

CZECH UNIVERSITY OF LIFE SCIENCES
FACULTY OF ENVIRONMENTAL SCIENCES
LANDSCAPE PLANNING PROGRAMME



**BROWNFIELD RESTORATION AT MEET FACTORY
SMICHOV, PRAGUE**

MASTER THESIS

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DIPLOMA THESIS ASSIGNMENT

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Landscape Planning

Thesis title

Brownfield Restoration at Meet Factory: Smichov, Prague

Objectives of thesis

The aims of this Masters Thesis Project are to prepare a series of restoration and remediation design concepts for the post industrial rail yard location near Smichov main rail station known as the Meet Factory.

Research will explore and summarize different types of post industrial sites that are commonly referred to as brownfields. The study site is certainly in need of soil remediation and infrastructure restoration. However, the location holds great potential for providing connections to the Vltava River non motorized recreational trail (greenway), the residential hill slopes to the north and west, and repurposing of the abandoned and under utilized industrial buildings adjacent to the rail corridor.

Additional research will explore the relationship of brownfields to railway yards.

The thesis project will result in a series of new design proposals for the project study area which will help guide IPR and others in

Methodology

The student will conduct a detailed literature review to help in the definition of brownfields, the need for and barriers toward their clean up, the social and the environmental impacts that they pose for communities today. He will also explore the economic impacts such as the disincentives toward their remediation. From this he will introduce the presence of brownfields in the Czech Republic, their history and efforts toward restoration. In particular, he will make the connection between brownfields and railway sites here and the challenges toward their redevelopment.

Secondary research will be based on the extensive assessment study performed by Wageningen University and Research in recent years where they conducted extensive public surveys and site investigations into brownfields and rail locations in Prague, those being Masarykovo Ndrazi, Zizkov Railway station, and Bubny-Zatory Railway.

From this analysis and literature review, Nawar will focus on the Meet Factory area, Prague 5, Smichov as a case study for site revitalization. Primary research will include gathering of soil samples from the study site for analysis by CULS Environmental Geoscience labs to determine the type of and extent of soil contamination at the Meet Factory area.

The student will then propose multi purpose site restoration concepts to restore the site itself and to also provide pedestrian and recreational connects to the Vltava River corridor situated adjacent to the Smichov and the Meet Factory site.

The proposed extent of the thesis

50+ pages with illustrative images

Keywords

Brownfield, Urban re-development, Soil contamination, Post industrial

Recommended information sources

Brownfields in Prague City Center: Criteria for Sustainable Development Research conducted by Wageningen University for Arnika, July 2009
Brownfields in the Czech Republic, 1989–2009: The long path to integrated land management Article U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response EVALUATION

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Hereby, I declare that this diploma thesis is a presentation of my original research work and that no other sources were used other than what is cited.

Prague

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(author's signature)

PREFACE

I offer my utmost thanks to my thesis advisor, Doc. Peter A. Kumble MLA, Ph.D who has provided guidance, support and thoughtful comments all the way through the past year of my graduate journey. This research thesis could not have been completed without his advice and encouragement. I am also grateful to Prof. RNDr. Michael Komarek, Ph.D. from the department of Environmental Geosciences for his help with analysing soil samples of my study area, and to everyone with whom I consulted and offered their precious suggestions on how to improve my thesis. Finally, my appreciation goes to my parents and friends for their consistent encouragement, love and support throughout my study.

ABSTRACT

The redevelopment of brownfield sites is an important way toward the sustainable development of cities. This is important as many of those sites are situated in the core of urban areas. Therefore, identifying new ways to reuse them and redeveloping their surrounding landscape is a key element for achieving urban redevelopment and environmental sustainability. The goal of this masters thesis project is to create a non motorized greenway in the southern part of Smichov in order to provide better connectivity within different points joining the residential zone on the hill with the recreational area on the riverside, turning the area into more valuable and appealing for investors and stakeholders, healthier for the communities and environment which will cause in the prosperity of the whole area. The proposed design will also suggest different solutions to solve problems that were stated in the analysis of the project site.

KEYWORDS

Brownfields, Urban re-development, Soil contamination, Post-industrial

ABSTRAKT

Rozvoj brownfieldů je významným způsobem jak pomoci udržitelnému rozvoji měst. Je významný i proto, že mnoho těchto lokalit se nachází v blízkosti centrálních částí měst. Nalézt možnosti jejich nového využití a obnovy okolní krajiny je základním předpokladem nového urbanistického rozvoje a environmentální udržitelnosti. Cílem této magisterské práce je vytvořit návrh stezky bez automobilového provozu v jižní části Smíchova, která by umožnila spojení mezi rezidenční částí na kopci a rekreační oblastí na břehu řeky. Tato změna by měla oblast atraktivní pro investory, a zároveň vytvořit zdravější prostředí pro místní obyvatele. Výsledkem by mělo být zvýšení prosperity oblasti. Dalším výsledkem tohoto projektu budou návrhy řešení problémů, které jsou popsány v analýze dané oblasti.

Klíčová slova

Brownfields, urban re-development, znečištění půdy, postindustriální

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1. INTRODUCTION

The topic of interest for this masters thesis focuses on the urban redevelopment of Prague's brownfields and in particular the railway brownfields. Sites that exist in the core of urban areas and their redevelopment is the key element toward a sustainable urban redevelopment.

Therefore, a project site in Prague 5 south of Smichov district was chosen as a model for the case study. This project location like many other brownfield sites in Prague has great potential when redeveloped to contain the urban growth caused by people moving to the City. So, newly developed areas are needed in order to contain more number of people instead of taking off new lands on the edges of the city for development. However, these brownfield sites with great redeveloping potential have many problems related to their ownership, soil contamination, redevelopment expenses that is limiting the public interest in finding a way to put these sites back in use. Therefore, it is necessary to educate communities and investors of the positive social, economic, and environmental impacts of brownfields redevelopment.

2. AIMS

The aims of this master thesis project are to prepare a series of restoration and remediation design concepts for the post-industrial rail yard location near Smichov main railway station where the contemporary art center known as Meet Factory is located in Prague 5. Research will explore and summarize different types of post-industrial sites that are commonly referred to as brownfields; the study site is certainly in need of soil remediation and infrastructure restoration. However, the location holds great potential for providing connections to the Vltava River non-motorized recreational trail (Greenway), the residential hill slopes situated to the north and west, and re-purposing of the abandoned and unused industrial buildings adjacent to the rail corridor. Additional research will explore the relationship of brownfields to the railway yards. The thesis project will result in a series of new design proposals for the project study area which will help guide IPR and others into considering different possible scenarios in the redevelopment of the area.

3. METHODOLOGY

This master thesis is divided into three parts; the first part is a detailed literature review to guide the reader in understanding the definition of brownfields, the need for and the barriers that inhibit their restoration to usable space and the social and the environmental impacts that they pose for communities today. The research will also explore the economic impacts of a brownfield, such as the disincentives towards their remediation. From this, an introduction about the presence of brownfields in the Czech Republic is presented and the history and the beginnings of efforts toward their rehabilitation. In particular, railway brownfields in the Czech Republic and the challenges toward their redevelopment. In addition to secondary research that will be based on the extensive assessment study performed by Wageningen University and Research in 2009, where researchers conducted extensive public surveys, interviews, and investigations into brownfields and rail locations in Prague, those being Masarykovo Nadrazi, Zizkov Railway

Station and Bubny-Zatory railway. From this analysis and literature review the second part of the thesis will focus on the Meet Factory area, Prague 5 Smichov as a case study for site revitalization. This research will also include gathering of soil samples from the study site for analysis by CULS Environmental Geosciences labs to determine the type of extent of soil contamination at the Meet Factory site and its surroundings. Finally, a third part which includes a design proposal for redeveloping the study area and proposes a solution for establishing connectivity in the area and these unused brownfields at the Meet Factory area.

4. LITERATURE REVIEW

4.1. BROWNFIELD DEFINITION

There are many brownfield sites that exist around the world today. It is perhaps accurate to that the term, brownfield, is surrounded by confusion. Several definitions can be found for the term due to the way of their formation. According to the United States Environmental Protection Agency established in 1970 in response to elevated public concern for human health and the impacts of pollution on the environment, brownfields are, “real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant” (EPA,2017). In other words, brownfields are defined as abandoned or underused rural or urban industrial and commercial sites (City of Ottawa, 2015). Most of us have likely passed through or nearby a brownfield site without recognizing their existence because they come in different sizes and various shapes; old factories, closed steel mills, gas stations, railway yards or abandoned

grocery stores (“Unlocking Brownfields About the National Association of Local Government Environmental Professionals,” n.d.). Contamination of the soil and groundwater are common consequences of post industrial brownfield sites. Therefore, due to the extent of contamination, the effort necessary to restore such a place can be a major inhibiting factor for those who are interested in future investment and redevelopment opportunities and who are also willing to bring a new future to such sites. Fears of costs, complications, delay, or even legal liability associated with pollution. Brownfield sites can be a serious blight within the neighborhood where they exist, they are the reason for many problems and risks that may append to the health of community and environment. These risks are mostly related to pollution in soil, air pollution, or even groundwater and surface water (Ionescu-Heroiu & Bank, 2010). Moreover, brownfields are also linked with abandoned and unsafe buildings, lost jobs and decreased property values, criminal activities and site vandalism. This is why brownfields are often ignored and forgotten. For this reason, redevelopment or remediation

of these sites becomes complicated by the existence or potential existence of hazardous substances, contaminants, and pollutants (“Unlocking Brownfields About the National Association of Local Government Environmental Professionals,” n.d.)

4.2. THE NEED FOR BROWNFIELD REVITALIZATION

Brownfield sites have serious negative effects on economic, environmental and social aspects of the life of communities (Ignjatić, 2017). Therefore, the successful cleanup and redevelopment of brownfields has the potential to create a healthy environment that can enhance the livability of communities that are threatened by environmental contamination. The City of Ottawa (2015) determined that, “Brownfields are valuable to community resource when they are revitalized and developed correctly.” Therefore, returning these sites back to productive use by stabilizing the contamination remaining and rehabilitating blighted buildings, will often become an economic economical

contributing to the vibrancy of built up areas and the overall health of the environment. Moreover, the benefits of the redevelopment will expand far beyond removal of the contaminants. It will provide significant economic, social and environmental benefits - such as; increasing job opportunities and allowing the job retention of existing jobs within the communities in the affected districts. Revitalizing will also increase the surrounding properties values by attracting more developers (Cich, 2018). The communities will become more extravagant and healthier when getting rid of the contaminant as well as preserving the natural and green areas by limiting or slowing down the urban sprawl, the different kind of pollution and the emissions which can be found more extensively around these sites (Brown, Faust, & Nygard, 2017).

4.2.1 SOCIAL IMPACTS

One of the values of the redevelopment of brownfield sites is the positive influence that affects individuals and communities in the neighborhoods surrounding

brownfields. These areas are usually considered to contain a high rate of poverty, crime and other social problems (City of Ottawa, 2015). One study found that the cleanup and redevelopment of these sites improves the public health and livability of nearby communities; making them more secure, powerful and vibrant. Remediation of these sites will bring back the productive use of it and the benefits will spread around the surrounding communities (Cich, 2018). The purging process will increase the property values of these neighborhoods and make the surrounding area more appealing for investors. This can be also related to and depend on the conditions, types and size of the brownfield. According to a national study, it was found that the cleanup of brownfield sites can lead to an increase in the property value ranging from 5-15% for properties within three-quarters of a mile (see figure 1) (Brown et al., 2017), as well as the increase in the demand for urban living, since renters and home buyers prefer more houses in compact and more urbanized neighborhoods; for shorter commutes and a safe infrastructure; sidewalks, bike lanes,

and space for recreation (Brown et al., 2017). Communities that are settled within a brownfield area are more likely to face multiple public health problems, which can differ from direct or indirect contact with hazardous chemical substances, poor air quality, insufficient green, open and recreational areas, elevated blood lead levels and asthma predominance, as well as serious illness which is related to respiratory and cancer. As a result; the cleanup of contaminated brownfield sites will ensure better health and minimize the risks of cancer for the neighboring communities (Brown et al., 2017)

Project Type (Geographic Radius = 2,500 ft)	Property Value Increase Achieved
Residential	3.1%
Commercial	4.6%
Parks	4.4%
Industrial	3.2%
All sample (net)	2.7%

Figure 1 Example of property value increase after the cleanup and redevelopment of Minneapolis. (Brown et al., 2017)

4.2.2 ENVIRONMENTAL IMPACTS

Worldwide; cities are trying to apply innovative and creative approaches to regenerate brownfield sites, since most of the construction land in cities are occupied by devastated brownfields (Dulic, Olivera & Krkljes, 2015). Communities should not forget about the importance of brownfield remediation and the associated benefits on their local environment (City of Ottawa, 2015). According to the US EPA (2009), the redevelopment of brownfield sites will assert the reviving of the environment in different ways such as preserving green fields, reducing the natural devastation resulted from habitats resulted by the urban sprawl, and improving air quality. Through the cleaning process of these sites' contaminated soils being removed and secluded to prevent exposure of any hazardous substances, surface and groundwater can be also treated in order to eliminate contaminants. As a result, these positive impacts can be summarized with the following impacts - (Brown et al., 2017)

4.2.2.1 THE REDUCTION OF ENERGY CONSUMPTION AND EMISSIONS

According to different examples from Minnesota and Ottawa in brownfields redevelopment around the US, it was proven that the redevelopment of certain brownfields had great results on the reduction of energy. For example, the University of Minnesota renovated its "steam plant" that was built in 1912 into the main energy plant, with a main goal of reducing the emissions of carbon by 50% by the year 2020. As a result, the university modified the century-old steam plant to simultaneously produce steam, heat and electric power, making this one of few facilities nationwide to combine both power generation and heat at large scale (Cich, 2018).

4.2.2.2 IMPROVEMENT OF AIR QUALITY

The reduction of the miles traveled by vehicles and the greenhouse gas emissions carried out by the redevelopment of brownfields can produce 32-57% less air

pollutant emissions per capita. (Brown et al., 2017). Usually through a better planning of the infrastructure and transport network around brownfield sites, by providing bike lanes for cyclists and promoting the different kind of shared alternative mobilities. As well as increasing the green spaces, parks and vegetation around developed sites (Kaplan, 2013).

