

**CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE**



**Faculty of  
Environmental Sciences**

Department of Landscape and Urban Planning

**Green infrastructure and landscape policy instruments in the  
Czech Republic**

Diploma Thesis

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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## DIPLOMA THESIS ASSIGNMENT

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Thesis title

**Green infrastructure and policy instruments in the Czech Republic**

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### **Objectives of thesis**

The first objective of this diploma thesis is to analyze how the concept of green infrastructure is understood across the process of public policy within the European Union and USA. Specifically, the aim is to explore what is the focus and what are the tools for its implementation, such as funding, strategies for implementation, crafting of localized programs, etc. There are some differences in the way that landscape policy decisions are made in the USA vs. Europe. In the EU, landscape policy, is often integrated with broader land-use planning and environmental policy, and there may be a greater emphasis on preserving cultural heritage and natural resources. In the USA, landscape policy is more fragmented, with different levels of government (federal, state, local and private sector) responsibility for different aspects of landscape management without the focus on preserving cultural heritage and natural resources. The main objective of this diploma thesis is to understand how green infrastructure is integrated into the policy system of the Czech Republic taking a closer look at spatial planning policy and the implementation of green infrastructure within it. In the final part of the study, three case study cities (Vienna, Prague, and Philadelphia) are examined to analyse the implementation of green infrastructure at the city level.

## Methodology

To answer the objectives, a literature study is conducted on the topic of green infrastructure and its policy instruments within the European Union and USA. This is accomplished by using the snowball method, starting with a small set of relevant policy documents, and then using them to identify additional policies through references or citations within the policy documentations. To identify the main relevant policy instruments for the analysis is used Evert Vedung's classifying system of government tools and programs. The Vedung's typology approach is divided in regulatory (sticks), economic (carrots) and information-based (sermons) policy instruments. Once the focus of policy instruments is chosen the comparative analysis is conducted. In the second part, the diploma thesis, focuses on policy planning instruments and green infrastructure implementation into spatial planning documentation using the comparative analysis between Czech Republic and EU. The last part is dedicated to comparison of approaches to the implementation of green infrastructure concept at the city policy level by examining the three cities of Vienna, Prague, and Philadelphia.

## The proposed extent of the thesis

60 pages + attachments

## Keywords

Green infrastructure; land use policy; Czech Republic

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## Recommended information sources

European Commission, 2019. Report from the commission to the European parliament, the council, the european economic and social committee and the committee of the regions. Brussels, Review of progress on implementation of the EU green infrastructure strategy COM(2019) 236 final.

Vedung, Evert. 1998. "Policy Instruments: Typologies and Theories," in Bemelmans-Videc, MarieLouise; Rist, Ray C 574 & Vedung, Evert, eds., Carrots, Sticks, and Sermons: Policy Instruments and Their Evaluation, 21-58, Piscataway, NJ & 575 London: Transaction Publishers

Živković, J., Lalović, K., Milojević, M. & Nikezić, A., 2019. Multifunctional public open spaces for sustainable cities: concept and application. Architecture and Civil Engineering, Volume 17, pp. 205-219.

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**Author's declaration**

I hereby declare that the work presented in this thesis entitled "Green infrastructure and landscape policy instruments in the Czech Republic." is original and done by me independently, under the direction of doc. Peter Kumble. I have listed all literature and publications from which I acquired information in the attached list of references at the end of the thesis.

In \_\_\_\_\_ on \_\_\_\_\_

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## ABSTRACT

This diploma thesis focuses on the implementation of green infrastructure concept into national landscape planning policy of the Czech Republic. However, using a term as "landscape planning policy" and "green infrastructure" might be very ambitious across the Czech Republic's planning system. The core question of the diploma thesis is if in the Czech Republic yet exists a concept of green infrastructure within a national policy instrument and if yes, which of policy instruments can be considered as part of green infrastructure concept. To identify the main relevant policy instruments for the analysis is used Evert Vedung's classifying system of government tools and programs. The Vedung's typology approach is divided in regulatory (sticks), economic (carrots) and information-based (sermons) policy instruments. Once the focus of policy instruments is chosen the comparative analysis is conducted. The second part the diploma thesis focuses on policy planning instruments and green infrastructure implementation into spatial planning documentation using the comparative analysis. The last part is dedicated to comparison of approaches to the implementation of green infrastructure concept at the city policy level by examining three cities of Vienna, Prague and Philadelphia.

**Key words:** green infrastructure; land use policy; Czech Republic

## ABSTRAKT

Tato diplomová práce se zaměřuje na implementaci konceptu zelené infrastruktury do národní politiky plánování krajiny v České republice. Avšak použití termínů jako "politika plánování krajiny" a "zelená infrastruktura" může být v rámci plánovacího systému České republiky velmi ambiciózní. Hlavní otázka diplomové práce zní, zda v České republice již existuje koncept zelené infrastruktury v rámci plánovacích procesů a pokud ano, které národní politické nástroje lze považovat za součást konceptu zelené infrastruktury. Pro tuto analýzu je použit Vedungův klasifikační systém vládních nástrojů a programů. Vedungův typologický přístup je rozdělen na regulační (sticks), ekonomické (carrots) a informační (sermons) politické nástroje. Ve druhé části se diplomová práce zaměřuje na územně plánovací nástroje a implementaci zelené infrastruktury do nástrojů politiky územního plánování pomocí komparativní analýzy. Poslední část je věnována srovnání přístupů k implementaci konceptu zelené infrastruktury na úrovni městské politiky tří měst, Vídně, Filadelfie a Prahy.

**Klíčová slova:** zelená infrastruktura, územní plánování, Česká republika

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## **1. Introduction**

With the aim of reducing land grabbing and preventing excessive land cover, densified cities will, on the one hand, have to reduce the area of settlement but, on the other hand, exploit open urban and green areas. Nowadays, the task for city planners to provide sustainability of urban areas is more pressing than ever. A significant and important factor in the successful redevelopment of the city is the support of GI, which, thanks to its multifunctionality, is a source of various benefits; whether through support of biodiversity, reducing of the urban heat island effect, direct and indirect increase of economic activity through recreation and increasing the value of land or addressing the impacts of ongoing climate change. This fact supports the relevance of ecosystem services and its implementation into the city planning processes (Mell et al., 2017).

Although GI is a widely established concept, the question is whether there exists a universal definition and if not, the question is, if this would be beneficial. The definition of GI is changing across countries and continents, in the minds of researchers or planners, and thanks to a variety of professions that define GI in their own, legitimate way, many approaches and strategies are developed (Davies & Roe, 2015). In response to the trend of horticulture, recreation and tourism related to the generous green spaces of earlier times, modern metropolises offer a different view of what should be the main management medium for successful green redevelopment of densified cities and show the importance of alternative green and nature based solutions within traffic or water infrastructure redevelopment and show the important role of the private sector by indirect management of their plots and support of participatory planning for increasing the effectiveness of the whole plan (Mell, 2010).

## **2. Objectives of the study**

The objective of this diploma thesis is to provide a clear definition of green infrastructure as it applies to the Czech Republic. Additionally, the study aims to examine whether green infrastructure planning differs fundamentally from earlier environmental planning methods and to identify if the principles of green infrastructure planning are being put into practice in the country.

The first objective of this diploma thesis is to analyze how the concept of green infrastructure is understood across the process of public policy within the European Union and USA. Specifically, the aim is to explore what is the focus and what are the tools for its implementation, such as funding, strategies for implementation, crafting of localized programs, etc. There are some differences in the way that landscape policy decisions are made in the USA vs. Europe. In the EU, landscape policy, is often integrated with broader land-use planning and environmental policy, and there may be a greater emphasis on preserving cultural heritage and natural resources.

In the USA, landscape policy is more fragmented, with different levels of government (federal, state, local and private sector) responsibility for different aspects of landscape management without the focus on preserving cultural heritage and natural resources. The main objective of this diploma thesis is to understand how green infrastructure is integrated into the policy system of the Czech Republic taking a closer look at spatial planning policy and the implementation of green infrastructure.

### **3. Literature review**

#### **3.1. Green infrastructure (GI) definition**

Questions such as what GI is or what its function are, are asked by various user groups, academics and experts who address GI as a concept and as elements of a given landscape (Mell, 2010). Recently, planning experts were present at the RTPi Green Infrastructure Conference in Leeds, where they presented the latest developments in GI policy discussions. But still, the participants were confused because they did not get a clear answer to what GI actually meant. Significantly different expressions were sometimes made in each interpretation (Wright, 2011). Based on this level of uncertainty in definition, is it appropriate to ask whether there is actually an agreement in its interpretation and if not, if the diversity in interpretations is beneficial (Mell, 2010)?

Although there has been a relatively rapid development in GI research, the boom in perception of GI has come out of nowhere. Thus, we should not be surprised by some authors who critically questioned the new approach to GI and simply called it "old wine in new bottles" or saw it as a redesign of existing green planning concepts (Mell, 2010; Thomas 2010). The history of the approach to landscape planning clearly shows that this is not a new idea, but rather a new concept. Many authors state that the idea of GI has evolved over a long period of time both in theories and approaches in various contexts (Benedict and McMahon 2006; Kambites and Owen 2006; Walmsley 2006; Mell 2008).

Another critical view adds to the uncertainty by highlighting the meaning of "green" in the GI-term, a word that is also expressed by non-green infrastructure planners and asking whether it means necessarily an umbrella for environmental and ecological thinking, or to what extent we are talking about a new concept.

It is true that the concept of GI acquires its importance the moment we talk about the context of human activity, especially human settlement. Then Benedict and McMahon (2002, 2006) emphasize that ecological elements and the inclusion of natural resources are an integral part of "green" infrastructure (ODPM, 2005).

The most critical expression of the definition and overall concept of GI is the opinion of other English experts who, based on possible indefinability, argue that GI could be a "corrupt concept". Davies and Laforteza (2017) also describe the promotion of green infrastructure in cities as a neoliberal concept due to its emphasis on economic value and potential contribution to gentrification. In this approach, green spaces are valued mainly for their economic benefits rather than their intrinsic or ecological value. According to Wright (2011), this is also due to the rapid rise of GI and the short time horizon when experts were able to reflect the meanings associated with the concept through various interest groups. Significant deviations from the definition that led English scientists to doubt, and criticism deepened more, was when it came to comparing the approach to GI between continents. The difference in the perception of GI between continents, for example in the EU and the US, is still substantial. The US regulatory planning system has provided greater certainty as to what development is allowed through spatial planning, while the planning system in Europe is more pragmatic (Booth, 1999). Greenbelt plans where urban sprawl has tripled land consumption (McMahon 2009). GI emerged as a natural step towards "smart protection" for the city (Wright, 2011).

What is sure from previous research is that GI is a flexible concept that represents diverse associations and interpretations that derive from a particular industry (Wright, 2011). There are several common assumptions within the available definitions.

Namely, that GI includes natural and managed green areas in urban and rural environments, that it is a well thought out interconnection of private and public green spaces, and that it should have a direct or indirect positive impact on society.

An interesting view is also provided by the work of Davies and Roe (2015) which describes the situation where stakeholders in the GI planning process have been asked to formulate a GI definition. The result was a comprehensive definition that says: "GI is the physical environment within and between our towns, suburbs, and villages. It is a network of multifunctional open spaces, including parks, gardens, forests, green corridors, waterways, street trees and open landscapes. It covers all environmental resources, so the GI approach also contributes to sustainable resource management." The desire to clearly name what GI represents, creates, and influences has driven many other professionals and organizations to create new definitions, such as Benedict and McMahon (2006), Natural England (2009), and recently the European Commission (2010).

Other definitions supporting the European approach are: "'Green infrastructure' is a network of multifunctional green space, both new and existing, both rural and urban, which supports the natural and ecological processes and is integral to the health and quality of life of sustainable communities" (DCLG, 2008). According to Mell et al. (2017) the most notable definition is the one from Benedict and McMahon's (2006): "Green infrastructure is our nation's natural life support system - an interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks and other conservation lands; working farms, ranches and forests; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life for America's communities and people."

From all the definitions mentioned, we see the complexity of the concept and how all the members involved struggle with its meaning. The purpose of this section is not to come up with a new breakthrough definition, because, as Wright argues, the definition is not a primary success for the effective use of GI, as we already understand the importance of GI, but rather still wonder how GI could have been reflected in policy or practice. Finally, Wright (2011) claims that GI is inherently ambiguous.

### **3.2. Factors influencing the implementation of GI.**

As already mentioned, GI can fulfil a wide variety of functions and can contribute to addressing ecological, economic, and socio-cultural challenges of spatial planning, providing a number of benefits in these areas. The ecological value of GI results from the biodiversity promotion through the characteristics of natural or nature-based solutions. If implemented in urban areas, GI can enhance the ecological quality of urban spaces by improving air and water quality, as well as the climate. The socio-cultural value emerges from the use of GI for community- and identity building and social interaction, economic values of GI show by increasing the attractiveness of areas for tourists and (new) inhabitants or the capacity to provide resources for various sectors as e.g. agriculture or leisure (Živković, et al., 2019).

