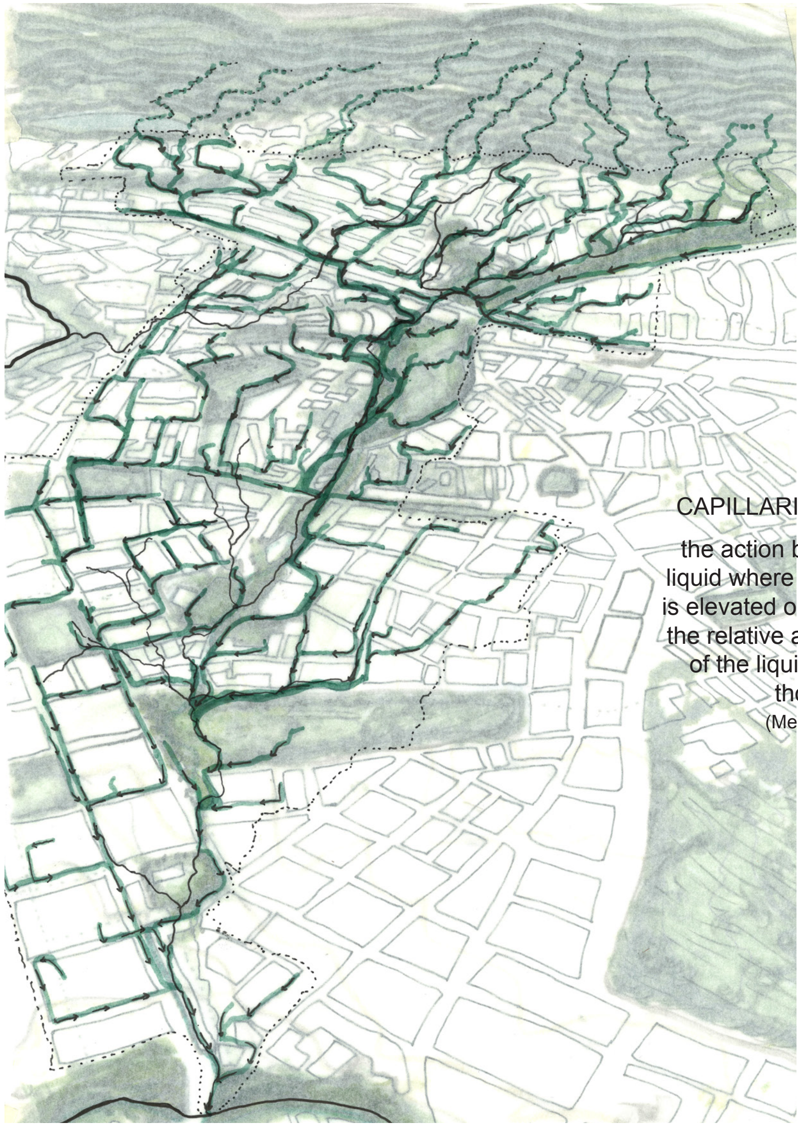
# CAPILLARY ACTION TORSHOV

Jayne Betina  Spring 2018



CAPILLARITY [ka-pə-ˈler-ə-tē] *noun*

the action by which the surface of a liquid where it is in contact with a solid is elevated or depressed depending on the relative attraction of the molecules of the liquid for each other and for those of the solid.
(Merriam-Webster, 2018)

Table of Contents

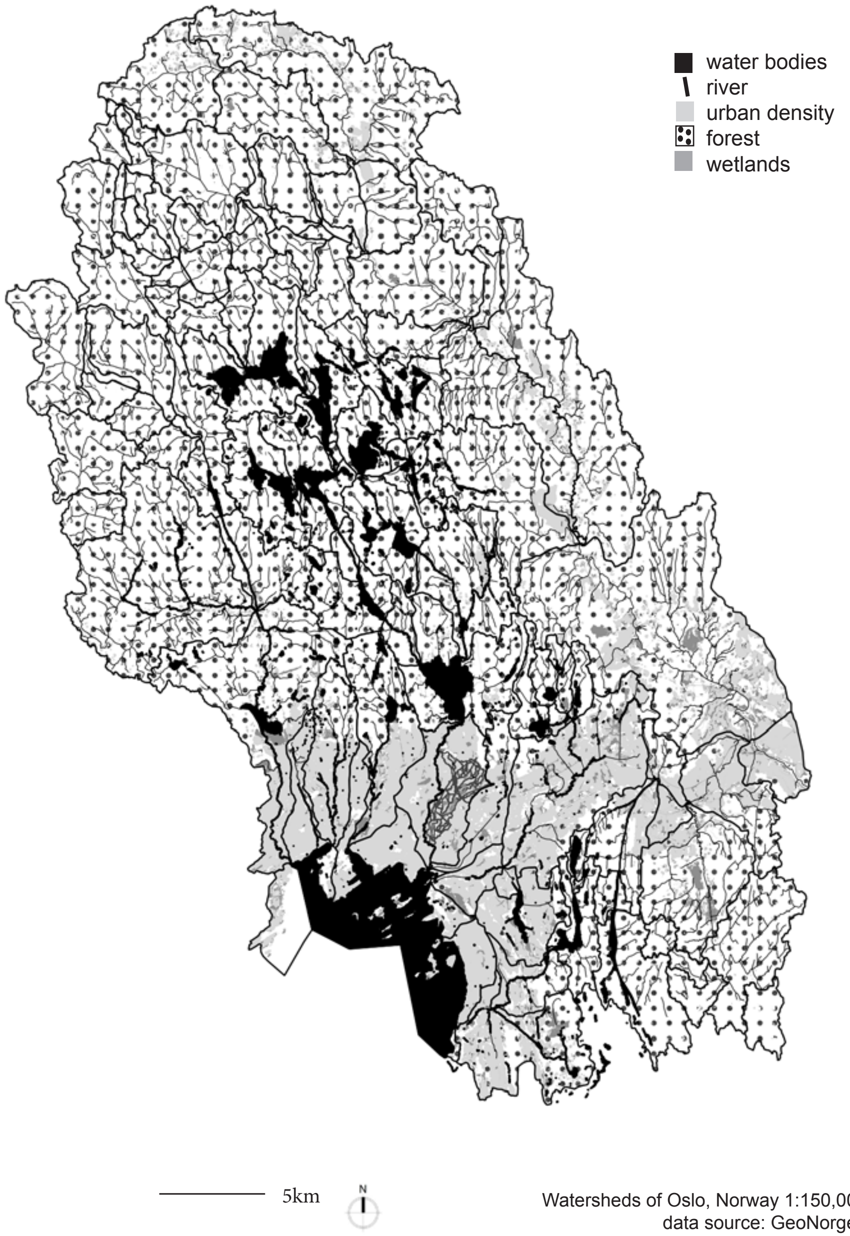


RESEARCH QUESTIONS

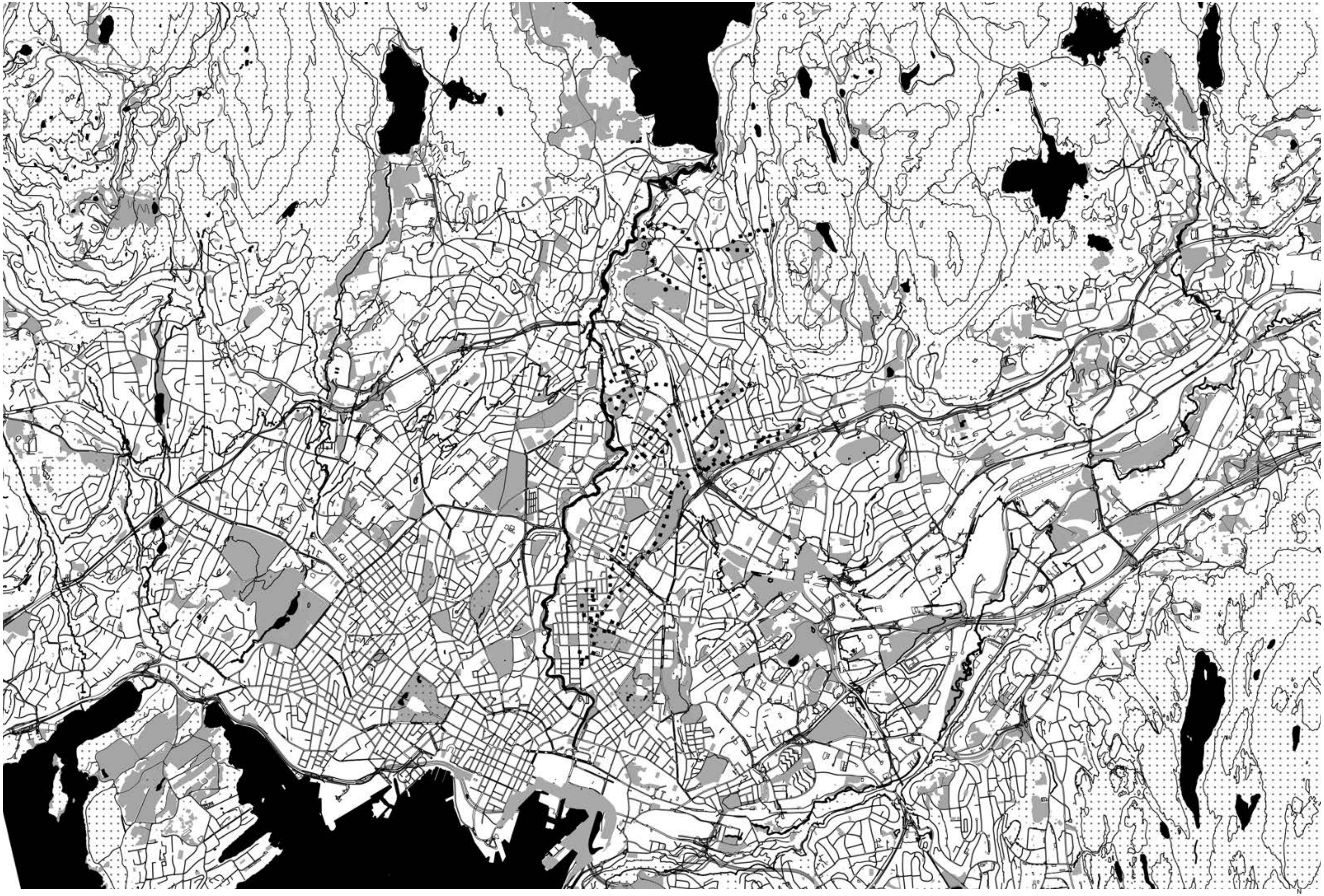
1. How can geo-physical conditions inform plant-based managment in often overlooked residual spaces?

2. How can Torshov’s strength of abandoned ecologies and shortcomings of impervious space and lack of micro-climate spaces be balanced and strengthened by working with a new water infrastructure that is necessary in any case?

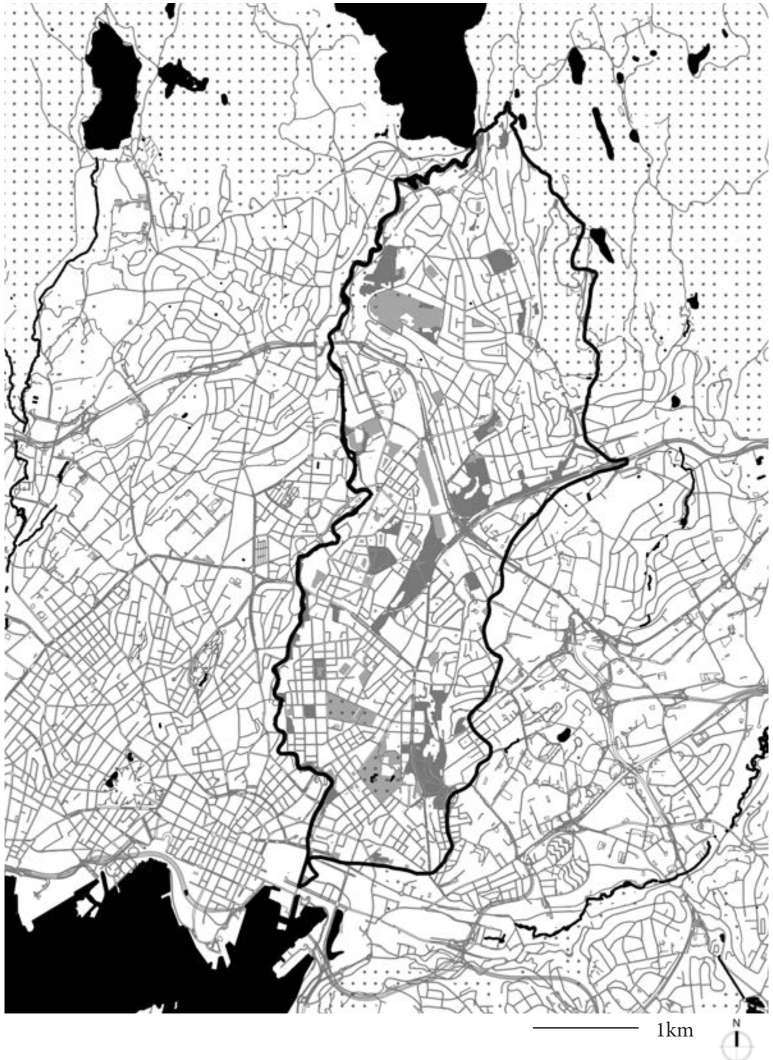
3. Can a focus on the “found” conditions, by building on local knowledge of inhabitants and an eye for the over-looked in-between spaces, encourage a design strategy that achieves the maximum impact with minimal means?

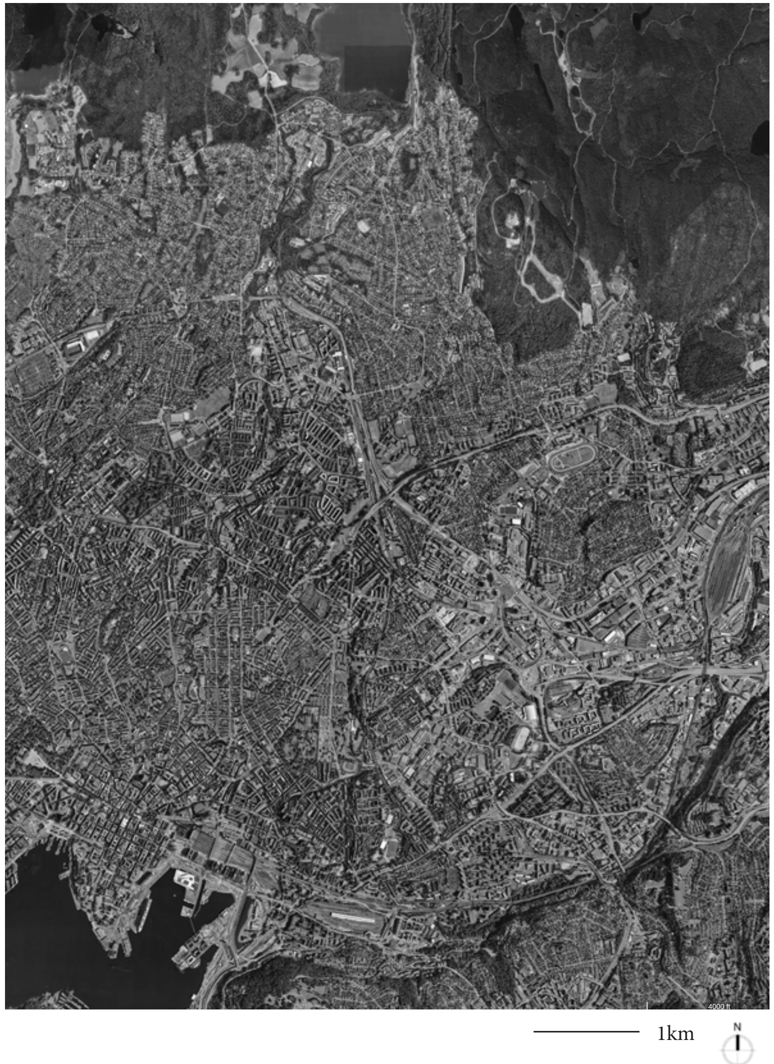



Watersheds of Oslo, Norway 1:150,000m
data source: GeoNorge.no



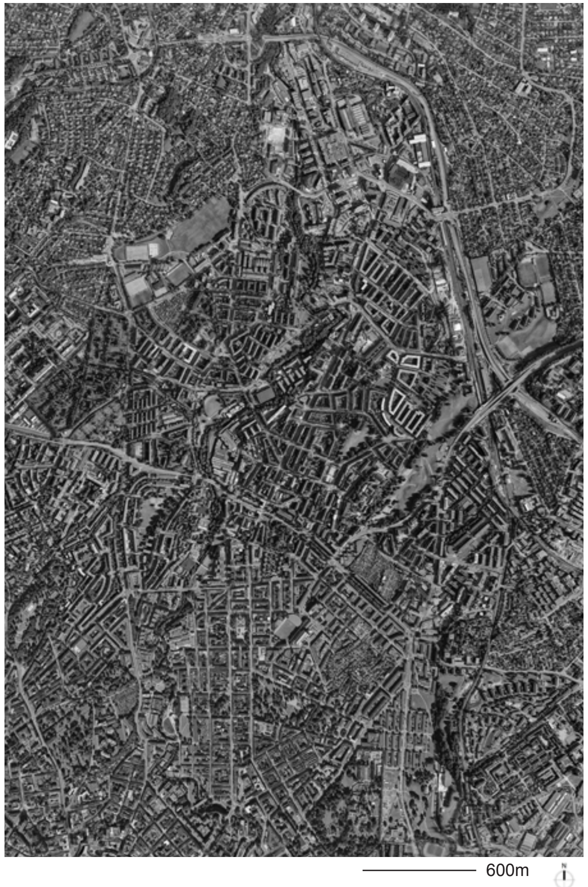

Greater Oslo, Norway. Torshovbekken within Watersheds of Oslo 1:45,000 m
data source: GeoNorge.no



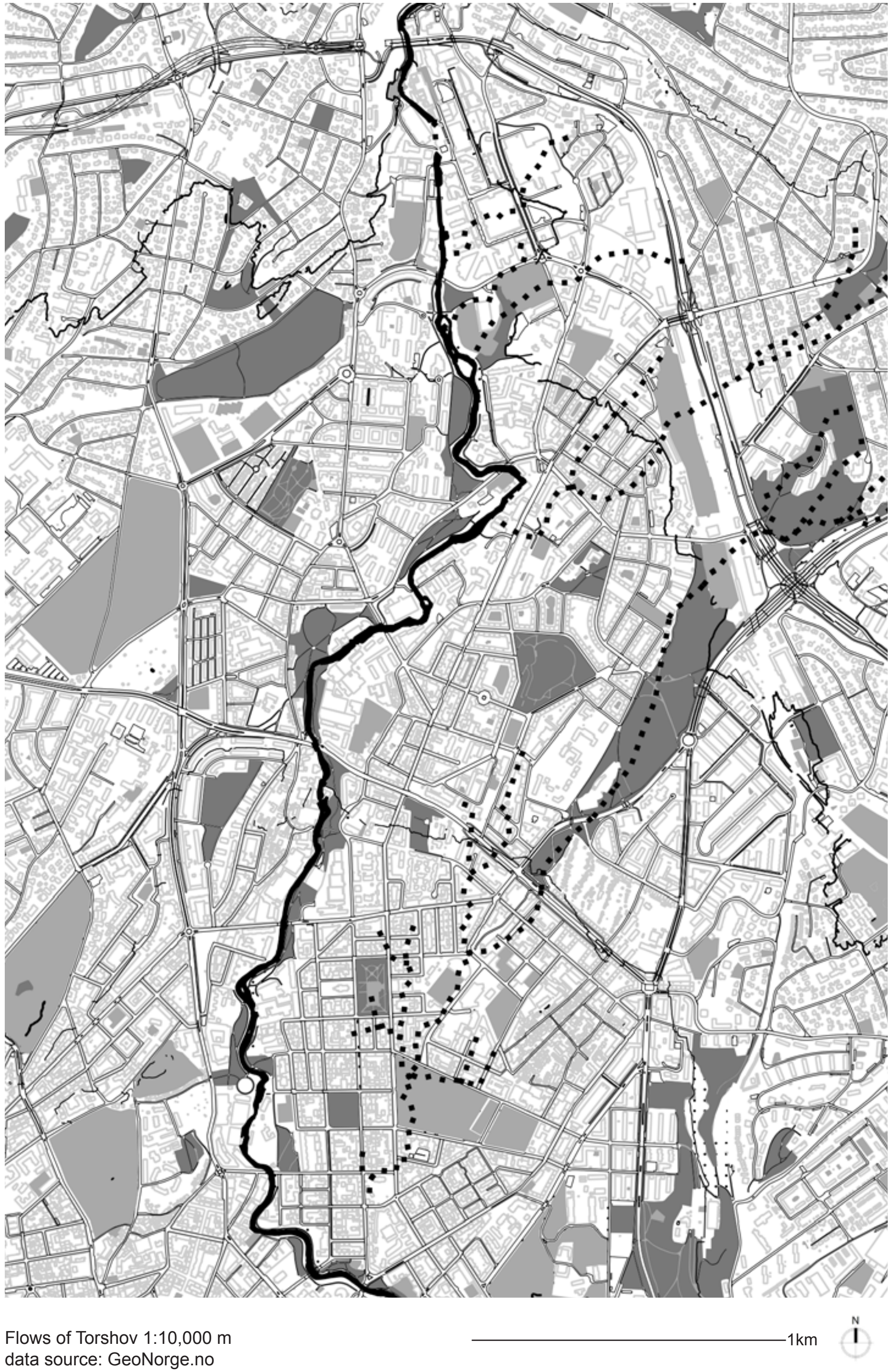




Historic buried Torshov Stream, a sub-catchment of Akers River. Oslo 1:30,000 m
data source: GeoNorge.no

Oslo's major watersheds. (Google Earth, 2006)



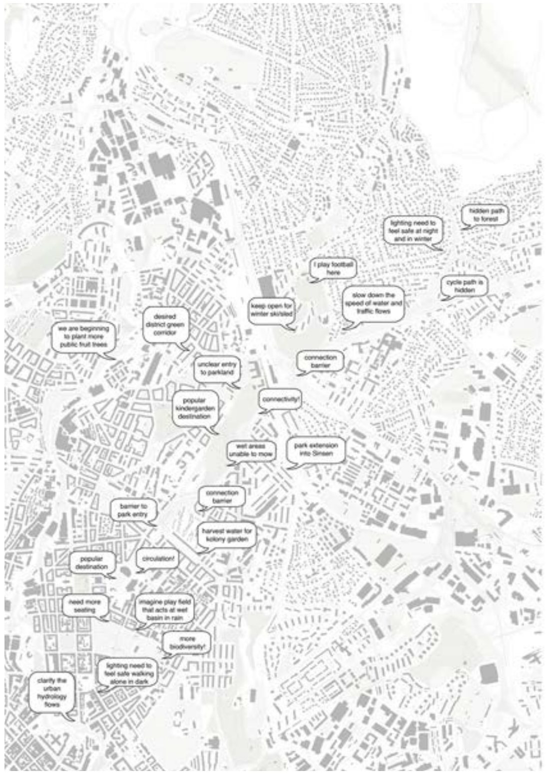

Challenges : historically flooding problematics and lack of economic resources
(Google Earth, 2006)




Flows of Torshov 1:10,000 m
data source: GeoNorge.no

# Oslo urban structure

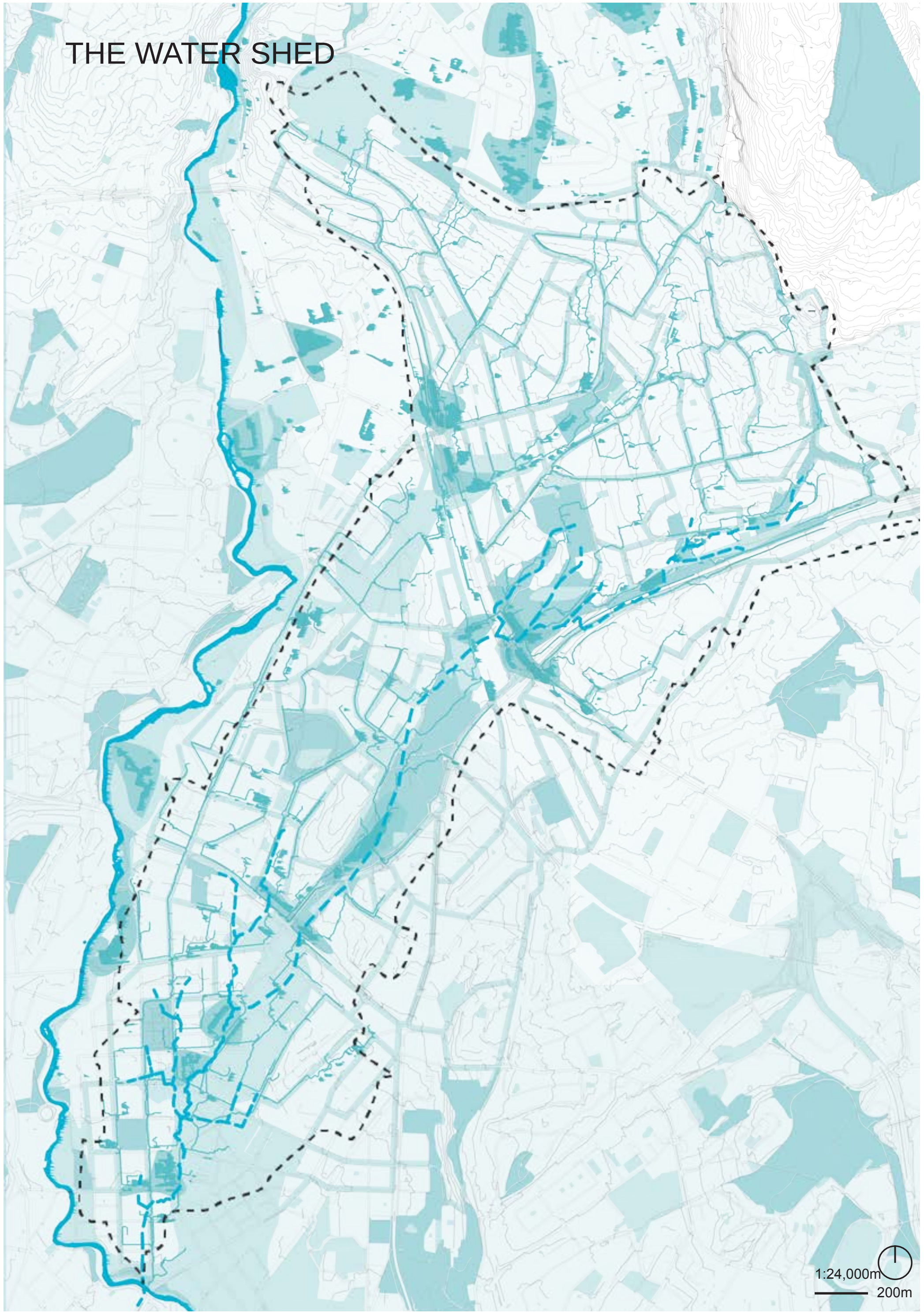
the historic river
informs the logic




social
perspective

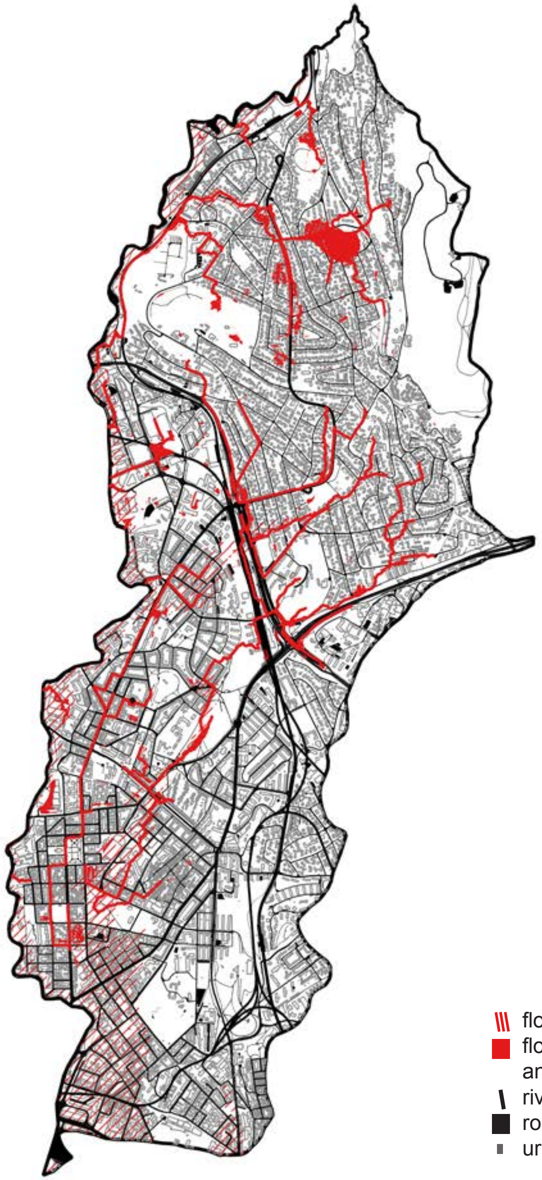
ground/climatic
conditions

agrarian
perspective




- Torshov watershed
- parks
- wet areas
- parkland with wet areas
- flood danger zone
- proposed roads for rain gardens
- stormwater routes
- identified flooding sites
- topography
- historic Torshov stream
- Akers river

Water Background and
Flood Risk
1:20,000 m



flood danger zone
flood risk drainage pipes and flooded depressions
river
roads
urban density

PROJECT GOALS

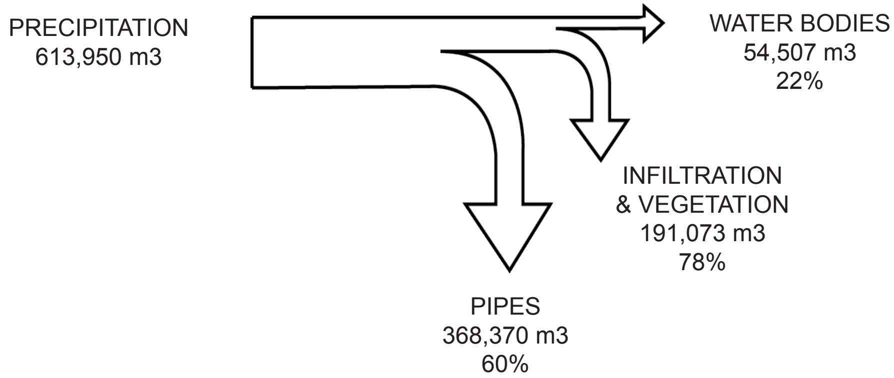
*Lower Max Flux at bottom*. increasing flux (storage capacity) upstream

*Reduce Max H*eight. Road regulation is less than 20cm of water

*Reduce Current Speed*. Shaping terrain barriers in areas of high speed and allow for other smaller riparian passages for water.

200 YEAR FLOOD EVENT

PRECIPITATION - PIPES =
**NET of 245,580 m3**



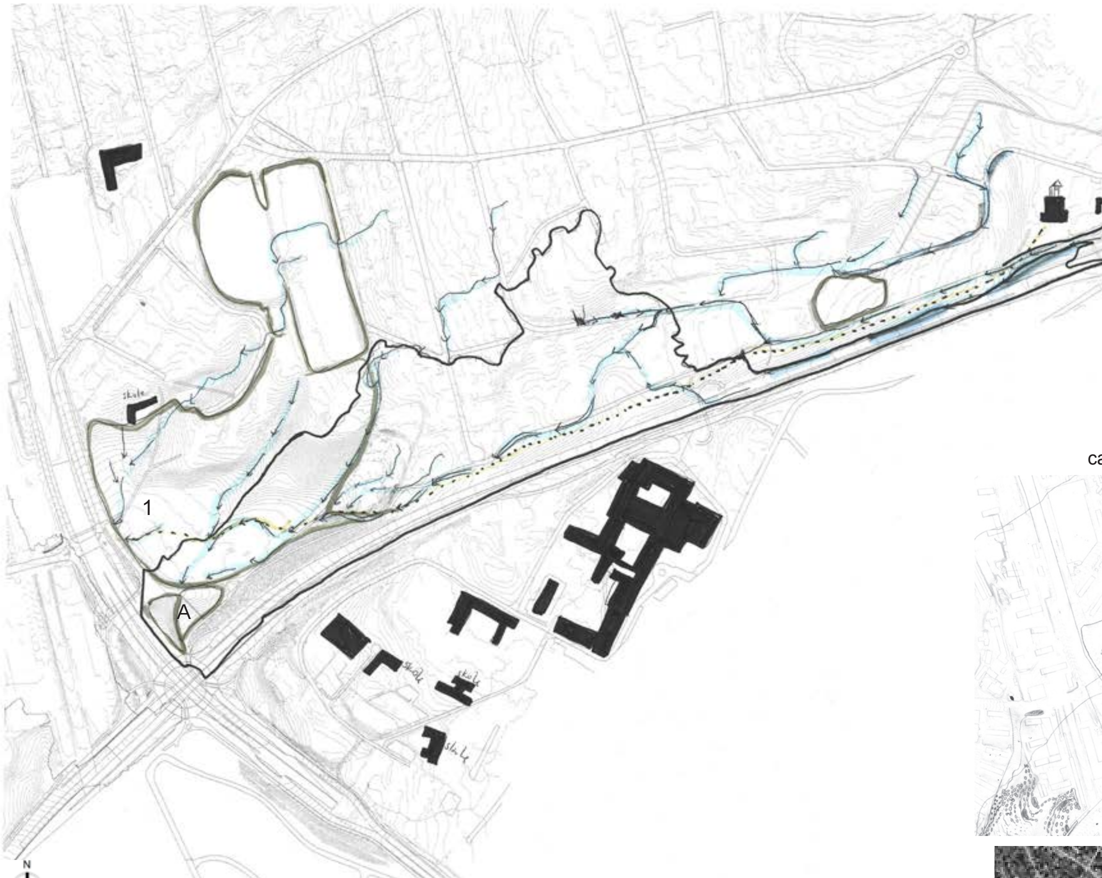

Water hits Infrastructure: Flood Clashes 1:20,000 m
data source: GeoNorge.no

N

1km

10yr. flood event
1 hour duration

Catchment 1
area: 16.8 hectares
depression volume: 1 249 m3



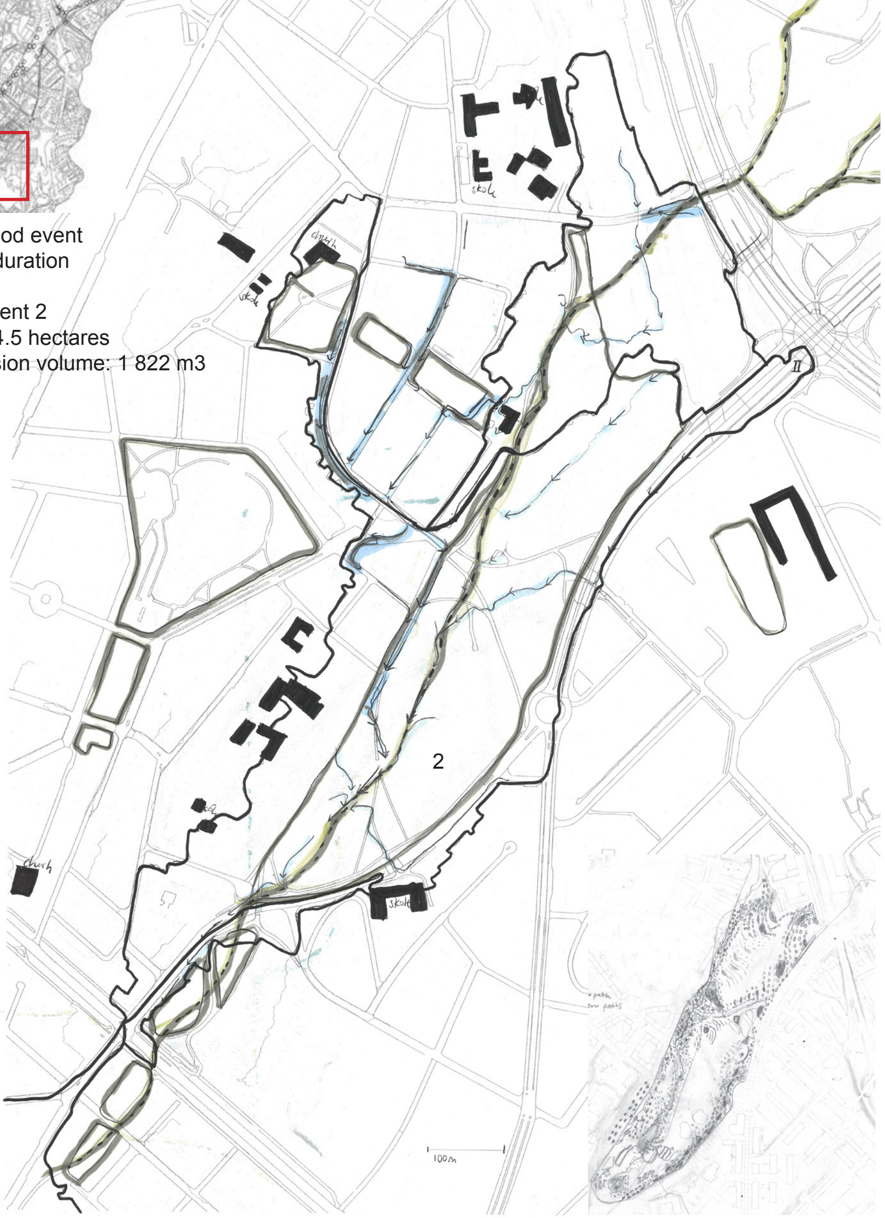

100m

catchment sketch

300m

10yr. flood event
1 hour duration

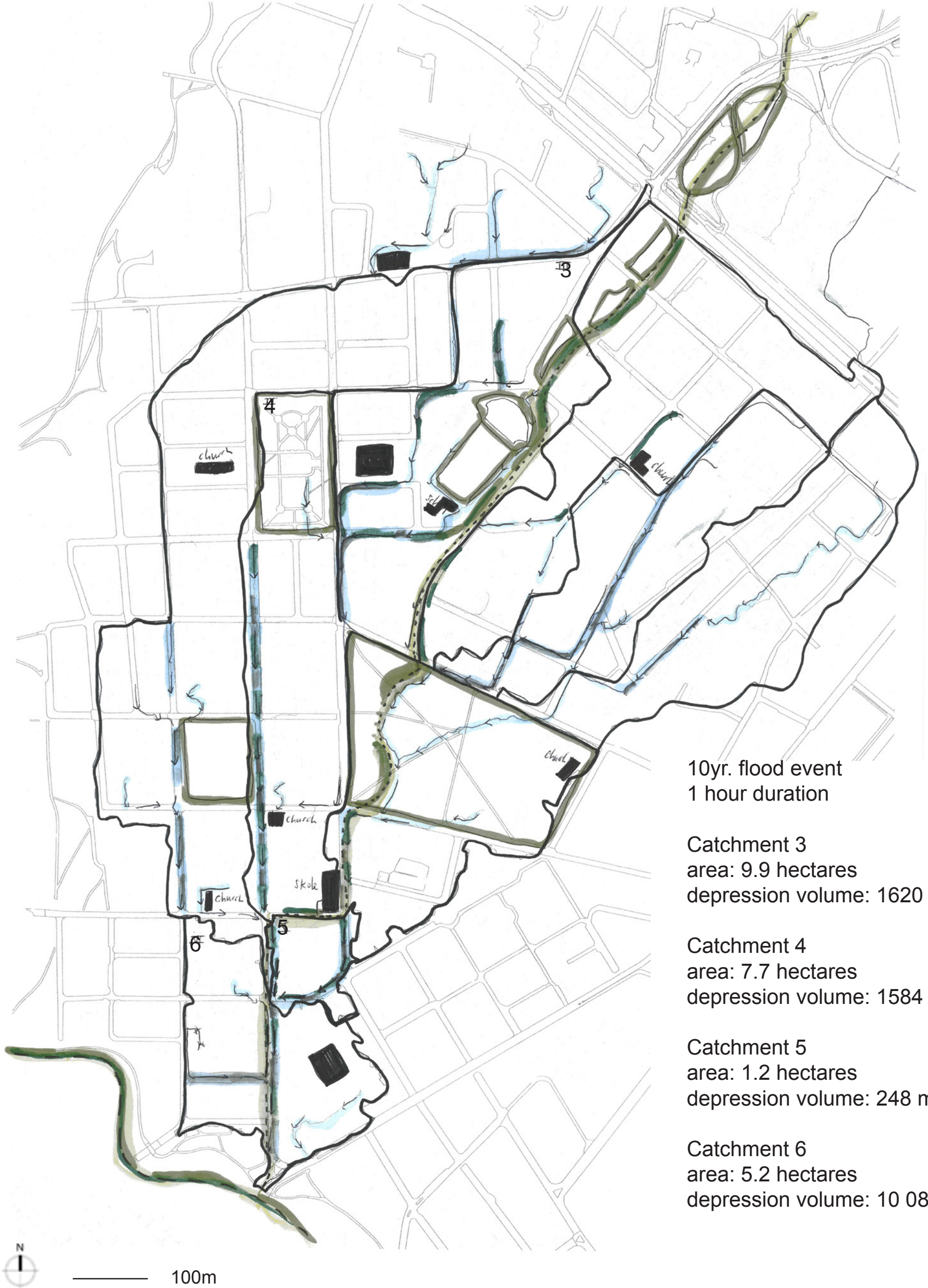
Catchment 2
area: 24.5 hectares
depression volume: 1 822 m3




catchment sketch

100m

300m




100m

10yr. flood event
1 hour duration

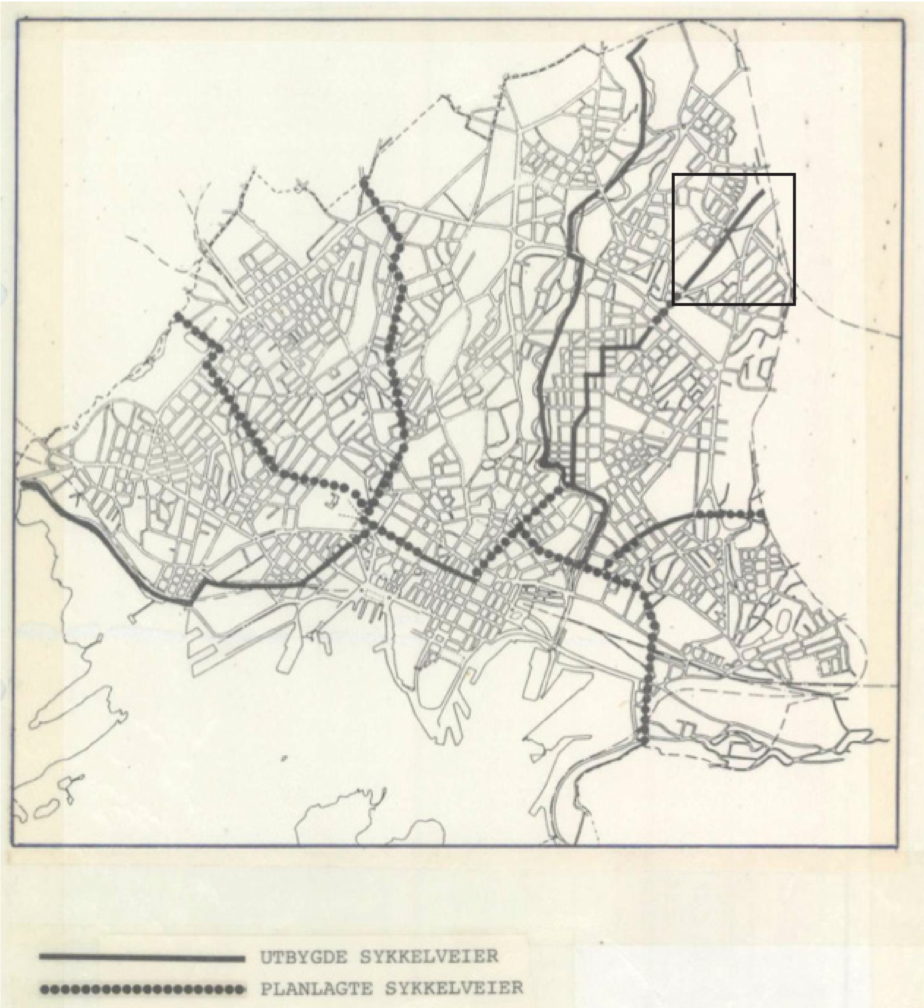
Catchment 3
area: 9.9 hectares
depression volume: 1620 m3

Catchment 4
area: 7.7 hectares
depression volume: 1584 m3

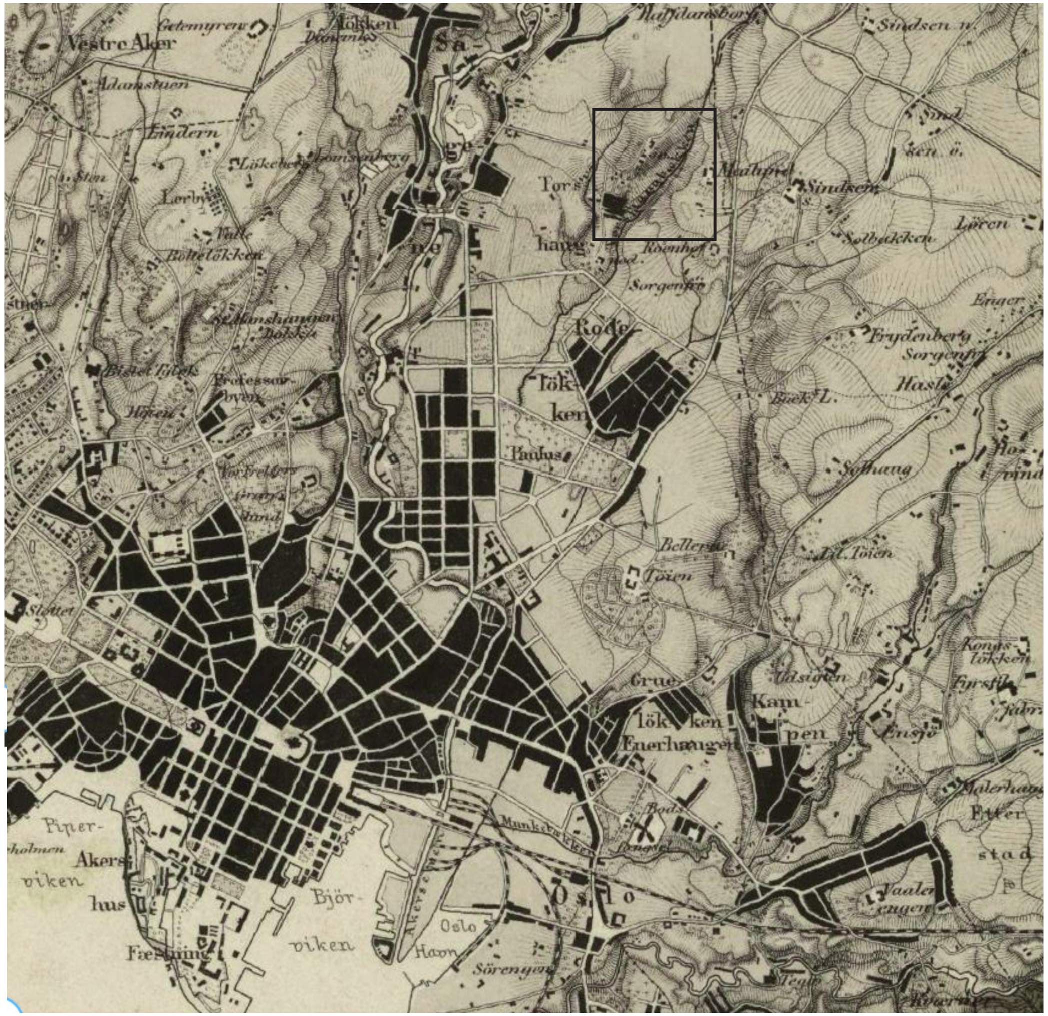
Catchment 5
area: 1.2 hectares
depression volume: 248 m3

Catchment 6
area: 5.2 hectares
depression volume: 10 080 m3

300m

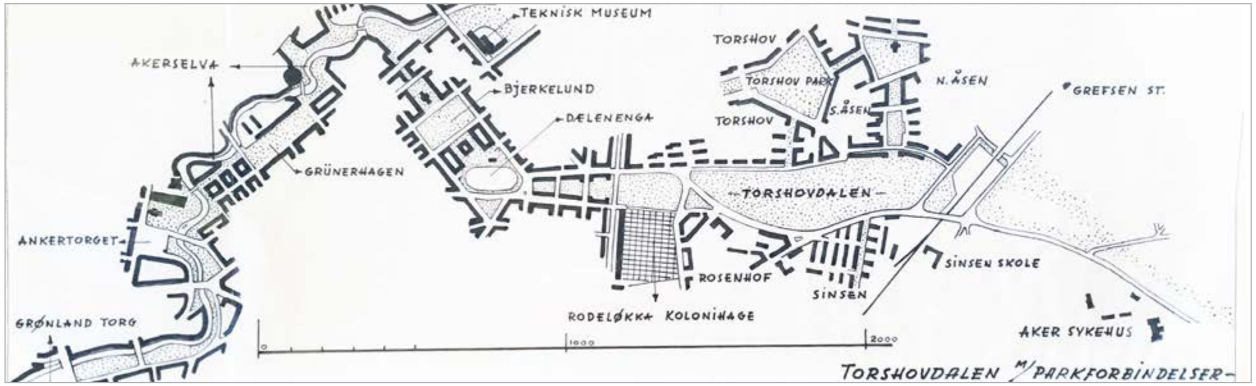



Cycle Map for Oslo. from 1988.
*(Kjelde: Byrådssak,* 1968)




Torshov stream buried between 1895 and 1905
(Nettstedskart, 1879)

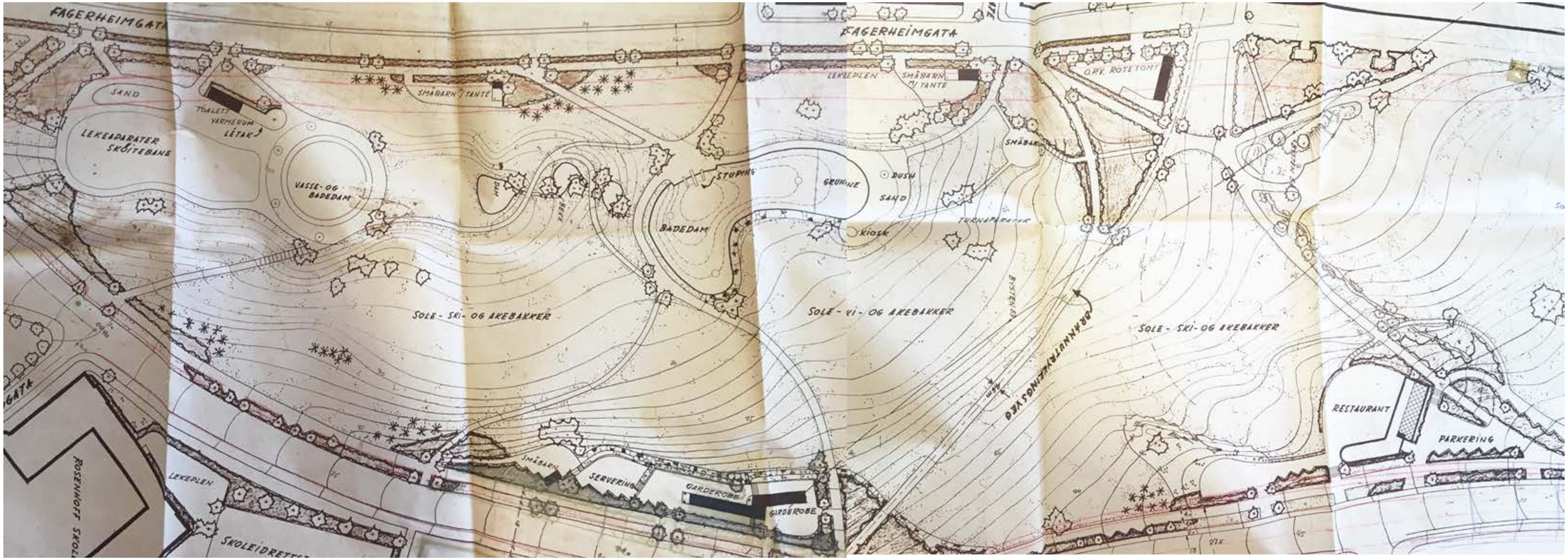
## Park Connectivity Scheme




Untitled sketch [1938] and Torshovdalen/ Parkforbindelser [1942]
Marius Røhne & Eivind Strøm, Oslo Municipality Landscape Architects.
Oslo Byarkiv, Archive: Park og idrettsvesenet T-0030, photos by the author