4.2.2.3 LIMITING URBAN SPRAWL AND CONSERVING LANDS

The redevelopment of brownfield sites allows the conservation of undeveloped lands and habitats at the urban fringe. Especially when these brownfields are re-purposed for residential purposes which makes it convenient for accommodating the growth of population (Brown et al., 2017). (Krkljes, 2015) states that one of the most important objectives in smart growth of cities is to focus more on building and redeveloping the already built up areas. Therefore, the city of Portland, Oregon is a good example of an enviable brownfield situation, since it became one of new hot spots to live in the United States, Due

to an extraordinary flow of people and jobs over the past ten years. Portland's local government has been preparing for this growth by establishing an Urban Growth Boundary (UGB). The UGB aimed for developing Portland's urban growth boundaries by limiting the new development and protecting the existing natural resources. So, the UGB achieved a densification of urban neighborhoods and inner-city properties redevelopment (City of Ottawa, 2015).

4.2.2.4 PROVIDING URBAN GREEN SPACES

Brownfield sites can be turned into green and recreational spaces such as parks, community gardens and green infrastructure. Repurposing these sites into green areas will improve the quality of life for communities. Specifically in underserved neighborhoods and incentives of private investments in the neighboring areas (Brown et al., 2017). Most of brownfields neighborhoods suffer from shortage of green spaces such as gardens, parks, playgrounds and other natural open spaces. Therefore, turning brownfield sites

into green spaces can be a possible solution to improve the natural environment and transform those distressed neighborhoods into a healthier environment for communities which will provide more opportunities and places for recreations and physical activities (Siikamäki & Wernstedt, 2008). The tracks at Brea trail, Brea, California is a good example where an abandoned and contaminated railroad was transformed into an amenity that encourages different kind of outdoors activities including walking and cycling (Manzanilla & Jones, 2015).

4.2.3 ECONOMICAL IMPACTS

In addition to these broader positive impacts of redeveloping brownfield sites, economic growth is one of a central policy goal in most brownfield redevelopment programs. The results of these impacts are one of the most evident and measurable after remediating a brownfield site (Brown, Faust, & Nygard, 2017). Many case studies show that brownfield redevelopment offers significant economic benefits at all geographic scales (local, provincial, and national) no matter the size of the project

and the re-use type (NRTEE, 2002). It is offering job opportunities and retention allowing private investments, tax base revitalization and functional effective use of the existing infrastructure, in addition to expanding these benefits to the neighboring properties and making it attractive for new businesses. Therefore, the scale of these benefits is expanding from a local level to a regional level (Brown et al., 2017)

4.2.3.1 JOB RETENTION AND CREATION

According to the US EPA ("Unlocking Brownfields About the National Association of Local Government Environmental Professionals," n.d.); brownfield redevelopment is a prime expedient for job creation and practice. More than 29,000 jobs appeared as a result of the exploitation in redeveloping brownfield sites. It is also an opportunity to train those citizens in the waste assessment and remediation fields, offering more than 1,740 brownfield employment opportunities. For example in Boston, Massachusetts, EPA funding

provided a 460- hour course to 60 young workers in different kind of fields such as handling hazardous substances and environmental chemistry. In addition to computer skills and applied mathematics (Unlocking Brownfields About the National Association of Local Government Environmental Professionals, n.d.).

4.2.3.2 ENCOURAGING PRIVATE INVESTMENTS

Redeveloping contaminated properties will involve a considerable amount of private investments, because most of the investments in brownfield redeveloped properties are from private sources. According to the EPA reports on this topic (EPA, 2012) brownfields gave more than \$22 billion in both public and private investments, since the establishment of the program in 1995. As a result, these private developments will strengthen the economic resurgence of an entire community (Brown et al., 2017).

4.2.3.3 THE EXPANSION OF LOCAL TAX REVENUES

The reuse and development of brownfields can have direct positive impacts with financing the local governments, by redeveloping these abandoned sites the local tax revenues will increase by the expansion of the properties which have been developed, by bringing in the right applicable owners, also by producing sales taxes through commercial development, hiring tax paying citizens and creating public amenities, recreation spaces that will raise the value of the surrounding properties (City of Ottawa, 2015). According to a study in a conference of Mayors in the US, they found that the redevelopment of 654 brownfield sites in 50 different cities yielded a \$309 million collective tax base increase between 1993-2010 (Jones & Welsh, 2010).

4.2.3.4 EFFICIENT USE OF EXISTING INFRASTRUCTURE & THE BENEFITS OF DENSITY AND CONNECTIVITY

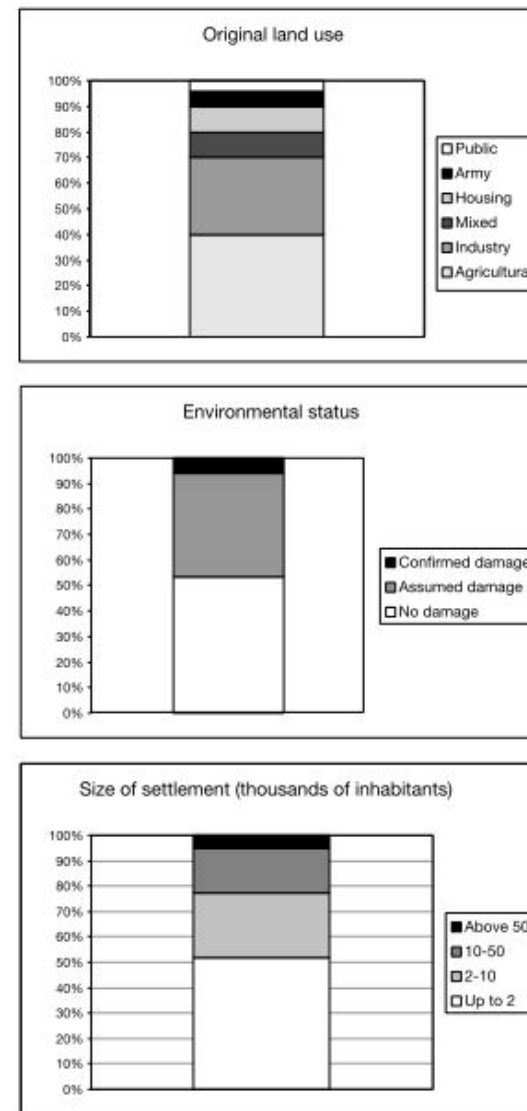
Remediation of brownfields will reduce the expenses of the public infrastructure when allowing the reuse of the existing infrastructure and preserving the undeveloped sites at the urban fringe. So, by supporting infill development on brownfield sites, the cost of the infrastructure is considerably decreased for municipalities and developers (Cich, 2018). When brownfields are turned into dense and compact development this results in a better return, more efficient transport system and enhances the flow of communities, which is leading to an increase in economic productivity (Brown et al., 2017).

4.3 BROWNFIELDS IN THE CZECH REPUBLIC

4.3.1 HISTORY

The Czech Republic recognized more than 10,000 brownfield sites. More than 2000 of these sites are larger than 2 hectares or with a building exceeding 500 square meters. While the majority of these brownfields can be found in smaller rural communities, many of them can also be found in prime locations as a peculiar feature of post-socialist cities (Garb, 2014). Ten percent of the land area in the socialist cities were devoted to the industrial uses in addition to the military sites and oversized rail facilities (Garb, 2014). The redevelopment of these sites was very risky and time-consuming due to the fragmented ownership patterns and the heavy contamination of pollutants found in soil. Government liability for environmental hazards and clean-up that might be discovered was often unclear or lost in ownership transfers (Garb, 2014).

Figure 2 Characteristics of Czech brownfield sites. based on various data from czechinvest(Garb,2014)



4.3.2 REGENERATION BEGINNING(1989-2009)

There was almost no recognition of brownfields as a phenomenon in the first decade after the transition from socialism. A desolated railway, abandoned Soviet army barracks and contaminated factory all sidings here and there, all constituted serious issues, massive challenges, and opportunities in the wake of a political revolution (Garb, 2014). Even after the rise of the awareness of the brownfields concept, there was still no exact determination of these underused lands, no central registry or mapping of them (Garb, 2014). As a result; it took years for the contours of the problem to be known. There was a rise in awareness by the end of the 1990s. But the first workshop on recycling the urban land was held in April 2001, with the cooperation of many stakeholders and representatives from the city of Prague (Garb, 2014).

1997	Impacts of brownfields begin to be sensed in a piecemeal manner
1999	Technical assistance to the Czech investment promotion agency identifies need to also ready and offer brownfield sites (rather than promoting only greenfield sites)
2001	Realisation of brownfield issue as widespread, and as a named category of problem
2002	First brownfield projects attempted
2002	First analytical report on brownfield situation, barriers, policies
2003	Pre-accession EU funding of know-how transfer projects
2003	Launch of industrial brownfield remediation programme
2003	First Czech web source
2003	First Czech handbook
2003	National development plan priorities for Structural Funds (SF) 2004–2006
2004	First assessment of scope of problem
2004	Commencement of first major brownfield development
2004	SF priorities make brownfields visible and spur private sector interest in finding eligible sites
2005	Research programmes
2005	Programme for communities dealing with army brownfields
2005	Regional data inventories tool available
2006	First attempt towards a national inventory (CzechInvest)
2006	First handbook and course materials for construction professionals
2006	National strategic reference framework priorities for SF 2007–2013
2007	New Planning and Construction Law requires inventory of already urbanised land with reuse potential
2007	SF and their programmes promote brownfield priorities
2007	Private sector boom in regional property including brownfields
2007	Administrative changes in CzechInvest reduce organisation's brownfield expertise
2008	PPP partnership forming
2008	National brownfield strategy fails to obtain support
2008	SF 2007–2013 financed brownfield projects commence
2008	Brownfields incorporated in national scale planning support GIS layers
2009	Recession effects most of commercial brownfield projects
2009	JESSICA contract signed between EIB and Ostrava region
2009	Regional and local authorities forecast serious budget shortfalls, which would limit their ability to support public brownfield projects
2009	Czech administrative regions show interest in compiling and analysing brownfield data on smaller brownfields as a step towards impact mitigation efforts

Figure 3 Czech brownfield timeline (Garb, 2014)
(PPP; Public Private Partnership. GIS; Geographic Information Systems. JESSICA; Joint European Support for Sustainable Investment in City Areas. EIB; European Investment Bank).

4.4 RAILWAY BROWNFIELDS IN THE CZECH REPUBLIC

4.4.1 HISTORY

There was a significant decrease in the volume of freight and railways across the whole of Europe during the second half of the 20th century; due to truck transportation of goods, personal autos and air travel. This decrease in the volume of railway devoted towards the transportation of freights (raw materials, manufactured goods, etc) had declined to just 20% during the last 20 years (Vodný, 2012). As a result, the large stations located in or near cities were no longer used or remained active. Some of them were redeveloped by the city to serve another purpose and the others remained unused; therefore it is called railways brownfield, these brownfields are very specific in terms of their structure. Mostly they are linear in the case of track, or designed for a special purpose in the case of buildings so they can't be re-transformed easily to serve another purpose (Vodný, 2012). The Czech Republic has one of the most dense rail networks in Europe as well as

Germany and Switzerland. It has always been one of the top ranked in the world in term of rail transport. However, nowadays many of these tracks are out of use with contaminated soils and are thus classified as brownfields (Polak,2005). Most of the railway infrastructure in the Czech Republic went through significant disturbances since most of the tracks came from the times when the Austro-Hungarian empire existed; when these tracks were built either by state or private investors (Vodný, 2012).

4.4.2 RAILWAY BROWNFIELDS PROBLEMS

According to (Vodný, 2012), there are many obstacles on these sites which are making the railway brownfield situation more complicated; requiring a specialized procedure to analyze these sites and the problems that come along during their development. The most important factors are:

- The ownership of the properties and their relations after the separation of the state organization Czech railways (Ceske Drah,

CD) into two inheritor companies: Czech railways JSC(CD) as a transport operator and railway infrastructure administration, state organization. Sprava Zeleznicni Dopravni Cesty,(SZDC) according to Act No. 77/2002 Coll. On joint stock company Czech railways and state organization railway infrastructure administration. (Vodný, 2012).

- The huge diversity and specific characteristics of these areas (line construction, station buildings, warehouses, terminals, ramps etc..) which can cause problems and limitation for future use (Vodný, 2012).
- One of the most serious problems related to brownfield sites is that there's a possibility of widespread contamination like fuels and greases on the surfaces and objects around the site. (Vodný, 2012).
- "strategic reasons" such as the interest of the state on maintaining specifically selected tracks even if it is out of order (for example national defense interests).
- Financial issues, for example; it is more economical (in short term) to maintain specific tracks instead of removing it completely (Vodný, 2012).

4.5 A STUDY BY WAGENINGEN UNIVERSITY AND RESEARCH

A study was made by Wageningen University (WUR) in the Netherlands presents research on sustainable development for some of the brownfields located in Prague, Czech Republic. The aim of this 2009 research was to develop an integrated analysis and practical criteria with a list of recommendations to Arnika; a non-governmental organization that is enthusiastic about a sustainable redevelopment of brownfields in Prague. (Wageningen University and Research, 2009). The study investigated different topics such as; communication, policy, ecosystem services, technology and infrastructure, and stakeholders analysis, as well as desk and field research and data collection by means of 37 interviews and 528 questionnaires. The study shows the barriers and opportunities plus the generation of recommendations in different themes such as spatial plan, environmental quality, accessibility, cultural heritage, and social considerations, public involvement, communication and cooperation, sustainable design and finally

the reuse strategy of these brownfields. (Wageningen University and Research, 2009).

4.5.1 SPATIAL PLAN

4.5.1.1 POLICY & THE NEW SPATIAL PLAN

Sustainable brownfield development has no specific policies in Prague and spatial planning becomes the scope that regulates urban development. The process of developing a spatial plan starts from the city development authority with inputs and suggestions from the city council, Prague district, different ministries, and citizens. There are also several possibilities for modification and alteration from external actors (Wageningen University and Research, 2009). Such external modification seems to veer the development from the concept of sustainable development. According to an interview with Ivana Bursikova, president of Agora (2009), “economically powerful external actors get development plans approved through informal influence at various levels of government by skeptics as merely a political game” (Bursikova, 2009).