However, the promotion of green spaces may also lead to gentrification, where improvements in the area lead to an increase in property values and displacement of low-income residents. summarizes the cement of low-income residents. Table 1 summarizes the different functions, GI can address. The main perceived functions that should legitimize and that are emphasized while implementing GI, as well as the understandings of the concept, vary across regions and countries. Although the functions might in general be the same, the way how GI is perceived and what the main reasons for the implementation are, differ, which is shown below by the examples of the US and the EU, two frontrunners in the development of the concept (Mell, et al., 2017).

Table 1. Focus of green infrastructure planning in the USA and Europe, modified by author (Mell, 2012)

USA	Europe
Climate change adaptation	High density urban development
Micro-climate control in urban areas	Mobility
Biodiversity conservation and assessments	Climate change mitigation and adaptation
Sustainable urban design	Sustainable urban design
Sustainable drainage systems	Biodiversity and conservation
Smart Growth	Spatial planning
Water resource management	

### 3.2.1. GI factors in USA environment

While parts of GI have their origin in the nineteenth century, where consciousness for recreational spaces to promote public health and flooding problems was growing (Lennon, 2014), elements of it were already touched on in several laws and directives over the course of the century, for example by the 1963 Clean Air Act, the 1969 Environmental Policy Act, or the 1972 Clean Water Act (Mell, 2015). The concept itself emerged in the late 1990s, concretely in 1999, when the former President's Council for Sustainable Development (PCSD) foregrounded the concept and tried to reconcile environmental conservation with growth facilitation (Lennon, 2014). Because of the strong fragmentation of the planning system in the United States, the implementation was faced with challenges. Due to weak linkages and feedback processes between the federal, state, regional and local level, translation from federal policy to state policy and the other way around has proven difficult. Consequently, isolated and locally aligned, instead of federal policies and practices were developed (Mell, 2010). At that point, especially water management and landscape conservation as well as biodiversity issues were the drivers behind the development of the concept (Mell, 2015; Lennon, 2014).

Water management policy and funding are centralized in the USA and mainly overseen by the EPA. This top-down approach and the mentioned missing linkages and feedback between the different political levels resulted in a narrow policy diversification and obstacles in adapting or translating GI policy and led to a maintained focus on water management. The strong focus on this topic in city-level GI policy, like Philadelphia's Green City, Clean Water program, underlines this state.

Over the last decades and due to raising attention to the concept, its multiple benefits and multifunctionality became more and more visible, which made a shift from the water-management-centric perspective towards a more flexible and varying approach observable (Mell, 2015). A number of regional- and city level initiatives with a broad portfolio of projects and followed approaches, a result of pursued aims of encouraging the local community and stakeholders for developing plans and community visions, (Di Marino & Lapintie, 2017) have, despite the lacking linkages between the political levels, lead to a spread of these multi-scale and holistic approaches of GI to the federal level, even though a federal framework and policy is still missing and hinders GI development. In order to effectively translate strategic goals to the state or local level, an overarching, general federal policy needs to be addressed (Mell, 2010).

### **3.2.2. GI factors in EU environment**

Like the US, there have been several policies and programs in the European Union, which dealt with subjects of GI long before the turn of the millennium (Slätmo, et al., 2019). However, the first policy document on the topic itself was the EU Strategy on Green Infrastructure, brought forward only in 2013, which aims to promote investments in natural capital, deliver multiple benefits, contributing to green growth and reach the 2020 biodiversity goals (Interreg Europe, 2017). This theoretical framework, focusing on multi-scale planning of GI, states that there is "no need for legislation exclusively designed to enforce



implementation, but calls instead for existing legislation, policy instruments and funding mechanisms to be used” (Slätmo, et al., 2019). Although progressions are visible and the GI concept was promoted in some of the main EU politics (as e.g., in the EU water policy or the EU strategy on adaptation to climate change), there are still some areas, where the GI concept is not yet considered, despite many studies demonstrating the positive benefits (EU health policy, or partly the Common Agricultural Policy). A strategic approach for GI has therefore not yet been implemented (European Commission, 2019).

As the political system of the EU is way less centralized and can only partly be compared to the US-one, different competences and responsibilities occur. The EU strategy for GI can therefore not be implemented by the EU itself, but rather by the now 27 member states. Slätmo, et al. (2019) found in this regard that the responsibility for developing a policy strategy lies mainly with the national governments, ranked before the local governments. Nevertheless, the authors conclude that the responsibilities for creating policies and implementing them lies on various governmental levels.

Figure 1. GI policy sectors in 32 European countries (Slatmo, 2019)

	GI specific policy	GDP per capita in 2017 above EU average	Policy sectors including GI principles															
			Land use and spatial development planning	Transportation	Water management	Agriculture, Forestry and Fisheries	Climate change mitigation and adaptation	Environmental protection	Disaster prevention	Finance	Energy	Cultural heritage	Health	Social services	Rural development			
AT																		
BE																		
BG																		
HR																		
CY																		
CZ																		
DK																		
EE																		
FI																		
FR																		
DE																		
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NO																		
CH																		

Ongoing forms of involvement and interactions between governmental bodies, citizens and non-state actors are observable (Di Marino & Lapintie, 2017). With the different approaches, also the planning systems vary.

Some countries explicitly include GI requirements for urban (re)developments, for example a green space factor, max density of built-up area, or green-area-per-capita factor, to incorporate elements of GI in the planning and building process (Slätmo, et al., 2019). Even though this conceptual fragmentation entails several different approaches and policy sectors involved in implementing GI (Figure 1), a common understanding of the concept is observable. Slätmo, et al. (2019) conclude, that the focus of the implementation has been on enhancing ecological networks, nature protection and biodiversity and most countries include green areas and the interconnectivity between them.

But also, other policy sectors, mainly water management, agriculture, climate change mitigation and adaptation and the land use and spatial development planning sector often include GI principles and confirm that the GI concept is perceived to go beyond the only biodiversity protection function. Lennon (2014) also states that in the EU GI is primarily interpreted as a “networked” approach to safeguard ecosystem services that provides socioeconomic and ecological benefits. At this point, the understanding of the concepts resembles the American one, by promoting sustainable forms of growth. Meeting the targets for biodiversity protection shall not hinder economic development, but shall, through the provision of ecosystem goods and services, create a win-win solution – also considering the broad array of functions GI can fulfil.

The report from European Environmental Agency (EEA, 2019) describes two approaches to GI planning that work together. The first approach involves mapping the existing components of green infrastructure (GI), such as protected areas and ecological networks, to identify and delineate landscape elements.

The second approach uses ecosystem service-based mapping to ensure that these elements deliver multiple ecosystem services, including provisioning, regulating, and cultural services, by targeting connectivity and service delivery. Together, these two approaches aim to optimize the delivery of ecosystem services through GI planning.

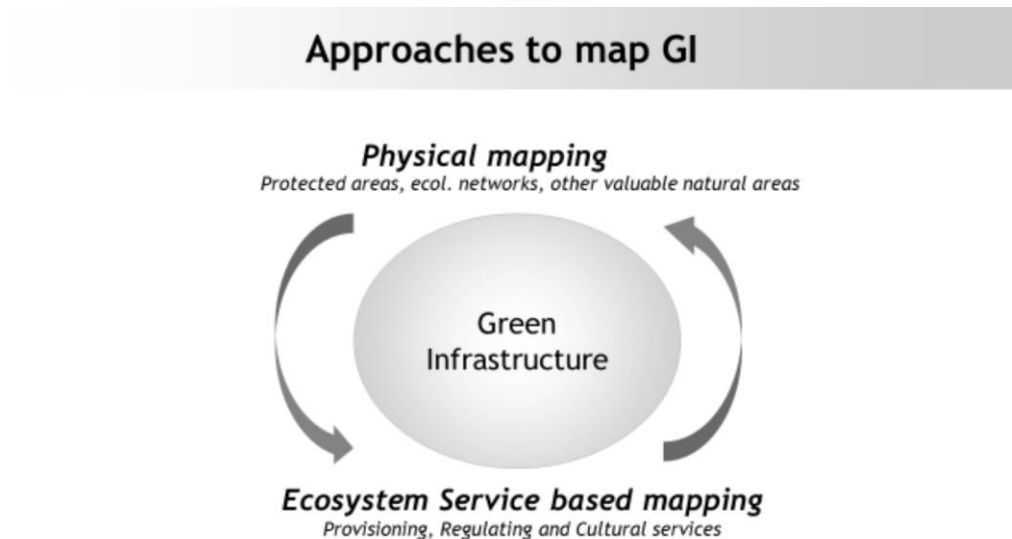


Figure 2. Approaches to map GI (Source, EEA 2019)

According to EEA (2019) the Ecosystem-based solutions and ecosystem services are related concepts but have different meanings. Ecosystem-based solutions refer to strategies or actions that utilize natural ecosystems to address environmental or societal challenges. These solutions rely on the natural functions and services provided by ecosystems, such as water filtration, carbon sequestration, and biodiversity conservation. Examples of ecosystem-based solutions include restoring wetlands to reduce the impacts of flooding, using natural vegetation to control soil erosion, and managing forests to enhance carbon sequestration.

On the other hand, ecosystem services are the benefits that humans derive from ecosystems. Ecosystem services can be divided into four categories: provisioning services (such as food, water, and raw materials), regulating services (such as climate regulation, water purification, and pollination), cultural services (such as recreation and spiritual experiences), and supporting services (such as nutrient cycling and soil formation).

While the US-approach has its roots in landscape conservation and water management, the European approach aims in simultaneously tackling urban issues such as high- density urban development. This is concordant with the generally observable, increasing role of GI in tackling urban challenges, that are often driven by densification processes (Di Marino & Lapintie, 2017). Mell (2010) underlines that the development of the concept in Europe is linked with the need to develop integrated green space effectively within high density landscapes.

### **3.3. Tools for the implementation of GI**

#### **3.3.1. GI implementation in US**

In the US the Green Infrastructure Collaborative, a network-based learning alliance was created to help communities more easily implement GI within their countries. The primary purpose of the Collaborative is to promote the multiple community benefits of GI, capacity building and the implementation of GI into the municipality infrastructure and policy issues and least but last facilitate the best way to encourage adoption of GI technologies. Additionally, each of the organizations joining the Collaborative is committed to undertake individual actions and encourage GI implementation (USEPA, 2014).

On the Federal level, the US offers Federal Agency Support for the GI Collaborative. Range of Federal programs is investing in green roofs, roadside rain gardens, increasing tree canopy and other forms of GI. The agencies that make up the Partnership for Sustainable Communities are U.S. Environmental

Protection Agency (EPA), U.S. Department of Transportation (DOT), and U.S. Department of Housing and Urban Development (HUD) – along with U.S. Department of Agriculture (USDA), U.S. Department of Interior (DOI), U.S. Department of Defense (DOD) and U.S. Department of Energy (DOE) – each of them is offering different expertise and resources that help communities plan, design, and implement GI (EPA, 2014). Despite this collaboration, the lack of funding is consistently cited as one big obstacle in implementation of GI (USEPA, 2021).

Significant advancements in GI have occurred in recent years and communities across the country have implemented the use of GI practices. As mentioned before, the US system of GI contains also the elements which focuses on blue infrastructure too, for example: combined sewer overflows, reduce stormwater pollution in municipal separate storm sewer systems (MS4s), and prevention of localized flooding's. GI continues to emerge as an approach to complement gray infrastructure and provide multi-benefit solutions that create resilient and sustainable communities. (USEPA, 2014). Within the funding programs, most options are represented by the funds with the focus on blue infrastructure and not specifically with the focus on GI.

Regarding EPA funding opportunities some examples of programs and initiatives which can fund the implementation GI can be mentioned: EPA Office of Sustainable Communities Greening America's Communities Program, DOI Rivers, Trails, and Conservation Assistance (RTCA) Program, EPA Clean Water State Revolving Fund (CWSRF), EPA Great Lakes Restoration Initiative, Five Star and Urban Waters Restoration Grant Program. These examples are supporting GI implementation, the Five Star and Urban Waters Restoration Grant Program seeks to develop community capacity by providing modest assistance to diverse local partnerships for river, wetland, riparian, forest and coastal restoration, and wildlife conservation.

In this way, this program can also be used as a source of funding for GI implementation even if there is no GI concept mentioned.

EPA offers dozens of programs and funding options for GI, but there is a necessity to find the opportunity for GI in the middle of programs apparently allocated for blue and grey infrastructure (USEPA, 2021). Within the federal system fund can be found many possibilities for GI, other options of financing and strategies the implementation of the GI concept are reported in Table 2. These examples are supporting GI implementation, the Five Star and Urban Waters Restoration Grant Program seeks to develop community capacity by providing modest assistance to diverse local partnerships for river, wetland, riparian, forest and coastal restoration, and wildlife conservation.

