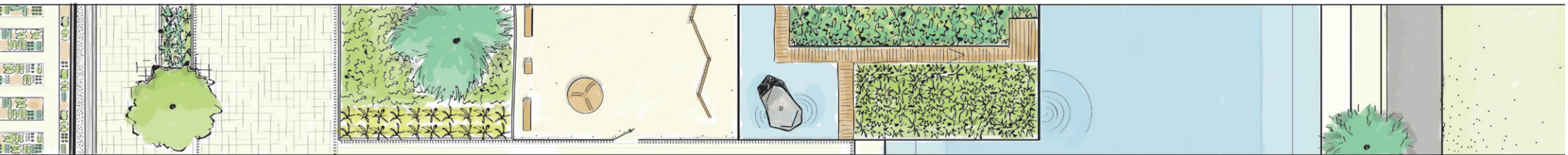


# URBAN LIVING WITH WATER

Sustainable stormwater management for Liesing in Vienna



Caroline Bruens  
Graduation Presentation



# CONTENT

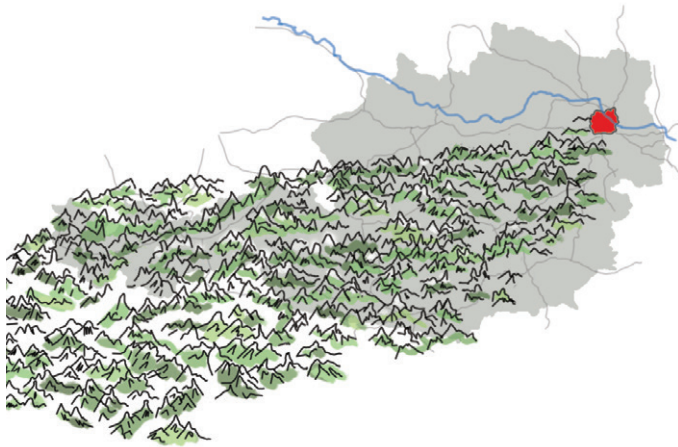
- 1: Introduction
  - Introduction site
  - Introduction theme
  - Fascination: Malmö
2. Aim & Research question
3. Methodology
4. Analysis
5. Strategy & Masterplan: Liesing Mitte
6. Design: In der Wiesen-Ost
  - Site introduction & experience
  - Spatial plan & Concept
  - Water Plan & Scheme
  - Detail 1: Entrance Liesingbach
  - Detail 2: Subarea Nursery
  - Detail 3: Subarea Field
7. Conclusion



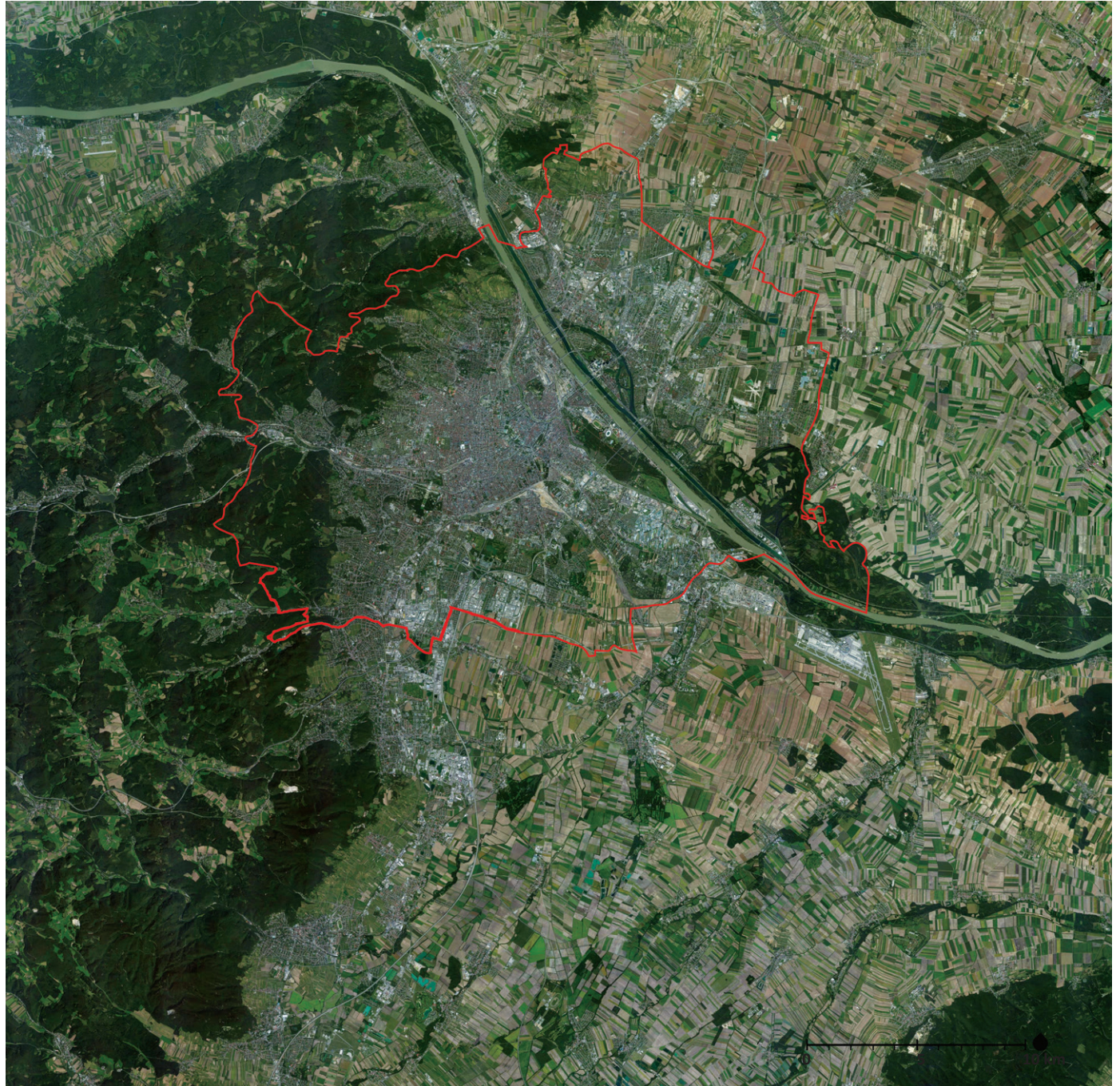
## *Vienna region*

Vienna is located on the edge of the Alps and along the river Danube.

Due to the protected environments in the east and west of Vienna, urban growth has occurred in a wedge shape to the south.



## INTRODUCTION SITE



## Vienna region

The Liesingbach & Wienfluss are characterised as heavily modified. The regulation of the Liesingbach happened between 1947 and 1969.

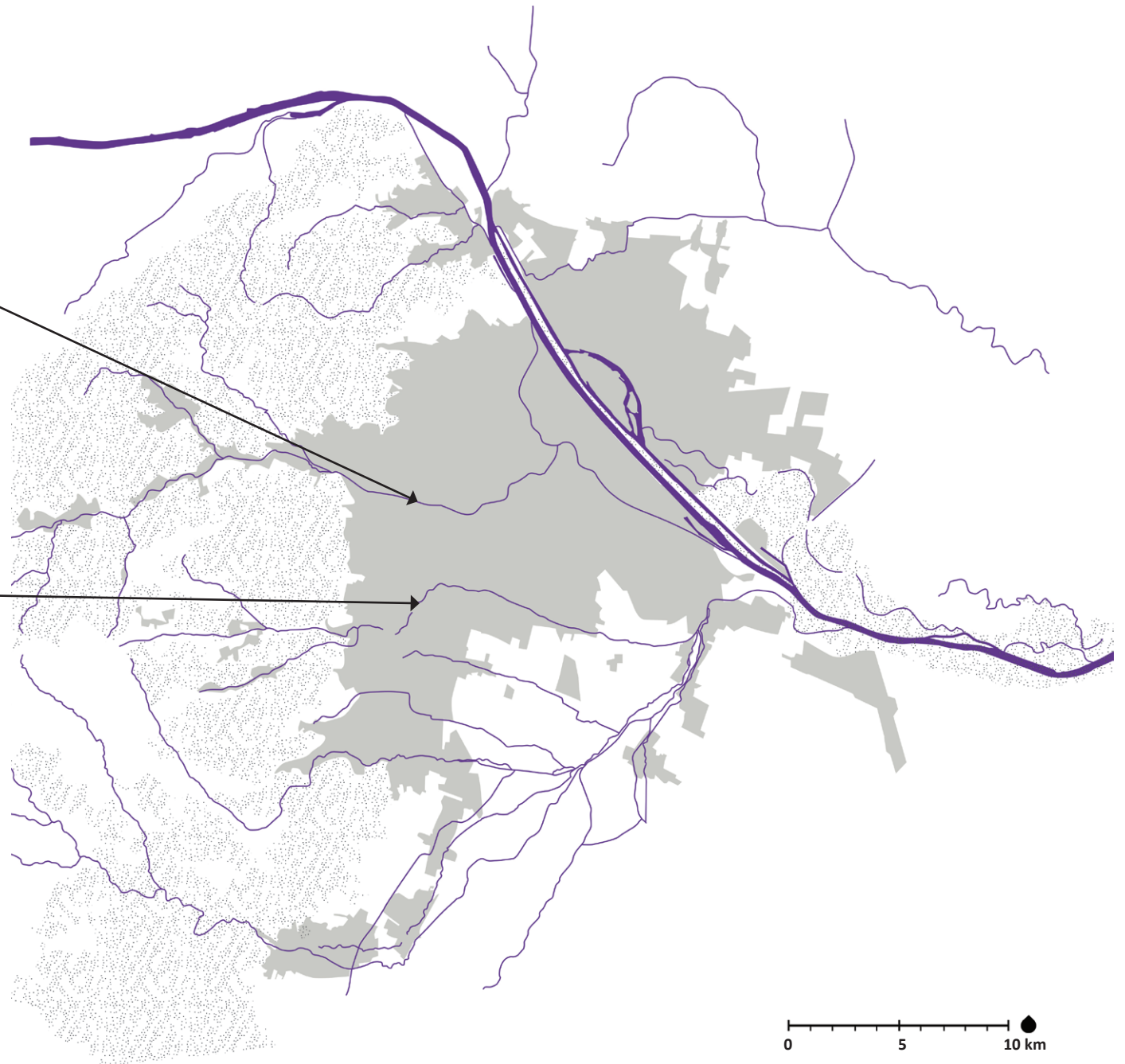
## INTRODUCTION SITE



Wienfluss:



Liesingbach:



# Vienna region

The Liesingbach connects the southern part of the Vienna Woods with the Terrace landscape, and National park Donau-Auen. In the last decade several revitalisation-projects along the Liesingbach have taken place.



Vienna Woods:

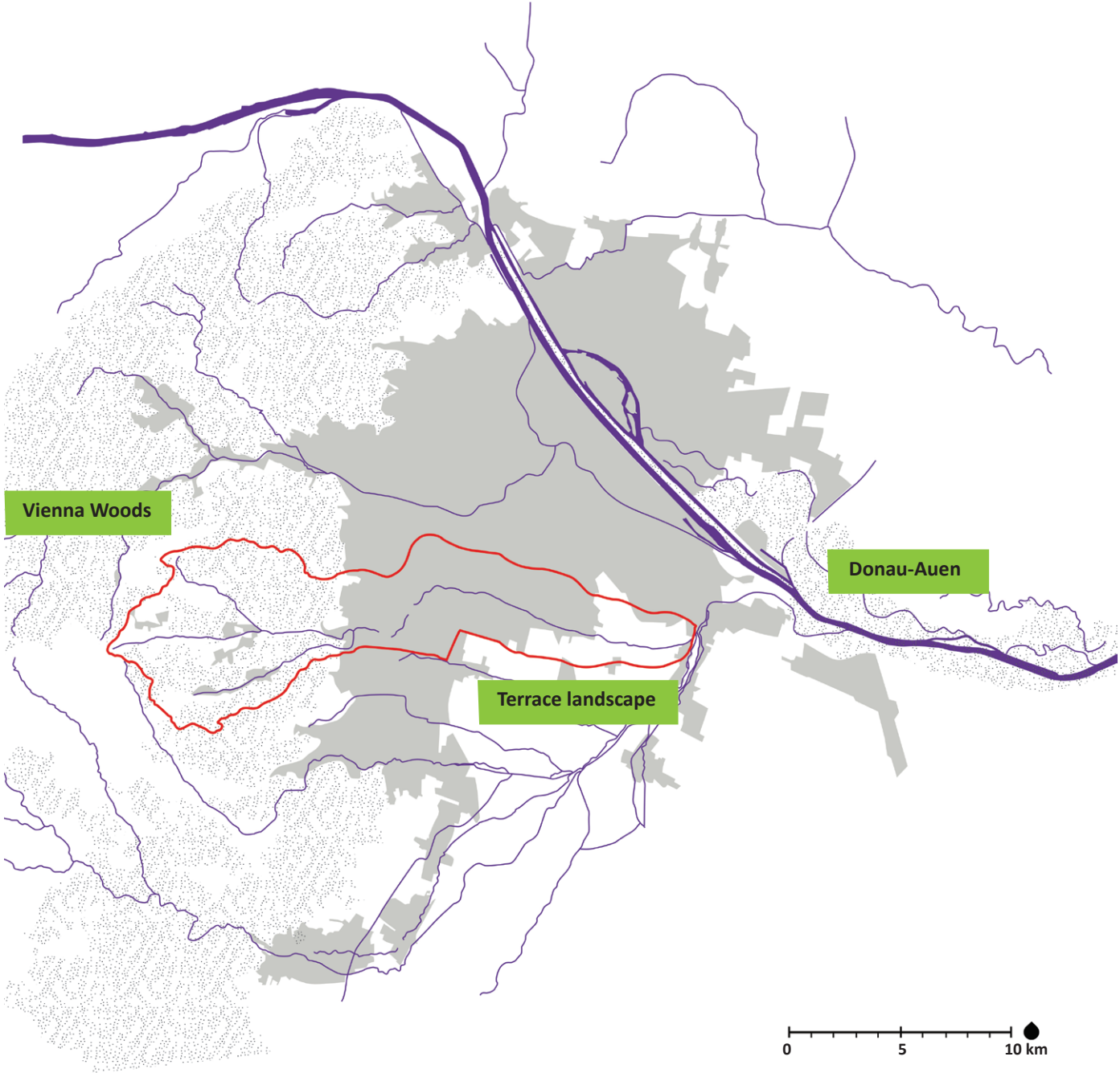


Terrace landscape:



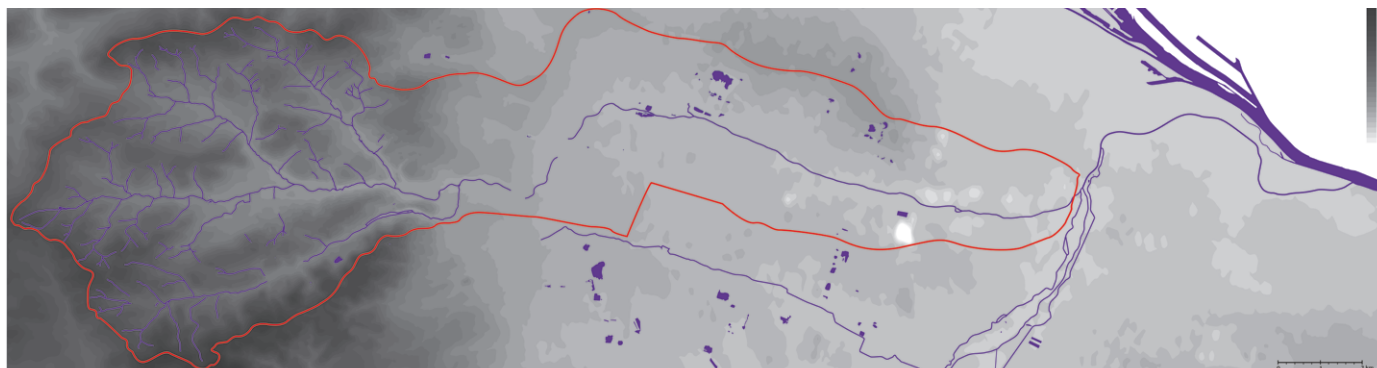
Donau-Auen:

# INTRODUCTION SITE

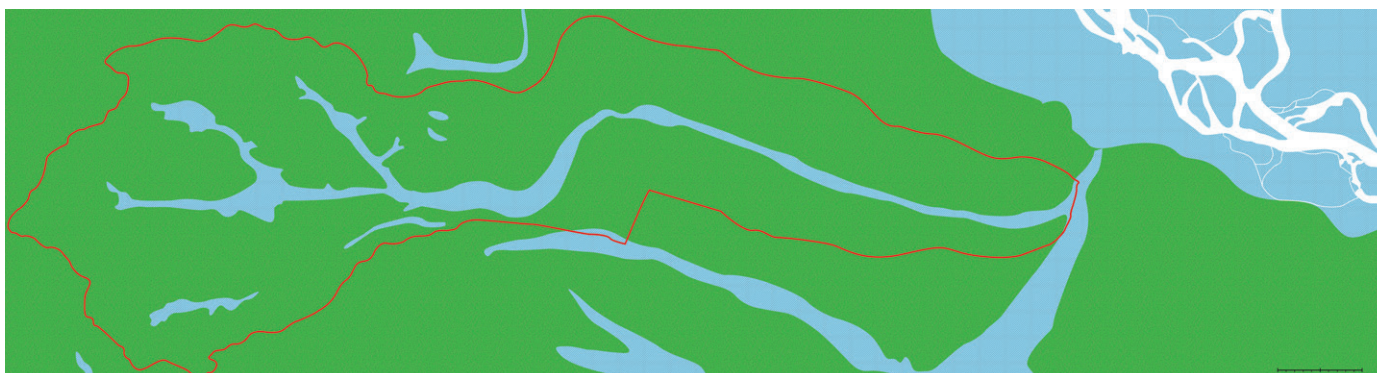


## Catchment basin - urbanization

## INTRODUCTION SITE



Catchment basin defined by relief



Natural situation: Forest and broad & dynamic streambed



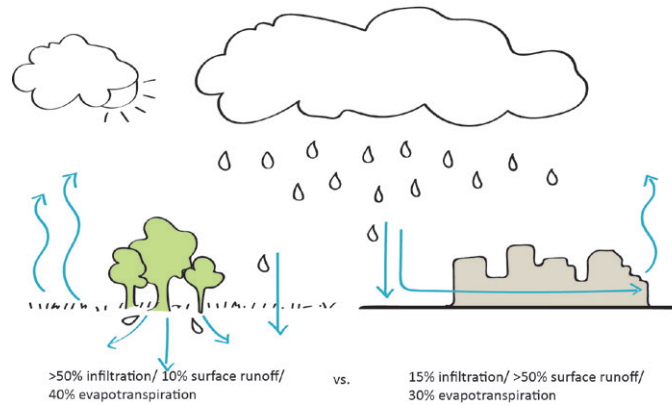
Current situation: Urbanization & agriculture and narrow streambed.



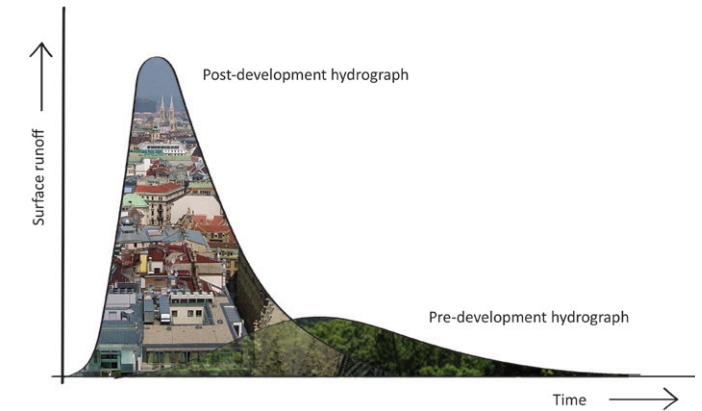
# Catchment basin - effect of urbanization on stormwater runoff

Stormwater is rainfall (or water from any other form of precipitation) that has fallen on a built up area and runs off from urban surfaces, like streets, sidewalks, rooftops, and parking lots.

# INTRODUCTION THEME



Effects of urbanization on watercycle.



Peak flow before and after urbanization.



Separate sewersystem & floodrisk

## *SUDS part of landscape*

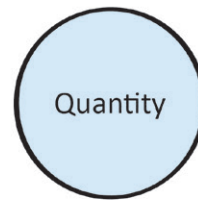
Before the 1970's, the focus was mainly on the water quantity and how to discharge stormwater runoff as quickly as possible. The traditional urban drainage is located underground.

In the 1990's the concept of sustainable urban drainage system (SUDS) was introduced. The focus was not only on reducing the potential impacts of development on the quantity and quality of the stormwater runoff, but also on maximizing amenity and ecology opportunities. Integrating stormwater requires a creative holistic approach to the design process of the urban environment.

Landscape architecture!

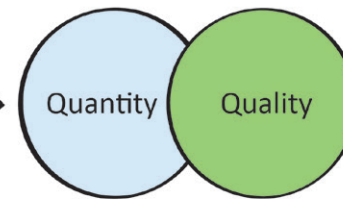
# INTRODUCTION THEME

### Traditional urban drainage



- 1975

### Sustainable urban drainage









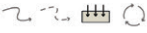













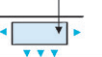








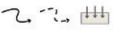









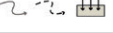





















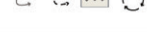










1975 - 1995



1995 -



# INTRODUCTION THEME

| SUDS element  | Description  | Water quantity  | Water quality   | Environmental benefits  | Management train  |
|---|--|---|---|---|---|
|    | Green roofs (GR)<br>A roof with plants growing on its surface, which contributes to local biodiversity. The vegetated surface provides a degree of retention, attenuation and treatment of rainwater, and promotes evapotranspiration. Sometimes referred to as an alternative roof. |    |    |    |    |
|    | Water butts, site layout<br>Small scale garden water storage device which collects rainwater from the roof via the drainpipe.  |    |    |    |    |
|    | Permeable pavements (PP)<br>A permeable surface that drains through voids that are integral to the pavement.   |    |    |    |    |
|    | Filter strips<br>A vegetated area of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.   |    |    |    |    |
|    | Soakaway<br>A sub-surface structure into which surface water is conveyed, designed to promote infiltration.  |    |    |   |    |
|    | Filter drain<br>A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage.   |    |    |   |    |
|    | Swales<br>A shallow vegetated channel designed to conduct and retain water, but may also permit infiltration. The vegetation filters particulate matter.   |    |    |    |    |
|    | Bioretention areas<br>Depressions backfilled with a sand soil mixture and planted with vegetation. Water enters through a vegetated surface and then trickles via a filter layer entering a perforated pipe at the bottom before   |    |    |    |    |
|    | Infiltration trenches<br>A trench, usually filled with permeable granular material, designed to promote infiltration of surface water to the ground.   |    |    |   |    |
|    | Pipes and subsurface storage<br>Conduits and their accessories as conveyance measures and/or storage. Water quality can be targeted using sedimentation and filter media   |    |    |   |    |
|    | Sand filters<br>Treatment devices using sand beds as filter media.   |    |    |   |    |
|  | Infiltration basins<br>A dry basin designed to promote infiltration of surface water to the ground.  |  |  |  |  |
|  | Ponds<br>Permanently wet depression designed to retain storm water above the permanent pool and permit settlement of suspended solids and biological removal of pollutants.  |  |  |  |  |
|  | Wetlands<br>Retention pond in which the water is shallow enough to enable the growth of bottom-rooted plants.  |  |  |  |  |
|   | Detention basin (DB)<br>A vegetated depression that is normally dry except following storm events. Constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.   |  |  |  |  |
|  | Silt removal devices<br>Manhole and/or proprietary devices to remove silt.   |   |  |   |   |



