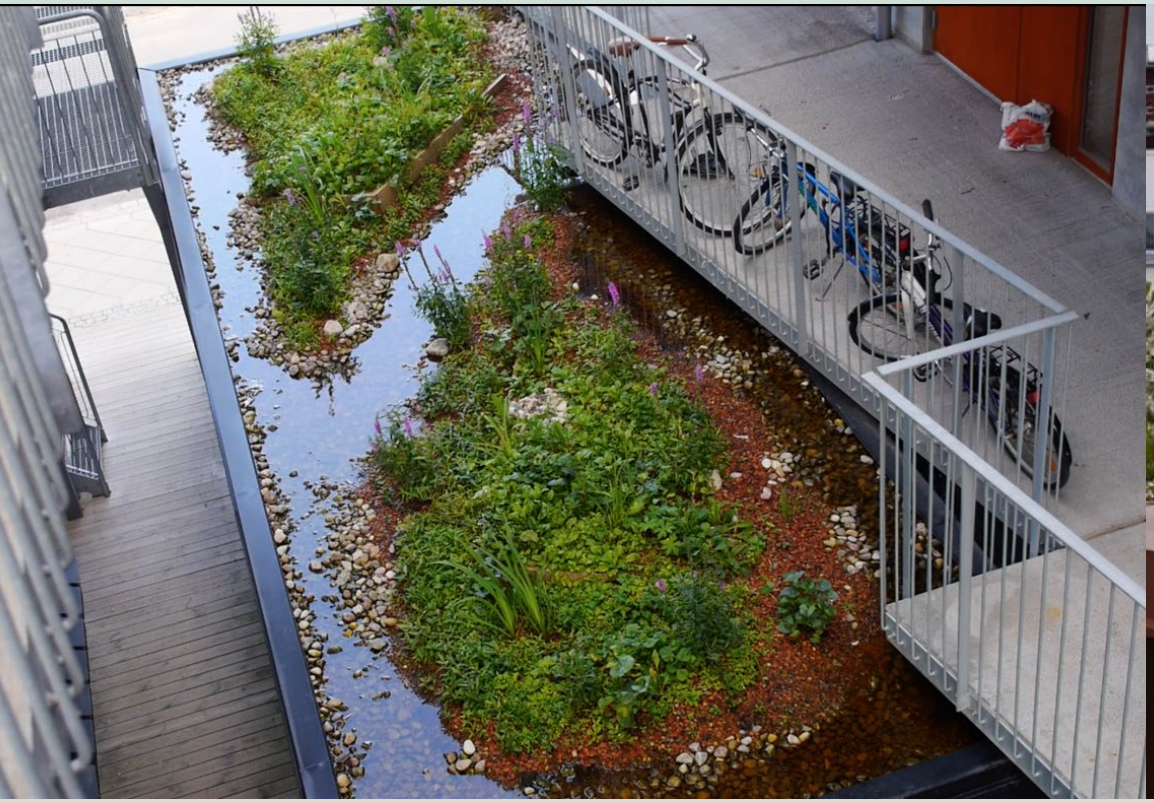
Because we need to do a lot with limited space

Malmö stad


Buildings
Mobility Infrastructure
Rural landscapes
Public space
Water
Nature

Malmö stad

Buildings



Wetland roof at Oh Boy in the Western Harbour



Biotope roof at Koggen in the Western harbour

Malmö stad

Mobility



Raingardens with skeletal soils under parking lots.



Biofilters. Photo: EDGE

Malmö stad

Rural landscapes







Bunkeflo salt marsh

Malmö stad

Public space



Urban microforest



Climate adapted park



From lawn to meadows.

Malmö stad

Public space







Malmö stad

Water





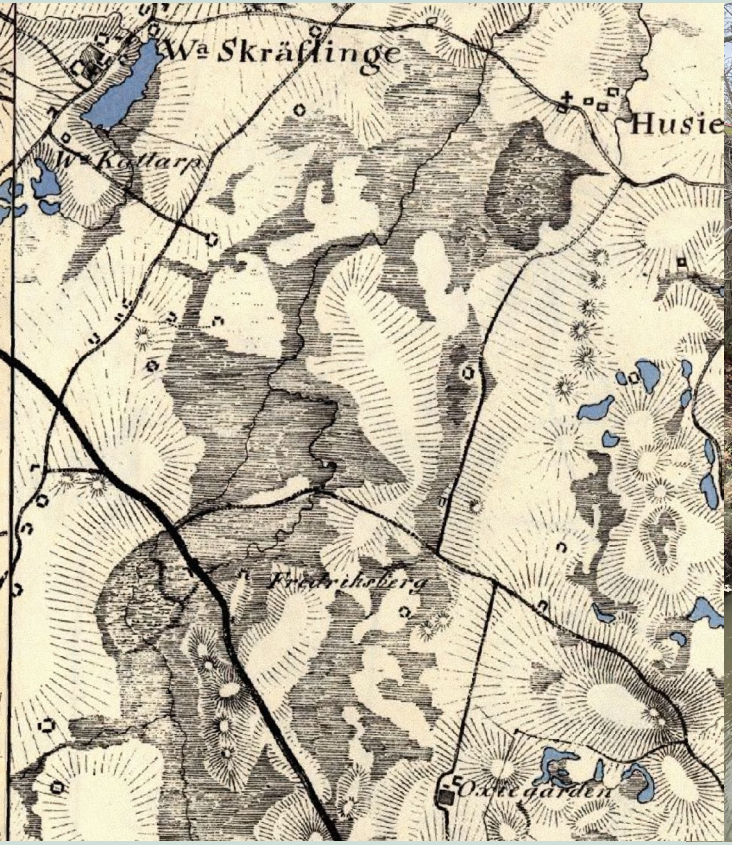


Restoration of seabed in Varvsstaden.
Photo: Marint Kunskapscenter/Michael Palmgren

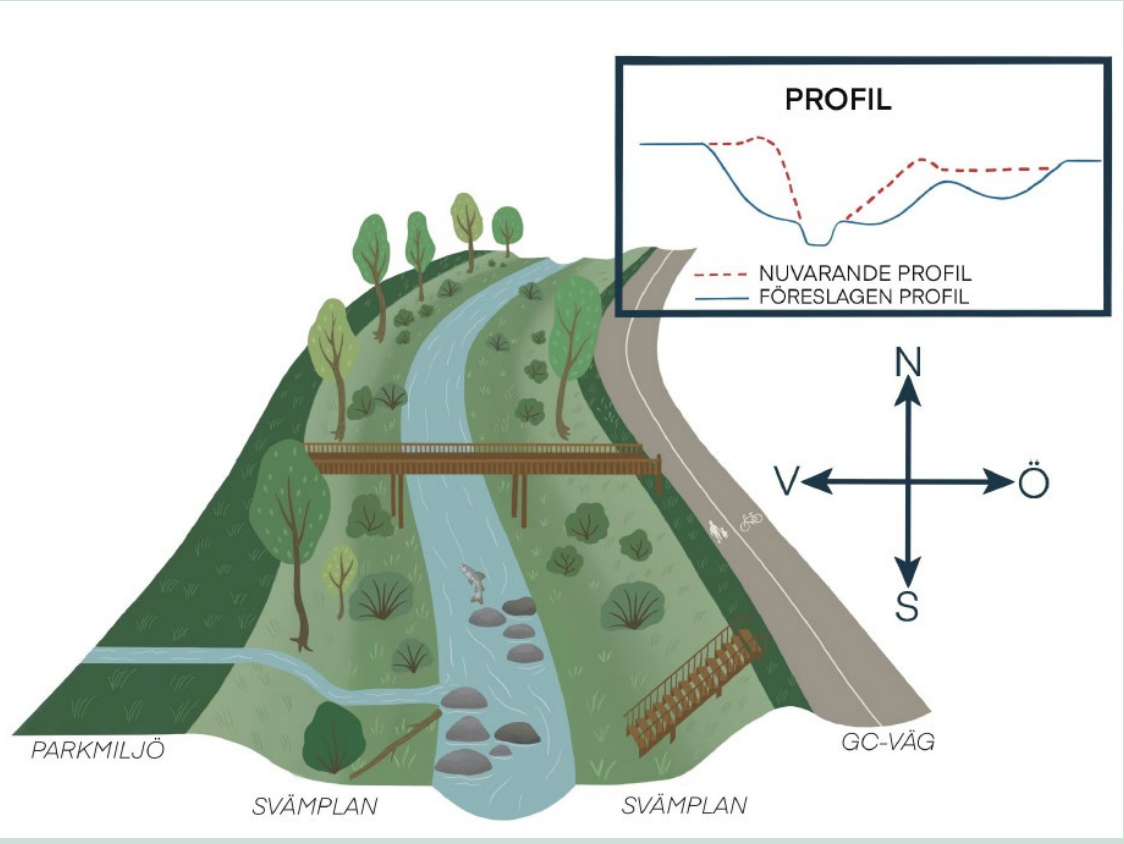
Climate adapted storm water management

Malmö stad

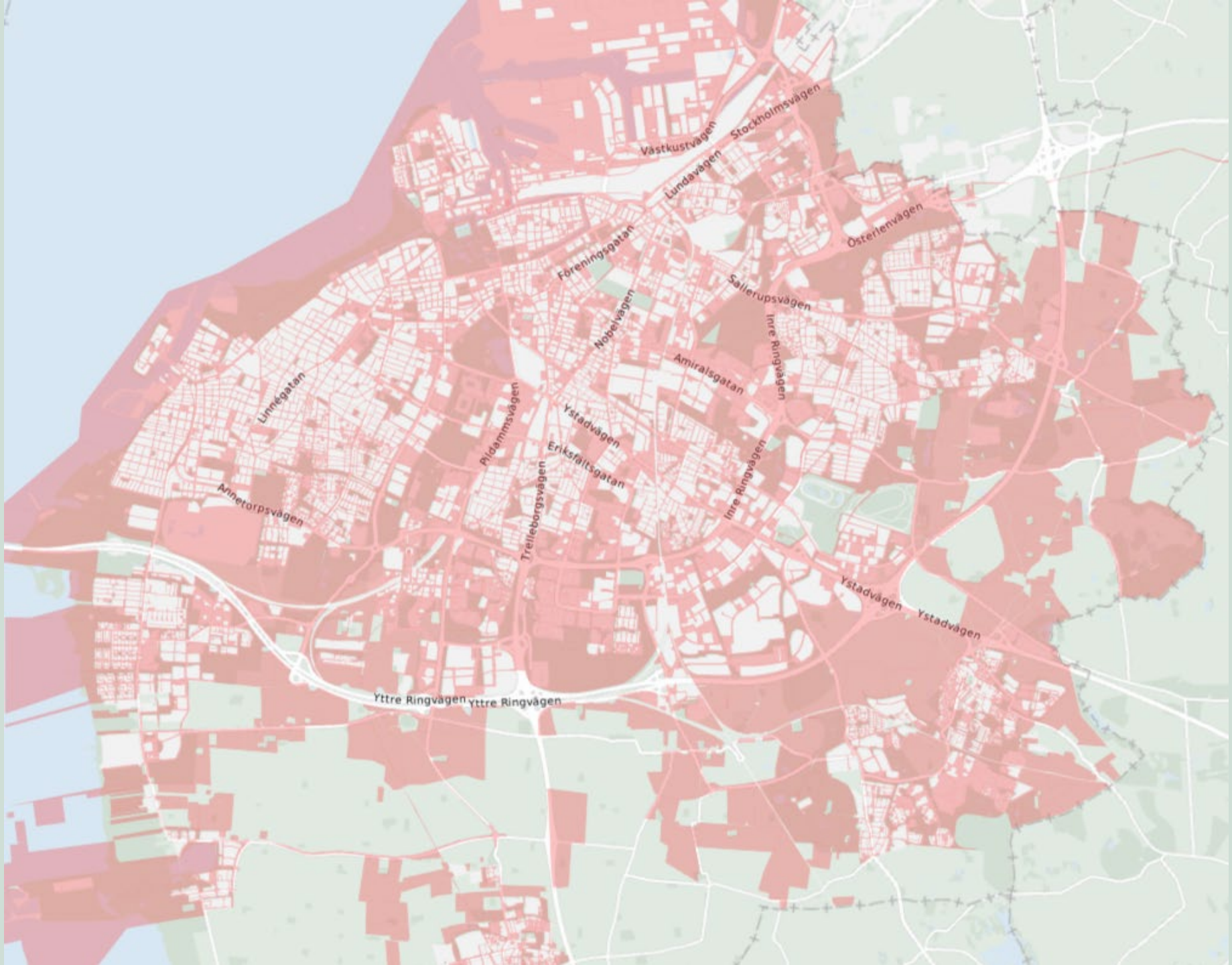
City Blues







Interreg
Baltic Sea Region
Co-funded by the European Union
SUSTAINABLE WATERS
City Blues
Malmö stad


Västkustvägen
Stockholmsvägen
Lundavägen
Föreningsgatan
Österlenvägen
Sallerupsvägen
Nobelvägen
Inre Ringvägen
Amiralsgatan
Limnégatan
Pildammsvägen
Ystadvägen
Eriksfältsgatan
Annetorpsvägen
Trelleborgsvägen
Inre Ringvägen
Ystadvägen
Ystadvägen
Yttre Ringvägen
Yttre Ringvägen

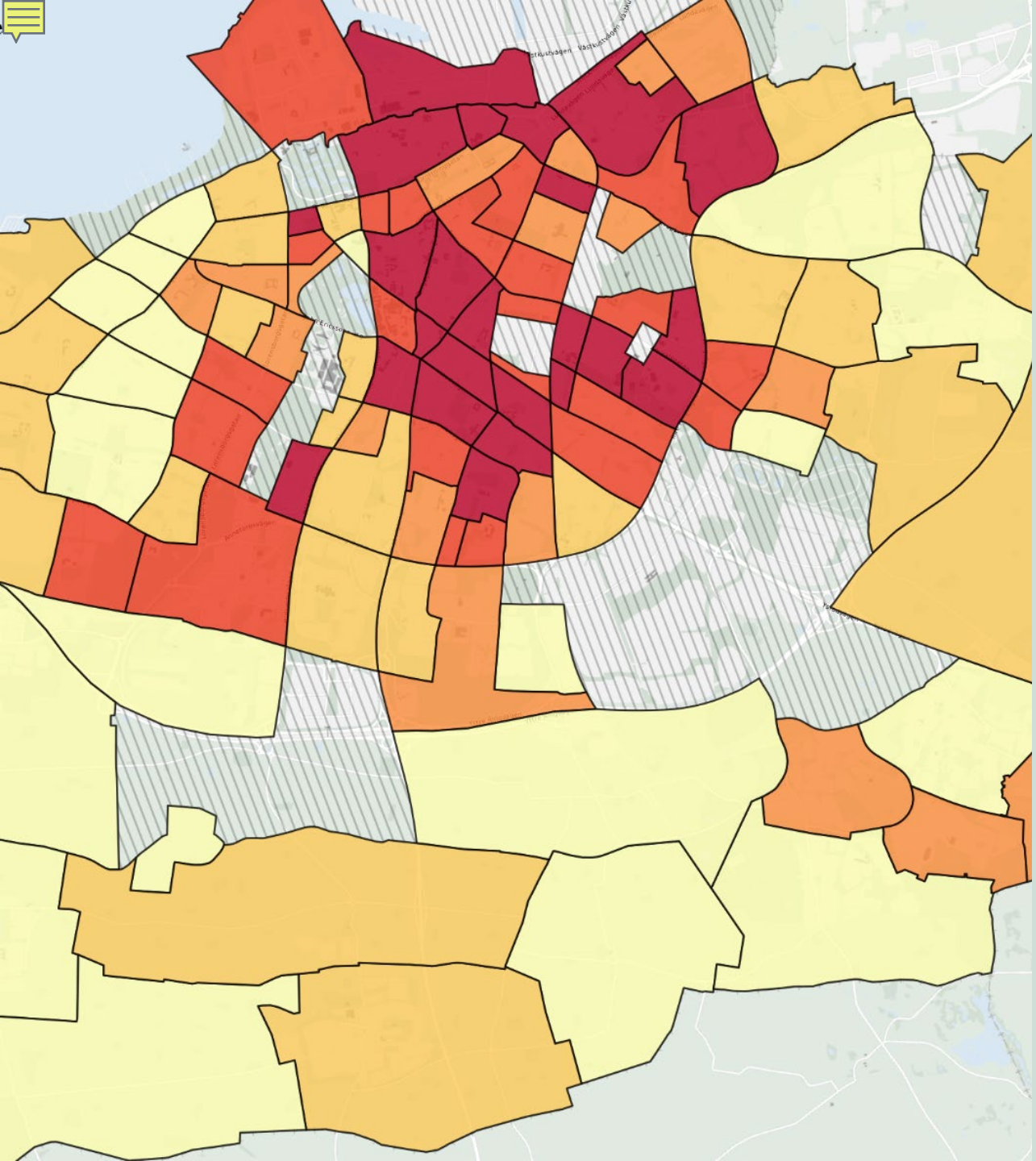
Malmö stad

Stakeholder engagement and collaboration – trial and error



Nature-based solutions need to benefit those with greatest needs

Malmö stad



Justice & Vulnerability

- Who lacks sufficient access to urban nature *and* are in most need of the values it provides?
- We mapped the *distribution* across socio-economic groups as well as the *vulnerability* of neighbourhoods to extreme heat.
- Evidence-based priorities to ensure greatest effect of nature-based solutions.

Malmö stad

Thank you.

Malmö stad

Interreg
Baltic Sea Region

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the European Union

SUSTAINABLE WATERS
City Blues

Holistic planning - Stormwater & Cities

Aarhus Municipality | 25.09.26
Mathias Skov Pristed

interreg-baltic.eu/project/city-blues



Urban planning & Stormwater management
”A matter of scale”

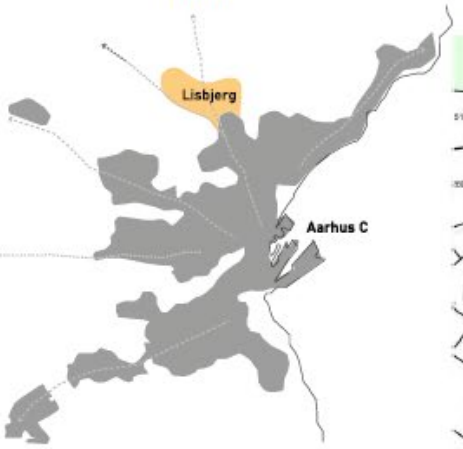
XL L M S XS

Shared vision
Aarhus Minucipality



condenced city
vs
open areas
1 : 100.000

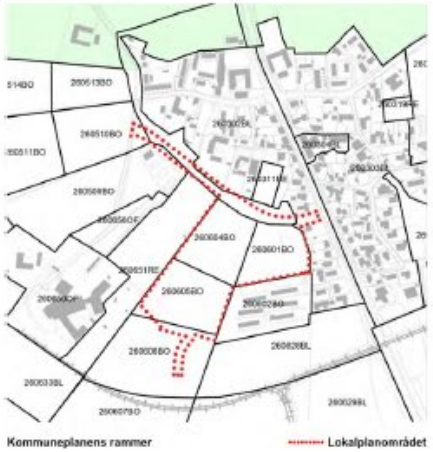
Holistic interdiciplinary
strategic plan
for a smaller
area



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.



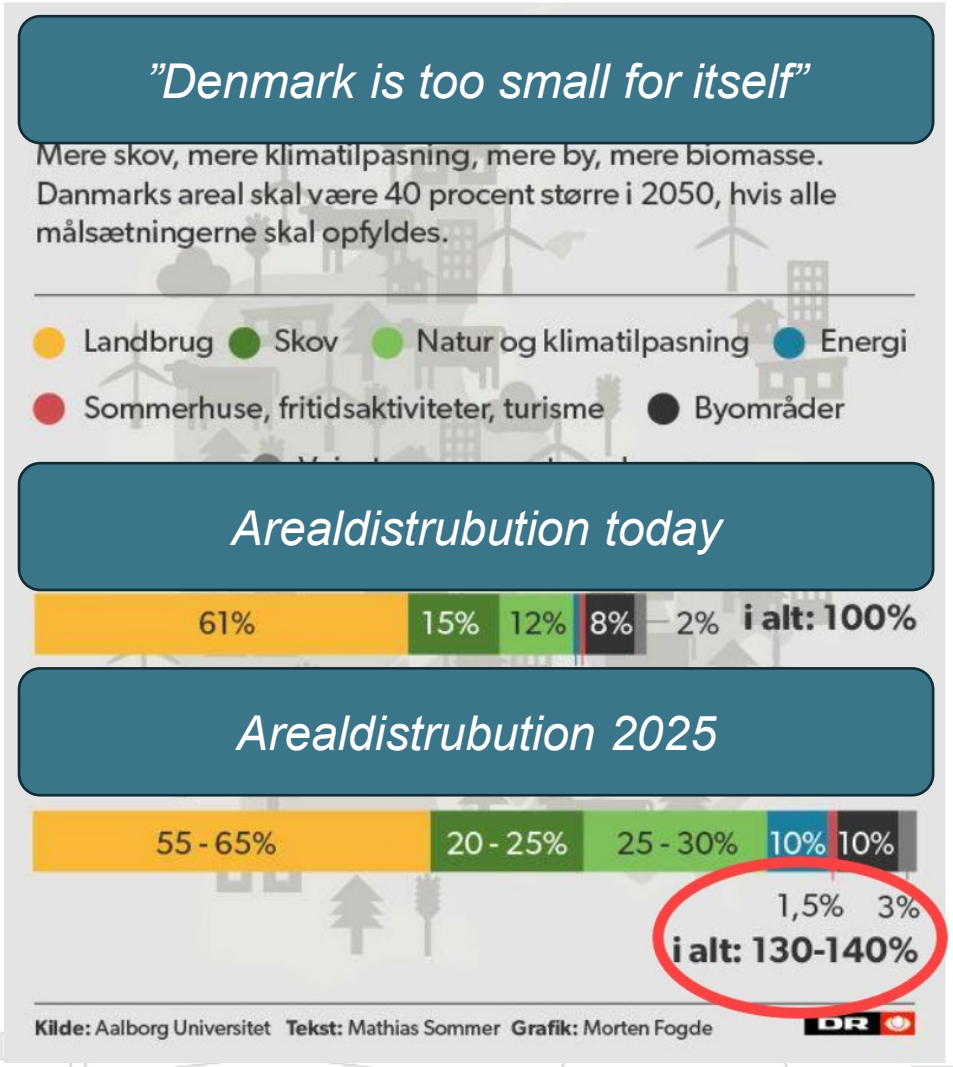
how

1:500 / 1:200

Building permission



Main issue & challenges



Kilde: DR

Conclusion

- We must plan our areas with intent
- Ensure the **correct** areal dispositions
- Remember our planning horizon

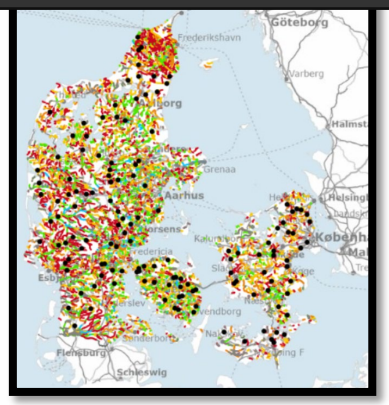
Problem!!!

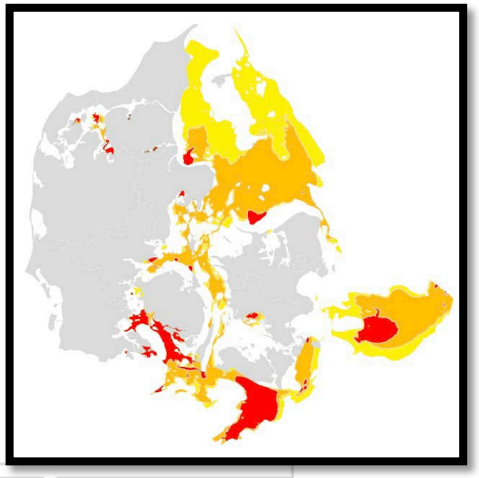
Main challenges in urban physical planning

(for wastewater planners?)

Ecological Status



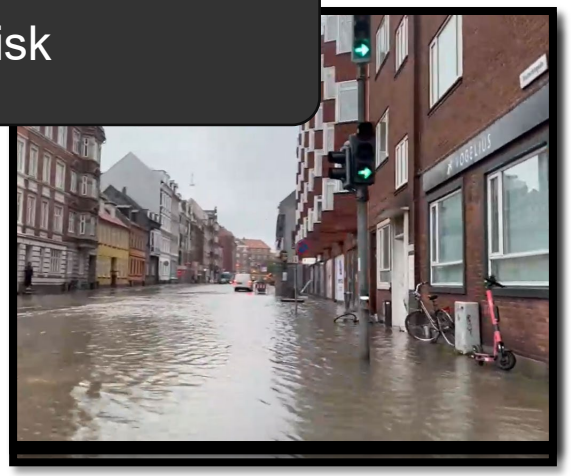




Waterframework directive

Flood risk



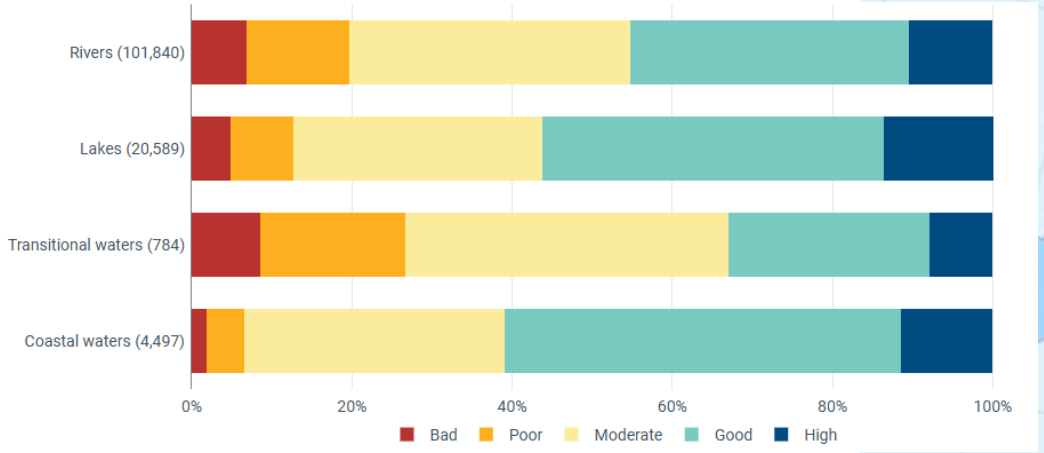


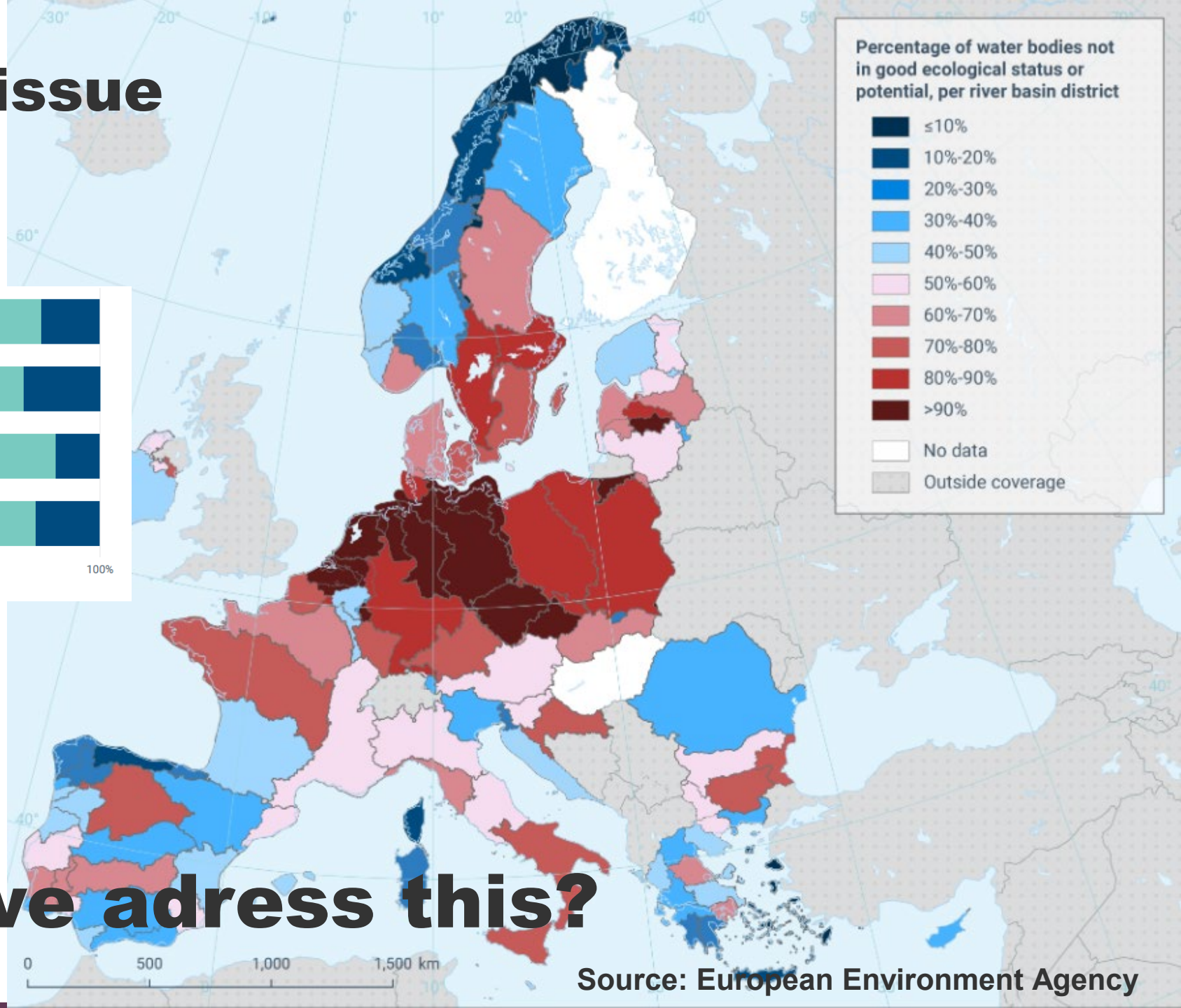




Floods directive

Not only a danish issue





So how do we adress this?

Source: European Environment Agency

Planning levels – physical planning
”A matter of scale”

XL

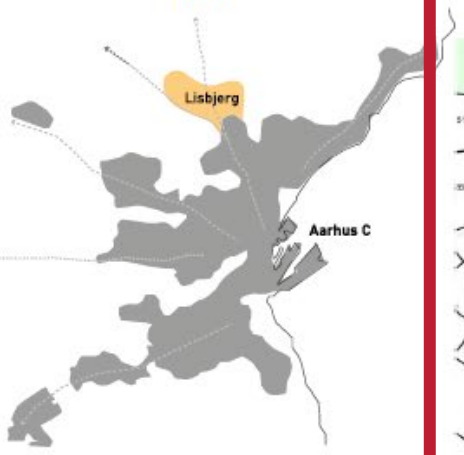
Shared vision
Aarhus Minucipality



condenced city
vs
open areas
1 : 100.000

L

Holistic interdiciplinary
strategic plan
for a smaller
area



theme plans

1 : 10.000

M

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what and where?

1 : 2.000

S

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



how

1:500 / 1:200

XS

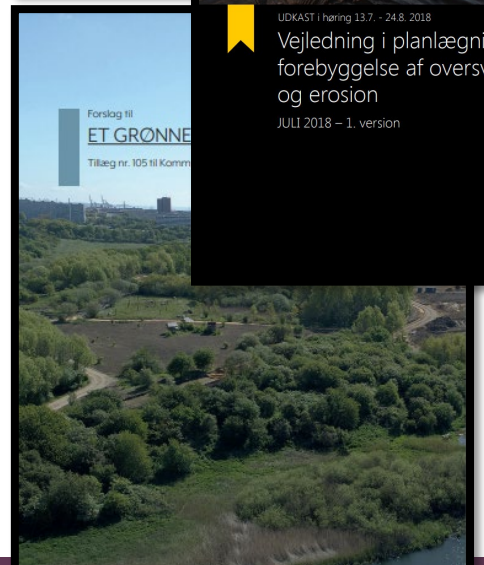
Building permission



Municipal Plan







RVDP

Aarhus Kommune samt Aarhus Vand

Regnvandsdisponeringsplan (RVDP)

Input til overordnet temaplan for arealer til alle boligtyper

EnviDan

Preventive measures





RVHP



Planning Coherency

Knowlegde



Municipal + sector plans

RVDP

Aarhus Kommune samt Aarhus Vand

Regnvandsdisponeringsplan (RVDP)

Input til overordnet temaplan for arealer til alle boligtyper

12. november 2020
(revision 4)

Udarbejdet til:
Aarhus Kommune samt Aarhus Vand

Udarbejdet af:
EnviDan A/S
Tina Kristensen Hettelfield
E-mail: tkn@envidan.dk
Direkte tlf.:
Projektnavn: Regnvandsdisponeringsplan (RVDP)
Projektnr.: 1202305
Kvalitetssikring: Mads Uggerby
Side 1 af 58

EnviDan

Holistic plans

RVHP



Local plan

Grundvand og Spildevand
Karen Blixens Boulevard 7, 8220 Brabrand

Aarhus Vand A/S
Gunnar Clausens Vej 34
8260 Viby J

4. september 2019
Side 1 af 16

Tilladelse udledning af overfladevand til Århus Å i udløb MU36, i forbindelse med separering i Åbyhøj og Gellerup

TEKNIK OG MILJØ
Plan, Byggeri og Miljø
Aarhus Kommune

Grundvand og Spildevand
Karen Blixens Boulevard 7
8220 Brabrand

Telefon: 89 40 22 13
Direkte telefon: 41 85 70 65

Direkte e-mail:
pmajo@aarhus.dk

Sagsbehandler:
Mathias Joachim Skov Pristed

Tilladelsen er meddelt i henhold til Miljøbeskyttelsesloven §19, § 28 stk. 1 og 2 til:

- Udledning af overfladevand fra bassin B047 til regnvandsgrøft med udløb i Århus Å via udløb MU36
- Etablering af regnvandsbassin B046 i den nordlige del af Gellerup skov, og regnvandsbassin B047 i den sydlige del af Gellerup skov i et område, hvor grundvandsbeskyttelsen kræver tæt bund i bassinet.

Tilladelsen er betinget af de vilkår, der er angivet under afsnit 2.

Med venlig hilsen

Mathias Skov Pristed
Biolog

Annemette Sørensen
Biolog

Bilag til afgørelsen:
Bilag 1: U-Skema for regnbetingede udledninger
Bilag 2: Oversigtskort - Koordinerende ledningsplan
Bilag 3: Kloakanlæg Gellerup
Bilag 4A: Arbejdsprocedure for etablering og kontrol med in-situ-lermembran (intakte leralleringer)
Bilag 4B: Arbejdsprocedure for etablering og kontrol med en udlagt lermembran

Annonceres onsdag den 4. september 2019
Klagefristen udløber den 2. oktober 2019
Søgsmålsfristen udløber den 4. marts 2020

Permit

strategy

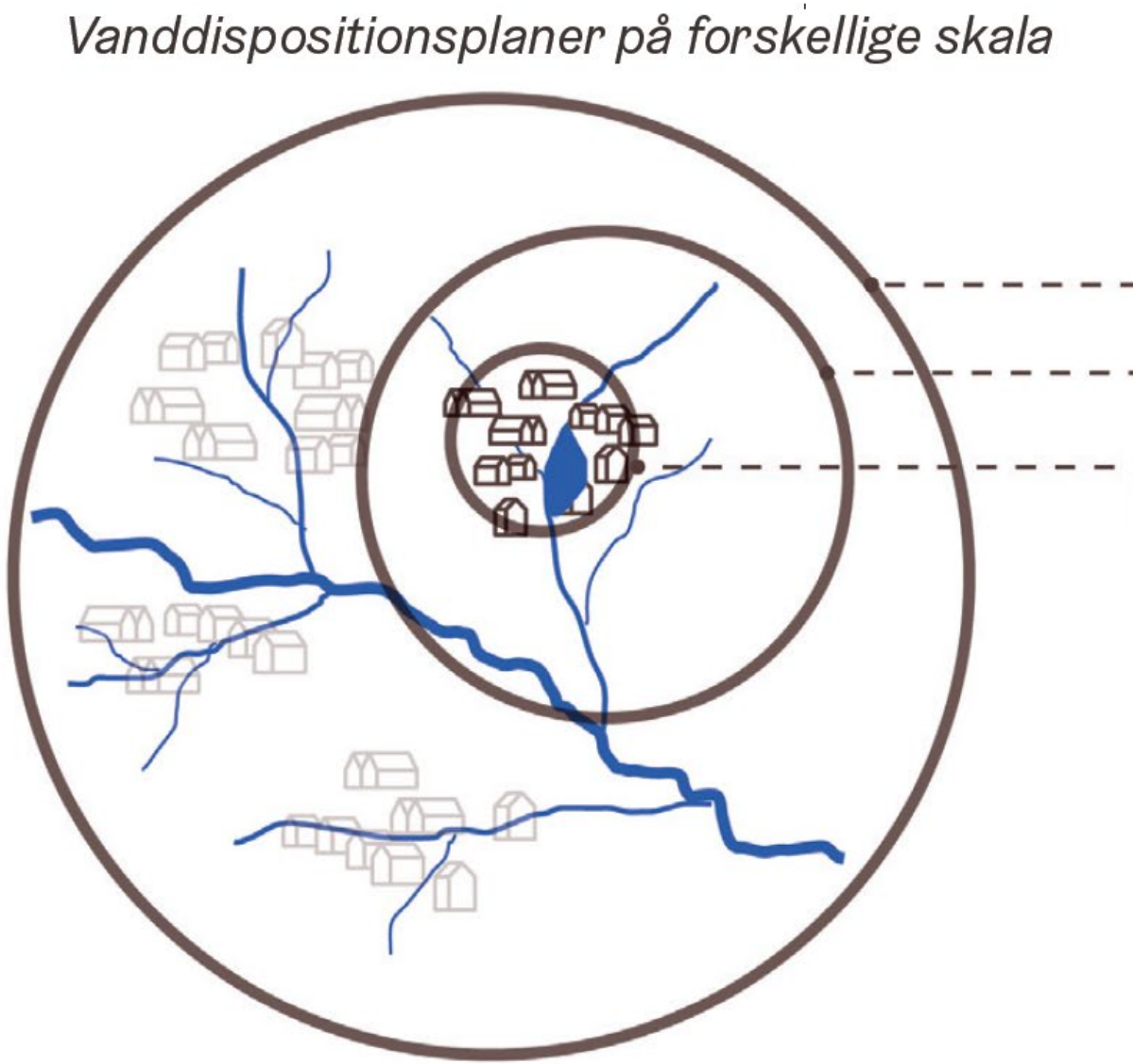
Probable

document

Master Plans: Urban Catchment scale

Purpose

- Ensure holistic planning for stormwater in coordination with the city
- Ensure areal dispositions for stormwater
- Ensure coordination of municipal disciplines & city development
- Ensure connection of planning chains



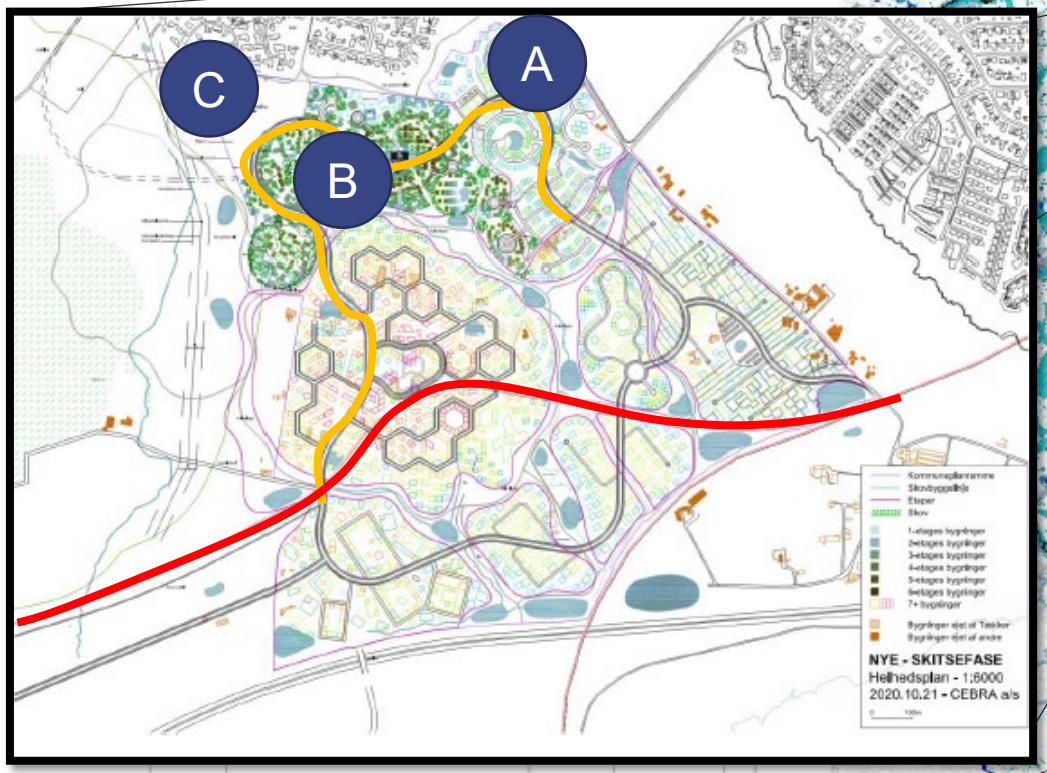


Masterplan

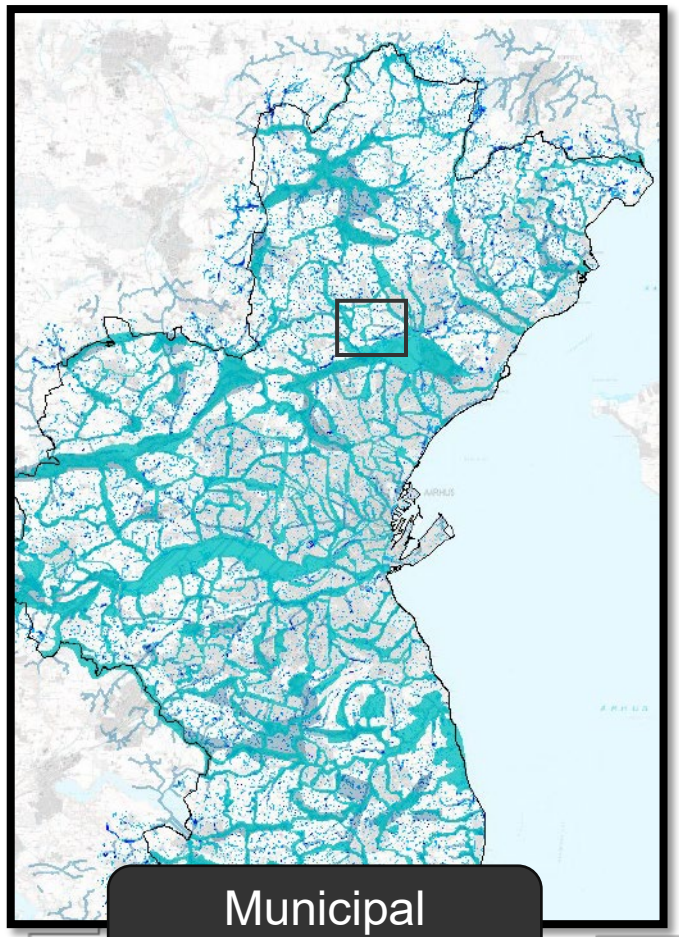
City Nye

City development

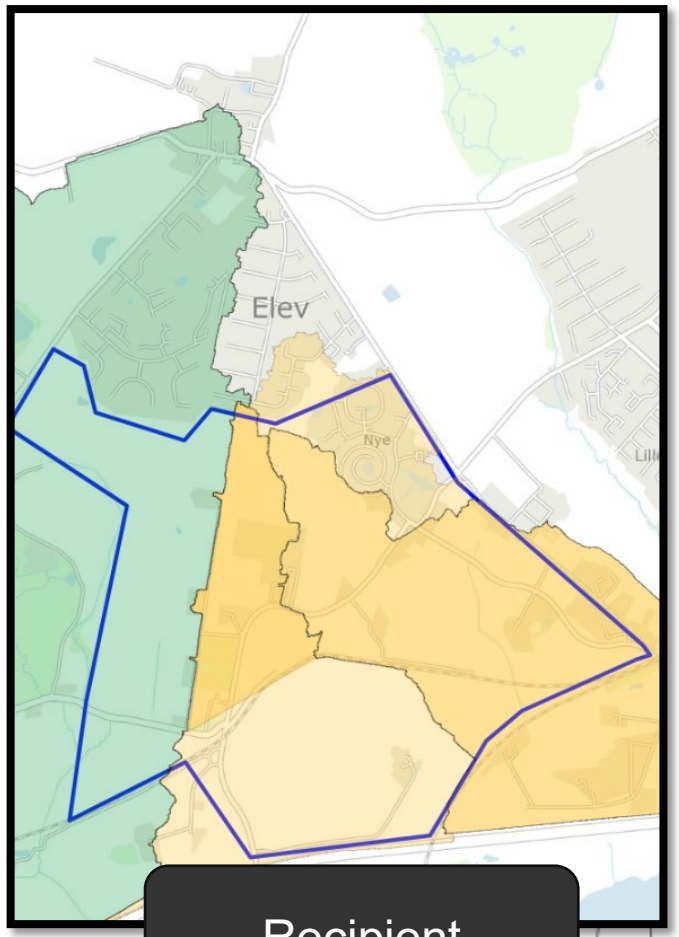
Infrastructure projects



Stormwater Masterplan
Framework & Prerequisites



Municipal planning



Recipient



Urban planning

Masterplan: framework

Stream analysis

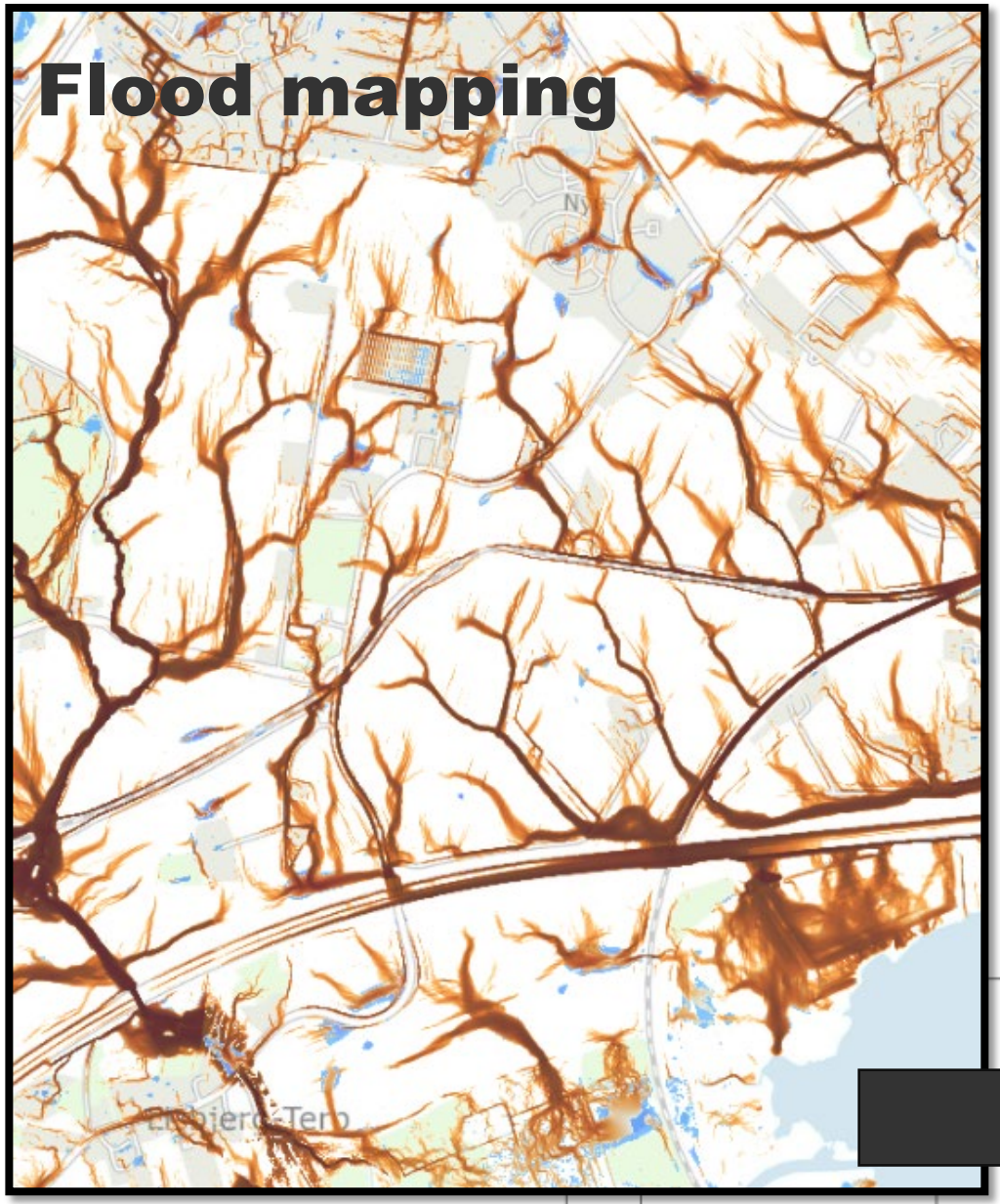
Analysis of

- Capacity
- Robustness
- Stream parameters
  - Size
  - Risk of droughts
  - Pollutants
  - Etc.