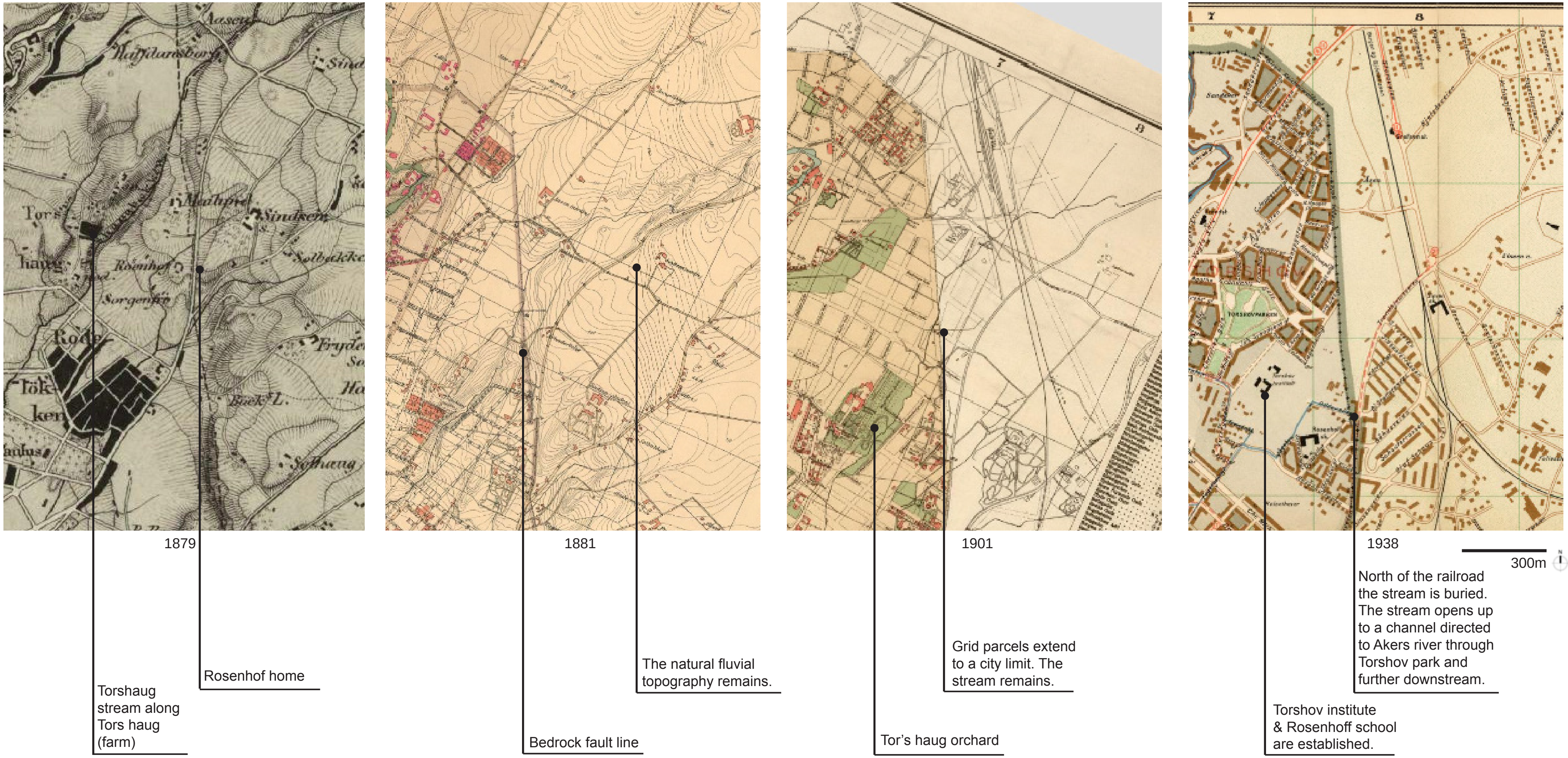
## Torshovdalen proposed perspective 1938

Torshovdalen plan 1942

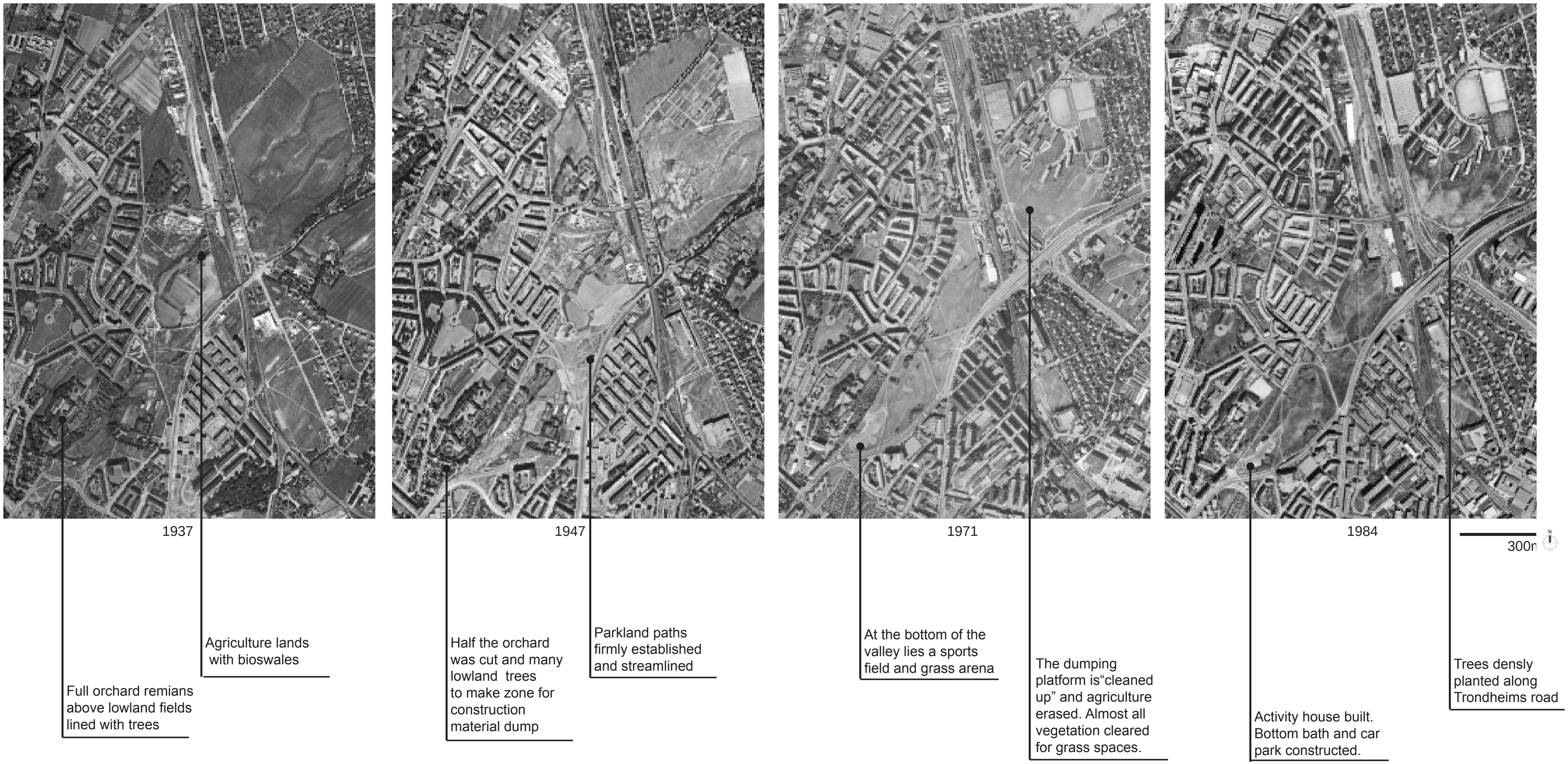



1:6000m 100m

Marius Røhne & Eivind Strøm, Oslo Municipality Landscape Architects
Oslo Byarkiv, Archive: Park og idrettsvesenet T-0030, photo by the author



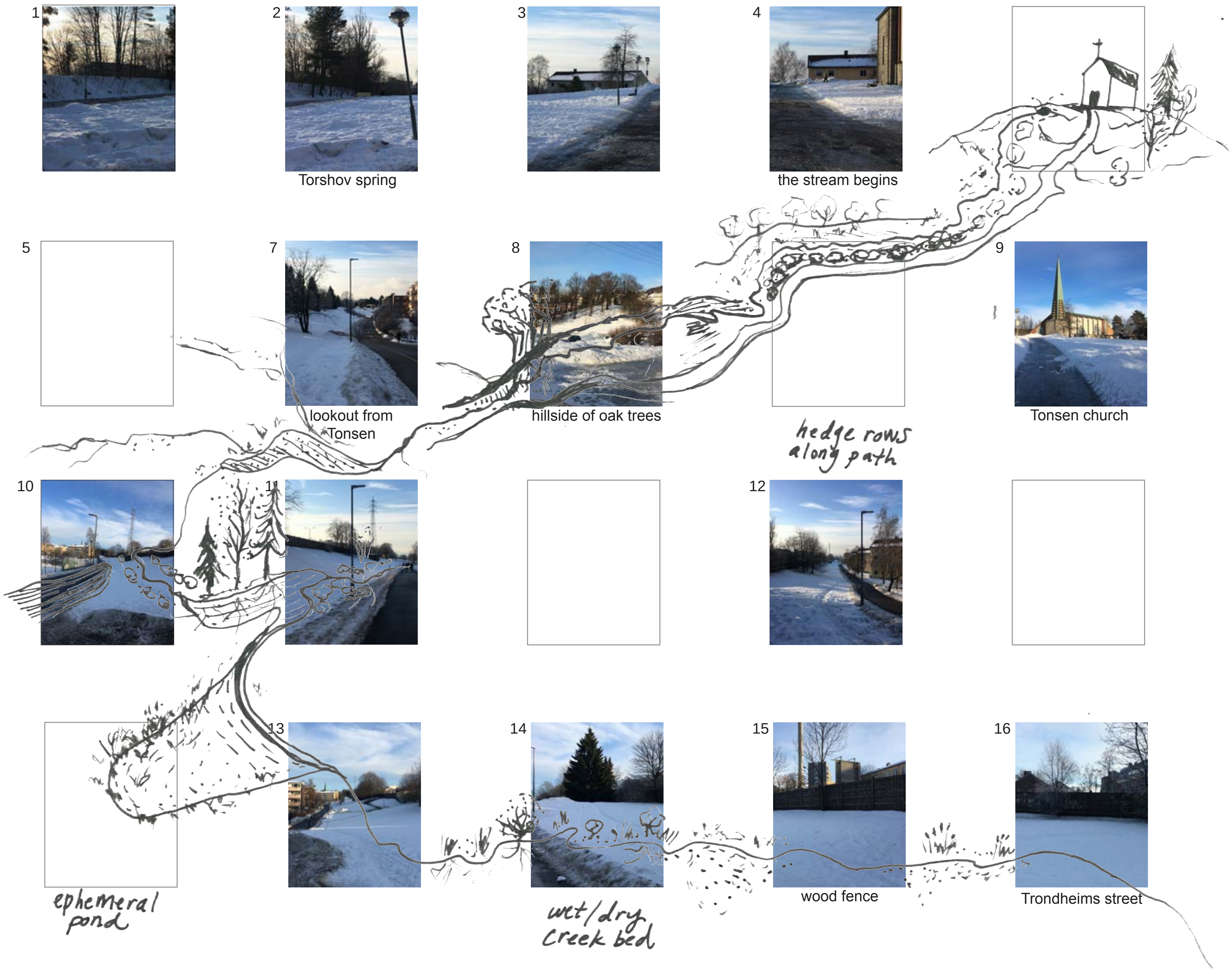

Torshov through time (Nettstedskart, 2018)



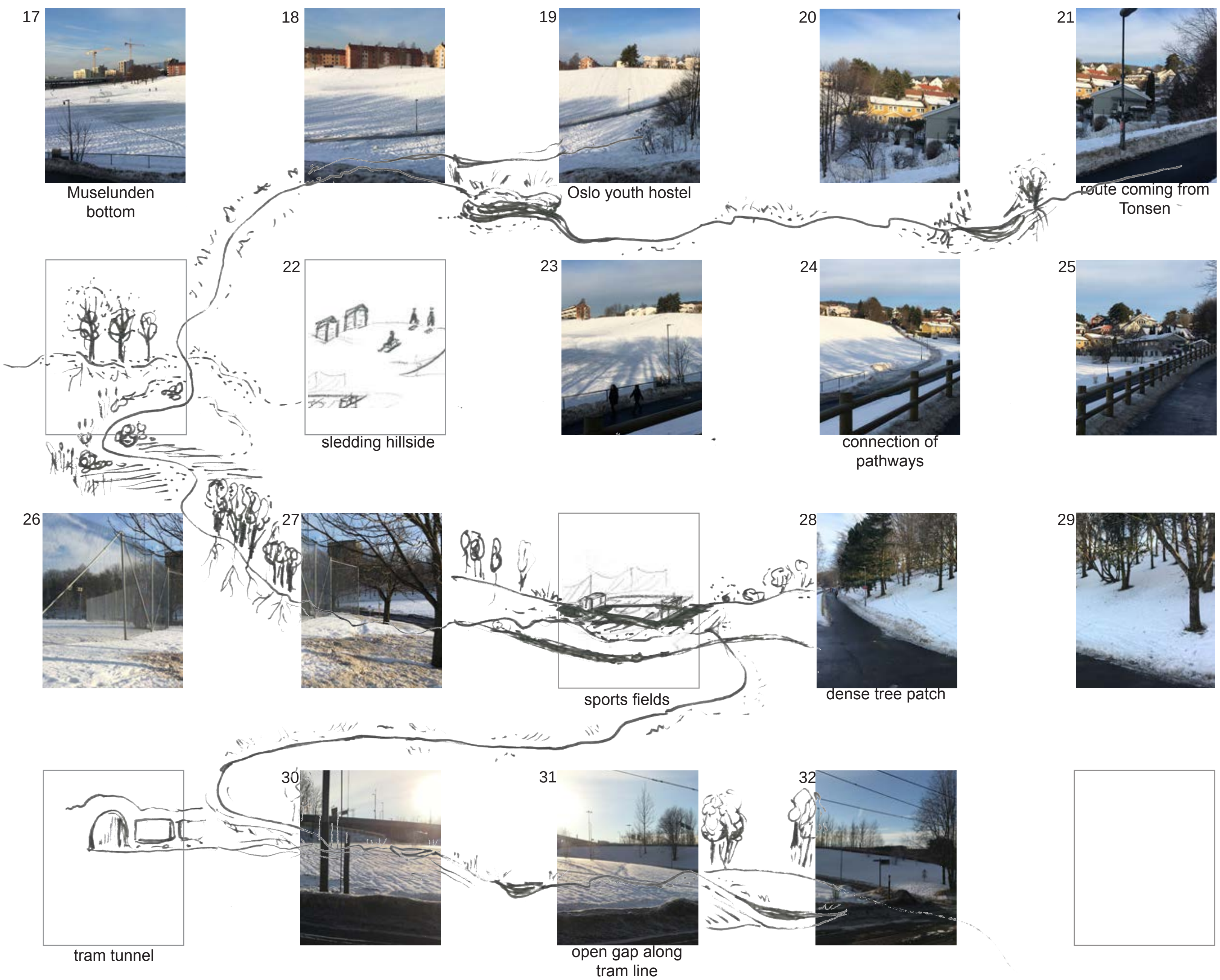

Torshov through time (Nettstedskart, 2018)


Torshov through time (Nettstedskart, 2018)

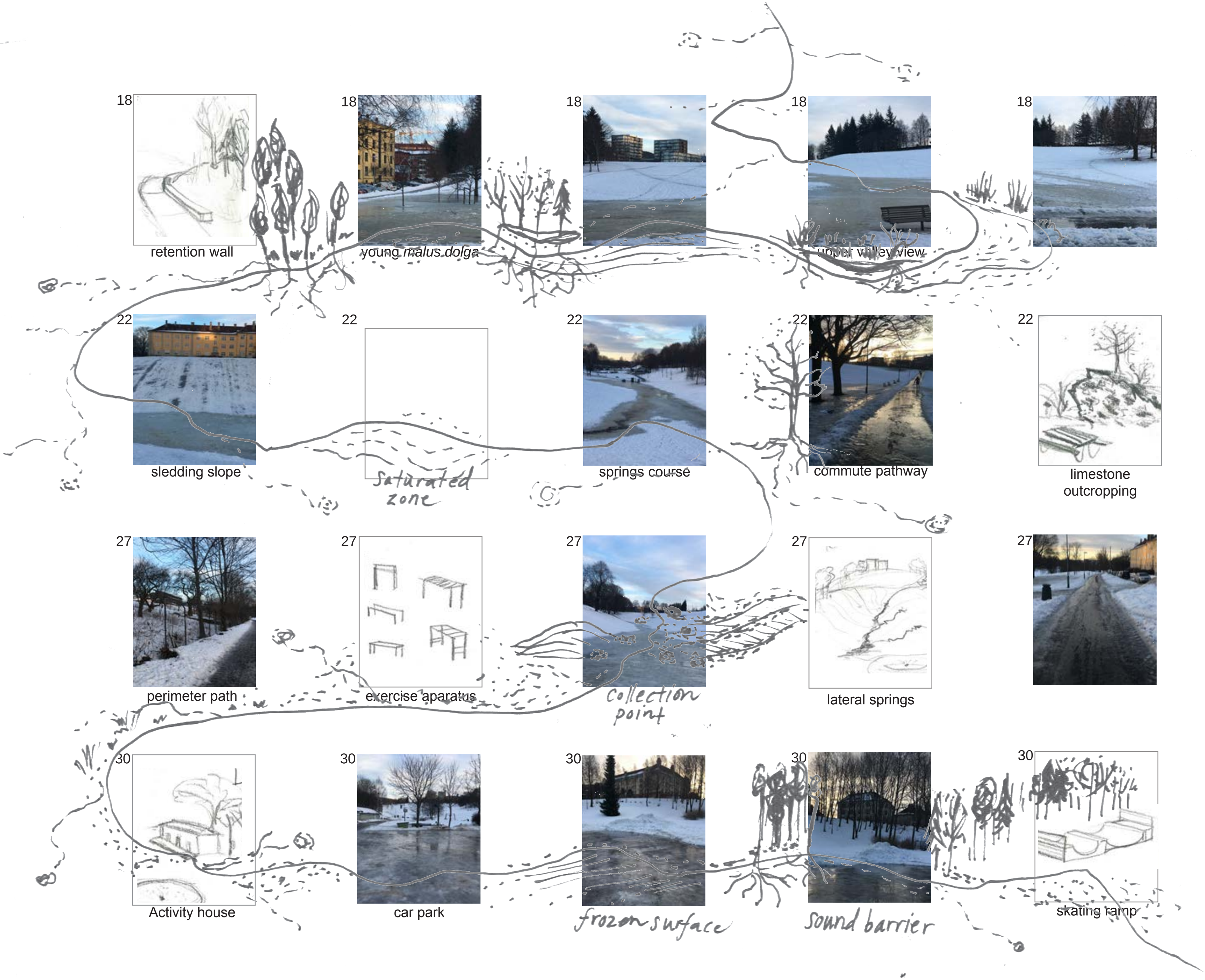
Capillary Action Torshov

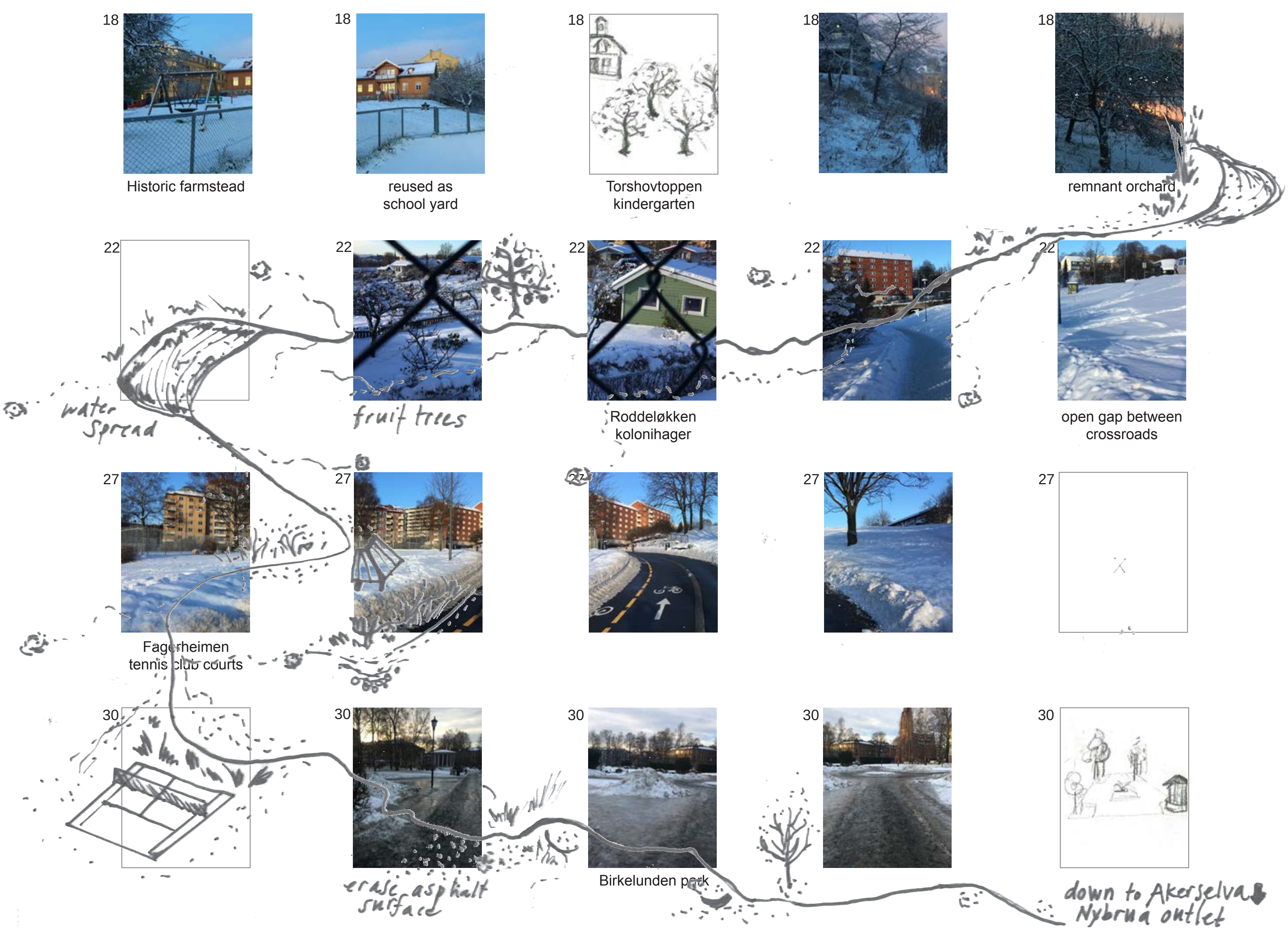



part I

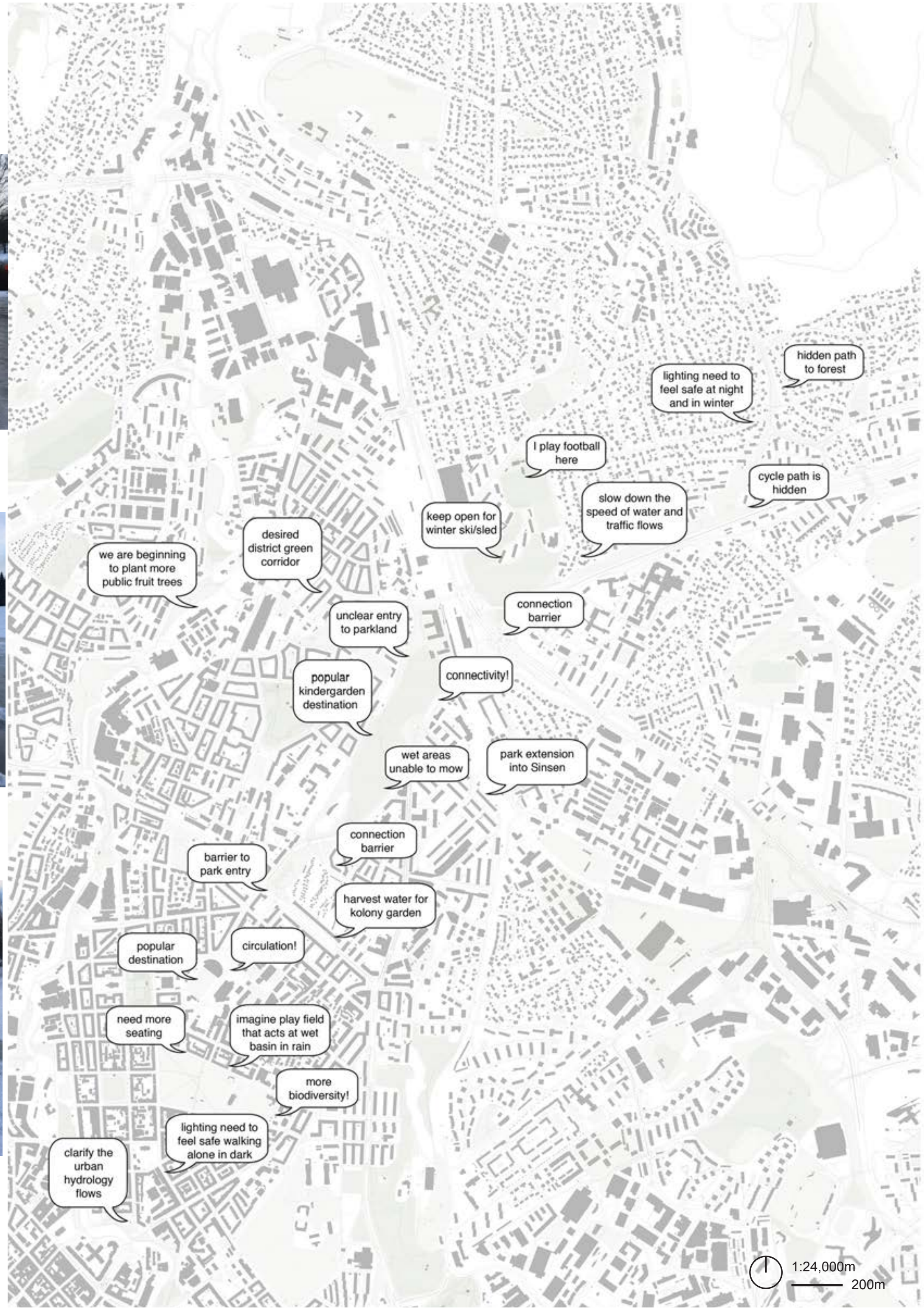


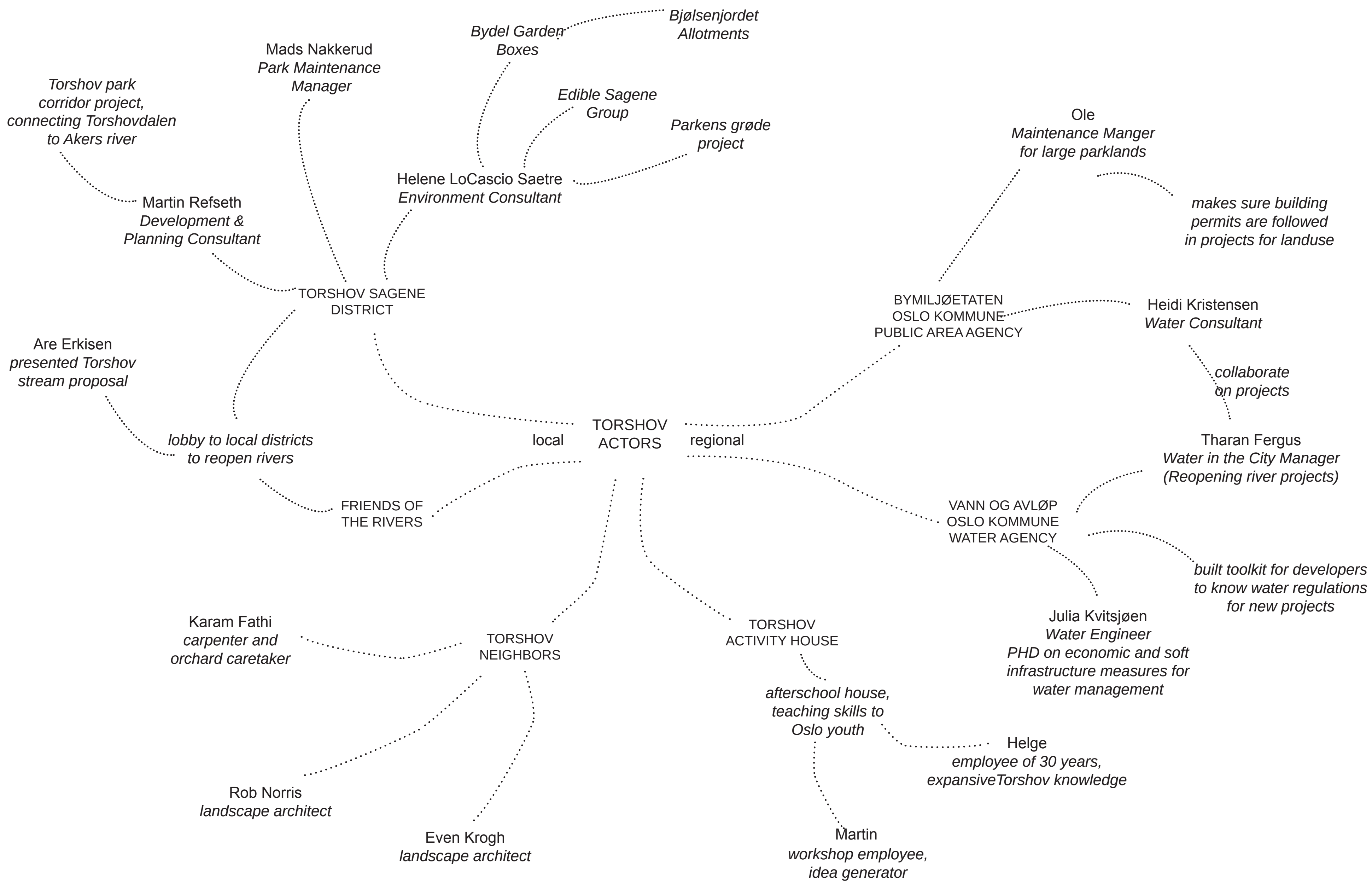
17
Muselunden bottom
18
19
Oslo youth hostel
20
21
route coming from Tonsen
22
sledding hillside
23
24
connection of pathways
25
26
27
sports fields
28
dense tree patch
29
tram tunnel
30
31
open gap along tram line
32

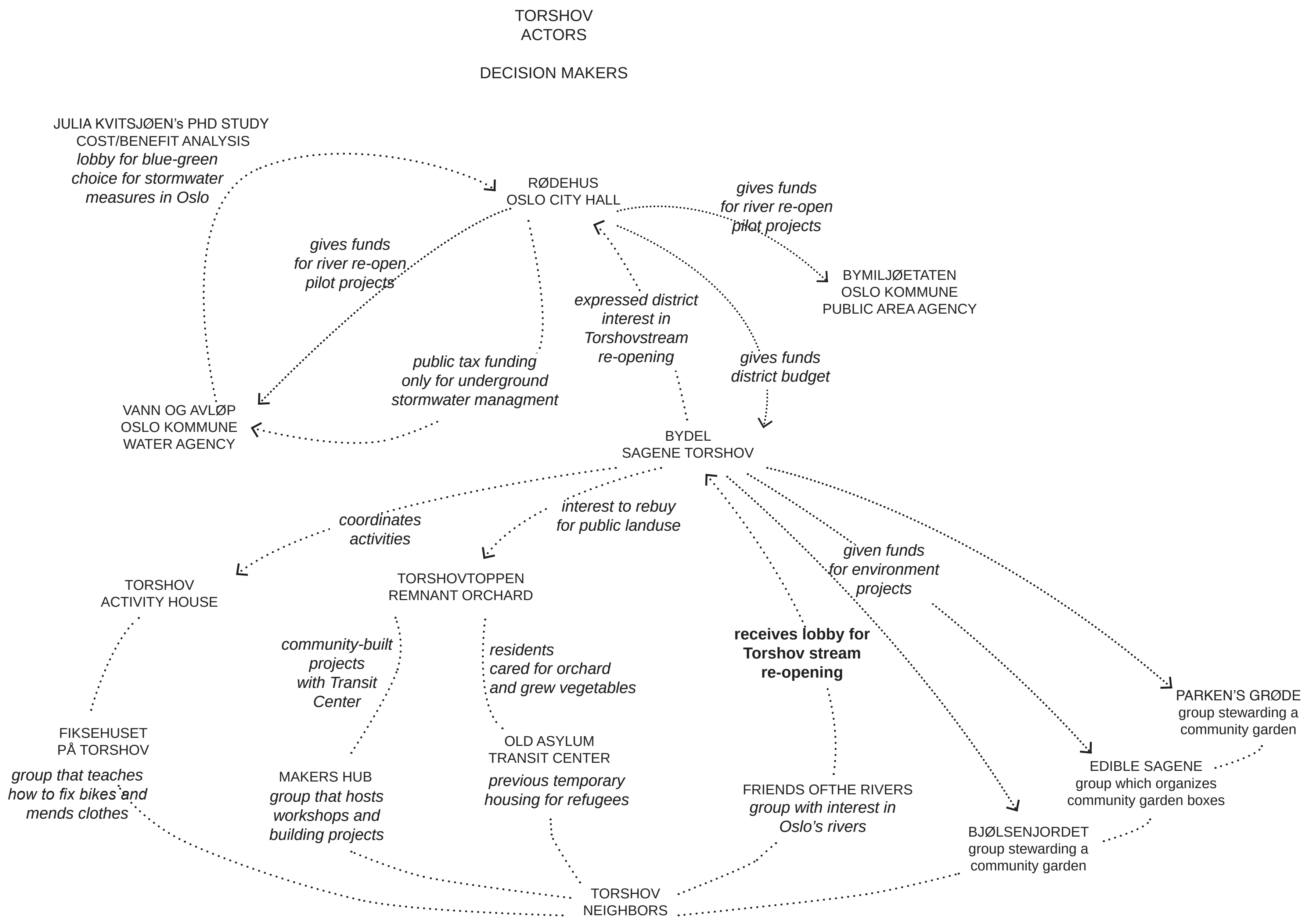

18
retention wall
18
young malus dolga
18
18
upper valley view
18
22
sledding slope
22
saturated zone
22
springs course
22
commute pathway
22
limestone outcropping
27
perimeter path
27
exercise aparatus
27
collection point
27
lateral springs
27
30
Activity house
30
car park
30
frozen surface
30
sound barrier
30
skating ramp


18
Historic farmstead
18
reused as school yard
18
Torshovtoppen kindergarten
18
18
remnant orchard
22
22
fruit trees
22
Roddeløkken kolonihager
22
22
open gap between crossroads
water spread
27
Fagerheimen tennis club courts
27
27
27
27
30
30
erase asphalt surface
30
Birkelunden park
30
30
down to Akerselva Nybrua outlet

social perspectives
local knowledge



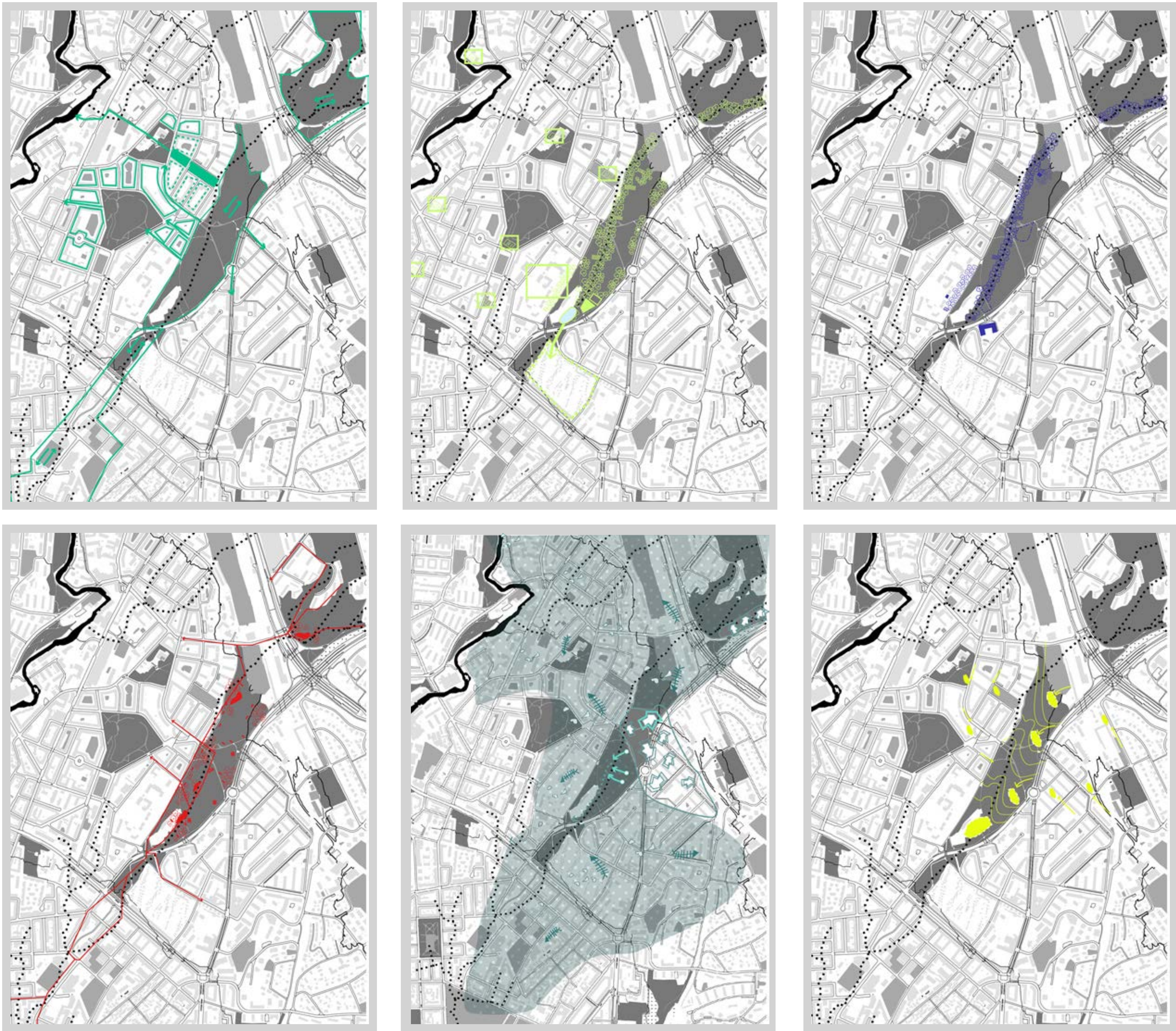

TORSHOV ACTORS
local
regional
TORSHOV SAGENE DISTRICT
Mads Nakkerud
Park Maintenance Manager
Bydel Garden Boxes
Bjølsenjordet Allotments
Edible Sagene Group
Parkens grøde project
Helene LoCascio Saetre
Environment Consultant
Torshov park corridor project, connecting Torshovdalen to Akers river
Martin Refseth
Development & Planning Consultant
Are Erkisen
presented Torshov stream proposal
lobby to local districts to reopen rivers
FRIENDS OF THE RIVERS
TORSHOV NEIGHBORS
Karam Fathi
carpenter and orchard caretaker
Rob Norris
landscape architect
Even Krogh
landscape architect
TORSHOV ACTIVITY HOUSE
afterschool house, teaching skills to Oslo youth
Helge
employee of 30 years, expansiveTorshov knowledge
Martin
workshop employee, idea generator
BYMILJØETATEN OSLO KOMMUNE PUBLIC AREA AGENCY
Ole
Maintenance Manger for large parklands
makes sure building permits are followed in projects for landuse
Heidi Kristensen
Water Consultant
collaborate on projects
Tharan Fergus
Water in the City Manager (Reopening river projects)
VANN OG AVLØP OSLO KOMMUNE WATER AGENCY
built toolkit for developers to know water regulations for new projects
Julia Kvitsjøen
Water Engineer
PHD on economic and soft infrastructure measures for water management


TORSHOV
ACTORS
DECISION MAKERS
JULIA KVITSJØEN's PHD STUDY
COST/BENEFIT ANALYSIS
lobby for blue-green choice for stormwater measures in Oslo
RØDEHUS
OSLO CITY HALL
gives funds for river re-open pilot projects
BYMILJØETATEN
OSLO KOMMUNE
PUBLIC AREA AGENCY
gives funds for river re-open pilot projects
expressed district interest in Torshovstream re-opening
public tax funding only for underground stormwater managment
gives funds district budget
VANN OG AVLØP
OSLO KOMMUNE
WATER AGENCY
BYDEL
SAGENE TORSHOV
coordinates activities
interest to rebuy for public landuse
given funds for environment projects
TORSHOV
ACTIVITY HOUSE
TORSHOVTOPPEN
REMNANT ORCHARD
community-built projects with Transit Center
residents cared for orchard and grew vegetables
receives lobby for Torshov stream re-opening
PARKEN'S GRØDE
group stewarding a community garden
FIKSEHUSET
PÅ TORSHOV
group that teaches how to fix bikes and mends clothes
MAKERS HUB
group that hosts workshops and building projects
OLD ASYLUM
TRANSIT CENTER
previous temporary housing for refugees
FRIENDS OFTHE RIVERS
group with interest in Oslo's rivers
EDIBLE SAGENE
group which organizes community garden boxes
BJØLSENJORDET
group stewarding a community garden
TORSHOV
NEIGHBORS

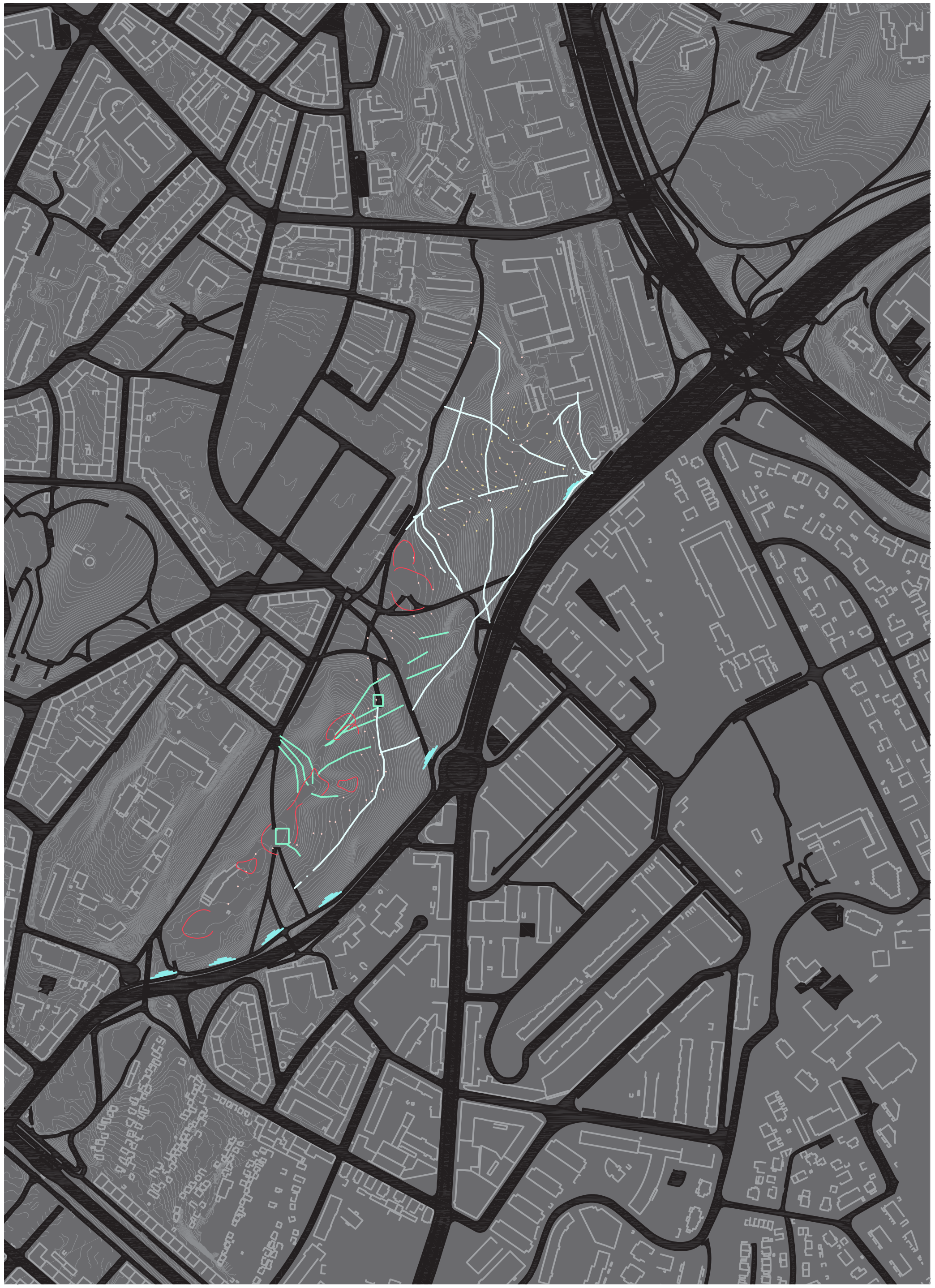
| Social Dynamics | Torshov Design Ideas |
|---|---|
| Collaborating across fields proves to always creating new learning and deepened understanding of the whole potential. One entity can't do a project on their own, projects must involve teamwork. | **Create barriers an areas to slow dow of runoff** and sprea of water so the height less and water can sp infiltrating on site. |
| We have to make sure that there is good cooperation and involvement from the different agencies and expertise, and that the right people are present when drawings are made, decisions are being taken, and on site when the project is being realized. | **"green creek"** - ve which would be a cree rainfall and dry, veget dry periods. |
| The Oslo municipality has a tree regulation which says that when a tree is cut down on municipality ground, it should be replaced with a new one. This is also often applied on private | Think of **drainage p** where it is often too w grass as rain-harvest |


matrix from local interviews

| Actor / Project | Description | Water Dynamics and Dimensioning | Ground / Vegetation / Climate Dynamics | Social Dynamics | Torshov Design Ideas |
|---|---|---|---|---|---|
| **Julia Kvitsjøen / PHD Project in Stormwater Managment and Torshovbekken Storwater Project** | The purpose of the PhD project is to develop a decision support system for an economical and resilient approach to stormwater management based on local conditions, technical capabilities and economic benefit. | The bottom half of the catchment empties at Midgarsdormen treatment plant. There are large amounts of water that flow to the cleaning plants during heavy rain events. Low impact development in parks aims to help with the flood risk. | Heavy metals that can pollute the rainwater on the roof, road runoff, or in pipes, this factor must be kept in mind and involve careful consideration. | Collaborating across fields proves to always creating new learning and deepened understanding of the whole potential. One entity can't do a project on their own, projects must involve teamwork. | **Create barriers and storage areas to slow down the speed of runoff** and spread out the sheets of water so the height and flow is less and water can spend more time infiltrating on site. |
| **Heidi Kristensen / Oslo Kommune Water Manager/project leader for Oslo water area** | She works with local water managment and recent river reopening projects. A recent example is the reopening of Hovin stream. | Reopening a river takes a lot of time, requiring careful attention to details. There is a lot of cooperation between the agencies in Oslo municipality, and we have a management document about reopening rivers. | The arborist chose which type of trees to plant, depending on soil conditions, access to water and sun/shade conditions. There were planted quite a few trees at the north end of the park a few years ago. | We have to make sure that there is good cooperation and involvement from the different agencies and expertise, and that the right people are present when drawings are made, decisions are being taken, and on site when the project is being realized. | **"green creek"** - vegetated areas which would be a creek during heavy rainfall and dry, vegetated areas durin dry periods. |
| **Ola Nygård / Oslo Kommune Controller of Oslo development projects near parks** | New development projects around the Torshov area in terms of the public permiting and tree replanting actions. | In terms of weekly maintenance of Torshovdalen, there are wet spots that can't be accessed or the grass cut. 20 years ago there was only one spot in Torshovdalen that had flooding issues so they were unable to mow. | In the 1930's this was a dumping ground for excess building fill, gravel, sand, rock. Vegetation is impactedt by water dynamics. in fact there are some newly planted trees which might have to move because of too much water in the area. | The Oslo municipality has a tree regulation which says that when a tree is cut down on municipality ground, it should be replaced with a new one. This is also often applied on private ground. | Think of **drainage problem areas** where it is often too wet to mow the grass as rain-harvest opportunities. |
| **Matthew Wells / Oslo Kommune Arborist for tree projects (Central area) and Stormwater/Arbor Research Project** | Tree-planting projects in large public parks in central and eastern Oslo.<br><br>Research project will measure trees for stormwater management with an aim to find which species store/take away most excess water in a cold-climate. | In the Northern area where the crabapples are now planted, there were oaks, but they struggled because of the water conditions and the compacted/polluted soil. A city tree regulation is being formed for new developments 'blue/green factor' | Social dynamics of a space such as gathering for festival events greatly impact planting plans.<br><br>There has been loss of Elm trees in the Torshovdalen recently because of strong whirlwinds. | New development north of park, used to be an industrial area. There was a significant loss of trees. We planted in replacement groupings of Acer and Quercus mainly. We made sure that the new apartments wouldn't have too little sunlight overtime. | There is an aim in Torshovdalen to keep the central area grassy **open slopes for sledding and skiing**<br><br>Trees align the parks perimeter, keeping an open view to the fjord at the top. |
| **Tore Næss / Oslo Kommune Arborist for tree projects (Western area) and Stormwater/Arbor Research Project** | Tree-planting projects in large public parks in western Oslo.<br><br>Research project will measure trees for stormwater management with an aim to find which species store/take away | *Alnus incana, Alnus glutinosa, Populus tremula* and *Salix caprea* are the wild growing Oslo species that are most willing to soak up water quickly and enjoy the wet habitat. | Plants from a Norwegian grower ensure the cold-climate heritage. It is important to be hardy enough to withstand the cold-climate. | There is a change in the way we take "wild species intot the city" rather than non-native ornamtental species. | Trees to explore for **water storage** *Larix*, Larch (hasn't been planted recently), *Carpinus betulas*, (has a lot of foliage) Hornbeam, *Populus tremula*, Poplar, *Platanus x hispanica "Stockholm"* Plane, *Corylus*, Hazelnu |
| **Helene Lo Cascio Sætre / Sagene Torshov Bydel environmental consultant for local environment projects** | District environmental projects provide initiatives and groups with funding for green projects that involve community participation and the environment. "Life between buildings" | The social connections through program and public places are vital in a district. They enable people to cross paths and share their different resources. The entryways to public spaces are very important. | The gardening boxes are placed in public parks and often utilizing the in-between areas and edges. | It is important in our district that we ensure activities and resources can be for everyone, all ages and eco-nomic means. It is key to allow people to take ownership for part of projects. | Biodiversity center for **hands-on nature learning** and acting as a **wildlife and pedestrian cooride**<br><br>Connecting to a funding source great helps our initiatives and learning-sharing community activities. |
| **Martin Refseth / Sagene Torshov urban development projects** | Sagene Torshov district urban planning team plays a role in the local new development projects by communicating local recommendations to the City Hall. | The district seeks to use parks for multifunctional use. Sagene Torshov has potential to use the buried stream waterway as a recreational and stormwater resource and collective representation. | The social connections through program and public places are vital in a district. They enable people to cross paths and share their different resources. The entryways to public spaces are very important. | Focus on winter season activities The Torshovdalen park could be more used in the summer season.<br><br>Clarify the entrances to public parks so the vegetated park tissue integrates into the neighborhood fabric. | Strengthen **connectivity** through the watershed from fjord to marka.<br><br>A need is more park areas with **human-scale spatial qualities**. "Torshovdalen is almost too big to fee comfortable to stay awhile". |
| **Line Barkved / I-Response Stormwater Project and New Water Ways** | I-Response is an exploratory project to gather local crowd-sourced ideas and data around flood safety and stormwater management opportunities in site-specific areas of Oslo (such as Sogns Koloniehager) | Wetland vegetation planting, water collection tank installation, and connective vegetation strips along pathways are the three most common stormwater measures of interest for the garden community to implement. | I-Response digital platform allows community member note where they see underutilized grounds (potential for project), and flood risk (stormwater collection areas) by digital mapping tools. | I-Response allows for community participation online by the platform to collect data and identify opportunity areas. I-Response also hosted community workshops to invite locals to assist in planning a pilot project. | Implement, test, and measure results as in a living laboratory.<br><br>Enable designs to be participatory for project ownership and long-term stewardship. |
| **Isabel Seifurt-Dahnn / I-Response Stormwater Project and New Water Ways** | New Water Ways is a collaborative research project for urban water managment in Norway. Oslo Kommune's VAV and Bymiljøetaten, NMBU, NIVA and NVE are involved in implementing and testing measures. | An aim is to improve the urban hydrologic modeling and dimensioning by taking further into account vegetation and impermeable urban surfaces using satelitte imagery. | New water ways seeks to have a living laboratory to test different vegetation measures, such as rain bed infiltration rates, green roofs, large tree plantings, and vegetation swales. | Will be building stormwater living laboratory projects where there are hands-on learning, testing, and measuring | Compare economic and social cost-benefit analysis of stormwater measures |
| **Clara Sena / Urban Hydrology Advisor for Torshovbekken Stormwater Project** | UiO students have two main foci: water quality (assessment of organic load from urban waste water in the recreational area of Torshovdalen) and physical hydrogeology (considering groundwater recharge and flow in urban development planning). | Mapping Torshovbekken's quality of the urban runoff, infiltration water and groundwater while. Hydrogeological estimatations of water fluxes and set up water budget (i.e. surface water runoff, evapotranspiration, infiltration, groundwater flux, hyporreic flow). | Different areas handle infiltration of groundwater to a shallow aquifer and vegetational storage better than others due to loose material deposits. | Geocatch spot of the outcropping and snowmelt springs. | Connect **ephemeral ponds to the infiltration wells** for the natural refilling of water table.<br><br>**Water infilatration opportunity** areas based on areas of stratification discontinuities and surficial deposits. |
| **Martin / Torshov Activityhus** | Activityhus projects for Oslo youth: Torshov Fixit Initiative helps kids with mending clothes, fixing bicycles and mobile devices. The Activityhus also hosts outdoor activities such as mountain biking in the North forest and sleds for Torshovdalen winter sledding. | There is a seasonal pond that forms in heavy storm events east of the building in the asphalt car park. | Homeless previously lived in the overgrown edges of the bottom of Torshovdalen. The forest edges were cleared out to stop the problem. | Social dynamics and hygenic quality of the bottom pool creates community friction. There is a problem though with dog owners who bring dogs to swim, causing the water to be contaminated. | **More lighting**: especially for winter<br><br>**Improve the existing pool**: opportunity for winter ice-skating rathe than municipal restriction.It is filled wi fresh water weekly in summer |
| **Helge / Torshov Activityhus** | Activityhus projects for Oslo youth: Skate ramp project at the southern edge of Torshovdalen. The Activityhus has workshop where things such as go-carts can be built on-site with kids. | The collection pond gets to be about a half meter deep, and hasn't damaged the Activityhus. | Water flows out of a terraced slope and creates a terrain cut down to the valley's bottom. | There is also social opportunity in the care of the park stewardship. The communication or overall plan of the park is not clearly understood by the users. There are landscape contractors, but minimal collaboration. | **Consider seasonal elements**: rope lift for sledding and skiing, bring people of the hill.<br><br>**Public art forms** that enable socia interaction of youth, less of large sculpture left untouched. |
| **Thea Hartmann / local resident and landscape architect at Snøhetta** | Hørsholm, water project example of taking in rainwater in centra basin perimeter and then wet woodlands in center, possible to flood, take in neighbors water, and control the overflow to further neighbor. Storing water on site is all in terrain shaping. | 1937 Marius Ruhne's Torshovdalen design - little planting, sunny open slopes, 2 terraced dams (100m long) naturally shaped. First pool is for fish and birds, then the lower pool is for swimming. There was a stream with 3 small waterfalls and 2 smaller swales. | Many people are unaware of a bike route to the forest from Muselunden. Torshovdalen's challenge are the major road barriers to be a resource and relate to the eastern side of Sinsen. | The social housing area and the new high-end apartments uses this park more than the Kvartal residents. They have a great picnic culture. It would be nice to have an opportunity for the neighbors to learn from eachother amidst socioeconomic difference. | **Good lighting**: to feel safe as one walks at nigth alne on park paths. **Connectivity** for the east side so they can use this recreational resource. **Accessibility,** three road barriers to pass to get to park areas. |
| **Rob Norris / local resident and landscape architect at LINK** | LINK landskap water projects- Holaløkka project includes swales, basins, and constrcted wetlands made in sections over a period of years | Start small-scale in local storage pockets, so the interventions can first handle the amount of runoff on-site. | Control of water speed is equally important as cut and fill depressions. if the ground's contour allow the water flow to slow, then it gives time for the bottom basins to infiltrate, then take in more water as it flows down. | Torshovdalen can offer large scale storage. In the form of a wet basin it could be utilized most of the time as a football field or open playfield | **Terrain changes:** carefully design to slow down the speed of flows by building **terraces** and **collection swales** as one moves through the elavations. |
| **Even Krogh / local resident and landscape architect at Barbakke** | Bar bakke landsakap water projects - Mainly new developments, both commercial and residential. New developments have the responsibility to handle most if not all their rainwater on-site. | I have been told by water engineers I work with that infiltration should not be the only water managment solution. If we only infiltrate below ground, we are simply directing the water must go somewhere else or be temporarily stored in an aquifer. | Infiltration has geologic implications. Measures upstream can make a change in the water table balance and create more hydraulic pressure further downstream on buildings foundations, so we must be careful. | Torshovdalen for many is mainly to go for a walk since it is an expansive size park. Many locals walk the pathway and rest at a bench. | **More seating**: a need for neighbor to stay awhile (steps or seating edges in the sloping terrain)<br>**Rainwater depressions:** rockbed or rainbeds to especially infiltrate water, or through more urban betong forms like a skate park. |
| **Karam Fathi / local resident, Makers Hub projects, and Torshov Transit Center gardening project** | Makers hub community built project of an outdoor pavillion. Transit Hub garden project involves taking care of apple and cherry trees. We grow potatoes, tomatoes, garlic, mint, onion, spinach, and strawberries. | People could enjoy this beautiful nature in Torshovdalen if there was a natural river forest running through. A waterway, more trees and maybe a small café situated along the river's forested banks. | Torshovdalen has strong summer sun and open areas not closed off by structures. People can observe surrounding games and activities. The autumn colors of the many trees and abundance of natural light create the sense of a poetic place. | Riversdie pathways is a significant resource for social engagement. Going on a walk along our forested river bank is always a social connecting place in my home city. | **Collective orchard-garden** with toolbox for the community caretaking and outdoor space to share meals.<br><br>**River woodlands** to walk along an capture water. **Natural arena** for season festivals in Torshovdalen. |
| **Eva Storrusten / local resident and Oslo Kommune Cycle Project** | Bymiljøetaten's Oslo Cycle Project aims to make cycling safer for all. New cycle road projects include upgrading existing bicycle routes, parking at major hubs, service stations and air pumps, and clear cyclist wayfinding. | Torshovdalen is the biggest area to roam for surrounding neighbors and dog walkers. In rain, dog walkers avoid Torshovdalen because of the valley terrain's drainage problems. | The climate and vegetation in Torshovdalen contrasts Torshov park, more of an urban forest or natural habitat. The valley park feels a bit loud and cold because it is surrounded by a very busy road. | Torshovdalen is unique because it borders Torshov, Sinsen, and Carl Berners Plass, creating a mix of people in the area. There is a different feel than Torshovpark, which feels like an urban attraction park full of people and activities. | **Better connectivity**: the park feel confusing and fragmented in terms o pathway routes to cross to Sinsen.<br><br>**Outdoor rooms; human scale,** It would be nice if Torshovdalen felt more cozy in some places |