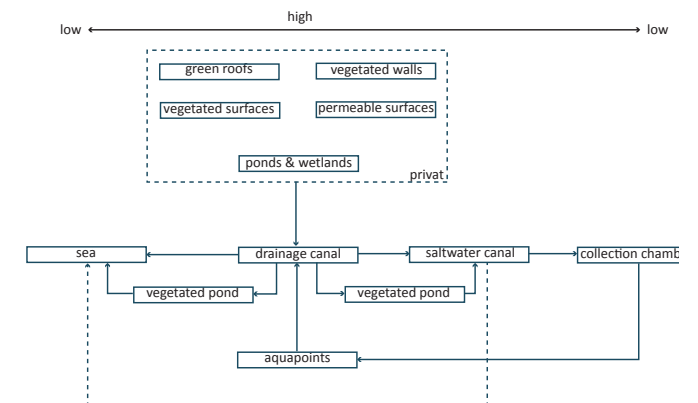


Bo01 housing exhibition (2000 - 2002) source control

Eco-district Augustenborg (1998-2005) source/onsite control

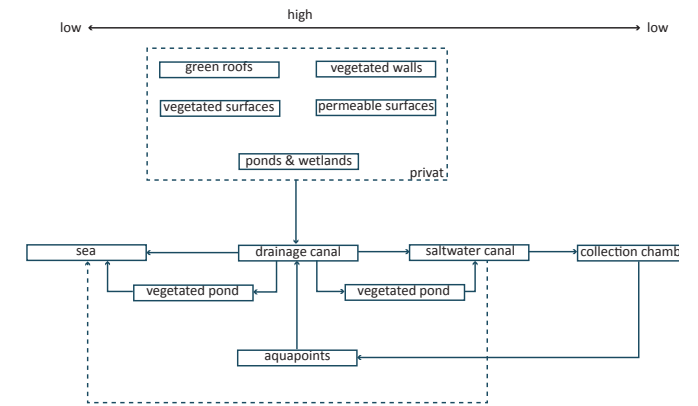
*Pond in private yard*

# FASCINATION MALMO



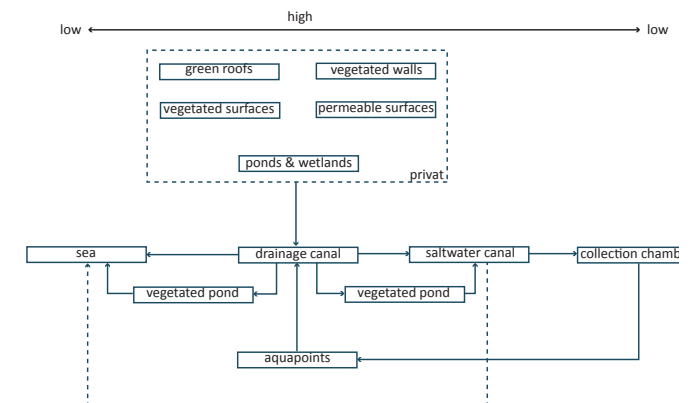
# Drainage canals

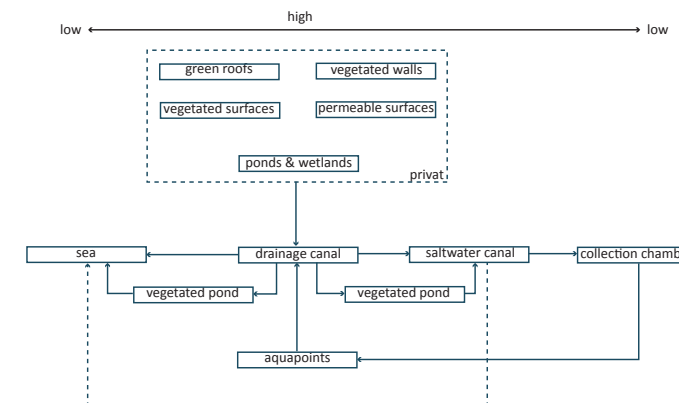
# FASCINATION MALMO



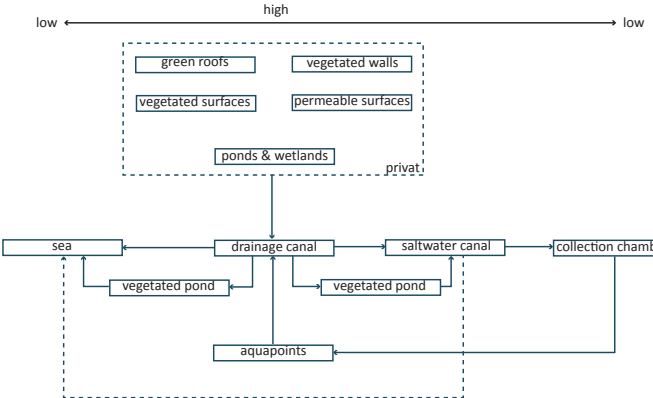
*Small vegetated pond*

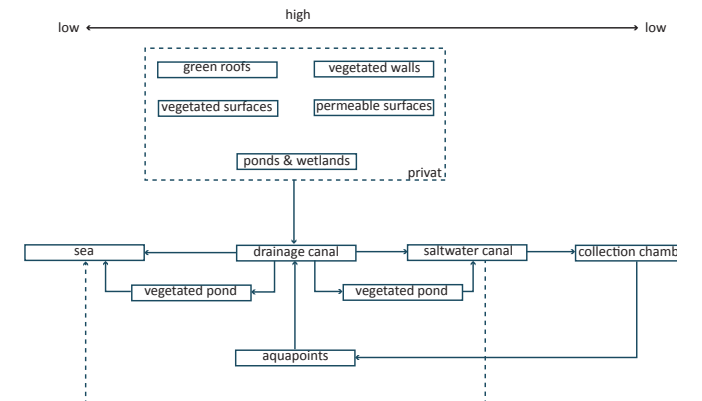
# FASCINATION MALMO

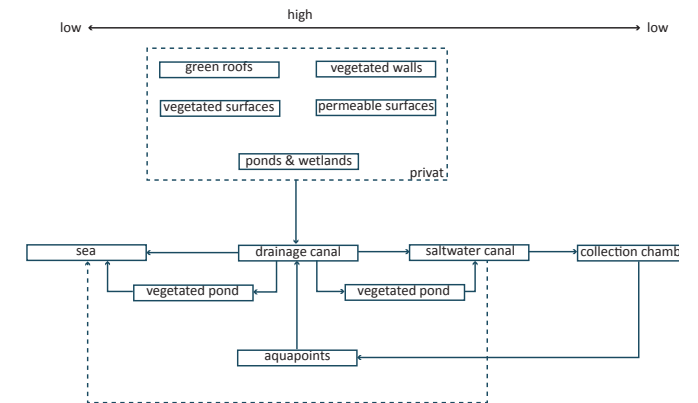






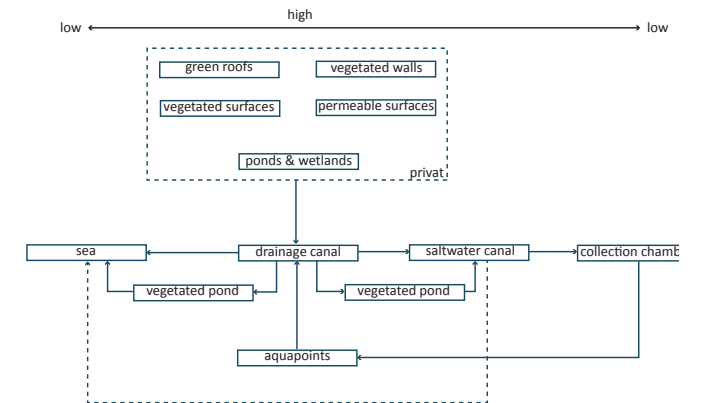






Art work

# FASCINATION MALMO



## AIM & RESEARCH QUESTION



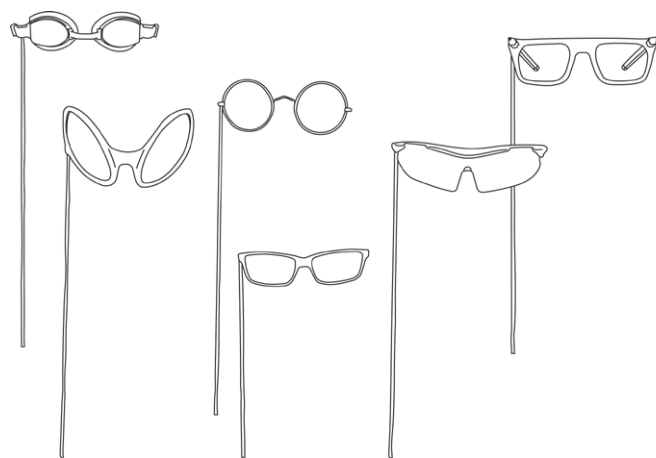
### AIM

To explore, through landscape design, the possibilities for integrating SUDS in the urban landscape of the Liesingbach catchment basin.

### RESEARCH QUESTION

How can stormwater management play a self-evident role in landscape design processes and improve urban quality in general.

## Trans-disciplinary process & Design criteria



## METHODOLOGY

|                | Sub criteria                             | Objectives for my area  |
|----------------|--|---|
| Water quantity | Prevention of urban flooding             | The capacity of a minor SUDS should deal with a runoff amount in a designated precipitation condition of 15 minutes storm with a return period of 5 years. The major SUDS should deal with precipitation condition of 15 minutes storm with a return period of 100 years. |
|                | Prevention from drought/<br>water supply | Provide seasonal water storage for supplement to drought.   |
| Water quality  | Protection of receiving water-courses    | Improve the quality of stormwater runoff before it reaches watercourse by using SUDS components in management train.  |
| Amenity        | Aesthetics                               | Create beauty of pleasure experience as a result of design composition (e.g. visual appeal and the absence of odors). Consider site specific characteristics.   |
|                | Usability                                | Provide opportunities for education and recreation to those who live close to area.   |
|                | Health and safety<br>(Operational risks) | Freedom from exposure to public health and safety risks (e.g. drowning hazards, sudden inflows, breeding ground for mosquitos or noxious weeds).  |
|                | Maintenance                              | Set an appropriate maintenance and management plan.   |
|                | Community acceptability                  | Consider the public's preference towards the appearance of SUDS. Engage stakeholders in the design process.   |
| Ecology        | Habitat creation                         | Create a range of habitat types for native flora and fauna and corridors for connection.<br>Use plants that grow under local conditions.<br>Enhance natural processes.  |

*I am...*

# METHODOLOGY

Water expert



Ecologist



Planner



Local resident



Landscape Architect



Outdoor tourist



## I am...

"SUDS can deliver benefits over traditional urban drainage systems. My aim is to use SUDS in order to bring the **peak of stormwater runoff in post-development closer to the pre-development hydrograph**. It will result in less direct stormwater runoff to the Liesingbach, no further increase of flood risk of the Liesingbach, and groundwater recharge. Besides that, the water quality can be further improved by disconnecting stormwater sewers from polluted business areas and main infrastructure, and clean it locally before it flows into the Liesingbach."

(water expert)



"The Liesingbach is an important ecological corridor between Vienna Woods and Donau-Auen. With several streambed revitalization projects in the last decade, a lot has been achieved for the ecological water quality. However, much more can be gained! Large parts of the stream are not liberated from its "stone corset" and obstacles. The major part of the Liesingbach has a uniform flow with no habitats for flora and fauna, and no self-cleansing ability. This improves when we give the stream more space and bring back its former dynamics. I hope to see the **entire Liesingbach green!** Furthermore, I think it is interesting to implement SUDS in the urban area and design it in such a way that it contributes to **urban nature..**"

(ecologist)



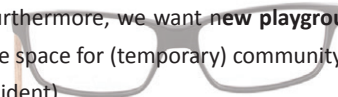
"SUDS is an essential part in **sustainable development**. It will help to meet runoff targets and water efficiency targets, contribute to **place making**, and bring value to the community. In Liesing Mitte a few new build projects, urban renewal projects, green infrastructure and bicycle routes have been planned. For example, in the area "In der Wiesen" we work on a SMART-city project in which we aim for zero emission and urban farming. I think it is interesting to explore how SUDS can be integrated in an **innovative way**."

(planner)



"I would like to have more **trees** in the street and **water for my garden** while at the same time save on energy bills. But also green connection needs to be improved between the Liesingbach and other green areas. Furthermore, **we want new playgrounds** for the children and more free space for (temporary) community projects."

(local resident)



# ANALYSIS

"As landscape architect, I have the ability to explore through research by design for integrated solutions of how sustainable stormwater management can be best introduced and **what it could look like** in the Liesingbach catchment basin.."

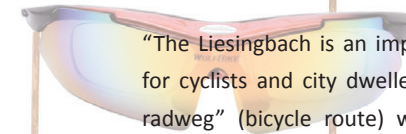
(local resident)



"The Liesingbach is an important and popular recreational corridor for cyclists and city dwellers. Along the stream is the "Liesingbach radweg" (bicycle route) which connects Vienna Woods with the Donau. On a sunny afternoon or weekend day, it is very busy. With this route, the first step is made. The second step will be **expanding the green recreational network** to other recreation areas. I think that SUDS can be integrated in this green network.

Besides that, if we look into the different "modes of experience" from Lengkeek and Elands, we see that the Liesingbach is mainly focused on the mode of change. This means basically going away from stress and boredom. However, the rich cultural history (the mode of interest) is hardly to be experienced. In order to experience the watersystem better, we could make the water accessible, **make cultural/ historic stories visible** (not by paintings on buildings), and do something special with the ends of the stormwater pipes in the Liesingbach."

(outdoor tourist)