Table 2. Financing Options and Resources of GI for Local Decision-Makers, modified by author (USEPA, 2014)

Funding source	Description	Advantages +/ Disadvantages -
<b>Taxes/General fund</b>	Funds raised through taxes such as, property, income, and sales that are paid into a general fund	<ul style="list-style-type: none"> <li>+ Consistent from year-to-year, existing funding system</li> <li>- Competition for funds, Tax-exempt properties do not contribute</li> </ul>
<b>Fees</b>	Funds raised through charges for services such as inspections and permits. Funds raised through developer impact fees are one-time charges linked with new development	<ul style="list-style-type: none"> <li>+ Specific permit and inspection fees allow for more direct allocation.</li> <li>- Requires administrative framework to assess and manage, Funding not available for larger projects</li> </ul>
<b>Stormwater Utility</b>	A stormwater utility generates its revenue through user fees and the revenues from the stormwater charges will go into a separate fund that might be used only for stormwater service	<ul style="list-style-type: none"> <li>+ Shared cost, Dedicated funding source,</li> <li>- Study required for implementation, fee structure, and administration of utility, approval by vote of the local legislative body</li> </ul>
<b>Grants</b>	State and federal grants provide additional funding for water quality improvements	<ul style="list-style-type: none"> <li>+ Existing sources available</li> <li>- Competitive, one-time project</li> </ul>
<b>Public-Private Partnerships</b>	Contractual agreement between a public agency and a private sector entity that allows for the private sector participation in the financing, planning, design, construction, and maintenance of stormwater facilities.	<ul style="list-style-type: none"> <li>+ Can reduce costs to government, ensures adequate, dedicated funding, significantly leverages public funding and government resource.</li> <li>- Perceived loss of public control</li> </ul>



### 3.3.2. The GI implementation in EU

GI is of has gained significance in the European Union and the network Natura 2000 could be seen as a backbone of the EU's GI concept. The integrative parts of GI within the EU are: parks, private gardens, hedges, vegetated buffer strips along rivers or structure rich agricultural landscapes, artificial features such as green roofs, green walls, or eco-bridges and fish ladders (European Commission, 2019). Significant financial support is allocated to EU member states for the implementation of nature-based measurements in the field of GI, such as the Common Agricultural Policy, the Cohesion Fund or Natura 2000, besides in the Cohesion Fund, GI has a priority of the investments (European Commission, 2013). The European Commission adopted an EU strategy on GI in 2013 where this infrastructure should be a pillar for regional policy and sustainable growth in Europe, it also highlights the need to ensure that GI becomes a standard part of spatial planning and territorial development within the EU member countries and its integration into the implementation of national policies (European Commission, 2013).

It includes four priority work streams:

- Promoting GI in the main policy areas
- Improving information, strengthening the base knowledge, and promoting innovation
- Improving access to finance
- Contributing to the development of GI projects at EU level

The EU supports the development of GI within member states through development of networks to facilitate GI implementation within existing legal, financial and policy instruments. In this way the member states are supported to participate in the EU funding programs.

EU investments in GI have significant potential to strengthen regional, urban development, inter alia by maintaining or creating work potential and reap its benefits for sustainable development (Science for Environment Policy, 2012).

At the same time the GI projects are carried out on a local, regional, national, or trans- boundary scale, project development on the different scales of GI should be interconnected and interdependent (Interreg Europe, 2017). For European Union it is important to make the GI concept the integral part of spatial planning and territorial development which is coherent to the member states policies and the EU has set this target for the 2014-2020 time period. The EU in this matter provided a budgetary framework to be integrated and used in the projects relevant to GI.

*Table 3. The main EU funds supporting GI implementation (European Commission, 2013)*

<b>The main EU funds supporting GI implementation</b>	
Common Agricultural Policy	The European Maritime and Fisheries Fund
The Cohesion Fund	The Financial Instrument for the Environment (LIFE)
The European Regional Development Fund	Natural Capital Financing Facility
Horizon 2020	The European Fund for Strategic Investments
Connecting Europe Facility	Natural Capital Financing Facility

## 4. Methodology

The main objective is to understand if and in which way are green infrastructure instruments anchored in the policy system of the Czech Republic. For this purpose, the regulative instruments according to Vedung's (1998) typology of policy instruments is selected. This typology is widely utilized in the field of public policy analysis and evaluation by researchers, policymakers, and practitioners. Vedung's three main policy classes are called regulations (sticks), economic means (carrots), and information (sermons).

The policy instruments in terms of regulation are tools (laws, directives, rules, planning instruments) used by governments to achieve their policy objectives. This option has been selected for this work because in the next step it analyzes spatial planning documents. The planning policy instruments are more focused on the process of developing and implementing policy (land use regulations, zoning laws, development permits, urban design guidelines, environmental impact assessments, transportation plans, and economic development strategies etc.).

Table 4. Vedung's typology of policy instruments (Vedung, 1998)

Policy instruments		
Regulations	Economic means	Information
Laws, directives, rules, planning instruments	Incentives, grants, subsidies, tax regulation	Communication campaigns, printed materials, audits, inspections, demonstration programs, educational efforts etc.

## **4.1. Selection of main important planning policy documents**

### **4.1.1. The GI indicators selection**

**Research question:** *Are the main GI indicators implemented into spatial planning policy instruments in the Czech Republic?*

According to Laforteza, Davies, Sanesi, and Konijnendijk (2013), GI can be an effective tool to support spatial planning in European regions. The first step, in understanding how GI can support spatial planning in the Czech Republic, is to identify the main GI indicators in the field of spatial planning policy from documents published by the European Commission and the European Environmental Agency. These are:

- a) Commission Staff Working Document – Technical information on GI (European Commission, 2013b)
- b) Spatial analysis of green infrastructure in Europe (EEA, 2014)
- c) Strategic Green Infrastructure and Ecosystem Restoration, geospatial methods, data, and tools (EEA, 2019)

Table 5. The main GI indicators adapted by author (European Commission 2013b, EEA 2014, EEA 2019)

<b>GI main drivers/variables</b>	<b>Explanation of the meaning in GI perception</b>
<b>Ecosystem based approaches</b>	Ecosystem-based approaches are strategies that involve using biodiversity and ecosystem services to help people adapt to or mitigate the adverse effects of climate change by conserving carbon stocks and reducing emissions caused by ecosystem degradation and loss. Examples of EBA include ecosystem restoration, conservation planning, and sustainable land use practices.
<b>Ecological networks</b>	Ecological networks are a way to represent the interactions between species in an ecosystem. The goal of ecological networks is to maintain the functioning of ecosystems and conserve species and habitats.
<b>Ecosystem services</b>	Ecosystem services refer to the benefits that people receive from ecosystems, such as food, water, flood control, and cultural benefits. They can be categorized into four broad categories: provisioning services (e.g., food, water, timber), regulating services (e.g., climate regulation, pollination), cultural services (e.g., recreation, aesthetics), and supporting services (e.g., nutrient cycling, soil formation)
<b>Natura 2000</b>	Natura 2000 is a network of protected nature areas across the European Union. The network aims to protect and conserve Europe's most valuable and threatened species and habitats for their long-term survival
<b>Biodiversity</b>	Biodiversity encompasses the variation among living organisms in all environments, including on land and in the water, as well as the ecological systems they are a part of.
<b>Resilience</b>	Resilience describes the ability of an ecosystem to return to its original state after being disturbed

In

Appendix 2. Main GI drivers according to EU – full explanation modified by author (European Commission 2013b, EEA 2013, EEA 2019).

#### **4.1.2. The Czech spatial policy instruments selection**

In the Czech republic exist several planning instruments dealing with the landscape or its parts, in this work compared spatial planning instruments are: the Spatial development policy of Czech Republic (Politika územního rozvoje, PÚR), spatial planning documents (Územně plánovací dokumentace, ÚPD), Landscape studies (Územní studie krajiny, ÚSK), and Landscape consolidation (Pozemkové úpravy, PÚ) see Table 6.

To provide a unified framework and be able to identify the GI indicators, the work focuses on procurement binding methodologies and laws of PÚR, ÚPD, ÚSK and PÚ. For exact name in national language and location of the documents see Appendix 1.

Table 6. Overview of examined spatial planning policy instruments (Source, Ahutor)

Spatial planning domain					
Planning instruments	Hierarchy	Responsible authority	Spatial focus	Status	
Spatial development policy of Czech Republic	national	Ministry for regional development/ Government	national	Legally binding	PÚR
Regional spatial plans	regional	Regional building authorities	regional	Legally binding	ÚPD
Land use plans	local	Municipal Board Building Authorities of Municipal Office of entire Municipality with extended power	local	Legally binding	
Landscape studies	local	Municipal Board Building Authorities of Municipal Office of entire Municipality with extended power	Municipality with extended power	Not legally binding	ÚSK and PÚ
Rural development – agricultural domain					
Land consolidation	Local	Municipal Board Building Authorities of Municipal Office of entire Municipality with extended power	Municipality/ specific part of its cadastral area	Legally binding	

## 4.2. Comparative analysis and evaluation

In this step I compared the main EU GI indicators from the Table 5 with the spatial planning policy instruments of the Czech Republic classified in the Table 6. The aim of this comparison is to determine whether the main indicators listed in EU documents for the GI implementation align with the spatial planning instruments of the Czech Republic. The regulatory plans, which are detailed plans created by local authorities to regulate land use and development in a particular area, are also an integral part of the ÚPD. However, due to their scale and level of detail, they have not been included in this work. The content analysis is done through these two data sets based on 6 main drivers from Table 5. To evaluate the implementation of individual indicators in Czech spatial planning instruments, I assigned the codes to each of them based on their occurrence and extent in the text see Table 7 . I utilized the evaluation scale developed by Semančíková (2019), which was originally designed to assess the strategic plans concerning the landscape policy instruments.

Table 7. Evaluation scale (Semančíková, 2019)

Scale	Evaluation criteria
0	The studied documentation does not deal with the GI variable at all. This category was given a score of 0.
1	The studied documentation discusses the GI variable only generally and neither tackles the problem nor gives possible solutions. This category was given a score of 1.
2	The studied documentation discusses the GI variable and only supports tackling the problem. This category was given a score of 2
3	The studied documentation deals with the GI variable, supports different ways of tackling it and suggests possible solutions to it. This category was given a score of 3.

#### **4.2.1. Case study selection**

In the final section, this work compares three cities - Prague, Vienna, and Philadelphia. This step demonstrates the different approaches of cities (and countries) in implementing GI at the urban planning level. Comparing the three cities, which have similar preconditions, as all of them are growing, count a similar number of inhabitants and face the same challenges caused by densification processes or climate change, there are differences observable. To compare these cities, the main strategic documents, documents issued by the city (both legally binding and non-binding), elements of the spatial plan, and building codes are examined.

## **5. Results**

### **5.1. Spatial policy instruments evaluation**

Spatial policy documentation of the Czech Republic (PÚR) is prepared by the Ministry of Regional Development (in cooperation with the regions and other central administrative authorities) as a cross-sectoral concept and approved by the government (Section 34 of the Building Act of 2006) for the entire territory of the country. It specifies as a national priority, the landscape, and its restoration in terms of its essential cultural, natural, and environmental values. Another priority is to plan the development of rural areas and regions in connection with the development of the primary sector, the protection of high-quality forest stands, bodies of water, and quality of agricultural land, especially arable land and the ecological functions of the landscape must be considered too. When determining land use in spatial planning documentation (ÚPD), it is preferable to prioritize complex solutions over the application of unilateral perspectives and requirements, which may ultimately worsen the condition and value of the territory.