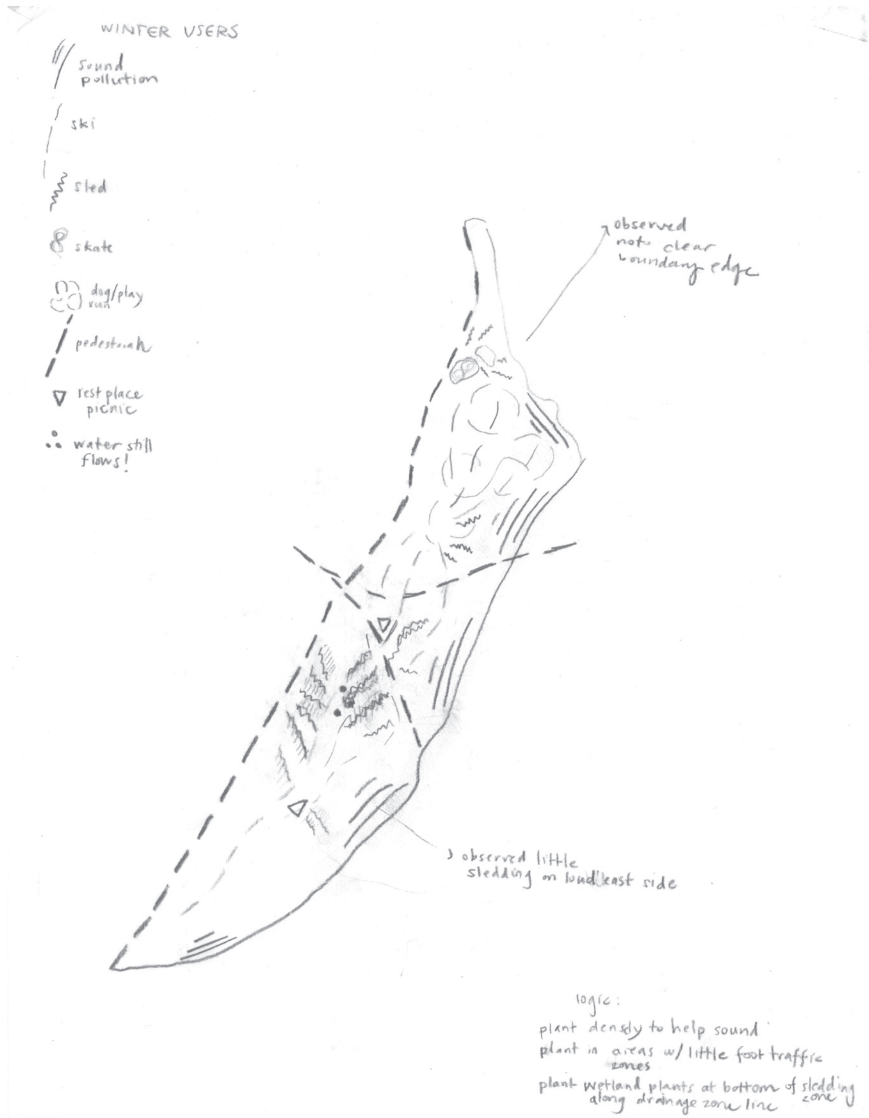
maps made after interviews with actors



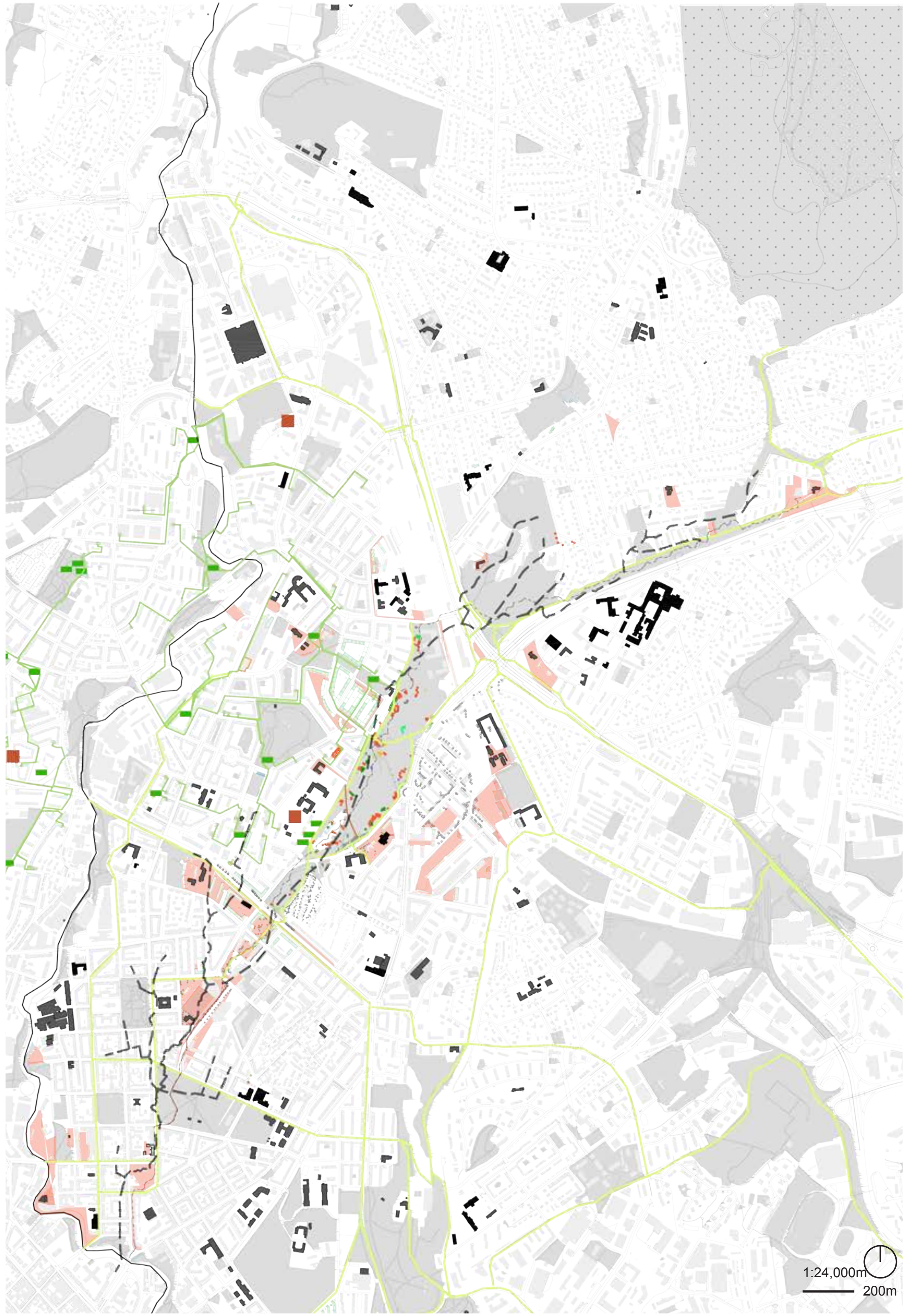
Winter Activity Observations1:8000m

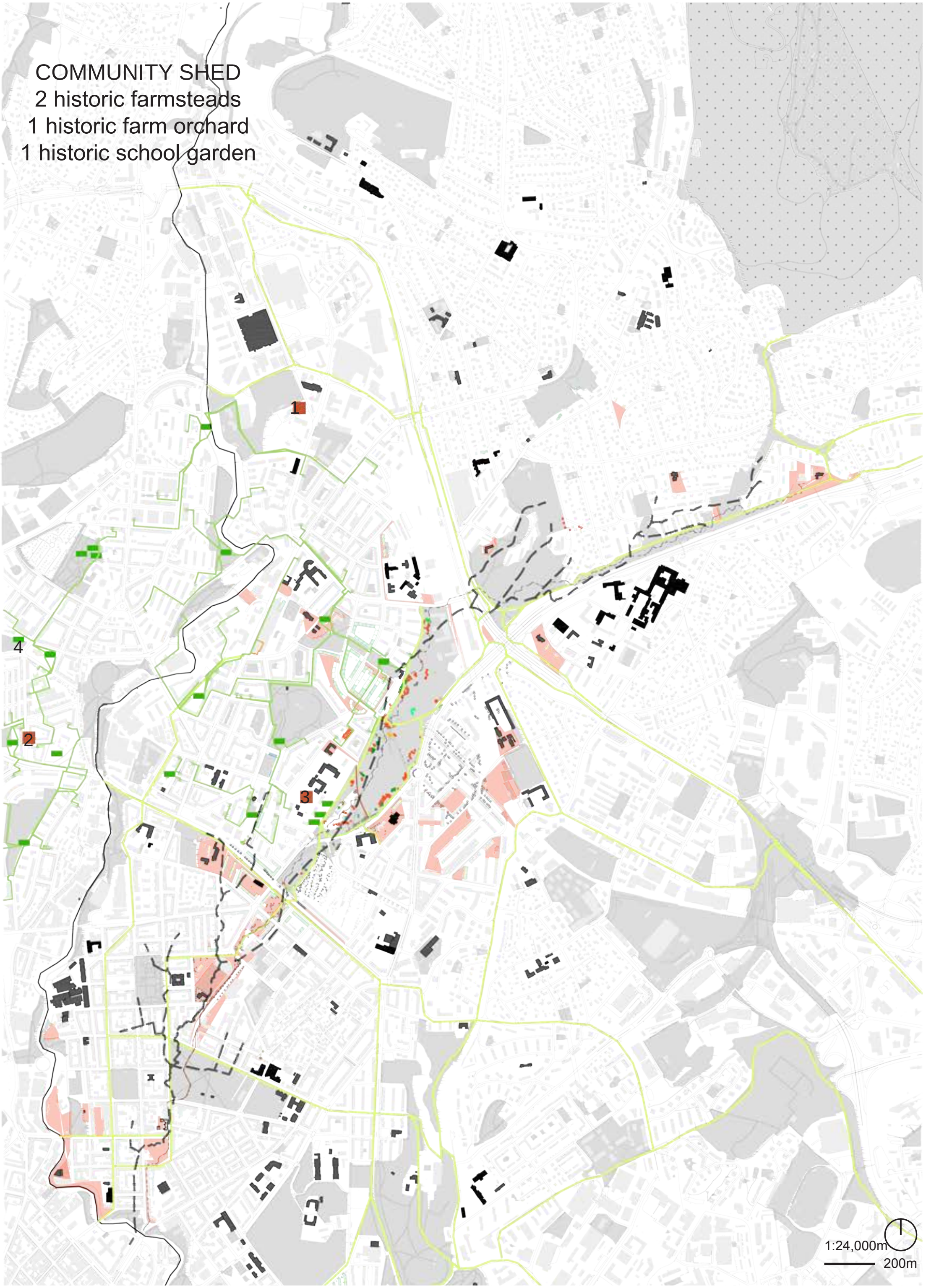
100m

- unofficial paths
- heavy sound disturbance
- observed saturated areas
- interesting found elements
- ski routes
- sled routes
- play with dogs
- roads



COMMUNITY SHED
13 garden sites
3-7 boxes each
1 allotment garden
1 community garden
2 historic farms
1 remant farm orchard
1 historic school garden
social housing
municipal buildings
health services
schools
churches







Lillo gård
1


Vøienvolden gård
2


Tors haug
3


Geitmyra skolehage
4

1615 Lillo farm begins

1683 Vølenvolden was first a town hall for Councilor Bergmand

1879 Torshaug farm is situated alongside the Torshaug stream in maps with upper and lower parts

1909 Geitmyra skolehage is started by the municipality of Kristiania ( later renamed Oslo)

1916 Kristiania bought large parts of Tors haug farm for housing and schools

1917 Architect Magnus Paulsson designs Vølenvolden's main building, with a new side wing with a kitchen and drawing room. An extension of the garden was demolished

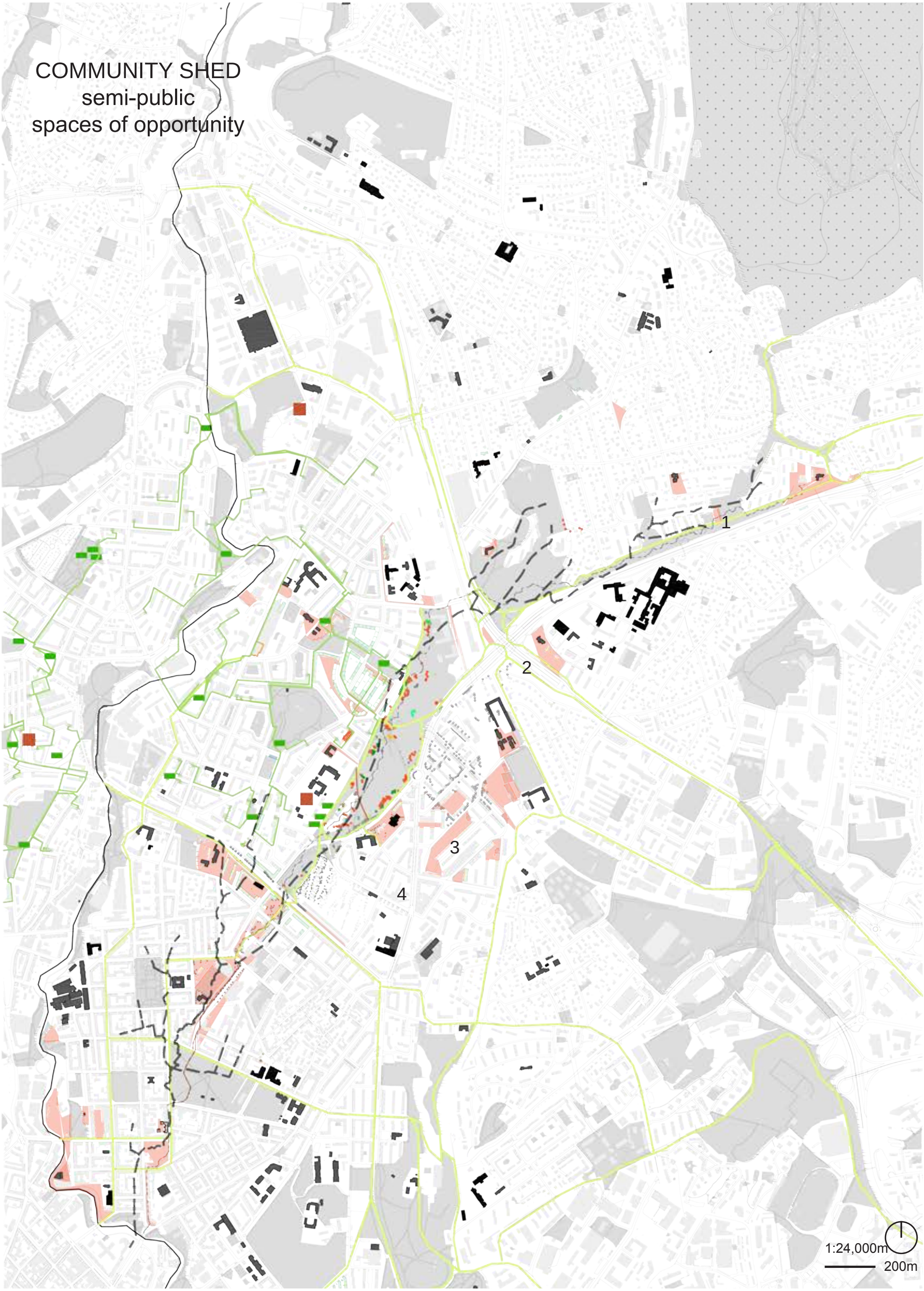
1941 Vølenvolden farm is bought by Oslo Kommune

1960 Vølenvolden farm opens to the public

1980 Lillo gård ends and is bought by Nycomed pharmaceutical company

2014 Lillo farm bought by developers, but preserved as cafe

2017 Geitmyra orchard and garden still operate by schools and community groups
(Moe, 2018) (OBUS, 2018) (Hansson, 2018)




Muselunden basin
1

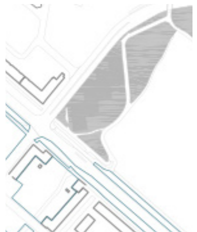
1:1000m

Footpath edge
2

1:1000m

Garden border
3

1:1000m



Tennis field
4

1:1000m

COMMUNITY DEVELOPMENT TOOLS

Tool-sharing program
Neighborhood directory
Networking group
Community website for public notices, ads, referrals, events
Community newsletter (bring together local writers, designers, and artists)
Neighborhood childcare co-op

Work and opportunity

Neighborhood “care” force
Emergency preparedness night, learn neighbors special skills, CPR training etc.
Aging-well resource center
Advocate for clean water sources
Outdoor exercise elements
Recreational fields

Health and Wellness

Engagement

Welcome new families
Annual block party
Little free library
Hang up a front yard swing
Regular monthly gathering
Home/garden tour for a cause
5K run/walk for charity
Holiday celebrations
Parents night out events

Transit, streets and sidewalks

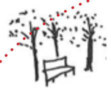
Protected Intersection
Protected Bike lane
Plaza
Streetscape
Parklet
Pathway lighting

Housing

Community-friendly Front Yard
Front yard swing or bench
Colorful perennial border to sidewalk
Seat-wall instead of full fence/wall
Firepit in front of house
Annual “barn-raising” event to help neighbors with fix-it projects

Arts and Culture

Start a book club
Local concerts
Neighborhood music lessons
Public Art Commissions
Art house
Arts council
Community murals
Sculpture tour



Outdoor spaces & public places

Establish a Community Garden
Convert neglected space into pocket park with seating
Volunteer Park Work Crews
Work with city to convert old easements or railroad tracks into mult-use trails
Community gathering spaces
New urban forest by community tree planting
Invent new play spaces
All season green house

sources: AARP Livable Communities, 2017
Ashton, 2017

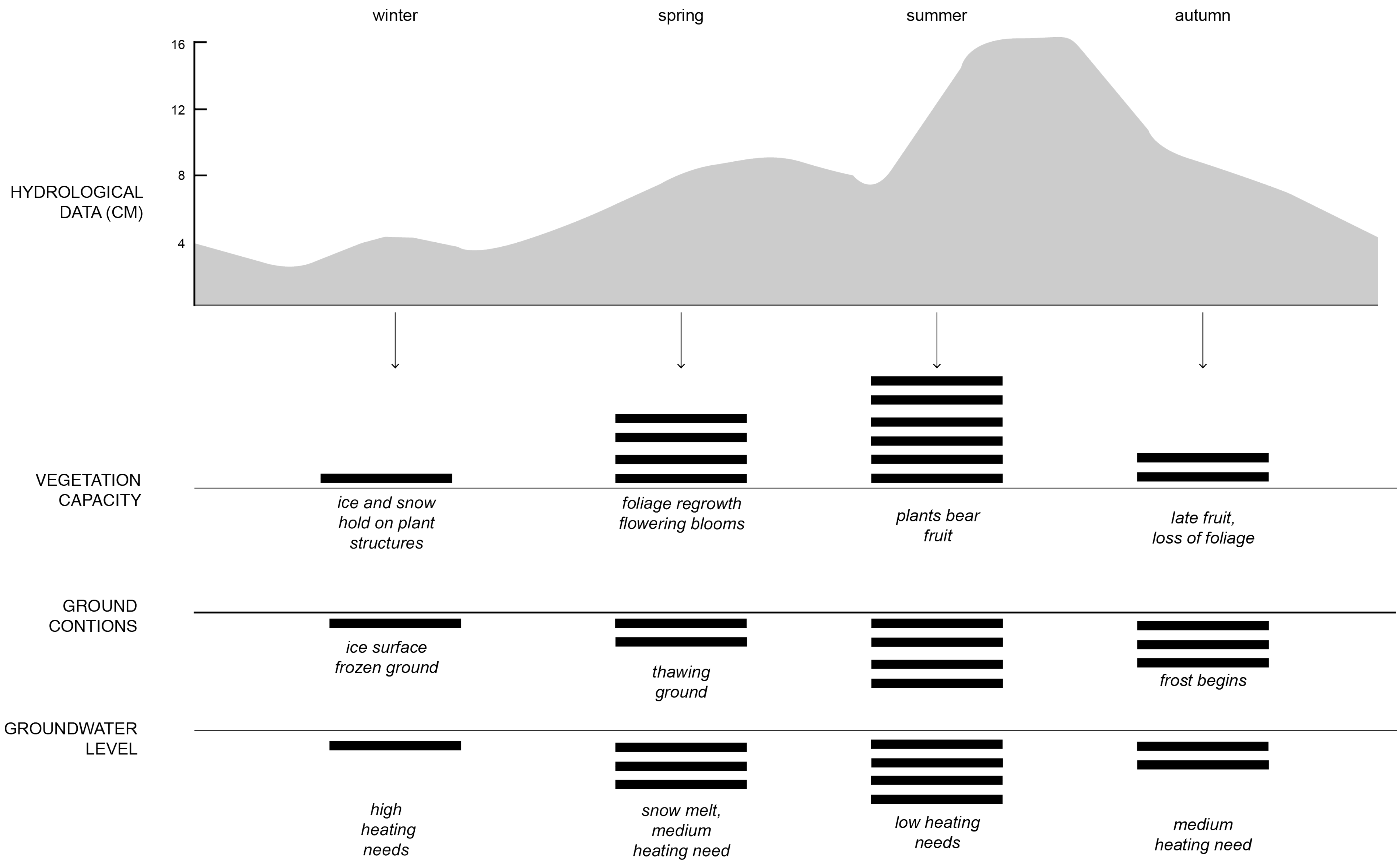
## ground/climatic perspectives

Rosenhoff school garden extends to Torshov valley (Skarpmoen, 1915-1927)

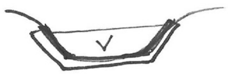
Ground and vegetation conditions through time

Dense tree planting (1125 Fra Torshovpark - Oslo, date unknown)

Role of Vegetation and Ground
*seasonal factor to infiltration capacity*



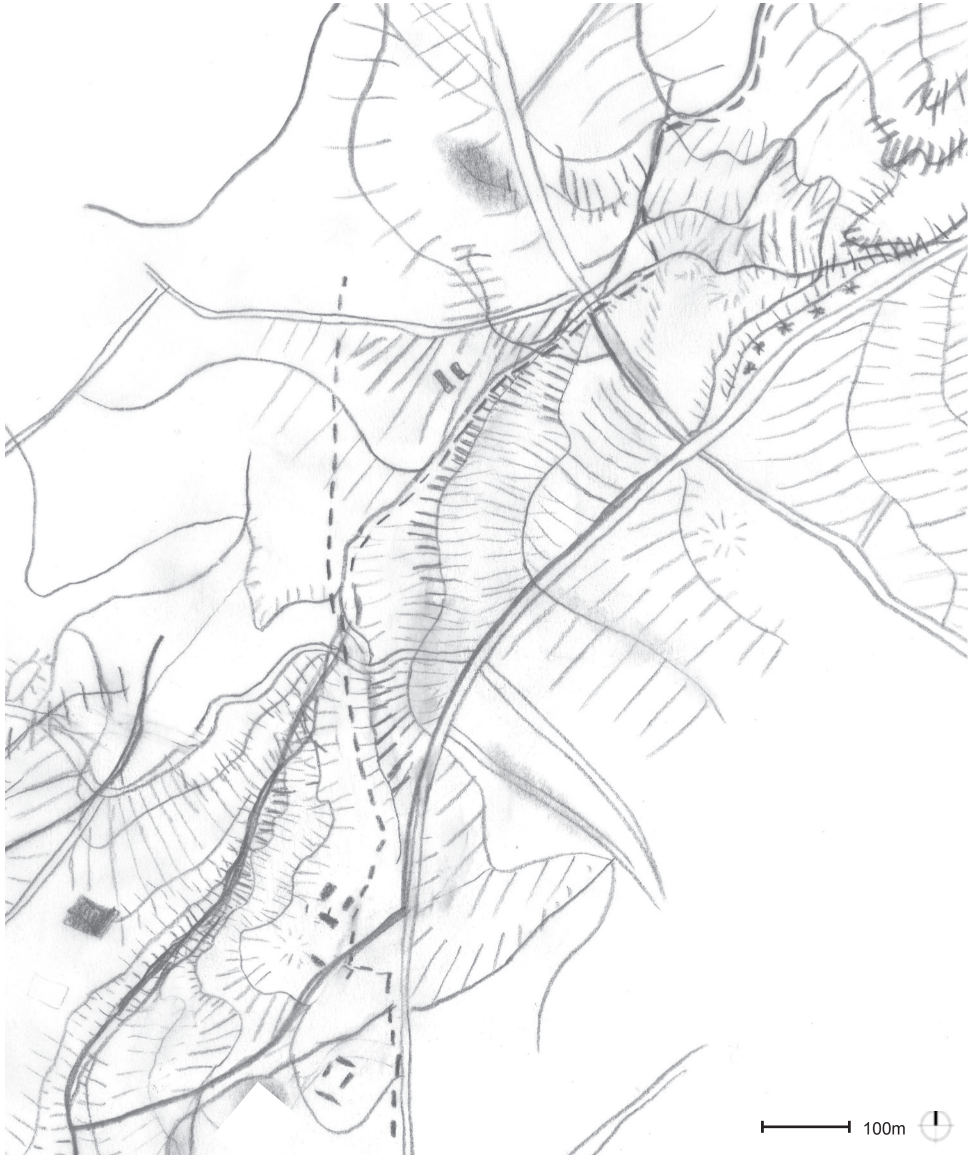
Role of Vegetation and Ground
*various factors to infiltration capacity*

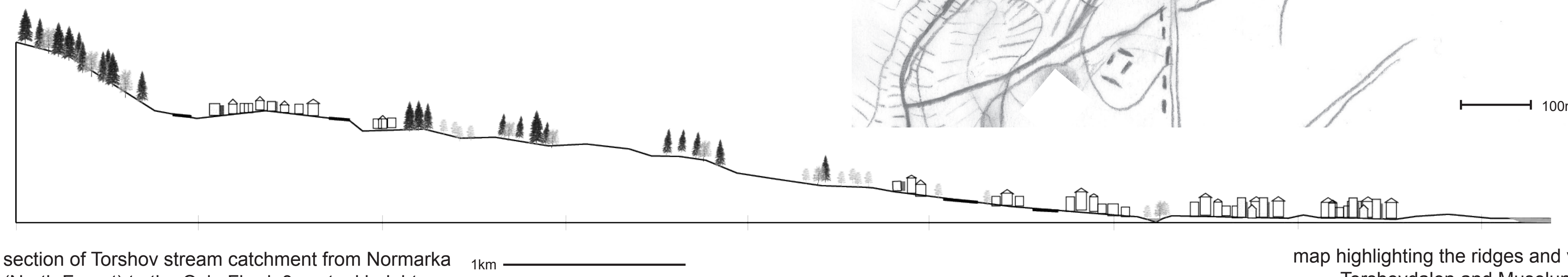
| **Basin** | **Material** | **Interparticle space** infiltration rate | **Vegetation** runoff coefficient and infiltration rate | **Rainfall intensity** filter medium's saturated hydraulic conductivity |
|---|---|---|---|---|
|  | concrete basin | 0 **mm/hour** | .95-1 concrete cover<br>0 **cm/hour** | impermeable |
|  | grassed-in swale<br>clay soil | **0.2-7 mm/hour**<br>Clay (smaller than 0.002mm diameter) | 0.2 grass cover/heavy soil<br>1.0 cm/hour infiltartion | 0.0038 clay m/hour |
|  | vegetated rain bed<br>sandy soil | **10-100 mm/hour** Sand (0.05-2mm diameter) | 0.15 pasture/sandy soil<br>3.5 cm/hour infiltration | 0.0425 fine sand m/hour |
|  | gravel bed & forest<br>sandy loam soil | **2-15 mm/hour**<br>Silt (0.002 - 0.05mm) | 0.15 forest cover<br>5.0 cm/hour infiltration | 0.0158 sandy loam m/hour |

Data source: (Marsh, 1981,p.277)
(Waterboards, 2011)

## PERSPECTIVE

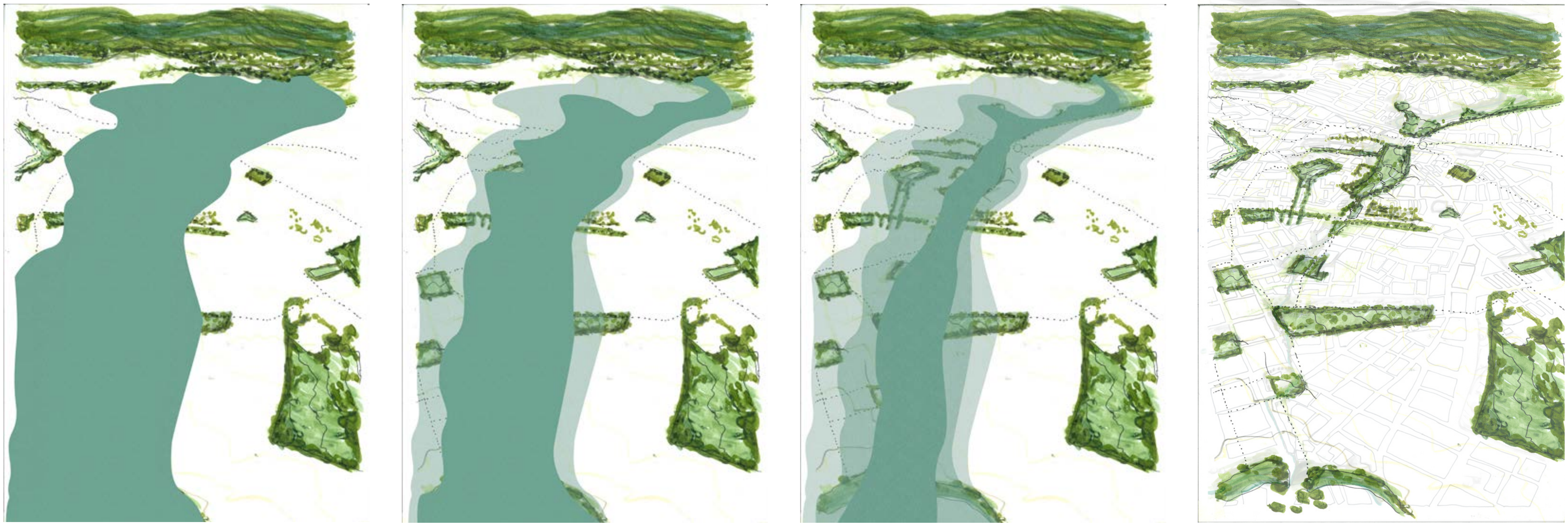
The fjord historically shaped the valley, it withdrew leaving deposits in the valley floor. It was then urbanized, parcelized, cultivated, asphalted, and piped. There was an attempt to keep a connection from the forest to fjord. However it may seem invisible, now it is coming back as an extensive water and forest network by re-exploring the concept and forms of in-between space its functions and specific roles (open public, collective space form, etc.) The design approach will be shaped new logic, form, and meaning to the urban territory, and new alliances among different fields of knowledge.



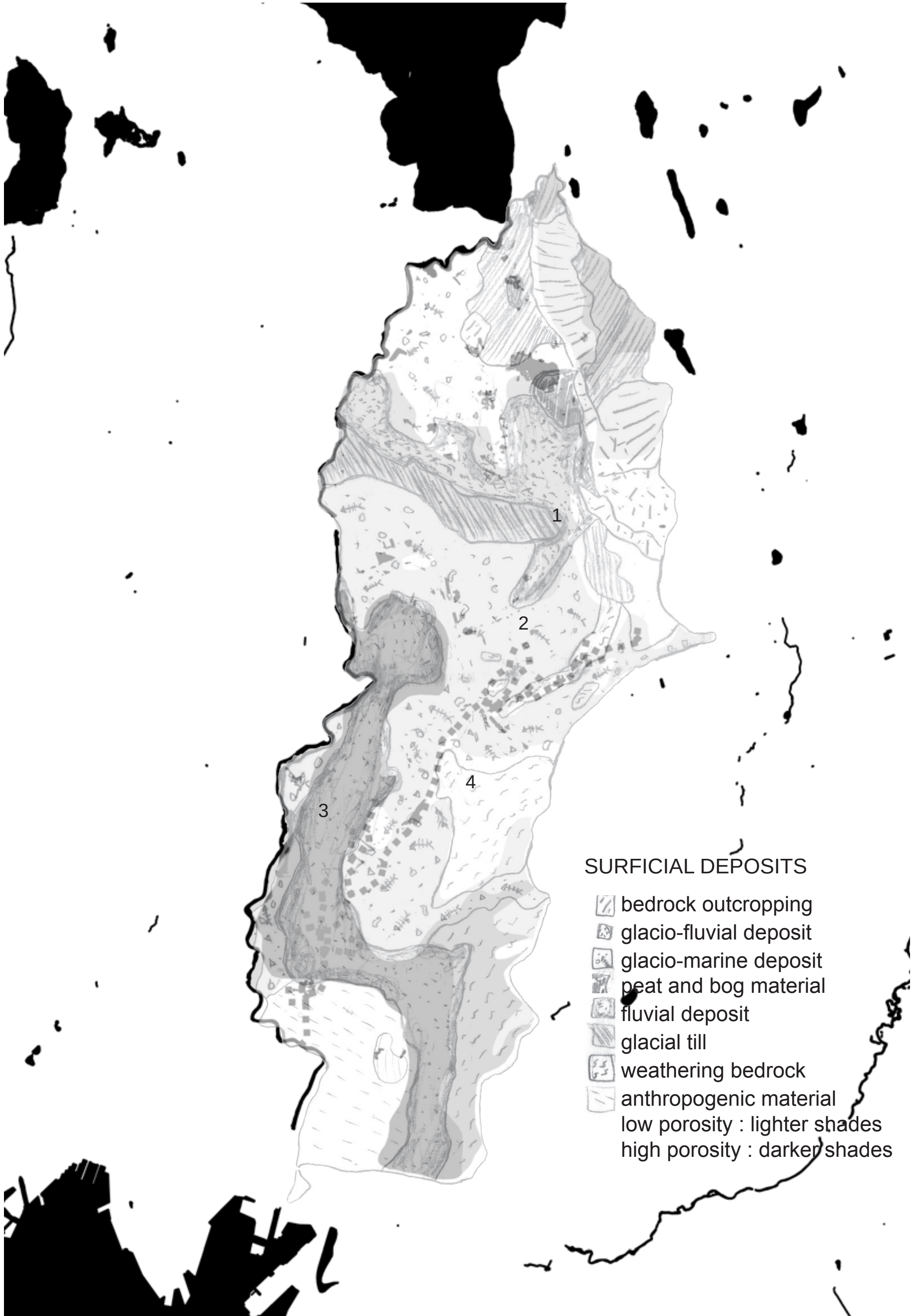




section of Torshov stream catchment from Normarka (North Forest) to the Oslo Fjord. 3x actual height

map highlighting the ridges and valleys of Torshovdalen and Muselunden area



glacier melt millions of years ago
shaping the valley floor




Fluvial
1

This deposit is well sorted, stratified deposits of sand and gravel along today's river. Formed by water transport of till, glaciogluvial or bedrock material, this common valley sediment is suitable for agriculture and groundwater use.

Glacial till(morene)
2

Morene material derives from erosion by the moving ice of a glacier. It has badly rounded rock gragments of all sizes in mostly fine-grained groundmass. The thickness varies from thin cover to ridges of 30m when cleaned for coarse fragments till is good agricultural land.

Glacio-marine
3

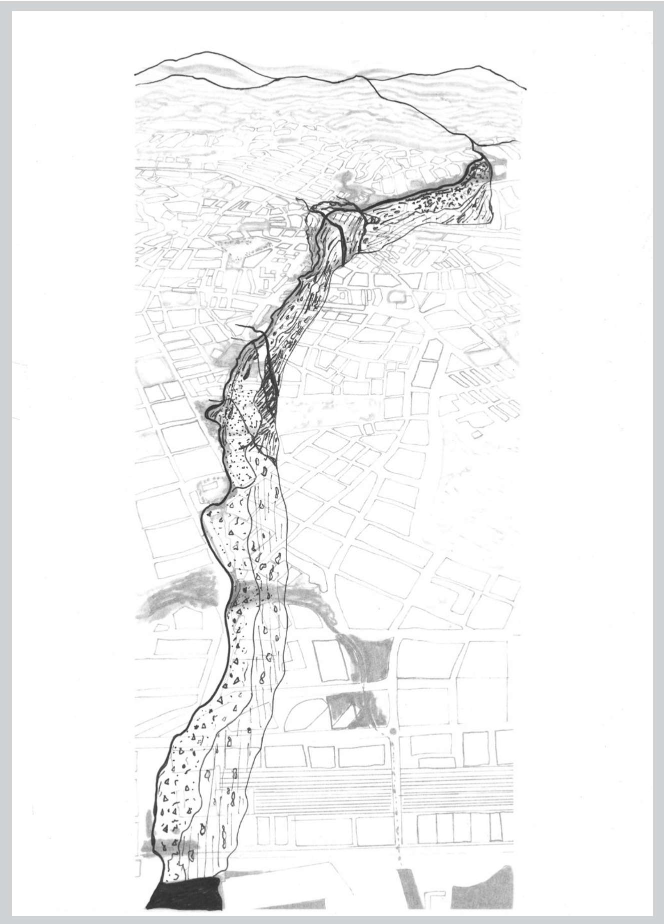
This fine-grained (clay-rich) sediment deposited in fjord up to the marine limit. It is ice-scoured material, washed out of till and glaciofluvial material, with some coarse fragaments. A thick cover often lies in fjord valleys downstream from till and glaciofluvial deposits, making lowland agriculture areas.

Limestone
4

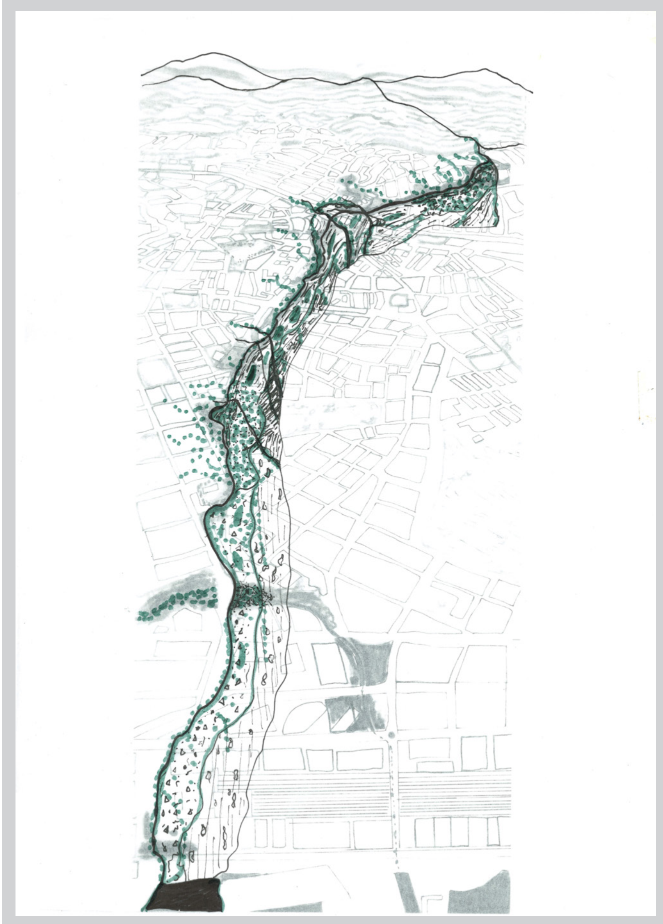
Outcroppings this metamorphic bedrock is over 250 million years old. When there is a dip in the direction, called a stratification discontinuity, the rock is often porous.

data source: (Heim, 2017) (Sena, 2018)
photos source : (Betina, J. and Heim)

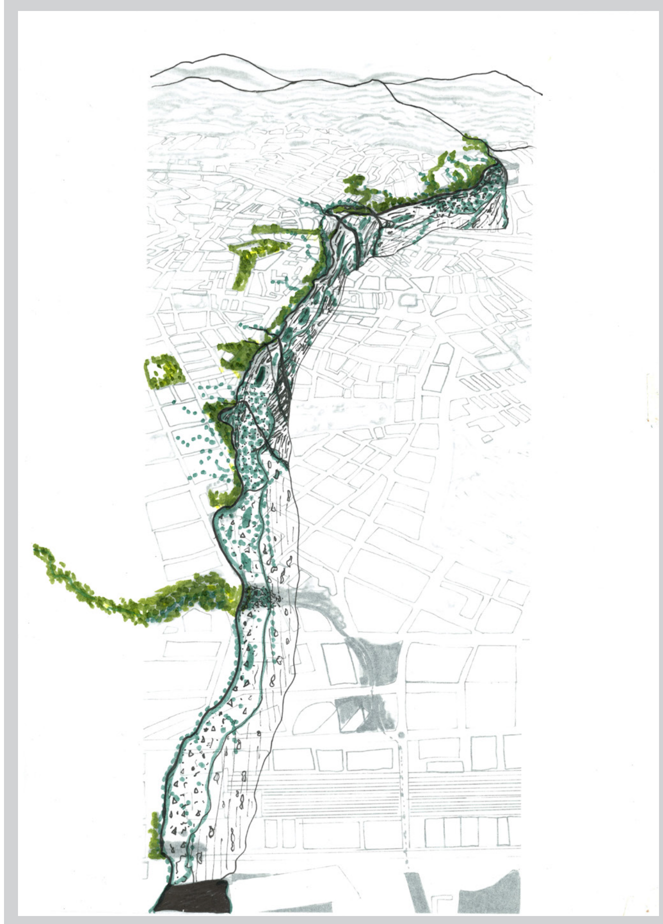
*from fjord to forest section cut*



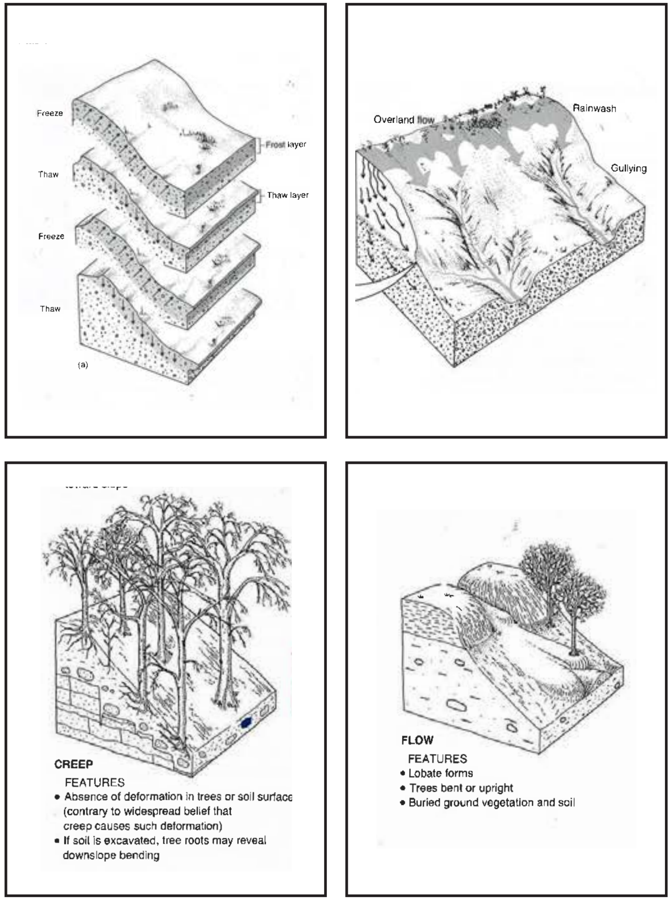
geomorphology



infiltration informs water below the surface



capillary action informs water above the surface



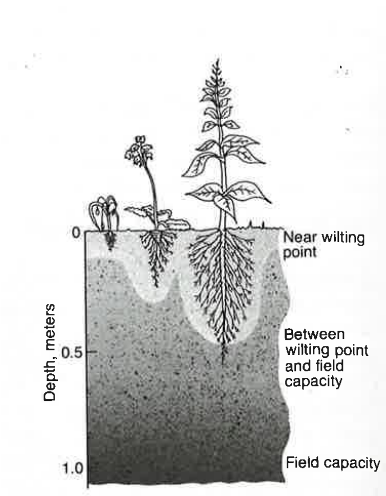

IMPACTS FROST-RELATED PROCESSES

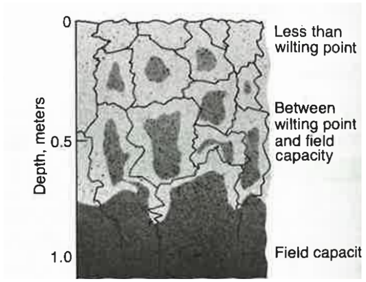
Mass movement is one result of freeze-thaw activity and wet soil conditions produce mass movement. When ice melts, runoff water produces erosion and gullies on hillslopes. Other hillslope movement examples such as creep and flow can take place as well from soil water and groundwater strength and stress. (Marsh et al, 1981)

“In warmer climate zones, the compression pressure enhances the challenges of handling urban surface water. This is also the case in cold weather, but here it is snow and meltwater that must be in focus. The solutions must be adapted to the challenge of running water on frozen land to a greater extent than the heavy rain showers. In situations of snow melting on frozen ground, it is in practice only the landscaping of the terrain that provides safe dewatering and which provides a reliable infrastructure”(Bergset et al, 2017).



Diagrams: Marsh, 1981 p.425,426,432

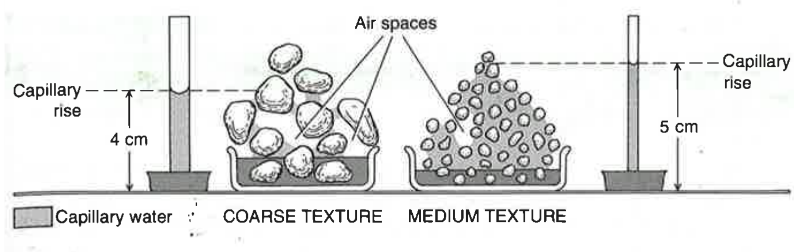



INFILTRATION FACTORS

VEGETATION
The roots and stems of plants loosen soil, further facilitating water penetration of the surface. Also burrows of creatures such as worms and moles, build passageways which serve as water entry routes in the soil. The primary type of water used by most land plants is capillary moisture that is held in the upper 0.5 meter of soil. **Moisture uptake by plants can be high; large fir trees consume as much as 1500 gallons (5.67m3) of water per day.**

The infiltration capacity of an old permanent pasture is nine to ten times greater than that of barren ground. In addition, plant stems and organic litter increase the roughness of the soil surface, decreasing the speed of overland flow and allowing more time for infiltration. In addition, we find that on bare soil the physical impact of rain drops compacts the soil and reduces infiltration capacity. Vegetation virtually eliminates this effect.




