# Blå Länken

Bridging the mental gap
between human and nature

Master's thesis

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Department Architecture and Civil Engineering
Examiner Marco Adelfio
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CHALMERS
UNIVERSITY OF TECHNOLOGY

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Department: Architecture and Civil Engineering
Program: Architecture and Planning Beyond Sustainability
Studio: Critical Spatial Perspectives
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Göteborg Spring 2019

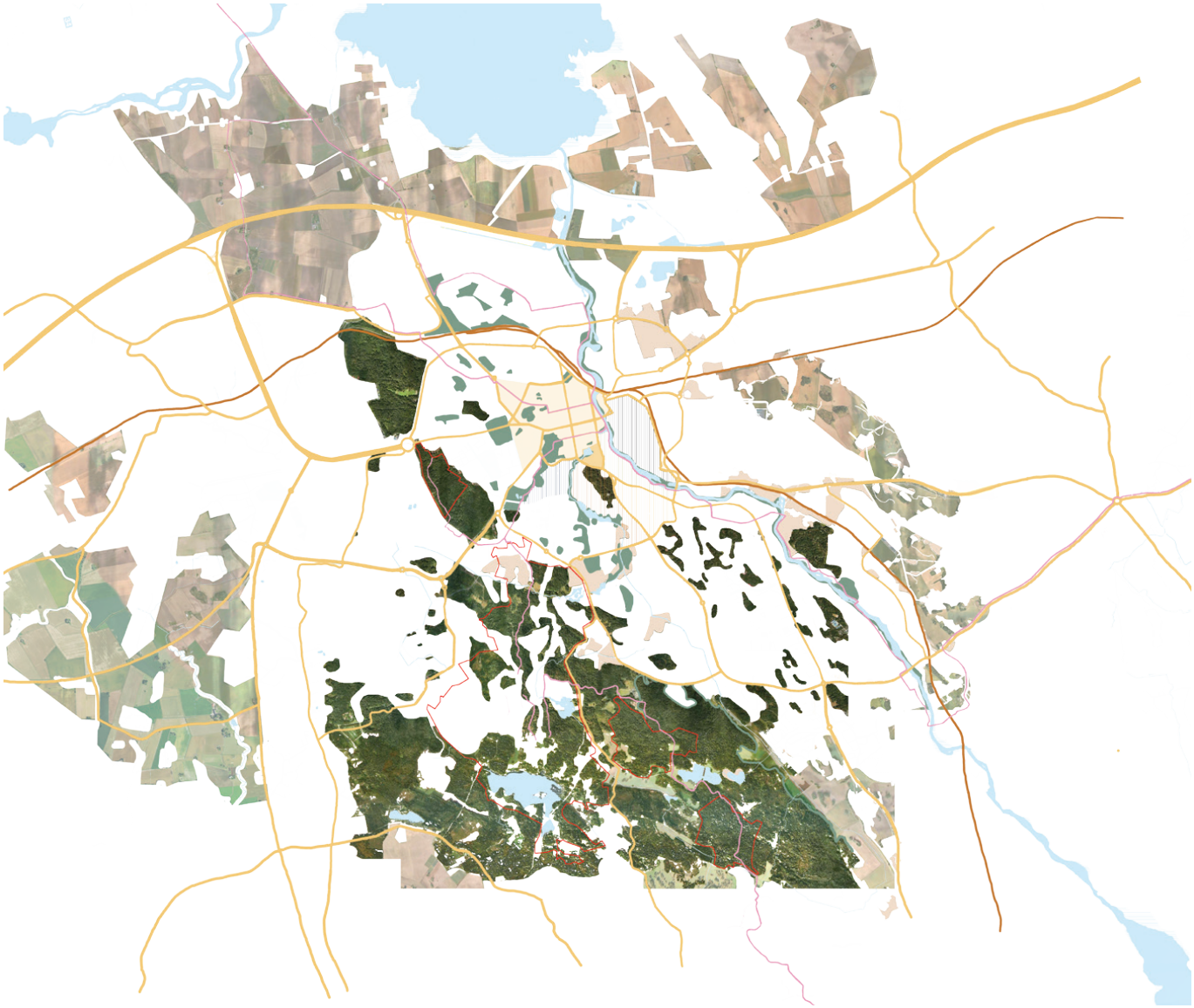

Figure 1. Image showing the site Folkungavallen in relation to its context of the city and outskirts. Differentiating between what can be seen as urban green and rural nature, showing the water ways and main infrastructure.

# Abstract

Our modern societies are generally built upon linear systems of consumption, economic growth and unsustainable overuse of materials. On the contrary, nature works in connected networks, so called ecosystems, with circular loops of nutrients, energy and material. There is no waste or overuse. Human existence depends on these ecosystems and the wide range of services they provide. By living in a linear way we are causing harm to the climate and the ecosystems, decreasing biodiversity and essentially reducing our own possibility to thrive.

Regenerative development gives the perspective of environmental problems being a symptom of a fractured relationship between human and nature. We no longer see ourselves as part of nature, rather superior, where we take advantage of ecosystem services in ways that suit us without thinking about the consequences. This becomes even more evident as urbanisation continues to increase and we are losing contact with nature. Nature is proven to have both calming and healing effects on humans, so why are we building cities where nature is not a main priority? How can we expose and bridge the mental barriers between human and nature in urban settings?

In order to change our relationship to nature and emphasise the importance of biodiversity we need to create built environments in symbiosis with the natural. This thesis investigates the possibilities of using circular thinking and biodiversity to bridge the mental gap between human and nature on Folkungavallen in Linköping. It explores the opportunities to shape the new urban environment from the natural elements on site, where the stream Tinnerbäcken is a staring point. This is done through literature, reference studies and site analysis in a parallel process of research for design and research by design. The result is a range of concepts and strategies within the themes of water and biodiversity showcased in a conceptual design proposal on Folkungavallen in Linköping. The thesis is meant to work as inspiration for further development.

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# About the author

## Carin Edlund

When I first started to explore my master thesis topic, I knew I wanted to make sustainable architecture. However, after digging deep into the topic, I realised what I really wanted to do was not architecture that compensates for its bad sides, but architecture that explores the possibilities to give something positive back to the environment.

MASTER OF ARCHITECTURE

*Architecture and Planning Beyond Sustainability*
*Chalmers University of Technology*

Göteborg Aug 2017 - June 2019

BACHELOR OF FINE ARTS IN ARCHITECTURE

*Umeå school of Architecture (UMA)*

Umeå Sept 2013 - June 2016

INTERNSHIP

*M5 Arkitektur*

Linköping Aug 2016- July 2017

# CHAPTER ONE
# INTRODUCTION

## Climate change & loss of biodiversity

*They are saying we are currently in the extinction era*

Persson. A.S., Smith. H.G (2014)

We are in a time of climate change, we are even in a new geological era called the Anthropocene, where human actions are the superior force of change on earth (Rockström. J.2015). Our modern society is generally built up on linear systems of consumption, economic growth and unsustainable overuse of materials. As world population continues to grow we are more people sharing the resources on earth. In 2018 the world overshoot day (the day that our consumption of ecological resources exceed what earth can generate for one year) occurred on the first of August. This means that by the start of August we had already consumed all the ecological resources that are available in order to secure resources for future generations. Today we are living like we have the resources of 1.7 earths. The trend of the overshoot day has been negative, with earlier overshoot by each year (Earth Overshoot day. n.d.).

The building industry plays a leading role, accounting for more than 35% of global final energy use and nearly 40% of energy-related CO2 emissions (UN 2017). This leads to a large number of negative environmental impacts. Even though there are many different stakeholders involved in a building process, everyone eager to profit from their point of view, nature, the environment and human well-being seldom seems to be one of them. Because, what would be best for our environment, in the current practice of building today, is usually to not build at all.

By using a sustainability approach it is possible to make a building that is balanced with its energy use and emissions, a so called Zero Emission and Zero energy building. However, only making sure that we do not harm the environment is not enough. **Should not our built environments help to improve the environment we live in overall?** When reading more about Regenerative development, that talks about environmental problems being a symptom of a fractured relationship between humans and nature (Mang. P., Haggard. B., & Regenesis, 2016), I became interested in investigating the view of humans being disconnected from nature. I wondered if a "human as nature approach" could be a guide to inspire a more climate positive approach for the building industry? **But what does it mean to go from building climate neutral to building climate positive ?**

We learn as children how everything in nature is connected. Organisms in an ecosystem benefit from each other in circular ways. Every end is the beginning of something new, there is no waste!

Human activities are disturbing the cycles, causing a shortage or overflow of nutrients. **The linear way of living have contributed to the consequences of climate change**. According to the report Living Planet (WWF, 2018), the population of wild vertebrate has decreased on an average of 60% in the last 44 years. If this trend continues in the same pace two thirds of the world population of mammals, fishes, birds, batrachians and reptiles are in the risk of extinction within a few years.

Even though we humans live in a linear way, often far from nature in urban settings, **our human existence is dependent on the prosperity of the ecosystem and the services they provide.** The health and resilience of ecosystems is linked to biodiversity. As biodiversity decreases the health and function of the ecosystems is threatened, especially in a time of climate change (Naturvårdsverket. 2011). One can say that nature is our life support system. **Continuing the negative trends of climate change and decrease of biodiversity means we are destroying our own possibility to live on earth.**

# Thesis framework

## Incitement

In an investigation done by *White Arkitekter* in collaboration with *Naturvårdsverket*, for the project *Ebbe Park* in Linköping, the citizens of Linköping where invited to give comments about what kind of environment they want in their new block of the city. (White Arkitekter, 2018) A large part of the answers was about a place for recreation and social interactions as well as calmer environments in combination with city life, restaurants and cafés. Bird song and the sound of rippling water was high in the ranking. There was also a big interest in cultivation and pedagogical sustainability. (Byggnyheter. 2018) This investigation shows that there is a general interest in the atmospheres that the natural environment can bring, and that it should be a part of planning in the city.

Evidence based design within health care also proofs that nature has a calming and even healing effect on patients (Roger S. Ulrich, et al. 2008). So being close to and having the possibility to experience nature in the city can perhaps be a way to both raise awareness of the importance of taking care of our environment but also for the well being of the citizens.

**Finding new ways to create climate positive architecture should focus not only on the issues of climate change but also why we are facing these changes.**

As urbanisation continues to increase more people are losing contact to nature, this issue is important to discuss. **If nature is making us healthier and happier why are we planning cities where nature is not a main priority?**

## Aim

The aim of this research project is to explore how biodiversity and water can help to expose and bridge the barriers between human and nature in urban settings.

The questions that guides the thesis are:

How can circular methods, water and biodiversity promotion be used to form the design of Folkungavallen?

How can the natural elements of Folkungavallen shape the future design of the site?

## Discourse

I have chosen to focus on water and biodiversity as main themes. Strategies of how to work with these themes in relation to the built and natural environment are addressed, in an attempt to bridge human and nature. Circular thinking and ecosystem thinking is a method to find suitable strategies and concepts for the site.

Functions and activities, buildings and paths are added to the site in relation to the ecological systems. A layer of materiality, including materials and details, shows another scale of implementation. Where biodiversity and water strategies are applied closer to humans.

The conceptual design proposal is addressed from a larger perspective with the site in its context of the larger city.

Themes and main theory concerning this thesis:

**Regenerative design:** Mang. P., Haggard. B., & Regenesis. (2016)

**Ecological design:** Rottle.M., & Yocom. K. (2010).

**Biodiversity:** Persson. A.S.,Smith. H.G. (2014), Naturvårdsverket. (2011), Linköpings Kommun, Miljö- och samhällsbyggnadsförvaltningen. (2018) *Naturvårdsprogram*

**Circular thinking:** Bokalders. V., Block. M.(2004)

**Natural material:** Bokalders. V., Block. M.(2004), Ekobyggportalen.(n.d.)

**Urban development:** Linköpings Kommun, Miljö- och samhällsbyggnadsförvaltningen. (2016). *Utvecklingsplan för Linköpings innerstad,* Anna S. Persson. A.S.,Smith. H.G. (2014),

## Delimitation

The thesis is build up by a strong theoretical background in order to formulate relevant strategies. The design proposal itself is a suggestion of how to implement the strategies and is shown on a conceptual level with some relevant details. I also use the design as a tool for reflection. Functions and buildings are shown in a typology outline in relation to the site, where focus lays more on the exterior than the interior.

I do not consider the financial feasibility of the project, since the wish is to show an alternative design perspective where ecological values are prioritised not economic profit.

In regard to cultural heritage I consider the value of the urban elements since I want to balance the urban and natural world. The site is located close to an outdoor bath, Tinnerbäcksbadet, with a long history as recreation for the citizens of Linköping. I do not include or affect the bath in my proposal. This is also to limit the scope and size of the project site.

The thesis operates within themes relevant to urban metabolism, however, urban metabolism as a theory is not discussed or applied to the work in order to delimit the scope of the thesis.

## Reading instructions

Chapter one (*Introduction*) presents the background to the topic as well as the frame work of the thesis including research questions, aim and methods.

Chapter two (*Background concepts*) and chapter three (*The site)* presents the concepts relevant to discuss for the topic of the thesis as well as the context, site and site analysis.

Chapter four (*Reference projects & theory*) gives an analysis of reference projects and applied theories.

Chapter five (*Strategies*) concludes the previous chapters in the form of strategies and concepts relevant for the research questions applied to the chosen site. As well as libraries of red-listed species, trees and material.

Chapter six (Design proposal) shows the strategies and concepts applied on site in a conceptual design proposal.

Chapter seven (Reflections) Reflects about the process, results of the thesis and answers to the questions

Chapter eight (References) is a list of references and figures

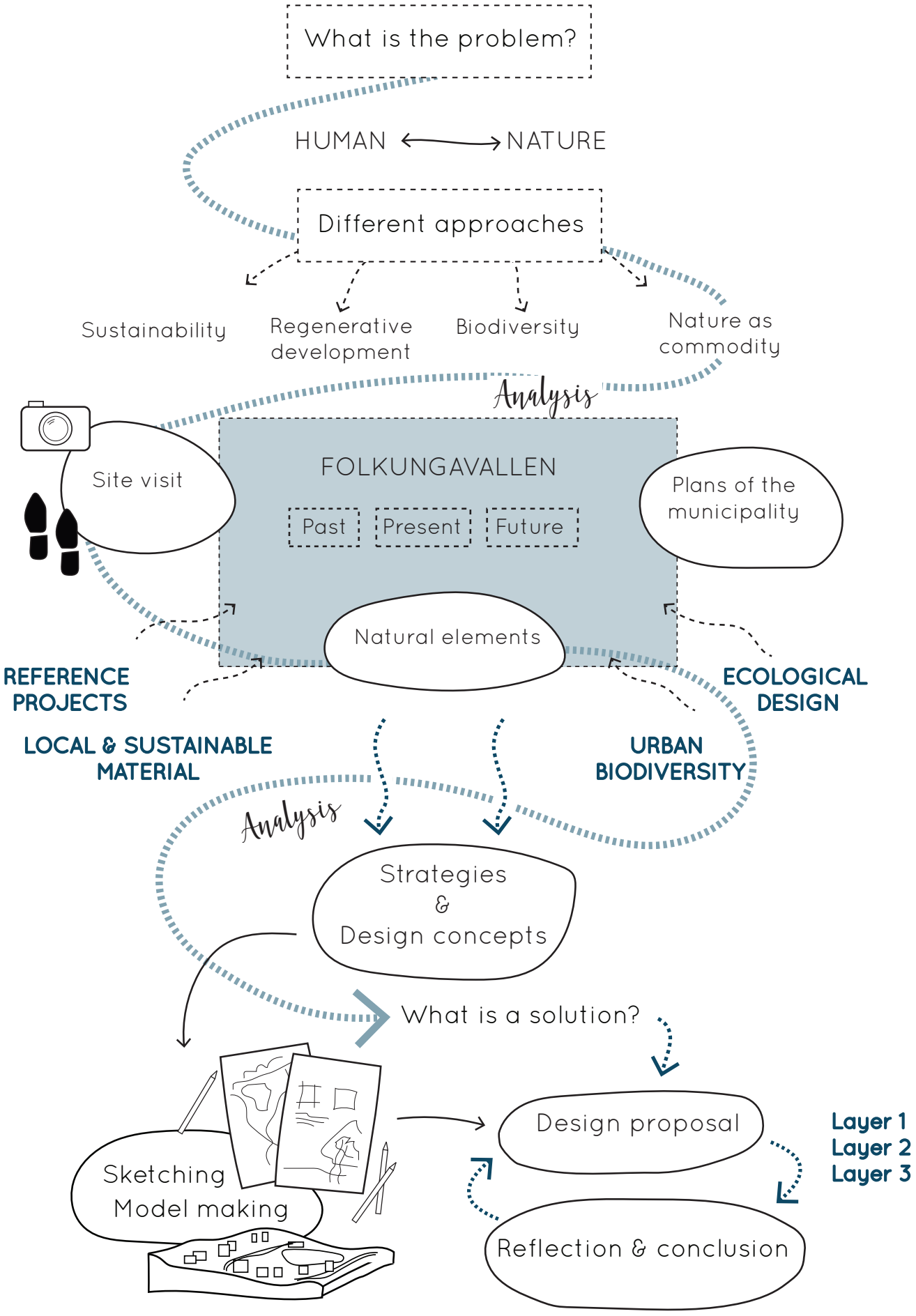



Figure 2. Method appears to be linear, but there are of course loops of information steering the project.

## Method

The Master Thesis is carried out in a parallel process of research for design and research by design. The result is a list of strategies, that are more wide and can be applied to other settings combined with more specific site concepts and a design proposal for the chosen site.

The chosen site is located in Linköping, a city with the aim of being "CO2neutral in 2025". I am investigating the site Folkungavallen, located just next to the city centre, that is currently being planned for future development. On the north part of the site the important biotope stream Tinnerbäcken is located, on the east the city forest Berga Hage. Folkungavallen has a long history as a sport arena (from 1919) and both my grandmother, father and myself have been using it for track and field. It has recently been demolished.

I address the question in three different layers.

**Layer 1:** The natural elements and ecology is the starting point for the design. Water is a main theme to investigate - since the stream Tinnerbäcken is a main feature of the chosen site.

**Layer 2:** This is what is added to the site in relation to the ecological systems present: buildings, functions, paths, activities that are relevant in order to connect the urban and natural environment and by this bridge humans and nature.

**Layer 3:** Materiality, including materials and details. Showing another scale of implementation, where biodiversity and water strategies are introduced close to the human habitat.

The strategies are inspired by circular systems and biodiversity promotion. Where the site is a part of the method to find these.

## Glossary

**Sustainability:** Sustaining resources for future generations, making sure we do not harm our environment.

**Sustainable design:** Contemporary conditions conserved rather than improved

**Regenerative development:** Humans enhancing ecosystems through participation as nature.

**Regenerative design:** Catalyse human and natural processes to improve environmental conditions. Closed loop thinking, to conserve and regenerate resources and ecosystems.

**Biodiversity:** The term describing the species variation of all living organisms on earth.

**Ecosystem:** A community of living organisms in relation to their environment of non-living components linked together by cycles of nutrients and energy.

**Habitat:** Environment considered liveable for a certain organism.

**Ecological design:** Design that integrates with the living systems of nature to minimise negative environmental impacts

**Resilience:** The possibilities of a system to withstand, adapt and recover after disturbances.

**Design for resiliency:** Anticipate future disturbances and adapt to these changes while maintaining the core ecological functions.

**Patches:** Fragments of a specific landscape form within a relatively homogeneous area. Often more favourable than the surrounding landscape.

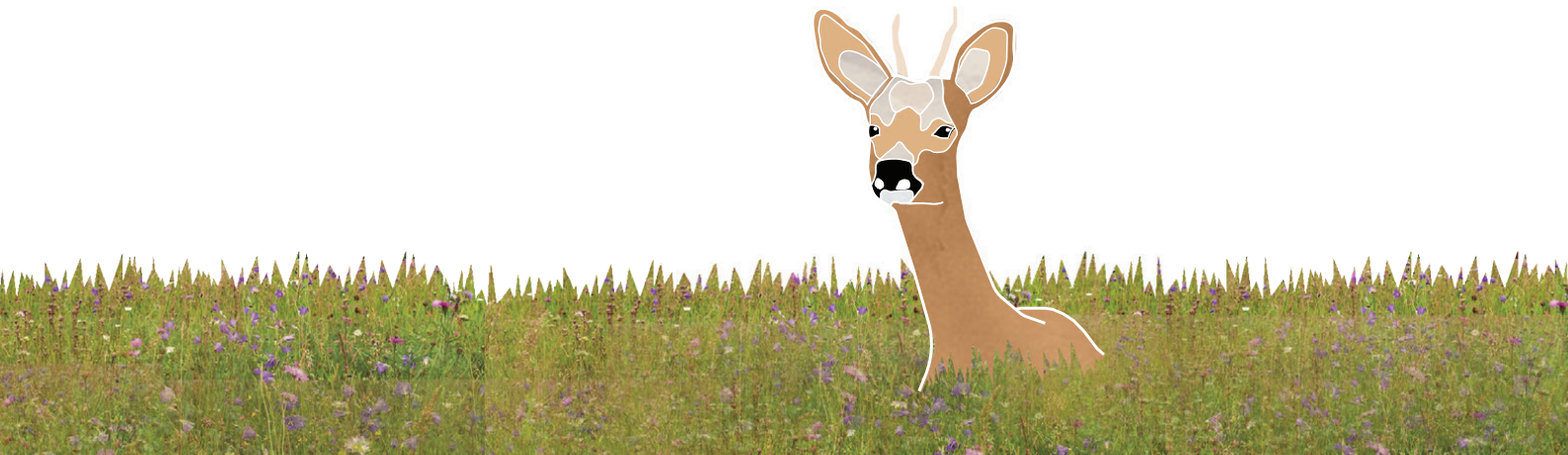
**Corridors:** Connection between patches of habitat, supporting movement of animals, plants, people, water and nutrients.

**Edge effect**: can be used to describe the processes that occur along the edges of a patch or corridor compared to the interior area.

**Land sparing:** Human activity is spatially mixed with biodiversity.

**Land sharing:** Human activity is more spatially densely concentrated whereas biodiversity gets a separate space.

# CHAPTER TWO
# BACKGROUND CONCEPTS



## Definition and aim

*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

United Nations (n.d)

Sustainability has gone from something that is an exception to a routine. We are no longer discussing whether we *should* work on sustainability, but *how* we should do it.

But what is sustainability really?

Dismantling the word, we have "sustain" and "ability". There is something we need to sustain, i.e. our planet and life on earth, and we need some kind of ability to do so.