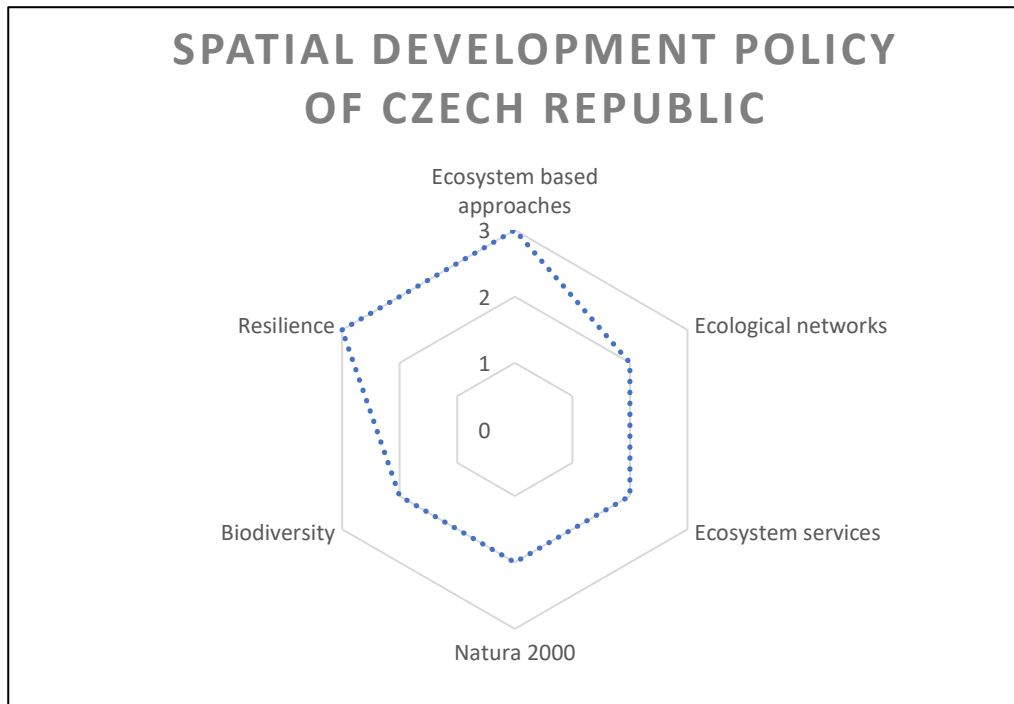
This section also outlines (the GI indicators biodiversity and Naura 2000) the importance of ecological networks for protecting biodiversity, and the need to improve the territorial system of ecological stability and enhance the connectivity of the landscape.

Another national priority (the GI indicator resilience) is to create conditions for the preventive protection of the territory and population against potential risks and natural disasters (floods, landslides, erosion, droughts, etc.) to prevent them and minimize their negative impacts. Then the PÚR defines development areas, development axes and specific areas. Defining specific areas serves the purpose of enabling regional authorities, ministries, and other central administrative bodies to create favorable conditions for addressing issues within their respective areas of jurisdiction. The specific areas are identified within municipalities, with explanations of the reasons for their delineation, the criteria, and conditions for decision-making in the area. The document always specifies who is responsible for implementing these priorities (the regional body, ministry department or spatial planning institution). The priorities often target areas that are less developed within the Czech Republic, such as Mostecko, Karvinsko, Beskydy, and Sokolovsko. On the page 40 of this documentation, a specific area called SOB9, which is endangered by drought, is identified. This area encompasses several municipalities with extended power within the whole Czech Republic. The reasons for defining SOB9, as well as its criteria and conditions for decision-making, are explained in detail.

The text also outlines concrete tasks for ministries and spatial planning institutions, such as enhancing the natural water regime in the landscape, protecting ecosystems, managing stormwater, increasing soil resilience, restoring watercourses, reducing the size of soil blocks or erosion control (the GI indicator of ecosystem based solution). Other contemporary landscape issues related to GI are also addressed, with specific responsibilities assigned to various entities. The text includes in this part the concepts of "landscape

planning" and "green infrastructure" also one of the pre-conditions in land use decisions is „Developing green infrastructure in built-up and unbuilt areas of municipalities and subsequent care for it“.

Table 8. GI indicators for PÚR

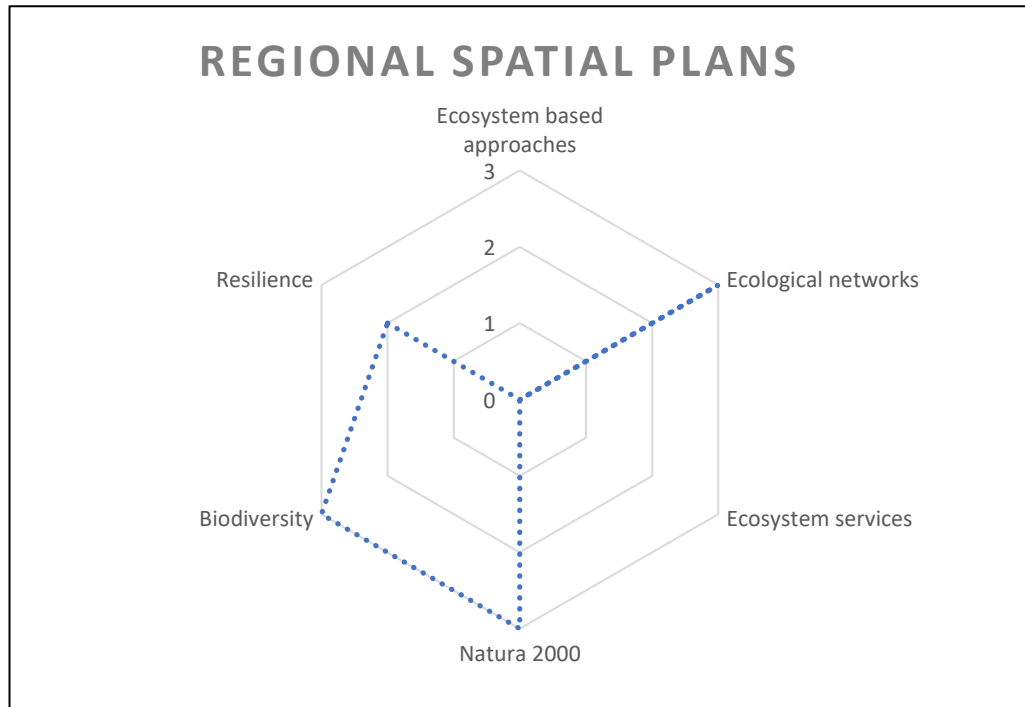


Regional development plan (Zásady územního rozvoje, ZÚR) are essential and legally binding documents that have a higher rank than other spatial plans and must adhere to the Spatial policy documentation of the Czech Republic (PÚR). The ZÚR focuses on the effective and sustainable use of the region's territory, and it defines the areas and corridors of regional significance. In this section, I did not use any specific methodology or documentation, as each region updates their own Regional Spatial Plans (ZÚR) on the base of already existing condition. I focused on laws. The indicators of GI can be perceived in this context, particularly within the framework of the spatial analytical data (Územně analytické podklady, ÚAP), which are defined by Act No. 500/2006 Coll.

These data contains the information of so-called phenomena and elements of green infrastructure are included, such as forests, protected areas, watercourses, riparian zones, landscape values, landscape character, own landscapes, territorial system of ecological stability and many others. These phenomena are subsequently incorporated into binding maps for lower-level spatial planning documents. According to EEA (2019) spatial implementation of GI involves mapping the existing components such as protected areas and ecological networks, to identify and delineate landscape elements. Another important aspect of GI within the ZÚR is the delimitation of own landscapes with defined target qualities as a part of the principles of spatial planning based on The European Landscape Convention No. 12/2017 Coll.

According to this convention, landscape means a part of the territory as perceived by people, and its character is the result of the interaction between natural and/or human factors. Initially and wrongly landscape types were defined rather than "own landscapes," which led to a significant generalization of delimitation. However, a disadvantage today is that while some regions have started defining their own landscapes, others are still limited to delimiting only landscape types. Another significant indicator of GI referring to ecological network, connectivity and Natura 2000 is the Territorial system of ecological stability. It is defined by Act No. 183/2006 Coll. and incorporated to ZÚR by Act No. 183/2006 Coll. The Territorial system of ecological stability (TSES) is a comprehensive tool for the protection and maintenance of ecological stability in the landscape. It is an interconnected set of natural and modified, but nature-like ecosystems that maintain natural balance. It consists of three basic elements, biocentres, biocorridors and interactive elements.

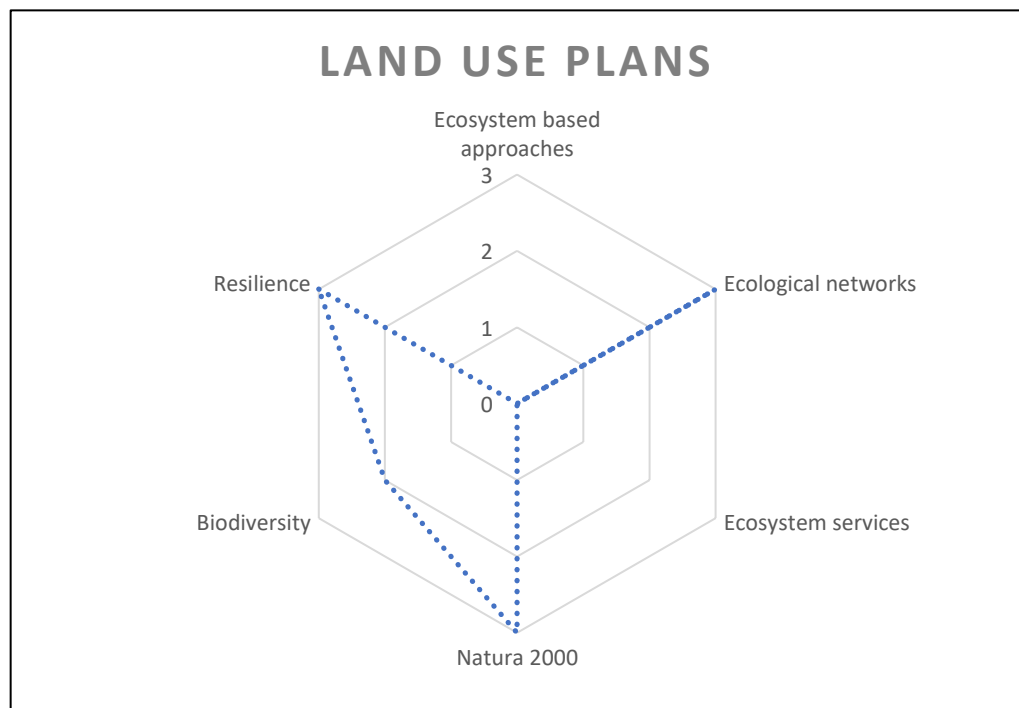
Table 9. GI indicators for ZÚR



Land use plans/Spatial plans are subject to the ZÚR and PÚR and must consider these binding documents. Therefore, when planning, the mentioned GI factors must be in line with each other. This gives the city or municipality a hierarchically predetermined basic arrangement of GI elements. In the outline and methodology of the spatial plan assignment are specified in the chapter a.3) requirements for the concept of landscape arrangement. This point specifies the requirements for the spatial arrangement and potential changes in undeveloped areas. This includes analyzing which areas are appropriate for prohibiting the placement of buildings, facilities, and other measures, as outlined in § 18 paragraph 5 of the Building Act (Act No. 183/2006 Coll). Essentially, it outlines the necessary steps for determining which areas should be protected from development and preserved for other purposes. Within the chapter a.1) is specified the system of urban greenery and its arrangements (GI indicator of biodiversity).

In the chapter a.3) is specified the Territorial system of ecological stability, spatial relations of landscape, landscape permeability and concept of landscape arrangement (GI indicator of ecological networks). In terms of GI indicator resilience can be specified the flood protection and erosion control which must be considered in spatial plan. Given that every spatial plan can incorporate these fundamental elements into their plans for specific areas, I have chosen to delve into the relationship between cities and GI in the following chapter of case studies. Through this analysis, I aim to compare various approaches taken by different cities (Prague, Vienna, and Philadelphia) towards the elements of GI.

Table 10. GI indicators for Land use plans



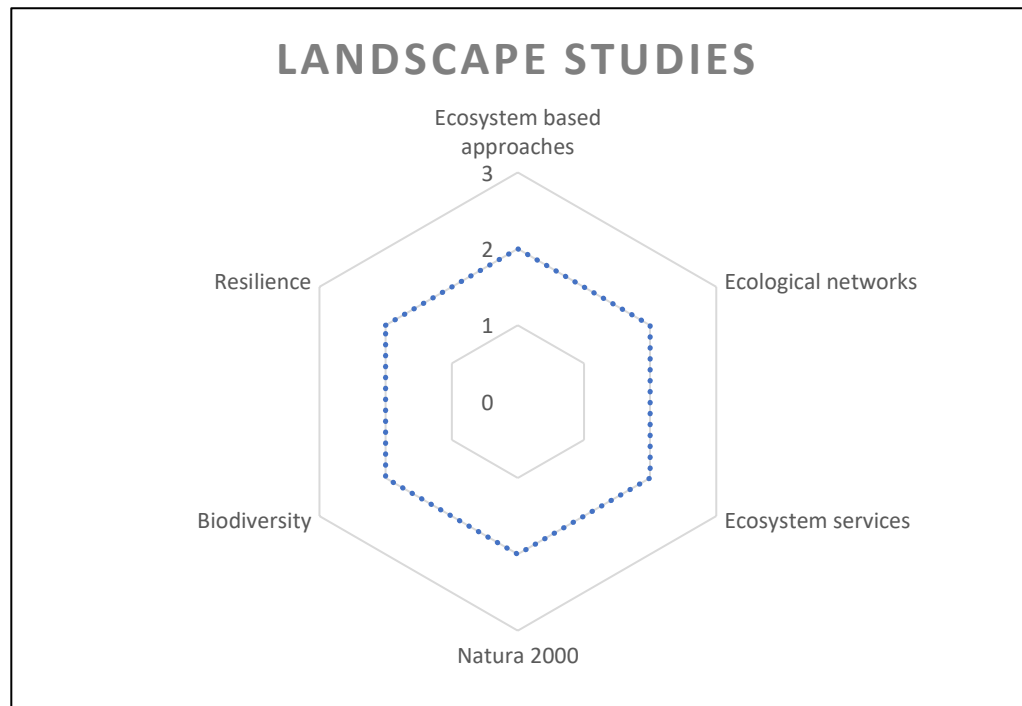
Landscape Study (ÚSK) is a territorial study in the sense of § 25 and 30 of the Building Act, not legally binding, which aims to establish a concept for the arrangement of the landscape in spatial and regulatory plans at the level of municipalities with extended competence (ORP). It is a joint methodological guideline of the Ministry for Regional Development and the Ministry of the Environment from 2016, which is primarily intended as a basis for planning and decision-making intentions in the landscape, or as a supplementary basis for

territorial analytical documents (ÚAP). To elaborate this study, it is necessary to consider the binding documents specified in this work (PÚR, UPD), as well as landscape consolidation outputs (PÚ) and other relevant plans. The proposal section of the ÚSK must always include a) setting the target vision for the landscape and b) dividing the territory into landscape districts. Subsequently, the methodology recommends addressing the given topics, which are further specified in chapter "3.2. Proposal of Landscape study", schematically predetermining the layout of chapters.

