PRAGUE 7 – BUBNY

THE URBAN ECOSYSTEMS AS FOUNDATION OF BROWNFIELD TRANSFORMATION

by Kateřina Vondrová

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Diploma Thesis Portfolio

Faculty of Architecture, Czech Technical University in Prague
Department of Urban Planning 15121
Atelier Hanson – Landscape Architecture Studio

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CONTENTS

THESIS ASSIGNMENT

The task of the master thesis is to transform the existing brownfield area in Prague 7 – Holešovice into livable, safe and healthy environment. The focus of the project that follows up on the previous structure plan of the area is put on the integration of ecosystem services, increasing permeability and accessibility of the design site, its reconnection with the surrounding, well-established residential areas and creation of livable urban fabric with active and diverse public space.

The expected result of the thesis project is to create a livable neighborhood that will offer quality and healthy living conditions to its future residents with minimal impacts on the urban ecosystems and surrounding environment.

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České vysoké učení technické v Praze, Fakulta architektury

2/ ZADÁNÍ diplomové práce

Mgr. program navazující

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ústav: 15121 Prostorového Plánování
vedoucí diplomové práce: Henry W. A. Hanson IV

téma diplomové práce:
Městské ekosystémy jako základ transformace brownfieldu

zadání diplomové práce:

1/ popis zadání projektu a očekávaného cíle řešení
Cílem projektu je vytvoření kvalitního, bezpečného a zdravého prostředí v území bývalého brownfieldu v Praze Holešovicích-Bubnech, s důrazem na zapojení služeb městských ekosystémů, zvýšení prostupnosti a přístupnosti území a jeho propojení s existující okolní zástavbou, aktivace a diverzifikace veřejných prostorů.
Projekt navazuje na předchozí předdiplomní projekt/masterplan. Očekávaným výsledkem je návrh kvalitního prostředí, které bude nabízet budoucím obyvatelům příjemné a plnohodnotné místo pro život s minimálními dopady na životní prostředí.

2/ součástí zadání bude jasně a konkrétně specifikovaný stavební program
Residenční, pracovní, volnočasové a komunitní aktivity, příslušná sousedská vybavenost, bezpečný a efektivní systém mobility, zapojení a služby městských ekosystémů.

3/ popis závěrečného výsledku, výstupy a měřítka zpracování
Minimálně 5 řezů nebo řezopohledů různých měřítek 1:100 až 1:1000, organizační diagram zobrazující prostorové uspořádání, prognóza využití navrhovaného prostředí s důrazem na veřejný prostor, minimálně 3 vizualizace z pohledu chodce, 3d zobrazení vnitřního a vnějšího propojení (může být v kombinaci s ostatními výkresy).

4/ seznam dalších dohodnutých částí projektu (model)
Fyzický model maximálního měřítka 1:1000.

Datum a podpis studenta

Datum a podpis vedoucího DP 29.9.2014

Datum a podpis děkana FA ČVUT registrováno studijním oddělením dne

STATEMENT

I hereby declare that I developed the submitted thesis independently and that I have faithfully and properly cited all sources used in the thesis project in accordance with the "Methodological guideline for ethical training of university theses".

In Prague, 09.01.2015

Kateřina Vondrová

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE
FAKULTA ARCHITEKTURY

AUTOR, DIPLOMANT: KATEŘINA VONDROVÁ
AR 2014/2015, ZS

NÁZEV DIPLOMOVÉ PRÁCE:
(ČJ) MĚSTSKÉ EKOSYSTÉMY JAKO ZÁKLAD TRANSFORMACE BROWNFIELDU

(AJ) URBAN ECOSYSTEMS AS FOUNDATION OF BROWNFIELD TRANSFORMATION

JAZYK PRÁCE: ANGLICKÝ

Vedoucí práce:	**HENRY W. A. HANSON IV., AIA ASLA, LEED AP** **Ústav: 15121**
Oponent práce:	**Ing. arch. REGINA LOUKOTOVÁ, Ph.D.**
Klíčová slova (česká):	BROWNFIELD, TRANSFORMATION, ECOSYSTEM SERVICES, PUBLIC SPACE, LIVABILITY, SUSTAINABILITY, WATER MANAGEMENT, URBAN CYCLE
Anotace (česká):	Tváří v tvář výzvám změně klimatu a pomalu se rozrůstající městské krajiny na okraji Prahy, cílem diplomního projektu je poskytnout alternativu k takovému rozvoji transformací brownfieldu v Praze 7 – Holešovicích v živou městskou čtvrť v souladu s trvale udržitelným rozvojem. Díky umístění brownfieldu v blízkosti řeky Vltavy a trvalým hrozbám povodní je jedním z hlavních cílů projektu navrhnout městskou zástavbu, která bude mít minimální dopad na životní prostředí, zejména redukcí důsledků současného hospodaření s městskou vodou. Projekt vytváří vyvážený městský ekosystém, který je schopen vypořádat se s výzvami měnícího se klimatu a zvýšeným množstvím srážek za využití služeb městských ekosystémů pro management dešťové vody v rámci řešeného území. Bývalá industriální zóna je transformována ve čtvrť se smíšeným funkčním využitím, která je propojena s okolními čtvrtěmi a na svém území spojuje rozmanitou městskou zástavbu s otevřenou městskou krajinou s významnou ekologickou a environmentální hodnotou. Projekt využívá potenciál současné vlakové zastávky a stanice metra a zahrnuje je do návrhu čtvrti s aktivním veřejným prostorem, rozmanitou městskou typologií a aktivní městskou krajinou. Návrh se soustředí na vybranou část území brownfieldu a v rámci jejího území demonstruje principy použití služeb městských ekosystému ve větším detailu.
Anotace (anglická):	Facing the challenges of the climate change and ongoing sprawling development around the city of Prague, the aim of the thesis project is to provide an alternative by transforming the existing brownfield area in Prague 7 – Holešovice into a sustainable neighborhood. Due to the site location on the Vltava river and reoccurring threat of urban flooding, one of the main goals of the project is to propose urban development which would have a minimal impact on the environment, especially reducing the consequences of the conventional urban water systems. The project creates a balanced urban ecosystem which is able to cope with the challenges of the changing climate and increased amount of precipitation by using ecosystem services to manage the rainwater within the site boundary. The former industrial area is transformed into mixed use neighborhood connected with its surroundings and integrating both, the diverse urban fabric and open green areas of ecological and environmental values, benefiting from the ecosystem services. The design site uses the potential of the existing train station and subway station and incorporates it in the design of mixed use neighborhood with livable public space, diverse urban typology and active urban landscape. The proposal focuses on a selected area of the former brownfield site and on its area demonstrates the principles of the urban ecosystems' framework in detail.

Prohlášení autora

Prohlašuji, že jsem předloženou diplomovou práci vypracoval samostatně a že jsem uvedl veškeré použité informační zdroje v souladu s „Metodickým pokynem o etické přípravě vysokoškolských závěrečných prací."

V Praze dne

09.01.2015

MASTER THESIS ABSTRACT

Facing the challenges of the climate change and ongoing sprawling development around the city of Prague, the aim of the thesis project is to provide an alternative by transforming the existing brownfield area in Prague 7 – Holešovice into a sustainable neighborhood. Due to the site location on the Vltava river and reoccurring threat of urban flooding, one of the main goals of the project is to propose urban development which would have a minimal impact on the environment, especially reducing the consequences of the conventional urban water systems. The project creates a balanced urban ecosystem which is able to cope with the challenges of the changing climate and increased amount of precipitation by using ecosystem services to manage the rainwater within the site boundary.

The former industrial area is transformed into mixed use neighborhood connected with its surroundings and integrating both, the diverse urban fabric and open green areas of ecological and environmental values, benefiting from the ecosystem services. The design site uses the potential of the existing train station and subway station and incorporates it in the design of mixed use neighborhood with livable public space, diverse urban typology and active urban landscape. The proposal focuses on a selected area of the former brownfield site and on its area demonstrates the principles of the urban ecosystems' framework in detail.

ILLUSTRATION OF THE NEIGHBORHOOD STREET WITH THE PUBLIC SQUARE

PROJECT INTRODUCTION

PROJECT FOREWORD

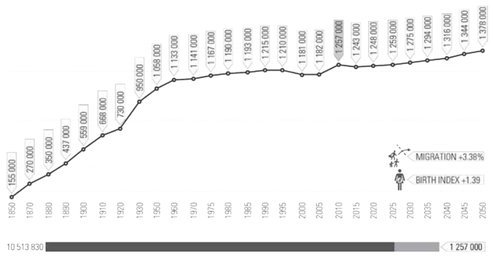
GROWING POPULATION

The city of Prague, located on both banks of the Vltava river, is an unique historical city with more than thousand years of tradition and continuous urban development. Its urban structure clearly illustrates different periods of historical development from the medieval structures of the compact inner city to the recent extensions in the suburb areas. The city itself has been growing continuously from the times of its foundation till the present although the growth is not caused by the birth rate anymore but by the migration of the population from other parts of the country moving into the city.

The growing population of Prague puts a big pressure on the future development of the city. The need for new residential areas for incomers creates strong forces that cause the sprawling development around the established city borders. In many cases, such development areas confiscate valuable agricultural land or ecogically precious green areas. It leads not only to the devaluation of the land around the city but also increases the need for individual transportation because the public transport to such areas is not effective or even provided. These areas usually consist of single-family houses with limited access to the public functions or services in the walking distance or to the public transit. Therefore, time consumed by commuting for acts of daily needs is very significant. The community feeling in such areas is also discutable, due to the lack of public spaces, community meeting points or simply primary public services.

The projected population growth and its trend shows that the population of the city will grow in the near future. So where these new Prague residents will find their home? Are the monofunctional residential areas on the edge of the city the only option for its future development?

POPULATION GROWTH PROJECTION



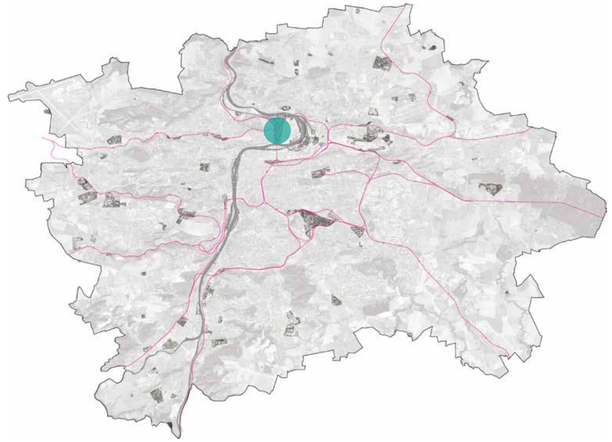
BROWNFIELD AREAS

The city of Prague has undergone, like many other European capital cities and former industrial metropolises, the same changes in its functioning due to the industrial revolution and later shift from the production sector to the service sector. The shift in industry from production to services led to the abandonment of the factories, industrial complexes or agricultural cooperatives. Also the change in the transportation played its role – the railway transportation was replaced by more flexible and efficient vehicular traffic and left the spacious railway stations, railyards and railway tracks unused and to its own destiny.

In Prague, these areas offer more than 1600 hectares of land that can be developed in the future and transformed according to the current/future needs of the city. Former industrial areas demanded strong and efficient infrastructure to deliver and distribute the good throughout the city, therefore the areas used to be very well-connected with the rest of the city by extensive network of railroads and roads. Even though the use of railway decreased when vehicular transport took over the market, the brownfield areas are still incorporated in the urban fabric of the city that slowly developed around them. They have very strong potential to be connected with neighborhoods around them and linked the public transport network with minimal interventions.

These brownfield areas represent valuable land for the future development of the city and can become sustainable livable neighborhoods reconnected with its surroundings.

BROWNFIELD AREAS AND POSSIBLE DEVELOPMENT SITES



- VLTAVA RIVER
- RAILWAY LINES
- DESIGN SITE

PUBLIC TRANSPORT ACCESSIBILITY FROM BROWNFIELD AREAS

- VLTAVA RIVER
- STREET NETWORK
- BUS LINES
- TRAM LINES
- RAILWAY LINES
- DESIGN SITE

PRAGUE : CITY ON THE RIVER

The Vltava river is, together with its valley, one of the key landscape assets to the city. The valley gives shape to the urban fabric of the city and together they form one whole. The Vltava river is almost 31 km long with more than 360 km of smaller streams and creeks flowing into the river.

During the last two centuries, the Vltava river and its tributaries were significantly transformed from the state of natural water bodies to the refined water works. The river banks were developed and reinforced, the streams were drained and floodplains were built on. The river and streams, due to the changes on their basins, lost their resiliency to the fluctuation of the water levels and mitigation of the impacts of floods.

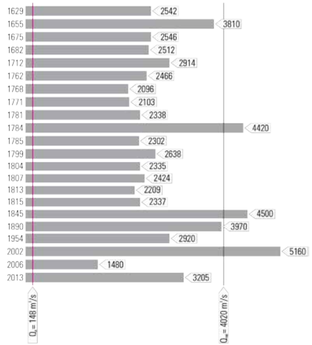
FLOODS ON THE VLTAVA RIVER

The city of Prague is often affected by different kinds of floods during different times of year. These floods are either caused by local thunderstorms, sustained heavy rainfalls or annual snowmelt and usually have destructive effects (as floods in 2002 and 2013 demonstrated).

Based on the climate change projections, more frequent and heavier rainfalls are expected during the winter time in central Europe leading to more severe winter floods. Opposing to that, increased temperature throughout the year will significantly decrease the amount of precipitation in the spring and summer season that will result in the droughty soils with decreased capacity to absorb the sudden rainfalls from summer thunderstorms and therefore will lead to summer flash floods.

The city of Prague is, and will be even more, facing many challenges of the climate change impacts. Heavier and more frequent summer rainfalls and increased threat of floods require systematic solution to decrease the impacts of the development on the natural water cycle and avoid urban flooding. Therefore, the new development has to be designed to minimalize the impacts of the urban area on the natural systems and with capacity to cope with occuring flooding in order to restore the resiliency of the whole city.