INTERPARTICLE SPACES - SOIL TEXTURE
Capillarity is higher in medium textures than in fine or coarse textures. Medium textures (silt, fine sand, and loam) has the greatest capillarity because the particles are small enough to develop strong meniscuses, yet large enough to allow ready movement of the moisture film between particles. This is a critical determinant of a soil's propensity for drought.

Large aggregates, as in a coarse prismatic structure, tend to minimize the number of aerated passageways which serves as the release routes from vaporized water. The cracks that enhance infiltration also enhance moisture loss through evaporation. (Marsh, p.156-57)

INFILTRATION FACTORS

RAINFALL INTENSITY
If the amount of rain that strikes the ground per minute or hour is so great that the infiltration capacity on a sloping surface is exceeded for a short time, water is lost to runoff. As rainfall continues, interparticle spaces become filled with water as well as with fine particles dislodged from the surface, resulting in a decline of infiltration and increase in rain converted to runoff.

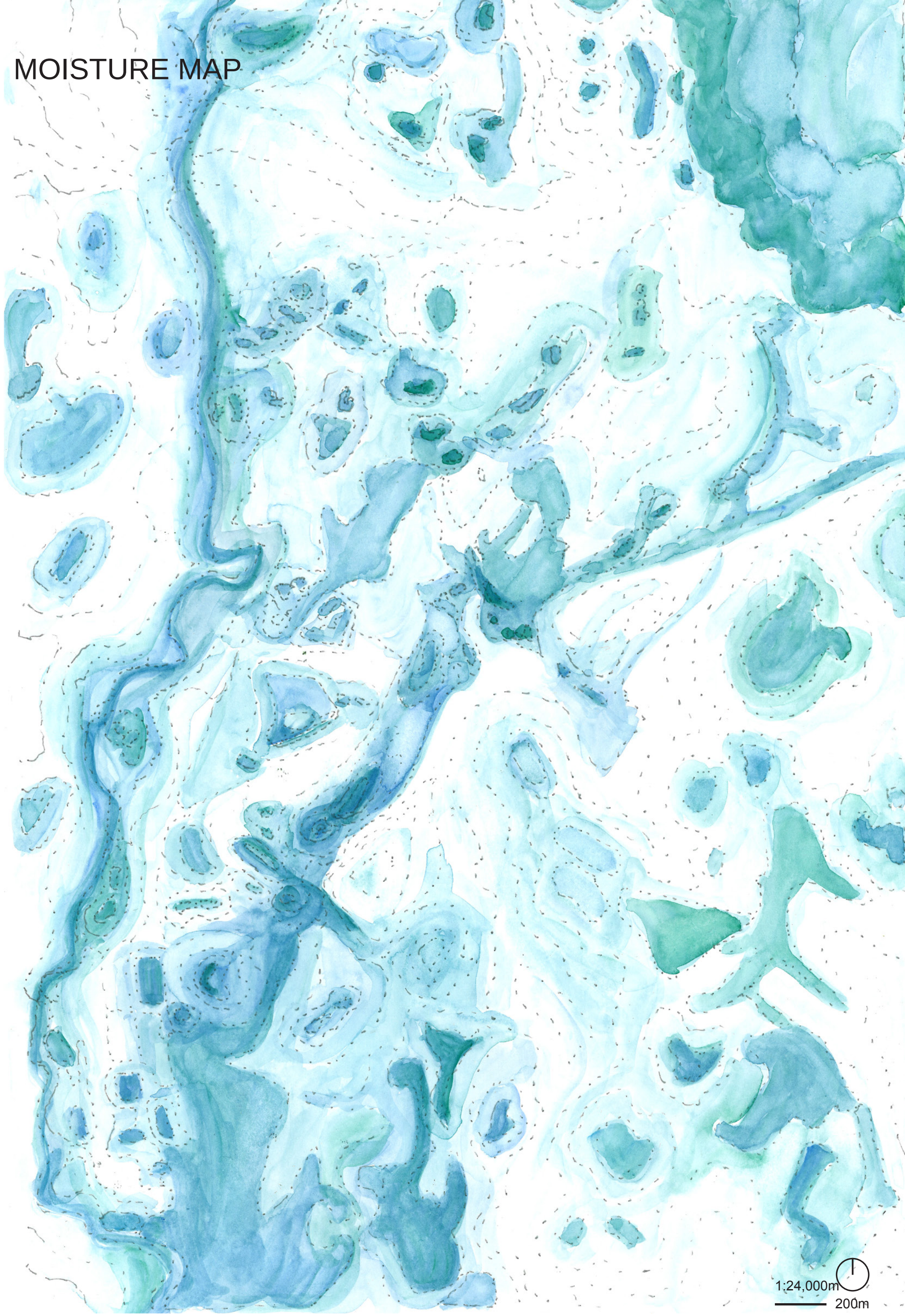
SEASONAL FACTORS
If freezing takes place when the upper soil is at or near saturation, a thin layer of interparticle ice can form and infiltration can be reduced to zero. Interparticle spaces become blocked with ice and divert essentially all rainwater or snowmelt water into runoff. Such conditions have been known to contribute greatly to flooding by locking out water from snowmelt and rain, thereby forcing essentially all of it into streams and rivers. Infiltration capacity may also change as the water content of the upper soil seasonally changes. In clay soils, addition of water may produce particle swelling and closing of interparticle spaces.

**These factors along with the seasonality of plant growth and the ground frost of winter, characteristically render changes of 25-50% in infiltration for periods ranging from a few days to several months.** (Marsh, p. 158)


Collage based on the artwork by: Maria Sibylla Merian
"Dandelion (*Taraxacum officinale*) and Tussock (*Dasychira fascelina*)"

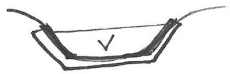
sources: , 2017

MOISTURE MAP



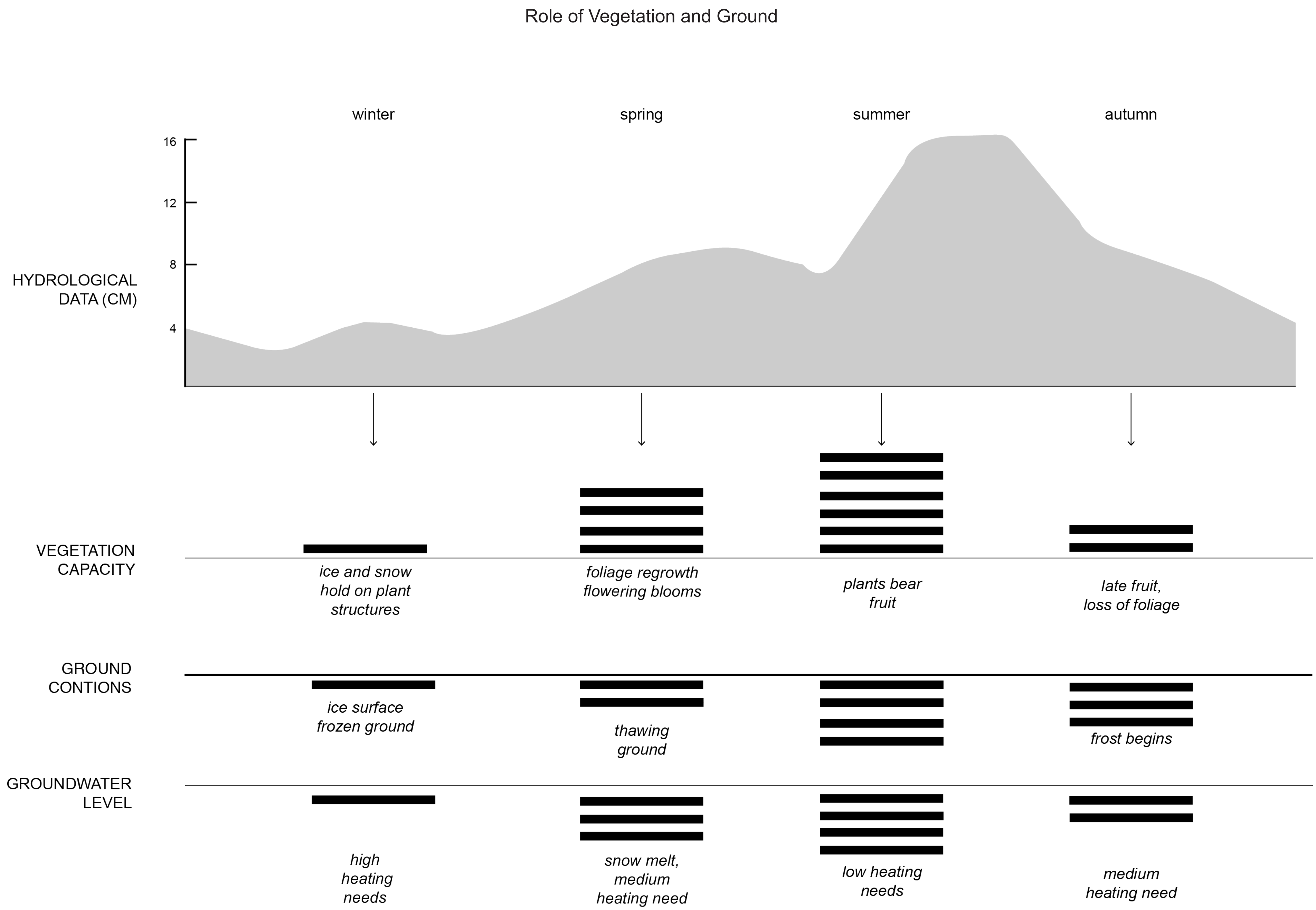

1:24,000m
200m

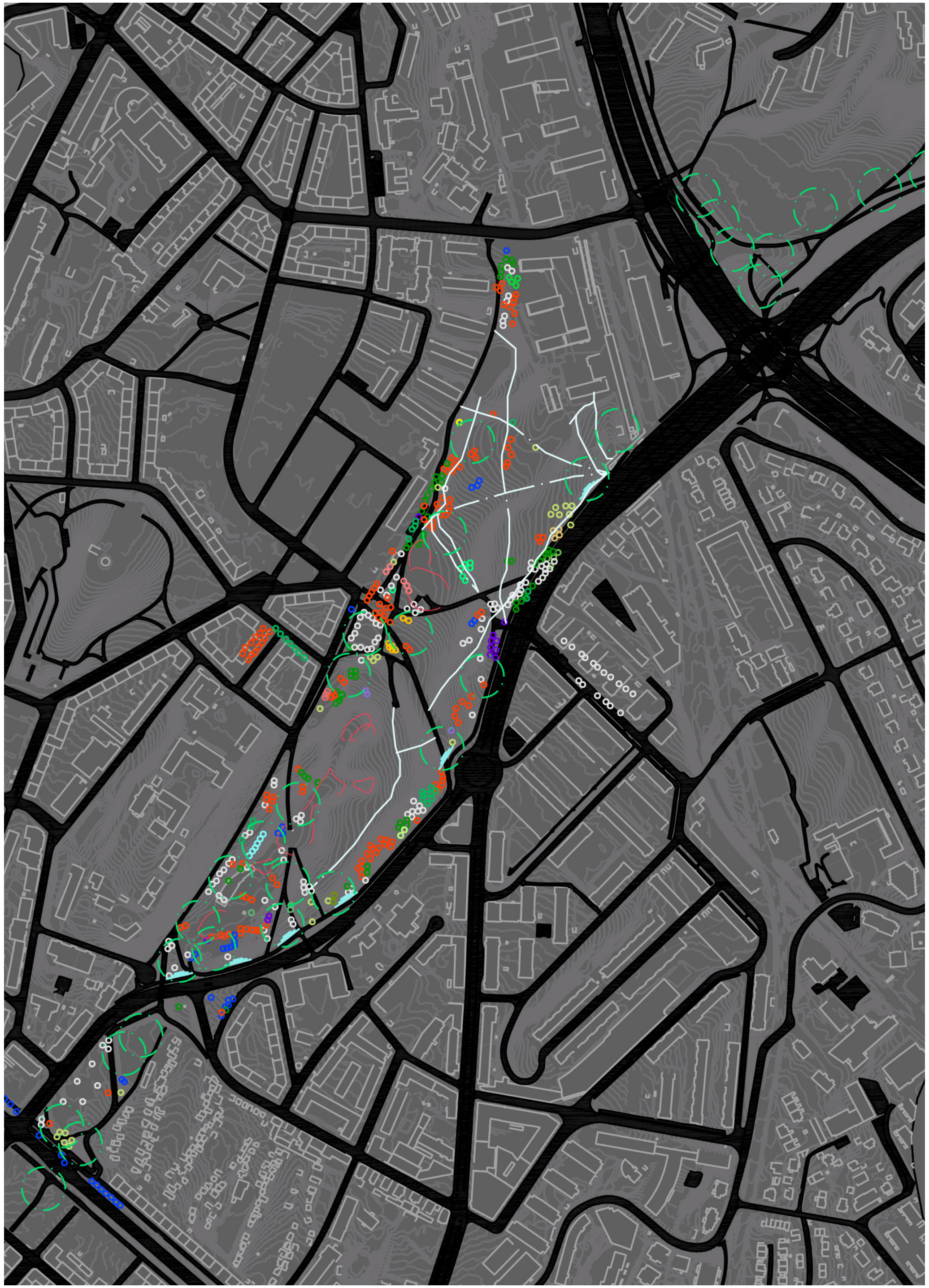
## Infiltration Capacity Factors

| | VOLUMES | INTERPARTICLE SPACES<br>measured by infiltration rate | VEGETATION<br>measured runoff coefficient and infiltration rate | RAINFALL INTENSITY<br>measured by filter medium's saturated hydraulic conductivity | SEASONAL FACTOR<br>see following page diagram |
|---|---|---|---|---|---|
|  | concrete volume | 0 | 0 | impermeable | |
|  | grassy swale clay soil | 0.2-7 mm/hour<br>Clay (smaller than .002mm diameter) | 0.2 lawn/heavy soil<br>1.0 cm/hour infiltartion | 0.0038 clay m/hour | |
|  | rain bed sandy filter me | 10-100 mm/hour<br>Sand (.05-2mm diameter) | 0.15 pasture/sandy soil<br>3.5 cm/hour infiltration | 0.0425 fine sand m/hour | |
|  | forest sandy loam soil + gravel rock bed | 2-15 mm/hour<br>Silt (.002 - .05mm) | 0.15 forest cover<br>5.0 cm/hour infiltration | 0.0158 sandy loam m/hour | |

VAV suggests the substrate is .1m/ hour or less.

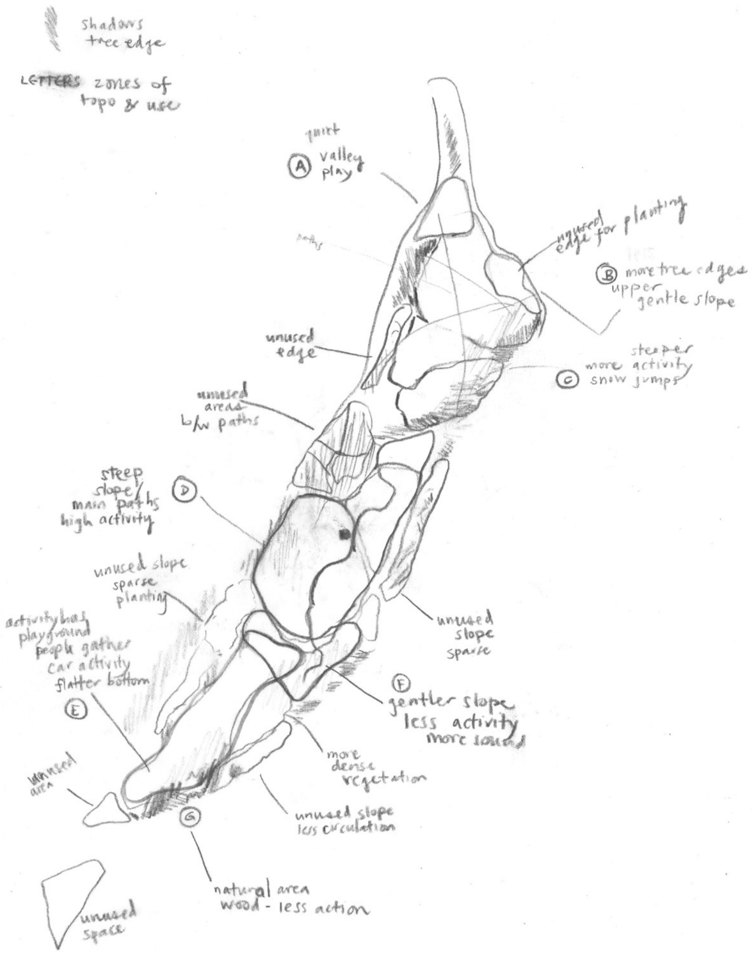
Data source: (Marsh, 1981,p.277)
(Waterboards, 2011)


Role of Vegetation and Ground
winter
spring
summer
autumn
16
12
8
4
HYDROLOGICAL DATA (CM)
VEGETATION CAPACITY
ice and snow hold on plant structures
foliage regrowth flowering blooms
plants bear fruit
late fruit, loss of foliage
GROUND CONTIONS
ice surface frozen ground
thawing ground
frost begins
GROUNDWATER LEVEL
high heating needs
snow melt, medium heating need
low heating needs
medium heating need



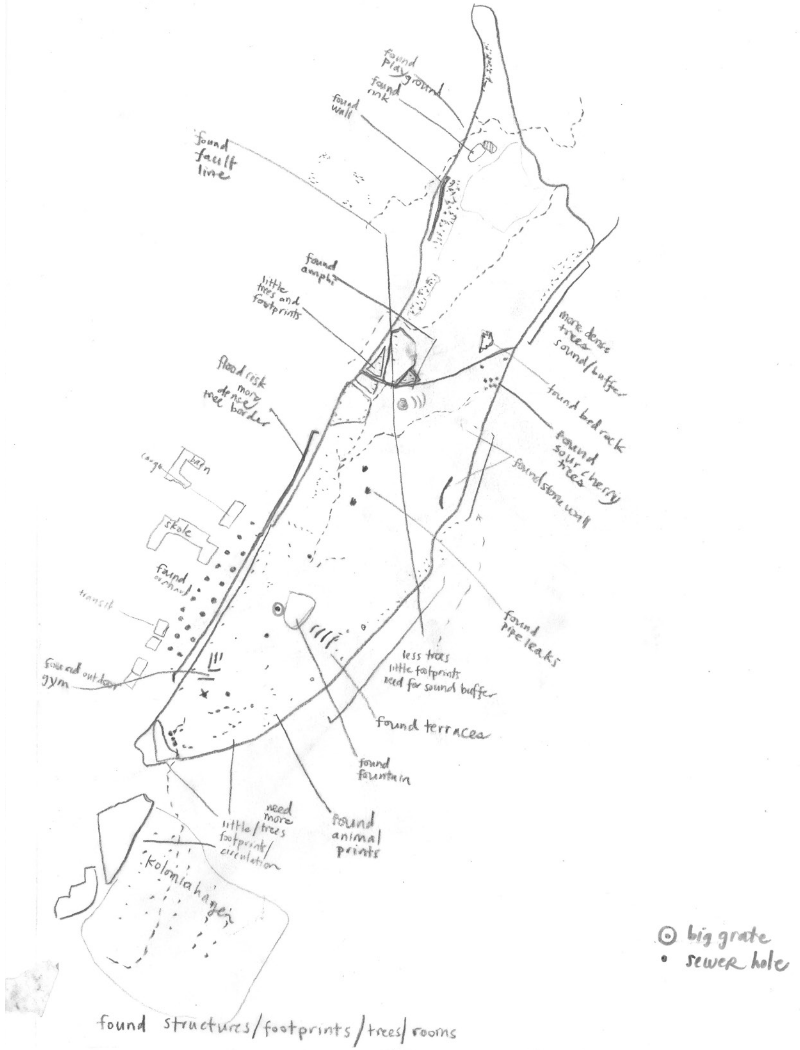
Trees, Existing and Opportunities 1:8000m
data source: Kartbank, Bymiljøetaten Oslo Kommune

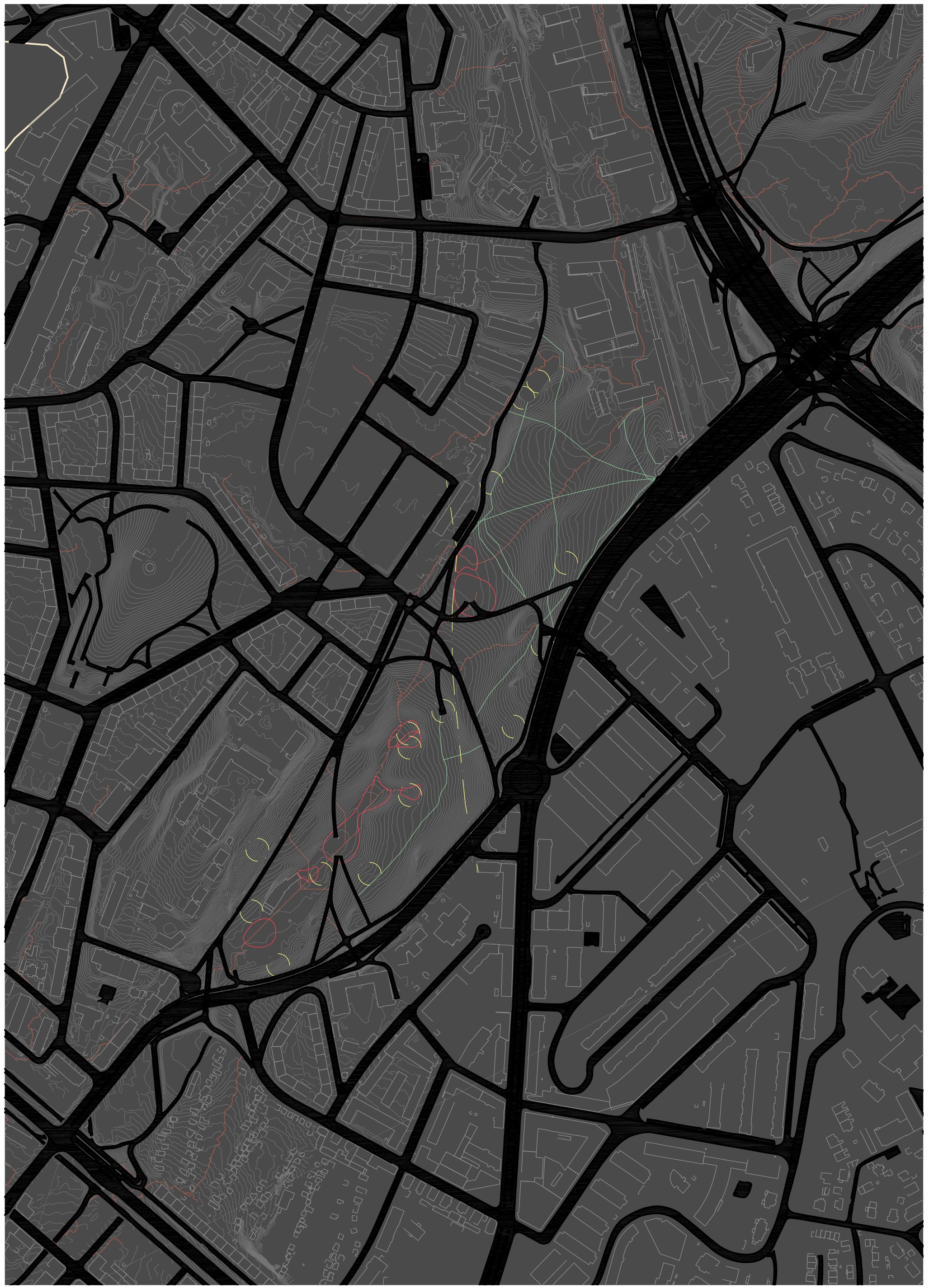
100m




- planting opportunity
- observed saturated areas
- *Pseudotsuga menziesii (douglas fir)*
- *Ulmus glabra (scotch elm)*
- *Betula pubescens (white birch)*
- *Acer platanoides (norway maple)*
- *Prunus sp. and Malus dolgo(cherry and crabapple)*
- roads

TREES OF AKERS RIVER BANK
*Salix sp. (willow species)*
*Populus sp. (poplar species)*
*Alnus incana (grey alder)*
*Fraxinus excelsior (common ash)*



- unofficial paths
- 5km2 drainage lines
- observed saturated areas
- interesting found elements
- roads

Existing Usage Observations1:8000m

100m

# WATER, MOISTURE, ICE

*a study of recent*
*Oslo water projects*
*in changing seasons*

The water body storage of Tiedemann Park.
photos: J.Betina

Water body expanded under the bridge and fully on the other end. The vegetation is not dormant but green and saturated.

Opportuniity: storage of moisture.Tiedemann Park. photos J.Betina

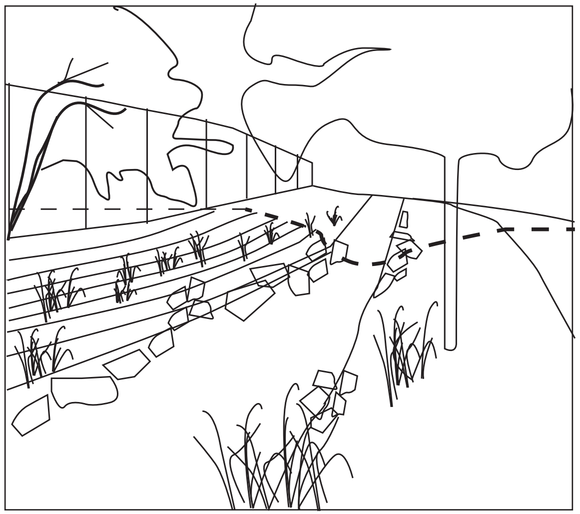
The area is much more saturated and ice covers the grass expanse.

Geographical circumstances. Teglværk dam.
photos by J.Betina

Little footprints are found descending down the steep slopes due to icy conditions. People walk down the path where gravel is on the ice.

Challenge of dimensions. Tiedemann Park.
photos by J.Betina

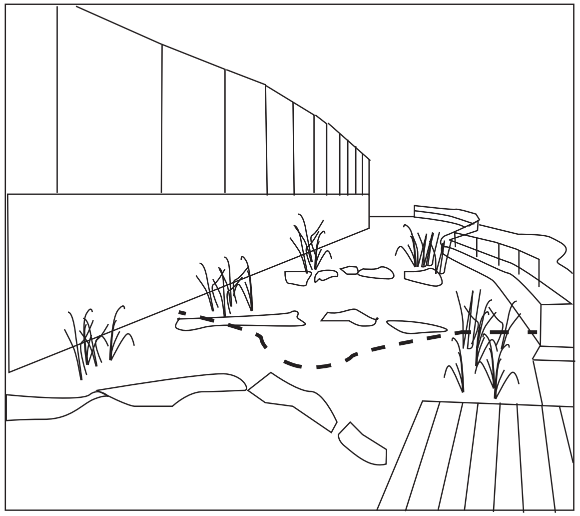
The steep water/path dimensions make walking on ice treacherous.



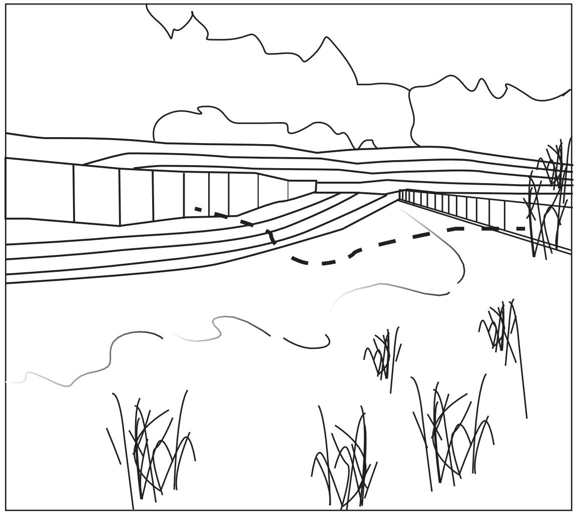
Challenge: wide forelands/flood zones for in-between areas.
Tiedemann Park. photos and re-drawing: J.Betina

In the winter conditions, little vegetation filters effusions from either the car park or road.

Challenge: ecological adaption for urban conditions and materials
Partially reopened Hovin Sream to Teglværk dam. photo J.Betina

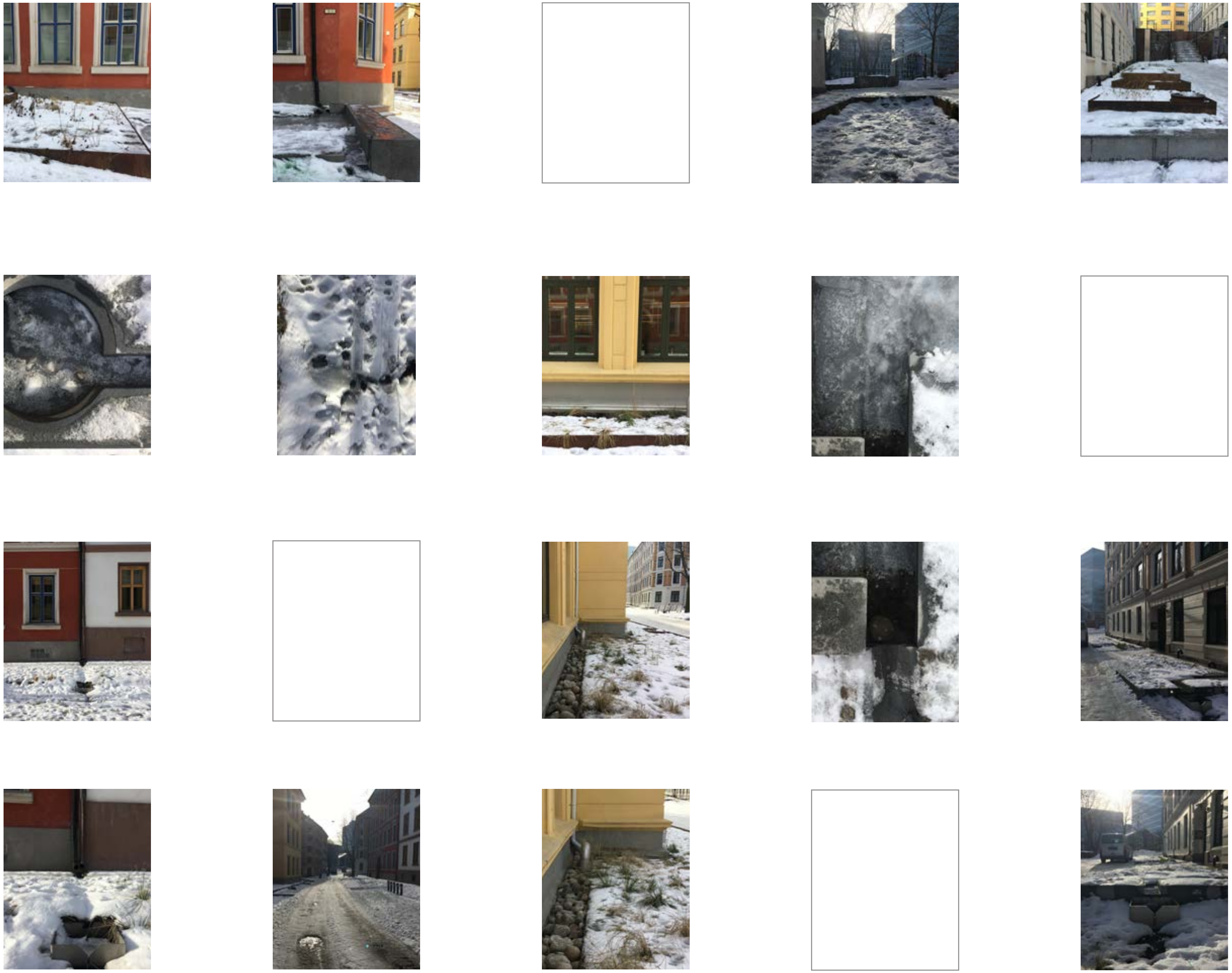


In winter, the neighbor car park places plowed snow in a heap. The effusions may run directly into the stream. The adjacent sidewalk is fully iced, showing that water is melting and moving along the route.

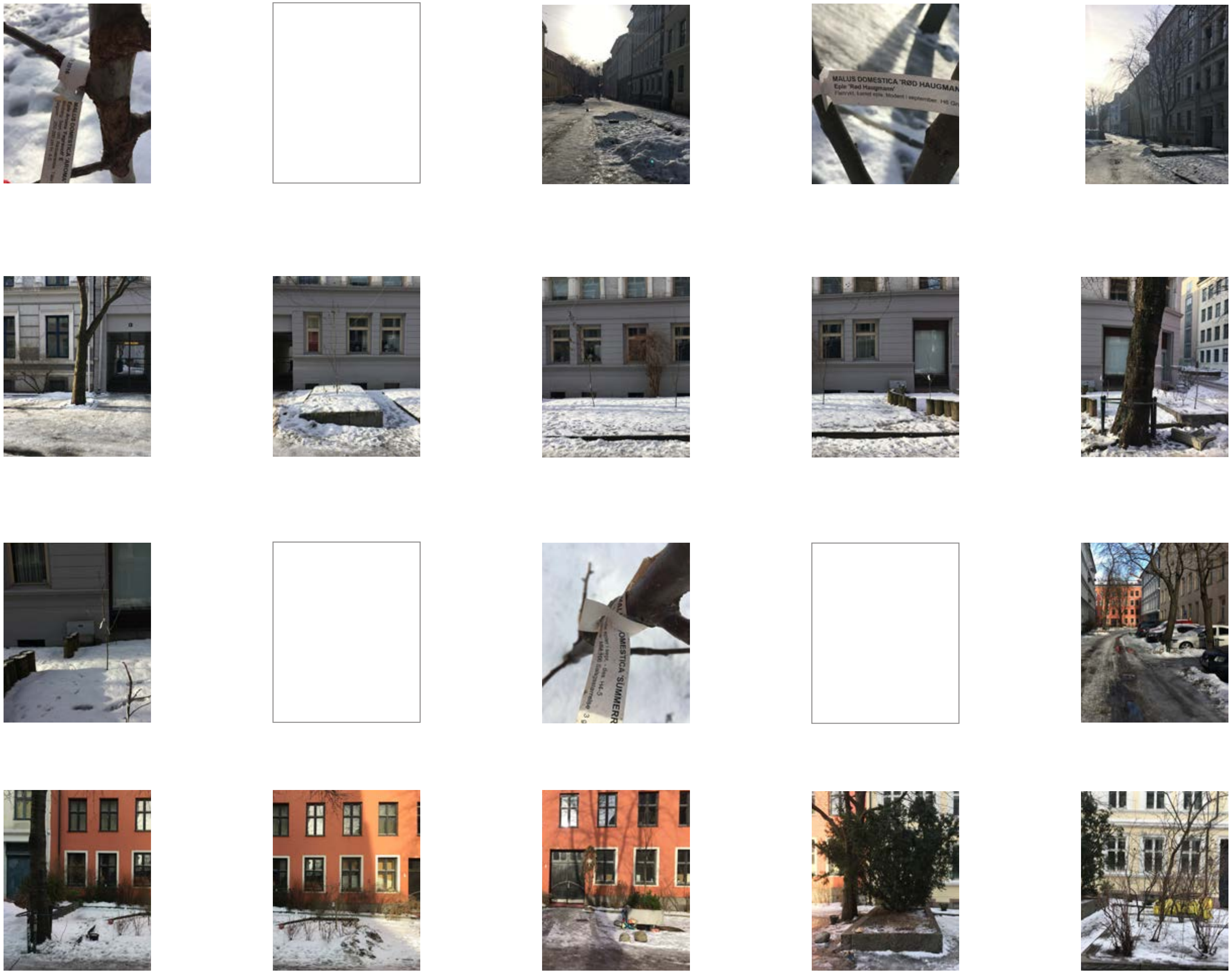


Challenge: subtle hills rather than steep erosive edges. Teglværk dam. photos and re-drawing: J.Betina

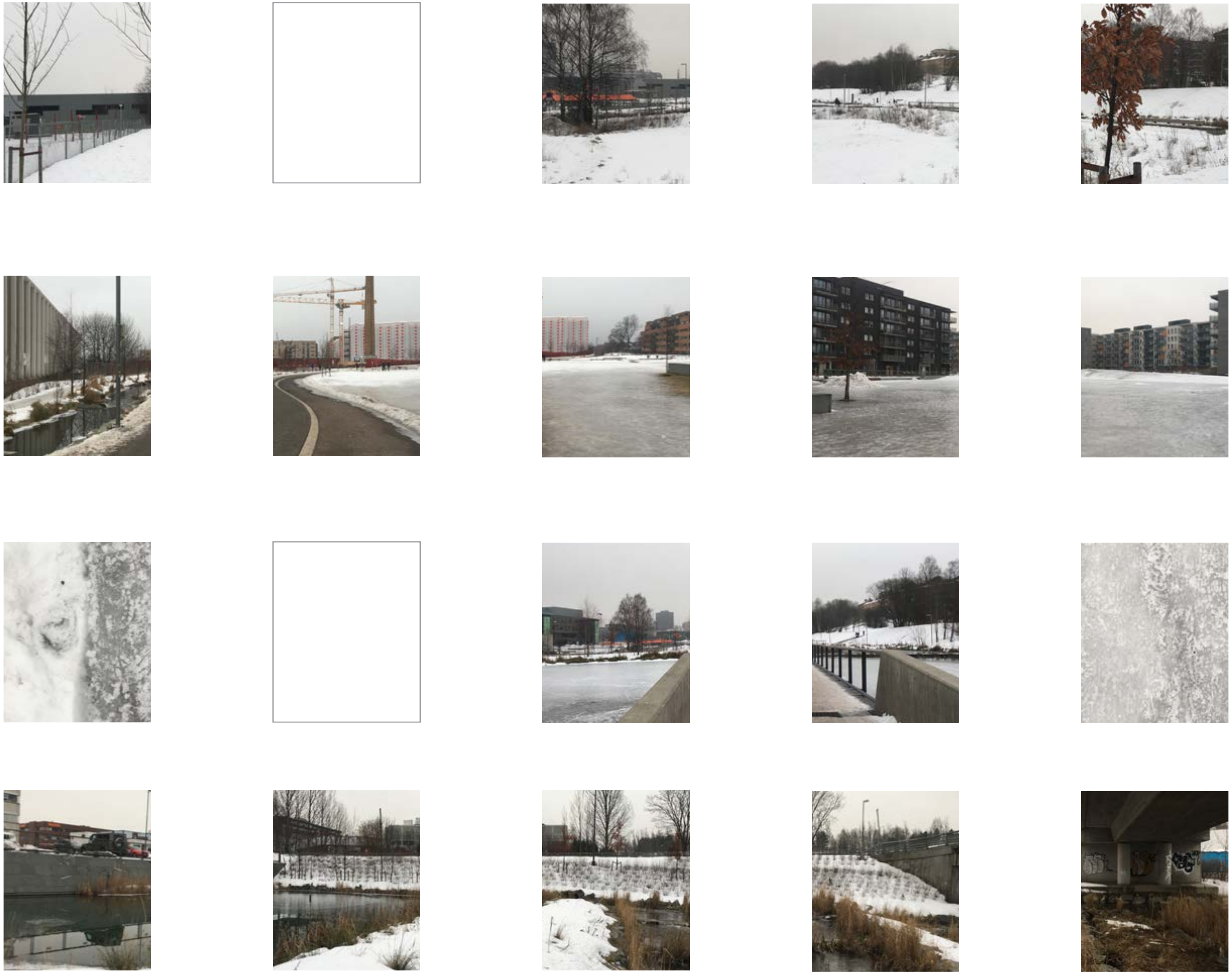
In the winter the plants are sparse along the edges to hold the soil.



DEICHMANS GATE, OSLO, NORWAY
stormwater project in February  photos: J.Betina

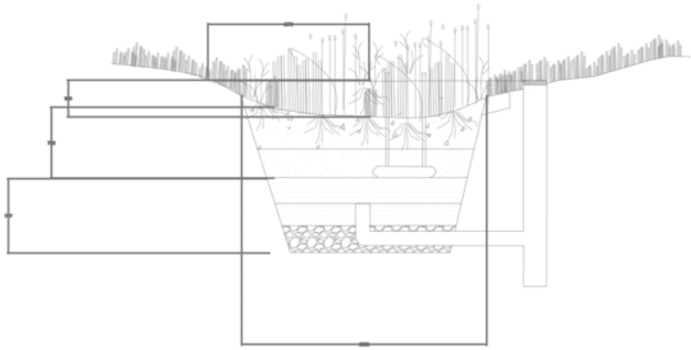



DEICHMANS GATE, OSLO, NORWAY
one block north photos: J.Betina



Hovin Sream to Teglværk dam, Oslo, Norway
river reopening project in February  photos: J.Betina

# PROJECT REVIEWS
*local rain garden precedents*



**rain garden project -** NILS BAYS VEI, OSLO, NORWAY

DESIGN
Elin Sørensen (COWI) and Bent Braskerud (NVE) 2009

ELEMENTS:
Heavy metals and dissolved pollutants are taken up in the top layer.
Saturated and electron layers promote dinitrification and keep the biological process aerobic.
Maximum water level is kept between 15-30cm high.
Drainage pipe has a diameter of 10cm or greater.

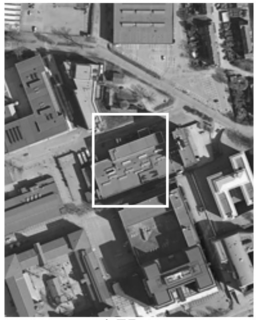
DIMENSIONS:
width at surface: 255 cm
depth of filtering material: 73 cm
depth of gravel: 78 cm
slope: 4.4:1

MATERIALS:
perennials
sand with leaf compost
sand with added iron
filtering medium
drainage gravel
drainage pipe
overflow outlet

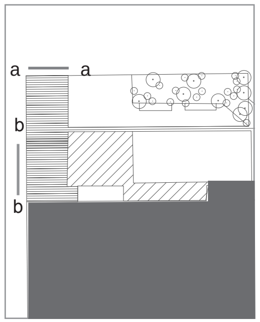
1:75 m

1m

Redrawing of rainbed cross-section (Paus, 2017)
Main principles in Nils Bays regnbed Photos: B.Braskerud



1:75 m




1:75 m plan

GRENSEVEIEN 97, OSLO, NORWAY

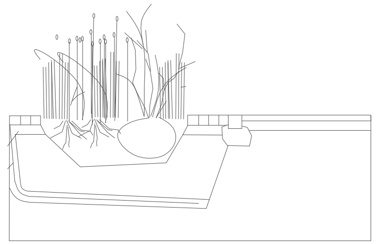
DESIGN
Bar Bakke landskapsarkitekter, 2017

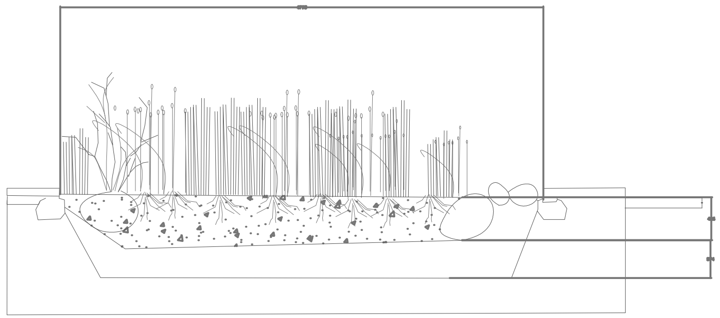
ELEMENTS:
Low relief pillars with mortar footings anchor the rainbed.
Natural cobble stones line the edges.
Thin layers of pea gravel, filtering fabric, and sand iline the bottom.
10 mm relief to the rainbed.
An impermeable membrane is situated under the surface of rainbed against the wall.

DIMENSIONS (A):
width at surface: 220 cm
depth of filtering medium: 46 cm
depth of natural rock: 32 cm
depth of sand: 5 cm

DIMENSIONS (B):
width at ground level: 480 cm
depth of filtering medium: 43 cm
depth of natural rock: 37cm

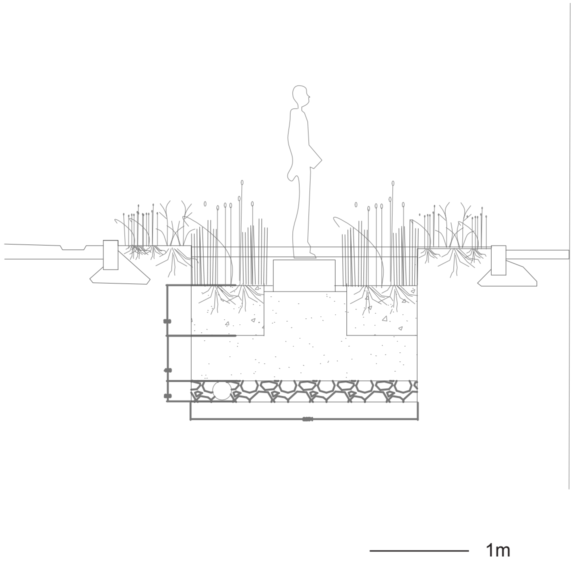
MATERIALS:
perennials
cobblestones
topsoil
pea gravel





1m

Redrawing of Grenselunden rainbed cross-section 1:50 (Bar bakke, 2017)




DEICHMANS GATE, OSLO, NORWAY

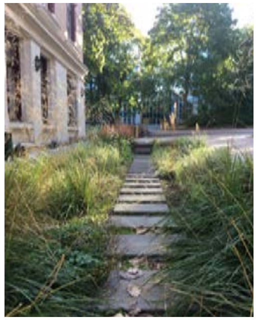
DESIGN
Asplan Viak AS 2016

ELEMENTS:
Stainless steel plates (1cm thick) lie along edge of rainbed.
Filtering medium inbetween concrete stepper with sand and crushed natural rock base.

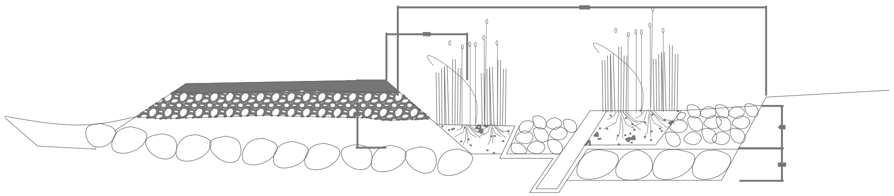
DIMENSIONS:
width at surface: 225 cm
depth of filtering medium: 50 cm
depth of sand: 45cm
depth of natural rock: 20 cm

MATERIALS:
perennials
sand

1:75 m



Redrawing of Deichmans Gate rainbed cross-section (Asplan Viak AS, 2016)
Photos: J.Betina



1m

CHARLOTTENLUND, TROMSØ, NORWAY

DESIGN
Steinsvik Arkitekter AS, 2015

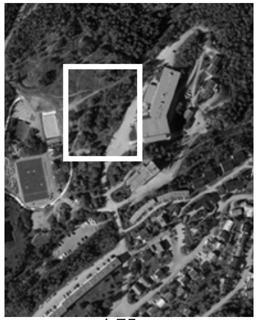
ELEMENTS:
Rubber is used as a reliable infrastructure and safe dewatering material in cold climate.

Course natural stone layer prevents holding and freezing of water. It instead leads the water to a filter medium even in cold climate.

The deeper layers of soil, natural rock, and added glass pores increase winter functionality of rainbed.

DIMENSIONS:
width at surface: 225 cm
depth of filtering medium: 32 cm
depth of natural rock: 45cm
slope: 1.2 to 1

MATERIALS:
perennials
local soil
filtering fibertextile
natural rock
non-permeable masses
glass pores
rubber
fjord gravel



1:75 m

Redrawing of rainbed cross-section in Charlottenlund, Tromsø (Steinsvik ARK, 2015) Photos: M.Bergset

1:75 m

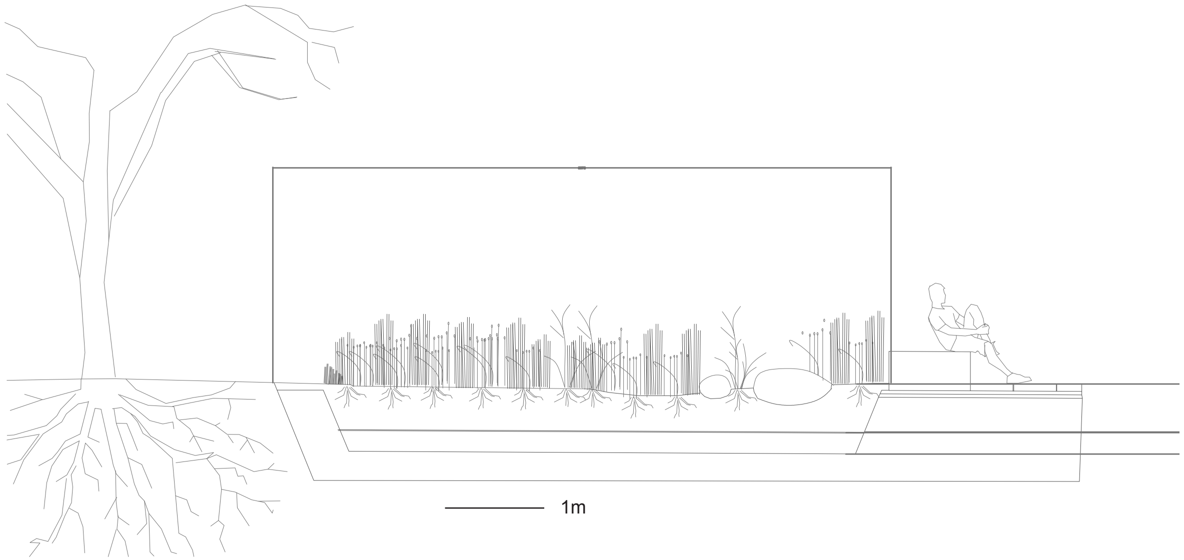
GRENSEVEIEN 97, OSLO, NORWAY

DESIGN
Bar Bakke landskapsarkitekter , 2017

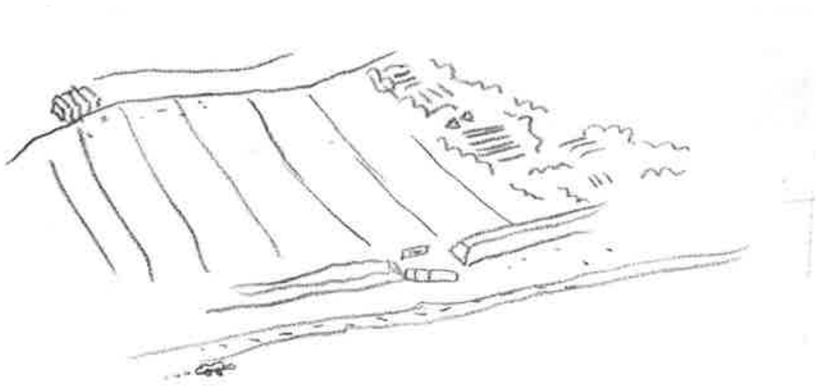
ELEMENTS:
Plant chamber contains diverse layers of natural materials: sand, compost, clay, soil. Multi-purpose design of seating and anchor to the rainbed.

