A TALE OF TWO GREEN CITIES

Exploring the role of visions in the development of green infrastructure in two European Green Capital Cities

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Summary

There is a pressing need for cities in Europe (and indeed worldwide) to incorporate more green space into their urban matrices. One manifestation of this is through the development of green infrastructure, which has been heralded as somewhat of a panacea to the numerous social, environmental and economic sustainability challenges facing cities. Despite this recognition, there is no universal strategy guiding the implementation of green infrastructure.

As a planning concept, green infrastructure is often implemented by cities in line with a certain vision, and with a set of pre – determined desired outcomes. However, the content of these visions, and how they are realised, varies greatly between cities, based on the characteristic geographic and socio – economic contextual factors.

Moreover, the visions developed by European cities guiding green infrastructure are likely influenced by those of the European Union (EU) which are embodied in various directives, strategies and targets. Given that the EU has limited, direct control over the urban environment at the municipal level, various 'soft' measures are deemed as an appropriate and convenient method of encouraging city authorities to comply with, and even champion, EU environmental standards and targets. The European Green Capital Award is a benchmarking tool, with the aim of providing a platform for sharing best practices, and show casing European cities which are leading the way in environmentally sustainable living, with the hope that other cities can take inspiration from 'contextually similar' cities. Interestingly, the European Green Capital Award has been described as a soft policy tool of the EU, and a way of ensuring that the EU agenda, expressed through its visions, is diffused to a local level, where the frameworks exist to effectively implement it.

Thus, this thesis seeks to understand the role of visions in guiding green infrastructure developments in two European Green Capital Award winning cities, Nijmegen (the Netherlands) and Essen (Germany). Furthermore, the role of various contextual factors, and the role of the EU, be it direct or indirect, are also explored. As European Green Capital Cities are regarded as frontrunners, the ways in which these cities develop and use guiding visions can provide a model for other cities.

Both Nijmegen and Essen have developed markedly different visions guiding the development of green infrastructure, and it became clear that the concept of visions themselves can be ambiguous and subsequently manifested through various means. In general, the development history of both cities, as a socio – economic contextual factor, proved to be instrumental in determining the resulting vision guiding the development of green infrastructure in the city. On the other hand, the role of the EU in the development of the resulting visions varied greatly between the two cities. The different manifestations of the role of the EU, and possible explanations for this, are presented.

Preface and Acknowledgements

This thesis marks the culmination of my Master's degree in Environment and Society studies, and furthermore, signifies a ***change(d) perspective***, from my natural sciences Bachelor's degree in the UK, to this integrated, social sciences Master's degree in the Netherlands. During my Bachelors, I developed a particular interest in the role of nature in the city, and my understanding and appreciation of this has since evolved from a truly ecocentric to a holistic approach, reflected in my decision to pursue this Master's degree.

The process of writing this thesis was only possible with the help and support of numerous people. First, I wish to thank my thesis supervisor, Dr. Sietske Veenman for her time spent reading my various concept chapters, and her guidance (and patience!), which made the process behind this thesis both enjoyable and rewarding. During this time, I had the opportunity to do an internship in the spatial development department at the Municipality of Nijmegen. Thank you to my internship supervisor, Ton Verhoeven, for your insightful comments, and for helping me gather my primary data, specifically by pointing me in the direction of possible respondents and taking me to the Green Surge Stakeholder Dialogue Forum conference in Essen. Next, I would like to thank all those who participated in my research interviews. Having never conducted research interviews before this was a learning process for me, and I deeply appreciate you having taken the time to partake in my interviews, and for sharing your expertise, knowledge and insights with me.

On a personal note, the option of coming to the Netherlands to undertake this Master's degree would not have been a possibility were it not for the encouragement and support of my parents, and for this I am truly grateful. Finally, Jeroen Berns, every day you make me happy, but today you get a special mention!

I hope that reading this thesis will be both an informative and entertaining experience, as was the process behind its creation.

Contents

1 Introduction

1.1 Urbanisation in a European Context

For the first time in human history, more than half the global population live in urban areas. This pattern of urbanisation is only set to continue, and the UN estimate that by 2050 there will be 6.5 – 7 billion people living in cities worldwide; effectively double todays urban population (UNDESA, 2014). Even though this trend is observable worldwide, the situation in Europe is even more pertinent, given that approximately 70% of European Union (EU) residents currently live in urban areas (European Commission, 2011). While the rate of urban growth in Europe is currently slow, the proportion of urban residents in the EU is the highest worldwide (Gardner, 2016). Given this, the EU has been described as 'an urban union' (European Commission, 2017).

Cities are pivotal to Europe's continued economic and social development, and yet they are also the source of numerous 'sustainability challenges'; including the pressing issues of social injustice, environmental degradation, and economic stagnation and decline (John, *et al*., 2015). Another consequence of urbanisation is the reduction in area of green spaces within the city, which can exacerbate issues such as social environmental injustice and the diminishing capacity of ecosystem services (Gulsrud, *et al.*, 2017). Furthermore, this can leave cities, and their residents, particularly vulnerable to the effects of climate change, notably rising temperatures, extreme weather events, and changing rainfall patterns (EEA, 2014).

It is becoming increasingly vital to find ways of mitigating and adapting to climate change, especially in urban areas, and to improve the resilience of European cities (Bulkeley, 2011). While more attention has historically been placed on climate mitigation measures than adaptation (Pielke, Prins, Rayner, & Sarewitz, 2007), the 5th Assessment Report by the IPCC recognises that there is a growing trend of climate adaptation measures being included in policy, at various institutional levels (IPCC, 2014). Furthermore, climate mitigation and adaptation techniques need to be an integrated part of a series of strategic methods, which together aim to tackle the recognised sustainability and socio - economic issues present in cities (European Commission, 2011).

1.2 The Role of Green Infrastructure

The enhancement and development of urban green space has been proposed as somewhat of a panacea for the numerous sustainability challenges facing todays cities; and as a potential method of climate adaptation. The term 'urban greening' refers to '[the] creation and maintenance of green space, such as parks; planting and care of trees; and the creation of green infrastructure such as rain gardens and green roofs' (Chiesura, 2004). Indeed, the specific concept of ***green infrastructure***, commonly defined as 'a strategically planned network of natural and semi-natural areas' (see section 2.2), has received increasing attention in recent years, and in 2016 was recognised as a principle theme of the European Commission's Urban Agenda (European Commission, 2016). Green infrastructure, as a climate adaptation strategy, is relatively 'quick and inexpensive' for cities to implement (Nielsen, Hedblom, Olafsson, & Wistrom, 2017). It is becoming ever-more apparent that the development of a multifunctional, green infrastructure network leads to better economic, environmental, and social health, and that these different domains are inextricably linked (Austin, 2014). As such, the EU recognises the importance of having an 'interconnected and interdependent' approach to green

infrastructure, and it could be suggested that the EU regards itself as being a pivotal steering force to this end, providing a framework and guidelines for cities to develop their own green infrastructure strategies (European Commission, 2011).

1.3 The Implementation of Green Infrastructure in European Cities

Despite its merits and recent increase in popularity as a planning concept (Tayouga & Gagné, 2016), there is no universally applicable strategy for developing green infrastructure. Given this, it is becoming ever more important to understand ***why*** and ***how*** different cities are driving the development of green infrastructure. It has been suggested that although the benefits of green infrastructure are recognised, there is a lack of knowledge and understanding among policy makers at the municipal level (Green Surge, 2015). To this end, developing a contextually appropriate green infrastructure strategy for a city could be aided through applying the concept of 'visioning'. Here, a 'vision' refers to a desirable state in the future (John, *et al*., 2015). Visioning has proven to be a powerful tool, able to influence societies discourse on sustainable development, and thus providing a stimulus for directional change (Wiek & Iwaniec, 2014). Additionally, visions can provide direction for urban planners and decision makers to ensure the sustainable development of urban areas (Eames, Dixon, May, & Hunt, 2013). It is becoming increasingly important to understand how visions are used by policy makers to influence the development of urban green space, and particularly with regards to green infrastructure, as there is a pressing need for cities worldwide to incorporate green infrastructure into their urban matrices. Green infrastructure contributes to a 'more liveable environment', through the multitude of environmental, economic and social benefits it confers (Lennon, 2014).

In their 2011 Cities of Tomorrow report, the EU state that, although there 'can be as many visions as Europeans', there is an overarching need to create shared visions. This notion of the EU regarding itself as a crucial driver, enabling cities to develop their own visions as part of a Europe – wide coordinated action is further embodied by the following sentence, taken from (European Commision, 2013): 'If no action is taken at EU level, there will be only a few independent initiatives that do not deliver their full potential to restore natural capital and cut the costs of heavy infrastructure'. Furthermore, the EU recognise that authorities at the municipal level develop green infrastructure initiatives in line with the unique context of a city (Naumann, Davis, Kaphengst, Pieterse, & Rayment, 2011). As such, numerous specific contextual factors influence the adoption of green infrastructure in a city, and can act as a barrier, or driver, to green infrastructure implementation (Tayouga & Gagné, 2016).

The contextual factors of a city are key to determining that city's vision, given that the resulting vision of a city is a unique reflection of the contextual factors, and their interactions, which were key to its formation. Furthermore, the vision of a city is the embodiment of ambitions and interests, and as such the unique city – specific characteristics could influence 'which sustainability challenges are predominant, the way they are approached and how visioning methods are selected and operationalized' (John, 2015).

The creation of the annual European Green Capital Award (hereafter EGCA) in 2010 allows for the recognition of 'cities that are leading the way with environmentally friendly urban living' (European Comission, 2017). Additionally, this benchmarking tool allows for the formation of powerful policy

networks among cities, resulting in the sharing of best practices, and can 'help foster a culture of sustainable governance' (Gudmundsson, 2015). The overall aim of the EGCA is to promote environmental awareness and share best – practices among a network of cities (Gudmundsson, 2015). As a Europe - wide benchmarking tool, the EGCA aims to 'bring about a learning curve effect, cross – fertilisation, and the sharing of successful approaches' (KPMG, 2010). Understanding how EGCA winning cities, as examples of best practices, vision and implement green infrastructure is of great benefit to city planners and policy makers elsewhere in Europe (and indeed worldwide). It is hoped that other cities can learn from these showcased cities, and subsequently develop their own applicable visions.

Furthermore, the EGCA has been described as a 'soft policy tool', used by the EU to 'encourage self-steering and network governance at the local level' (Gulsrud, *et al.*, 2017). Given that the EU has limited, direct control over the urban environment at the municipal level, 'soft' measures, such as the EGCA, are an appropriate and convenient method of encouraging city authorities to comply with, and even champion, EU environmental standards and targets (Jordan & Adelle, 2013). In this way, the EGCA could potentially be seen as a way of ensuring that the EU 'agenda' is diffused to a local level, where the frameworks exist to effectively implement it.

1.4 Research Goal & Questions

The research aim of this project therefore is ***to understand and explore the role of guiding visions in the development of green infrastructure at the city level, and how these visions develop, given the possible roles of contextual factors and EU governance through a comparative case study of two European Green Capital cities, with a view for other cities to be able to learn from these examples of best practice.***

It is becoming ever more pertinent to understand ***why*** and ***how*** different cities are driving the development of green infrastructure. The European Green Capital Award recognises cities which are seen as 'frontrunners' in Europe with regards to 'environmentally friendly urban living' (European Comission, 2017). Given this, two EGCA winning cities were selected as the case studies for this project: Essen, Germany (2017 EGCA winner) and Nijmegen, the Netherlands (2018 EGCA winner); (the justifications for the selection of these two case studies are presented in section 3.2).

This leads to the following research question and associated sub-questions:

1. ***What is the role of guiding visions in the development of green infrastructure in two European Green Capitals, Nijmegen and Essen, and how can this be explained in the context of various socio – economic factors, geographic factors, and EU governance?***
    a. ***How do the underlying visions play a role in the development of green infrastructure in each city?***
    b. ***Which unique contextual factors are important in shaping the resulting visions in each city?***
    c. ***What role does the EU play in the development of these visions in each city, be it either in a direct, or a more indirect way?***

1.5 Scientific Relevance

The body of literature exploring the environmental benefits, and potential for climate adaptation, of various manifests of green infrastructure is well developed. Notably, green roofs have been found to reduce storm water runoff (Mentens, Raes & Hermy, 2006), open green space can reduce the urban heat island effect (Sovacool, 2011), urban vegetation can remove particulate matter from the air (Willis & Petrokofsky, 2017), and connected networks of green spaces have been found to positively effect biodiversity, specifically increasing the abundance and diversity of birds, insects, and small mammals, in part through an increase in habitat connectivity (Garmendia, Apostolopoulou, Adams, & Bormpoudakis, 2016). Finally, urban green spaces sustain various ecosystem services, which are loosely defined by the Millennium Ecosystem Assessment (MEA) Report as 'benefits people obtain from ecosystems'. The MEA identified 15 ecosystem services (non-exhaustively) which convey anthropocentric benefits, broadly categorised into 4 functional groups: supporting functions (e.g. nutrient cycling), provisioning functions (e.g. provision of resources), regulating functions (e.g. water purification) and finally cultural functions (e.g. spaces for recreational activities) (Millennium Ecosystem Assessment, 2005). It should be reiterated that the aforementioned environmental benefits and ecosystem services do not necessarily occur exclusively; instead, a carefully and strategically planned green infrastructure is capable of simultaneously providing multiple services (Lennon, 2014). For example, a green roof is able to provide improved storm water management, support biodiversity, mitigate the urban heat island effect and regulate building temperatures (Oberndorfer, *et al.,* 2007). Additionally, the functioning of certain ecosystem services is oftentimes dependant on, and supports, the functioning of others. For example, green infrastructure is often manifested through an increase in plant biodiversity, which is in itself an ecosystem service. However, increased biodiversity also results in the production of more biomass, which supports the functioning of nutrient recycling, classed as a separate ecosystem service (Green Surge, 2015).

One branch of literature which has received increasing attention over the past 10 – 15 years views green infrastructure as 'an important public health factor' (Tzoulas, *et al.,* 2007). Numerous studies have found that proximity of residents to urban green space and urban green space provision can have a positive effect on their health. Notably, citizens living closer to open green spaces have better health and lower obesity levels (Chiesura, 2004), urban tree density positively correlates with senior citizen longevity (Takano, Nakamura, & Watanabe, 2002), higher prevalence of urban green space has been found to result in reduced mental fatigue (Kuo & Sullivan, 2001), and increased tree cover has been found to result in lower rates of antidepressant prescriptions (Taylor, Wheeler, White, & Osborne, 2015). These apparent health benefits also appear to convey associated economic benefits. In his 2004 paper, Bird modelled the economic benefits of using green space for physical activity. Here, it was estimated that if 20% of residents who live within 2km of an existing open green space use that space for 30 minutes of physical activity, 5 times per week, the National Health Service in the UK would save almost £2 million per year. Similarly, a Canadian study estimated that planting 10 more trees per city block along streets improved the heath perception of citizens in a way comparable to a $10,000 annual increase in personal income and moving to a neighbourhood with $10,000 higher median income, or being 7 years younger (Kardan, *et al.,* 2015). From this point, by adding one additional tree per city block, i.e. having 11 new trees per block, the rate of cardio – metabolic conditions decreased in a way comparable to having an $20,000 annual personal income increase and moving to a neighbourhood with $20,000 higher median income (Kardan, *et al.*, 2015). These examples illustrate

the economic benefits to be gained from developing green infrastructure, through associated health benefits, and the relationship between health gains and financial gains.

It is important to note that while there has been much focus on the various environmental and public health benefits of urban greening and the development of green infrastructure, the development of green infrastructure can also possibly provide a solution to the myriad of socio - economic issues which are currently facing cities (Austin, 2014). Notably, the presence of green spaces in cities can increase property values, and has been linked to an increase in revenue in commercial districts (Ridder, *et al*., 2004), voluntary urban greening projects can lead to better social cohesion through citizen participation (Westpal, 2003), and through the reduction of social exclusion and isolation (European Commision, 2013), and there is evidence that the presence of open, green spaces in cities encourages social connections between residents (Buizer, *et al*., 2015).

Despite the acknowledged environmental, economic, and social benefits which stand to be gained from the implementation of green infrastructure, cities approach this in vastly different ways. Furthermore, this causes problems given the lack of universally applicable guidelines for the implementation of green infrastructure. While this project suggests that the role of visions could be used herein, presently, there is a marked gap in the literature discussing the role of visions. Indeed, while the body of literature exploring visions for holistic strategic urban development is ever growing (see Gardner, 2016; Lang *et al*., 2012), ***how*** visions have been used with regards to urban greening policies, and specifically green infrastructure, remains a much-understudied branch. Understanding the guiding visions of green infrastructure in a city is vital, as it can help explain why, and how, green infrastructure develops, and what is deemed 'desirable', in line with the terminology of visioning science.

Furthermore, while it is recognised that the unique context of a city is pivotal to its green infrastructure development, there is an apparent knowledge gap as to the intermediary role of visions. In effect, there is little scientific literature exploring how contextual factors influence the vision of a city's green infrastructure development, and how these visions in turn influence the resulting green infrastructure developments. Finally, there is little literature about the 'ideational' role of the EU, encompassing the role of the EU in developing and diffusing EU – conceived ideas and principles, and their impacts. It could be inferred that this operationalisation role of the EU in turning visions into policy represents a 'missing' stand of literature.

The ever-growing need for cities to incorporate green infrastructures in their urban matrices, combined with the very limited knowledge about the role of visions herein, and the need for cities to select role models based on the similarities of their contextual factors, all contribute to the necessity of this unique project, using Green Capital winning cities as the selected case studies.

1.6 Societal Relevance

Green infrastructure is becoming ever more employed as a concept by planners, and thus it is vital to deepen our understanding about ***why*** and ***how*** green infrastructure develops, and as such call for attention on the visions which were instrumental herein. At present, there is a lack of guidance for the implementation of green infrastructure, and also, in many cases, a disaccord between what is planned, and what actually gets realised (Green Surge, 2016). By selecting two case studies which are

current frontrunners in Europe, and exploring the development of their visions regarding green infrastructure, and the role of contextual factors therein, this project will serve to provide a systematic example of how different best practices can be achieved in different contextual settings, with an aim for policy makers elsewhere to learn from these examples. Given this, it is vital that cities have contextually – appropriate role models when attempting to develop their own green infrastructure.

Despite EGCA winning cities being regarded as role models, it has been recognised by various authors that cities can only adopt practices from geographically and socio-economically similar cities, i.e. cities with similar contextual factors (KPMG, 2010). It is important to point out that all EGCA applicant cities compete on the same indicators, regardless of their 'characteristic starting points, prerequisites and environmental factors' (KPMG, 2010). Indeed, critics have highlighted the fact that it is trivial to attempt to compare the environmental sustainability of cities which have such different sizes, climates, topographical & physical welfare features (Turksever & Atalik, 2001). It has been suggested that the contextual factors of a city must be taken into account in order to provide a meaningful comparison between cities (Meijering, Kern, & Tobi, 2014).

In addition, the Green Surge consortium stated the need for further research into 'good practices' with regards to the development of green infrastructure in European cities, with a view to emphasise the various city – specific contextual factors which play a role therein (Green Surge, 2016). With this in mind, understanding the processes involved in developing green infrastructure in EGCA cities, as representatives of best practices, can enable other cities to learn from them. The need for cities to act as 'role models' of sustainable development, and particularly with regards to their vision and subsequent application of green infrastructure, is paramount (Beatley, 2012).

Similarly, understanding the origin and articulation of a vision is vital to contextualising the resulting actions (Young & McPherson, 2013). Thus, it could be said that the vision provides us a frame through which to view, and contextualise, observable green infrastructure developments.

The aim of this project reiterates the desire that city planners and policy makers can learn from this project, with regards to how 'best practice' cities vision, and implement green infrastructure. Thus, it is hoped that this project shall provide two clear examples of how two different front-running, European cities create different visions which are bound, and at the same time influenced, by their unique contextual factors. From this, it is possible that these two cities will act as different examples of best practices, with the hope that contextually 'similar' cities can learn from them.

2 Theoretical & Conceptual Frameworks

The function of theory in this project is to provide a framework through which the role of visions in the development of green infrastructure can be best understood. To this end, a series of theoretical frameworks were selected, to provide a sound theoretical underpinning from which to build this research project. First, the existing literature regarding the concept of guiding visions will be explored. Second, the concept of green infrastructure will be examined, and the role of contextual factors in the development of green infrastructure is addressed. Third, the multi – level governance model will be introduced, given that it provides a framework through which the relationship between the supranational EU and subnational city institutional levels can be perceived. Finally, these concepts will be brought together with a discussion of the EUs vision of green infrastructure.

Elements from these selected frameworks shall be used to develop a conceptual framework. This conceptual framework shall provide links between the various concepts included in this project; and thus, will provide a context for understanding, and analysing, the findings of this project.

Each of the aforementioned sections shall close with an explanation of how these concepts will be operationalised for the purpose of this project. Operationalisation is the process of translating theoretical concepts into measurable indicators (Bryman, 2012), i.e. allowing for concepts to be 'measured' through the use of selected indicators. This project investigates the role of visions in the development of green infrastructure through the use of three sub-questions; the first addressing the role that visions play with regards to the development of green infrastructure; the second the socio – economic and geographic contextual factors which are important in shaping these visions; and the third the role of the EU regarding the development of visions. Thus, the operationalisation will elaborate ways in which each of these questions, and the concepts contained herein, shall be measured.

2.1 Guiding Visions

A vision is most commonly defined as a 'a desirable state in the future' (Shipley, 2002), and as such visioning refers to 'the process of creating visions' (Wiek & Iwaniec, 2014). It is important to note that visions refer specifically to ***desirable*** future states, and thus are distinct from 'predictions', which are ***likely*** future states (Iwaniec, 2013). Additionally, using the above definition, the process of visioning differs from the similar concepts of 'backcasting' (developing pathways to desirable future states), and 'forecasting' (predicting likely future states) (Iwaniec, 2013). For the purpose of this project, the term 'vision', and its associated derivatives, shall refer to 'desirable states in the future', and therefore the concepts of predictions, backcasting and forecasting are outside the scope of this definition.

Numerous schools of thought have contributed to the development of the concept of visions (Iwaniec, 2013). As such, the use of visions spans numerous disciplines, resulting in the development of numerous 'vision types' (van der Helm, 2009). Despite visions being employed by a wide range of fields, van der Helm identified three key elements which all visions must share, namely: reference to the future, reference to an ideal state, and the assumption that the vision can help 'converge actions into a desired direction' (van der Helm, 2009). Under these criteria, one key strand of literature explores the role of visions for steering society towards sustainability and sustainable urban development (Gardner, 2016). This branch of the concept of visions shall provide the focus for the rest

of this theoretical framework, and indeed this project, given that the development of green infrastructure has been cited as a planning tool which can promote sustainable urban development (Mell, 2009).

While the notion of 'utopian thinking' has driven society towards certain actions since ancient times (taking Plato's 'Republic' as the first, recorded 'utopian vision') (van der Helm, 2009), contemporary use of visions (as defined above), to guide planning decisions, and monitor and adapt implemented plans dates from the 1990s (John, 2015). It has been stated that visions act as 'an influential, if not indispensable, stimulus for change' (Iwaniec, 2013), and direct actions and behaviour through the operationalisation of visions into specific goals and targets (Wiek & Iwaniec, 2014). To this end, it has been stated that 'the path to sustainability begins with a vision' (Gardner, 2016).

Visioning is a powerful tool for steering societal discourses (Gardner, 2016), and in particular stimulates discourses focussing on social innovation and transformation (Constanza, 2000). The vision of a city can be communicated, and consequently interpreted, through various means, including (but not limited to): city-wide or regional vision reports and documents, specific project documents, municipal protocols and local policies (John, 2015). As an extension of this, it has been suggested that vision documents themselves provide a forum through which the conceptual and theoretical ideas are translated into clear visions, thus representing the transition from ideas into actionable plans, or theory into practice (Mell, 2010). Yet while it is acknowledged that a vision is able to trigger action, the successful, long term implementation of the vision often depends on it being integrated into various sustainability policies (Young & McPherson, 2013).

The need for widely accepted visions which can guide society to 'a sustainable future' is becoming ever more pressing (Rockström, 2009); indeed, the creation of a shared vision of a sustainable society has been described as 'the most critical task facing humanity today' (Constanza, 2000). In their 2011 Cities of Tomorrow report, the EU state the overarching need to create shared visions. To this end, the EU state four elements which describe a vision, namely:

- Its aims
- Its major projects and desired outcomes
- A system of shared values
- A collective desire to fulfil these outcomes

Despite the need for clear, guiding visions, it has been argued that visions remain often ambiguous and somewhat vague, and thus are open to be interpreted and operationalised into action in numerous ways (Lang, *et al.,* 2012). Indeed, in their 2014 review, Wiek and Iwaniec argued that there was no universal set of guidelines regulating the quality, or content, of sustainability visions (Wiek & Iwaniec, 2014). Subsequently, their review identified 10 quality criteria which they deem to be necessary when constructing visions, presented along three 'spines' (figure 1). A brief explanation of these terms is presented in table 1. While the authors state that ideally all visions exhibit characteristics of all ten quality criteria, it is recognised that the specific contexts which influence the development of these visions will result in different emphasis being placed on certain quality criteria over others. Finally, it is important to remember that these quality criteria pertain to sustainability visions in general, not

specifically related to urban green space. Aspects of these quality criteria will be drawn upon to inform an appropriate definition for the term 'vision' for this project (see section 2.1.1).