A new, more flexible spatial plan is being developed for the city of Prague (Figure 4) There will be only 15 functions defined instead of 69 functions as in the previous plan. Where different actors took advantages of the spatial plan functions to serve their own interests, which of course clashes with the basic principles of sustainable development. Moreover, it's more important to know the definition of each function more than just decrease the number of functions. Unclear definitions could lead to misinterpretation and corruption within the level of the district (Wageningen University and Research, 2009).

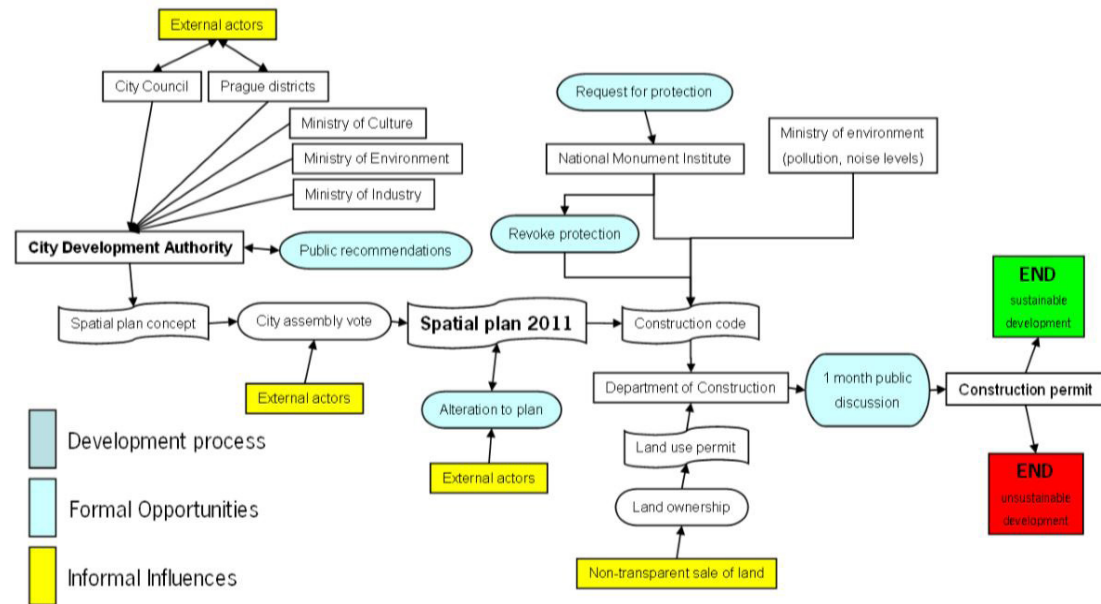


Figure 4 Spatial Plan 2011, by the City of Prague (Wageningen University and Research, 2009).

4.5.1.2 LEADERSHIP

The public interest and the legal power are expected to be represented by the political authorities who are responsible to get these duties granted. (Wageningen University and Research, 2009). However, the reality of the current situation differs completely from the expectation. Political authorities give proof of courtesy towards economic actors regarding the sale of public land which is often a decision at a national level and the preparation of a spatial plan is usually decided at the level of Prague city. Therefore, the submission to private economic interest is a decision made without any transparency and justification towards the citizens. (Wageningen University and Research, 2009). According to Grab. Y and Jackson, (2006), this problem is assigned to the period of transition from the Soviet state to pro-capitalistic period. Martina Paskova from the ministry of environment states that this situation of not having a single-cut body responsible for addressing brownfield issues at the moment is mainly due to the lack of education related to specific environmental issues in the Czech

Republic. Therefore, resulting in this lack of knowledge among the political and citizen spheres, not to ignore the problem of the mistrust between politicians and citizens, which creates a barrier to an effective decision-making process in order to have a sustainable redevelopment of the area (Wageningen University and Research, 2009). It is the duty of environmental NGOs to enlighten the citizens and politicians groups to drive the city council to the right direction by raising their voices and unite together to stand against any development that is unsuitable to the public of Prague. (Wageningen University and Research, 2009).

4.5.2 ENVIRONMENTAL QUALITY

Remediation and redevelopment of brownfields improves the quality of the environment. The contamination available on these sites is often the number one threat of human health and environment, based on EPA guidelines the cleanup of these sites is including air quality improvement and preservation

of the natural habitat and biodiversity (“Benefits of Brownfield Redevelopment in Minnesota,” 2018) . The environmental quality in Prague is not optimal due to the existence of air pollution and noise which is mainly around the main highways of Prague. In addition to soil pollution; the redevelopment of brownfields should be a major interest in order to provide opportunities to improve the environment and air quality in the city. (Wageningen University and Research, 2009).

4.5.2.1 AIR QUALITY

The air pollution that is caused by the emission of pollutants from different sources as a result of human activities such as industrial activities, transportation, and combustion is the main negative effect on human health, vegetation, and the entire ecosystems and materials according to the website of (Ministry of the Environment of the Czech Republic). Prague, North Bohemia, and North Moravia regions together recorded the highest rates of air pollution in the Czech Republic. Mainly in the city center near the industrial zones and main highways where the national

emission limits are exceeded. According to (website state of the environment Prague, 2009); another problem is the experience of bad smells and negative health effects due to the formation of smog. (Wageningen University and Research, 2009). (Figure 5) represents the opinions of citizens who live in the districts of the studied brownfield sites. As a result, in order to improve air quality in Prague, it is important to reduce emission by the use of public transportation, provide bicycle tracks and pedestrian-friendly neighborhoods, which all together can be applied within a brownfield sites' development("Transport Annual Report," 2009). As well as transfer parts of the redeveloped brownfields to green areas for air filtration. (Givoni,1998). This function will result in improving the quality of the environment in Prague. (Wageningen University and Research, 2009).

4.5.2.2 NOISE POLLUTION

Noise is the definition of any undesirable sound, which is intrusive or disturbing in nature or harmful on people's health. ("Environmental Health Monitoring

System in the Czech Republic," 2006). The maximum limits of 60 dB during the day and 50 dB during the night are often exceeded in Prague, especially areas around the major highways. Therefore, one of the solutions that were provided by the municipality was constructing a ring road around the city, but this will take years to construct ("Transport Annual Report," 2009). Solutions can be on a local level in order to reduce noise pollution, these solutions include the establishment of green spaces in the city which can form buffers and will work on absorbing the noise (Givoni,322). The idea of creating green areas in the city should be supported by policies to promote the use of shared transportation in order to reduce traffic, this will help to reduce the noise pollution which is caused by the overuse of vehicles in the city (Wageningen University and Research, 2009). (Figure 6) shows people's opinion on noise pollution in brownfield districts and that the majority agree that it should be reduced.

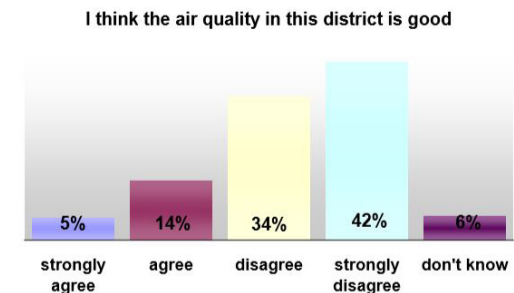


Figure 5 Citizens opinion on air quality (Wageningen University and Research, 2009)

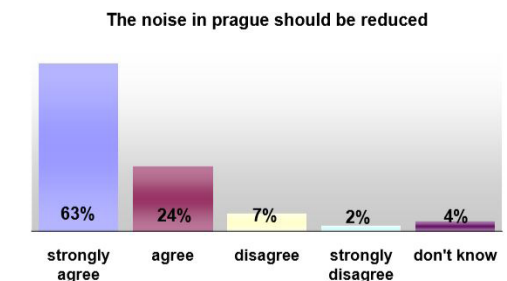


Figure 6 Citizens opinion on noise pollution (Wageningen University and Research, 2009)

4.5.2.3 SOIL POLLUTION

According to interview with Robert Rashman from Dekonta remediation company, (2009), the most common types of pollutants that can be found in the studied brownfield sites are usually: Petrohydrocarbons, chlorinated hydrocarbons, heavy metals and PCB's, since most of the brownfield sites are railway stations (Arnika,2009). These contaminated soils in most of the brownfields can cause a lot of risk for people's health as well as the environment (Wageningen University and Research, 2009). For example, PCB's are extremely harmful organic compounds to the central nervous system. Unfortunately, most of the stakeholders are not aware of the extreme level of contamination in these sites or they don't own an official report about the types of pollutants in the soil, so they just expect that it will be cleaned somehow. However, it is a really serious issue and requires serious and accurate actions. (Jilemnicka,2007). Excavation and off-site treatment are the most common methods used due to the short time process needed but it is much more expensive. In addition to complications

with identifying who is responsible for this pollution and who is going to pay for the remediation. Therefore, the results should be open to the public and base a discussion according to facts (Wageningen University and Research, 2009).

4.5.3 ACCESSIBILITY

4.5.3.1 TRANSPORTATION INFRASTRUCTURE

Vodný, (2012) states that, "Not operated railroads are still a valuable part of the transport infrastructure," therefore, removing this infrastructure leads to greater consequences than the removal of unused industrial buildings. In a survey by (Arnika,2009) that was made to get the opinion of the people who live around these studied brownfields, where over half of the people agreed or strongly agreed that they were well connected to the rest of the city by public transport (bus, trams, metro, and trains), see figure 7. The case studied brownfields in Prague are surrounded by a network of roads which experience a high concentration of traffic. So, it is expected that the

redevelopment of the brownfields will cause an increase and more pressure on the existing transportation network. Thus, more problems related to traffic in the city of Prague will be triggered. (Wageningen University and Research, 2009). Therefore, it is necessary to plan a clean solution to make sure of good connectivity and access along with the redevelopment of brownfield sites. Furthermore, it is very important to strengthen the accessibility of different transportation mobilities and to ease commuting between different locations in the new development brownfields areas. As well as solving the accessibility on a district and a whole city scale (Wageningen University and Research, 2009). According to Roland Berger ECC ranking of 2009, "Prague was ranked the highest eastern capital city regarding the capacity in public transport around 16,000 passenger seat kilometers per inhabitant, due to its extensive subway network of 55 kilometers which transports over half of the city's public transport ridership" (Roland Berger Strategy Consultants, 2009).

4.5.3.2 GREEN CORRIDORS

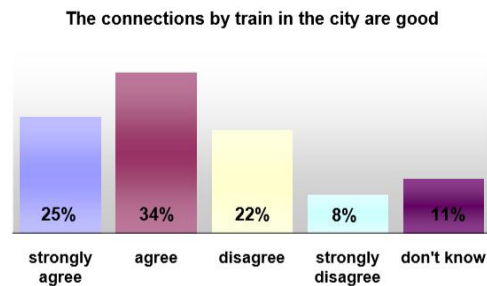


Figure 7 The public's opinion on the quality of connections by trains(Wageningen University and Research, 2009)

Green Corridors are a primary component of our cities ecological networks, due to their dual purpose. They play an ecological role in creating a pure vision; providing better communities for people to live in, as well as their access route function, improving the quality of social life. (Aly & Amer, 2010), in addition to aesthetic benefits and linkage of fragmented sites of biodiversity. This can be done through a different kind of landscaping, tree and shrub planting and habitats such as woodlands, wetlands, grasslands, heathland (“Waveney Open, Needs, & Corridors”, 2015). Thus, it is preferable to provide these green corridors wherever possible in the cities to maintain well connected green areas and increase biodiversity. As well as increasing the value of real estates in the city of Prague. (Wageningen University and Research, 2009). Jan Sedlak an architect in Zizkov states in an interview with Arnika, “Prague does have significant green areas but the problem is that they are often not well connected or difficult to reach”; establishing these green corridors in

brownfield redevelopment is not the only challenge. But what its more challenging is getting to an agreement between the developers and the city district on the size of these corridors. (Wageningen University and Research, 2009). As a result, brownfield developers should always take into consideration connecting the surrounding green areas through ecological corridors that will provide social benefits in connectivity and additional benefits such as reducing the air and noise pollution. (Wageningen University and Research, 2009).

4.5.4 CULTURAL HERITAGE & SOCIAL CONSIDERATION

working on the redevelopment is often perceived as an inconvenience by developers. Prague brownfields, such as Masarykovo Nadrazi, contain different monuments of cultural and industrial heritage which is under the protection of the National Heritage Institute. But other brownfields like Smichov and Bubny-Zatory railway stations have not been granted under this protection. (Wageningen University and Research, 2009). The adaptation of the protection and re-use concept of the industrial heritage structures is one of the most essential ways to achieve sustainable redevelopment of cities. It is necessary for the conservation of the cultural values, the re-use of all the possible and available resources as well as saving energy. Therefore the protection of these sites and the recycling of the resources deserve attention from the public and developers (Sýkora & Marková, n.d.). However, with the current legislative situation in Prague, it is a time-consuming procedure of getting buildings protected. One example was

the case of the industrial buildings in the Bubny-Zatory railway station, whose status as a protected monument was rejected due to the different desire of the developers. (Wageningen University and Research, 2009). Another Survey by Arnika shows the public opinion about the conservation of monuments in the studied brownfields. See figure 8.