Spatial & design requirements of ponds

Flood mapping

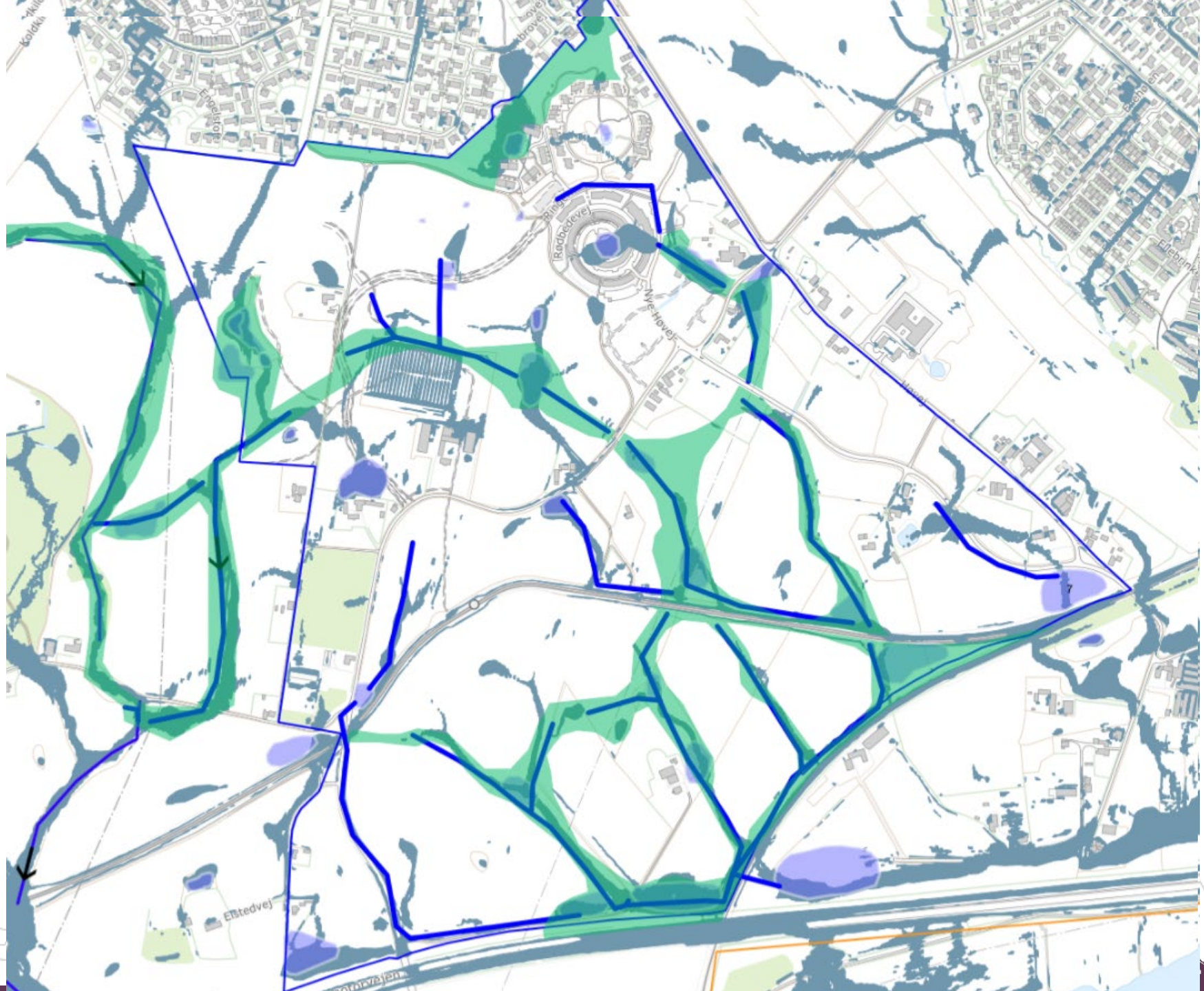




Spatial & design requirements of blue-green connections

100 year event, 2100, RCP 4,5 – Mike 21 FM.
Flux > 25 l/s/m

Waterdepth >10 cm


Ellstedvej

What do we achieve?



- Detailed overaching plan of holistic stormwater management
- Blue/green corridors to transport stormwater and increase accesibility
- Planning foundation for achievement of frameworks



Climate adaptation – 100 year event - 2100

What happens when things change?

XL L M S XS

Shared vision
Aarhus Minucipality

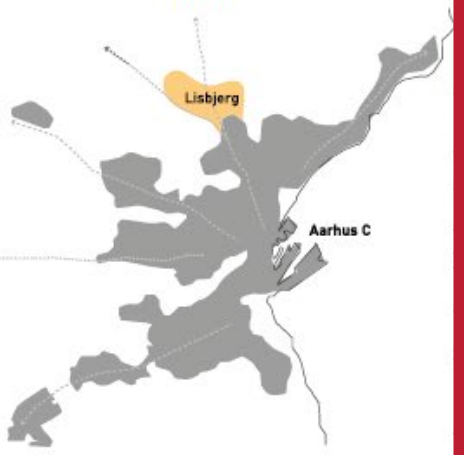
Holistic interdiciplinary
strategic plan
for a smaller
area

Guidelines for communal
living
- priorities of programs

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

Building permission











condenced city
vs
open areas
1 : 100.000

theme plans

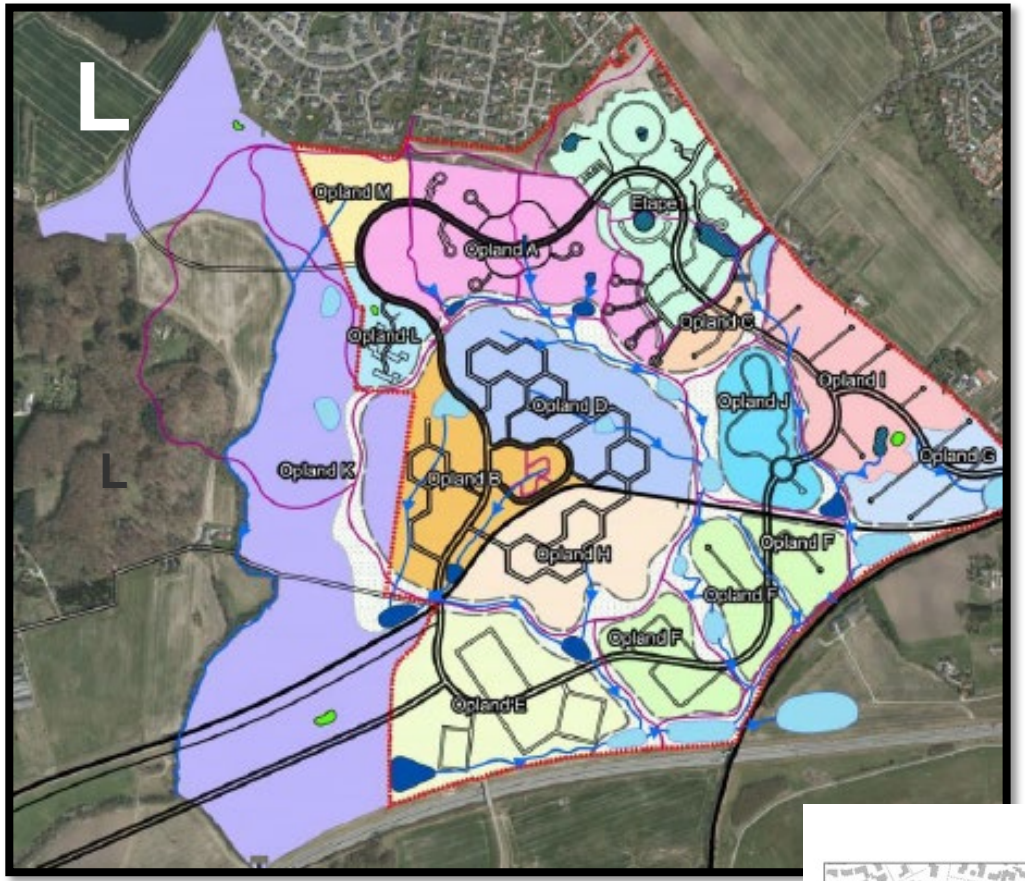
1 : 10.000

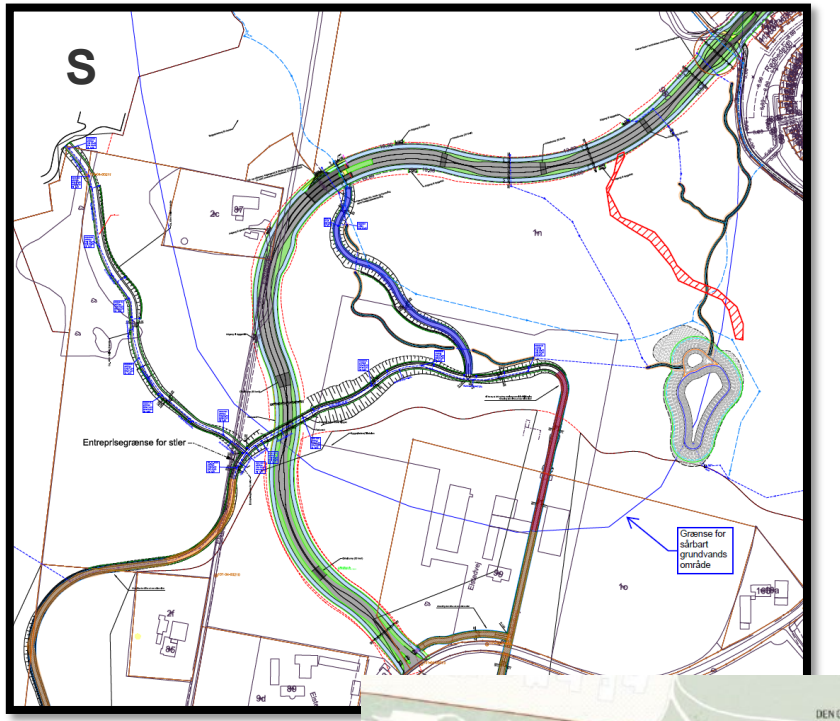
what and where?

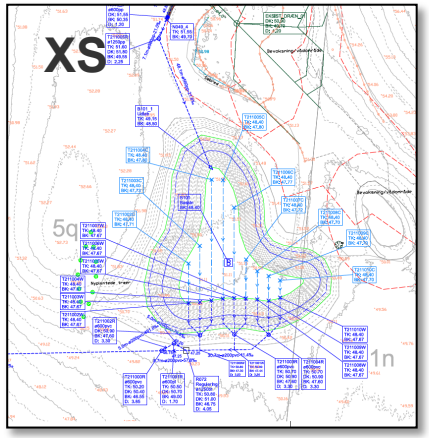
1 : 2.000

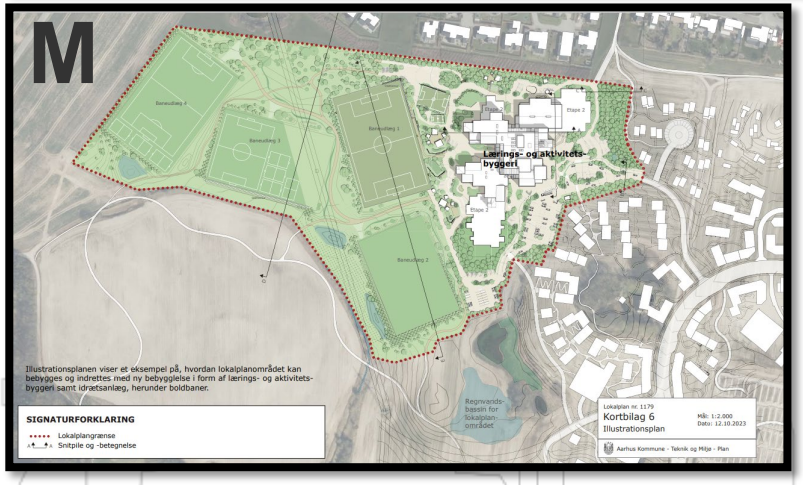
how

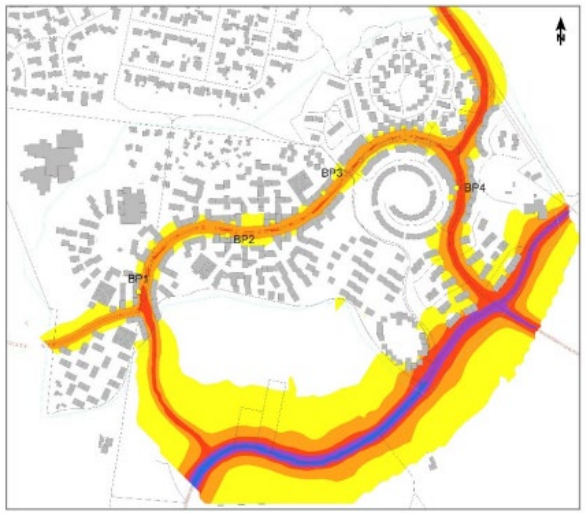
1:500 / 1:200









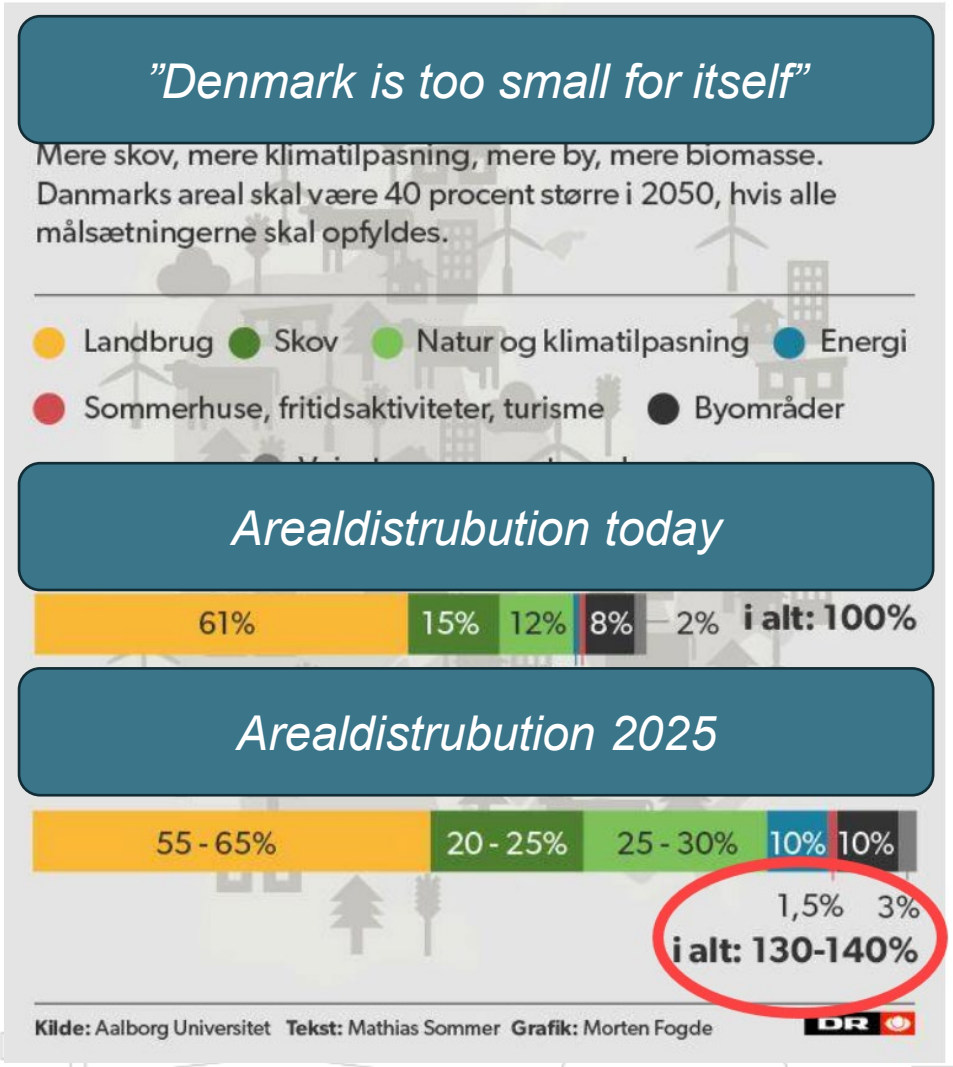


Figur 2: Støjudbredelse af trafikstøj ved udbygning af etape 1-2

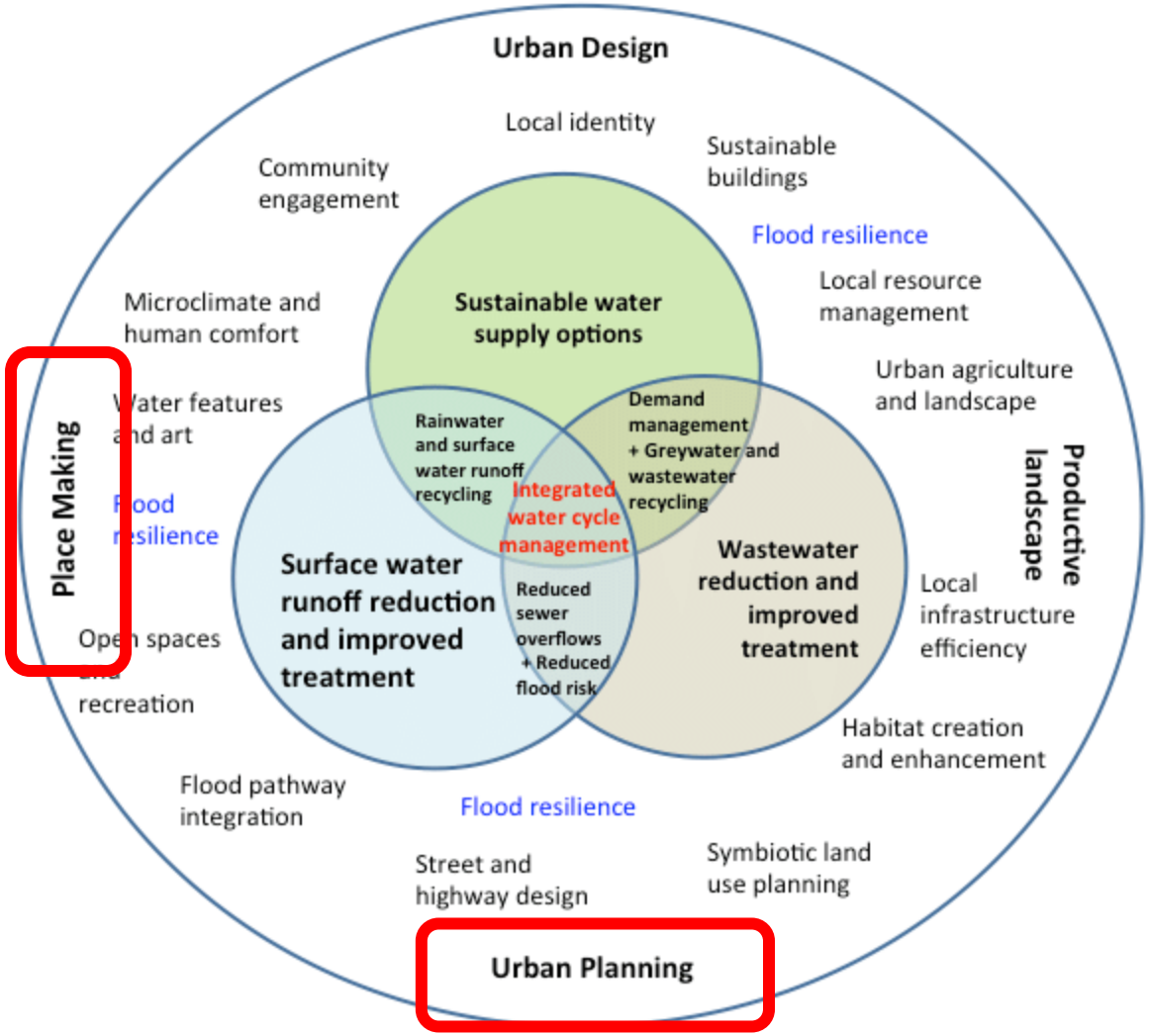



Signaturforklaring
Bygninger
Boldbaner
Lokal Veje
Bassin
S3 Mose
S3 Sø
Vandveje
Letbane
Ringen
Etaper
Etape 2

Solution



Kilde: DR



Catchment-based stormwater planning in Tampere

Salla Leppänen
Stormwater Specialist
City of Tampere
Finland

Århus 26.9.2025

Photo: Laura Happo

Interreg Baltic Sea Region
Co-funded by the European Union
SUSTAINABLE WATERS
City Blues

Tampere in figures

260 000
inhabitants

~850 km
stormwater sewers

98%
of
sewers separated



Tampere in figures

160
lakes

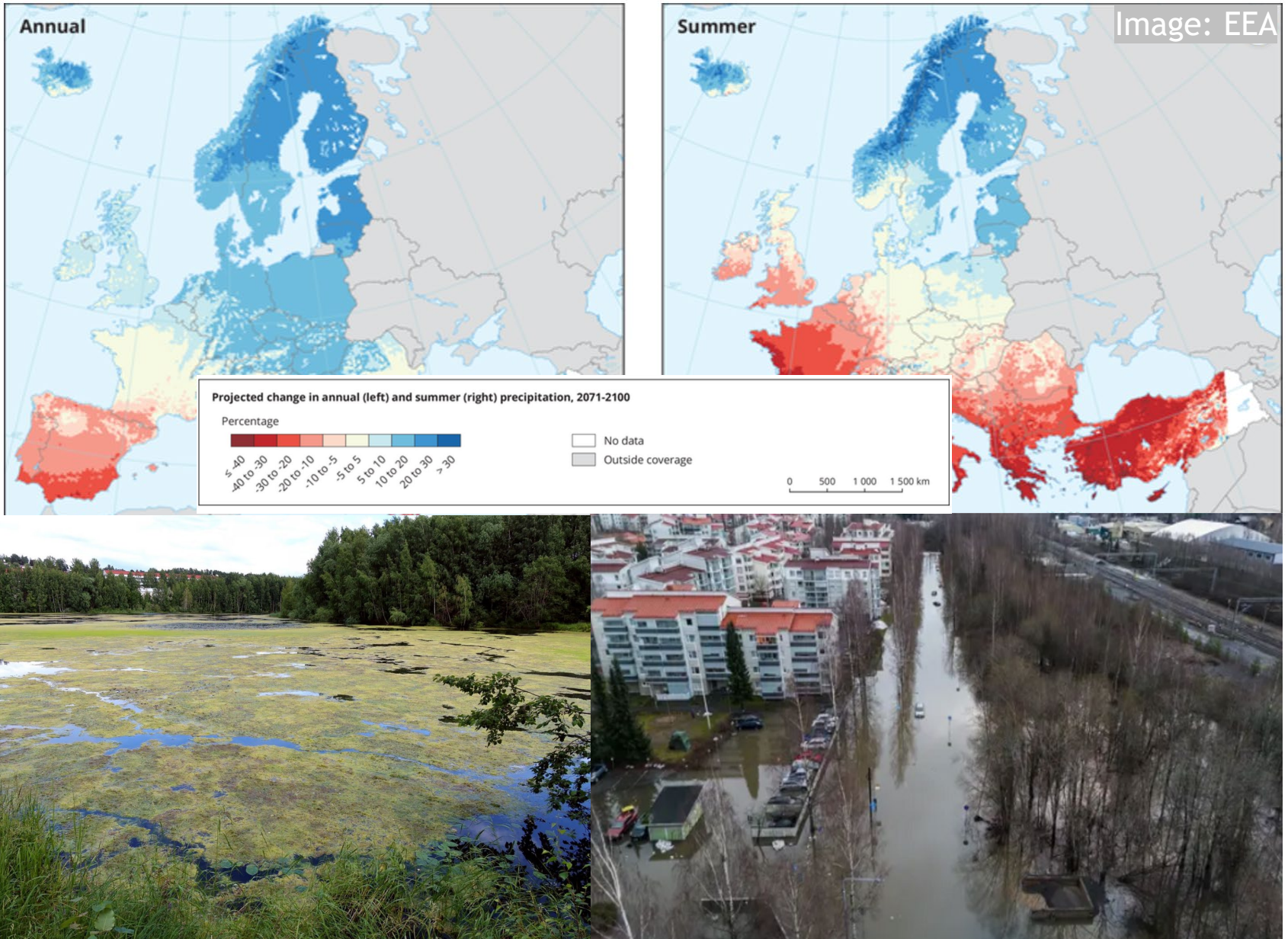
260 km
streams

~100
nature-based solutions (NBS)



Photo: Laura Happo

Challenges

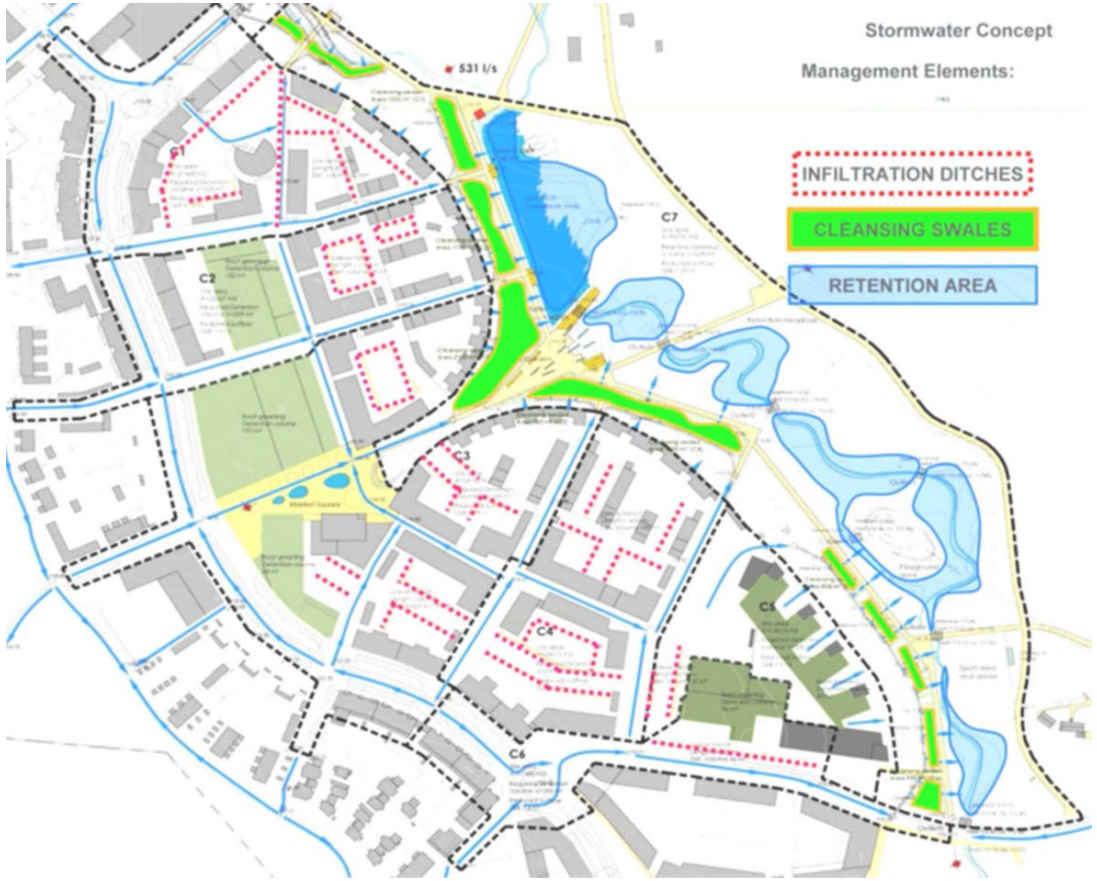


- Climate change
- Urban densification

➔More stormwater, pollution & habitat loss

➔Catchment-based planning & NBS

Stormwater management in new districts



- Decentralised systems
- Property-specific retention requirements in zoning plans (1,1-2 m3/100 m2)
- NBS a priority

Stormwater management in old areas

- Based on stormwater sewers
- NBS implementation with street and park renovations
- Catchment-based stormwater plans



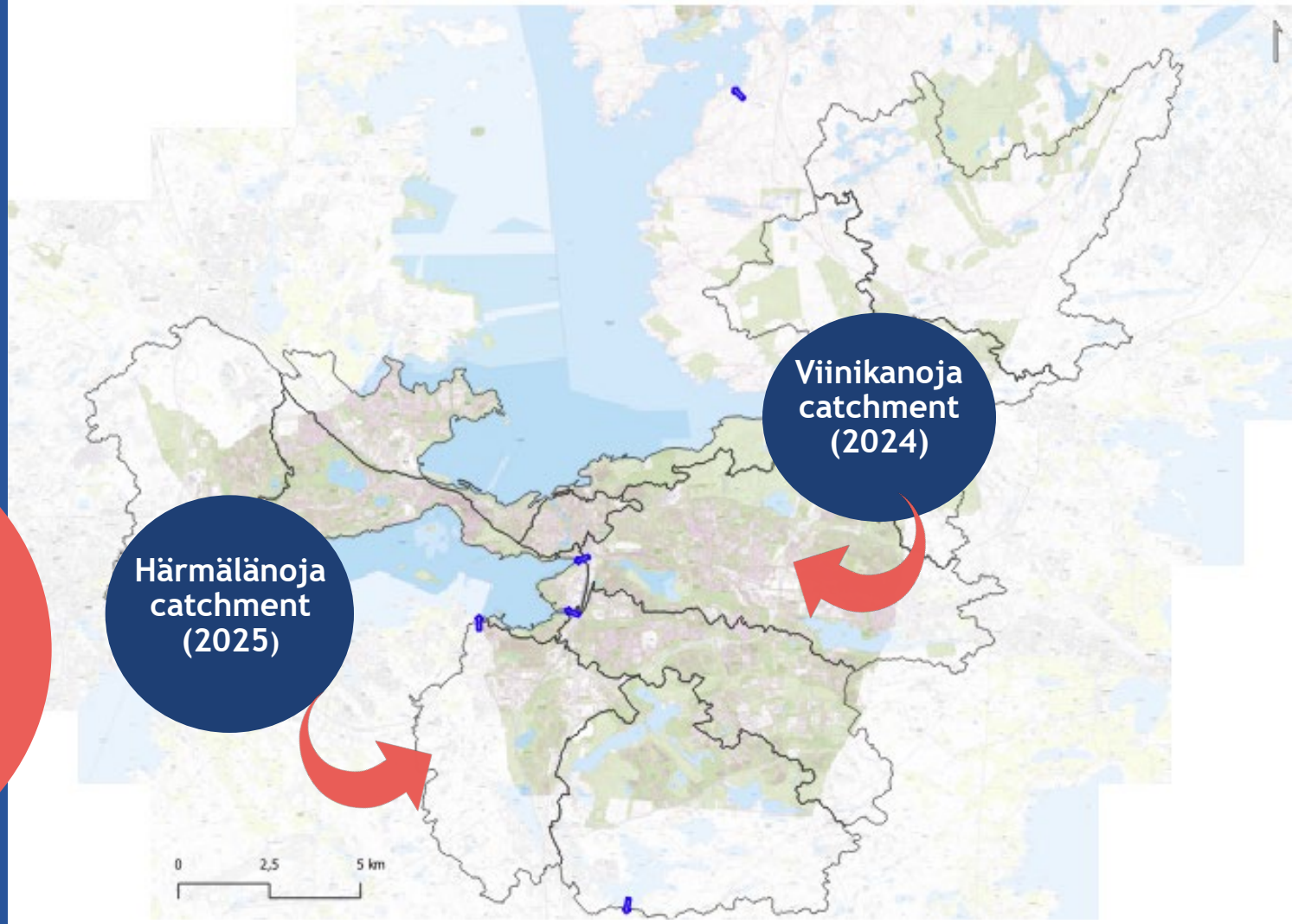
Underground retention
In the city center

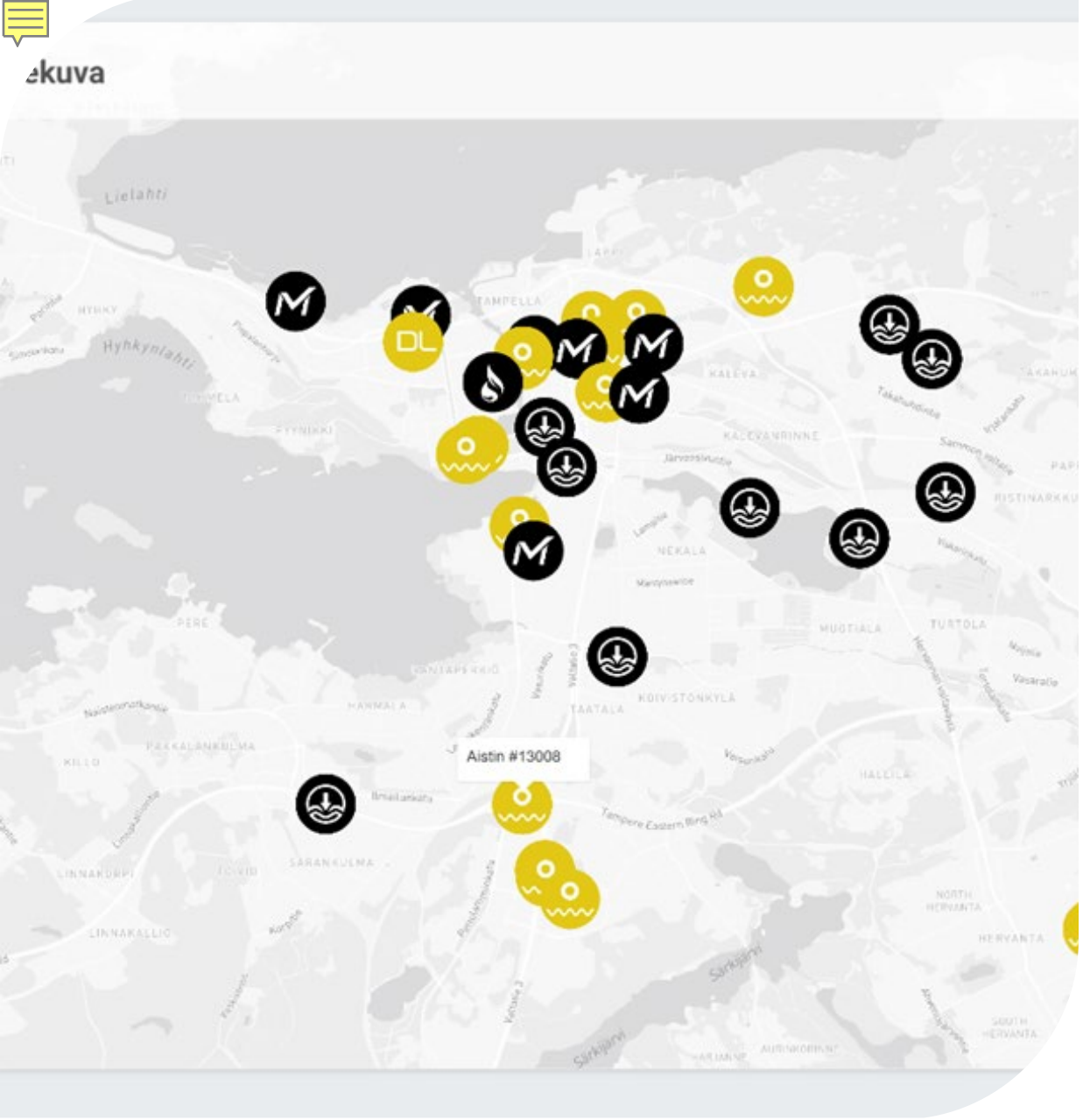
Sandelin Park is restored with flood meadows

Photo: Laura Happo

Catchment-based stormwater planning in Tampere

Objective: improve stormwater treatment & retention





In the background

- Data from smart water quality and quantity monitoring stations and weather stations
- Flood risk analysis



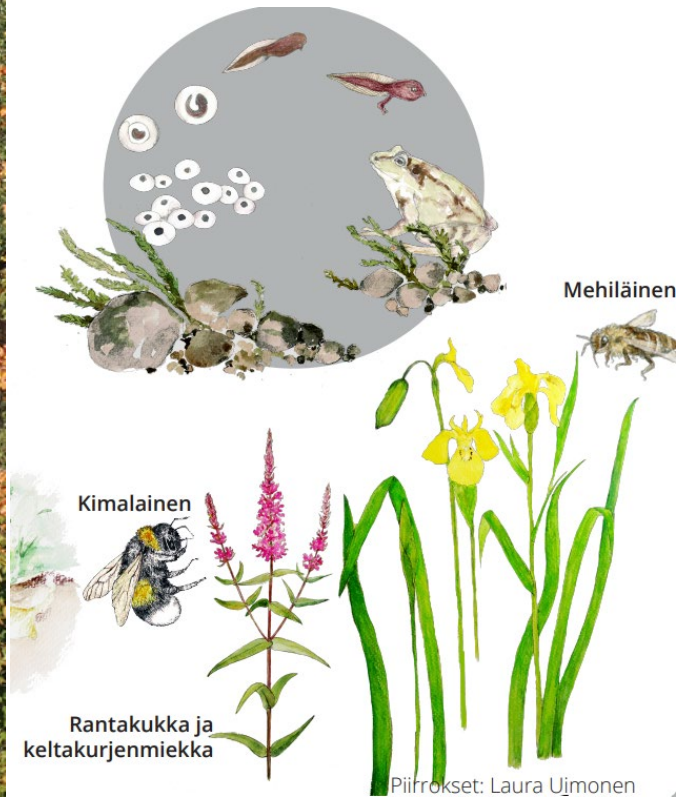
Benefits

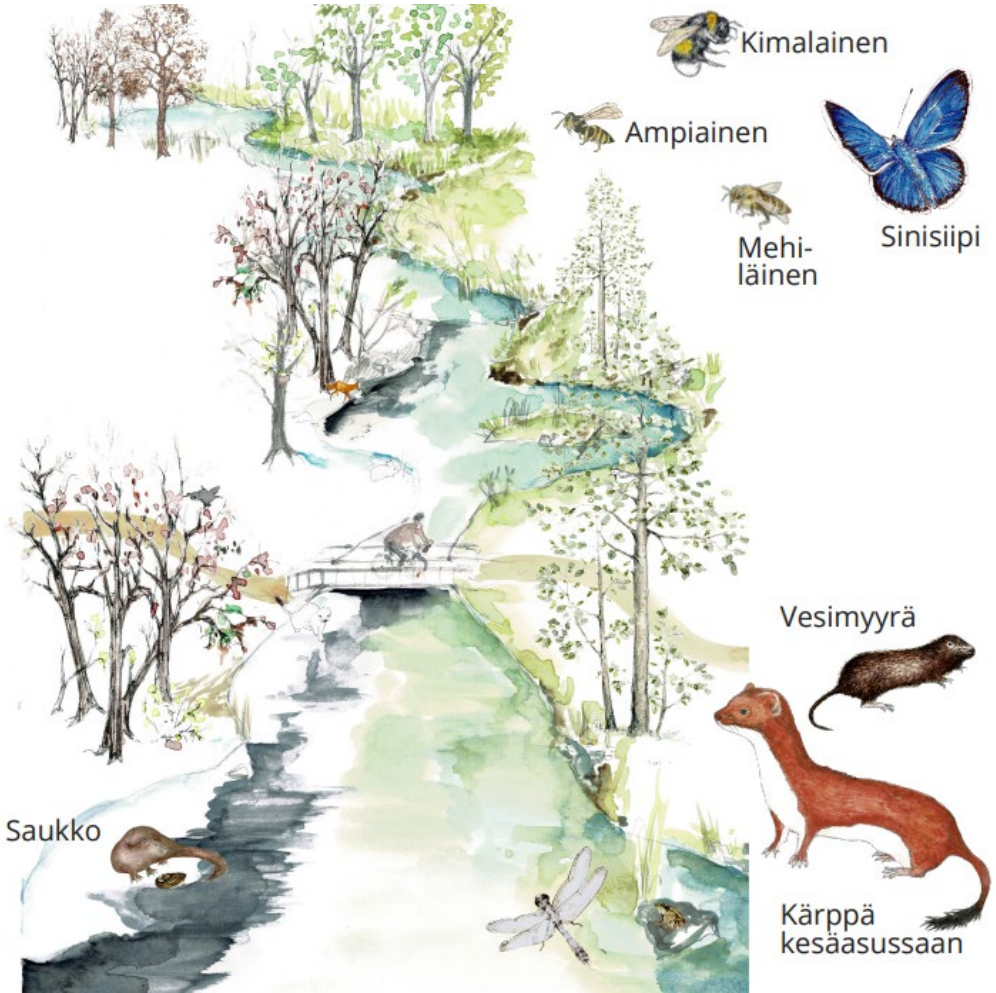
- Flood management
- Improved water quality
- Increased biodiversity
- Benefits for well-being
- Cost-efficiency
- Climate change adaptation

Hydrological connectivity is considered as a whole - how water moves through the landscape



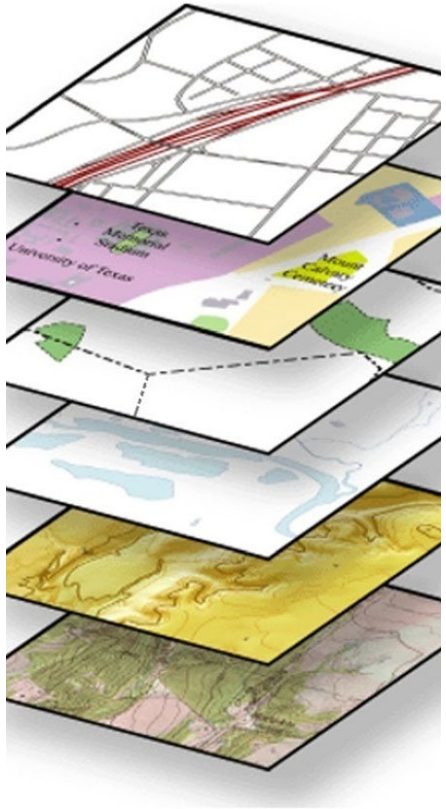






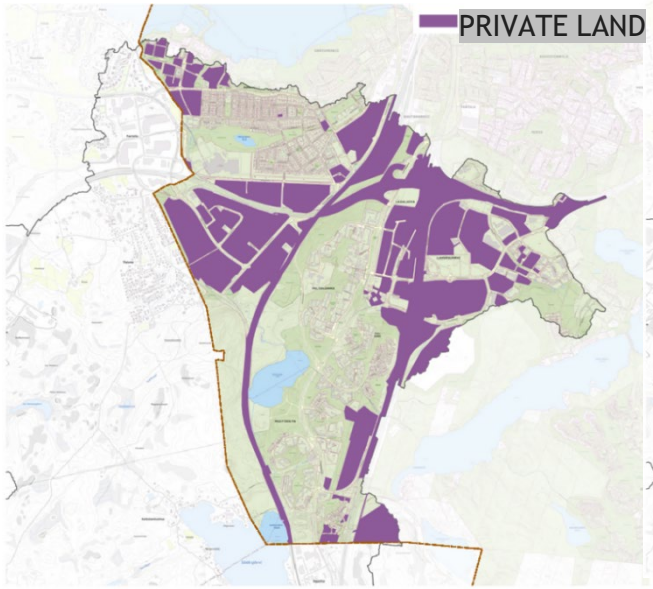
Planning is based on spatial data analysis

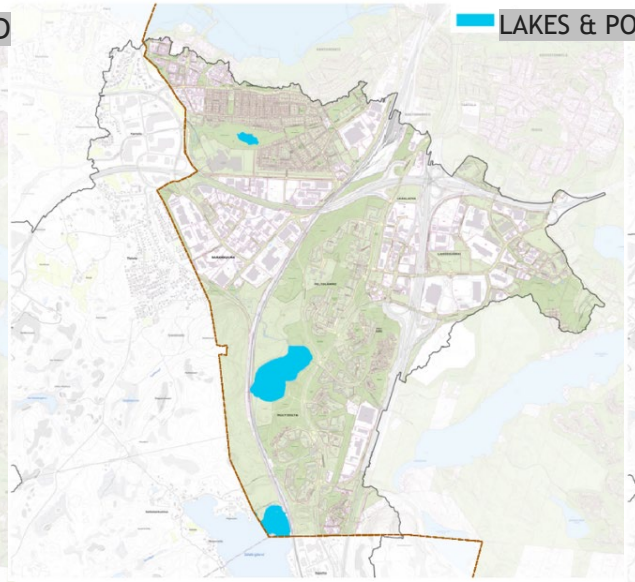
Unsuitable areas are sorted out:

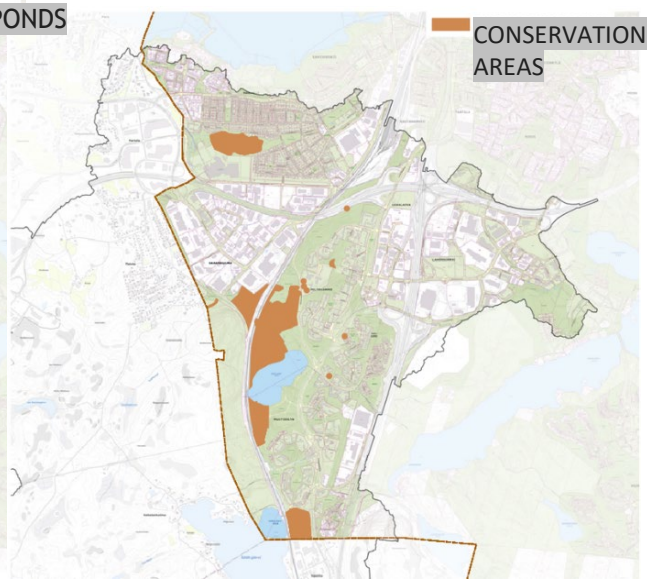


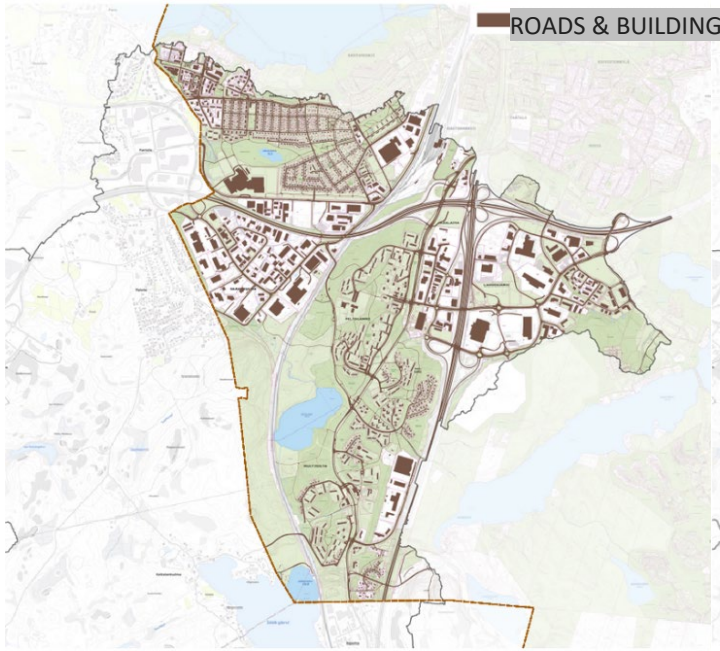
- Privately owned land
- Areas with natural or cultural values
- Buildings and their immediate surroundings
- Slope (+15%)
- Water, sewer and gas pipes

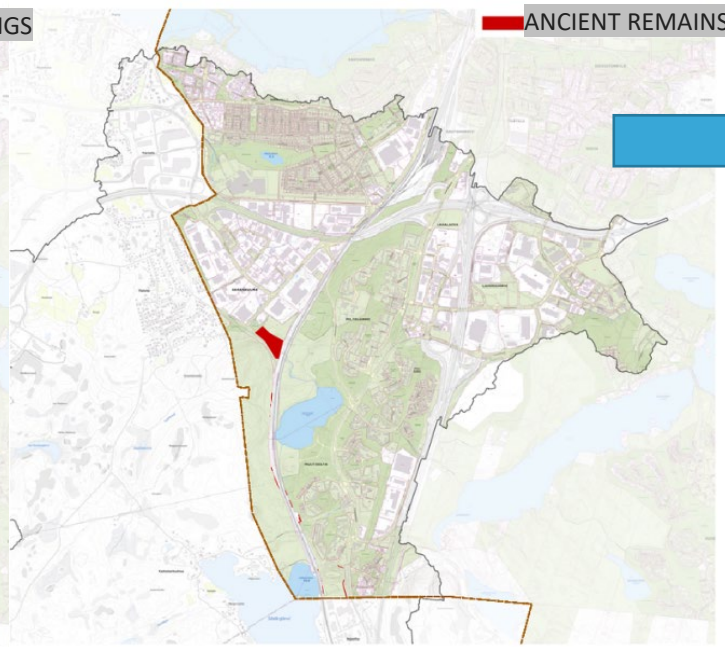
Unsuitable areas in Härmälänoja catchment

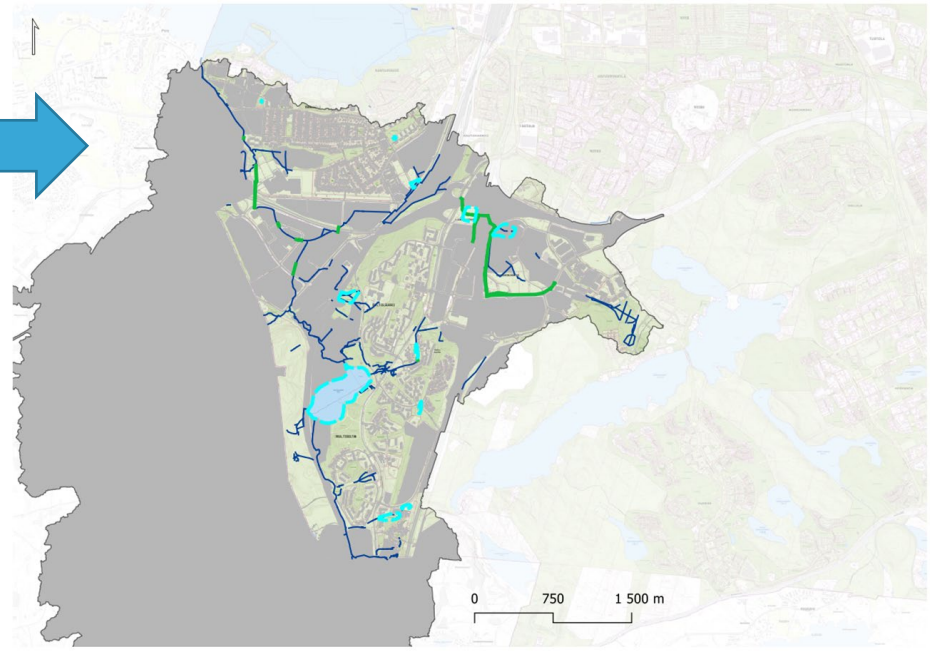




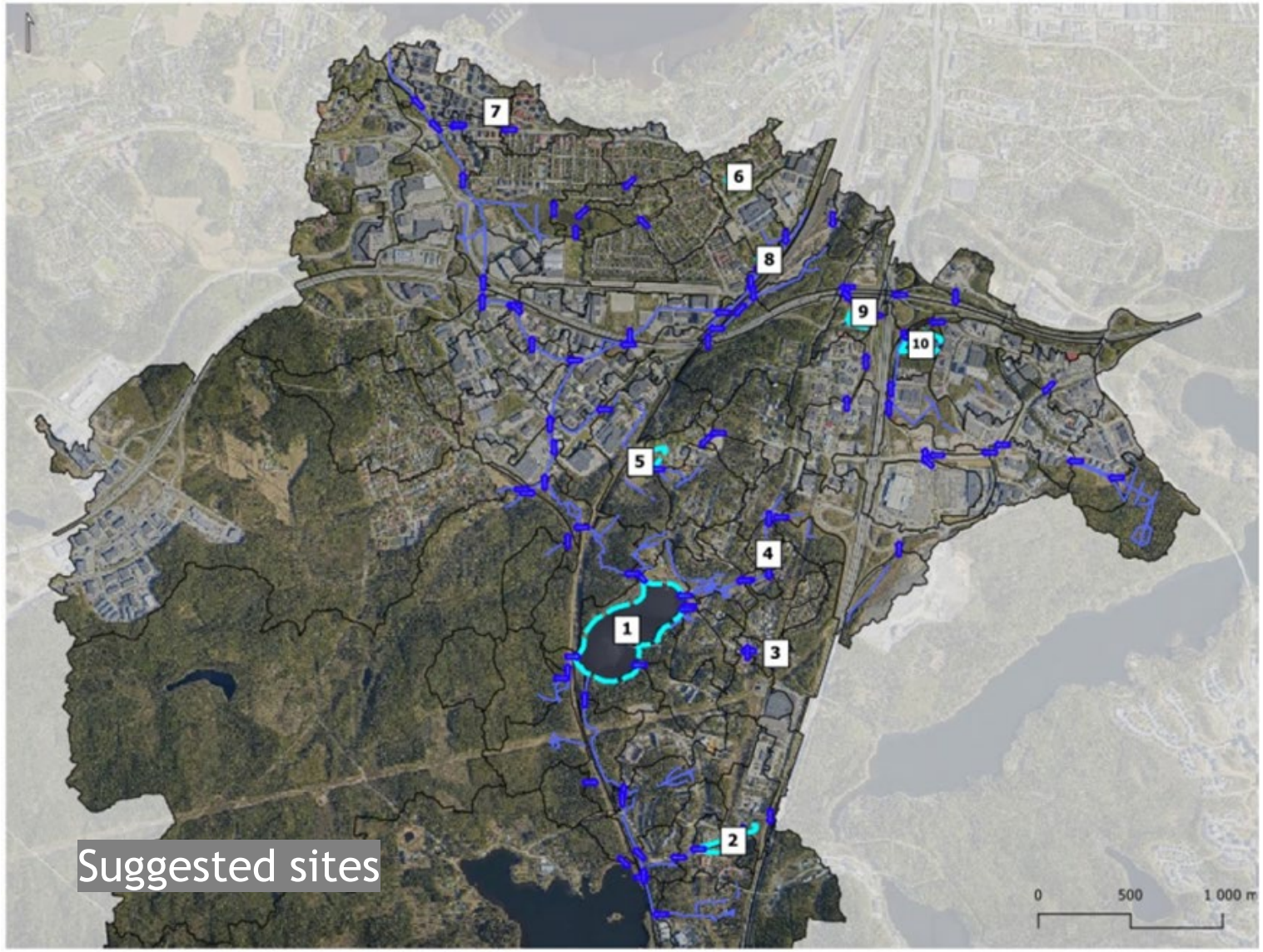








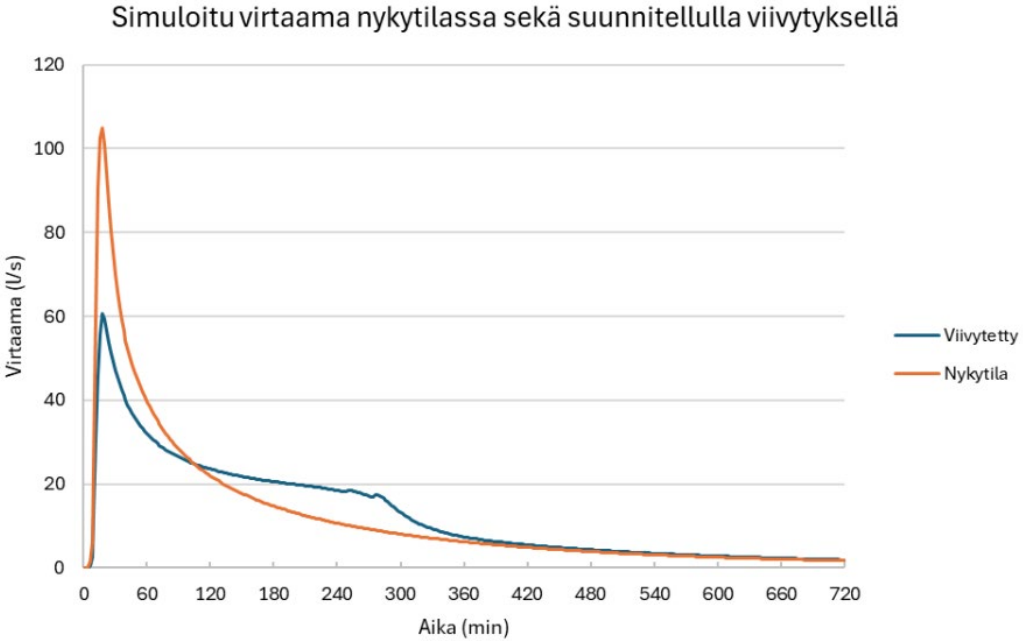
Suggestions for new NBS in Härmälänoja catchment



Impacts



- Local effects of each site were modeled
- Retention was simulated with 300 m2 area with water depth 0,5 m (150 m3)

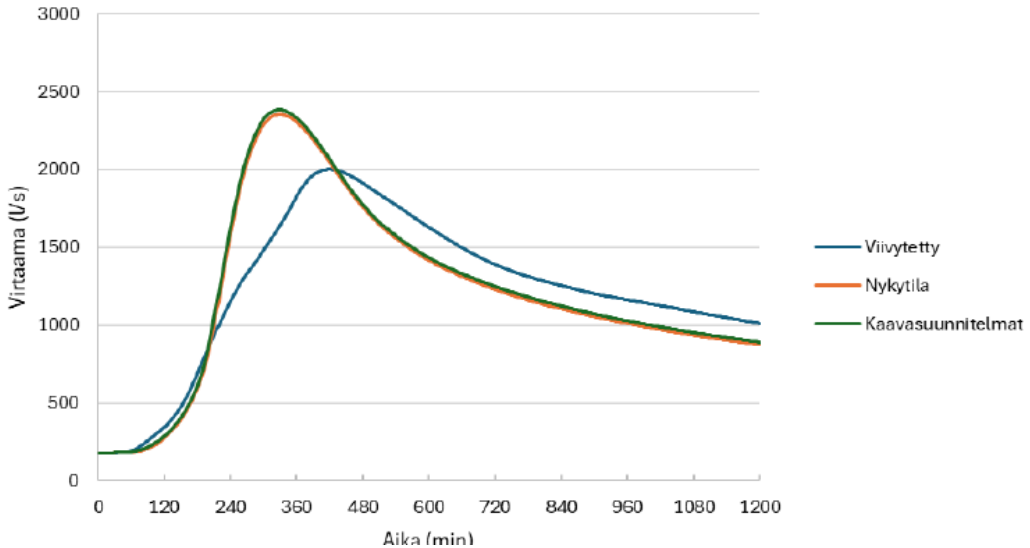


TAMPERE



Impacts

- The impact on the main stream was simulated with the suggested NBS
- If all the NBS are implemented, the flow peak will decrease by 15 %



Simulated flow with the new NBS (blue line)



Challenges

- Lack of suitable space
- Competing interests



Next steps

- Detailed planning & implementation according to prioritization
- 7 more catchment-scale stormwater plans
- Modeling the impact on water quality (TSS & TP)



Thank you!