New build  
?%



Single family housing  
21-30%



Multi family housing  
21-30%



Terraced housing  
21-40%



Summer cottages  
26-40%



Social housing  
31-35%



Flat  
35-60%



Perimeter block housing  
46-60%



Old village centre  
51-60%



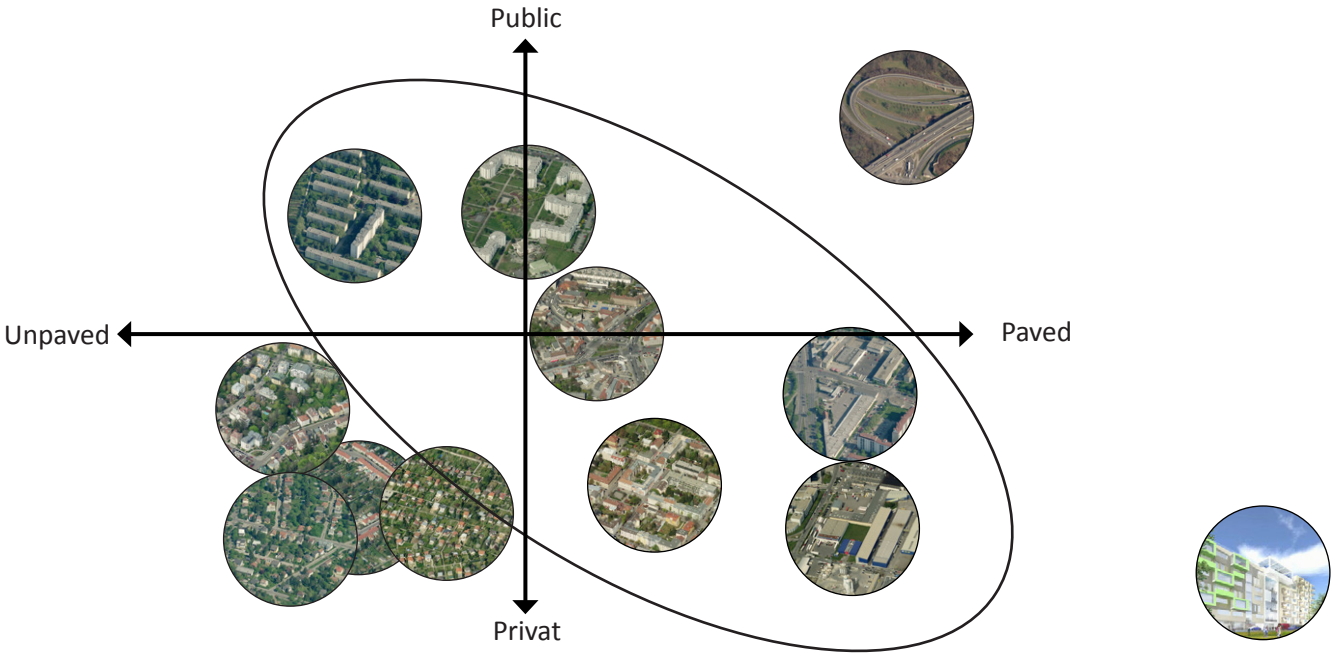
Commercial area  
81-90%

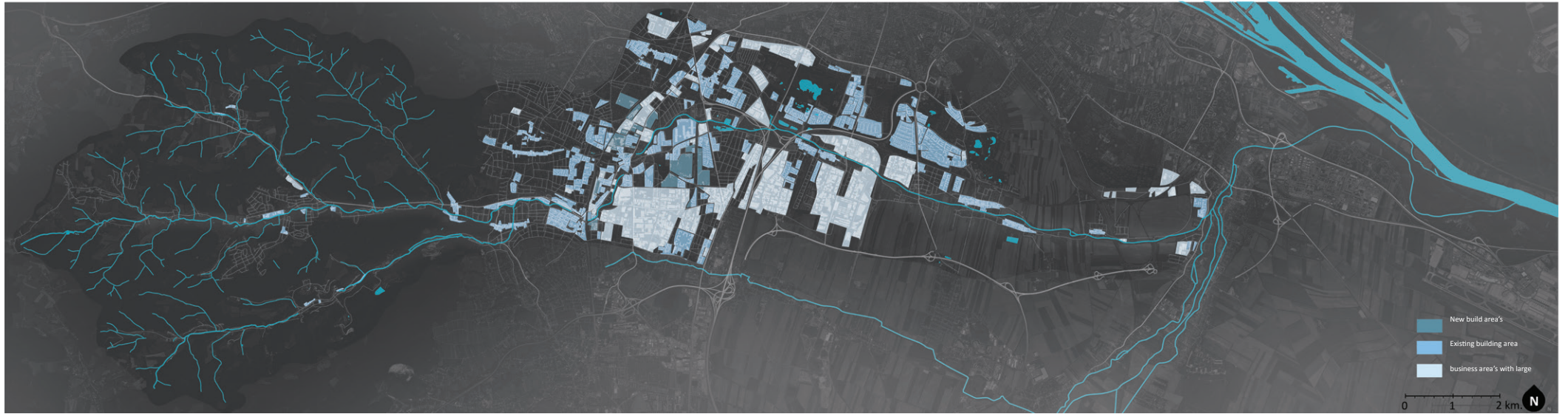


Business area  
60-100%



Infrastructure  
100%





# Catchment basin - problems and opportunities

# ANALYSIS



Water expert



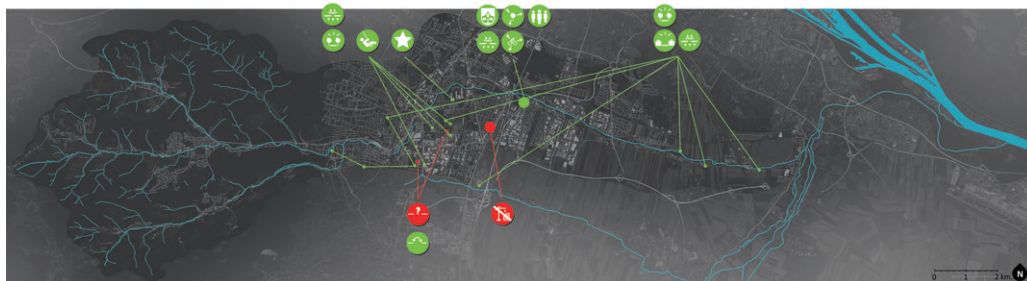
Outdoor tourist



Ecologist



Planner

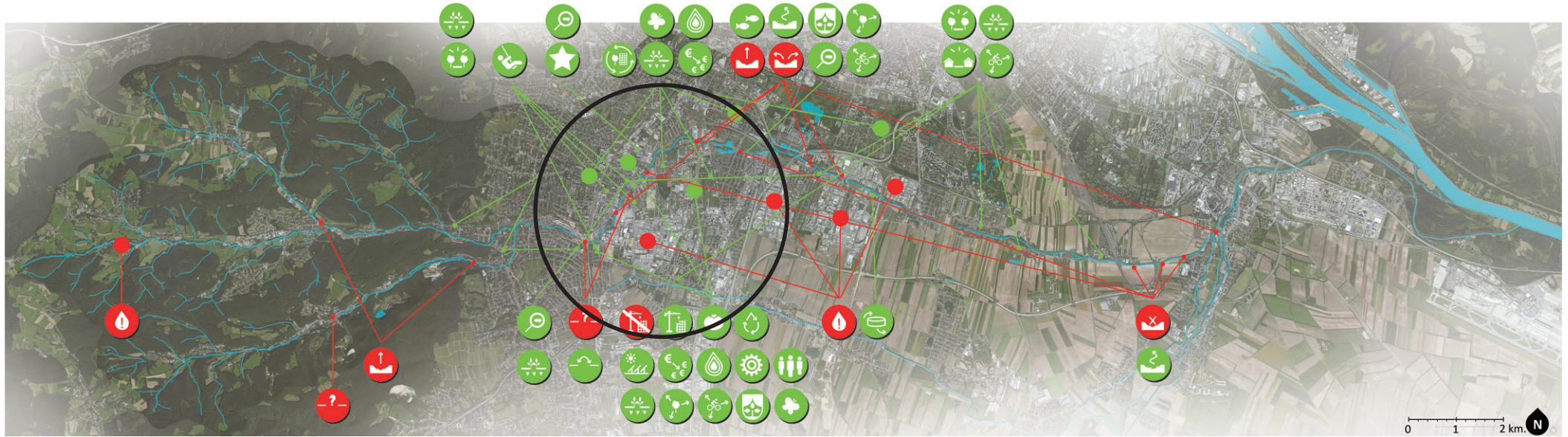


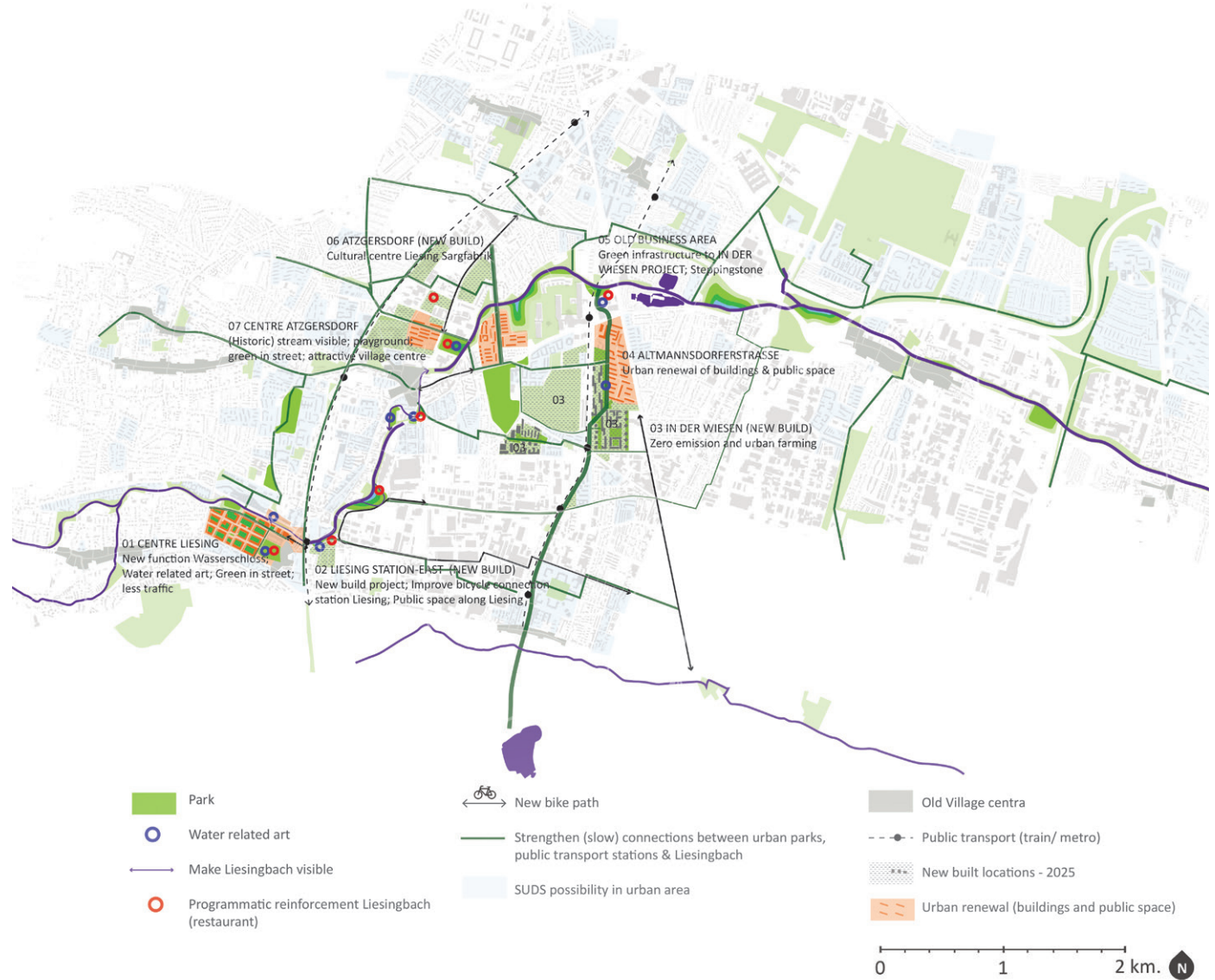
Community

- |  |   |  |  |
|--|---|--|--|
|  Contaminated stormwater runoff |  New build project in planning     |  No new building project!         |  Liesingbach not visible                    |
|  SUDS                           |  Urban renewal project in planning |  New playground                   |  Significant floodrisk                      |
|  Water re-use                  |  Zero emission target             |  Contaminated stormwater runoff  |  Uniflow, no habitat                       |
|  |  Urban farming                   |  Villages more attractive       |  Obstacle                                 |
|  |  Expand green network            |  Green in streets               |  More space, dynamic and green banks      |
|  |  Expand bicycle network          |  Make history/stories visible   |  Treatment contaminated stormwater runoff |
|  |  Innovation                      |  Room for urban experiments     |  Improve aquatic ecology                  |
|  |  Runoff target                   |  Contaminated stormwater runoff |  |
|  |  Combine projects                |  Liesing identity               |  |
|  |  Small scale urban ecology       |  |  |

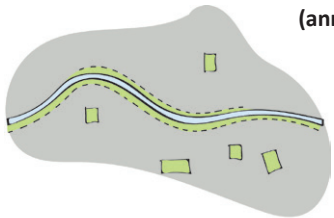


- |  |   |  |  |
|--|---|--|--|
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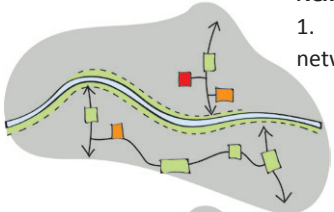