The processing of individual topics should serve to formulate the framework conditions for the use of landscape districts and framework recommendations for measures, which also contribute to refining the ZÚR. In terms of GI indicators many of them are in practice here. The proposal and recommendation in this study as a GI resilience indicator, are for example, improving the water regime of the landscape, the framework for delineation of watercourses floodplains, and erosion protection or flood protection.

As a biodiversity, connectivity and ecological networks GI indicators can be mentioned the territorial system of ecological stability, significant areas for migration, long-distance migration corridors, measures for the protection and enhancement of biodiversity and the prevention of landscape fragmentation. The GI indicators of ecosystem services are included also, development of recreation and tourism, adaptation to climate change, increasing the coefficient of ecological stability. Gi indicators for ecosystem-based solutions are the changes in land use to enhance soil quality, changes in the size of land blocks, landscape revitalization, or renaturation (restoration of the original natural state after some anthropogenic intervention).

Table 11. GI indicators for Landscape studies



Landscape consolidations are carried out in accordance with the Act on Land Consolidation No. 139/2002 Coll. and its implementing regulations. Land consolidations in the Czech Republic are a process aimed at improving and facilitating the use of agricultural land. Within the framework of land consolidations, issues such as land subdivision, land exchange between owners, adjustment of watercourses and other elements of the landscape, establishment of new roads and communications, or protection of nature and landscape are addressed. Land consolidations are processed in areas defined as cadastral territories. The territorial units that serve to record real estate and ensure ownership rights, at the same time they are the smallest territorial units that serve for a detailed description of the territory.

This is a very detailed assessment of the territory, especially in terms of erosion risk, water management, and agrotechnical measures. It is also a powerful tool in defining and specifying elements of the territorial system of ecological stability. It also involves the demarcation of historical paths or access roads to make the land better accessible for the residents and landowners.

It is specified that the areas with high occurrence of drought are the priority for PÚ, it means that the areas specified in PÚR should be selected first. While implementing the plans of common facilities, the PÚ must consider higher-level documentation. In the terms of GI indicators ecosystem-based solutions soil stabilization and improvement of quality are in place. The Gi indicator of biodiversity is not specified as the interventions mainly focus on soil, water, and impermeability of landscape. GI indicator of ecological networks is specified as the territorial system of ecological stability. GI indicator of resilience is included in wind and water erosion control, measures for improving water conditions and water management.

Table 12. GI indicators for Land consolidations

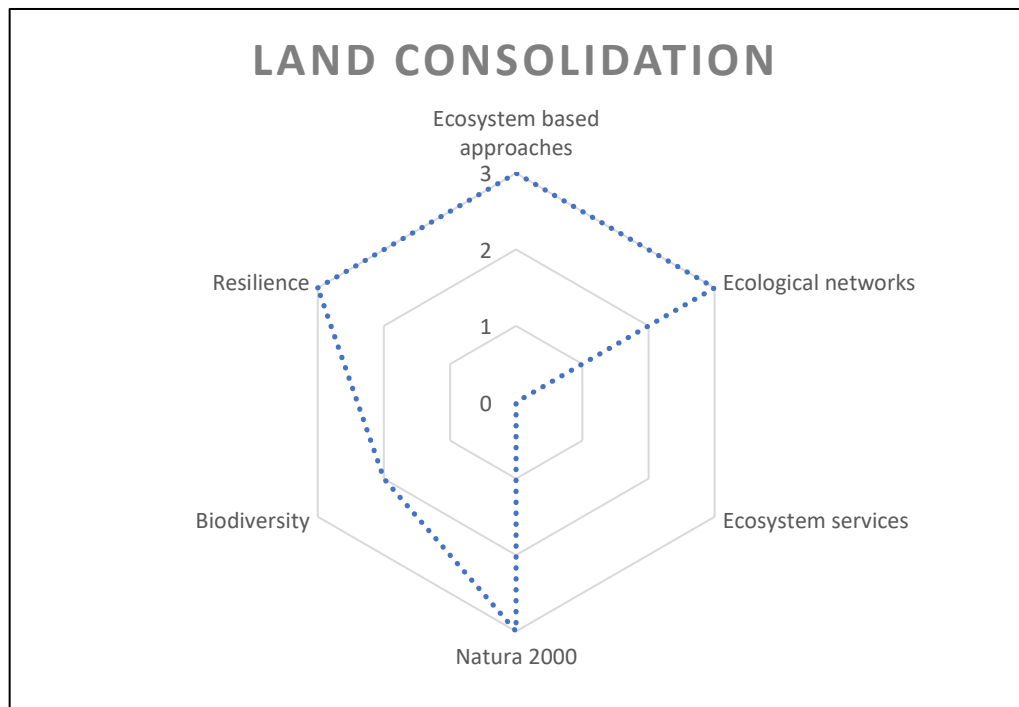
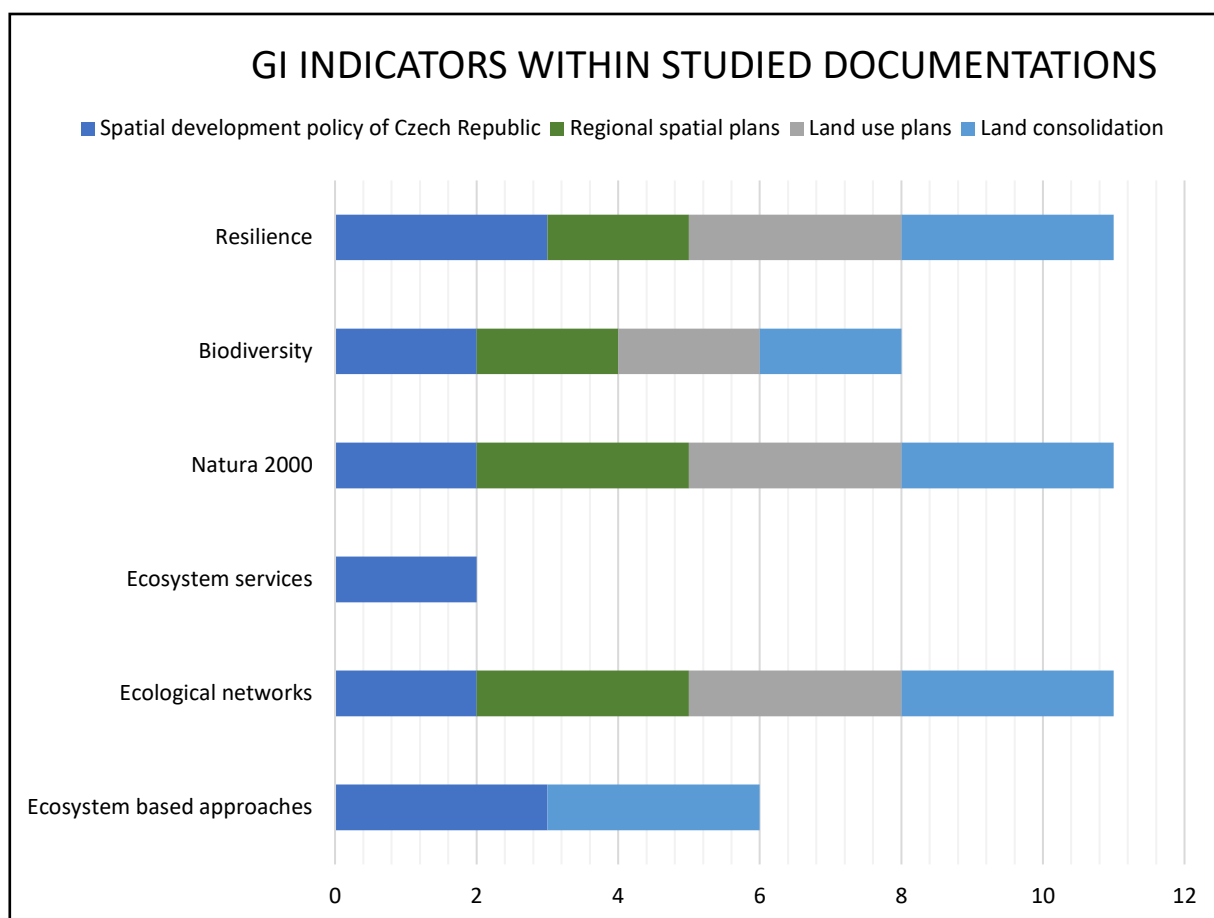




Table 13. GI indicators and results from the study.



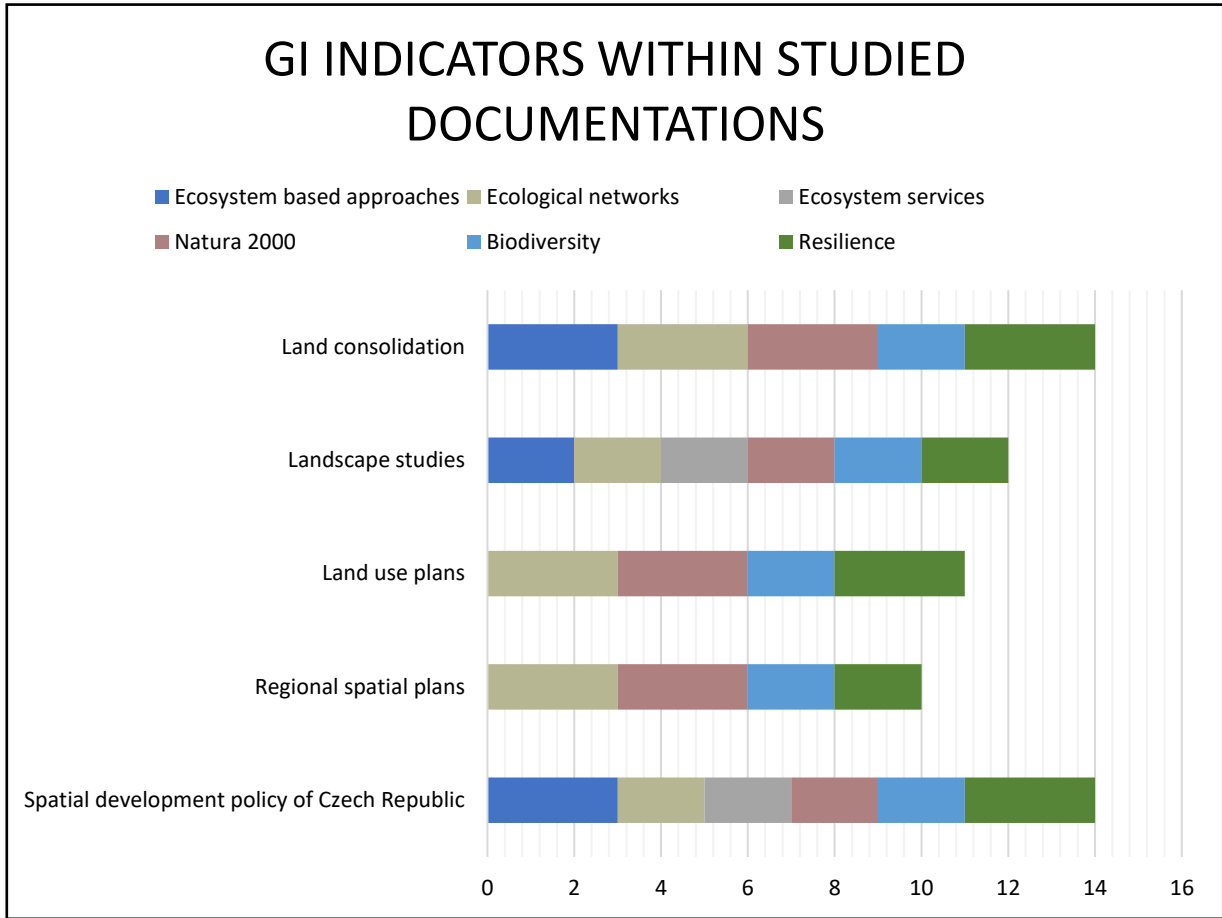
The results show that the documentations primarily fulfill the part of physical mapping of GI components as explained in the literature review and these factors include Ecological networks and Natura 2000. Ecological networks are mainly represented by TSES elements. Based on the results, it may appear that the Czech Republic has an excellent system of interconnected ecological networks. However, it is known from practice, that the TSES is often defined as non-functional. For it to become a functional and continuous system, a change in the spatial plan must occur, and if the owner of the land on which the TSES is delineated never seeks a change, the TSES may not be delineated. Resilience is also a highly represented factor of GI, especially because in the ZÚR flood zones and soil protection classes must be indicated and at the level of spatial plan respected.