Photo: Laura Happo

Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS
City Blues

Contact:
salla.leppanen@tampere.fi

Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS City Blues

Holistic planning in Tampere – lessons learned from case Varsanpuisto

Project Manager Anna Vilhula | 26 September 2025 | Aarhus

interreg-baltic.eu/project/city-blues



Holistic planning



Community building



Recilience

No silos





Sustainability

Pilots in City Blues project

Interreg Baltic Sea Region | Co-funded by the European Union | SUSTAINABLE WATERS City Blues



Aarhus (DK) is re-opening and restorating two streams



Malmö (SE) creates a development plan for the catchment of Risberga stream



Tartu (EE) is building flood derivation cascade to support biodiversity with wetlands



Tampere (FI) creates new flood meadows in the Varsanpuisto park near old residential area



Stavanger (NO) is renovating urban square and managing stormwater through rain beds

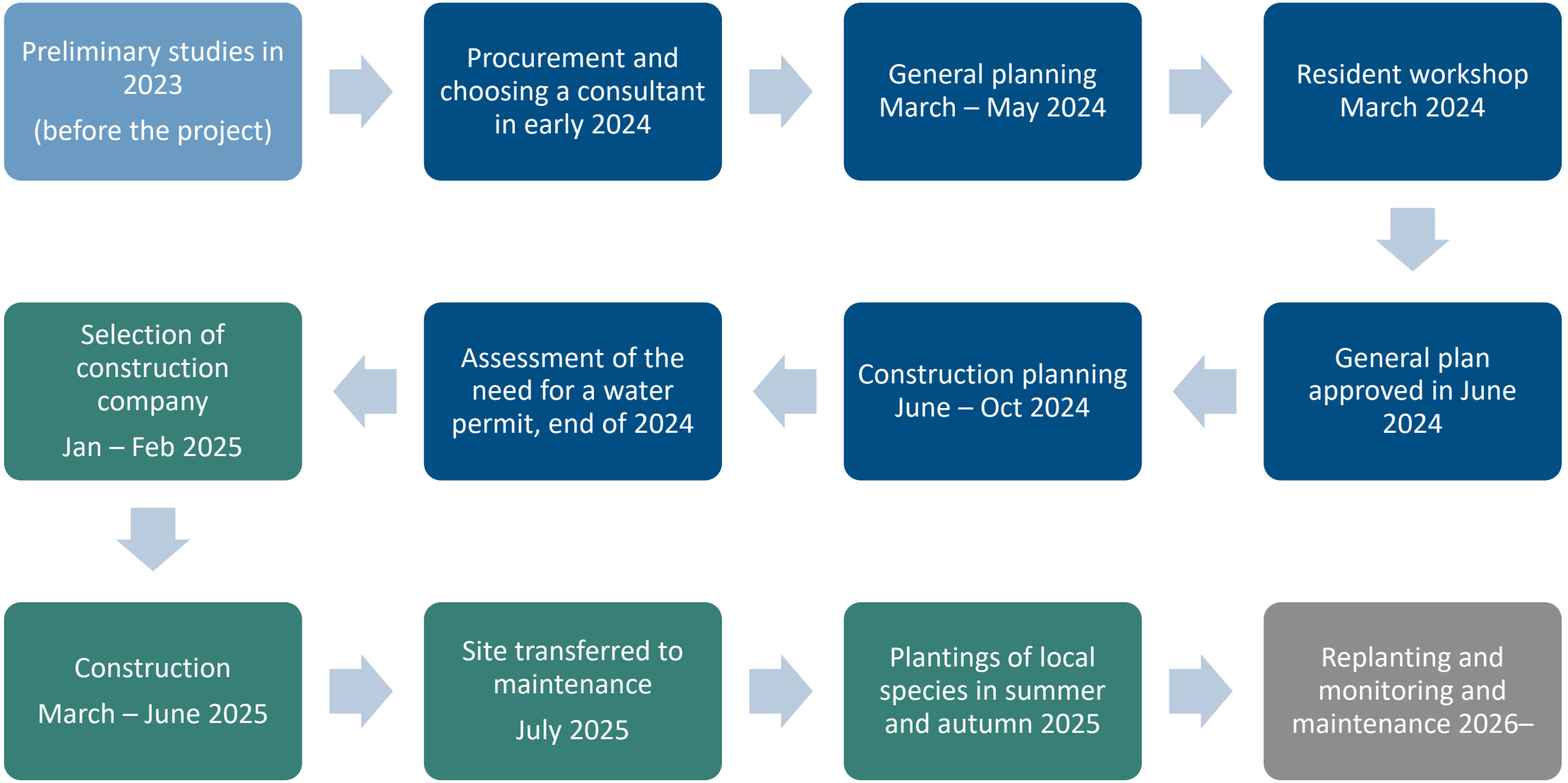




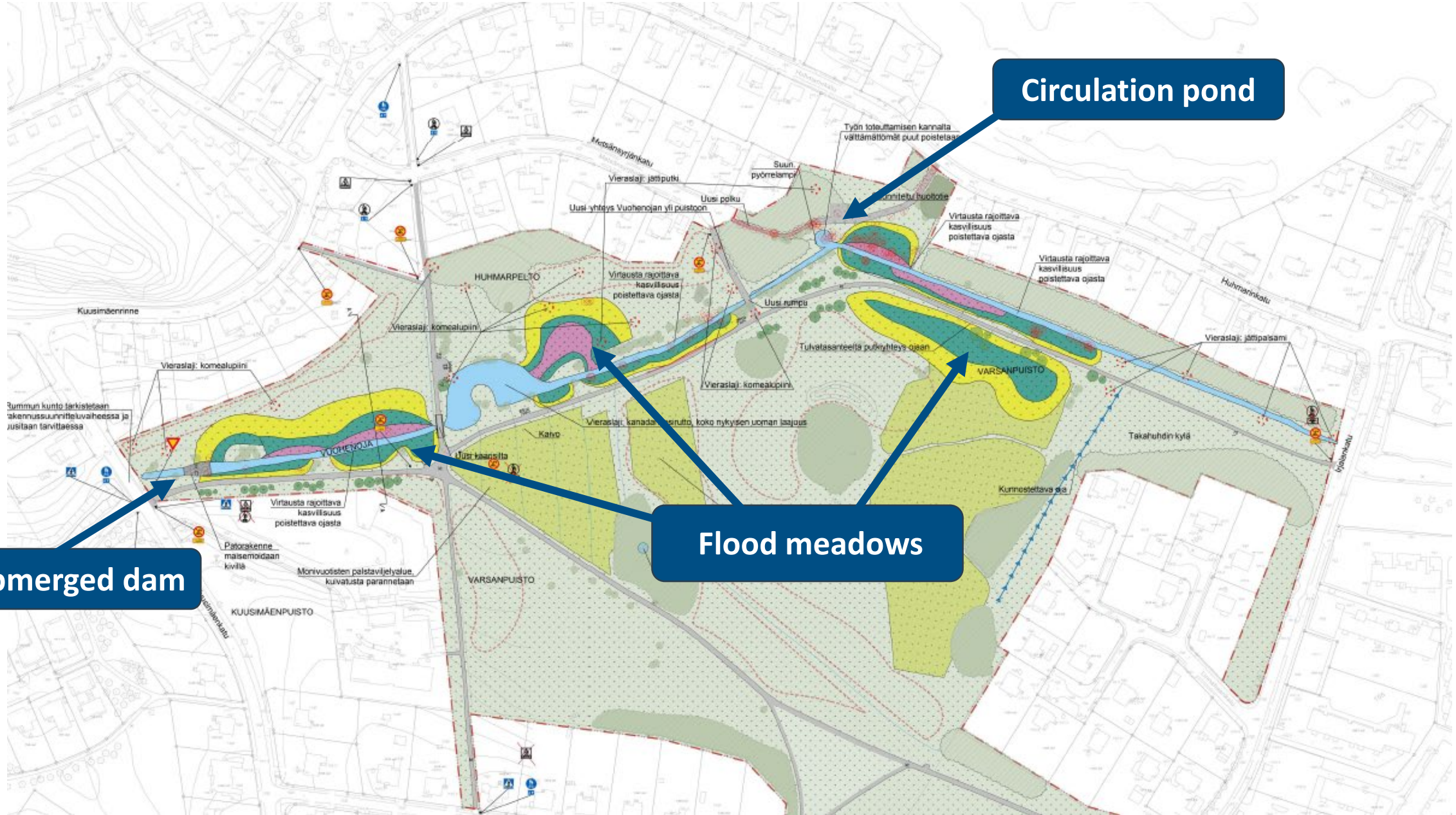
Goals of the Tampere pilot

- Less flooding near Lake Iides
- Increased biodiversity
- Less invasive alien species
- Enabling natural reproduction of highly endangered brown trout
- Improved recreational value

Pilot implementation

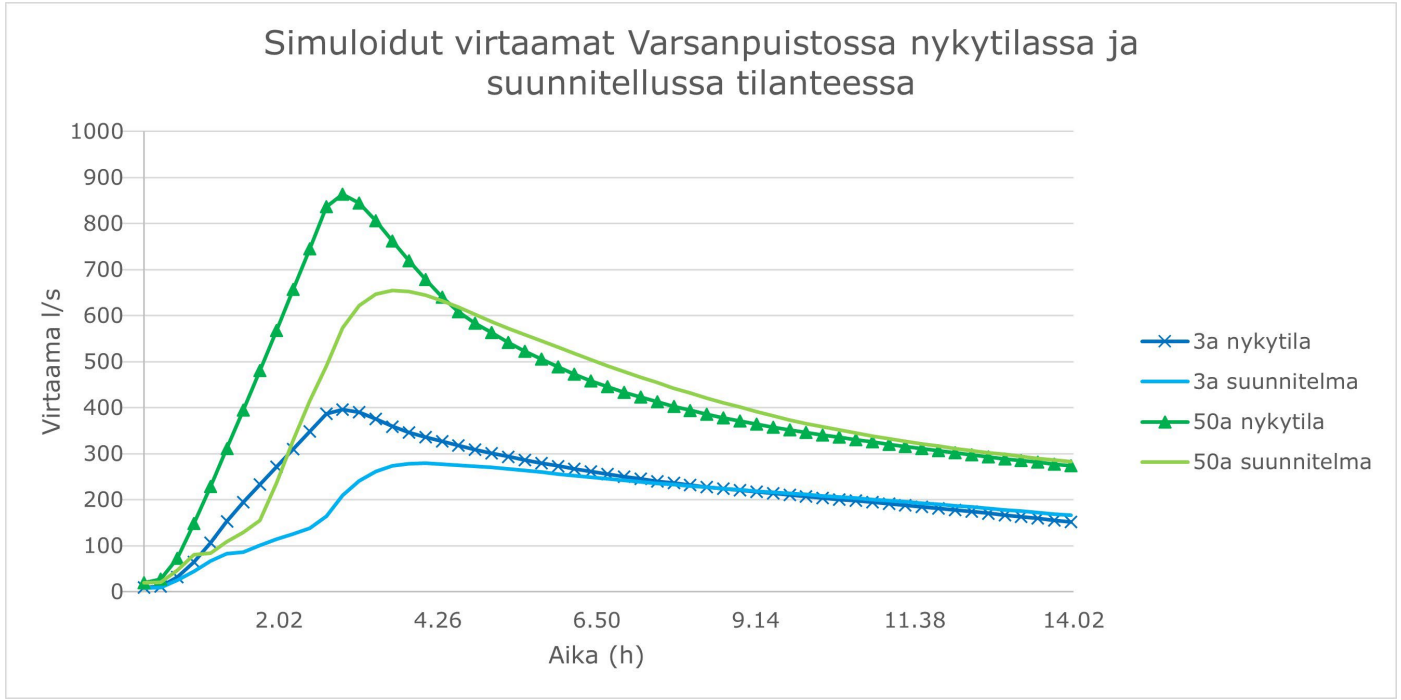


General plan



Modeling was used to study the impact of the solution

With alluvial meadows flow peaks can be cut by about 120 l/s (30%) in the 1/3a situation and 200 l/s (24%) in the 1/50a situation.



The simulated flow rates of pilot site

Flood map

The picture shows the flood areas according to the modeling made based on the plan, in areas colored from light to dark blue, with flows recurring once every 3, 50 and 100 years.



Situation before (February and June 2024)







Situation after (2025)



Flood meadows and the new bridge



Circulation pond retains and purifies water



Submerged dam raises the water level in a controlled manner to the floodplains

Solutions in action (July 2025)







Specific features of the Tampere pilot

- **Resident workshop** at an early stage
- **Voluntary events** for the residents
- Use of **local species**
- Use of **foreign trees**
- Elimination of **invasive alien species** on site



Lessons learned

Stakeholder engagement

1. A **resident workshop** at the beginning of the general planning process provides useful information for designers.
2. **Marketing** is needed. NGOs can help city to spread information effectively.
3. The construction of NBS sites is viewed **positively**, if it does not compromise services, for example.



Lessons learned



Planning

1. The more diverse the **group of experts** involved in the work, the better the end result.
2. Design requires high-quality **data**.
3. It is advisable to leave room for surprises in the planning **schedule**.

Lessons learned

Construction

1. Permit process and procurement takes **time**.
2. It is important that **supervisors** are on site every day to resolve any issues so that work on the site does not slow down.
3. All **machinery and equipment** must be suitable for the site.
4. It is beneficial if the construction company has previous **experience** of similar work.



End result





Better urban environment



Increased biodiversity



Increased awareness of NBS

“We got an impactful solution that brings multiple benefits.”


Nallenpuisto NBS site
in Tampere

Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS City Blues

More information

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anna.vilhula@tampere.fi



interreg-baltic.eu/project/city-blues
nbsmodel.eu

Project has received funding from the EU's Interreg Baltic Sea Region programme.

Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS City Blues

Climate adaptation process and the River Kolding Project

- retention of water in the River Kolding Valley

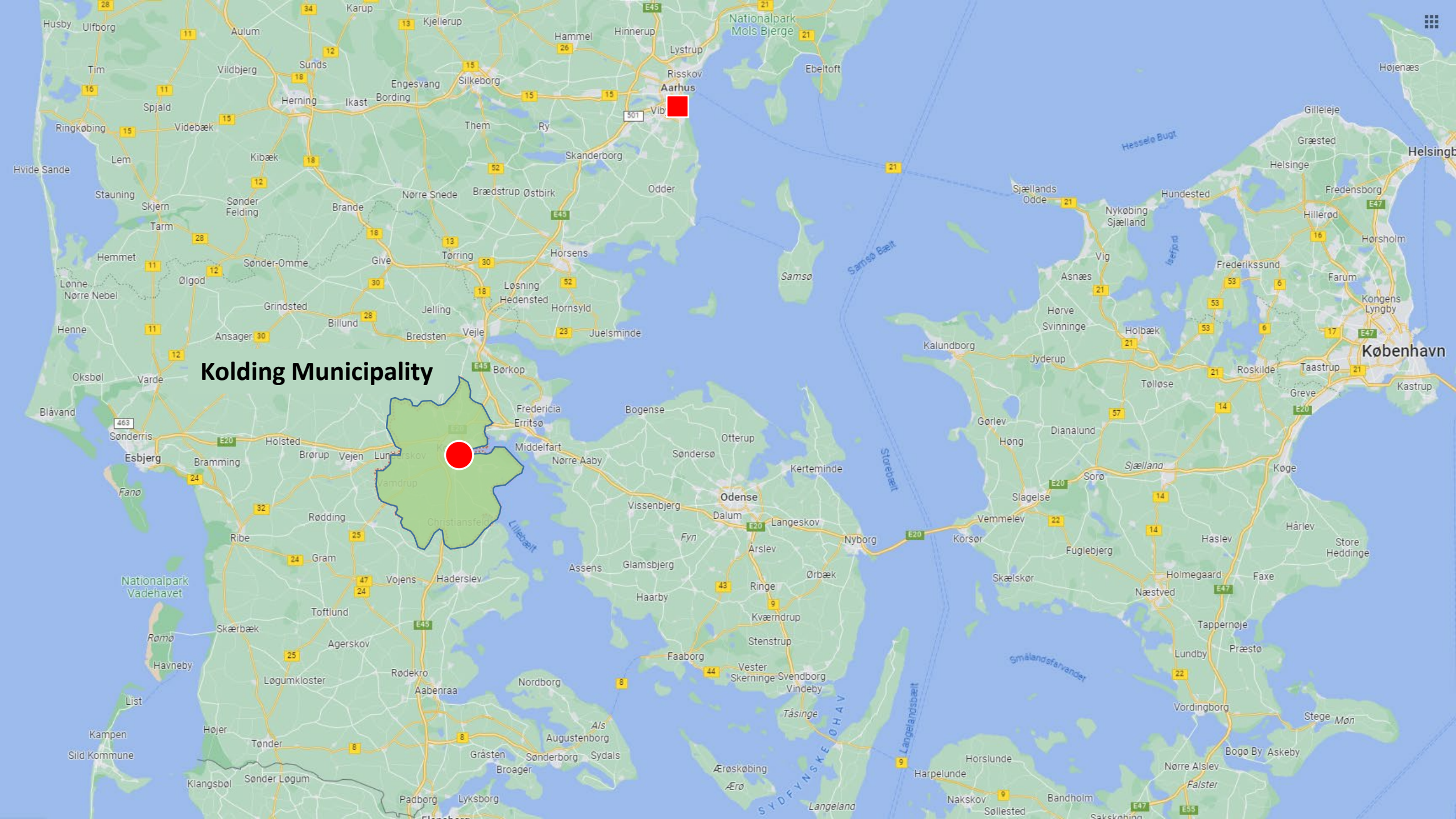
Sten Frandsen
Kolding Municipality
Nature and Water Department

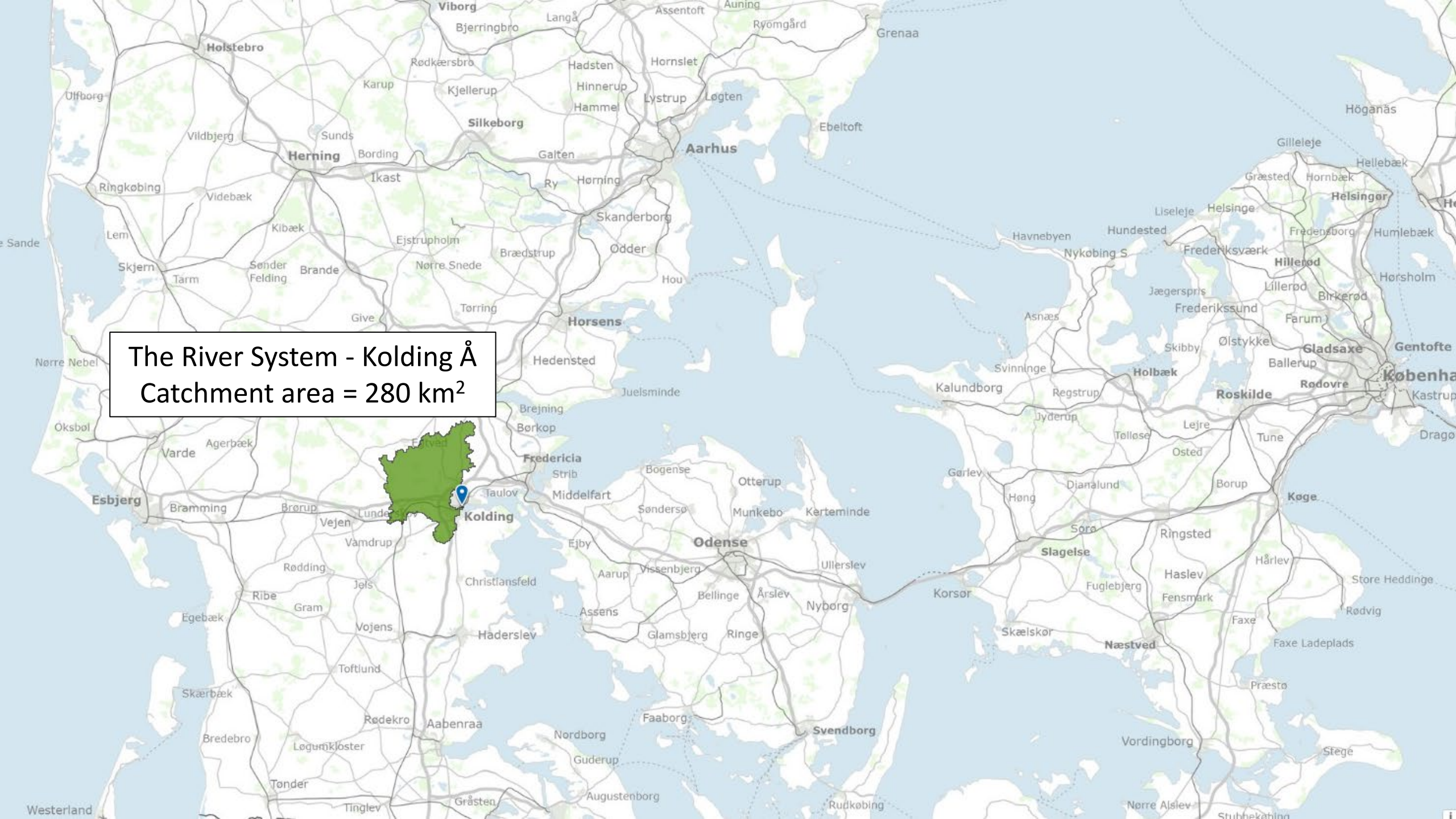
Kolding Kommune
en del af trekantområdet

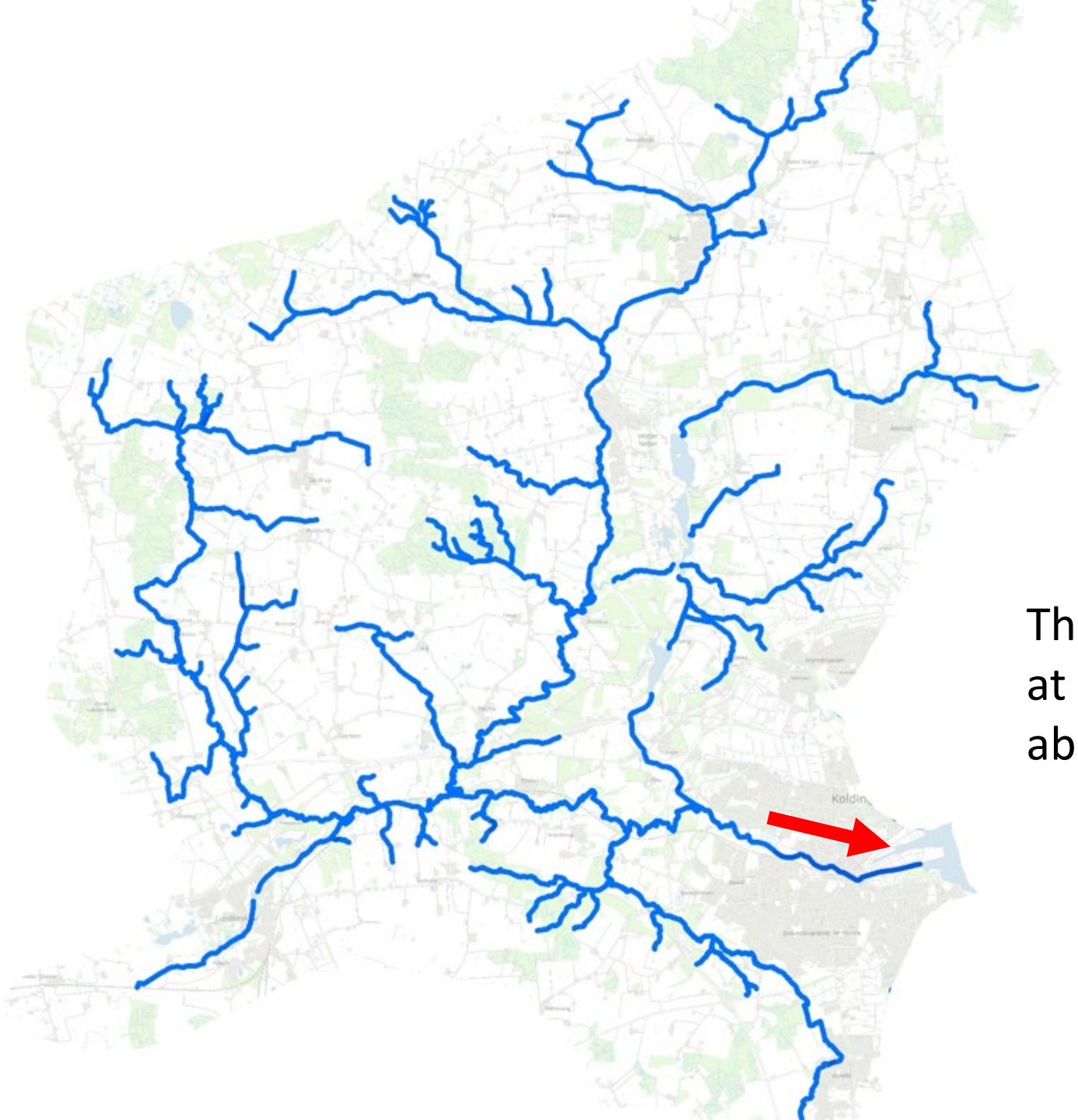


How to retain 2.3 million cubic meters of water in a river valley to prevent flooding in a city




Kolding Municipality
Aarhus
København


The River System - Kolding Å
Catchment area = 280 km²
Viborg
Bjerringbro
Langå
Assentoft
Ryomgård
Grenaa
Holstebro
Rødkærsbro
Hadsten
Hornslet
Karup
Kjellerup
Hinnerup
Hammel
Lystrup
Løgten
Ulfborg
Silkeborg
Ebeltoft
Vildbjerg
Sunds
Herning
Bording
Galten
Aarhus
Ikast
Ry
Hørning
Ringkøbing
Videbæk
Skanderborg
Lem
Kibæk
Ejstrupholm
Brædstrup
Odder
Skjern
Tarm
Sønder Felding
Brande
Nørre Snede
Hou
Tørring
Give
Horsens
Nørre Nebel
Hedensted
Juelsminde
Brejning
Børkop
Øksbøl
Agerbæk
Varde
Fredericia
Strib
Bogense
Otterup
Esbjerg
Bramming
Brørup
Taulov
Middelfart
Sønderso
Munkebo
Kerteminde
Kolding
Vejen
Vamdrup
Ejby
Odense
Rødding
Aarup
Vissenbjerg
Ullerslev
Jels
Christiansfeld
Ribe
Bellinge
Årslev
Gram
Assens
Nyborg
Egebæk
Vojens
Glamsbjerg
Ringe
Haderslev
Toftlund
Skærbæk
Rødekro
Aabenraa
Faaborg
Svendborg
Bredebro
Løgumkloster
Nordborg
Guderup
Tønder
Augustenborg
Tinglev
Gråsten
Westerland
Rudkøbing
Nørre Alslev
Stubbekøbing
Vordingborg
Stege
Præstø
Faxe Ladeplads
Rødvig
Store Heddinge
Faxe
Næstved
Skælskør
Korsør
Fuglebjerg
Fensmark
Haslev
Hårlev
Slagelse
Ringsted
Søro
Køge
Borup
Høng
Dianalund
Gørlev
Tølløse
Lejre
Osted
Tune
Jyderup
Regstrup
Roskilde
Kalundborg
Svinninge
Holbæk
Rødovre
Ballerup
Skibby
Ølstykke
Gladsaxe
Gentofte
Asnæs
Farum
Frederikssund
Jægerspris
Lillerød
Birkerød
Hillerød
Hørsholm
Frederiksværk
Nykøbing S
Havnebyen
Hundested
Liseleje
Helsinge
Fredensborg
Humlebæk
Helsingør
Hornbæk
Græsted
Hellebæk
Gilleleje
Höganäs
Kastrup
Drago



The River System - Kolding Å

Catchment area = 280 km^2

The runoff through Kolding City at a 20 year flood situation is about 20 - 25 m^3/sek.


Heavy and prolonged rain causes problems with flooding in Kolding City


30




US 50 726



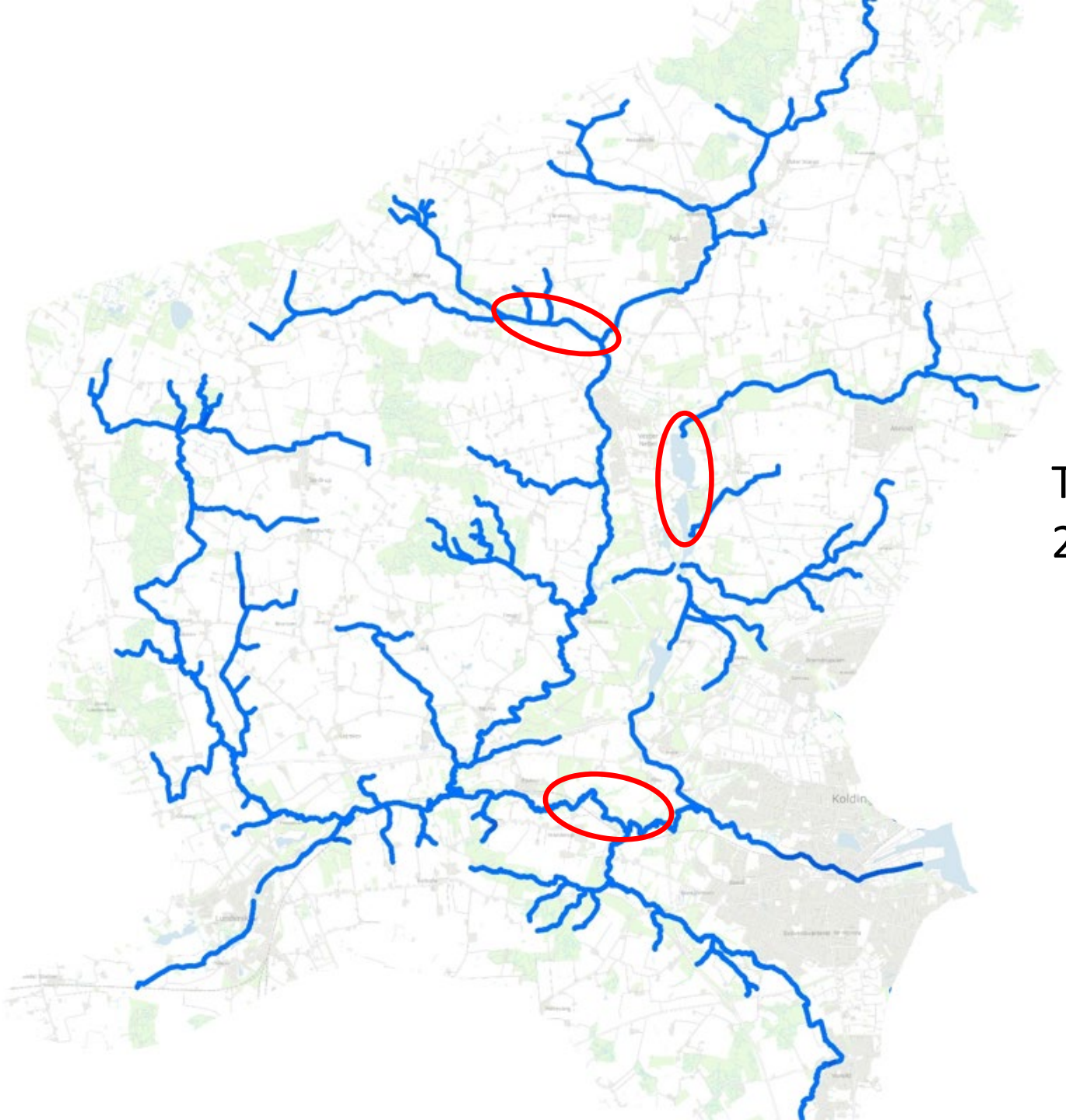


The National Emergency Management is trying to help with their pumps


FUNSKE BANK
Centru

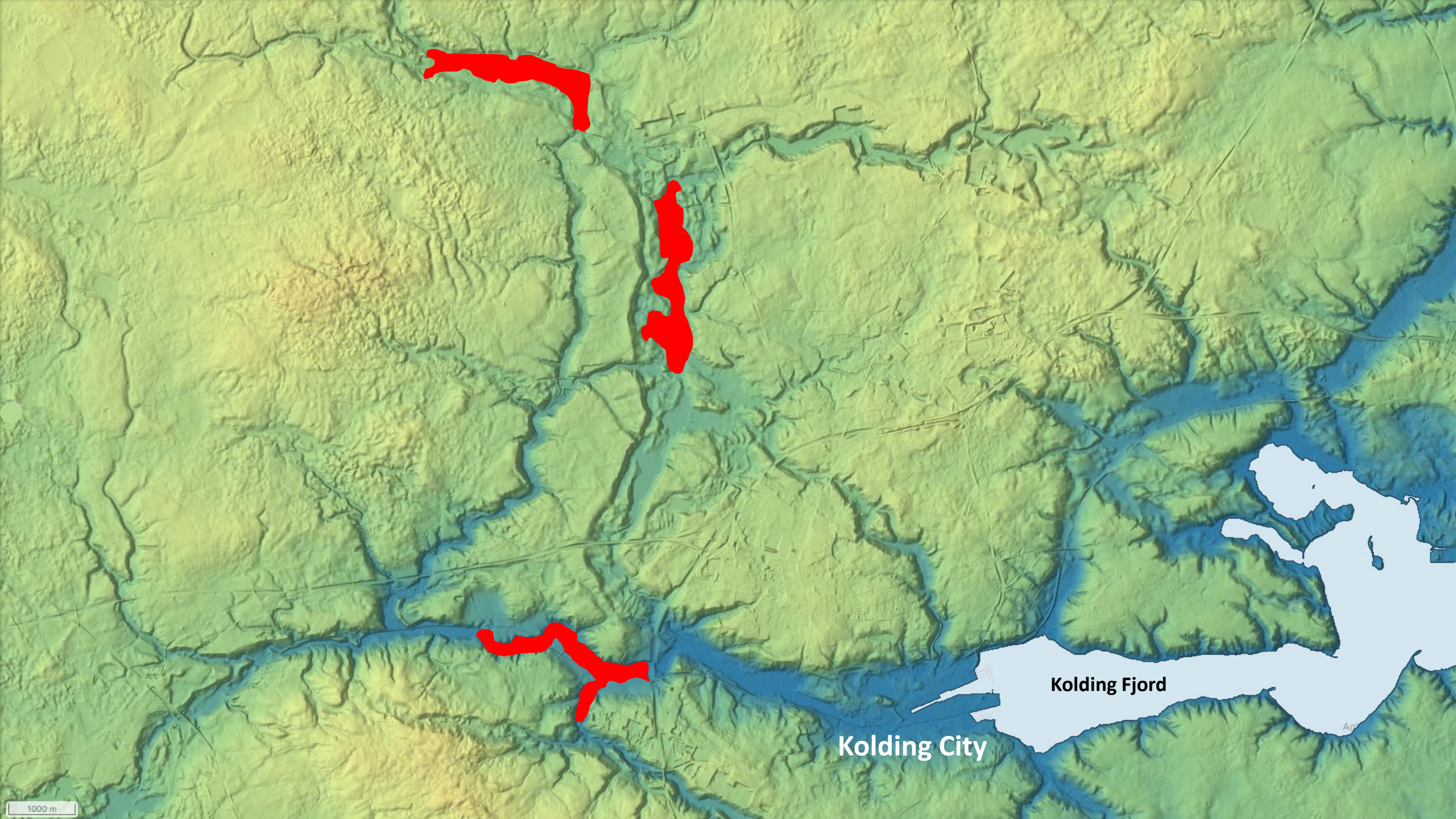

RESTAURANT
Admiralen
dlg
E20 E45
Centrum





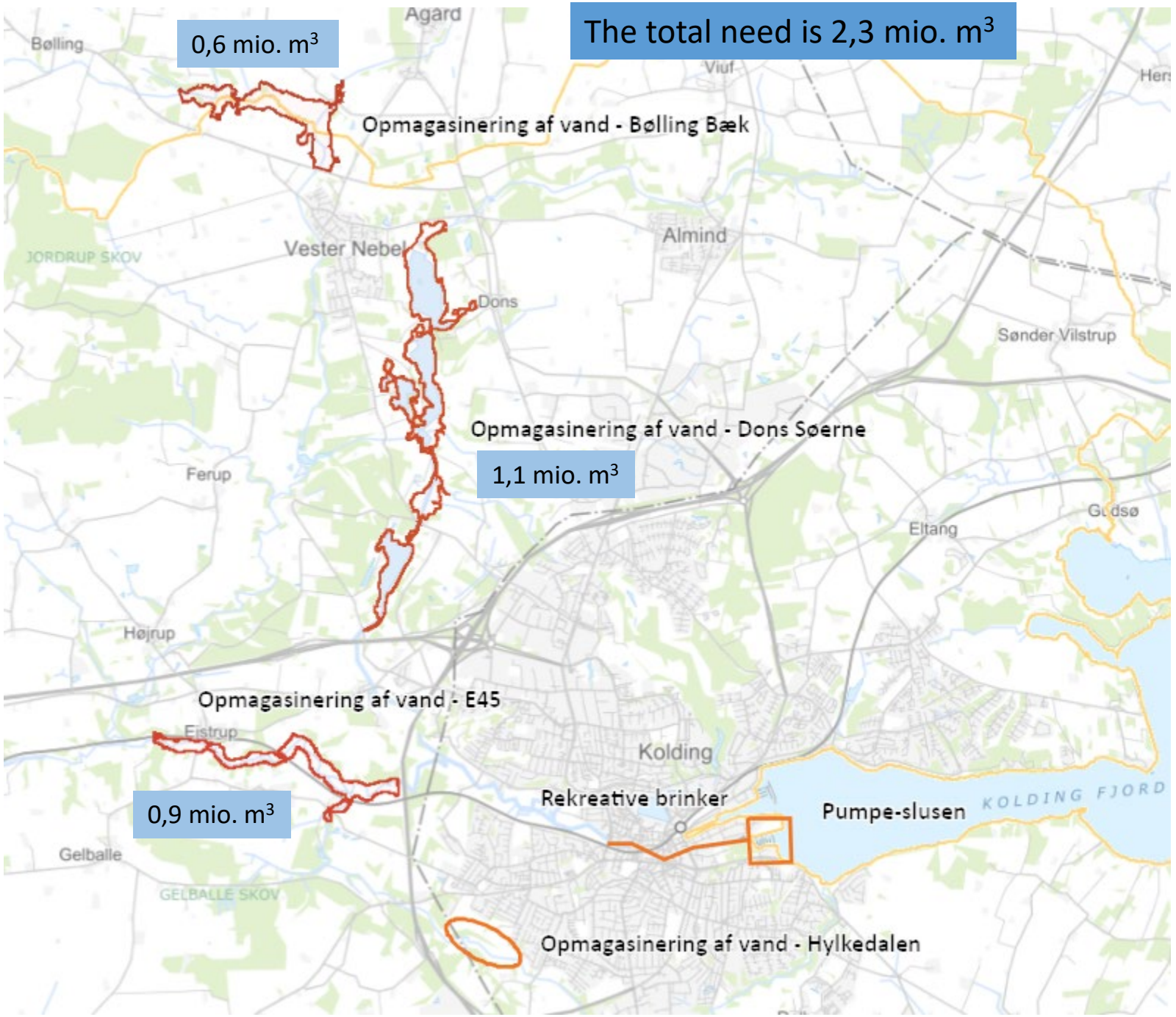
Kolding Å – River System

To prevent flooding, we must retain 2.3 million m^3 of water in the rivers


Kolding Fjord
Kolding City
1000 m

Climate adaptation projects in the River Kolding System

- Retension of water in the catchment area
- The pump-sluice project prevents seawater from flooding the city
- The purpose is to protect Kolding City up to a 100 -year event during the project's 50-year lifespan