**Current situation Liesingbach (anno 2016):**

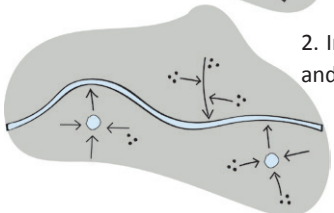


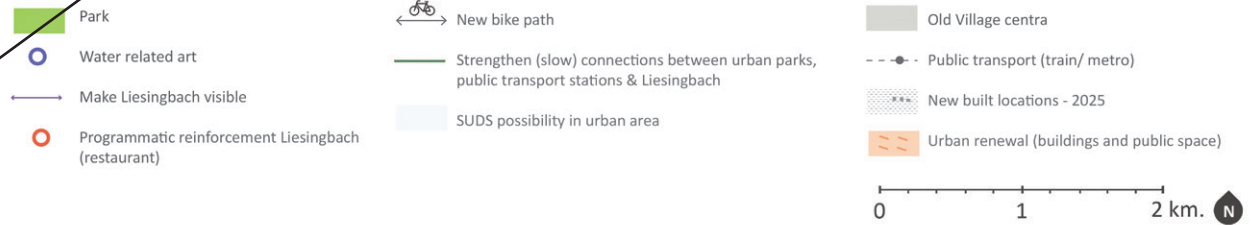
**Next phase 2016 - 2025:**

1. Expand green/ recreational network

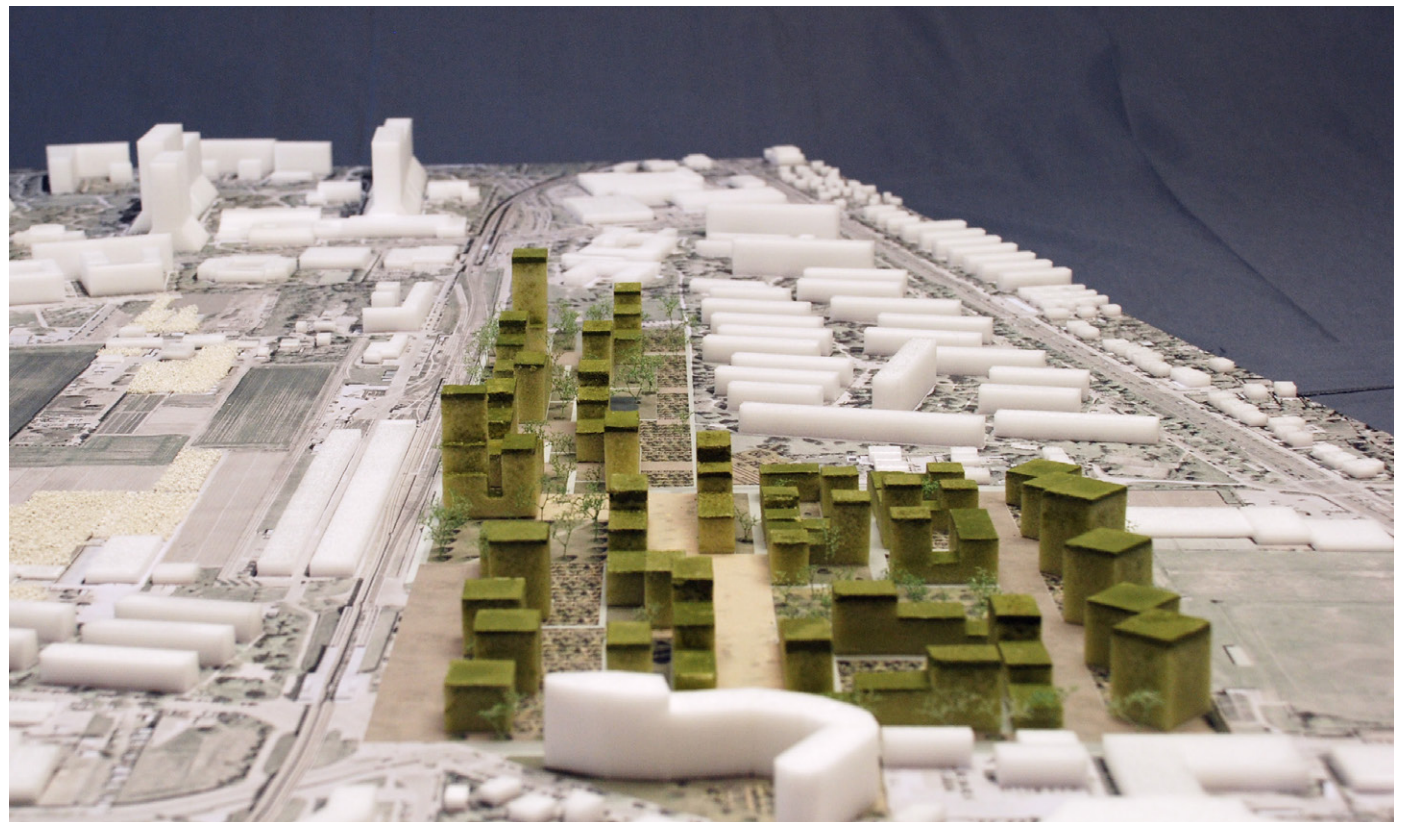


2. Integrate SUDS in green network and urban planning projects









Model preliminary design

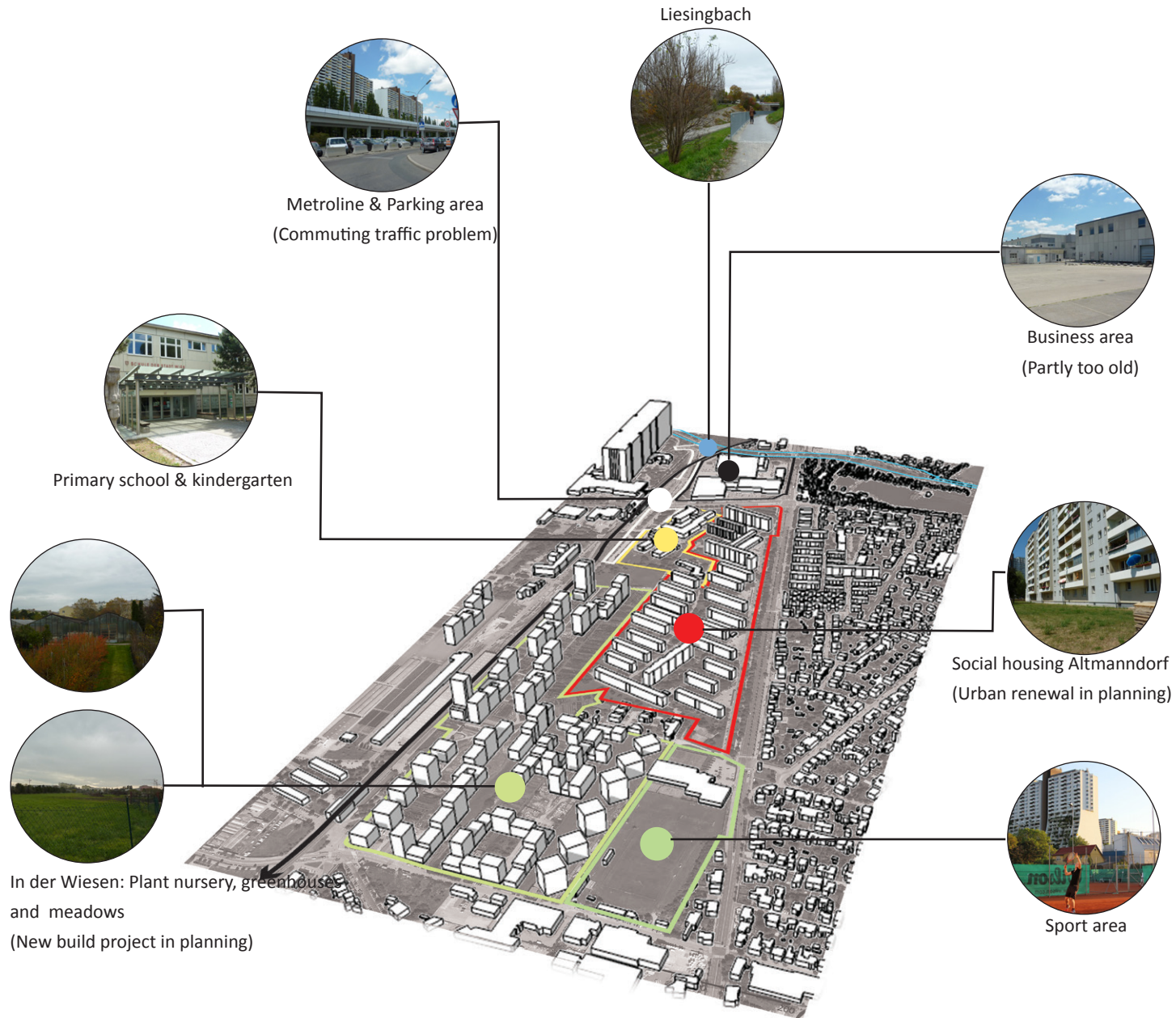
Key aspects SMART CITY: Zero emission & urban farming

3000 WE

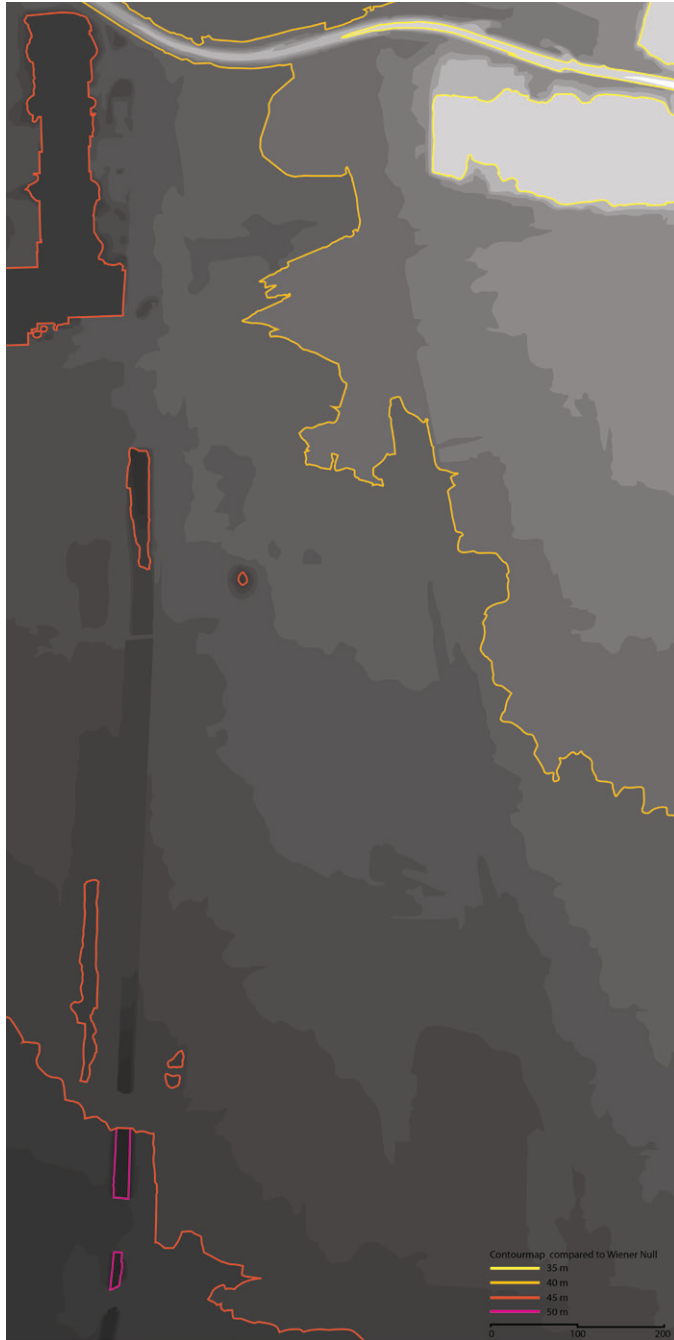
# Site introduction & experience



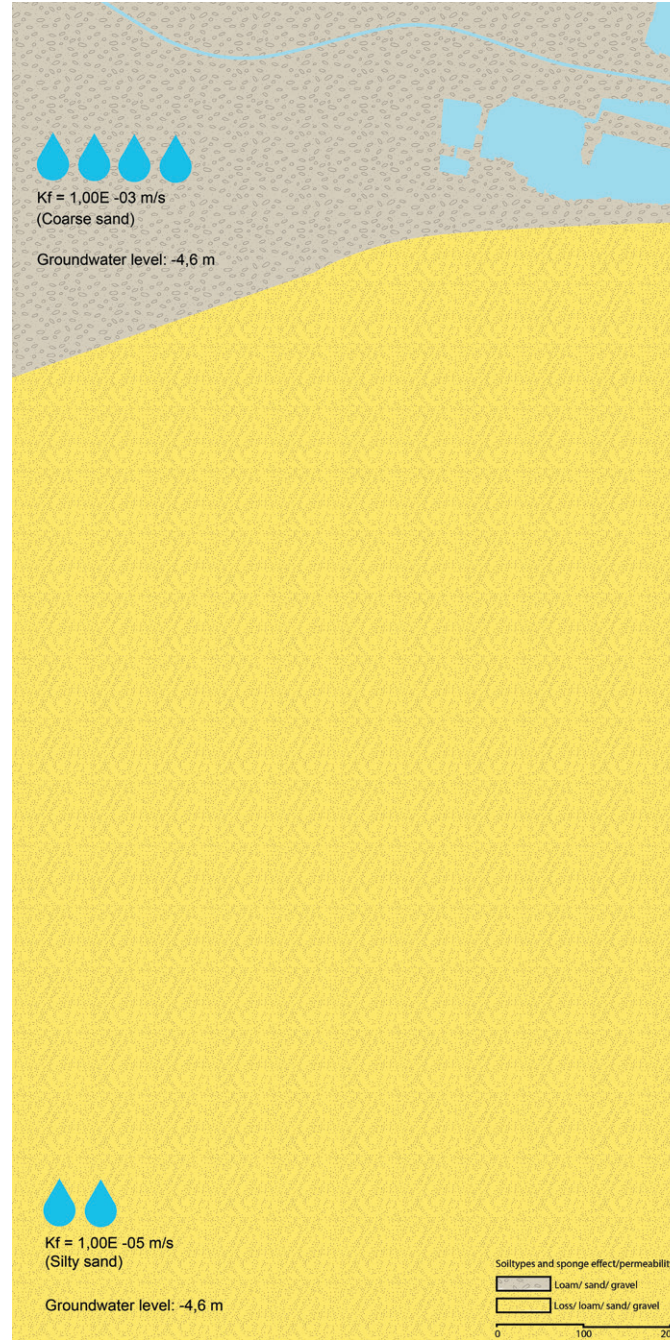
# DESIGN: WIESEN-OST



# Site introduction



Elevation map with contour interval of 1 meter



Soil permeability and groundwater elevation

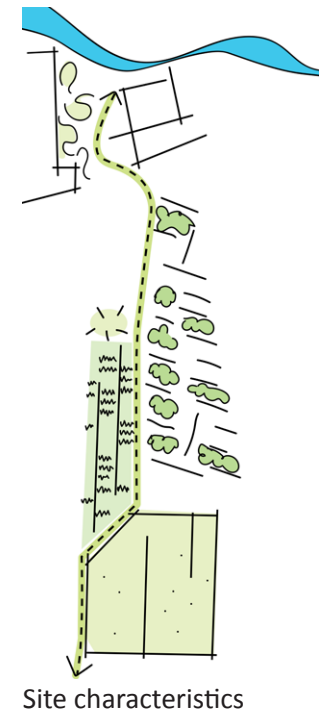
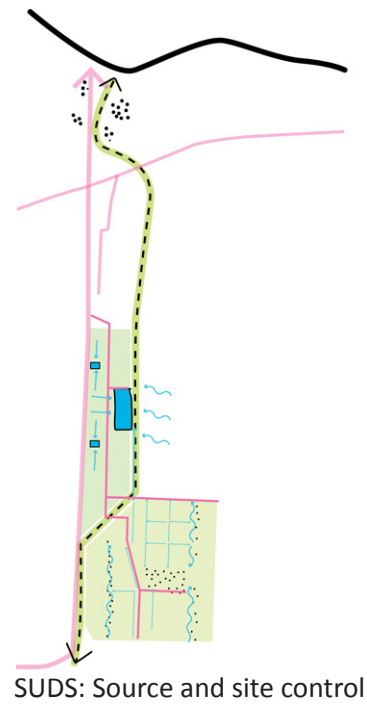
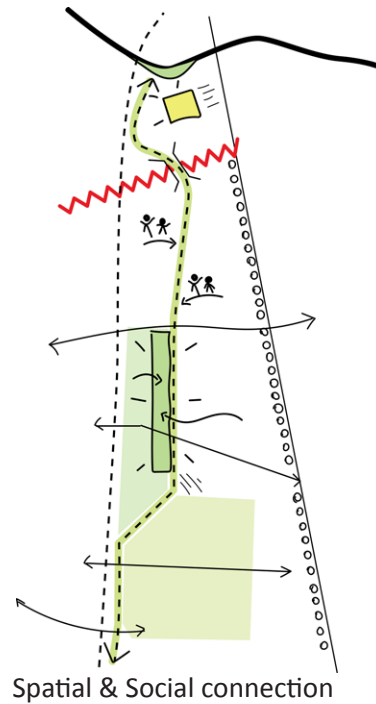
# DESIGN: WIESEN-OST