DIMENSIONS:
width at surface: 837 cm
depth of filtering medium/sand: 65 cm
depth of natural rock: 29 cm

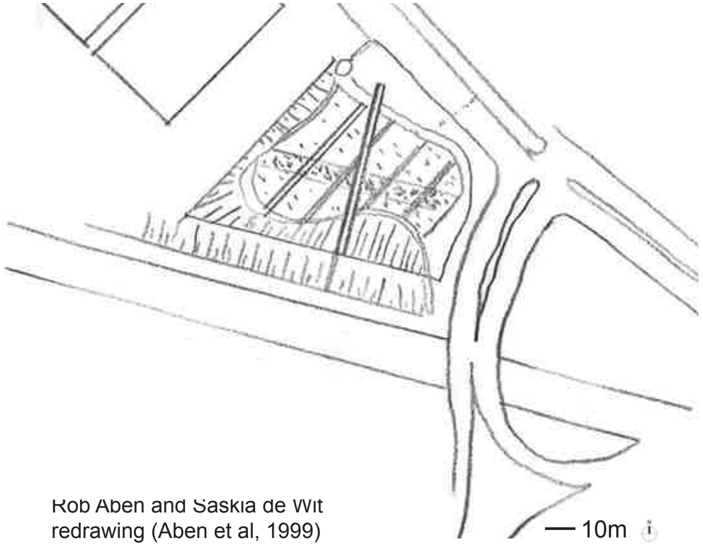
MATERIALS:
perennials
filtering fibertextile
boulders
crushed foundation
fjord gravel
concrete
drainage soil layers:
topsoil
sand
compost
clay



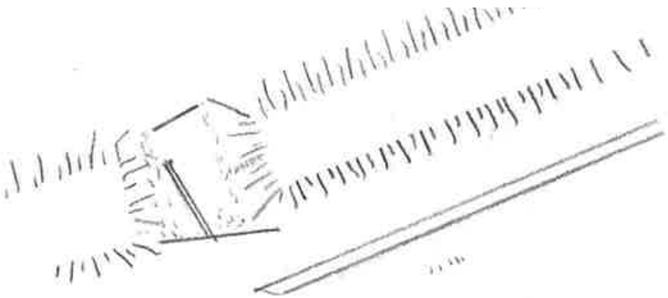

Redrawing of Grenselunden rainbed cross-section (Bar bakke, 2017) *highlighting terrain walls and depressions*

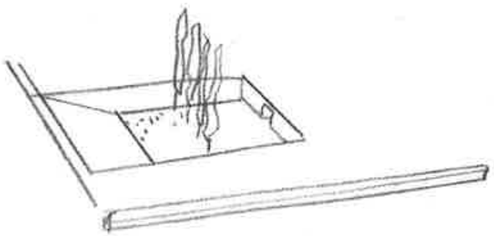


Observatory on the periphery of the
Rottemer Polder Design
West Rotterdam, Holland
redrawing (Aben et al, 1999)

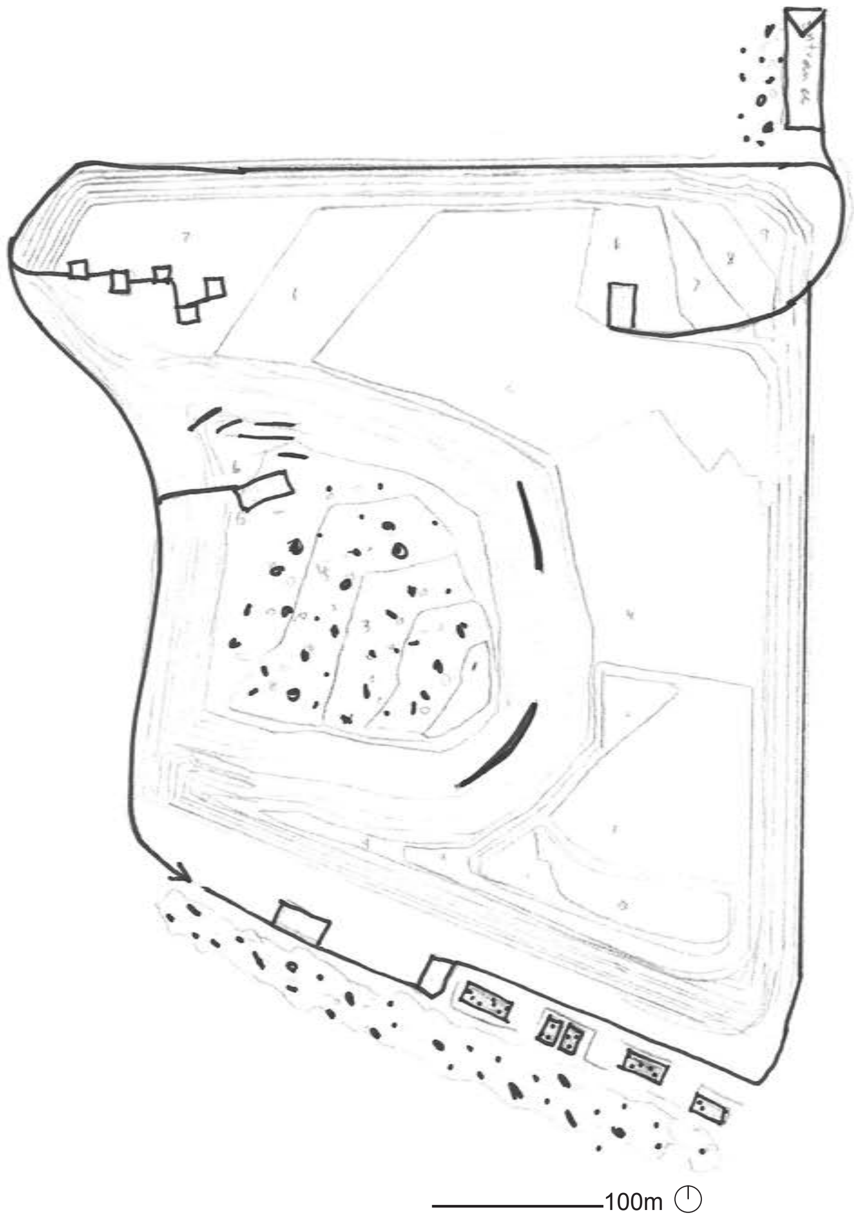



Rob Aben and Saskia de Wit
redrawing (Aben et al, 1999)





Duivendrechtse Polder Design
East Amsterdam, Holland
Rob Aben and Saskia de Wit
redrawing (Aben et al, 1999)




Merotto Gravel Pit Research Project
Veneto Region, Italy
redrawing (Vigano et al, 2009)

general elements:
designed for present and future climatic conditions
combines cultivation, ecosystem services, recreation,
tourist activites, and water storage
clarity of entrance by dense tree grouping
perimeter path along reservoir
recreational fields
viewing platforms
rest stop benches
jetties to access the basin in wet period

spatial elements:
spaces change based on seasonal conditions
wet woodland at low point of basin
tree colonade and hedge border along recreation area
brings sense of enclosure
permanent grass-in clearing forms a
natural arena area slightly higher in elevation

climatic principles applied to contemporary
common ground (semi-public) space
*highlighting tree-enclosed rooms and guiding pathways*

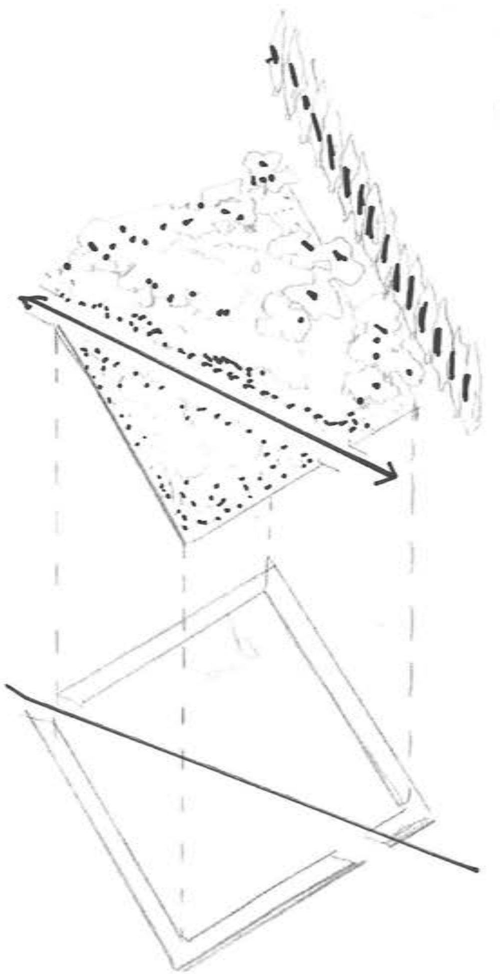
Skogskyrkogården
Stockholm, Sweden
Gunnar Asplund and
Sigurd Lewerentz 1920

general elements:
both outdoor and indoor structures
main and secondary pathways off the axis
specifici clearings of expanded view from a top ridge
green allées along north south axis

spatial elements:
large areas and pathways divede the spectrum of enclosure and open zones
tree enclosure and foliage color change by season
longitudional spaces and intimate rooms enclosed by row of trees
wild forest pattern spread out in several parts

100m

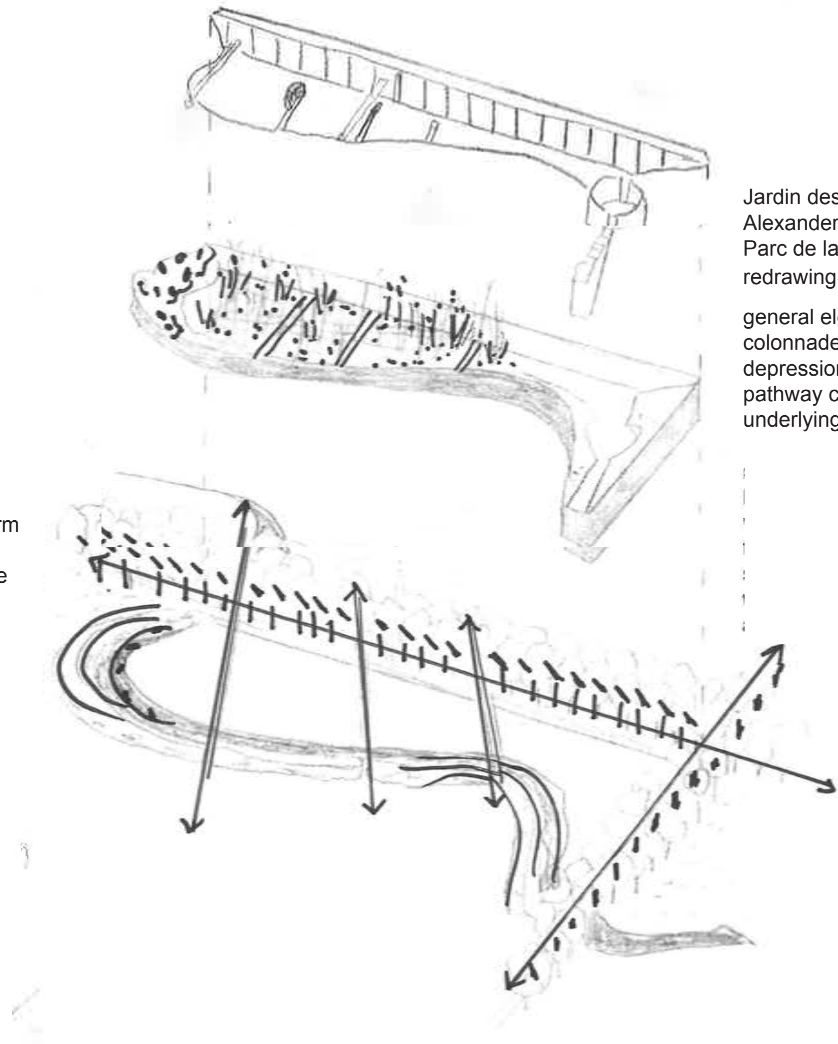
climatic principles applied to contemporary
common ground (in-between) space
*highlighting tree buffers and rain beds*



diesgarten, Berlin
el Libeskind, 1998
wing: J.Betina (Aben et al, 1999)

ral elements:
sed room with small rentional wall
e depression for excess rain water
al spring in northern corner
netric path

al elements:
cuts through the walls of basic enclosed garden form
ioned in fragmented urban fabric
nade of trees on east border announcing the space



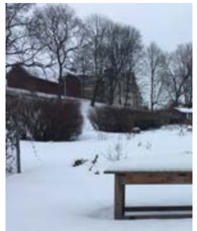
Jardin des Bambous
Alexander Chemetoff 1989
Parc de la Villette, Paris
redrawing: J.Betina (Aben et al, 1999)

general elements:
colonnade of trees
depression gently sloped
pathway crossing the ephemeral pond
underlying wall to form

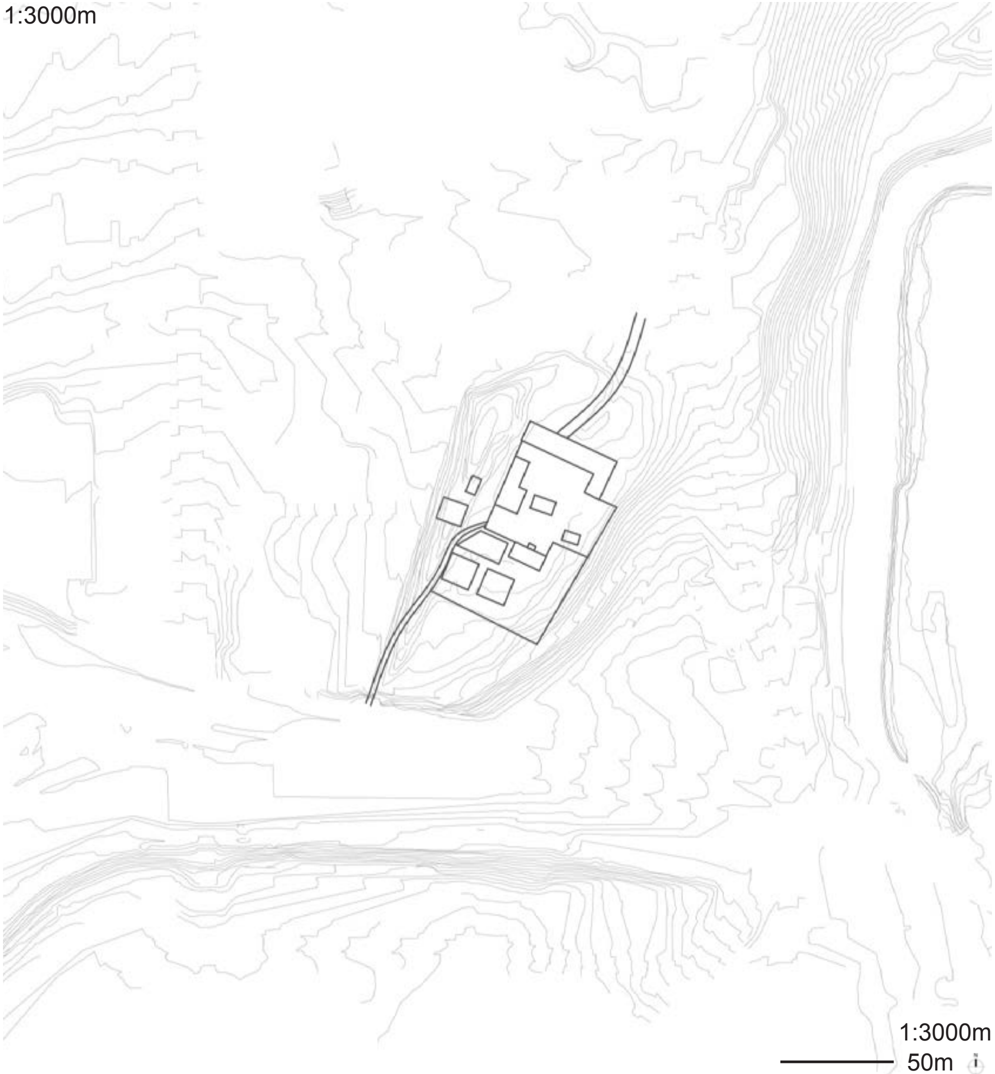
ks for

of enclosure
g into view

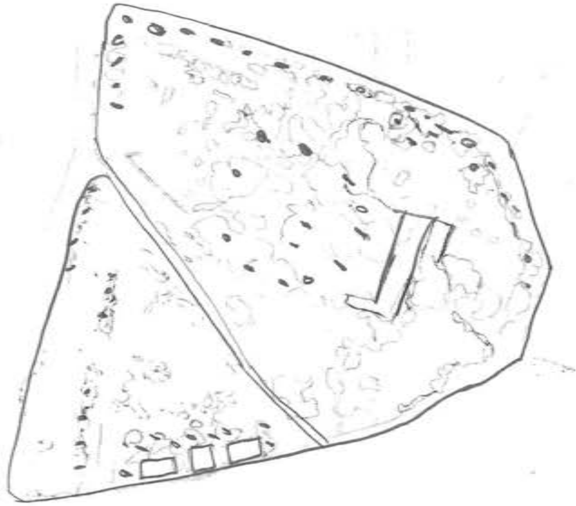
formal agrarian perspective
vegetation and rain-harvest patterns



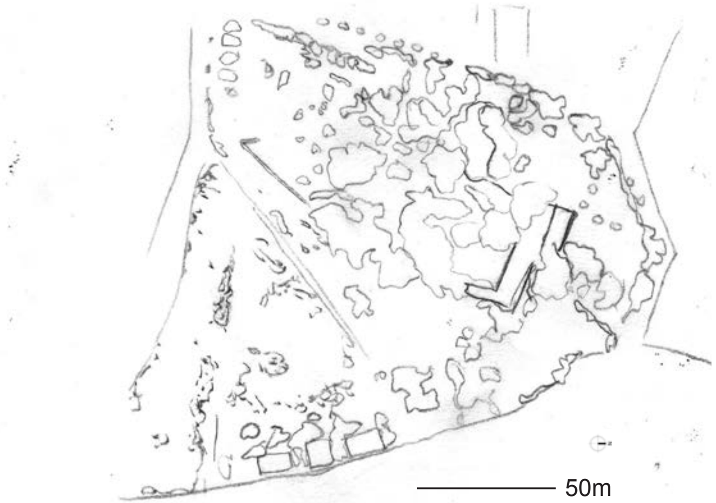
*Vøienvolden Gård* Vegetation Patterns 1937
Farmstead and Paths 1901
1:3000m







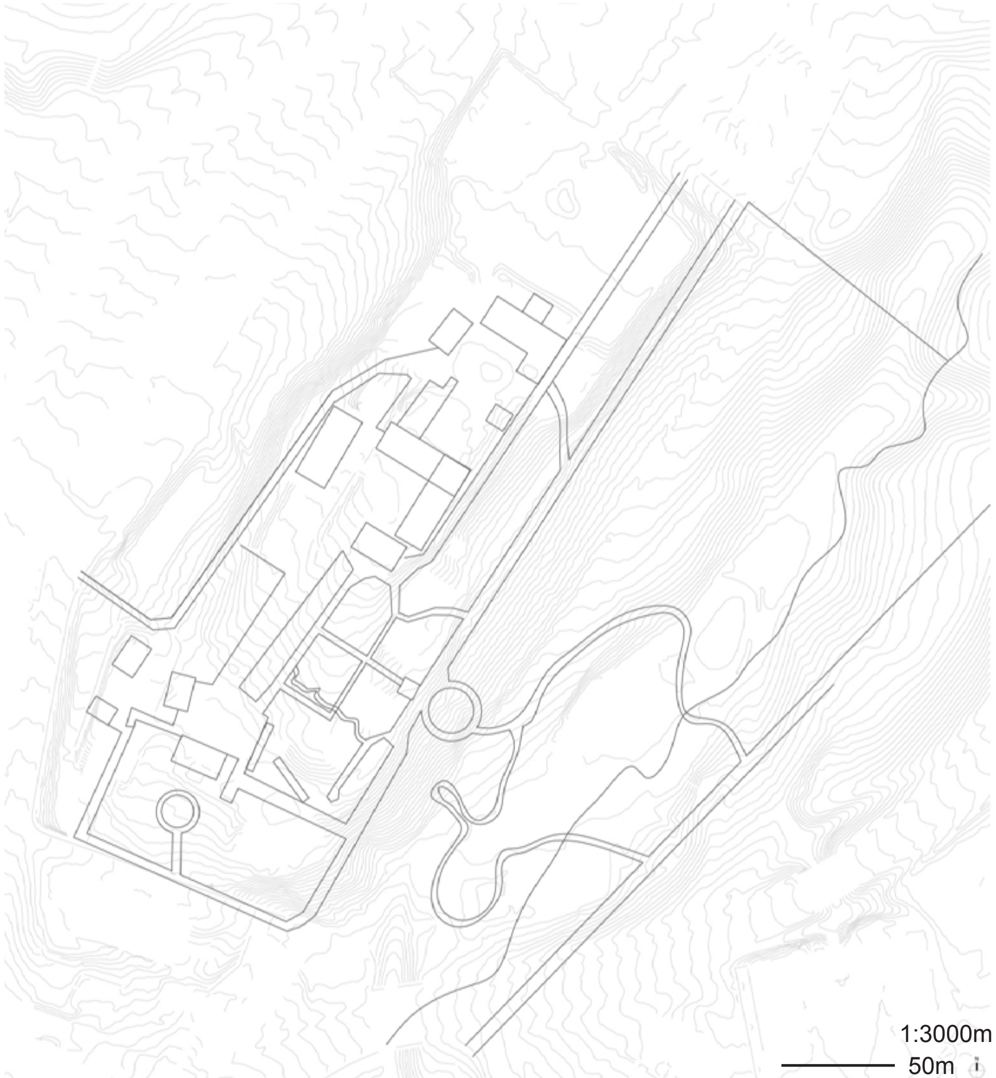



Spatial Elements:
vegetation buffer to road
farmstead enclosed by trees
courtyard enclosed by farmstead buildings
farmstead situated on hilltop
small fields surrounded by hedge rows
enabling micro-climatic conditions

*Lillo Gård* Vegetation Patterns 1937
Farmstead and Paths 1901
1:3000m


Spatial Elements:
farmstead situated on ridge
courtyard surrounding farmstead buildings
orchard situated on gentle hillside
orchard rows north/south next to small fields
vegetation buffer around upper keyline,
holding wind from small garden beds
trees surround upper ridge of farmstead
furrow allée pattern of plants then orchard trees

## *Torshaug Gård* Vegetation Patterns 1937
## Farmstead and Paths 1901




Spatial Elements:
farmstead situated on ridge
orchard situated on hillside
courtyard enclosed by farmstead buildings
pastures enclosed by trees, micro-climatic conditions
main pathways running north to south
vegetation buffer along stream & upper keylines
furrow allée pattern of plants then orchard trees
viewing terrace looking out to valley

## Formal Agrarian Principles

*making landscape that is utilitarian and beautiful*

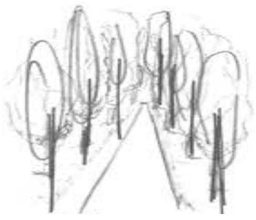
Intervals of cultivation
Density, tree corridors and paths
Clear connectivity
Accessible circulation
Collective imagination
Texture, vegetation diversity
Field geometric pattern marked by rows of trees or paths

TOOLBOX:
Path (density)
Cut & Fill (keylline swale and berm logic)
Ephemeral pond
Colonnade (green allées of trees)
Orchard grid and hedge row (utilitarian)
Vegetation between furrows (swales and berms)
Wall around a yard or court

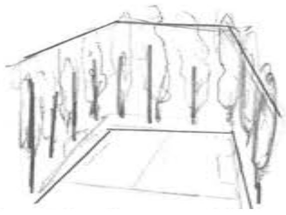
TYPOLOGY FORMS
presented in new way
based on formal agrarian
principles of utility and
beauty

+

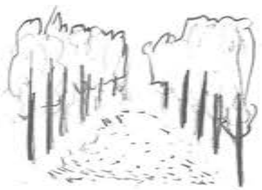
PERFORMATIVE QUALITIES
urban farm
wild meadow
terrace lawns
wet forests
rich bank



grid of trees to walk through in any direction

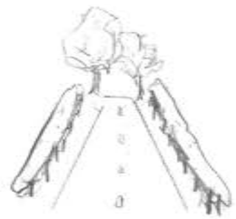


row of trees around a football field

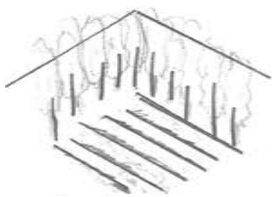


enclosed pasture

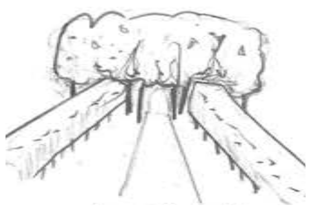
two cypress announcing a villa



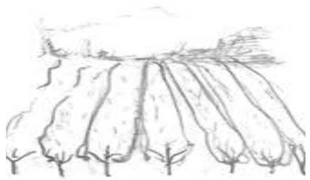
two oaks framing the road



line of trees enclosing a field of chard



the path in a park is an entrance

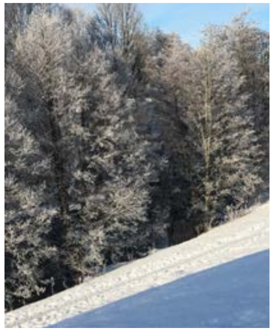


grid of vineyards relentlessly carpeting the valleys

water leading to the horizon by wet forests

line of trees along bank reflect in the water

(Solomon, 1994)



The following four scenarios address problematics around flood risk and district redevelopment together. Thus these scenarios for managment are evaluated through the lens of water economic efficeiency, *the watershed*, and through the lens of what it does socially, the *community shed.*Which scenario reaches the double goal best?

Progress is made from complete separation fo two aspects in the first scenario towards the move to an integrated and complex channel network with variable cross-sections in the fourth scenario. The in-between scenarios could be applied, but do not seem to fit as well in the built-out urban fabric and budget restraints

The testing grounds experiements with:
1. use of parks as floodwater storage
2. waterproof banks and possible purification of the water table by vegetation
3. suggests conditions for a landscape transformation of historic stream, not to be piped to Akers river in same pipe as sewage
4. introduction of a new channel is a starting point for ideas of environmental restoration of the area


SCENARIO I

Division of functions. Uninterrupted pipe to connect buried Torshov stream to the Akers river. All stormwater managment measures continue by concrete infrastructure underground, replacing pipse when needed. On the surface there remiains traces of the pre-existing river channel. A 3m grassy carrier swale is created in heavy floodways.

WATER

(+) there is a natural added component

(-) the dimensions are small compared to the volume of water needed to store

(-) not addressing three found “springs” close to the ground’s surface that are likely related to the lateral flow of infiltration water above the water table (also known as lateral subsurface flow)

(-) not versatile for different parts of the watershed, to also integrate ecology

(-) high construction and material costs

SOCIAL

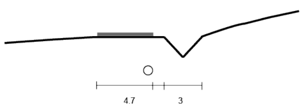
(+) all stays “as is” , no uses are changed

(-) no new forms of usage for collective activity or individual free time

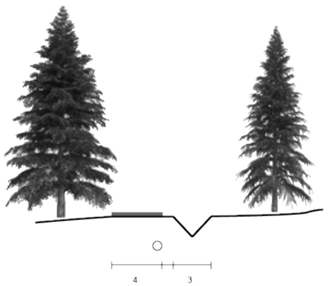
(-) little measures to encourage collective representation

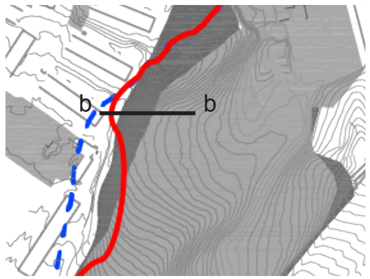
(-) depressions and aspahlt will continue to fill as a pool and limit circulation through parkland

zoom 1

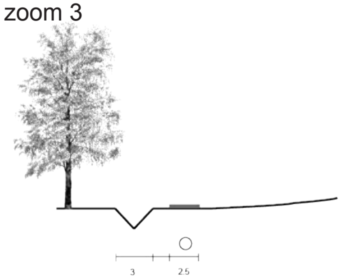


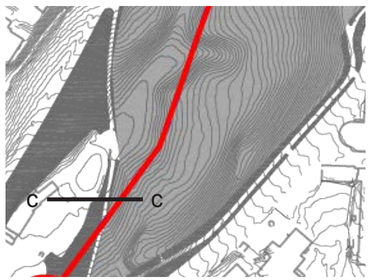

zoom 2






zoom 3





SCENARIO II

Re-open the extent of Torshov stream on a new linear course, proposed by Miljø-foreningen Akerselvas Venner (friends of the river). This constant cross-section natural channel allows the river take in some rainwater as a storage site to its bank capacity in the valley floor (fixed 10m width, 2.5m depth).

WATER

(+) reopening a natural waterway that can hold stormwater in large rain event

(+) building a riparian riverbanks for ecological adaption, also storing water

(-) high cost for demolition, sewage pipe separation, and construction of stream tunnel at Trondheims road

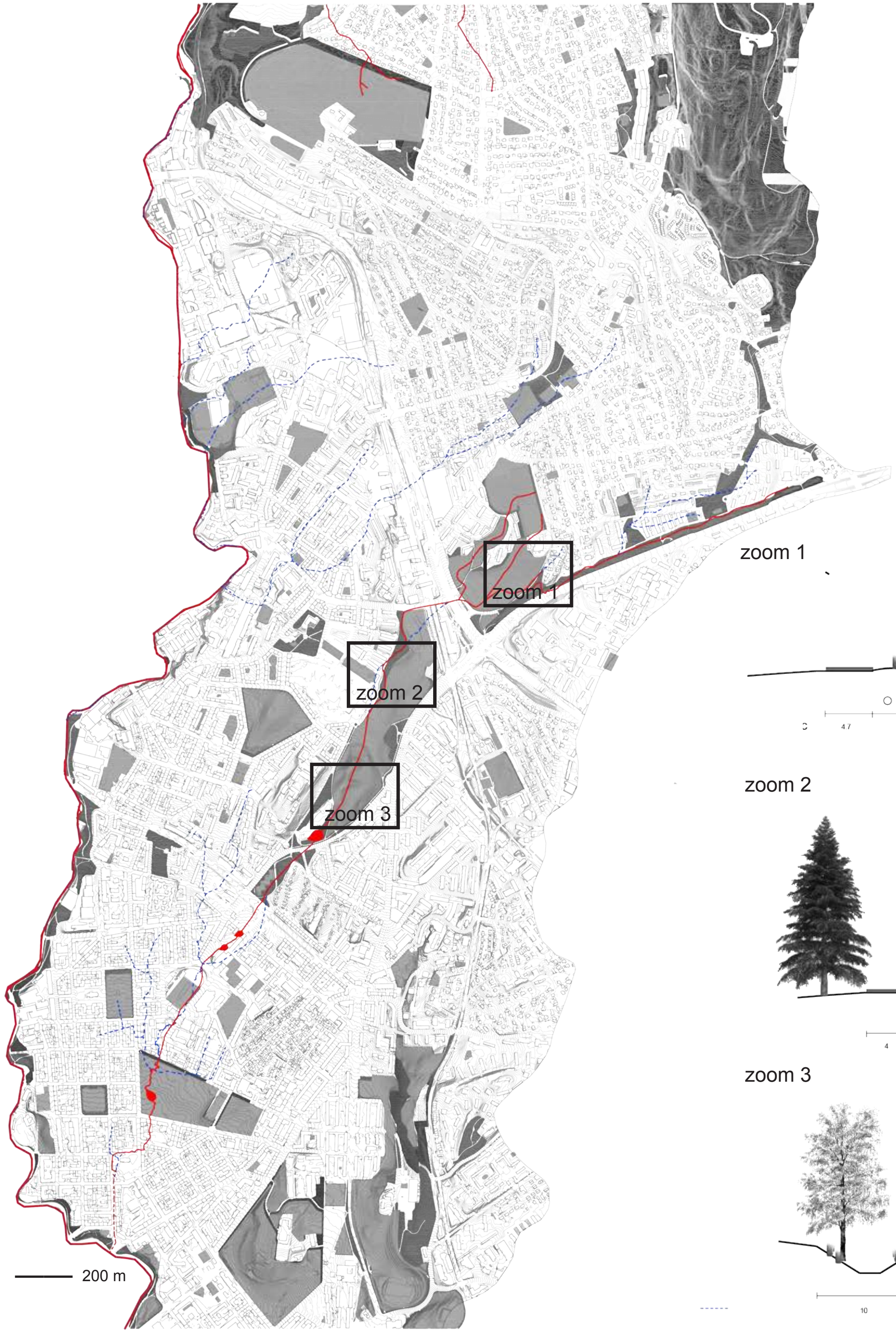
(-) several trees and hedges would need to be cleared

(-) not variable for different spatial situations

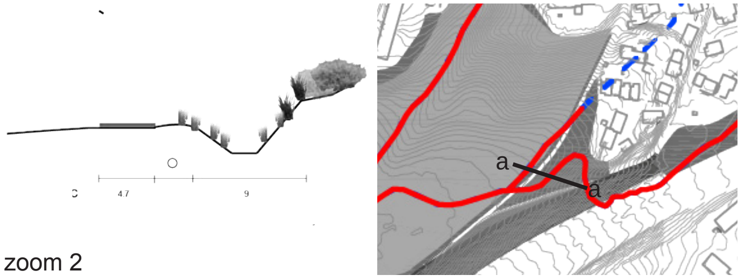
SOCIAL

(+) offers new forms of use for humans and wildlife along the river

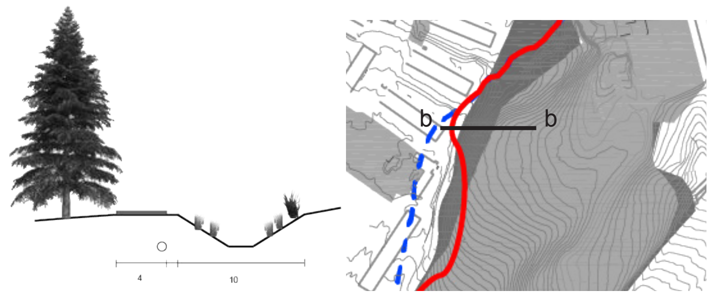
(-) little measures to encourage collective representation/community development



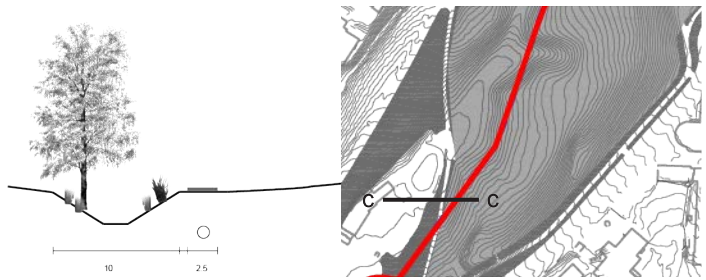

zoom 1

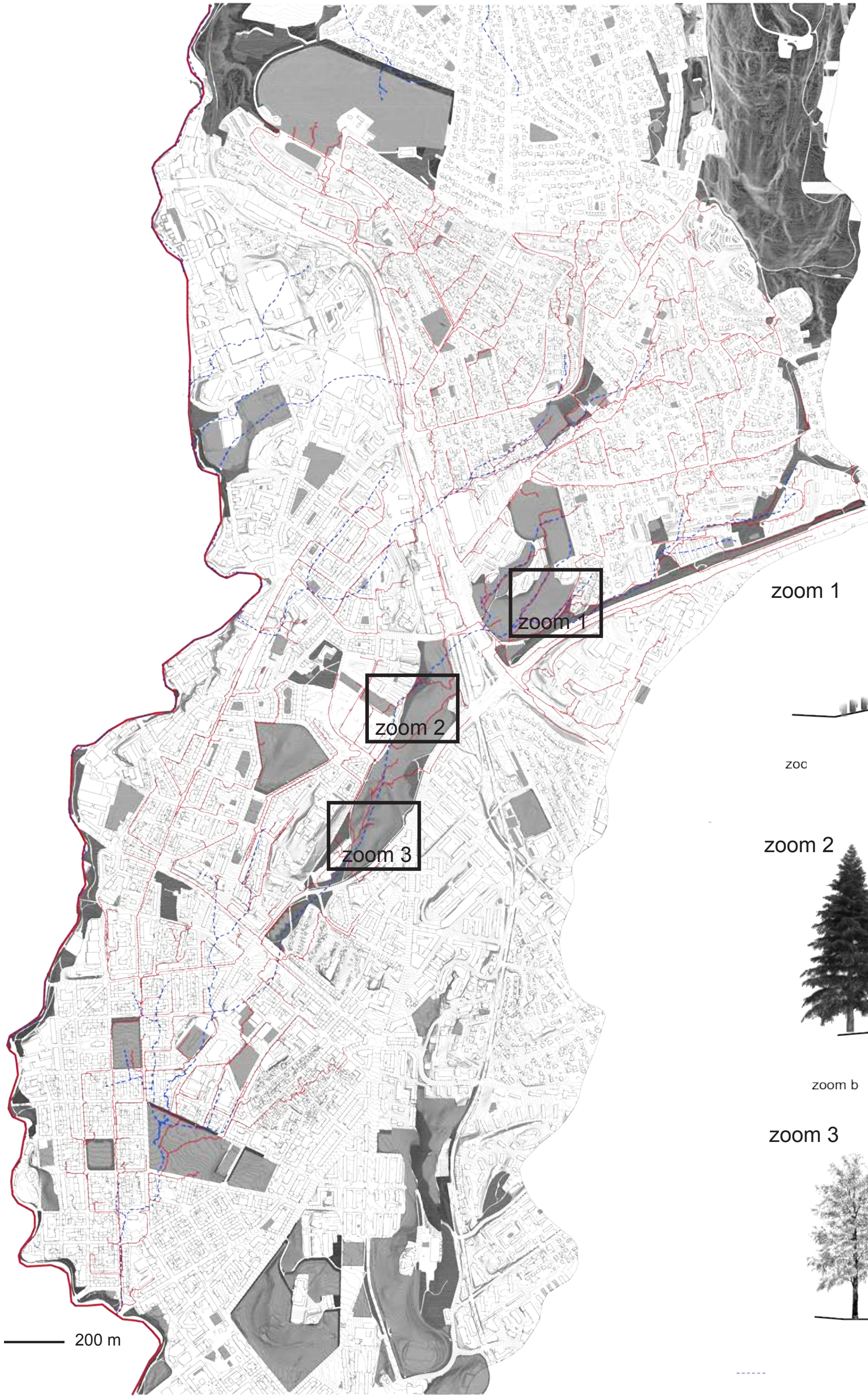



zoom 2




zoom 3






SCENARIO III

Rely on a wider network. Based on existing water and settlement, scenario III proposed the creation of drainage swales and micro ponds based on urban flow routes (3m width and 2m depth).

WATER

(+) water flows addressed on capillary level, local situations

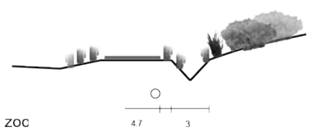
(+) fine-grain requalification of ecological/ water corridors

(+) modest initial cost

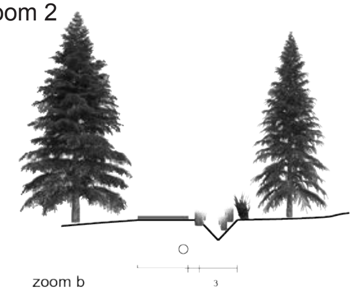
(-) canals and storage swales' close proximitiy to buildings could lead to flooding problematics and maintenance costs

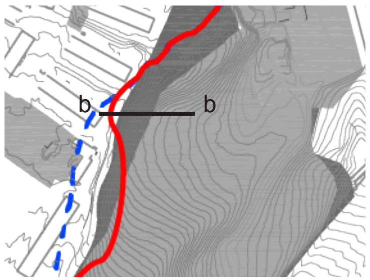
(-) less spatial capacity to expand storage of water, rather in large parkland

zoom 1

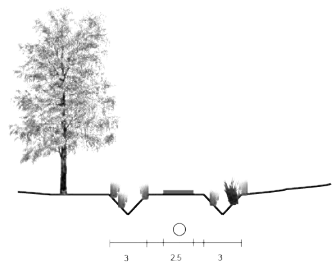


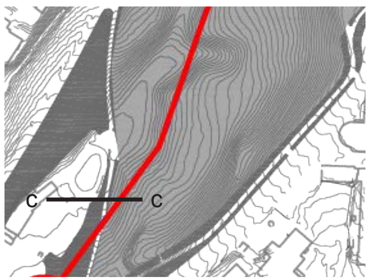

zoom 2




zoom 3



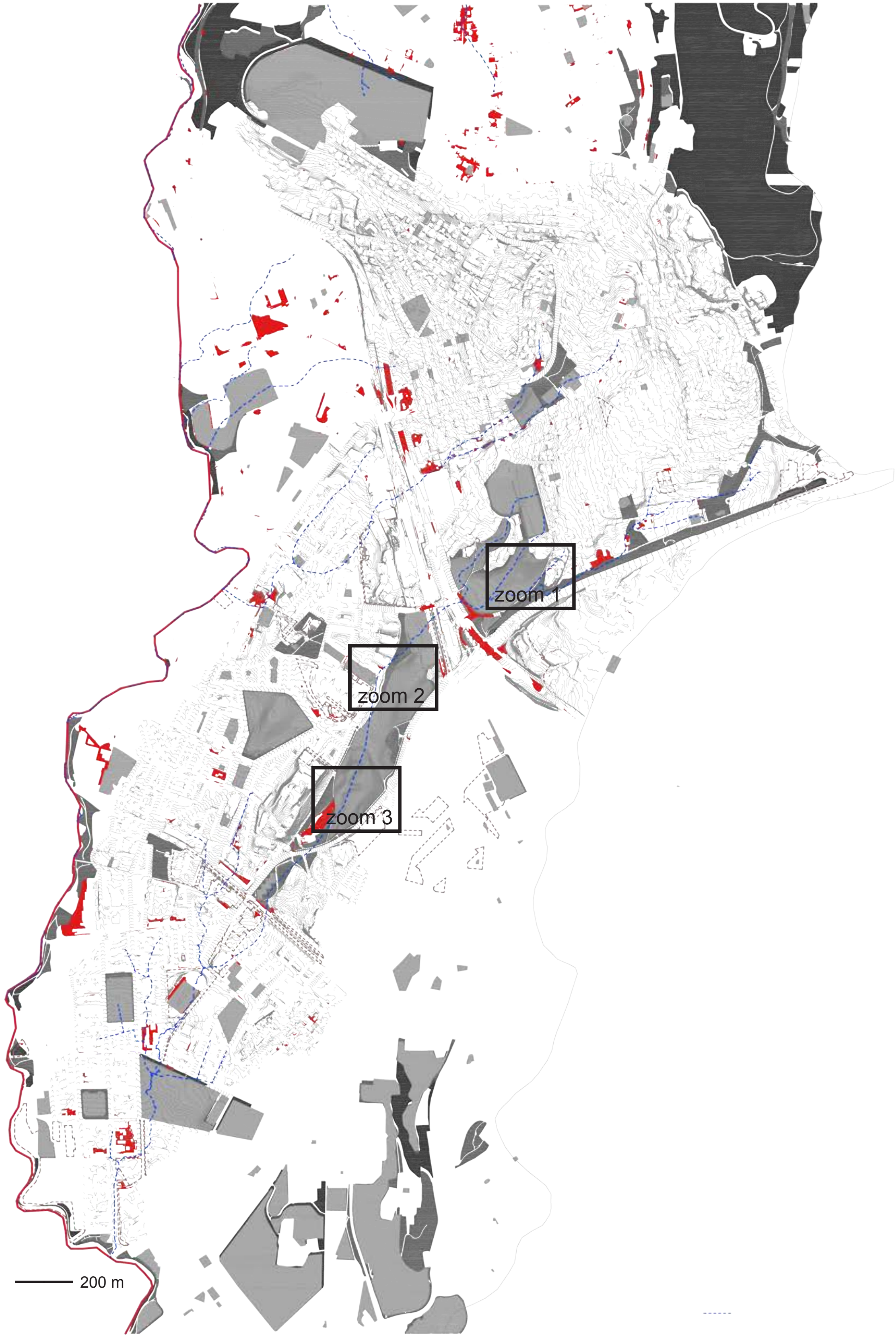



SOCIAL

(+) offers ownership of micro rain gardens and swales on many city blocks

(+) growth in awareness of existing water at eye-level at local situations

(-) not many new forms of activity or community usage in free time

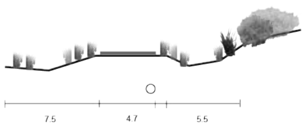


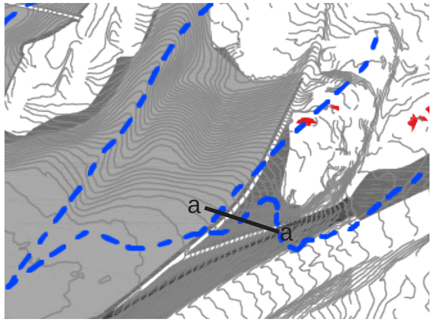

SCENARIO IV

Seasonal expansion and diverse biotypes. A constructed rainwater channel and arboreal network of a traditional municipal scale with variable sections that adapt to different circumstances.

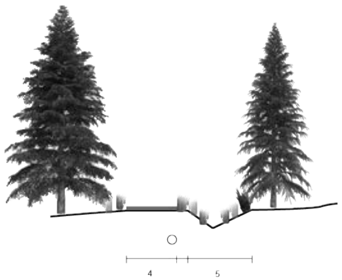
Scenario IV takes advantage of capacity to expand and only be a pipe-line in necessary circumstances. Tree corridors act as water storage, purification, infiltration and flood safety measures. The connection from the Oslo fjord to Normarka (Oslo's North Forest) comes back through linear woodlands, orchards, hedges, mesophytic grass clearings and vegetative slopes. The parkland will also contain wet woodlands, wetlands, and tall-grass edge areas.

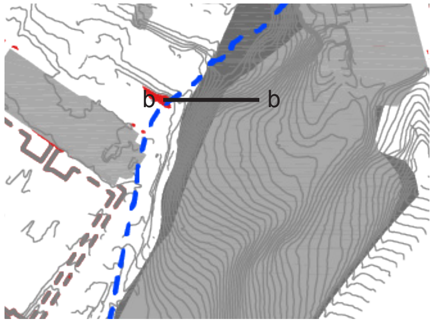
Moving through the topography, there is potential for rest stops, viewing platforms, jetties, and grassy plateaus that can be used as an arena.



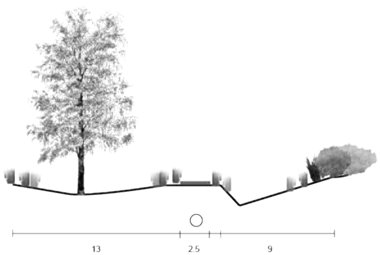



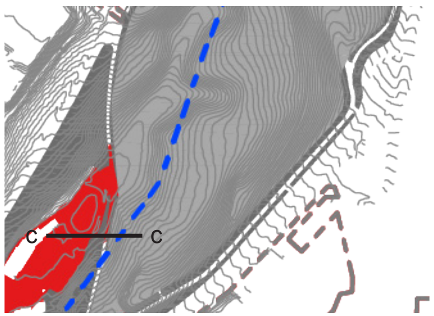

zoom 1




zoom 2




zoom 3

WATER

(+) mitigate flood risk and ensure storage

(+) re-qualify the buried stream corridor, in hopes of later phase of reopening

(+) modest initial cost

(+) canals and storage swales are situated in public parklands, taking advantage of spatial capacity to expand storage of water

(+) follow the topographic key lines for maximum storage on parkland

(+) opportunities to test direct improvement of reservoir bed, subsurface porosity by vegetation approach on surface

SOCIAL

(+) many new forms of use and reinterpreting the existing elements (concrete pipe pieces as jetties and platforms)

(+) reuse existing concrete pool as a reservoir and arena for gatherings

(+) reviving the orchard as a form of collective representation in community

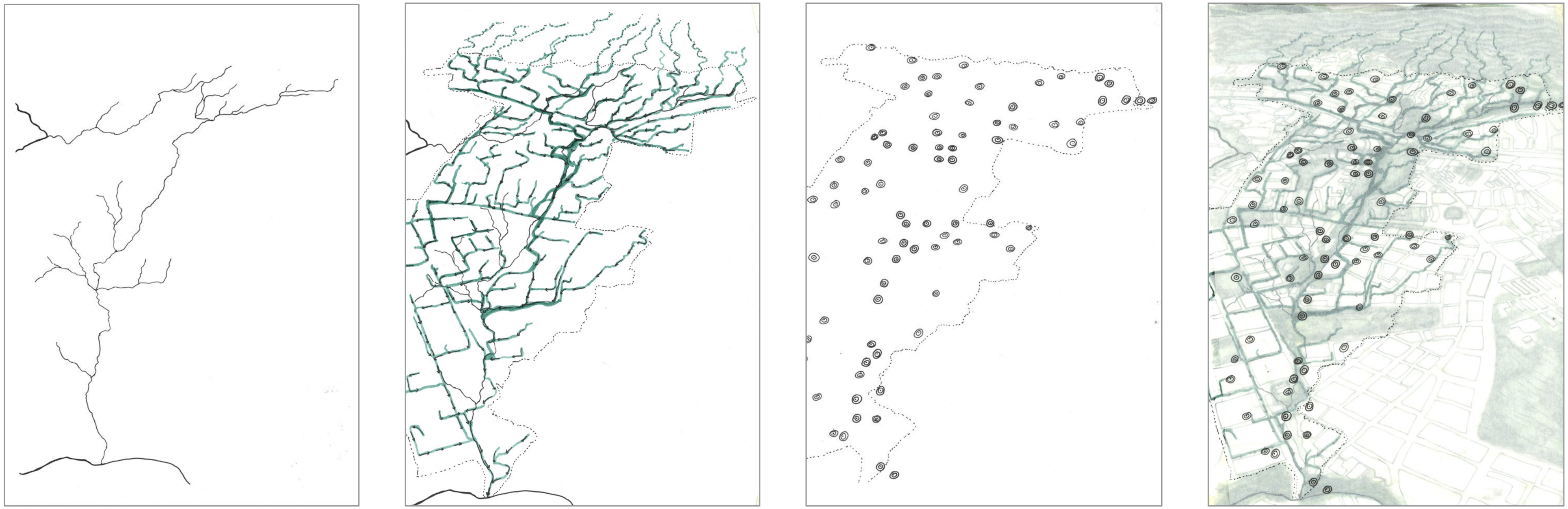
(+) center for both recreation and biodiversity learning

# Capillary Action: Oslo territory scale *from fjord to forest*

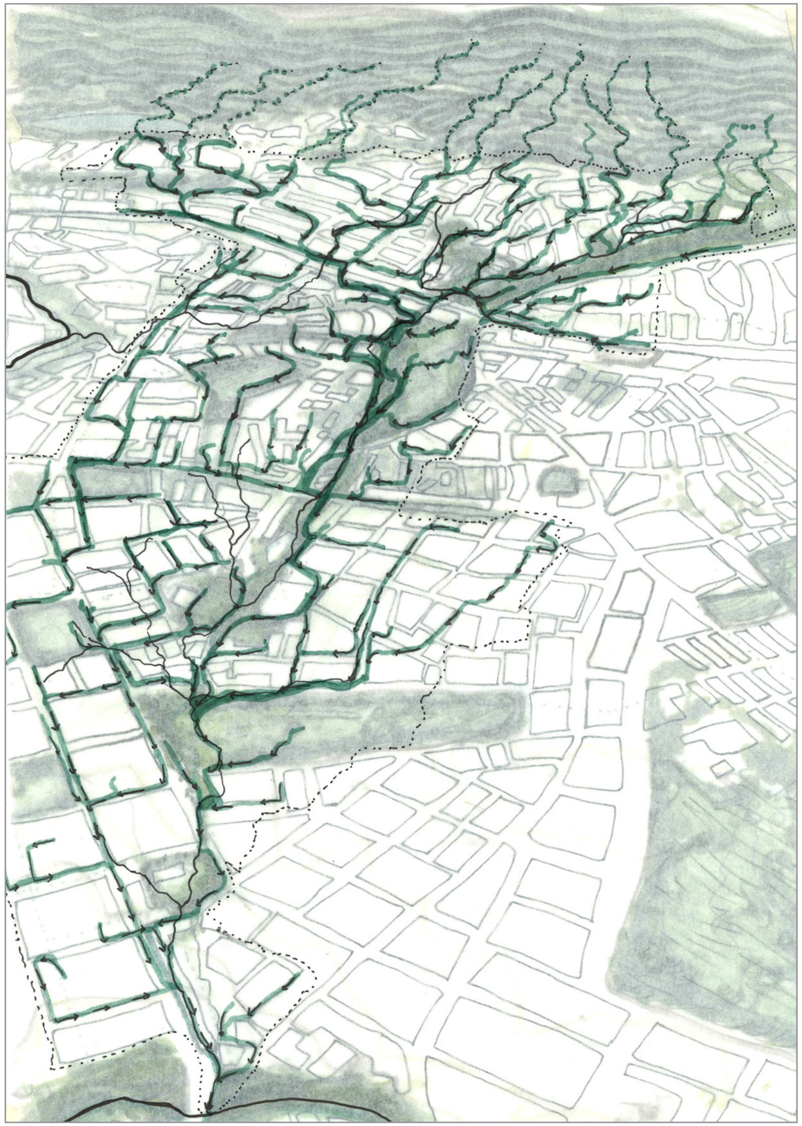
today

historic river form, flows, and in-between spaces

strategy over time



historic river form flows residual spaces together with existing ground conditions



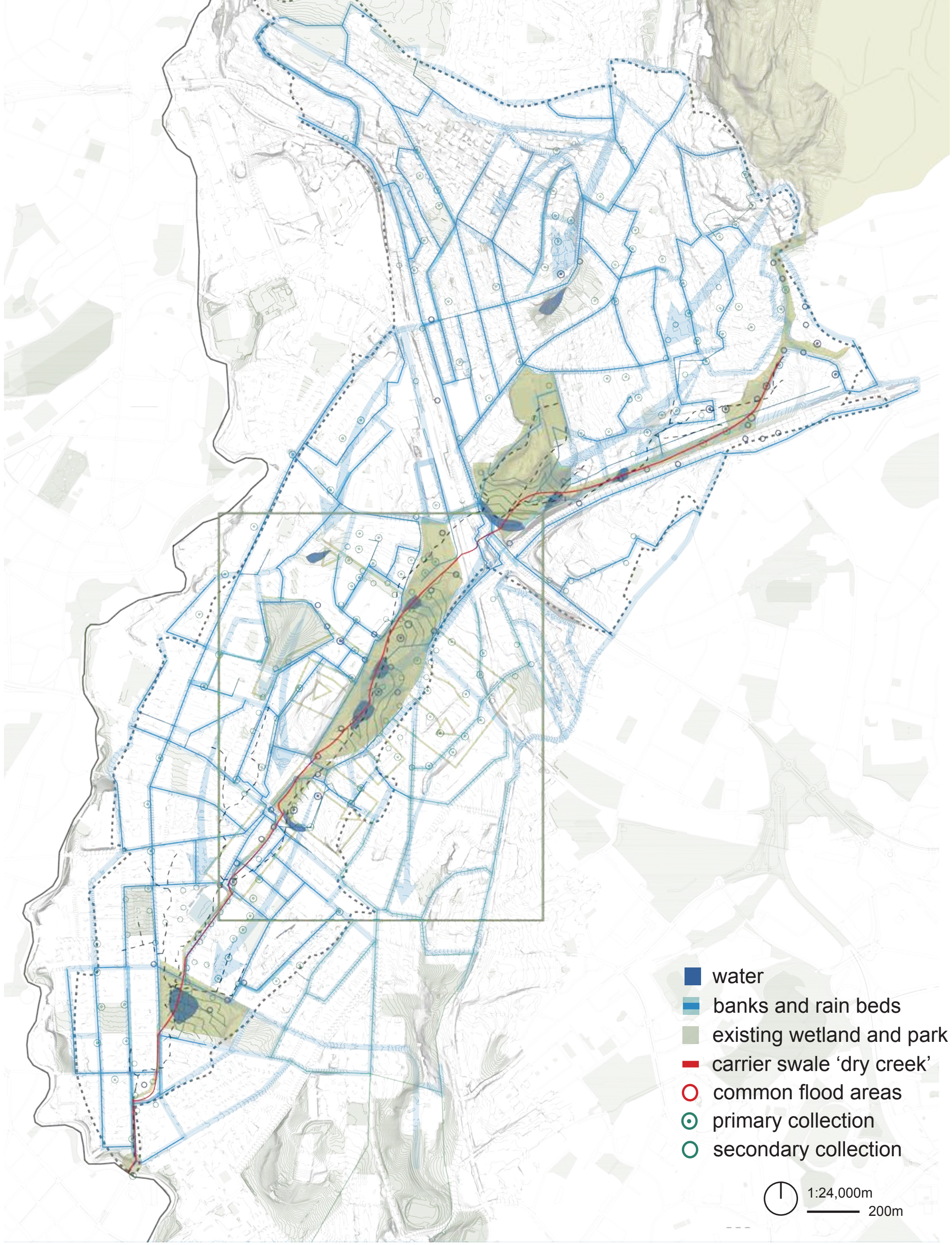
flows

residual spaces

# CAPILLARITY & INFILTRATION

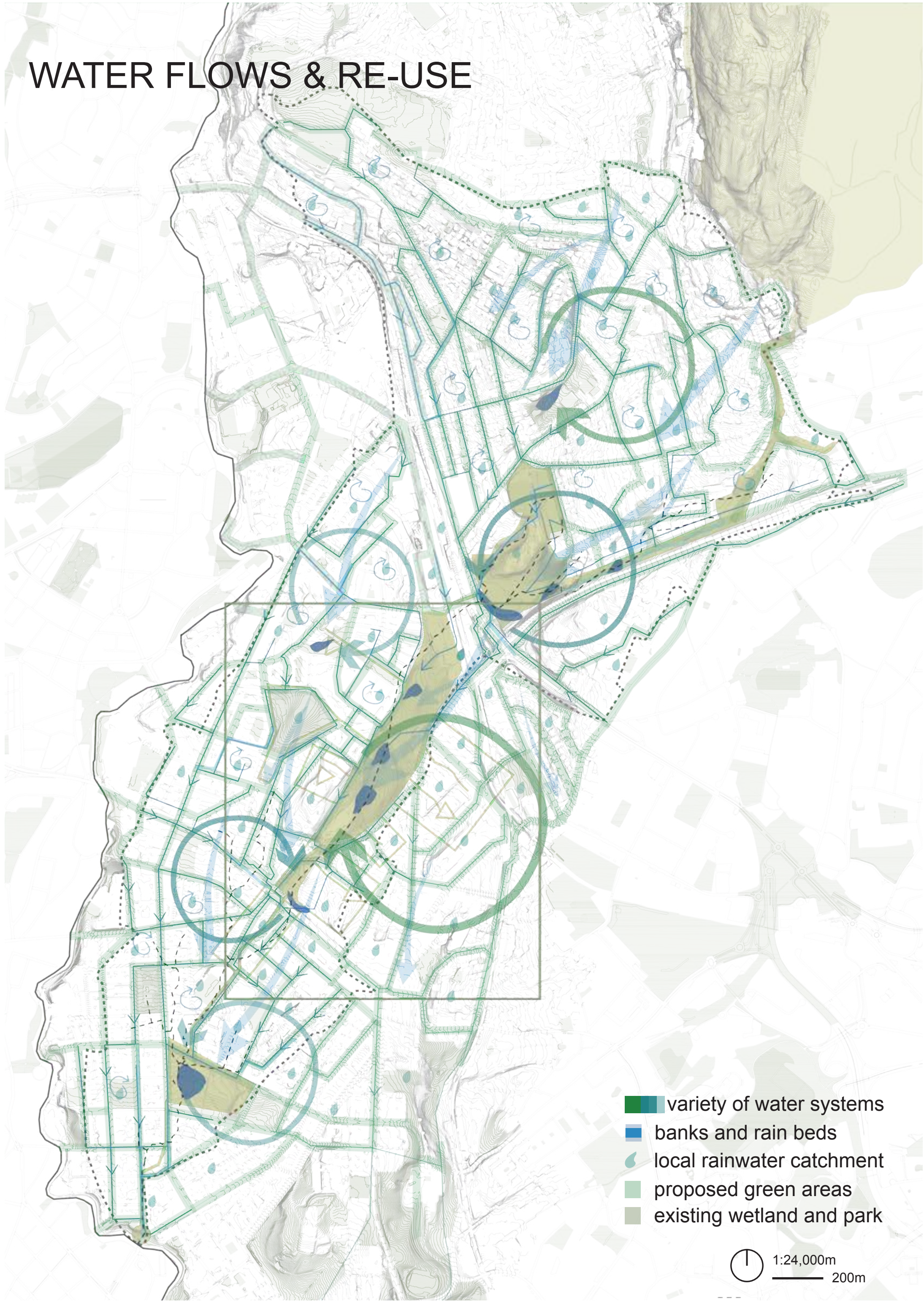
## WATER SAFETY

Flood risk is addressed by barrier measures and expansion of the vegetation buffer. As water is given more space to be present longer, it is now a part of the blue-green drainage veins. Primary and secondary collection rainbeds, reed banks directly take in excess water by plant-based capillary action. The gentle carrier swales created by cut and fill techniques direct the water to areas with little slope so the water slows and has room and time to infiltrate into the soil and tree root systems.