In the context of land consolidations, resilience is directly practiced and extended to erosion control measures, renaturation of water courses and redefinition of TSES. In the case of the land consolidation also ecosystem-based solutions are present. In the methodological guidelines is specified how to reduce the impacts of flooding and how to control and calculate erosion control. As also reported by EEA (2019) the examples of ecosystem-based solutions include restoring landscape to reduce the impacts of flooding, using natural vegetation to control soil erosion, and managing forests to enhance carbon sequestration. In this case also the Spatial development policy of Czech Republic is included because it specifies these measures too, but as said before this is rather a conceptual documentation.

Only in the Spatial development policy of Czech Republic are ecosystem services represented. This documentation specifies the importance of wider areas (Šumava, Beskydy, Krušnohoří) the importance of their rational planning of tourism trails, the support of local products and local “identity”. In context of Czech planning system this are rather soft planning measures, but these can be understood as ecosystem services in terms of GI indicators. As specified European Commission (2011) ecosystem services are the benefits that humans derive from ecosystems.

From the results, it is apparent that the studied documentations primarily utilize elements of physical mapping and their subsequent implementation into binding documents. At this point, data on the Landscape studies (ÚSK) were not evaluated as they are the only non-binding documentation. The GI factor of biodiversity is a relatively neutral topic that is often mentioned but not always fully elaborated upon. It could be interpreted that this subject is already adequately covered in other conservation documents that were not included in the study, or that there is not a well-developed, specific conservation approach for it (as is the case in the Vienna case study).

Table 14. GI indicators and results from the study.



It is interesting from this study that the Spatial development policy of Czech Republic (PÚR) achieves the same score as the most restrictive tool in this study, which is the Landscape consolidation (PÚ). As mentioned earlier PÚ are developed only within cadastral areas. This often means that PÚ are implemented only in part of a municipality and not across the entire municipality. The new strategy proposes that these measures could be implemented on larger spatial units or along the entire water course. The results may suggest that is appropriate to use restrictive methodologies such as those used in PÚ.

The Landscape consolidation focuses on a very small area, specifically on agricultural landscapes, and it is often initiated by a majority of landowners, or in response to significant environmental problems by municipalities. On the other hand, spatial plans must deal with much larger areas and restrictive, precisely defined methodologies are not desirable as they would rather limit their scope. The question then is how to achieve a higher score in GI planning within the framework of spatial plans. National policy sets parameters for GI planning to be fulfilled, but the spatial plans already have their established structure, and planners often do not change their approach to planning.

## **5.2. Case studies**

### **5.2.1. Vienna**

As Slätmo, et al., (2019) describe in their work (see figure 1), Austria has no GI specific policy implemented at a national scale, nor a lot of policy sectors that include GI principles, with disaster prevention as the lone exception. The corresponding “Austrian strategy for adaptation to climate change “, deals with that topic covering both, disaster prevention, especially induced through climate change, and GI.

The involved actors for implementing green and blue infrastructure within residential areas are mainly located in spatial planning, where because of the responsibility of the federal states mainly state governments, urban regions, municipalities and planning firms are involved, and in other subject areas, as nature conservation, which also falls under the jurisdiction of the states, urban planning, landscape, and open space planning (Federal Ministry for Sustainability and Tourism, 2019). The Austrian Biodiversity Strategy 2020+ (BMLFUW, 2014) as another federal strategy also covers the GI concept.

The special division of competences in Austria therefore leads to no or few responsibilities of the national level, but of the state- and municipal level. Vienna, at the same time municipality and federal state, has more autonomy compared to other cities and is therefore endowed with regulative and financial power (Mocca, et al., 2020).

The protection of green areas in Vienna has a long history. From the protection of the Wienerwald in 1872 to the establishment of an environmentally protected area and therefore the setting up for the Vienna green belt, to the clear and modern conception of for the green areas in Vienna in the 60s and 70s and a zoning system for their protection (Breiling & Ruland, 2008).

During the 80s, the Department for Urban Planning increasingly influenced and shaped the environmental discourse and formulated a socio-ecological problem - solving attitude, which prioritizes urban renewal over urban expansion and pushed for a protection and development of urban green spaces for enhancing the resident's quality of life. Even though there was an observable shift of focus towards economic development and a lesser weighing of green space protection and promotion – mainly because of the ongoing population growth and the necessity for increasing the housing stock – a departure from environmental protection cannot be identified in urban planning; however green space declined by 3% from 2005 to 2015 (Mocca, et al., 2020).

The basis for this development lays the Urban Development Plan, the STEP 2005, which defines a line that represents the boundary of the superordinate landscape vis-à-vis the buildable city. Outside this boundary, no development and settlement may take place (MA 18, n.d.), "

Even though the Urban Development Plan is resolved by the Vienna municipal council, it is not legally binding and more a guideline for sectoral planning. However, also the new STEP 2025 supports and maintains this separation between settlement area and landscape in its principles (MA 18, 2014).

As mentioned before, there are literally no federal planning documents and regulations that influence the development of GI in Vienna. Besides the Urban Development Plan, which specifies the direction for the city development on a macrosocial level until 2025 and inter alia defines target areas which show high development potential, there are a number of planning instruments and strategic documents that cover and promote the implementation of GI in the urban area.

The Smart City Wien Framework Strategy (Vienna Municipal Administration, 2019), which serves as a long term umbrella strategy and tries to steer the direction of the city development until 2050, the Climate Protection Program of Vienna (Vienna Municipal Administration, 2009), which inter alia shows the urban planning design options for GI and aims at linking small scale green elements with the large agriculture areas, respectively the green belt and create a connected system of green elements, the Public Space Development Plan, which focuses on the densely built-up city areas and works on a district level; these are just a few of them.

The most relevant and specific strategic concept for the planning and implementation of GI might be the thematic concept Green and Open Spaces, which was published in 2015. It describes a typology of elements and the variety of functions of GI, and emphasizes the role of a so called “Freiraumnetz Wien”, which wants to point out the structure of Vienna’s open space network and connect different green and open spaces, as well as the “Local Green Plan”, which is seen as the future standard description instrument for green and open space planning and serves as an initial information for concrete planning solutions. The focus of this instrument lays in the design of urban development areas and in areas of compaction.

Figure 3. Standarts for green and open spaces in Vienna (MA 18,

GREEN AND OPEN SPACES	CATCHMENT AREA (m)	SIZES (hectare)	m <sup>2</sup> per inhabitant		
Neighbourhood	250	< 1	3.5		
Residential area	500	1–3	4.0	8.0	13.0
Urban quarter	1,000	3–10	4.0		
	1,500	10–50			
Region	6,000	> 50	5.0		
+ sports ground			3.5		
+ green spaces per working place (catchment area 250 m)			2.0		

The concept also described quantitative goals, as the maintenance of a 50% green space-share in the city, which, considering the continued urban growth, basically demands an increase in green and open spaces, or the green and open space supply standards, shown in figure 2 (MA 18, 2015). Morawetz et al. (2016) refer to this 13m<sup>2</sup>-goal in their work, noting however, that GI must not only be installed on public spaces, which fall under the competence of the city management, but also on private building areas and therefore call for a “Green Space Factor”, that calculates the % of the site that can be built upon with green requirements on a building site.

At the level of building sites, no target value explicitly related to green space exists up to now – existing rates, as e.g., the floor area ratio only indirectly determines the supply of green and open spaces and leave the quality of these areas aside (Czachs, et al., 2016)The strategic documents and its target values are, as said, not legally binding. The legislative anchoring happens in the specification of land use categories in the Vienna Building Code, which serves as the land use planning instrument, and in the Nature Conservation Act, which aims at protecting habitats, species, biotopes, and objects.

Also, the Vienna Act on Allotment Gardens, the Vienna Tree Conservation Act and the Vienna Act on Biosphere Parks partly cover GI-relevant regulations. The Vienna Building Code plays a major role in protecting and zoning green areas and differentiates between several land use categories: rural zones, mainly for agricultural and forestry purposes, leisure zones, so parks, allotment areas, etc. and protected zones, especially the wood and meadow belt. Incentives for the private implementation are primarily given through grants and financial funding (Czachs, et al., 2016), for example for roof or facade greening (Vienna Municipal Administration, 2009).

A complex and wide topic as GI protection and development requires holistic concepts and a cross-departmental commitment for a consequent anchoring in urban development (Rößler, 2015). In Vienna, there is no single department responsible for GI development, but rather many different magistrates. These include the MA18 Urban Development and Planning, MA19 Architecture and Urban Design, MA21 Urban District Planning and Land Use, MA22 Environmental Protection (including nature conservation), MA25 Urban Renewal, MA42 Urban Park Management and MA45 Vienna Water. Astleithner & Hamedinger (2003) noted tendencies towards a lack of coordination and communication between departments in the early 2000s, which would hinder a comprehensive and holistic development.



These tendencies have, however, weakened, and interdepartmental cooperation increased especially after the smart turn in 2011, although projects are often still subsidized by lone departmental funds (Mocca, et al., 2020). Most of the strategic planning documents mention the multifunctionality of GI and the broad variety of functions the concept can address, which explains the broad range of magistrates dealing with or approaching the topic. While the functions might be inseparable connected with each other, some tendencies in the planning process or the factors that influence an implementation, might be apparent.

Analyzing the involved departments and the strategic planning documents, a tendency towards an ecological, nature conservation, networking approach can be observed, even though topics as stormwater management are also addressed by several planning documents. Issues, such as climate change adaptation, cultural identity and economic competitiveness are mentioned, are considered however not as objectives, but mainly to describe the variety of functions GI can fulfil.

The nature conservation areas, however, do rather represent a protection, than a development category, as the explanations and zoning categories of the Vienna Building Code indicate (Gantioler, 2019). The Austrian Biodiversity Strategy (BMLFUW, 2014) named the importance to integrate biodiversity and ecosystem services in sectors such as spatial planning and the designation of priority areas in regional plans. Gantioler (2019) however cited an interviewee, that the city's nature conservation law would be "mostly reactive and applied too late in the land use planning process, limited to some areas and often to the protection of certain species rather than the design of habitats and ecosystems". Slätmo et al. (2019) underpin this perception, and declare Austria as one of the countries, in which a prioritization of GI in spatial planning on a regional, local and city level is not always observable.

The thematic concept for green and open spaces highlights another core instrument to successfully adopt GI, which is the participation of citizens in the planning process (MA 18, 2015). Several initiatives and strategies highlight the importance of a participatory process, as the city development plan Vienna and Local Agenda 21, (MA 18, 2014), the Practice Manual on Participation (MA 18, 2012), or the initiative “Gebietsbetreuung Stadterneuerung”, which functions as an interface between local inhabitants and the planning level and tries to locate ideas and needs in a city districts through a bottom-up principle. Even though these initiatives gain ground, Mocca et al. (2020) still recognize a top-down organized decision-making structure in Vienna, with little involvement of non-public actors. Especially civil society is not sufficiently engaged yet and is primarily seen as the recipient of services.

### **5.2.2. Prague**

To explain how the City of Prague is implementing the concept of GI into the practice is necessary to mention, that in the whole country there does not exist a GI concept or strategy. The Ministry for Regional Development was commissioned to prepare a methodological guideline for the definition of GI within the national spatial planning documentation. A research project aims to unify the potentials and possibilities of implementing GI into spatial planning documentation. The research lead partner of the project is Mendel University in Brno, and the expected output is *“The methodology of defining green infrastructure in spatial planning documentation, especially in the spatial plan”* (TAČR, 2020). This call came as initiation from the Ministry for Regional Development within the program of The Technology Agency of the Czech Republic, which is an organizational unit of the state in support of research, experimental development, and innovation (TAČR, 2020).