Figure 1: From Wiek & Iwaniec, 2014: 'The 10 quality criteria for sustainability visions are presented

along the three 'spines', as backbones of a sound sustainability vision'.

Table 1: The key features of the 10 quality criteria for sustainability visions. Taken from Wiek & Iwaniec, 2014.

Quality Criterion	Key Features
Visionary	Desirable future state; with elements of (aspirational) surprise, utopian thought, far-sightedness, and holistic perspective
Sustainable	In compliance with sustainability principles; featuring radically transformed structures and processes
Systematic	Holistic representation; linkages between vision elements; complex structure
Coherent	Composed of compatible goals (free of irreconcilable contradictions)
Plausible	Evidence-based, informed by empirical examples, theoretical models, and pilot projects
Tangible	Composed of clearly articulated and detailed goals
Relevant	Composed of salient goals that focus on people, their roles, and responsibilities
Nuanced	Detailed priorities (desirability)
Motivational	Inspire and motivate towards the envisioned change
Shared	Display a critical degree of convergence, agreement, and support by relevant stakeholders

Although this project focuses on the contextual factors which shape visions in a city, and indeed the empirical content of the visions themselves, it is important to note that there is a body of literature which explores the collaborative processes between stakeholders to develop these visions, see (Wiek & Iwaniec, 2014), (Robinson, Burch, Talwar, O'shea, & Walsh, 2011). However, the participation

process is outside the scope of the research questions proposed for this project, and so this concept is not further addressed.

2.1.1 Operationalisation of Guiding Visions

The first sub-question addresses the role of visions with regards to the development of green infrastructure. As part of the operationalisation process, it is important to clarify what the term 'vision' shall refer to for the purpose of this project.

In section 2.1, the four elements which characterise a vision according to the 2011 EU Cities of Tomorrow report are addressed. Furthermore, the 10 quality criteria of guiding visions were identified, and grouped into those pertaining to the construct quality, the normative quality and the transformational quality of a vision (Wiek & Iwaniec, 2014). For the purpose of this project, elements from both of these defining criteria shall be used to create an appropriate definition of the term vision, and subsequent operationalisation. Using the 4 EU – defined elements of a vision, the 5 quality criteria from Wiek & Iwaniec which most relate to, and elaborate upon, these elements were selected. Thus, for the purposes of this study, a vision is defined as being a desirable state in the future, and is qualified as being 'visionary, plausible, tangible, shared and motivational' (table 2).

Table 2: The criteria for defining a vision used in this project.

Elements of a Vision[1]	**Related Quality Criteria of a Vision** [2],[3]
The aims	Visionary
Major projects and desired outcomes	Plausible
	Tangible
System of shared values	Shared
Collective desire to fulfil these outcomes	Motivational

Furthermore, it is important to dissect the four elements which characterise a vision, according to the 2011 EU 'Cities of Tomorrow' report. The first two elements, 'the aims, and major projects and desired outcomes' (table 2) are ***characteristic*** of visions, but in themselves are not considered to be a vision; i.e. an aim in itself is not a vision. It has been recognised that 'visions can be operationalised into specific goals and targets' (Wiek & Iwaniec, 2014). Given this, 'the aims' are viewed as the operationalised product of a vision, in that they are the measurable concepts which embody the desired outcomes. Furthermore, the aims are achieved through various projects, where projects are the second element characteristic of a vision (table 2). Thus, this project takes the stance that visions are operationalised into aims, which are in turn embodied in projects (figure 2). Definitions of the three terms, for the purpose of this project, are presented in table 3. This distinction, and also

[1] Taken from EU Cities of Tomorrow Report, 2011 (page 22)
[2] Taken from Wiek & Iwaniec, 2014
[3] Definitions of these terms in table 1

relationship, between vision, aim and projects shall be continued into the case studies and the conclusions.

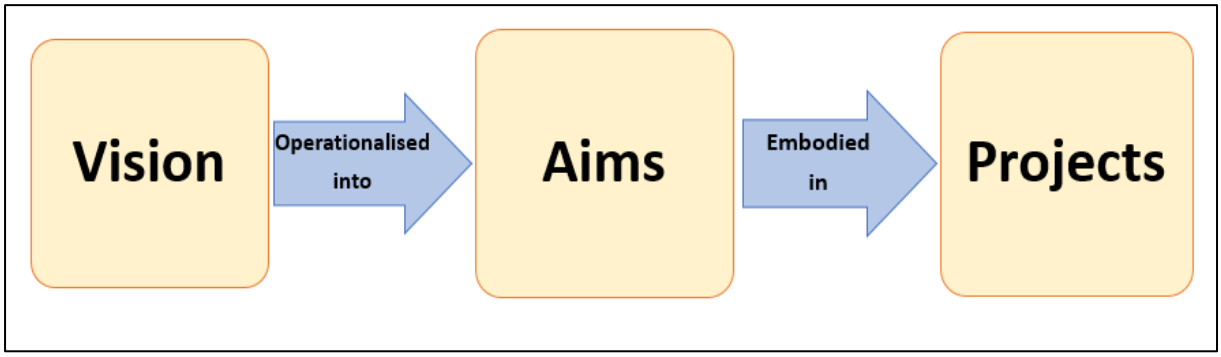

Figure 2: The relationship between visions, aims and projects for the purpose of this study. Informed by the EU 'cities of tomorrow' report, and Wiek & Iwaniec, 2014.

Table 3: The definitions of the terms 'vision', 'aim', and 'project' as employed by this study.

Term	Definition for The Purpose of This Project
Vision	• A desirable state in the future • Qualified as being visionary, plausible, tangible, shared, motivational[4]
Aim	• Operationalised product of a vision • Describes desired outcomes of projects in general terms • 'The general goals perceived as an ideal that can be achieved'[5]
Project	• Carefully planned, designed to achieve a particular aim[6] • Provides empirical evidence that the vision is plausible and realisable

2.2 What Constitutes Green Infrastructure?

The European Commission define green infrastructure as 'a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation, and climate mitigation and adaptation' (European Comission, 2015). This is markedly similar to the widely-adopted definition proposed by Benedict and McMahon, 2006, stating that green infrastructure is 'an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife' (Benedict & McMahon, 2006). Both of these popular definitions draw attention to the fact

[4] See table 2
[5] Taken from EU Cities of Tomorrow report, 2011
[6] Wiek & Iwaniec, 2014

that green infrastructure is a planned, structural entity, which provides ecosystem services of value to society.

In its most basic form, green infrastructure can be considered as a structural network incorporating natural, semi-natural and artificial networks of 'multifunctional ecological systems' (Tzoulas, *et al.,* 2007), and has been described as a way of upgrading urban green space to a 'coherent planning entity' (Sandstrom, 2002). A proposed distinction difference between green infrastructure and green space in general pivots around the use of the word 'infrastructure'. Through the use of this word it is implied that green infrastructure is indeed necessary to have, like its counterpart grey infrastructure, which is commonly defined as 'networks of energy and material supply systems' (European Commision, 2013) (Schaffler & Swilling, 2012). Furthermore; the use of the word 'infrastructure' places emphasis on the interconnectedness, and services, which are to be derived from green infrastructure (Benedict & McMahon, 2001). This requisite for interconnectedness and forward planning in green infrastructure is embodied in the following quote: 'A city would never build a road, water or electrical system piece by piece, with no advanced planning or coordination. Green infrastructure is the idea that nature in cities should be administered in an integrated way, just as grey infrastructure systems have been' (Wolf, 2004). Concerning the services which stand to be gained from green infrastructure, the definition proposed by Benedict & McMahon (2006) explicitly mentions the benefits green infrastructure can have for both society and nature. It has been argued that green infrastructure, as a planning concept, is at the heart of a 'socio-ecological crossroads' (Young, Zanders, Lieberknecht, & Fassam-Beck, 2014). There is a growing school of thought which places increasing focus on the social benefits to be gained from green infrastructure (see (Ely & Pitman, 2014) & (Naumann, Davis, Kaphengst, Pieterse, & Rayment, 2011)). Indeed, it has been stated that greater focussed attention placed on the interaction between the social and ecological processes involved in the development of green infrastructure leads to enhanced social and ecological health (Young, Zanders, Lieberknecht, & Fassam-Beck, 2014).

However, constructing a more detailed and specific definition of green infrastructure has been the cause of extensive debate, with copious proposed, and often conflicting, definitions. The concept of green infrastructure is built upon theories taken from fields such as landscape ecology, planning, and geography (Mell, 2010), and has thus been described as being 'swamped in complexity and confusion' (Lennon, 2014). The contested definition of green infrastructure is perhaps attributed to the numerous disciplines, and their associates purposes, which make use of the concept. These disciplines include, (but are not limited to) urban planning, urban design, landscape architecture, urban forestry, urban ecology, geography, epidemiology and urban climatology (Bartesaghi - Koc, Osmond, & Peters, 2016). Indeed, these different disciplines each have their own research methods and academic traditions, and possibly a lack of common theories between them (Moss, 2000). The diversity in opinions about what constitutes green infrastructure has resulted in the development of numerous typologies, which aim to categorise elements of green infrastructure, and discern between definitions of a functional nature (i.e. concerned with the services provided by green infrastructure), and those of a spatial nature (i.e. concerned with the physical form and location) (Mell, 2010). A vision of green infrastructure will likely have been developed with a specific definition of green infrastructure in mind. Therefore, it is important to understand exactly ***what*** is being referred to when the term 'green infrastructure' is used, as this will have consequences when discerning the role of visions herein.

It is important to bear in mind the myriad of definitions, and contextual placements, of green infrastructure in a city. In order to achieve a fully integrated green infrastructure which is capable of delivering various ecosystem services, providing climate adaptation, and conveying human health benefits and economic benefits, it is vital to articulate the multitude of values that green infrastructure can have for actors in the various, concerned disciplines (Tzoulas, *et al.*, 2007). Indeed, in his influential 2014 book, Austin argues the need for 'transdisciplinary integration', and a unified approach to implementing green infrastructure, effectively merging both 'ecocentric and anthropocentric value frames' (Austin, 2014). Similarly, Massini (2016) states the need to frame green infrastructure from an anthropocentric perspective, in order to allow for a greater understanding of the benefits society stand to gain from this planning concept (Massini, 2016). In other words, by framing the need for green infrastructure from an anthropocentric perspective, it will become easier for society to engage with, and champion, as the benefits are framed in such a way as to provide direct benefits for citizens. It follows that the value frame through which green infrastructure is perceived will affect, and perhaps be affected by, the vision of green infrastructure at play.

2.3 The Role of Contextual Factors in the Adoption of Green Infrastructure

It is vital to gain an understanding of how various contextual factors shape the development of green infrastructure, through their role as either a driver or a barrier. This will help to develop our understanding of how visions of green infrastructure form. Young *et al*. (2014) highlight the importance of addressing both socio – economic and geographic contextual factors, as this enables for 'improved social and ecological planning', with the aim of developing a contextually appropriate, and effective green infrastructure implementation strategy (Young, Zanders, Lieberknecht, & Fassam-Beck, 2014). Both geographic and socio – economic factors will be discussed below.

Despite the numerous benefits, and the apparent feasibility in developing green infrastructure, in practice, the adoption of green infrastructure has been slow (Matthews, Lo, & Byrne, 2015). This has been explained by various 'institutional barriers', and particular attention has been placed on the various 'socio – political dimensions' which can hinder adoption. In their 2009 paper, Byrne & Yang suggest that 'biophysical characteristics; institutional frameworks and governance structures; planning systems; and residents' perceptions and values' are the four key factors which shape the development of green infrastructure (Byrne & Jang, 2009). Similarly, Tayouga & Gagné (2016) identified six 'socio – ecological' factors which influence the uptake of green infrastructure, and through their literature review identified three of these six factors as being, in their view the 'most important', namely, education; the provision of ecosystem services, and financial incentives (Tayouga & Gagné, 2016). While these factors differ in name from those suggested by Byrne & Lang (2009), there are clearly identifiable themes; these factors could be broadly classified as either geographic or socio – economic factors. This distinction between geographic and socio – economic contextual factors shall be drawn throughout this project.

Geographic factors can act as a barrier or a driver of green infrastructure, and can determine which manifestation of green infrastructure is most appropriate for a city (Matthews, Lo, & Byrne, 2015). Various typologies identify geographic factors as including: local climate, natural ecosystem or biome, landscape characteristics - including the presence of coastline, mountains, rivers, wetlands, or other geographic features, and substrate (KPMG, 2010) (Young, Zanders, Lieberknecht, & Fassam-Beck, 2014). However, it is important to add here that, according to (Bartesaghi - Koc, Osmond, & Peters,

2016), geographical context includes 'biophysical settings, institutional research interests, geopolitical conditions and country based GI planning strategies'. For the purposes of this project, 'geographic' factors shall refer to, as Bartesaghi – Koc, Osmond & Peters call, biophysical settings. The intonation of this definition shall include local climate, natural ecosystem, and landscape characteristics, as shall be elaborated in section 2.3.1.

It has been stated that the design and management of a green infrastructure strategy should 'respect and enhance the character and distinctiveness' of an area (Cameron & Blanusa, 2016). Thus, a green infrastructure should be designed in a way specific to its local geographic factors. Furthermore, green infrastructure developments should take into consideration the 'diverse values' of the local landscape, which are embodied through its 'diversity, form, function, and quality' (Mell, 2010). This implies that green infrastructure should be designed in such a way which maximises the potential functionality of a landscape, innkeeping with the natural and social values placed upon it (Benedict & McMahon, 2001).

The term socio – economic factors incorporates the myriad of both social and economic factors which can drive or hinder the development of green infrastructure. Although different terms are used in different publications (such as the use of socio – political factors and socio – ecological factors, see below), it was decided to use the term 'socio – economic' for this project, as it is seen as the most encompassing. Taking what could be seen as a different approach, the Green Surge consortium posit that the two main limiting factors to the planning and implementation of green infrastructure are 'money and personnel', both of which could be seen as institutional barriers (Green Surge, 2015). Here, 'personnel' refers to a series of identified constraints. Particularly, the lack of expertise among local planning organisations, and a lack of cooperation and collaboration at the expert level can lead to an engrained silo mentality when it comes to the development of green infrastructure (Green Surge, 2016). Similarly, it has been suggested that while spatial planners 'recognise multiple rationales' associated with green infrastructure, there is a tendency for institutional path dependency regarding urban land – use priorities (Matthews, Lo, & Byrne, 2015).

The successful implementation of green infrastructure in a city stems from the intersection between the planning and design processes (Lennon, 2014). In order to provide the maximum amount of benefits, green infrastructure projects need to be incorporated into, and indeed connected to, a broader network of projects which span across the city (British Ecological Society, 2015). However, green infrastructure projects in urban areas are often still bound by various spatial scales, namely at the neighbourhood, municipal and regional levels. Therefore, it is imperative that cities adopt a holistic approach to developing green infrastructure, which extends 'beyond administrative and other boundaries' (Kambites & Owen, 2006). Linked to this is the notion of 'plan nesting', as proposed by (Lafortezza, Davies, Sanesi, & Konijnendijk, 2013). Here, green infrastructure plans are nested in a variety of spatial scales, effectively creating a continuous link from the local, or neighbourhood, to the city, or regional scale and beyond (Green Surge, 2016).

2.3.1 Operationalisation of Contextual Factors

The second sub-question addresses the contextual factors in each city that shape the development of visions. In order to answer this question, the following contextual factors were selected, based on the stated influence of these factors on the development of guiding visions of green infrastructure in current literature (see section 2.3.2):

- **Geographic:**
    - Natural Ecosystem & Landscape Characteristics
    - Local Climate

- **Socio – Economic**
    - City Size (as a function of population, density, and geographic area)
    - Development History
    - Institutional Organisation (money and personnel)

It was decided to distinguish between geographic and socio – economic factors, given the slightly different roles these factors play in the formation of guiding visions. It has been suggested that geographic factors are important in 'bounding' visions, whereas socio – economic factors can act as more of a driver or a barrier. The relationship between these two different types of factor is represented visually in section 2.5.

Of these contextual factors, the geographic factors, and city size were mainly investigated through a literature search. Conversely, information pertaining to the socio – economic factors of the city's development history and the institutional organisation was mainly gathered during semi structured interviews with representatives of Nijmegen and Essen. Through the combination of these factors, it was possible to build a picture of how these factors interact in each city and shape the resulting vision of green infrastructure.

2.4 Multi – Level Governance in The EU and The Implications for Green Infrastructure

In their 1996 seminal paper 'European Integration from the 1980s: State-Centric v. Multi-level Governance', Hooghe and Marks first present the Multi – Level Governance (hereafter MLG) model (Hooghe & Marks, 2001). The MLG model regards the EU as a political system in its own right, and as such, numerous other actors are involved in the policy making process, as well as national executives. The EU, as a political system, is structured along various levels; the most commonly used distinctions are the EU level, the nation state level, the regional level and the local level (European Committee of the Regions, 2017). Furthermore, the MLG model posits that power has shifted 'upwards' from nation states to the EU, at the same time as it has shifted 'downwards' from nation states to subnational actors (Hooghe & Marks, 2001). The nation state thus appears to be 'losing' power to both higher and lower institutional levels.

While the European Commission monopolise the right of initiative among the EU institutions, they hold very little power regarding the implementation of legislation (European Parliament, 2017). Given this, decisions taken at the EU level are implemented by 'lower' institutional levels. It has been stated that local and regional authorities are currently responsible for the implementation of roughly 70% of EU legislation (European Union Committee of the Regions, 2009). This highlights the important relationship between the EU and the subnational institutional levels. Furthermore, this supports the suggestion that the city level is the nexus of sustainability transformations.

The MLG model is also important given its ability to contextualise the growing trend of 'horizontal' governance in the EU. Horizontal governance can be understood as a replacement to the 'vertical' governance structure, where vertical governance refers to how local authorities interact with higher

governing bodies, be they regional, national or European (Lenhart, 2015). As such, horizontal governance allows for interactions between actors within the same level. The EGCA promotes the development of best – practice sharing among a network of cities; thus, it follows that the EGCA could be used as an example of horizontal governance.

Looking at green infrastructure in the context of the MLG framework, it has been suggested that green infrastructure transcends institutional 'boundaries', and often requires coordination between actors at these different institutional levels (Mell, 2010). In his 2010 work, Mell found evidence of green infrastructure developments being planned and spearheaded at both the 'higher' (national) level, and the 'lower' (regional and local) institutional levels, however he highlights the need for initiatives taken at the national level to be able to be applicable and relevant at a local scale. The need for the development of measures which are applicable at lower levels is paramount, given the apparent implementation gap between what is visioned, and the resulting actions taken (Hansen & Pauleit, 2014). Furthermore, the EU highlight the importance of maintaining links between the national and local institutional levels, and state that 'engagements at the local level … are key for successful implementation of green infrastructure projects' (Naumann, McKenna, Kaphengst, Pieterse, & Rayment, 2011).

Figure 3 shows the values citizens stand to gain from green infrastructure at each institutional level. Pyramid A shows the increasing size of green infrastructure allocation, in terms of area. Here, the national and regional levels will have the highest amount of area available for green infrastructure developments, with the local and metropolitan areas having the smallest areas of land. However, pyramid B shows the value which citizens stand to gain from the development of green infrastructure at each of the institutional levels. Here, developments at the local and metropolitan levels stand to convey more benefits to individuals. Conversely, it has been suggested that while green infrastructure developments at the national level stand to convey benefits to the population as a whole, these developments will not have as great a value for individuals.

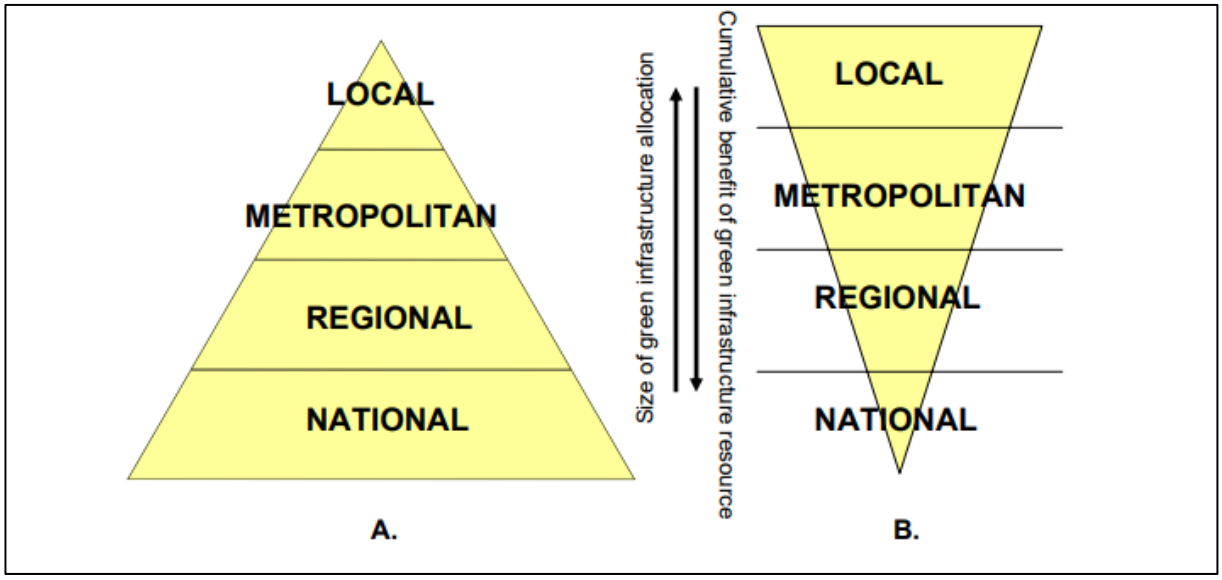

Figure 3: The relationship between institutional level and the proportional green infrastructure values for citizens. Taken from (Mell, 2010).

However, the role of the EU was not addressed in the aforementioned work, and so figure 4 is an adaptation of figure 3, which draws special attention in particular to the EU level and the municipal level (using the term 'municipal' instead of the 'metropolitan' to follow the terminology employed in this project). Furthermore, it was decided to adapt figure 3 in order to ensure a less ambiguous relationship between the arrows and portion of area in the pyramid, as this appeared somewhat unclear.

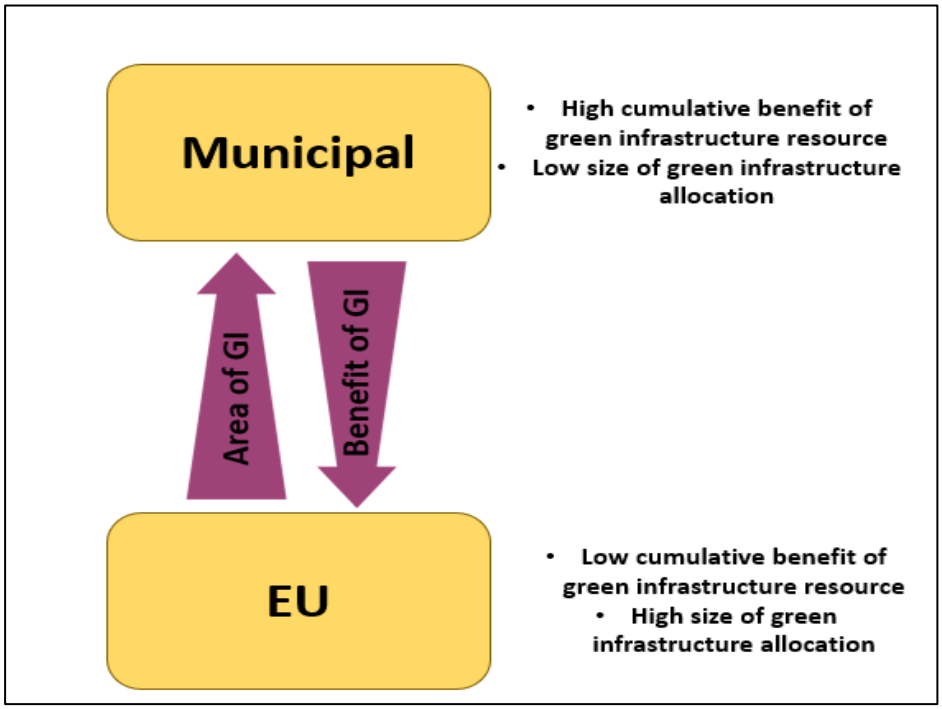

Figure 4: An adaptation of figure 3, taking the EU level and the municipal level as the empirical units of focus.

2.4.1 Green Infrastructure In EU Publications

The EU 2020 biodiversity strategy cites the development of green infrastructure as a key action to 'maintain and enhance ecosystems and their services' (see action 6, target 2, EU Biodiversity Strategy) (European Commission, 2017). Furthermore, the establishment of green infrastructure is one of the targets for the EU Habitats Directive, as a way of achieving its vision of halting biodiversity loss and restoring ecosystem heath and services (European Commission, 2013). The EU recognises the multifunctional merits of green infrastructure, and various EU publications from recent years, see (European Commision, 2013) (European Comission, 2015) (European Commission, 2017), have reiterated the dedication of the EU to the development of green infrastructure, which has the potential to make significant contributions to the achievement of numerous, and various, EU policy objectives (DG Environment, 2017).