FLOODS ON THE VLTAVA RIVER



THE VLTAVA RIVER AND ITS TRIBUTARIES

WATER SURFACES
CITY BORDER
DESIGN SITE

FLOODS ON THE VLTAVA RIVER

ACTIVE FLOODING ZONE
FLOOD LEVEL 2013
FLOOD LEVEL 2002
VLTAVA RIVER
DESIGN SITE

PROJECT SITE

SITE HISTORY

The design site is located in Prague 7 - Holešovice in the inner compact city just 2.5 kilometers from the existing historic city center of Prague. It is one of the biggest and oldest brownfield areas that has overwhelming and rich history. It used to be an old fisherman village founded in 1088 close to the Vltava river ford. In 1850, the new railroad from Prague to Dresden with the train stop Holešovice - Bubny was established and rapid urbanization of the floodplain area transformed the old village into urban district with mainly block structure typology. New important investments were made, such as new bridge connection or new shipyards and harbors, linking the area with the city of Prague. In 1884, the area was officially connected to the city as its new lively industrial district.

The area remained almost unmodified till the Velvet revolution in 1989. After the Revolution, many factories were closed down and industrial complexes started to decay. Main investments were appointed towards the city-scale infrastructure project, e.g. main north-south highway.

SITE LOCATION

The site is located in a lower part of the sloping Letná Hill to the north from the historic city center. The site spreads as a stretch of narrow land connecting the two waterfronts on the left bank of the Vltava river. The site itself is framed by two busy traffic roads of city-importance from east and west and by the Vltava river from north and south.

Adjacent to the site, the two popular and well-functioning city districts are located, spreading up to the Letná Hill and down to the Vltava river. These two districts, Letná and Holešovice, consist of mainly mixed-use block structure buildings with commerce, small retail, services and public facilities on the ground floor and offices and housing on the upper floors. Many educational, cultural and governmental buildings can be found in the neighborhood, well-connected to the rest of the city via public transport network or individual transport routes.

THE SITE

The site itself is a former cargo and service railway station, the remains of the industrial past are two still functioning but not very busy train stops [Holešovice - Bubny and Nádraží Holešovice] and a few industrial buildings with railway tracks, currently fenced off and unaccessible.

As mentioned before, the site is very much incorporated in the urban fabric but is almost unaccessible and disconnected from the surrounding neighborhoods and act as a barrier. This feeling is even enhanced by the busy roads [Bubenská and Argentinská], cutting the site off from the neighboring city districts.

SITE DATA

PRAGUE 7

AREA: 7.14 km² [714 HECTARES]

POPULATION: 41672

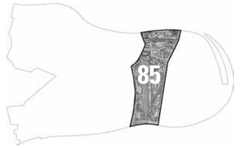
DENSITY: 58 / HA [GROSS]

HOLEŠOVICE + LETNÁ

AREA: 4.0 km² [400 HECTARES]

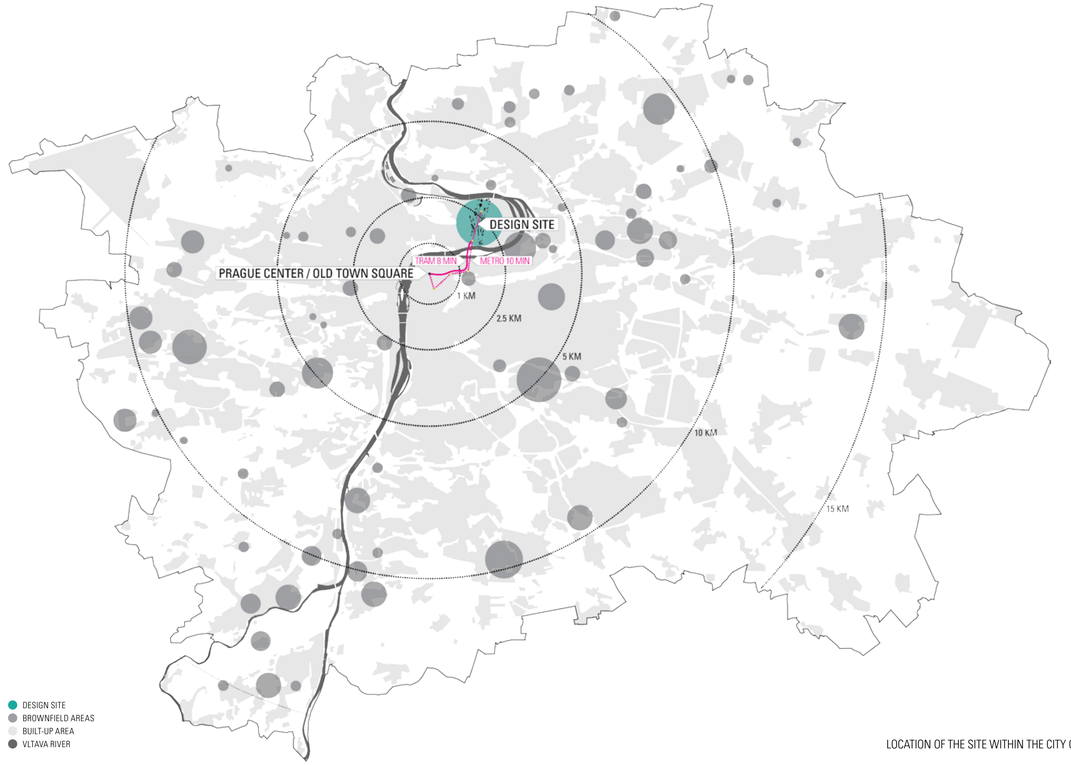
POPULATION: 41672

DENSITY: 105 / HA [GROSS]



BUBNY

AREA: 0.85 km² [85 HECTARES]



LOCATION OF THE SITE WITHIN THE CITY OF PRAGUE

CONNECTIONS

The area around Holešovice - Bubny railway station is, despite of the overall abandonment of the site, very well-connected with the rest of the city. There are two subway stations in the area [Vltavská and Nádraží Holešovice] that act as important transition nodes with possibility to transfer to tramways, trains and buses, both national or international. The rest of the area is served by integrated public transport with more than eight tram lines, four bus lines and one subway line.

One of the biggest challenges of the design project is the vehicular traffic that occupies most of the public space of the site. The dominance of the vehicular traffic is obvious not only during the day by the alarming number of cars passing through the area but also by the number of parking places in the residential streets and enormous amount of parking lots. As mentioned before, the major city highway is passing through neighborhood, separating the two districts and occupying the most of the riverfront, leaving it unaccessible and unattractive. The elevated highway junctions only demonstrate the dominance of the car traffic over the pedestrians and bikers.

GREENERY

The site is, due to its location in the meandering river valley, surrounded by many green areas of the city-scale importance. The closes city park Stromovka which used to be a royal deer park is very well-used, especially during the summer time.

Even though the site is located on the river, the close connection to the Vltava river is not taken as an advantage of the area. The riverfront is usually, both visually and physically, unaccessible, not allowing any sort of interaction with the water surface or the riverfront itself. Moreover, the riverfront is cut off from the site by roads and high flood protection wall.

Even thought the site is located in the close distance to the city park and other green areas, the lack of greenery on the site and in surrounding neighborhoods is evident. Compared to the historical city center where the greenery occupies more than 20% of the whole area and is evenly distributed throughout the area (in the means of historical gardens and parks), the area around the site does not dispose of any pocket parks or smaller green areas but the city park. Due to this fact, the average area of green space per person is less than 19 m^2 in the neighborhood, compared to 97 m^2 per person in Prague in general. Therefore, the design site has a potential to integrate the greenery in the proposal, improving the conditions for the new inhabitants and old residents as well.

SITE PHOTOS


HOLEŠOVICE - BUBNY TRAIN STATION


BUBENSKÁ STREET

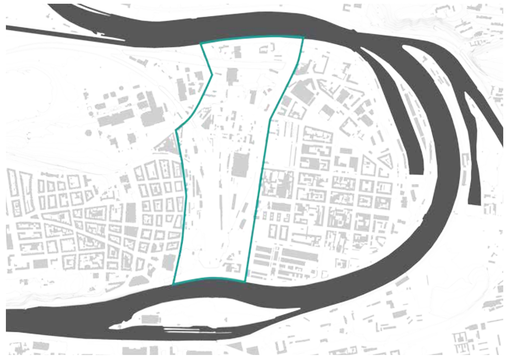

HOLEŠOVICE - BUBNY RAILYARDS


ARGENTINSKÁ STREET

DESIGN CONCEPT

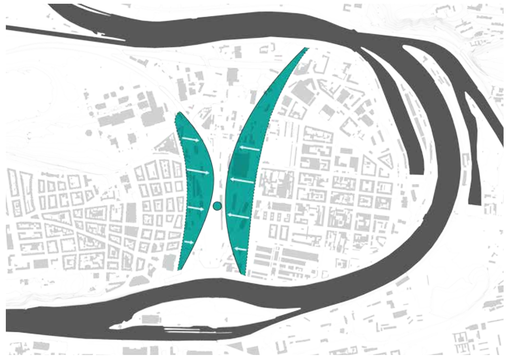
EXISTING CONDITIONS

The site is currently cut off from the adjacent neighborhoods by the roads with high volumes of traffic [Argentinská 62000 cars and Bubenská street 26000 cars per day]. Due to this fact, there is almost no interaction of the buildings with the site. Most of the buildings does not have any functions or activities on the ground floor and turn their back towards the road.



NEIGHBORHOOD CONNECTION

As a first step of the brownfield transformation, the two highway-like street will be reconfigured into the urban street with suitable pedestrian paths and bike lanes and small commerce and retail on the ground floor. The streets will be framed by new development to create the frontage for the streetscape and clear street hierarchy and to connect the site with the adjacent neighborhoods.



LANDSCAPE CONNECTION

The existing number of rail tracks is decreased and incorporated in the green corridor that is linking the Stromovka city park with the design site. This green corridor is also designed in the north-south direction, connecting the opposing river banks. The parkland with different landscape types provides a space for recreation and leisure activities but also implements the benefits of ecosystem services, e.g. the integrated urban water cycle and on-site stormwater management.

PROPOSED INTEGRATED URBAN STRUCTURE

The site itself which combines built and open spaces with balanced ecosystems is reconnected with the surrounding neighborhoods by newly proposed tramline and series of streets, shared spaces and pedestrian paths over the site. The newly proposed tram station is directly connected to the preserved train station 'Bubny' and to the new entrance to the existing subway station 'Vltavská'. This transportation hub is directly linked to the sequence of the main public spaces connecting the two neighborhoods over the site.

LANDSCAPE NETWORK

The open green arean in the central part of the site is connected with the surrounding recreational urban landscapes, benefiting the ecological and environmental performance of the ecosystems and providing connected public green space for the resident of the city. By connecting the greenery the new permeable network can be established within, allowing for new possibilities to move around the site and to connect with the surroundings.

URBAN STRUCTURE AND IMPORTANT PLACES

The mixed use urban fabric which is reconnected with the surrounding urban areas provides an active public space and integrates various public facilities and community meeting places. The existing preserved railyard buildings could be transformed into community centers, having a flexible space to host different activities inside and even in the adjacent outdoor spaces. New proposed public buildings, such as art galleries or libraries, can serve as important meeting places and catalysts for activating the public space.

INTEGRATED MOBILITY AND ACCESSIBLE PUBLIC TRANSIT

The proposal implements a new tram line running throgh the central part of the site, connecting Holešovice and Letná via the shortest public transport route. The two train stations designed on the site improve the missing connection to the public transport. Tram line is directly connected to the train and subway network, providing sustainable solution for daily commuting within and outside the design site.

DIPLOMA THESIS FOCUS

The diploma thesis focuses on a selected part of the brownfield area which serves as an example area demonstrating how the proposed connection of the neighborhoods and the green network can be done in more detail.

DESIGN VISION

The site consists of three key elements that are currently placed next to each other without any interactive relation among them. These key elements are the landscape, the water and the city. The aim of the design project is to implement such solution that can reconnect the three assets and integrate them in one symbiotic urban ecosystem on the site.

The vision of the site is a livable mixed-use neighborhood that is reconnected with the surrounding urban districts and takes the advantage from its location in between the two river bank. The site will provide active and diverse public spaces of various scales, rich building typology, balanced green network with increased biodiversity and recreational potential and accessible urban environment and housing for various age, social and background groups with minimal impacts on the environment.

INTEGRATED URBAN LANDSCAPE

CONNECTIVITY AND ACCESSIBILITY

CONNECTED NEIGHBORHOODS
The design site has a potential to reconnect the area into one whole. Goal for the design project is to bring the currently divided neighborhoods together and join them with new urban fabric on the site. Improving connections and paths over the site is essential not only for creating connected and accessible neighborhood on the site but also for reconnecting the design site with the city.

ACCESSIBLE PUBLIC TRANSPORT
Public transport is one of the important aspects of sustainability. The public transport network and sustainable mobility is one of the key goals of the project, promoting healthy movement and reducing impacts on the environment caused by the individual car transportation. Therefore, the design will be accessible by different means of transportation, especially public transport, and new ways of sustainable mobility in the city will be promoted, such as biking or car-sharing.

DIVERSE, HEALTHY AND ACCESSIBLE DEVELOPMENT

DIVERSE AND ACTIVE PUBLIC SPACE
Aim of the project is to create livable urban landscape with diverse public spaces of various scales and intimacy for all age and target groups of people, both residents and visitors. The urban environment should be in balance with living ecosystems, taking advantage of ecosystems services for healthy environment, improving biodiversity in the area and providing recreational potential for the residents of new development and surrounding neighborhoods.

MIXED-USE DEVELOPMENT
The site will provide attractive living conditions for various age, social and background groups with strong access to the public transit and public facilities, services and functions of daily need in the walking distance. One of the key aspects is to provide job opportunities to increase activity in the public space throught the day and night to create safe and living urban environment.

MINIMAL IMPACTS ON THE ENVIRONMENT

One of the key aims of the project is to propose such development that will have minimal impacts not only on the site itself but also on the adjacent neighborhoods around it. This goal can be achieved by thorough analysis of the existing urban cycle. This master thesis project seeks to find a solution for how the system that is dependent on the resources coming from outside the site can be improved in order to minimize its impact on the environment, both local and global, or can even contribute to the well-functioning and balanced urban ecosystem.

SUSTAINABLE WATER MANAGEMENT
The goal of the project is to propose an urban environment that has minimal impacts on the water cycle and the ecosystems. The aim is to implement such design measures to harvest, restore and recycle the rainwater on the site in order to decrease the fresh water consumption and waste water production as well as to retain the stormwater to slowly infiltrate to the ground to decrease the amount of water entering the sewage system and therefore not contribute to the urban flooding.