% imperviousness and green infrastructure

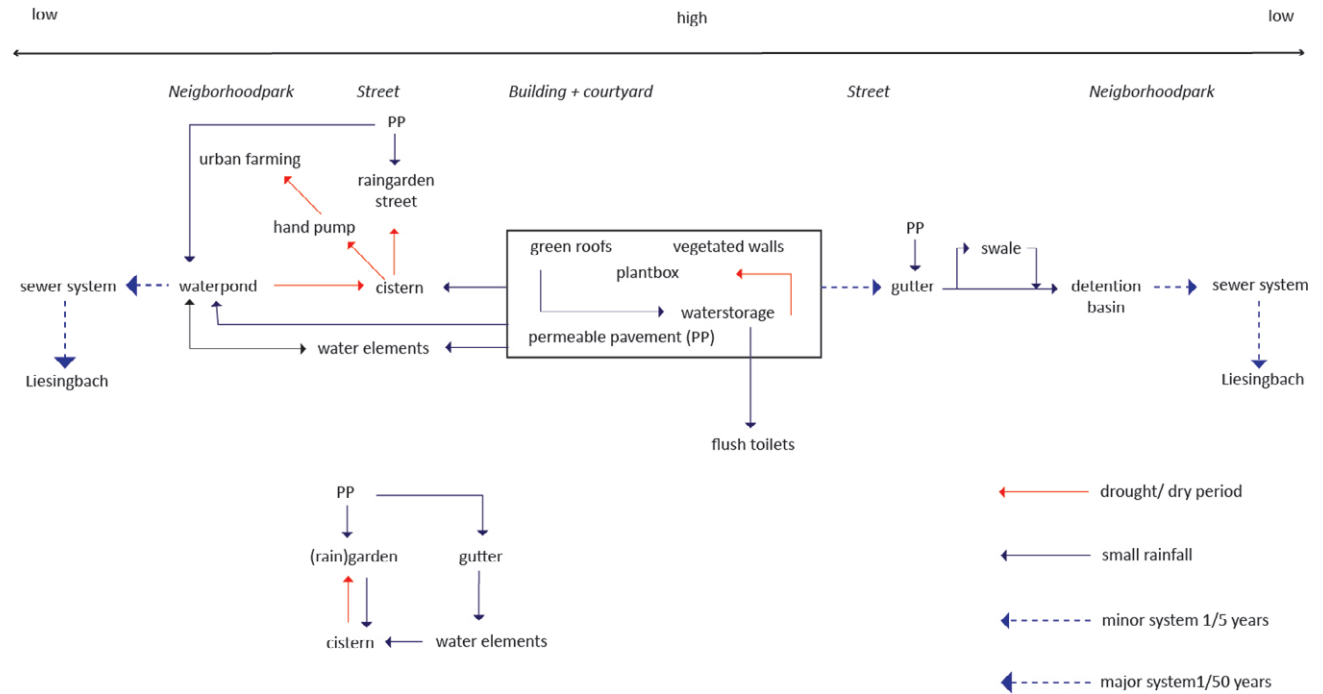
# Spatial plan & Concept

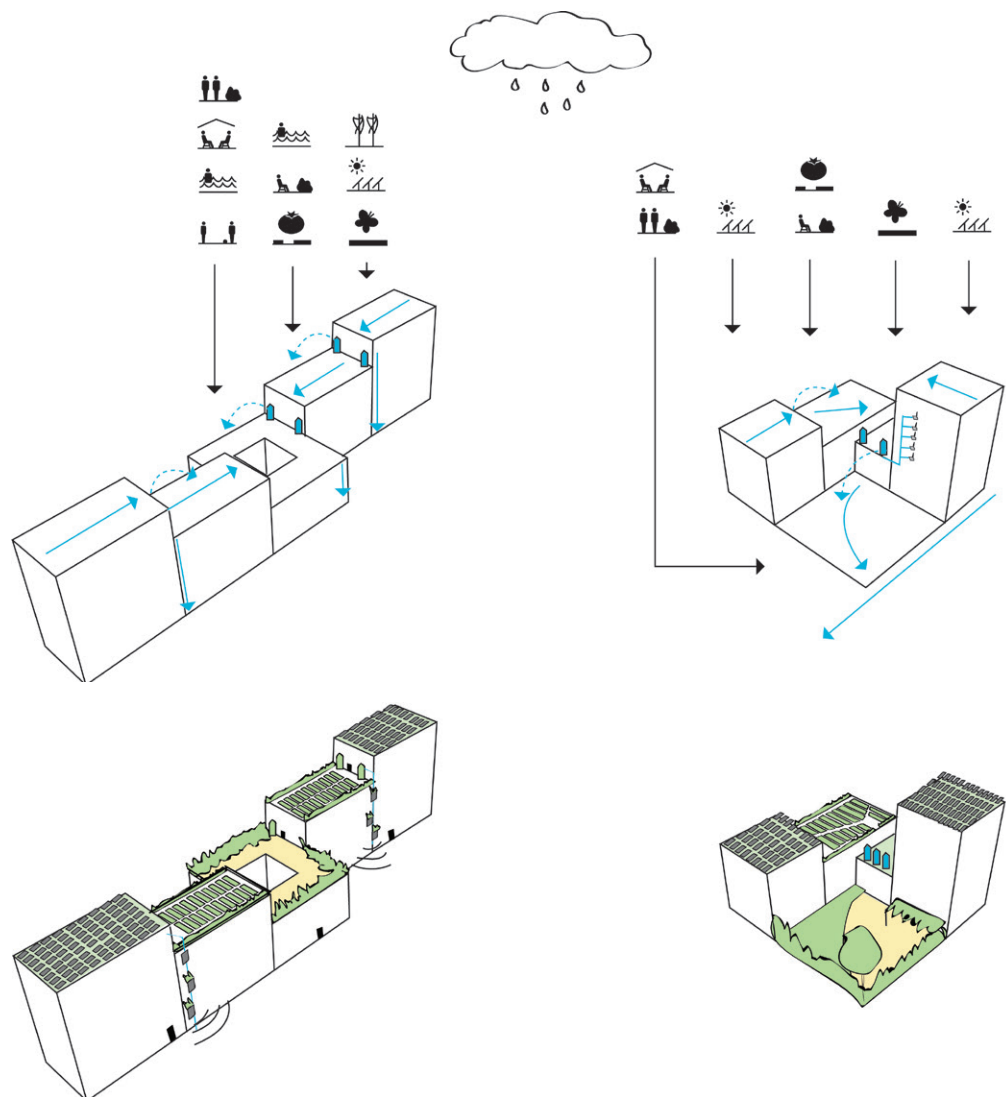
# DESIGN: WIESEN-OST



# Water plan & Scheme

# DESIGN: WIESEN-OST







Detail: Entrance Liesingbach



Detail: Subarea nursery

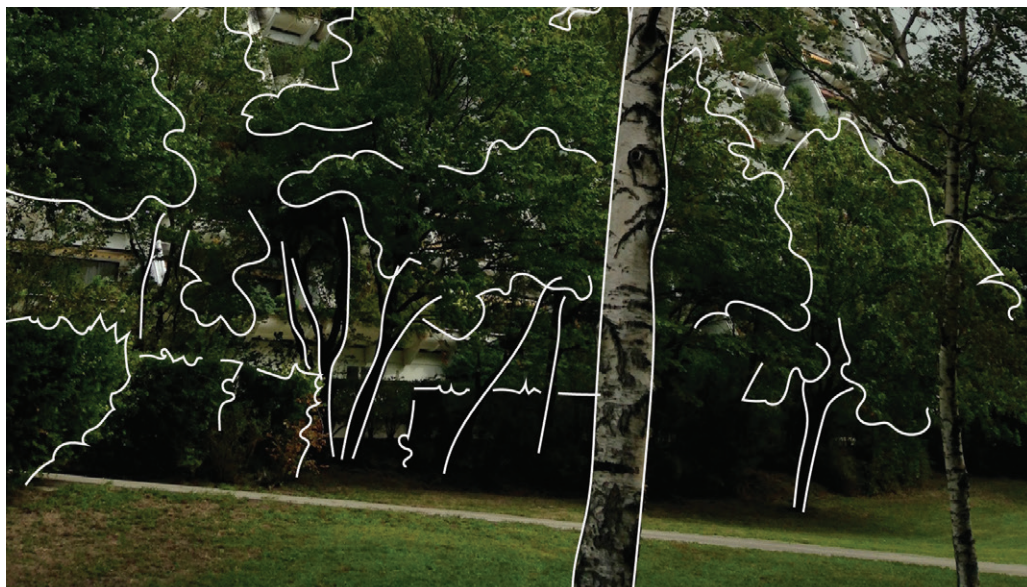


Detail: Subarea Field

Site characteristics:



## DETAIL ENTRANCE LIESINGBACH





*Spatial plan:*

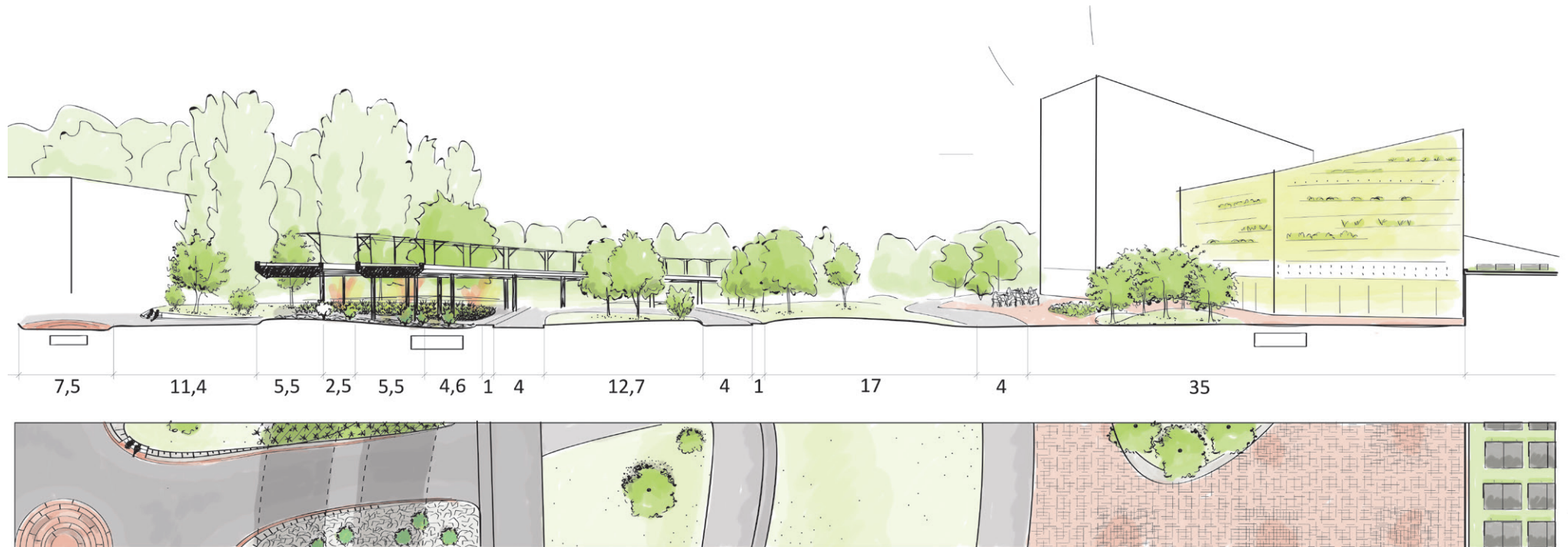


# DETAIL ENTRANCE LIESINGBACH



Section:

# DETAIL ENTRANCE LIESINGBACH



Asphalt



Gutter brickstones



Raingarden



Stones



Underground storage + handpump



Grass (mowed)



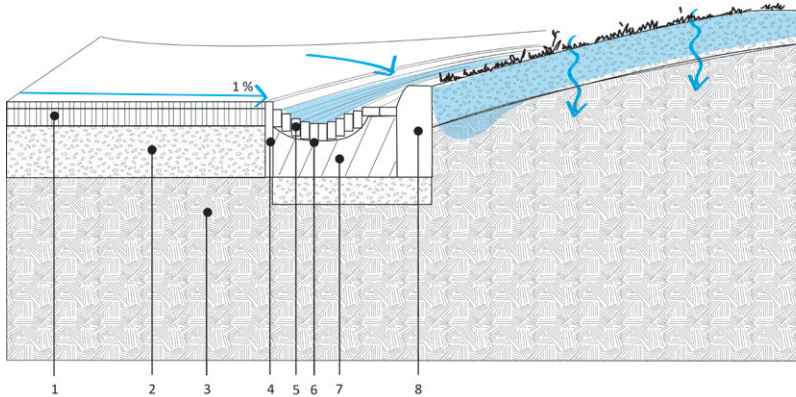
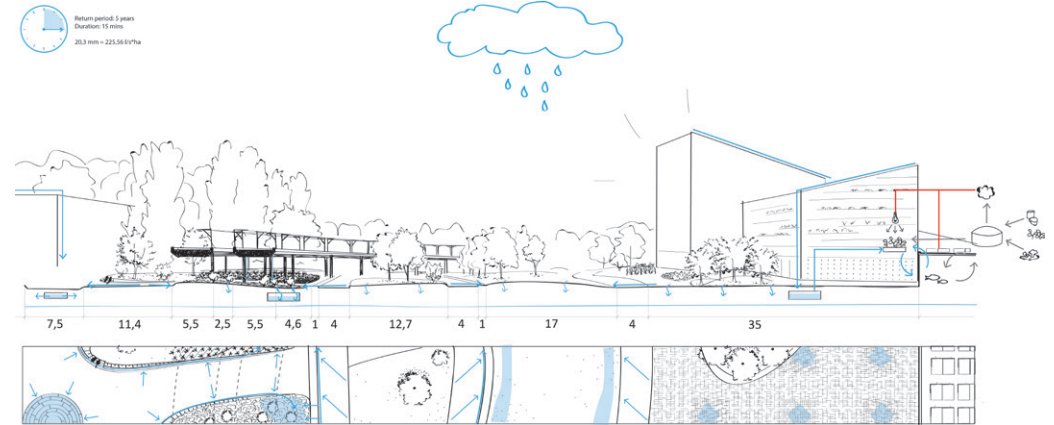
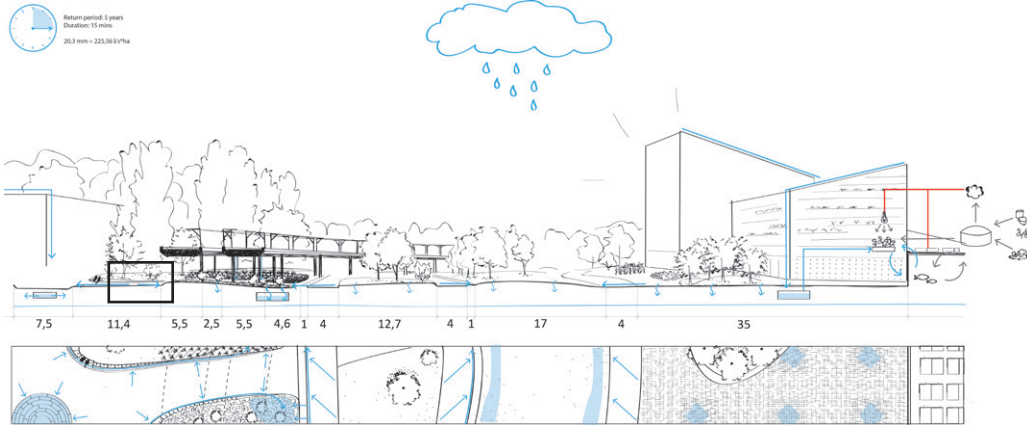
Asphalt



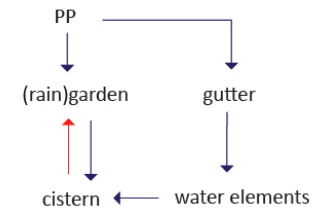
Brickstone (permeable)

Section:

# DETAIL ENTRANCE LIESINGBACH



1. Asphalt
2. Frost protection/gravel 30 cm
3. Subsoil  $K > 10^{-3} \text{ m/s}$
4. Curb
5. Red brickstone
6. Crushed sand 3 cm
7. Concrete
8. Concrete curb