The European Union Green Infrastructure Strategy, speared under the tagline of 'enhancing Europe's natural capital' guides the implementation of green infrastructure at the EU, regional, national and local levels. Through this strategy, green infrastructure as a planning concept has been integrated into

three main policy domains, namely regional development, climate change and disaster risk management, and natural capital and biodiversity (European Commision, 2013). Furthermore, it is hoped that the EU Green Infrastructure Strategy, will provide a framework for integrating green infrastructure into other policy domains, including the stated desire to mainstream green infrastructure into spatial planning, in order to allow for society to access the range of ecosystem services it can provide (Hansen & Pauleit, 2014). In their 2011 report for the DG Environment, Naumann *et al*. identify the potential for green infrastructure to be incorporated into an additional 9 policy areas as well as the three previously mentioned, namely agriculture and development, forestry, water, green growth: territorial cohesion and innovative financing, transport and energy, impact assessment, damage prevention and remediation, spatial planning, marine and coastal zones, environment and health, and finally, research and innovation (Naumann, McKenna, Kaphengst, Pieterse, & Rayment, 2011). The authors of the aforementioned report highlight the numerous opportunities within each of these above domains for cross – sectoral integration.

The European Commission highlights the important, holistic, role that green infrastructure plays as part of a cities strategy to become 'sustainable and resilient in the 21st century' (see The EU Urban Agenda, 2016, and The EU 7th Framework Programme, 2015); they describe green infrastructure as 'a tool for providing ecological, economic and social benefits through natural solutions' (European Commision, 2013). Furthermore, the European Commission recognises that local authorities often take the lead to this end, developing their own, typically more detailed, set of locally applicable policies and guidelines. Given this, it has been stated that the city spatial - level is of particular importance with regards to the development, and implementation of green infrastructure in the EU. Actions taken at this scale are large enough to 'be strategic with identifiable … links to the regional and national scale' (Green Surge, 2015), while at the same time these actions are 'not too large to be remote from community level activities' (Lafortezza, Davies, Sanesi, & Konijnendijk, 2013). Furthermore, it is at the local scale which benefits of green infrastructure are first observed (European Commision, 2013) (figure 3).

Given its ever-growing presence in EU policies, green infrastructure is presently integrated into various funding streams, including the European Regional Development Fund (ERDF), The European Social Fund, The Cohesion Fund, The European Agricultural Fund for Rural Development, Horizon 2020 project Funds, and the Natural Capital Financing Facility of the European Investment Bank (European Commision, 2013) (European Commission, 2017). The non – exhaustive list of funding streams presented above highlights the varied streams which support the development of green infrastructure, and also indicates the different spatial scales at which it is implemented.

2.4.2 Operationalisation of The Role of the EU

The third sub-question looks at the role of the EU in the development of visions for green infrastructure in each city. One way to investigate this was to look at the city's involvement in EU projects, to see if there was evidence of influence of the EU vision on the city vision. In cases where the development of green infrastructure arose as a direct result of involvement in European projects, it was also possible to see from which EU funding stream the funds came, and as such this could also infer which vision of green infrastructure the EU was championing. Finally, as has been noted the EU has published a Green Infrastructure Strategy (2013), detailing the desired development of green infrastructure in Europe. Following the nomenclature defined in table 3, the 2013 EU Green Infrastructure Strategy is best

classified as a series of aims, given that this strategy delineates a series of desired outcomes from the successful development of green infrastructure in Europe. An acknowledgement of this strategy, if it is embodied into city projects, and visions aligned with those described in other EU targets will also be investigated in order to answer sub question c.

As a concluding thought, it is important to remember that subquestion c of this project adresses the role of the EU in the development of visions of green infrastructure. Leading from this, understanding how the EU directly implements their guiding visions, and how these are operationalsed into policy, would have developed this theoretical framework even further. An extensive literature search for the 'ideational' role of the EU, encompassing the role of the EU in developing and diffusing EU-concieved ideas and principles, and their impact, returned no relevant results. It could be inferred that this operationalisational role of the EU in turning visions into policy represents a 'missing' strand of literature. Following this unfruitful search for literature, through discussions with professors it was suggested that it would be more appropriate to look for insights as to how these visions are actualised into policy in a more indirect way. While having access to literature exploring the ideational role of the EU would have contributed nicely to this theoretical framework, this further highlights the important role this project will serve in filling an apparent knowledge gap.

2.5 Conceptual Framework: Bringing it All Together

The purpose of this final section is to connect the concepts of visions, the role of contextual factors and the role of the EU in the development of green infrastructure on a theoretical level, to provide a holistic underpinning to this project. First, a brief analysis, which attempts to discern where the EU vision of green infrastructure lies, shall be presented. Next, the role of contextual factors herein shall be reiterated. Finally, these concepts shall be brought together in a coherent and applicable conceptual framework designed for the purpose of this study.

in their 2016 paper, Garmendia *et al*. (2016) suggest that the EU vision of green infrastructure focusses primarily on promoting economic development, often at the expense of focussing on providing climate adaptation or ecosystem services (Garmendia, Apostolopoulou, Adams, & Bormpoudakis, 2016). While the authors of this paper do not elaborate their reasons for taking this stance, a reading of the 2013 European Commission communication, titled 'Green Infrastructure – enhancing Europe's natural capital' appears to place a heavy emphasis on how the concept of green infrastructure can contribute to 'smart and sustainable economic growth in Europe', and brings this to the forefront of the stated potential benefits of green infrastructure (European Commision, 2013). Additionally, the European Commission place emphasis on the possibility of green infrastructure to support a 'green economy' (European Commission, 2017). This again suggests that the EU focuses on the potential economic benefits of, and indeed benefits to the economy provided by, green infrastructure. Therefore, from this perspective it could be connoted that the EU vision of green infrastructure is economic – centric.

The apparent differences, although somewhat subtle, in where the focus of the visions lie in different EU publications could provide an interesting point for discussion. Different EU documents appear to have a different vision of green infrastructure, with some suggesting an economic-centric vision (see above), and others apparently focusing on social cohesion (Garmendia, Apostolopoulou, Adams, & Bormpoudakis, 2016). This is embodied through the certain emphases placed on some benefits of green infrastructure over others. As previously mentioned, green infrastructure is being championned

by various EU policy domains, and as such is being developed as a concept with different desired outcomes in mind. Given this, it follows that potential differences in guiding visions could arise between these different policy domains. Furthermore, the numerous funding streams could be interpereted as promoting the development for a given vision of green infrastructure.

Linking this to the role of contextual factors in the development of green infrastructure visions, one school of thought could posit that the unique context of a city determines which vision guiding green infrastructure development is most appropriate for that city. For example, a city which has various social problems and a need for social integration could develop its green infrastructure in line with the vision (and funding) from the European Cohesion Fund. Thus, the context of the city has a direct impact on the selection of an EU vision for green infrastructure.

Figure 5 is a visual representation of the conceptual framework which guides this research project. Here, concepts are split between the EU level and the municipal level, where the municipal level is either Nijmegen or Essen. The EU is shown to have a direct role on the resulting green infrastructure in the city, and a direct role in the formation of the visions guiding this green infrastructure. It is important to note that it is unlikely that each of these three scenarios occur simultaneously in equal weighting. To recognise this, a conceptual framework describing each city's unique situation can be found in sections 5 and 6, after consideration of the role of the EU in determining each city's vision of green infrastructure.

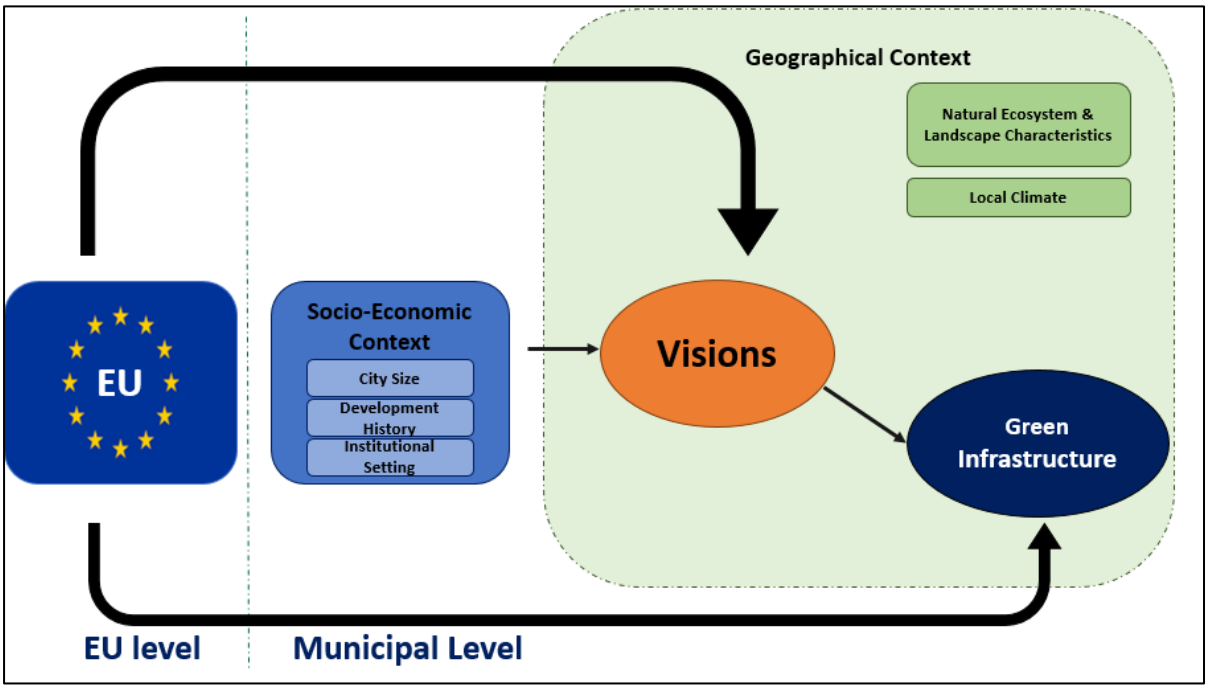

Figure 5: The conceptual framework guiding this project. Authors own image.

In this conceptual framework, the socio – economic context has a direct role in shaping the resulting visions. The visions have a direct influence on the resulting green infrastructure. Furthermore, the resulting green infrastructure is bound by the geographical context of the city.

As stated in section 2.3.1, it was decided to include the local climate, and the natural ecosystem and landscape characteristics as the geographic factors in this study. The socio – economic factors included are the city size (as a function of population, density, and area), the city's development history, and institutional organisation, where institutional organisation refers to money and personnel, as delineated in the Green Surge ***Green Infrastructure Planning and Implementation Work Package***, 2015 (see section 2.3).

3 Methodology

The so called 'Research Onion' (figure 6) is a visual representation of the different components of research, and allows for the development of a progressive research methodology (Saunders, Lewis, & Thornhill, 2007). This visual model was used to inspire and inform the different levels of research methodology in this project.

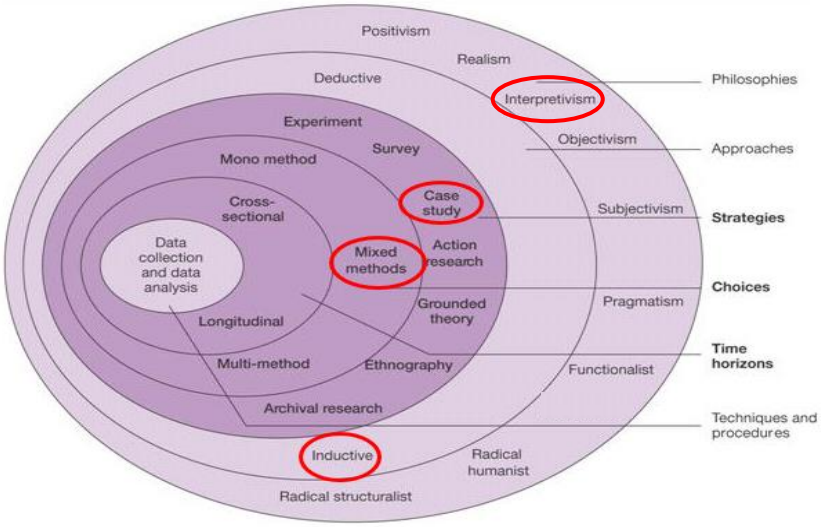

Figure 6: The 'Research Onion' developed by (Saunders, Lewis, & Thornhill, 2007). The research philosophy, approach, strategy and choice employed in this project are circled in red.

3.1 Research Philosophy, Approach, Strategy and Choice

The research ***philosophy*** is 'an overarching term relating to the development of knowledge and the nature of that knowledge' (Saunders, Lewis, & Thornhill, 2007). In other words, a certain research philosophy can describe the lens through which the researcher views the world, and as such reflects certain assumptions made by the researcher. This study is best aligned with an interpretive research philosophy. Interpretivism is characterised by a researcher's own interpretation of the study, and is based on a 'naturalistic approach of data collection' (Dudovskiy, 2017). Finally, interpretivism is a conducive approach to understanding phenomena, and searching for unique and specific meaning in case studies, instead of generalisations. Given the research aim of this project, to explore the role of guiding visions in the development of green infrastructure in two case study cities, an interpretivist approach is most appropriate. The research approach, strategy and choice therefore reflect this.

The research ***approach*** can either be deductive or inductive. A deductive approach is also known as a 'top down' approach, thus beginning with a specific theory, using this to generate related hypotheses which can be tested through observations, and finally either confirming or denying the original theory. An inductive approach, otherwise known as a 'bottom up' approach, works the other way, i.e. it begins with specific observations, which are then combined into patterns, leading to tentative hypotheses and finally resulting in the development of general conclusions or theories (Trochim, 2017). Regarding this project, the research questions allowed for an inductive research approach, due to the fact that observations of visions guiding green infrastructure developments under different contexts in two European Green Capital cities were the 'starting point', hopefully leading to the development of

general conclusions as to how, and why, different cities develop different visions, driving different resulting green infrastructures.

The research ***strategy*** provides an explanation as to ***how*** the author intends to conduct research (Saunders, Lewis, & Thornhill, 2007). Furthermore, the research strategy ensures that the research design for a project is an appropriate method of collecting the relevant data, as determined by the research questions. In effect, the research strategy ensures that the necessary data can be collected (Bryman, 2012). Following the terminology of the 'research onion', the research strategy of this project was 'case study', more specifically a comparative multiple case study. Data were collected from two separate cities, with the aim of leading to an explorative comparison into how these two cities use visions to guide the development of green infrastructure. This shall be further discussed in section 3.2.

The research ***choice*** can be either mono-method, i.e. using a single research method; mixed-method, i.e. using two or more methods resulting in 'a combined methodology that creates a single dataset' (Goodrick, 2014); or multi-method, i.e. separate strands of research producing separate datasets. The research choice most appropriate for this research project was a mixed-methods approach, making use of various qualitative methods which shall be discussed in turn below. Furthermore, the mixed methods approach is highly suitable for comparative case studies (Goodrick, 2014).

3.2 Research Material and Data Collection

3.2.1 Comparative Case Study Selection and Justification

As stated in section 3.1, the research strategy for this project was a comparative multiple case study. Whereas a case study is an in-depth analysis of a single 'case', a comparative case study allows for more generalised knowledge to be produced when there is a need to understand and explain how 'features within a specific context influence the success of programme or policy initiatives' (Goodrick, 2014). Additionally, comparative case studies have been recognised for their usefulness explaining how various socioeconomic contexts can influence the outcomes of policy interventions (Goodrick, 2014). Therefore, it was deemed appropriate to use a comparative case study to investigate the research questions of this project given the inherent possibilities this provided to explore socio – economic contextual factors in the two, selected cities.

It was decided to select two EGCA winning cities, Nijmegen and Essen, as these are apparent 'frontrunners' in sustainable urban development in Europe. Given this, it follows that this project shall develop an understanding of how these cities champion their unique characteristics to create contextually – appropriate visions guiding the development of green infrastructure. Furthermore, as has been stated previously, the EGCA, has been stated to be an appropriate and convenient method of encouraging city authorities to comply with, and even champion, EU environmental standards and targets (Jordan & Adelle, 2013). In this way, the EGCA could potentially be seen as a way of ensuring that the EU 'agenda' is diffused to a local level, where the frameworks exist to effectively implement it. Thus, it follows that by selecting two EGCA winning cities, there could stand to be a greater level of EU influence on the visions guiding green infrastructure developments in these cities.

3.2.2 Literature Review

The literature review informing the background of this project is presented in the form of the theoretical framework in section 2. Here, numerous scientific publications from different fields of literature were brought together and were used to inform the development of a relevant theoretical framework, and subsequent contextual framework guiding this project.

In addition, various types of literature were also extensively used with the aim of answering the research questions. Various policy documents from each city were used as a first base to establish the standing of green infrastructure in policy in each city. In the case of Nijmegen, this included the 2008 green policy plan; in the case of Essen this centred around the 2016 Green Infrastructure Ruhr publication. Through these documents it was also possible to discern the vision driving the implementation of green infrastructure. Next, other published material describing green infrastructure projects in each city, including press releases, specific project publications were consulted. Finally, numerous documents published by the EGCA were consulted to gain a deeper understanding of how green infrastructure has been used in each city in the context of various projects. Furthermore, sub-question c, which addresses the role of the EU in the development of green infrastructure visions, called for a document analysis of both grey and white EU publications. Although not unforeseen, my lack of comprehension of written Dutch and German did provide a potential barrier to understanding the content of city policy documents. In order to overcome this, the content of this strand of necessary literature was aided through conversations or correspondence with key individuals, and where necessary through the semi – structured interviews.

3.2.3 Semi – Structured Interviews: Respondents

Semi structured interviews are useful for 'investigating complex behaviours, opinions and effects and for collecting a diversity of experiences' (Longhurst, 2016). A semi structured interview is characterised by a set of pre – determined questions or concepts to be addressed during the interview, in the form of an interview guide, however the respondent has much flexibility and is able to elaborate upon topics of interest to them (Bryman, 2012).

In the case of this project, semi structured interviews were used to investigate concepts pertaining to all three research questions. Semi structured interviews were conducted with 8 respondents and 3 informants.

Respondents were selected based on their relationship with, and involvement in, green infrastructure developments. Of the 8 respondents, 5 were employees of the municipality of Nijmegen. It is important to note that due to internal restructuring, the municipality of Nijmegen no longer has a dedicated 'green' department. Instead, employees from different departments are concerned with green in the city, and in some cases, are further divided between maintenance and 'design' roles. Given this, the 5 respondents from the municipality of Nijmegen came from different backgrounds and had various functions, and therefore relationships, with the development of green infrastructure: one respondent was a water policy advisor who had a particular interest in climate adaptation in the city, one respondent was a city urbanist responsible for the Waalsprong development, one respondent was, at the time of writing, heading the project to write Nijmegen's new Green Policy Plan, one respondent was a policy advisor for public spaces with previous experience working in the green maintenance

department, and one respondent was overseeing a collaborative project ('Wij zijn groen, gezond en in beweging Nijmegen', we are green, healthy and in movement Nijmegen) with the Nijmegen Municipality, RadboudUMC hospital, and the GGD (regional health service), with the aim of developing the link between green in the city and public health. Furthermore, one respondent worked at the regional health service, GGD Gelderland Zuid, and was participating in the project 'Wij zijn groen, gezond en in beweging Nijmegen'.

From the Essen case study, interviews were conducted with respondents from two different local and regional government organisations, which represented two different spatial levels. One respondent was a project manager for the European Green Capital Award in Essen, and worked in the municipal department for building and environment. One respondent was a landscape planner who was heavily involved in the Emscher Park redevelopment. In addition, this respondent worked at the Regionalverband Ruhr (RVR) [7] as the Director of the Department European and Regional Networks Ruhr. Furthermore, this respondent is the EU Representative of the RVR in Germany. It is important to note that the interview with the EGCA project manager was conducted in two parts over two days, leading to a total interview time of almost 2 hours. The collection of data for the Essen case study was further aided through attendance at Green Surge Stakeholder Dialogue Forum, and subsequent question and answer session in Essen 10.05.2017. Thus, it is believed that the depth and quality of data collected meant that the Essen case study was not 'weakened' through the comparatively smaller number of respondents.

Furthermore, interviews were conducted with 3 informants, where the term informant is used to describe a person who can be seen as an 'expert' in the field, and as such who can provide answers which feed from a wider pool of knowledge (EUROAC, 2016). These informants provided expertise about the key concepts addressed in this project. In particular, one informant was an EGCA expert panel member, and as such was able to provide valuable insights into the ways in which green infrastructure is evaluated in the context of the EGCA; one was a university researcher involved in European projects exploring the functions and benefits of green infrastructure in different geographical contexts; and one was an independent researcher focusing on the nexus between urbanism and ecology, and as such developed the ECOPOLIS concept (which shall be explored in detail in Section 5.4).

It is important to address here the potential issue of bias. In qualitative research bias is commonly defined as 'any tendency which prevents unprejudiced consideration of a question' (Pannucci & Wilkins, 2011). In his seminal article on the subject of bias, Norris identified numerous sources of potential bias when conducting qualitative interviews, including potential selection biases pertaining to the respondents invited for interview (Norris, 1997). One particular manifestation of selection bias is the so – called elite bias. This could occur when the researcher conducts interviews with people of high status within the target organisation, and results in 'overweighting data from articulate, well-informed, usually high-status informants' (Myers & Newman, 2007). To overcome this bias, Myers & Newman suggest selecting respondents from different roles within an organisation, in order to achieve 'triangulation of respondents' and allow for different discourses on the subject to emerge. While the selection of interview respondents was non – random, the decision was taken to select respondents with different roles and from different departments in the municipality of Nijmegen, thus representing

[7] Hereafter Regionalverband Ruhr will be abbreviated to RVR

various relationships and experiences with green infrastructure, and allowing for a wider knowledge pool to be tapped in to. In the case of Essen, the respondents worked at different organisations. In this sense, it is hoped the potential for elite bias is minimised. Finally, it is important to point out that of the 11 total respondents, 5 were female and 6 were male, thus the selection of respondents showed no gender bias.

In total, 37 individuals were contacted, through tailored emails and personal conversations, to request an interview. Non – acknowledgement of contact attempts, or refusal to participate for various reasons resulted in fewer interview being conducted than was initially hoped, and indeed planned, for. Furthermore, time and resource constraints impeded the possibility of interviewing substitute respondents in some cases. Despite this, there was evidence of theoretical saturation from the interviews, therefore it can be deduced that the somewhat smaller sample size than was initially hoped for did not hinder the data collection process (Bryman, 2012). A list of interview respondents and informants is presented in Appendix 9.1.

3.2.4 Semi – Structured Interviews: Procedure

Eleven interviews were conducted during the period 26.05.2017 – 10.08.2017. Two interviews were conducted by telephone. In these cases, conducting a face to face interview was not an option for logistical reasons; in one case the respondent was travelling, and in the other the respondent was too far for a face to face interview to be a possibility. While it is recognised that telephone interviews can potentially have drawbacks, including the loss of visual cues contextualising spoken responses (Novick, 2008), it was decided to conduct these interviews regardless, given the wealth of information which stood to be gathered from these respondents. Furthermore, this was taken as an opportunity to develop a new set of interview skills. Face to face interviews were conducted in Nijmegen and Wageningen in the Netherlands, and in Essen in Germany.

In one instance, two respondents were interviewed in a joint interview. This was deemed appropriate as both individuals were involved in the 'Wij zijn groen, gezond en in beweging Nijmegen' project, however they had different functions, and came from different organisations (see appendix 9.1). While it has been recognised that joint interviews can have potential drawbacks, such as one respondent dominating the other (Arksey, 1996), considerations were made to ensure that each respondent had opportunities to elaborate upon their own perspectives of the project. As such, this particular interview was significantly longer than most of the others (1 hour 25 minutes). Furthermore, given that one respondent felt less confident in spoken English, and the inability of the researcher to communicate in Dutch, having another Dutch native speaker in the room helped the respondent feel confident and overall aided the communication.

Sub – questions a and b were primarily investigated during semi structured interviews with representatives of Essen and Nijmegen, with questions pertaining to: the desired role of green infrastructure in the city, both currently and the in the future; the motivations of developing green infrastructure; the barriers or challenges to green infrastructure development; the projects through which green infrastructure is developed; and what role green infrastructure has in the cities overall sustainability vision (see appendix 9.2). By posing similar, but differently-worded questions, it was possible for respondents to develop and elaborate upon their answers. Furthermore, sub question c explores the role of the EU in influencing a cities vision of green infrastructure. In this case,

respondents were asked questions about awareness of EU strategies and targets related to green infrastructure, namely the 2013 Green Infrastructure Strategy; the involvement of the city in European projects, and the motivations behind this involvement.

An interview guide was used during each interview, to ensure that all the main points were addressed, however the structure of the interview guide varied between respondents, and as such there are a couple of interviews which could, arguably, be considered as non-structured interviews. The interview guides for each respondent are presented in Appendix 9.2. Interviews typically lasted between 45 minutes and 1 hour (excluding time spent on introductions and concluding the interview). All interviews were recorded and transcribed verbatim, with the exception of one of the telephone interviews due to technical difficulties when trying to record the interview. In this case, extensive notes were taken throughout the interview which were subsequently typed and used side by side with the other transcripts for analysis. The second telephone interview was successfully recorded and transcribed.

Transcribed interviews were analysed in line with the method of 'constant comparison' for qualitative data. Under this method, 'each interpretation and finding is compared with existing findings as it emerges from the data analysis' (Lewis - Beck, Bryman, & Liao, 2004). Each transcript was reread in detail, and during this process certain themes became apparent, both within and between interview transcripts. These were highlighted and the themes marked, and the process was repeated. Quotations pertaining to each theme were subsequently collected and grouped accordingly.