In the next chapter, the existing urban cycle and performance of ecosystem services is studied and the evaluation for each of the discussed possibilities is introduced. The design project tries to learn from the informed research and implement such measures that can promote healthy, quality and safe environment by integrating ecosystem services as a foundation for the urban development. The design project focuses on the parts of the system that are the most quantifiable and demonstrable in the urban design of public space, such as water and waste management (rainwater harvesting, stormwater retention and infiltration, grey water recycling) or renewable energy generation (solar energy, domestic waste recycle and waste-to-energy generation, black water separating and energy generation).

VISION FOR THE SITE - PLACE INTEGRATING BOTH GREEN AND BUILT ENVIRONMENT WTH BALANCED URBAN ECOSYSTEMS. SUSTAINABLE PUBLIC TRANSPORT. HEALTHY LIVING CONDITIONS AND DIVERSE PUBLIC SPACE

URBAN CYCLE

URBAN CYCLE

The cities today are facing many challenges not only connected with the global climate change, such as heavier and more frequent rainfalls, flash floods, urban flooding or droughts, but also with the problems of modern society highly dependent on fossil fuels, such as excessive use of car leading to pollution of the environment, sugar overuse and genetically modified food intake or lifestyle diseases such as obesity, diabetes or cancer. All of these problems are mirrored - and vice versa - in the way our cities operate and one of the biggest challenges of for the future developments is to fight these threats and implement such solutions that can improve the system, not only mitigate the consequences.

CONVENTIONAL URBAN CYCLE

Even though the society and its lifestyle changes rapidly, many of the cities, including Prague, are not fast enough to cope with some changes or retrofit the existing development. These cities are highly dependent on the resource inputs and produce enormous amount of different kinds of waste that is, in most cases, landfilled or, even worse, released to the environment without treatment. This outdated system has a significant carbon footprint because its dependent on fossil fuels for transportation of goods, food, energy and heat generation. In this system, the rainwater and stormwater is treated as a waste product right away, being mixed with the waste water from the households, devaluated and cleaned in waste water treatment plants, putting a pressure on the sewage network and causing urban floods. Household waste is, with exception, sorted and recycled for reuse, but considerable amount of waste is still stored in the landfilles, threatening the environment.

IMPROVED CONVENTIONAL URBAN CYCLE

Even though changing the urban cycle of existing cities is highly complex solution, small "soft" changes can be implemented right away to contribute to decreasing of the CO_2 footprint of each and every households. These changes focus on household consumption of fresh water, energy and food and propose such interventions that are easy to incorporate without loosing the quality of life. The citizens can produce its own food, reducing the need for transportation of their products from far distances. The home appliances can be replaced with more energy-saving ones, decreasing the consumption of fresh water and electricity. Basic building interventions can improve the insulation of the house, decreasing the heat consumption. Rainwater, catched from the rooftops or fallen on the plot, can be harvested and reused for the secondary household uses, such as washing clothes or flushing the toilet. Overflow can be infiltrated on site, having not only aesthetical but also environmental and cooling effects.

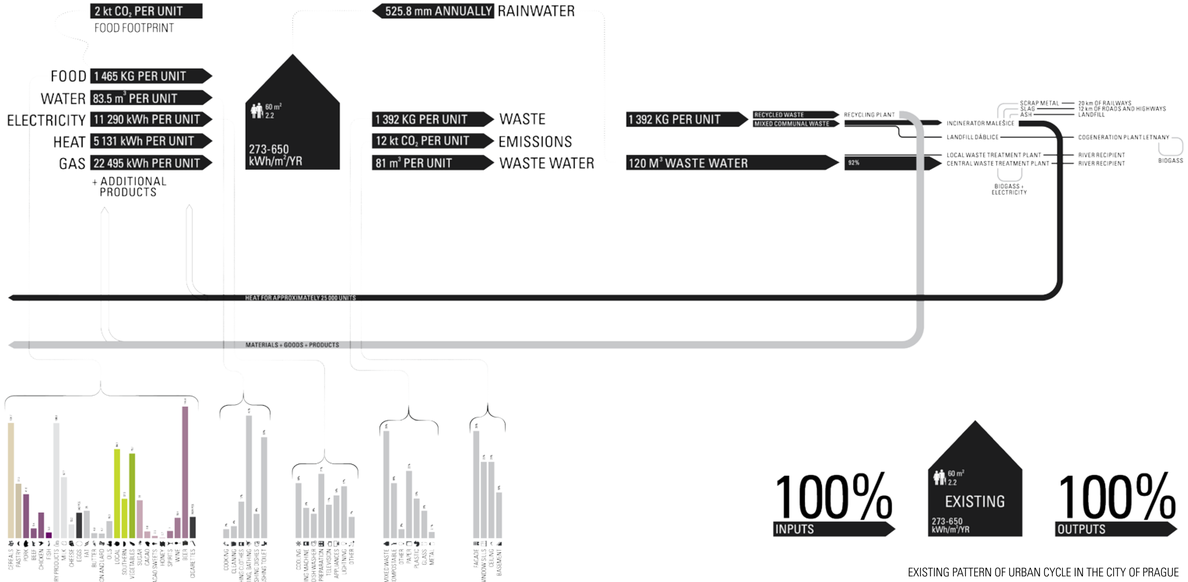
PROPOSED URBAN CYCLE

The proposed urban cycle is based on the principle of "reuse, restore and recycle" and on the assumption that waste can be a source at the same time. Rainwater is treated as a primary water source for households and overflow is infiltrated locally. The separated system for grey water and black water is introduced, where grey water is cleaned and reused for irrigation or in the households while sludge together with compostable waste is used as a primary resource for energy generation in cogeneration plant. Other combustible waste is used for energy generation while recycled waste is used for other production. The new development is proposed as low-energy housing with minimal energy demands for heating and cooling with implemented measures to generate renewable energy [solar, wind, thermal] to cover the needs. Green roofs are implemented where possible to decrease the runoff. The system puts emphasis on incorporating ecosystem services to achieve maximum goals.

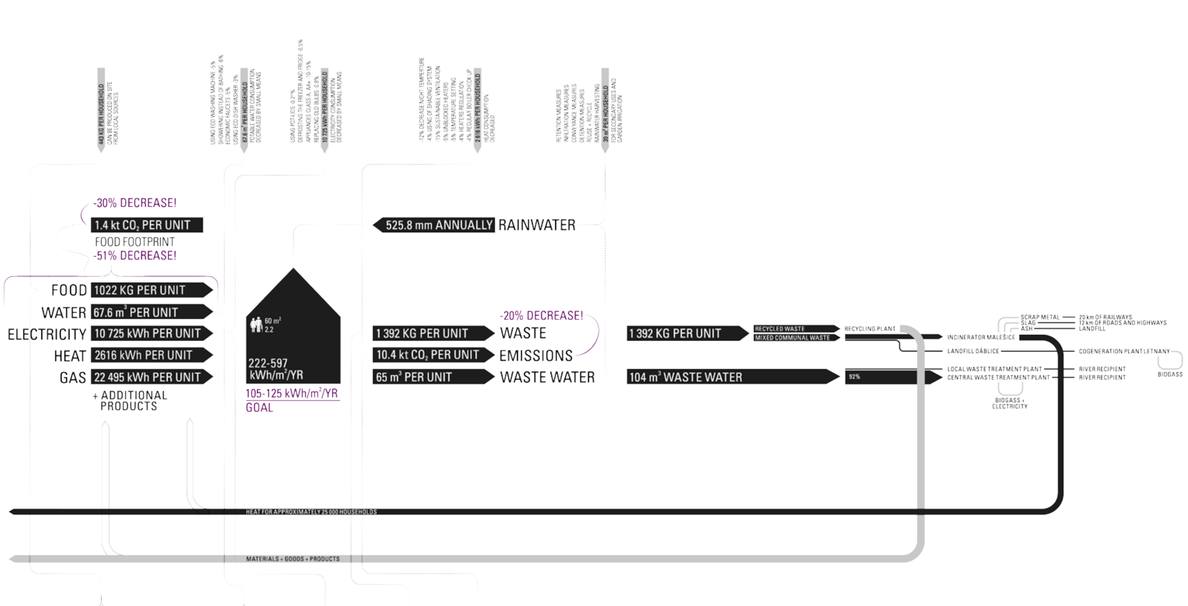
CONVENTIONAL URBAN CYCLE

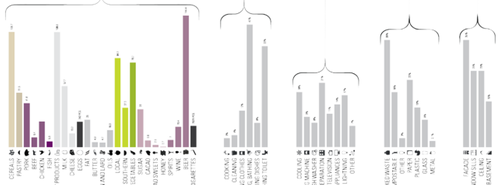
IMPROVED CONVENTIONAL URBAN CYCLE

PROPOSED URBAN CYCLE

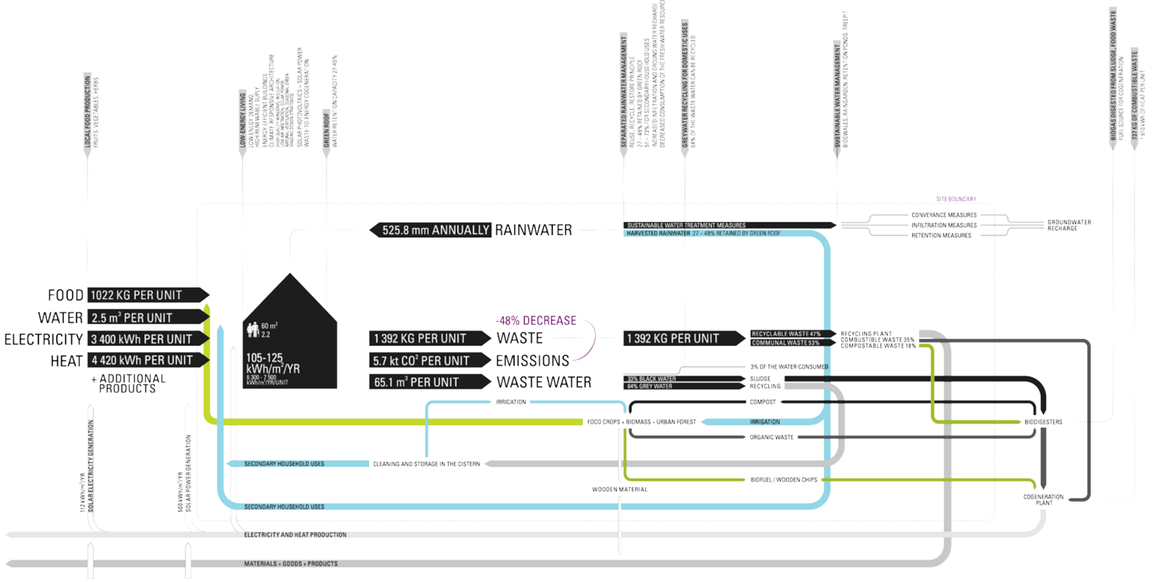


EXISTING PATTERN OF URBAN CYCLE IN THE CITY OF PRAGUE





PROPOSED SOFT CHANGES TO THE CONVENTIONAL URBAN CYCLE



PROPOSED INTEGRATED URBAN CYCLE BASED ON RECYCLING AND REUSING OF GOODS

ECOSYSTEM SERVICES

One of the key aspects of the design project is to incorporate the ecosystem services in the design in order to create balanced living urban landscape environment. Ecosystem services are the benefits that are provided by ecosystems. Naturally, those ecosystem services are provided without any limits but by extensive degradation of the natural environment by humans these benefits are often lost. By incorporating the ecosystem services in the foundation of the design project the balanced living environment can be established, ensuring the benefits provided by ecosystems and improving the living conditions on the site naturally and systematically. These ecosystem services have supporting, provisioning, regulating and cultural aspects.

SUPPORTING ECOSYSTEM SERVICES
Supporting ecosystem services are the necessary and essential basis for other ecosystem services. They include soil formation and primary production, nutrient recycling, biodiversity and habitat. Without supporting ecosystem services, the ecosystem would not be possible to provide any other functions.

PROVISIONING ECOSYSTEM SERVICES
Provisioning ecosystem services are products that can be provided by ecosystems, such as production of food, fresh water, wood anad organic material or pollination. They include all sorts of raw materials provided by nature for other use.

REGULATING ECOSYSTEM SERVICES
Regulating ecosystem services are benefits that regulate ecosystem processes, such as purification of air and water, climate and flood regulation, carbon sequestration or temperature cooling. They can be used as tools in a design process because they provide services essential for creating healthy living environment.

CULTURAL ECOSYSTEM SERVICES
Cultural ecosystem services are non-material benefits achieved from aesthetic experience and perception of the nature and natural landscapes. They include educational, recreational, easthetical and spiritual benefits that form the way we perceive the nature and how we treat the environment.

ECOSYSTEM SERVICES IMPLEMENTATION

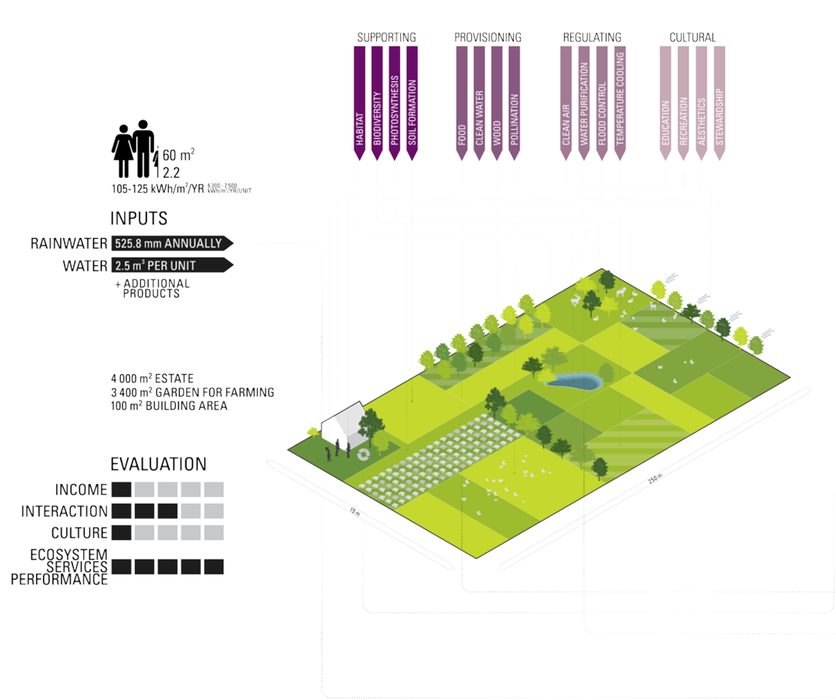
On the next three pages, three scenarios of ecosystem services implementation are studied and quantified in order to gain the knowledge on how the ecosystems services works and how they can be used in the design process as tools for urban developement.