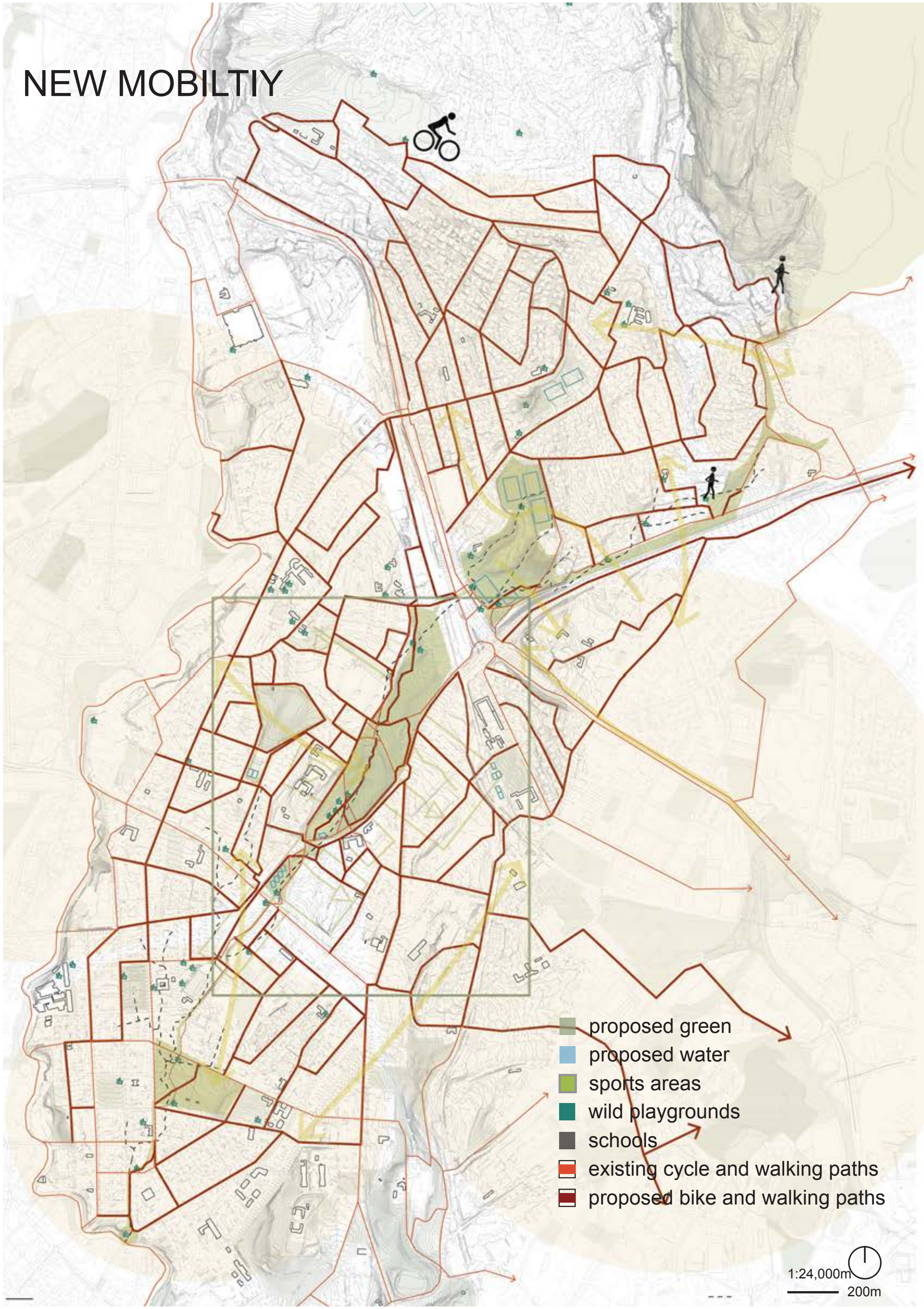
## NORDIC CLIMATE ADAPTION

Forms of design for climate adaption are catchment, heat/cooling regulation and infiltration enablement. Catchment enables re-use of stormwater in the watershed's blue-green capillaries for irrigation of gardens and orchards. Passive thermal heating regulation is found by a refined green tree structure. Cooling happens by water circulation systems fed by cold groundwater of deep sand mining ponds and shallow aquifers. Higher infiltration during increasingly irregular frost/thaw periods is helped by glasopor (recycled glass), cobblestones, and sand/gravel rainbeds.



## CONNECTING COMMUNITIES

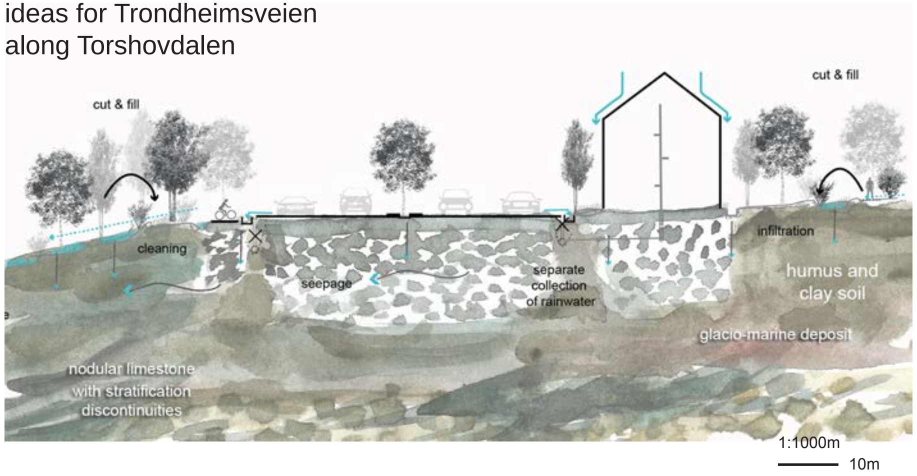
Social and recreation forms are proposed to connect to the blue-green capillaries. The first form is a fine-grain bike and hiking network alongside the drainage routes and enabling direct access to playgrounds, sports fields, and the forest. A second form is a “wild playground” that performs as a water storage space and nature play area. The space changes based on season and often includes wet play with abundant rain collection swales. Both forms provide social interaction and fresh air for children adults, and elderly.



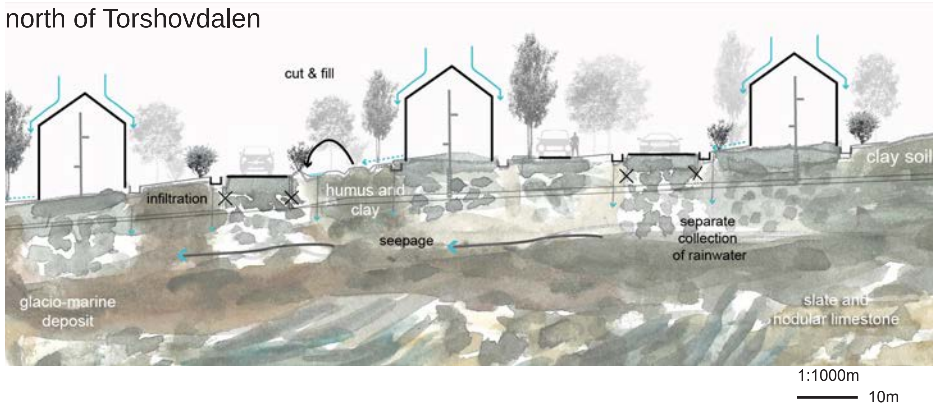
# WATER REUSE & INFILTRATION

*preliminary sketches informed by ground conditions*

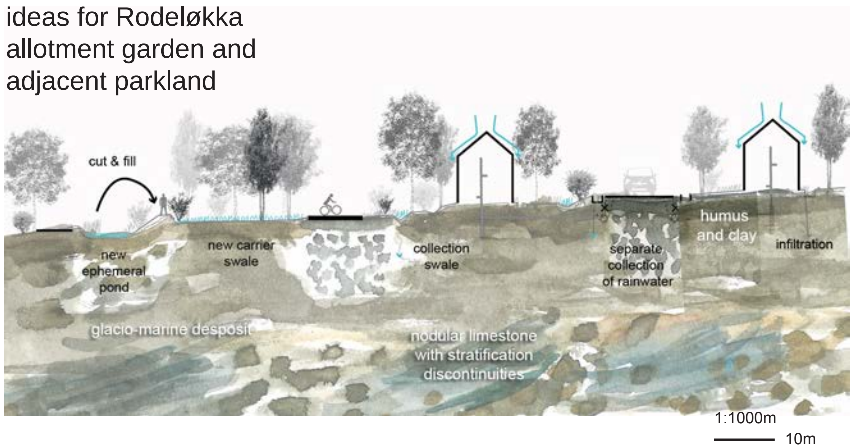
ideas for Trondheimsveien
along Torshovdalen



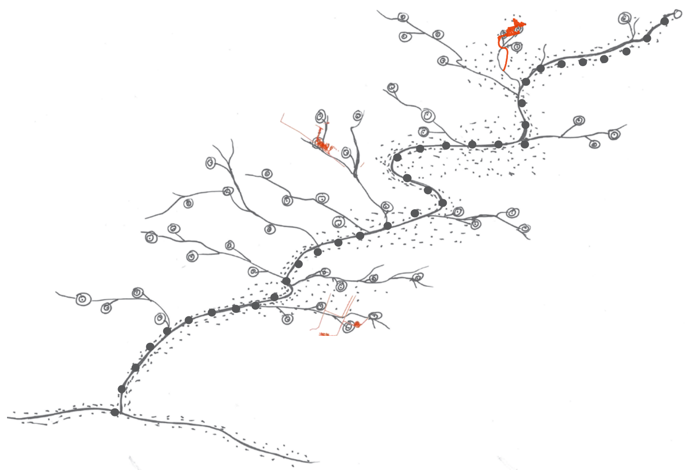

ideas for residential area
north of Torshovdalen



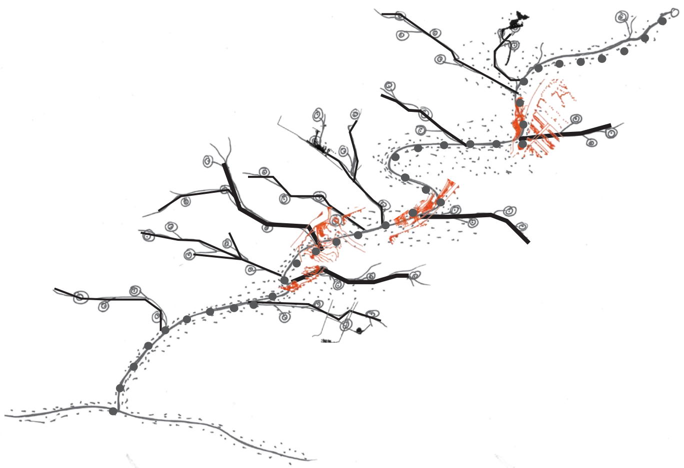

ideas for Rodeløkka
allotment garden and
adjacent parkland



PHASE 1: TRIBUTARY EDGES AND PATHWAY
private primary elements
diversity - choice of program



PHASE 1: COMMON GROUND SPACES
public land
continuity - municipal program



PHASE 2: RE-OPEN HISTORIC RIVER
public land
continuity - municipal program

Design in phases

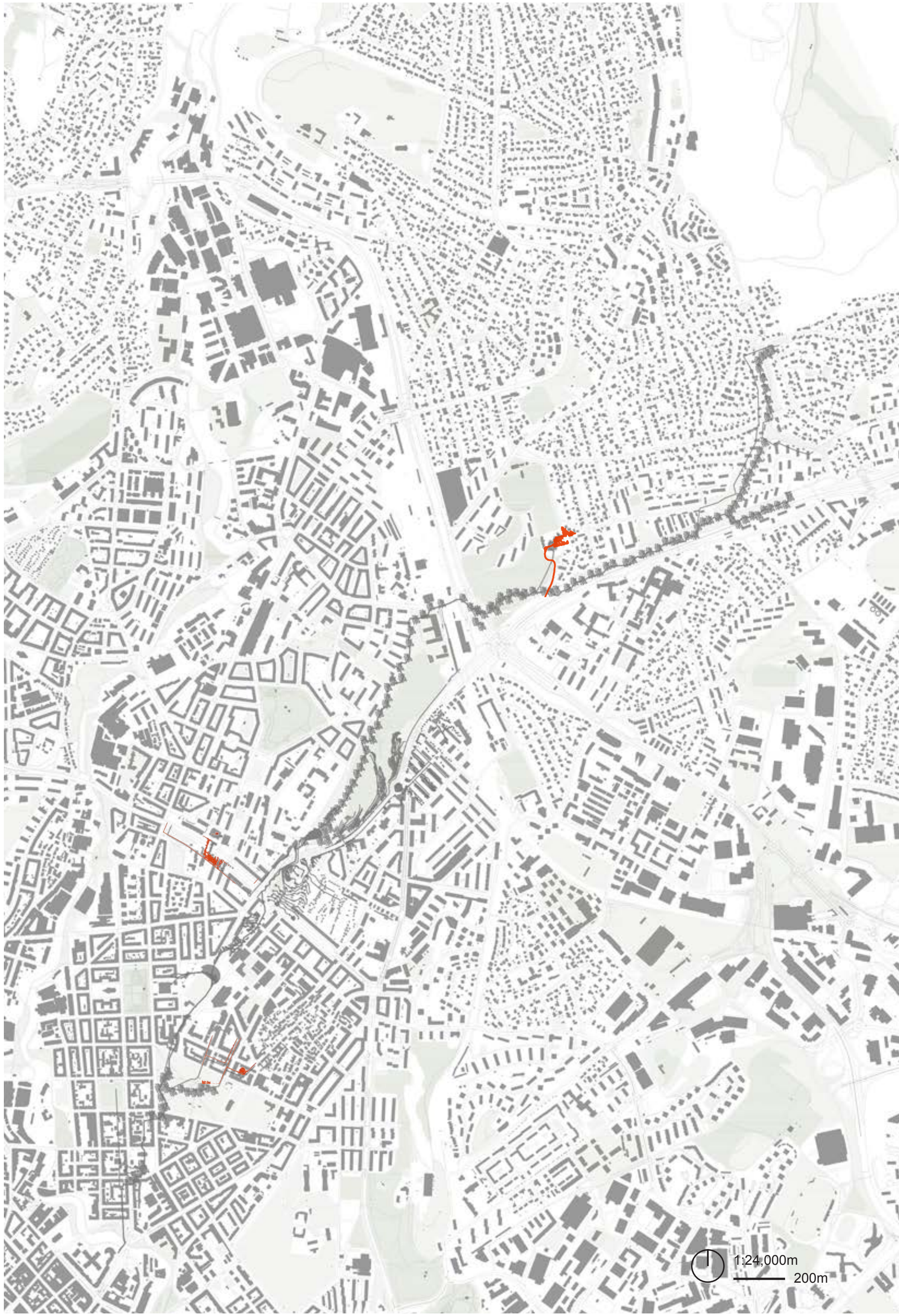
capillary action torshov


part VI

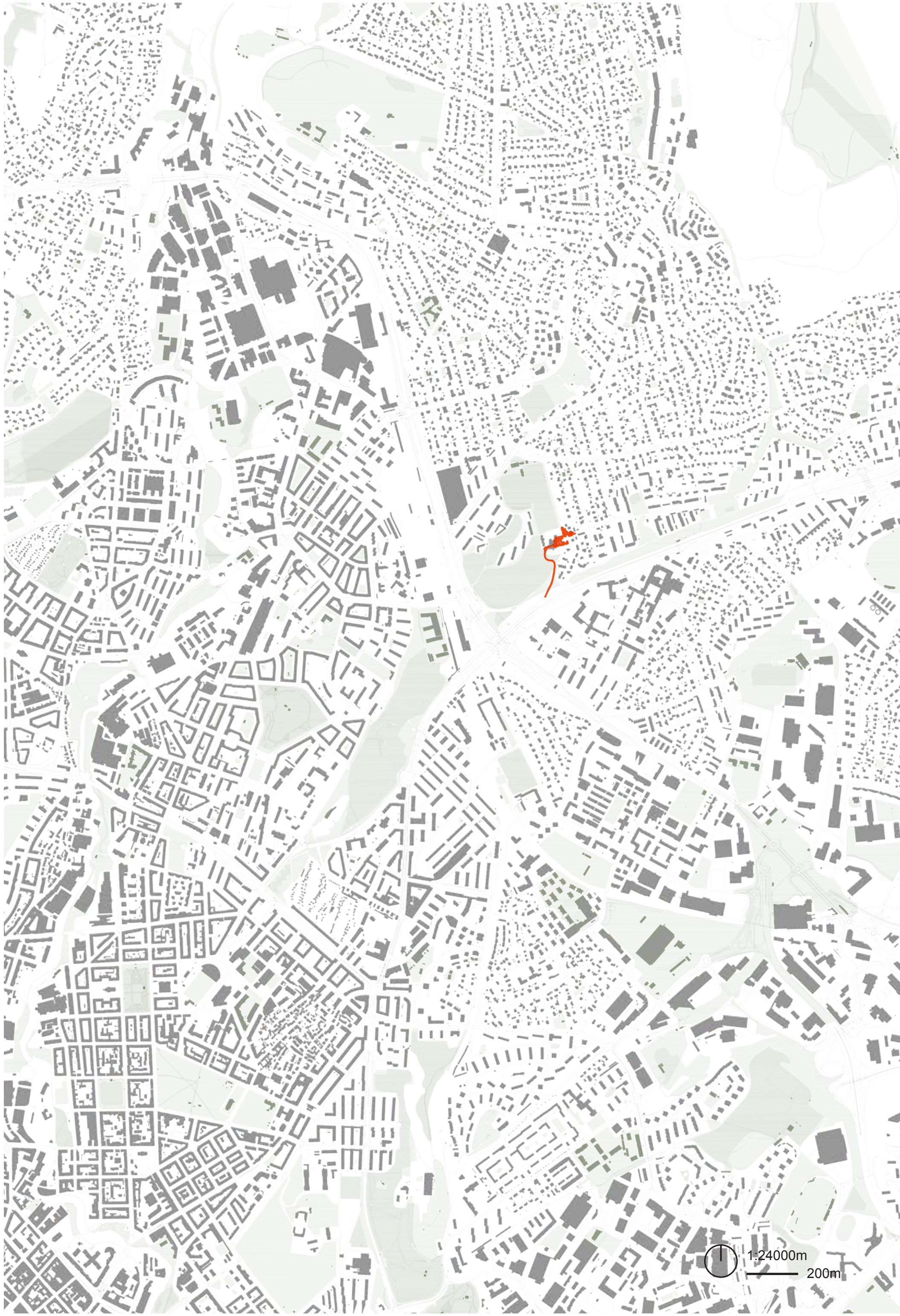

phase I
1:24,000m
200m


phase III
1:24,000m
200m

DESIGN PHASE I:  TRIBUTARY EDGE SPACES
private primary elements
diversity - choice of program



the collection gardens



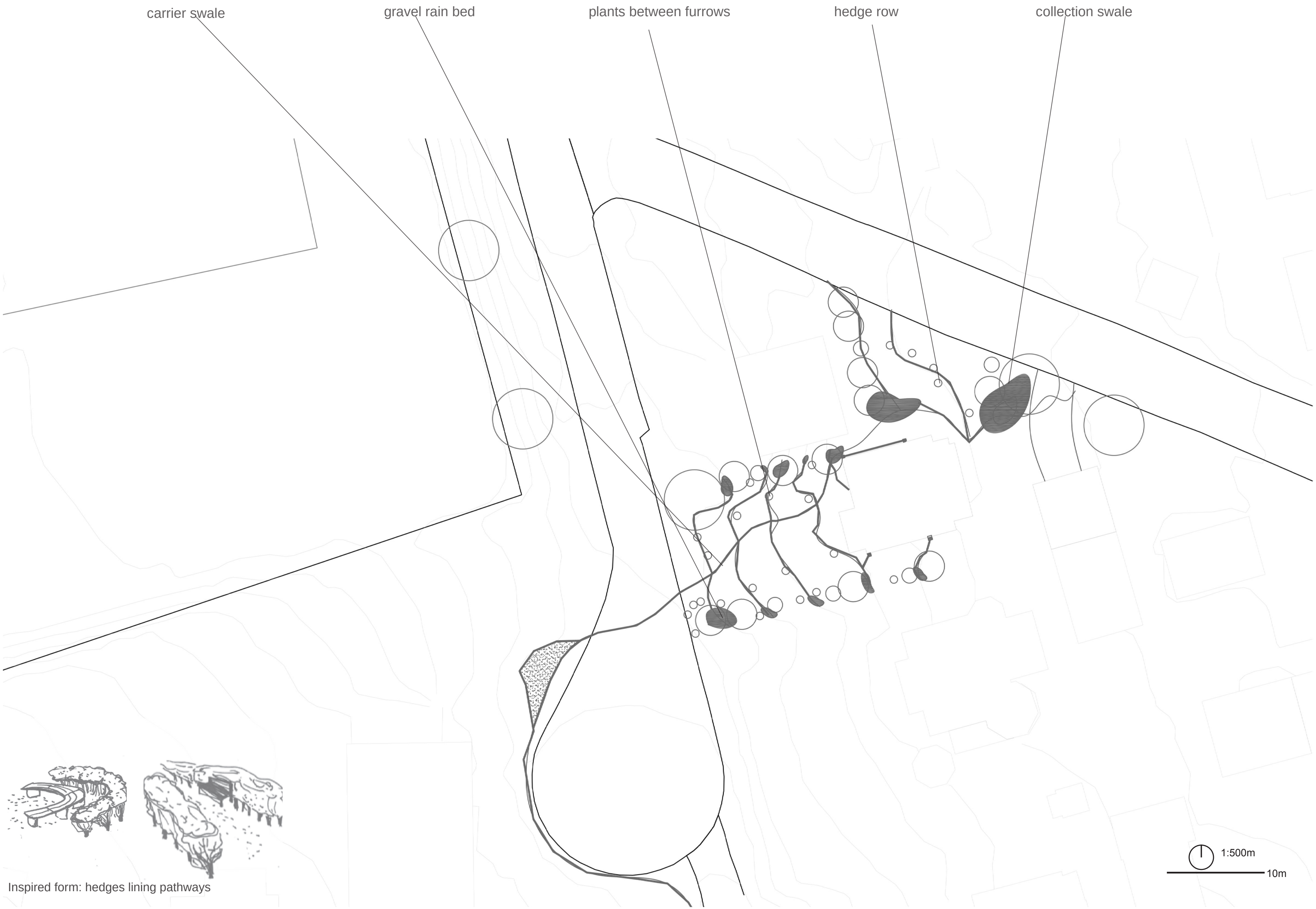
**The Collection Gardens**



Surroundings:
Residential Home
Oslo Youth Hostel
Nordre Åsen Park (Bymiljøetaten)
Roadside edges (Bymiljøetaten)

Field notes:
fine-grain soil, clay and silt
glacio-marine loose sediment with
some coarse fragments
several existing trees in yard


proposed design




Inspired form: hedges lining pathways

the hillside edge

**The Hillside Edge**

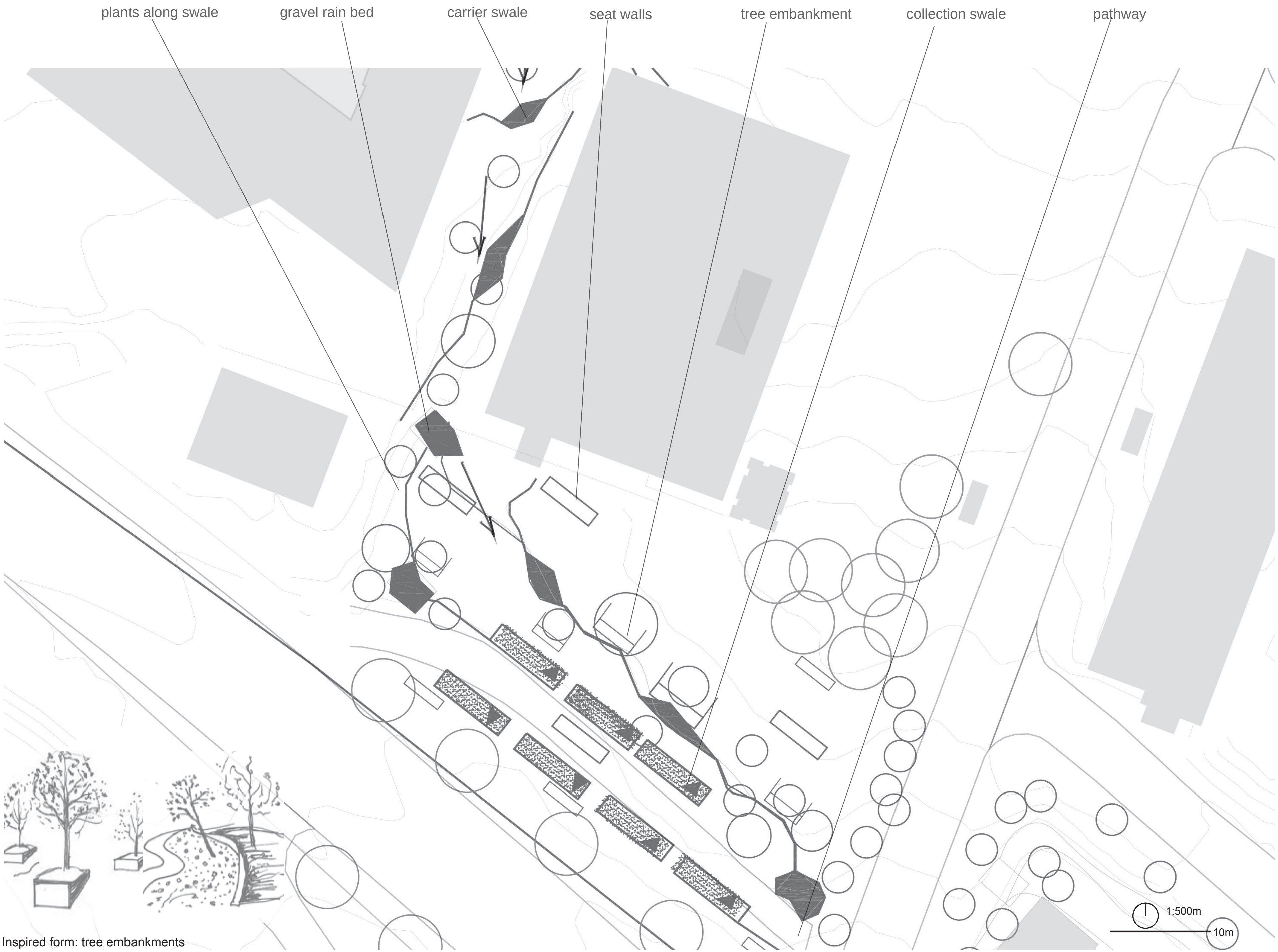


Surroundings:
Social Housing (Boligbygg)
Lilleborg Church
Residual Space (Bydel)
Roadside edges (Bymiljøetaten)

Field notes:
sand and gravel and humus topsoil
fluvial loose sediment

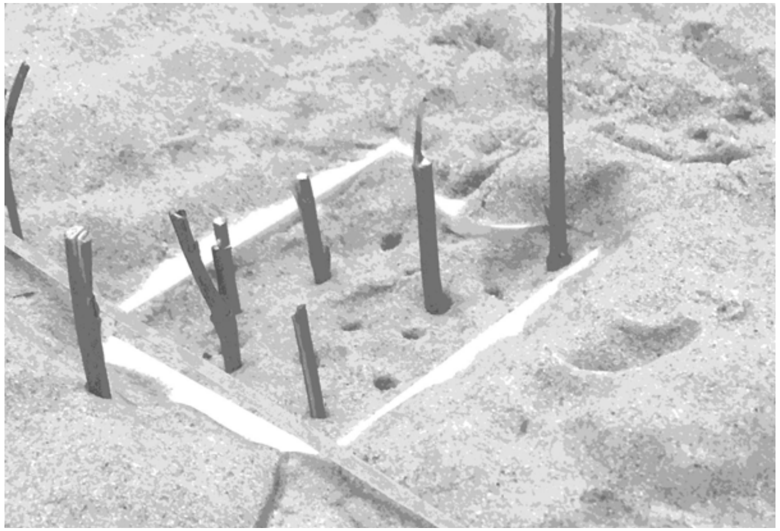

proposed design

10m




Inspired form: tree embankments

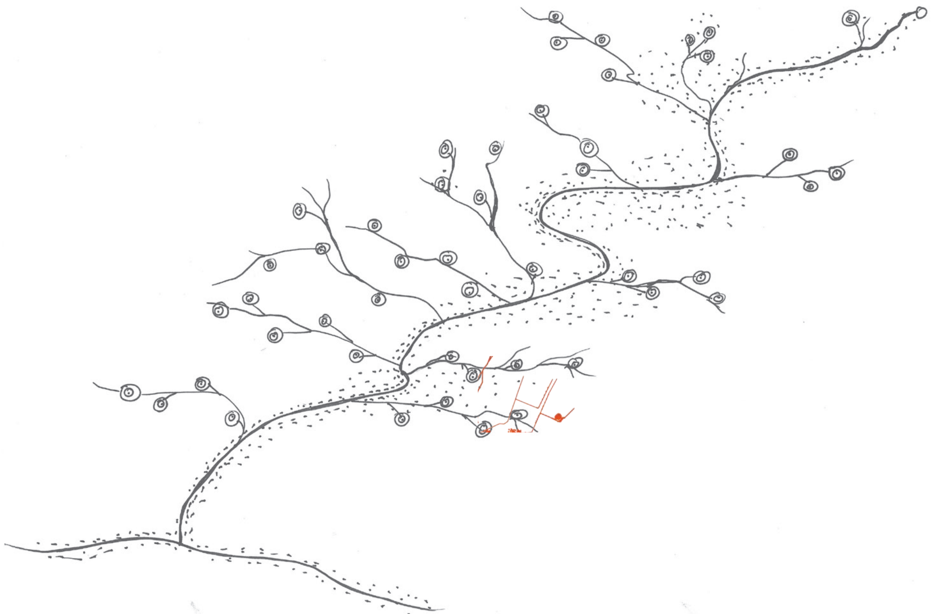




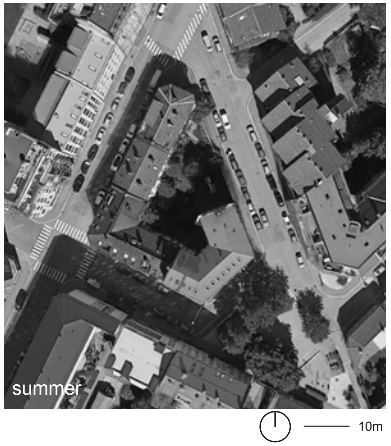

Design plans in phases

## the tree deposits

capillary action torshov

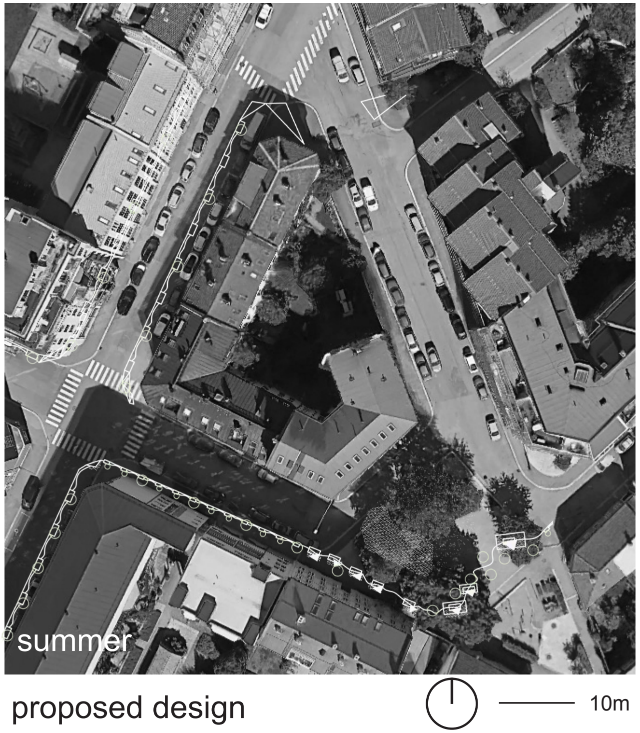


**The Collection Gardens**

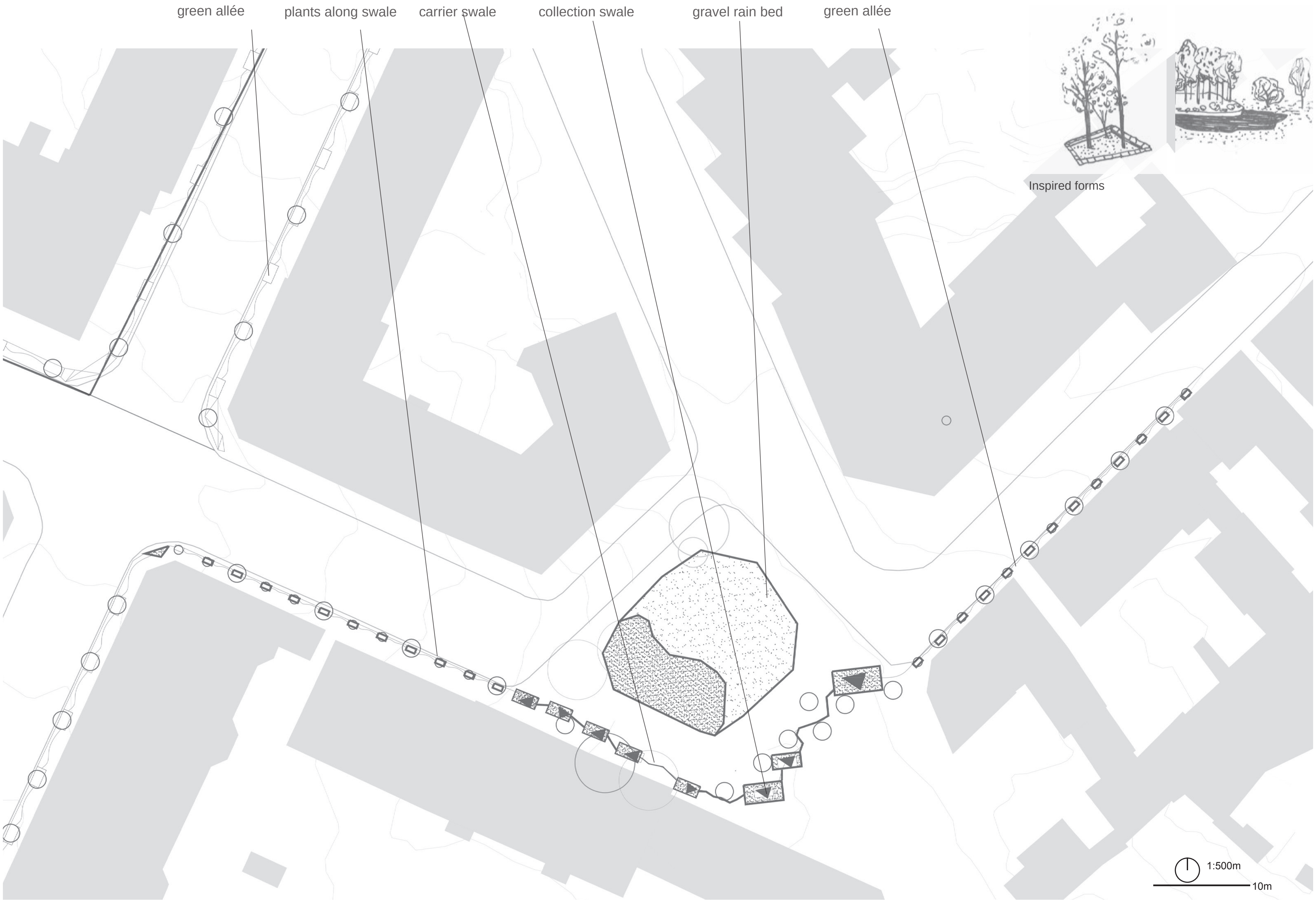




Surroundings:
Rodes Plass (Bydel)
Roadside edges (Bymiljøetaten)
Apartments

Field notes:
sand and gravel and humus
topsoil
fluvial loose sediment
existing trees: *Prunus and Malus species, Quercus robor, Alnus glutinosa and Sorbus aucupaila*

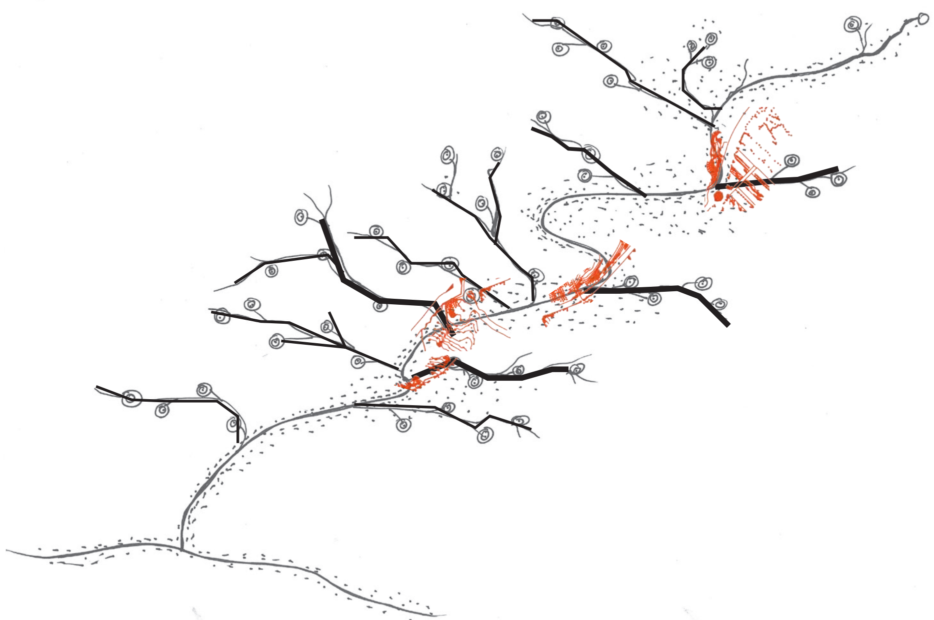


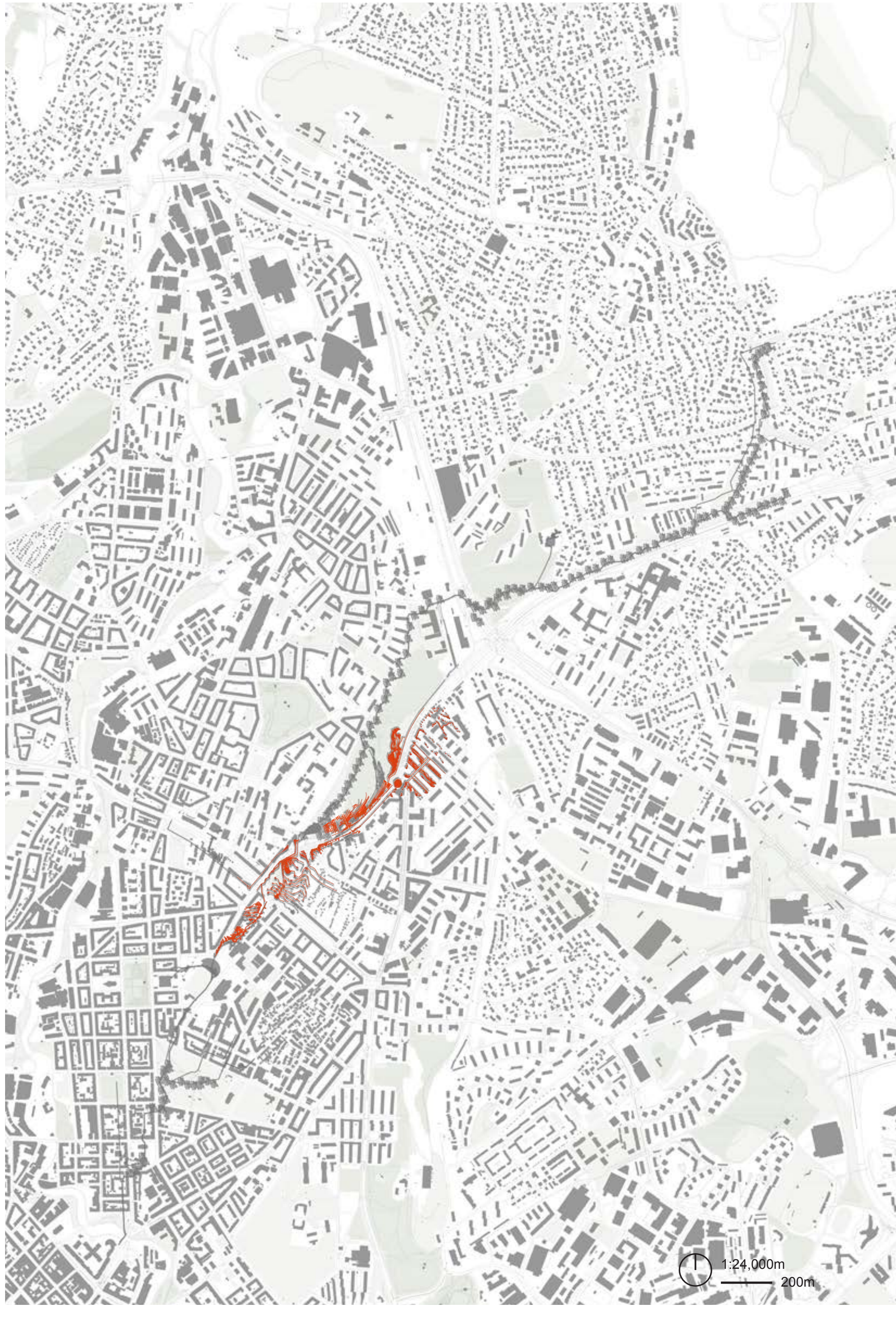

proposed design


green allée
plants along swale
carrier swale
collection swale
gravel rain bed
green allée
Inspired forms
1:500m
10m