According to the definitions used in this work, it can be stated that elements of GI are already to some extent included in the spatial planning documentation. Slätmo (2019) suggests that the EU legislation specifically designed to enforce the implementation of GI is not necessary. Instead, existing legislation, policy instruments, and funding mechanisms should be utilized and improve the quality of planning. However, certain policy sectors, such as land use and spatial development planning, water management, agriculture, forestry and fisheries, environmental protection, and rural development, include GI principles more frequently than others.

Prague is a municipality and at the same time a region, this fact is really advantageous in the conditions of spatial planning in the Czech Republic because none of the cities within the country have this status. (Praha EU, 2020). This ensures that Prague can individually and at the same time process spatial planning documentation (ÚPD). The legally binding documentation for Prague within spatial planning is the Spatial Development Policy (PÚR), which is a nationwide legally binding document as mentioned before. Prague is a part of the specific territory SOB9. For the implementation of GI indicators, there is a support at the national level as specified in the previous section and it is now the task of lower-level authorities to implement these national priorities on a smaller scale.

At the level of GI, points such as the revitalization and renaturalization of watercourses, the management of rainwater, resilience to wind and water erosion, and the creation and maintenance of diverse and varied landscapes are specified. It is also stated that spatial planning authorities should use Landscape studies (ÚSK) as the main basis to tackle these problems. However, Prague does not have any ÚSK and the ones in neighboring municipalities with extended powers are very different in their approach, content, and recommendations. Another important factor specified in PÚR is the delimitation of metropolitan area to connect Prague with surrounding

municipalities within planning processes (metropolitan areas should be delineated for some other cities as well).

In the Regional spatial plan (ZÚR) of Prague are specified the GI indicators as green development areas, areas where the conditions of nature and landscape protection intersect with demands for recreational activities for residents, such as the confluence of the Vltava and Berounka rivers and the Prokop and Dalej Valleys. The delineation of specific areas and corridors identified in the Czech Republic's Spatial Development Policy, as well as the identification of areas and corridors of regional and metropolitan significance for watercourses and small streams and territorial system of ecological stability (TSES) along with corresponding tasks for detailed territorial planning documentation are specified here.

This documentation also includes general city-wide principles of the concept of development for the protection of natural, cultural, and civilization values where conditions for the protection of natural values are specified. The target landscape characteristics are delineated, according to old adaptation of The European Landscape Convention No. 12/2017 Coll. (ZÚR Praha, 2022).

The actual spatial plan from 1999 has a strong focus on functional land use and recognizes 11 different types of green areas such as agricultural land, natural areas, sports and recreational areas, green spaces, and landscapes. The plan falls short in providing a conceptual approach. However, the plan does not provide a comprehensive depiction of the public spaces in the area (IPR, 2014a). The urban greenery primarily includes parks and park-like areas, forests, cemeteries, tree-lined streets, as well as gardens in individual buildings or scattered greenery, including individual trees. Individual trees are protected by the Nature and Landscape Protection Act No. 114/1992 Coll., which applies to greenery located outside forests. The greenery areas within cities and their possible use are subject to the spatial plan. The Building Act specifies the

conditions for the efficient use of built-up areas and ensures the protection of undeveloped areas and non-buildable land.

The greenery still includes agriculturally managed land. According to Act No. 334/1992 Coll., on the Protection of Agricultural Land Fund. Additional conditions are stipulated by Decree No. 6/2001 Coll. of the Capital City of Prague, on the protection of public greenery, which considers publicly accessible land registered in the Land Register as greenery. The spatial plan must also adhere to the Territorial system of stability which is defined in the ZÚR.

The processed new Metropolitan Plan (yet not in force) includes a redesignated landscape boundary that separates the built-up urban landscape (city landscape) from the natural or semi-natural suburban landscape (open landscape).

Definition of the landscape interface (in between the city and open landscape) is a non-buildable area of land surrounding the compactly built-up area of the city (IPR, 2014). By designating an unbuildable landscape boundary, the Metropolitan Plan aims to preserve and protect the suburban landscape from further urbanization, while also promoting the development of the city. This approach helps maintain a balance between the urban and suburban landscapes, ensuring that the needs of residents are met.

The objective is not to achieve strict "greenness" of this area by means of afforestation. Rather, the aim is to establish a clearly defined and respected non-buildable zone, with the understanding that the demands of metropolitan life may sometimes require exceptions. The Metropolitan Plan suggests moving away from the current system of functional zones and instead proposes a new division of the city into "localities." The division is based on respect for the city's structure and its unique characteristics. (IPR, 2014). In open landscapes, the Metropolitan Plan also introduces the possibility of making changes to improve

the ecological stability of the area using ecological stability index (SES) (IPR, 2015). The Institute of Planning and Development (IPR) of the City of Prague is responsible for the creation of the new Metropolitan Plan. The IPR was established in 2013 and it has in competence coordination of documents in the field of strategic and spatial planning development. Subsequently the Office of Landscape and Green Infrastructure has been established.

The IPR is responsible for larger-scale projects within GI concept. Currently IPR is processing projects such as the competition for the landscape of the confluence of the Berounka and Vltava Rivers, Rohan Island, and Imperial Island etc. Additionally, it processes data related to GI factors and coordinates the TSES (IPR, 2020a). Another official entity to cope with the GI is the Department of Environmental Protection (OCP). This department is primarily responsible for ensuring the management of small watercourses, ensuring, and coordinating the management and maintenance of specially protected areas, and representing the owner of waterworks and forests owned by the City of Prague (OCP, 2023).

The Adaptation strategy of the City of Prague and the Strategic plan 2023 are also considering the aspect of GI and specifying how The City of Prague should tackle the current environmental pressures (IPR, 2016). At the same time, several practice-oriented documents are being created within several working groups and commissions, such as the Prague Building Regulations, Prague Rainwater Management Standards, Standard for Planning, Planting and Caring for Street Trees or the Concept of Vltava's shores (IPR, 2020b). The success of the implementation of GI projects depends crucially on whether the projects will be initiated, accepted, and supported by the entities as regional and local planning authorities, city, municipalities, organizers of infrastructure projects, farmers and foresters, businesses and developers, environmental civil society organizations and trade unions (Slazmann, 2015).

### 5.2.3. Philadelphia

To avoid the unplanned consequences of urbanization, the city of Philadelphia made efforts to strengthen and enhance green spaces in the city, from 2008 to 2015 (City of Philadelphia: Office of Sustainability, 2016). Despite this fact, the city still increased impervious surface area 11% (Shade and Kremer, 2019). As part of the program, new efforts are being made to increase green space in Philadelphia through GI. On-site solutions are implemented locally but are driven by federal and state level policies (American rivers, 2020).

The US EPA plays an elementary role in the planning and implementation of GI in all areas of the United States. Which mainly defines GI in the context of state water management and stormwater practices. Although various departments and intermunicipal cooperation are also involved in GI planning in the areas of transportation, watershed management, wastewater management, zoning, local codes, and ordinances, official statements and practices of United States shows that GI is in general managed by water in the city and offers many guides and support for smaller units of the state, be it loans, sewerage fees or awards and proposals for cooperation to achieve this goal.

The second superior institution for Philadelphia is Pennsylvania Government, specifically the Department of Environmental Protection, which manages all forms and elements of the GI under the *Restore Pennsylvania program* (Pennsylvania Government, 2018). Like the Clean Water Act for the whole state, The Clean Streams Act authorizes the Pennsylvania Department of Environmental Protection (DEP) to maintain or improve the required water infrastructure. One of potential but not finished programs are Pennsylvania's stormwater program. Another program is the Keystone Principles which refers to Criteria for Growth, Investment and Resource Conservation with principles as redevelopment, sustainability, efficient infrastructure, and environmental support.

The Keystone planned practices include the following: improvement of existing water and sewer capacity, design of new water storm, and sewer facilities and utilizing best management practices that emphasize usage or infiltration within permeable surfaces. Additional criteria explain the green building standards and development practices. While these principles could have a strong influence, the adoption of GI practices is left to each agency without stable requirements.

The most recent state effort that may influence cities include Philadelphia is the State Water Plan adopted in 2008 by the DEP, which must be submitted by each city, so Pennsylvania could control management of all cities. Not all cities have taken part yet. Successful institutionalization of GI is needed not only for planning and controlling but also for financial support. Both federal and state funding programs can provide money for the GI practices. Unfortunately, many of these resources are untapped because the trend toward more environmentally focused practices occurring across the state, has not been institutionalized in Pennsylvania. Few resources have been successfully exploited. One of them has been recently under the Pennsylvania Infrastructure Investment Authority (PENNVEST), and this funding has forced the state to seriously solicit green projects and consider how best to evaluate and support such projects (Pennsylvania Government, 2018).

In April 2009, PENNVEST under the auspices of the Pennsylvania Department of Environmental Protection and the U.S. EPA provided under the auspices of Clean Water Act a \$ 30 million green loan to Philadelphia for sustainable infrastructure development throughout the city (American rivers, 2020). The city of Philadelphia has implemented GSI (Green Stormwater Infrastructure) by a combination of public and private investment. The main types of implementations are following:



a) Development and Redevelopment: Landowners install GSI to comply with Philadelphia's Stormwater Regulations.

b) Incentives / grant retrofit programs: By implementing GSI, landowners can retrofit their properties thanks to funding or apply for a credit to reduce their monthly stormwater bills.

c) Philadelphia Water Department Capital Projects: PWD is a biggest owner and actor in designing, installing, and maintaining the GSI based public or on city-owned properties.

For better work efficiency, the area of Philadelphia is divided into four PWD planning districts. PWD planning includes detailed technical analysis, building relationships with implementation partners, reviewing community plans, which helps identify stakeholders and create potential collaboration in the next phases of the project. Such participants may be owners of private plots, which make up more than 50% of the area of the current non-green water infrastructure. In the next part of planning, a list of GSI alternatives is created, all required maps and summary statistics are created using GIS Base Map, Highway Supervisor Plans, PGW gas plants and City Plans (as zoning maps, land use maps etc.).

During the planning phase, a Rainwater Improvement Plan is being developed. This relatively significant document summaries existing outcomes of recent work. During the next phase, called the design phase, the whole project is discussed with all parties involved, mainly with the city agencies, implementing partners and stakeholders. As GSI design is still a novelty, design must be open to new innovative ways, changes, and exceptions.

That enables effective planning and implementation. In the last phase of the project, there is a publication and cooperation with the public and companies to complete the project. An important part is GSI Monitoring (GSIM), which monitors the development of the project and serves, not only Philadelphia, for performance evaluation.

Detailed binding manuals called the As-Built Survey & Drafting Manual and Maintenance Manual are created for monitoring and maintenance (Philadelphia water department, 2021). In 2011, the Philadelphia Water Department (PWD) launched its recently most successful GI plan called the Green Cities Clean Waters (GCCW) to reduce combined sewage overflow and meet all CWA points.

The program is scheduled for the next 25 years with a total investment of \$ 2.4 billion from the PWD budget (Shade, 2019). GCCW 25 years graphs are expected to show the management of runoff from over 9,000 acres of impervious surface and reduction of sewage overflow pollution by approximately 85 percent. Financial return with complete return is estimated to be nearly 45 years after realization (American planning association, 2021). Intensive cooperation between the city and the US EPA is expected not only during the implementation period. EPA will provide consultation, technical advice, and implementation examples from across the country from small-scale projects such as living wall designs, medium-sized projects such as green open spaces and vacant land, and larger-scale projects such as urban proposed districts to improve rainwater. Demonstration projects with the new Philadelphia projects will show the early benefits to the livable neighborhood residents through innovative green approaches. These projects serve to document the cost and effectiveness of GI for highly urbanized communities (American rivers, 2020).

## **6. Discussion**

### **6.1. The Czech spatial policy instruments and GI**

The field of GI is, as described in the theory part, a very broad, ambiguous, flexible concept which cannot be wrapped up within one definition. As the concept is perceived differently depending on its geographical application or the main following functions, not only the respective definitions differ, but also the involved actors, tools and the factors that influence the implementation of GI. As stated, the US heavily focuses on stormwater management, which is underlined by the strong focus on this topic in city-level GI policy, as the city of Philadelphia with its Green City, Clean Water program has shown, but also the programs, funds, and initiatives on federal level. There cannot be drawn to such a clear conclusion in analyzing the European approach. The mentioned European approach of GI as a networking or biodiversity- oriented approach, is to some part true for the city of Vienna and the city of Prague, as both highlight the connectivity, or rather networking perspective of green elements on a local and regional scale. However, the ecological, nature-conservation approach that is apparent in Vienna, is not that heavily pronounced in Prague.

Based on the European political system, these variations come as each member state has its adoption scheme in place and distributes the competences within the national level, as both cities have shown. Considering the different preconditions and political structures of different geographical areas, a broad and not sharply delimited definition of the framework, leads to a facilitated adoption and contextualization of the GI implementation. On the other hand, strict definitions help quantifying policies, measure their effectiveness and make them comparable.