The general perspective on how to achieve sustainability is through the three pillars:

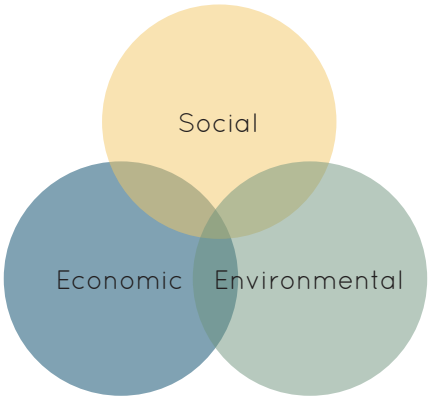



Figure 3. The three pillars of Sustainability

Sustainability is achieved in the meeting point where social environmental and economic interests are balanced equally. However, according to Rockström (2015) this model is insufficient when tackling the climate challenges of today and in the future. A key factor he says is that economic growth is prioritised and put above natural and human capital. We are failing to understand how our local actions influence on a global scale.

Instead Rockström suggests an approach where human development connects to the biosphere. Economy is seen as a tool to achieve social just and prosperity within the limits of the planet.

Agenda 2030 from the UN, is a globally joint attempt to work towards a just and sustainable world. The agenda contains 17 sustainable development goals, as well as 169 sub goals and 230 indicators. The common goal of Agenda 2030 is to end extreme poverty, inequality and climate change by the year 2030. (United Nations. n.d)


Figure 4. Sustainable Development Goals

Goals 11, 13 and 15 are goals applicable to the way we plan and build our homes and cities and shows that the topic of this thesis is relevant in the global discussion of sustainable development.

### Reflection

I believe sustainability has become a new "it-word", something that feels green, organic, healthy and automatically makes something bad a bit less bad. **Sustainable strategies are necessary for our development; however, I believe we should see it as a starting level.** All projects should do *at least* sustainable but aim to do more than that.

# Regenerative development

## Human as nature

*The founders of Regenesis began with a fundamental belief that environmental problems were symptoms of a fractured relationship between people and nature*

Mang. P., Haggard. B., & Regenesis (2016, changing our minds xiv)

Is sustainability in is self is enough to create a thriving planet for the coming generation? Regenerative development can be used as a perspective to create architecture that not only minimise the negative impacts but also improves the conditions of the given environment.

So how did the regenerative perspective develop?

At first sustainability was seen as a state of *equilibrium*, where focus was put on minimising and limiting negative impacts of resource and energy use. As green technologies grew we went from net-neutral to net-zero to, in the recent years net-positive buildings to be able to do less and less harm to living systems. Even though this has been an important step in sustainable development, a state of equilibrium cannot be applied to living systems, they survive by adaptation evolving as changes occur.

This awareness set the base for the second phase, here sustainability is viewed as *resilience* where unpredictable changes in the environment are taken into account, and the design strives for resilience to maintain a healthy system. The approach of resilience takes into account that change is non-linear and a result of actions by multiple actors. Humans and ecosystems have a mutual relationship, where the resilience of humans depends on the resilience of nature.

In the third phase, sustainability becomes co-evolution, where humans play a role adding value within nature instead of standing on the outside. This phenomenon is not new but has been the way of life for indigenous communities, where their interaction with nature increased biodiversity and productivity. **Co-evolution requires a new orientation, where human activities connect to natural systems.**

Thus, regenerative development gives a framework for pursuing sustainability within living evolving systems, social and natural and developing their capability to prosper.

## A guide to evolve regenerative processes in design.

Regeneration is one of four steps of work necessary to enable *evolution*; a state where actors in nature can sustain themselves. These steps can be put in hierarchy, where the lower part is focused on existence and the higher part on potential.

The steps can help the designer to integrate evolution and provides a guide to where different sustainable strategies can be applied and how they together form a regenerative goal.

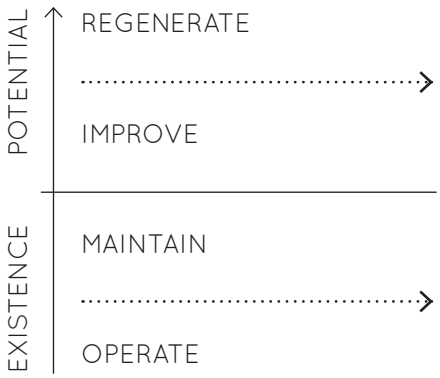



Figure 5. Model for Regenerative development

On the *operate* level the goal is to achieve higher standards, by phasing out toxic substances and increasing efficiency of material use and energy. This level of work has been the base for the green building movement for many years, and they have achieved results like zero-energy buildings, non-toxic materials and cradle to cradle manufacturing

On the *maintain* level, the aim is resilience against disturbance and environmental uncertainty.

On the *improve* level, the aim is to improve the conditions, humans adding value to natural systems. For example, permaculture and other

ecological design systems supporting self-organising productive agricultural ecosystems.

On the top level, *regenerative* processes aim at utilising the potential a system has within its context. Thus, "Regeneration produces a field within which the improvement of living systems can take place and provide a coalescing direction for the other levels of work." (Regenesis 2016, The future of sustainability XXX)

It is important to consider all levels of work in a process, as that is the way living systems work, failing to address one can affect the outcome of the others. According to the regenerative perspective we humans must learn to integrate all four levels of work to be able to prosper in symbiosis with nature.

Working in *place* is important for the vision of humans as nature, as it brings concretion and specificity.

**If humans want to co-evolve in partnership with nature, we have to do so place by place; as each place has its own characteristics and possibilities, solutions have to be site specific rather than general.**

A place is its physical, cultural, historical, social, political and economic environment. Each place has its identity

By including human development in every aspect of a project, a regenerative development project enables a project to continue to grow after the design is done, providing capability in the people affected. This is done through dialogue with the local community, stakeholders and ecosystems, trying to improve their ability to do their work.

Finally, there are three agents that influence a design project and its success; the product, the design process and the designer.

In order to be a successful practitioner of regenerative development one must work with these three agents simultaneously.

(Regenesis 2016, The future of sustainability XXXIV)

## Reflection

Making a regenerative design project would be to put theory into practice. Making sure that the project continues to evolve even when the designer has left. The principal, of letting something evolve and continue to flourish is a high ambition but I think it is something we should strive for. **In this thesis I have chosen to take with me the view of humans being separated from nature.** If we would consider ourselves as part of nature that means we need to find our place in the ecosystem we live in. **What services do we use in our ecosystem and what role do we play in contributing to it? Can the built environment work in the same way as nature?** Where every player has a role in the system, contributing or benefiting from each other.

# Biodiversity

## Life support system

*Biodiversity has been described as the infrastructure that supports all life on earth. It is, simply, a prerequisite for our modern, prosperous human society to exist, and to continue to thrive*

World Wildlife Fund ( 2018, p. 7)

Biodiversity, is the term describing the species variation of all living organisms on earth. The evolution, developed since the start of live on earth 3500 billion years ago, has constantly brought new species with their individual way of tackling their environment and make use of its opportunities.

Within each species there are different variations of genes, enabling each species to evolve according to their trait. There is also a diversity between each ecosystem. An ecosystem can be used to define the whole biosphere, general nature types such as ocean, forest or mountain but also specific biotopes in different scales: for example, a specific kind of swamp-forest, a puddle or tree stump that can contain habitat for a wide range of species.

The composition of the atmosphere, the soil, the temperature and the rainfall, among others, are directly or indirectly affected by biological processes like photosynthesis and turnover of nutrients. Whose processes are crucial for the carbon- and oxygen cycle and other cycles between the air, the earth and the water. Without these cycles humans would not only be without food, but also lose the ozone protection from the sun and the oxygen we breathe.

If an ecosystem is composed of too few species, it is more vulnerable to change, thus **biodiversity is a key factor in an ecosystems resilience.**

In an era of climate change, a rich biodiversity is important for an ecosystem, species that are seen as "abundant" today can be of high importance in the future. (Naturvårdsverket. 2011)

**The circular processes occurring in ecosystems can be referred to as ecosystem services. These are services from nature that humans depend on directly or indirectly.**

The ecosystem services can be described as:

Supporting: nature loops, photosynthesis
Providing: Material, water, food
Regulating: temperature, water filtration
Cultural: Recreation, pedagogical, aesthetically
(Persson. A. 2015)

Looking at the nine planetary boundaries (Rockström. 2015) loss of biodiversity is today one of the environmental impacts that humans have affected the most. According to recent report Living Planet (WWF, 2018), the population of wild vertebrate has decreased on an average of 60 % in the last 44 years. The biggest cause behind loss of biodiversity is that ecosystems have been destroyed or exposed to change, directly or indirectly caused by human impact.

### Reflection

All organisms are part of ecosystems, where the ecosystems resilience is depended on the richness of the organisms living in it. A mutual relationship of symbiosis. If we view our own society as an ecosystem where choices and changes affect other stakeholders, and the whole does not work without the parts it is easier to see how important this relationship is. **To emphasise the importance of biodiversity in our environment is crucial, as it is essentially the base of our existence. How can we promote biodiversity in our urban environment, as part of our ecosystem the city, which we need to sustain life?**

## Nature and the city

Kaika and Swyngedouw discusses in the article Fetishizing the Modern City (2010) the relation between the urban and natural world and how technology has the potential to both visualise and hide their connection.

Urban networks are hidden whereas nature networks are visible. The relation between nature and city becomes blurred and the social transformation of nature unclear as power of the flows from nature to urban are invisible.

Commodification of nature is a historical, cultural, geographical and social process , where nature is turned into something urban.

For example, water, it flows from nature to the city. It goes from $H_2O$ to treated and priced tap-water. The social relation between nature and the city is masked by technology and the urbanisation of water. The technologies of water become the source of the city's water and the real source of water originating in nature is forgotten. Nature becomes reinvented in an urban from.

| Nature | | Network production process | | City |
|---|---|---|---|---|
| $H_2O$ | —— | | ⟶ | tap-water treated, priced |

Nature is transformed through human labour (Social environmental metabolism) with the creation of commodities

Since the socio-environmental conditions are hidden in the process of producing a commodity from nature, the cultural, ideological and aesthetic role of technological networks are neglected.

Nature becomes an exchange value, without considering the social power relations of the production. This allows "the goods of nature" to be viewed as exceptional, when the reason for it is really their social existence.

During the Industrial revolution there was a belief in reason to solve social problems. Equality and freedom would be achieved through reason. Progress was the key to moving forward and staying connected. Global networks became important. Networks was the way to reach ultimate freedom from nature.

The technical innovations would allow the human to "break the chains of slavery to nature" and to master nature through "taming". (Kaika. M., Swyngedouw. E. 2000.p125)

There was a fascination with technology and its own special aesthetics, where the objects of networks became landmarks, showing the image of the city - their promise of freedom and a better future through technology. However, the origin of the networks and their social transformation from nature was not shown.

During the inter-war years technology became a necessity rather than a desire or wish. With the development of the machine and assembly line production. Networks went underground, and the city planning changed. Urban mobility, highways, links, domestication and privatisation.

The city image was to be pure and transparent, and the flow from nature to the city hidden. (Kaika. M., Swyngedouw. E. 2000)

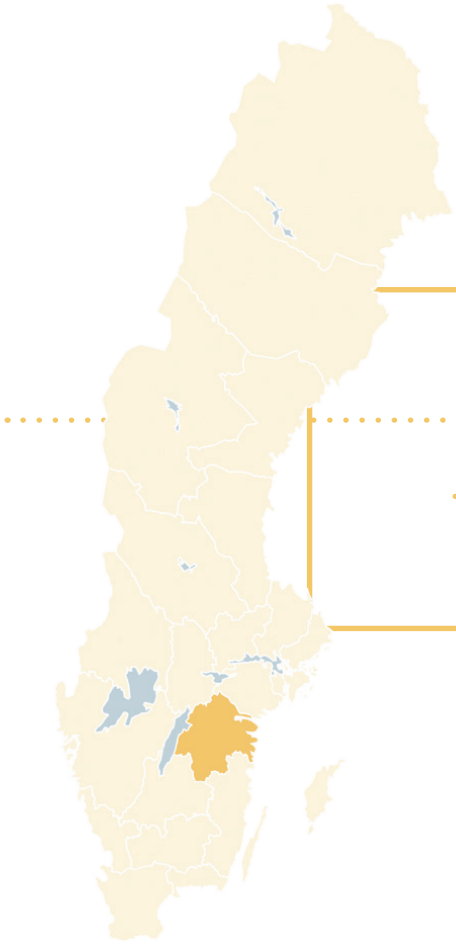
### Reflection

Putting a price on an ecosystem service is difficult, **how can you value something in economic terms that is invaluable to us?**

**Has not seeing our dependency on nature and how everything we need to sustain life is originating from it, caused a break in our relationship to nature?** How can we bridge nature and the urban environment? and by that emphasise the importance of nature, not only for sustaining life and moral but also for well-being for all future generations?

Exposing the systems and flows of nature in urban environments can be a step to show how we are connected to nature.

**Looking as cities as ecosystems, how can our built environment work in circular systems without waste?**



# CHAPTER THREE
# THE SITE

In this chapter the site is introduced and analysed. Starting with the city of Linköping, its history and municipal plans and goals for the future.

Followed by an introduction to Folkungavallen and its history.

In the analysis I look at the layers of the site from different perspectives. The natural and built environments are identified and analysed.

Finally, the future plans of the site from the perspective of the municipality are explained

SITE INTRODUCTION

Linköping

Folkungavallen

Past

Present

Folkungavallen

Future

ANALYSIS

Surrounding city

Urban environments

Nature types

Blue structures

Layers of site

Hard and soft surfaces

Blue and green structures

Cultural heritage

The stream

Present state

Future plans

Historical position

Natural elements

Municipal goals

Natural elements on site

# Linköping

## Facts and figures

Linköping is the fifth biggest city in Sweden with 160.000 inhabitants (2017). It is the region-capital of Östergötland, and a node for 20.000 daily commuters. Linköping is famous for its air industry with SAAB having its production in the city since 1939 and Malmen with the Swedish air force. The university of Linköping was founded in 1975 and has 27 000 students. The four biggest employers are the municipality, the region of Östergötland, SAAB AB and the university. The city has a young population with a low average of 39 years. Linköping university hospital is one of the foremost hospitals in the country. (Presentation Linköping, n.d)


Figure 6. Shifting landscape

Figure 7. Östergötland region

## History

The city of Linköping has a long history of over 700 hundred years. It was a central church town in the region from the beginning of the 12th century but is said to be officially founded by Magnus Ladulås and bishop Bengt Magnusson with the monastery of Frasiscaner in 1287.

The town continued to grow, though in a rather slow pace due to many fires. In the 16th century there was an important battle of "Stångebro" taking place in the city, this lead to the famous blood bath of Linköping, Linköpings blodbad. In the 18th century there was a huge fire, destroying almost all of the city except for the cathedral, the castle and a few other buildings. (Linköping.com, n.d.)

Figure 9. The large square 1950

Figure 8. Linköping city Market 1955

## Architecture and identity

Due to its long history, Linköping has architecture from several eras. The street structure is influenced by systems from all time epochs dating back to the medieval. Public spaces and squares have been there since. The core of the city is rather small for a city with over 100 000 inhabitants, but the central part has a rich history and vibrant life.

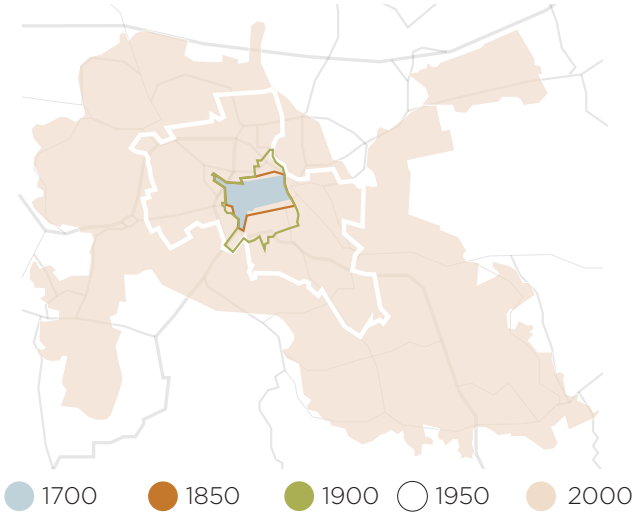



Figure 10. The growth of the city between year 1700-2000

## Future development

The city has a strategic position on the east coast; close with train to both Stockholm, Malmö and Copenhagen. The future plan of "Ostlänken", new train track between Linköping and Stockholm and a new station and city district will enhance the connection further and strengthen the city's position in the region.

Linköping has a gaol to be $C0_2$ neutral in 2025, and a long term aim of 200 000 inhabitants in the future. To be able to grow sustainably the municipality has set some common goals and strategies.

Today there is a strong city centre with historic inner-city qualities. However, there are clear divisions between the different sub-areas and suburbs. The aim of the municipality is to let the city core grow and connect the surrounding areas by spreading the character of the inner city and keeping its identity. The inner-city character is described as an interplay between streets, buildings, squares and parks and the activities taking place. Activities like housing, commerce, office and service. Activity is also people in motion, by foot, bike, bus or car. The vibrant street is a character of the inner city. (Linköpings Kommun, Miljö- och samhällsbyggnadsförvaltningen, 2016)

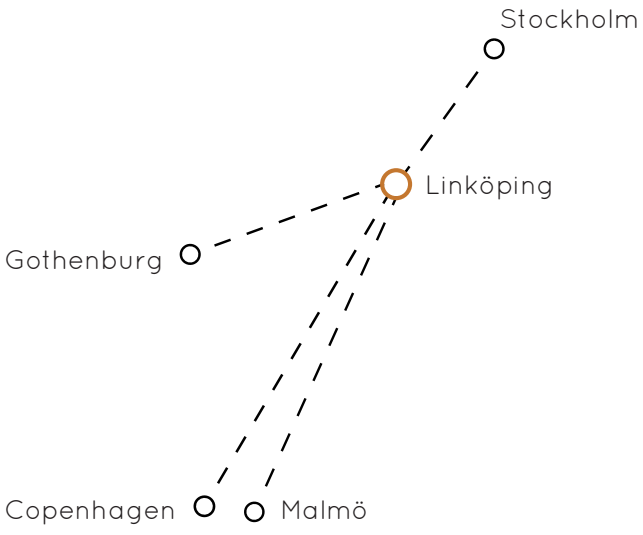
To develop the city the municipality has formed some strategies:

- High density and variation
- Connected street network
- Clear street room with entrances towards the street
- Conscious form-given relation between the width of the street and the height of the building
- Clearly defined open spaces, squares and parks
- Room for activities on the ground floor in buildings

Socially the inner city should provide housing options for all periods in life with different family constellations. Functions should be mixed, and the flows of transportation should be varied, prioritising pedestrians and cyclists.

In a city growing in different areas there needs to be focus on the "in-between spaces". Building new to remove the barriers and connect different parts of the city, physically and mentally, to create a common whole.

Recreation paths of the city should be enhanced and used to connect the city to nature. Squares and parks should be designed with high interest on the architectural language and provide possibilities for festivals and markets. (Linköpings Kommun, Miljö- och samhällsbyggnadsförvaltningen, 2016)



# Linköping city

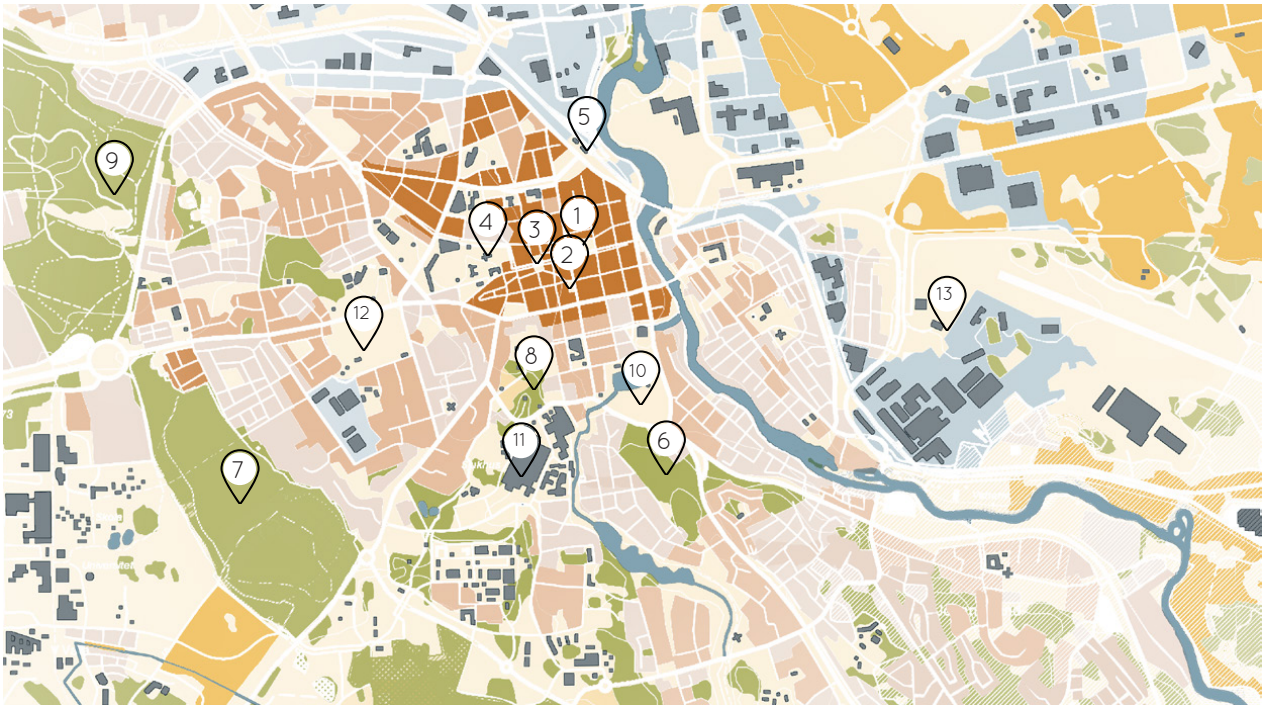



Figure 11. Linköping city scale: 1 : 40 000

1. St. Lars church
2. Trädgårdstorget square
3. Stora torget square
4. The Main cathedral
5. Central station
6. Berga Hage forest
7. Vallaskogen nature reserve
8. Trädgårdsföreningen park
9. Rydskogen forest
10. Folkungavallen sport area
11. Hospital
12. Cemetery
13. Airport

## Reflection

The city of Linköping won "City centre of the year" (Årest stadskärna) 2018 and the Planning prize 2018 (Planpriset). Today the inner city is often seen as the ideal image of the city. Which might be preferable from some perspectives. However, **planning cities with a dense character might not be the best in terms of prioritising biodiversity.** I discuss this further in chapter four.

1919 - 2019

Figure 12. Site location scale: 1 : 25 000

Folkungavallen is a former sports field close to the city centre of Linköping. The site is located in an area of sport, with the city's indoor and outdoor swimming pools, indoor sport arena, and the artificial lake Tinnis. The forest Berga hage and the stream Tinnerbäcken is located in connection to the site.

The site is currently being planned and investigated for future development of 500 apartments, a kinder-garden, a school and the new indoor swimming pool.