It is important to note that all interviews were conducted in English, with a native English-speaking researcher and native Dutch or native German speaking respondents. While the respondents generally had perfect – level spoken English, it is recognised that it could potentially be more difficult to express oneself eloquently and fluently in a non – native language (Squires, 2009). However, given the perfect level of English spoken by respondents, and the fact that at no point did any respondent express that they were having significant difficulty to find the correct words or feelings in English, it could be assumed that this did not affect the overall validity or reliability of the data collected from these interviews.

4 Introduction to the Selected Case Studies

The next three sections will explore the case study cities, Nijmegen and Essen. Section 4.1 will provide a brief exploration of the EGCA assessment process, with a focus on the 12 indicators used as assessment criteria and a reflection on the inherent visions herein. This will be done in order to determine if Nijmegen and Essen indeed share the vision of the EU in the case of the EGCA, embodied in these 12 indicators. Next, section 4.2 will provide an initial exploration of comparative points between the two cities, with data pertaining to their socio – economic and geographic status. This is in order to gain a first understanding of the characteristic starting points of each city, and as such set the basis for comparisons to be drawn later.

Section 5 will explore the Nijmegen case study. First, section 5.1 will introduce the visions guiding the development of green infrastructure in the city. Next, to contextualise this, the development history of Nijmegen will be presented, given that the development history of the city is a socio – economic factor. Section 5.3 shall explore the institutional organisation relevant to the development of green infrastructure in the city, and the involvement of Nijmegen in European projects, to assess the role these have had on the development of visions. Next, sections 5.4 - 5.7 will discuss projects guiding green infrastructure development, in order to assess the role of visions herein. Here, the ECOPOLIS concept, Nijmegen's new green policy plan, the 'we are healthy, green and in movement' project, and finally the aim to increase residents access to green space shall each be explored in turn. Section 5.8 will examine the challenges to green infrastructure development, with a specific focus on how these challenges can be regarded in terms of their influence on the guiding visions, before leading to a presentation of the conclusions to be drawn from this case study, represented visually as a conceptual framework.

Section 6 will explore the Essen case study. Similar to the Nijmegen case study, section 6.1 will begin by introducing the visions guiding the development of green infrastructure in the city. Section 6.2 shall elaborate the contextualisation of this by exploring the development history of green infrastructure in Essen, given that this is considered a socio – economic contextual factor. The next section, 6.3, follows with an exploration of the institutional organisation relevant to the development of green infrastructure in the city, and the involvement of Essen in European projects, again, given that these are considered socio – economic factors which play an influential role of the development of visions. Given the unique combination of Essen's institutional organisation and involvement in European projects, attention shall then be placed on the multi – level interactions, drawing upon the cities interactions with the Ruhr region, and the EU with regards to its development of visions guiding green infrastructure. Next, section 6.4 will examine the role of visions in the development of green infrastructure in Essen, particularly focusing on the operationalised joint aims of increasing attractivity and improving quality of life. Building upon this with an appropriate example, section 6.5 will present the case of the Emscher landscape park, with a special focus on the role of visions herein. Section 6.6 will address the challenges to green infrastructure development, with a specific focus on how these challenges can be regarded in terms of their influence on the guiding visions. Finally, the conclusions from this section shall be presented in section represented visually as a conceptual framework.

It was decided therefore to keep the same, broader structural framework for the Nijmegen and Essen case study sections, while also taking license to elaborate upon city – specific concepts which have shaped the existing green infrastructure in each city. Therefore, some subheadings differ between the

two case studies, so does certain information about specific aspects of the cities green infrastructure. This was deemed the most appropriate way to eloquently and precisely present the results of this study, reflecting the unique approaches of each city. In section 7, comparisons will be drawn between the two case studies presented in sections 5 and 6.

4.1 Selection of Essen and Nijmegen as Two EGCA Winners

The ECGA is classified as a benchmarking tool, and as such applicant cities must demonstrate their past achievements, current situation & future projects in line with selected key indicators. Since its conception in 2006, the annual indicators have been inspired by the Ten European Common Indicators (Directorate - General for the Environment, 2000) and the Aalborg Commitments (Sustainable Cities Platform, 2017). The selected indicators are also based on the 7th Environment Action Programme (Directorate - General for the Environment, 2014), and the 2006 EU Thematic Strategy on the Urban Environment (European Parliament, 2017). Collectively, these indicators aim to provide a well – rounded, holistic overview of a cities achievements in the field of environmentally sustainable living and quality of life (European Comission, 2017).

In the 2018 application cycle, 12 equally – weighted environmental indicators were used as assessment criteria, with all applicant cities being ranked on each of the following (European Commission, 2016):

1. Climate change: mitigation and adaptation
2. Local transport
3. Green urban areas incorporating sustainable land use
4. Ambient air quality
5. Quality of the acoustic environment
6. Waste production and management
7. Water management
8. Waste water treatment
9. Integrated environmental management
10. Eco-innovation and sustainable employment
11. Nature and biodiversity
12. Energy performance

While only indicator 3, green urban areas incorporating sustainable land use, explicitly addresses the presence of urban green space, the benefits of urban greening, and indeed green infrastructure, can extend to, and incorporate, indicators 1, 4, 5, 7, 8 and 9. It is important to draw attention to this as it highlights the interdisciplinary nature of green infrastructure, and the different streams through which green infrastructure could be implemented. Following this, it is possible that Nijmegen and Essen implement their green infrastructure development plans through different streams related to those presented above; thus, perhaps reflecting different visions based on the characteristics and so-called 'starting points' of each city.

Table 4 presents an overview of all the indicators used in each assessment cycle from 2010 to date. Indicators which change from one year to the next are highlighted in blue. The 2010 and 2011 cycles; 2012 and 2013 cycles; and 2017 and 2018 cycles are combined, given that there were no changes to

the assessment criteria between these cycles. This table shows that the winning applications of Nijmegen and Essen were assessed in line with the same indicators.

Interestingly, according to Gulsrud *et al.* (2017), the assessment criteria for the EGCA have undergone a shift in focus since their conception. In their view, the original indicators in the 2010 and 2011 cycles placed more weight on 'visually (and ecologically) green resources', whereas indicators used in the more recent cycles focus more on 'infrastructure characterised as sustainable'. Although subtle, it has been suggested that this transition is reflected in applicant cities 'environmental visions', which, since the 2013 and 2014 cycles (table 4) appear to be based more and more on the development of sustainable, grey, infrastructure, with apparently less focus on green resources themselves (Gulsrud, *et al.,* 2017). It is important to understand the underlying motives for each of the 12 indicators, given that an apparent technocentric change could indicate a change in vision at the EU level towards a more technical approach to green infrastructure. Furthermore, if Nijmegen and Essen approach green infrastructure in a more technical way, it could perhaps be inferred that this is a reflection of a trend lead by the EU.

An example of this could be interpreted through the evolution of the nomenclature of indicator 3 (table 4). At present, indicator 3 reads 'green urban areas incorporating sustainable land use'. During an interview with an EGCA expert panel member, it became apparent that for the 2018 application cycle, this indicator was assessed using 3 focal points, namely: 'improving the living environment using green infrastructure; limiting urban sprawl; limiting, mitigating or compensating soil sealing' (EGCA expert panel member, personal communication, 26.06.2017). Comparing these three focal points to the original title of indicator 3, 'availability of green areas open to the public', there is clearly evidence of a transition from 'visually (and ecologically) green resources' to a wider inclusion of infrastructure deemed as sustainable. However, it is important to note that while these three focal points were used during the 2018 application cycle, they were not explicitly defined in the 2017 application cycle. Despite this, the EGCA expert panel member ascertains that Essen did comply with these 3 focal points, 'between the lines they were there for Essen too, but … they may have been less explicit. However, I have seen some marvellous examples of how to renovate brownfields in Essen' (EGCA expert panel member, personal communication, 26.06.2017).

Given that these cities are the two most recent EGCA winners, and that both were assessed on the same criteria (table 4), it will be interesting to investigate the content of visions of green infrastructure in Nijmegen and Essen, and to see if there is any indication of these visions being formulated from a more technocentric perspective, thus indicating that they follow the apparent EU – wide trend. It is also worth noting that both of these cities highlighted in their applications their specific focus on the development of urban green spaces, and particular mention of green infrastructure, as part of their sustainable development programmes (European Commission, 2017), (European Commission, 2016). Given these apparent similarities, it will be interesting to see how each city goes on to develop its own vision which drives the development of green infrastructure.

It is important to point out that while all applicant cities compete on the same indicators (table 4), cities are able to 'provide a sketch of the city context …. of how the city has been developing throughout the centuries' (EGCA Expert Panel Member, personal communication, 26.06.2017). Thus, the EGCA does take into account the characteristic starting point of a city, although this is based solely on the narrative that the city provides itself. It is recognised by the EGCA that the context of a city

affects its resulting green infrastructure. It will be interesting to see how visions fit into this; in effect, the contextual factors will influence the vison, which in turn will shape the resulting green infrastructure.

Table 4: An overview of the indicators used in each assessment cycle of the EGCA to date. Indicators which are highlighted in blue indicate that they changed from the previous year. Where no change to the assessment indicators occurred from one year to the next, these years are combined. Adapted from Gulsrud** et al. **(2017).

Year	2010/2011	2012/2013	2014	2015	2016	2017/2018
City	**Stockholm/Hamburg**	**Vitoria-Gasteiz/Nantes**	**Copenhagen**	**Bristol**	**Ljubljana**	**Essen/Nijmegen**
Indicator 1	Local contribution to global climate change	Local contribution to global climate change	Local contribution to global climate change	Local contribution to global climate change	Climate change: mitigation & adaptation	Climate change: mitigation & adaptation
Indicator 2	Local mobility & transport	Local transport	Local transport	Local transport	Local transport	Local transport
Indicator 3	Availability of green areas open to the public	Green urban areas	Green urban areas with sustainable use	Green urban areas with sustainable use	Green urban areas incorporating sustainable land use	Green urban areas incorporating sustainable land use
Indicator 4	Quality of local ambient air	Quality of local ambient air	Quality of local ambient air	Quality of local ambient air	Ambient air quality	Ambient air quality
Indicator 5	Noise pollution	Noise pollution	Noise pollution	Quality of the acoustic environment	Quality of the acoustic environment	Quality of the acoustic environment
Indicator 6	Waste production & management	Waste production & management	Waste production & management	Waste production & management	Waste production & management	Waste production & management
Indicator 7	Water consumption	Water consumption	Water consumption	Water consumption	Water consumption	Water management
Indicator 8	Waste water management	Waste water management	Waste water management	Waste water management	Waste water management	Waste water management
Indicator 9	Sustainable management of the local authority	Environmental management of the municipality	Environmental management of the municipality	Environmental management of the municipality	Sustainable management of the local authority	Integrated environmental management
Indicator 10	Sustainable land use	Sustainable land use	Eco – innovation & employment	Eco – innovation & employment	Eco – innovation & employment	Eco – innovation & sustainable employment
Indicator 11	Dissemination programme	Nature & biodiversity	Nature & biodiversity	Nature & biodiversity	Nature & biodiversity	Nature & biodiversity
Indicator 12	N/A	Dissemination programme	Energy performance	Energy performance	Energy performance	Energy performance

4.2 Initial Exploration of Comparative Points Between Nijmegen and Essen

Before exploring each case study in turn in the next two sections, a series of comparative points, pertaining to the geographical and socio-economic context of each city shall be briefly discussed. This is important to gain an initial understanding of the contextual factors of each city. This will provide a useful basis for developing this concept further on. The information provided in this initial comparison shall be further analysed in the context of the case studies in the following sections.

Table 5 presents a series of key comparative points between Nijmegen and Essen. Rows 1 – 4 inclusive contain data relating to the socio – economic context of each city; whereas rows 4 – 8 inclusive contain geographical data. While Essen has a much higher population and larger area, both Essen and Nijmegen have similar population densities (table 5). According the EU – OECD classification, both Nijmegen and Essen can therefore be considered as high density urban areas (Dijkstra & Poelman, 2012). However, it is important to remember that, under this same EU – OECD classification, Essen is considered a large city (having more than 250,000 inhabitants), whereas Nijmegen is considered a mid – sized city (having 100,000 – 250,000 inhabitants). The implications of this for the development of green infrastructure visions shall be discussed in the following section. Note that the GDP of Essen was not presented in the 2017 EGCA technical assessment report. Therefore, the value quoted in table 5 is taken from an alternative source (see footnote 8, page 34).

Rows 6, 7 and 8 of table 5 provide an initial indication as to the prevalence of green infrastructure in both Nijmegen and Essen. While Essen has a higher share of urban green areas, Nijmegen has a much higher effective green infrastructure. Although at first this may appear somewhat counterintuitive, this can be explained by the difference in spatial focal unit in each definition (footnotes 10 and 11). Here, the share of urban green areas addresses the area of green as a percentage of total land area within the urban core. Conversely, the effective green infrastructure is concerned with the peri – urban area, and is a measure of connectivity between 'green infrastructure elements'. As such, it can be deduced that while Essen has a higher percentage of land area in the city core covered in green, the surroundings of Nijmegen contain a higher proportion of green infrastructure elements, and these are perhaps better connected to each other.

Finally, the geodesic distance between Nijmegen and Essen is 90 km, and as such the two cities both have the same climate (table 5). This is an important similarity which the two cities share, as it has been argued that the ideal green infrastructure strategy for a city is inherently interlinked with its natural conditions (Matthews, Lo, & Byrne, 2015). As elaborated in section 2, the local climate contributes to the natural conditions (Bartesaghi - Koc, Osmond, & Peters, 2016), and is identified as one of the geographic factors which shall be used for the purpose of this project. Therefore, it is appropriate that the two case study cities have the same climate, as this variable is thus, in effect, controlled for.

Table 5: A comparison of Essen & Nijmegen Key Characteristics (taken from EGCA technical assessment reports, 2017 and 2018) and Urban Green Indicators (taken from EEA urban vulnerability to climate change in Europe – an interactive map book, 2017).

		Nijmegen	Essen
1	**Population (2015)**	170,774	582,624
2	**Area (km²)**	57	210
3	**Population Density (2015)**	3000 inhab/km²	2770 inhab/km²
4	**GDP (2010)**	28,100/capita	47,900/capita[8]
5	**Climate Classification (Koppen – Geiger classification)**	Cfb climate Relatively mild winters & summers, precipitation all year	Cfb climate Relatively mild winters & summers, precipitation all year
6	**Share of Urban Green Areas[9]***	35%	42.1%
7	**Distribution of Urban Green Areas[10]***	29.1 m/ha	31.04 m/ha
8	**Effective Green Infrastructure[11]***	57.05%	18.2%

It was decided to conduct a typology analysis, to ascertain exactly how the cities of Nijmegen and Essen have been classified. The results of this are presented as table 6. These typologies provide an initial

8 Data for the GDP of Essen were not available from the EGCA technical report 2017, so this figure is taken from an alternative source. The stated figure is also from 2010 (City Data, 2017).

9 Green urban areas as a proportion of total area inside the core cities. It is defined as the proportion of all vegetated areas within the city boundaries in relation to the total area.

10 The ratio of the length of the urban area perimeter (in metres) to the urban area (in hectares). This measure provides a proxy for the equal or non-equal distribution of green urban areas in the city. Increasing the green area and distributing it more evenly is an effective measure in reducing the undesired effects of clustered urban green areas.

11 The potential distribution of green infrastructure in the peri-urban area, that is, the probability of finding a green infrastructure element in the territory or in the neighbouring area. Connecting (adjacent) green areas in the peri-urban area can effectively extend urban green areas.

description of the characteristics of each city, which allows for a contextualisation of the visions of green infrastructure employed in both cities. Thus, this will help develop an initial understanding of the socio – economic context of each city, and how they differ, in line with sub – question b.

The typologies in rows 2 and 3 draw attention to the size difference between Nijmegen and Essen, both in terms of land area and population, and as such the cities are classified based on these data. These tables reiterate the fact that Essen is a large city, whereas Nijmegen is a regional city. By selecting one large city and one medium city as the two case study cities, it allowed for the size of the city to be taken as a variable. Thus, it was possible to see if the size of the city had an effect on the development of visions guiding green infrastructure. Furthermore, it has been recognised that benchmarks typically exclusively include national capitals or other large metropolises. Therefore, by selecting Nijmegen, a medium sized city, this study aims to provide a novel comparison between cities of different sizes.

In row 4, Nijmegen and Essen are classified as the same type of city, namely they are both green sealed cities. This definition characterises these cities based on various features, as elaborated in footnote 14 on page 36. Of particular interest, green sealed cities characteristically have a relatively low proportion of green urban areas, and a relatively low amount of effective green infrastructure. In the case of Nijmegen, this appears to contradict somewhat the results presented in table 5, where Nijmegen was stated to have an effective green infrastructure covering 57.05% of its urban and peri – urban areas. A possible explanation for this apparent discrepancy could be that Nijmegen is characteristic of a green sealed city in other ways, namely through a possible high degree of soil sealing and low proportion of urban forests, although this speculation is uncorroborated.

The typology in the first row, 'Integrated Sustainability Monitoring of 58 EU Cities' warrants further discussion. Here, Nijmegen is classified as a Harbour City, and Essen as a Compact City, a Shrink City and a Wealthy City (table 6) (Zoeteman, Zande, & Smeets, 2015). Nijmegen is classified as a harbour city, under the condition that 'ports cover more than 0.3% of the municipal area'. Indeed, Nijmegen has the largest inland port in the Netherlands. However, it should be noted that various staff members of the municipality of Nijmegen view the city as a compact city, and do not necessarily instantly think of Nijmegen as a harbour city (personal communications, 2017).

Another point of contention stems from the criteria used to define a 'Compact City'. In this typology, the unit of measurement used here is habitants per hectare, where the threshold for being classed as a compact city is above 2500 habitants per hectare. However, converting hectares to km², this would give a population density of 250,000/km². This appears ludicrously high, and using the city centre area of Essen, as presented in table 5, would result in an urban population of around 52.5 million inhabitants (effectively ~ 2/3 the population of Germany!). Thus, it is almost certain that the authors of this typology made an error of unit, and as such the definition of a compact city should read that the population density is greater than 2500 habitants/km². This is also in line with the population density of Essen presented in table 5. However, under this definition, Nijmegen could also be classified as a Compact City, given its population density of 3000 inhabitants/km². The typology by Zoeteman, Zande & Smeets fails to recognise this. Although Essen is categorised as a compact city, it is important to point out that Essen is one of the eleven cities which form the Ruhr metropolitan area, and as such is part of one of the five largest European conurbations with a total population of 5.2 million inhabitants (Metropole Ruhr, 2017).

Table 6: A summary of the relevant 'classification' of the cities of Nijmegen and Essen according to various typologies. Only typologies which mention both cities are included in this table.

	Typology	Nijmegen	Essen
1	**Zoeteman, Zande & Smeets 2015 Integrated Sustainability Monitoring of 58 EU-Cities**	**Harbour City** (ports cover more than 0.3% of the municipal area)	**Compact City** (Population density is greater than 2500 habitants/hectare)[12]
2			**Shrink City** The city has experienced a decline in the total population over the past 10 years.
3			**Wealthy City** The metropolitan area of the city has a GDP in million (PPS) larger than € 50,000 (2010)
4	**The Second State of European Cities Report 2010**	**B3: Regional Centre with a growing population**	**A2: National Capital and/or metropolis**
5	**Beveridge *et al*. 2016 EU City Types & Selected mid-sized Cities**	**Regional Centre with a growing population**	**National Capital and/or metropolis**
6	**EEA Urban Green Infrastructure Typology[13] 2017**	**Green sealed city[14]**	**Green sealed city**

The purpose of this section was to outline comparative points between Nijmegen and Essen, and to build a case justifying the selection of these two cities as the case study units for this project. To summarise the main points discussed in this section, it was vital for this project to select two EGCA winning cities, as European frontrunners, and the decision was taken to choose two cities which were

[12] Please see discussion on page 34

[13] Taken from EEA urban vulnerability to climate change in Europe – an interactive map book, 2017.

[14] Green sealed cities are characterised by:

- High degree of soil sealing and low proportion of green urban areas (which are relatively well distributed)
- Low proportion of urban forests
- Relatively low amount of effective green infrastructure, Natura 2000 sites and low-density areas

assessed on the same indicators to account for this variable. Although not included in the table, according to Green Surge WP6, both Germany and The Netherlands belong to the 'Central planning family: regional economic planning' (Green Surge, 2016). Given that the two countries share the same city planning style, this again provides for a valid comparison to be drawn between the two case study cities.

Despite these similarities, Nijmegen and Essen have different 'starting points', characterised by their different sizes (both in terms of area (km^2) and population). As previously explained, it was decided to select case study cities of different sizes due to the fact that most benchmarks are targeted specifically at capital cities or metropolises (KPMG, 2010). Furthermore, the development histories of each city are markedly different, as shall be discussed in the next section, and as such it follows that this was manifested through the development of different trajectories of green infrastructure development, guided by different visions.

As a final thought, this section showed that both Essen and Nijmegen are classed as compact cities. This is characterised by a high population density, which, as a contextual factor, has had a marked effect on the development of visions guiding green infrastructure development in both cities. This shall be discussed in sections 5 and 6.

5 Case Study: Nijmegen, the Netherlands

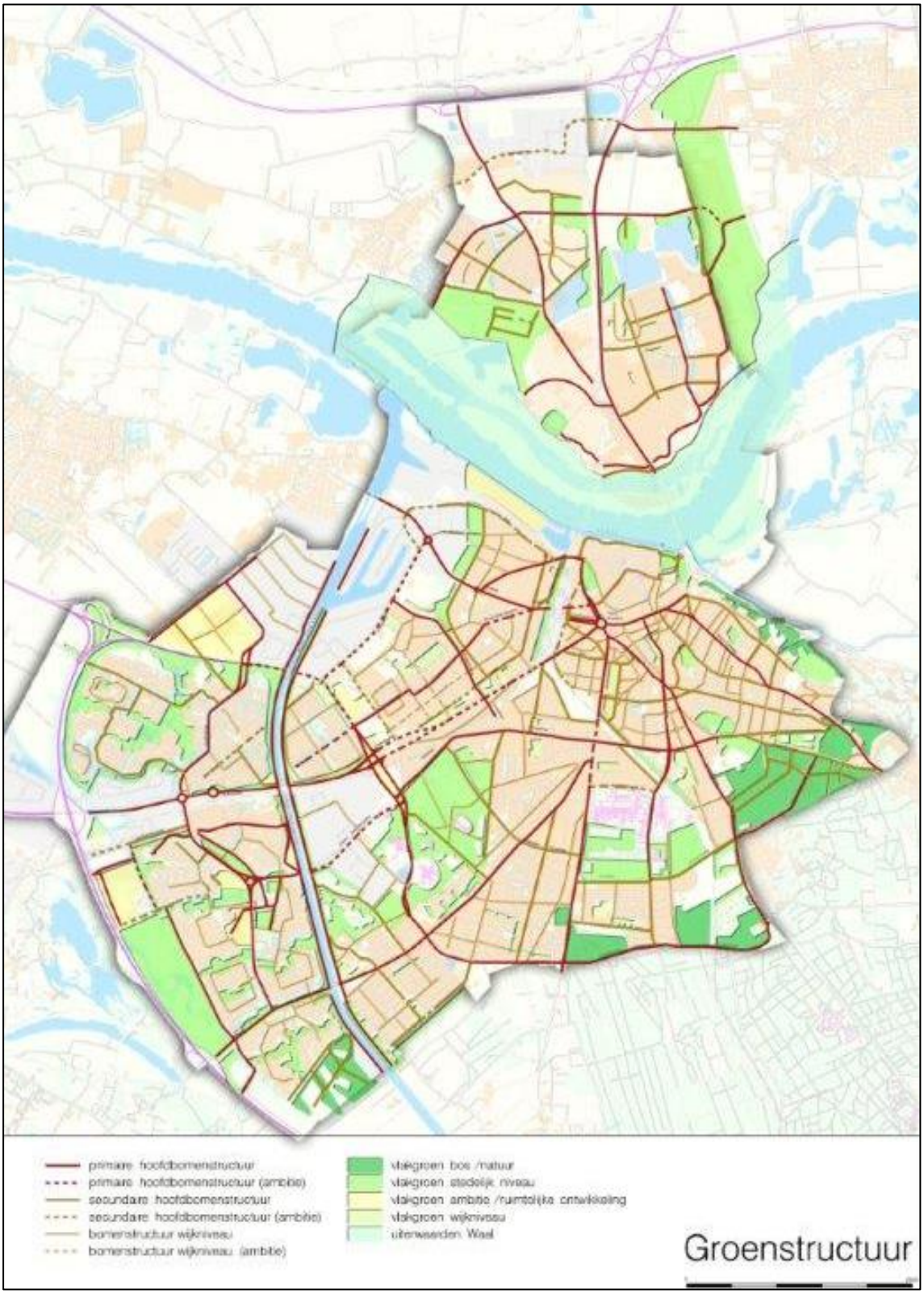

Figure 7: The green and blue structures in Nijmegen, 2014. Dotted lines indicate future plans which have yet to be completed. Unpublished and provided through personal request.