*Site characteristics:*



## **DETAIL SUBAREA NURSERY**



*Spatial plan:*

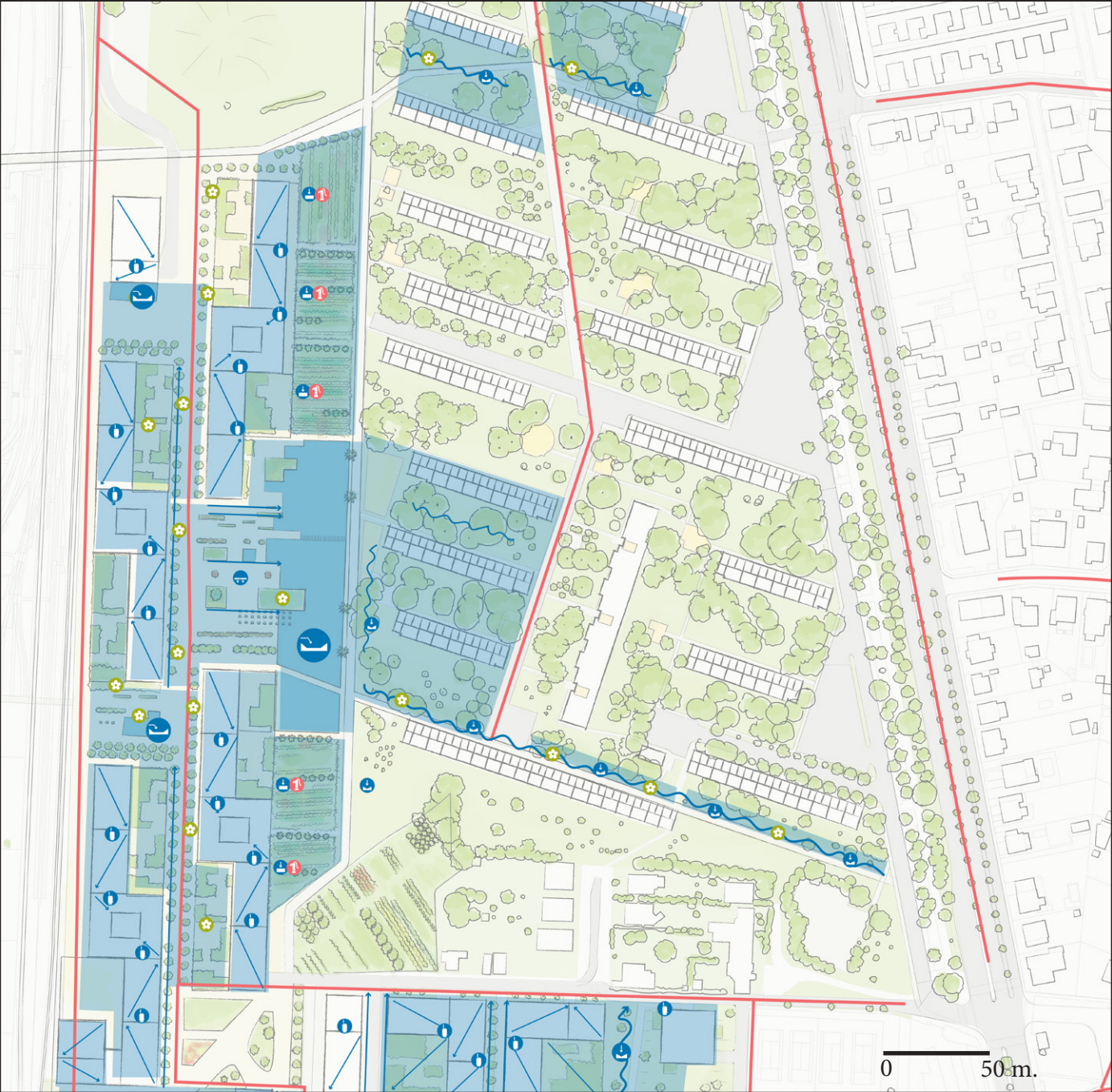


# DETAIL SUBAREA NURSERY



Water plan:

# DETAIL SUBAREA NURSERY



Legend:

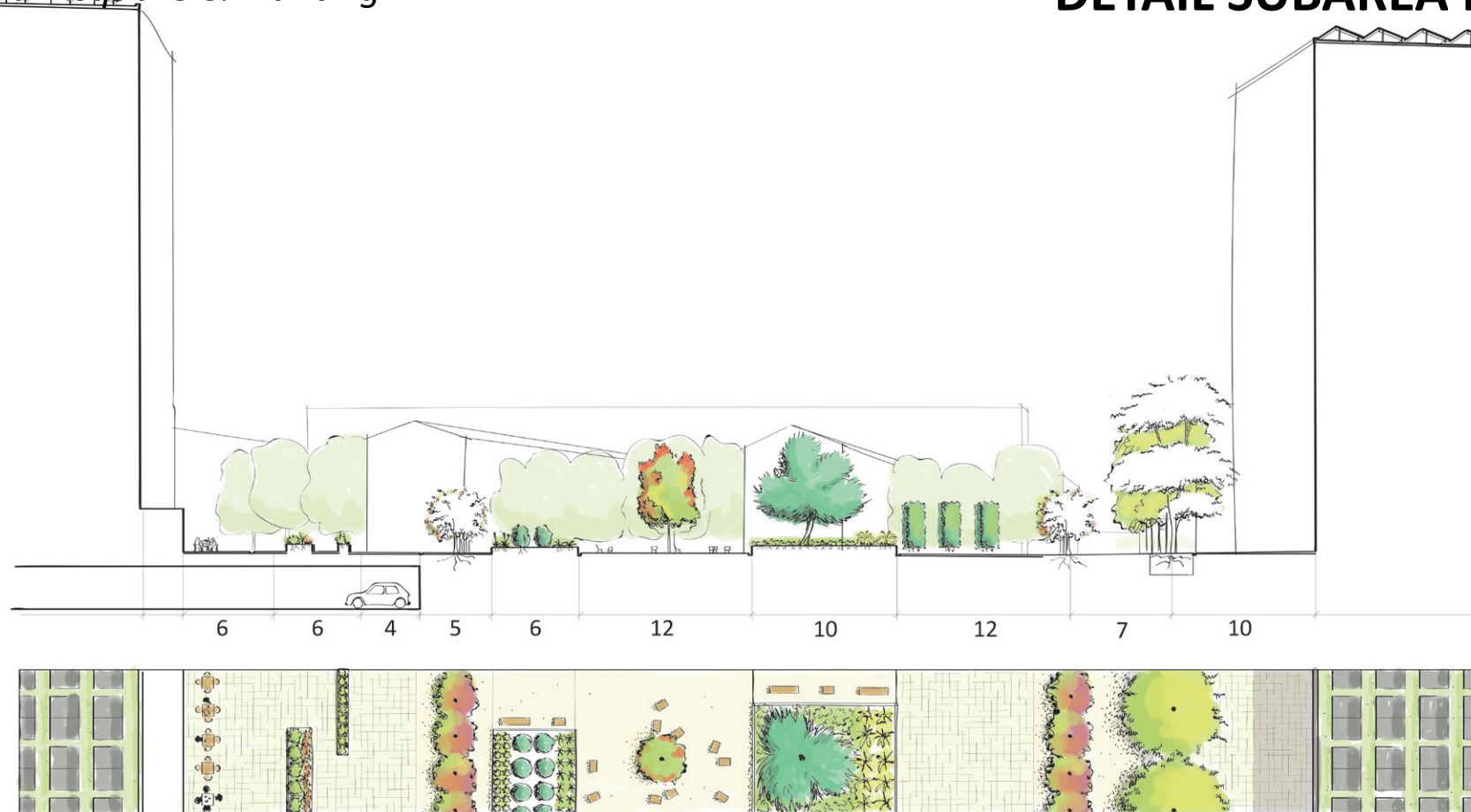
- Rainbutt
- Cistern
- Swale
- Pond
- Rainwater garden
- Waterpump
- Stormwater flow (drain)
- Storm sewer
- Catchment area

# DETAIL SUBAREA NURSERY



# Section Main square & Planting

# DETAIL SUBAREA NURSERY



(Monumental) perennials  
for boxes



*Prunus avium*



*Taxus baccata*



Liquid amber *styraciflua*



Silva



Rhododendron

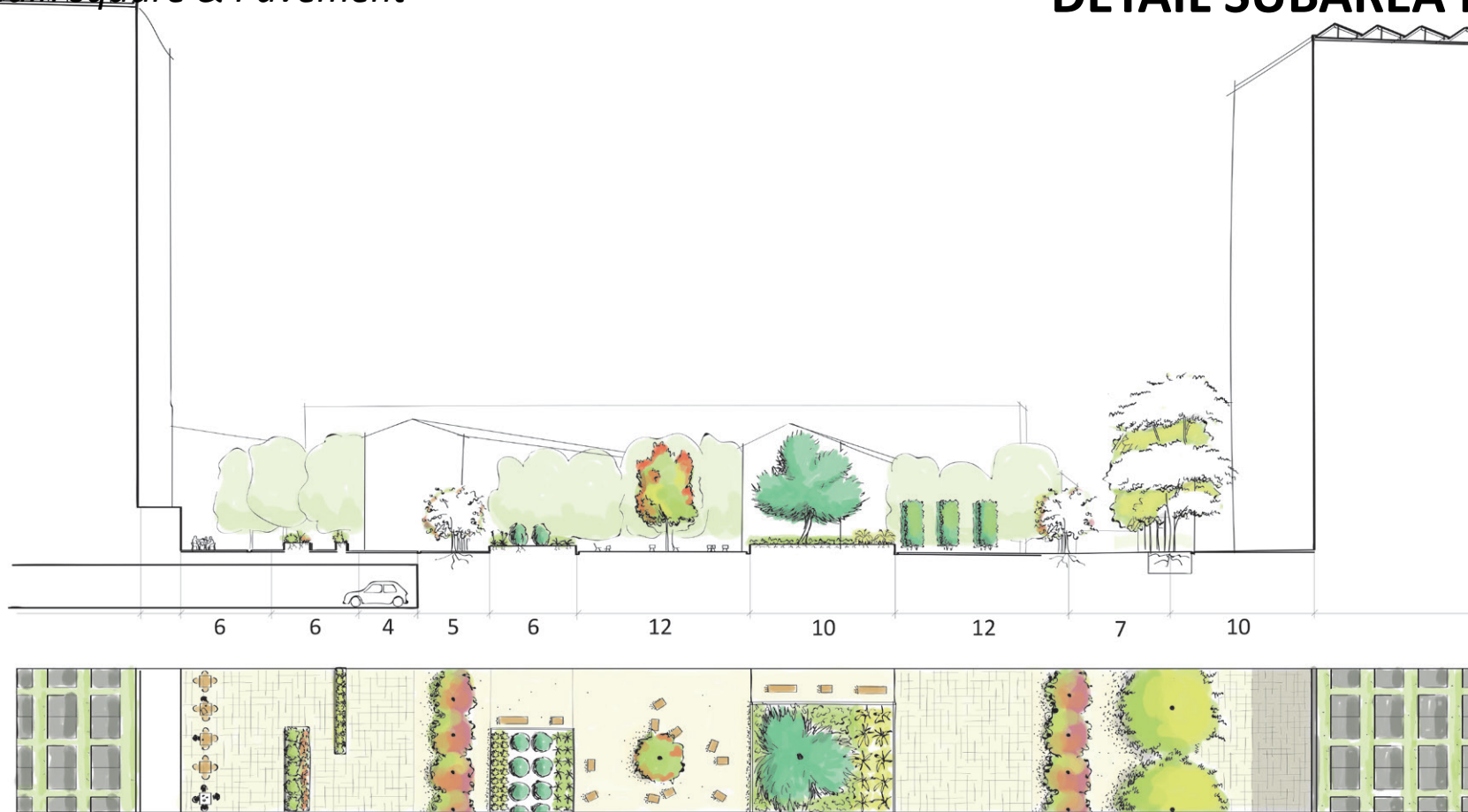


*Robinia pseudoacacia*  
"Frisia"