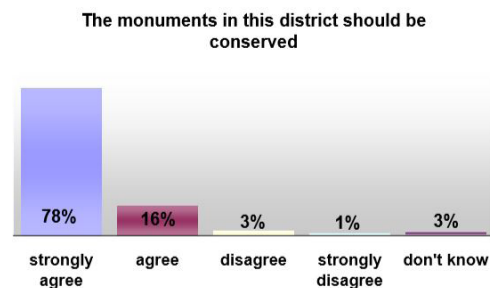


Figure 8 The public opinion about the conservation of monuments in brownfields (Wageningen University and Research, 2009)

4.5.5 PUBLIC INVOLVEMENT

The participation of community and stakeholders play an essential role in a successful process of brownfield redevelopment. Yet through history, the participation of the community was

perceived more as an obstacle that will slow down a project more than increasing its likelihood of success (Bartsch & Wells, 2003). In contrast, it was proven that public participation is a main motif of the planning and redevelopment process. This participation is providing local knowledge for decision making, it is also a principle of a democratic positive society (Spiess, 2008). The legal framework of the spatial plan usually provided for the public community one month before the approval, therefore this late involvement of the public is a serious problem because until this time many decisions are already made about the functions and type of the redevelopment. Thus, the government is effectively obstructing citizens involvement. (Wageningen University and Research, 2009). As a result, citizens feel that their voices and opinions do not matter and believe that there is no opportunity to hear them and consequently, their trust in institutions gets weaker. This problem can be attributed to the communist history of the Czech Republic where the public are not used to the participation in the decision-making process. In conclusion, what is missing

is a special leading agent such as an energetic organization or/and enlightened politicians who will fight through the bureaucratic process to prove the citizens that they have power and their voices will be heard and respected in order to create sustainable redevelopment of brownfields. (Wageningen University and Research, 2009).

4.5.6 SUSTAINABLE DESIGN

The sustainable urban development of a city means the improvement of the life quality in this city including the cultural, political, institutional, economical and social component (Yigitcanlar, 2015). According to (Pahlen & Glöckner, 2004), the regeneration of brownfields combines the main three pillars of sustainable development; economical, through generating development and employment in deprived urban areas; environmental, by the remediation of hazards from the industrial past and saving the previously undeveloped open spaces; and social, by offering new opportunities for communities bringing a new life and identities to

the neighborhoods, cities and regions. Therefore, brownfields regeneration is the key element of sustainable urban development, but the question is which practices and tools do brownfields projects have to meet to be sustainable? (Pahlen & Glöckner, 2004). During the past years, a green certificate was enough for so-called sustainability. However, nowadays ambitions aims for more goals for example (zero energy buildings, passive houses). Thus, brownfields can be an opportunity to apply new concepts and ideas of sustainability and use of limited resources. For instance, applying the concept of urban harvest, which focuses on the conversion of resources use from linear to circular metabolism and emphasize the use of the primary resources(solar energy, wind energy, rainwater) and second resources (waste heat, households and businesses waste, construction materials removed from houses). Thus, the ultimate goal of urban harvest concept is zero-escape scenario (Rovers, 2007). A research by Wageningen University and Research, (2009) revealed that many of stakeholders in the Czech Republic do not understand the concept of sustainability.

In an interview with a consultant who provides advice to private developers, he said “In my job as consultant I just tell private developers how they can make profit from their lands. Other aspects of sustainability are not a top priority for my clients.” On the other hand, a survey by Arnika (2009) of brownfields sites is showing the majority support of the public on using renewable materials for the new constructed buildings (See figure 10). Therefore, it is recommended from Arnika and different NGOs to work hands in hands with stakeholders to introduce sustainable concepts from the beginning, following the urban harvest in using what is available and produced on sites in terms of waste, water, energy, food, space and construction.

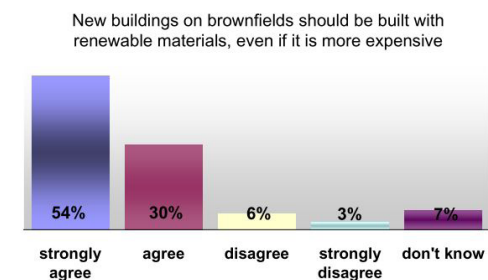


Figure 9 Public opinion about sustainable building in brownfields (Wageningen University and Research, 2009)

4.6 CASE STUDIES FROM PRAGUE ON RAILWAY BROWNFIELDS

4.6.1 MASARYKOVO NADRAZI

Masaryk station is situated in the heart of Prague, in Florenc district one of the most valuable districts in Prague in terms of development (Figure 10) (ARNIKA, 2018a). According to the proposal of Prague city hall and Czech railways, a part of the railway land will be released and transformed into a new city district to be built instead. (“Unofficial pages of the railway station Praha Masarykovo nádraží,” 2007) The proposal of the transformation of Masaryk Railway station appeared already in the so-called Territorial Development Principles, which should be the basis for the new Prague urban plan. In the concept of the new zoning plan, the size of the railway station will be first reduced, thereby releasing 19 hectares of land for mixed use with the a new road access. The railway lines will be completely abolished and the territory will function as a green area. (ARNIKA, 2018a) According to the research in

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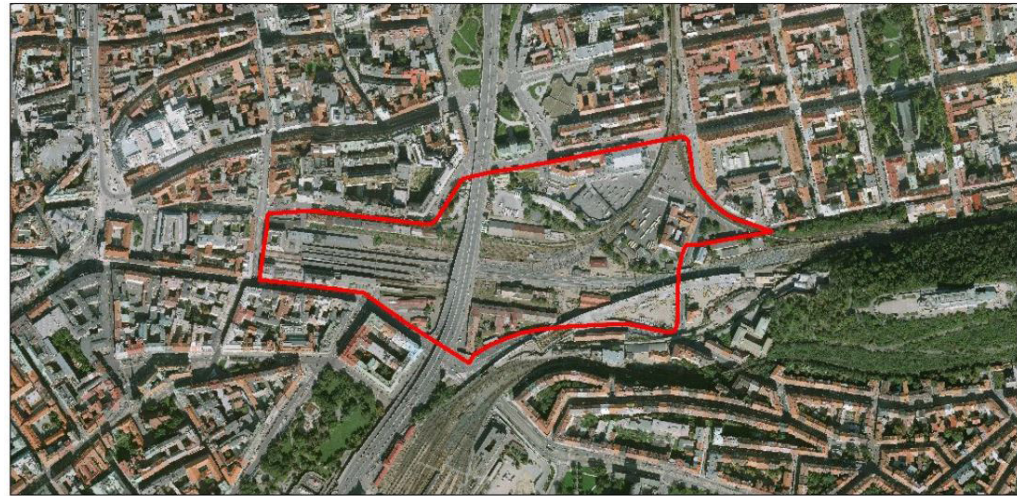


Figure 10 The location of Masarykovo nadrazi joining both districts of Prague 1 and 8 (ARNIKA, 2018a)

Prague in 2009 by the international student research team from the Dutch University of Wageningen “The obstacle of the sustainable development of this brownfield is the land purchase agreement between the owner, Ceske Drahy and Masaryk Station Investment (MSI). Wageningen University and Research, (2009) is suggesting that the redevelopment of the Masaryk brownfield should consider a solution of the high levels of noise and air

pollution found on the site. A green park which connects the adjacent nature area on the hill as well as the bus station which is located 800 meters from the train station is a possible proposal in the 2011 spatial plan. It is also recommended to make the case of Masarykovo nadrazi an example of the positive public involvement by directing the City Council in zoning the 19 hectares site as a green park in the new spatial plan. According to Wageningen

University and Research, (2009) this will lower the value of land for developers and force MSI to rethink speculating on this 19 hectares piece of downtown Prague. This path of action was supported by the 87% of citizens vote on redevelopment of area as a park/ green area (Figure 11). However, the last phase of the revitalization plan of the Masaryk station is under the preparatory phase and will be completed by 2022 - 2025 with an intention of creating a new central business district in Prague. A new building designed by Zaha Hadid Architects aims to respect the historical center of Prague while integrating an “architectural masterpiece” which will become a part of contemporary Prague. The project will also include new office spaces, shops, restaurants and cafes without ignoring the importance of public space, greenery and urban parks. (“Masarykovo nádraží – CBD - Penta Investments,” 2016).

Citizen Preference for Types of Regeneration in Masarykovo Nádraží brownfield

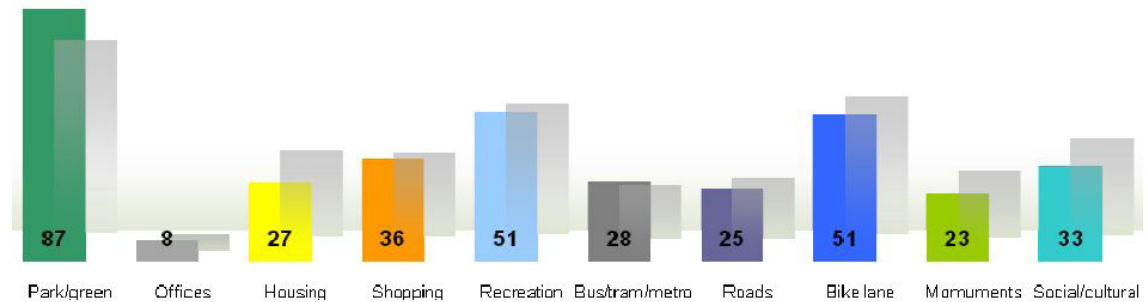


Figure 11 Percentage of respondents who answered yes to function types on this brownfield versus yes average for all brownfields (Wageningen University and Research, 2009)



Figure 12 Zaha hadid Architects Project Visualization for Masarykovo Nadrazi, Prague (“Masarykovo nádraží – CBD - Penta Investments,” 2016)

4.6.2 ZIZKOV CARGO RAILWAY STATION

The former freight railway station is located in Prague 3, Zizkov, between Olsany cemeteries and Ohrada connected to the historic Zizkov (ARNIKA, 2017) (Figure 13). The railway was built in the 1930s with a working life from 1936 until 2002. The main use of the railway station was mainly to supply Prague with food, therefore it was equipped with cold storage and coal (Lacina, 2012). According to Wageningen University and Research, (2009) the 33 hectares area is currently underused, with illegal squatters, parking lots and sparse warehouse businesses. A development company are the only ones who have done some study about the contamination in the area and took the responsibility of the cleaning process. The area of the Zizkov railway station is divided up amongst several owners; the northern part of the area is owned by Discovery Group which wants to build the area with apartments, offices and a shopping center. Meanwhile the southern and larger part belongs to the Zizkov Station Development Consortium, which

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Figure 13 Overview of the Zizkov station location (ARNIKA, 2017)

has set up the Sekyra Group Development company together with the Czech Railways (IPR, 2015). However, the city Council of Prague 3 approved an announcement for a competition of an urban plan to decide the new look of Zizkov freight railway station, to be organized by the Prague Institute of Planning and Development. Petr Hlavacek the director of IPR said, “this competition will result with a concept that will suits everyone and will open the opportunity to

the public to get involved.” Furthermore, another survey by Wageningen University and Research, (2009) was done to get the opinion of citizen preferences for types of regeneration in Zizkov Railway station brownfield and the result was again supporting the establishment of green and park areas. (Figure 14).

Figure 14 Percentage of respondents who answered yes to function types of brownfield versus yes average for all brownfields (Wageningen University and Research, 2009)

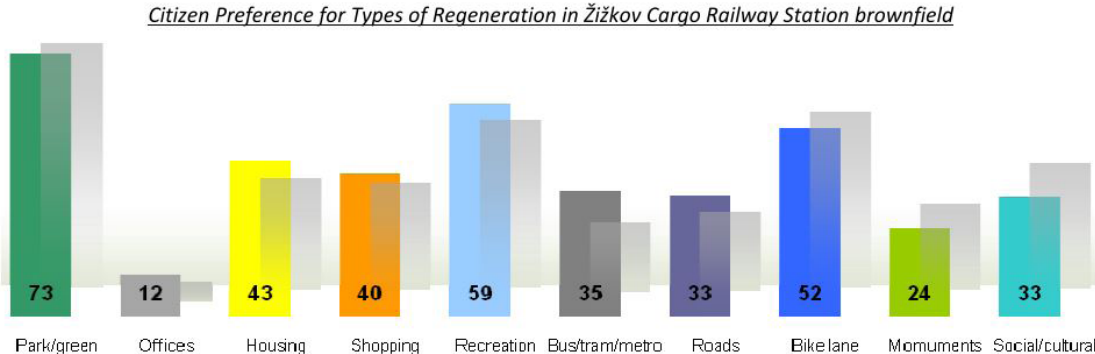


Figure 15 Project visualizing by Sekyra Group (Sekyra,2015)



4.6.3 BUBNY-ZATORY RAILWAY STATION

The brownfield Bubny-Zatory is located in Prague 7, Holesovice district near the historic center of Prague. The brownfield area is 90 hectares, therefore it is considered one of the largest and most valuable development sites in Prague (ARNIKA, 2018b) (Figure 16). The Prague City Hall prepared a new zoning plan which includes the construction of a new city district, and fast train station which will connect the area directly to the airport as well as a city rail stop (ARNIKA, 2018b). However, on the 4th of July 2006 the land was purchased by the company ORCO OMICRON from the Railway Infrastructure Administration for CZK 1.1 billion (Railway Infrastructure Administration, 2006). Therefore, the landowner, Orco Property Group, plan is to build a new neighborhood on 27 hectares, which will include the construction of luxurious and classic apartments, office space, a new school, a medical facility and a university campus. Overall, it should be 1.2 million square meters of aboveground areas, of which half



Figure 16 Overview of the Bubny-Zatory Railway station brownfield (ARNIKA, 2018b)

of office space and one third of residential space. However, ARNIKA, (2018b) thinks that the proposal of Orco doesn't respect some regulatory elements for the new constructions, such as the height limit of new constructed buildings, the amount of greenery, transport infrastructure and other important elements. Although the investor claims that greenery will occupy 40% of the area within the quarter, it is largely intended to go green on the roofs of buildings that do not perform the same functions as the greenery of the street parterre. But according to the Survey done on the citizens preference of types of regeneration in the brownfield Bubny-Zatory the results is showing again a big responds which supports the function of Park/ Green establishment (Figure 17).As a result, Such an extensive development area would deserve its own central park and several smaller public green areas.