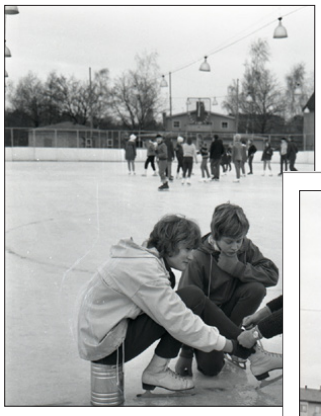


Figure 13. Eavesdropping crowd 1960

Figure 14. Kids ice-skating on Folkungavallen 1961

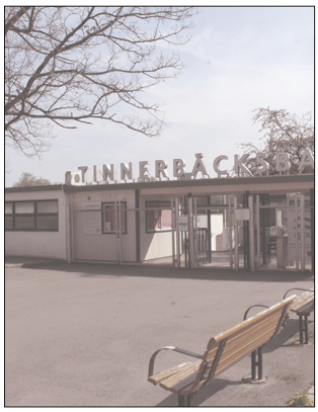



Figure 15. Tinnerbäcksbadet 2019

## History

In 1912 the Olympic games were held in Stockholm, increasing the interest in sports all over the country and so in Linköping. There was a will to get young people to exercise. Folkungavallen has a history of 100 years. It was first initiated in 1919, on a site donated by the city. In the 1930s Folkungavallen was renovated. Entrance buildings where added in the 1950's designed by the architect Axel Brunskog, a famous architect in the city. In the 1970's the larger audience stand in concrete was added and this stood on the site until it was demolished in 2018. In 2011 the new outdoor arena for track and field was built on Campus Valla close to the current Vallastaden, and in 2013 the new football arena in Kallerstad outside the city centre.

Both my grandmother, my father, my brother and myself have been running on the tracks of Folkungavallen, so for me it was hard to see it go. (Linköping Play, 2017)

Next to the site there is an outdoor swimming pool *Tinnerbäcksbadet* or as it was I called *Tinnis* with a large artificial lake from 1938. At that time Tinnis was very modern and had the first 50 meter outside pool in Sweden, attracting people from all over the country. The plan and the buildings, designed by the city architect Sten Westholm, are highly appreciated and considered one of the nicest functionalism environments in the city. (Linköpings Historia. n.dn) In my project I do not include this area in the suggestion as I believe it's important to find a balance between the build and natural environment and preserve cultural values.

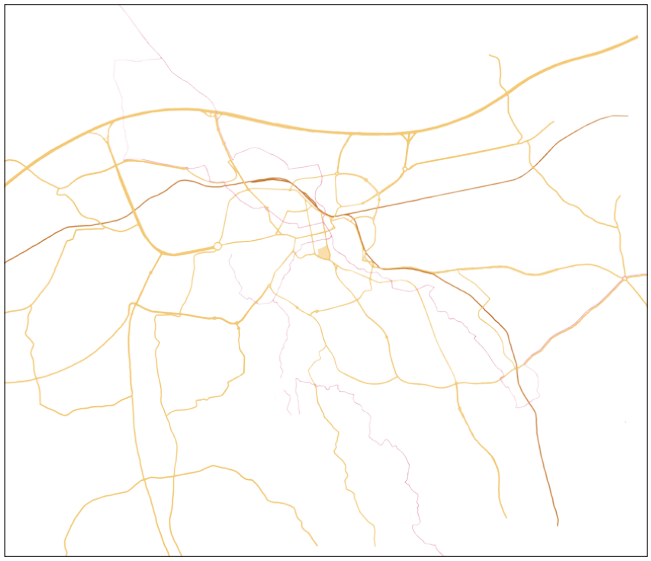
# Site analysis

## Layers of city and surroundings

### Neighbouring areas

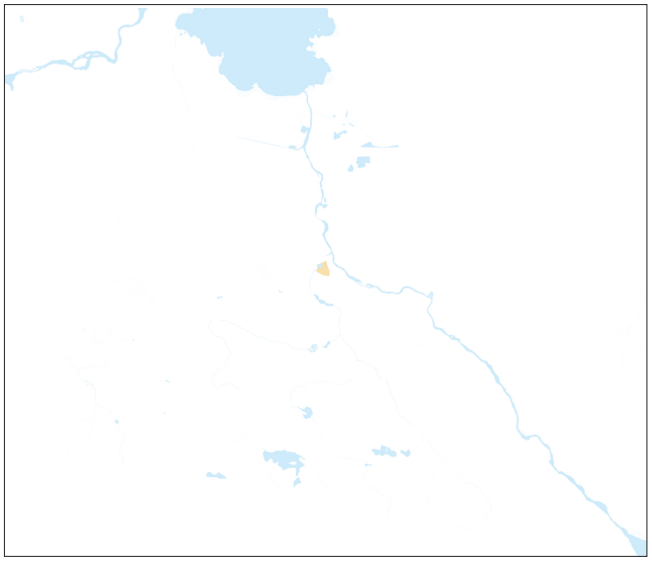
- Site
- City centre
- Tannefors, apartments
- Hejdegården, apartments, villas
- Ramshäll, villas
- Vimanshäll, villas
- Hospital area

### Infrastructure



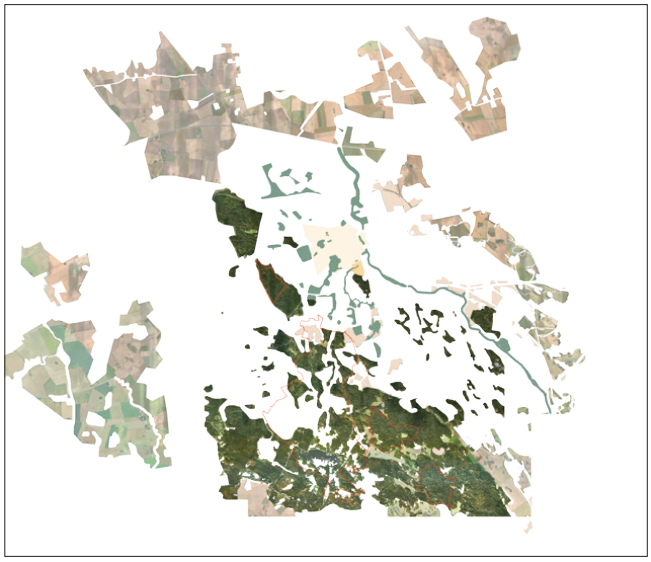
- Road network
- Hiking paths
- Railway

### Blue structures



- Water

### Nature types



- Urban agricultural land
- Urban green area
- Forest
- Agricultural land
- Nature reserve

# City and surroundings

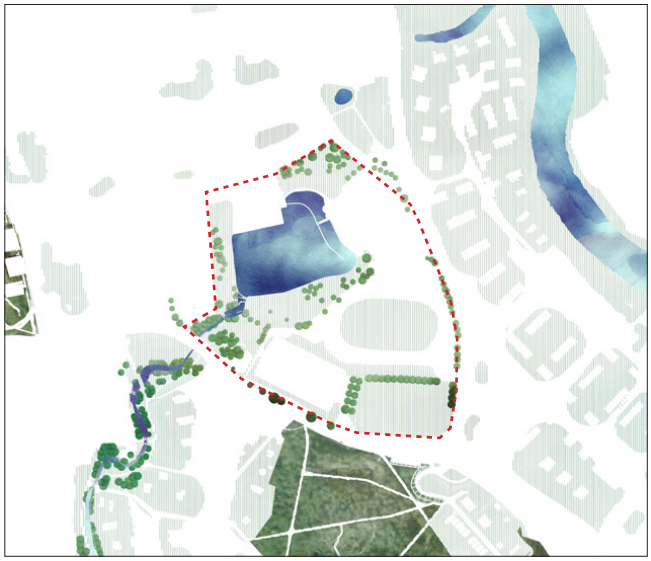

Figure 16. Linköping scale 1 : 50 000

# Layers of site

## Urban surfaces

- Hard surfaces
- Roads

## Blue and green structures



- Green areas
- Forest
- Trees
- Water

## Buildings

- Buildings - housing
- Buildings - other functions

## Built cultural heritage

- Extensive cultural heritage
- Great cultural heritage
- Cultural heritage
- Less cultural heritage
- Built after 1980

## Movement framework


Figure 17. Movement around Folkungavallen scale 1 : 8000

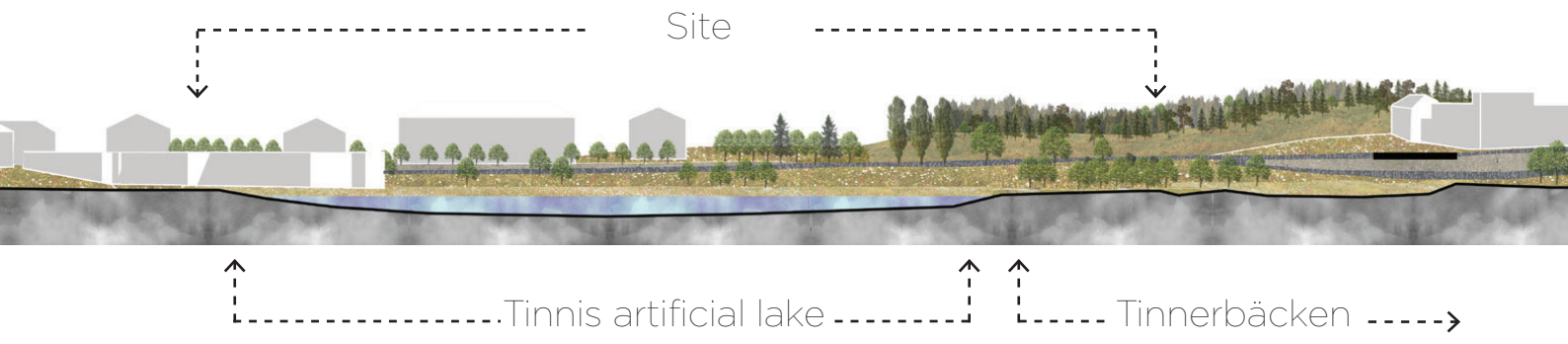



Figure 18. Site section scale: 1 : 2000

Folkungavallen

Red-listed species

Entrances

(Linköpings Kommun. (n.d.).Naturdatabasen.)


Figure 19. Folkungavallen scale 1 : 4000

The row of Cotton wood, Linden and Spruce

The former grass field and tracks on Folkungavallen

Tinnerbäcken seen from the bridge

Berga hage

Figure 20. Photos from site visit 26 April 2019

# Tinnerbäcken

## Stream

Tinnerbäcken, starts in an agricultural area south of the city and travels approximatively 6.5 km, mostly through urban environments, until it has its outlet in Stångån. The stream is highly affected by its urban location, regarding the physical shape and the quality of the water. The stream is 2-meter-wide on average and about 0.2 meter deep. It has faced a lot of damping and cleaning resulting in a rather strait stream. Most of the shores are of unnatural character. However, there are still areas that are relatively natural even in the city, like the ravine with surrounding forests just next to the site of Folkungavallen.

Chemical toxins, foreign species, morphological and connectivity deterioration has affected the quality of the water and it is in its current state very disturbed. The stream also handles a lot of stormwater.

The stream is one of larger in the municipality and is of high interest, due to its size, its part of an ecosystem for many species on the red-list and for the natural areas still present. It is important to preserve for recreation and for the city image as well.

Before its outlet in Stångån, the stream passes in a culvert under the artificial lake Tinnis, just next to Folkungavallen, and the streets Snickaregatan and Hamngatan. This is a huge problem for the wild life in the stream, in regard to flooding and the quality of the water. Today the culvert part of the stream is basically lifeless in regards to larger animals. Some of the species of fish that have been present in the stream have been negatively affected, decreasing their change of reproduction. (VISS, 2017). Today the stream is of bad ecological status but has a goal to be of good ecological status in 2021. (Linköpings Kommun, Teknik- och samhällsbyggnadskontoret. b.2016)

## Future position

There are three options for the future of the stream, investigated and summarised in a report by *Tyréns*. The possibilities and consequences of keeping the culvert or lifting the river up on the north or south side of the site are evaluated according to economy, ecology, environment and climate, social aspects and urban qualities. (Tyréns 2016)

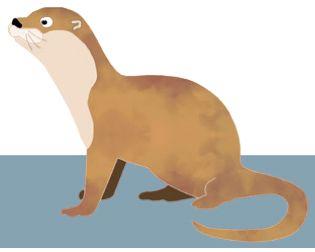
In the MKB ( Miljökonsekvensbeskrivning) document from the municipality the different solutions for Tinnerbäcken are evaluated based on the investigation by Tyréns.

The option that would benefit the most from an ecological perspective is to lift the whole stream from its culvert and create a natural like setting. By lifting the stream form its culvert the path for animals following the stream is continuous and not broken. The green corridor with natural setting will provide a healthier habitat for both water living and land living species in the city.

A natural stream has a variation of flows. Water in movement is beneficial for fishes reproducing and improves the oxygen levels. Where the water moves more calmly it is possible to create ponds where particle pollution can be absorbed.

Today Tinnerbäcken manages a lot of the city's storm-water. Most of the areas where the stream flows are of urban character, thus a lot of hard surfaces, this increases the change of flooding. In the area before the stream's outlet in Stångån the risk of flooding is high. If the whole stream is lifted from its culvert it is important to dimension it to be able handle large rain falls as well as include other strategies to manage stormwater

By lifting the stream from the culvert, it is possible to design natural like shores that can flood during high rain fall. This could be an aesthetically beautiful area for recreation, with placement of sun-decks an seating. The design



can vary with flatter areas with natural stone and steeper areas with hard surfaces. Walking bridges can be added to provide accessible recreation for the inhabitants.

The municipality has a will to connect parts of the city to create more coherency. By letting Tinnerbäcken connect naturally to Stångån, the connection is clearer and a "green path" for pedestrians can be formed. (Linköpings Kommun, Teknik- och samhällsbyggnadskontoret.b. 2016)

The three options investigated by Tyréns are based on the plan with the new swimming pool in the middle of the site of folkungavallen.

With the option of the stream running on the north side, Tinnis will be replaced with a new smaller one. The stream will be able to have wider flat shores that can flood, avoiding the bottom of the stream to be flushed away with heavy flows of water. The shores are more adapted to vegetation and wild life can easily move along the stream. New buildings on Folkungavallen will not shade the stream.

Placing the stream on the south side will demand some compromises in order to combine ecology with social interests. Placing the new swimming pool on the south side will reduce the area available to the stream, and the stream would thus be of a more urban character. The stream will be narrower with steep shores, which will affect flora and fauna. The narrow stream will limit the possibilities of a natural ground structure of the stream. Tinnis bath lake will not to be affected as much as placing the stream on the north side. However, the recreation aspects will be less favourable due to the position in the shade of the new swimming pool as well as the height differences on the ground. The stream can also be covered with a walking grid, this will reduce the visual contact.

The third option is a new larger culvert, this will do little to improve the ecological or social recreational conditions of the stream. (Tyréns 2016)

## Reflection

I am not restricted by the design proposal of the municipality. Their placement of the swimming pool on site is not something that shapes my proposal.

**Connecting the new area on Folkungavallen with the stream is important** as bridging natural and built environments is part of the thesis aim. I want the site of Folkungavallen to connect visually and physically with the stream and create the new buildings around that. At the same time, I want to preserve Tinnis bath as it is, due to its historical and cultural values. Therefore, a placement on the south side is a better option. The typology on the south side demands some work, and the stream would have to be excavated according to the hight curves. Some parts of the stream would be narrower and in the flat areas the stream could instead spread out.

Avoiding high buildings on the north side of the plot avoids shading of the stream and makes it more attractive for recreation. **Having Tinnerbäcken as a main blue structure or spine of the area would emphasise its importance in the city.** Connecting the new residents and users of the site to the stream and inviting the inhabitants of the city to use the site **makes Folkungavallen available to the public** and avoids it turning into a private residential area.

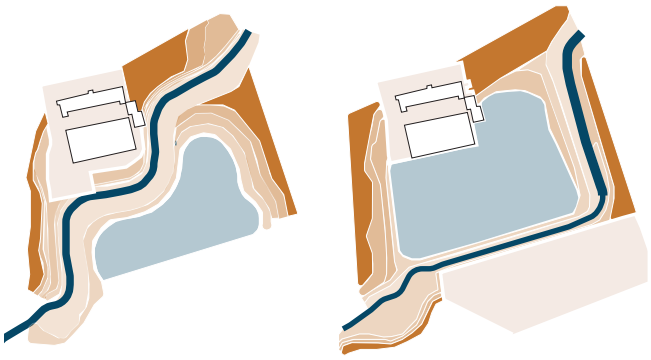


Figure 21. Suggestions for new position of stream

## Linköping year 1868-77

Figure 22. Linköping year 1868-77 scale 1: 20 000

## Linköping today

Figure 23. Linköping scale 1: 20 000

### Reflection

**Historically Tinnerbäcken had a natural outlet in the bigger river Stångån.** In 1943 the culvert was constructed. Lifting the stream from its culvert and looking at the historical position can guide the new design of the area

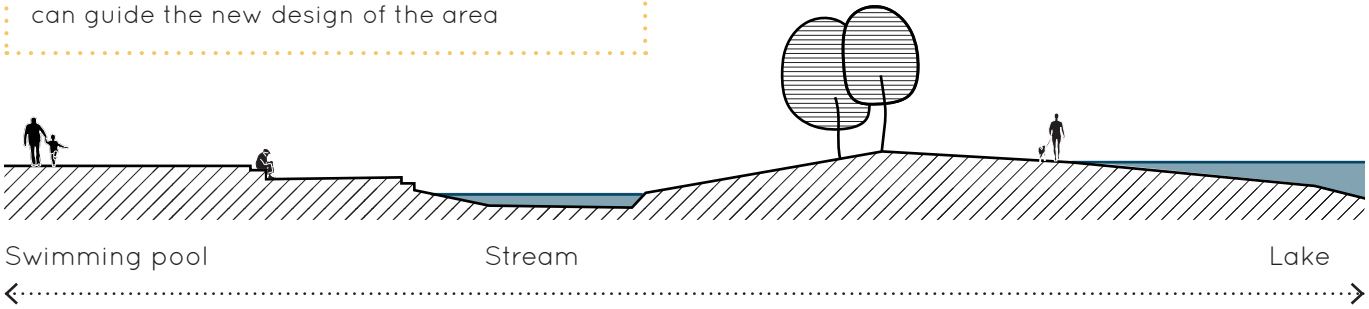



Figure 24. New suggestion for the position of the stream on the north side by Tyréns.

## Goals and strategies

*The municipality of Linköping, just like other municipalities in Sweden, is faced with an important development step where ecosystem services can and should be highlighted as a natural step in the physical planning for a sustainably growing city*

Linköpings kommun, Miljö- och samhällsbyggnadsförvaltningen (2018, p.18)

In Sweden 4273 species are threatened or near threat of extinction according to 2015 years red-list. The red-list is an important tool to bring awareness to the issue of decreasing biodiversity and gives a base to act. The list is revised every fifth year. (SLU, 2017)

"Linköping is a city growing rapidly, which puts high demands on how urban environments as well as the countrysides, are developed in regard to biodiversity, closeness to rich natural recreation and accessibility for everyone." (Linköpings kommun, Miljö- och samhällsbyggnadsförvaltningen, 2018, p.3)

The program for nature conservation from the municipality is a document describing goals and strategies on how to strive for this.

Nature database (Linköpings kommun, Naturdatabasen, n.d.) gives an overview of the state of the well-being in natural areas, ecosystems, biotopes and species in the municipality through inventories on different scales. This together with an action plan for the program for nature conservation sets the base for the municipality's work on nature preservation

A guide book is also provided for the inhabitants of the city, showing good areas to visit for natural recreation.

Looking at the nature database I could see several species on the site of Folkungavallen that are on the red-list. Otter, some species of bats, mosses, fungi, insects and several species of birds are listed in the area. These are catalogued in chapter five.

Some of the goals of the municipality that are relevant to this thesis are:

- Living lakes and streams
- Living forests
- A rich cultivation
- A good urban environment
- A rich fauna and flora

Here are some of the relevant strategies from the municipal strategies for 2018-2022 that I can use as inspiration in my thesis.

- Free water ways for fish and water living organisms
- Investigate urban waterways to improve the ecological status, For example Tinnerbäcken
- Create new ponds and small waters
- Increase accessibility to urban forests
- Change use of municipal grass lawns and roadsides to increase biodiversity
- Increase sand environments and plants for pollinating insects
- Preserve trees, dead and alive, important for biodiversity
- Increase meadows, with flowers, herbs and bushes for biodiversity
- Include ecosystem services in the planning process and use the nature conservation plan as base to preserve natural areas.
- Develop the green infrastructure and ecological links between natural and urban environments
- Manage storm water in open solutions

(Linköpings kommun, Miljö- och samhällsbyggnads-förvaltningen, 2018)

# Natural elements on site


Figure 25. Natural elements on site

Scale 1 : 3000

## Current municipal plans of the site

Folkungavallen is currently being planned for new development by the municipality. The new swimming pool that was designed in a competition is supposed to be placed in the middle of the site opposite to Tinnerbäcksbadet. There will be four new blocks for housing and a primary school of up to 350 students.

The aim is to develop Folkungavallen according to the inner-city strategies, with qualities of density and range of activities. Tinnerbäcken, Tinnerbäcksbadet and the new swimming pool becomes the new green blue meeting place, and oasis in the city.

The plan is estimated to fit up to 500 apartments, depending on size and configuration. The aim is to create clear city blocks with commerce or service on the ground floors towards the streets. The tenure form should be varied and there should also be a balance between density, noise reduction and sun and light conditions. Entrances are put towards the street for a more vibrant street life and feeling of safety. Vallastaden is evaluated and used as inspiration. The heights vary between six and eight floors, restricted by the airport at Saab.

Tinnerbäcken needs to be restored in order to reach good ecological status by 2021, there are different strategies for this, as mentioned earlier.

The area will be exposed to more traffic, increased noise and air-pollution. However, in the future, the streets of Hamngatan and Lasarettsgatan will be reconstructed, which will change the traffic condition.

The new plan of exploitation causes an increase of hard surfaces that will increase the flow of storm water. The water needs to be stalled and filtered before it is released into its recipient Stångån. The exploitation of Folkungavallen, also means that existing trees will have to be removed. This affects some of the red-listed species that are present on the site.