Kolding River Vally



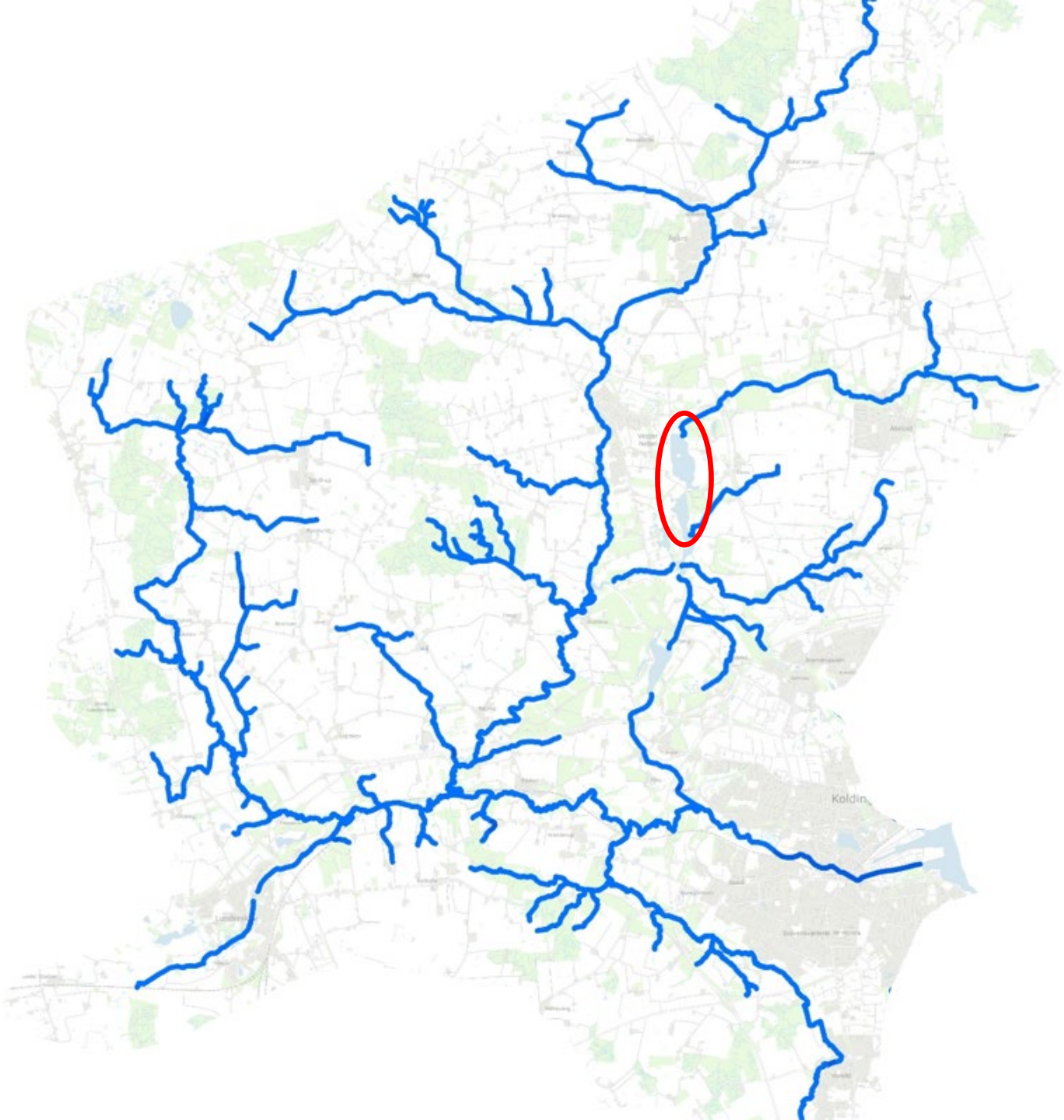

Kolding River Vally

Kolding River Vally




Kolding River Vally

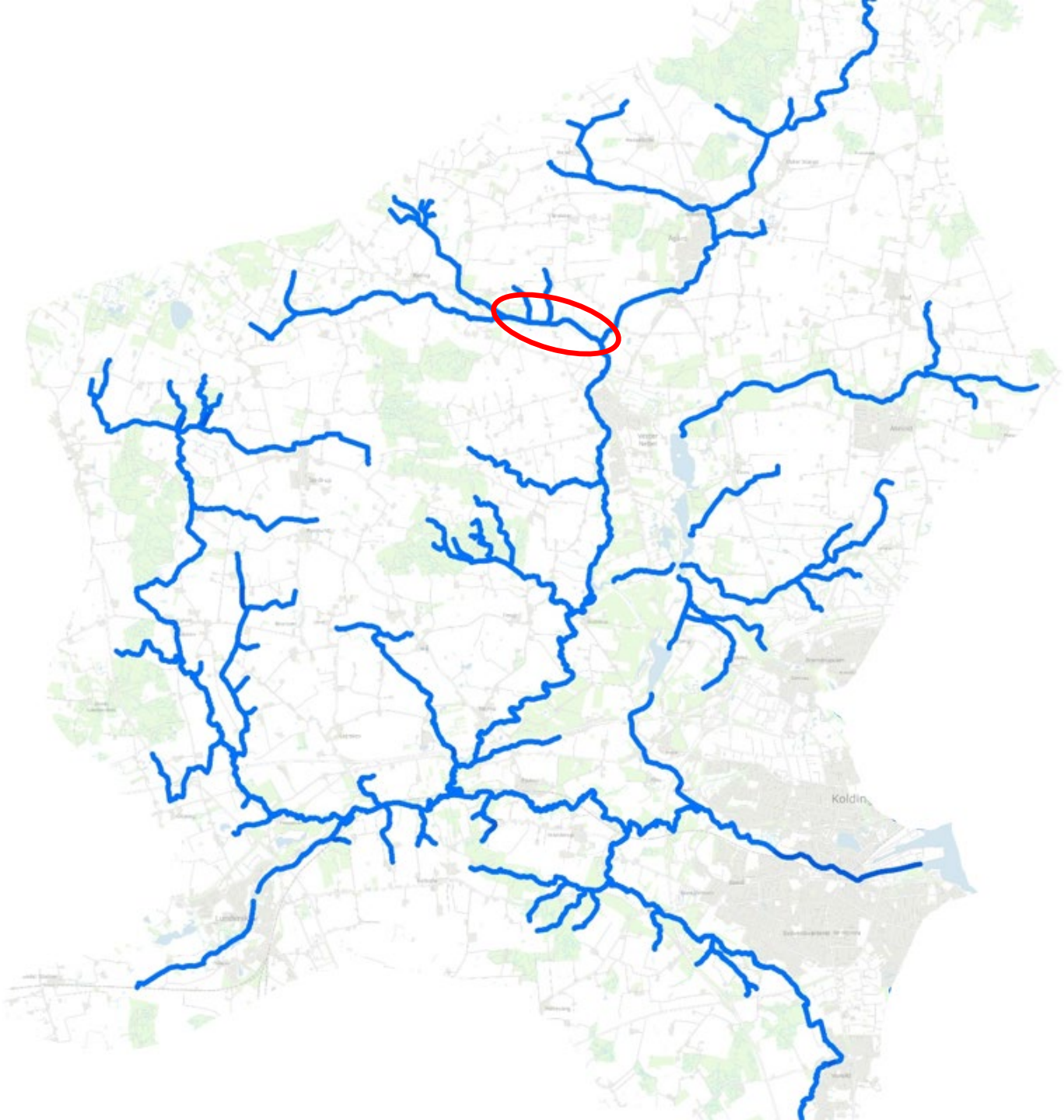
Kolding Å – River System



Harte - Dons Lakes



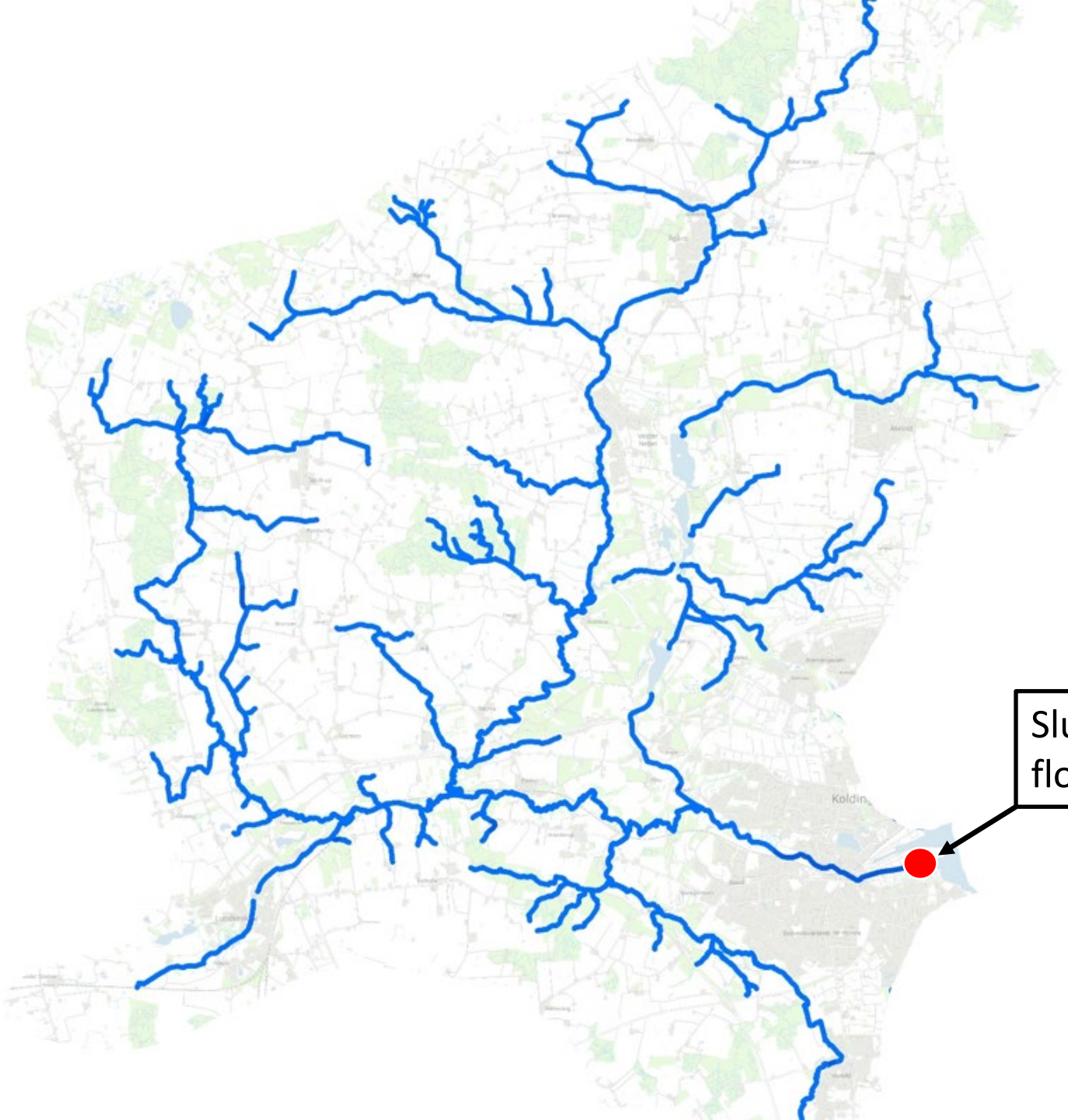
Kolding Å – River System



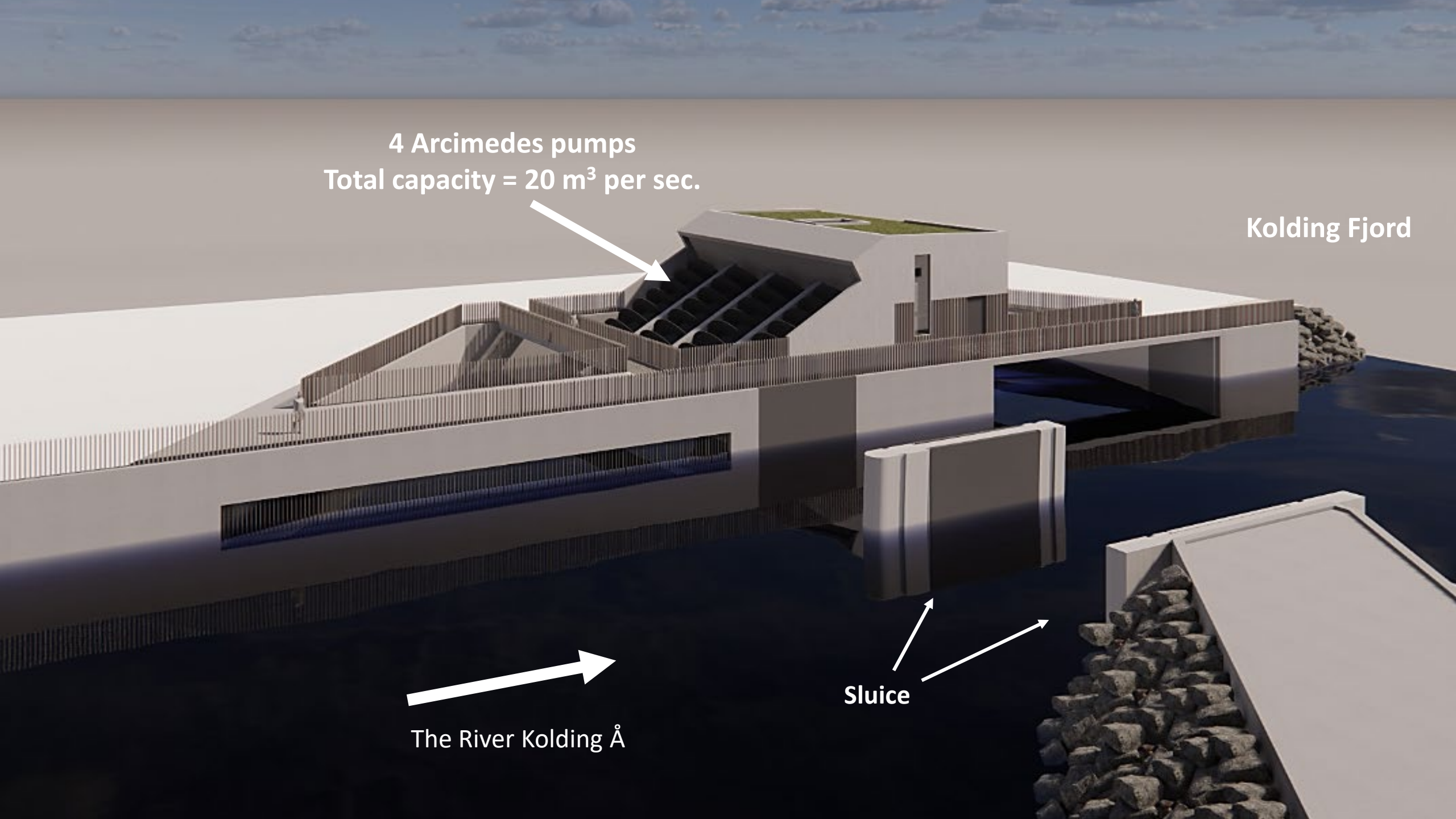
Bølling Bæk – River Valley



Kolding Å – River System

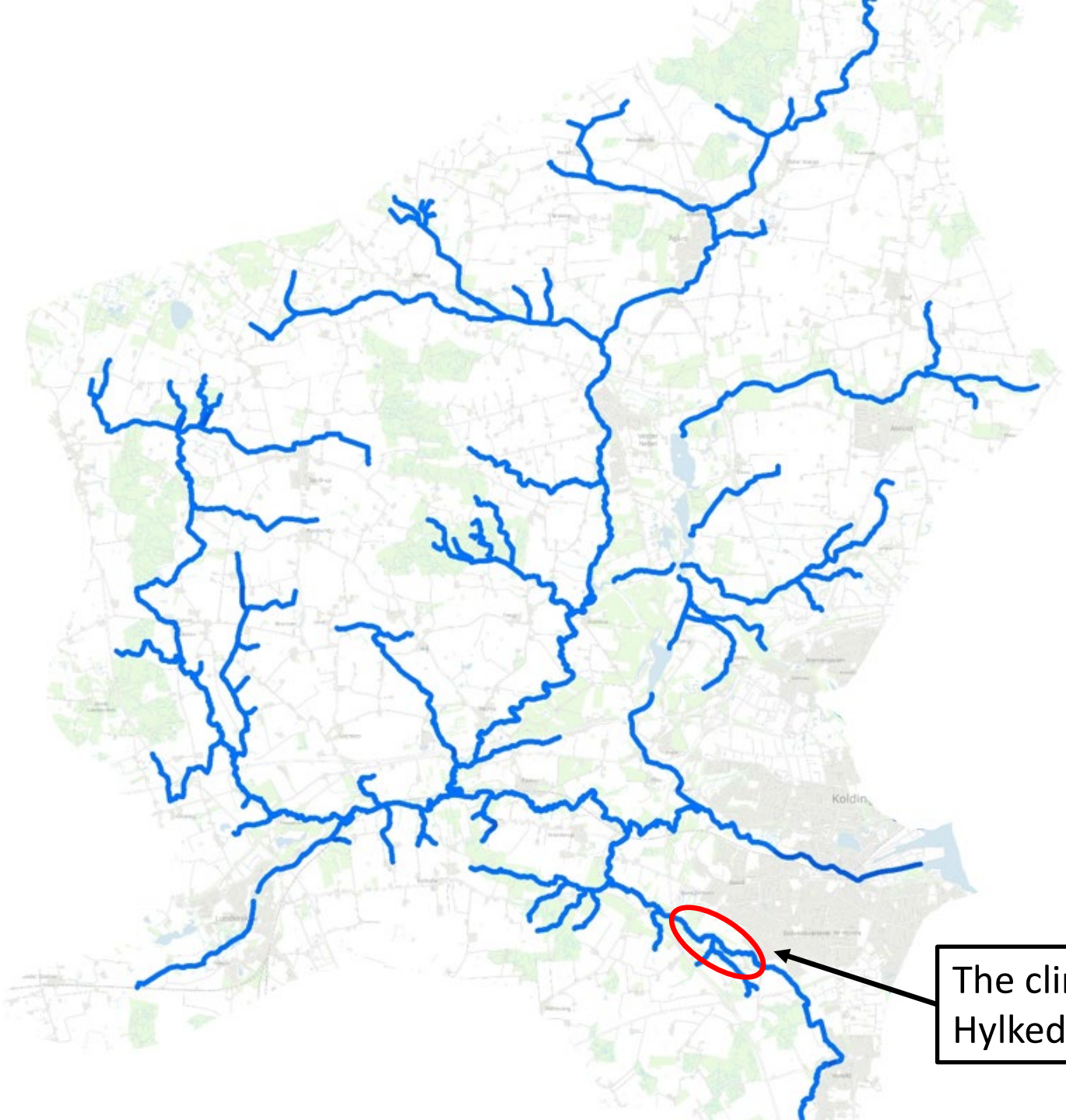


Sluice and pumps – preventing sea water from flooding the city of Kolding at storm surge


4 Arcimedes pumps
Total capacity = 20 m³ per sec.
Kolding Fjord
Sluice
The River Kolding Å



Kolding Å – River System



The climate adaptation project in Hylkedalen in the River Seest Mølleå



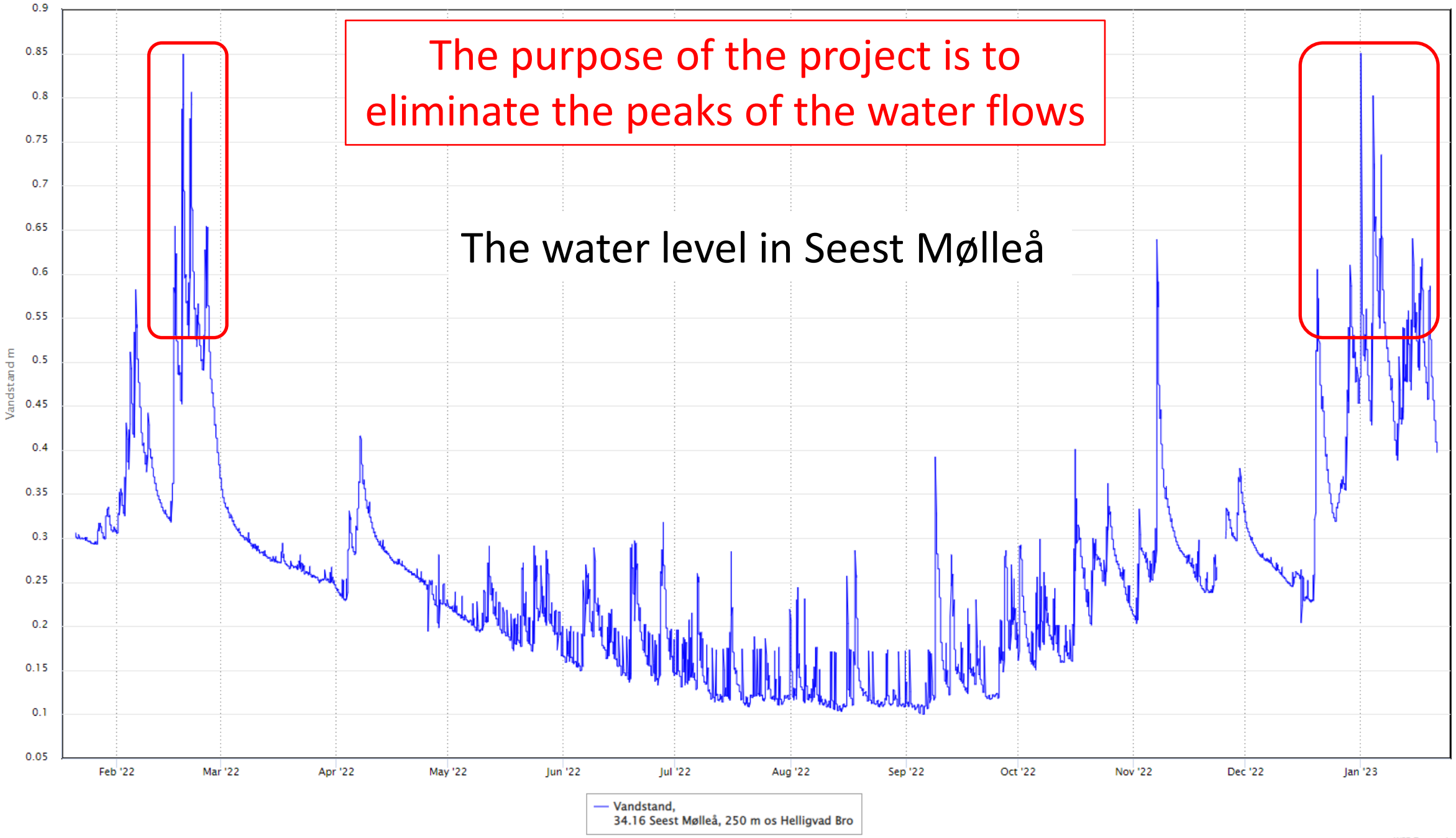
River Seest Mølleå

The water flow varies
from 2 litres/sec
to 3.500 litres/sec

The terrain is very
steep, so the water
runs very fast


The eastern project area


The western project area


The purpose of the project is to eliminate the peaks of the water flows
The water level in Seest Mølleå
Vandstand m
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
Feb '22
Mar '22
Apr '22
May '22
Jun '22
Jul '22
Aug '22
Sep '22
Oct '22
Nov '22
Dec '22
Jan '23
Vandstand,
34.16 Seest Mølleå, 250 m os Helligvad Bro

The climate adaptation project in Hylkedalen



The Hylkedalen project combines climate protection against flooding in Kolding city with nature improvements and new recreational facilities

Water retention



The size of the inlet opening at the underpass at the dike determines, how much water can flow through



Here, the capacity is almost used


Here the water rises in front of the dike


13. DEC 2022
- no water retention


4. JAN 2023
- water retention
The total amount of water
that can be retained is
60.000 cubic meters



Questions

Using Native Species to Support Biodiversity:

Why does it matter to make the right knowledgeable

knowledgeable decisions

Dr. Anita Jain, F.E.S, F.A. P.T.

Associate Professor, VBRI, Udaipur, MLS
University Director, Usanas Foundation

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dir.usanasfoundation@gmail.com





Global Environmental Crises

Climate Emergency

2024 poised to be the the warmest year on on record, accelerating environmental degradation worldwide.

Biodiversity Collapse

Over 47,000 species threatened with extinction, including 44% of reef-building corals and 41% of amphibians.

Pollution Crisis

Environmental risks claim 12.6 million lives annually, (WHO 2022 assessments).

We face an existential threat to humanity that demands immediate action.

Made with GAMMA

Revolutionary New Concepts

The European Commission (2015) recognized the transformative transformative capacity of green and blue spaces within urban urban areas, leading to groundbreaking approaches that address address multiple challenges simultaneously.

Nature-Based Solutions

Cost-effective interventions inspired by natural natural processes

Ecosystem-Based Adaptation

Climate resilience through natural ecosystem services

Green Infrastructure

Interconnected natural systems supporting urban environments

Disaster Risk Reduction

Natural barriers and buffers against environmental hazards

Water Retention Measures

Natural systems for water security and flood management

Made with GAMMA

Nature-Based Solutions

Nature-based solutions represent cost-effective interventions inspired and supported by nature that simultaneously address environmental, social, and economic challenges.

Climate Regulation

Carbon sequestration and temperature moderation through natural processes and ecosystem services.

Water Security

Enhanced groundwater recharge, flood control, and sustainable water management systems.

Soil Enhancement

Fertility improvement, erosion control, and restoration of degraded landscapes.

Habitat Restoration

Species survival support and biodiversity conservation through ecosystem rehabilitation.





Understanding Nature-Based Solutions

NBS encompasses a comprehensive range of practices designed to work with natural systems rather than against them, creating sustainable solutions for environmental challenges.

Protecting Ecosystems

Safeguarding existing natural habitats and their biodiversity through conservation strategies and protective measures.

Managing Resources

Sustainable stewardship of natural resource to maintain ecosystem health while meeting human needs.

Restoring Ecosystems

Rehabilitating degraded environments through strategic native species plantation in urban forests, wetlands, agroforestry, and grasslands.

Made with GAMMA



Why Native Plant Species Matter in NBS

Local Adaptation

Higher resilience to local Climate conditions, pests, and diseases due to evolutionary adaptation.

Biodiversity Support

Provide essential food and shelter for native pollinators, wildlife, and maintain ecological balance.

Enhanced Carbon Storage

Superior carbon sequestration capabilities capabilities compared to to non-native species in local conditions.

Water Cycle Regulation

Optimize local precipitation Patterns and groundwater Recharge through adapted root systems.

Soil Health

Increase fertility, regulate food webs, and prevent erosion through natural soil-plant interactions.

Cultural Preservation

Maintain traditional ecological knowledge and support diverse livelihoods: food, fodder, fiber, and medicine.

Made with GAMMA

Butea monosperma – "The Flame of the Forest" "Parrot tree"

Local name : *Khakara, Tesu, Kankhera*



Multipurpose Native Champion

Ecological Powerhouse:

Soil improvement, wasteland reclamation, and er
control capabilities make it ideal for restoration p

Biodiversity Hub:

More 50 avian species depend on this tree for feeding, nesting, and roosting. Supports count less number of pollinators including bees, butterflies, insects, and also valuable for rearing lac insects.

Economic Value:

NTFP production supports small-scale industries: disposable plates, cups, bowls. Wood for agricultural implements and charcoal. Bark fiber for cordages and nutritious leaves as livestock fodder.

fodder.

Medicinal Properties:

In traditional system of medicine barks and red gum exudates secreted from the bark known as *Butea* kino is used.

Made with GAMMA



Cultural Heritage in Conservation

The cultural significance of *Butea monosperma* demonstrates how native species interweave cultural values, creating deeper community connections to conservation efforts.



Natural Dyes & Pigments

Flowers produce vibrant yellow-orange dyes used in traditional paintings and textile coloring from centuries.

Festival Celebrations

Traditionally for making 'Gulal' powder during Holi festivals, connecting communities to biodiversity

Traditional Adornment

Flowers crafted into 'Gajara' garlands for cultural ceremonies and celebrations.

Natural Cosmetics

Leaves traditionally used in 'Heena' preparations, showcasing sustainable beauty practices.

Bombax ceiba – The Silk Cotton Giant



Local Name:
Semal

Biodiversity Support:

Avian Paradise

Over **94 bird species species** utilize this magnificent tree, for for feeding, roosting & roosting & nesting. Each species finds specific ecological niches within its canopy.

Critical Nesting Habitat

Large endangered birds like like White-rumped Vultures Vultures (*Gyps bengalensis*) *bengalensis*) depend heavily heavily on *B. ceiba* for secure nesting sites, with with high percentages of of their populations relying relying on these trees.

Pollinator Support

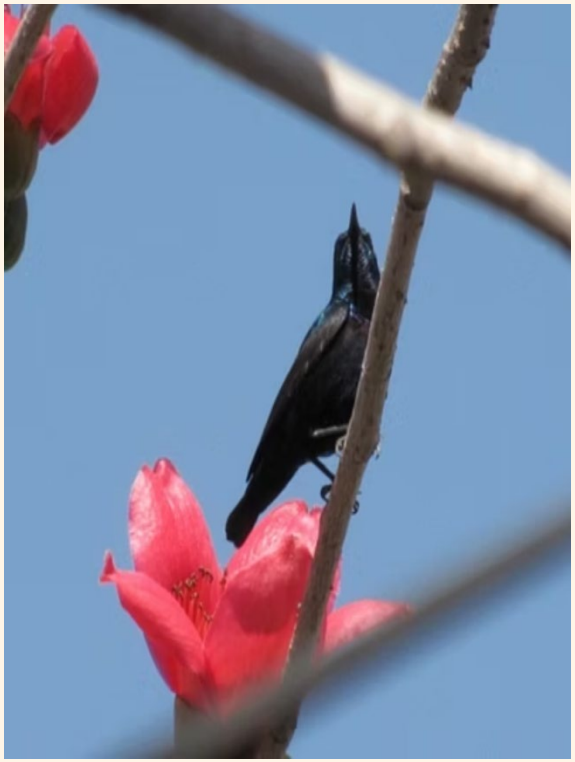
Extensive networks of birds, bees, insects, and and mammals depend on the tree's resources, resources, creating complex ecological webs that webs that support entire ecosystem functions. functions.

Made with GAMMA

Ecosystem Services in Action







•Ecological Benefits

- Soil improvement through nitrogen fixation
- Wasteland reclamation capabilities
- Natural erosion control

- Biodiversity support for frugivorous birds, bats, flying squirrels

Made with GAMMA

Cultural Values of *Bombax ceiba*







Bombax ceiba stands as a towering symbol of strength and renewal across South Asian cultures. During the *Holi* festival, the sturdy stem o*f Bombax ceiba,* known for its thick, fire-resistant bark, is traditionally chosen as the central pole for the ceremonial bonfire.

Made with GAMMA

Madhuca indica: The Sacred Mahua Tree



Common name: Mahua

Ecological Benefits

- Soil improvement through nitrogen fixation (Mycorrhizal association)
- Waste land reclamation capabilities.
- Biodiversity support for frugivorous birds, bats, flying squirrels.
- Natural erosion control.

Biological Properties

Flowers, seeds and bark has Diverse medicinal properties used in traditional healing practices for centuries. Now pharmacologically Proven.

Economic Value

- NTFP support for local industries
- Traditional fermented drink 'Maudi' from flowers
- Seed oil for soap, detergent, biodiesel production

Native Species in Protection & Conservation

Sacred Groves

Ancient forest patches protected by traditional beliefs and community stewardship, preserving endemic species and cultural heritage.







Made with GAMMA

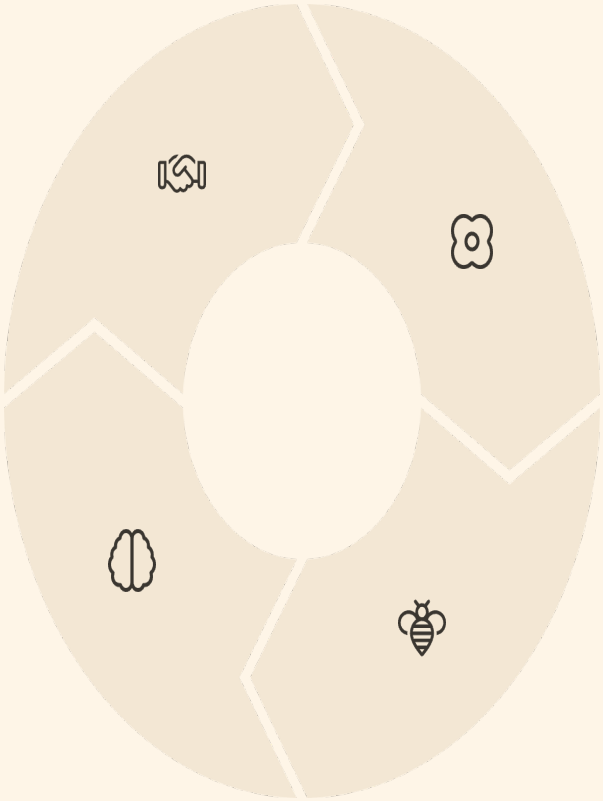
Co-evolution and Coexistence of Species

Mutual Benefit

The fundamental principle where relationships benefit both parties, creating sustainable ecological partnerships

Behavioral Evolution

Complex behavioral adaptations emerge as as species learn to optimize their interactions over evolutionary time



Plant Adaptations

Plants evolve specialized specialized features: nectar production, attractive colors and scents, and specific flower shapes to attract attract pollinators

Pollinator Adaptations

Pollinators develop longer tongues, specialized mouthparts, mouthparts, and body body structures for efficient resource access

This remarkable dance of adaptation demonstrates how species species influence each other's evolutionary trajectory, creating the creating the intricate web of life we observe in nature today. today.

Made with GAMMA



Ornithophilous Adaptations

Butea monosperma – The "Parrot Tree"

The distinctive **beak-like keel petal** of this remarkable tree resembles the curved, conical beak of common tropical birds like crows.

This specialized structure is perfectly designed for avian pollinators to crush and access the nectar within.

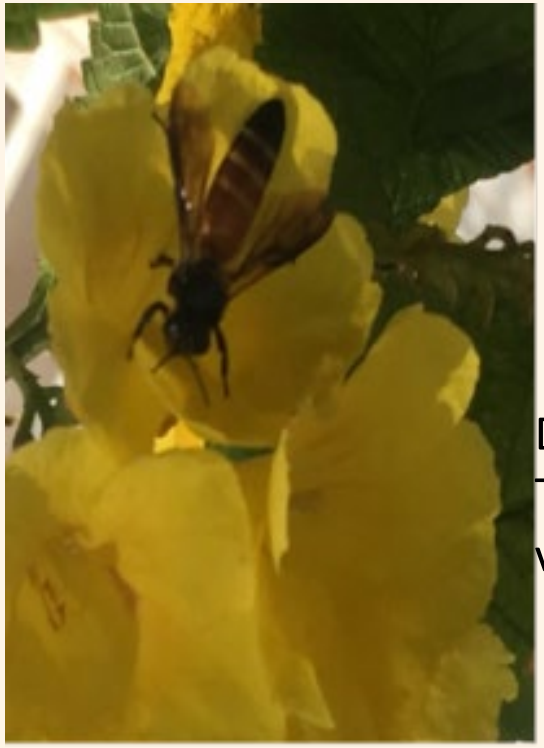


Evolutionary Marvel

Hummingbirds and similar nectar -feeding birds have co-evolved with deep flowers, developing elongated beaks and tongues that facilitate both feeding and pollination in one efficient motion.

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Co evolution: Bees and flowers



Bees and Flowering Plants

A Remarkable coevolutionary partnership spanning millions of years,where bees have perfected pollen and nectar collection techniques essential for their survival and reproduction.

Butterflies and Blooms

Delicate butterflies have evolved specialized proboscis structures To access nectar from deep flowers ,while plants developed vibrant Colors and landing platforms.

Birds and Fruit Trees

Frugivorous birds and seed-bearing plants have created a perfect dispersal system, with birds receiving nutrition while transporting seeds to new locations

These intricate relationships demonstrate nature's extraordinary capacity for Mutual adaptation, creating sustainable partnerships that have flourished across evolutionary time scales.

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Native **Species** in Resilience & Restoration

Urban Forest Development



→ **Creating green corridors** with indigenous tree species to enhance urban biodiversity and air quality

→ **Riparian Buffer Zones**

Establishing native grass and reed systems along waterways to prevent erosion and filter pollutants.

→ **Wetland Revival**

Restoring aquatic ecosystems using native plant species to support water purification and wildlife habitat.

→ **Agricultural Biodiversity**

Reviving traditional crops like millets and pulses to enhance food security and soil health.

→ **Mine Land Rehabilitation**

Using hardy native vegetation to restore degraded mining areas and prevent further environmental damage.







Native Species for Sustainable Utilization

Food Security

Traditional food crops including nutrient-rich millets, Indigenous fruits, and medicinal plants provide sustainable nutrition

Natural Resources

Sustainable harvesting of fodder for livestock, fuelwood for energy, and natural fibers for textiles

Eco-tourism

Nature-based tourism and recreation opportunities that generate income while preserving ecosystems.

Traditional Crafts

Supporting local cottage industries through sustainable use of native plant materials for handicrafts and artisan products









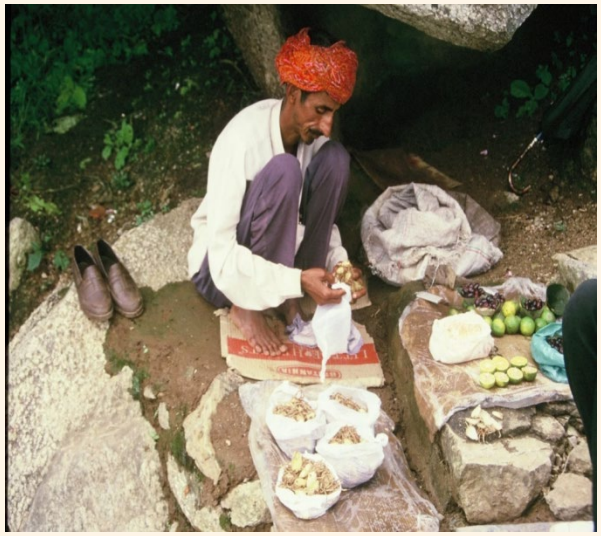




Indigenous botanical knowledge represents millennia of accumulated wisdom about plant properties, sustainable sustainable utilization practices, and traditional applications in applications in medicine, nutrition, and daily life.

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Native species provides opportunities for the Livelihood of local people both in urban and rural areas. .

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Impact of Coevolution on Plant-Pollinator Relationship

Increased Biodiversity

The specialized interactions fostered by by coevolution are a major driver of the incredible diversity we see see in flowering plants and their pollinators. This This evolutionary arms race has created a stunning array of forms, forms, colors, and behaviors across ecosystems worldwide.

Co-extinction Risk

For obligately associated species—where one cannot survive without the other—the extinction of one partner can trigger the extinction of the other.

Interdependence and Specialization

This evolutionary process can lead to remarkably specific, almost exclusive relationships between a between a single plant plant species and a single pollinator species. species. These partnerships represent represent millions of years of fine-tuned adaptation and mutual mutual dependence.

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Butterfly-Host Plant Coevolution Examples

These butterfly species demonstrate the intricate relationships between lepidopteran larvae and their specific host plants, showcasing millions of years of coevolutionary adaptation.



Common Grass Yellow

Eurema hecable



Larval Host: *Prosopis cineraria*



Common Striped Tiger

Danaus genutia



Larval Host: *Bryophyllum pinnatum*

Each butterfly species has evolved specific adaptations to digest the chemical compounds in them plants, while the plants have developed defensive strategies.

This ongoing evolutionary dance shapes both partner's overtime.

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Native Plant Species Matter in NBS

These native species has the remarkable interconnectedness of ecological, economic, and cultural values. Through strategic conservation and restoration using native plants, we create resilient ecosystems that serve multiple functions while preserving biodiversity for future generations.

Every native tree planted is an investment in biodiversity, climate resilience, and cultural Heritage preservation.



Why not Exotic and invasive species

Ecological and Environmental

- Loss of Biodiversity
- Soil Degradation
- Habitat Disruption
- Introduction of Pests and Diseases
- Increased Fire Risk

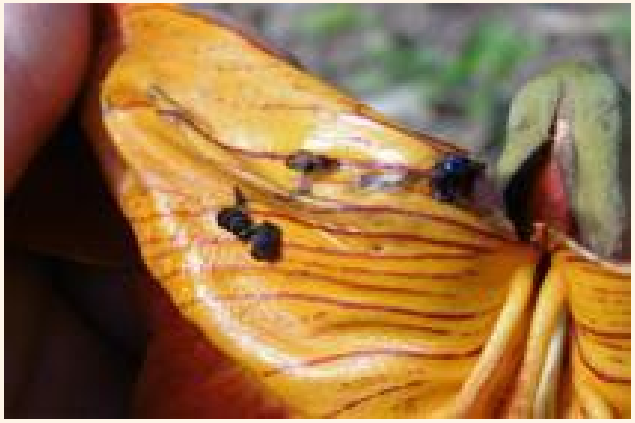
Socio-Economic Impacts

- Damage to Ecosystem Services
- Impacted on Livelihoods
- Costly Management:

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Exotic **African tree-** *Spathodea campanulata*





Loss of Biodiversity : Nectar and pollens are poisonous to Stingless bees

Bees is effective pollinator for many local species like *Jatropha* etc.

Socioeconomic loss : makes honey poisoning

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The ambition: offer solutions to remove existing pollution and, simultaneously, implement environmentally sound measures that promote and revitalize biodiversity to connect and harmonize:

- The River | Biodiversity | The City | The People
- Climate Regulation – A complete environmental cycle with emphasis on
- Bioremediation for water quality improvement and resilience of life
- Architectural enhancements to strengthen the city's connection to Gumaniya Nala

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Criteria for the zonation :

On the basis of topography, terrain, soil type, water availability, existing biodiversity, type of ecosystem and cultural significance, required intervention of NBS etc.

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Local Environmental Crises

Water Quality Crisis

- Storm water mixing with sewage
- Industrial & solid waste waste and other contamination
- Eutrophication of channels

Environmental Degradation

- Climate change impacts
- Air pollution from traffic
- Soil erosion and salinity

Biodiversity Loss

- Habitat destruction
- Tourism development pressure
- Urban expansion effects

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Native Species Selection Criteria

Our comprehensive approach evaluates multiple environmental and social factors to ensure optimal species selection for ecosystem restoration.

Ecological factors

- Ecosystem type (forest, grassland, wetland, desert etc.)
- Native species supporting feeding , nesting, and roosting of avifauna.
- Native supporting butterflies , bees, bats other pollinators
- Essential climate variables (ECVs) – it includes set of all the physical, chemical, and biological variables of Soil, water and air
- Land use pattern both present and past
- Biological interactions with existing invasive species
- Role of existing biodiversity
- Canopy of the tree
- Native plant species having high Air Pollution Tolerance Index (APTI)

Environmental conditions

- Hydrology of the area (basins, drainage, groundwater)
- Type of topography and soil characteristics
- Local reasons for environmental degradation and pollution

Community integration

- Cultural and socioeconomic values of native plants
- Recreational, aesthetic, and livelihood dimensions
- Bioremediations of water body
- Health of the surrounding society

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Thank You

Rewilding in Aarhus
Experiences from Geding- Kasted Mose and Vilhelmsborg

Lars Eg Hoppe – Aarhus Municipality

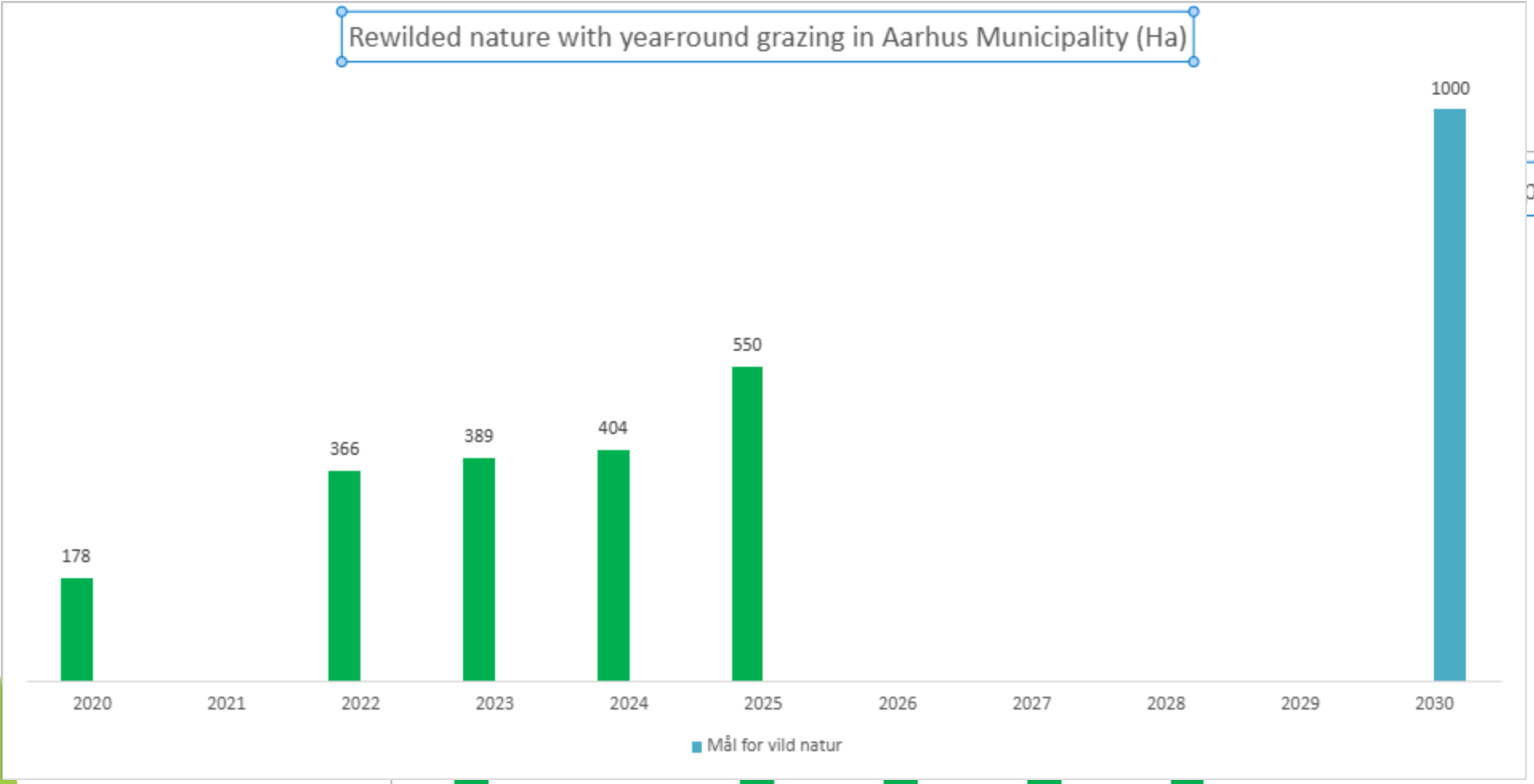
Holistic framework for successful development of Nature- based solutions
City Blues Conference 25-26. september 2025 in Aarhus City Hall



CITY OF AARHUS

Session 2: Ecological and biological impacts - exploring various strategies and solutions for enhancing biodiversity

- Green Ambitions for nature in Aarhus
- Tools for Better Biodiversity in projects
- Examples from Geding Kasted Mose (and Vilhelmsborg)



= 1/3 of the municipality

Goal by 2030: 1000 Ha wild nature with year-round grazing

Restoring habitats on farm land

- The starting point

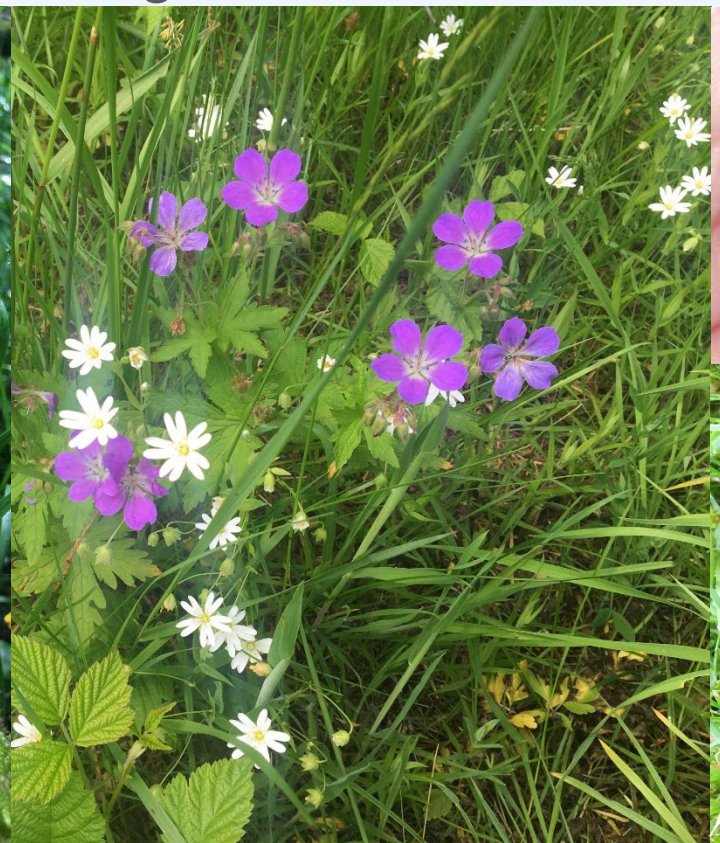
Monotonous landscape with few habitats for living organisms





Overall objectives in Self-Sustaining Mangagement (Rewilding)

- Goal:
  - Bring back natural biological, chemical and physical processes
  - To create great diversity in the landscape and many possible habitats for all organisms






New nature on farmland ”the tools”

- Initial measures – Bring water back in the landscape
- Remove or block drainpipes in the fields and recreate waterholes









Drainpipe



Stor Blåpil - hun (*Orthetrum cancellatum*)
Samsø, sommeren 2013



New nature on farmland - ”the tools”

- Initial measures "Forest land creation" and "bushy brows"
- Plant native species – e.g. flowering shrubs and trees
- Allow natural re-growth
- Soften the sharp transitions between forest and fields (open woods)







Landscape management

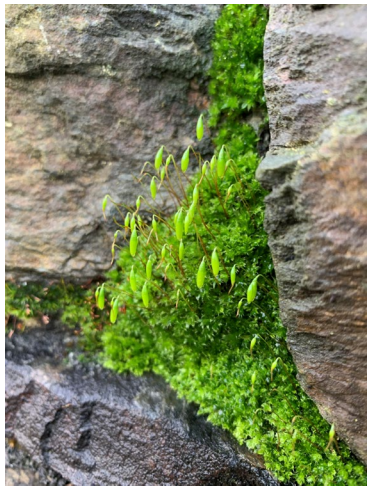
Bringing back structure, messiness & substrates















New nature on farmland - ”the tools”

AARHUS KOMMUNE



Initial actions:

Depletion of nutrient-rich agricultural land for a few years reduces the amount of nutrients in the soil so that “low nutrient species“ can thrive

Sowing native species harvested from nearby nature - by machine or by hand



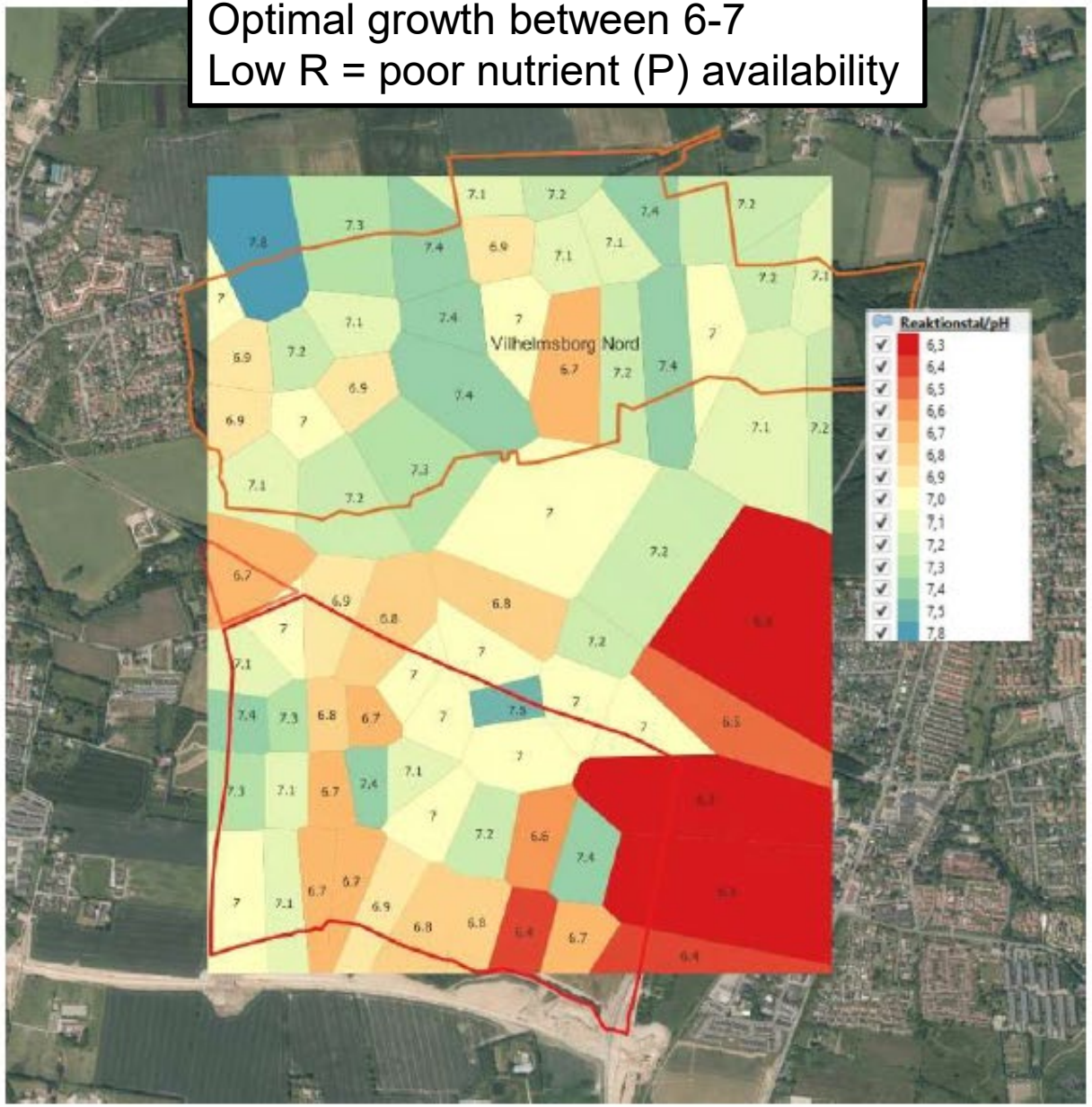


Soil samples in Vilhelmsborg

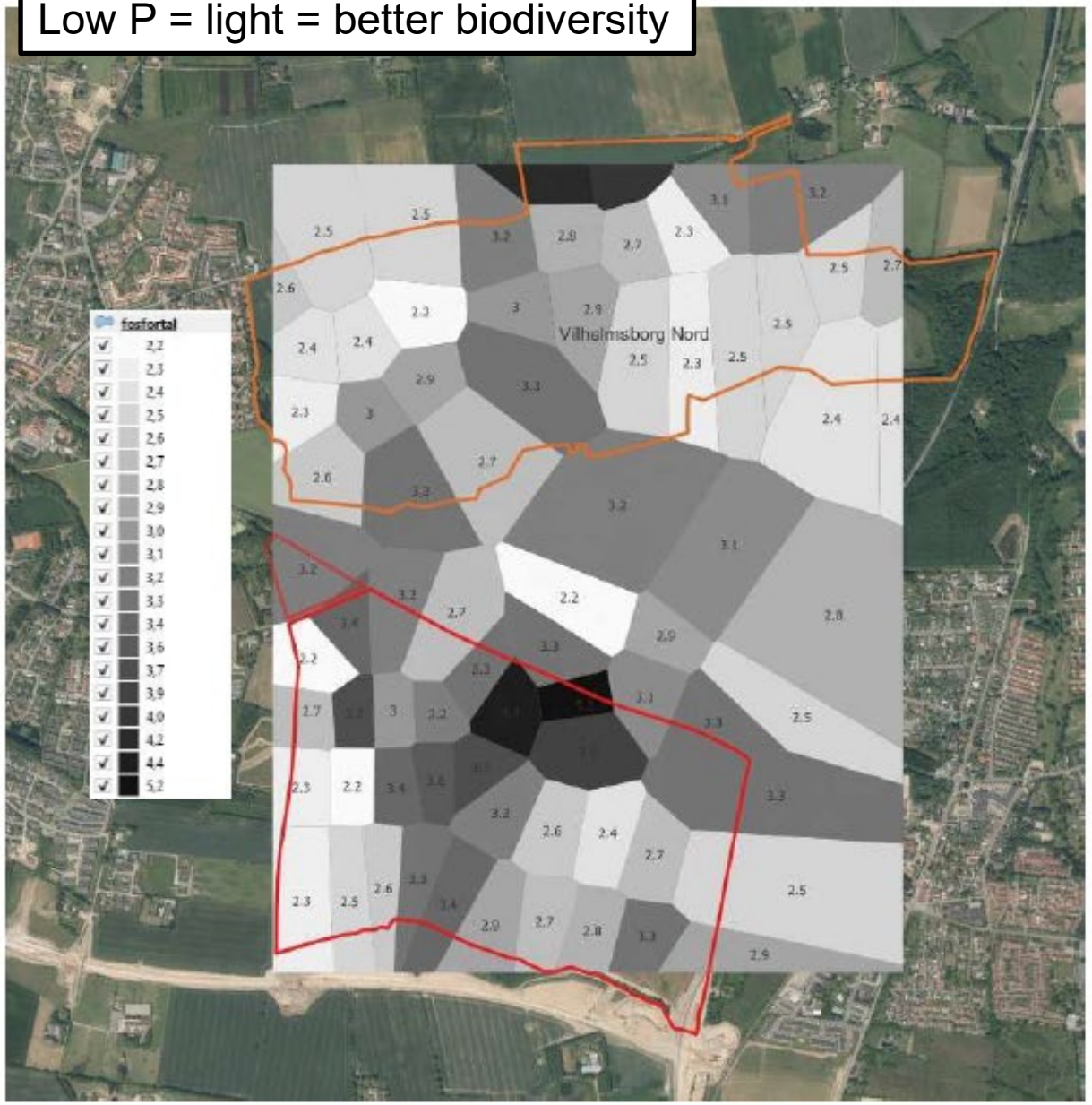


Jordprøver

Reaction rate/pH
Optimal growth between 6-7
Low R = poor nutrient (P) availability