SELF-SUFFICIENT UNIT
Ideal self-sufficient units generates all the resources by integrating the ecosystem services with minimal footprint on the environment. This possibility is environmentally-friendly but highly unsuitable in dense urban areas because it is spatially inefficient.

SUPPORTING, PROVISIONING, REGULATING AND CULTURAL SERVICES PROVIDED BY NATURAL ECOSYSTEMS

CONVENTIONAL URBAN SYSTEM
Conventional cities do not often benefit from the ecosystem services because they are usually very much undervalued or degraded. The services provided by ecosystems are very limited and do not contribute to the system fully.

PROPOSED INTEGRATED URBAN SYSTEM
In the proposed urban system, ecosystem services are integrated as a tool to provide energy, food, stormwater and rainwater treatment and waste water management. They contribute to the healthy environment not only aesthetically, but mainly environmentally because they help to manage the input and output flows on site, decreasing the need for transport and making the system more resilient.



SELF-SUFFICIENT UNIT WITH BENEFITS AND PROVIDED BY BALANCED ECOSYSTEMS

SUPPORTING
HABITAT
BIODIVERSITY
PHOTOSYNTHESIS
SOIL FORMATION

PROVISIONING
FOOD
CLEAN WATER
WOOD
POLLINATION

REGULATING
CLEAN AIR
WATER PURIFICATION
FLOOD CONTROL
TEMPERATURE COOLING

CULTURAL
EDUCATION
RECREATION
AESTHETICS
STEWARDSHIP

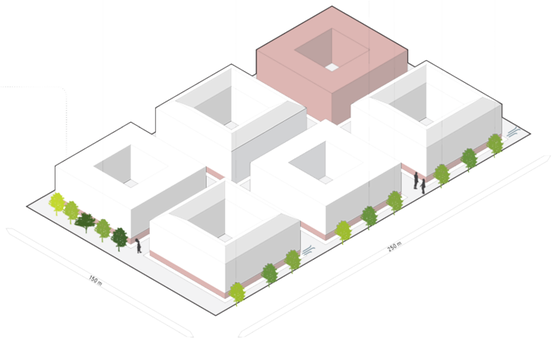
60 m²
2.2
241-570 kWh/m²/YR (4 680 - 14 200 kWh/m²/YR/UNIT)

INPUTS

ELECTRICITY **11 290 kWh PER UNIT**
HEAT **5 131 kWh PER UNIT**
GAS **22 495 kWh PER UNIT**
FOOD **1 465 KG PER UNIT**
RAINWATER **525.8 mm ANNUALLY**
WATER **83.5 m³ PER UNIT**
+ ADDITIONAL PRODUCTS

EVALUATION

INCOME
INTERACTION
CULTURE
ECOSYSTEM SERVICES PERFORMANCE



OUTPUTS

1 392 KG PER UNIT WASTE
WASTE TO THE LANDFILL OR INCINERATOR PLANT,
RECYCLED WASTE TO THE PROCESSING IN THE RECYCLING PLANT

12 kt CO_2 PER UNIT EMISSIONS
OVERALL CO_2 EMISSIONS PRODUCTION
[BAD ENVIRONMENTAL PERFORMANCE OF BUILDINGS,
FOOD AND GOODS PRODUCTION AND TRANSPORTATION]

81 m³ PER UNIT WASTE WATER **120 m³ WASTE WATER**
DOMESTIC WASTE WATER MIXED WITH STORMWATER TO THE CENTRAL
WASTE WATER TREATMENT PLANT AND TO THE ADJACENT RIVER

CONVENTIONAL URBAN SYSTEM WITH LIMITED ECOSYSTEM SERVICES

SUPPORTING
HABITAT
BIODIVERSITY
PHOTOSYNTHESIS
SOIL FORMATION

PROVISIONING
FOOD
CLEAN WATER
WOOD
POLLINATION

REGULATING
CLEAN AIR
WATER PURIFICATION
FLOOD CONTROL
TEMPERATURE COOLING

CULTURAL
EDUCATION
RECREATION
AESTHETICS
STEWARDSHIP

60 m²
2.2
105-125 kWh/m²/YR (1 500 - 1 900 kWh/m²/YR/UNIT)

INPUTS

ELECTRICITY **3 400 kWh PER UNIT**
HEAT **4 420 kWh PER UNIT**
FOOD **1022 KG PER UNIT**
RAINWATER **525.8 mm ANNUALLY**
WATER **2.5 m³ PER UNIT**
+ ADDITIONAL PRODUCTS

EVALUATION

INCOME
INTERACTION
CULTURE
ECOSYSTEM SERVICES PERFORMANCE

OUTPUTS

1 392 KG PER UNIT WASTE
RECYCLED WASTE TO THE PROCESSING IN THE RECYCLING PLANT,
BIOLOGICAL WASTE TO THE BIODIGESTERS + COMBUSTIBLE WASTE
TO THE COGENERATION PLANT FOR ENERGY PRODUCTION

5.7 kt CO^2 PER UNIT EMISSIONS
DECREASED OVERALL CO_2 EMISSIONS PRODUCTION
[GOOD ENVIRONMENTAL PERFORMANCE OF BUILDINGS – PASSIVE,
LOCAL FOOD PRODUCTION, EFFICIENT PUBLIC TRANSPORTAT]

65.1 m³ PER UNIT WASTE WATER
SEPARATED WASTE WATER MANAGEMENT
[BLACK WATER TO THE BIODIGESTERS FOR ENERGY PRODUCTION,
GREYWATER FOR RECYCLING IN THE HOUSEHOLDS]

ON-SITE PRODUCTION

112 kWh/m²/YR OF ELECTRICITY ENERGY
ROOFTOP PHOTOVOLTAIC PANELS AND COLLECTORS

443 KG PER HOUSEHOLD FOOD
LOCAL PRODUCTION OF FRUIT, VEGETABLES AND HERBS ON SITE
[30% OF UNIT FOOD CONSUMPTION]
BEE-KEEPING FOR HONEY PRODUCTION ON ROOFTOPS
[11 kg OF HONEY – 53% OF SUGAR CONSUMPTION]

STORMWATER RETENTION STORMWATER
NEIGHBORHOOD RETENTION POND
77.2 mm/m² OF RAIN IN THE MOST RAINY MONTH

65 m³ OF HARVESTED RAINWATER RAINWATER
HARVESTED RAINWATER FOR HOUSEHOLD USES
[PROBABLY SMALLER AMOUNT DEPENDING ON
SYSTEM IMPLEMENTED IN THE NEIGHBORHOOD]

PROPOSED INTEGRATED URBAN SYSTEM FULLY OPERATING WITH ECOSYSTEM SERVICES

BUILDING LEVEL

BLOCK LEVEL

NEIGHBORHOOD LEVEL

ENERGY PRODUCTION

BUILDING LEVEL

ROOFTOP SOLAR COLLECTORS
SOLAR POWER GENERATION (ROOF, SHADINGS, FACADE)
SOUTH-FACING PANELS GENERATE 500 kWh/m²/YR
RENEWABLE ENERGY GENERATION REDUCING DEMAND ON OFF-GRID SUPPLY

ROOFTOP PHOTOVOLTAIC PANELS
SOLAR POWER GENERATION (ROOF, SHADINGS, FACADE)
SOUTH-FACING PANELS GENERATE 112 kWh/m²/YR
RENEWABLE ENERGY GENERATION REDUCING DEMAND ON OFF-GRID SUPPLY

BLOCK LEVEL

ROOFTOP SOLAR COLLECTORS
SOLAR POWER GENERATION (ROOF, SHADINGS, FACADE)
SOUTH-FACING PANELS GENERATE 500 kWh/m²/YR
RENEWABLE ENERGY GENERATION REDUCING DEMAND ON OFF-GRID SUPPLY

ROOFTOP PHOTOVOLTAIC PANELS
SOLAR POWER GENERATION (ROOF, SHADINGS, FACADE)
SOUTH-FACING PANELS GENERATE 112 kWh/m²/YR
RENEWABLE ENERGY GENERATION REDUCING DEMAND ON OFF-GRID SUPPLY

NEIGHBORHOOD LEVEL

PHOTOVOLTAIC PANELS + SOLAR COLLECTORS ON PUBLIC FACILITIES
SOLAR POWER GENERATION (ROOF, SHADINGS, FACADE)
SOUTH-FACING PANELS GENERATE 500 kWh/m²/YR
RENEWABLE ENERGY GENERATION REDUCING DEMAND ON OFF-GRID SUPPLY

COGENERATION PLANT WITH BIODIGESTERS FOR SEWAGE
WASTE-TO-ENERGY POWER GENERATION
BURNING THE COMBUSTIBLE WASTE AND BIOMASS (WOODEN CHIPS) AND SLUDGE FROM THE HOUSCHOLDS IN FORM OF BIOGAS
RENEWABLE ENERGY GENERATION REDUCING DEMAND ON OFF-GRID SUPPLY

GROUNDWATER-SOURCE HEAT PUMP
ENERGY FROM A GROUNDWATER AQUIFER
RENEWABLE ENERGY GENERATION REDUCING DEMAND ON OFF-GRID SUPPLY

PROVISIONING ECOSYSTEM SERVICES

FOOD MANAGEMENT

BUILDING LEVEL

WINDOW / BACKYARD / BALCONY GARDEN
ORGANICLY GROWN FOOD (ESPECIALLY HERBS)
SMALL-SCALE PRODUCTION

ROOFTOP EDIBLE GARDEN
COMBINING THE GREEN ROOF AND FOOD PRODUCTION
BEEHIVE ON THE ROOFTOP FOR POLLINATION AND HONEY PRODUCTION
HARVESTED RAINWATER USED FOR IRRIGATION
REDUCING HEAT ABSORPTION AND MITIGATION OF URBAN HEAT ISLAND
IMPLEMENTATION ON THE BUILDING'S STRUCTURE (HEAVY MATERIAL)

BLOCK LEVEL

WINDOW / BACKYARD / BALCONY GROWING
ORGANICLY GROWN FOOD (ESPECIALLY HERBS)
SMALL-SCALE PRODUCTION

ROOFTOP EDIBLE GARDEN
COMBINING THE GREEN ROOF AND FOOD PRODUCTION
BEEHIVE ON THE ROOFTOP FOR POLLINATION AND HONEY PRODUCTION
HARVESTED RAINWATER USED FOR IRRIGATION
REDUCING HEAT ABSORPTION AND MITIGATION OF URBAN HEAT ISLAND
IMPLICATION ON THE BUILDING'S STRUCTURE (HEAVY MATERIAL)

ROOFTOP BEE-KEEPING
INDEPENDENCE ON SUGAR SUPPLY
HEALTHY CARBOHYDRATES
POLLINATION OF THE SURROUNDING URBAN AGRICULTURE FIELDS AND MEADOWS – PRODUCTION

COURTYARD GARDENING
SELF-SUPPLYING WITH LOCALLY GROWN FOOD
REESTABLISHMENT OF THE CONNECTION TO THE LAND

RESTAURANT WITH OWN BACKYARD PRODUCTION
LOCALLY PRODUCED FOOD – BACK TO THE ROOTS' GASTRONOMY
ORGANIC AND ENVIRONMENTALLY FRIENDLY PRODUCTION
'FIVE-MILES RADIUS STRATEGY'
SUPPORTING THE LOCAL BUSINESSES

NEIGHBORHOOD LEVEL

COMMUNITY ALLOTMENT GARDEN
ORGANICLY GROWN FOOD (HERBS, FRUITS, VEGETABLES)
SOCIAL INTERACTION WITHIN THE RESIDENTS AND VISITORS
SMALL-SCALE PRODUCTION, SELF-SUPPLYING
EDUCATIONAL PURPOSES

NEIGHBORHOOD ANIMAL FARM
EDUCATIONAL PURPOSES
RECYCLING OF THE RESOURCE FLOW ON SITE (CHICKENS EAT THE LEFTOVERS, LAY EGGS...)
GRAZING OF THE ANIMALS REDUCING GREEN AREAS MAINTENANCE COSTS
ORGANIC FERTILIZERS
POSSIBILITY TO SUPPLY LOCAL RESTAURANTS AND RESIDENTS WITH FRESH PRODUCT

NEIGHBORHOOD ORCHARDS WITH FRUIT TREES
FRESH FRUIT PRODUCTION
NEIGHBORHOOD FAIRS – SOCIAL INTERACTION (FRUIT PICKING, SUMMER EVENTS...)
GREEN AREAS CLEANING AIR, MITIGATING THE URBAN HEAT ISLAND, CLIMATE STABILISATION
RECREATIONAL PURPOSES
RAINWATER INFILTRATION
STORMWATER RETENTION

FARMER'S MARKET
LOCAL MEETING POINT
SMALL SCALE BUSINESSES
ECONOMY
SOCIAL INTERACTION
FRESH, LOCALLY GROWN, ORGANIC PRODUCTS

PROVISIONING ECOSYSTEM SERVICES

SOCIAL INTERACTION AND TRANSPORTATION

BUILDING LEVEL

SMALL PLOTS
MULTIPLY ARCHITECT OR DEVELOPER TEAM ALLOWING FOR WIDER VARIETY OF BUILDING TYPOLOGY IN THE BLOCK

BLOCK LEVEL

VARIETY OF BUILDING TYPOLOGY
ACCESSIBILITY FOR DIFFERENT TARGET SOCIAL AND INCOME GROUPS
FLEXIBILITY
AFFORDANCE
ACCESSIBILITY

MIXED-USE FUNCTIONS IN THE BLOCK
REDUCED NEED FOR TRIPS BEYOND THE NEIGHBORHOOD
SMART GROWTH
PARKING IN THE UNDERGROUND LEVELS

COMMERCIAL ACTIVITIES IN THE GROUND FLOOR
ACTIVE STREETSCAPE – ECONOMICAL INCOME, SAFETY, SOCIAL INTERACTION

PEDESTRIAN PATHS THROUGHT THE BLOCK
INTERESTING WALKING ENVIRONMENT THROUGHOUT DIVERSE RANGE OF URBAN SETUPS

NEIGHBORHOOD LEVEL

EFFICIENT PUBLIC TRANSPORT – 300-400 m BY WALKING TO THE STATION
STATION 300-400 m TO THE RESIDENTS, INTERCHANGE 4-8 MINUTES