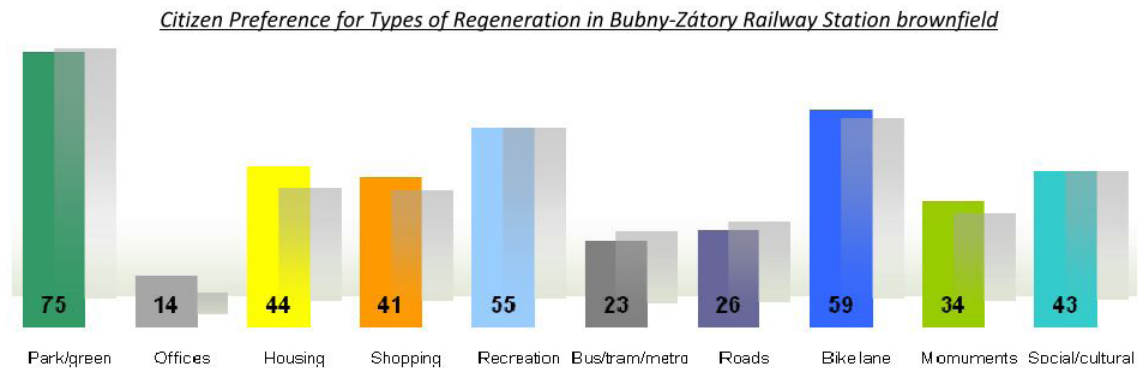


Figure 17 Percentage of respondents who answered yes to function types on this brownfield versus yes average for all brownfields

5. APPLICATION IN PRAGUE 5 SMICHOV

5.1 HISTORY OF THE AREA

Prague 5 is considered one of the largest districts in the city based upon its physical area and population. It is situated on the left bank of the Vltava river close to the historical center of Prague, where a preserved prehistorical settlement called the hunger wall divides Prague 5 district from the historical city center in Prague 1 (Prague 5 City District, 2019). Prague 5 district consists of several separate municipalities; Smichov, Kosire, Motol, Hlubocepy, Radlice, Jinonice-Butovice and the southern part of Mala Strana-Ujezd. Therefore, the area is very diverse, with infrastructure development, villa districts, smaller housing estates, new residential complexes, factories and a number of protected natural areas and parks (Prague 5 City District, 2019). The central part of Prague 5 Smichov was mentioned in the 13th century for the first time in connection with King Wenceslas the second coronation, when it was built between the bank of Vltava river and

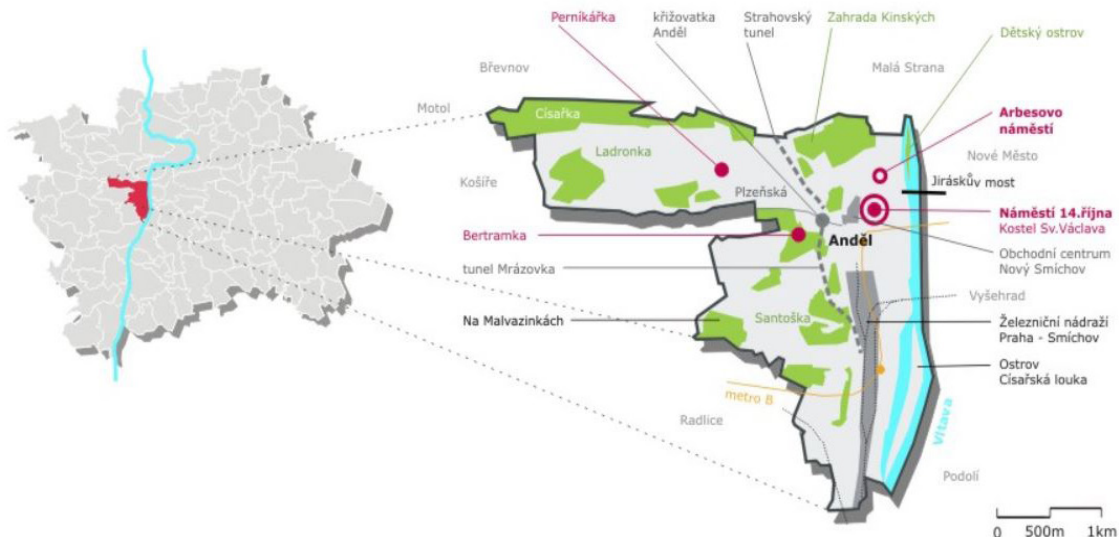


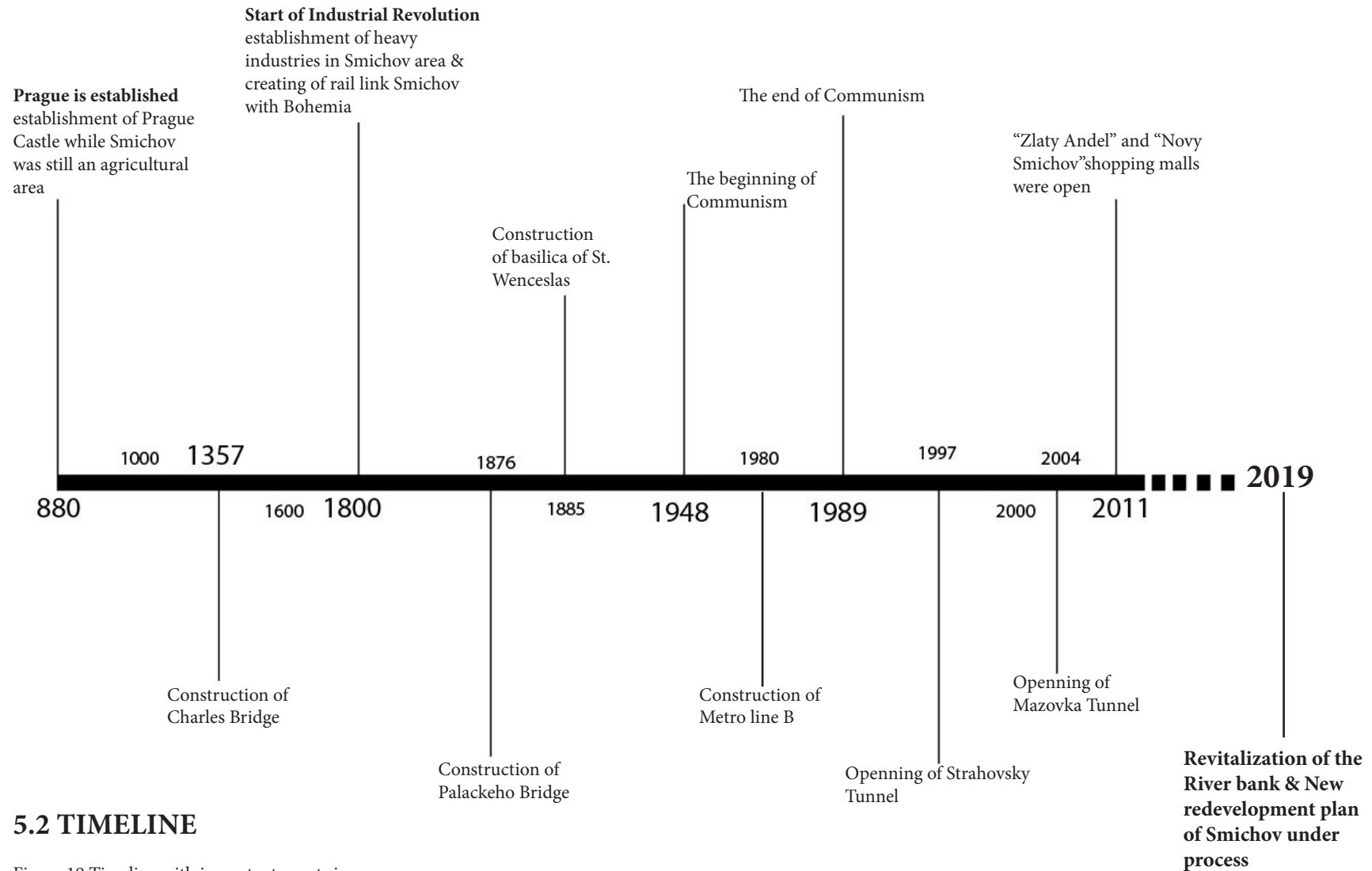
Figure 18 Map of Prague, with Smichov area highlighted within Prague 5 district, showing the significant places around the area. (Prague 5 City District, 2019)

Petrin hill. The name Smichov was used for the first time in 1406 in court records. The district of Smichov has a special character due to the existence of vineyards, hop gardens, courtyards, fields and gardens that belonged to the church and were situated in the vast majority of the area since the middle ages and the end of

the 16th century, especially during the stay of emperor Rudolf the second. The huge industrial growth of Smichov marks the emergence of several manufactures in the 18th century. In the beginning of the 19th century, gardens, summerhouses, and fields gradually started to give a way to the construction of factories for the production

of various goods; favorable conditions for the development of industrial production led to the construction of weaving mills, chinks, textile factories, porcelain factories and brewery(Nemovitalita, 2013). Later in the second half of the 19th century, a town hall was built which is still standing in Stefanik area, opposite to the new church of St. Wenceslas. Residential houses and working class colonies were also built along with factories. After that the building industry in Smichov culminated in the last decade of the 19th century when two art nouveau buildings were built on the site of the original botanical garden (Prague 5 City District, 2019). The post-second world war period was mainly characterized by a lack of flats, which later began to be solved by the construction of the prefabricated housing estates, mostly on the uninhabited edges of the city. After November 1989, a new chapter of the district began to be written, a Civic Forum was established in Prague 5, and a lot of important political and economical changes took place during those years. Also, new political parties emerged from the disparate Civic Forum over time and Legislation changed. Nowadays, the center

part of Prague 5, Smichov is gradually changing, several commercial and administrative centers were established on the sites of the former buildings and former former factory halls, what's called nowadays "brownfields"(Prague 5 City District, 2019).



5.2 TIMELINE

Figure 19 Timeline with important events in Smichov area since 880 until 2019 (AlTalli,2019)

5.3 ANALYSIS OF THE STUDY AREA

5.3.1 CONTEXT

The selected study area is a small part of a larger area which is under transformation. The whole area is exhibited in Center of Architecture and Metropolitan Planning (CAMP) showing the plans for the new neighborhoods against the backdrop of Smíchov as a whole. The exhibition draws on detailed knowledge of the respective area and seeks to identify the objective impacts and benefits of developing this space. It also includes a map analysis and the results of the public's involvement in the planning of the public space in this area (Kajpr, 2018). The rationale for selection of southern area of Smíchov, around the contemporary art center known as “Meet Factory” situated beside the rails, is because this area has a great potential for a variety of re-developments. In particular this location is full of different brownfield contamination and provides examples to implement the different solutions of a successful brownfield remediation. The site is

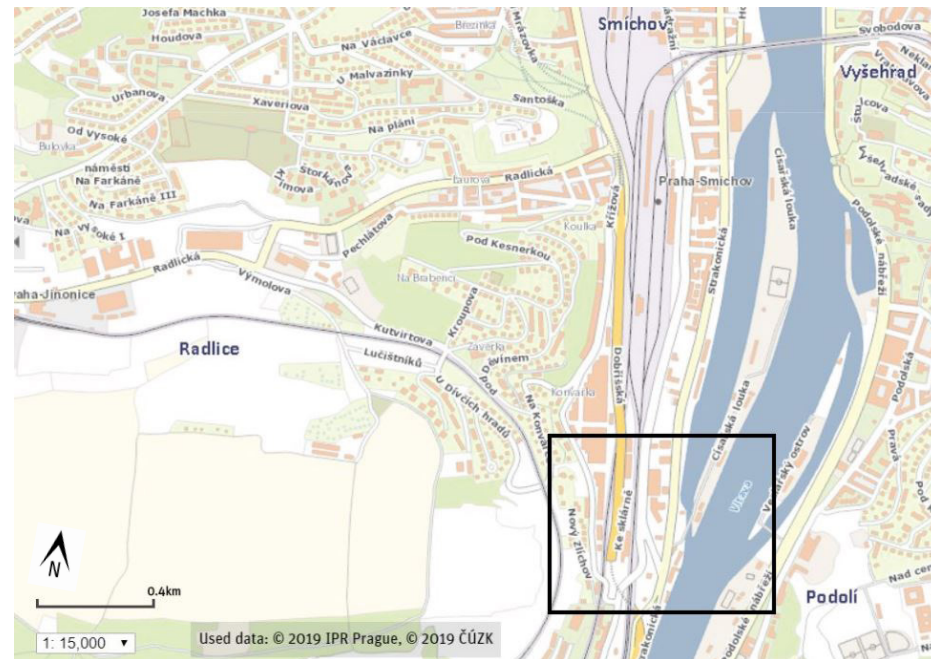


Figure 20 A frame around the area of interest southern Smíchov within its surrounding (IPR.2019)

located within an area with a very specific characteristics; in a middle point around a heavy transportation infrastructure system including highways, bridges, train rails, trams and bus stops, laying down between the Green hill “Ctirad”, Louka Island and Vltava River. Many brownfields and old industrial buildings are around that area which is facing an unknown destiny,

therefore, it is important to base a design or solution for this study area based on a site and SWOT analysis to spot the light on the different aspects and problems that should be taken into consideration during the design process.