The trees on Hamngatan are considered a tree “allé” (row of trees) a protected biotope and removing them needs to be approved by the county administrative board. The placement of the swimming pool also affects some trees on the south side of Tinnerbäcksbadet. The overall assessment from the municipality is that the development plans of Folkungavallen does not have a significant impact on the environment. (Linköpings kommun, Teknik och Samhällsbyggnadskontoret.a.2016)

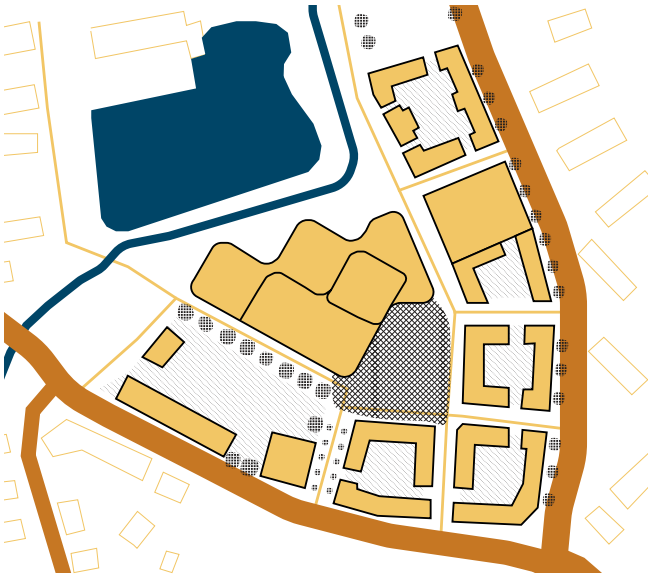
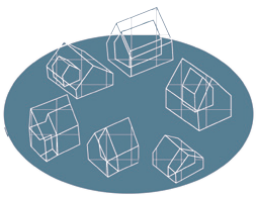
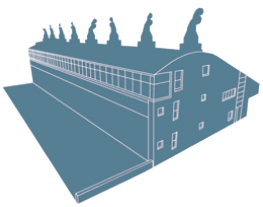


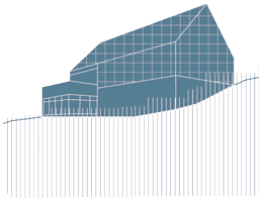
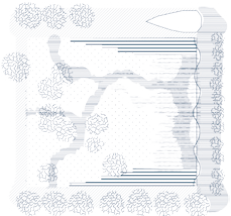
Figure 26. Municipal suggestion for Folkungavallen with the new swimming pool in the middle

### Reflection

I see the plans of municipality as inspiration. Having read the document of the program for nature conservation, I believe it is important to incorporate those aspects for Folkungavallen and use that as a starting point rather than an exception in the end. **There are trees important for red-listed species on site and that should be seen as an inspiration for the design not a limitation.** Tinnerbäcken is a strong natural resource and should be a focus point. **A balance between the city block and nature** is in focus for this thesis, not maximising the site. I also question the placement of the new swimming pool.

# CHAPTER FOUR
# REFERENCE PROJECTS & THEORY

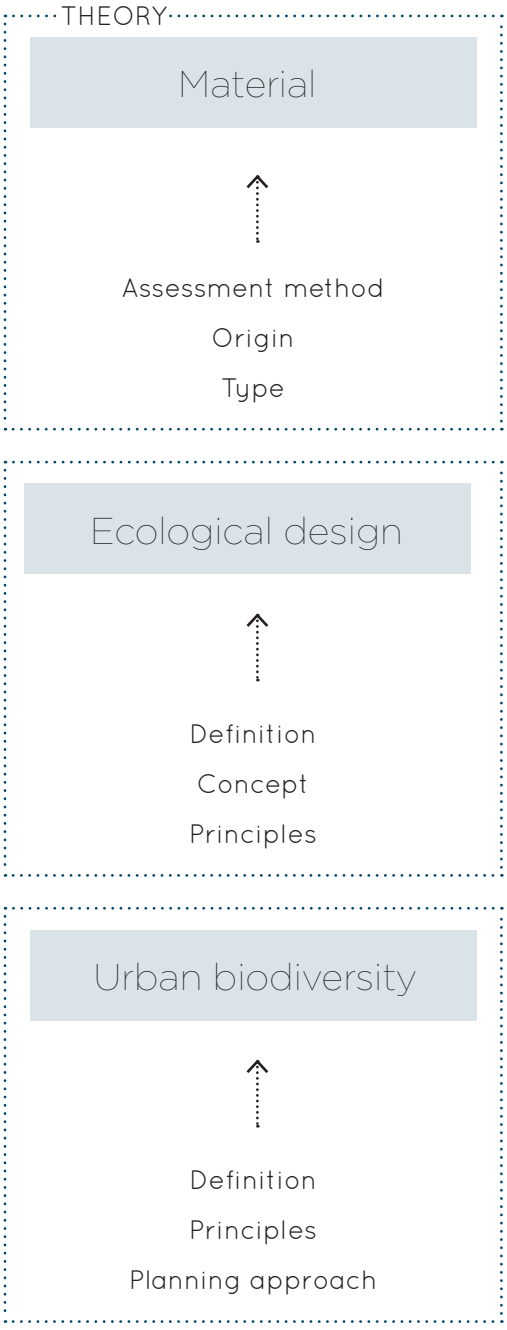



# Reference projects & theory

In this chapter I analyse the reference projects according to concepts, strategies and context. I make a reflection after each project to see what I can take with me in the thesis.

I look at assessment methods for materials, and what is important to consider when choosing a building material.

Furthermore, ecological design and urban biodiversity are theories where I discuss the city and its conditions, how cities grow and the effects on biodiversity, what ecological principles can be applied to a design and how biodiversity promotion can be a part of the planning. They are important theories used to form the strategies in chapter five.

# Reference projects

## ReGen village

**Location:** Almere in the Netherlands
**Year:** On- going
**Architect:** Effekt Architects Denmark.
Founder of Regen Village: James Ehrlich

A modern eco-village (Suburb living) with focus on self-resiliency and local community based farming.

Food as a starting point with farm-to-table tradition creating a sense of community.

Organic food, clean water, waste, recycling and energy.

Biomimicry, software and technology. Larger sensors send information to the cloud (AI)

Sited optimised for climate on site a concept that can be copied and applied in other contexts

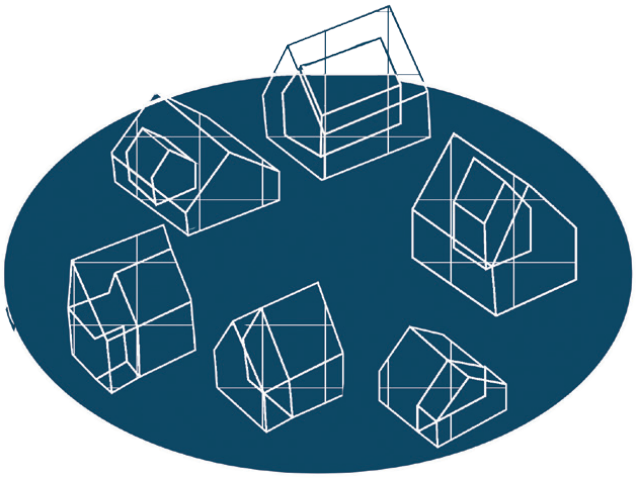
Architecture:
- Housing typology + glass envelope
- Natural ventilation
- Solar heating, passive heating
- Water collection

Circular systems:
- Water, energy, food, waste

(Effekt, 2018) (Singularity University, 2017-10-05)

### Reflection

The proposal is quite an utopian suggestion with the future eco-village controlled by AI. Still, I think it is an **interesting investigation where strategies for total self-sufficiency is tested**. In an rural setting it is a nice way of connecting to the nature and site, using what is there and creating a community by resilience, not only for one building, but for all the connected parts. In an urban setting however, the neighbourhood would have to be connected to the rest of the city in order to be resilient over time. **I also believe it is important to connect to the specific site. What are the cultural and historical aspects and values of the place?** This proposal creates a typology that can be applied and adjusted to sites all over the world and I think some of the traditional values and customs can be lost. However, the strategies themselves focusing on circular systems, are ideas that can be used s inspiration for my project.



Relevant theme : **REGENERATIVE DESIGN**

# BedZed

**Location:** Hackbridge, London, UK
**Year:** 2002
**Architect:** Bill Dunster

UK's first Large-scale, mixed-use sustainable community. Suburban homes with private gardens

Main goal: A test ground and prototype to learn from in future projects. Set the base for new policy for sustainable buildings, zero emission and zero energy buildings in the UK.

Reduce energy use and demand:

- Passive solar heating (thick walls + air tightness ), good daylight
- Centralised heat and power-plant, Biomass boiler, green electricity
- Reclaimed material (12%), recycled material, new local material (52%) with low embodied energy.
- Natural ventilation
- Energy saving appliances

Minimise the impact on the sewage system:

- Rain water is separated from sewage water
- Green water treatment plant - filtering the water that can be used for toilet flushing, irrigation
- Green roofs for biodiversity and storm water management

Permeable paving

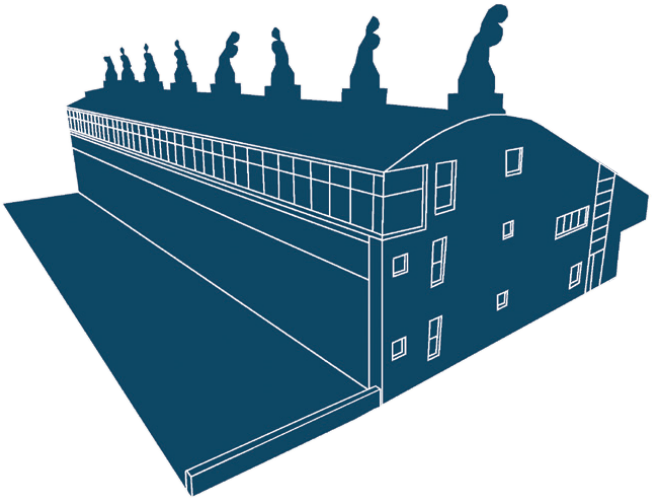
Create a sense of community promoting mental health and a whole sustainable lifestyle not just green building. A hopeful message showing that a "one planet living" is possible. Make the green choice the easy choice:

- Mixed size and tenure form
- Public transport and car pool, bike storage
- Meters showing use of water
- Live and work- units

(Schoon. N.2016-04-06) (Bioregional.2016)

## Reflection

An interesting project that was before its time, exploring the possibilities of a sustainable building. Making use of the sun for passive solar gains is a clever way to reduce energy costs. The setting is rural, where every ground-floor apartment has a private garden. This is a nice feature but can be hard to apply in an urban setting. Furthermore it is not very space efficient, and I also believe that **sharing garden and outdoor space with your neighbour is perhaps a better way to create a sense of community and a common stewardship.** Balconies for each apartment can be a better option for private space. **The idea of using the project as a test ground is a good way to explore new ideas and push the conservative building industry forward.** This is something that I can have in mind in my project, to dare to test and do something new and exceptional.



Relevant theme : **SUSTAINABLE BUILDING, CIRCULAR THINKING**

# Plan programme Sege Park

**Location:** Malmö, Sweden
**Year:** Ongoing
**Architect:** Malmö Stad, (Concept for block in competition *Nordic Built Cities Challenge* with wining proposal by Kjellander Sjöberg "It Takes a Block")

"Sustainable spearhead in an old cultural-heritage environment"
Area: 250 000 square meters
Large park 4 km form the centre of Malmö

Existing:
Five existing schools, two pre-schools, 125 residents, Health centre

Future:
600-750 apartments (including 125 existing student housing), 45 row houses, LSS- boende home for the mentally or physically disabled), one new school, commerce 2100 sq. m , health care 12000-15000 sq. m, art studio, parking garage

Strategies:
- Sightliness and several clear entrances.
- Keep important trees
- Material according to LCA, solar panels
- A mixed district, a diversity of meeting-places and buildings
- Building same width as existing (12m) mixed heights. Entrances towards street.
- A distinction between private and public spaces. Closed housing courtyards
- Prioritise pedestrians and cyclists

Sustainability:
- Open rainwater management
- Large park with eight different characters
- Cultivation for all, green houses
- Nature is invited, insect hotels, bird houses
- Local recycling of food waste
- Self-sufficient street lighting
- Reduced car traffic, bike- and car pool
- Recycling station
- 50% of the commerce/service should have a sustainable profile
- Renewable energy, local energy sources
- Energy efficient buildings

(Malmö stadsbyggnadskontor. 2015)

Relevant theme : **BIODIVERSITY, URBAN PLANNING**

## Reflection

The proposal for Sege Park is focusing on sustainability aspects, and **I especially appreciate the idea of keeping a large park with several different characters.** This is something that can be hard to find in urban settings. Even though the area is much larger and situated outside the city centre, there are some strategies that can be applied to Folkungavallen. There are already buildings on the site and some trees, but they are kept in the proposal. Folkungavallen has no buildings, but trees that are important for biodiversity. Focusing on pedestrian and cyclist is a good way of reducing traffic and emissions.

# Uppgrenna naturhus

**Location:** Uppgränna, Sweden
**Year:** 2015
**Architect:** Fredrik Olson, Tailor made Arkitekter in collaboration with Green house living

A spa- and conference building with view overlooking lake Vättern and Visingsö. A house and greenhouse in one with a closed loop system within the building. Creating a climate inside similar to northern Italy. The house is not connected to the municipal sewage system. Plant beds in the greenhouse filter and cleans the sewage water and absorbs the nutrients. Proving the building with fruit and vegetables.

The aim is to create sustainable buildings that can produce food instead of waste. A house that generates energy instead of consuming, and gives opportunities to reflect and learn about consumption and that what we eat and eventually flush down the toilet can be part of a system instead of just waste.

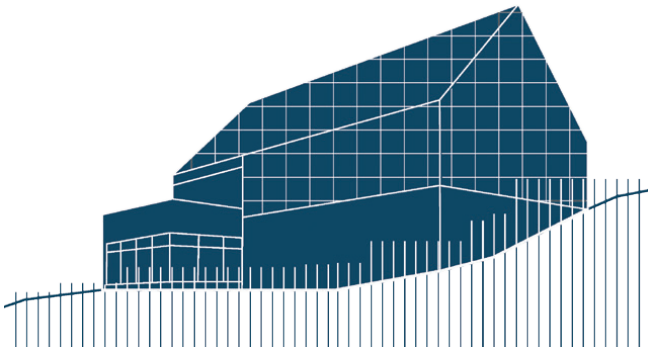
The concept Nature house was developed by Bengt Warne in the 1970's according to the principal of an insulated house as a core surrounded by a climate membrane of glass and a cyclic system. The climate membrane creates another climate zone around the building, that can be used all year round.

The greenhouse protects the house on the inside from the elements, meaning that the house itself can be built with more freedom. The house is also protected from UV-radiation which minimises the maintenance on the facade and roof. The greenhouse and solar collectors, where the insulated house stores heat results in low energy demands. (Öfverholm. C. 2016-12-16, Tailor Made Arkitekter. n.d, Uppgrenna Naturhus. n.d.)

## Reflection

The principle of the nature house goes hand in hand with my ideas of circular thinking. I believe it as a tangible way of showing and educating us about circular loops of nutrients. That what we eat end up in the toilet and is considered waste. Our sewage system is constantly overloaded, especially with heavy rains. **If we instead can make use of the waste, which contains so many important nutrients, and use it again within the building that would be more sustainable.** Not taking care of nutrient means they can end up in water ways and cause eutrophication. Nutrients are vital for our food production. In the recent years warnings about nutrients shortage of phosphorus have been raised (Snaprud.P, 2010-05-04).

**Applying the principle to larger buildings would be interesting to test. Especially in an urban setting where greenhouses can work as both food production and recreation.** For schools it can be a good way of educating the students.



Relevant theme : **SUSTAINABLE BUILDING, CIRCULAR THINKING**

# Tanner Springs Park

**Location:** Portland, Oregon, USA
**Year:** 2010
**Architect:** Atelier Dreiseitl (now Ramboll Studio Dreiseitl)

A city park combining local ecology, sustainable strategies, water management, art and civic participation to create a calm escape for the residents and wildlife of Portland. The area is a former industrial site, that has now developed into a vibrant urban district where the park is of high value to the residents. Prior to its industrial character the site was a wetland, bisected by Tanner creek and sided by the stream Willamette. One of the design strategies was to go back to the sites original natural state by introducing water features and vegetation.

The park offers a range of activities and spaces and a pond in the park manages rainwater. Surrounding the pond on one side is an art installation made of old rails from the area combined with glass and on the other side there are terraced permeable steps for seating. Right across the pond there is also a raised walk leading through the wetlands and to lawn spaces for human activities.

On street level a rain pavilion is located, protecting the visitors from the rain at the same time collecting water, before filtering it down into the park.

During the design process residents, local business and users where invited to participate in workshops

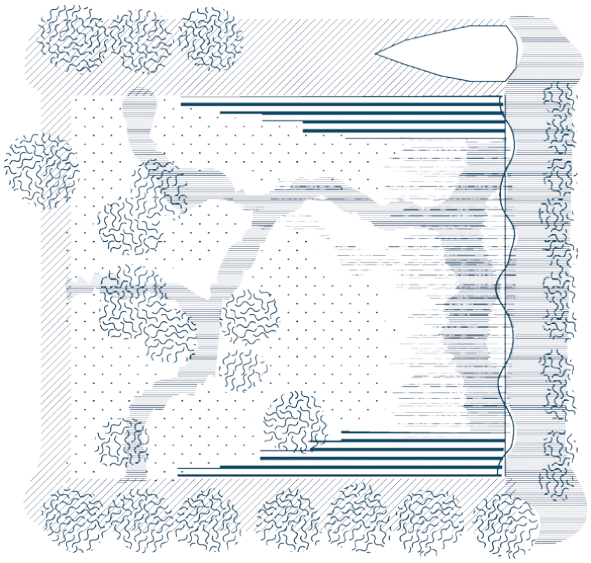
(Urban green-blue grids. n.d., Land 8.2015-05-05)

## Reflection

The site has similarities to Folkungavallen. With an urban setting. On Folkungavallen Tinnerbäcken was once a stream running free connected naturally to Stångån, but now it is put in a culvert, affecting its natural state and possibilities to support wildlife.

**I appreciate the efforts to support both human and wildlife in the park with both wetlands, vegetation but also lawn areas for people to sit and relax and play.**

There are possibilities at Folkungavallen to let Tinnerbäcken go back to its natural state and create a recreation area around the stream that can be enjoyed by both humans and wildlife. But also combine the natural setting with park areas that are more accessible.



Relevant theme : **ECOLOGICAL DESGIN, URBAN PLANNING**

## Sustainable building

To create sustainable buildings the choice of material is important. The following aspects should to be considered:

- The content
- Manufacturing
- Amount of resources needed
- Emissions
- Energy usage and what kind of energy that is used for manufacturing and transportation.
- What waste products that are produced

To find this information an EPD, environmental product declaration, can be used. This document should contain

- Material content
- Production
- Distribution
- Building state
- Usage state
- Demolition
- Recycle opportunities
- Waste material
- Indoor environment - toxic content

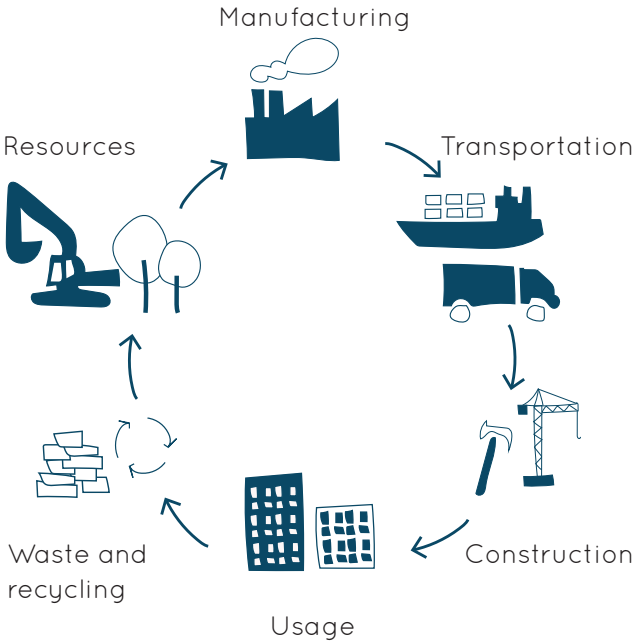
These documents can be found at the company providing the material but there are also data bases that lists materials, for example BASTA, SundaHus and Svanen.

LCA, life cycle assessment, is a method where the total environmental impact of a product is assets, from its resource extraction and manufacturing, to use and waste managing. All transports are included and all the energy that is necessary during the different steps of the product's lifetime. (Bokalders. V., Block. M.2004). In the studio Sustainable Architectural Design (ARK466) that I took during the spring semester 2018, we evaluated materials according to the LCA principle. These materials work as a library for me in this thesis. In addition, I have looked into materials listed in the handbook for sustainable buildings by Varis Bokalders and Maria Block (2004).

In the material library that is presented in chapter five I have summarised materials that are local to the region or neighbouring regions. This reduces transports and thus also emissions, that would otherwise increase due to longer transportation.

Furthermore, I present materials that are renewable and not finite, which is another way of reducing the negative impacts on the environment.

In addition, avoiding toxic materials is important in order to provide buildings that are healthy for the builders, users and the surrounding environment.



# Ecological design

## Ecological understanding

*There is no such thing as a blank slate, when designing from a perspective that embraces ecological thinking.*

Rottle.M., & Yocom. K. (201.0 p. 8)

A landscape is always influenced by its physical, biological and social relations, thus a specific site needs to be understood as a part of these dynamic relationships.

Applying ecological design principles means to consider the **flows of energy, nutrients and organisms**. With the aim to mimic the circular systems of nature and minimise waste on a wide range of scales. **Ecological design aims to connect people and nature**, showing the processes and giving stewardship. This will support sustainability and at its best, regeneration over time. Using an ecological perspective helps me to find strategies in my thesis.

When designing new built environments, it is important to keep environmental processes resilient to change over time and at the same time promote diversity and health for both the natural and human communities. This is to minimise negative environmental impacts and increase social equality.

Many cities are situated close to ecologically sensitive areas such as lakes and streams. The city could either block the flows and degrade the environmental qualities or provide citizens with natural interactions. On Folkungavallen Tinnerbäcken has the opportunity to do so.

Ecosystems are not in a state of equilibrium or constant steady state, rather in disequilibrium where any ecosystem, urban or natural, are dynamic and adapting to changes on different scales, local, regional or global. Each project within its context, is a new experiment to learn from. (Rottle.M., & Yocom. K. 2010)

"Green infrastructure is comprised of natural, semi-natural and artificial networks of multifunctional, ecological and low-impact systems that provide ecological services while promoting the health of humans and related environments." (Rottle.M., & Yocom. K. 2010. p.49)

**Green infrastructure can help to span urban and natural systems.**

Overlapping aspects that create value and benefits on several levels:

**Providing access to public open space**

The community system is about people and the places that connect them, composed of different public open spaces like parks, squares, markets, recreation spaces, civic art, and vibrant streets. These spaces are considerably important in dense urban contexts

**Improving habitat conditions for wildlife**

The presence of different landscape conditions is important in cities who are often located in critical habitat areas, in order to support the organisms living there. Preserving and resorting ecological habitats in the city supports wild life and connects humans with nature

**Conservation and cleaning of water**

Water is important for all forms of life and is today highly affect by urbanisation. It is possible to use green stormwater infrastructure to harvest and clean water for reuse. Lessening the impact on our groundwater. This can be done by rain gardens, wetlands, bio-filtration swamps, green roofs, ponds and stormwater planters. These components can also provide habitat and public open space.