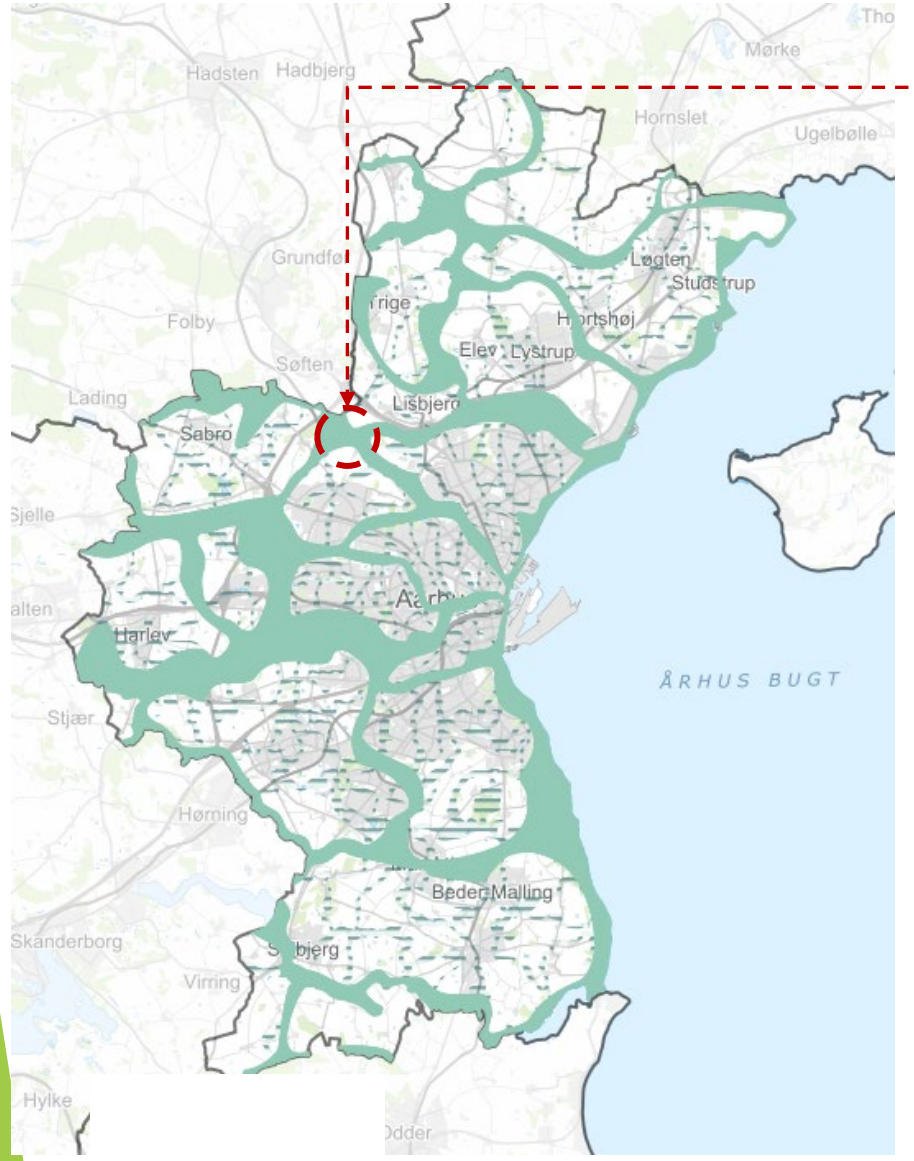


Phosphorus
Low P = light = better biodiversity



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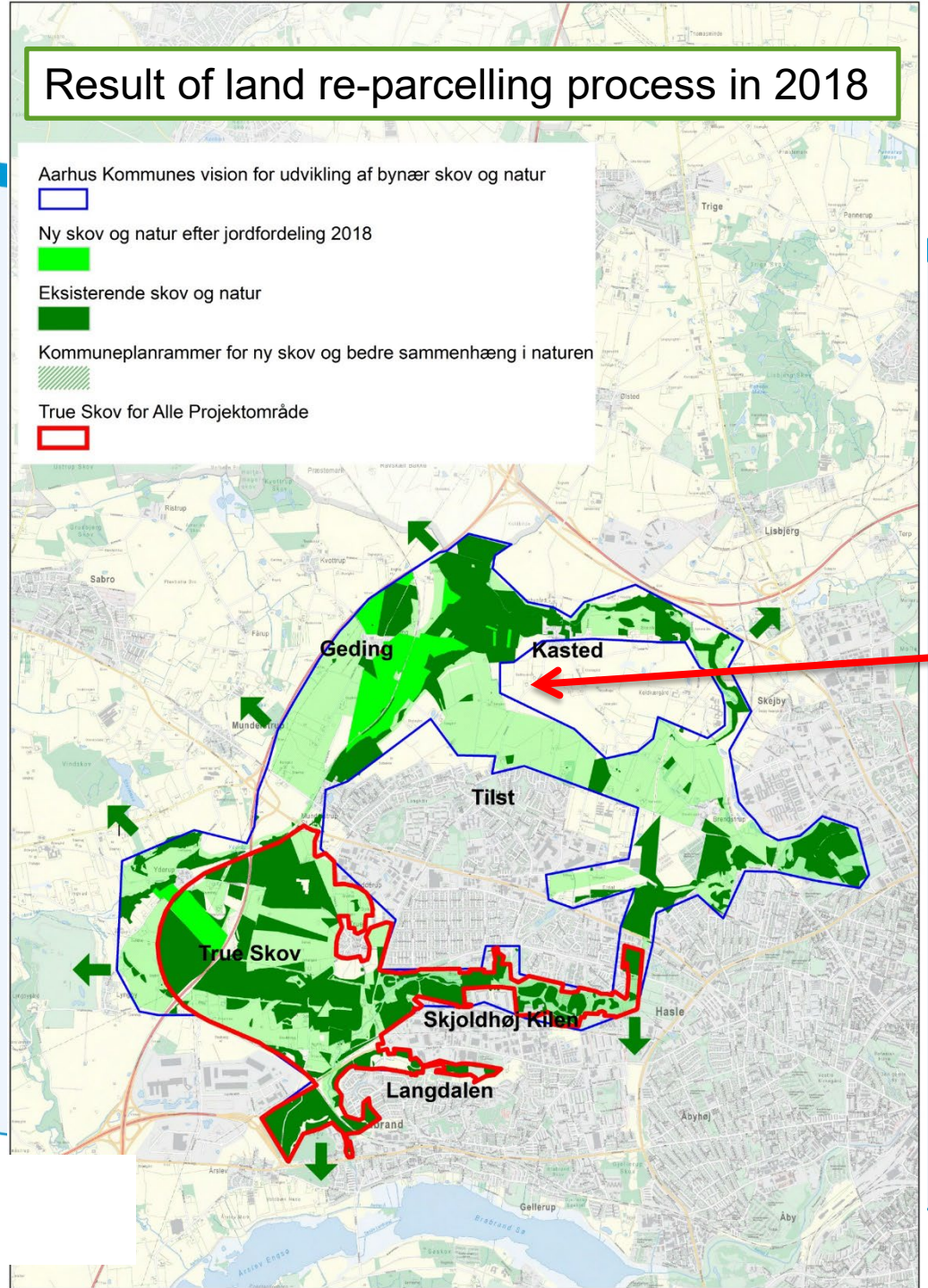
Case Geding Kasted Mose

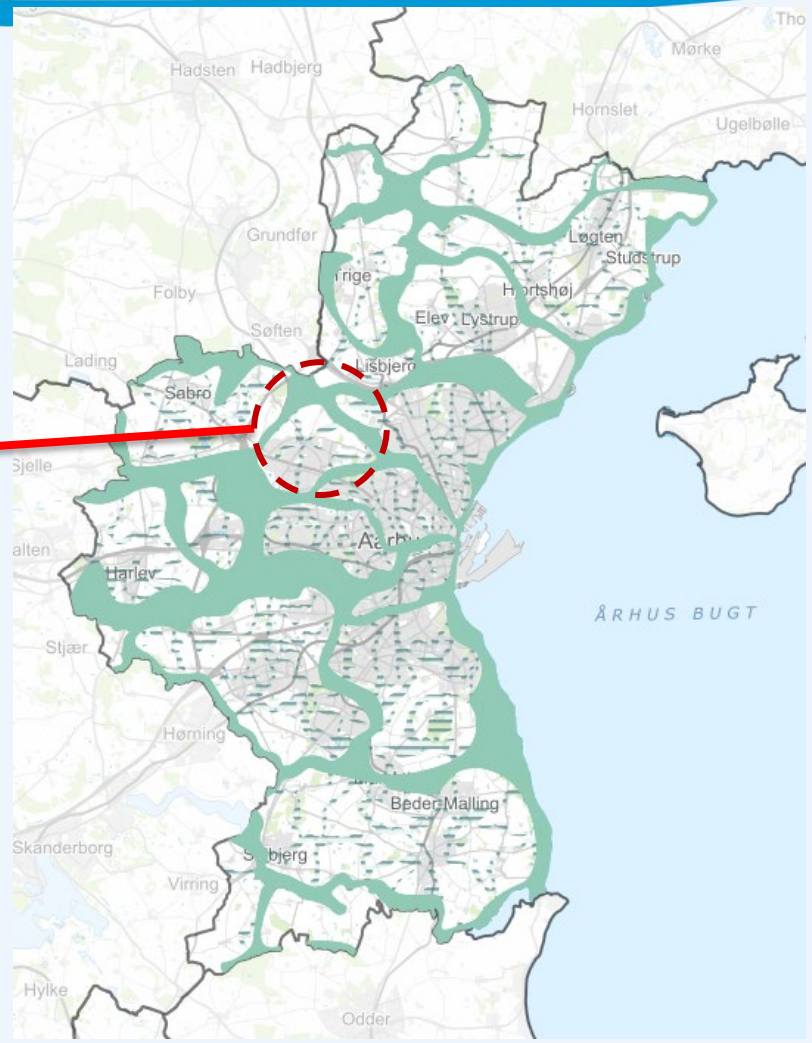




Result of land re-parcelling process in 2018

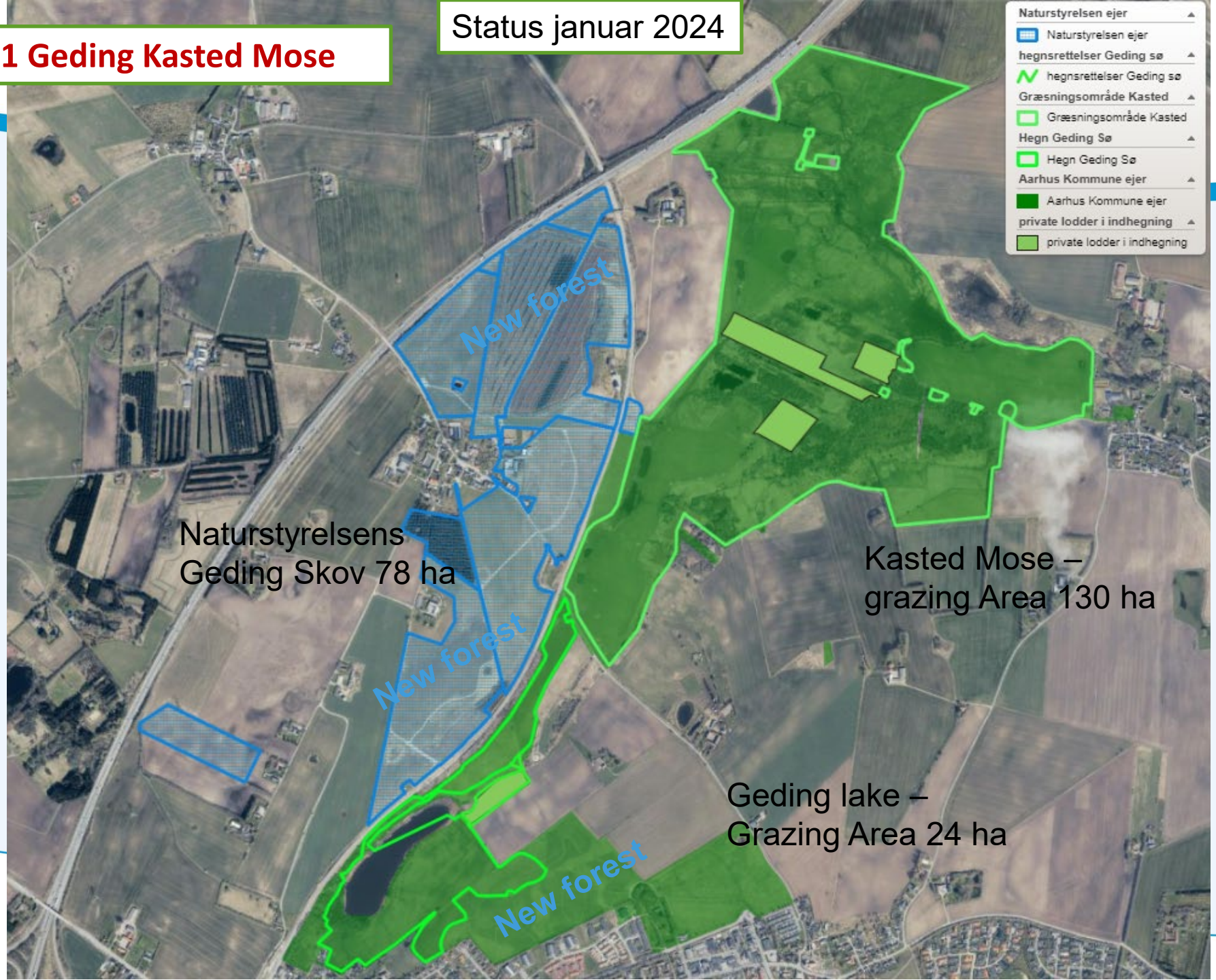
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Case1 Geding Kasted Mose

Status januar 2024



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Grazing Animals in Kasted/Geding since the start in 2017

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70-100 Galloway cattle in Kasted mose



7 x Exmoore horses in Kasted Mose

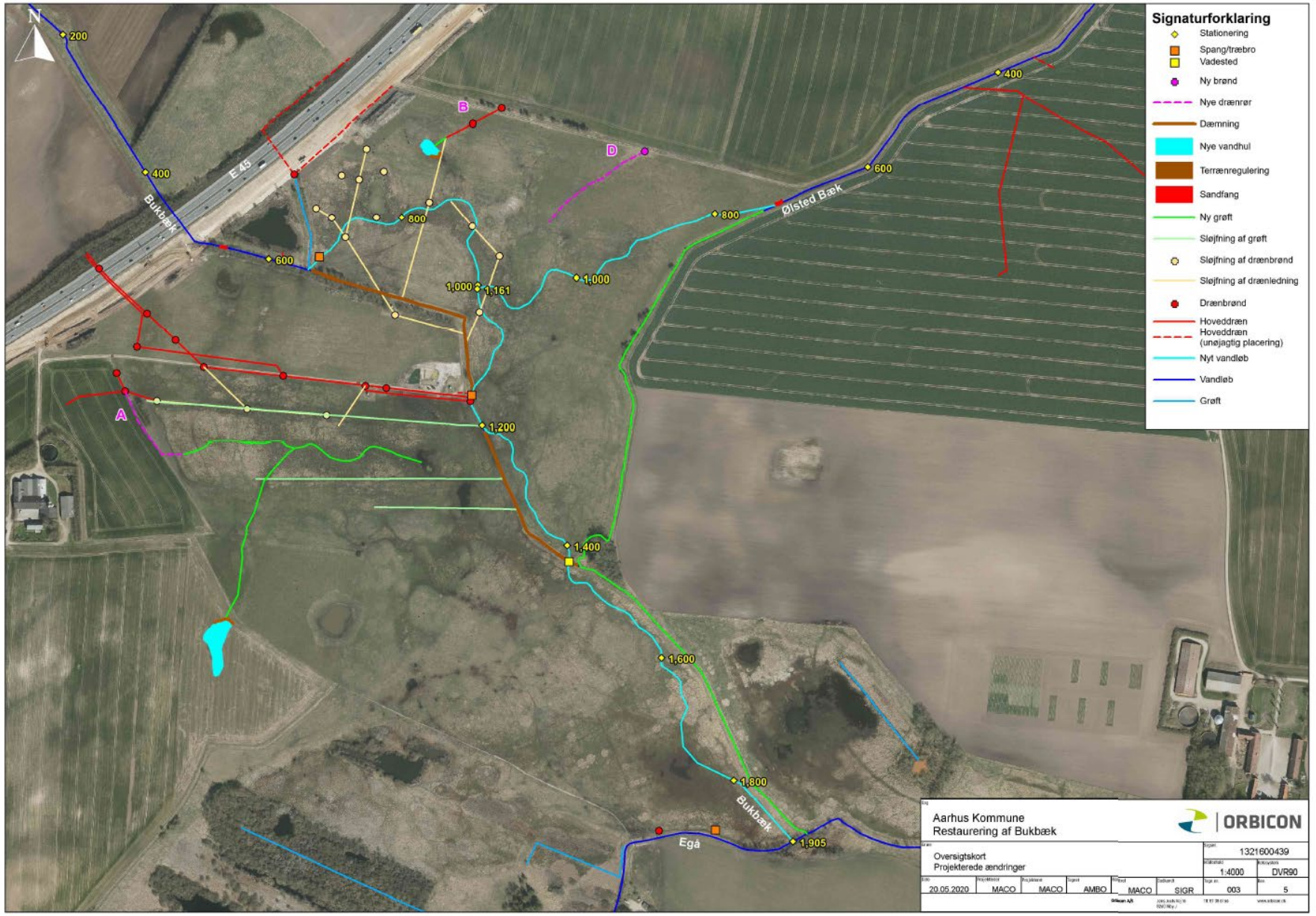


~~3 water buffalos~~
removed for security reasons



+ 10 dexter cattle at Geding Lake

Water stream restauration of Bukbæk in 2022



Water stream restauration of Bukbæk in 2022





Project in Kasted with WWF – New ponds and tree frogs and habitats for the Sand Lizard



17. Maj 2023:
Queen Marys releasing Tree frogs into 15 nye ponds

Plantning solitary trees and bushes

New habitats for the sand lizard (mark-firben)



Project in Kasted with WWF – New ponds and tree frogs and habitats for the Sand Lizard

AARHUS KOMMUNE











WWF

Summery of tools for better biodiversity

Secure a positive long-term nature development after the initial efforts

➔ Grazing (and to a lesser extent haymaking) is good for maintaining and developing the species rich habitats

➔ Year-round grazing provides the best nature effect and exciting nature experiences all year round

➔ Animal welfare must be a priority and supplementary feeding must be provided if necessary (e.g. in severe winter or severe drought)





Thank you for your attention!

Biodiverse Cities | Interreg North Sea

Co-funded by the European Union



Lars Eg Hoppe
Specialist Consultant
Project leader and Biologist
Phone +45 8940 4026
Email LHOP@aarhus.dk

AARHUS KOMMUNE

Low-tech and low-cost NBS river restoration in Estonia to support biodiversity

From young enthusiast and starting researcher/expert point of view

Jürgen Karvak

2025

My background:
Fishing >
studying fish >
reciprocal impacts between aquatic and riparian areas

+ Underwater photography

University of Tartu, Estonian Fund for Nature








Shigeru Nakano and studies about aquatic and riparian area connections

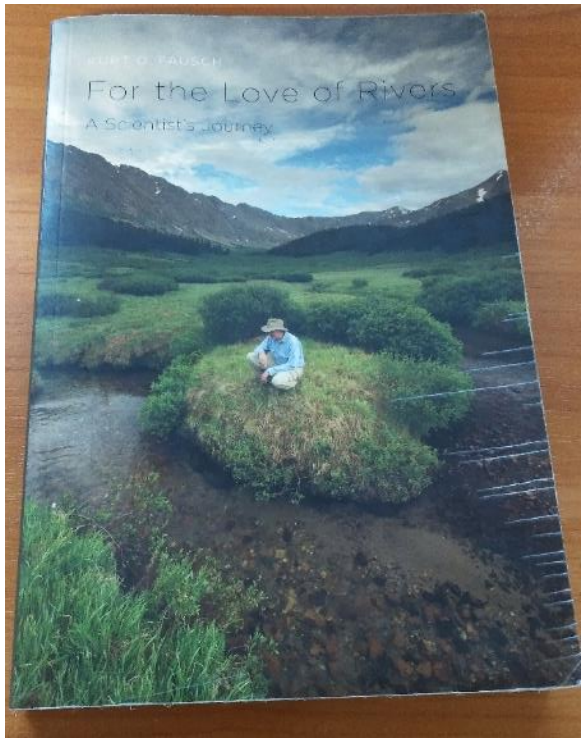
- Until 2000: rivers get energy from land (leaves, woody debris)
- Greenhouse experiments to mimic forest logging and alien species
- Paradigm shift: rivers also impact riparian ecosystems



S. Nakano, S. Kitano ja K. Fausch
Poroshiri stream, Hokkaido, Japan (1991)

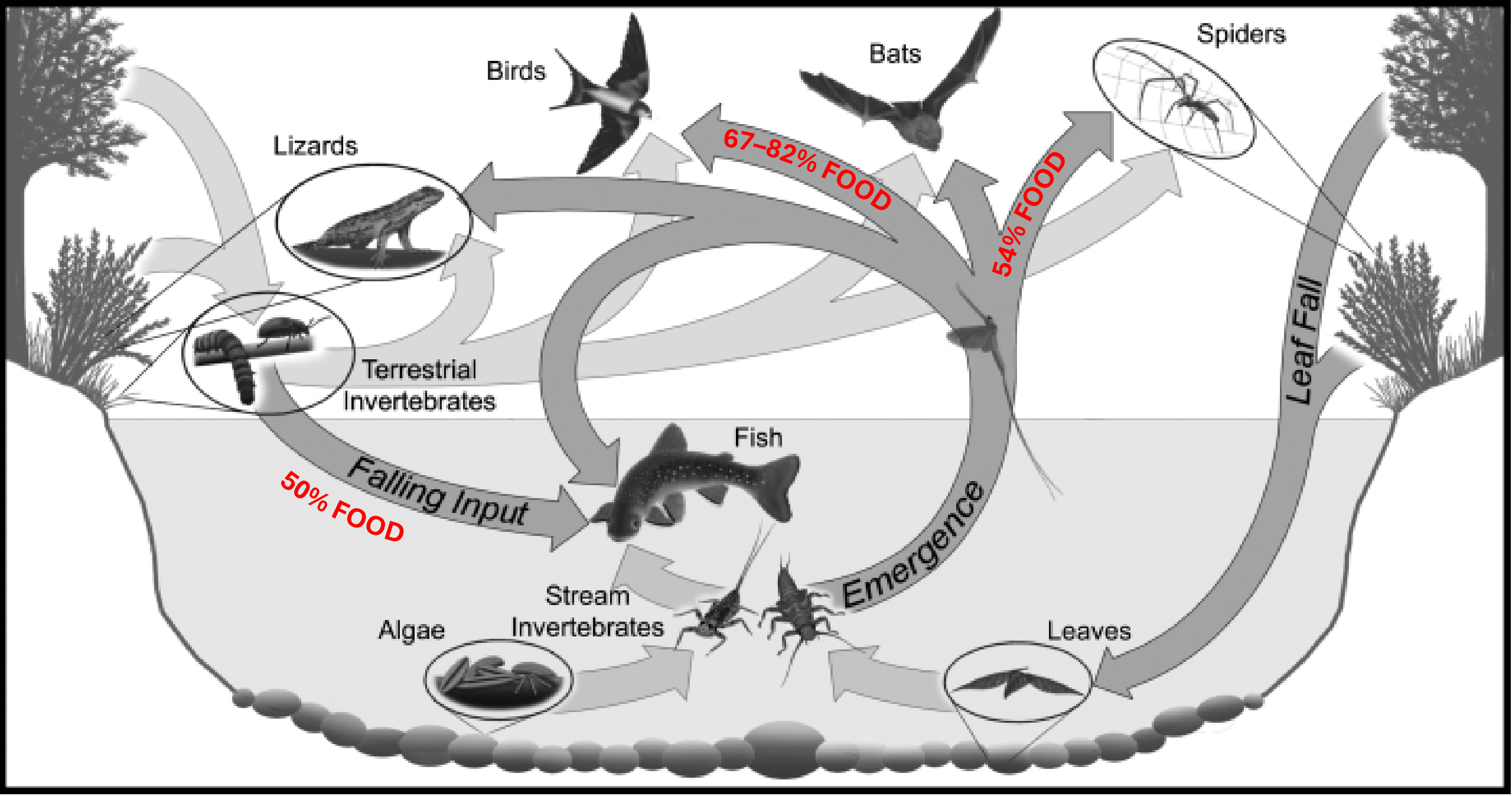


Greenhouse with net separated invertebrate movement between water and riparian area



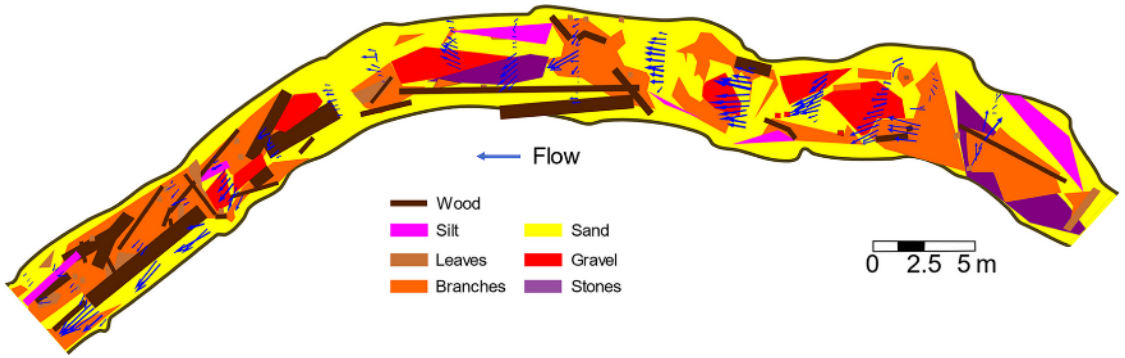
"For the Love of Rivers"

Fausch, K.D. Crossing boundaries: Shigeru Nakano's enduring legacy for ecology. *Ecol Res* **33**, 119–133 (2018). https://doi.org/10.1007/s11284-017-1513-9



BAXTER, C.V., FAUSCH, K.D. and CARL SAUNDERS, W. (2005), Tangled webs: reciprocal flows of invertebrate prey link streams and riparian zones. Freshwater Biology, 50: 201-220.
*Laeser, S. R., Baxter, C. V., Fausch, K. D. 2005. Riparian vegetation loss, stream channelization, and web-weaving spiders in northern Japan. Ecol Res **20**: 646–651.*

Riparian forest and trees in water: many roles in creating physical variation and supporting biodiversity



Attachment & shelter

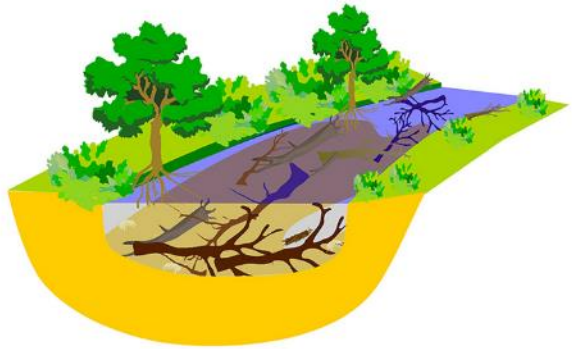
- Substrate for organisms (e.g., collectors, filter feeders, climbers, clingers)
- Residence for animals (e.g. beavers)
- Resting spots for invertebrates

Food resources

- Resources for microbes (e.g. bacteria, fungi)
- Obligate and facultative xylophagous (e.g., burrowers, miners)
- Surface food provision for invertebrates (e.g., shredders, gatherers, grazers, scrapers, filter feeders, predators)

Dispersal

- Passive and active transport of life organisms and propagules (e.g., seeds, coccoons)



Survival

- Refuge during high flows
- Cover from predators
- Plant succession

Reproduction

- Spawning & rearing (e.g., fish)
- Oviposition (invertebrates)
- Capture & germination of seeds

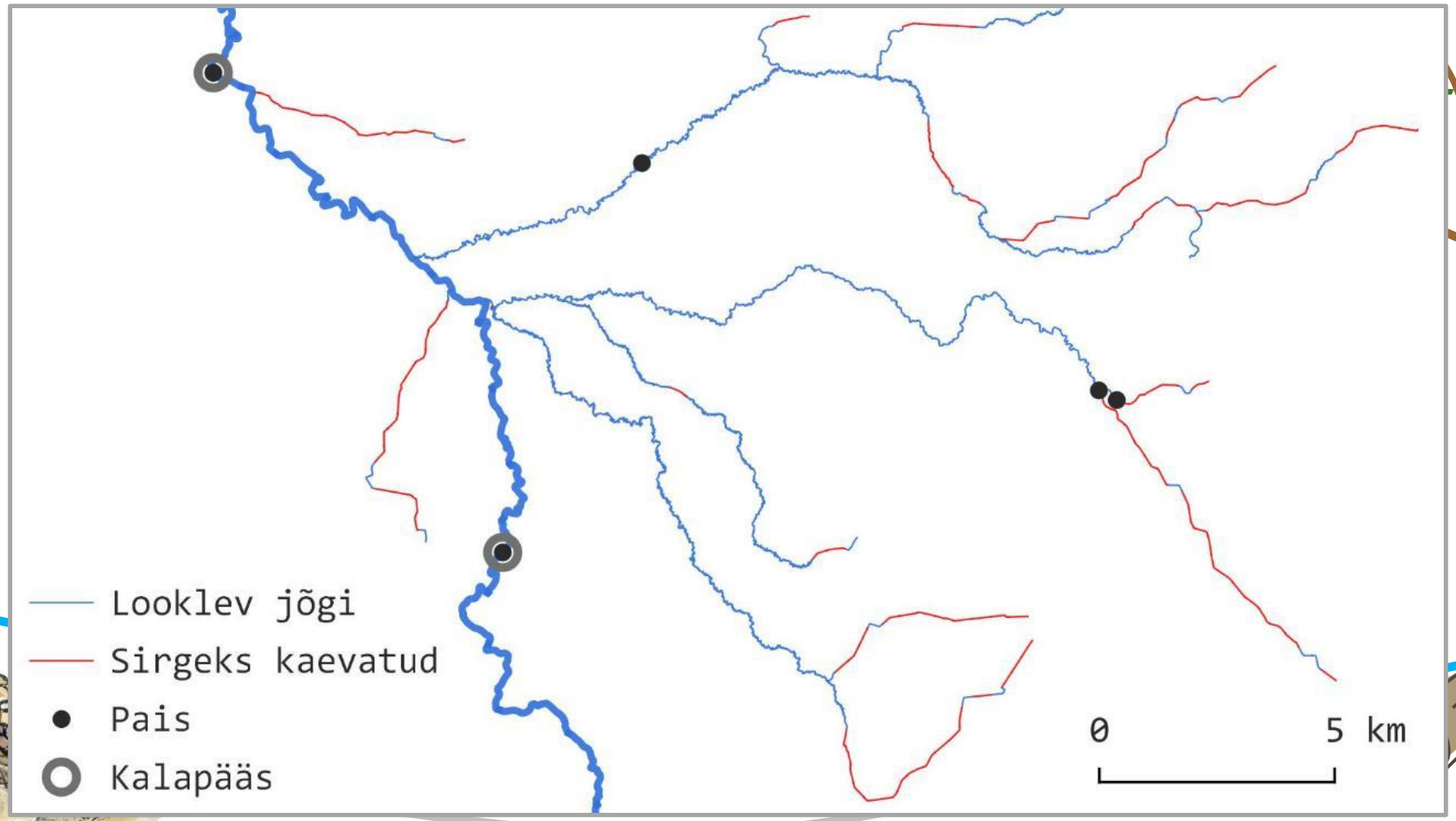
Habitat enhancement

- Provision of hard substrate
- Habitat provision on the outer surface and inner matrix
- Habitat enrichment in the near surrounding (e.g. by erosion-sedimentation and flow alterations)
- Inducement of habitat dynamics in the stream bed

Verdonschot, P.F.M., Verdonschot, R.C.M. Ecological Functions and Management of Large Wood in Fluvial Systems. Curr. For. Rep. 10, 39–55 (2024). https://doi.org/10.1007/s40725-023-00209-x

Important: habitat quality and connectivity

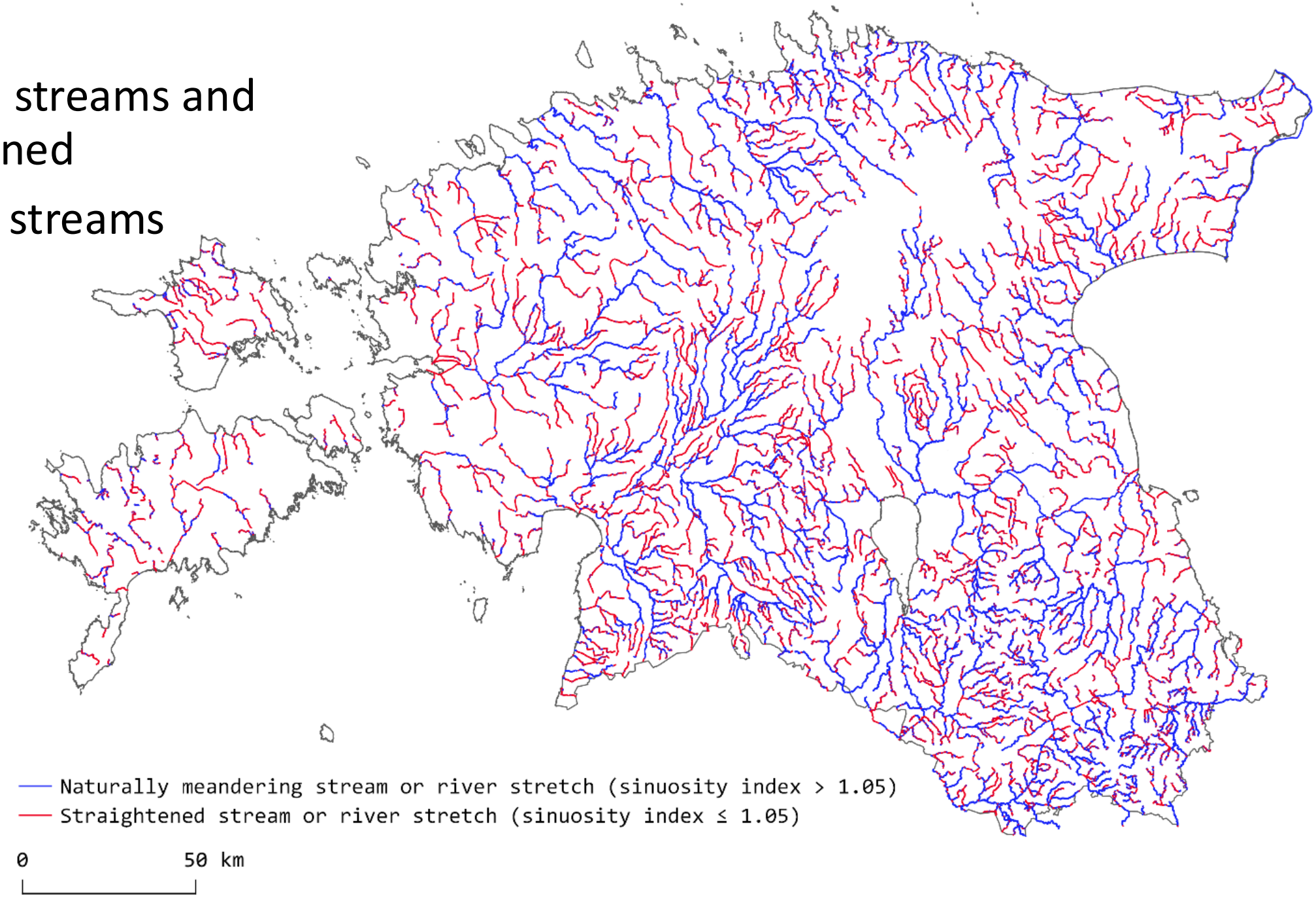
Elements to fulfil species life cycle and opportunities to move up- and downstream.



Joonistused: Seppo Leinonen, http://www.seppo.net/e/

42% (6038 km) streams and rivers straightened

60% of smaller streams straightened



Example: river Altja

RIVERINE NETWORK

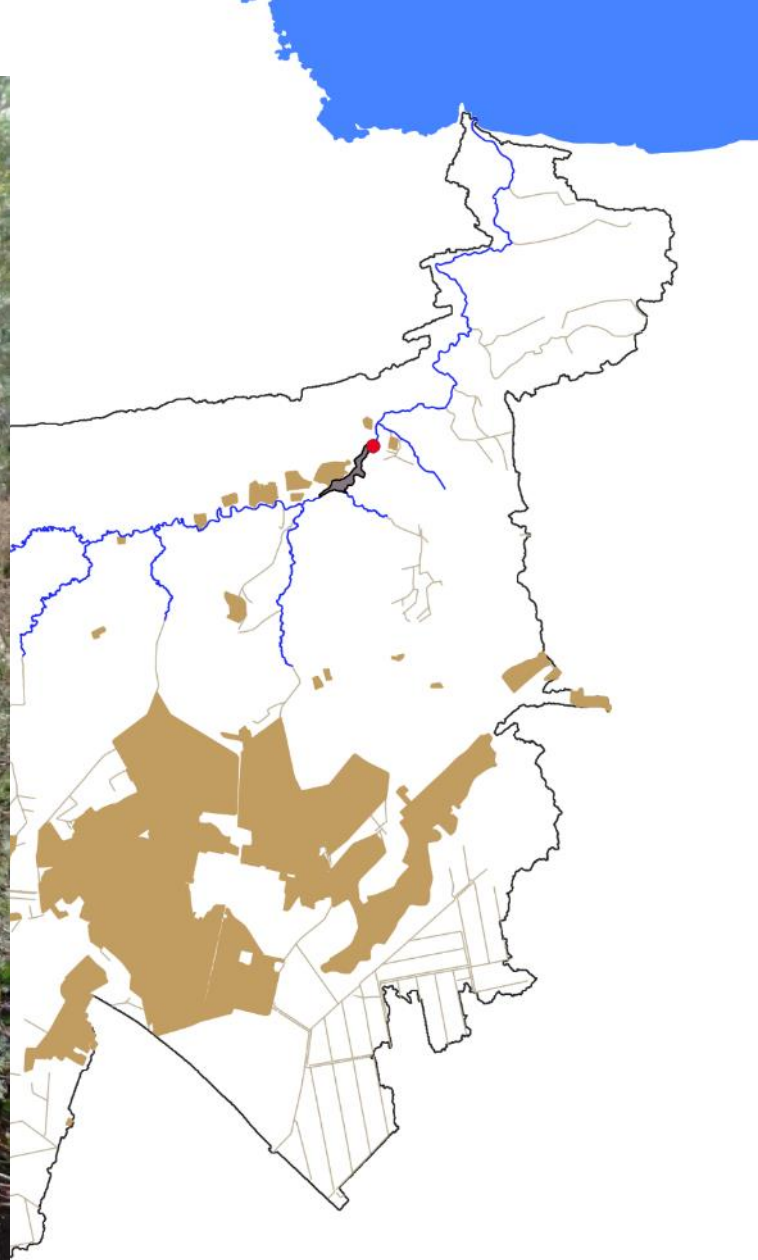
BRANCHING STREAMS STRA
DRAINAGE

UPSTREAM STRAIGHTENED

AGRICULTURAL LAND

DAM + RESERVOIR





Defining nature based solutions for this presentation

- Local materials
- Small restoration disturbance
- Use the flow energy to support gradual change in the habitat
- Mimic natural processes

= small scale

- Streams and rivers that are not priority on state level, but may be upstream from these reaches.



Restoration: flow deflectors for habitat diversity

Small disturbance, gradual habitat diversity development with the help of flow.



Large wood into rivers

+ Fast, cheap

– Riparian forest needed



Thinner wood trunks binded

+ more accurate results

– slow



Arc-shaped braided deflector

+ nature education, looks more tidy

– slowest

+ Licensing for all quite simple

River Altja

Photos half a year after falling the trees, spring 2024





Arc shaped braided deflectors: ?restoration? and nature education

Building day
27.05.2022



Summer low water level
17.08.2022

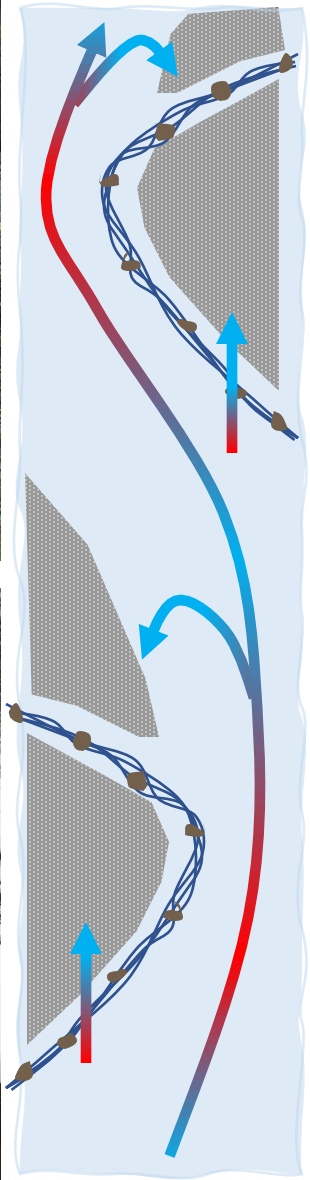


Autumn
12.10.2022



Winter
01.12.2022





HABITAT DIVERSITY

SINUOSITY

WATER DEPTH VARIATION

CATCHING FINE SEDIMENTS

Slower flow

Faster flow

Fine sediment

River Pudisoo

Built 2015,
photo 2024



Built 2022,
photo 2023





Restoring the connection between people and nature





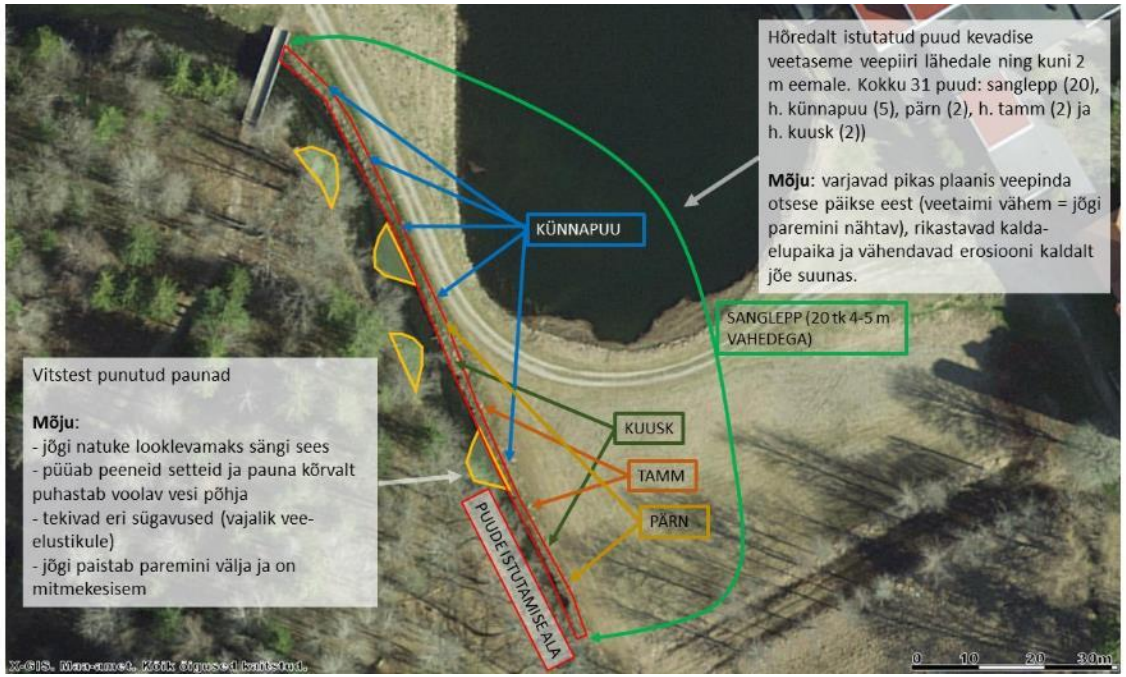


River Jänijõgi

Riparian trees planted (5 local species)

Arc shaped deflectors

Engaging locals









ESTONIAN FUND FOR NATURE

Upstream reaches as donor areas and river as a carrier



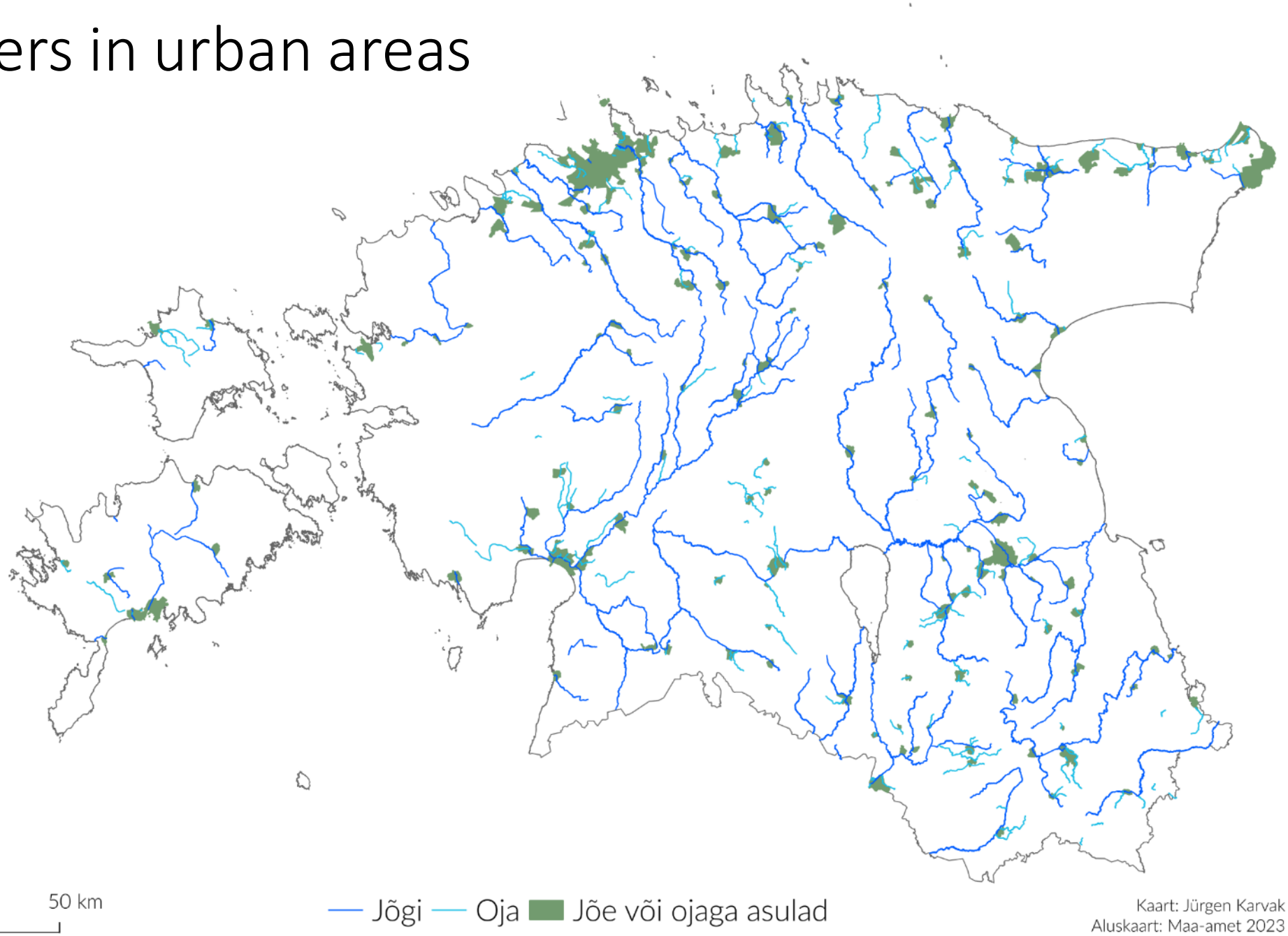


Impatiens noli-tangere (touch-me-not balsam) plant

Streams and rivers in urban areas

Population census 2021: **61%** from Estonian 1,33 miljon people live in settlements.

Almost **1/5** of Estonian 1200 streams and rivers impacted by urbanization.