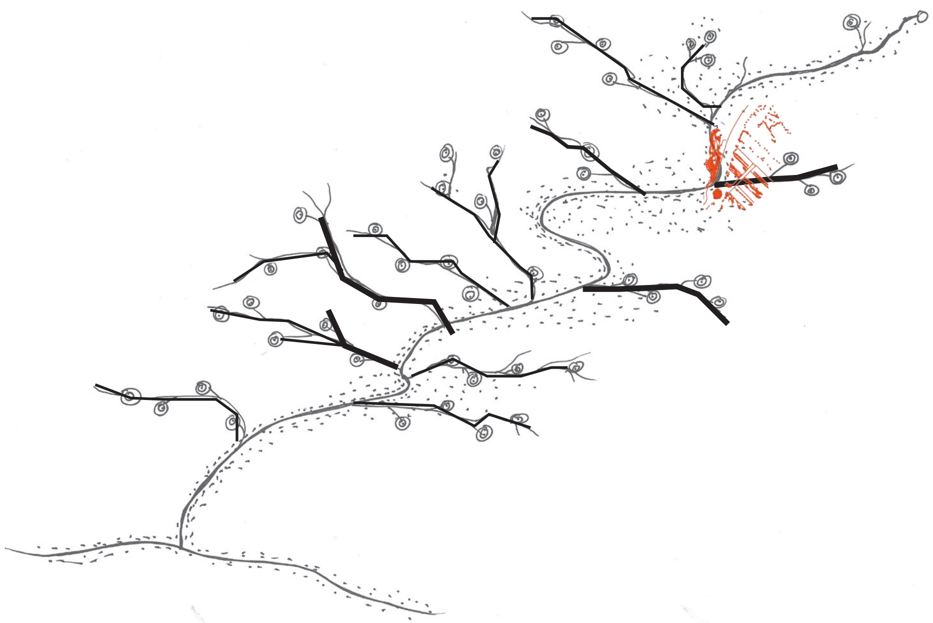


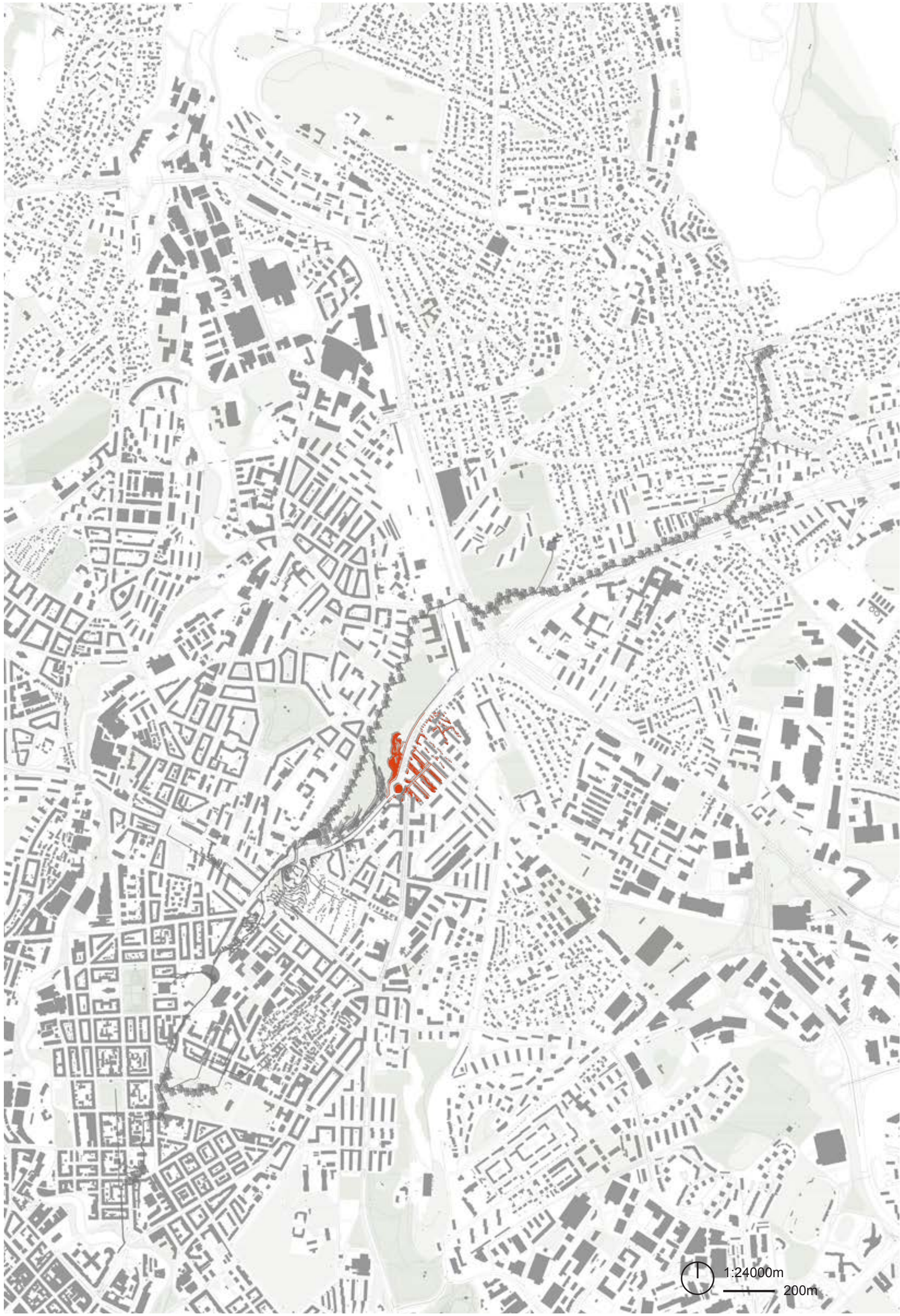

PHASE 1:  COMMON GROUND SPACES
public land
continuity - municipal program





the forested ridge





**The Theater**

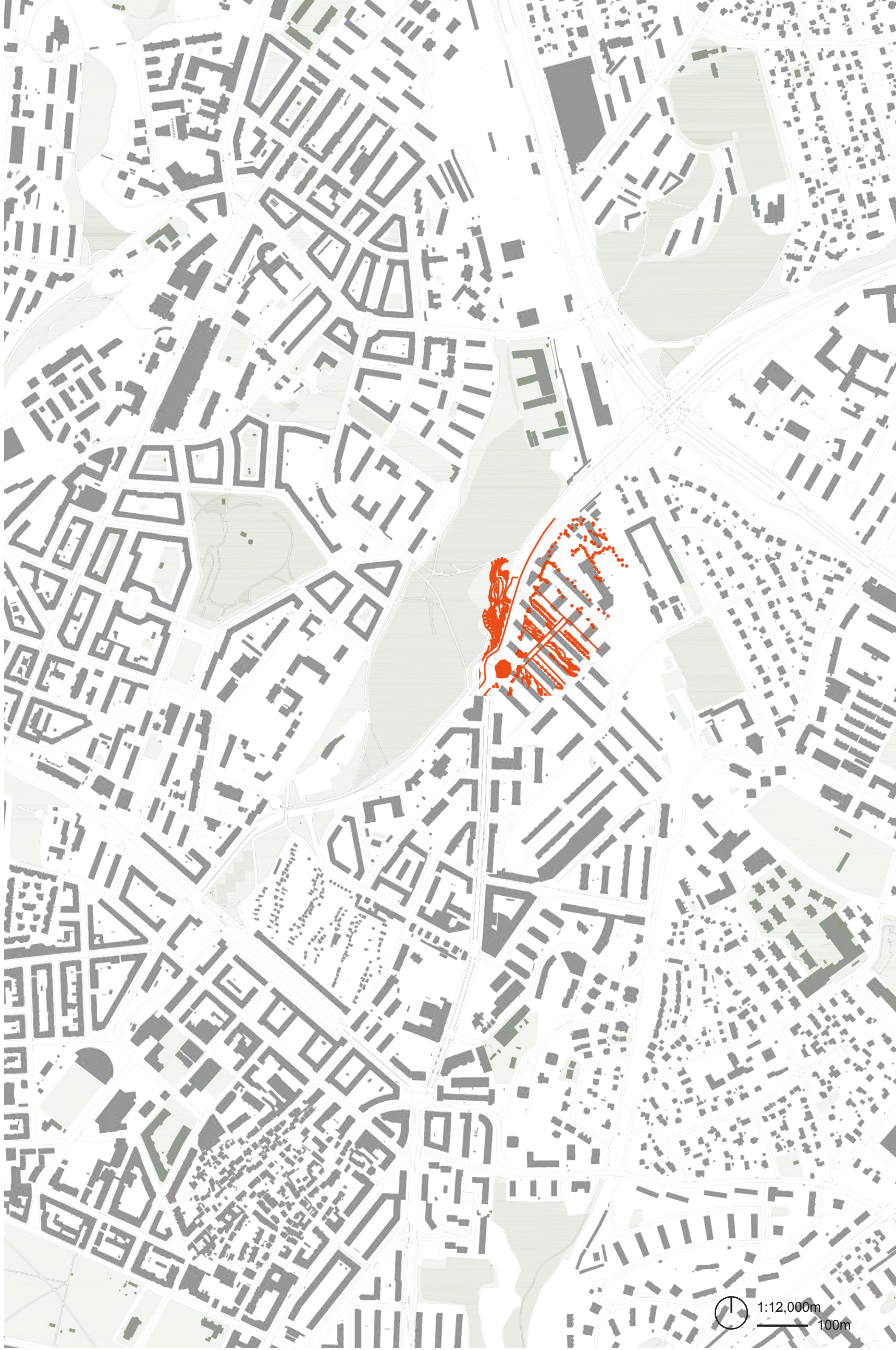


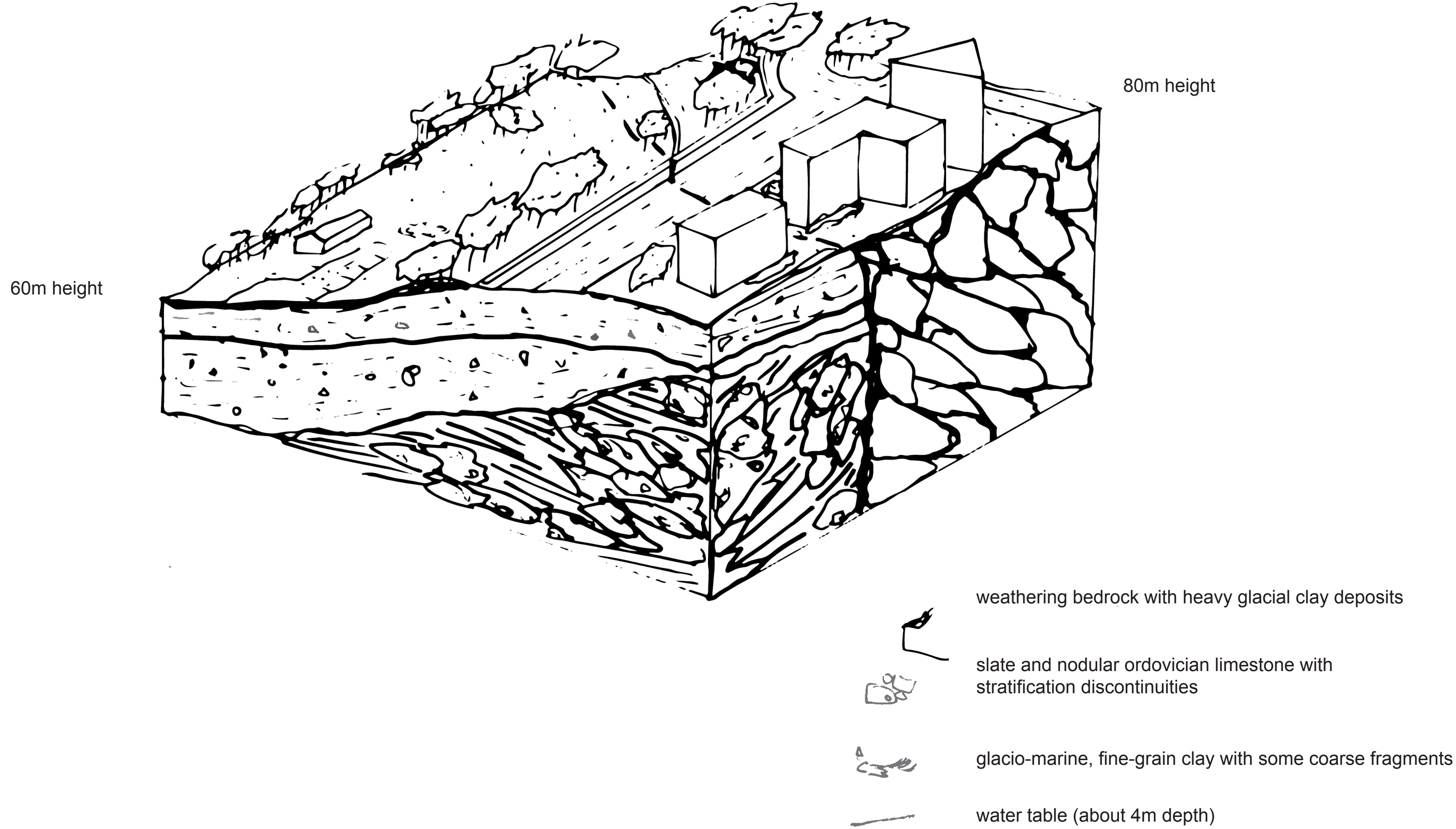
1:3000m

existing lighting 20m

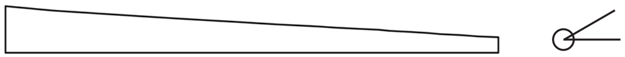
Surroundings:
Health clinic (Oslo kommune)
Elderly home (Oslo kommune)
Torshov Valley (Bymiljøetaten)
Mailundenveien edges (Bymiljøetaten)
private apartments

Field notes:
clay and humus topsoil
marine deposit
282m to groundwater monitoring well:
64.2m height of bedrock
3m depth to groundwater
data source: Oslo Kommune, VAV

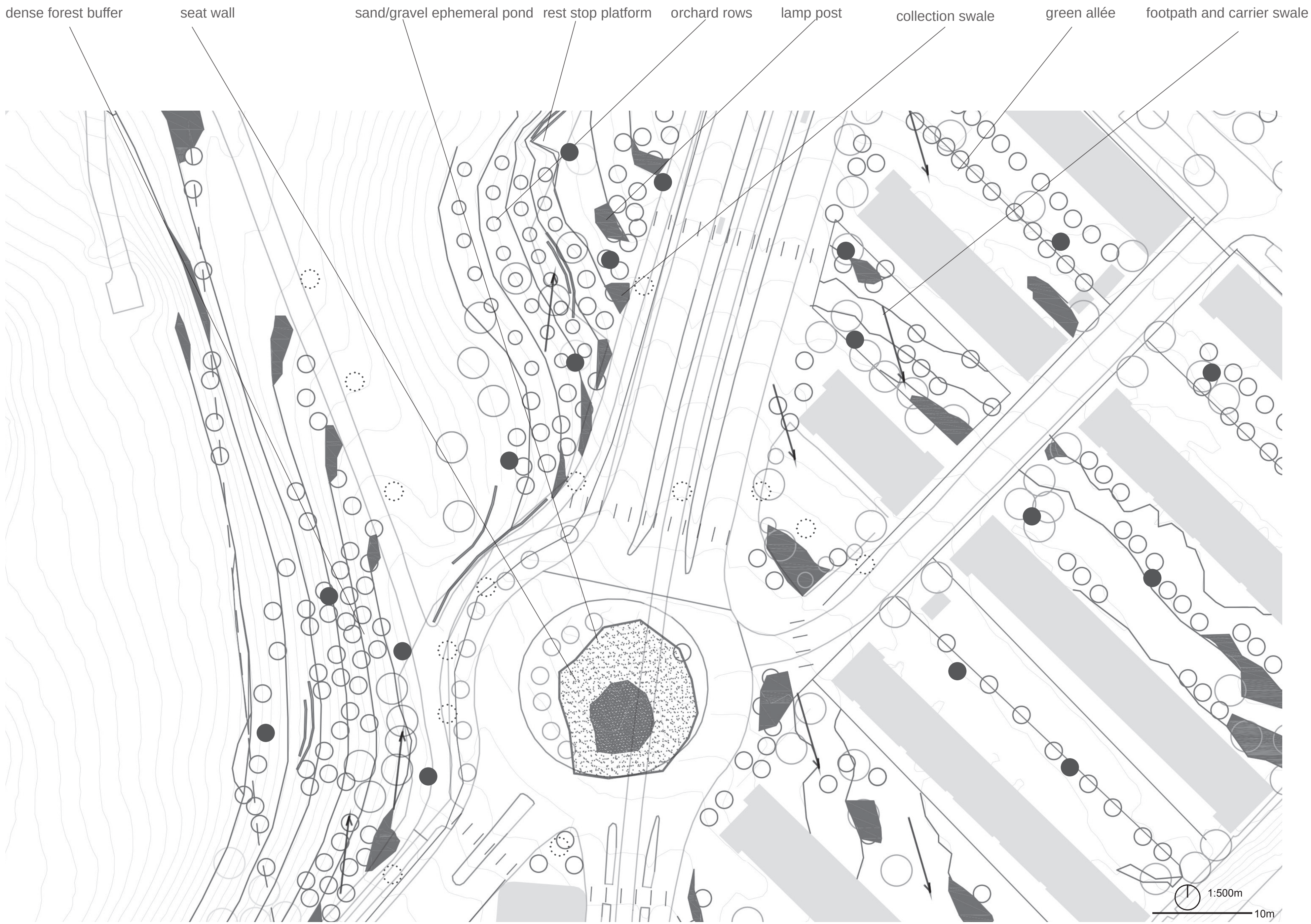


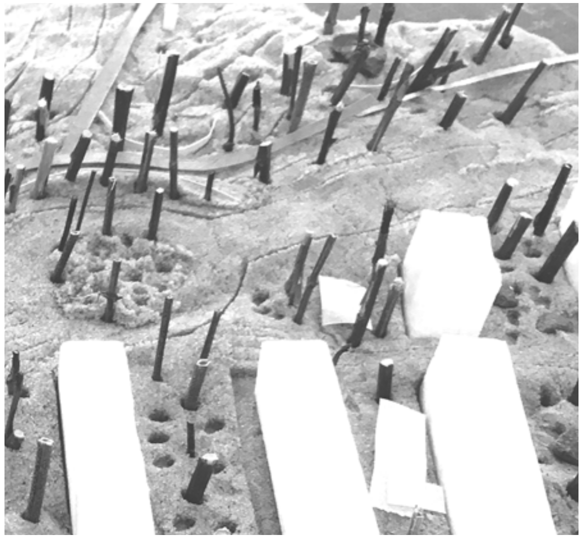

80m height
60m height
weathering bedrock with heavy glacial clay deposits
slate and nodular ordovician limestone with stratification discontinuities
glacio-marine, fine-grain clay with some coarse fragments
water table (about 4m depth)

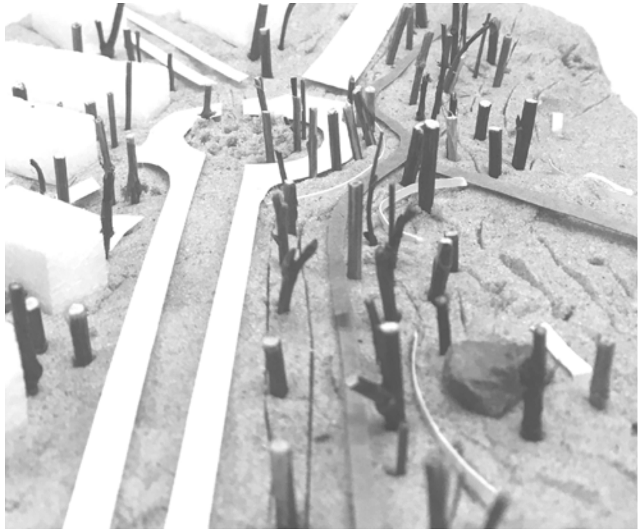
proposed design

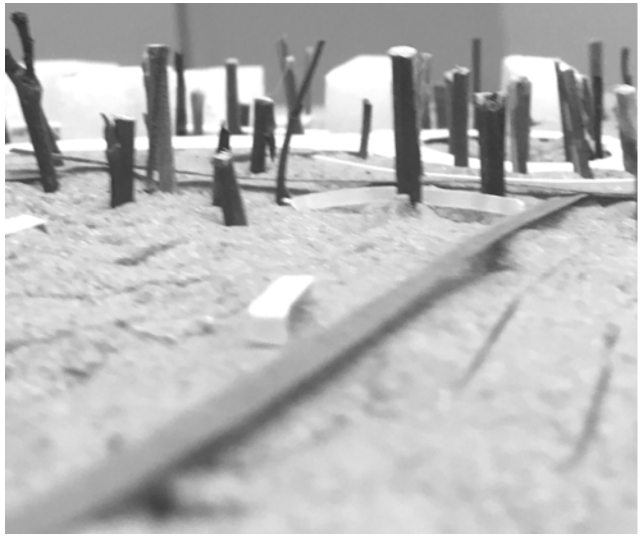



elevation: 0.0°- 12.8°


dense forest buffer
seat wall
sand/gravel ephemeral pond
rest stop platform
orchard rows
lamp post
collection swale
green allée
footpath and carrier swale
1:500m
10m







seat walls

tree sound barrier along road

viewing platforms to fjord

wooded foot path

tree colonnade clarifying path to forest

orchard rows

crosswalks; more park entrances

extended parkland into the neighborhood fabric

slower pace of road

parkland resource to Sinsen school

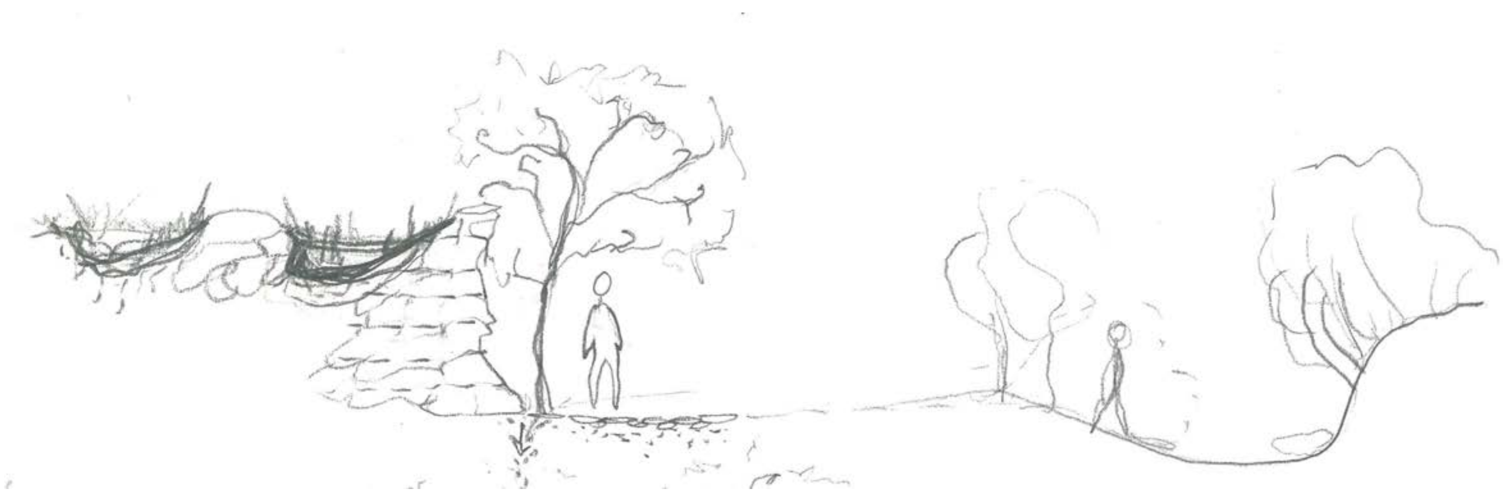
grass swales to plant edibles between

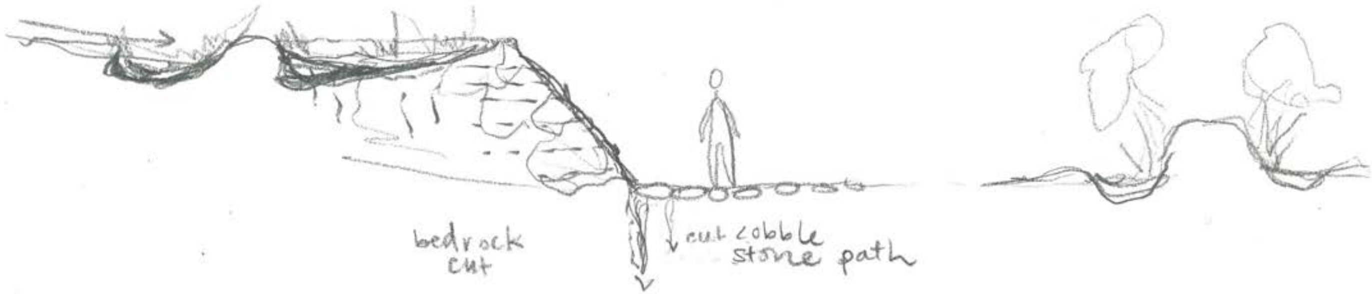
lamp posts

safe feeling to run at night

elderly home crosswalk

forested ridge section sketches:
geomorphology cuts
swale channels
embankment clearings



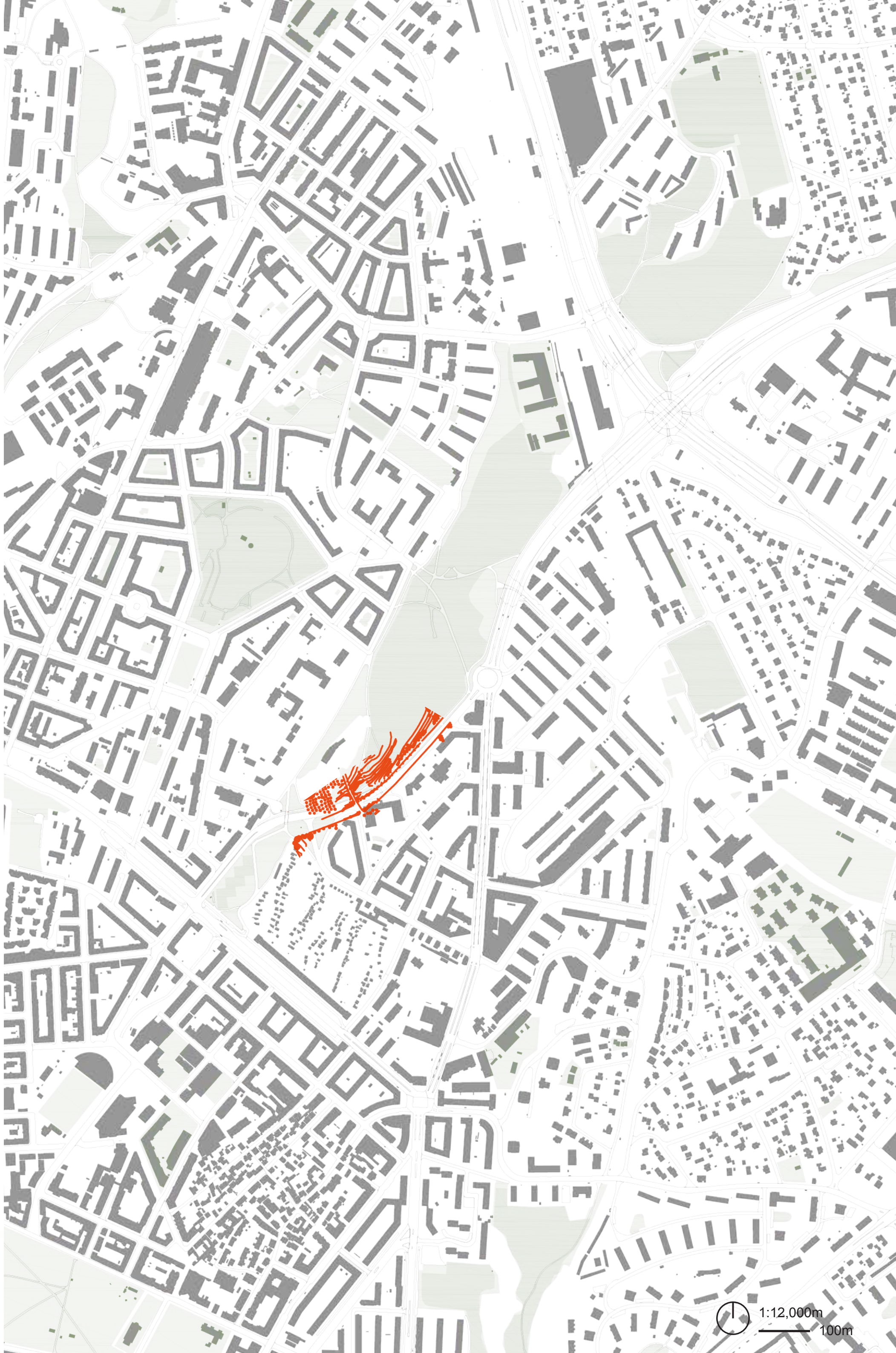



inspired by Novartis Campus Park project (Vogt and Foxley, 2010)

the lush tunnelway


1:3000m

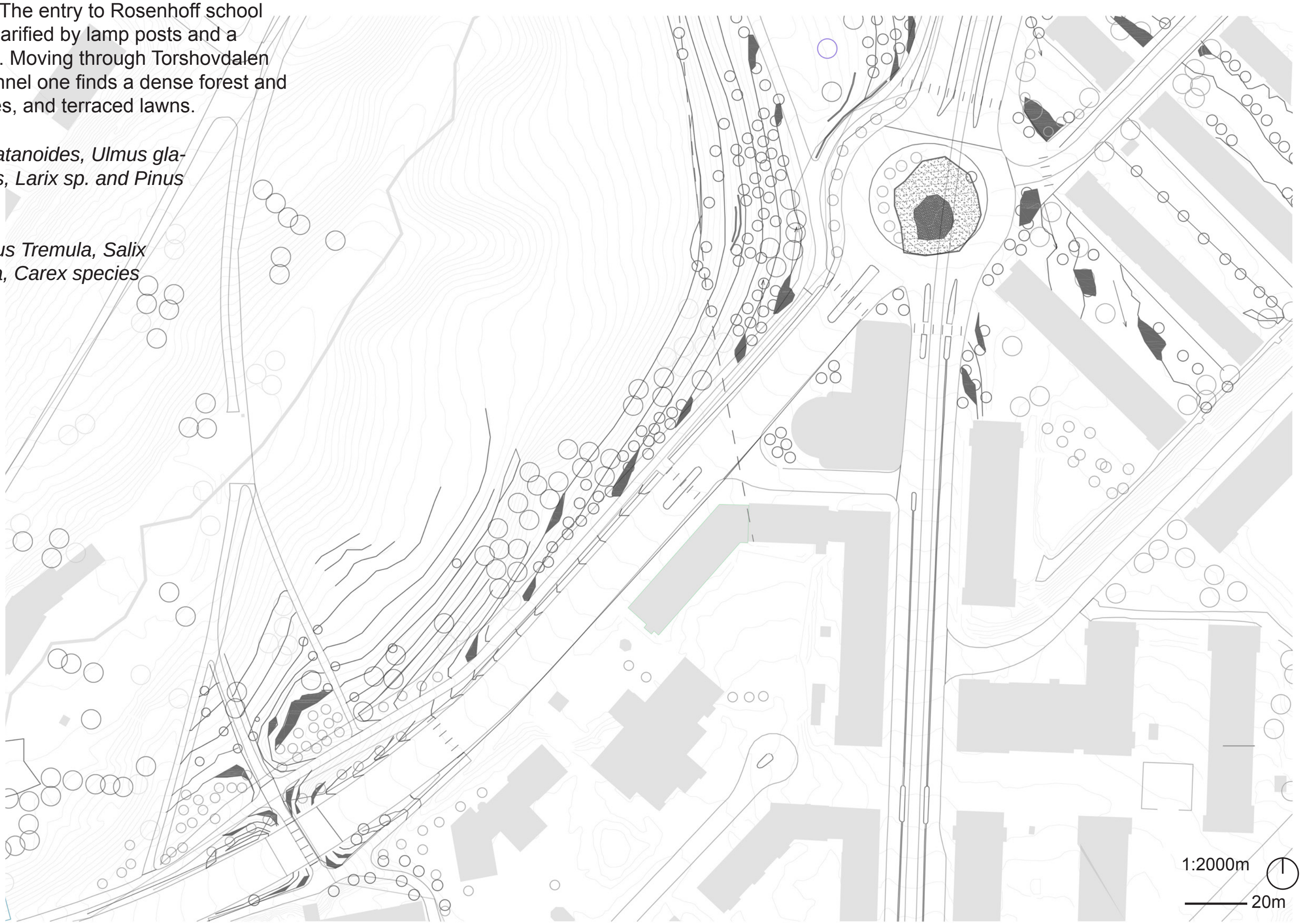

existing lighting — 20m



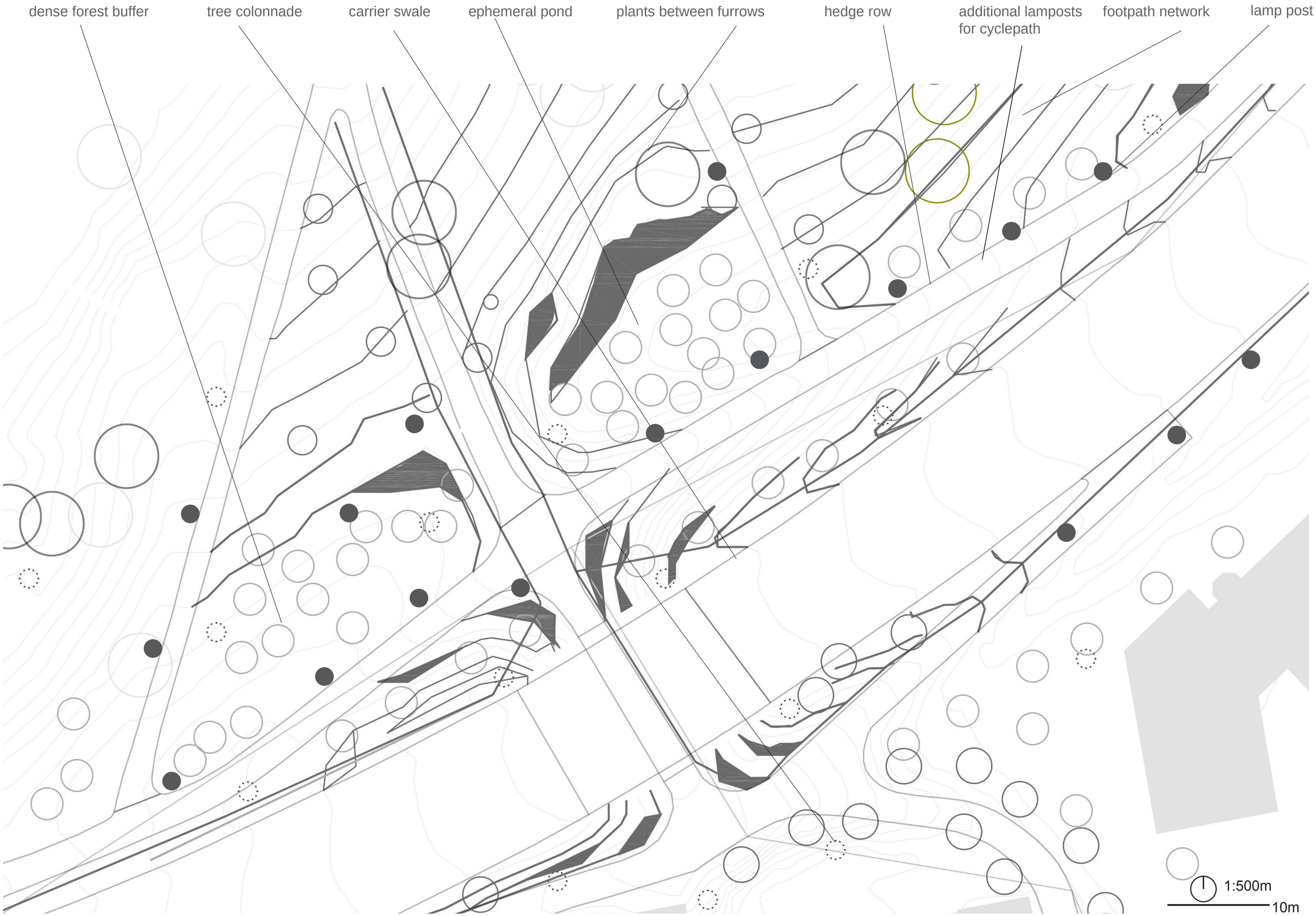
The lush tunnelway consists of plant life and light in abundance as the blue veins allow water to flow in cases of storm. The periodic brush along the roadside is a riparian flesh that cleans and stores road effusions. The entry to Rosenhoff school and Torshovdalen is clarified by lamp posts and a Poplar tree colonnade. Moving through Torshovdalen elevations from the tunnel one finds a dense forest and footpaths, grass swales, and terraced lawns.

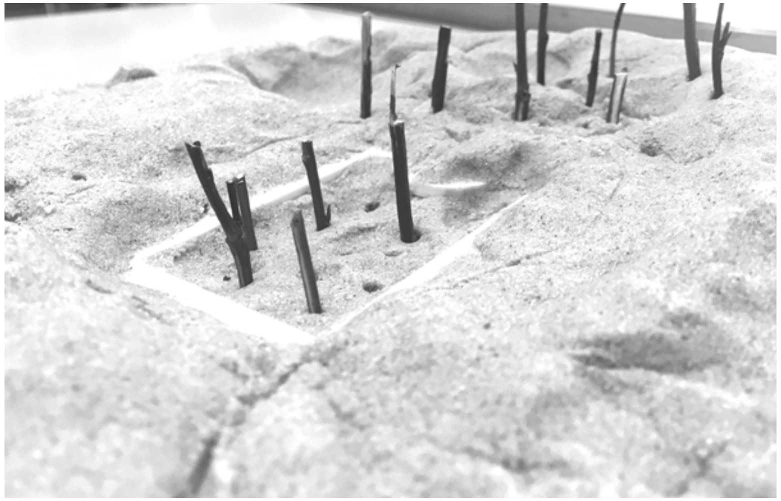
existing trees: *Acer platanoides, Ulmus glabra, Betula Pubescens, Larix sp. and Pinus silvestris*

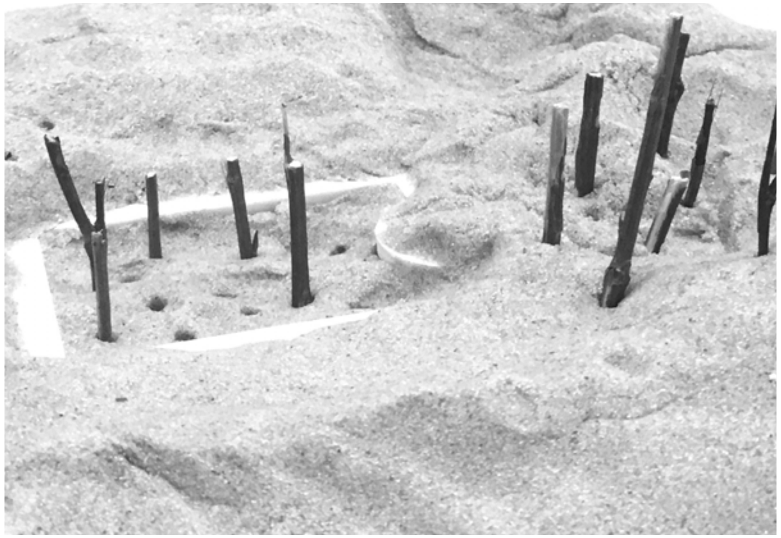
plant additions: *Populus Tremula, Salix caprea, Quercus rubra, Carex species*




elevation: 0.0°- 22.4°


dense forest buffer
tree colonnade
carrier swale
ephemeral pond
plants between furrows
hedge row
additional lamposts
for cyclepath
footpath network
lamp post
1:500m
10m





protection from road

playful terraces

rest stop seats

wooded foot path

lush tunnel

connecting cycle trail

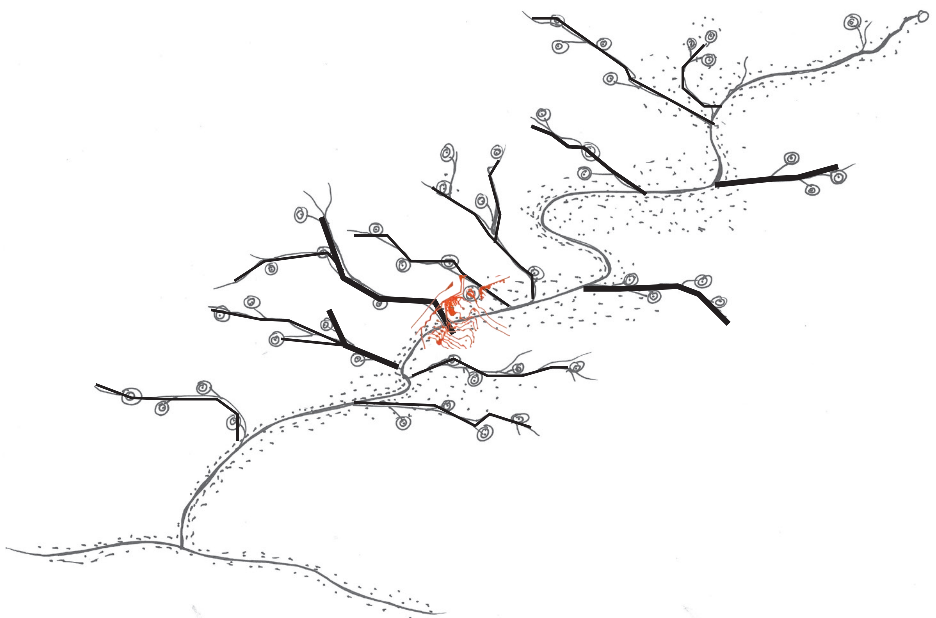
extended school yard

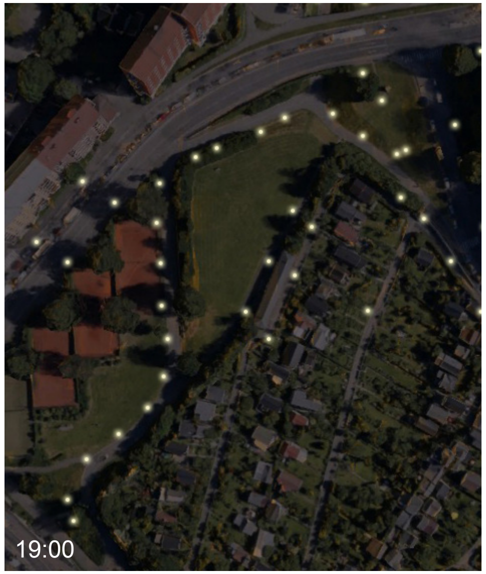
forest rooms

gravel rain beds

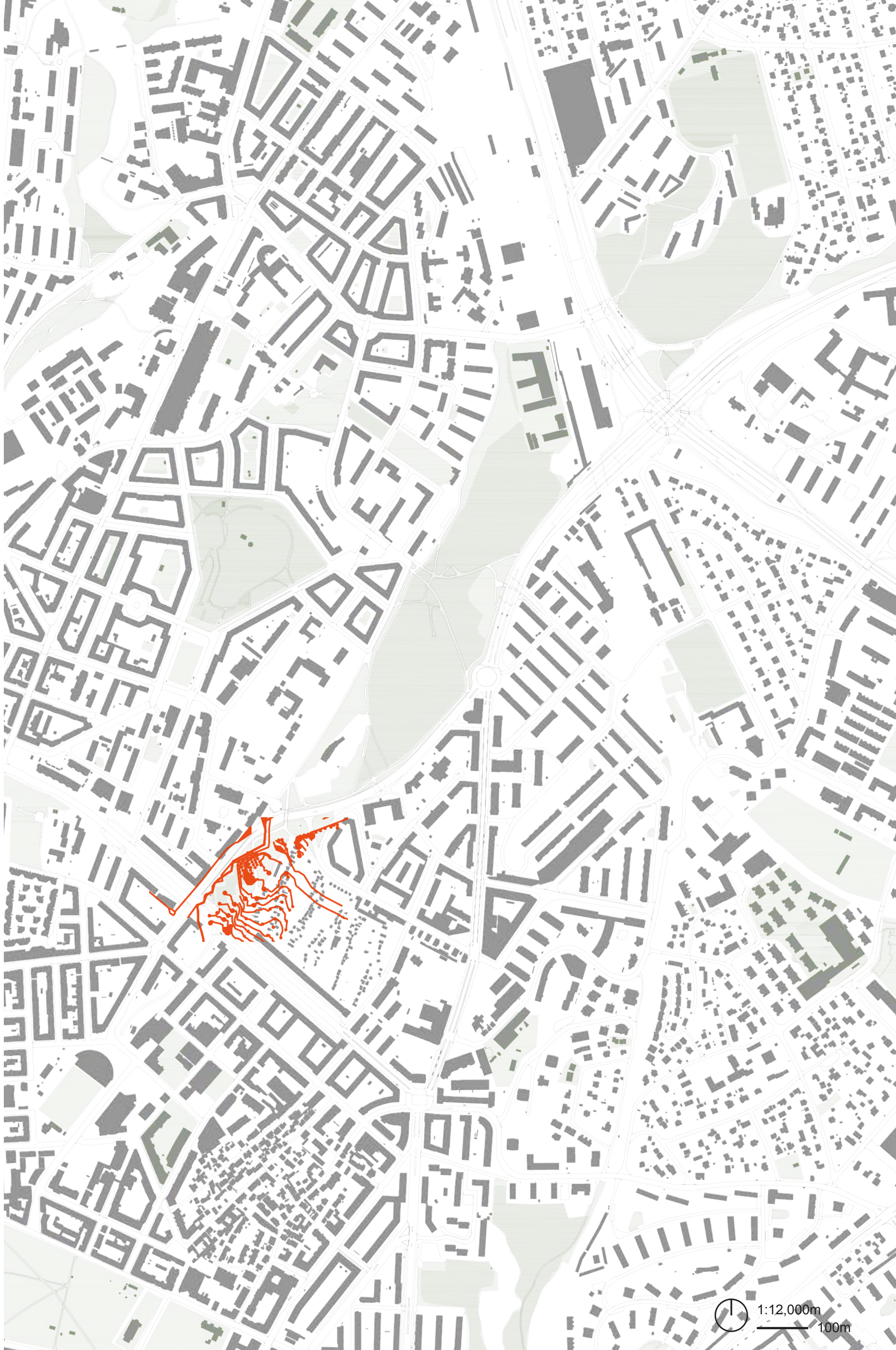
lamp posts

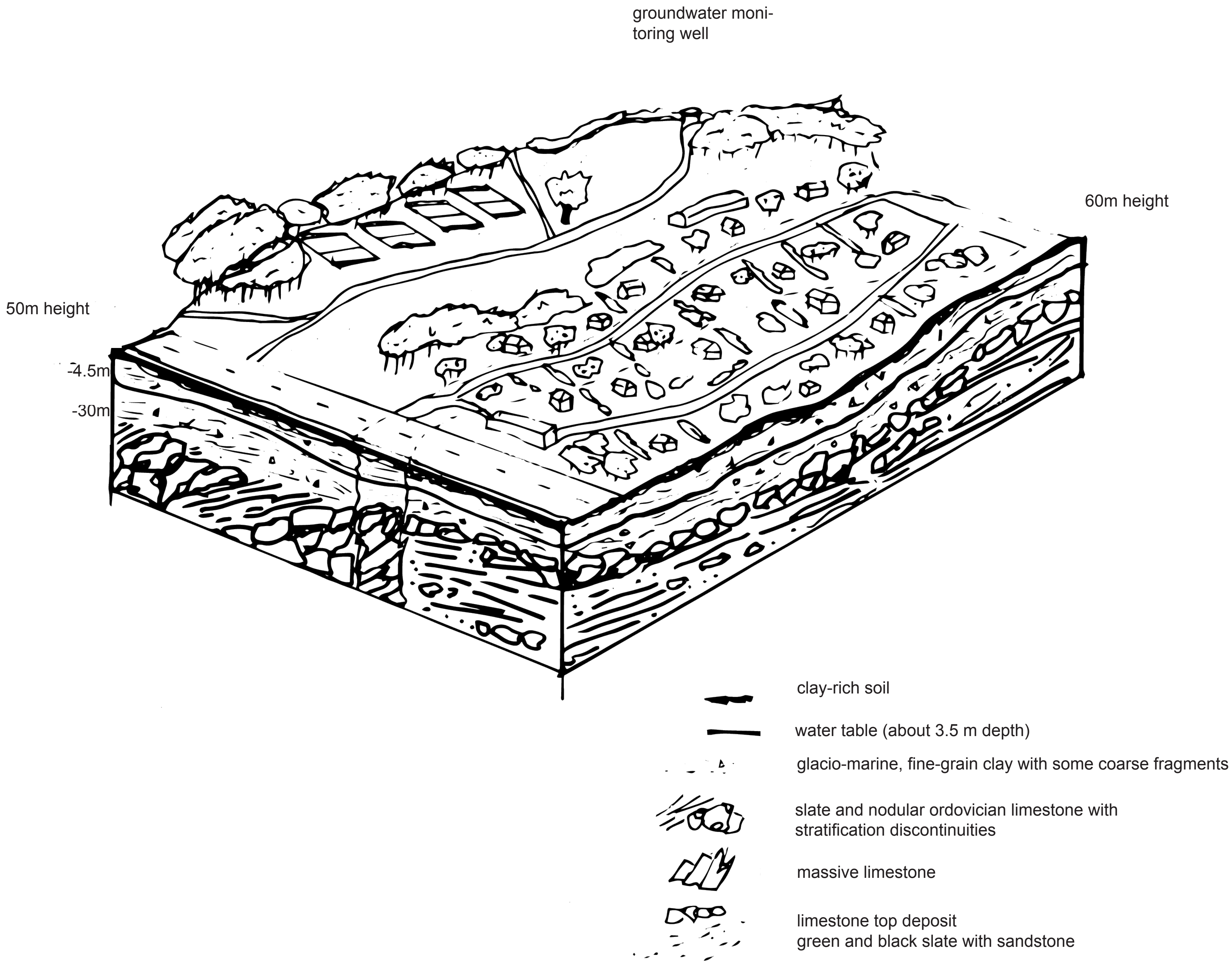
the rain-harvest channel



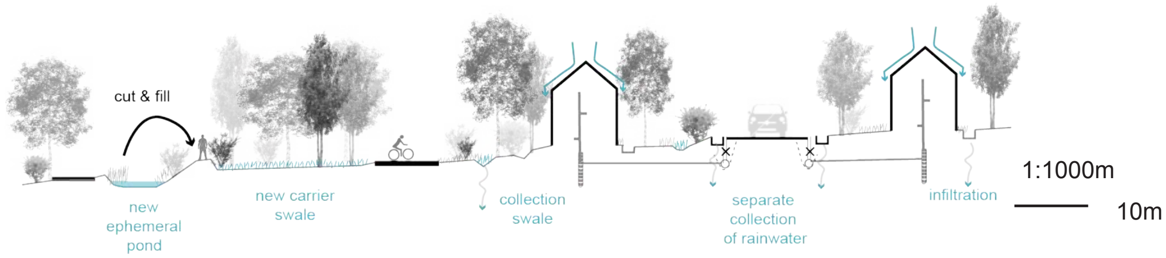



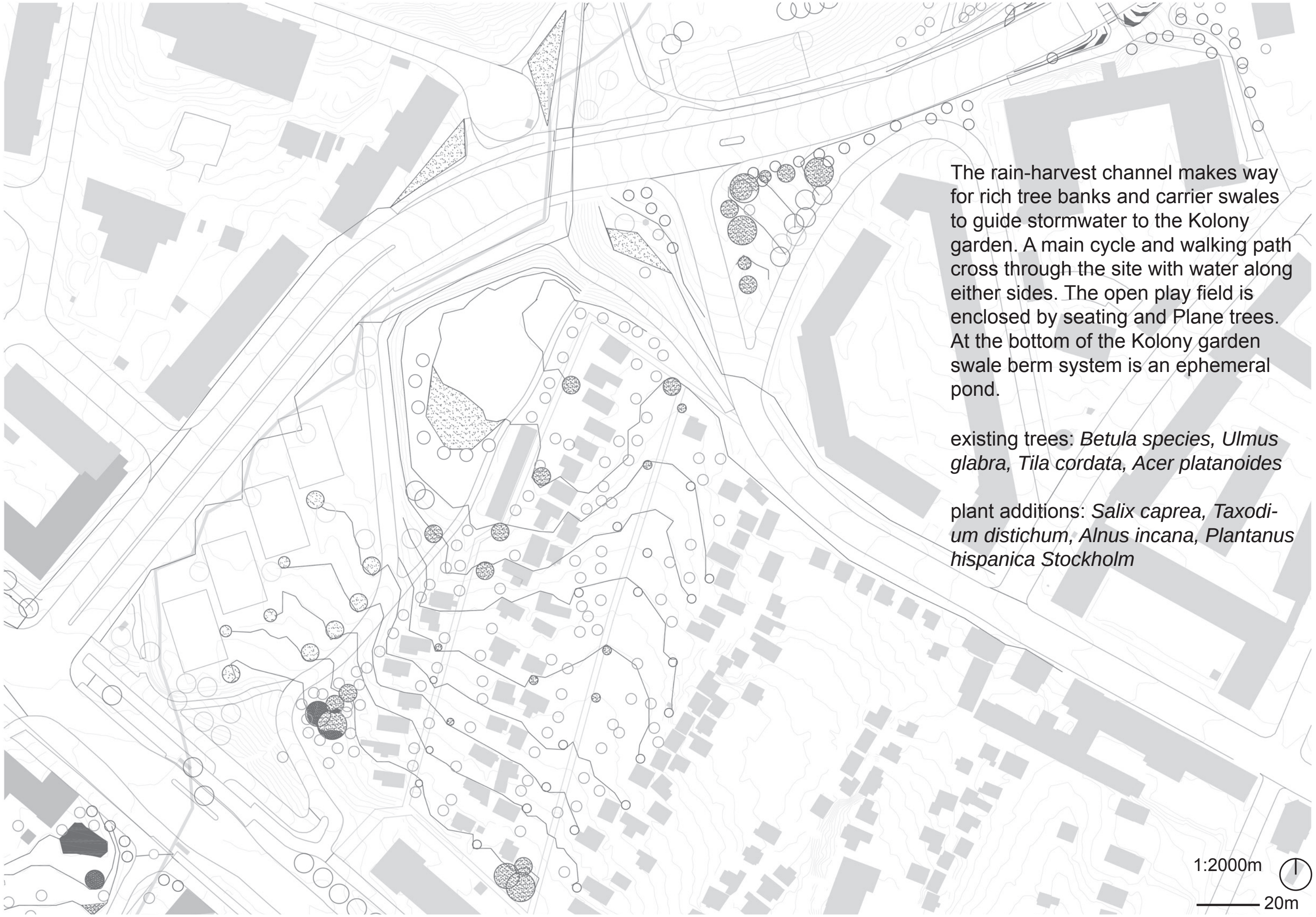

1:3000m existing lighting 20m




groundwater monitoring well
60m height
50m height
-4.5m
-30m
clay-rich soil
water table (about 3.5 m depth)
glacio-marine, fine-grain clay with some coarse fragments
slate and nodular ordovician limestone with stratification discontinuities
massive limestone
limestone top deposit
green and black slate with sandstone