Strength

- The location is close to Prague 5 center Andel and to the city center
- The proximity to the Vltava River
- Connecting Smichov with the southern part Barandov
- The presence of huge green area (Ctirad)
- different type of transport infrastructure (highway, bike lane, rail infrastructure, metro, bus, tram)

S

Weaknesses

- Presence of spatial and physical barriers between the hill and river side
- no recognizable center for locals except for Andel
- Inadequate state of the infrastructure
- Lack of cycling routes
- brownfields
- land ownership

W

Opportunities

- Brownfield remediation and redevelopment
- Increase the interest in public spaces and cultural facilities
- Creating local center
- Reduce cars and emissions, giving greater importance for pedestrians, cyclists)
- Symbiosis with the city and River
- Greenway connecting the hill with the River

O

Threats

- Presence of spatial barriers
- reduced in safety
- lack of connectivity
- increase in the neglected spaces and brownfields
- Erasing the past of the area

T

5.3.3 LAND USE & LAND COVER

According to the land use planning documents by (IPR, 2016) the City of Prague would like to make use of its neglected city potentials and the existing brownfields instead of developing land on the outskirts of the city. The aim of this land use plan is to create new parks, buildings, and recreational areas. It is important to define the land use character of a specific area and define the built-up areas, landscape, cultural and economic conditions. In the case of the project site, the southern part of Smichov is mostly industrial, unlike the upper northern part which is mostly dominated by a mix of a dense residential zone and a commercial center. It is also clear that the grid pattern of the area is bisected by the rail lines and the Dobrisska highway axis in the middle, therefore, it gives you the feeling of disconnection in this specific area. It is noticeable that the eastern riverside has more dense building pattern and a huge area of devastated land and brownfields which holds a big potential for redevelopment because of its strategic location near the riverside. Therefore, the

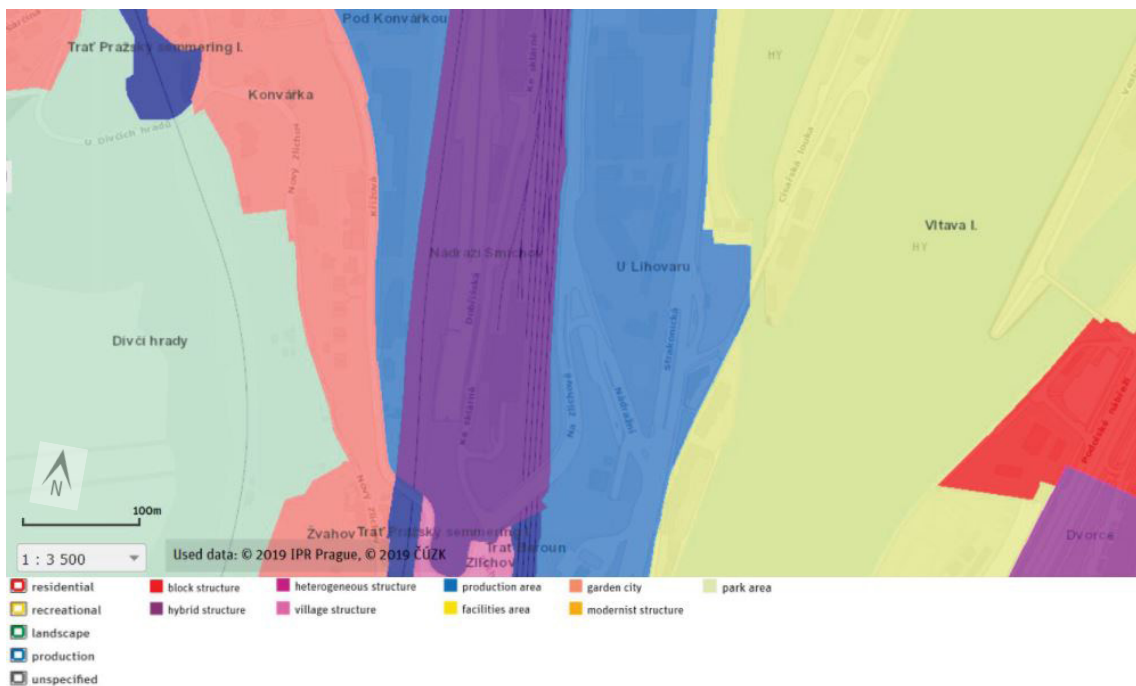


Figure 21 Map of the land use & Land cover in the study area (IPR, 2019)

study area could be turned into a mix of residential, parks and recreational area for the community. On the other hand, the pattern on the western hillside where it is following a completely different system of smaller houses and bigger commercial buildings, with its private backyards. The project site has two significantly important buildings which are the Meet Factory and Vytopna Zlichov in addition to school, gas station, sports facilities, camping area, breweries, and various industrial facilities.

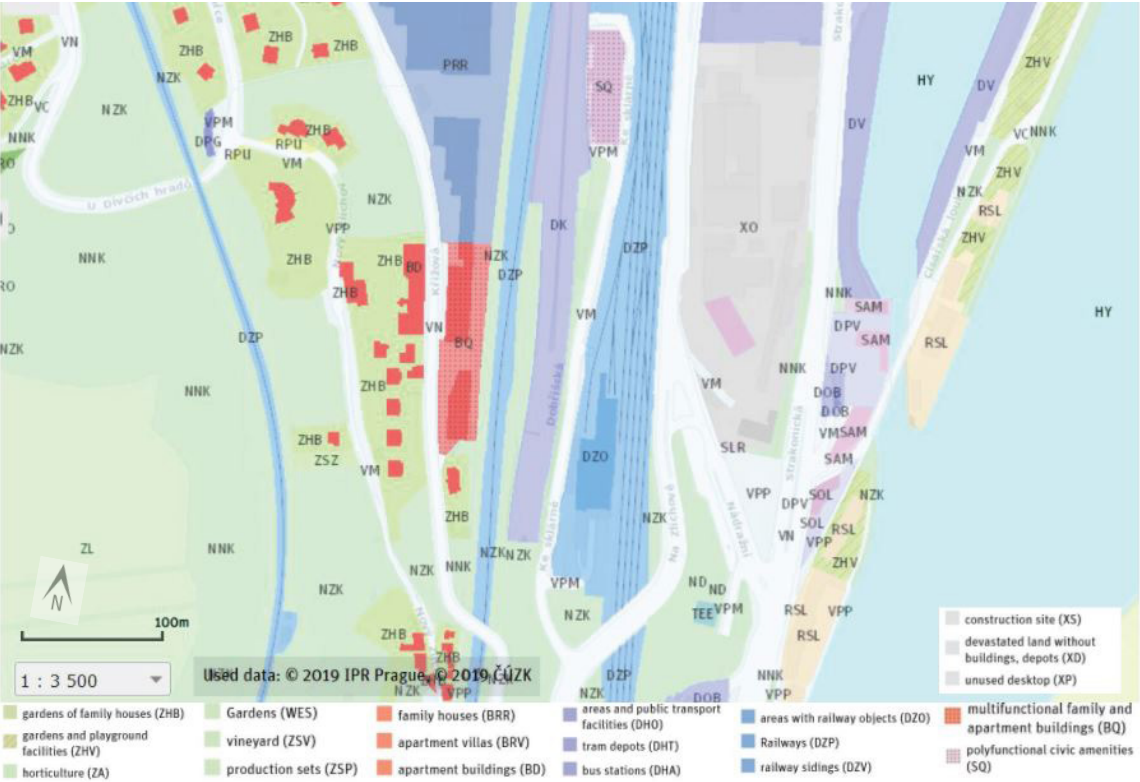


Figure 22 Map of the land use & Land cover in the study area(IPR,2019)

5.3.4 GREEN MOSAIC

The figure 23 shows clearly that the hill (Ctirad) on the western side of the rails represents the most significant green area. Here one can distinguish the presence of a mutually interconnected complex of both natural and semi-natural, an ecosystem represented by different elements from the Territorial System of Ecological Stability(TSES) which is bio-centers, bio-corridors, and interaction elements. In addition to specially protected areas and zone of supra-regional bio-corridors on the top of the residential houses. But on the contrary, there is a lack of green areas on the Riverside due to the characteristics and the topography of the site, and the interruption of the highway and railways in the middle, which is stopping the continuity of the green connection.

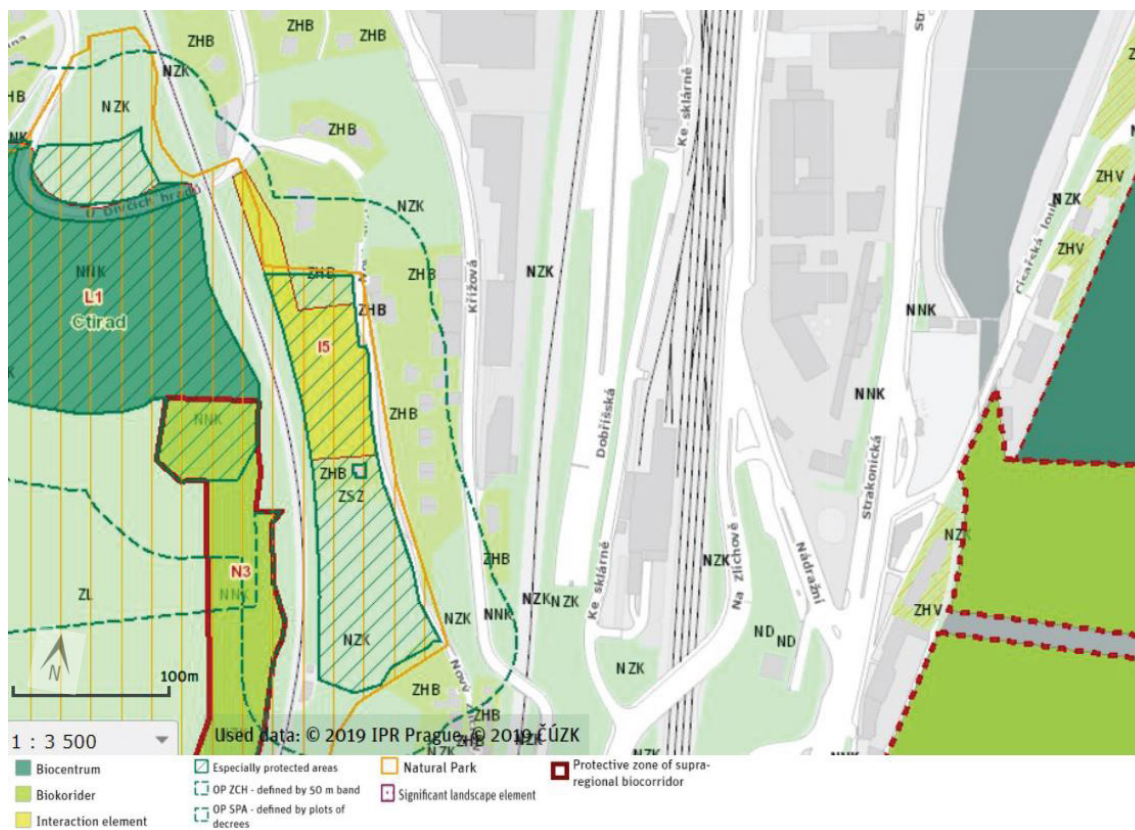


Figure 23 Map of the Green Mosaic and protected natural zones in the study area(IPR,2019)

5.3.5 TRANSPORTATION INFRASTRUCTURE AND CONNECTIVITY

The site is dense with a different network of transportation including the various types of infrastructure for different mobilities including tunnels, bridges, highways, tram and train railways, and bus lines, but unfortunately poor with a non-motorized infrastructure for pedestrians and cyclists. So, it is creating an unsafe experience and the impression of disconnection and making it harder for communities along the hill to commute and reach the riverside easily without spending time on roads, or using their private auto-mobilities or public transport to reach a certain area. There is only one bike lane in the site, parallel to the axes of the railways connecting the northern part of Smichov with the south but the west-east horizontal connection is missing. Therefore, there is a huge barrier for cyclists and physical activities as a daily way of commuting in the area. So it is important to find a solution for cycling in the area which will improve the lifestyle and health of the communities, provide

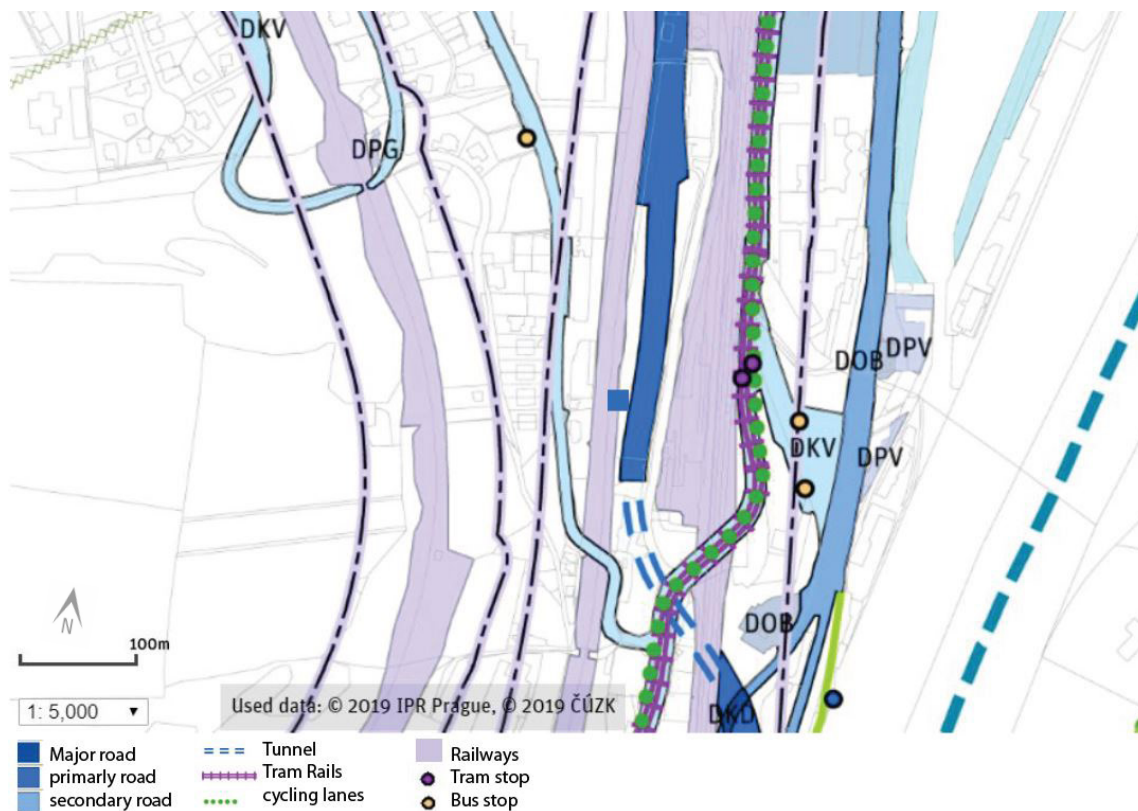


Figure 24 Map of the transportation in the study area (IPR, 2019)

better accessibility and lower the use of auto-mobilities.