MODERATE URBAN DENSITY (NET DENSITY 240 UNITS/HECTARE)
BALANCE OF JOBS AND HOUSING
PUBLIC AMENITIES (SCHOOLS, SHOPS, SERVICES, SMALL SCALE BUSINESSES)

PRIORITY TO PEDESTRIAN AND BIKE CIRCULATION TO CAR USE
PEDESTRIAN AND BIKE SHORTCUTS
LIMITED PARKING IN THE STREETSCAPE (0.2 – 0.8 PARKING SPACE PER UNIT)
TRAFFIC-CALMING MEASURES IN THE STREET

VARIETY OF URBAN BLOCK TYPOLOGY AND CONNECTION TO THE PUBLIC SPACE
DIVERSITY IN FRACTION BETWEEN BUILDING AND PUBLIC SPACE IN FRONT OF IT
CLEAR HIERARCHY OF THE SPACES
OWNERSHIP – PRIVATE, SEMI-PRIVATE, SEMI-PUBLIC, PUBLIC
LIMITED PARKING IN THE STREETSCAPE (0.2 – 0.8 PARKING SPACE PER UNIT)

CULTURAL ECOSYSTEM SERVICES

BUILDING LEVEL

BLOCK LEVEL

NEIGHBORHOOD LEVEL

RAINWATER + STORMWATER MANAGEMENT

BUILDING LEVEL

GREEN ROOF
GREEN ROOF REDUCING THE HEAT ABSORPTION
RETENTION OF THE RAINWATER AND SLOW DRAIN TO THE SYSTEM
FILTRATION OF THE HARVESTED RAINWATER

RAINWATER TANK
DECREASED USE OF FRESH WATER
RAINWATER HARVESTING FOR SECONDARY HOUSEHOLD USES

GREYWATER RECYCLING SYSTEM
IMPLEMENTED CLEANING SYSTEM
DECREASED USE OF FRESH WATER

RAINGARDEN IN THE YARD
RETENTION AND INFILTRATION ON SITE MEASURE
IMPROVING MICROCLIMATE
REDUCING URBAN HEAT ISLAND
PREVENT THE LOCAL FLOODS

BLOCK LEVEL

GREEN ROOF
GREEN ROOF REDUCING THE HEAT ABSORPTION
RETENTION OF THE RAINWATER AND SLOW DRAIN TO THE SYSTEM
FILTRATION OF THE HARVESTED RAINWATER

RAINWATER COLLECTOR / CISTERN
DECREASED USE OF FRESH WATER
RAINWATER HARVESTING FOR SECONDARY HOUSEHOLD USES

BLOCK GREYWATER RECYCLING FACILITY
IMPLEMENTED CLEANING SYSTEM
DECREASED USE OF FRESH WATER

PERMEABLE SURFACE IN THE COURTYARD
IMPROVING MICROCLIMATE AND REDUCING URBAN HEAT ISLAND
PREVENTIVE MEASURE AVOIDING THE LOCAL FLOODS

RAINGARDEN IN THE COURTYARD
RETENTION AND INFILTRATION ON SITE MEASURE
PREVENTING THE LOCAL FLOODS
RECREATIONAL AND AESTHETIC POTENTIAL

NEIGHBORHOOD LEVEL

PERMEABLE AND SEMI-PERMEABLE SURFACES / PAVEMENT
IMPROVING MICROCLIMATE AND REDUCING URBAN HEAT ISLAND - THANKS TO EVAPOTRANSPIRATION
PREVENTIVE MEASURE AVOIDING THE LOCAL FLOODS

GREEN STREETS – BIOSWALES, TREE PITS, RAINGARDENS, RETENTION PONDS
PREVENTIVE MEASURE AVOIDING THE LOCAL FLOODS CONVEYING THE RAINWATER TO THE DESIGNATED AREAS
FLASH FLOODS MITIGATION

NEIGHBORHOOD RETENTION POND
RETENTION AND INFILTRATION ON SITE MEASURE
PREVENTING THE LOCAL FLOODS
RECREATIONAL AND AESTHETIC POTENTIAL

NEIGHBORHOOD RAINWATER HARVESTING AND INFILTRATION AREA
DECREASED CONSUMPTION OF THE FRESH WATER RESOURCES
POSSIBLE USE FOR IRRIGATION OR STREET CRUZZING DURING THE HEAT PEAKS

PROVISIONING + REGULATING ECOSYSTEM SERVICES

WASTE MANAGEMENT

BUILDING LEVEL

RECYCLING BINS
VACUUM CHUTE SYSTEM ON A BUILDING LEVEL
WASTE SEPARATION – RECYCLED, COMBUSTIBLE, ORGANIC, GARDEN WASTE

BLOCK LEVEL

RECYCLING STATION FOR SEPARATED WASTE
VACUUM CHUTE SYSTEM ON BLOCK LEVEL

BLOCK COMPOSTING CONTAINER
COMPOSTING OF GREEN WASTE FROM THE COURTYARD OF HOUSEHOLDS
REUSE AS A FERTILISER ON COURTYARD GARDENS, FEEDS ON ENERGY GENERATION

NEIGHBORHOOD LEVEL

COLLECTION POINT FOR SEPARATED WASTE
VACUUM CHUTE SYSTEM ON NEIGHBORHOOD LEVEL REDUCING THE CO² EMISSIONS

COMPOSTING PLANT
NEIGHBORHOOD COMPOSTING PLANT

COGENERATION PLANT WITH BIODIGESTERS FOR BIOLOGICAL WASTE
GREEN WASTE AND FOOD WASTE COMBINED IN BIODIGESTER TO GENERATE BIOGAS FOR HEATING AND ELECTRICITY PRODUCTION
ENERGY PRODUCTION REDUCING DEMAND ON OFF-GRID ENERGY SUPPLY ON NEIGHBORHOOD LEVEL
SMART GRID

REGULATING ECOSYSTEM SERVICES

URBAN HEAT ISLAND MITIGATION

BUILDING LEVEL

BUILDING ORIENTATION NORTH-SOUTH, GREEN FACADE ON EAST-WEST SIDE
BUILDING ORIENTATION ALLOWING FOR CROSS VENTILATION (BREEZE FROM SW, S)
SEASONAL GREEN SHADING MEASURES REDUCING THE HEAT GAIN IN THE WINTER AND ALLOWING FOR WINTER SUN TO GET IN THE UNIT
POSSIBILITY TO GROW FOOD ON THE FACADE

GREEN ROOF (EXTENSIVE, INTENSIVE, EDIBLE)
GREEN ROOF ABSORBING THE WATER AND THE HEAT FROM THE SUNLIGHT
MITIGATION OF URBAN HEAT ISLAND

BLOCK LEVEL

PERMEABLE GREEN COURTYARD ALLOWING INFILTRATION + EVAPOTRANSPIRATION
RETENTION AND INFILTRATION ON SITE MEASURE
IMPROVING MICROCLIMATE AND REDUCING URBAN HEAT ISLAND
STORMWATER RETENTION AND SLOW INFILTRATION

TREES, TRELLISES
NATURAL SHADING DEVICE INFILTRATING THE AIR
COOLING EFFECT AND MICROCLIMATE STABILIZATION
REDUCING THE URBAN DUST IN THE AIR

NEIGHBORHOOD LEVEL

PERMEABLE GREEN AREAS ALLOWING INFILTRATION + EVAPOTRANSPIRATION (AT LEAST 50% OF GREEN SPACE)
RETENTION AND INFILTRATION ON SITE MEASURE
SYSTEMATIC IMPROVING MICROCLIMATE AND REDUCING URBAN HEAT ISLAND
SIGNIFICANT STORMWATER RETENTION AND SLOW INFILTRATION
RECREATIONAL AND AESTHETIC FUNCTION IN THE NEIGHBORHOOD
POSSIBILITY TO COMBINE WITH OTHER URBAN FUNCTIONS (FOOD PRODUCTION, RECREATIONAL FACILITY...)

TREES, TRELLISES
NATURAL SHADING DEVICE INFILTRATING THE AIR
COOLING EFFECT AND MICROCLIMATE STABILIZATION
REDUCING THE URBAN DUST IN THE AIR AND POLLUTION
POSSIBILITY TO INCORPORATE FRUIT TREES – ED BLE TREE LINES AND FORESTS (ORCHARDS)

GREEN STREETS
A COMBINATION OF RETENTION AND INFILTRATION ON SITE MEASURE (OPEN BIOSWALES, TREE PITS, RAINGARDENS)
IMPORTANT AESTHETICAL AND ENVIRONMENTAL FUNCTION
COOLING EFFECT AND MICROCLIMATE STABILIZATION

REGULATING ECOSYSTEM SERVICES

SCALES OF INTEGRATION OF VARIOUS ELEMENTS FOR CREATING BALANCE ECOSYSTEMS

DESIGN PROJECT

EXISTING CONDITIONS

ABANDONED AREA

The design site is located in southern part of the brownfield area around old train station Holešovice - Bubny. The vast area is partly used as a train station, covered with many unused railway tracks and former cargo railyard buldings, but the rest of the area is mostly withou the use. The whole railway area is fenced off and disconnected from the surroundings.

In the recent years, many of the valuable railyard buildings were tore down to make space for the future development. Only few of the old buildings were left on the site, including the historic building of train station Holešovice - Bubny, former heating station or railway service station and the design project aims to sensitively incorporate such valuable structures into its urban fabric.

PUBLIC TRANSPORT

As mentioned before in the site analysis, the whole brownfield area is very well-accessible by various means of public transport. There is a bus stop, train stop and subway stop in the walking distance from the center of the area. These nodes are very busy during the daytime but also during the night time, especially the transport hub around the Vltavská subway station where the tram, subway and bus routes intersect.

Although the connections to the other parts of the city are efficient, the permeability of the area itself is very low. The orientation and walking around is complicated due the lack of clear street hierarchy and safe and interconnected public paths. The lack of maintenance is visible in the urban design details and street furniture that is very often missing. Due to this fact, the area is used mainly by people passing by.

FUTURE TRANSFORMATION

The site itself provides a valuable land for future development and possible densification of the site. Transformation of such area can be highly beneficial not only for the area itself which could provide housing in attractive location for future residents of the city to come but also for the surrounding neighborhoods because it can bring job opportunities and economical benefits for established retail and commercial units, create recreational areas and meeting places or enrich the city of missing functions.

However, the answer to question on how the brownfield areas should be transformed is very complex and has many variables. New development should certainly promote sustainable approach towards the development in order to create livable urban environment with balanced ecosystem and safe and healthy living conditions with possibilities to live, work and relax throughout all seasons.

AREA DATA

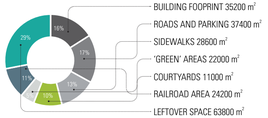
AREA: 22 HA

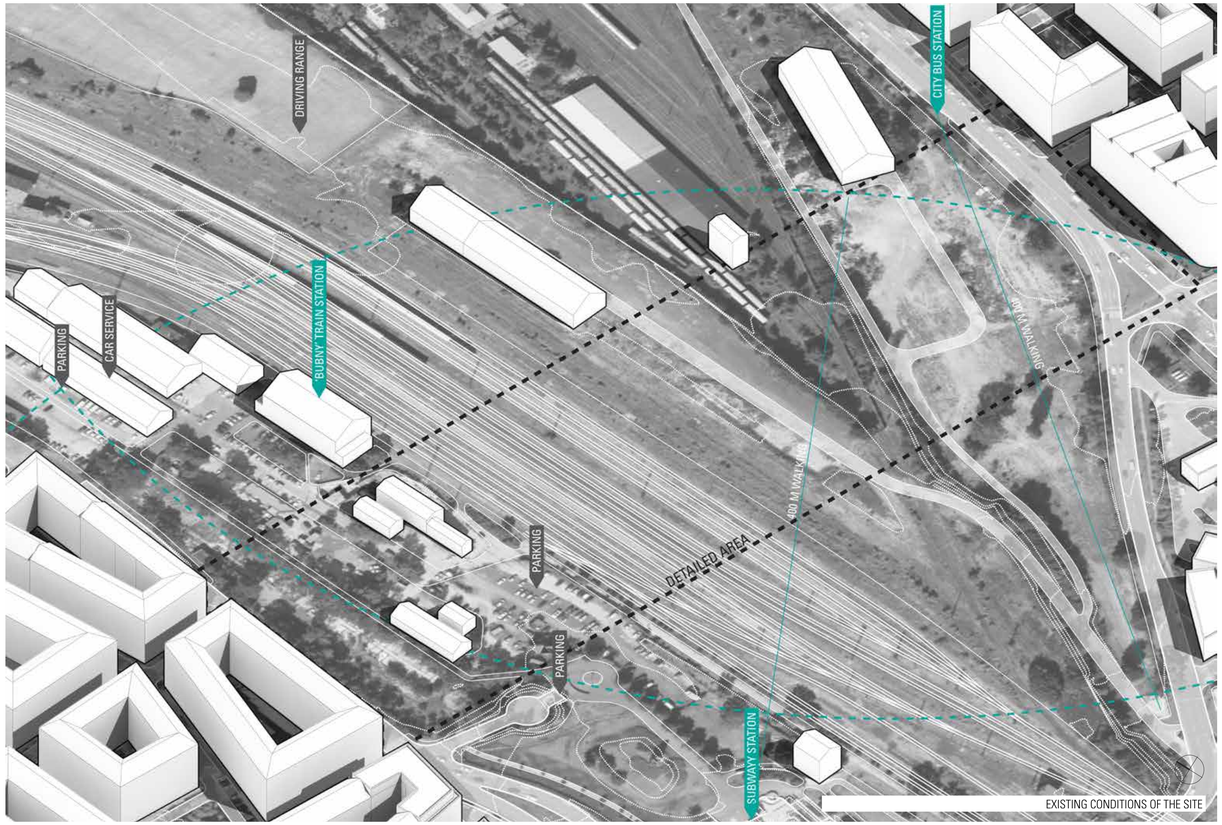
AREA DIMENSIONS: 500 x 440 m

BUILT-UP AREA: 3.5 HA

POPULATION: 300🚻

DENSITY: 58🚻 / HA [GROSS], 105🚻 / HA [NET]





EXISTING CONDITIONS OF THE SITE

DESIGN PROPOSAL

MIXED-USE NEIGHBORHOOD

The design project proposes mixed-use urban development along the two redesigned city boulevards [Bubenská and Argentinská street] with active open green space in the central part of the area. The project proposes compact dense block structure, inspired by typical urban blocks of surrounding neighborhoods, along the main city boulevards with more sparse semi-open urban blocks, combining low-rise high-dense structures within the proposed blocks.