5.1 The Role of Visions in the Development of Green Infrastructure

It has been suggested that the concept of green infrastructure is not as widely used in the Netherlands as it is in other European countries (Konijnendijk, (2007), quoted in Mell, (2010)). However, as Mell explains, this is perhaps attributed to the fact that the term 'green infrastructure' is perhaps not widely known, whereas the principles behind green infrastructure have indeed been used to develop various 'green structure plans' (Mell, 2010). This suggests that the same underlying concepts of green infrastructure are being used, albeit with different terminologies.

The role of visions in the development of green infrastructure in Nijmegen has been manifested in different ways. Indeed, in Nijmegen there is currently not an overarching vision guiding the development of green infrastructure in the city, 'there is not one whole vision for the city, that is missing' (Water Policy Advisor, personal communication, 26.05.2017). Despite this, it is apparent that various visions have been employed in different projects.

As such, this section shall explore the role of four visions which guide, or have guided, the development of green infrastructure in Nijmegen, through four different projects. As explained in section 2, visions are operationalised into aims, and these are achieved through projects. Therefore, table 7 presents the visions, and aims, for the four projects detailed in this section.

Table 7: The 4 selected projects in Nijmegen, with the associated aims and visions.

Vision	Aims	Projects
A sustainable city, prepared for the future	- ecologically sustainable urban development - self-supporting sustainable water system	ECOPOLIS in the Waalsprong
A liveable, healthy city	- developing green infrastructure	Nijmegen's new green policy plan
A healthy city	- health promotion through development of green space	'Green, healthy and in movement'
A socially cohesive city	- Connect existing green areas - All residents have access to green within 300m of home - increase resident's satisfaction and quality of life	Increasing residents access to green

5.2 The Development History of Green Infrastructure in Nijmegen

Before discussing the visions presented in the previous section, a brief history of the development of green infrastructure in Nijmegen shall be presented, in order to go some way to contextualise the content and development of the visions guiding green infrastructure.

Stadsdeel	oppervlakte openbaar groen per inwoner (m^2)
Stadscentrum	15,7
Oud Oost	6,3
Oud West	6,4
Nieuw West	35,6
Midden Zuid	47,5
Zuidrand	22,6
Dukenburg	108,5
Lindenholt	85,3
Nijmegen Noord	43,3

Bron: Gemeente Nijmegen, Registratie afdeling Milieu 2000

Table 8: The public green space (m^2) per capita in selected neighbourhoods in Nijmegen. Selected neighbourhoods are highlighted in red and green. Taken from: Groenplan de groene draad, 2007.

Figure 8: The locations of the 9 neighbourhoods in Nijmegen, as indicated in table 4. The train tracks, main roads, river Waal, and the Maas – Waal channel are depicted. Taken from: Gemeente Nijmegen, 2007.

Nijmegen is the oldest city in the Netherlands and is situated on the river Waal (figure 7). The city centre developed as a half concentric circle around the ancient roman settlement on the southern riverbank (Gemeente Nijmegen, 2016). In the years following the second world war up until the 1980s, Nijmegen underwent a 'massive expansion'. Given this, Nijmegen has 'barely any open space', however is surrounded by a 'green ring' (European Commission, 2015).

It is recognised that different neighbourhoods in Nijmegen have different characteristic 'starting points'. Table 8 shows the public green space (m^2) per capita in selected neighbourhoods in Nijmegen. Here, it is evident that the areas Stadscentrum, Oud Oost and Oud West (highlighted in red) have far fewer green areas per capita than Dukenburg and Lindenholt (highlighted in green). Understanding why and how these patterns of green infrastructure development originated in these different neighbourhoods, and what potential there is for greening the currently 'under -greened' areas is paramount. Furthermore, it has been stated that there is a need to develop different strategies which are specifically relevant for the different neighbourhoods in Nijmegen, given the unique combination of contextual factors in each area (Water Policy Advisor, personal communication, 29.05.2017).

Development of the residential Dukenburg and Lindenholt areas, which began in the 1960s and 1970s, represented a change to the previous pattern of city development. These two neighbourhoods, which are located on the western side of the Maas - Waal channel (figure 8), are characterised by high levels of 'green and blue infrastructure' (see table 8) (Gemeente Nijmegen, 2007). In these neighbourhoods, residential developments consisted mostly of apartment buildings, which were 'surrounded by large areas of grass and shrubs' (Water Policy Advisor, personal communication, 26.05.2017). However, it is most likely that these areas developed with higher levels of green infrastructure when compared to the city centre for purely aesthetic purposes. When interviewed, one respondent stated that the potential for climate adaptation was not a factor influencing the design of these areas and the decision to incorporate large areas of green here. Furthermore, whether there were 'higher purposes' leading to the inclusion of green areas around the buildings is unknown (Water Policy Advisor, personal communication, 26.05.2017). As such, it can perhaps be inferred that there was no vision of green infrastructure guiding the development of these areas, despite the high prevalence of green space. Further, it was suggested that, despite having more visible green resources, these areas are still lacking in 'functional green', 'We have in Dukenburg and Lindenholt extremely green ***[sic.)***, but these are just green lanes where you can sit. We could make something more so that people use it more' (Public Spaces Policy Advisor, personal communication, 17.07.2017). This suggests that while these two neighbourhoods have a higher proportion of green spaces and resources compared to other city areas, they perhaps lack functionality, thus possibly reinforcing the notion that these areas were developed with a lack of vision.

Historically, Nijmegen's factories and housing for factory workers were built in and around the Oud West neighbourhood '… the density of houses is most of the time the highest [in Nijmegen Oud West] … historically factory workers were living in this area, near the factory' (Urbanist, personal communication, 29.06.2017). Due to the high density of building in this area, there was a marked lack of open green space, '… historically there were a lot of houses and factories but not enough green facilities' (Water Policy Advisor, personal communication, 26.05.2017). Given this, these areas are of particular focus in the municipality's urban greening projects, '… especially the west side of the city is lacking green, so the main goal was to create green spaces [here]' (Urbanist, personal communication, 29.06.2017). Furthermore, connecting the green spaces in this area is of particular importance, given the current lack of ecological corridors in this area, '… on the west side, there are some green blocks that reach into the city, but it is not consistent … the ones who are really suffering are in the station area, so here is where we create the green spots and try to connect them to each other, I think that maybe is the answer.' (Urbanist, personal communication, 29.06.2017).

5.3 Institutional Organisation

In Nijmegen, there is no longer a designated 'green' department at the municipality. Instead, employees from different departments are working on urban greening projects in various capacities (an overview of the functions of interview respondents and their involvement with green infrastructure was presented in section 3.2.3). Additionally, it has been stated that green infrastructure has been on the city agenda as a planning concept in Nijmegen for the past 5 – 10 years (Water Policy Advisor, personal communication, 26.05.2017).

Furthermore, understanding the institutional organisation also calls for an understanding of how green infrastructure projects are funded. Nijmegen has previously been involved in two European funded

projects, as described below. However, with the exception of EU funds for these two projects, funding for green infrastructure comes primarily from public funds. The municipality has a budget for green, although this budget is divided between policy making, subsidising projects, and maintenance of public space, where maintenance of public space includes street cleaning and rubbish disposal (Green Policy Advisor, personal communication, 05.07.2017).

The implications for the institutional organisation, in terms of 'money and personnel', on the development of visions guiding the development of green infrastructure shall be addressed later in this section.

5.3.1 Involvement in European Projects

Given that sub-question c explores the role of the EU in the development of visions in each city, it is appropriate to look at how this relationship can be manifested. As mentioned, one way of doing this is to look at Nijmegen's involvement in European projects, as this shall elaborate on the links between strategies at the EU level and the resulting actions taken at the municipal level. From this, it may be possible to see if the EU vision of green infrastructure is reflected in the city vision.

The EGCA changed the application criteria from the 2016 cycle, lowering the population requirements of applicant cities to 100,000 instead of 200,000. Following these changes in selection criteria, Nijmegen applied for the EGCA in the 2016, 2017 and 2018 cycles. By winning the award in the 2018 cycle, Nijmegen became the first official 'medium sized' green capital city, following the OECD – EC classification (Dijkstra & Poelman, 2012). Although the EGCA promotes the share of best practices and aims to provide examples of sustainable urban living, it has been argued that cities can only learn from comparable cities (KPMG, 2010). Given this, Nijmegen is in a unique position as a medium sized EGCA winner, and hopes to provide an example for other medium sized cities in Europe who are seeking to implement green infrastructure.

Between 2008 and 2013, Nijmegen participated in the EU - Interreg IVB-project 'Future Cities - urban networks to face climate change' (Future Cities, 2017). The Future Cities project sought to create a network of cities in North – West Europe able to share best practices and examples of climate change adaptation measures (The Future Cities Project Partnership, 2013). Using the funding from this project, which came from The ERDF, the municipality realised various green infrastructure projects, under the premise of climate adaptation. The urban greening projects undertaken in the context of Future Cities were also in line with the goal of making the inner city greener and improving the quality of public space (The Future Cities Project Partnership, 2013). This is particularly pertinent in the city centre of Nijmegen given that Nijmegen is a stony city, and does not have many large areas of green within the city (Gemeente Nijmegen, 2016). The roofs of the municipality building were converted into green roofs and the elevator shaft of a municipal building was transformed into a 'living wall' (The Future Cities Project Partnership, 2013). The role of the municipality, as a pioneer, was brought to the forefront through these projects 'this green roof, this is a pilot, it has to inspire private persons as well to do something more with their roofs … we should be an example for others … that's also our task as a public institute, to stimulate others…' (Urbanist, personal communication, 29.06.17). Furthermore, by addressing the fact that there is a lack of open space in the city centre in a unique way, through using a wall and a roof as the location for the development of green infrastructure, the municipality showcased their creative thinking.

Another noteworthy outcome of the Future Cities Project was the transformation of an old car park in the city centre into a green park, as a manifestation of green infrastructure. This project was completed with the hope that the new park would provide additional rain water storage, as well as go some way to mitigating the urban heat island effect. Furthermore, the creation of this park has created new value for residents, and given its success, there are now plans to transform more public, stony areas into green areas. 'This was such an inspiring and successful project that we want to continue with it …' (Urbanist, personal communication, 29.6.2017). Again, the stated desired outcomes of this project are evident of a vision which has the aim of providing climate adaptation methods.

The rest of section 5 shall explore the visions presented in table 7, and shall discuss their formation and their role in four main projects; first in the exemplary development of a new, sustainable city neighbourhood, second in the updating of a green policy plan for the future development of green in the city, and the integration of this with public health, and thirdly in the creation of a target driving the development and connectivity of green infrastructure.

5.4 The ECOPOLIS Conceptual Tool and Its Use in the Waalsprong Development

Developed in the early 1990s by Sybrand Tjallingii, ECOPOLIS is an integrated urban planning concept which aims to create guiding principles for 'ecologically sustainable urban development' (Tjallingii, 2002). To this end, ECOPOLIS takes the approach that the city itself can, and indeed should, be viewed as a complex and dynamic ecosystem (Tjallingii, 1995). Traditionally, city planners have used nature and ecology to create limiting conditions for urban development, rather than using nature as a structural condition (Developer of ECOPOLIS concept, personal communication, 21.06.2017). Furthermore, the traditional discourse views nature as an object, whereas ECOPOLIS regards nature as a process, and thus calls for land – use planning to take natural processes as the starting point (Tjallingii, 2000). As such, the general principle of ECOPOLIS can be viewed as an approach to integrate ecological processes into the social, economic and spatial development of the city (Tjallingii, 2016).

It is important to note that ECOPOLIS is not a set of concrete objectives; Tjallingii specifies that the development of 'precise targets' which are appropriate for local circumstances remains within the domain of the appropriate authorities (Tjallingii, 2002). Instead, ECOPOLIS 'provides guiding principles' and can thus be used to guide the development of plans and assess developments which are currently underway.

ECOPOLIS as a guiding principle consists of three layers, and can be seen as a process which results in an ecologically sustainable urban development. The first layer comprises the conceptual frame, and is viewed as a triangle with flows, areas, and actors in the three corners, and the subsequent plan in the middle. The original visual representation of ECOPOLIS is shown in figure 9, and the authors own representation for the purpose of this project in figure 10. As Tjallingii explains, flows, areas and actors are the three focal fields of the frame. The justification for the selection of these three focal fields lies in the fact that 'good plans create conditions for interrelated activities, and interrelatedness takes place when activities affect the same area, flow or network of actors' (Tjallingii, 2002). In other words, it is a requirement of an integrated urban plan to contain flows, areas and actors.

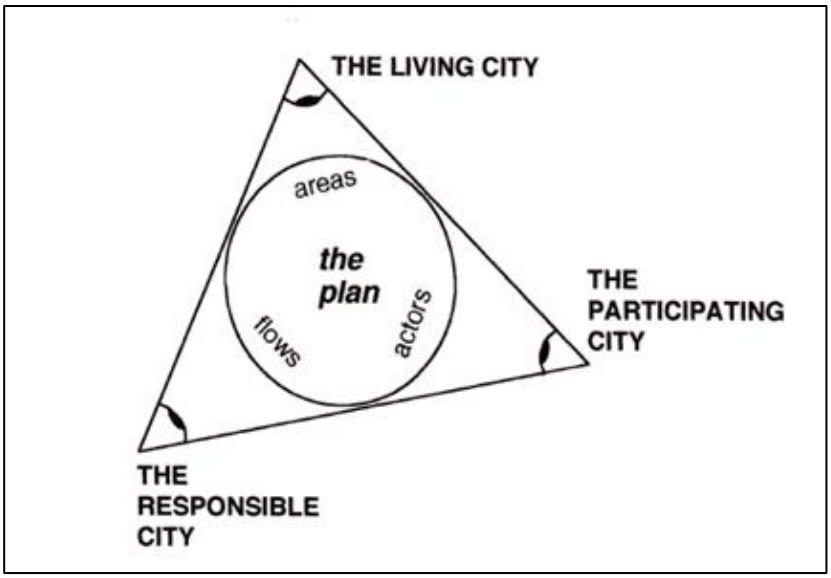

Figure 9: the conceptual frame of ECOPOLIS, taken from Tjallingii, 2002. The original caption read: *Three eyes look at a plan or an existing system. They look at three decision fields. Together, decisions in these fields create the structure of the plan. From each point of view a strategy for sustainable urban development is formulated.*

It was decided to redraw the original representation for the purpose of this project to highlight the fact that the three 'eyes' looking at the plan in the middle do not focus exclusively and specifically on one of the focal fields. By moving the text, the original caption (figure 9) still holds true, and thus figure 10 still shows the 'Three eyes look at a plan or an existing system. They look at three decision fields. Together, decisions in these fields create the structure of the plan'. However, it is hoped that in figure 10 it is clearer that each point of view is not specifically focussed on just one focal field. The arrows in figure 10 show different viewpoints, and represent the need for integrated and holistic thinking by different departments about the whole plan, instead of focusing solely on one's own domain (Tjallingii, 2002).

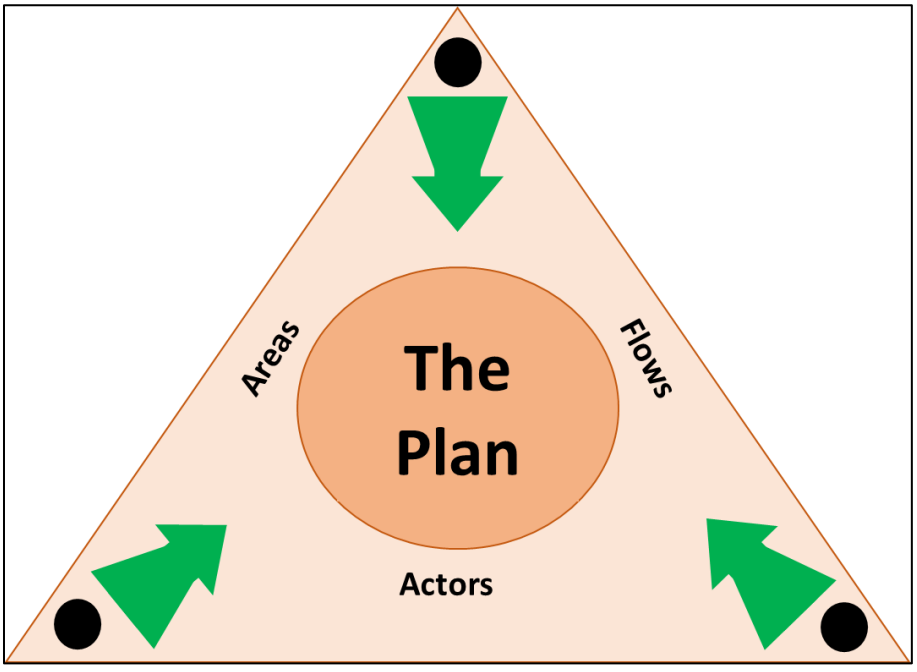

Figure 10: A visual representation of the conceptual frame of ECOPOLIS, the first layer. Authors own schema based on that presented in Tjallingii 2002.

As ECOPOLIS takes ecological processes as the starting point for developing plans, viewing the three focal fields through this lens led Tjallingii to the creation of three 'mottos' (Tjallingii, 2016):

- ***The responsible city***: responsible for incoming and outgoing flows and connections
- ***The living city***: design with nature
- ***The participating city***: foster a sense of commitment from citizens, businesses and other stakeholders

The second layer outlines the priorities for flows, actors and areas as aspects of one plan (Tjallingii, 2002). While an in-depth explanation of the content of these priorities is perhaps outside the scope of this project, they are summarised in table 9 (taken from Tjallingii, 2002). To what extent these priorities were recognised and used to inform the development of the Waalsprong neighbourhood in Nijmegen shall be discussed further in this section.

Table 9: The second layer of the ECOPOLIS conceptual tool, the priorities for each flows, areas and actors. Taken from (Tjallingii, 2002).

Flows	Areas	Actors
Prevent unnecessary use	Use natural and cultural heritage and landscape potentialities	In the planning process: Create consensus about the frame for sustainable development
Use sustainable and durable resources: reuse and recycling	Create conditions for safety, health and quality of life	In the stage of use and maintenance: Interactive management
Take responsibility for supply and discharge flows	Create conditions for wildlife	Create a learning organisation

Finally, the third layer of ECOPOLIS is concerned with the use of guiding models. These guiding models can be used by city planners to plan effectively for flows, areas and actors. As such, guiding models act as 'prototypical solution schemes' to arrive at planning solutions which fully integrate the three fields (Tjallingii, 2002). As Tjallingii notes, in cases where there is an agreement among stakeholders, it is appropriate here for a 'technical model for optimising planning solutions' to be used. However, as it could be the case that conflicts arise 'in the process of defining the priorities and criteria for flows, areas and actors', a guiding model here can act as a prototypical solution scheme to this end. There are various guiding models which could be used at this stage. The guiding model used to inform the Waalsprong development in Nijmegen shall be explored below.

In the early 1990s, Nijmegen was required to build 12,000 new homes (Gemeente Nijmegen, 2016). The city did not want to build on its natural areas, and so the decision was made to 'jump over the Waal'; thus, giving the new development on the north side of the Waal the name Waalsprong. The

development of the Waalsprong marked the first time that the city boundaries expanded north of the river Waal. City planners opted for a guiding role of water and green structures to replace what was usually dominated by 'hard', or grey, structures, for this development. As such, in 1994 and 1995, the municipality decided to adopt ECOPOLIS as its guiding strategy for the planning process of the Waalsprong (Tjallingii, 2002). At the planning stage, this was manifested through the use of ECOPOLIS guiding models to 'generate concrete proposals'. The planners of the Nijmegen municipality here opted to use the 'soft' structures of water and green to play a guiding role in the planning process (Tjallingii, 2002).

Under the concept of ECOPOLIS, authorities in Nijmegen used 'some principles of sustainability … [to create] … a city area which is prepared for the future', in this case, being prepared for the future refers to the capacity for climate change adaptation (Urbanist, personal communication, 29.06.2017). Of particular interest, ECOPOLIS was used to inform the development of a 'sustainable, and self – supporting water system' (Urbanist, personal communication, 29.06.2017). The motivation to create this self – supporting water system stemmed from the natural landscape of this neighbourhood. The Waalsprong is developed on a flat polder area and '… is below the higher levels of the river and protected against flooding by a dyke … it should therefore have an internal water system that is not directly connected to the river' (Tjallingii, 2002). This is important given the possible flood risk when the river runs high. Thus, it can be inferred that the 'some principles of sustainability' referred to by the Urbanist indeed refer to the three 'mottos' and the priorities for flows areas and actors, as described by layers 1 and 2 of ECOPOLIS. In the case of the sustainable and self-supporting water system, this can be interpreted as a direct manifestation of 'the responsible city: responsible for incoming and outgoing flows and connections' and 'the living city: design with nature' of the first layer of ECOPOLIS. Furthermore, from the second layer of ECOPOLIS the water system developed in the Waalsprong satisfies the three priorities for flows, as described in table 9.

The guiding model (in line with the third layer of ECOPOLIS) which was used to inform plans guiding the development of this self sufficient water system was the circulation model (figure 11). The circulation model dictates the 'seasonal storage of unpolluted rainwater' (Tjallingii, 2002). As part of the Waalsprong development, wadis (water ponds) were created (figure 12). The intention was for rain water to flow over the surface into these wadis, where the water would be collected and then infiltrate and be purified naturally (Water Policy Advisor, personal communication, 26.05.2017). This contrasts with the traditional method of storm water management whereby rain water enters the combined sewer system and is subsequently treated with refuse water. Furthermore, replacing a combined sewer system with a decouple sewer system confers important environmental benefits, given that combined sewer systems often experience problems of flow capacity caused by fluctuating rainfall levels (Developer of ECOPOLIS concept, personal communication, 21.06.2017). This results in the efficiency of purification changing during different rainfall periods (Geretshauser & Wessels, 2007).

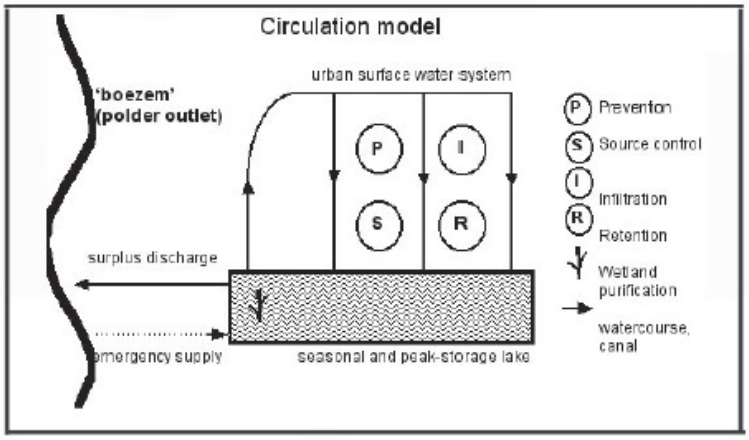

Figure 11: A visualisation of the circulation model, used as a guiding model in line with the third layer of ECOPOLIS. Taken from Tjallingii, 2002.

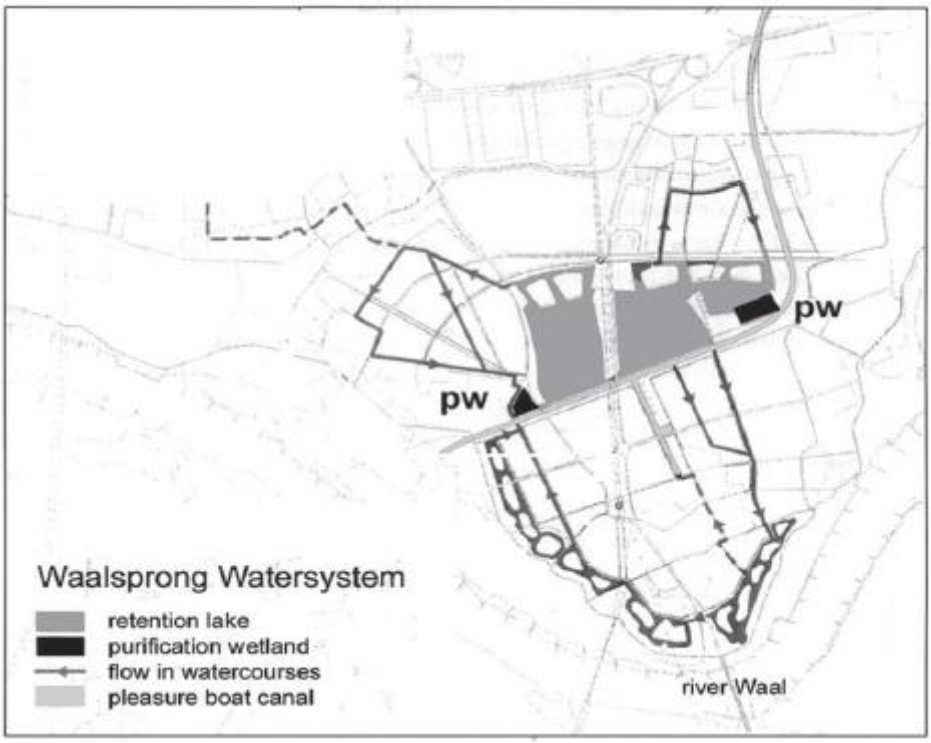

Figure 12: The originally planned Waalsprong water system. Note the absence of the ancillary channel. Taken from Tjallingii, 2002.