Jaamamõisa stream

- Biodiverse aquatic-riparian habitat
- Potential: connecting blue-green corridor
- Potential: recreation area and moving corridor for humans





urban LIFE circles
Co-funded by the European Union

Using large wood to create habitat diversity and connect people to nature





Tree trunks in different set-up







urban LIFE circles

Co-funded by the European Union

We added tree trunks, the flow is reconfigurating simplified stream channel.



urban LIFE circles

Co-funded by the European Union

Small steps to upscale:

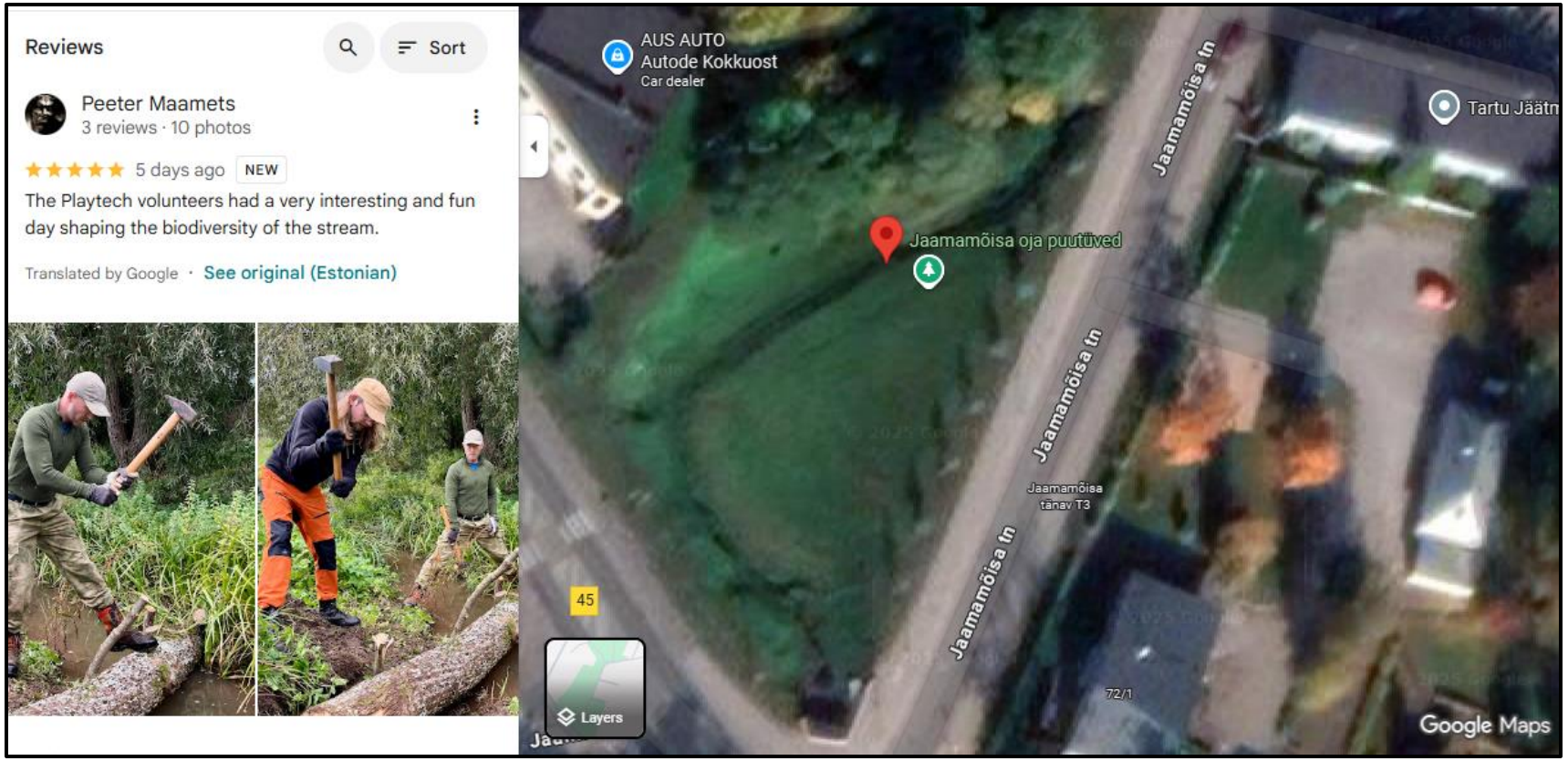
creating simple manuals for landscape architects, officials and others.

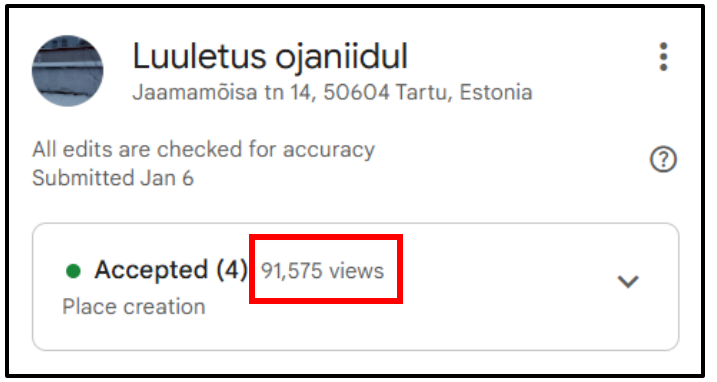


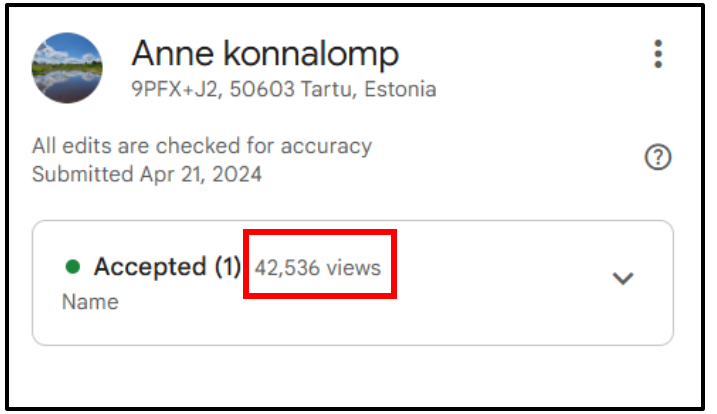
DOWN-EROSION TREE TRUNK

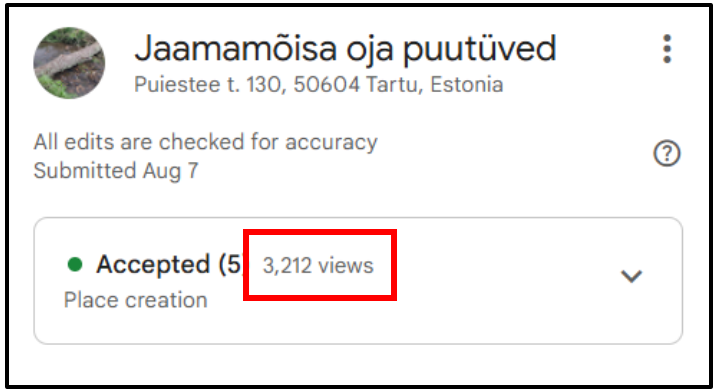
- During low water tree trunk barely touches water
- During higher water level tree trunk hinders flow, which erodes deeper pool under and downstream
- Tree trunk functions as a small bridge to insects, small mammals and people

Easy tricks to try: use Google Maps









Benefits for web-spinning caddisflies: *Hydropsyche angustipennis*





Photos: Jürgen Karvak

Meadow: 5 years, mowing manually once a year















Trail camera videos:

https://drive.google.com/drive/folders/11t19br84lS018CWVAKk3UhQm9tMtq_fe?usp=drive_link

Stream for nature and humans, The Rush, UK

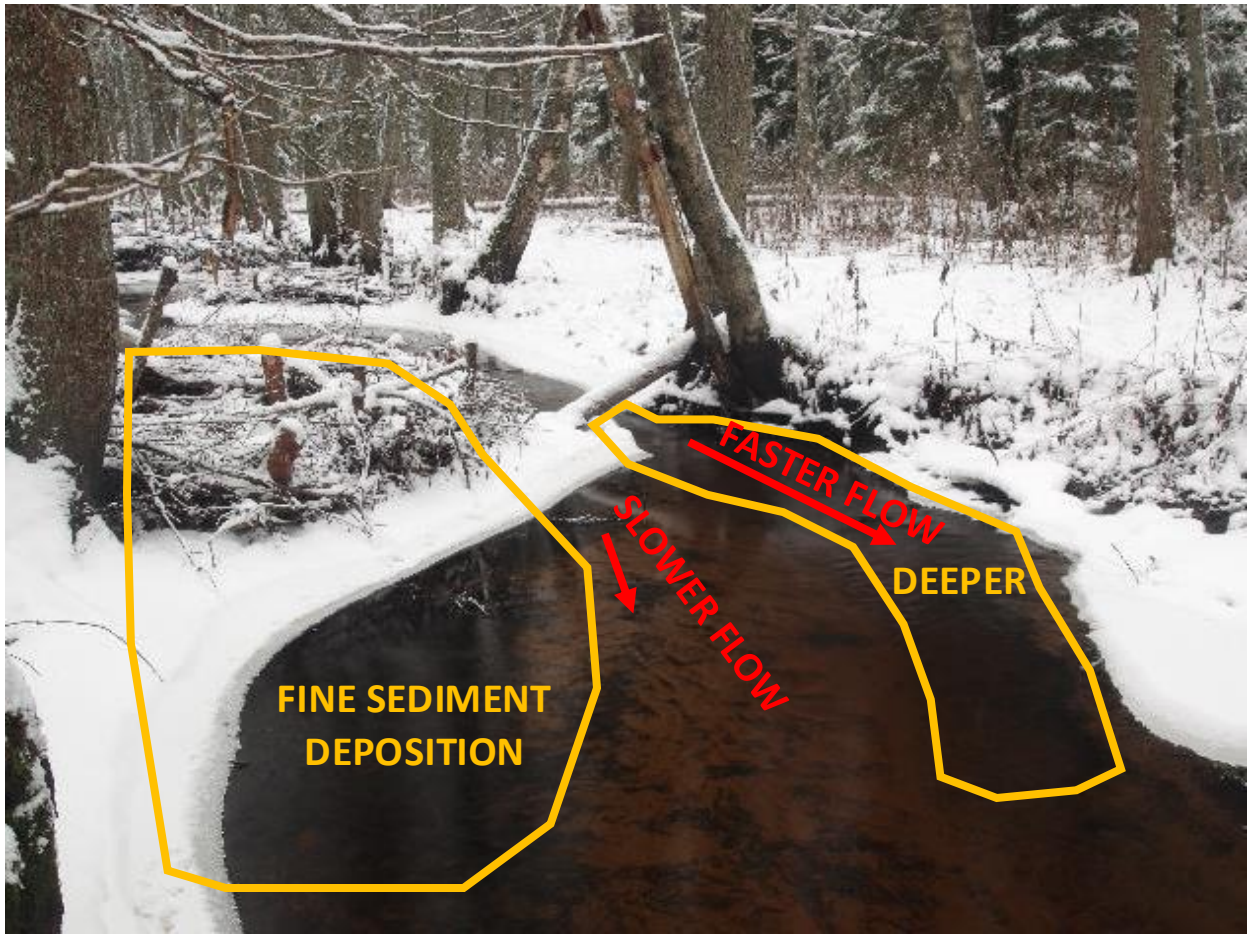


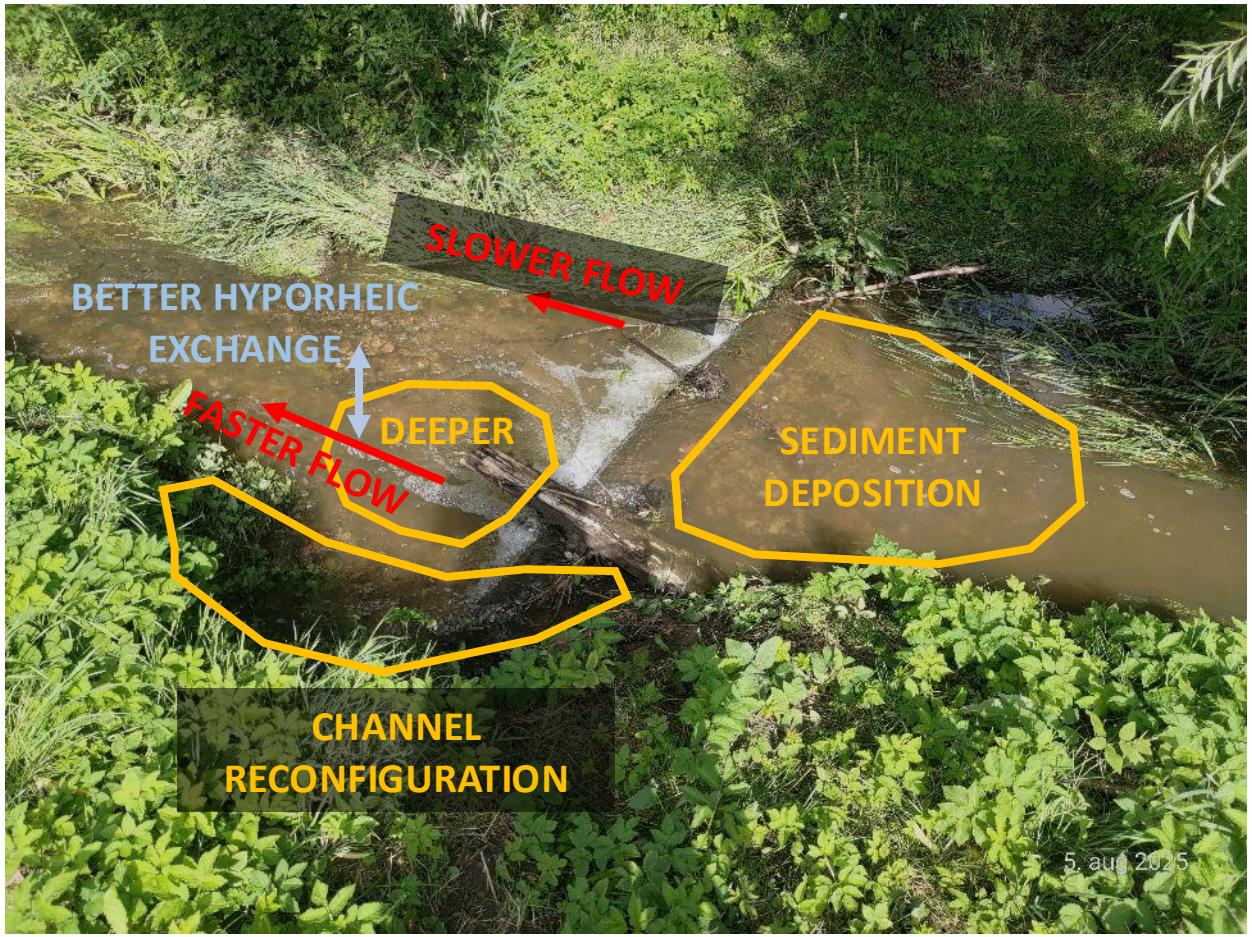






We aim **spatial variation** in a simplified stream or river channel.
Physical diversity supports biodiversity!



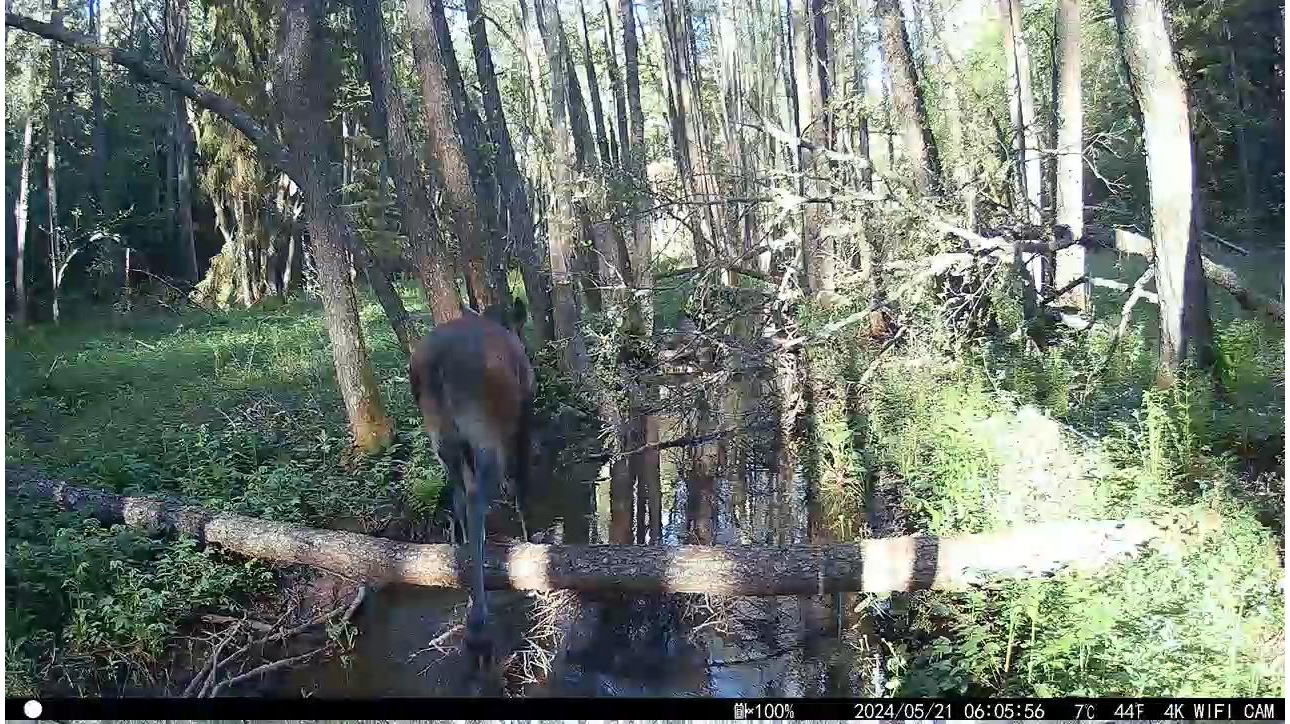


Thank you for thinking along!

Aquatic and riparian areas are connected.

Habitat diversity and connectivity.

Restoring: using NBS to create spatial heterogeneity, promote self-recovery and increase human connection to nature.







Role of Vegetation Maintenance in Sustainable Urban Stormwater Systems (SUDS)

MSc Gen Mandre

Associate professor Margit Kõiv-Vainik

Department of Geography, Institute of Ecology and Earth Sciences, University of Tartu, Estonia

26.09.2025



Why is SUDS/NBS still looked at with skepticism?



Biggest reasons why sustainable stormwater solutions are often not considered in public spaces

Knowledge & Awareness Gaps

- Low awareness among decision-makers and the wider public
- Misconceptions that SUDS are experimental or unreliable
- Lack of visible success stories in certain regions

Design errors!





Example from Montreal, Avenue Papineau

- 38 rain gardens
- More than 35,000 plants
- Managed to divert nearly 100,000 m³ of stormwater from the sewer system (2019-2021).



Design and maintenance errors!



Photo: City of Montreal, Papineau Avenue

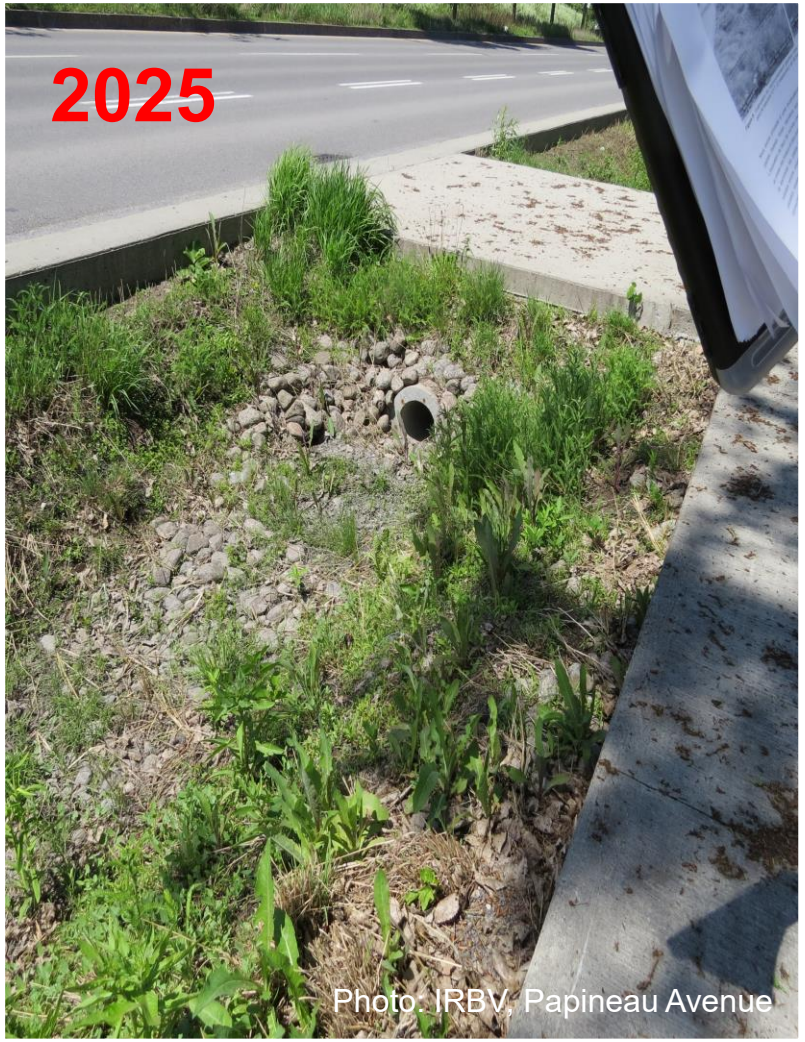
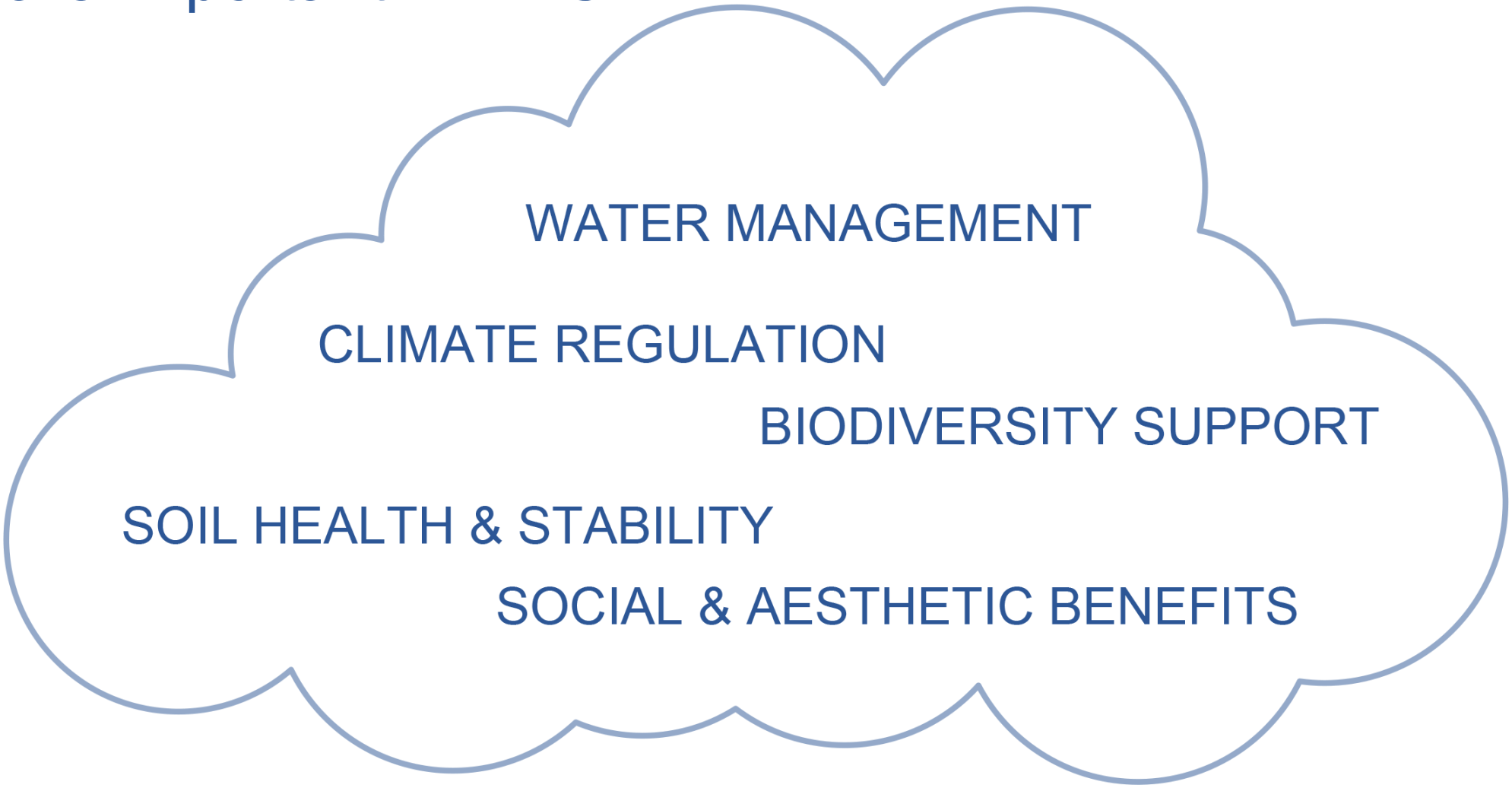


Photo: IRBV, Papineau Avenue

Why plants are important in NBS ?



Plants aren’t just “decoration” — they are the **working infrastructure** of NBS, performing the critical functions that engineered systems alone cannot achieve.



Biodiversa+ project:

"BioReStorm - Anticipating Biological Succession in Rehabilitation of Long-Term Operated Nature-Based Solutions for Stormwater Treatment in Different Climate Zones".

BIO RE STORM

Duration 01/04/2025 – 31/03/2028



Understand ecological succession in NBS

- Study how plant and microbial communities (fungi, bacteria) evolve over time under stress from pollutants, hydraulic loads and climate conditions.
- Assess plants role in supporting vegetation survival, pollutant removal and biodiversity.
    - Determine species
    - Differences between planned and existing
    - Plants health
    - Cover %
    - Plant measurements
    - Infiltration tests
    - Soil sampling (chemical composition, microbiological, including mycorrhiza)

No maintenance this year – result >30 spontaneous plant species, 11 planted species



Technical & Performance Uncertainty

- Skepticism about whether SUDS can handle extreme rain events
- Lack of trust compared to conventional “grey” drainage systems
- Perceived risk of flooding if systems fail

Evaluate system ageing and technical performance

- Investigate how long-term operation affects hydraulic capacity, pollutant accumulation, and treatment efficiency.
- Identify when and why failures (e.g., clogging, reduced infiltration) occur.



Maintenance Concerns

- Fear of high or unpredictable long-term maintenance costs
- Uncertainty over who is responsible (municipality, community, private owners)
- Worries that lack of upkeep will lead to failure or unattractive appearance



Photo: Trios-Rivières, Canada
Danielle Dagenais

Develop rehabilitation and design strategies

- Propose methods to restore ageing systems (e.g., substrate replacement, replanting strategies).
- Incorporate biological succession knowledge to optimize plant selection for functionality and biodiversity.

Simplify long-term monitoring

- Create checklists and easy-to-use field tests for municipalities and practitioners to assess system health and detect rehabilitation needs.

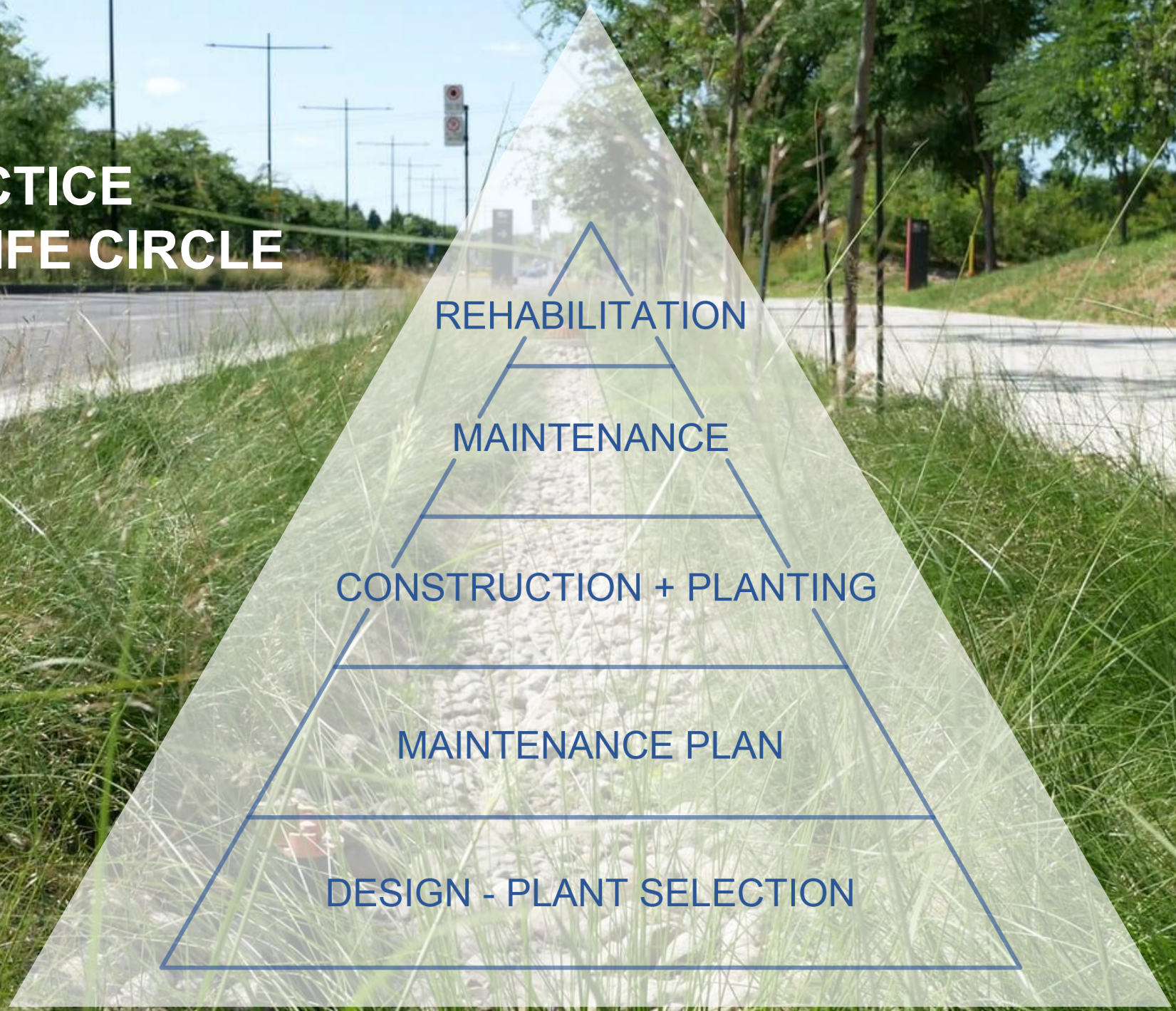
Aesthetic & Public Perception

- Concern that systems will look “messy” or “weedy” rather than ornamental
- Risk of public complaints if expectations for manicured landscaping aren’t met
- Fear that biodiversity = “uncontrolled wilderness”



Photo: Margit Kõiv-Vainik

BEST PRACTICE OF SUDS LIFE CIRCLE



TARTU ÜLIKOOL
1632

Our cities are stuck between the past and the present


Photo: Alar Mik

Thank you!

MSc Gen Mandre
Associate professor Margit Kõiv-Vainik
gen.mandre@ut.ee; margit.koiv.vainik@ut.ee

Department of Geography, Institute of Ecology and Earth Sciences, University of Tartu, Estonia

TARTU ÜLIKOOL
1632

BIO RE STORM

FIRST STAKEHOLDER WEBINAR!


Photo: Alar Mik

This first seminar will:

- Introduce the project's **goals, activities, and expected outcomes**.
- Provide space to **hear from different stakeholders** about local needs, challenges, and experiences.
- Explore opportunities for **collaboration and knowledge transfer** between countries, organizations, and people with different levels of experience.

Date & Time: November 27, 15:00 CET
Format: Webinar
Duration: 1.5 hours



Water Management in Denmark

Focus: Nature based solutions and co-benefits

RAMBØLL

Introduction

- Living in Aarhus with my wife and 1-year old daughter
- Educated Master in Water and Environmental Engineering at Aalborg University in 2020
- Working in Ramboll since 2020 with focus on water management, climate adaptation and utilities

Andreas Kvist Fredberg
Civil Engineer
Utilities & Climate Adaptation
Mobile: +45 51610445
E-mail: akvf@ramboll.dk



Agenda

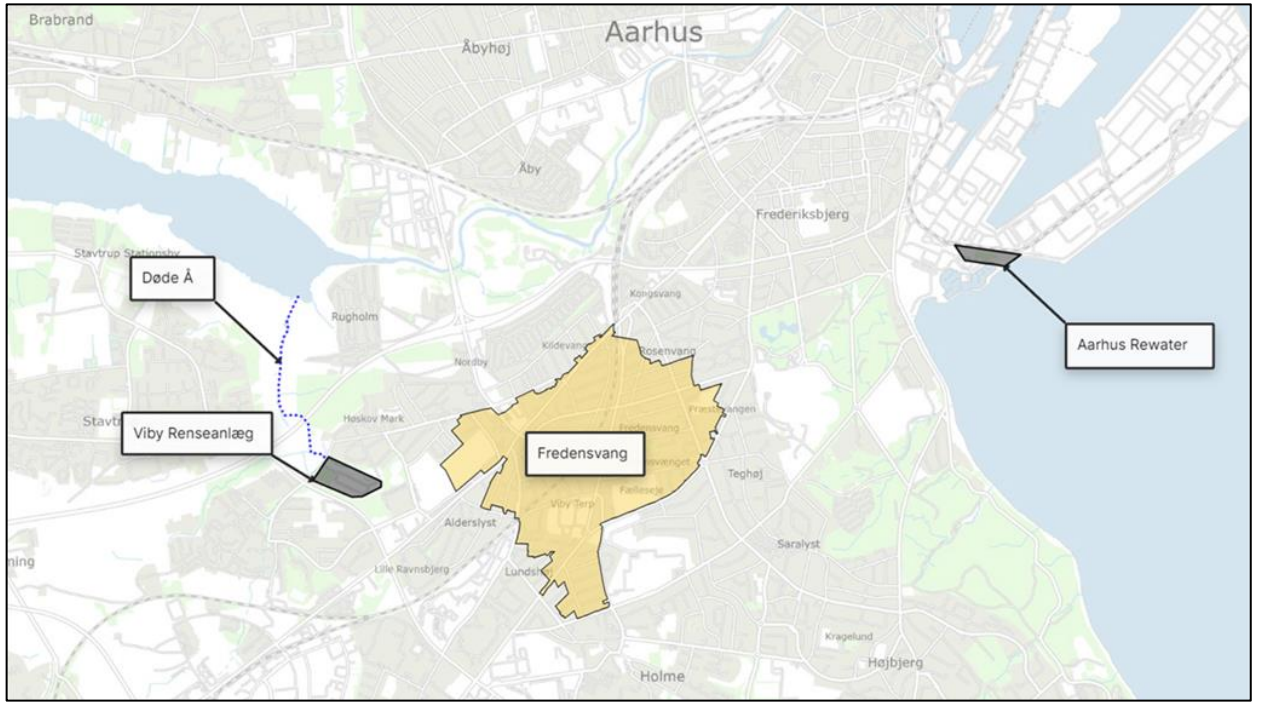
01 Water Management in Fredensvang (Project example)

02 NBS Value – Method to calculate Socio-economic value

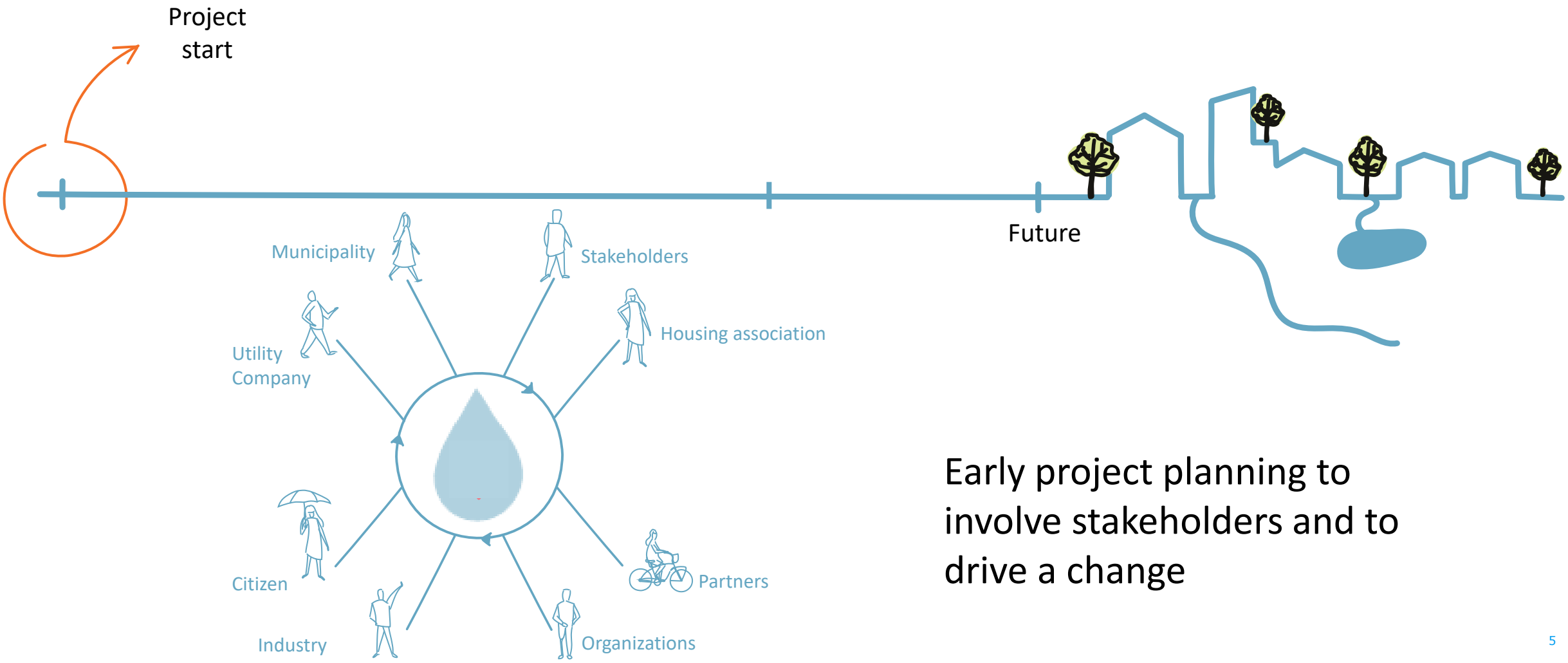
03 International perspective - Nature based solutions abroad

Fredensvang

- Purpose is to make a stormwater management plan for a 214-hectare catchment
- Plan for sewer separation and reduced flooding
- Co-creation with Aarhus Municipality with the aim of developing nature-based solutions, sustainable initiatives, and synergies
- Co-benefits