**Reducing energy consumption and greenhouse gas emissions**

Clean, small-scale energy production, local production and trade of food, composting facilities, biological agents digesting and neutralising hazardous waste and revitalisation of urban brown field for new use reduce energy, emissions and waste.

**Alternative low impact transportation**

An active transport system reduces negative impacts on the environment and provides positive effects on public health and social connections.

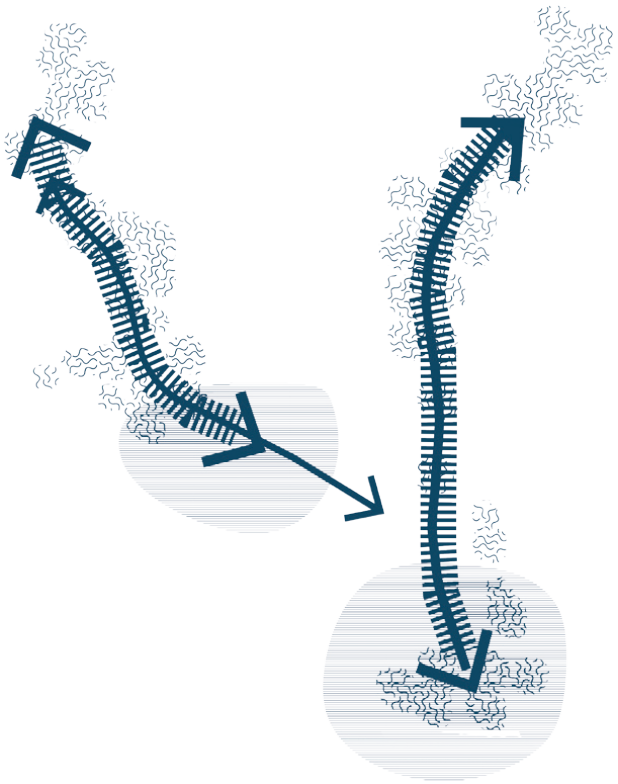
(Rottle.M., & Yocom. K. 2010.)

## Designing for ecosystem health and biodiversity:

- Consider the various spatial scales of ecosystems and their interactions, flows and potential impacts.
- Protect the existing
- Prioritise protection and restoration of water habitats and their edges. Water habitats harbour the most diverse life of plants and wildlife species.
- Use the known requirements, but consider time, process and stages when planning.
- Know the site and its opportunities and challenges
- Principles of landscape ecology
- Cross-disciplinary work
- Give opportunities for human interaction and stewardship

## Reflection

Ecological design is an important theory for my project. **The aim of ecological design is to connect people and nature by mimicking the circular systems of nature. This goes hand in hand with the aim of this thesis.** Some of the strategies that are suggested by ecological design theory, like the importance of the site and its context, protecting the existing and providing opportunities for human interactions are key aspects that helps me in my process.



# Urban biodiversity

## Why biodiversity in cities?

*One can actually state that the sustainable society with a stable economy and a stable relation to nature has never been as remote as it is today. We must begin to question the institutional circumstances that determines our relation to nature and within what frames we are forced to act when it comes to solving environmental problems.*

Bokalders. V., Block. M (200, p. 376)

A decrease of urban biodiversity influences the ecosystem processes taking place and thus also the services that they provide for the inhabitants in the city. **A rich biodiversity creates a more resilient environment in the face of climate change**, where green and blue structures can help to regulate temperature and water. Furthermore, urban biodiversity is important in order to **connect people and nature and emphasising the importance of the ecosystems.** (Persson. A.S.,Smith. H.G.2014) Close contact to nature has also proven to have health benefits, reducing stress, and increasing relaxation and concentration (Roger S. Ulrich, et al. 2008).

In the report Ecological diversity in urban environments (Biologisk mångfald i urbana miljöer) the authors Persson and Smith (2014) discusses previous architects and their view on biodiversity in urban environments.

Fredrick Law Olmsted, claimed that strategies based on natural processes were to prefer over just technical, as they would provide aesthetic and recreational values in addition to its functions. Parks and other green areas should therefore be as important for city planning as buildings, squares and streets, and help to set the frames of the city's expansion.

Kevin Lynch, believed that a city should be seen as part of the surrounding landscape and region, and that the design of the city should be connected and adapted to the surrounding natural landscape and cultural heritage. He believed that this would create a sense of place and coherency, increasing the feeling of safety and well-being.

## Requisite of urban biodiversity

In urban environments the lager amount of smaller green areas is dominated by the edge effect, here there is often more disturbance affecting the kind species that are able to live there. However, **If we would view the urban landscape from an ecological perspective we would find other type of edges and borders than what we would find merely looking at buildings, roads and squares.** (Persson. A.S.,Smith. H.G.2014)

It is important that the green areas can complement each other in terms of variation and quality. Increasing the amount of green habitat in the city is one way to support biodiversity, but it is also important that species can travel between the different green areas, therefore, green corridors are essential.

Preserving natural areas close to the city is essential in order to secure a spread of organisms and species to smaller green areas within the city.

There is often a spread of invasive species in cities which are a threat to the local biotope. Therefore, it is important to plant local species, instead of exotic, in urban environments.

To have a variation of natural like habitats in the city is important, trees are especially valuable for the micro climate in cities. The larger and older the trees are, the more variation and dynamic their structure is which improves biodiversity.

**By highlighting the natural processes and making them visible in the city, the city and its inhabitant's part of nature will be emphasised.** (Persson. A.S.,Smith. H.G.2014)

### Reflection

The trees on Folkungavallen are varied in size and age and are home to some of the red-listed species. **Determining the distance that is needed between the trees and the new buildings, would be a good method to find the position and space available for new development on site.** The forest and stream are richer habitats that can work as a source for species to establish a new green habitat on site.

## Shape of city and biodiversity

Urbanisation is a fact, today more people than ever are living in cities, and it is estimated that in 2050 6 billion people will live in cities across the world (SCB.2013) This means we need to have a plan on how all these people can live sustainable in urban areas.

Generally, there are two ways that cities tend to grow. One is where the city spreads out in what is called urban sprawl, leaving more space in-between the buildings in the city and surrounding areas, and taking in a larger area in total in claim. The green areas that are formed are often small and in close contact to the built environment, resulting in poorer biodiversity.

Another solution is where the city is densified on already exploited blocks in the city. The overall area that is affected by humans is reduced. However, this demands that there are lager natural areas close to the city to support the flora and fauna.

A dense city creates a clear division between the built environment and the nature of the city, resulting in less contact between the inhabitants and nature. The green areas that are available needs to be shared among more people. **As cities grow and more and more people live there having to share the little nature that is left, will the environment still be attractive?**

Both a dense city and a sparse city are threatening biodiversity in urban regions. (Persson. A.S.,Smith. H.G.2014)

## Land sparing vs. lands sharing

Sparing in an urban context could mean to build dense without green areas to be able to "spare" larger green areas. Sharing would instead mean a greener city as a whole with more environmentally friendly strategies. This would result in a green matrix and improve the connections in-between the green areas. **Sharing would also benefit the inhabitants as they would have closer access to natural areas.**

It is important to consider the goal of urban biodiversity, the ecosystem services available and the species that need to be protected in the certain area when considering the form for the built environment in the city. Furthermore, the scale of implementation is crucial, comprehensive plans for the city usually have little real impact to improve conditions, instead strategies for urban biodiversity should be implemented in detail plans.

The city and all its parts: the inner city, the suburb and the outskirts, all have to offer good and attractive environments for the citizens. The largest threat in urban environments is areas that are considered low quality and unattractive. Then we are somehow "wasting" space and land where no one wants to live, increasing segregation and social injustice. (Persson. A.S.,Smith. H.G.2014)

### Reflection

Folkungavallen is a site located just outside the city centre, when planning the area, I think it is important to consider the position next to a forest and the stream Tinnerbäcken but also the urban fabric. **When attempting to bridge the mental barrier between the humans and nature there needs to be balance between the dense inner city and the natural areas.** How can one deal with the psychical barriers and edge zones and how can the site connect to the natural areas already in use and create possibilities for biodiversity and recreation in the city?

# CHAPTER FIVE
# STRATEGIES

# Strategies

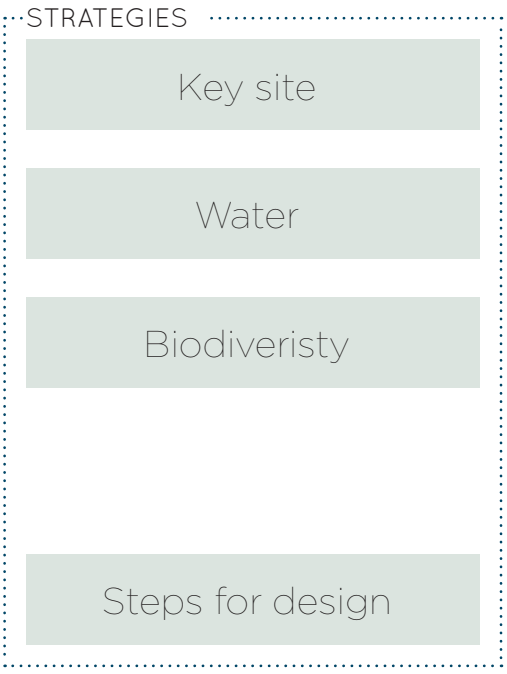
In this chapter I conclude the site, reference project and theory analysis by formulating strategies.

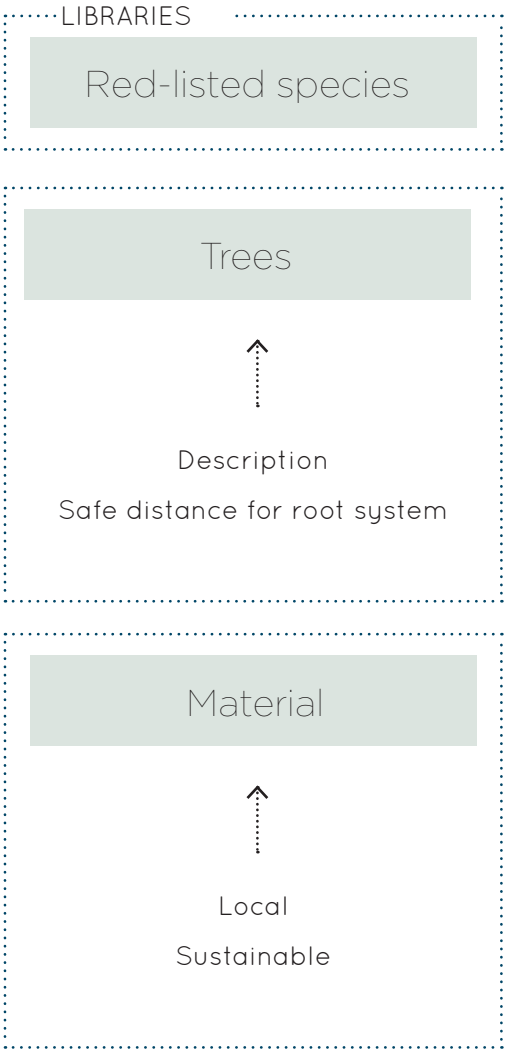
First the key site strategies that guide the overall design of Folkungavallen.

Followed by strategies in the themes of water and biodiversity.

Thirdly, I propose steps for the design.

Lastly libraries of red-listed species, trees on site and materials are presented.



# Strategies

## Key site strategies

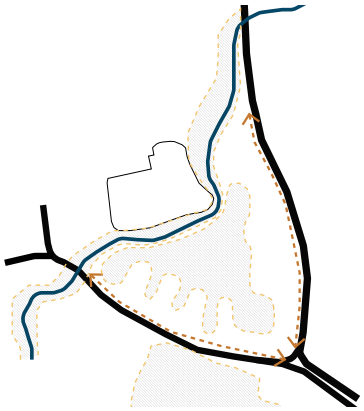
Folkungavallen is situated next to an urban forest (Berga Hage) and the stream Tinnerbäcken. However, two larger streets, Lasarettsgatan and Hamngatan, are creating an urban border between the site and the natural areas. The site is located very close to the city centre, so to work both with the urban architecture and the natural environment, where they are valued equally, and create transitions between them two can be a way to reduce the feeling of borders. A more urban architecture and language toward the street with a vibrant city life and a more open area on the other side might be a starting point.

I am using the stream Tinnerbäcken as a starting point of the design for the area. The stream works as a focal point and spine for the site and how it connects to the larger stream Stångån and the area surrounding context. Green paths on site connecting the area to the stream, creating visibility are guiding the design.

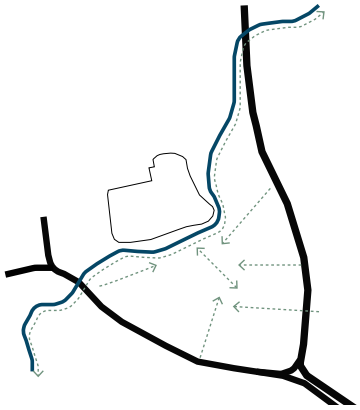
All trees are kept emphasising their importance for biodiversity and especially the red listed species that inhabit them. The placement of the trees in regard to the root systems determines where the buildings and paths are placed.

The site is 60 000 square meters. To work with both private and public spaces, a range of activities as well as the natural form of them creates a diversity in space for both humans and wild life. Increasing biodiversity also highlights the ecosystem's importance for humans. Diversity creates more flexibility and by that also resilience for future changes. By exposing ways to incorporate biodiversity the value of it is also enhanced.

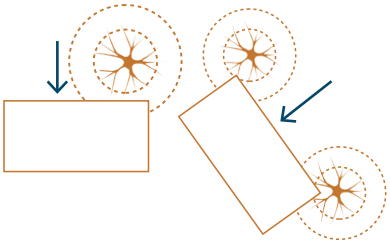
Nature side urban side



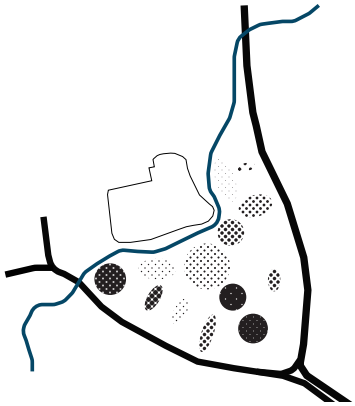
Blue and green paths



Save trees



Exposing diversity

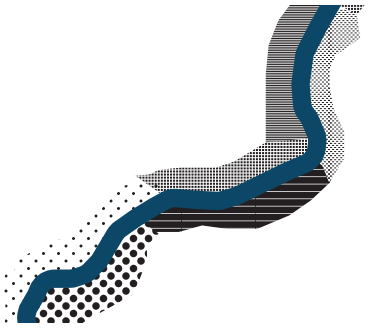


## Strategies in themes

In addition to the key site strategies there are strategies presented within the themes of water and biodiversity. Some are more general and can be applied to other sites whereas others are more specific to Folkungavallen.

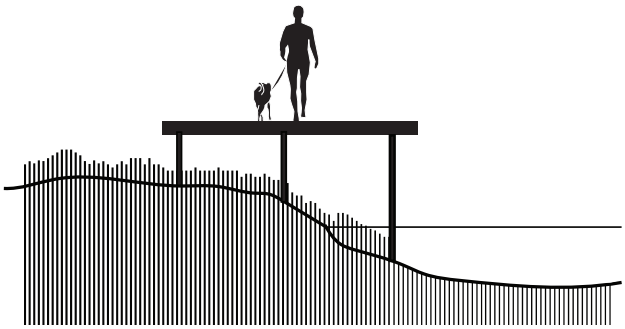
## Water

Lift Tinnerbäcken from its culvert with a natural like setting with a mixture of soft and hard surfaces. Some areas of the shore should be able to flood during heavy rains.



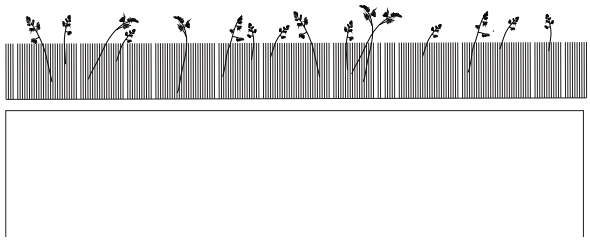
••• This connects Tinnerbäcken to its recipient Stångån in a natural way and improves the possibilities of wildlife to travel via the stream.

A walking/running path and recreation area along the stream with seating areas in the shade of trees or in the sun. The path should be raised in areas closest to the stream in order for the stream to flood and for wild life not to be disturbed.



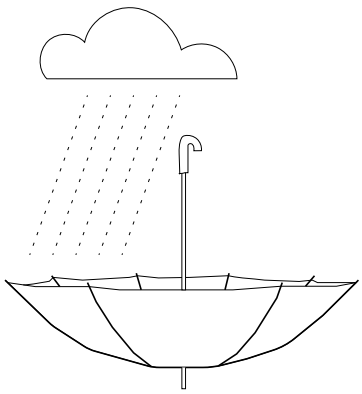
••• This strengthens the role of the stream in the city and makes it available to the public. A walking and running path promotes public health. Making the stream socially available brings stewardship to the natural area and makes sure it is not forgotten.

To manage storm water there are several strategies than can be applied:



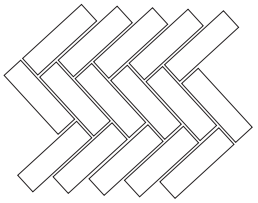
••• A thicker green roof with native biotopes handles heavy rains but also promotes biodiversity. In an urban landscape with many hard surfaces, softer roofs can be a good complement to aid wildlife in the city.

Collecting and using roof run off for irrigation and flushing toilets



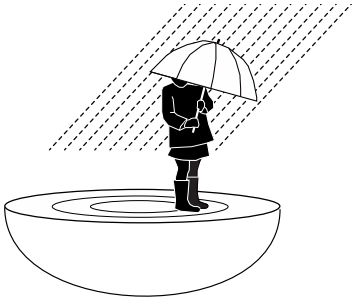
••• Using clean tap water to flush the toilet is not a sustainable solution. Using rainwater instead of using tap water that has gone through a process demanding energy, is a better option. Collecting and storing rainwater for irrigation is also good for dry seasons.

Permeable pavings, with bigger distance in-between, enables water to be filtered in the ground



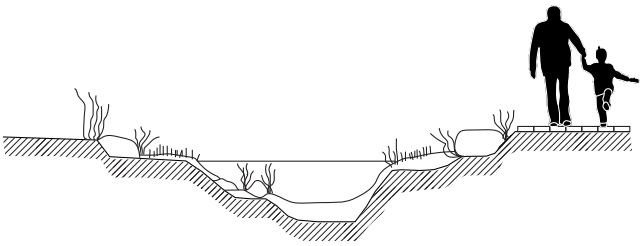
This can avoid large pools of water to form. Using reclaimed brick is a good option to reduce energy and emissions.

Areas of the site can be designed to be able to flood



Seeing the water as a possibility to be creative. Thinking ahead, reduces the risk of floods destroying property.

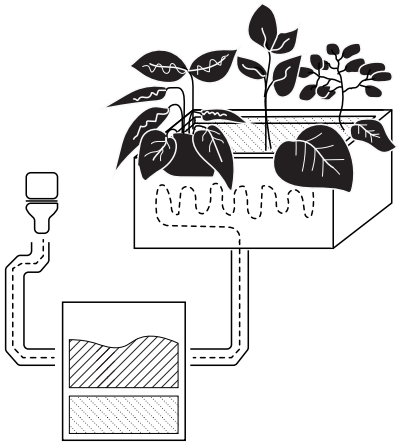
Ponds, ditches and canals that slow down the flow of water before it reaches the recipient which in this case is Tinnerbäcken.



Leading the water on site, slowing it down before it reaches the stream reduces the risk of flooding. It filters the water, that might contain pollution from streets before it reaches the stream.

To find more sustainable solutions for sewage treatment where nutrients can be taken care of is one way to close the loop.

The Tree Well system, is a strategy where sewage water is filtered in the soil on-site and cleaned via a system of plants before it is released into a waterway. Putting less strain on our conventional sewage system, that can be over loaded after heavy rains. When this happens the treatment plant releases untreated sewage water into water ways. It is therefore important to both manage stormwater and perhaps also reduce the dependence on conventional sewage systems.



Separating toilets where the urine is treated and turned into fertilising powder for cultivation. This reduces the amount of nutrients in our water system, nutrients are not be lost as waste, instead reused.

# Biodiversity

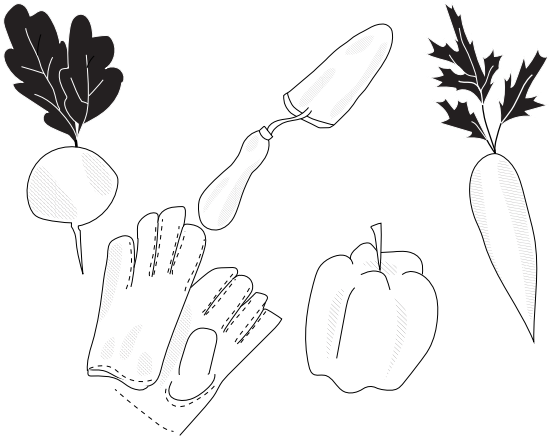
To promote biodiversity there are several strategies that can be used. A main concept to think about is to create diversity in the natural areas that are provided on site. By offering a wide range of spaces, with different character it is more likely that different species can adapt.

Meadows

A meadow provides a wide range of species. The maintenance level is low and thus also the disturbance level on wild life.

Orchards with fruit trees and bushes

Attracting pollinating insects and birds. Fruit fallen from the tree or left on the branch offer an important source of food for many species in the cold seasons . Fruit can also be enjoyed by humans in a sustainable food production.



Urban farming and cultivation

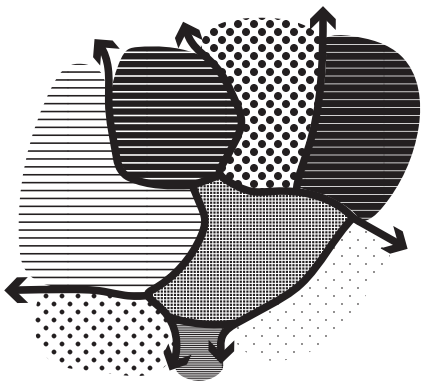
A good strategy combing biodiversity, sustainable food production and recreation and education values

Parks and gardens with different expressions and size

Diversity in spaces offered means there is an increased resilience. More species are able to adapt to the environments offered in the city. People of the city can enjoy different kind of green areas and learn about the species.