After this, the water is transported to three large lakes, which were artificially created (figure 12). The idea behind the creation of these lakes was threefold, 'this will be a self-supporting sustainable system … But of course, you want to offer the people who live here not only every spot built [***sic***.] but also some recreational area. So, we designed this area … and also, we have to take out the sand and we can sell it, from a different point of view that's an interesting development' (Urbanist, personal communication, 29.06.2017). In effect, the creation of this water system conferred recreational and

economic benefits for the neighbourhood and for the municipality. This example of rain water storage and purification can be seen as a manifestation of a priority of flows, as described by the second layer of ECOPOLIS (table 9).

However, from the planning stages of the Waalsprong in the mid-1990s until today, things have changed. Around the year 2000, as part of the national 'room for the river' project, Nijmegen designed an ancillary channel parallel to the main water course, in order to reduce the risk of high river levels and flooding (Gemeente Nijmegen , 2017), in effect creating an artificial island in the Waal. To allow room for this development, the original dyke was moved 350m further inland on the northern bank of the Waal. This had consequences for the original plans for the Waalsprong. 'We already had agreements with developers for the old plans, then we had to say stop – we have to look for room for the river in this area…' (Urbanist, personal communication, 29.06.2017). Tjallingii himself recognised that the role of ECOPOLIS changed as the development of the Waalsprong continued, 'during these later stages ECOPOLIS, only indirectly through the structure plans frame, influenced the planning process' (Tjallingii, 2002). However, the Waalsprong is still regarded as an ecologically sustainable urban development, in line with the ECOPOLIS concept, 'we had the room for the river intervention, and then later on the financial crisis, so many things have changed. If you look at how we started in the 90s, now after 25 years we have to be more and more flexible, but the main issues [of ECOPOLIS] are still there, the principles are still there' (Urbanist, personal communication, 29.06.2017).

Given the apparent heavy focus of the role of water in Nijmegen's manifestation of the ECOPOLIS concept, it is perhaps important to reiterate the link between ECOPOLIS and green infrastructure. It has been suggested that city planners traditionally use nature to create limiting conditions for urban development, as opposed to using nature as a structural condition (Developer of ECOPOLIS concept, personal communication, 21.06.2017). However, under ECOPOLIS, green and blue are seen as important structural factors, and as such are used to inform and guide 'ecologically sustainable' developments. Thus, it can be inferred that the ECOPOLIS concept supports, and indeed builds upon, concepts of green infrastructure.

Regarding the interaction between green and blue infrastructure, the notion that it is in the interest of sustainable urban development to have a green infrastructure which is closely linked to the blue structures in the city is gaining traction. 'Blue can play an important role in carrying green, and this is becoming more and more recognised by local authorities and planners' (Developer of ECOPOLIS concept, personal communication, 21.06.2017). Additionally, it has been suggested that connecting green and blue infrastructures is in the interest of a more 'balanced' urban development (Developer of ECOPOLIS concept, personal communication, 21.06.2017). Despite this, green and blue are often regarded as the focus of separate departments; and it has been suggested that the departments concerned with green tend to have a greater focus on maintenance, whereas water is often managed in a more technical way (Developer of ECOPOLIS concept, personal communication, 21.06.2017). Given these differing approaches, it follows that green and blue have different publics.

It has been stated by one respondent that the use of the ECOPOLIS concept to inform this development was akin to using a vision: 'from the beginning of the development of the Waalsprong … there was an underlying vision, total vision, called the ECOPOLIS vision' (Water Policy Advisor, personal communication, 26.05.2017). Referring to ECOPOLIS as a total vision highlights the notion that ECOPOLIS truly integrates different domains. However, in line with the defining criteria of visions, aims

and projects delineated for the purpose of this study, ECOPOLIS as a planning concept in the Waalsprong is best described as a project. The use of the ECOPOLIS concept satisfies the conditions of being a project presented in table 3; through the use of ECOPOLIS, the aims of ecologically sustainable urban development can be achieved. Further, the use of ECOPOLIS to inform the Waalsprong development demonstrated that the vision of 'a sustainable city, prepared for the future' is plausible and realisable. Finally, ECOPOLIS was used to inform the creation of a self – sustaining water system in the Waalsprong. Thus, the successful creation of this system further reinforces that ECOPOLIS is a project, and as such is a vehicle to achieving stated aims in line with an overarching vision.

As has been stated, the vision behind the ECOPOLIS concept is to create a sustainable city, prepared for the future. To wrap up this section, this vision shall be qualified in line with the five quality criteria of a vision. The far – sightedness and holistic perspective of this vision satisfy that this vision is visionary. Next, the clear goals, as delineated by ECOPOLIS, and the theoretical underpinnings of ECOPOLIS mean that this vison is indeed plausible and tangible. As has been discussed, the decision to use the ECOPOLIS concept, as a project spearheaded by the vision of a sustainable and climate resilient city resulted from various discussions with the municipality and other stakeholders. Therefore, this demonstrates that this vision is shared, and motivational.

5.5 Nijmegen's New Green Policy Plan: Developing A Green, Healthy and Mobile City

As mentioned, it had been suggested that the terminology 'green infrastructure' in the Netherlands is not extensively used. However, it is important to bear in mind that this assertion was made 10 years ago, in 2007, and as such it follows that there could have possibly been a trend towards more awareness of green infrastructure as a planning concept since, coupled with greater usage of the term. Indeed, Water Policy Advisor (26.05.2017) stated that '… They ***[sic]*** didn't know about that [higher purposes of green infrastructure for climate adapation] until the last 10 years or maybe 5 years'. This indicates that in Nijmegen green infrastructure could be seen as a new addition to the planning agenda, and a new planning tool to achieve desired outcomes.

This notion is supported by redevelopment of Nijmegens green policy plan. The first green policy plan for the city was published in 2008, and currently a new green policy plan is being created, with the expectation that it shall be published next year. As stated by a Green Policy Advisor (05.07.2017), 'the reason (for the update) is that the last green policy plan is already 10 years old, and a lot of things happen in 10 years, like climate issues, health issues … the previous one was just about green but not about the connection with green and health, or green and climate change'. This highlights an aknowledgement of, and indeed understanding of how green infrustructure can be championed to convey its numerous associated benefits. The new policy plan shall focus on developing three main areas, ' [developing] green infrastructure is one of the main things … you have to do something with the new Nature Conservation Act, and the handbook of trees should be actualised … ' (Green Policy Advisor, personal communication, 05.07.2017). The first two of these focal points shall be adressed in turn in this section, however it was decided not to elaborate on the handbook of trees given that it does not support the development of knowledge which can help answer the research questions of this project. It is important to highlight that this green policy plan will aim to set a foundation for green infrastructure which should be able to be built upon as new issues arise, 'The lifespan [of a green policy plan] is always a problem because there are new issues coming, but you should have a good base, a good infrastructure which works for the next 10 years… at least the green infrastructure should have

a vision of 5 to 10 years and you should be able to adapt it … it should always be there so you kee building on it …' (Green Policy Advisor, personal communication, 05.07.2017). This is a particularly pertinent statement given that two other respondents from Nijmegen commented on the outdatedness of the previous policy plan.

Furthermore, the new policy plan is currently being developed in line with a ***vision*** for sustainable living, 'a city should be liveable, ready for play and movement, especially movement like cycling and walking, so it should be a healthy city, and it should be a city that you can eat, beacause there's a big problem with agriculture so why shouldnt we have agriculture in the city? … All these things should really give direction to the city development' (Green Policy Advisor, personal communication, 05.07.2017). The holisiticity and description of this desirable future state qualify this vision as being visionary, in line with table 1. Furthermore, the clear goals of this vision, to have a liveable, healthy city in movement, and its theoretical underpinnings satisy that it is plausible and tangible. Given the bredth of this vision and its holisitic approach, it follows that decision makers from different deprtments and organisations share, and indeed support, this vision. Finally, this vision is motivational, in that it describes a utopian scenario and motivates residents and policy makers towards the envisoned change.

The vision is driving the deveopment of the new green policy plan, which is the project. Indeed, the development of nijmegens new policy plan is carefully planned in line with the desired aims of the vision; thus satisfying the criteria of a project presented in section 2.1. The way in which this vision is embodied in the new policy plan shall be further discussed below.

It is the aim that green infrastructure shall have a more prominent role in Nijmegens new green policy plan compared to its previous counterpart. 'Green infrastructure wasn't really a big part [of the old policy plan]. I think they knew it was important, but they never got the chance to build on it, to finish it, and that's the backbone of the whole policy plan, so this time they should really take care of it …' (Green Policy Advisor, personal communication, 05.07.2017). This statement could also reflect the suggested trend that awareness of green infrastructure as a planning concept is gaining greater traction in the Netherlands. In addition, green infrastructure has been described as a tool which can be used to implement the aforementioned vision for sustainable city development in Nijmegen, 'our gear exists of green infrastructure, because green infrastructure is more than just a map, it links us to climate change [climate change adaptation], biodiversity, possibilities for walking or cycling routes, so its also for health…' (Green Policy Advisor, personal communication, 05.07.2017). Adding to this list, green infrastructure in Nijmegen has also been stated to have an important role in mitigating the urban heat island effect (Water Policy Advisor, personal communication, 26.05.2017), and it has been aknowledged that green infrastructure correlates positively with real estate values (Urbanist, personal communication, 29.06.2017). This shows a knowledge and acceptance of the multitude of benefits which stand to be gained from the development of green infrastructure, as discussed in chapter 1.2. Additionally, this also shows an aknowledgement of how green infrastructure could be championed as a way to driving the implementation of the vision for Nijmegens sustainable living.

The Dutch national government recently introduced The Nature Conservation Act, which took effect on 1 January 2017 (Government of the Netherlands (Rijksoverheid), 2017). The Nature Conservation Act was created to be more in line with European Directives, notably the Habitats Directive (Stibbe, 2017), and in effect combines and replaces three previous acts; The Nature Conservancy Act 1998,

which protected nature areas; The Flora and Fauna Act, which protected wild animals and plants; and The Forestry Act, which protected forests (Government of the Netherlands (Rijksoverheid), 2017). Furthermore, under this act the 'care competance of flora and fauna' is transferred from the Dutch state to the provinces (Stibbe, 2017). As such, it is the role of the province to set the rules and regulations concerning nature protection in their own province, and anyone who wishes to undertake an activity which could potentially cause harm to the environment can apply for an integrated environmental permit from the local municipality (Government of the Netherlands (Rijksoverheid), 2017). 'The Nature Conservation Act makes it possible to redevelop an area, but you have to ask for permision … and you have to say you will take care of the animal and plant life … and will take them somewhere else or will take care of them while planning the new area' (Green Policy Advisor, personal communication, 05.07.2017). Incoportating aspects of the Nature Conservation Act into the new green policy plan is one of Nijmegens goals, '… maybe [we] can make a plan for the whole area and say well anyway we will always take these kinds of precautions [to protect nature] … so [we] have to do something to make a kind of policy of that as well [***sic.***]' (Green Policy Advisor, personal communication, 05.07.2017). This would be particularly pertinent given the increasing 'power' of the municipality regarding the implementation of the Nature Conservation Act. Furthermore, given that this Act was created by the national government in an attempt to align Dutch national laws better with European Habitats Directive, and that it is the responsibility of the municipal level to integrate and enforce this act into local policy, it follows that this could be used as an example of an indirect role of the EU on the development of green infrastructure in cities. The vision of the Habitats Directive centres around preventing the loss of biodiversity and restoring ecosystems and ecosystem services (European Commission, 2013). Indeed, action 2 of this directive highlights the need to establish green infrastructure in Europe, in order to achieve the aformentioned vision. It will be intersting to see how Nijmegen incorporates the Nature Conservation Act in its new policy plan, to see to what extent the EU vision, depicted in the Habitats Directive, is reflected herein.

It has been recognised that 'the maintaining of green is very important as well because a policy is just something on paper, but you really need to take care of your green and develop your green …' (Green Policy Advisor, personal communication, 05.07.2017). To this end, the need for a detailed agenda and plan of action with specific goals in place will be a crucial accompaniment to the new green policy plan of Nijmegen, to ensure that the new green policy plan should act as a basis for future developments, and that future actions can build upon what will have been established herein (Green Policy Advisor, personal communication, 05.07.2017). Indeed, linking this to terminology in table 1, there is a recognised need for the new policy plan to be coherent and tangible, thus satisfying these criteria for a quality vision. Finally, it is important to point out that one respondent stated that 'the policy plan is the vision, but not a long-term perspective'. However, in line with the definitions used for this study, the development of Nijmegen's new green policy plan is classed as a project.

Finally, it has been stated that Nijmegen's new green policy plan will not have a long-term lifespan, given that new issues are constantly arising (Green Policy Advisor, personal communication, 05.07.2017). Thus, it has been stated by another respondent that 'the biggest challenge we face is that we need to develop a long-term vision' (Water Policy Advisor, personal communication, 26.05.2017). This recognition of the need for a long-term vision guiding green infrastructure development is vital. It could be proposed that a long term, shared, and integrated vision of green infrastructure would bring together the different departments and streamline actions.

5.6 Connecting Green Infrastructure with Health

The possible health benefits associated with the implementation of green infrastructure is an area of research which has gained much attention in recent years (Tzoulas, *et al.*, 2007), (Kardan, *et al.,* 2015). There is a strong association between the development of green space and health in Nijmegen, and this is proving an integral part of Nijmegen's green infrastructure development, 'Nijmegen were quite explicit in they wanted to connect green infrastructure to health, and that was a very strong connection' (EGCA expert panel member, personal communication, 26.06.2017). The attention on health can be seen in the aforementioned vision driving the development of the new green policy plan, 'this new vision … it should be a healthy city' (Green Policy Advisor, personal communication, 05.07.2017). Furthermore, it has been stated that 'green and health have the same goals … the health policy in Nijmegen links green and movement' (Green Policy Advisor, personal communication, 05.07.2017). This link between, green, health and movement shall be explored here.

The vision for developing 'a liveable and healthy city' is being manifested through the project, 'wij zijn groen, gezond en in beweging Nijmegen' (we are green, healthy and in movement Nijmegen). The impetus for the project came 1.5 – 2 years ago, and it is a collaboration between the municipality of Nijmegen, the regional health service (GGD[15] Gelderland-Zuid), and the RadboudUMC hospital in Nijmegen (GGD Gelderland-Zuid, Radboudumc en de gemeente Nijmegen, 2017). This project is a ten-year collaboration between these three organisations, with the overall aim of creating connections between the three organisations for the promotion of health (Overall Project Manager GGB[16], 28.07.2017). This aim is clearly defined, and the project is formed of smaller 'work packages'. Further, achievements of the project will be monitored, in order to ensure that developments within the context of the project are indeed in line with the overall vision. At present, the 'theme' for the project is healthy weight, and this theme shall be the main focus for 4 years (GGD Project Manager, personal communication, 28.07.2017). After this time, another theme shall be added, with the hope that the infrastructure for healthy weight promotion was established in such a way that this theme can continue. Given this, it is easy to understand how 'healthy weight' could be seen as a goal of a city which is 'green, healthy and in movement'. The project acts a forum for sharing best practices, and aims to create connections between the operation level and strategic level of various organisations to ensure that health promotion is approached in such a way as to gain momentum and achieve results (GGD Project Manager, personal communication, 28.07.2017). Given this, it is clear that the project does indeed satisfy the criteria defining a project.

Green infrastructure is recognised as being an integral driver of health in Nijmegen, 'green is a condition that you need [in promoting public health]' (Overall Project Manager GGB, personal communication, 28.07.2017). Furthermore, the role of green infrastructure in the promotion of public health is receiving growing attention from the three organisations involved in the project, 'we noticed than we started to have conversations and talk to people [at the three organisations] that green is one of the words that comes onto conversation and people's eyes light up … they say that's what they're really thinking about now as well … there's a lot of energy around the theme and it is really fundamental' (GGD Project Manager, personal communication, 28.07.2017).

[15] GGD is an abbreviation of gemeentelijke gezondheidsdienst – translated in English to the 'regional health service'

[16] GGB is an abbreviation of 'groene, gezond en in beweging'.

The implementation of public health is often derived from a certain model (GGD Project Manager, personal communication, 28.07.2017). One of such models which informs various interventions and plans in Nijmegen is the GIDS (Gezond in de stad) model. This model is formed of 5 pillars (figure 13), and together these form the basis of an integrated approach to tackle various public health problems (Gezond in..., 2017). One of the five pillars is the physical environment. The GIDS model recognises that the physical environment can 'promote, but also limit, health' (Gezond in ..., 2017), and as such can provide a basis for the promotion of public health. However, the GGD Project Manager stated that the physical environment is difficult to influence, 'the physical environment is where the green fits in. But it is also one of the hardest … it's really hard to influence.'

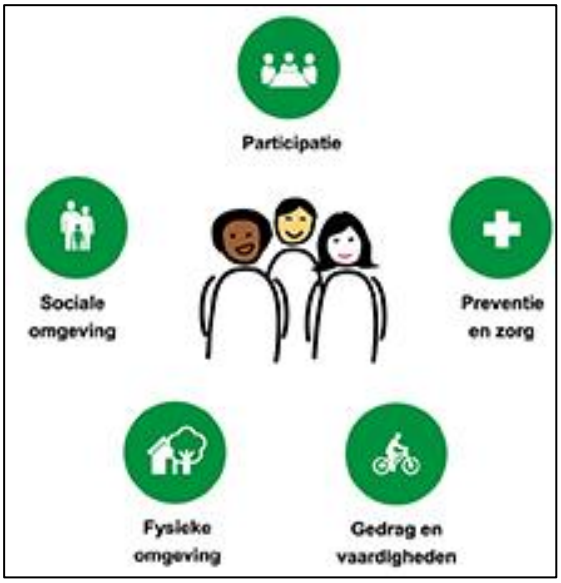

Figure 13: The 5 pillars of the GIDS model. Themes translated into English clockwise from the top: Participation, prevention and healthcare, behaviour and skills, physical environment, social environment. Image taken from (Gezond in..., 2017).

Another conceptual model of public health which has gained much attention in recent years is the concept of Positive Health, developed by Machteld Huber. The standard definition of health was developed by the World Health Organisation (WHO) in 1948 and reads 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (Huber, 2011). Under the concept of Positive Health, the WHO definition is outdated, given that advances in health care and demographic changes allow people to live longer, and that today there are more people living with chronic illnesses which they manage through medication. Furthermore, achieving a state of truly 'complete physical, mental and social wellbeing' has been criticised as being somewhat impossible to quantify, and has the potential to vary on a daily basis (GGD Project Manager, personal communication, 28.07.2017). Therefore, Positive Health proposes that health should no longer be defined by the absence of illness, but instead should focus on people's 'ability to adapt and self-manage in the face of social, physical, and emotional challenges' (Huber, 2011). The concept of Positive Health also draws attention to the empowerment and resilience of a person, and given this, Positive Health recognises the integral role of a person's mental health and wellbeing.

The growing acceptance of the Positive Health model thus confers a new appreciation of, and indeed necessity for, green infrastructure in a city. 'if resilience is one of the most important things in people

which makes them healthy or not … then suddenly mental health is a condition for being healthy as well. We know that green really affects your mental health, so that becomes more essential' (GGD Project Manager, personal communication, 28.08.2017).

5.7 Increasing Residents Access to Green Open Spaces

At the European level, in 1995 the European Environment Agency (EEA) set the target that residents should have access to green space within 15 minutes walking distance from their home. The percentage of residents living within this threshold was used as an indicator of urban environmental quality in the first EEA state of the environment report, referred to as the Dobris Report (Stanners & Bourdeau, 1995). While this indicator still holds today, various other interpretations have since been formed. Notably, the European Commission in 2000 suggested that this indicator should be changed to the percentage of residents living within 300m of a green area (European Commission, 2000). It is important to point out that neither of these two indicators set any spatial scale requirements for the 'green area'.

Under Dutch national law, the 'amount and spread' of green is not legally dictated. Instead, the development of green areas is viewed as mainly a 'local ambition' (Gemeente Nijmegen, 2016). However, although not legally binding, the Netherlands national target states that there should be a minimum green provision of 60m2 per-capita within 500m from a person's home (Wustemann, Kalisch, & Kolbe, 2016). This appears to be based on the EEA target, and addresses the issue of the lack of spatial requirements.

The city of Nijmegen has championed their own target based on both this EEA target and the Dutch national target. 'The main goal, also of the political coalition, was to create green places of a half-acre within 300 metres from the house' (Urbanist, personal communication, 29.06.2017). It is important to point out that this target does not dictate the minimum requirement of green area per capita, instead just access to an area of a half-acre within a 300m distance from each house. At present, over 95% of households in Nijmegen fall within this threshold (Gemeente Nijmegen, 2016).

Furthermore, the municipal budget for green and water is partly determined by citizens satisfaction with the management of green and water in different districts within the city (Gemeente Nijmegen, 2016). In the areas with a low the public green space (m^2) per capita (table 8), the public satisfaction averages at 53%, compared to 75% for the overall city. Given this, it is hoped that through improving citizens access to green space in these neighbourhoods, people's satisfaction will increase to be in line with the overall level. This could demonstrate a social motivation for increasing access to green.

The creation of this target has been instrumental in decision making at the city level in Nijmegen. Indeed, one respondent stated that the implementation of this target could be viewed as the cities vision guiding the development of green infrastructure, 'the distance to these green spots, there are still some parts left which need to be created so that everyone can have these areas 300m from his or her doorstep that they are entitled to, and to have some kind of chain so that all of them are connected …to extend and connect them … I think that could be our vision' (Urbanist, personal communication, 29.06.2017). However, under the defining criteria of projects, aims and visions for this study, the goal of increasing, and connecting, green spaces in Nijmegen is indeed best described as an aim; given that

it describes the general ambition of increasing the spread of green, and accessibility to residents. By referring to this as an aim, it follows that this is the operationalised product of a vision.

While the aim of having access to green space within 300m of each household is accepted to be one of the main goals driving the development of green infrastructure in Nijmegen, interviews with respondents working at the municipality revealed that the origin of this goal was unclear. In an informal conversation, one employee confirmed that they thought this goal could possibly have come from an EU target, although they were unsure of the details of this (Water Policy Advisor, informal communication, May 2017). Thus, this possibly reflects an apparent lack of awareness of EU targets pertaining to urban green space distribution, and as such supports the notion that the EU perhaps plays a lesser role in the development of guiding visions for green infrastructure in Nijmegen.

An interesting perspective to connecting these green spaces is to use cycle paths as a method of creating ecological corridors, '…bikes are very popular in the Netherlands, and are a very good instrument to make some kind of corridor, and if you connect this with ecological zones, they go quite well together, the bikes and green infrastructure …' (Urbanist, personal communication, 29.06.2017). Given that the existing cycle path network connects the entire city, it follows that championing this existing network could prove instrumental to achieving the goal of connecting green areas. Furthermore, in section 2 it was recognised that the design and management of green infrastructure should 'maximise the potential functionality' of a landscape. By connecting cycle paths and green corridors, it is hoped that this will indeed increase the functionality of an area. It is hoped that the new green policy plan will in effect provide a framework through which this goal can continue to be championed.

Much attention has been placed on the role of Green Infrastructure for developing social cohesion, sometimes referrred to as social sustainability, in Nijmegen (Gemeente Nijmegen, 2016). Indeed, it has been stated that connected green and blue areas, and cycling infrastructure, 'form a basal, connective structure for urban development and for cohesion' (Gemeente Nijmegen, 2016). The ability of green infrastructure to maintain social cohesion pivots around the notion that 'if an area is not really green it is not really liveable, in a green area people are calmer and they value their neighbourhood' (Green Policy Advisor, personal communication, 05.07.2017). Indeed, it appears that social cohesion is a desired outcome of the aim of having green spaces within 300m of all residents' homes.

5.8 Conclusions

To conclude, it could perhaps be stated that Nijmegen may not have one explicit vision currently guiding the development of green infrastructure per se, but instead employs various other visions over various platforms. This section has explored 4 of these visions, and their associated aims and projects (see table 7). Research question b addresses the contextual factors which shape resulting visions of green infrastructure. Here, the role of various socio – economic factors on the resulting visions guiding the development of green infrastructure shall be discussed.

One of the described challenges to implementing green infrastructure in the Stadscentrum area is that it is a particularly 'stony' area, 'the problem is that the Nijmegen city centre is very stony, and there is not much green in some parts of the city' (Green Policy Advisor, personal communication, 05.07.2017).

This has been recognised as having consequences relating to climate change adaptation strategies, including the infiltration ability of storm water and the urban heat island effect (Gemeente Nijmegen, 2016). Furthermore, the high presence of stone creates challenges when attempting to develop green infrastructure in the city centre, as there is a need to work with 'the existing structures' in the city (Urbanist, personal communication, 29.06.2017). As such, the high prevalence of stone here could be viewed as a geographic factor, in that it is a landscape characteristic which bounds the development of green infrastructure. However, one respondent saw this as an opportunity to 'think creatively', 'maybe it takes some creativity to do something in a small space where you wouldn't expect to do anything, but there is always room for green. If there is no room on the ground level, there is room on the walls, or high up …' (Green Policy Advisor, personal communication, 05.07.2017). Indeed, the green roofs of the municipality building and the living wall of the elevator shaft of a municipal building which were created using funding from the Future Cities Project) are in the Stadscentrum area. These projects were undertaken with the aim of inspiring private stakeholders to follow suit, '[the green roof] is a pilot project, it has to inspire private persons as well to do something more with their roofs … we should be an example for others … that's our task as a public institute to inspire others' (Urbanist, personal communication, 29.06.2017). The recognition of the need to inspire change in others, and gain the support of others are described by Wiek & Iwaniec (2014) as necessary quality criteria for sustainability visions (table 1). However, the lack of resources, be it money or expertise, can be viewed as a contextual factor hindering the successful implementation of visions.