Section - Main square & Pavement

**DETAIL SUBAREA NURSERY**



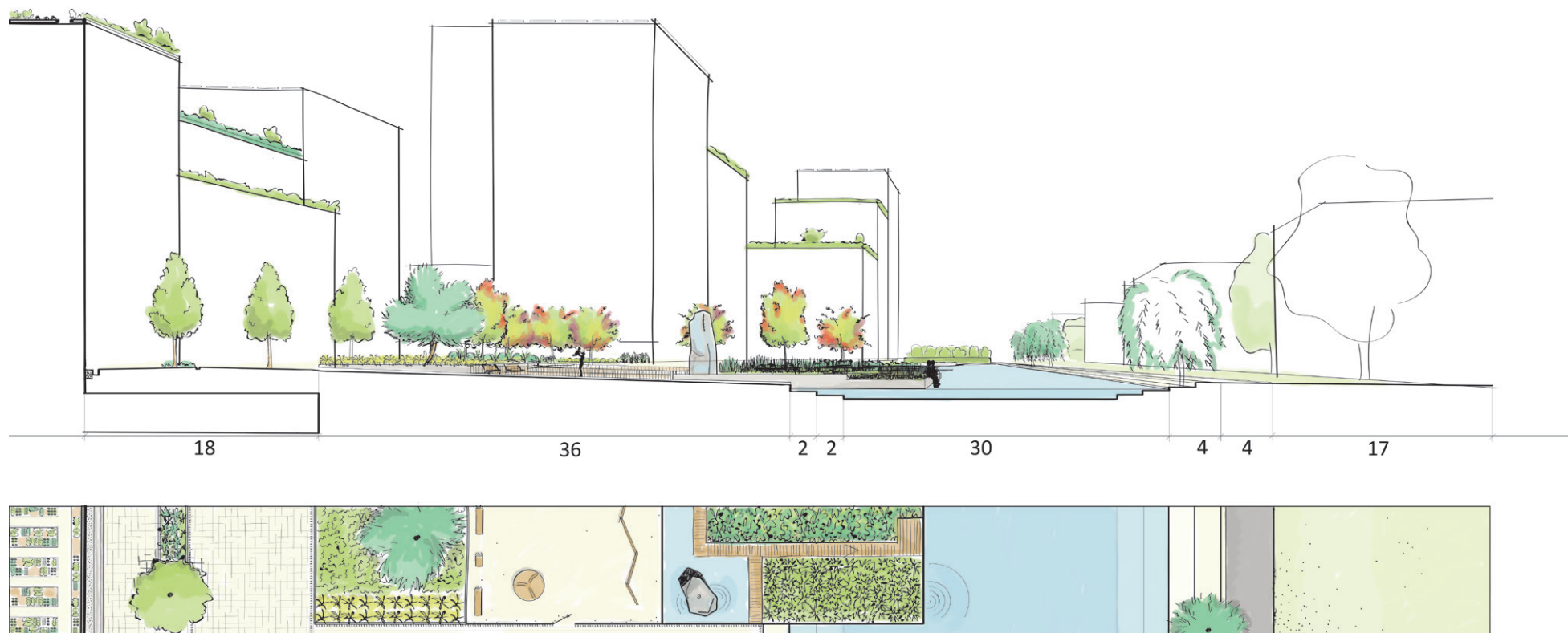
Gravel



Gravidux



Stone tiles



Green Roof



Rain barrels on roof



Raingarden



Filter drain



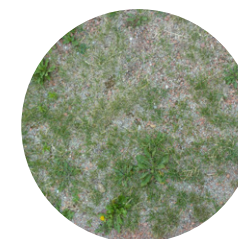
Drain



Pond with helofyten filters



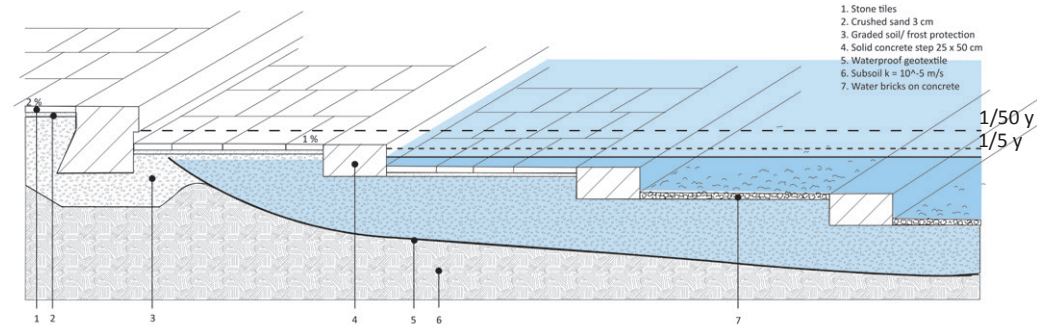
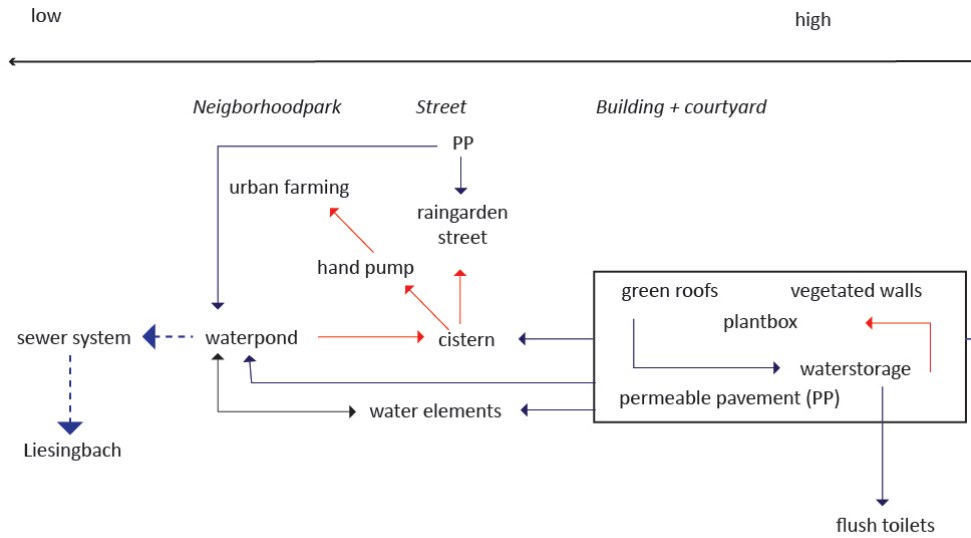
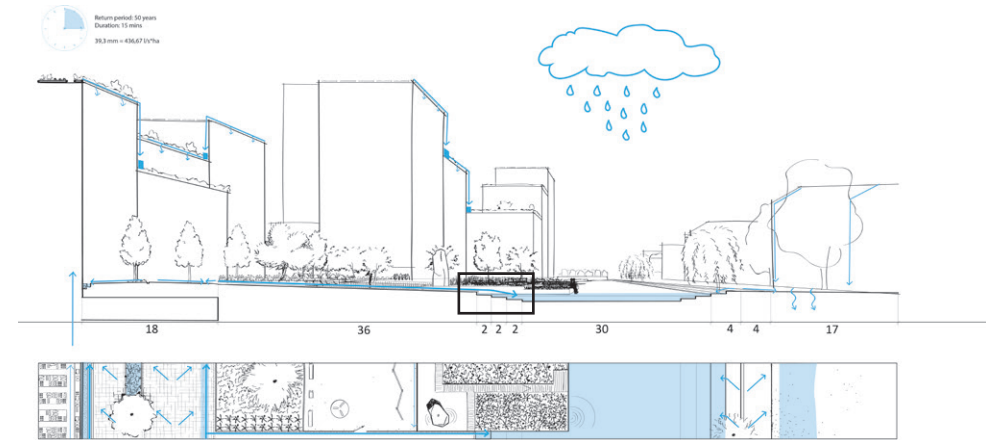
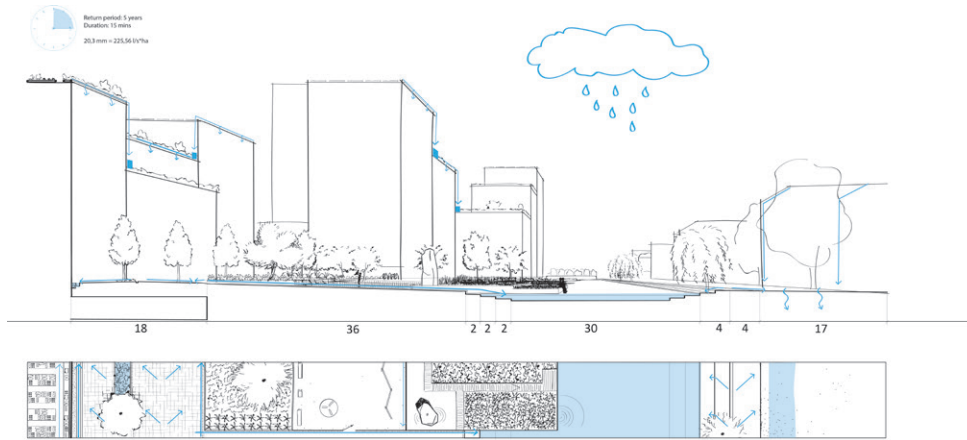
Pond



Graded soil

# Section Pond: SUDS & safety

# DETAIL SUBAREA NURSERY



*Site characteristics:*

## DETAIL SUBAREA FIELD



*Spatial plan:*









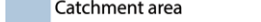
# DETAIL SUBAREA FIELD



Water plan:

# DETAIL SUBAREA FIELD

Legend:

-  Rainbutt
-  Permeable pavement
-  Swale
-  Detention basin
-  Stormwater flow (gutter)
-  Storm sewer
-  Catchment area



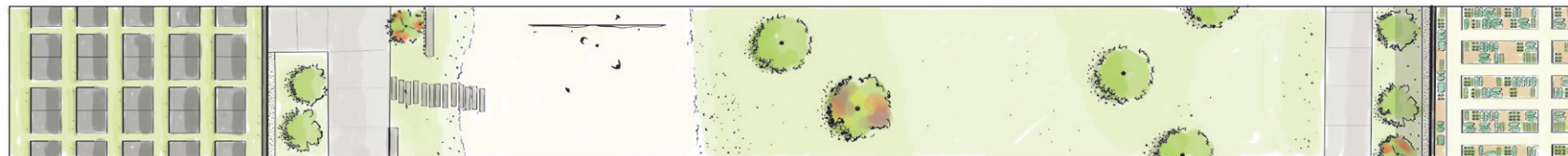
*Plan and sections:*

# DETAIL SUBAREA FIELD



Section: Detention basin & planting

DETAIL SUBAREA FIELD



Grass (mowed)



Sambucus nigra



Sorbus aucuparia  
(multistem)



Quercus robur



Tilia cordata



Prunus avium



Ecological meadow



Carpinus betulus

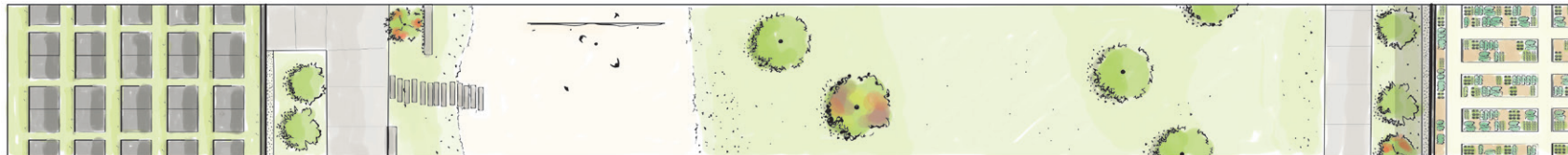


(Acer campestre)  
Elsrijk/



Section: Detention basin & materials

DETAIL SUBAREA FIELD



Filter drain



Concrete slabs



Concrete bench



Sand



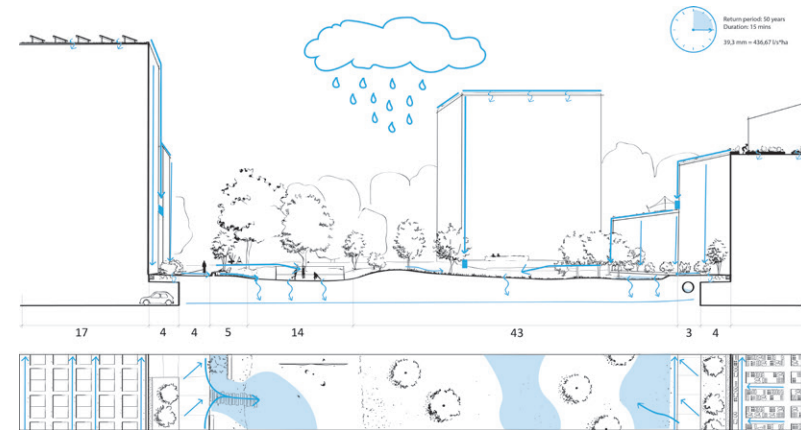
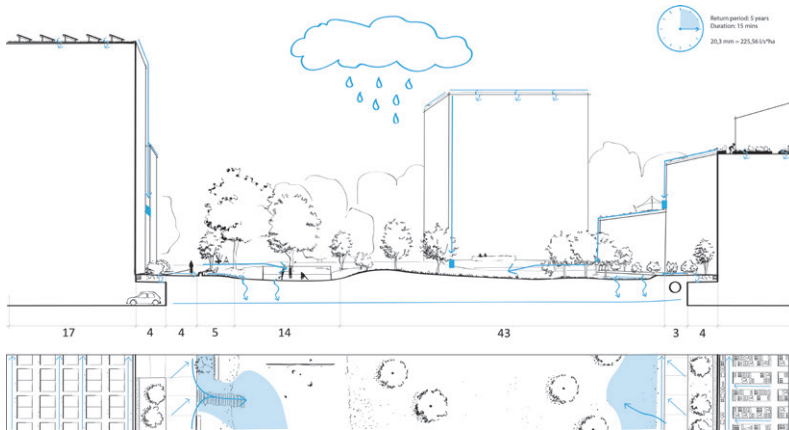
Detention basin



Grass pavers

# Section: SUDS & play

# DETAIL SUBAREA FIELD



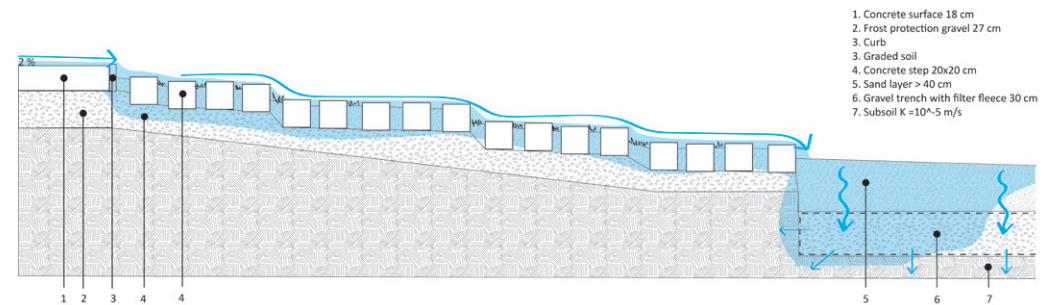
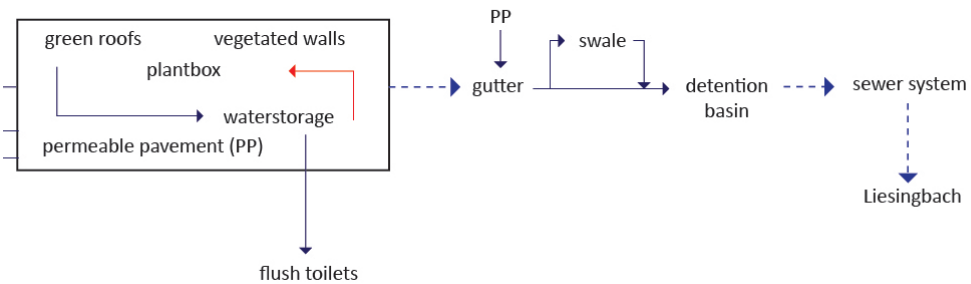
high

low

Building + courtyard

Street

Neighborhoodpark



# CONCLUSION

How can stormwater management play a self-evident role in landscape design processes and improve urban quality in general.

- Watersystem as basis
- Work through the scales
- SUDS approach
- Transdisciplinary design process
  - Each scale different design team
  - Distributed agencies: need teammember in production!
- SUDS design criteria and objectives as guideline for designer