Areas with softer surfaces, sand for insects

Provides important habitats for wild bees



Connecting the different natural areas with green paths and corridors

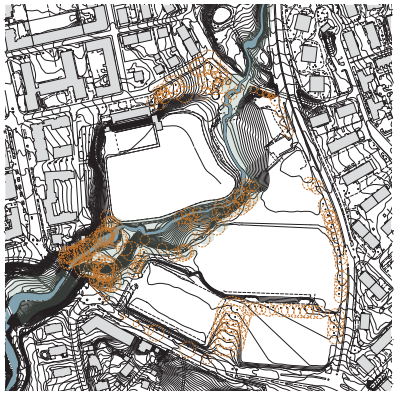
In order for wild life to transport themselves between “patches” in the city there must be safe connections in between

# Steps for design

## 1 New position of stream

Lifting up Tinnerbäcken from its culvert and placing the new path of the stream according to the height curves on the south side of Tinnis. Surrounding the stream space is reserved for wildlife who follow the stream. The area can also be used for recreation and a walking/running path. The stream should also be able to handle larger flows of water and flood in the area marked out.

## 2 Distance to tree roots

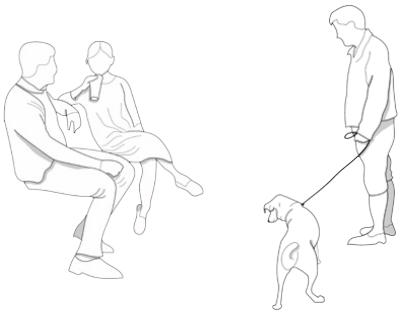


By looking in the library of trees and the distance their roots system need from built structures it is possible to mark out the safe distance for the trees. This area should not be built upon.

## 3 Available area

This leaves the area that is available for functions and buildings. Approximatively 35 000 square meters.

## 4 Activities



In regard to activities they are based on the natural elements on site and should be a mix of private and public spaces and tenure forms. Housing, office and a new school. The new recreation path offers an invitation to the public and makes sure that the area is not privatised.


Figure 27.

Blyth's reed warbler


Figure 28.

Black Woodpecker


Figure 29.

Greenish warbler


Figure 30.

Green woodpecker


Figure 31.

Lesser spotted woodpecker


Figure 32.

River warbler


Figure 33.

Lemon Lichen


Figure 34.

Grimmia dry rock moss


Figure 35.

Clustered bracket


Figure 36.

Longhorn Beetle


Figure 37.

Bat


Figure 38.

Otter

# Trees and safe distance

From the tree inventory Fennicus Natur (2016)

Figure 39.

Figure 40.

Figure 41.

Figure 42.

## Linden

Along the street of Hamngatan, hosting the red-listed species Grimmia dry rock moss. A mature tree reaches up to 20-30 meters. The Linden tree can successfully adapt to the urban setting. It can handle quite poor soil and water conditions. However, it is quite sensitive to air pollution. (Trafikverket.2010). A safe distance from building to tree is half times the length of the height of the tree.

## Horse chestnut

Along the street of Hamngatan. Some are hole trees that can host insects and fungi. Horse chestnut have a mature height of 10-12 meters. It is sensitive to disturbances in the soil and demands a lot of water. (Trafikverket.2010).A safe distance from building to tree is the length of the height of the tree.

## Spruce

On the south side of the site there are two older spruce trees in a low of linden and maple. They host the red-listed species Longhorn beetle. The spruce tree is a coniferous tree that can grow up to 51 meters. It can handle very low temperatures and lack of sunlight; however, it is sensitive to drought, air pollution and storms. (SkogsSverige.2017). A safe distance from building to tree is half times the length of the height of the tree.

## Cotton wood (poplar)

A row of cotton wood is located in the entrance from Lasarettsgatan. Some are hole trees that an host insects and birds. Cotton wood are tough against wind and grow fast. Age and size vary depending on location and type. They require a lot of water, oxygen, nutrients and sunlight and should not be planted to close to buildings or infrastructure due to the root system. (Trafikverket.2010). A safe distance from building to tree is the length of the height of the tree.

## Other trees on site

### Ash

Figure 43.

Usually between 20–25 meters high. High demands on water, air quality and nutrients. (Trafikverket.2010)

### Mountain ash

Figure 44.

10-15 meters high, up to 80 years in age. Very durable against wind and cold. (SkogsSverige.a. 2019)

### Hackberry

Figure 45.

20 meters + in height and up to 3 meters in circumference Usually never older than 100 years.Strong but shallow root system. (SkogsSverige.b.2019)

### Elm

Figure 46.

“Noble tree” usually between 25-35 meters high. Can handle a wide range of soil and wind conditions. (Trafikverket.2010)

### Alder

Figure 47.

Usually between 15–20 meters high. Can handle a wide range of soil conditions with good nutrients available, grow rather quick even in poor conditions. (Trafikverket.2010)

### Swedish White-beam

Figure 48.

Usually between 10-15 meters high, but up to 20 and 5.8 meters in circumference. Usually never older than 100 years. (SkogsSverige.c. 2019)

### Downy birch

Figure 49.

Up to 29 meter in height and 2.9 meter in circumference. Can grow for up to 300 years. Shallow root system. (SkogsSverige. d. 2019)

### Field maple

Figure 50.

Usually between 10-15 meters in height. Highly threatened on the list of red-listed species. Host to Clustered bracket

(Artdatabanken SLU. n.d.)

### Willow

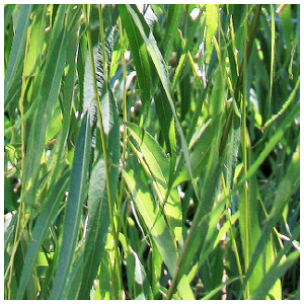


Figure 51.

6-25 meter in height. Fast growing, large crown with hanging leaves (Nationalencyklopedin. n.d.)

### Oak

Figure 52.

Up to 30 meter in height. Large older oaks can host a lot of organisms. (Skogskunskap.2018)

# Material

## Local material

Figure 53.

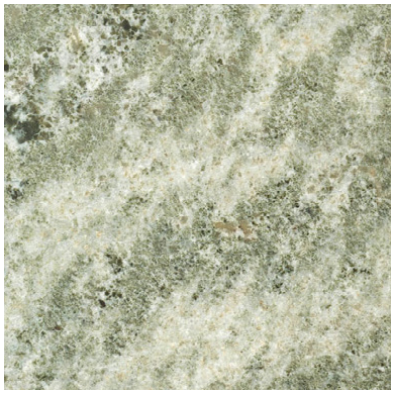


Figure 54.

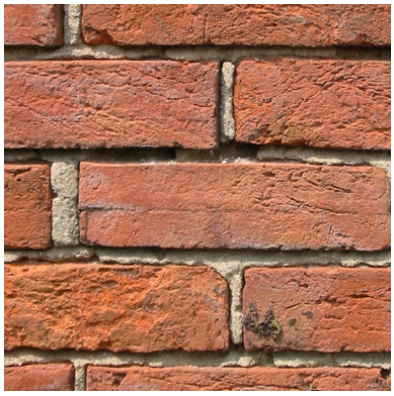


Figure 55.

Figure 56.

### Limestone

Limestone is a common stone in Sweden. It mainly consists of calcium carbonate and is considered to be a relatively pure mineral. Limestone is a hard and durable material than can be used for interior and exterior surfaces. It is considered a sustainable material assuming it comes from a quarry close by. In Borghamn 70km from Linköping, there are limestones ranging from colours of grey, brown grey to red. (Borghamns Stenförädling.a.n.d.)

### Marble

In some places limestone has been exposed to high pressure and high temperatures, when this happens marble is formed. Swedish marble is one of the hardest marble types. The Kolmård type is famous for its beautiful green colour and is very durable. Kolmård marble is mined in Bråviken 50 km from Linköping. (Borghamns Stenförädling. b.n.d.)

### Brick

Brick is made of clay that is dried, pre-heated and burned at high temperatures (800-1000 °C). Brick can be used in construction, facades, flooring or as pavement material. It can be covered with flaxseed oil, plaster or paint. Brick can also be reused after the plaster has been removed, for example as pavement. The closest manufacturer is located in Enköping 200km from Linköping. (Bokalders. V., Block. M.2004)

### Wood

Wood is a renewable material that can be used in several parts of the building. As construction material, insulation, facades, roofs and interior surfaces. Using local types of wood can increase biodiversity among flora, insects and birds. Östergötland and Småland has plenty of forest. In Linghem 11km from Linköping and Bråviken 50km, there are sawmills. Spruce and pine are most commonly used for building material. (Bokalders. V., Block. M.2004)

Figure 57.

Figure 58.

Figure 59.

Figure 60.

## Leca

Lightweight expanded clay aggregate is clay heated up to 1150°C under rotation. Small, light balls with hard surfaces and porous interior, with good insulating properties are formed. Used as ballast, in foundations and as insulating material. Leca blocks and cement can be used as structure in buildings. Leca is produced in Linköping , and the clay is taken from the fields of Östergötland. It is easy to reuse. A heat recovery system can take care of rest heat. (Leca.2018)

## Wool

Today over 1 ton of Swedish wool is burned and wasted every year (Sveriges Radio. 2018-01-03). Taking care of it, using it as insulation material would be more sustainable. However, to do so the wool has to be treated to avoid moths. The insulation can be loose or as boards. The closest wool wash is located on Gotland 335 km from Linköping. To find building materials in wool produced in Sweden is today hard. (Bokalders. V., Block. M.2004)

## Reed

Reed has a high resistance to moist. Carpets of reed are suitable as insulation for exterior walls and can also be used as a backdrop for plaster. Reed roofs were more common before. Roofs made by experts are often long lasting, ca 30 years, and both insulate from cold temperatures and sound. However, they are highly inflammable, which results in high insurance costs. Tåkern located 65km from Linköping has a large bird lake with lots of reed. (Bokalders. V., Block. M.2004)

## Clay

Clay regulates moist, demands no energy in manufacturing and is a very common material all over the world. It can be used in different ways: stamped clay walls, clay mixed with insulating materials or in a wooden structure. It can also be used in paint and plaster. Processes are often labour intensive and more suitable in low budget or self-building projects. In Germany they are trying to rationalise the use of clay in buildings. There is plenty of clay in the fields of Östergötland (Ekobyggportalen.n.d.)

# Sustainable material

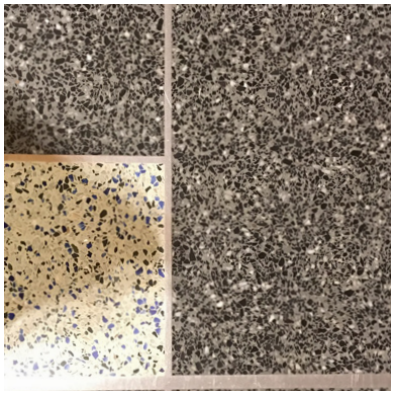


Figure 61.

Figure 62.

Figure 63.

Figure 64.

## Terrazzo

Terrazzo consists of ballast (limestone and dolomite) can be rest production in quarries. Recycled glass, stones and pigment can be added for colour. Can be used as flooring and other interior surfaces ad well as facade cladding. The material is durable and easy to handle with only mild chemicals. Herrljunga Terrazzo meets demands of Miljöbyggand and BREEAM. (Herrljunga Terrazzo.n.d.)

## Thermo wood - Moelven

Heat treated wood that can be used for external cladding, facade, ceilings. The wood is treated in a process of high temperature (185 to 215 °C) combined with water vapour. No chemicals are added. The treatment increases the weather- and decay-resistance as well as stability. The high temperature also removes the resin from the wood. There are different wood types to choose from. Thermo wood has a wide range of certifications and is swan labelled. (Moelven.n.d)

## Träulit

Träulit is made of wood fibre, cement and water and can be used for outer walls, inner ceilings, slabs, outer roofs and sound protection boards. It provides good thermal insulation, has a high heat storage ability, and good noise absorption. Träulit is also resistant against fire, mould and rot. The surface is suitable for plaster. It is available in a wide range of shapes, forms and colours. Swan labelled product. (Träulit.n.d.)

## Foam glass

Made of recycled glass products. Crushed glass goes through a heat process where cells in the glass are fermented. The glass is then pressed together to form stones. Suitable for insulation for foundations and roofs, but also other parts of the building. No toxic emissions during manufacturing, use or disposal and it contains no harmful chemicals. Hasopor produces foam glass in Sweden, their product is registered in BASTA, SundaHus and has EPD. (hasopor.n.d)

Figure 65.

Figure 66.

Figure 67.

Figure 68.

## CLT and glulam

Solid wood slabs of planed wood, glued together with each other layer crossed for increased stability. The result is a structural element that is strong and durable in relation to its low weight. It allows for both wide ranges and quicker assembly. Wood is almost fifth times lighter than concrete. The disadvantage of CLT wood is the glues that are added containing phenol formaldehyde or polyurethane. It should be used when massive wood construction is not strong enough. (Bokalders. V., Block. M.2004)

## Cellulose fiber

Cellulose fibre is used as insulation and is produced by old newspaper or new cellulose. It comes as loose fibres, boards or strips. To avoid fungi and mildew and to make the cellulose fibre fire resistant it should be impregnated. Cellulose is moisture regulating and has good insulating properties. It also insulates well in regard to noise and it is a cheap material. Cellulose made from recycled newspapers is better from an energy perspective. (Bokalders. V., Block. M.2004)

## Hemp fiber

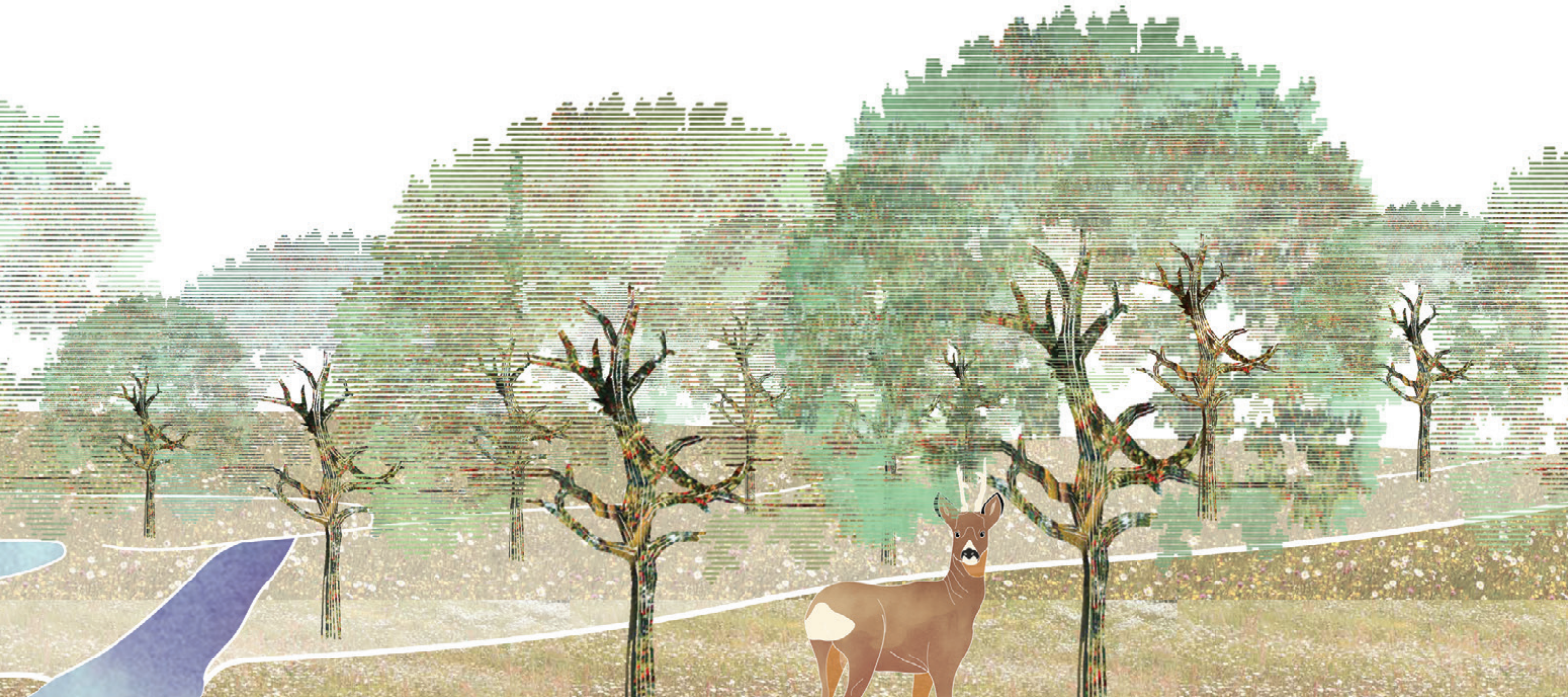
Cellulose insulation that is naturally fungi- and bacterial resistant. No need for impregnation. Carpets of hemp fibre have good moist and sound properties. The plant is robust, and no fertilisation or chemical spray is needed during cultivation. Contains very small amounts of narcotic substances.

(Bokalders. V., Block. M.2004)

## Cork

Bark from the cork-oak grown in Spain, Portugal and North Africa. The bark can be peeled every 8-15 years. You take no more than one third of the bark of one tree. Grained or in the form of boards. Can be used as insulation. Works well for exterior insulation. Resistant against moisture, rot and pest. To increase the insulating capacity, the cork can be processed in water vapour to form boards where no artificial glue is needed as the corks' natural glue work as binder. (Bokalders. V., Block. M.2004)

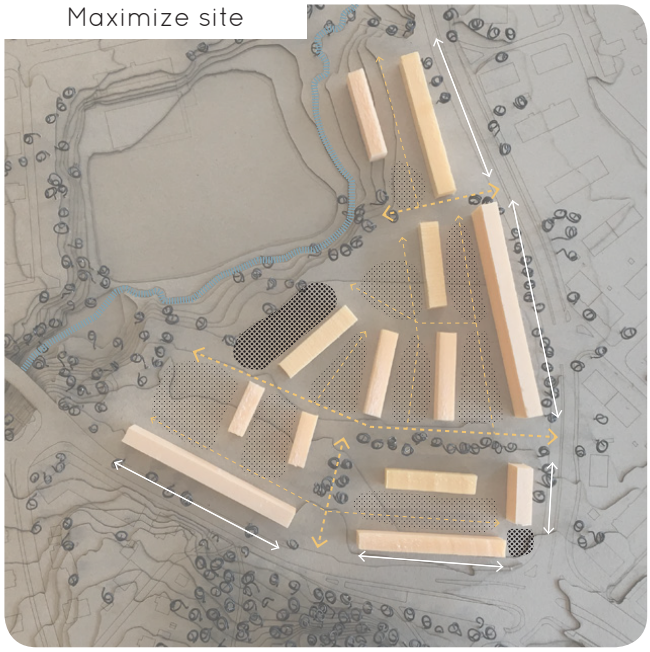
# CHAPTER SIX
# DESIGN PROPOSAL



# Volume testing

Volumes are 12-14 meter in width and differ in length and height

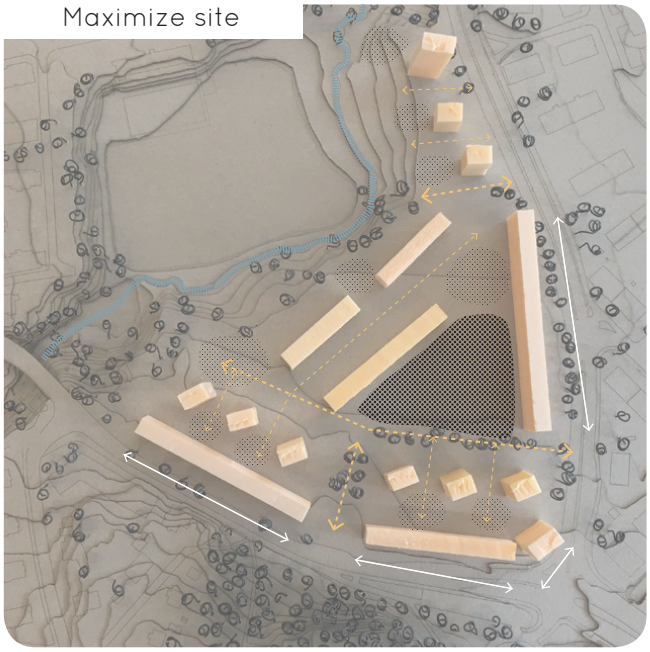
Maximize site



59 000 square meters BTA. 5-9 floors.

- Closed off towards street.
  Longer volumes. Wind tunnel effect
- Clear sight lines

Maximize site



59 000 square meters BTA. 5-18 floors.

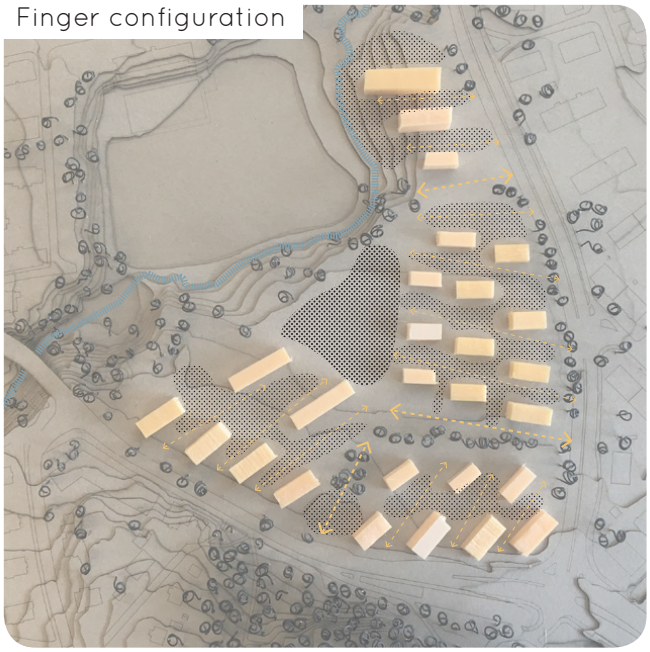
- Closed off towards street. Higher volumes creating shadows.
  Disconnection to site
- A lot of ground area available

More outdoor space

30 800 square meters BTA. 4-7 floors

- Less square meter for housing. Longer volumes. Wind tunnel effect
- Block configuration with open ends.
  Sight lines from street.

Finger configuration

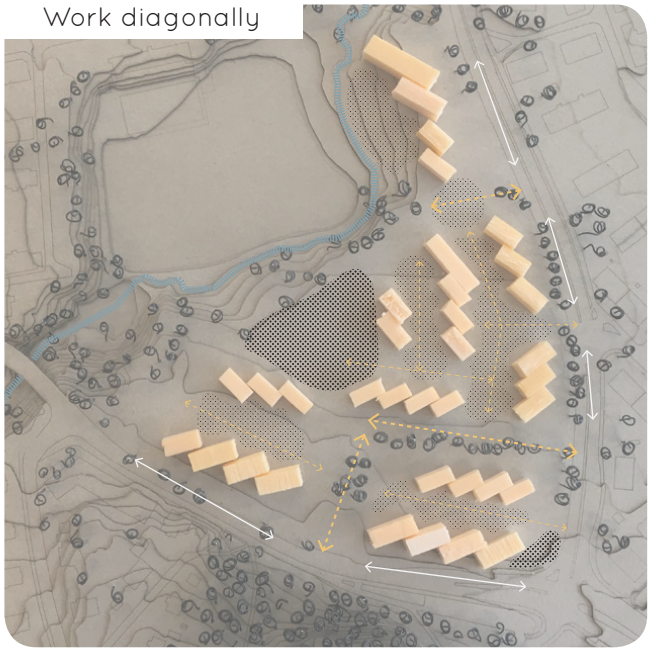


36 000 square meters BTA. 3-6 floors

- Wind tunnel effect. Lack of more closed outdoor spaces. Very rational
- Clear sight lines of entire site. Open towards the street. Smaller volumes

Sight lines  Urban street  Green area

Work diagonally



35 000 square meters BTA. 3-5 floors.