In Nijmegen, there is no longer a specific 'green' department, and as such knowledge of, and interest in, green infrastructure is spread among different departments and manifests itself through diverse roles. Given this, creating a truly integrated approach is paramount, and in order to do so there is an awareness of the need for communication, 'the biggest jump you have to take is to talk to each other, and that's the first step in integration.' (Water Policy Advisor, personal communication, 29.05.2017). However, this has also been stated to be a challenge for Nijmegen, 'not everybody has the same long-term vision, or they may be short sighted, or they may be too conservative to think in a new way, and that's difficult. Or else you can't change the city ***[sic.]***' (Water Policy Advisor, personal communication, 29.05.2017). Furthermore, it has been suggested that there is an apparent implementation gap between what the city would like to achieve and what could actually be achieved, '… what you have in mind is not always practical, you can think of something but then people have to actually do it … from a plan until [implementation] there's a lot of stages and processes and people…' (Public Spaces Policy Advisor, personal communication, 17.07.2017). In order to ensure that designated plans are tangible, and thus in line with the quality criteria for a vision, it has been suggested that communication between the maintenance and design teams needs to be prioritised, with the aim of creating 'understanding of both worlds' (Public Spaces Policy Advisor, personal communication, 17.07.2017).

Finally, an institutional barrier which most respondents discussed was the financial cost to implementing green infrastructure, 'there is always a lack of money…' (Green Infrastructure Researcher, personal communication, 26.06.2017). As costs fall under the socio – economic context of 'institutional setting', it is worth exploring this further. In Nijmegen, green infrastructure projects are funded with public funds. It has been stated that the budget for green in Nijmegen 'is in fact too small. Too small to really take care of our green environment …' (Green Policy Advisor, personal communication, 05.07.2017). Despite the growing attention on green infrastructure development for healthcare benefits, there is no part of the health budget earmarked for urban greening project, '… no

money whatsoever [is coming from the health department] …' (Green Policy Advisor, personal communication, 05.07.2017).

Figure 14 is a visual representation of the conceptual framework, applied to Nijmegen. Here, the EU has a role on the resulting green infrastructure. The mechanism of this influence is through the realisation of EU funded projects, in particularly Nijmegen's involvement in the Future Cities project. It is important to note that there is no arrow leading directly from the EU to the visions. After exploring this case study, and the four leading visions as depicted in table 7, it became apparent that the visions guiding green infrastructure in Nijmegen are greater influenced by the socio – economic factors, especially that it is a compact, mid – sized city, and bound by the geographic factors rather than by the EU's visions. The visions, and resulting green infrastructure are bound by the geographical context. In this case, this specifically relates to the fact that Nijmegen is a stony city with little open green space in the centre, however there is a 'green ring' surrounding the city. This creates opportunities for the development of a green network, through creating connections between the city and its surroundings.

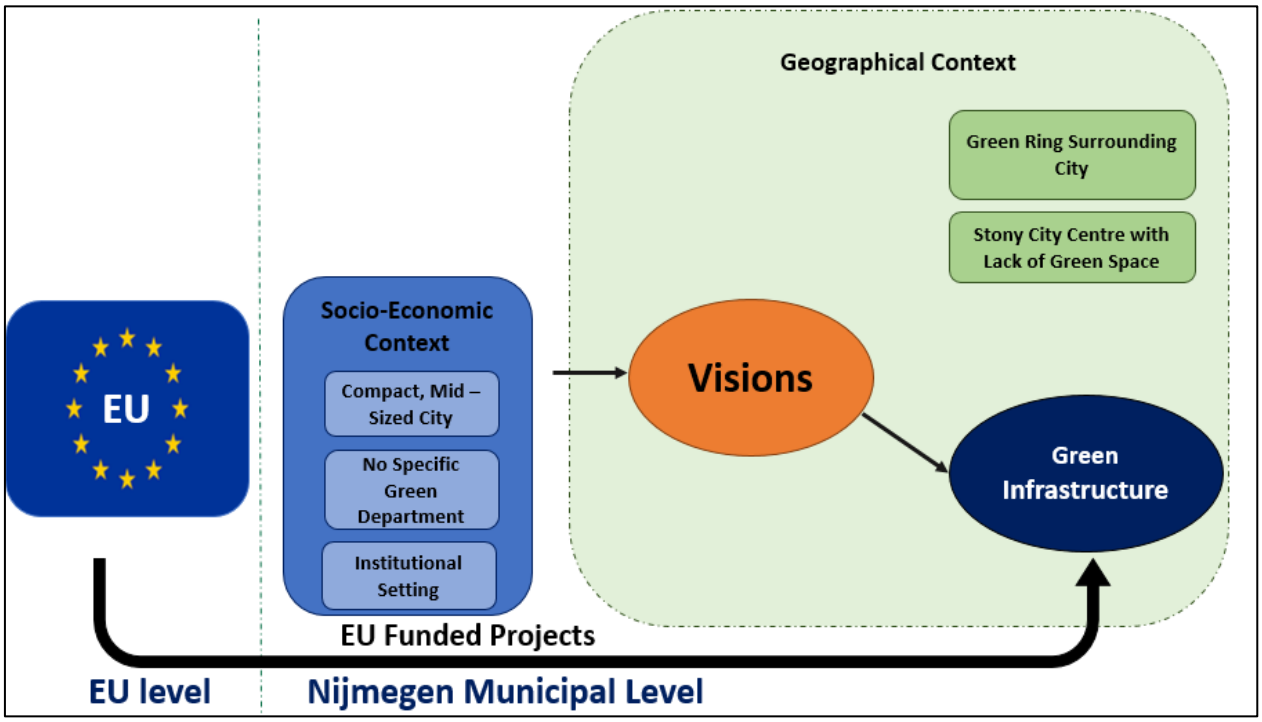

Figure 14: The conceptual framework in the case of Nijmegen.

6 Case Study: Essen, Germany

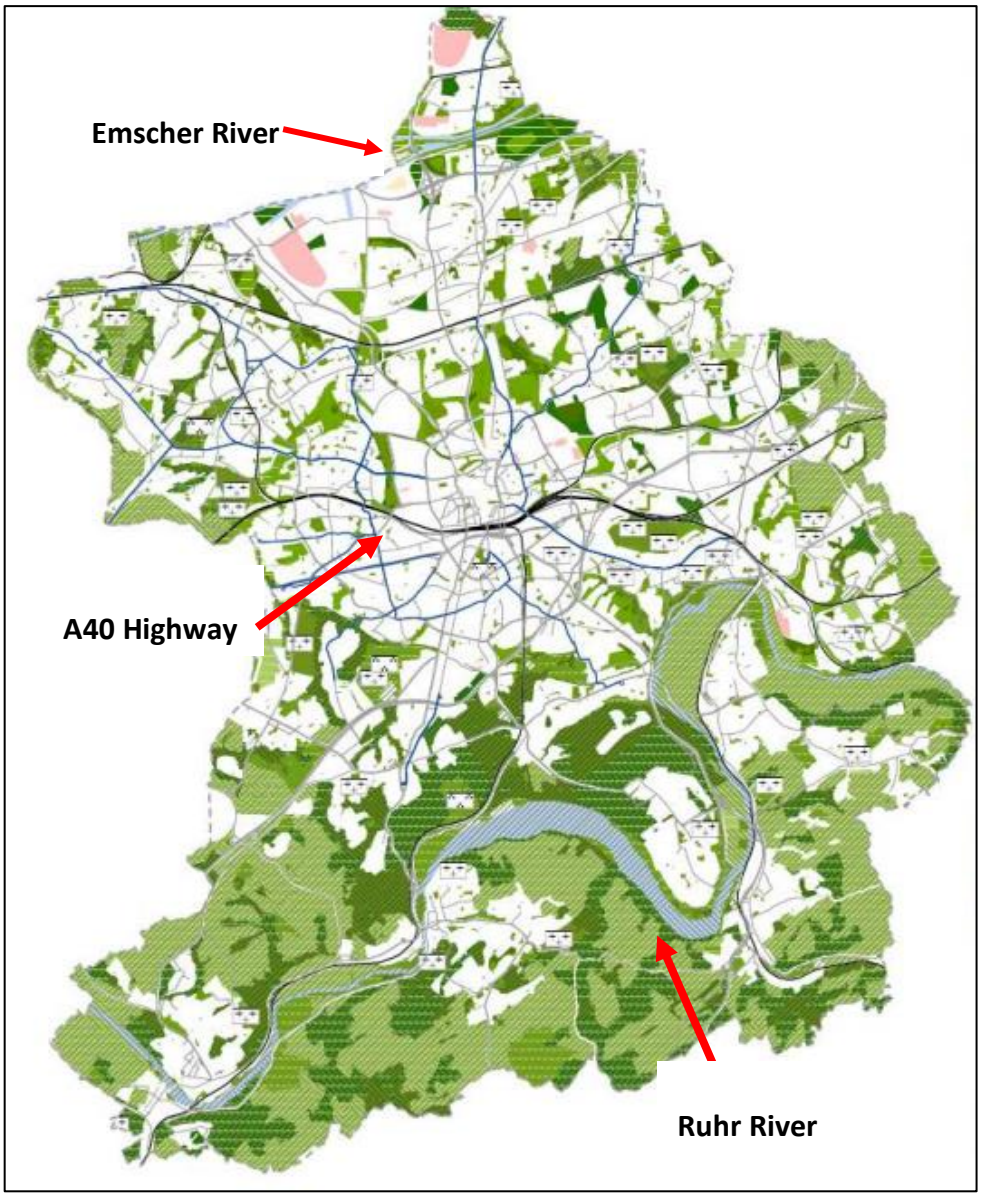

Figure 15: The projected green and blue structures in Essen. Taken from (City of Essen, 2015).

6.1 The Role of Visions in the Development of Green Infrastructure

Similarly, to the Netherlands, it has been suggested that, although the concept of green infrastructure 'by name' is not widely employed in Germany, the German planning system does use a series of 'landscape plans' which can be based on similar principles to the concept of green infrastructure (Pauleit, (2007), quoted in Mell, (2010)). This notion is supported by the assertion that although Essen has paid much attention to integrated and sustainable models for development based on green infrastructure for the past 25 years, principles of green infrastructure were being used before this time,

'it was not called green infrastructure but we were doing it' (EU representative of the RVR, personal communication, 12.07.2017).

At the national level, green infrastructure in urban areas in Germany became the focus of much attention in June 2015 when the 'Green in Cities - for a liveable future' national conference took place. One outcome of this was a 'green paper', outlining the importance and multitude of benefits to be gained from urban green infrastructure (European Comission, 2015).

Table 10 presents the visions, aims and projects guiding green infrastructure in Essen. It has been stated that green infrastructure in Essen is developed in line with the overall vision for sustainable development in the Ruhr area, which reads, ***'to see and use the structural change in economy and society as a unique potential and challenge for sustainable urban development'.*** This vision is operationalised into the joint aims of 'improving quality of life', and 'increasing attractivity', where attractivity connotes financial and economic attractivity. It is with these two, joined outcomes in mind that various green infrastructure projects are developed, as shall be explored in this section. Given this, Essen's vision satisfies the quality criteria of being plausible and tangible. Furthermore, this vision is shared by all cities in the Ruhr region, and transcends departments and institutions, demonstrating its shared and motivational value. Finally, the concepts of far - sightedness and utopian thought is addressed in this vision, through addressing the potential for sustainable urban development in the region.

Table 10: The visions, aims and projects guiding the development of green infrastructure in Essen.

Vision	Aims	Projects
'to see and use the structural change in economy and society as a unique potential and challenge for sustainable urban development'	Improving Quality of Life	Green Infrastructure Ruhr New Ways to the River Grüne 14 Emscher Landscape Park
	Increasing Attractivity	

Essen, as well as the greater Ruhr area as a whole, underwent vast economic and societal structural changes in the last half of the 20th century. This unique socio-economic context has had a visible effect on the formation of the cities vision guiding its sustainable development. As such, the vision of the Ruhr area as whole reads, '***to see and to use the structural change in economy and society as a unique potential and challenge for sustainable urban development (for Ruhr transformation)***' (Green Surge Stakeholder Dialogue Forum, 10.05.2017). This highlights how the Ruhr area is championing its past in such a way as to create a contextually appropriate guiding vision. The development history has had a marked effect on the distribution of green infrastructure in Essen, characterised by 'a poor, industrial north', and a 'wealthy and attractive green south' (EU representative of the RVR, personal communication, 12.07.2017). Thus, much current green infrastructure projects focus on developing the long-term liveability and attractivity of the north (EGCA Project Manager, personal communication, 10.08.2017). To contextualise this, a brief history of the development of the city of Essen, and the role of green infrastructure there in, is presented below.

6.2 The Development History of Green Infrastructure in Essen: From Green to Grey to Green

Essen is the ninth largest city in Germany and is located in the Ruhr area, in the state of North Rhine Westphalia. The Ruhr area is an urban network of 53 cities, 4 counties and over 5 million residents, and as such is the third largest conurbation in Europe (European Commission, 2017). Essen is bound by the Ruhr river to the south, and the Emscher river to the North (figure 15). The Ruhr District is one of Europe's oldest centres of underground coal mining and heavy industry, and as such these were Essen's major economic activities until 1986, when the last colliery was closed (European Commission, 2015). Given the industrial past of the city, Essen has faced numerous challenges caused by the resulting air, water and soil pollution.

The spatial and temporal distribution of coal mining activities in the city has had a marked effect on the socio economic, and environmental, patterns of development (EU representative of the RVR, personal communication, 12.07.2017). The coal bed in Essen is located on a gradient, whereby coal in the south of the city, by the Ruhr river, is found at the surface, and descends to a depth of 1200m in the north. Given this, the first locations of coal mining and industrialisation in the 18th and 19th centuries in Essen were in the south of the city, and following technological advancements it subsequently became possible to mine at greater depths. 'With the development of technologies in the sense of steam pumps and electricity, the miners were able to follow the coal getting deeper and deeper, so we have an economic development of Essen going from the Ruhr river over the hills to the Emscher river [from south to north]' (EU representative of the RVR, personal communication, 12.07.2017). As heavy industrial activities moved north, the south began to regenerate (EGCA Project Manager, personal communication, 10.08.2017). In the south of Essen mining activities ceased over 100 years ago, and as such a marked 'economic and societal structural change' happened at that time, 'the south is the rich area, the structural change here happened 100 years ago … it took 100 years to develop this area and to become a rich knowledge base …' (EU representative of the RVR, personal communication, 12.07.2017). In the North of Essen, when mining and steel activities ended in the second half of the 20th Century it resulted in an economic depression, coupled with high unemployment rates, the abandonment of numerous buildings, and areas which were highly polluted with the chemicals and acids used in steel production (EGCA Project Manager). Thus, the 'structural change' in the north 'has just happened' (EU representative of the Regionalverband Ruhr (RVR), 12.07.2017).

The different development trajectories in the north and south of Essen have resulted in markedly different socio – economic situations, '… the socio-economic realities are the result of long term development' (EU representative of the RVR, personal communication, 12.07.2017). It has been stated that there is effectively a 'north – south divide' in Essen, in which the A40 highway, which runs through the centre of the city (as indicated by the annotated red arrow in figure 15) acts 'as a kind of equator' (EU representative of the Regionalverband Ruhr (RVR), 12.07.2017). Furthermore, patterns of green infrastructure appear to have been influenced by this development trajectory. In the years following the Second World War, many new residential areas were constructed in the north of the city, despite this area already being more densely populated and having few green and recreational areas (City of Essen, 2015). Thus, the north of Essen is characterised as having high density building with fewer green resources, and the most polluted areas (City of Essen, 2015).

Following the terminology used today, green infrastructure has been apparent for the past 25 – 30 years as a planning concept in Essen (Green Surge Stakeholder Discussion Forum, 10.05.2017). However, it has been suggested that the principles of green infrastructure have been used in city planning by Essen for almost 100 years. In the 1920s, a city planner named Robert Schmidt was working as the deputy mayor for 'building and environment' in Essen, and he is credited as having implemented the green infrastructure concept in the city (EGCA Project Manager, personal communication, 10.08.2017). Schmidt sought to create 'green ways', in effect bringing nature from outside to inside the city. By doing so, it was hoped that these green corridors would aid in air purification and enable people to have access to recreational green spaces close to their homes. Furthermore, Schmidt recognised that open green spaces are essential if a city is to be liveable (EGCA Project Manager, personal communication, 10.08.2017). The developments undertaken during this period are cited as being fundamental in founding the green infrastructure of Essen today.

Another noteworthy strategy which 'set the scene' for the green infrastructure of Essen today was the 'Green 14' (Grüne 14) project which officially ran from 1975 – 1995 (EGCA Project Manager, personal communication, 10.08.2017). This was a collection of 14 initial projects which focused on increasing green space in the north of the city, with the goal of improving the quality of life for the residents there (City of Essen, 2017). The 'Green 14' project was deemed so successful that it was continued and upgraded. One important project which initially was launched as part of the 'Green 14' strategy is the 'new ways to the water' (Neue Wege zum Wasser) programme (figure 16). The waterways of the Emscher cover much of the city of Essen, and since the 19th century, the Emscher river had been used as an open sewer and as a depository for industrial waste (Green Surge Stakeholder Dialogue Forum, 10.05.2017). In 1990, 19 municipalities and other organisations formed the 'Emscher Cooperative' (Emschergenossenschaft), with the aim of decoupling the sewer and water systems and restoring the Emscher river system to 'near – natural water bodies' (City of Essen, 2015). At present, this project is still underway, with the aim of completion in 2020 (EGCA Project Manager, personal communication, 10.08.2017).

The 'new ways to the river' project aimed to effectively connect the Ruhr river in the south of the city with the Emscher river in the north (figure 16), through a series of green corridors, cycle paths and pedestrian ways (Neue Wege zum Wasser, 2017), and the project has been stated to play a central role

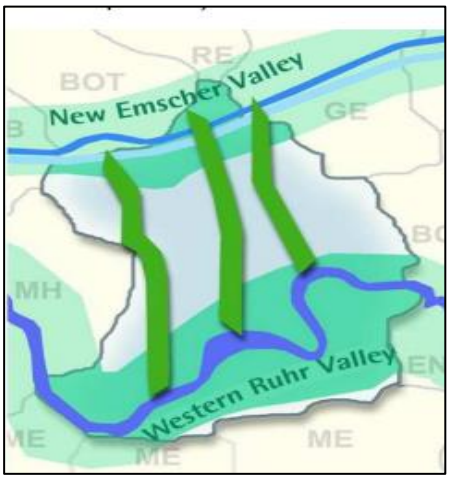

Figure 16: A visual representation of the increased habitat connectivity to be gained through the 'new ways to the river' project' (City of Essen, 2015).

in the development of a city – wide network of open spaces (City of Essen, 2015). One guiding principle of this project is to 'combine blue and green structures for better habitat connectivity', thus highlighting an acceptance of the relationship between green and blue infrastructure. Furthermore, the new ways to the river project, in combination with the regeneration of the Emscher water system has resulted in clean water flowing through the north of Essen, which is marked as a great achievement (EGCA Project Manager, personal communication, 10.08.2017). Finally, it is important to point out that Essen has good infrastructure, in terms of roads and public transport, on a west to east axis, however there is a lack of infrastructure connecting the north to the south. Therefore, it is hoped this project shall make it easier to travel between the north and the south, and that the north and south can be effectively connected using blue and green infrastructure (EGCA Project Manager, personal communication, 10.08.2017). This has also conferred various economic benefits through the possibilities for investment.

6.3 Institutional Organisation

It is important to note that the political organisation of Germany differs somewhat from that of the Netherlands. The 16 Länder (states) which constitute the federal republic of Germany are largely responsible for the planning and implementation of green infrastructure, and each Länder have their own specific 'policies and activities' (European Comission, 2015). However, the federal government is also able to implement overarching 'policy and planning programmes' (European Comission, 2015). Therefore, it follows that the Länder have a greater role in influencing the role of visions in developing green infrastructure than does the national government of Germany. An example of this influence will be the focus of the rest of this section.

Figure 17: The 5 operational levels. Inset image is the original German version taken from Grüne Infrastruktur Ruhr, 2016. The main image is a translated version of the original image, created by author. Translation conducted with Google translate and subsequently verified with a German native speaker.

Published in November 2016, Grüne Infrastruktur Ruhr (Green Infrastructure Ruhr) is a political agreement between all cities and mayors within the Ruhr area, and outlines a 'strategic approach to sustainable urban development and sustainable regional development' (Regionalverband Ruhr, 2016) (Figure 17).

Work started on this strategy in response to the 2013 publication of EU Green Infrastructure Strategy (see section 2.4.1) (European Commission, 2013). The concept delineated in the Green Infrastructure Ruhr (hereafter GIR) document is the guidance for the regional development of green infrastructure, from a 'highly developed starting level', based on the green and blue investments of the past 25 years, and a conceptual action plan for future developments (EU representative of the RVR, personal communication, 12.07.2017). In order to achieve this, an integrated platform for cooperation for the region was created, and is formed of 5 operational levels (figure 17). It is the goal to fully integrate these operational levels, 'you have to not think separately, not side by side, but you have to think about integrating … GIR means we try to develop these 5 levels as a whole … ' (EU representative of the RVR, personal communication, 12.07.2017). Thus, it can be suggested that GIR is a project, in line with the terminology used for this study, given that is 'carefully planned, designed to achieve a particular aim'; where the aim is to create an integrated, regional network of green infrastructure. The desired outcomes of this are clearly articulated, as explained above, and strategic pathways to achieve these outcomes are apparent. Furthermore, the GIR model contributes to the overall vision guiding the development of green infrastructure in Essen, and the greater Ruhr region.

The concept of 5 operational levels guiding green infrastructure developments in the Ruhr area, with the overall aim of providing a strategic approach to sustainable urban and regional development has received much attention and praise. 'With this concept of the 5 levels, we went to Brussels with our mayors, and the EU commissioner and the Directorate General of the Environment were very impressed that it was the mayors who put down these 5 levels … ***[sic.],*** the EU said you are not the environmental directors, you are they mayor and you understand this as a strategic approach to sustainable urban development …' (EU representative of the RVR, personal communication, 12.07.2017). This highlights the truly integrated approach to developing green infrastructure in the region, and the interactions between the city and EU level.

Following the public and media response since the publication of these 5 operational levels guiding green infrastructure development in the region, at the time of writing further studies are underway, exploring how elements in each city in the Ruhr area 'will fit into the GIR in the next 10 years' (EU representative of the RVR, personal communication, 12.07.2017). The outcomes of this will be published in a document titled 'operative dimensions of Green Infrastructure Ruhr', in November 2017.

However, it is important to note that the internal structure of the municipality of Essen is not organised in line with these 5 levels, so in effect there are separate teams each working towards one of these five levels of green infrastructure (Green Surge Stakeholder Dialogue Forum, 10.05.2017). As such, it has been recognised that there are '5 layers with 5 different groups of responsibilities … so these are different skills, different plans, requiring different data and different investments …' (EU representative of the RVR, personal communication, 12.07.2017). Furthermore, city planning is a separate department from environment and building, as such 'discussions are had in 2 separate

departments', which can result in discussions, and subsequent decisions, taking longer (EGCA Project Manager, personal communication, 10.08.2017).

6.3.1 Involvement in European Projects

There exist numerous city ranking & benchmarking initiatives in Europe, and each operate within the framework of their own methodologies and assessment criteria. Given this, it can be expected that a city that performs well in one ranking is not automatically predestined to do so in another (Meijering, Kern, & Tobi, 2014). A pertinent example of this can be seen when comparing the relative position of the city of Essen across different rankings. In their 2012 German Green City Index, the Economist Intelligence Unit ranked Essen as 12th out of 12 major German cities. Furthermore, the city was just one of two which were classed as 'average' in terms of overall green performance, with all other German cities included in the report (except Munich) performing at 'above average' (Economist Intelligence Unit, 2012). Despite this low ranking in 2012, Essen won the EGCA in the 2017 application cycle, which took place in 2014 (European Commission, 2017). This example highlights how the EGCA should not be seen an initiative which seeks to reward the most sustainable city in Europe each year, but how each city is reviewed based on its own merits and development trajectories based from their own characteristic starting points (EGCA expert panel member, personal communication, 26.06.2017).

When Essen first applied for the EGCA in 2012 it did so with the hope of representing the Ruhr area as a whole, as had been the case when Essen won the 2012 European Capital of Culture Award (under the slogan of 'Essen for the Ruhr'). However, 'the EU commissioner and the Directorate General for the Environment said it would not be possible, the standards only allowed big cities and they would not accept a region' (EU representative of the RVR, personal communication, 12.07.2017). Following this decision, Essen decided to apply alone for the EGCA. Despite this, it is noted that numerous projects told in Essen's story as the 2017 Green Capital occur at the regional scale, including the Emscher Landscape Park, the redevelopment of the Emscher river system, and the development of a regional high-speed cycle highway, among others (EGCA Project Manager, personal communication, 10.08.2017). Furthermore, it was noted by one respondent that Essen's application for the EGCA, through the 12 indicators, was developed in direct response to EU, 'The city followed all the 12 indicators … if you think about EU papers for green infrastructure and EU standards, they match what we make in Essen' (EU representative of the RVR, personal communication, 12.07.2017). This represents a direct role of the EU on the making of Essen's green infrastructure strategies. Therefore, it follows that this direct influence could be extended to the visions behind these EU 'papers and standards'. This shall be elaborated in section 7.