The mixed-use urban development combines residential functions with work and retail uses mainly along the main street while the green open space provides various mix of functions for residents, from active landscapes to more passive parklands. The central park and greenery, integrated within the urban structure, provides important rainwater and stormwater management, benefiting from the ecosystem services.

CONNECTED PUBLIC REALM

The connected public realm consists of series of public spaces of different scales and functions, linking the two neighborhoods over the site. The central main public space spine connects the public spaces around the train station with the main plaza adjacent to the former heating station. The courtyards of urban blocks along the main streets provide possibilities to host more informal or intimate activities whereas the open squares and plazas of the public space spine represent flexible places for different activities and temporary uses of bigger scales.

The streets, crossing the site, are designed with focus on pedestrian movement with wide sidewalks and integrated bike paths. The sidewalks, adjacent to the buildings, provide enough space for outdoor seating or street furniture to create livable and active streets and interesting urban environment throughout the design site.

INTEGRATED GREEN NETWORK

The green network consists of spacious green area in the center of the area and smaller green spaces, integrated in the urban fabric, such as pocket parks, street tree lines with treepits and raingardens, courtyard retention ponds or urban farming fields. The green space provides valuable ecosystem services, improving living conditions and creating healthy environment with rich biodiversity and habitat for wildlife, provisioning rainwater infiltration and food production while providing space for active or passive recreation for residents of the new development as well as surrounding neighborhoods.

PROPOSAL OVERVIEW

AREA: 22 HA

AREA DIMENSIONS: 500 x 440 m

BUILT-UP AREA: 5.25 HA

POPULATION: 3650

DENSITY: 165 / HA (GROSS), 695 / HA (NET)

1650 UNITS = 3650 PEOPLE

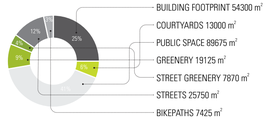
950 PARKING SPACES

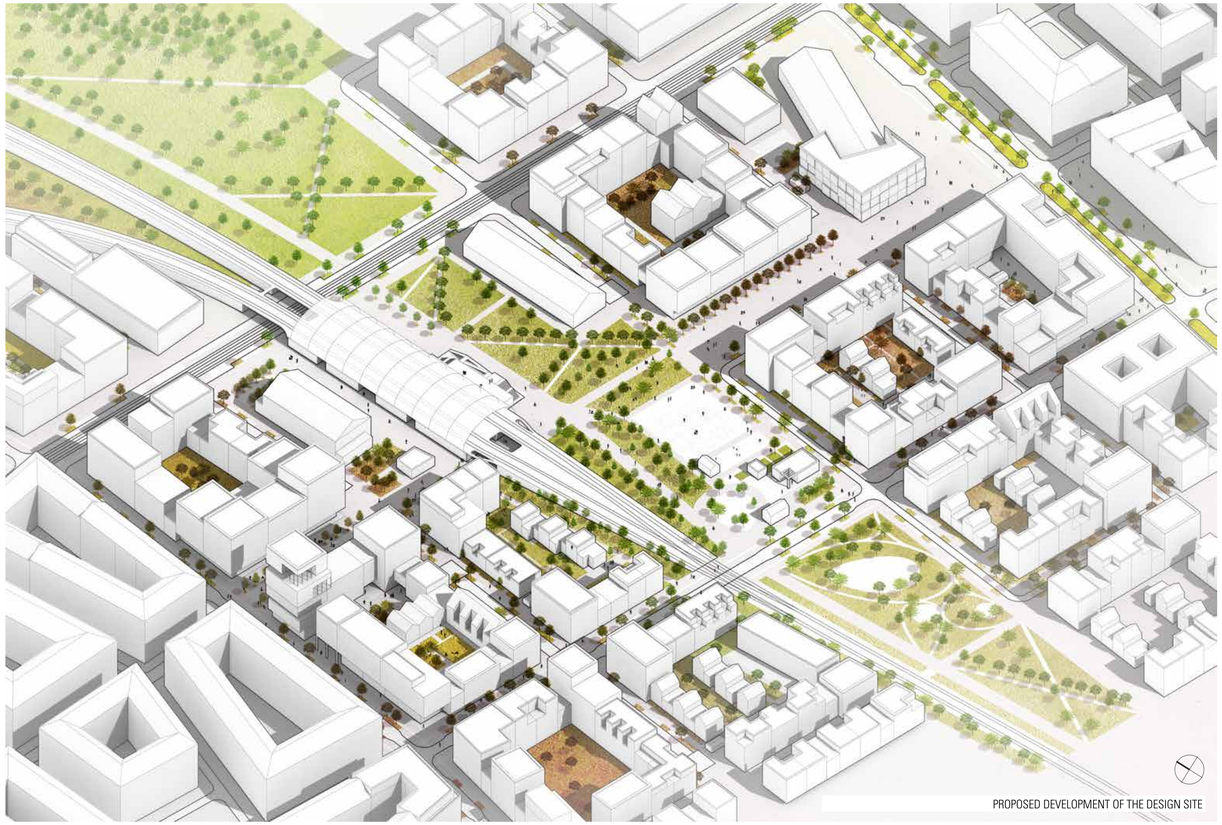
- 750 RESIDENTIAL PARKING
- 200 WORK + RETAIL + OFFICE PARKING

300 STREET PARKING

400 PARKING HOUSES

250 UNDERGROUND PARKING

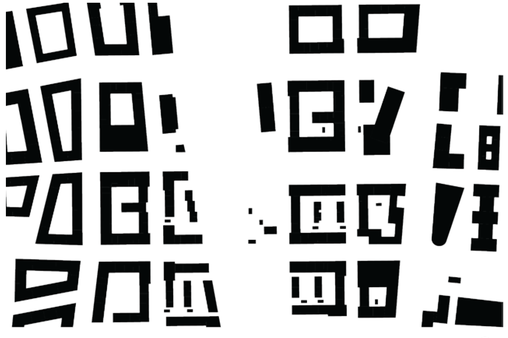




PROPOSED DEVELOPMENT OF THE DESIGN SITE

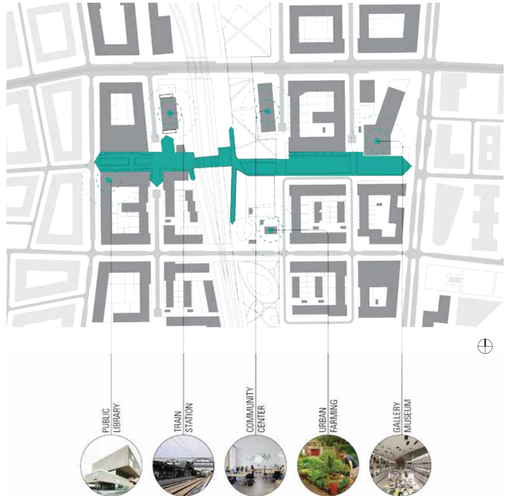
SCHWARZPLANN

The diagram below shows the schwarzplann of the proposed urban development. The urban fabric is inspired by the block dimensions of the surrounding area but the proposed blocks continuously open up and the typology is more diverse. The valuable existing buildings are kept and transformed into community and public buildings.



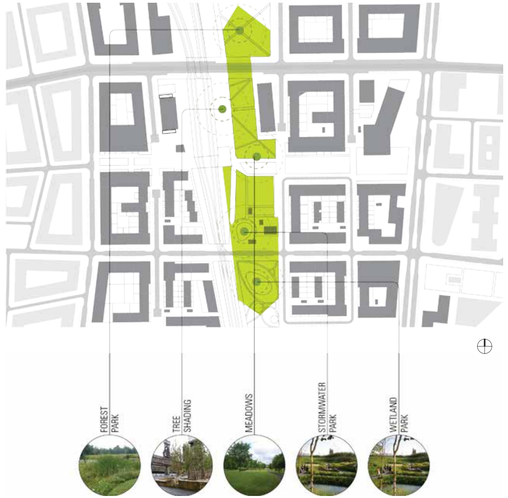
PUBLIC SPACE FUNCTIONS

The series of public spaces are designed to connect the two neighborhoods together and provide save pedestrian and bike friendly connection to the train and subway station. Along the public realm spine, there is a variety of not only active groundfloors with small businessess but also several important public buildings for the whole disctrict, such as public library, community center or train station.



LANDSCAPE FUNCTIONS

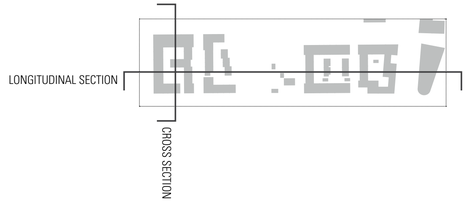
The urban landscape, connecting the site with the Stromovka city park and the two river banks, is divided into several segments with different functions and activities happening within them. There is a passive greenery with forest and meadows, providing spaces for walking and passive recreation. Adjacent to the train station, there is a formal park with treelines, providing shadow during the summer time. In the detailed area, there is a activity parkland with urban farming, playgrounds, sport courts and retention pond for stormwater from adjacent public spaces. In the south in the lowest part of the area, there is a wetland park, retaining the stormwater from the neighborhood.



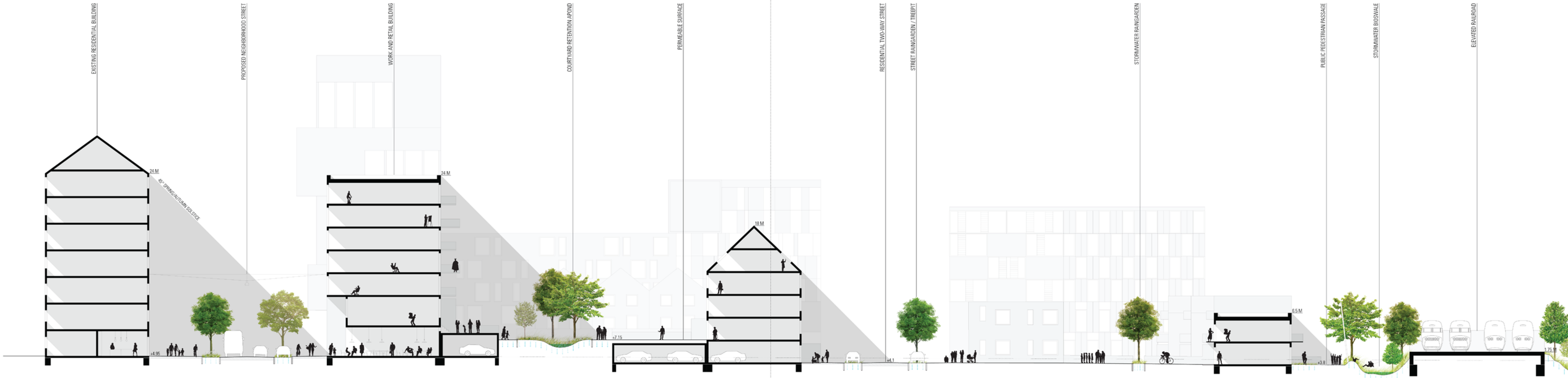
MOBILITY AND STREET HIERARCHY

There are five different types of street with different levels of car access. The whole neighborhood is well-accessible by walking because all of the public transit stations are within 2 minutes walk [200 meters radius]. There is two train stations, train station with subway station in the center of the neighborhood and bus station in the main city-scale boulevard. The area provides connected biking infrastructure to promote sustainable mobility as well as pedestrian-friendly car-free public space spine, connecting the two neighborhoods.