- More closed off from street.

+ Sight lines kept. Diagonal pattern reduce the feeling of long volumes.

Towards stream

32 000 square meters BTA. 3-5 floors.

- Lack of hierarchy

+ Closed from street but with sight lines kept. More enclosed larger courtyards, reduce wind tunnels.

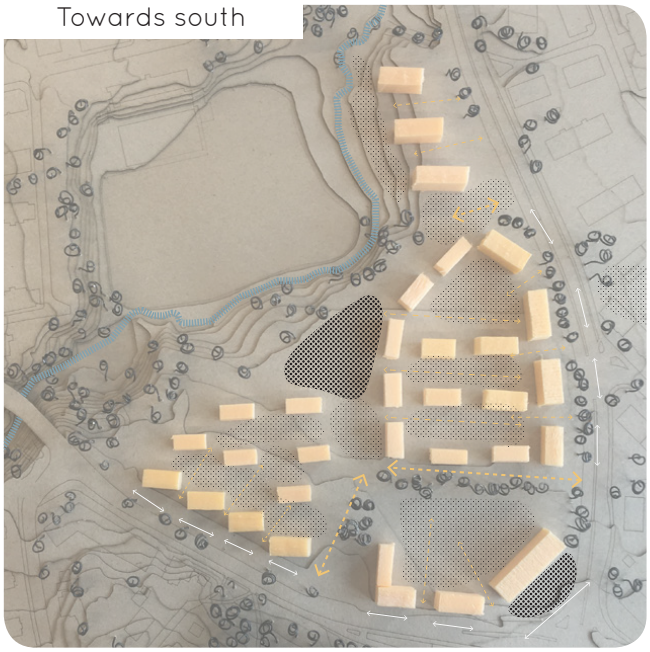
Work linear

32 000 square meters BTA. 3-5 floors

- Wind tunnel effect. Lack of smaller more closed outdoor spaces.

+ Clear sight lines. Open towards the street. Larger outdoor spaces are kept free.

Towards south



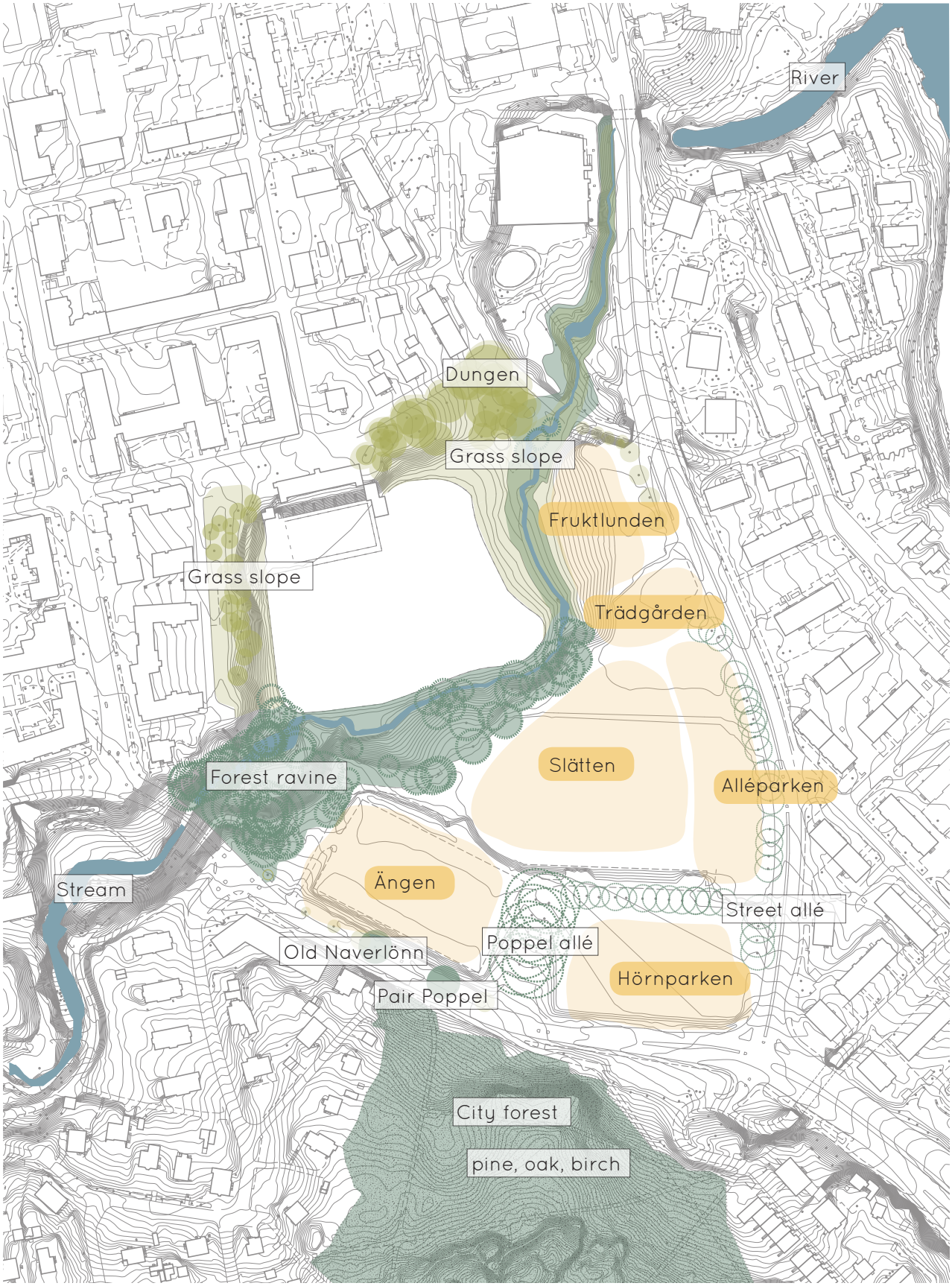
35 000 square meters BTA. 3-7 floors

- A more scattered outdoor area

+ More closed off from street but with clear sight lines. More differentiation between the different areas. Volumes following south.

# Site concept

## According to natural elements




Surfaces divided according to natural elements

Scale 1 : 3000

## Slätten (Field)

Similar to the fields of Östergötland, called Slätten, the large area in the middle of Folkungavallen is kept free from buildings. This space is the home of wild life in the city shared with the inhabitants. The vegetation is free to grow and there should be low maintenance not to disturb wild life, perhaps it is even possible to have some grazing sheep here. Paths for humans surrounds the space, in the transitions between Slätten and the other areas. Raised walkways used after heavy rains can be combined with reclaimed brick paving.

From Slätten you can view the other areas of Folkungavallen and the stream. Slätten works as nature's equivalence to the urban square. Small ponds or wetlands can be formed to manage stormwater and Slätten would then filter the rainwater before it reaches Tinnerbäcken.

## Fruktlunden (Orchard slope)

A slope leading down to the stream surrounded by apple and cherry trees. Inviting the birds to feast and the people to sit down among the trees for a picnic in the evening sun.
The buildings in the orchard slope are turned towards south, placed crosswise from the street to enable views down to the stream. The orchard starts down by the stream, where the citizens can take an apple from the tree on their evening walk and continues up in between the buildings.

The shape of the buildings transcends towards the stream following the slope of the landscape. Better views are created with the green terraces on each floor. The green biotope roofs manage stormwater and promotes biodiversity.

## Trädgården (growing garden)

The growing garden is placed on the east side of the site where there is a gap between the row of trees. This works as a natural entrance to Folkungavallen. Here there are spaces to grow vegetables, fruit and flowers. This attracts not only pollinating insects and birds but also people passing by the stream or entering the site. This area is kept empty of buildings with the exception of greenhouses. The growing garden is supposed to work as a meeting point, as sort of square where urban farming brings the residents together. Since there is a growing interest in cultivation the growing garden can be used as a platform for learning, for instance inviting schools nearby.

A lager green house is connected to the building in the entrance to the garden. This could work as a café or shop where the produce from the garden can be cooked or sold to the public.
If there is a big interest more growing pots can be added by the residents or the city.

## Alléparken (Allé park)

The buildings, parallel to the street, follow the line of trees along Hamngatan. Closing of the site a bit from the traffic on the street, however where there are a larger gaps between the trees there are entrances and views to the inside of Folkungavallen. This creates a visual connection between the urban side and the nature side of Folkungavallen.

The buildings keep a safe distance to the trees, making sure they can grow in peace and continue to host the species that depend on them. The larger distance between the tree and the facade creates room for a plaza in front of the building. In the ground floor it is possible to have a café or shop, that uses the plaza for people to sit and walk.

The green roofs of the buildings along Hamngatan are following the pattern of the trees, emphasising their form. The height of the buildings can vary to create more diversity

On the inside the buildings create open end courtyards. This enables more privacy for the residents who are facing Slätten which are used by the public.

## Ängen (Meadow)

On the south side of Folkungavallen the buildings follow the position of the trees where the two larger Cotton wood trees are dominant. They are important for biodiversity and are therefore given extra space. A “pocket” in front of the buildings creates public plazas and meeting spaces that becomes a transition between the urban street, the building and the nature on the inside.

Buildings face south, with lager gaps in between to keep sight lines from street to inside where the meadow is placed. The meadow with native biotope is connected to the stream ravine and helps species to travel in between.

The buildings along Lasarettsgatan vary in height with a combination of flat green roof and sloped roof where small birds and bats can live.

The meadow is given space towards the stream ravine and then grows in between the buildings like fingers.

## Hörnparken (Corner park)

When entering the city from the southeast you reach the corner of Folkungavallen. The corner is empty of trees and instead becomes a small square in front of a “landmark” building. I suggest the school to be placed here. Then the square becomes a good entrance.

The row of Cotton wood and the row of Linden and spruce naturally frames the corner park and creates a nice park that feels enclosed and protected without walls. The buildings are placed along the street to continue the frame around the space and create a safe school yard for the kids. How the buildings are connected can create sight lines from the urban side to the nature side. For example, greenhouses in the joints of the buildings can be used without a risk of the children running out on the street. They can be used as green passages for the interior circulation.

The buildings in the corner park have a combination of flat green roof and sloped roof. The green roof is facing the street to substitute the lack of trees towards the street. This creates a green frame surrounding the corner park.

## Sequence

Walking through the neighbourhood is like a journey through a sequence of spaces with different characters of nature and urban environment.

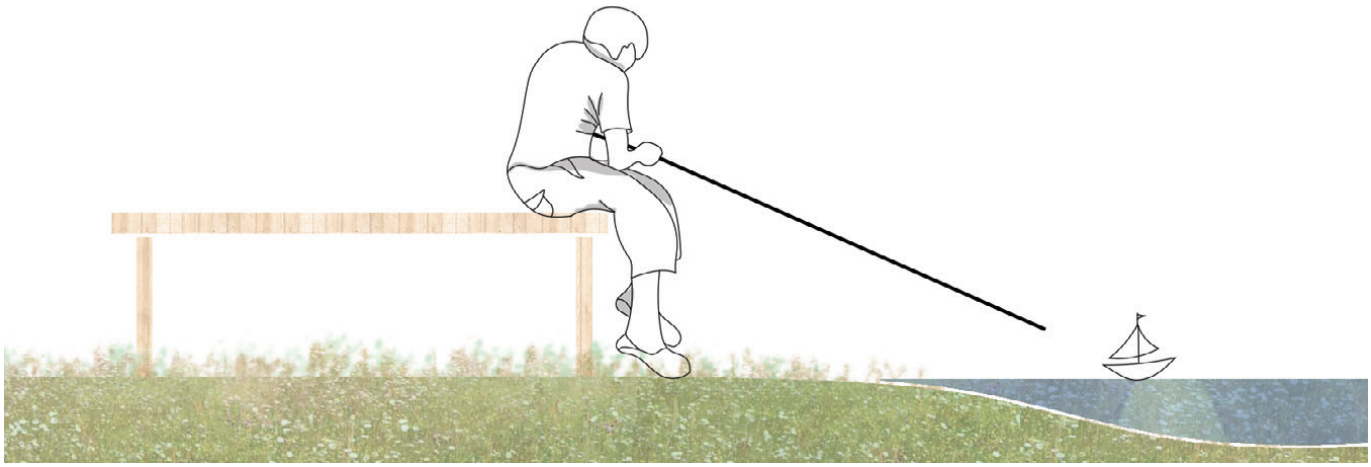
In the edge zones between the different areas the paths are located. This creates interesting meetings between the natural character of one zone and the other.

The area is a mix of private and public spaces. Squares and meeting spaces that usually exists in a urban block are on Folkungavallen replaced with spaces of natural character. Interaction between wild life and humans is encouraged. By inviting the citizens to experience a bit of wild life in the city, the stewardship that humans feel towards the environment and the species in the ecosystems, can be strengthened.

# Sun and rain

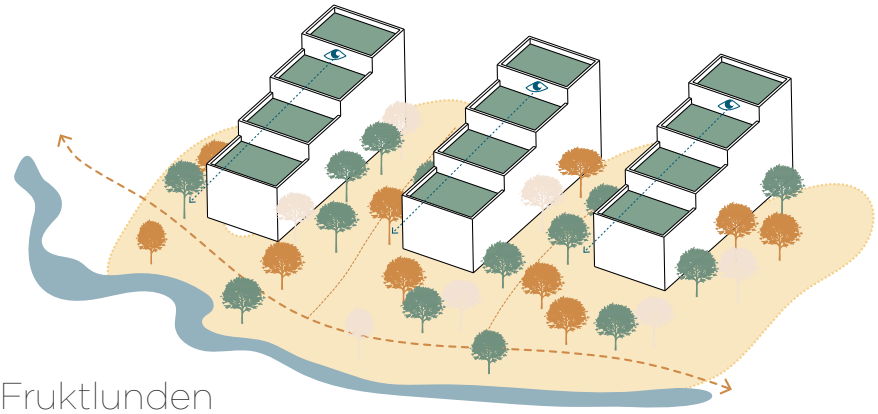
The green areas on the site manage the storm water and filter it before it reaches the stream.

By letting the rainwater become a welcomed feature that can be experienced and seen in the open the circular systems of water are exposed.

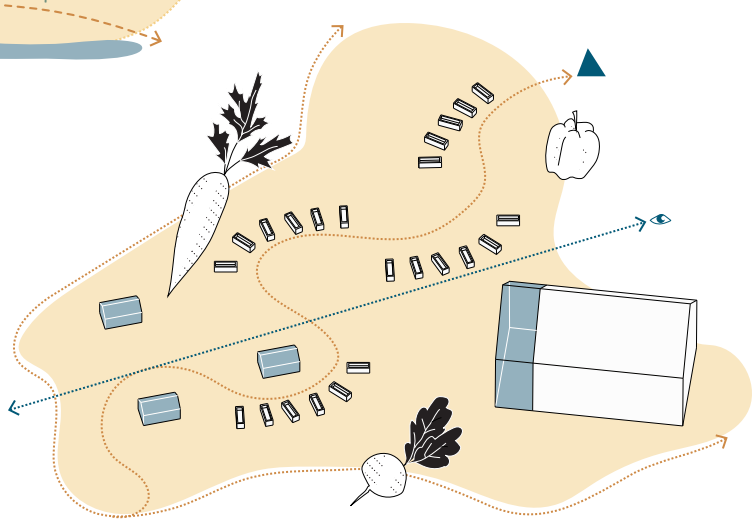


# Different zones and their character

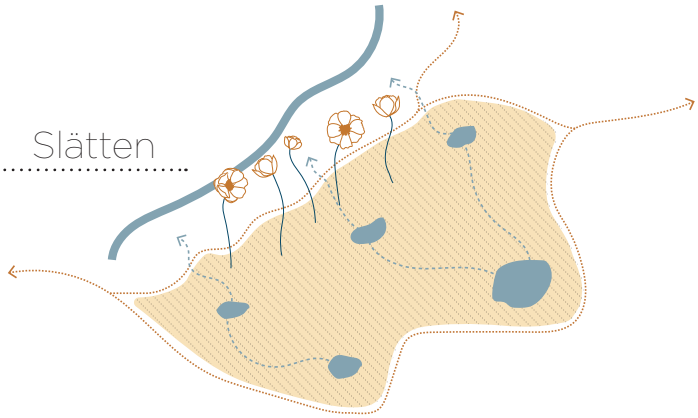
Scale 1 : 3000



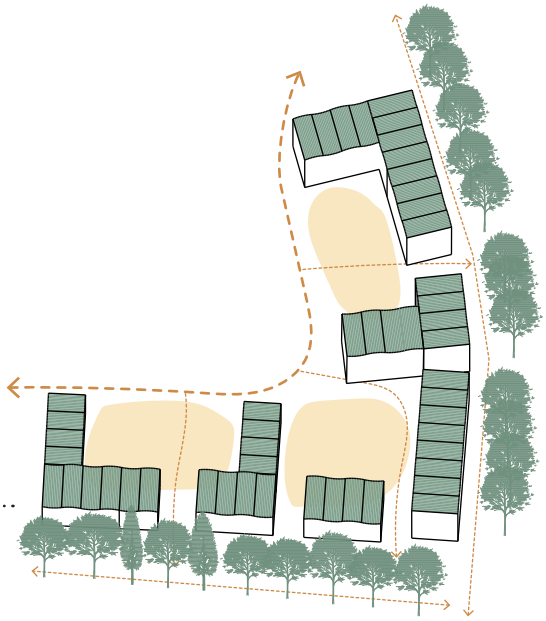
Fruktlunden



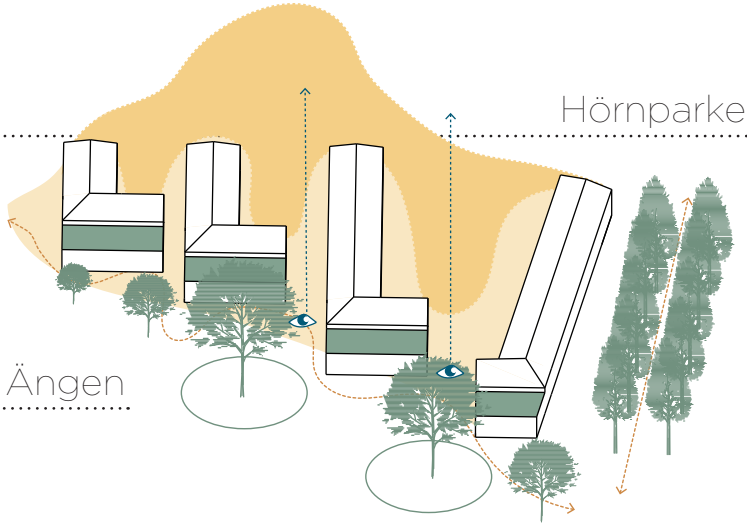
Trädgården



Slätten

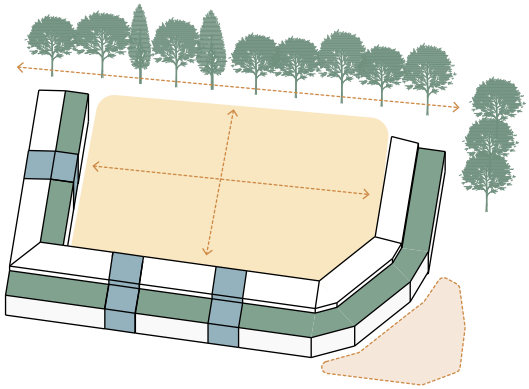


Alléparken



Ängen

Hörnparken



# Proposal

## Site plan

Alléparken

Hörnparken

Fruktlunden

Trädgården

The areas promote biodiversity in different ways, providing space for wild life in the city and offer different ecosystem services for humans

The green surfaces and trees mitigate climate change, purify the air and water. The fruit trees and garden promote pollination and food production. Overall the area offers recreation and promotes health and pedagogical learning.

Section

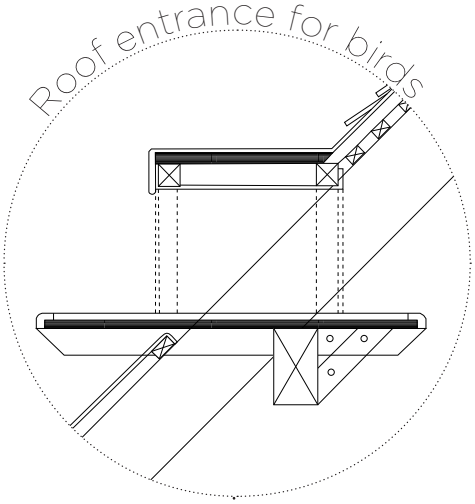




Figure 69.

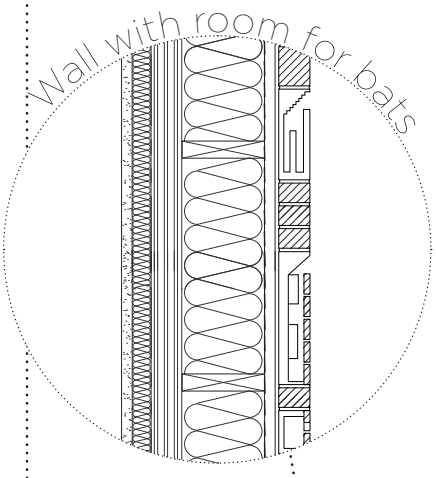



Figure 70.

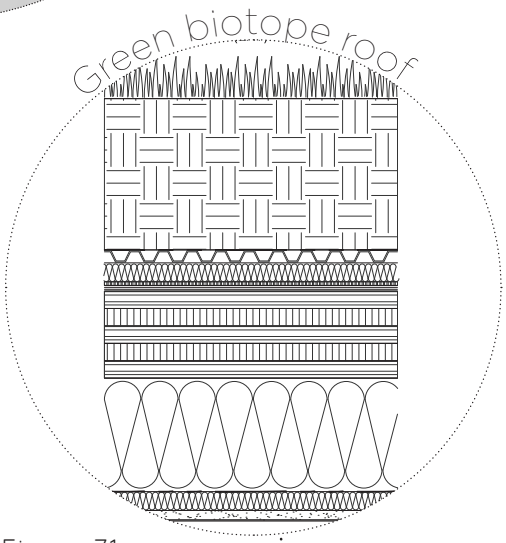
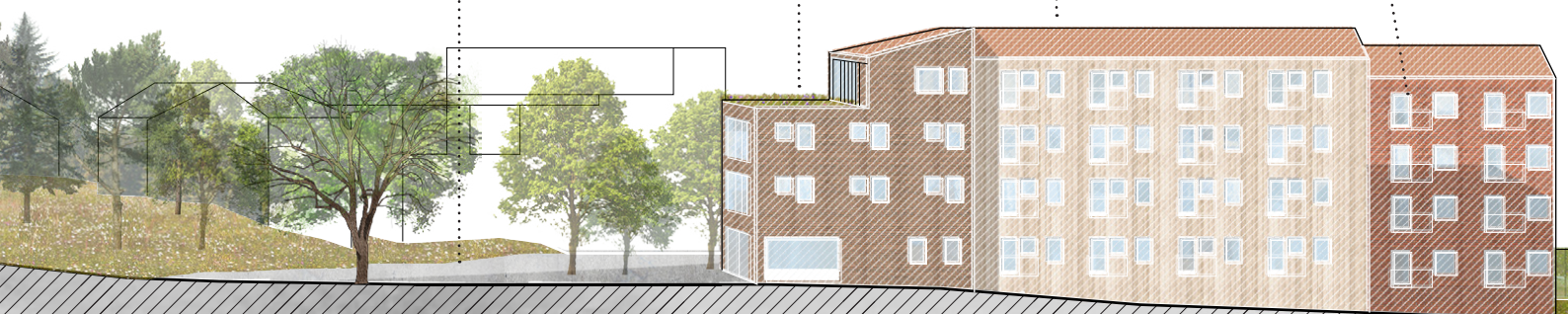



Figure 71.