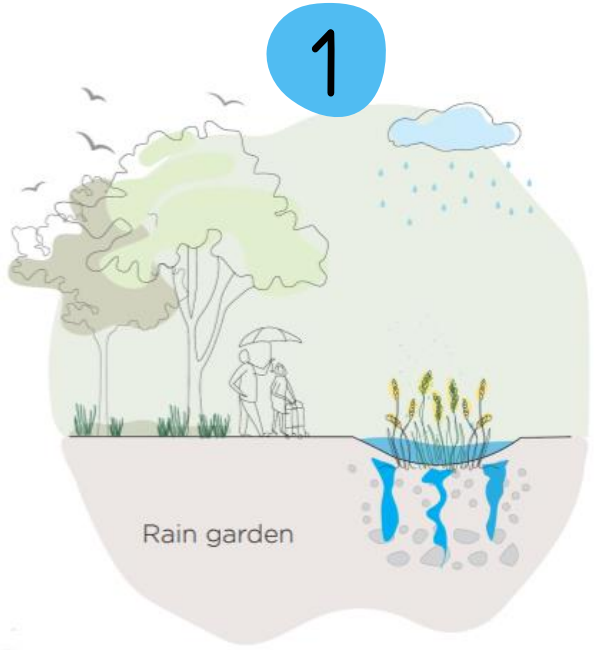


Fredensvang

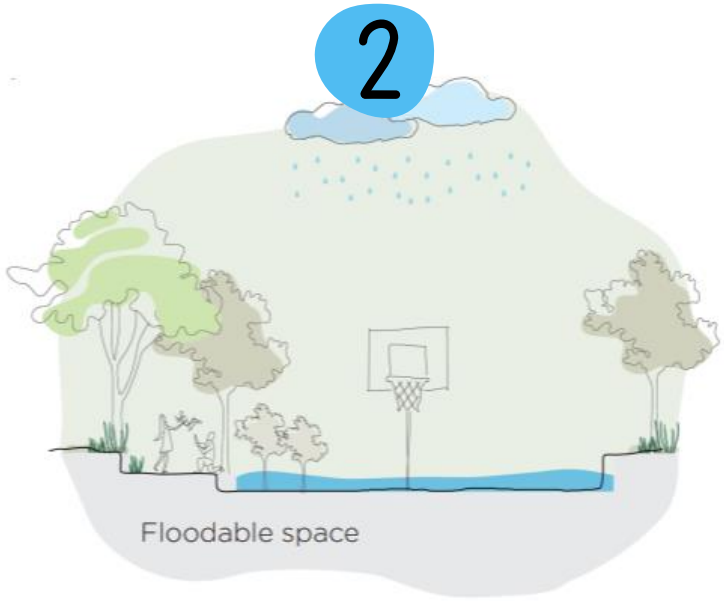


Early project planning to involve stakeholders and to drive a change

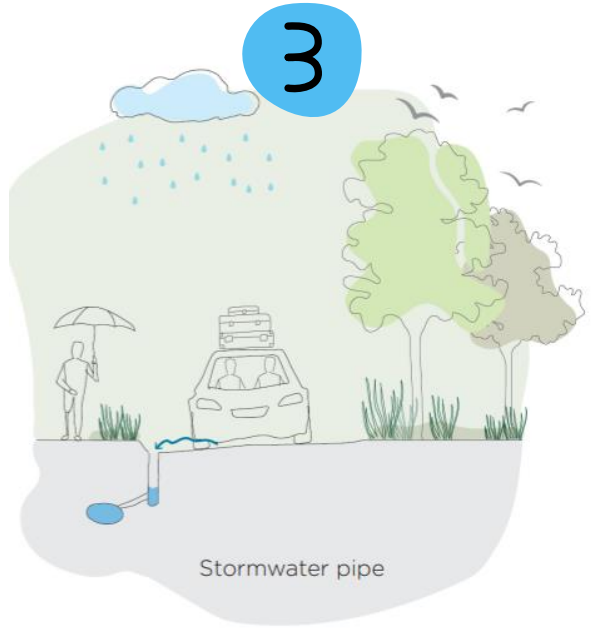
Approach to water management



Nature-based approach



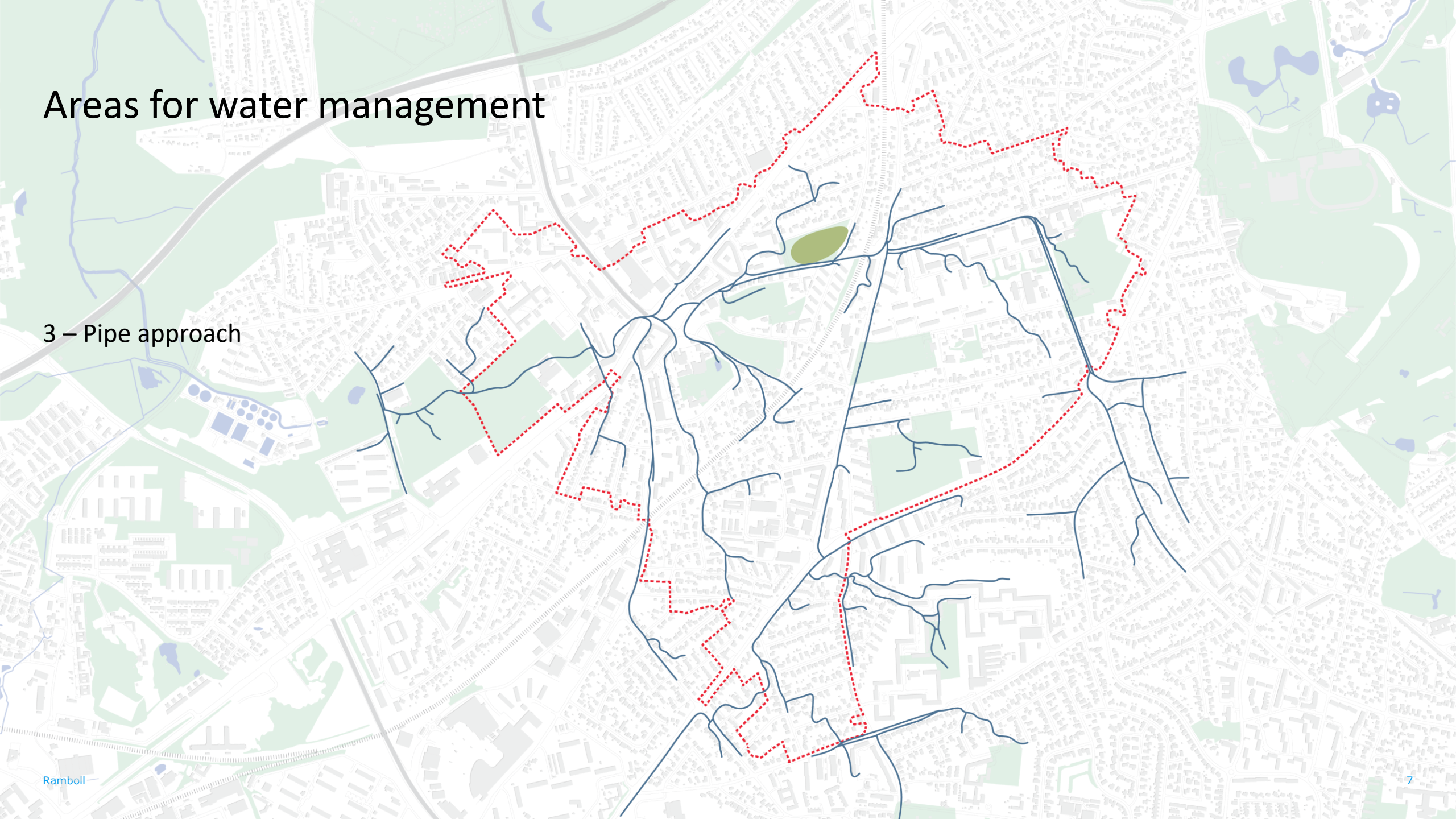
Water delay approach



Pipe approach

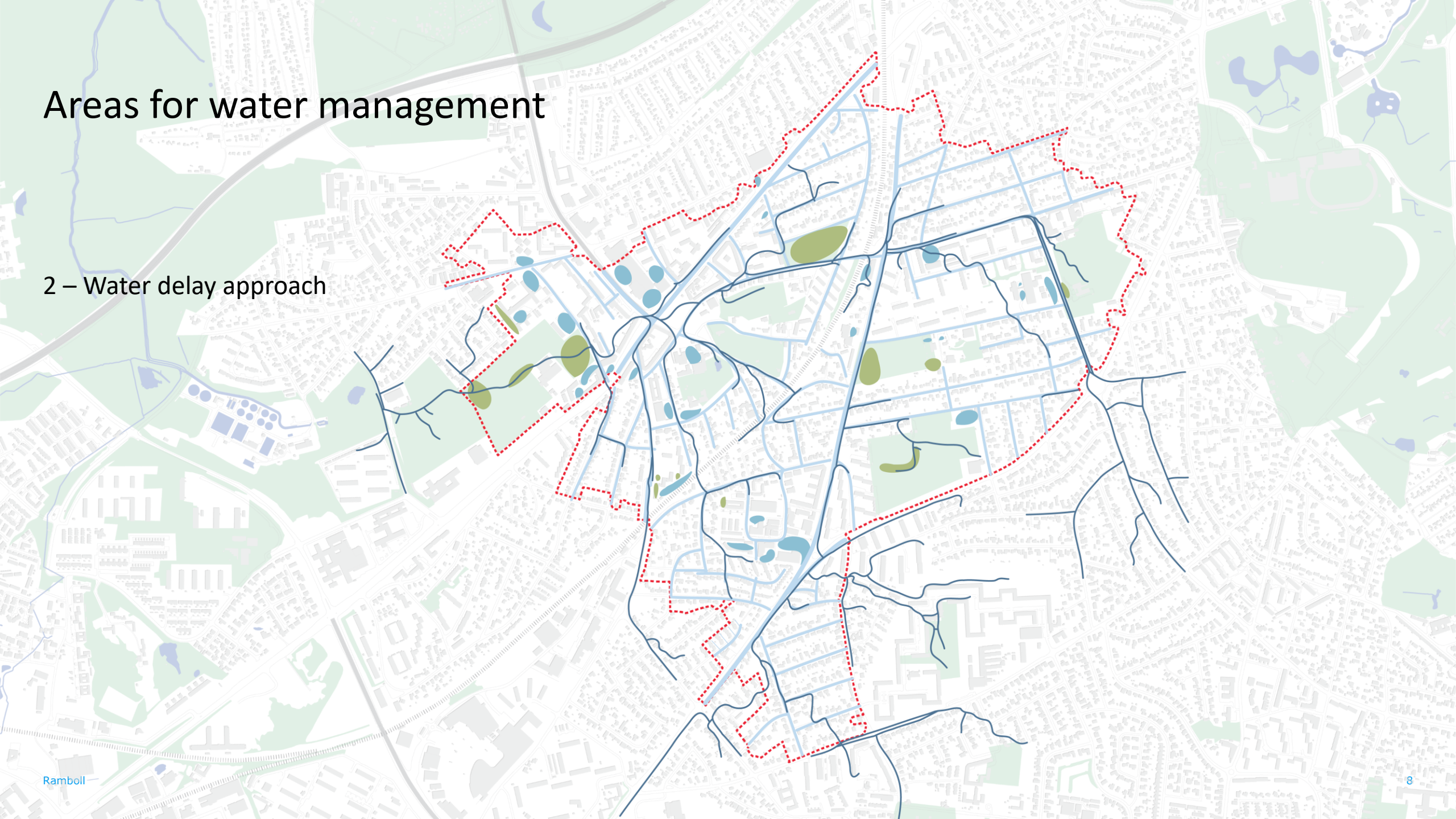
Areas for water management

3 – Pipe approach



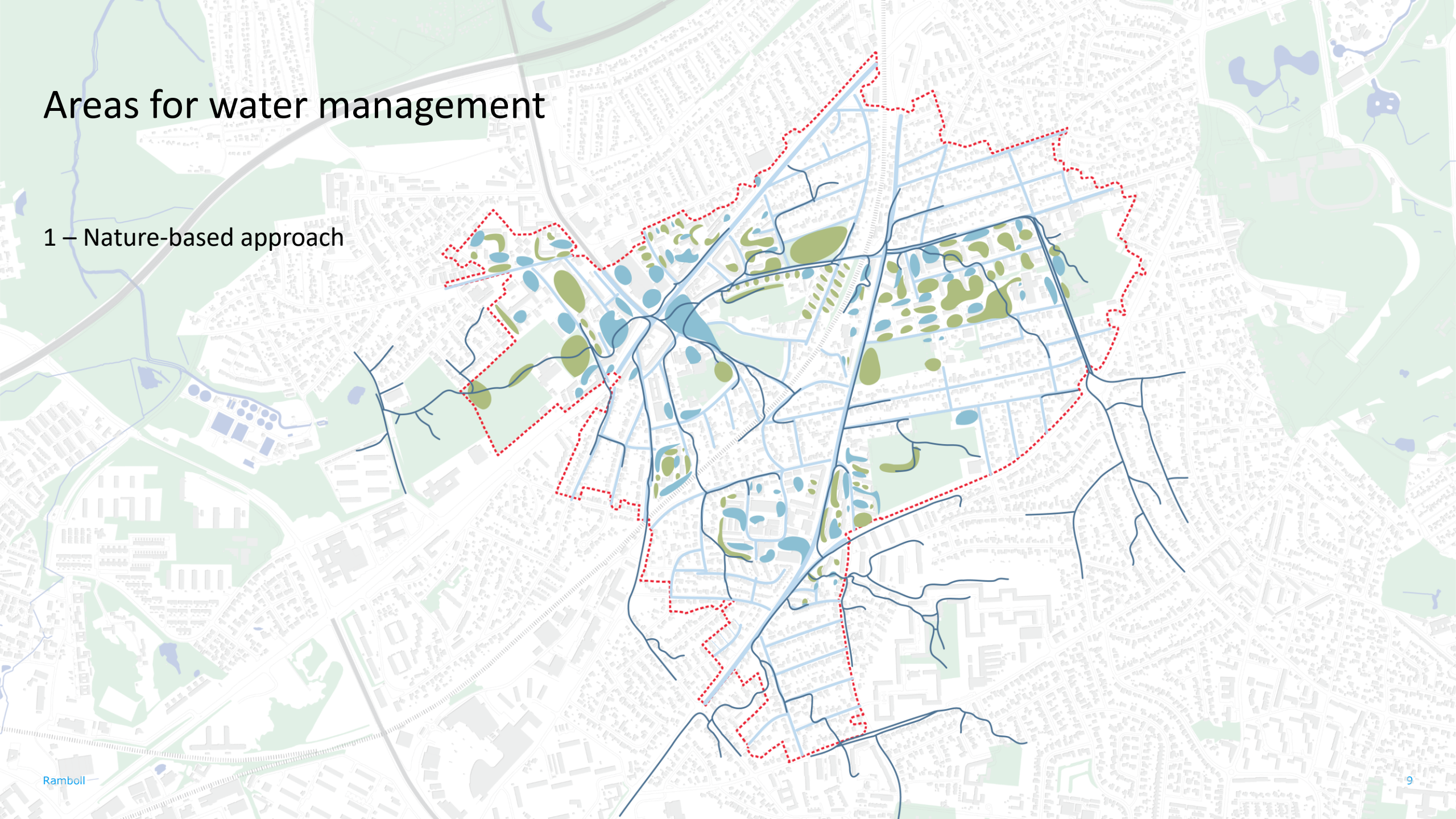
Areas for water management

2 – Water delay approach

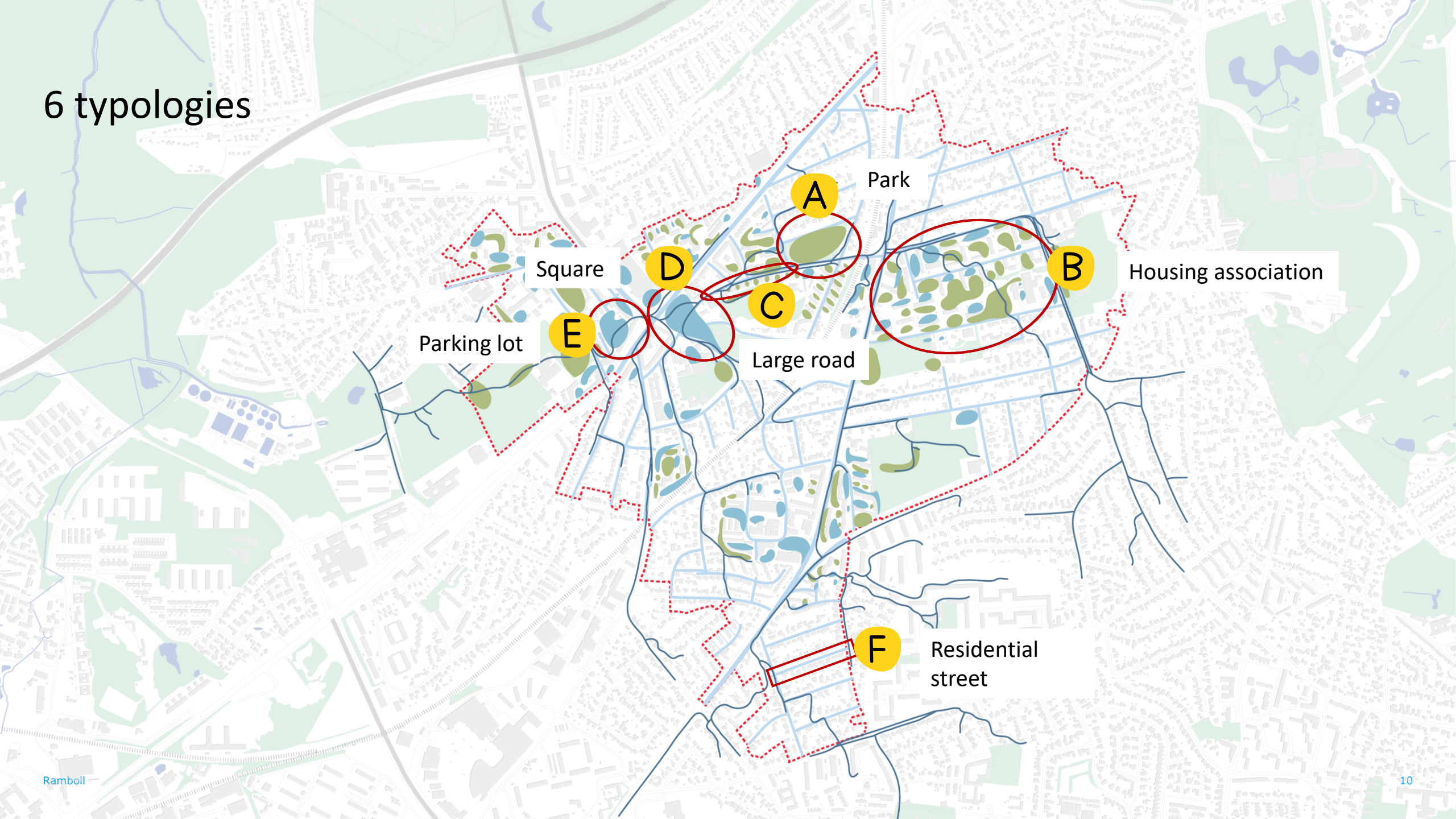


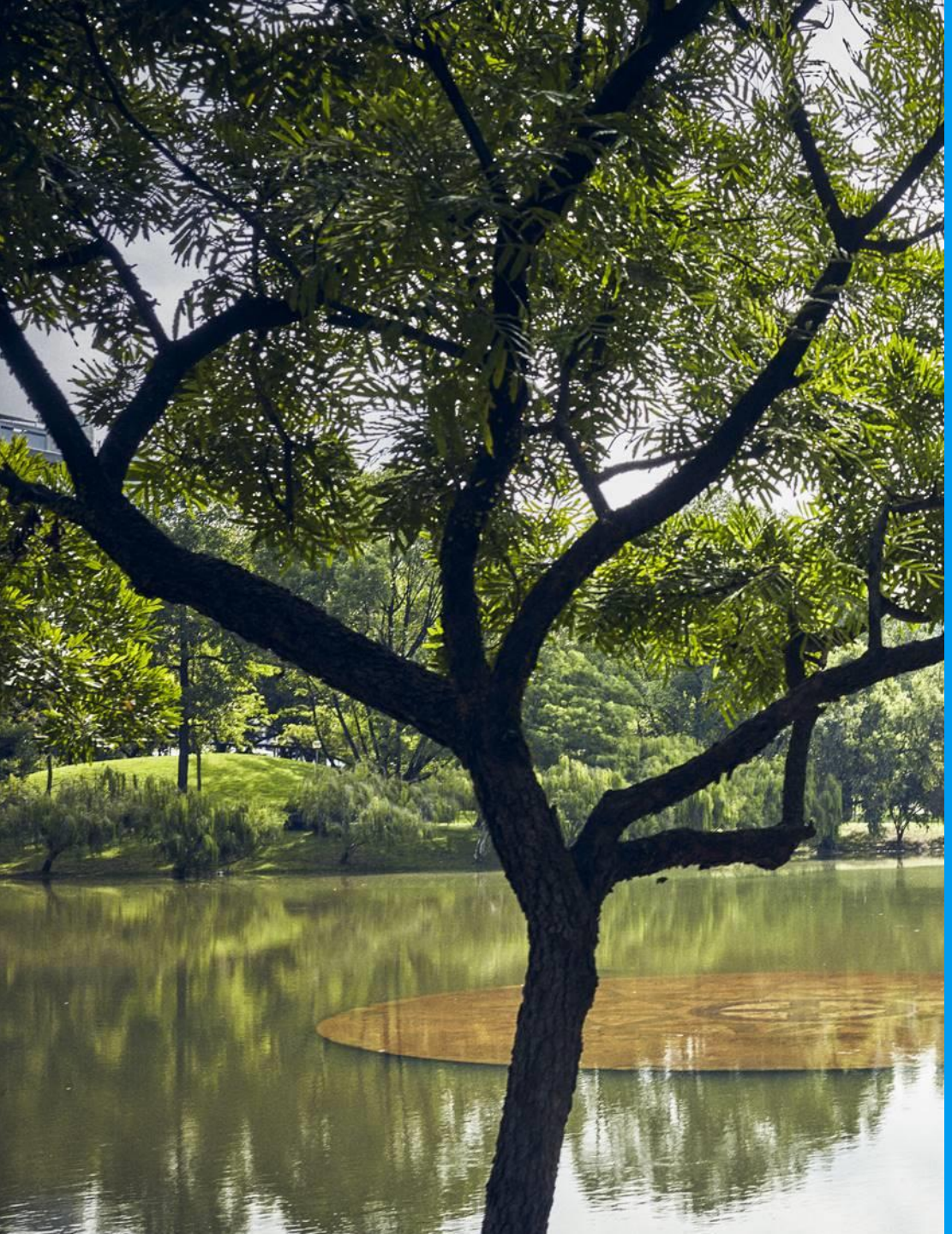
Areas for water management

1 – Nature-based approach



6 typologies





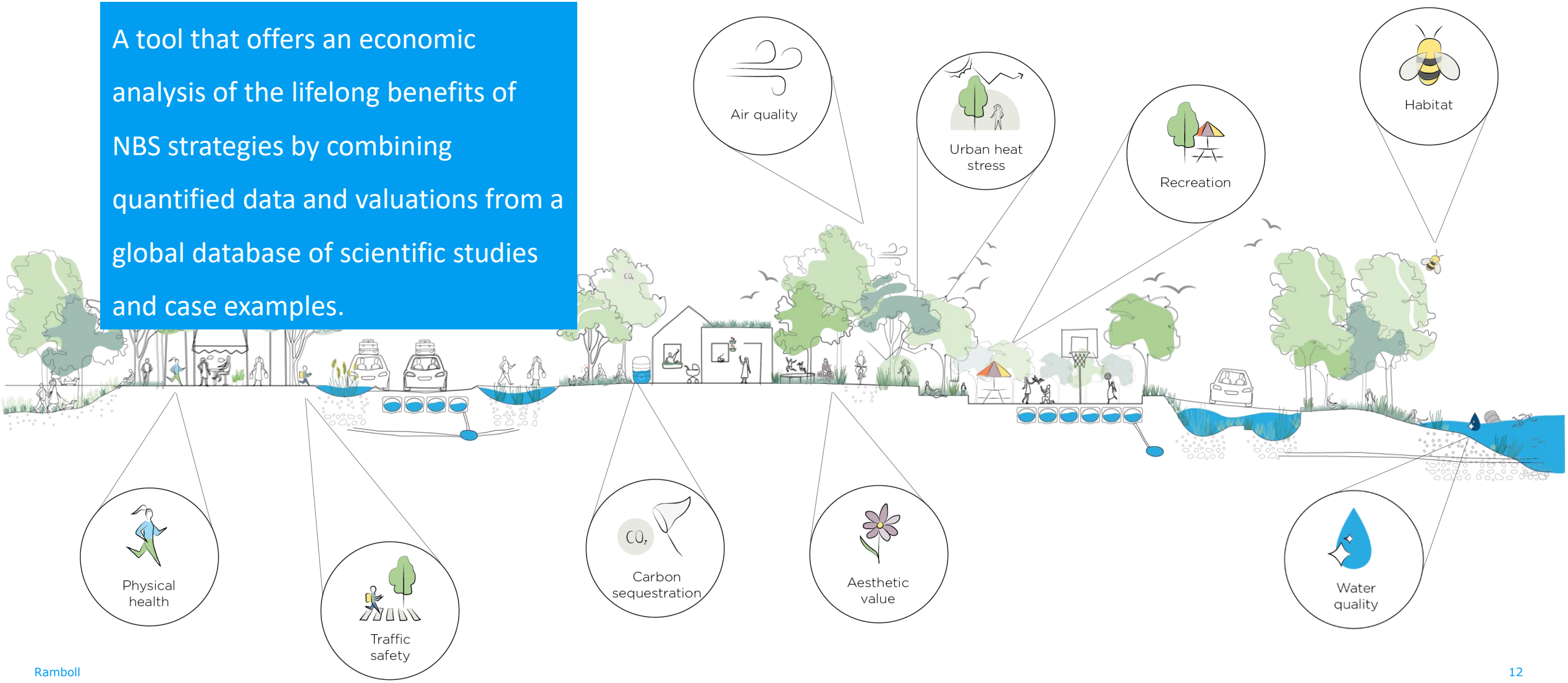
NBS Value

Making the case for
Nature-Based Solutions

RAMBØLL

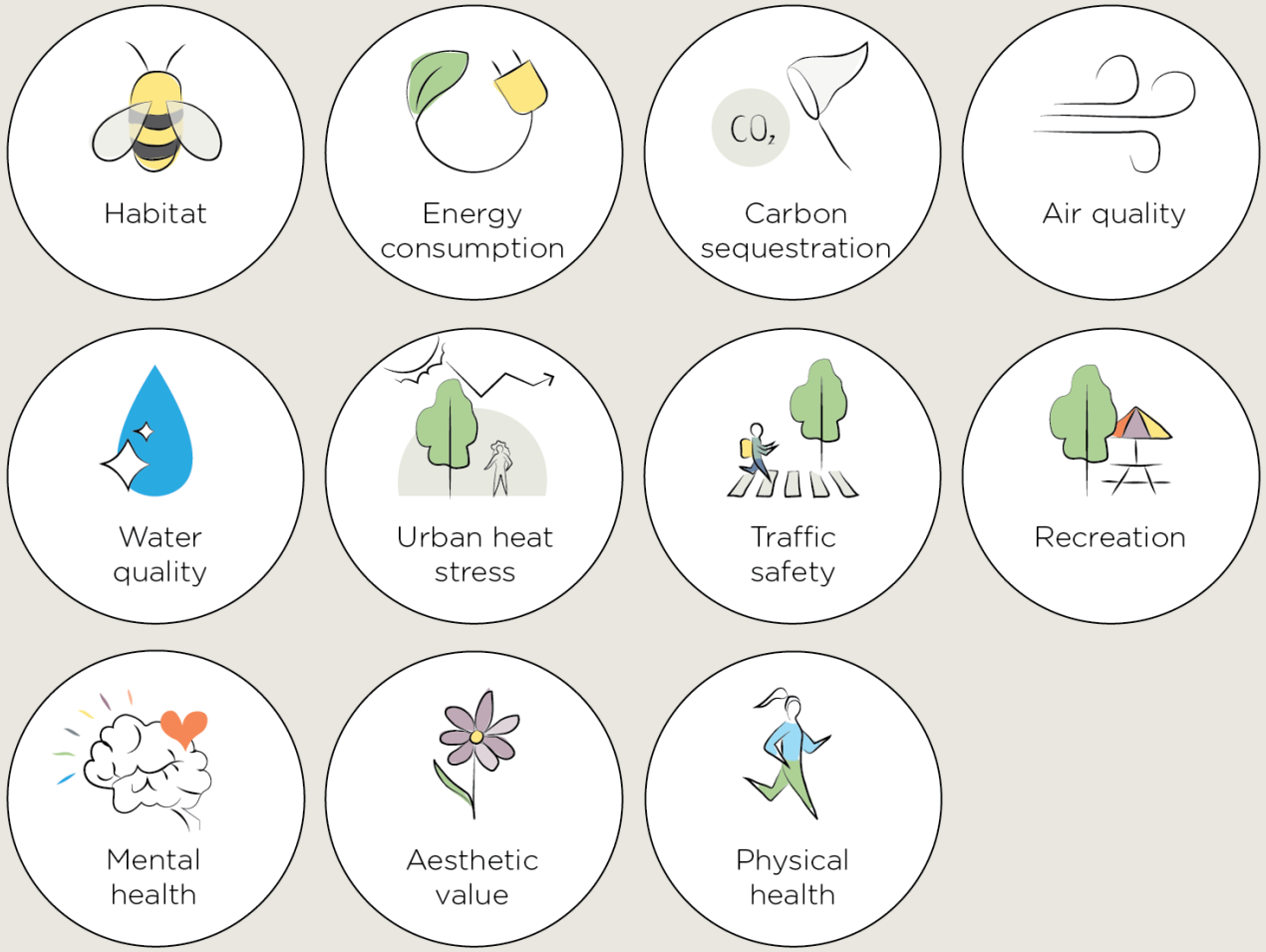
The power of nature-based solutions beyond flood risk reduction

A tool that offers an economic analysis of the lifelong benefits of NBS strategies by combining quantified data and valuations from a global database of scientific studies and case examples.



What are co-benefits?

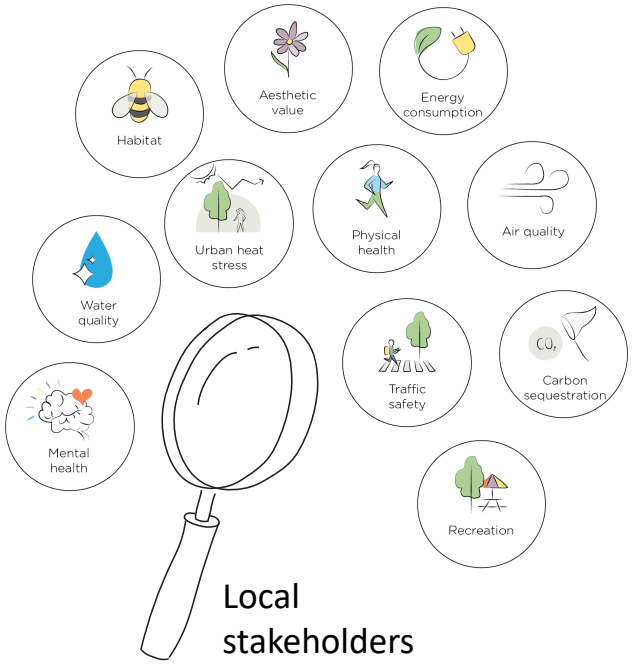
Co-benefits refer to the additional positive externalities or advantages that occur as a result of implementing Nature-based Solutions (NBS) that go beyond the primary benefit of flood risk reduction.



Steps & process

1 Visioning

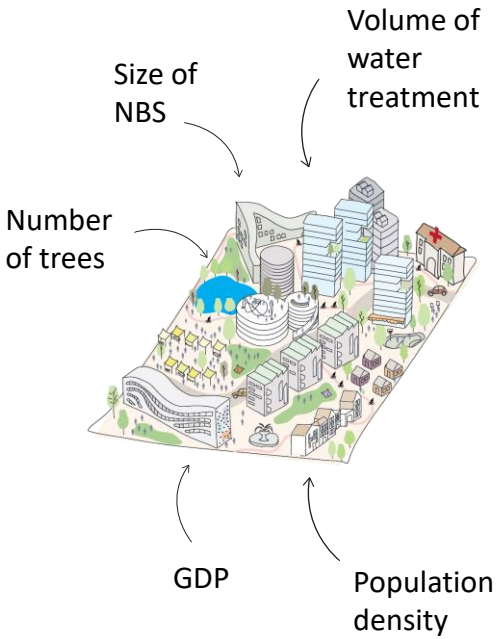
Co-benefit identification/ prioritization



Local stakeholders & clients

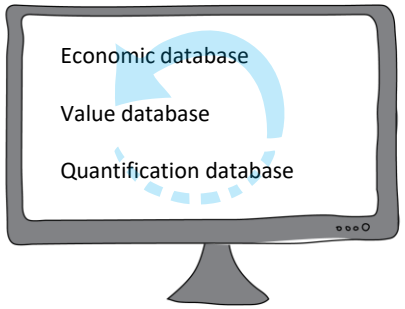
2 Data collection

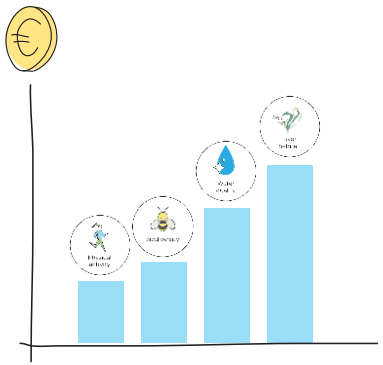
Project specific input data



3 Co-benefit assessment

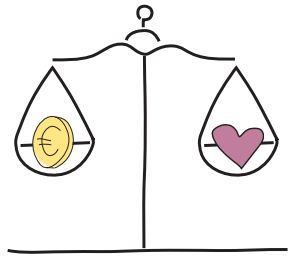
Tool application & output





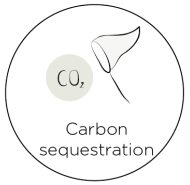
4 Decision making

Cost benefit analysis





What is calculated and how?



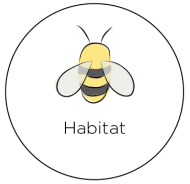
Estimates the value of removing carbon dioxide from the air by trees.

Quantification: based on non-traded and traded carbon and control costs incurred by municipal governments.



Value associated with the human experience of landscapes, sounds and smells of nature.

Quantification: willingness-to-pay elicited using preference-based methods.



Estimates the value associated with ecosystems providing shelter, promoting growth of species, and maintaining biological diversity.

Quantification: based on the ecosystem type and the area (ha) of the NBS.



Estimates the societal value of increasing physical activity among citizens.

Quantification: based on costs for the health sector due to inactive citizens, lost earnings due to more sick-days and share of the adult population who are inactive.



Values green areas' impact against the effects of urban heat stress.

Quantification: avoided mortality costs due to lower impacts of heat stress days within 300m from the NBS.



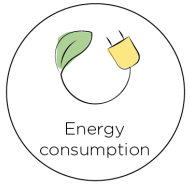
Describes ecosystems' ability to improve air quality.

Quantification: value associated to a specific amount of airborne pollutants removed (g/year).



Estimates the value of natural areas due to increased recreation opportunities (e.g. facilities for walking, sitting, and social gatherings).

Quantification: willingness-to-pay elicited using preference-based methods.



Estimates the value of green spaces' cooling effects for nearby occupants and buildings.

Quantification: reduction in energy costs from cooling effects based on number of trees planted.



Assessed based on expected annual pollution load reductions including total nitrogen and total phosphorous removal.

Quantification: multiplying the annual load reduction (kg/year) with the standardised cost of removing a kilogram of nitrogen or phosphorus ($/kg) obtained from wastewater treatment plant costs.



Evaluates the economic benefits of increased traffic safety due to the implementation of the NBS.

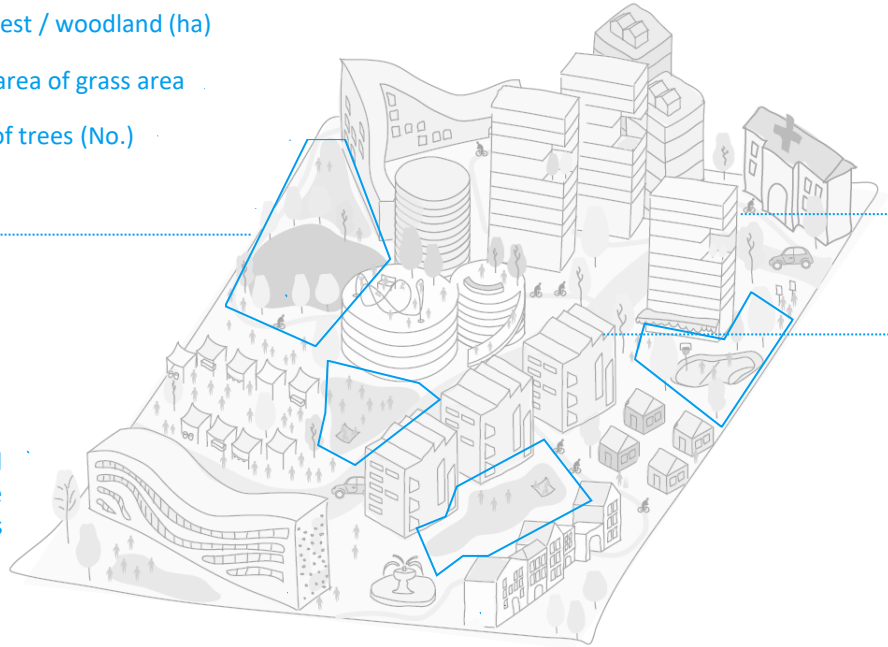
Quantification: costs saved due to fewer traffic accidents, estimated through traffic intensity and speed.



Assesses the value attributed to lower psychological distress thanks to green infrastructure/NBS

Quantification: calculating the reduction of both healthcare and sickness days costs for the population living close to and spending time in the NBS

Straightforward data requirements and input parameters



Air quality

Net added area of forest / woodland (ha)

Net added area of grass area

Number of trees (No.)

Energy consumption

Carbon sequestration

Number of trees (No.)

Water quality

Reduced nitrogen and phosphorus loads due to the NBS components

Habitat

Households within 2000 m of NBS >1ha (No.)

Households within 1000 m of NBS <1ha (No.)

Urban heat stress

Inhabitants within 400 m of NBS (No.) for park areas above 0.3 ha

Physical health

Households within 0-500 m of NBS (No.)

Households within 501-1000 m of NBS (No)

Recreation

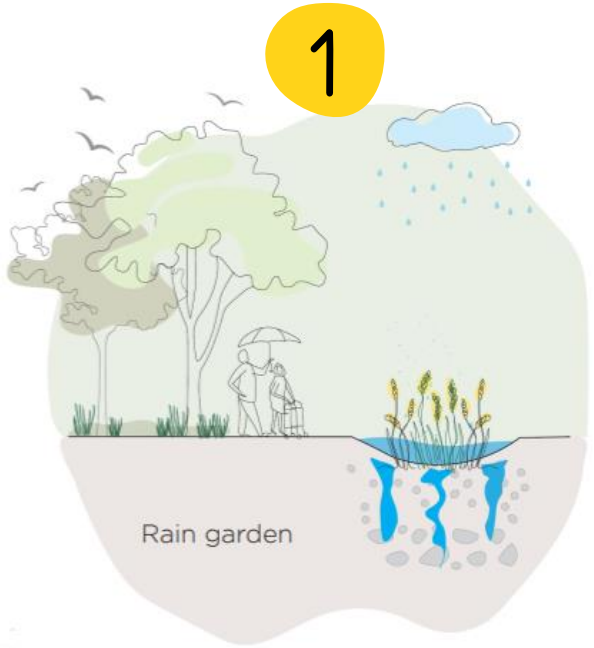
Area of park (m^2)

Households within 0-500 m of NBS (No.)

Households within 501-1000 m of NBS (No.)

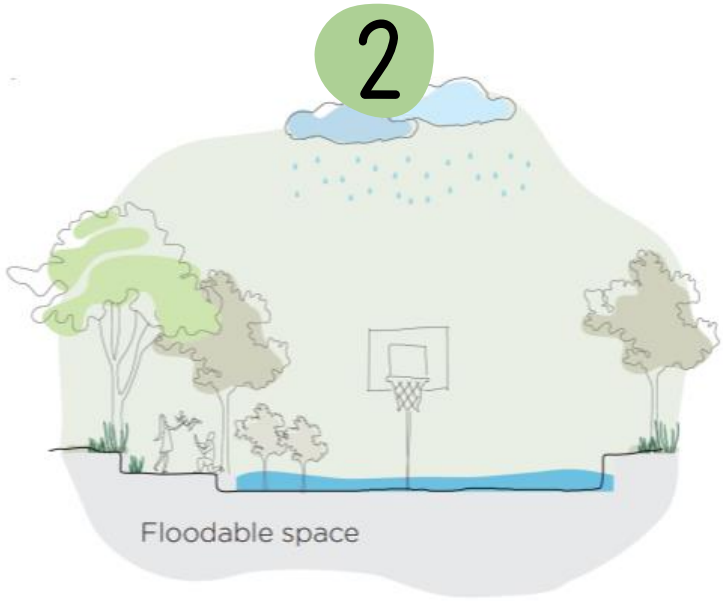
Population density (persons/ha)

Fredensvang - Socio-economic value (for 6 typologies)



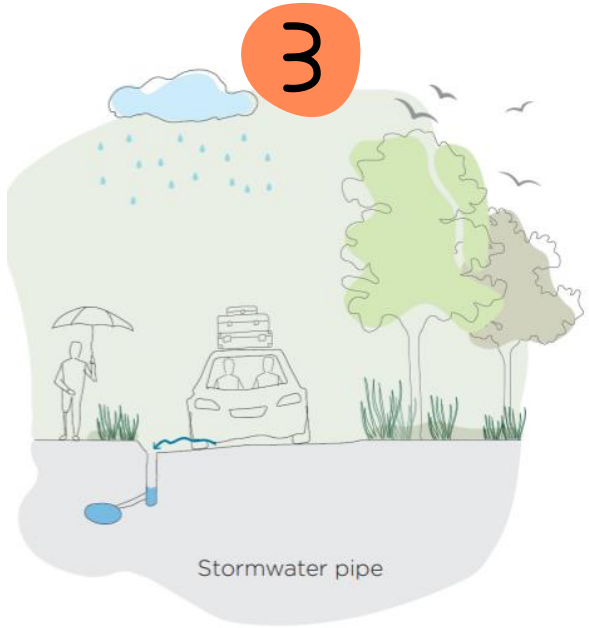
Nature-based approach

5,7 mio. DKK/year



Water delay approach

2,2 mio. DKK/year

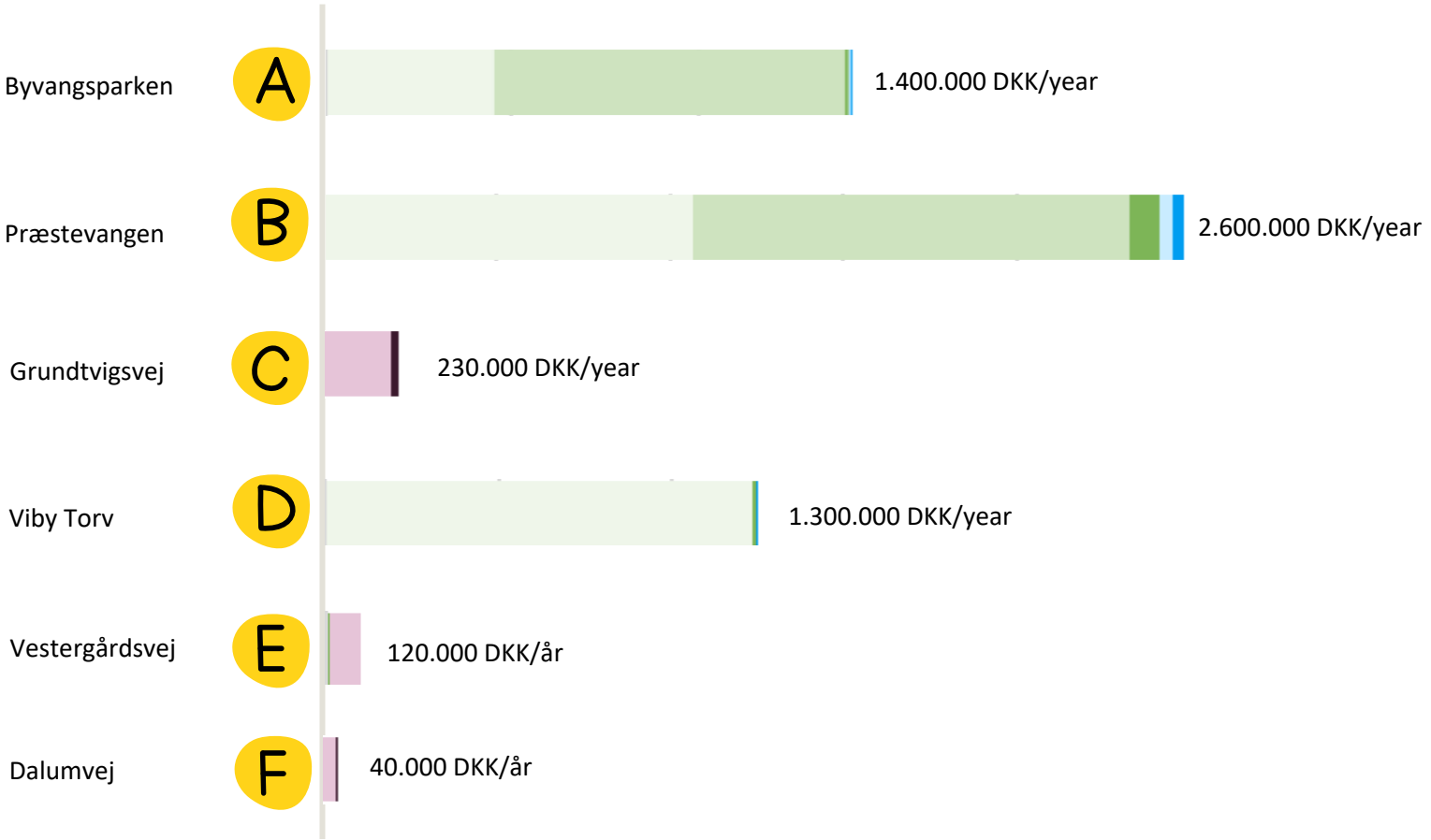


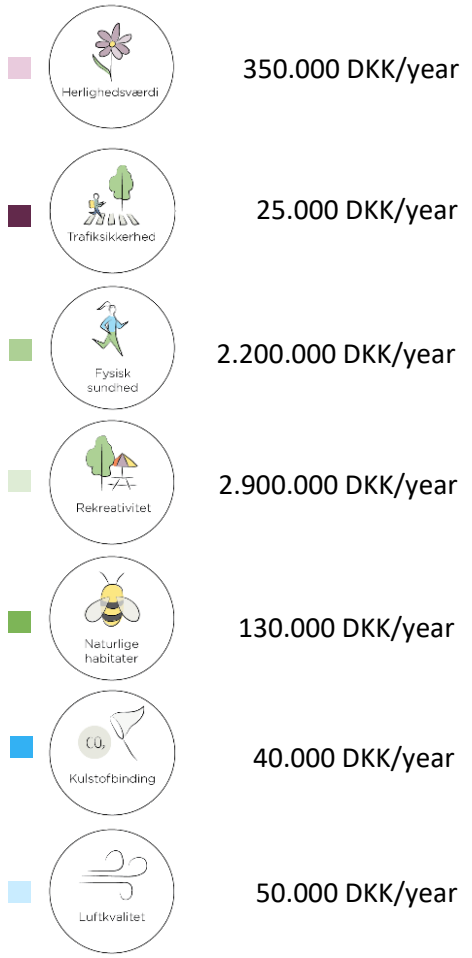
Pipe approach

0,1 mio. DKK/year

Better understanding of the value creation

(Results for approach 1)







International perspective

Projects worldwide that benefited from NBS Value tool



New York Business Case, USA
Client: Water utility
Project type: CBA
Year: 2023

Skien Cloudburst Masterplan, Norway
Client: City department
Project type: Concept design
Year: 2022

SIBU, Malaysia
Client: Land Custody and Development Authority
Project type: Strategic
Year: 2024

Buzzard Point, Washington DC, USA
Client: Water utility
Project type: Neighborhood plan
Year: 2023

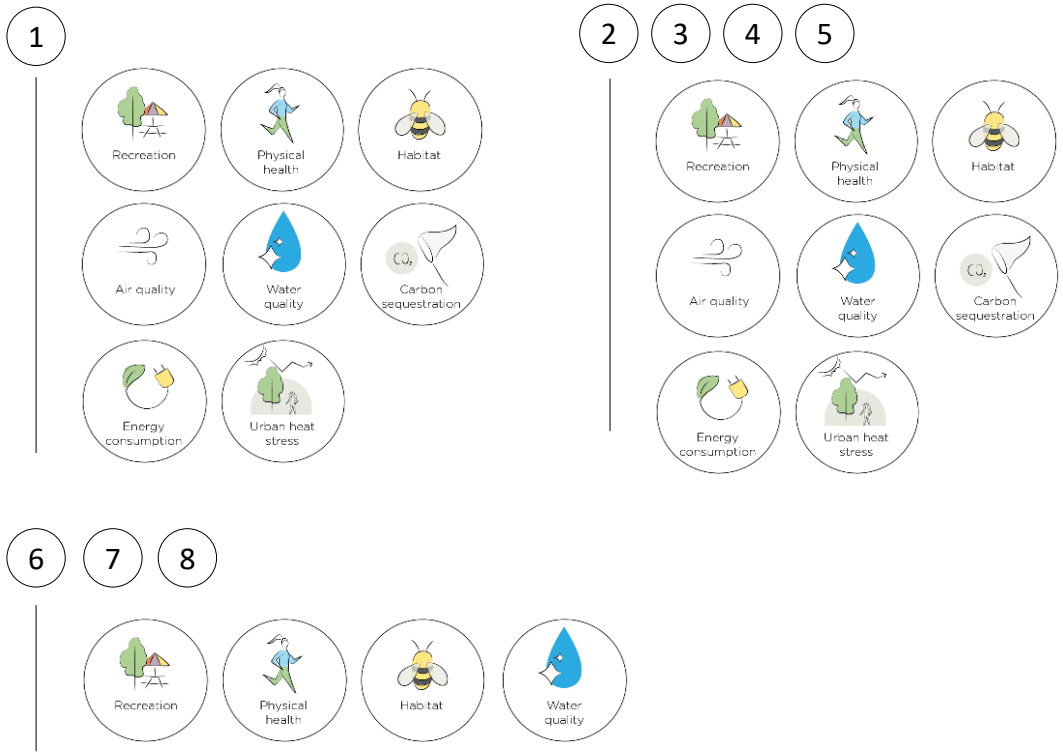
Semarang and Banjamasin, Indonesia
Client: Development Bank
Project type: Strategic
Year: 2023

Project case: SIBU, Malaysia



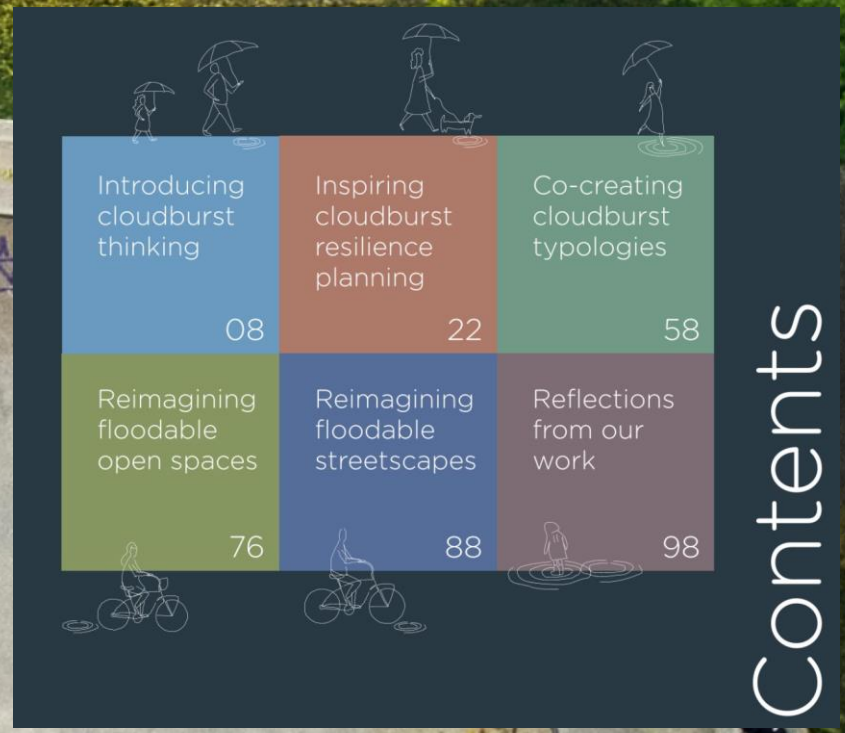
Strategic nature-based masterplan for stormwater management for Bukit Assek neighbourhood in Sibu.

NBS Value used for assessment of added nature and people benefits.



Cloudburst catalog

A co-created collection of lessons learned from 10 years with cloudburst planning and design around the world



Link: https://c.ramboll.com/cloudburstcatalog

Bright ideas. Sustainable change.

RAMBØLL

Thank you



Cristian Tosa, Ana Llopes Alvarez, Ari K.M. Tarigan

University of Stavanger

Co-Creation Workshop Design for NBS Stakeholder Engagement

Practices from Stavanger, Norway

Interreg Baltic Sea Region
Co-funded by the European Union
SUSTAINABLE WATERS City Blues

Our last event



Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS City Blues

City Blues partner meeting

University of Stavanger (UiS), Stavanger | 9–10 April 2025
interreg-baltic.eu/project/city-blues

WATER-SMART SOCIETIES

University of Stavanger

Key insights

- Engagement lessons from the Stavanger field trip
- The workshop’s goal – enhance NBS model
- Introducing the Co-creation matrix.
- Defining phases & participation levels.
- The process.
- Key takeaways.
- Q&A.

Interreg Baltic Sea Region
Co-funded by the European Union
SUSTAINABLE WATERS City Blues
University of Stavanger

Stavanger Aftenblad

«Nye» Nytorget kan koste 70 millioner

Kommunedirektør Per Kristian Vareide anslår at det vil koste 70 millic kroner å ruste opp byrommet Nytorget.

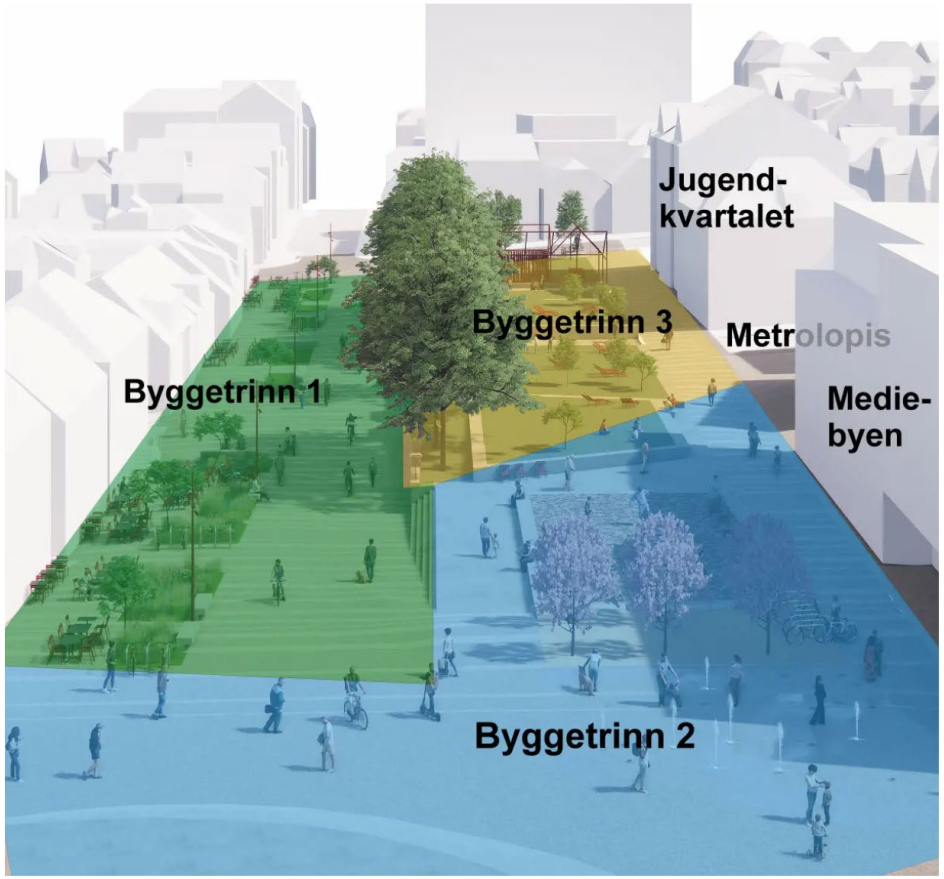


Nytorget, med trerekken og jugendmuren i midten, skal etter planen bli et myldrende bindeledd mellom ø vest i Stavanger. **Foto: Fredrik Refvem**



Av **Stein Halvor Jupskås**

Parkens tre byggetrinn



Nå	2	3
Byggetrinn 1: Nedre del av Nytorget	Byggetrinn 2: Plassen mellom kirka og Mediegården	Byggetrinn 3: Øvre del av Nytorget

University of Stavanger

Lessons from the field

- **Observations**
  - field trip to NBS projects in Stavanger and Sandnes
- **Mosvatnet Lake**: engagement through policy and incentives
- **Nytorget Square**: the need for proactive communication to manage central areas.
- **Sandnes City**: decentralised policy, making property owners responsible for their own stormwater.

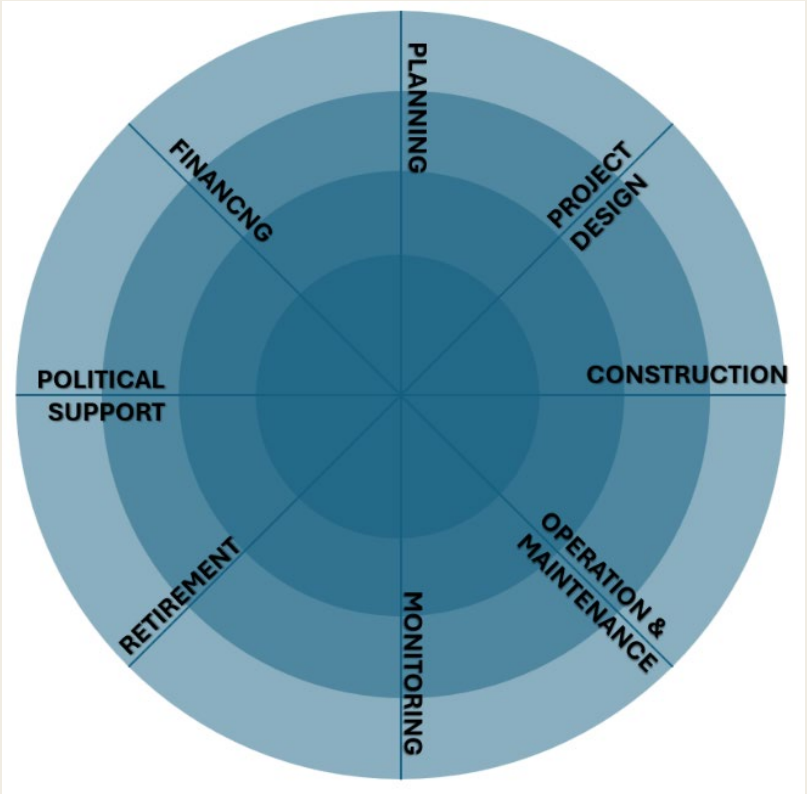






The Workshop's Goal: Enhancing the NBS Model

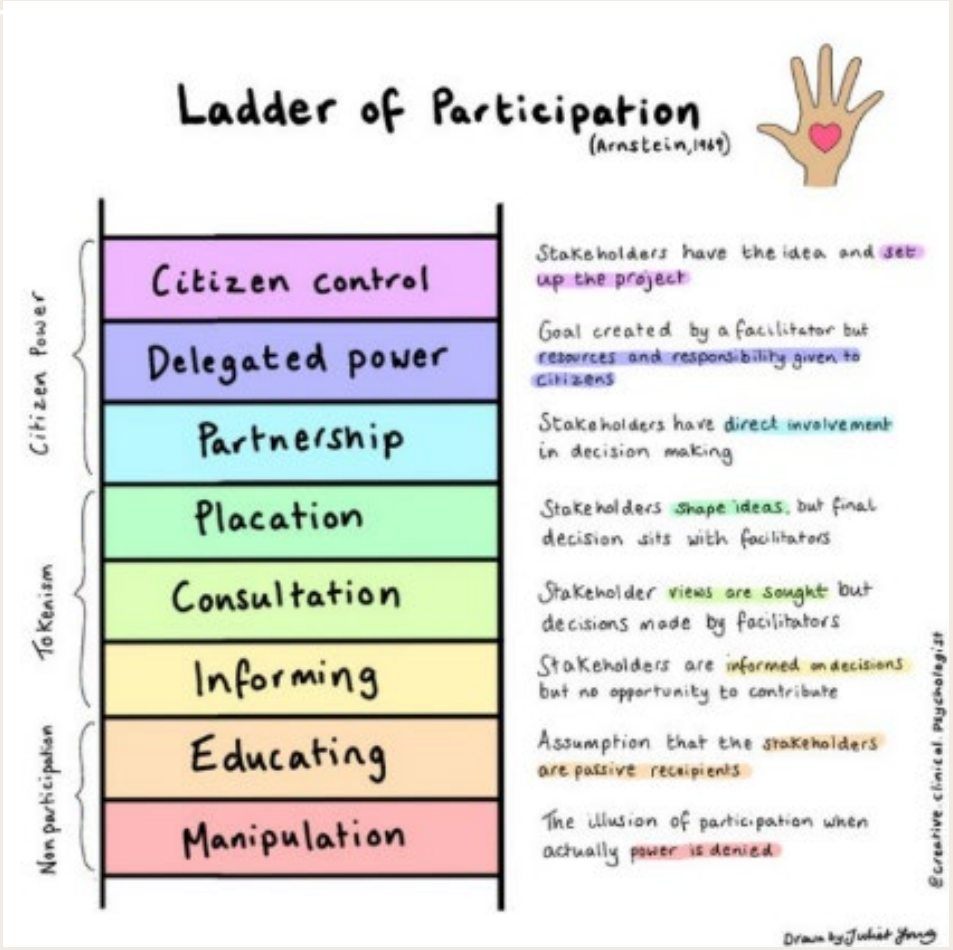
- **Primary goal**: share insights, identify challenges, and develop innovative solutions for stakeholder engagement across all NBS implementation phases.
- **The NBS model**: conceptualised by TalTech partners describing the important steps in an NBS project cycle.
- **Our contribution**: to directly feed into and enrich this model, making it more robust and practical.



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The core tool: the Co-creation matrix

- **Theoretical framework**: the ladder of participation
- **Setup**: A large grid, or matrix.
- **Rows**: Represent the phases of NBS implementation.
- **Columns**: Represent the levels of stakeholder participation.
- **Input method**: Participants contribute their insights using sticky notes, allowing for a visual co-creation process.