5.3.6 SOIL CONTAMINATION & SOIL SAMPLE RESULTS

The previous report and case studies that were done by Wageningen University and Research, there was no data or information about soil contamination in brownfield sites, nor specific or suggested methods for soil remediation. Although, contamination is a serious problem related to brownfields and influencing the process of its redevelopment if any contaminants found. Therefore, an investigation and collecting of soil samples were made on the project site in order to discover which area is the most contaminated if any hazardous exists. So, 16 soil samples were taken from 4 different as in (Figure 25) and then 4 samples per point of (A, B, C, D) on two different depth. The samples were analyzed by CULS Environmental Geosciences labs to determine the type of and extent of soil contamination in the project site. The results came out quite positive in points (B, C, D) where the samples were taken and it did not show any high or even more than average concentration of a certain element from the stated elements (Zn, As, Pb, Cr, Cd, and Cu) as in the figure 26 for

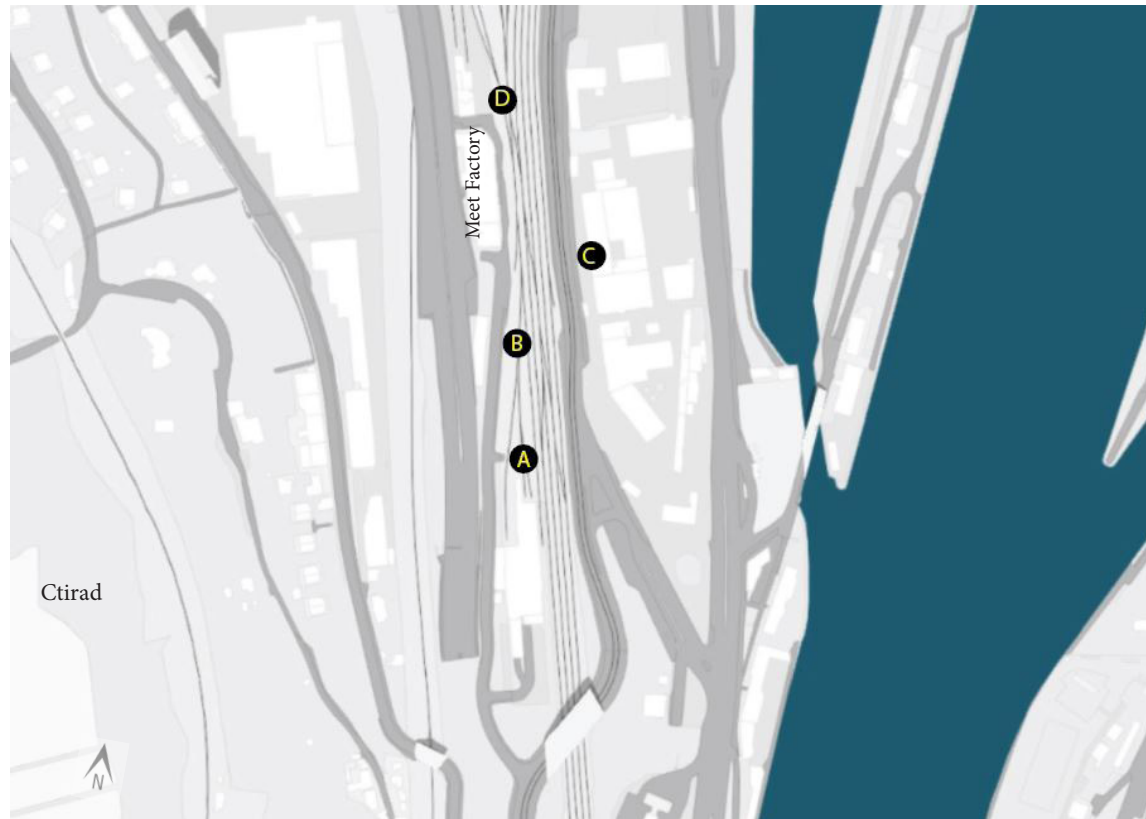


Figure 25 Map of the study area with the 4 points were Soil samples were collected (AlTalli,2019)

the results report. At point (A) which is located right after the building of Vytopna Zlichov near the rails, there was recorded a slightly higher percentage of Copper and Zinc. As a result, excavation or any other type of soil remediation process is not needed according to the results from the mapping of the contamination in the site.

SAMPLES	wt.% Zn	wt.% As	wt.% Pb	wt.% Cr	wt.% Cd	wt.% Cu
a1	0.0305	0.0023	0.0104	0.0079	<LOD	0.0201
a1	0.0321	0.0024	0.01	0.008	<LOD	0.0187
a2	0.0595	0.0038	0.0185	0.0089	<LOD	0.0246
a2	0.0583	0.0046	0.0184	0.0092	<LOD	0.0256
b1	0.0097	0.0006	0.0013	0.0116	0.0021	0.0053
b1	0.0093	0.0007	0.0011	0.0092	0.0031	0.0048
b2	0.0357	0.0007	0.0024	0.0079	0.0028	0.0078
b2	0.0342	0.0009	0.0021	0.0088	0.0026	0.0082
c1	0.0083	<LOD	0.0022	<LOD	<LOD	0.0048
c1	0.0092	0.0005	0.0023	<LOD	<LOD	0.0055
c2	0.0089	0.001	0.0022	<LOD	<LOD	0.0049
c2	0.0085	0.0006	0.0033	<LOD	<LOD	0.0052
d1	0.01	0.0015	0.003	0.0059	<LOD	0.0048
d1	0.0101	0.0013	0.003	0.0081	<LOD	0.004
d2	0.0144	0.0023	0.0066	0.0085	<LOD	0.0079
d2	0.0138	0.0019	0.0068	0.0057	<LOD	0.0068

wt.% weight (mean value)	Medium Value
Zn: Zinc	Cr: Chromium
AS: Arsenic	Cd: Cadmium
Pb: Lead	Cu: Copper

Figure 26 Table with the results of Soil samples analysis (AlTalli,2019)

5.3.7 AIR QUALITY

According to the model of air quality monitoring, Nitrogen Dioxide(NO_2) and Carbon Monoxide (CO_2) are one of the most common pollutants in the ambient air, and mainly caused by the traffic emission of vehicles. Both have very bad sequences on human health causing respiratory infections, asthma, decreased lung function and diseases of the circulatory system. (IPR, 2004) The average annual concentration of NO_2 is reached in the area and exceeded the $40 \mu\text{g}\cdot\text{m}^{-3}$ limits in some parts of the area, it is recorded especially on Palacky and Barrandov bridges around the project area. (IPR, 2004) also, visible in the project site around the railways and major streets increasingly when moving far west from the green field on the Ctirad hill as in figure 27

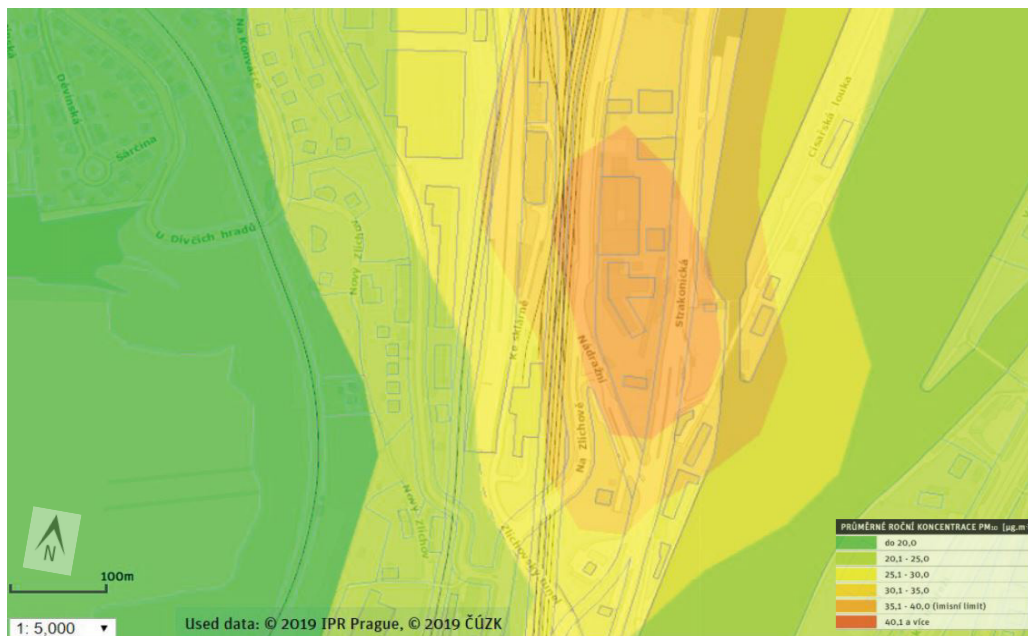
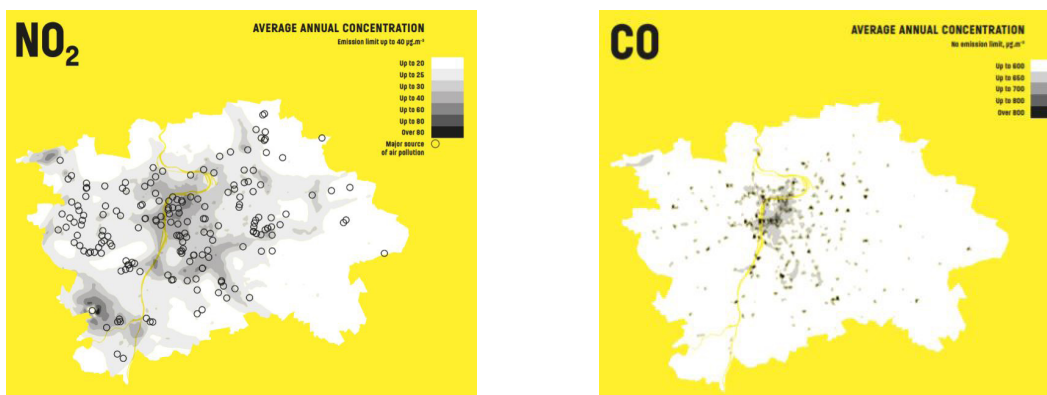


Figure 27 Map of the study area illustrating the air quality (IPR, 2019)



Figures 28-29 The average annual concentration of NO_2 , CO in Prague (IPR, 2014)

5.3.8 NOISE POLLUTION

The figures below show the level of ambient from all traffic during the day time or at night in whole Prague. The limit of 50 dB was exceeded in most places with a heavy noise sources, such as noise from traffic on motorways, 1st and 2nd grade roads, tram track, noise from train railways which appear visibly in red in the project site along the highway, train rails and the secondary road with the tram rails.

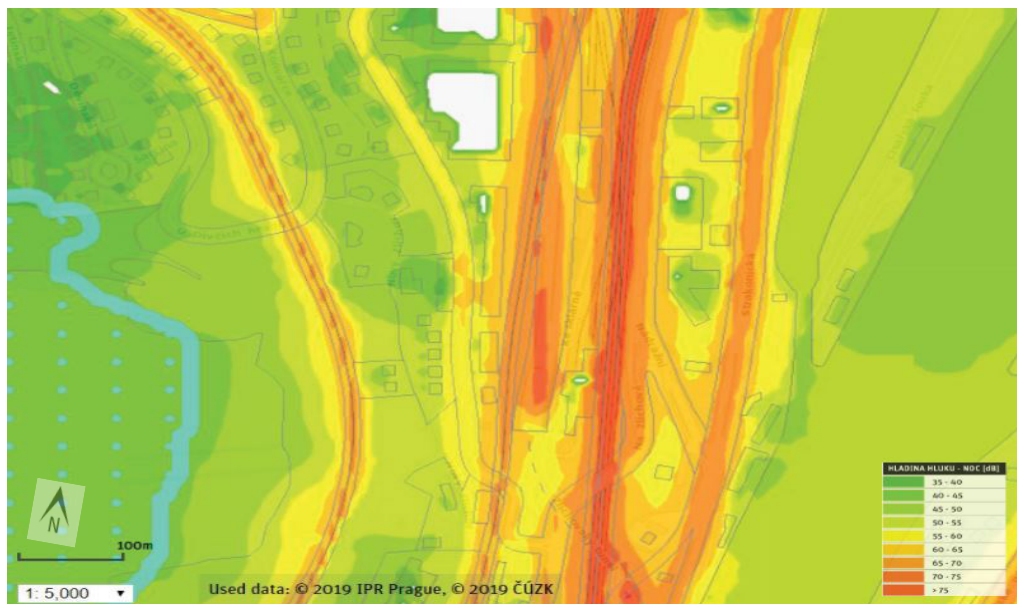
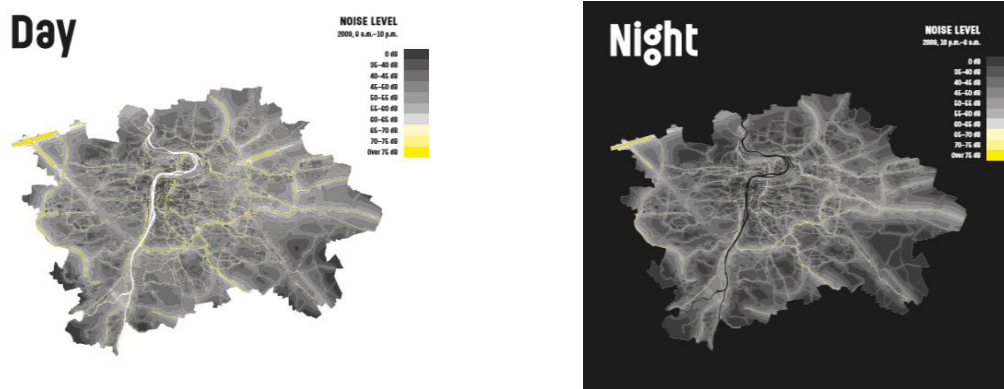


Figure 30 Map of the study area with the maximum noise pollution illustrated in red (IPR,2019)



Figures 31-32 The Noise level in Prague during the day and night (IPR,2014)

J E S I G N

6.1 OVERVIEW OF THE PROJECT SITE



Figure 33 A drone photo of the contemporary art center”- Meet Factory” (AlTalli, 2019)



Figure 34 A drone photo of Vytopna Zlichov (AlTalli, 2019)



Figure 35 An overview drone photo facing the direction of the south showing Ctirad hill to the right and the train rails in the center (AlTalli, 2019)