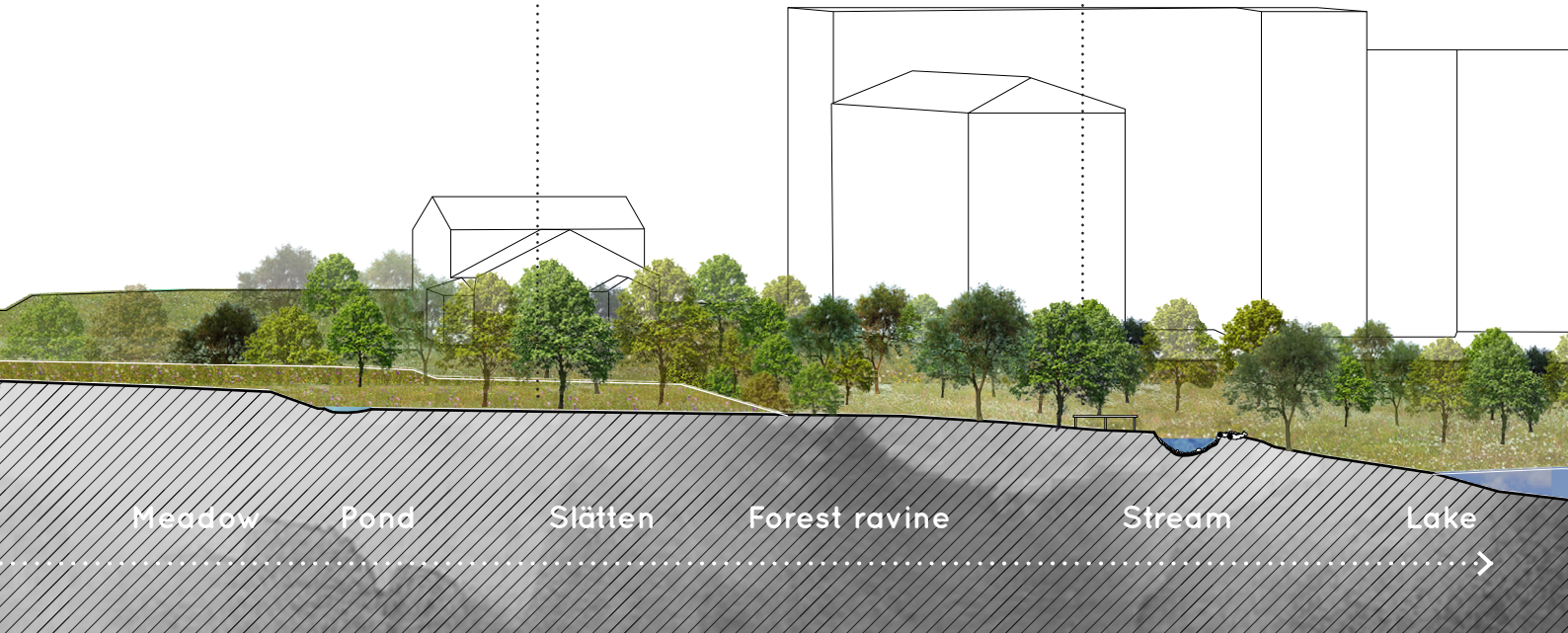


Forest Street Poppel tree Plaza Commerce Housing

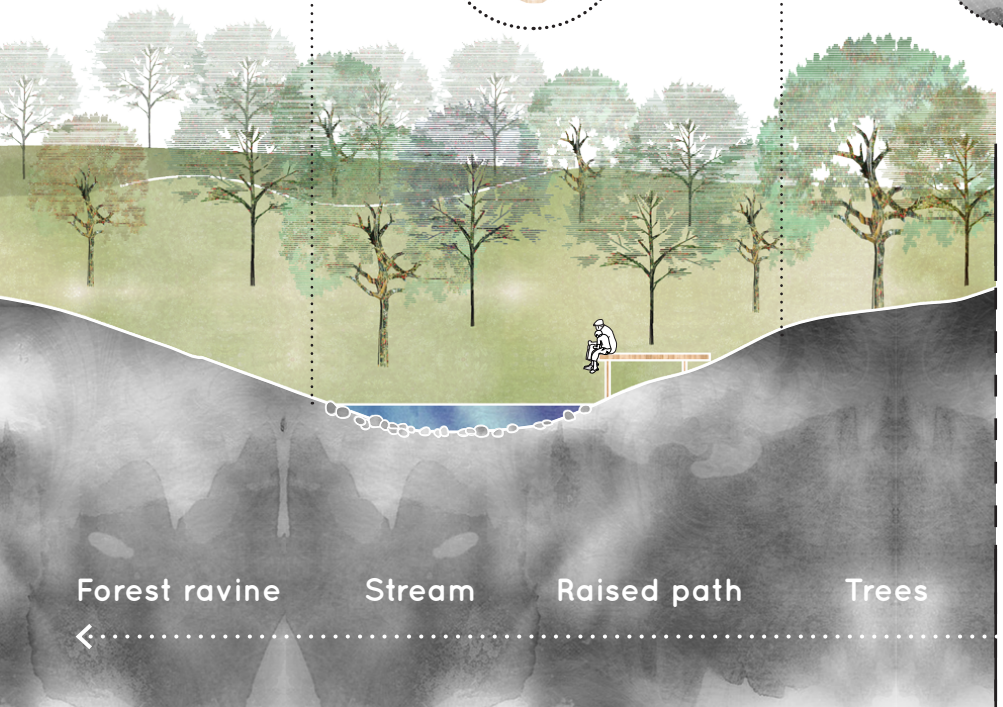
A walk on Slätten

Scale 1 : 400

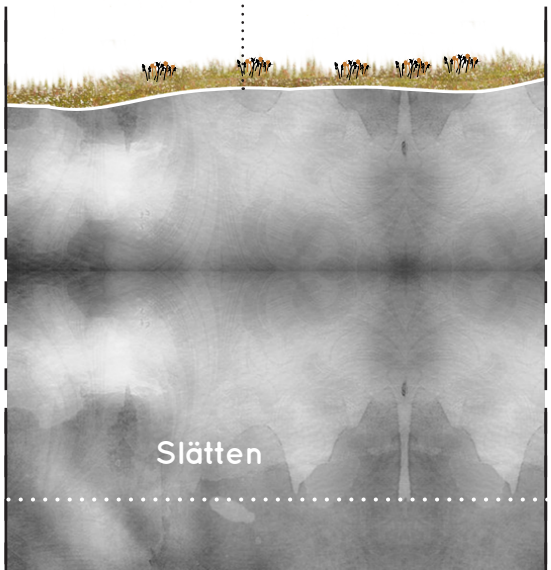
Stream walk



Who lives here ?

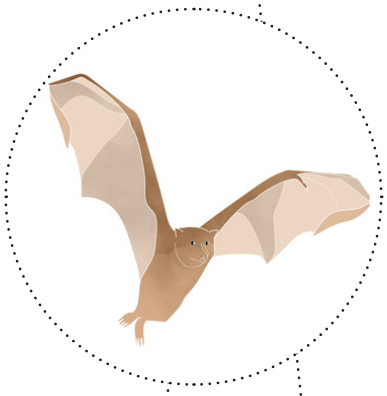


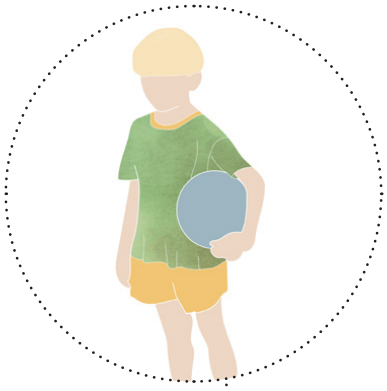
Forest ravine Stream Raised path Trees

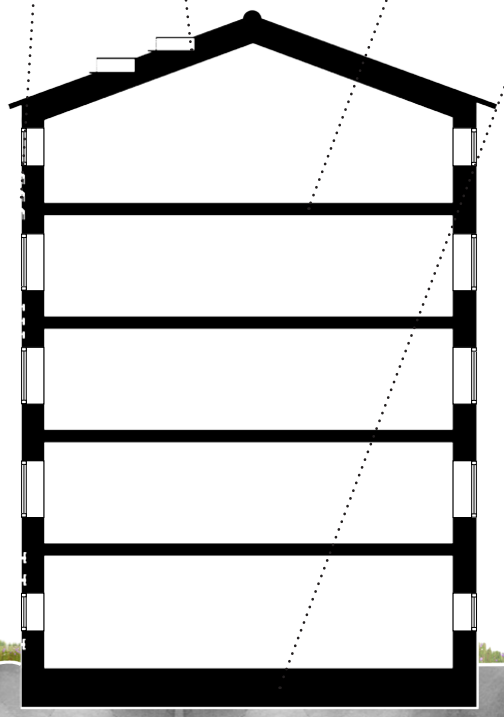


Slätten

Scale 1 : 200

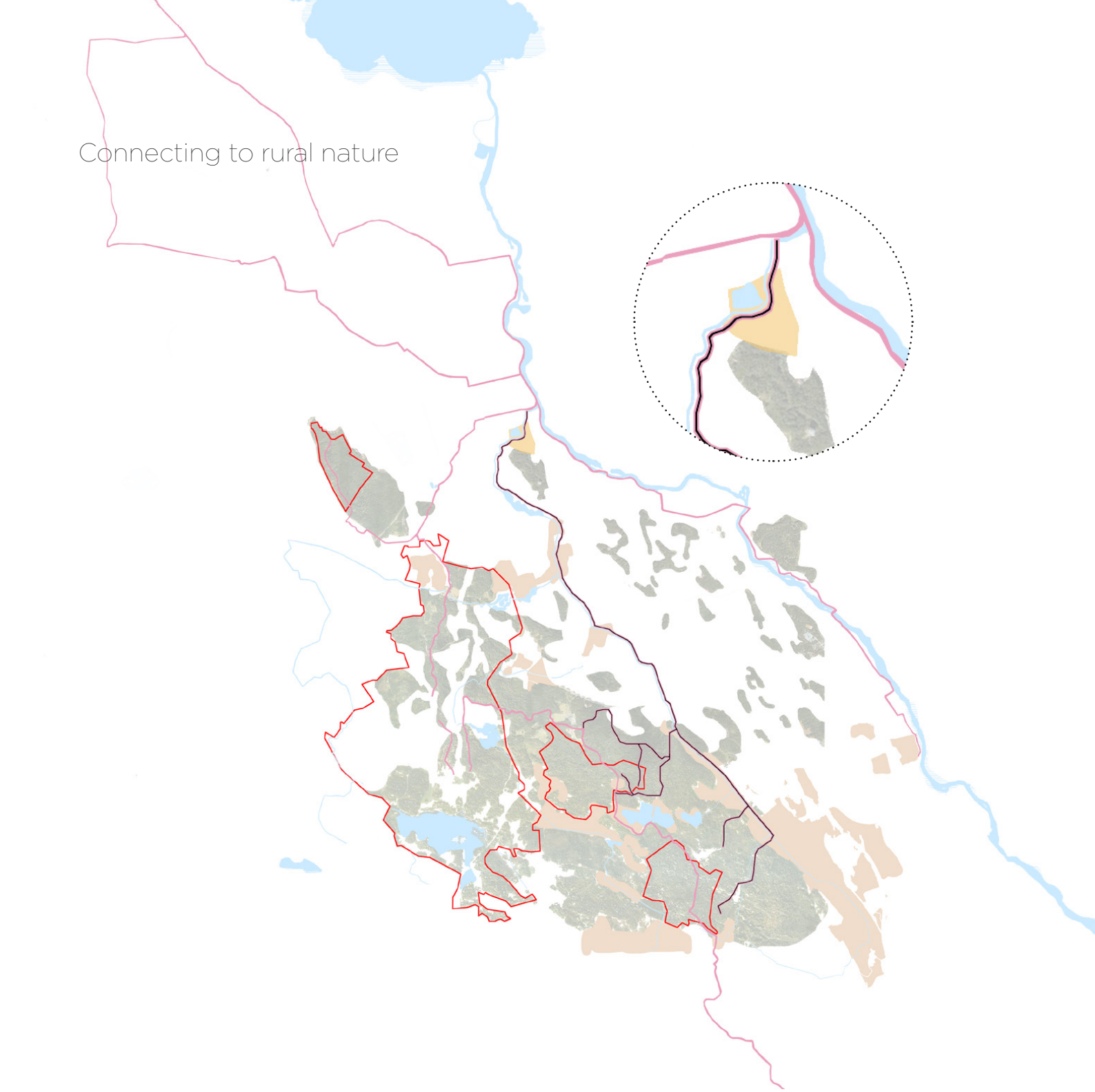






Meadow Path Housing Poppel tree Path Poppel tree School

# Connecting to rural nature



- Site
- Current hiking path
- New walking path
- Tinnerbäcken reconnected with Stångån

Tinnerbäcken is now functioning like a blue corridor. Animals following the stream are now able to reach Stångån without the hinder of the culvert on Folkungavallen.

The stream walk connects the citizens of the inner city with rural nature.

# CHAPTER SEVEN
# REFLECTIONS

# Answering the question

## Aim

The aim of this research project is to explore how biodiversity and water can help to expose and bridge the barriers between humans and nature in urban settings.

The questions that guided the investigation was:

How can circular methods, water and biodiversity promotion be used to form the design of Folkungavallen?

How can the natural elements of Folkungavallen shape the future design of the site?

## Answers

There is not one answer to the thesis questions, but several. The findings of the investigation are comprised of a combination of the strategies dealing with water and biodiversity, the site concepts and the design proposal for Folkungavallen

Some strategies are more general and meant to be applicable to other sites and in other urban settings. They are divided into two themes; water and biodiversity.

Regarding sustainable solutions for water, they often go hand in hand with circular thinking. They are about finding ways to reduce the use of water and about exposing the circulation of water with open solutions for stormwater handling. By exposing the filtration of water in the open and not hiding it under the streets of the city the residents are more connected to the element that they depend on. The design of the urban environment becomes softer with more green areas and thus nature is brought to the city. At the same time biodiversity is promoted.

Regarding strategies to increase biodiversity the core idea is to think in terms of diversity; meaning to avoid homogeneous areas copied around the city with few connections in between. Areas that are left freer for nature to take over, like meadows, are more favourable. Making sure green and blue corridors are not interrupted is also important.

The design proposal is rooted on the chosen site in Linköping and the solutions suggested are specific to Folkungavallen. The proposal combines the current ecological systems with suggested new additions that complements the existing. The proposal shows my interpretation of them combined with the different strategies.

On Folkungavallen the strategy of lifting Tinnerbäcken from its culvert was a main focus. This means that the stream becomes a continuous blue corridor that wild life in the city can follow. The new position of the stream is the backbone of the design proposal.

The natural elements that are present, the new position of the stream, sun direction and views forms six sub areas for the site:

**Slätten:** Preserves a larger surface for wildlife to promote biodiversity and works as a connection between the other sub-areas. By spatially prioritising wild life, its importance for humans is highlighted and the citizens of Linköping are invited to experience wild life in their everyday life in the city.

**Ängen:** The two larger Cotton wood trees guide the position of the buildings who face south, with lager gaps in between to keep sight lines from street to inside where the meadow is placed. The meadow stretches in between the buildings to connect the residents with the meadow. The meadow is connected to the stream ravine and helps species to travel in between, butterflies, insects, birds and small animals can hide in the meadow and the citizens can experience them more closely.

**Alléparken:** The buildings follow the line of trees along Hamngatan but keeps a safe distance to the trees, making sure they can grow in peace and continue to host the species that depend on them. The roofs follow the line of the tree tops.

**Fruktlunden:** A slope leading down to the stream surrounded fruit trees. Inviting the birds to feast and the people to sit down among the trees for a pick nick in the evening sun. The buildings are turned towards south in the slope and transcend towards the stream to follow the landscape and create better views.

**Trädgården:** Placed on east side of the site where there is a gap between the row of trees, working as an entrance to Folkungavallen. Here there are spaces to grow vegetables, fruit and flowers. This attracts not only pollinating insects and birds but also people passing by the stream or entering the site.

**Hörnparken:** The corner on the south east is empty of trees and instead becomes a small square. The row of trees naturally frames the corner park and the buildings continue this frame. Glassed passages in between the buildings visually connects the urban street to the corner park.

In regard to materials and construction the buildings host more than humans. The facade and roofs are designed with spaces for small birds, bats and insects. This is another way of bridging humans and nature. We use the service that the ecosystems provide us and by designing buildings and urban areas that can aid wild life we are letting our built environment contribute to our ecosystem.

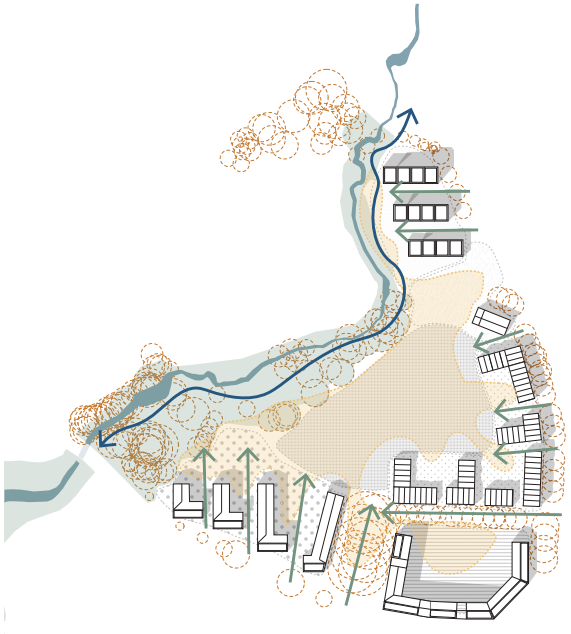


figure 72. Site plan showing how the key site strategies from chapter five have been applied.

## Urban biodiversity

How we plan our cities affect how much nature humans are exposed to in our everyday life as well as the urban biodiversity.

The design proposal approaches a mix of land sparing and land sharing methods.

The buildings are integrated with nature in different ways in each sub area, this is an attempt to bridge humans and nature and value them equally. This is a land sharing approach, where human activities are spatially mixed with biodiversity promotion.

At the same time larger areas are kept free from buildings and human activities and meant to be more for wild life. This could be seen as a land sparing approach.

The new position of Tinnerbäcken is combined with a walking and running path following the stream. This creates another connection between humans and nature in the city. The stream in its larger context becomes a continuous blue corridor and by this connects the flows of water between the city and the outskirts.

How Folkungavallen can function as a new green habitat is something that will evolve with time. The function of the streets surrounding the site today will be changed in the future, reducing the speed and traffic around the site. By focusing more on pedestrians, the borders between nature and urban become less hard and instead a transition zone can be formed making the movement of wild life in the city easier.

As time goes on nature will grow on site and change the character.

**Important learnings from the design that can be applied in other settings:**

- Use the ecological perspective as a possible starting point of the design
- Think about the site and its context on several scales.
- Analyse and value both the natural elements and the built environment equally.
- Work on all scales, from master plan to construction detail.
- Combine different approaches of biodiversity promotion in order to balance the well-being of both humans and wild life.

# Concluding thoughts

## Work process

I started my project plan with the hope of creating a new climate positive city block, addressing sustainable solutions for all aspects of the building. As I started working I came to realise that what I was most interested in was to investigate the relationship between humans and nature and themes that did not address this could be excluded.

The process started with a rather linear way of working, with theory and reference projects. Parallel to this I analysed Folkungavallen and its context of the city and region.

From the theory and the site analysis I decided upon two themes. Biodiversity is the core of our ecosystems and thus became something I wanted to focus on. Tinnerbäcken and its current state inspired me to investigative solutions for water. To conclude the theory, I formulated strategies that I then investigated further in the design.

Reading about urban biodiversity made me reflect upon the way we plan out cities, and I came to question the plans of the municipality more. I decided not to let my design be restrained by municipal plans and started working more freely with the layout.

I started volume testing with models and sketching to test the exploitation rate of the site.

To find a more controlled testing I went back to the site analysis where I had analysed the natural elements on site and categorised and valued them in the same way that we value built elements. This helped me to define sub areas on Folkungavallen that could help me to use the natural elements as a base for the design.

The design proposal is a starting point. The next steps would be to go down in scale, design the buildings and test if the same way of thinking can be applied on all scales of architecture.

By looking at the site from an ecological perspective it came naturally to exclude financial aspects. The investment on biodiversity for our planet sake and for future generations has no price since it is invaluable to our human existence.

## Next step

The understanding of how important biodiversity is for our future on this planet has grown during this process. As I am writing this reflection a new report from IPBES initiated by the UN, was released for the public on may 6th 2019. This report confirms that we are currently in a mass extinction of species, with accelerating speed. The trends in Sweden are following the same global pattern.

This report is the most comprehensive study of life on earth that has ever been made. It shows that the loss of biodiversity is a fatal question of our time and that we have to act now.

Promoting biodiversity can no longer be seen as an additional interest, it is a core question for our future on this planet as we know it.

Humans and nature are connected. What we as humans do affect the global nature, causing an unbalance in the circular systems that need to function in order to support the global fauna and flora, and ourselves. Humans are causing an accelerating mass extinction, where 1 million species are threatened within the next decades, more than ever in human history.

What I want to challenge with this thesis is a way of thinking, where we value economic profit above all other aspects. Putting nature and the health of our ecosystems first means we are investing in ourselves, our ability to live on the planet and for future generations do be able to do the same.

I as an architect can affect the field that I am working in, which we know contribute to negative environmental impacts leading to climate change and loss of biodiversity. Furthermore, I can inspire the work of others, affect people in their everyday life by offering cities and buildings that promote a climate positive lifestyle. This work is a starting point.

# CHAPTER EIGHT
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