Arnstein, 1969

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Dimension 1 - Phases of NBS implementation

- Capture the entire lifecycle of an NBS project to ensure a holistic view.
- **Planning**: Define goals and assessing feasibility.
- **Design**: Create detailed plans and specifications.
- **Construction**: actual building or installation of the NBS.
- **Operation & maintenance**: Ongoing management and upkeep.
- **Monitoring**: Tracking performance and impacts over time.
- **Retirement and repurposing**: Managing the end-of-life options.

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Dimension 2 – Levels of stakeholder participation

- based on a spectrum of engagement, from one-way communication to full ownership.
- **Inform**: Providing information to stakeholders (e.g., a city newsletter).
- **Consult**: Gathering feedback and opinions (e.g., a community meeting).
- **Involve**: Actively engaging stakeholders in the process (e.g., a collaborative design workshop).
- **Collaborate**: Partnering to share decision-making (e.g., a joint committee with an NGO).
- **Empower**: Placing leadership and control with stakeholders (e.g., a community-led green alley project).

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Workshop process: (1) Share experiences

- The first step was about filling in the matrix with real-world examples.
- Participants asked to think about a stakeholder interaction they experienced or observed in an urban greening project.
- Actions:

1. Describe the experience on a sticky note.
2. Indicate the relevant NBS phase and participation level.
3. Place the note in the corresponding cell on the collaboration board.

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Workshop process: (2) Reflect and identify issues

- groups shifted from sharing to analysing.
- In stakeholder groups (Administration, Citizens, NGOs, Academia), participants discussed the shared experiences.
- Actions:

1. Focus on what went wrong or what could have been done better in the engagement process.
2. Note down these key challenges or shortcomings on sticky notes.
3. Place “issue notes” near the relevant experience on the matrix.

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Workshop process: (3) Brainstorm improvements

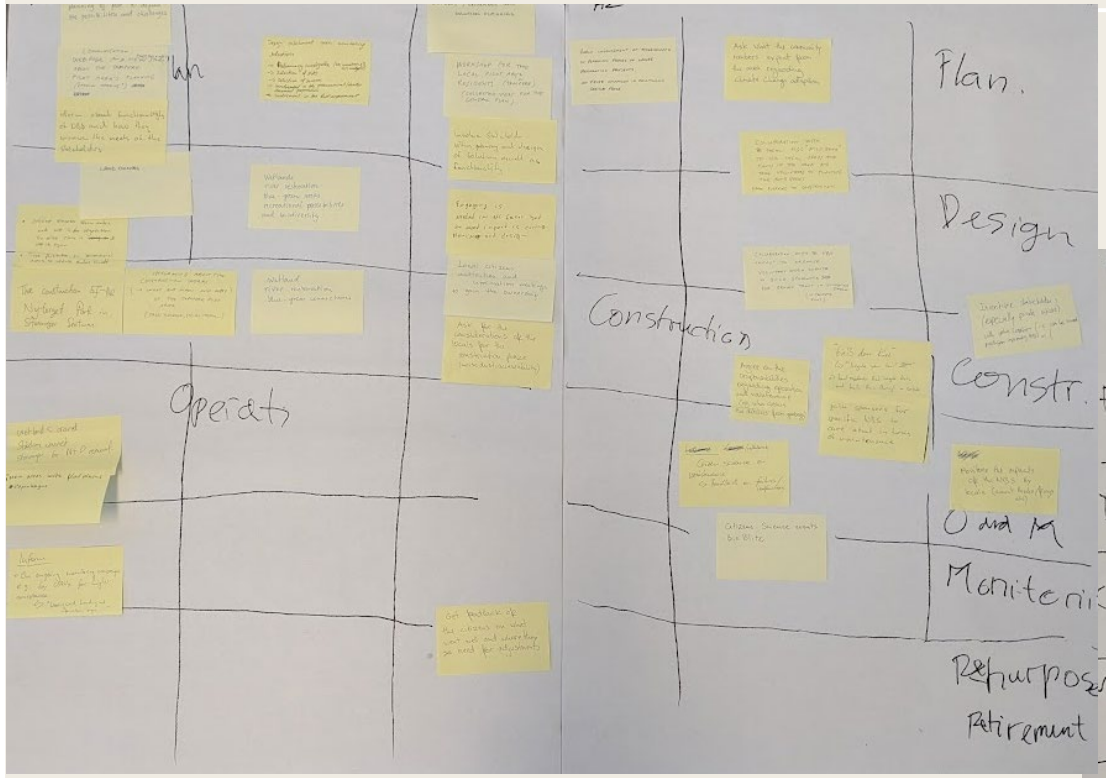
- focused on moving from problems to solutions.

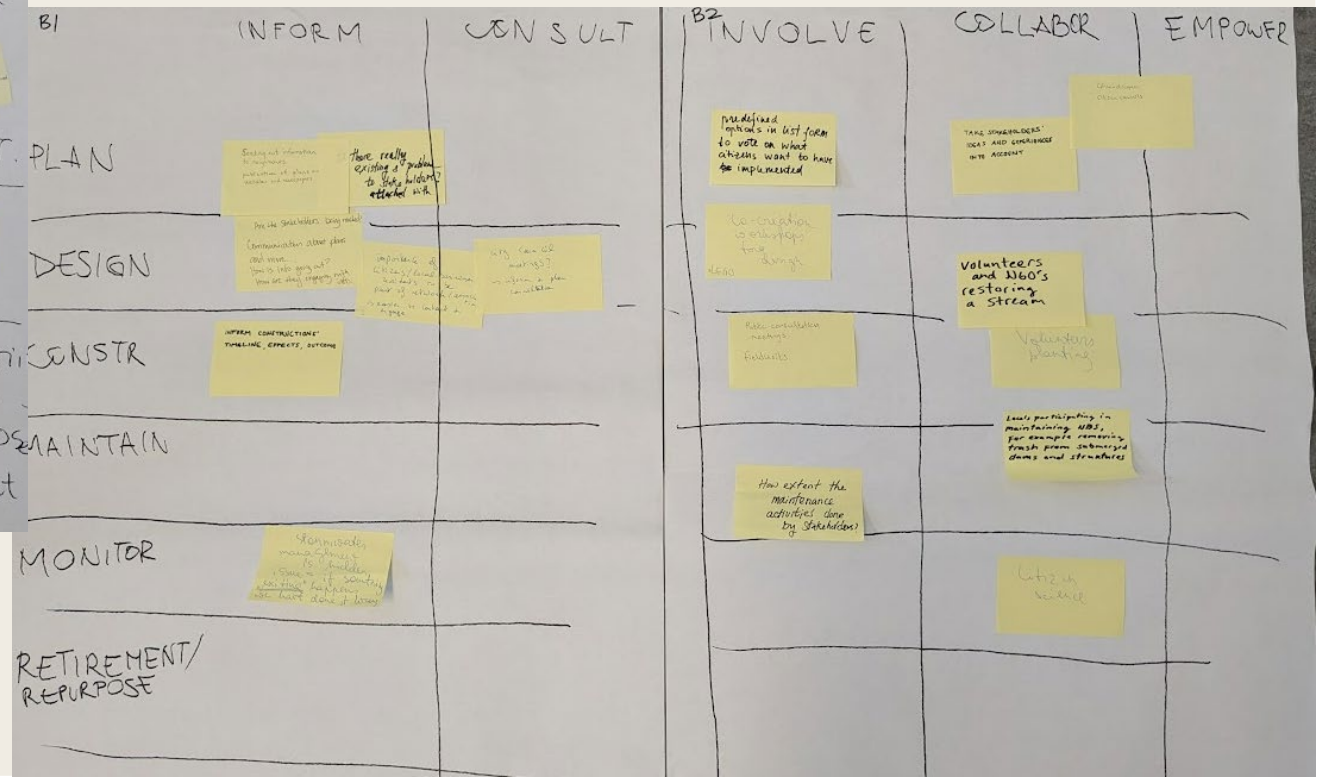
- Actions:

1. Discuss specific actions or innovative approaches that could have led to a better outcome.
2. Write these ideas for improvement on a third color of sticky notes.
3. Place the “solution notes” next to the corresponding “issue notes” on the matrix.

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Results





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Few examples Step 1: Sharing experiences

- Participants shared specific case studies and past projects to create a shared context.
- Example Quotes:

“Collaboration with the local NGO 'Wild Zone’ to use local seeds and plants in the area – from planning to construction.“

“The construction of the Nytorget Park in Stavanger Sentrum”

“Citizen Science events Bio Blitz”

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Few examples Step 2: Identifying Issues

- Analysing the shared experiences to find common challenges and problems.
- The groups identified key barriers to effective engagement that the NBS model needs to solve.
- Example Quotes:

"Define responsibilities. Too big, too much, loses the overview, no one feels the responsibility"

"There really exists a problem to get input related with"

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Few examples Step 3: Brainstorming solutions

- Moving from problems to actionable solutions and best practices.
- Outputs: The majority of the content consisted of concrete methods, tools, and principles to be integrated into the NBS model.
- Example Quotes:

"Hold co-creation workshops for design"

"Incentivise stakeholders (especially private citizens) with value creation..."

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Takeaways for workshop design

- Grounded in reality: start with real-world examples (like a field trip) to provide context and a shared foundation.
- Structure: the matrix transforms a complex discussion into organised, visual, and actionable data.
- Clear process: the “Share -> Reflect -> Improve” model guides participants from individual experience to collaborative problem-solving.
- Define roles: clear instructions for participants and facilitators ensures understanding role and contribute effectively.
- Purpose is vital: Link the workshop activity to a larger goal (enhancing the NBS Model) gives meaning and ensures the results will be used.

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Thank you!



River Restoration Gudenåen



Hans-Martin Olsen, COWI A/S

Ministeriet for Grøn Trepart
Naturstyrelsen

Horsens Kommune

COWI

Agenda

- Danish rivers and streams – characteristics
- River Gudenå – Denmarks longest river
- Utilization of the gradient in Gudenå
- History
- Challenges
- What defines the project (commitments)
- Proposed project
- Expected outcome
- Conclusion



Ministeriet for Grøn Trepart
Naturstyrelsen

Horsens Kommune

COWI

Danish Rivers and Streams

General characteristics

- Low gradient
- Relatively small and short rivers
- Relatively young rivers (15.000 years)
- Postglacial rivers - gravel and stones -> suitable habitat for salmonids and lithophile invertebrates
- Heavy landuse in the catchments (appx. 60 % agriculture and 14 % urban and infrastructure areas)
- Extensive modification and utilization of rivers and streams



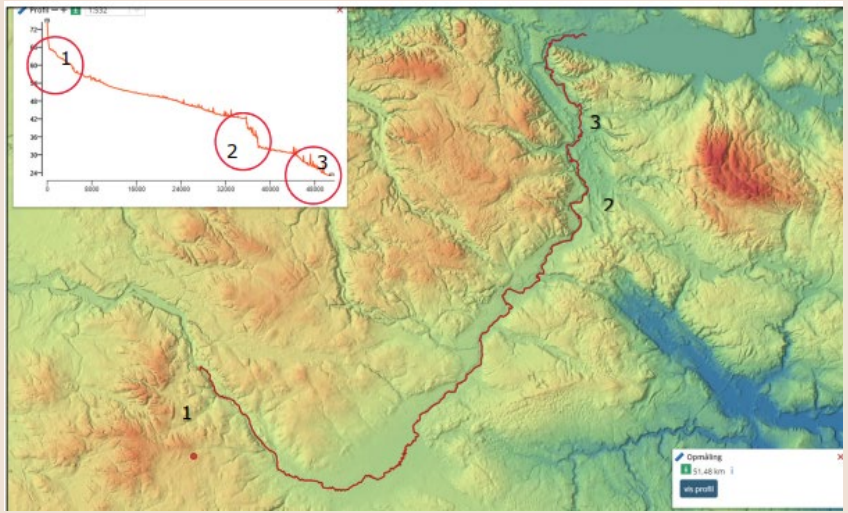
River Gudenå

- 2.600 km² catchment area
- Main river 160 km long – Denmarks longest river
- Intensive damming – some of them very old (1.000 years)



Utilization of the gradient Upper Gudenå

- 3 areas with high gradient has been utilized:
  - Hammer Mølle (watermill)
  - Vestbirk (knitting factory 19th century; hydropower dam 1924)
  - Klostermølle (watermill since the Middle Ages)



Vestbirk hydropower plant

- Established 1924
- Important for development of a large geographical area when established
- Production today equals consumption of 600 households
- Life expectancy of turbines has been exeeded
- Not cost-effective to replace turbines



Challenges

Lack of continuity

Heavily modified river

Poor ecological quali´ty



Sedimentation incl. polluted sediments

Lost habitat – best part of river

Downstream migration

Upstream migration

Cannot obtain goals in WFD

COWI

Status



- Poor ecological quality on modified parts of the river
- High ecological quality on natural part – but reduced discharge
- Few fish or absent – except on natural part of the river
- Unlikely to achieve a sustainable fish population due to the dam









COWI

Commitments

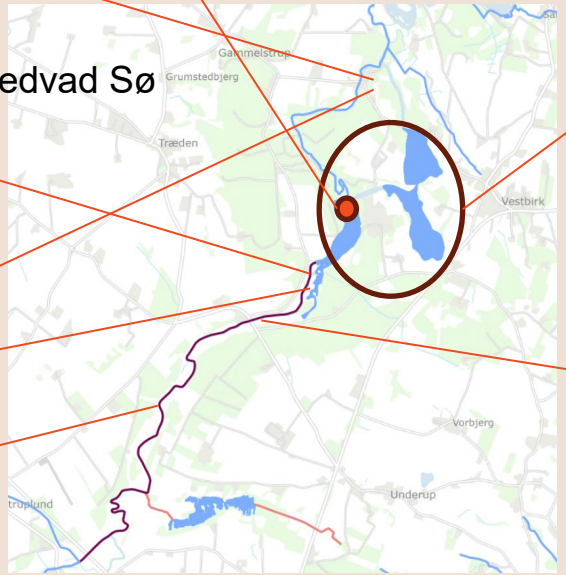
Protected forest

Handle polluted sediment

Danish Nature Agency primary landowner

Reestablish Gudenå through Bredvad Sø

Maintain lakes



Handle landowners and others with interest in the project

Protected nature

Remove backwater zone

Recreational use (e.g. canoeing), also when executing the project

COWI

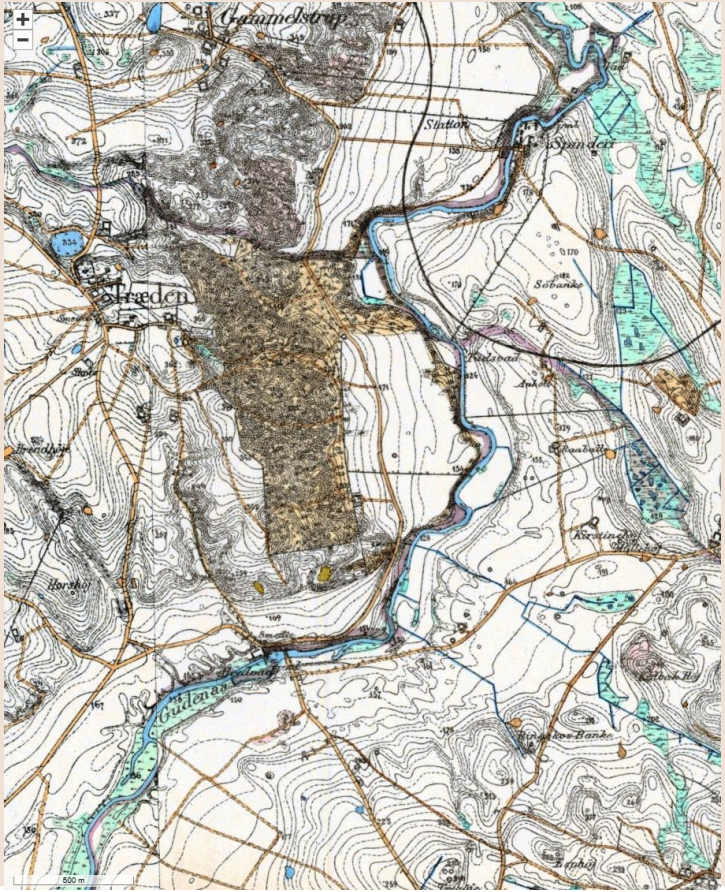
Project basis

- 10 m slope to be distributed across more than 8 km river
- 1.7 km restored river in lake Bredvad
- Old cut-off part of the river will be put back into function





COWI



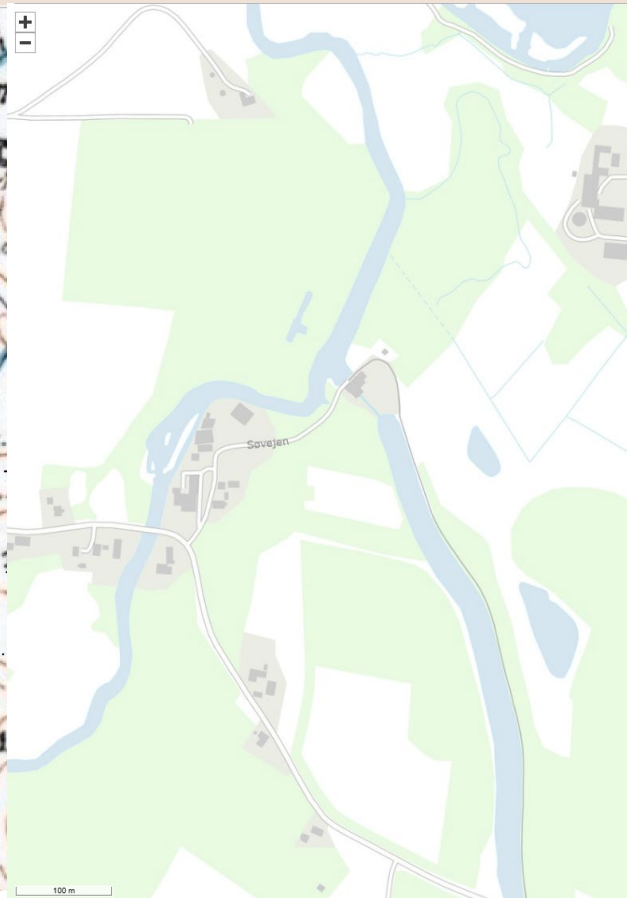


Lake Bredvad Area – before and after

COWI







Before and after – Vestbirk hydropower plant

COWI

Project Lake Bredvad

Maintain lowered water level in the lakes through the project period

Northern dam geotubes filled with polluted sediment and covered with sand

Temporary divertion of river

Restoring old river corridor on dry lake bottom



Track for canoeing

Southern dam build with sand

Old fish passage is removed

COWI

Geotubes and suctioncutter





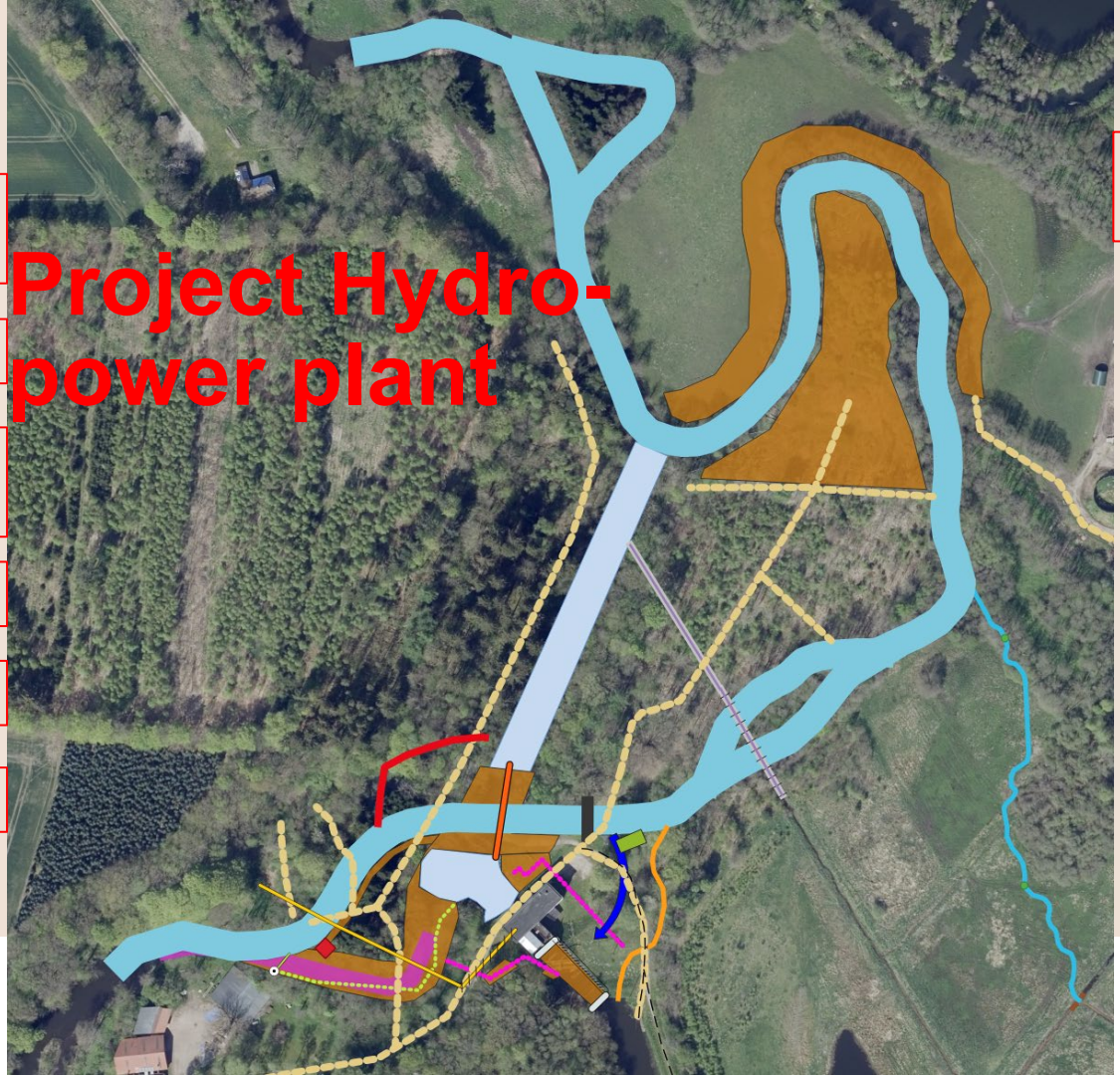






COWI

Project Hydro-power plant



New river corridor at the powerplant

Temporary divertion

Connect to old cut-off part

Cleanup old cut-off part

River cross river

Terrain modification

Shutdown powerplant

COWI

Expected outcome

- River Gudenå is restored to the situation before the damming of the river
- Free migration in river – access to 186 km designated waterbodies
- More than 8 km river with expected high ecological status
- Great increase in fish population
- Improved water quality in the remaining lakes
- Still room for recreational use.



Overall time schedule

Next week: call for tender send to contractors

Dec. 2025: Project start-up

Fall 2026: Project completed



Conclusion

- Large scale river restoration is complicated – but the impact is big
- Dialogue, patience and perseverance is vital
- Experiences from this project could be valuable when solving the next challenge further downstream
- Follow the project (in Danish): Vestbirkprojektet - et historisk stort vandløbsprojekt



River Gudenå, Tange Hydropower plant

26-09-2025

Nature Based Solutions

Mobilising private investments

Kristian Eriknauer
Director for Strategy, Marketing and ESG



DALGAS

Mere end
150 år
med Hedeselskabet

Tidsrejse



1910



1940



1960



1993



2004

2002

Fremtid



1867



1930



1970



1999



1880

1890

1894



1947



1990

I dag

1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 I dag

Mergling, Plantning, Engvanding

Mosekultur

Plantageanlæg, Vandløbsregulering

Grundforbedring

Beskæftigelsesprojekter

Landvindings- og dræningsprojekter

Naturplejeprojekter

Bred indsats på miljøområder

Udnyttelse af energiressourcer

Overførsel af de første klimakreditter fra Polen til Danmark

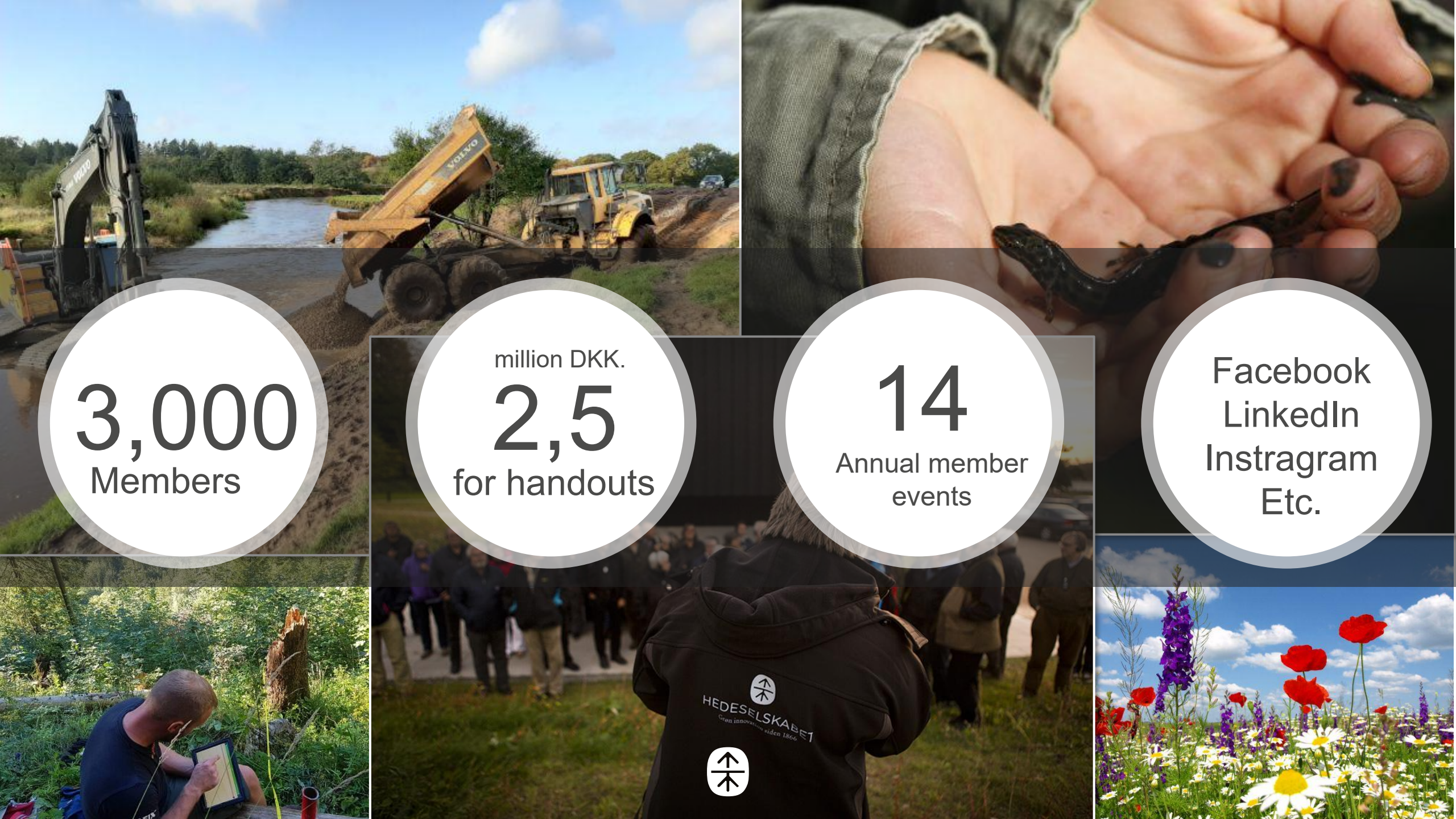
Fortsat investeringer i kommercielle aktiviteter samt i skov- og naturejendomme

NATURLIG VÆKST

ANNO 2025

DALGAS
En del af Hedeselskabet


Hedeselskabet (“the heath company”) is an association with the status of a commercial foundation.
- Dalgas is the business!



3,000
Members

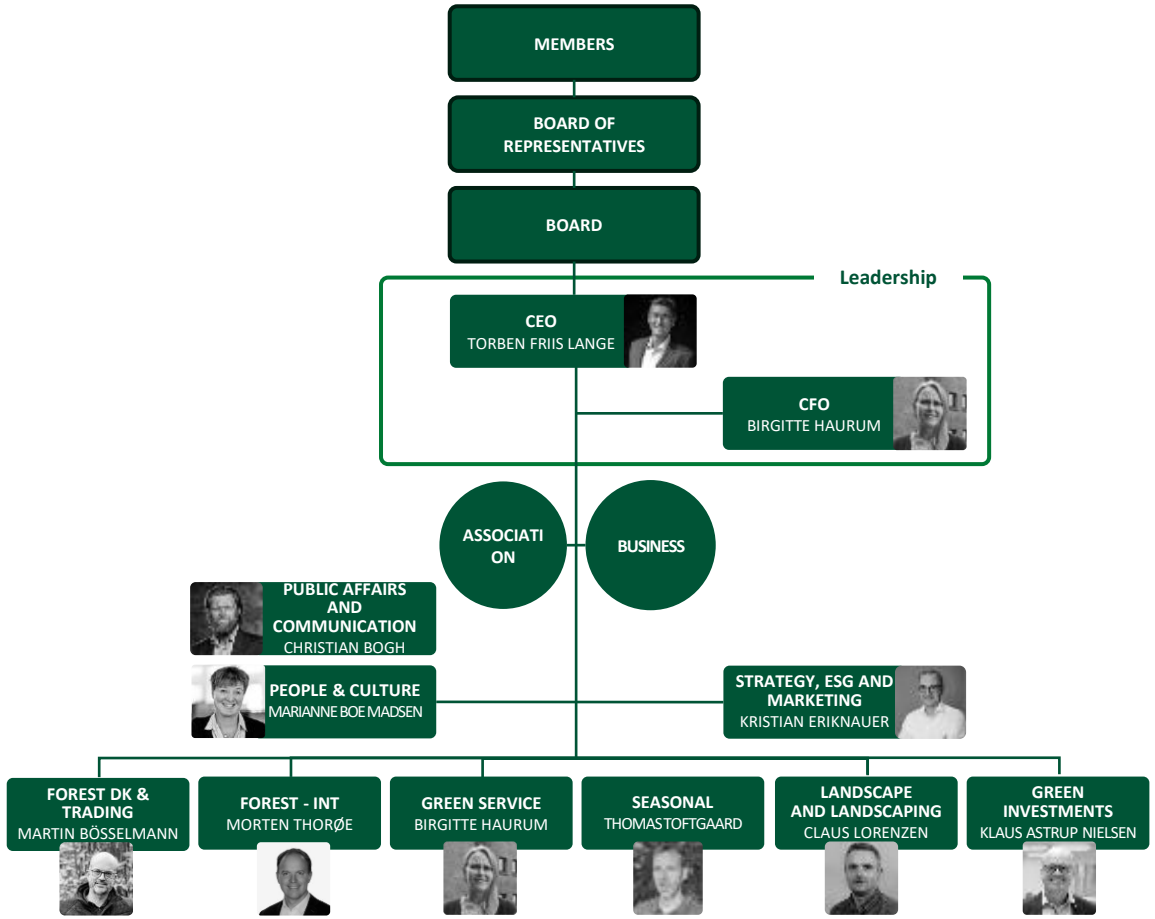
million DKK.
2,5
for handouts

14
Annual member events

Facebook
LinkedIn
Instragram
Etc.

One unified organisation: Hedeselskabet and Dalgas

Million Danish kroner (MDK)	2024	2023	2022	2021
Net sales, MDK	2.350	2.299	2.159	1.991
Profit before tax, MDK	77,6	65	67,7	64,7
Profit after tax, MDK	84,2	53,1	57,7	56,3
Equity, MDK	1.233	1.153	1.104	1.040
Full-time employees	804	839	912	1.077



Dalgas is present in a number of European countries



DALGAS' BUSINESS AREAS

- Forests and trees
- Landscape and sea
- City and outdoor environment
- Recycling and energy

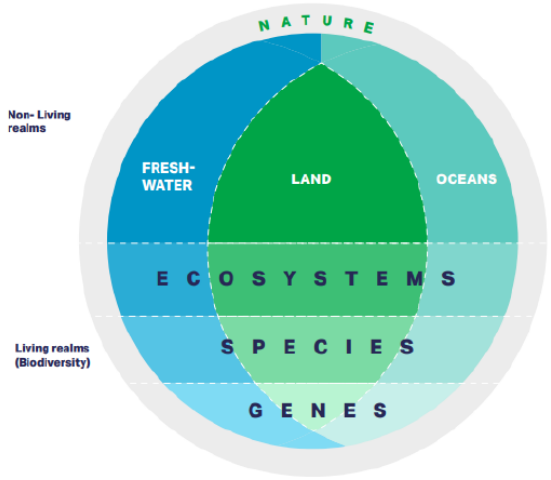
DALGAS' STRATEGIC FOCUS AREAS

- Increase biodiversity
- Responsible use of resources
- Counteracting climate change

AGREEMENT ON BIODIVERSITY CRISIS

WORLD ECONOMIC FORUM

Human activity is eroding the world's ecological foundations, with many ecosystems reaching dangerous tipping points



Land and freshwater

- More than **85%** of wetlands have been lost
- **1/3** of the world's topsoil has been degraded
- The Amazon has lost **17%** of its size in the past 50 years

Ocean

- At least **55%** of ocean area is covered by industrial fishing
- **50%** of the worlds' coral reef system has been destroyed

Species

- **83%** population decline across freshwater species since 1970
- **41%** of known insect species have declined in the past decades

AGREEMENT ON BUSINESS RISK

FIGURE C **Global risks ranked by severity over the short and long term**

"Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period."

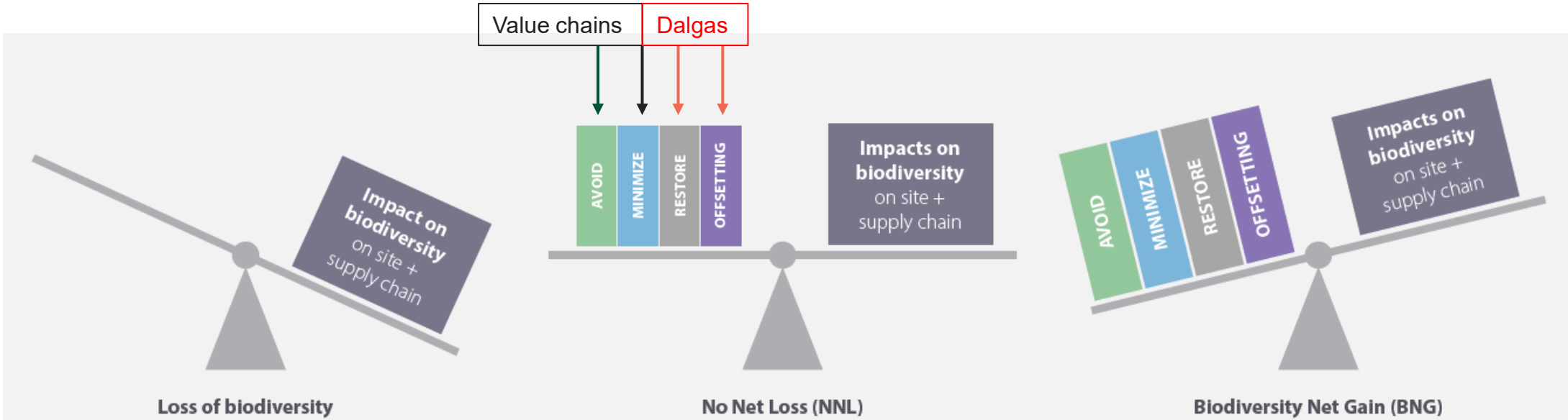
Risk categories
- Economic
- Environmental
- Geopolitical
- Societal
- Technological

	2 years	10 years
1st	Misinformation and disinformation	Extreme weather events
2nd	Extreme weather events	Biodiversity loss and ecosystem collapse
3rd	State-based armed conflict	Critical change to Earth systems
4th	Societal polarization	Natural resource shortages
5th	Cyber espionage and warfare	Misinformation and disinformation
6th	Pollution	Adverse outcomes of AI technologies
7th	Inequality	Inequality
8th	Involuntary migration or displacement	Societal polarization
9th	Geoeconomic confrontation	Cyber espionage and warfare
10th	Erosion of human rights and/or civic freedoms	Pollution

Source
World Economic Forum Global Risks Perception Survey 2024-2025.

Global Risks Report 2025

What should companies be aware of?



AFVÆRGEHIERARKIET

Til at modvirke påvirkninger på biodiversitet anvendes fire overordnede tilgange i prioriteret rækkefølge:

1. **Avoid:** Undgå påvirkningerne, så vidt muligt
2. **Minimize:** Minimér påvirkningerne, hvis de ikke kan undgås
3. **Restore:** Genopret biodiversitet i påvirkede områder
4. **Offsetting:** Erstat biodiversitet i andre områder som kompensation

Kombinationen af disse tilgange kan anvendes til at neutralisere påvirkningen (NNL) eller endda forbedre biodiversitet (BNG).



Nature-based solutions



AFFORESTATION



NATURE RESTORATION ON LAND



NATURE RESTORATION IN THE SEA



URBAN BIODIVERSITY



Data and documentation

Collection of data



BASELINE MEASUREMENT
Baseline measurement collects data on current nature quality and helps assess biodiversity measures.



MONITORING
Monitoring is recommended to assess the effect of biodiversity measures.



ESG REPORTING
Baseline measurement and monitoring can be used for ESG reporting on biodiversity work.



LONG-TERM DATA
Repeating monitoring for at least three years ensures solid data on biodiversity.

DALGAS

Baseline 2024
Sparekassen Kronjylland

Mindstrupvej 11,
7300 Jelling



3. Beskrivelse af eksisterende areal

Baselinemålingen blev foretaget dag den 14/8-2024 i tidsrummet 11:00-16:30. Observationerne er henført i tabel 1 (abiotiske forhold), tabel 2 (floraregistreringer) og tabel 3 (faunaregistreringer), se bilag 1. Der blev i alt fundet 31 arter af planter og 27 arter af dyr. Registreringerne er lavet på selve områdefladen, men betydningsfulde tilgrænsende planter er medtaget. Området bar stort præg af intensiv dyrket landbrugslandskab, hvor de opdyrkede marker udgjorde alle 170 hektar, se figur 3 for generelle billeder af området taget under feltarbejdet.

Ud over de dyrkede afgrøder, var markerne, primært markskællende, domineret af forskellige græsser, men arter som almindelig røllike (*Achillea millefolium*), agersnerle (*Convolvulus arvensis*), gråbynke (*Artemisia vulgaris*) og mælkebøtte (*Taraxacum sp.*) var også på arealet. Arterne i området har overvejende samme blomstringsperiode, hvilket begrænser nektar- og pollenbidraget til området til start og højsommer. Mælkebøtter har dog en tidlig blomstringssæson, fra april til juni, men planten vil ikke alene kunne opretholde et sundt fødegrundlag for smådyr på og nær arealet i det tidlige forår. Artssammensætningen på markerne indikerer også, at jorden er næringsrig og har været gødet, hvilket gør det vanskeligt for mere nøjsomme og langsomt voksende plantearter at etablere sig, da græs vokser hurtigt og optager pladsen på arealet. Desuden fremstår området meget åbent og uden læ til de forskellige dyrearter.



Figur 3. Billeder fra lokaliteten ved baselinemålingen.

Der blev observeret adskillige gravede kanaler langs flere markskel. Disse kanaler var delvist eller helt tilgroet flere steder. Vandstanden i kanalerne var forholdsvis lav, hvilket formegentlig skyldes de mindsket nedbør i sommerperioden. Grundet markernes udformning fremstod kanalerne udrettet,

DALGAS
En del af Hedeselskabet

Bilag

Bilag 1, Artsregistrering i felten

Tabel 1. Skema over de fysiske forhold, som feltarbejdet blev foretaget under

Abiotiske/fysiske forhold	
Beskrivelse	Noteret
Dato	14/8-2024
Tidsinterval	11:00-16:30
Temperatur	18,9-22,4 grader
Luftfugtighed	91,8-76,8 %
Nedbør	0 mm
Vind	2,0-2,5 m/s
Vejrkommentar	Sol og skyer

Tabel 2. Samlet tabel over registret flora på og langs området.

Videnskabeligt navn	Almindeligt navn	Rødliste	Status i dk
Hjemmehørende arter			
Achillea millefolium	Almindelig Røllike	LC	Almindelig
Anthriscus sylvestris	Vild Kørvel	LC	Almindelig
Argentina anserina	Gåsepotentil	LC	Almindelig
Artemisia vulgaris	Grå-Bynke	LC	Almindelig
Cirsium arvense	Ager-Tidsel	LC	Almindelig
Cirsium vulgare	Horse-Tidsel	LC	Almindelig
Convolvulus arvensis	Ager-Snerle	LC	Almindelig
Epilobium montanum	Glat Dueurt	LC	Almindelig
Equisetum arvense	Ager-Padderok	LC	Almindelig
Hypochaeris radicata	Almindelig Kongepen	LC	Almindelig
Jacobaea vulgaris	Eng-Brandbæreg	LC	Almindelig
Knautia arvensis	Blåhat	LC	Almindelig
Lotus pedunculatus var. pedunculatus	Sump-Kællingetand	LC	Almindelig
Medicago lupulina	Humle-Snegleбælg	LC	Almindelig
Mycelis muralis	Skovsalat	LC	Almindelig
Myosotis arvensis	Mark-Forglemmigej	LC	Almindelig
Persicaria amphibia	Vand-Pileurt	LC	Almindelig
Plantago lanceolata	Lancet-Vejbred	LC	Almindelig
Plantago major ssp. major	Glat Vejbred		Almindelig
Rubus idaeus	Hindbær	LC	Almindelig
Rumex acetosa	Almindelig Syre	LC	Almindelig
Rumex crispus	Kruset Skræppe	LC	Almindelig
Senecio vulgaris	Almindelig Brandbæger	LC	Almindelig
Tanacetum vulgare	Rejnfan	LC	Almindelig

DALGAS
En del af Hedeselskabet

CO2 sequestration by afforestation

Årligt CO_2-effekt (t CO2 eq /år)													
Projektets alder:	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	GNS 0-60
Årlig CO_2-effekt - ophør af landbrug:	-	-	-	-	-	-	-	-	-	-	-	-	-
Årlig tilvækst i CO_2-lager i eksisterende skov og natur:	-	-	-	-	-	-	-	-	-	-	-	-	-
Årlig tilvækst i CO_2-lager i ny skov og natur:	63	230	317	457	930	1.012	572	345	325	374	295	233	429
Årlig CO_2-optag i ny skov og natur (incl. hugst):	63	245	387	527	999	1.416	1.169	1.169	1.006	916	838	813	796
Årlig CO_2-optag - eksisterende skov og natur (incl hugst):	-	-	-	-	-	-	-	-	-	-	-	-	-
Årlig CO_2 udtaget som hugst (ny og eksisterende skov):	-	14	70	70	69	404	597	824	682	543	543	580	366
Årlig samlet CO_2 - effekt på projektareal:	63	245	387	527	999	1.416	1.169	1.169	1.006	916	838	813	796
Årlig CO2-effekt (excl hugst):	63	230	317	457	930	1.012	572	345	325	374	295	233	429
Årlig samlet CO_2 - effekt, gns. pr. ha:	1,3	4,9	7,7	10,5	20,0	28,3	23,4	23,4	20,1	18,3	16,8	16,3	15,9
Årlig CO2-effekt (excl, hugst), gns. pr. ha:	1,3	4,6	6,3	9,1	18,6	20,2	11,4	6,9	6,5	7,5	5,9	4,7	8,6

Can be used in relation to one's scopes or LCA for new construction?

Example: 10,000 m2 with LCA 10 kg/m2 = approx. 10 ha of forest

26-09-2025

Example from Sparekassen Kronjylland

DALGAS

The savings bank's wishes for the project

1. Absorption of min. 600 tonnes of CO2/year for an average of 60 years.

2. Development of new natural areas to accommodate biodiversity.

3. Development of recreational initiatives to accommodate the local population and other guests to the area.

DALGAS
En del af Hedeselskabet

ONE STOP SUPPLIER

February 2024	AN IDEA
July 2024	PURCHASE OF LAND
August 2024	BASELINE AND DESIGN OF FOREST
Oct-Dec 2024	REGULATORY APPROVALS
Spring 2025	AFFORESTATION AND NATURE DEVELOPMENT
Summer 2025	CERTIFICATION
Continuous...	MANAGEMENT AND MONOTORY

DALGAS
En del af Hedeselskabet

Support for existing natural values



Focus species found on the property from baseline measurement



Bride

Observed on fieldwork
Protected in Denmark
Means: Stones, firewood stacks and light-open areas



Onion Frog

Naturbasen (latest 2016)
Protected in Denmark
Means: Small clean lakes, sunny, without fish

.



Bat

Naturbasen – several species observed
Protected in Denmark
Means: Area with many insects and old trees



Brownish mother-of-pearl butterfly

Naturbasen – Almost threatened
Instruments: Violets and small clearings



Bully bluebird

Naturbasen – Moderately threatened
Means: Bog areas, bog bully, cranberries, blueberries



Crane

Fieldwork
Breeding and migratory birds
Means: Wet areas with plenty of space, eating amphibians and larger insects

A holistic forest and nature project

- Afforestation = **CO2 sequestration**
- Water and open spaces = **biodiversity**
- Recreational elements = **social considerations**



Water back in the landscape



Water back in the landscape





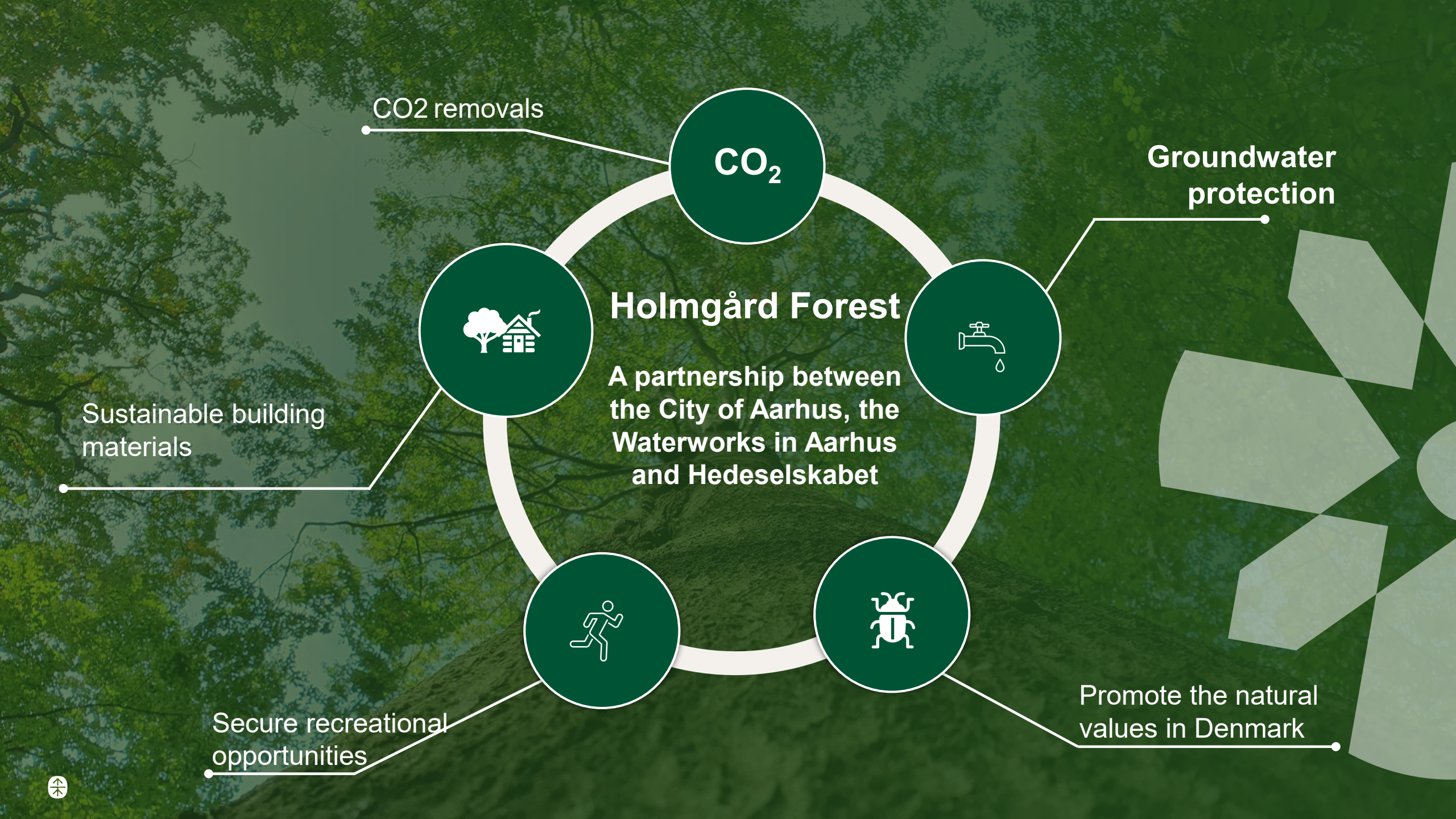
Natural processes with grazing animals







Groundwater protection in Aarhus Municipality


CO2 removals
CO_2
Groundwater protection
Holmgård Forest
A partnership between the City of Aarhus, the Waterworks in Aarhus and Hedeselskabet
Sustainable building materials
Secure recreational opportunities
Promote the natural values in Denmark


Trige
Estrupvej
Randersvej
PANNERUPVEJ
SKÅRUPGÅRDVEJ
Skaarupgaard.
SKÅRUPGÅRD SKOV
Trige Skovvej
Ørnstrupvej
Ørnstrupvej
Aarslevvej
Lystrup
Langegervej
Randersvej
KLOKBAKKEN
Lille Todbjerg

Træart	Holmgård Skov
Bøg	4.200
Stilkeg	12.825
Rødeg	1.825
Ahorn	
Avnbøg	2.825
Fuglekirsebær	8.425
Navr	
Rødel	
Spidsløn	7.775
Vortebirk	3.175
Dunbirk	975
Lind	5.125
Kæmpegran	
Hybridlærk	3.500
Skovfyr	1.375
Douglasgran	
Rødgran	800
Rød kornel	
Hassel	500
Hvidtjørn	2.125
Benved	
Skovæble	1.250
Mirabelle	1.075
Fjeldribs	
Røn	
Kvalkved	1.425
Alm. hæg	2.125
Æblerose	1.250
Alm. hyld	
Dunet gedeblad	
	62.575
Areal - netto - tilplantet	14,1
Planter pr. ha.	4.441

HedeDanmark
En del af Hedeselskabet

Skovrejsningskonsulent
Niels Jacobsen

Skovkort Vennemindevej 51

N

a Vær
d Bøg
Vandhul
Eng
e Fuglekirsebær
c Rødeg
a Vær
b Stilkeg
a Vær
Overdrev
Overdrev
Eksisterende Eng
a Vær
c Løn
Eksisterende Eng
Eng
Vandhul
b Stilkeg
Overdrev

0 200 400 m

- Hegnslinje
- Nye vandhuller
- Potentiel ekstra areal til skovrejsning

Vennemindeskov
- Vær
- Stilkeg
- Bøg
- Rødeg
- Løn
- Fuglekirsebær

Lysåben natur
- Eng
- Overdrev
- Eksisterende Eng

26-09-2025

Thank you for your attention

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