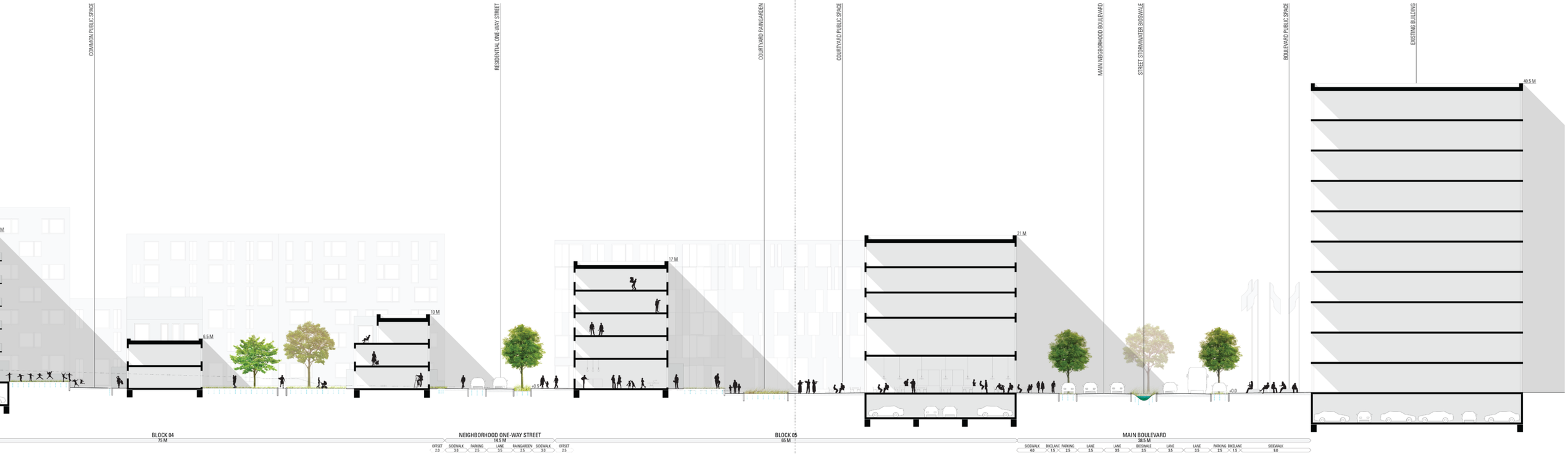
SECTIONS



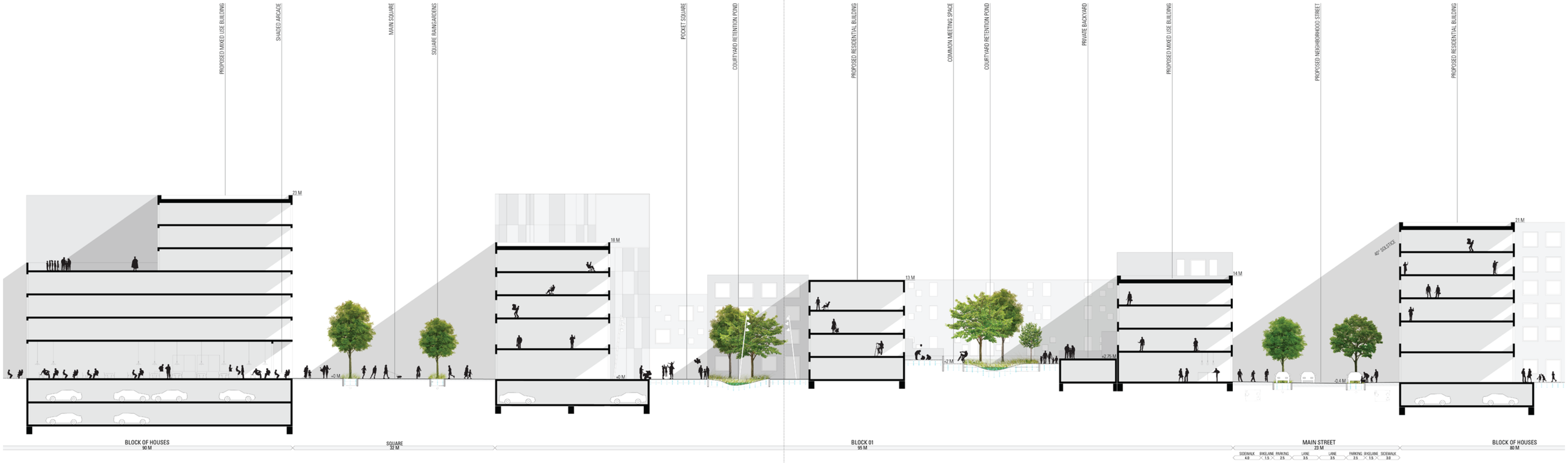
LONGITUDINAL SECTION
SCALE 1.250




PUBLIC PEDESTRIAN PASSAGE
STORMWATER BIOSWALE
ELEVATED RAILROAD
PARK STORMWATER BIOSWALE
MAIN PARK PEDESTRIAN AND BIKE PATH
URBAN PLAYGROUND
RESIDENTIAL ONE-WAY STREET
COMMON PUBLIC SPACE
6.5 M
+3.8
1.75 M
+2.0
+1.35
20 M
6.5 M
PATH
3 M
OFFSET
4.0
SHARED PATH
3.0
BIOSWALE
9.0
BIOSWALE
9.0
RAILROAD
20 M
BIOSWALE
10.0
BIOSWALE
10.0
SHARED PATH
6.5 M
BIKELANE
2.0
BIKELANE
2.0
PATH
2.5
BLOCK 03 (PARK)
68.5 M
NEIGHBORHOOD ONE-WAY STREET
14.5 M
PATH
2.5
TREEPIT
2.0
SIDEWALK
3.0
PARKING
2.5
LANE
3.5
PARKING
2.5
3.0
OFFSET
2.5
BLOCK 04
75 M


COMMON PUBLIC SPACE
RESIDENTIAL ONE-WAY STREET
COURTYARD RAINGARDEN
COURTYARD PUBLIC SPACE
MAIN NEIGBORHOOD BOULEVARD
STREET STORMWATER BIOSWALE
BOULEVARD PUBLIC SPACE
EXISTING BUILDING
6.5 M
10 M
17 M
21 M
40.5 M
±0.0
±0.0
BLOCK 04
75 M
NEIGHBORHOOD ONE-WAY STREET
14.5 M
OFFSET 2.0
SIDEWALK 3.0
PARKING 2.5
LANE 3.5
RAINGARDEN 2.5
SIDEWALK 3.0
OFFSET 2.5
BLOCK 05
65 M
MAIN BOULEVARD
38.5 M
SIDEWALK 4.0
BIKTLANE 1.5
PARKING 2.5
LANE 3.5
LANE 3.5
BIOSWALE 3.5
LANE 3.5
LANE 3.5
PARKING 2.5
BIKTLANE 1.5
SIDEWALK 9.0

CROSS SECTION
SCALE 1:250



BLOCK SEQUENCE

BLOCK SEQUENCE

BLOCK OVERVIEW

The detailed project focuses on the sequence of blocks located in the central part of the design site. The 500 meters long and 145 metres wide area connects the two surrounding neighborhoods by series of public spaces linked to the existing train station and by neighborhood street in the south of the block.

The block sequence consists of four mixed-use urban blocks and one open segment of the public park adjacent to the existing railway tracks. The built-up area is approximately 1.6 hectares and is divided into 51 building plots to create various and diverse urban environment. The urban fabric provides more than 30450 m^2 of housing and could accommodate around 1000 new inhabitants in more than 450 housing units. The proposed gross density is 165 people per hectare which is much higher compared to the gross density of the whole Prague 7 [58 people per hectare]. The net desity of the proposed blocks is 625 people per hectare.

One of the goals of the project is to provide not only accessible and affordable housing but also integrate job possibilities within the walking distance. There is more than 30450 m^2 of commercial and office spaces in the block sequence from which 9940 m^2 is located on the ground floor. These spaces can host not only small retail and office spaces but also public services and small commercial units, integrated within the neighborhood. This could provide more than 125 of workplaces in the small retail units and 375 workplaces in commercial and office spaces.

The improved accessibility to the public transport system is one of the key assets to the sustainable and resilient neighborhood. Therefore the amount of public space assigned to the parking of the individual cars is reduced to the smallest possible ratio of 0.5 parking space per housing unit. Overall, there is 290 parking spaces in the zoom-in sequence of blocks, 100 of them in the streetscape and 190 in the underground garages.

BLOCK SEQUENCE DATA

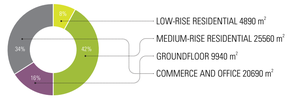
AREA: 6.1 HA

AREA DIMENSIONS: 500 x 145 m

BUILT-UP AREA: 1.6 HA

POPULATION: 1000

DENSITY: 165 / HA (GROSS), 625 / HA (NET)



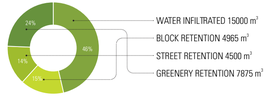
- 51 BUILDINGS / PLOTS
- FOOTPRINT 15670 m^2
- 450 UNITS = 1000 PEOPLE
- 375 WORKPLACES
- 125 RETAIL WORKPLACES

- 290 PARKING SPACES
  - 230 RESIDENTIAL PARKING
  - 60 WORK + RETAIL + OFFICE PARKING
- 100 STREET PARKING
- 190 UNDERGROUND PARKING

*1 UNIT = 60 M^2 = 2.2 PERSONS
**1 OFFICE WORKPLACE = 40 m^2 PER PERSON
**1 RETAIL WORKPLACE = 60 m^2 PER PERSON

WATER MANAGEMENT DATA

- ANNUAL RAINWATER 32340 m^3
- WATER INFILTRATED 15000 m^3
- BLOCK RETENTION 4965 m^3
- STREET RETENTION 4500 m^3
- GREENERY RETENTION 7875 m^3



*ANNUAL PRECIPITATION – 0.525 m^3
**COEFICIENT RUNOFFS:
GREEN ROOF – 0.3
HARD ROOF – 0.95
COURTYARDS [GREEN] – 0.4
PAVEMENT [POROUS CONCRETE] – 0.5
STREETSCAPE [POROUS ASPHALT] – 0.8
STREET RAINGARDENS – 0.1
GREENERY – 0.1
PUBLIC SPACE PAVING – 0.75

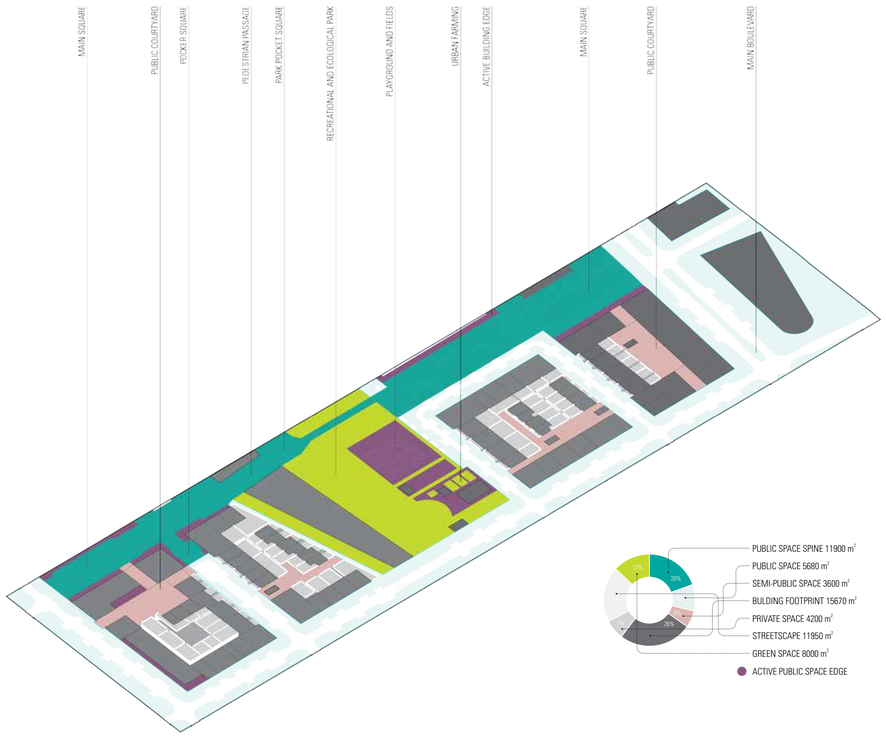
ISOMETRIC VIEW OF THE PROPOSED SEQUENCE OF BLOCKS

BUILDING FUNCTIONS

The urban fabric in the chosen set of blocks is designed as mixed use, with balanced overall ratio of residential area and work, retail and office spaces.

The commercial uses are located mainly along the main neighborhood streets with active groundfloors and (in most cases) underground parking for visitors. The residential functions are concentrated in the blocks futher to the inner parts of the design site and served by small-scale residential streets or shared spaces.

The typology of the housing varies, from more medium-rise residential buildings along the main streets to low-rise high-dense structures within the semi-open blocks, combining living in the individual house in the dense urban neighborhood.



PUBLIC SPACE FUNCTIONS

The main public realm spine connects the two neighborhoods over the site and provides series of interconnected public spaces of various scales and functions.

Main squares to the north of the block offer possibilities to host activities of bigger spatial demands, such as farmers' markets or art performances, whereas more intimate semi-public spaces within the block or pocket parks can accommodate more informal activities.

The big open green space in the center of the design area combines passive parkland of environmental values with more active recreational active greenscape with urban farming, outdoor sport courts or playgrounds.

WATER INFILTRATED 15000 m³
BLOCK RETENTION 4965 m³
STREET RETENTION 4500 m³
GREENERY RETENTION 7875 m³

WATER HANDLED ON SITE 32340 m³
WATER LEAVING THE SITE 0 m³

BLUE/GREEN ROOF
SEMI-PERMEABLE AREA
STREET RAINGARDENS
STORMWATER SWALE
RETENTION POND
WETLAND

ECOSYSTEM SERVICES : WATER

The design project implements integrated water management, dealing with stormwater from the public spaces as well as from the private areas on site.

The runoff from the streets is retained in the curb raingardens and slowly infiltrated to the ground. The overflow, if the capacity is exceeded, is led to the retention ponds in the park where the stormwater from public spaces is retained and slowly seeped through layers of filtrate to the ground. The green roofs and permeable or semi-pervious types of pavement are implemented where possible to decrease the amount of runoff and increase the amount of water infiltrated.

By these interventions almost 100% of the rainfall can be infiltrated or retained right on site.

GREY WATER RECYCLED 18720 m³
BLACKWATER REUSED 6740 m²

RECYCLABLE WASTE 294410 kg
COMBUSTIBLE WASTE 219240 kg
COMPOSTABLE WASTE 112750 kg

BLACK WATER PIPELINE
COGENERATION PLANT
GREYWATER RECYCLING
PHOTOVOLTAIC PANELS
SOLAR COLLECTORS
RECYCLING STATIONS

ECOSYSTEM SERVICES : WASTE

On the design site, there is proposed separated waste water system. The greywater from the households is collected and cleaned for secondary household uses. The black water is led to the neighborhood biodigester where sludge is turned into biogas for energy generation in a local cogeneration plant.

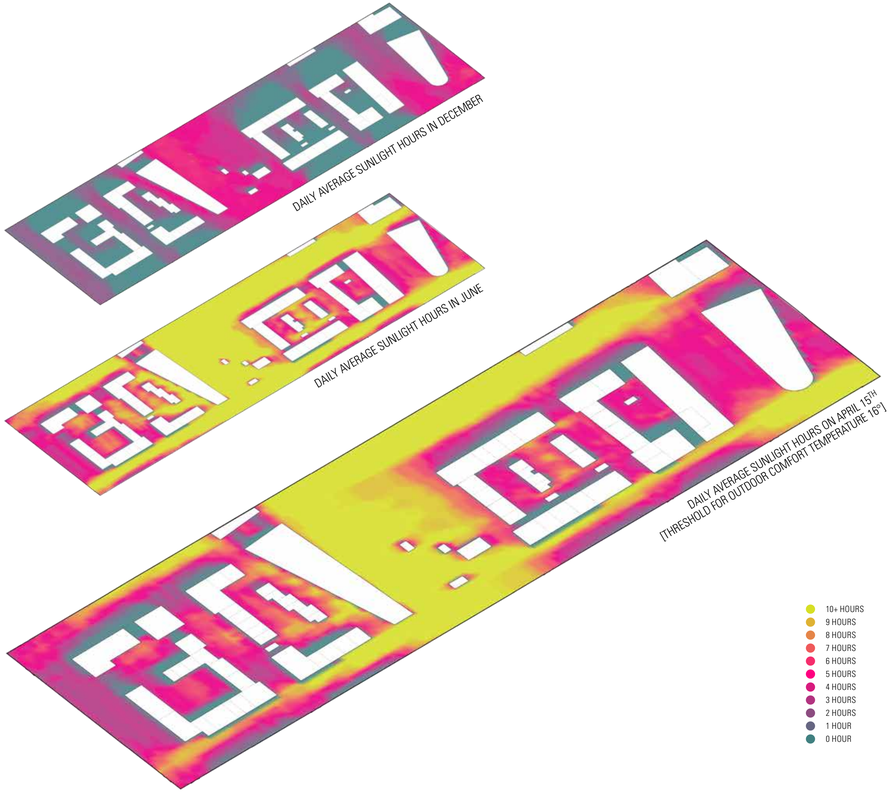
This waste-to-energy cogeneration system is supported by solid waste produced on site. The solid separated waste is collected in assigned collection stations from where it is moved by a vacuum chute system to a single pickup location, limiting the need of vehicular transport of garbage collection. Combustible waste is used as fuel source in local cogeneration plant while compostable waste is converted into biogas in neighborhood biodigester or composted on site as part of urban farming.