SITE 3
proposed design
the rain-harvest channel

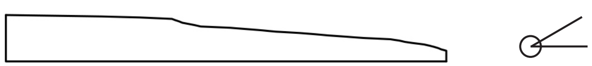


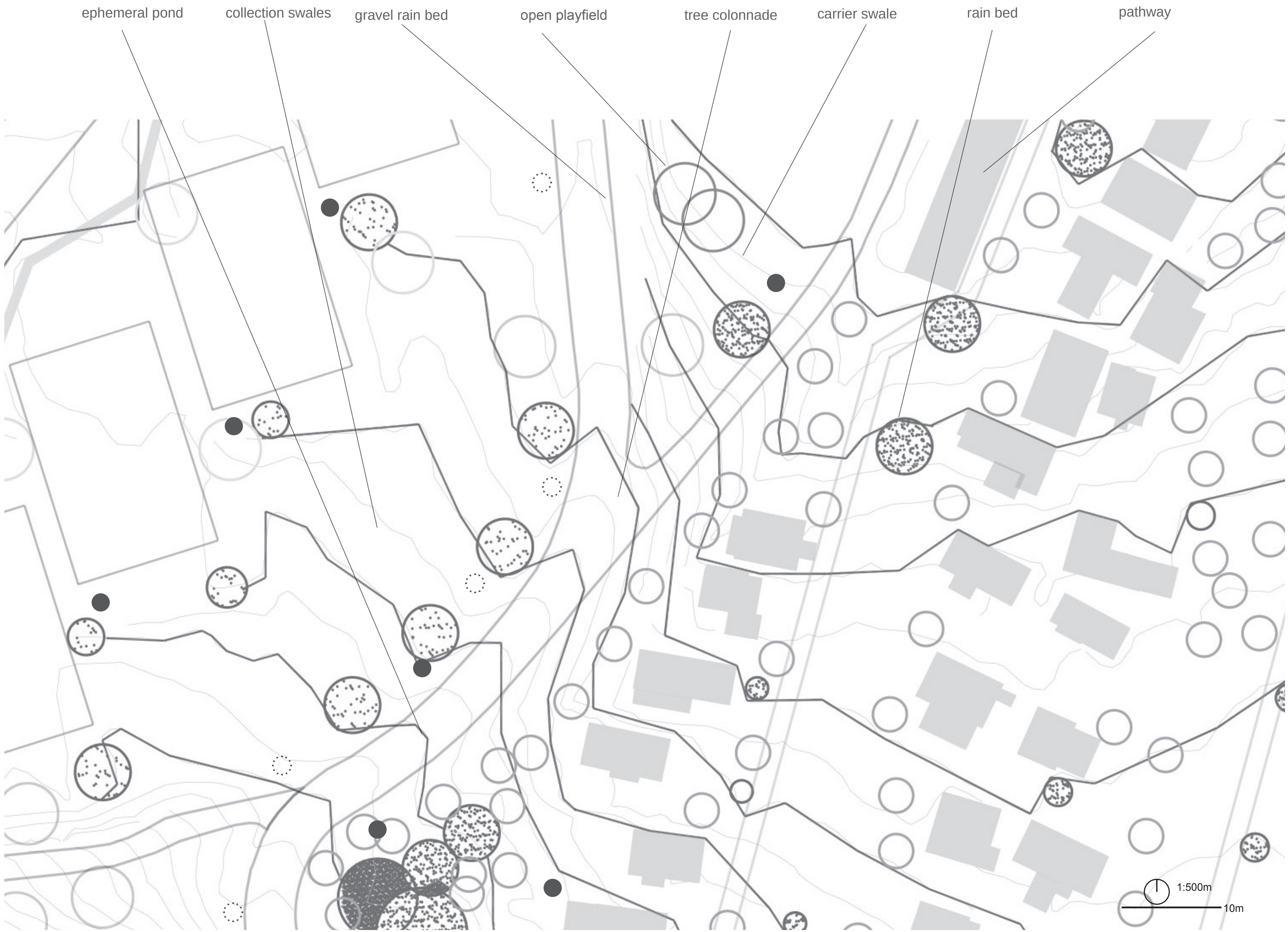



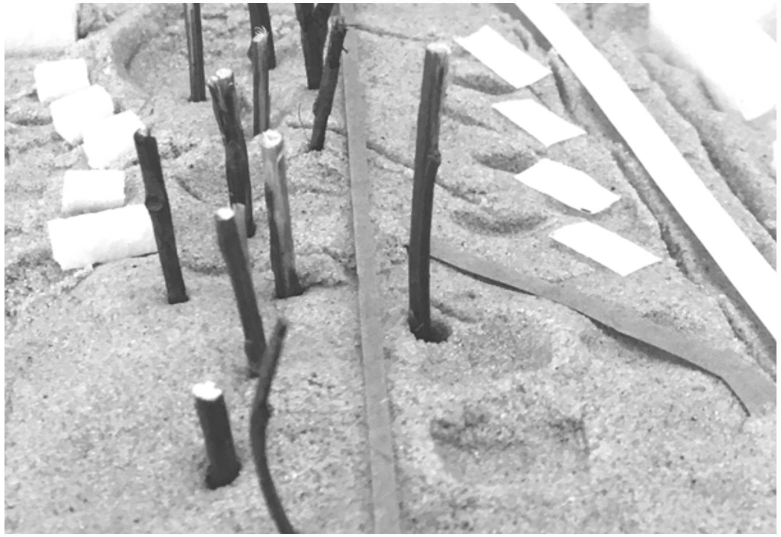

The rain-harvest channel makes way for rich tree banks and carrier swales to guide stormwater to the Kolony garden. A main cycle and walking path cross through the site with water along either sides. The open play field is enclosed by seating and Plane trees. At the bottom of the Kolony garden swale berm system is an ephemeral pond.

existing trees: *Betula species, Ulmus glabra, Tila cordata, Acer platanoides*

plant additions: *Salix caprea, Taxodium distichum, Alnus incana, Plantanus hispanica Stockholm*




ephemeral pond
collection swales
gravel rain bed
open playfield
tree colonnade
carrier swale
rain bed
pathway
1:500m
10m



wet woodland along Kolonygarden

benches to stay awhile

gravel swales for garden
rain harvest

lamp posts

feeling welcome to play

dense forest to buffer sound
of major roads

pollination

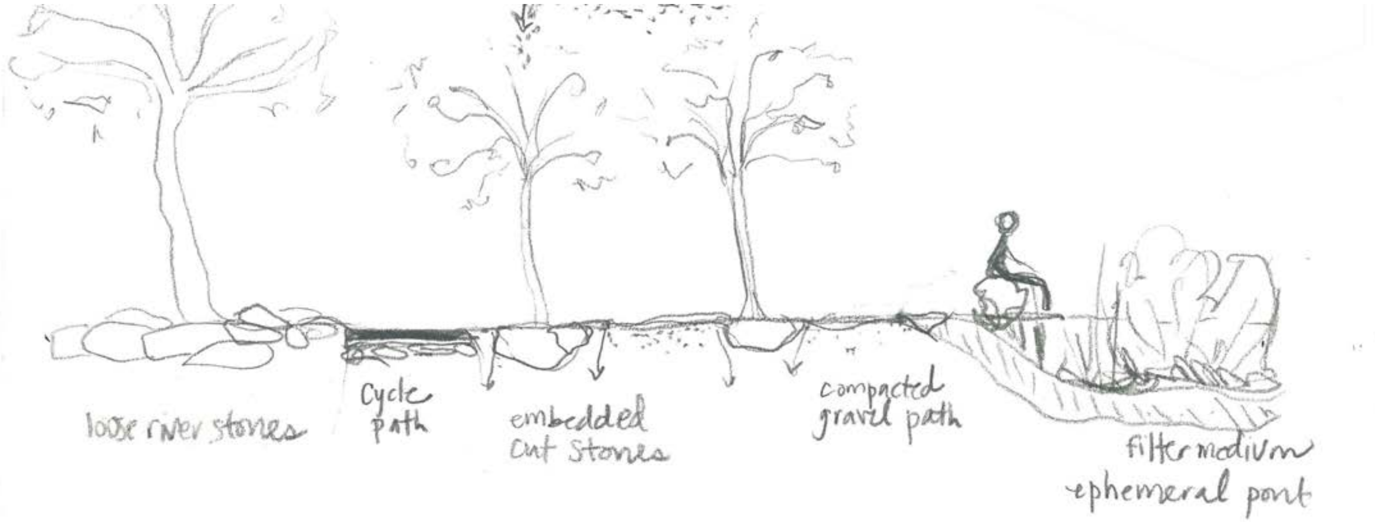
large ephemeral ponds

biodiverse wetland

fruit trees surround field

tree colonnade clarifying
path to forest

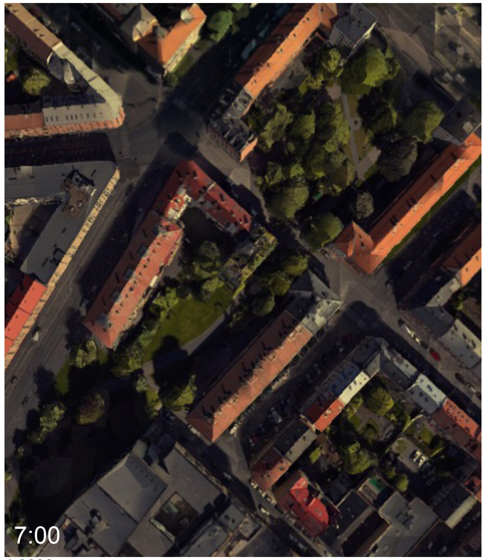
rain-harvest channel section sketches:
geomorphology cuts
swale channels
embankment clearings



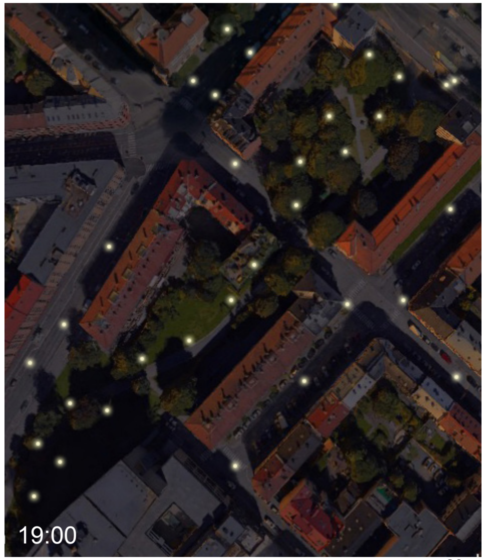


inspired by Novartis Campus Park project (Vogt and Foxley, 2010)

## the cycle allée

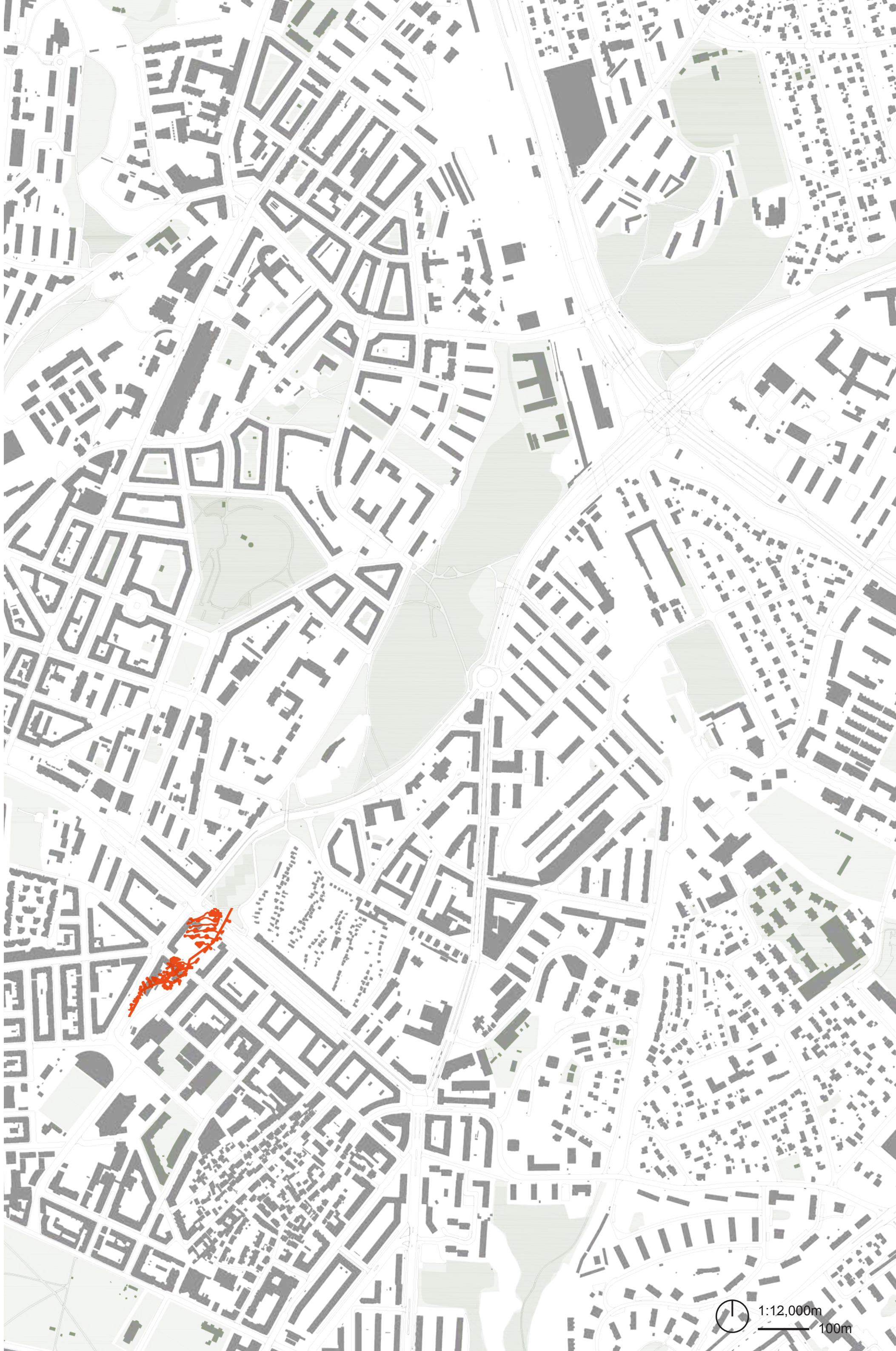


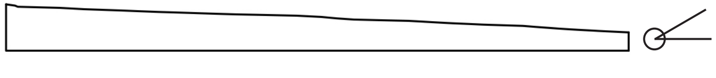

1:3000m



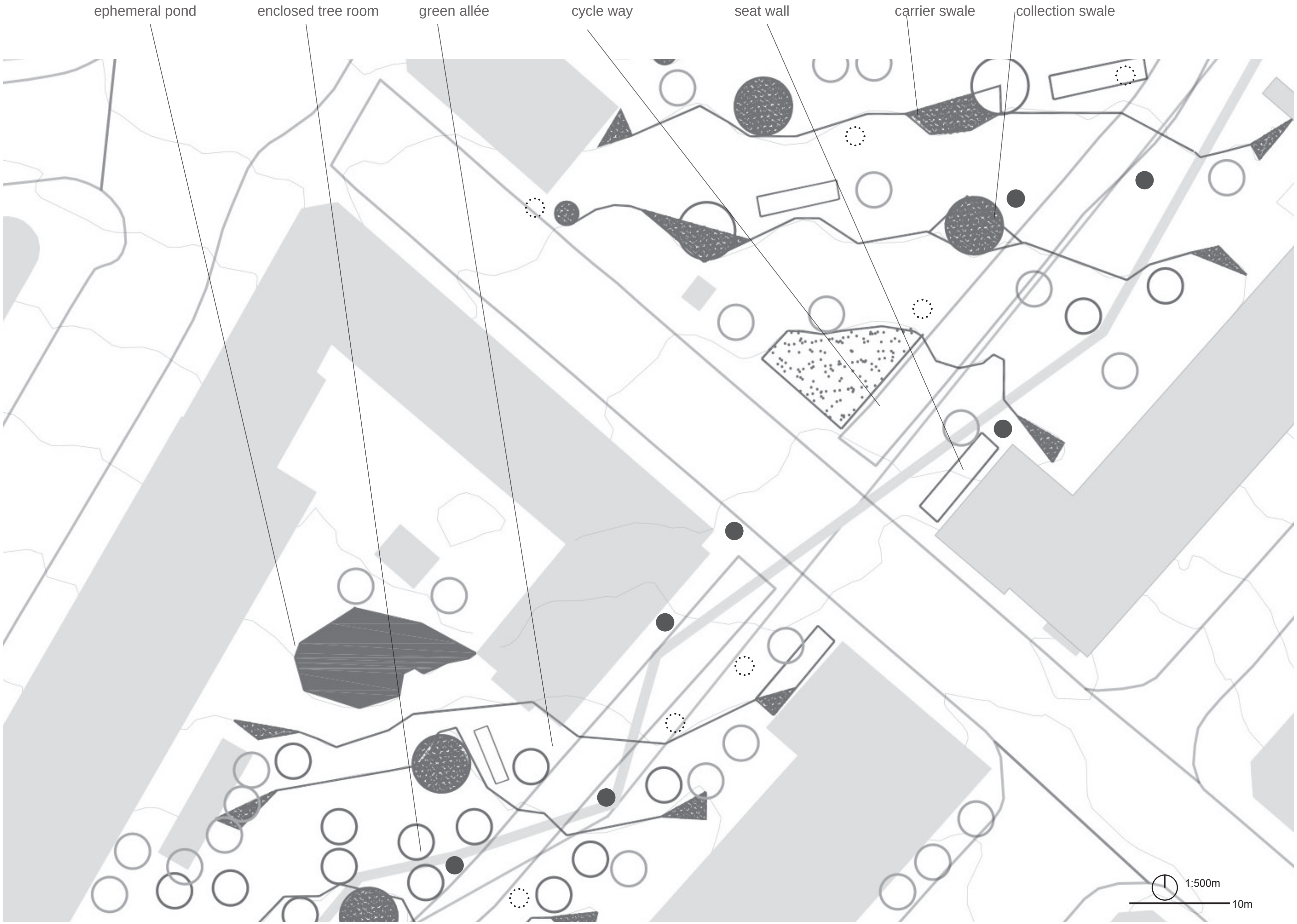

existing lighting

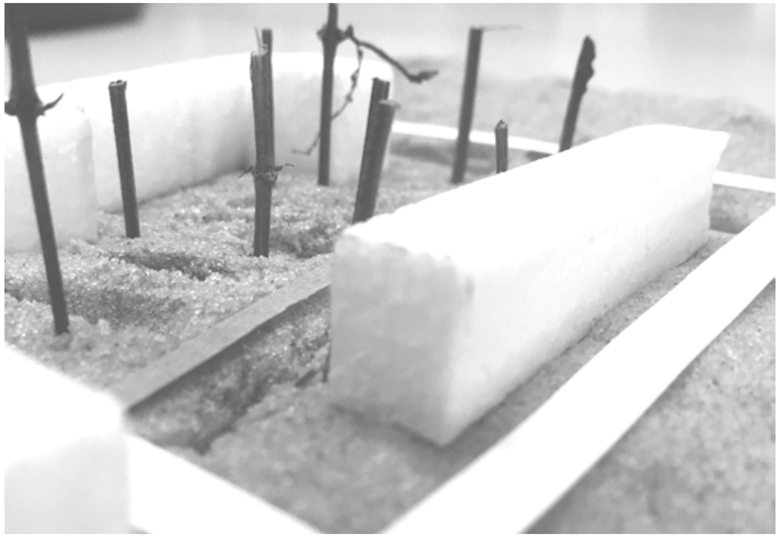
20m

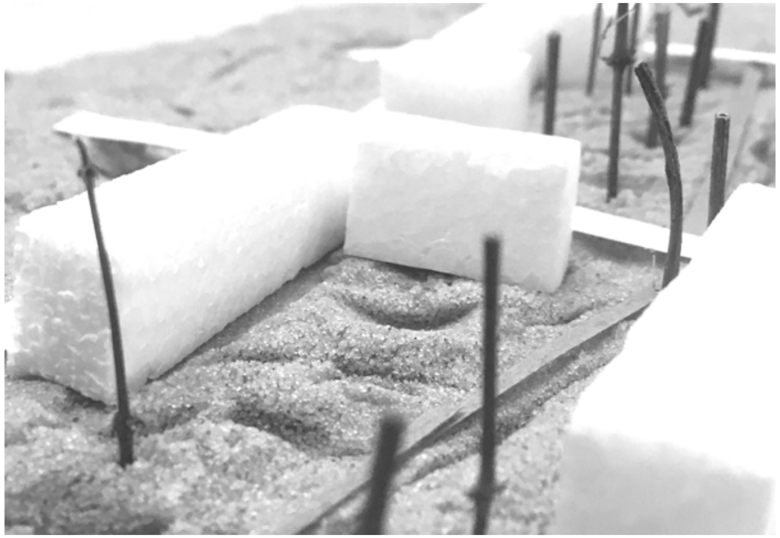


elevation: 0.0°- 10.5°


ephemeral pond
enclosed tree room
green allée
cycle way
seat wall
carrier swale
collection swale
1:500m
10m





safe to cycle in evening

rest stop picnic tables

gravel swales under tree canopy

lamp posts

gravel footpaths

tree colonnade along cycle route to forest

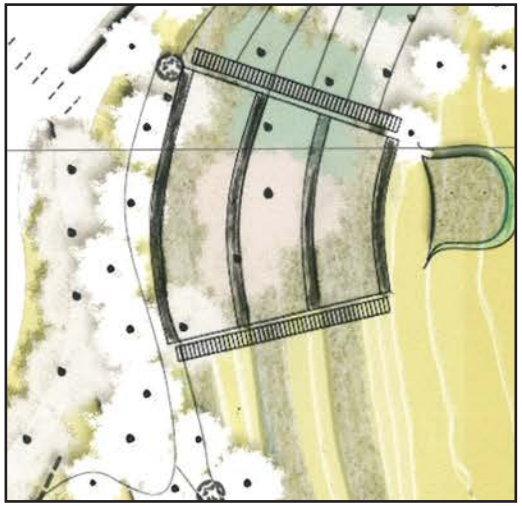
pollination

biodiverse forest floor

seat walls along rain beds

hedge rows enclose rooms to sit

COMMON GROUND SPACES
three design proposals



THE THEATER
*of Torshov Valley*

THE SCHOOLYARD
*of Lønnebakken School*

THE ORCHARD
*of Rodeløkka Alottments*

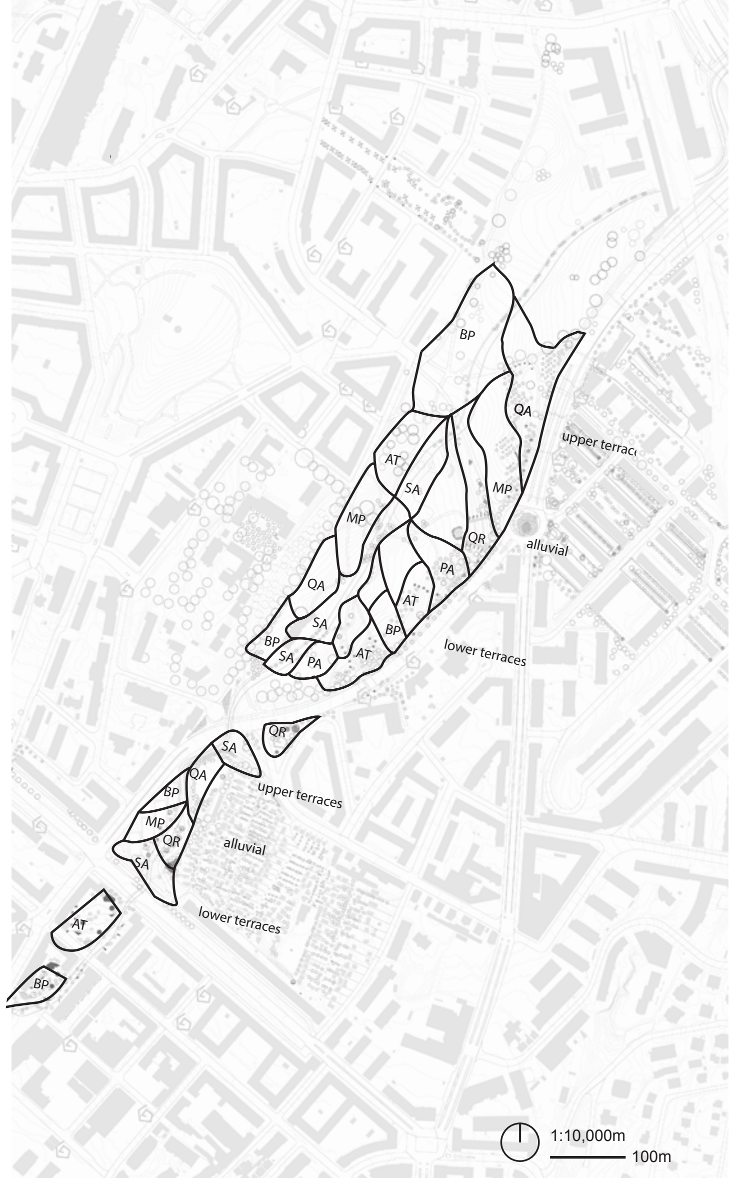
# Situation Plan


**LEAD TREE SPECIES**

AC - ACER TATARIUM, *TATARIUM MAPLE*
BP- BETULA PUBESCENS, *WHITE BIRCH*
QR - QUERCUS ROBUR, *ENGLISH OAK*
QA- QUERCUS RUBRA, *RED OAK*
MP - MALUS PUMILLA, *APPLE*
PA - PRUNUS AVIUM, *SWEET CHERRY*
SA - SALIX ALBA, *WHITE WILLOW*

# VEGETATION PALETTE

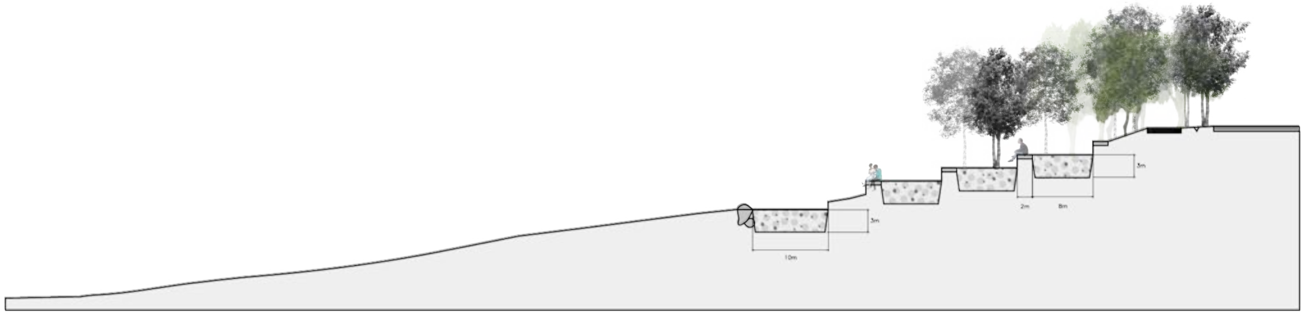
*based on found tree species*




inspired by Novartis Campus Park project (Vogt and Foxley, 2010)

TILIA CORDATA
GINGKO BIBLOA
LARIX DECIDUA
BETULA SPECIES
MALUS PUMILLA
AESCULUS HIPPOCASTANUM
SALIX SPECIES
PICEA PUNGENS
ACER PLATANIODES
QUERCUS SPECIES
ACER TATARICUM
CERCIDIPHYLLUM JAPONICUM
PRUNUS AVIUM
PSUEDOTSUGA MENZIESII
MALUS DOLGO
ULMUS GLABRA
PROPOSED TREE
UNKNOWN SPECIES
PROPOSED RAIN GARDEN


b
b
1:1000m
10m




the theater
section b

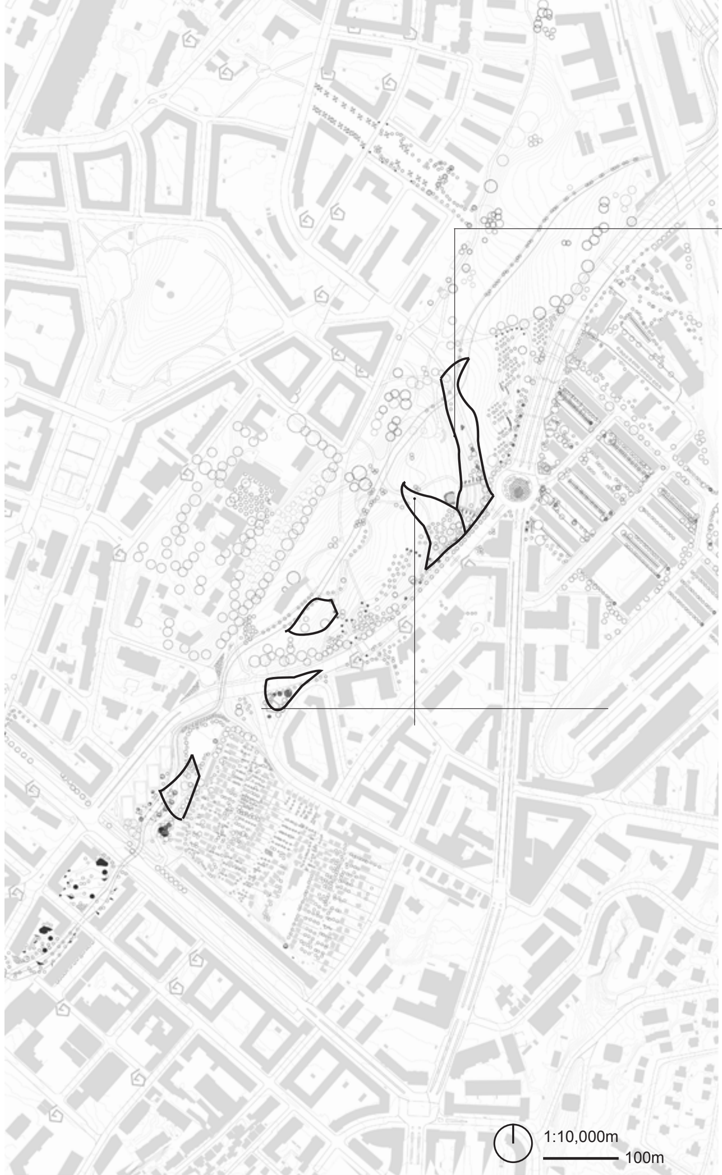
1:1000m 10m

## THE THEATER

In the courtyard of Lønnebakken school lies rows of fruit trees alongside a wall leading to the remnant farm orchard below the ridge and further entering Torshov Valley. The school orchard trees can be cared for and harvested by the school children in different seasons. The wall intends to make rainwater visible and playful. Students can watch the water gather in a side rainbed and then spill over into the next rainbed, until slowly flowing outside the wall and be absorbed by the dense root systems along the hillside of Torshov Valley.

# THEATER AREA VEGETATION PALETTE

*based on found tree species*




**QUERCUS RUBRA**

**Tree species**
Quercus rubra 45%
Carpinus betulas 15%
Prunus Avium 15%
Fagus sylvatica 10%
Corylus avellana 10%
Quercus robur 5%

**Perennial species**
Carex pendula
Ribes nigrum
Convallaria majalis
Fragaria vesca
Polygonatum multflorum
Asparagus officinalis

**PRUNUS AVIUM**

**Tree species**
Prunus avium 45%
Malus Pumilla 20%
Pyrus communis10%
Corylus avellana 10%
Quercus rubra 10%
Prunus domestica 5%

**Perennial species**
Carex pendula
Polygonatum multiflorum
Convallaria majalis
Polystichum aculeatum
Rubus idaeus
Rheum rhabarbarum

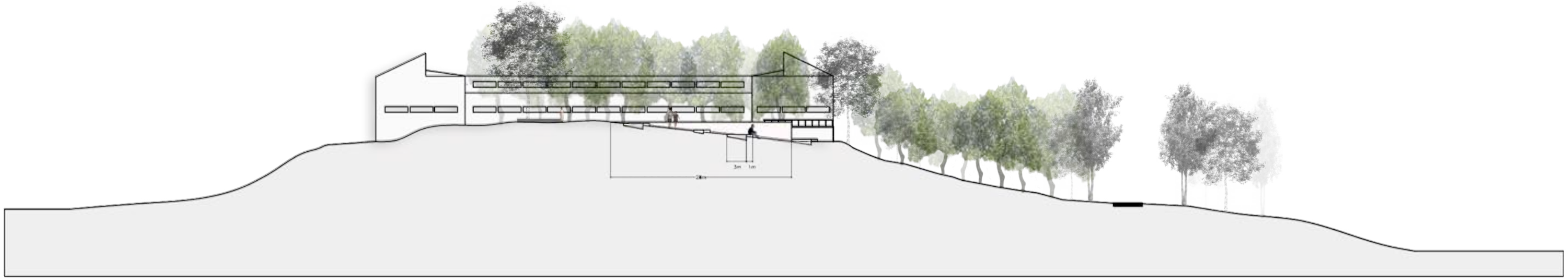

existing ridge


proposed phase I: theater


proposed phase II: theater, river, ponds


TILIA CORDATA
LARIX DECIDUA
MALUS PUMILLA
SALIX SPECIES
ACER PLATANIODES
ACER TATARICUM
PRUNUS AVIUM
MALUS DOLGO
PROPOSED TREE
GINGKO BIBLOA
BETULA SPECIES
AESCULUS HIPPOCASTANUM
PICEA PUNGENS
QUERCUS SPECIES
CERCIDIPHYLLUM JAPONICUM
PSUEDOTSUGA MENZIESII
ULMUS GLABRA
UNKNOWN SPECIES
PROPOSED RAIN GARDEN


a
1:1000m
10m



the schoolyard
section a 1:1000m 10m


existing schoolyard


proposed schoolyard

# SCHOOLYARD AREA VEGETATION PALETTE
*based on found tree species*

## THE SCHOOLYARD

In the courtyard of Lønnebakken school lies rows of fruit trees alongside a wall leading to the remnant farm orchard below the ridge and further entering Torshov Valley. The school orchard trees can be cared for and harvested by the school children in different seasons. The wall intends to make rainwater visible and playful. Students can watch the water gather in a side rainbed and then spill over into the next rainbed, until slowly flowing outside the wall and be absorbed by the dense root systems along the hillside of Torshov Valley.

**ACER TATARICUM**

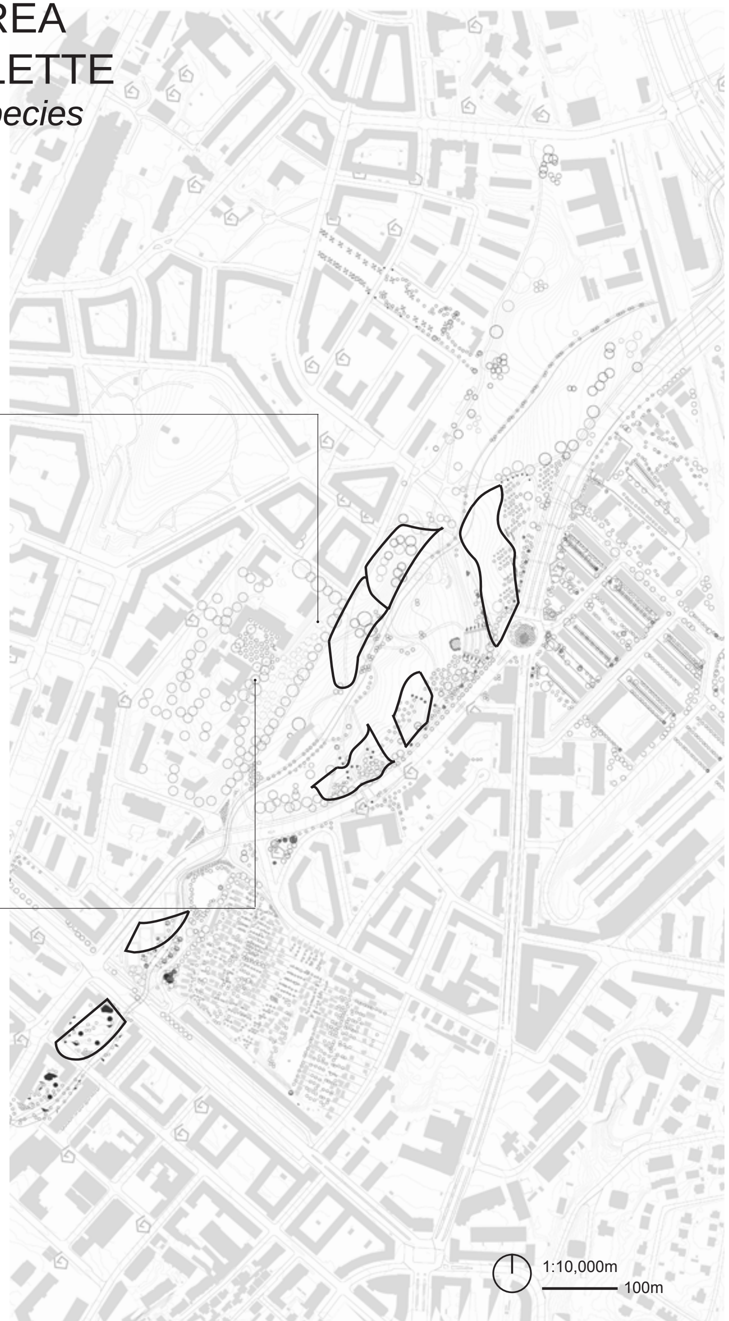
**Tree species**
Acer tataricum 35%
Acer platanoides 15%
Prunus avium 15%
Carpinus betulas 15%
Sambucus nigra 10%
Fagus sylvatica 10%

**Perennial species**
Carex sylvatica
Carex montana
Aquilegia vulgaris
Fragaria vesca
Polygonatum multflorum
Convallaria majalis

**MALUS PUMILA**

**Tree species**
Malus pumila 45%
Corylus avellana 20%
Pyrus communis10%
Prunus domestica 10%
Malus dolgo 5%

**Perennial species**
Anemone nemorosa
Campanula persicifolia
Ribes uva crispa
Lilium martagon
Eurphorbia amygdaloides
Melissa officinalis
Nasturium




TILIA CORDATA
LARIX DECIDUA
MALUS PUMILLA
SALIX SPECIES
ACER PLATANIODES
ACER TATARICUM
PRUNUS AVIUM
MALUS DOLGO
PROPOSED TREE
GINGKO BIBLOA
BETULA SPECIES
AESCULUS HIPPOCASTANUM
PICEA PUNGENS
QUERCUS SPECIES
CERCIDIPHYLLUM JAPONICUM
PSUEDOTSUGA MENZIESII
ULMUS GLABRA
UNKNOWN SPECIES
PROPOSED RAIN GARDEN
C
C
1:1000m
10m

## the allotment gardens section c

1:1000m 10m

existing allotment garden

existing upper field next to allotments


existing allotment garden road


proposed allotment rain storage

## THE ORCHARD

The Rødelokken alottment garden is built upon rain-harvest passages. The irrigation channel captures and reuse stormwater to irrigate the allotment's fruit trees. Riparian swales gather the surface water and carry it along each garden house. When it rains rain can be gathered by tank or bucket along the roadside path. At the bottom of the allotment garden water system is an ephemeral pond for seasonal water play.

# ORCHARD AREA VEGETATION PALETTE

*based on found tree species*


**QUERCUS ROBUR**

**Tree species**
Quercus robur 45%
Quercus rubra 15%
Betula pendula 10%
Carpinus betulas 10%
Prunus Avium 10%

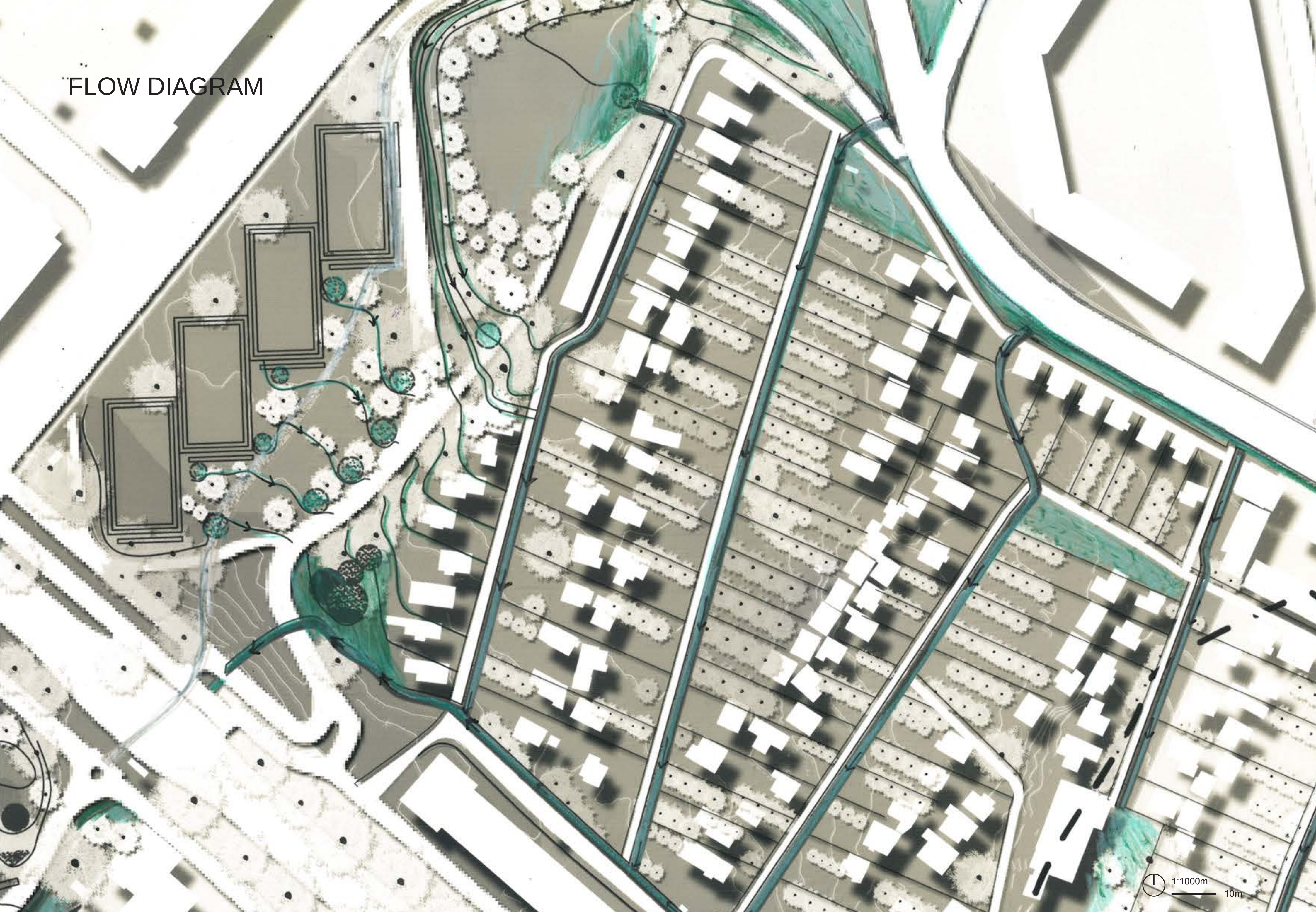
**Perennial species**
Carex sylvatica
Aquilegia vulvarins
Ribes rubrum
Convellaria majalis
Fragaria vesca
Polystichum aculeatum

**BETULA PUBESCENS**

**Tree species**
Betula pubescens 35%
Betual pendula 20%
Prunus avium 15%
Amelanchier canadensis 15%
Quercus robur 10%
Prunus domestica 10%

**Perennial species**
Oxalis acetosella
Digitalis purpurea
Viola riviniana
Vaccinium myrtillus
Dryopteris carthusiana
Solidago candensis

# FLOW DIAGRAM



## THE PATHWAY

The final element in Phase I of Capillary Action Torshov is a pathway moving along the surface where the river is piped. This crushed stone trail is a beginning effort to draw awareness to the historic Torshov stream and excitement for the water and social resource to re-emerge.

# TORSHOV VALLEY LOWER LANDS VEGETATION PALETTE

*based on found tree species*

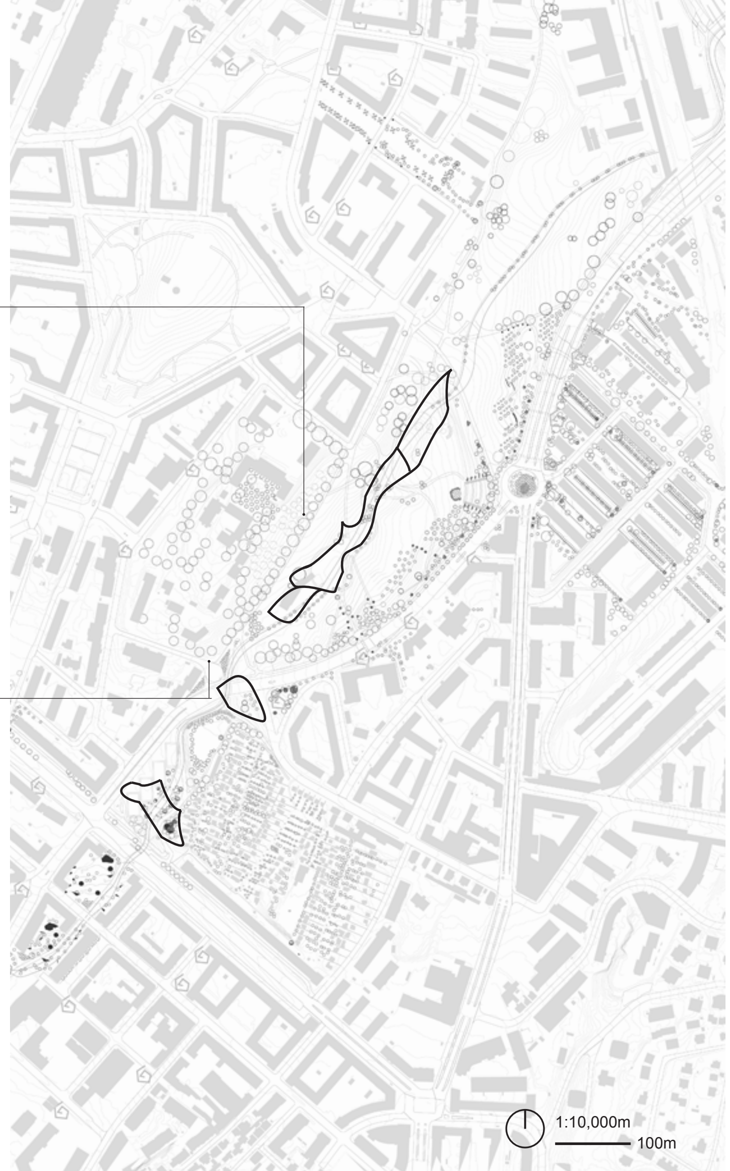
Lower land structure
proposed tree and perennial species

**SALIX ALBA AND ALNUS GLUTINOSA**

**Tree species**
Salix alba 25%
Alnus glutinosa 20%
Populus tremula 15%
Salix purpurea 15 %
Alnus incana 15 %
Populus nigra 10%

**Perennial lead species**
Iris sibirica O
Carex flacca (O
Filipendula ulmaria O
Agrimonia eupatoria O
Aquilegia vulgaris O
Campanula rotundifolia O
Knautia arvensis O
Primula veris O

**Other**
Geranium pratense ()
Geranium sylvaticum ()
Silene dioica ()
Primula elatior ()
Trichophorum cespitosum (O
Sparganium glomeratum (O
Calla palustris ()
Menyanthes trifoliata (O
Myosotis scorpiodes (O



# List of References


*1125 Fra Torshovpark - Oslo* [photograph]. Available at: National Library of Norway, https://urn.nb.no/URN:NBN:no-nb_digifoto_20150915_00066_bldsa_PK05290 (accessed: 5 February 2018).

*66. Flight photo. Thorshov* [photograph]. Available at: National Library of Norway, https://urn.nb.no/URN:NBN:no-nb_digifoto_20150915_00061_bldsa_PK05298 (accessed: 5 February 2018).

AARP Livable Communities. (2017). *Where we live, communities for all ages, summary.* viewed 4 February 2018. <http.www.aarp.org/livablecommunities>.

Ashton, A. (2017) 25 More Ways to Make Your Neighborhood a Community. Sunset. Available at: https://www.sunset.com/food-wine/25-more-ways-to-make-your-neighborhood-a-community (accessed: 6 February 2018).

Asplan Viak AS. *Oppbygning av regnbed* (2016) [drawing]. Available in: Regnbed_Deichmans_gate_Horten_og_Ensjø_Egeberg.pdf (accessed: January 25 2018).

Barbakke. *L508 Snitt - regnbed og trapper* (2017) [drawing]. (accessed: January 18 2018).

Barbakke. *L209 Prinsipsnitt - regnbed* (2017) [drawing]. (accessed: January 18 2018).

Beckestad, H. (2017) *Gross Income, Atlas of Sp(c)lashes* [map]. Available at the Oslo School of Architecture & Design, Oslo.

Beckestad, H. (2017) *Housing Prices, Atlas of Sp(c)lashes* [map]. Available at the Oslo School of Architecture & Design, Oslo.

Bergset, M. Skunke, L.M. Haukeland, A. (2017). *Snøens muligheter.* Arkitektur N, 10 July 2017. Available at: https://www.arkitektur-n.no/artikler/snoens-muligheter (accessed: 10 January 2018).

Bjørbekk J. and LIndheim, T. (2016) Utbygging av bekk og park på Ensjø / Hasle, *Bjørbekk & Lindheim Landskaparkitekter blogg*, May 5. Available at: http://www.blark.no/blogg/page/2.html (accessed: 1 November 2017).

Foxley, A., and Vogt, G. (2010) Novartis Campus Green, In Foxley, A. and Vogt, G. *Distance and Engagement.* Baden: Lars Müller Publishers, pg. 97 - 290.

Google Earth Pro 7.3. 2015. Torshov Park 59°58'1.47"N, 10°45'53.32"W, elevation 100M. 3D map, Buildings data layer, viewed 21 October 2017.<http://www.google.com/earth/index.html>.

Gulsider. 2017. Oslo 59°55'25.17"N, 10°47'43.50"W, elevation 100M. 3D map, Buildings data layer, viewed 28 October 2017.<http://kart.gulsider.no>.

Hansson, S. (2018). *Norges største skolehage.* Geitmyra Skolehage, Available at: https://www.geitmyraskolehage.no (accessed: 14 February 2018)

Heim, M. (2017). Properties of Common Surficial Deposits. *Landscape Urbanism in Practice*. accessed: 10 February 2017).

Kartbank. 2018. Oslo Kommune, Bymiljøetaten. Esri. Oslo 59°55'25.17"N, 10°47'43.50"W, elevation 100M. 2D map, Tree data layer, viewed 6 January 2018. <http://www.arcgis.com/apps/webappviewer/index.html>.

*Kjelde: Byrådssak (*1968) [print]. Available at: https://kvardagssyklist.wordpress.com/tag/historie (accessed: 4 November 2017).

Lichtenstein, C. and Schregenberger, T (2001). *As Found, The Discovery of the Ordinary.* Berlin. Springer Science & Business Media. pp.196-201.

Marsh, W. and Dozier, J. (1981). *Landscape, An Introduction to Physical Geology.* Reading. Addison-Wesley Publishing Co. pp.149-165.

Moe, I. (2018). *Vøienvolden gård*. Fortidsminneforeningen. Available at: https://www.fortidsminneforeningen.no/vare-eiendommer/voienvolden-gard (accessed: 14 February 2018).

Nettstedskart. 2018. Oslo Kommune, Plan og bygningsetaten. Norkart AS. Oslo 59°55'25.17"N, 10°47'43.50"W, elevation 100M. 2D map, Buildings data layer, viewed 7 February 2018. <http://kart.no>.

OBOS. (2018). *Historien om Lillo Gård*. Lillo Gård, Available at: https://lillogard.no/historien-lillo-gard (accessed: 14 February 2018).

Oslo Kommune. (2015). *Kommuneplan 2015: Samfunnsdel og byutviklingsstrategi.* Available at: https://www.oslo.kommune.no/politikk-og-administrasjon/politikk/kommuneplan/kommuneplan-2015/#gref.html. (accessed: 12 November 2017).

*Paus, K.* Conceptual illustration of a rainbed as 3-step cleaning process. *Regnbed som renseløsning for forurenset vann.* (2016) [drawing]. Available at: https://www.oslo.kommune.no. (accessed January 25 2018).

Reference. (n.d.) In: Merriam-Webster [online] Springfield: Merriam-Webster, Inc. Available at: http://www.merriam-webster.com/dictionary/reference [Accessed 8 Nov. 2017].

Røhne, M., Strøm, E. (1942) *Torshovdalen* [landscape plan]. Available at Oslo Byarkiv, Park Archive Collections, Oslo, Park og Idrettsvesenet T-0030.

Røhne, M., Strøm, E. (1942) *Torshovdalen/ Parkforbindelser* [landscape plan]. Available at Oslo Byarkiv, Park Archive Collections, Oslo, Park og Idrettsvesenet T-0030.

Sibylla Merian, M. "*Dandelion (taraxacum officinale) and Tussock (dasychira fascelina)" [*watercolor drawing]. Available at: https://picturingplants.com (access: 5 May 2018).

Skarpmoen, Narve. (1915-1927) *Rosenhoff Skolehaver* [photograph].
vailable at: National Library of Norway, https://urn.nb.no/URN:NBN:no-nb_digifoto_20160419_00090_NB_NS_NM_10141 (accessed: 5 February 2018).

Steinsvik Ark. *Raingarden Section* (2015) [drawing]. Available at: https://www.arkitektur-n.no/artikler/snoens-muligheter (accessed: January 18 2018).

Strøm, E. (1938) *Untitled* [landscape perspective]. Available at Oslo Byarkiv, Park Archive Collections, Oslo, Park og Idrettsvesenet T-0030.

Tvedt, K. (5th ed.) (2010) *Oslo byleksikon*. Oslo: Kunnskapsforslaget (Leksikon is Norwegian for encyclopedia).

Viganó, P., Degli Uberti, U., Lambrechts, G. Lombardo, T. and Zaccariotto, G. (2009). *Landscapes of Water.* Pordenone. Risma Edizioni. pp.20-130.