Figure 36 An overview drone photo facing the direction of the North showing Ctirad hill to the left and Vltava River on the right side with the complex roads network (AlTalli, 2019)

6.2 CONCEPT

The main concept of the project is inspired by the High Line linear park that has been carved out of New York's City existing urban fabric. One of the very successful examples for the reuse of an abandoned elevated railway brownfield. The redevelopment has brought unprecedented growth in the area (Edgar, 2015). Edgar also added that "Billions of dollars were spent into investments in the area along the High Line." In addition to broader environmental, housing, transport, social life and health benefits for the district. Therefore, the High Line project achieved all the positive social, economic, and environmental impacts of redeveloping brownfields. So, creating a similar concept of a non-motorized greenway in an area with big potential for redevelopment will help in increasing the interest of investors and the value of its surrounding as well as a healthier community. The proposed design also considering the concept of "Sense of The City" an alternative approach to urbanism book by Mirko Zardini (2005) which proposes a rethinking and re-presenting of the city and offers a more

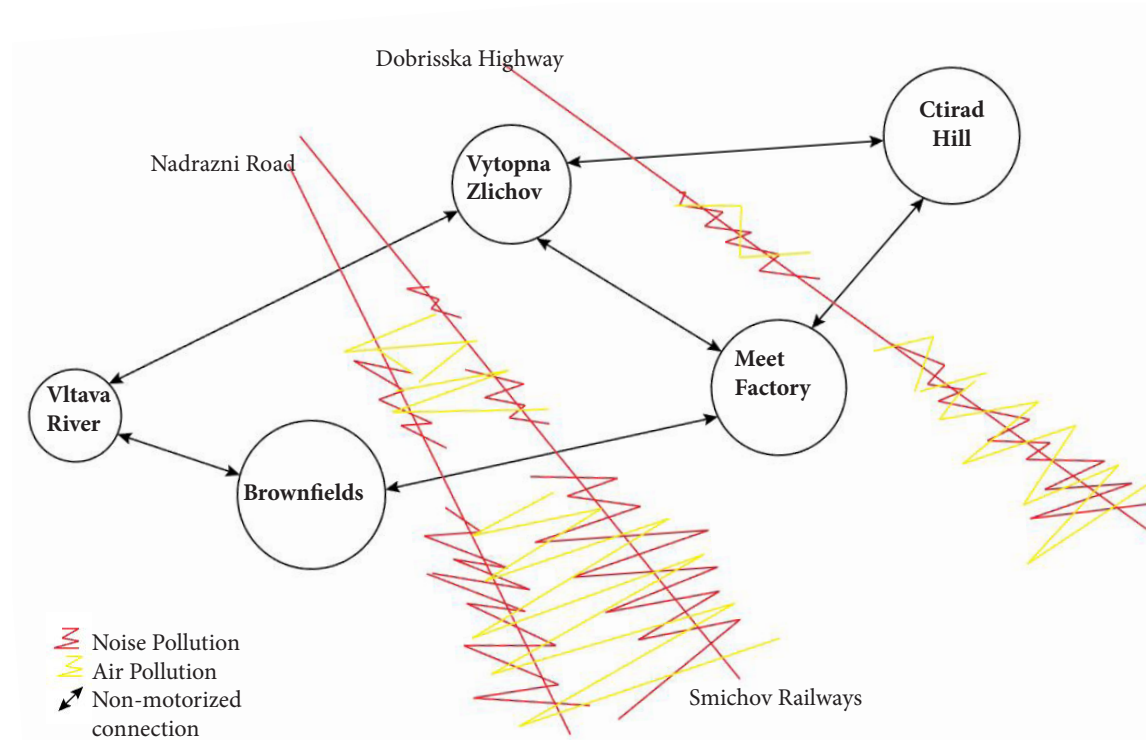


Figure 37 Concept diagram illustrating points of interests and barriers with the recommended non-motorized connection (AlTalli,2019)

complex analysis of the qualities, comforts, communication systems and sensory dimensions of urban life. An alternative approach to urbanism "Sensorial Urbanism" which aim to analyze urban phenomena in terms of luminosity and darkness, seasons and climate, the smell of

the air, the material surfaces of the city and sounds (Zardini, 2005). as a result, the concept of the proposed project is a combination of different approaches and solutions in order to sustainably redevelop the area.

6.3 AIMS OF THE PROJECT

- The green-way will ease the connectivity and circulation horizontally in the project area from Ctirad hill to the riverside.
- Finding a safer and more attractive route for pedestrians and cyclists to commute within the area. This will improve the lifestyle and health of the community.
- The greenway will help to decrease the use of auto-mobilities and encourage physical activities.
- The green-way will pass by the undeveloped zone with brownfields situated on the riverside which will make it more pleasant and attractive for community and investors.
- The greenway will play a role as a barrier against noise and emission, by the increase of vegetation in the area that will work on filtrating the air from pollutants such as Carbon Monoxide, Sulfur Dioxide and airborne particles of heavy metals (Benefits Of Greenways, 2011).
- Allowing effective and smooth interconnection of residential areas, recreational areas, public spaces, and other civic amenities.
- Multiple environmental benefits such

as protecting the function of natural ecosystems in addition to linking fragmented habitats and providing protection for plants and animal species (Benefits Of Greenways, 2011).

- Promote tourism in the area especially with the existence of two significant buildings like the “Meet Factory” as a contemporary art center and “Vytopna Zlichov” as a museum of steam trains.

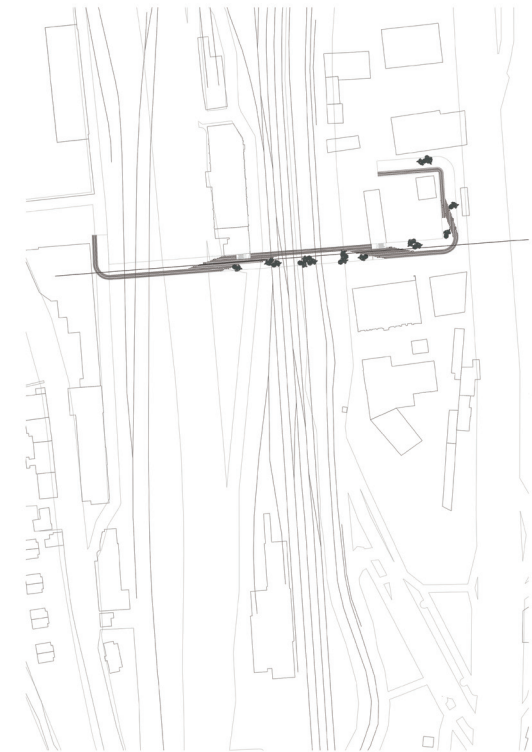


Figure 38 A Site Plan with the Greenway connecting the area horizontally (AlTalli,2019)

6.4 DESIGN VISUALIZATION

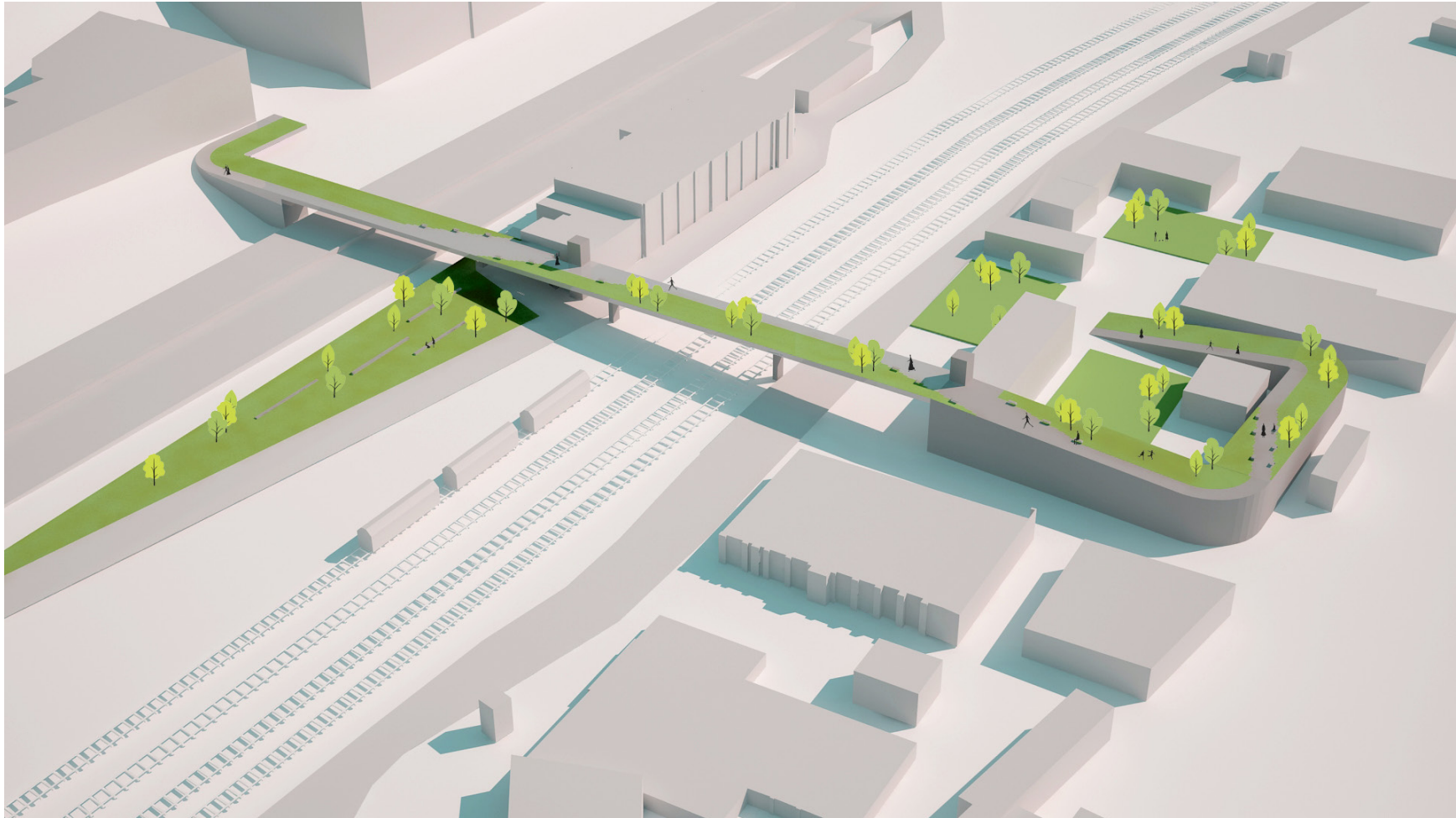


Figure 39 Visualization perspective of the project area showing the increase of green areas, recreational and public spaces in addition to placing train cars on the abandoned railway to be used as small shops and cafes to serve the needs of the people around the area (AlTalli, 2019)



Figure 40 Visualization perspective of the project area facing Ctirad hill (AITalli, 2019)

6.5 SECTIONS

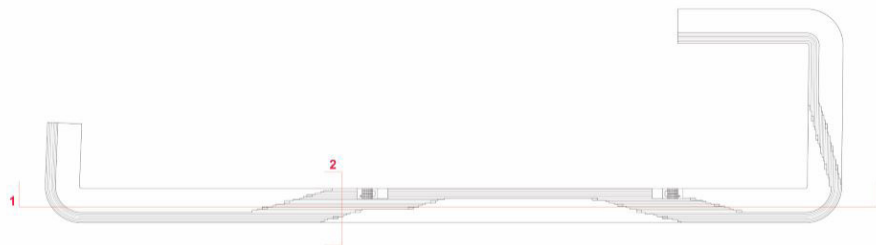


Figure 41 Plan of the greenway with the location of the cross section(AlTalli, 2019)

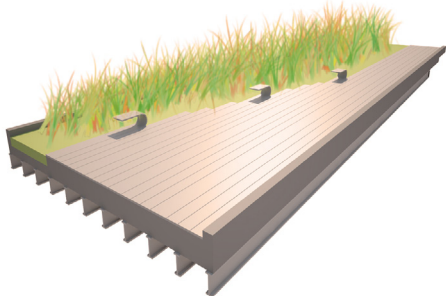


Figure 43 Detailed section of the greenway divided into different pathways for pedestrians, cyclists and vegetation (AlTalli, 2019)

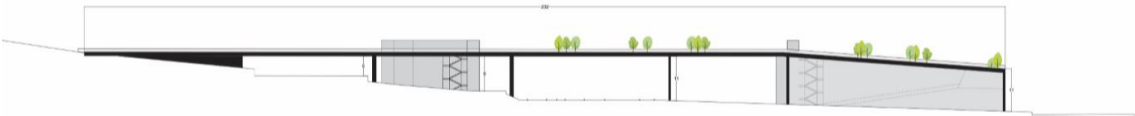


Figure 42 Section 1 of the greenway within the project site (AlTalli, 2019)

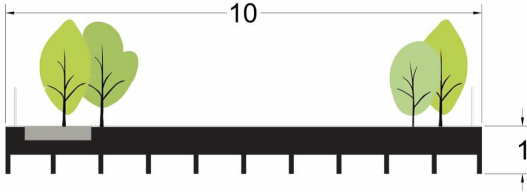


Figure 44 Section 2 of the greenway (AlTalli, 2019)

7. CONCLUSION

The growth of our Cities caused by the intensive movement of people seeking a better life, jobs, and opportunities can only be solved when cities are taking into consideration the potential of redeveloping brownfield sites, these contaminated sites which exist in the core of urban areas. In addition to finding a sustainable way for the reuse and transformation of its purpose, function, and surroundings. Therefore, it is important to create a quality residential areas, offices, open public spaces to be used as parks and recreational areas, as well as increasing the green areas in the core of urban areas and improving the existing infrastructure which will improve the ecosystem services, species, and habitats. It is important to limit the expansion of the urban areas on the edges of the cities when the city still has thousands of hectares in need to be redeveloped and put back into use again. Therefore, this masters thesis spot the light on brownfields issues and the numerous benefits that come along after the redeveloping process. Also, the project analysis and proposed

design highlighted these great potentials and opportunities that the chosen site is holding.

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