ECOSYSTEM SERVICES : GREENERY

The implemented green network consists of different types of urban landscape, both for active or passive uses and of various environmental performance.

The extensive and intensive green roofs on structures decrease the amount of runoff and help to create thermal comfort in the buildings. The front and back gardens, adjacent to the residential buildings, provide spaces for individual recreation or food production.

The park combines passive parkland with integrated rainwater measures with active grassland and open permeable surfaces, reducing urban heat island effect. Treelines in the streets provide natural shading protection to the adjacent buildings and retain runoff from the streetscape.



SOLAR EXPOSURE

The urban fabric is designed in order to create a livable outdoor environment with thermal comfort throught the whole year. The blocks are formed in the way they allow for solar radiation into the public spaces and courtyards during the winter time and provide shade in the summer time.

The most exposed spaces are protected by trees and vegetation to create natural shading system to protect the spaces in the summer and cool down the surrounding surfaces, mitigating the urban heat island effect of the urban area. In the winter time, the defoliated trees allow the maximal solar radiation for possitive thermal gains.

THE BLOCKS

BLOCK 01

66% COMMECIAL
34% RESIDENTIAL

BLOCK 01 DATA

AREA DIMENSIONS: 90 x 145 m
BLOCK DIMENSIONS: 65 x 95 m

AREA: 1.31 HA

BUILT-UP AREA: 0.41 HA

POPULATION: 250

DENSITY: 190 / HA (GROSS), 610 / HA (NET)

10 BUILDINGS / PLOTS
FOOTPRINT 4100 m²
115 UNITS = 250 PEOPLE
185 WORKPLACES

ISOMETRIC VIEW OF THE BLOCK 01

BLOCK 02

48% COMMERCIAL
52% RESIDENTIAL

BLOCK 02 DATA

AREA DIMENSIONS: 95x 145 m
BLOCK DIMENSIONS: 50 x 95 m

AREA: 1.35 HA

BUILT-UP AREA: 0.42 HA

POPULATION: 165

DENSITY: 120 / HA (GROSS), 390 / HA (NET)

13 BUILDINGS / PLOTS
FOOTPRINT 2375 m²
75 UNITS = 165 PEOPLE
50 WORKPLACES

ISOMETRIC VIEW OF THE BLOCK 02

ILLUSTRATION OF THE COURTYARD WITH COMMON SPACE AND BACK GARDENS

ILLUSTRATION OF THE RESIDENTIAL STREET WITH FRONT GARDENS

BLOCK 03

7% BUILT
93% OPEN

BLOCK 03 DATA

AREA DIMENSIONS: 75 x 145 m
BLOCK DIMENSIONS: 55 x 95 m

AREA: 1.05 HA

BUILT-UP AREA: 0.03 HA

POPULATION: 0

DENSITY: – / HA (GROSS), – / HA (NET)

- 4 BUILDINGS / PLOTS
- FOOTPRINT 305 m²
- 0 UNITS
- 15 WORKPLACES

- COMMUNITY + ACTIVE GROUNDFLOOR 300 m²
- PARK AND RECREATION 1850 m²
- COMMUNITY SPACE + PLAYGROUNDS 1700 m²
- COMMUNITY GARDEN + RESTAURANT 800 m²

0 10 25

ISOMETRIC VIEW OF THE BLOCK 03

BLOCK 04

32% COMMERCIAL
68% RESIDENTIAL

BLOCK 04 DATA

AREA DIMENSIONS: 90 x 145 m
BLOCK DIMENSIONS: 75 x 80 m

AREA: 1.28 HA

BUILT-UP AREA: 0.35 HA

POPULATION: 400

DENSITY: 315 / HA (GROSS), 1140 / HA (NET)

- 18 BUILDINGS / PLOTS
- FOOTPRINT 3450 m²
- 180 UNITS = 400 PEOPLE
- 50 WORKPLACES

- LOW-RISE RESIDENTIAL 1510 m²
- MEDIUM-RISE RESIDENTIAL 9600 m²
- GROUNDFLOOR 2235 m²
- OFFICE AND RETAIL SPACE 2975 m²

0 10 25

ISOMETRIC VIEW OF THE BLOCK 04

ILLUSTRATION OF THE PARK WITH RETENTION POND AND PAVILION WITH BISTRO

ILLUSTRATION OF THE NEIGHBORHOOD STREET WITH THE PUBLIC SQUARE

BLOCK 05

66% COMMERCIAL
34% RESIDENTIAL

BLOCK 05 DATA

AREA DIMENSIONS: 75 x 145 m
BLOCK DIMENSIONS: 62.5 x 82.5 m

AREA: 1.1 HA

BUILT-UP AREA: 0.36 HA

POPULATION: 190

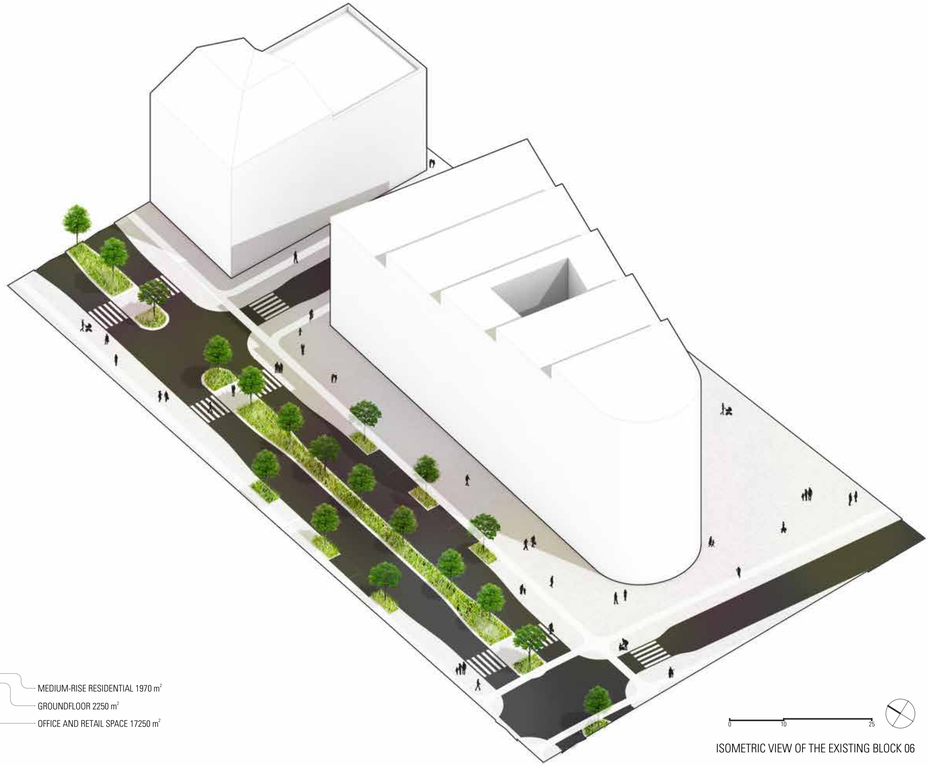
DENSITY: 172 / HA [GROSS], 525 / HA [NET]

6 BUILDINGS / PLOTS
FOOTPRINT 3605 m²
85 UNITS = 190 PEOPLE
120 WORKPLACES

ISOMETRIC VIEW OF THE BLOCK 05

BLOCK 06

91% COMMERCIAL *[EXISTING]*
9% RESIDENTIAL *[EXISTING]*



BLOCK 06 DATA

AREA DIMENSIONS: 77.5 x 145 m
BLOCK DIMENSIONS: 40 x 75 m

AREA: 1.2 HA

BUILT-UP AREA: 0.36 HA

POPULATION: 90

DENSITY: 75 / HA [GROSS], 250 / HA [NET]

2 BUILDINGS / PLOTS
FOOTPRINT 2645 m²
30 UNITS = 90 PEOPLE
300 WORKPLACES

ISOMETRIC VIEW OF THE EXISTING BLOCK 06

CONCLUSION

CONCLUSION

INTEGRATED NEIGHBORHOOD

The presented diploma thesis project seeks to find an answer to very complex question of how to reconnect the brownfield areas that are, although very often in the central parts of the cities, disconnected from their surroundings. Such areas provide an enormous reserve of hidden land fund that can be used as a sustainable alternative for ongoing sprawling development and uniform monofunctional zones that arise at the fringe of the urban areas. The transformation of such areas of hidden potentials can direct the forthcoming development of the existing cities towards the more sustainable future.

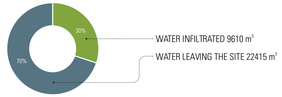
One of the key aspects during the design process was the minimal impact of the proposed development on the environment on and around the design site. Therefore, the existing urban areas were researched and analyzed in order to learn how the existing organism of the city can be improved. The data were an important tool for the design project and served as a basis for the implemented development.

The design project tried to reflect the gained knowledge and implement sustainable solution that could benefit not only the site itself but also the surrounding areas. The emphasis was put on the connections to the adjacent neighborhoods, implementation of various means of sustainable mobility and creation of spaces for social interaction, such as diverse and active public spaces and pedestrian-friendly streets with clear hierarchy and possibilities to accommodate multiple functions in the adjacent buildings.

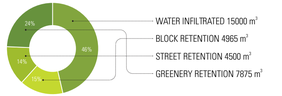
One of the main goals of the master project was to propose an urban environment with minimal impacts on the water cycle and surrounding ecosystems. The proposed integrated urban cycle treats any output of the urban ecosystem as a source, therefore decreases the amount of waste leaving the site. The greywater is recycled and used in the households for secondary uses, blackwater is collected and used for the energy generation in the neighborhood cogeneration plant. The rainwater is harvested and used in the housing units for use or for irrigation, stormwater from the open spaces is retained and slowly infiltrated into the ground, recharging the groundwater supply. By implementing these systematic measures, the proposed development becomes independent on the existing sewerage network and does not contribute to the flooding or pollution of the water sources, compared to the existing urban water cycle where more than 70% of the on-site precipitation enters the combined sewerage network and leaves the site.

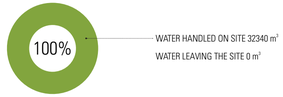
By taking all the measures mentioned above, I have tried to do my best to propose a living urban environment that could represent the sustainable future for the city of Prague. I hope that my design project could bring a relevant contribution to the ongoing discussion of the transformation of brownfield ideas.

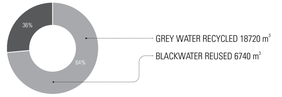
WATER MANAGEMENT OF THE EXISTING SITE

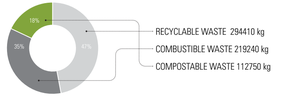


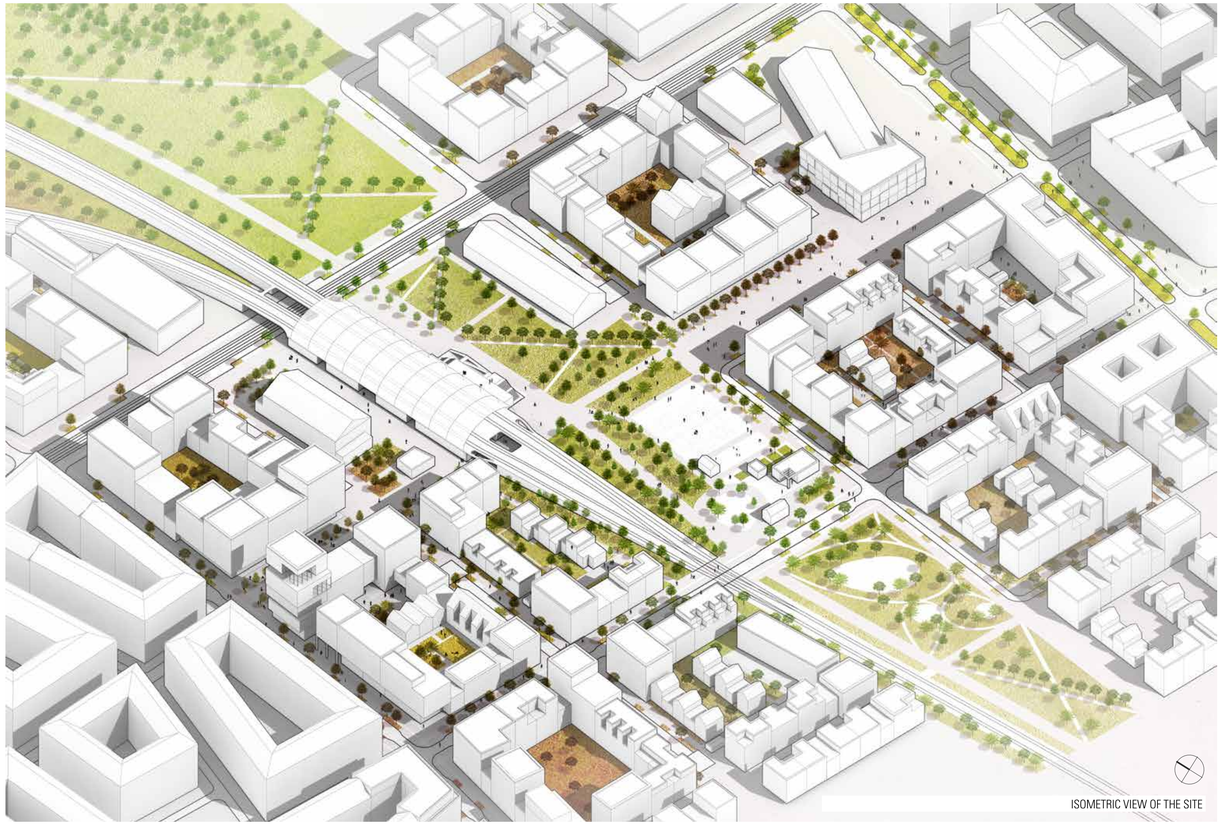
WATER AND WASTE MANAGEMENT OF THE PROPOSED DEVELOPMENT











ISOMETRIC VIEW OF THE SITE

ENDNOTES

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