In the Czech Republic, country's multi-level governance system means that the success of partial policies is highly dependent on their relationship with higher-level policies. These sectoral policies vary in their focus and scope, and their effectiveness is dependent on their integration into the wider governance system. Successful landscape policies require a coordinated and planned effort across different administrative levels, with a clear understanding of their relationship to higher-level policies. This is crucial to ensure that policy goals are achieved in a coherent and effective manner (Semančíkova, 2019).

The PÚR specifies national priorities in specific areas with a focus on drought prevention, indicating who should address issues related to land, water, and landscape elements. However, this can lead to discrepancies, duplication of efforts, and inefficiency in addressing complex and multidisciplinary topics such as GI concept. In the Czech Republic, the issue of "resortism" is frequently mentioned where uncoordinated approaches to the spatial planning are taken, often resulting in ministries and authorities exercising their powers without sufficient coordination with local bodies, leading to inefficiency and wasted time and resources (Salzmann, 2020).

The current system of responsibility for "landscape planning" in the Czech Republic is divided among various government departments and organizations, which leads to the development of differing plans and visions for different aspects of the landscape. As a result, there is an unorganized set of documents, each focusing on specific areas of the landscape, such as forest management plans, river basin plans, plans for protected areas, land consolidation plans, land use plans, and other similar documents.

This fragmented system of responsibility can have a negative impact on the overall conception. It's not about one ministry driving the entire landscape concept, but rather about the lack of vision and professional approach to planning across multiple sectors. Even if the focus is only on the selected topic of this thesis, it is observable how disjointedly individual planning tools work through land-use planning policies.

From the results of this study, it is evident that the planning processes, as understood by the concept of GI, only consider non-binding documentation and the binding PÚR, which is more of a conceptual document. Essential documentation such as the spatial plan and ZÚR (legally binding) also apply the GI concept, but only in a monitoring capacity. This means that these instruments consider certain phenomena from the spatial analytical data (ÚAP) and reflect them in their binding maps. It is very difficult to find a consensus on how to approach GI, as can be seen in the different methodologies between the Landscape consolidations (PÚ) and Landscape studies (ÚSK). Landscape consolidations have a very strict legally binding system of guidelines for how landscape interventions should be carried out within cadastral area.

In contrast, ÚSK (not legally binding) have more flexible requirements and address all indicators of the GI on larger area than cadastral territory (on the entire municipality with extended competence). However, the results of landscape consolidations demonstrate a uniform, strict and professional approach, whereas ÚSK often vary significantly and the documentation outputs are completely different, in some cases very difficult to be used for another planning purposes (Masojídková, 2020).

The Czech Republic addresses more the top-down model in public administration and spatial planning, which is characterized as a centralized, hierarchical approach, in which decisions are made from the top down without active participation from other interested parties. This model prevailed in Europe until the 1960s when it emerged as an effective tool for managing and planning the development of territories and infrastructure (Pissourios 2014; Matland 1995).

## **6.2. Case studies**

Comparing the three cities, which have similar preconditions, as all of them are growing, count a similar number of inhabitants and face the same challenges caused by densification processes or climate change, there are differences observable. Even though the concept of GI has a short history and evolved in the late 90s, policies dealing with green and open spaces have a long history, in the EU as in the US. Nowadays, a clear responsibility and division of competences for implementing GI is still not always observable, which however might not be practicable or even be desirable.

However, the interdisciplinarity of the approach postulates interdepartmental cooperation and exchange processes between political levels. As described, there are many departments held responsible and involved in the GI planning and implementation process in Vienna, but even though the cooperation and communication between them increased, there are still signs of lacking cooperation observable. Also, in Philadelphia, various departments such as the Department of Parks and Recreations, Streets or Planning and Development are involved in GI planning and intermunicipal cooperation has been established. The fact that the Philadelphia Water Department (PWD) plays a central role in the planning process, again underlines the described stormwater-centered approach in the US.

In Prague, the creation of the Office of Landscape and Green infrastructure points in a somehow other direction, as the office overviews several topics and city concepts, ranging from the concept of Prague's shores to the connectivity of parks. The office responsible Institute of Planning and Development (IPR) is in addition in charge of coordination of documents in the field of strategic and spatial planning development and elaborating the strategic plan 2030. The fact that IPR and therefore a spatial planning institute stand at the core of GI planning in Prague, could be traced back to the spatial development policy - the national level of planning.

While the federal level plays an elementary role in the planning and implementation of GI in Philadelphia, the federal level does only indirectly and very vaguely influence the Viennese planning system. The city of Prague has as a city and region at the same time similar competences as Vienna but contrasts with it also influenced by the federal, legally binding Spatial development policy. Looking at funding, similar pictures occur, with federal and state funding programs in the US and therefore in Philadelphia, although they are not fully exploited, in contrast to Vienna, where because of the competences, no federal funding program is in place.

The Czech Republic has through its special division of competences, similar to the US, federal and European funding programs in place. Another important aspect for GI implementation within Europe, are European Conventions. We can mention The European Landscape Convention (ELC), which Austria as one of the few, in contrast to the Czech Republic, did not sign. The implementation of the ELC in each European country must be adapted to its own division of competences, possibilities of its implementation in the field of conceptual planning instruments and in landscape policies. This is based on constitutional principles and administrative organization while respecting the principle of subsidiarity (delegation of powers to the lowest possible level of management). The Czech Republic, due to the ELC, prepared the strategy on how to implement

this convention into its national policy. This didn't happen in Austria, also due to the lack of planning or supervisory authorities allocated to the matter. Common international projects, as the European Natura 2000 network or the UNESCO concepts are in this regard of weightier meaning. Thus, it can be concluded that, although of a contribution to the general awareness for the importance and functions of landscapes, the European Landscape Convention did not significantly change the development of the GI concept or the underlying processes.

In all three cities, the public sector plays an important role in providing financial resources. Philadelphia also emphasizes the importance of private investments as a complement to public funding. By regulatory changes, obligations for providing stormwater management are in place. Such regulatory instruments are not used in both observed European cities. Slightly decreasing green area in the city of Vienna, shows that the involvement of the private sector is no necessity in protecting and developing new green spaces. No kind of building site specific “Green Space Factor” is anchored within the Vienna Building Code, the mentioned standards (figure 2) are only target values and thus not legally binding. However, as the city of Vienna is still one of the largest landowners and possesses one of the largest shares of housing in Europe (Statistik Austria, 2016), it can influence and promote the implementation of GI even without these regulatory elements. As not every city has the kind of prerequisites that Vienna has, the importance of maintaining and promoting private green elements will be crucial for the successful development of urban GI. This can happen through financial incentives or regulatory changes, even though a shift of focus towards the public sector seems necessary.



The involvement of citizens in the implementation of GI is such an important matter in Philadelphia. The common participative strategy is perceived as an irreplaceable opportunity to streamline efforts for a sustainable city, including GI in detail. Since the private sector owns more than 50% of the city water infrastructure, the green stormwater infrastructure planning does cooperate with residents, local corporations and communities and creates financial and social benefits for successful planning, implementation, and maintenance. The participation aspect in Prague is slowly starting to gain more attention within the planning process but it is not very broadly anchored. The same development is observable in Vienna. The Viennese thematic concept for green and open spaces mentions the importance of regional cooperation, meaning with other states such as Lower Austria, leaving interstate cooperation out. It is obvious that nowadays the concept of GI is a necessary tool for preventing and mitigating climate change within urban planning processes, the implementation of this concept is not obvious, and approaches vary greatly across countries and continents. The importance of GI is indisputable, and it should reach the same level of importance, as we see, for example, in transport and technical infrastructure within urban planning processes. This work confirms that in all three cities the concept of GI is considered whether to a greater or lesser extent.

## **7. Conclusion**

The Czech Republic is integrating the principles of Green infrastructure to a certain extent, particularly in the monitoring and data collection. However, it still struggles to integrate planning processes that would enable broader stakeholder engagement. In Prague, the IPR is making efforts to achieve this and has already initiated some projects. The successful implementation of these primary processes within the hierarchical political structure relies on the active participation of local authorities, who play a crucial role in facilitating (and initiating) the creation of opportunities for the advancement of Green infrastructure and also other development. The Czech Republic needs a comprehensive landscape planning approach that can accommodate the needs of all sectors and, rather than regulating, should facilitate agreement between stakeholders across the territory. This should be done through the highest quality landscape planning, supporting ecosystem-based solutions that are subsequently linked to ecosystem services. The European Union's Green infrastructure framework offers us valuable guidance, examples, and opportunities. It's ultimately our responsibility to customize and apply it in a way that suits our specific needs.

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**Laws:**

1. Act No. 500/2006 Coll, app. No. 4
2. Act No. 183/2006 Coll.
3. Act No. 114/1992 Sb.
4. The European Landscape Convention No. 12/2017 Coll.

## 9. Appendixes

The procurement binding methodologies and laws		
Planning instruments	Title EN/CZ	Link
Spatial development policy/ Politika územního rozvoje	Spatial development policy of the Czech Republic	<a href="https://1url.cz/QK08u">https://1url.cz/QK08u</a>
	Politika územního rozvoje České republiky	
Regional spatial plans/ Zásady územního rozvoje	Act No. 500/2006 Coll, app. No. 4	<a href="https://1url.cz/BrckD">https://1url.cz/BrckD</a>
	Act No. 183/2006 Coll.	
	The European Landscape Convention No. 12/2017 Coll.	
	Act No. 114/1992 Sb.	
Land use plan/ Územní plán	Outline and methodology of the spatial plan assignment. Background for completing requirements	<a href="https://1url.cz/krchizadani">https://1url.cz/krchizadani</a>
	Osnova a metodologie zadání územního plánu. Podklad k doplnění požadavků	
Landscape studies/ Územní studie krajiny	Assignment of Landscape studies for the Administrative District of the Municipality with Extended Competence	<a href="https://1url.cz/xrcI9">https://1url.cz/xrcI9</a>
	Zadání územní studie krajiny pro správní obvod obce s rozšířenou působností	
Land consolidation/ Pozemkové úpravy	Methodology guidelines for Landscape consolidation	<a href="https://1url.cz/4rcI8">https://1url.cz/4rcI8</a>
	Metodický návod pro provádění pozemkových úprav	

Appendix 1. Czech spatial planning documents for analysis (Source, Author)

<b>GI main drivers/variables</b>	<b>Explanation of the meaning in GI perception</b>
<b>Ecosystem based approaches</b>	Ecosystem-based approaches are strategies that utilize nature's services, also known as nature-based solutions, for mitigating and adapting to climate change. These approaches are considered a part of Green Infrastructure and involve using biodiversity and ecosystem services to help people adapt to or mitigate the adverse effects of climate change by conserving carbon stocks and reducing emissions caused by ecosystem degradation and loss, or by enhancing carbon stocks to increase resilience and reduce vulnerability. Green Infrastructure adds spatially planned, multi-purpose elements to these ecosystem-based approaches.
<b>Ecological networks</b>	Ecological networks are a way to represent the interactions between species in an ecosystem. These networks can encompass a variety of conservation measures, from small eco-ducts to large, interconnected networks of protected areas. The goal of ecological networks is to maintain the functioning of ecosystems and conserve species and habitats.  To be part of green infrastructure, these elements must be coherent and resilient, and may include urban elements that are not traditionally part of ecological networks
<b>Ecosystem services</b>	Ecosystem services refer to the benefits that people receive from ecosystems, such as food, water, flood control, and cultural benefits. While supporting services like nutrient cycling are also part of ecosystems, they may not be considered ecosystem services because people do not directly benefit from them
<b>Natura 2000</b>	Natura 2000 is a network of protected nature areas across the European Union established under the Habitats Directive in 1992 and the Birds Directive in 1979. The network aims to protect and conserve Europe's most valuable and threatened species and habitats for their long-term survival
<b>Biodiversity</b>	Biodiversity encompasses the variation among living organisms in all environments, including on land and in the water, as well as the ecological systems they are a part of. Biodiversity includes differences within species, between species, and among ecosystems. To understand the relationship between biodiversity and ecosystem functioning, it is necessary to consider multiple dimensions, such as taxonomic diversity, phylogenetic diversity, functional diversity, interaction diversity, and landscape diversity. These dimensions help to describe the ways in which organisms are relate
<b>Resilience</b>	Resilience describes the ability of an ecosystem to return to its original state after being disturbed

*Appendix 2. Main GI drivers according to EU – full explanation modified by author (European Commission 2013b, EEA 2013, EEA 2019)*

Main drivers for EU green infrastructure implementation							
Planning policy instruments		Ecosystem based approaches	Ecological networks	Ecosystem services	Natura 2000	Biodiversity	Resilience
	Spatial development policy of Czech Republic	3	2	2	2	2	3
	Regional spatial plans	0	3	0	3	2	2
	Land use plans	0	3	0	3	2	3
	Landscape studies	2	2	2	2	2	2
	Land consolidation	3	3	0	3	2	3

Appendix 3. Results from comparative analysis (Source, author)