The fact that Essen has been awarded both the European Capital of Culture Award, and the EGCA, demonstrates a desire on the part of the city to participate in these European benchmarking schemes. This could perhaps indicate that the city is aware of the visions behind these EU projects, and indeed reflects these in its own visions.

Finally, at the regional level, the state of North Rhine Westphalia has earmarked 83 million euros to be used for green infrastructure investments over the period of 2014 – 2020 (The Biodiversity Information System for Europe (BISE), 2017). These funds come from the federal state and municipalities in the region, however a sizable portion of these funds were made available from the ERDF. As such, projects

which hope to use this fund must be integrated action plans for green infrastructure (Green Surge Stakeholder Dialogue Forum, 10.05.2017). The implications of this shall be explored in section 7.

6.3.2 Multi – Level Interactions

Essen developed its GIR concept in response to the 2013 publication of the EU Green Infrastructure Strategy. This demonstrates an awareness of EU trends and developments regarding green infrastructure, 'if you think about EU papers and EU standards for green infrastructure, they match with what we are making in Essen' (EU representative of the RVR, personal communication, 12.07.2017). Furthermore, it is evident that Essen shares the EUs focus on the potential economic benefits which stand to be gained through the development of green infrastructure, and it was suggest by one respondent that 'this thinking about natural capital … was really an impulse from the EU' (EU representative of the RVR, personal communication, 12.07.2017).

The EU has invited the member states to 'make national concepts and measuring strategies for green infrastructure, and Germany did so' (EU representative of the RVR, personal communication, 12.07.2017). The outcome of this was the production of two 'white books' in early 2017 by the federal ministry of environment and housing; the 'Weißbuch Stadtgrün' (white book for green in the city), and the 'Bundeskonzept Grune Infrastruktur' (national concept for green infrastructure) (Green Surge Stakeholder Dialogue Forum, 10.05.2017). It is important to point out that the second white book, the national concept for green infrastructure specifically concerns nature protection outside of the city. The white book for green in the city details the current situation regarding urban green infrastructure at the national level, and also future plans for green infrastructure development, organised by the main fields of activity. Furthermore, the white book details 'for each field of activity, what is it, what's generally to be done, what should everyone do, and what will be done on a federal level' (EU representative of the RVR, personal communication, 12.07.2017). The current government has voted on and accepted the actions delineated in this white book, and as such the federal government has a platform to work from. It could be hypothesised that the vision delineated in these publications would ultimately influence the vision in Essen. However, as shall be discussed in the next paragraph, Essen views its development of green infrastructure as being somewhat 'ahead' of the national level.

One respondent highlighted the interactions between the newly published white book at the federal level and actions taken at the city and regional level, specifically with regards to the 5-level model, 'with these 5 layers we are crossing these national documents, we are doing more than they are asking for' (EU representative of the RVR, personal communication, 12.07.2017). Furthermore, it has been suggested that the level of integration depicted in the 5-level model is innovative when compared to the national strategy, 'If I talk about green infrastructure they [the national state] think about level 1, but green infrastructure Ruhr has 5 levels … If I talk about climate they [the national state] ask what that has to do with green infrastructure? But it's in our 5 levels' (EU representative of the RVR, personal communication, 12.07.2017). Thus, this highlights how the regional level have developed a truly integrated concept of green infrastructure, ahead of the national level. 'I think that we are ahead of the standard discussion … we follow the national details, and they follow what we are doing here' (EU representative of the RVR, personal communication, 12.07.2017).

6.4 Improving Quality of Life and Increasing Attractivity

It has been stated that green infrastructure in Essen is developed with the joint goals of 'increasing living quality' and attaining 'higher attractivity' (EU representative of the RVR, personal communication, 12.07.2017). In this case, living quality is said to refer to people's daily lives, and how the surroundings of their neighbourhoods and the city affect their quality of life. Furthermore, living conditions encompasses 'natural living conditions, including water, air, soil quality … the ecosystem as a whole'. This emphasises an understanding of how green systems are inextricably linked with water, air and soil. Attractivity in this case refers to 'attractivity in the sense of economy … economic figures, the value of a neighbourhood, the value for several economic purposes like houses, shopping, etc…' (EU representative of the RVR, personal communication, 12.07.2017). Furthermore, both of these goals are intertwined, and the development of green infrastructure is seen as a way to attain this, 'Its directly linked to social and economic purposes … These two things are balance d and both are very relevant and green infrastructure is serving this' (EU representative of the RVR, personal communication, 12.07.2017). Thus, it could be inferred that the social and economic development is a key driver for the development of green infrastructure. It is interesting to point out that the possible environmental benefits are not mentioned here, and indeed a reading of social and economic benefits implies that green infrastructure development is viewed through an anthropocentric lens in Essen.

The 5-level model for GIR was developed in direct response to the 2013 EU Green Infrastructure Strategy. It has been suggested that the goal of 'enhancing natural capital' depicted in this document 'really does mean capital … it looks at the economic services that green gives instead of grey' (EU representative of the RVR, personal communication, 12.07.2017). The economic focus of this paper makes a pertinent point, 'the EU started from the point that the asked what is the value of biotope connectivity is for society and the economy … because society works in that way. If it costs, you can bounce it, if you don't have costs you are not even counted, not even seen' (EU representative of the RVR, personal communication, 12.07.2017). As such, viewing the benefits of green infrastructure from an economic perspective allows for their value to be conveyed to a wider public, and an understanding of the economic benefits that stand to be gained from green infrastructure can generate greater interest in the concept. One of the goals of Essen's green infrastructure development is to improve attractivity for financial investment. One respondent stated that the EU focus on the economic benefits to be gained from green infrastructure was influential in Essen developing a similar economic focus, 'really the EU paper and this thinking about natural capital, and enhancing our natural capital was really an impulse from the EU' (EU representative of the RVR, personal communication, 12.07.2017). Therefore, it can be stated that the economic focus of Essen's green infrastructure vision was directly influenced the EU. Additionally, this economic aspect plays a role in green infrastructure policy, in the context of the operationalised aim of 'increasing attractivity'. Below, two examples which concisely and effectively demonstrate this economic – centric approach to the development of green infrastructure are presented.

An example of how the development of green infrastructure was used to bring about financial investment in Essen is seen in the case of a planned housing development, the Niederfeldsee. Historically, the proposed site was an old freight railway, and following the demise of mining and steel production the site had been empty for over 30 years (EGCA Project Manager, personal communication, 10.08.2017). Initial plans for the site were to create high quality housing, however no investors were interested, given the association with the past use of the site. The department of

environment and building then constructed a 3.4-hectare green area on the site, surrounding a 2.2-hectare lake, using funds from the Urban Development Programme of North Rhine Westphalia, which in turn receives grants from the EU Regional Development Fund (City of Essen, 2017). Furthermore, the development was connected to the regional cycle highway. These initial developments sparked renewed interest from investors and all the slots designated for housing development were subsequently quickly sold (EGCA Project Manager, personal communication, 10.08.2017). This example provides a good demonstration of how the city of Essen harnessed the power of green infrastructure to generate high level investment. Furthermore, investors reportedly noted numerous economic benefits from having green infrastructure in a development (EGCA Project Manager, personal communication, 10.08.2017).

Another pertinent example of how green infrastructure was used to increase living quality and attain higher attractivity is the return of the headquarters of the international steel company Thyssen Krupp Essen. In 2000, the company decided to move its international headquarters back to Essen, 30 years after they had left the city (Thyssen Krupp, 2017). In doing so, Thyssen Krupp developed a 2000 ha area of abandoned land, which the company had previously used as a steel factory, effectively renovating a brownfield site (Thyssen Krupp, 2017). It was stated by one respondent that this move directly resulted from Essen's goal of using green infrastructure to increase living quality and improve 'attractiveness', '… it is very clear that the decision of management was because they believed that, after an economic decline and a depression, [Essen] is going to be attractive again and is getting better living conditions ...' (EU representative of the RVR, personal communication, 12.07.2017).

It is also important to draw attention to the strategies used to renovate the site of the Thyssen Krupp headquarters, as they provide an exemplary case of brownfield site renovation. The soils around the abandoned Thyssen Krupp steel factory, and subsequent international headquarters, are heavily polluted given the decades of industry. Despite this, upon regeneration of the site, '… they built a pond which is completely sealed so the water is not seeping through polluted soils, it is drained off on the surface to another area where there is no risk of leeching of heavy materials through the ground water' (EGCA expert panel member, personal communication, 26.06.2017). As previously mentioned, EGCA cities are judged based on their characteristic starting points, and in the case of Essen, this was as a city with a history of heavy industry. [Essen] were very conscious about their brownfields … I think the fact that they were handling concrete, polluted soils and brownfields is one of the reasons they were chosen as a green capital' (EGCA expert panel member, personal communication, 26.06.2017). As such, it has also been suggested that the vision driving Essen's green infrastructure development would focus on changing the perception of the city as being 'dirty', 'Essen had a vision … they wanted to get rid of the dirty, polluted image …' (EGCA expert panel member, personal communication, 26.06.2017).

6.5 The Emscher Landscape Park

Between 1989 and 1999 the Ruhr area hosted the International Building Exhibition Emscher Park (hereafter IBA), an initiative by the Ministry of Urban Development, Housing and Transport in the state of North – Rhine Westphalia (IBA, 2017). This project aimed to 'develop and implement concepts for the ecological, economic and social renewal of the Ruhr area', and to encourage 'urban revitalisation' (City of Duisburg, 2017). The IBA was designed to be an impetus for restructuring the Emscher region, given the decades of social, environmental and economic decline in the region (Shaw, 2002). Furthermore, the IBA addressed the social, environmental and economic attributes of sustainability in

the Emscher region, and was praised for the integration of these three aspects (Shaw, 2002). During the IBA, over 100 projects were realised, and investment totalled 2.5 billion Euros (Green Surge Stakeholder Dialogue Forum, 10.05.2017). It has been stated that one of the primary goals of the IBA was to give the Ruhr area a greener image (Danish Architecture Centre, 2014). From this, one important outcome of this project was the attention placed on the lack of open green space in the region. Subsequently, the Emscher Landscape Park was developed (figure 18).

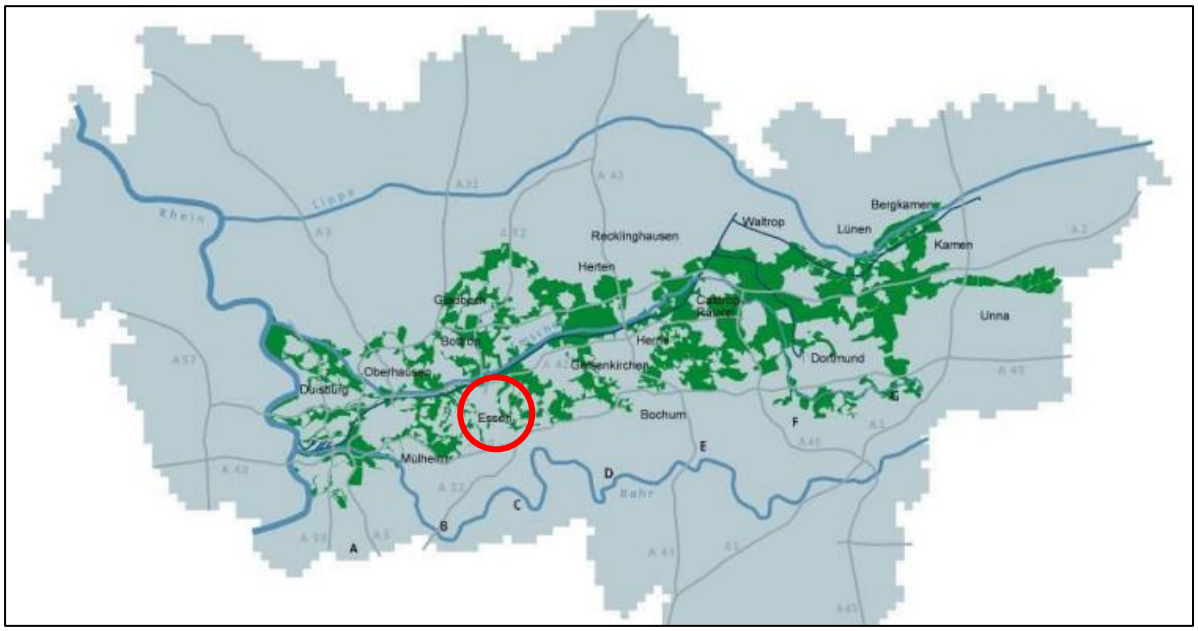

Figure 18: The Emscher Landscape Park, marked in green. The city of Essen is circled in red. (Regionalverband Ruhr, 2016)

Currently, the Emscher Landscape Park covers an area of 457 km² and 20 cities, and is comprised of more than 400 projects (Metropole Ruhr, 2013), 'covering regenerated brownfields, reclaimed forests, and existing recreational areas that together provide a cohesive set of green infrastructures for the entire region' (Danish Architecture Centre, 2014). In addition to allowing old industrial spaces to have a contemporary cultural use, the regeneration of various brownfield sites is allowing for the region to develop a new narrative connecting nature and the regions industrial past. Furthermore, the development of the Emscher Landscape Park acts as a green corridor and connects towns and cities in the area through a series of networks. Furthermore, the Emscher Landscape Park is in the north of Essen. Given this, there is a strong desire to connect the neighbourhoods in the north of the city, which historically were densely built and lacking substantially in green, to the network established by the Emscher Landscape Park. This is done in the context of the aims of increasing quality of life and improving attractivity, as described in the previous section.

While there are many aspects of the development of the Emscher Landscape Park which are worthy of in depth discussion given their demonstrable transformation from industrial sites to areas with recreational, cultural and economic value, one such example which is located within the city of Essen shall be elaborated upon here. The Zollverein coal mining complex in the north of the city is cited as being 'one of the most beautiful collieries in the world' (Metropole Ruhr, 2013). Following the closure

of the colliery in 1986 and the coking plant in 1993, it was unsure what would happen to the site. However, the state of North Rhine Westphalia declared the colliery as a heritage site after its closure, and similarly the coking plant was also listed as a heritage site in 2000 (UNESCO, 2017) .

In December 2001, the Zollverein industrial complex was declared a UNESCO world heritage site, showcasing the 'complete infrastructure of a historical coal mining site', and as such 'remarkable material evidence of the evolution and decline of an essential industry over the past 150 years' (UNESCO, 2017). Since 2010, the Ruhr museum is housed in the former coal washing plant, and as such is a monument to the natural and cultural history of the Ruhr area (Ruhr Museum, 2017).

The abandonment of numerous coal and steel plants resulted in large areas in the region being left as wasteland (Metropole Ruhr, 2013). In numerous locations, nature has been left to 'reconquer' the former industrial sites. The Emscher Landscape Park has therefore created the 'industrial nature trail', which showcases the ecological communities which have established in the region. It is estimated that there are currently 1500 plant species in the Emscher Landscape Park accommodates, 50 of which are on the IUCN Red List (City of Essen, 2015). It is important to note that in some cases, the conversion of former waste land to nature parks was a strategic choice. Indeed, the surrounding land in the Zolleverein complex has been turned into a park, comprising of 'contrasting laid out green areas and jungle – like industrial woodland' (Metropole Ruhr, 2013). This has had a marked positive effect on biodiversity in the area, and a recent survey counted 550 species in the Zollverein park (EGCA Project Manager, personal communication, 10.08.2017).

The funding for the Emscher Landscape Park came from three main sources, roughly 30% came from the state of North Rhine Westphalia, 20% from the municipalities involved in the project, and the remaining 50% came from the EU. The EU money came primarily from the European Regional Development Fund, and from different projects within this fund. 'We follow a lot of EU funding instruments, and whenever it fit to our structural change we applied … the whole amount of EU money into the Ruhr structural change was 4 billion Euros since the 1990s, we were quite successful in attracting EU money for structural change' (EU representative of the RVR, personal communication, 12.07.2017).

6.6 Conclusions

To conclude, the overarching vision for green infrastructure development in the Ruhr area derives from the vision guiding the areas sustainable development, ***'to see and use the structural change in economy and society as a unique potential and challenge for sustainable urban development'.*** it is clear that the development history of Essen has directly influenced the spatial distribution of green infrastructure in the city, and has in effect created a city of two halves; a poor, industrial north and a wealthy and attractive green south. Thus, projects developing green infrastructure in Essen are geared towards closing this apparent gap. Given the history of economic, social and environmental decline following the end of heavy industry and mining activities in the city and in the Ruhr area, it has been suggested that green infrastructure development in Essen is guided by the joint aims of improving liveability and generating attractivity. In this instance, developing green infrastructure is seen as an important way for attracting financial investment. This focus on the economic benefits of green infrastructure is said to have been influenced somewhat by the 2013 publication of the EUs Green Infrastructure Strategy, and the economic centric approach therein.

Given the disparities in green infrastructure between the north and south of the city, and that the spatial distribution of green infrastructure in Essen is linked to socio-economic trends in the city, different strategies are employed in different city neighbourhoods (EGCA Project Manager, personal communication, 10.08.2017). Furthermore, it has been suggested that there is a much greater need for green infrastructure developments to take place in the north of the city, 'qualifying the north on the sense of green infrastructure is the necessary thing … we concentrate on things that need to be done in the poor north, and green infrastructure is directly combined with the need to do something in the poorer neighbourhoods' (EU representative of the RVR, personal communication, 12.07.2017). This highlights an understanding of the role that green infrastructure can play in improving social cohesion, and improving the liveability of a city. Furthermore, this social, and environmental divide has already been the focus of various projects which aimed to create connections between the north and south and to increase the amount of green in the north, including the Grüne 14, and new ways to the river. In these examples, greening the north and creating social and ecological connections throughout the city was undertaken in the context of the joint aims of improving quality of life and increasing attractivity, in line with the overall vision to use the structural change in Essen as an impetus for sustainable urban development (table 7).

Similar to Nijmegen, one of the recognised barriers to the implementation of green infrastructure in Essen is the financial cost, as an institutional barrier. Furthermore, it has been noted that green infrastructure investments are not a one-time occurrence; keeping green infrastructure 'alive' has been cited a significant challenge which requires constant maintenance and investment (Green Surge Stakeholder Dialogue Forum, 10.05.2017). 'You cannot by a bus and then it runs forever, it's the same with green, and water, and cycle and footpaths …' (EU representative of the RVR, personal communication, 12.07.2017). This results in a need for constant financial resources in order to sustain green infrastructure (Green Surge Stakeholder Dialogue Forum, 10.05.2017). Referring back to the quality criteria for sustainability visions presented in section 2.1, there is a need for visions to address the long-term viability of the desired projects; in this case, the long-term maintenance costs.

Green infrastructure in Essen is still viewed as 'an innovation, and not the standard practice', it follows that this can be a source of challenge. Indeed, it has been stated by one respondent that Essen, and the greater Ruhr area, are 'very good in flagships … its accepted, demanded, financed to make new things, and at the same time, we have a great gap to standard situations' (EU representative of the RVR, personal communication, 12.07.2017). The consequences of this mean that innovative projects do not always relate to citizens realities, 'if you declare yourself as the Green Capital because of flagships, and people in neighbourhoods have a park in a bad condition they say, is this a lie?' As such, it can be said that there is a misalignment of goals for innovative future green infrastructure developments and the realities for caring for the current green infrastructure. Linked to this idea of citizens perceptions of green infrastructure is the issue that many residents still hold the view that the Ruhr area is dirty and polluted. However, it was suggested by one respondent that winning the EGCA will 'act as an anchor for creating a new identity', and as such it is stated that the population of Essen are becoming more aware of the role of green infrastructure in this changing narrative. Following the definitions of quality criteria for visions presented by Wiek & Iwaniec (table 1), it could be suggested that this changed mentality, from viewing the Ruhr area as dirty and polluted, to an understanding of why it won the EGCA and a knowledge of the role of green infrastructure pertains to a vision being shared, given the municipal and regional support and public acceptance and engagement demonstrated, and motivational, given that the cities in the Ruhr area are part of a network inspiring

transfer of knowledge and best practices. It could perhaps be suggested that Essen is on the path to fulfilling these criteria, however the situation described above highlights the fact that this transition is perhaps still underway.

Finally, in the interest of sustainable development, the need for an approach which integrates blue, green and housing is recognised (EGCA Project Manager, personal communication, 10.08.2017). However, this can cause challenges when attempting to integrate green and blue infrastructure into existing areas. One of the reasons for this could be that it is easier to apply Essen's overarching vision for development on areas which are still under development, and as such where it is easier to influence a change in planning practices, resulting in adherence to Essen's vision. On the other hand, existing neighbourhoods pose a particular challenge, given that they were perhaps designed and constructed during a time with a different vision. It is necessary therefore for the city to develop projects with specific aims and targets, tailored to the characteristics of the neighbourhood, yet still in line with the overarching guiding vision.

Figure 19 is a visual representation of the conceptual framework, applied to Essen. Here, the EU has an influential role on the resulting green infrastructure. The mechanism of this influence is through the realisation of EU funded projects. Additionally, the 2013 EU Green Infrastructure Strategy has been paramount in the development of visions guiding green infrastructure developments in Essen. First, this publication has had a direct influence on the visions guiding the development of green infrastructure in Essen. This is evident through the desired economic benefits which stand to be gained through green infrastructure, and the EU's vision is reflected in Essen's vision here. Second, there is also an arrow from the EU to the socio – economic context of the city. This arrow points directly to the Green Infrastructure Ruhr model, given that this model was created in direct response to the 2013 EU Green Infrastructure Strategy. Finally, there is an arrow pointing directly from the industrial history, as an indicator of the socio – economic context, to the green infrastructure. This arrow represents the spatial disparities in green resources between the north and south of the city, as a legacy of the city's industrial history.

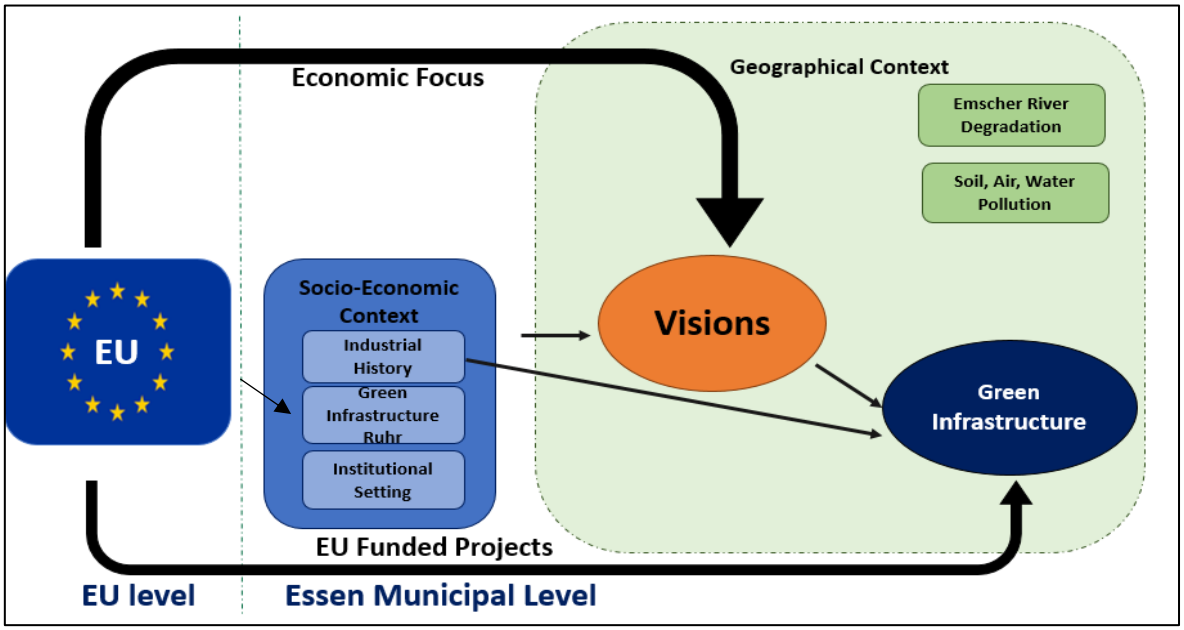

Figure 19: The conceptual framework in the case of Essen.

7 Conclusions and Reflections

There is a pressing need for European cities to incorporate green infrastructure into their urban matrices. This project aimed to contribute to the knowledge about how different cities vision, and subsequently develop green infrastructure. To achieve this, this project investigated the role of guiding visions in the development of green infrastructure in two EGCA cities, given that EGCA winners are seen as examples of best practices, and as such provide a platform for other cities to learn from example. Furthermore, this project sought to understand how geographic and socio – economic contextual factors shape visions guiding the development of green infrastructure, and addressed the role of the EU, be it direct or indirect, herein.

While sections 5 and 6 addressed the empirical findings for each case study in turn, in the following section conclusions shall be drawn through discussion of both case studies together, in response to the three sub-questions which guided this project. This analysis shall best be achieved through an exploration of the conceptual frameworks of each city, first presented in sections 5.8 and 6.6. To this end, the conceptual frameworks shall be compared, with reference to the role of visions on green infrastructure development, the importance of contextual factors in developing visions, and the role of the EU in the development of visions in each city. Figure 20 shall be referred to throughout this section.

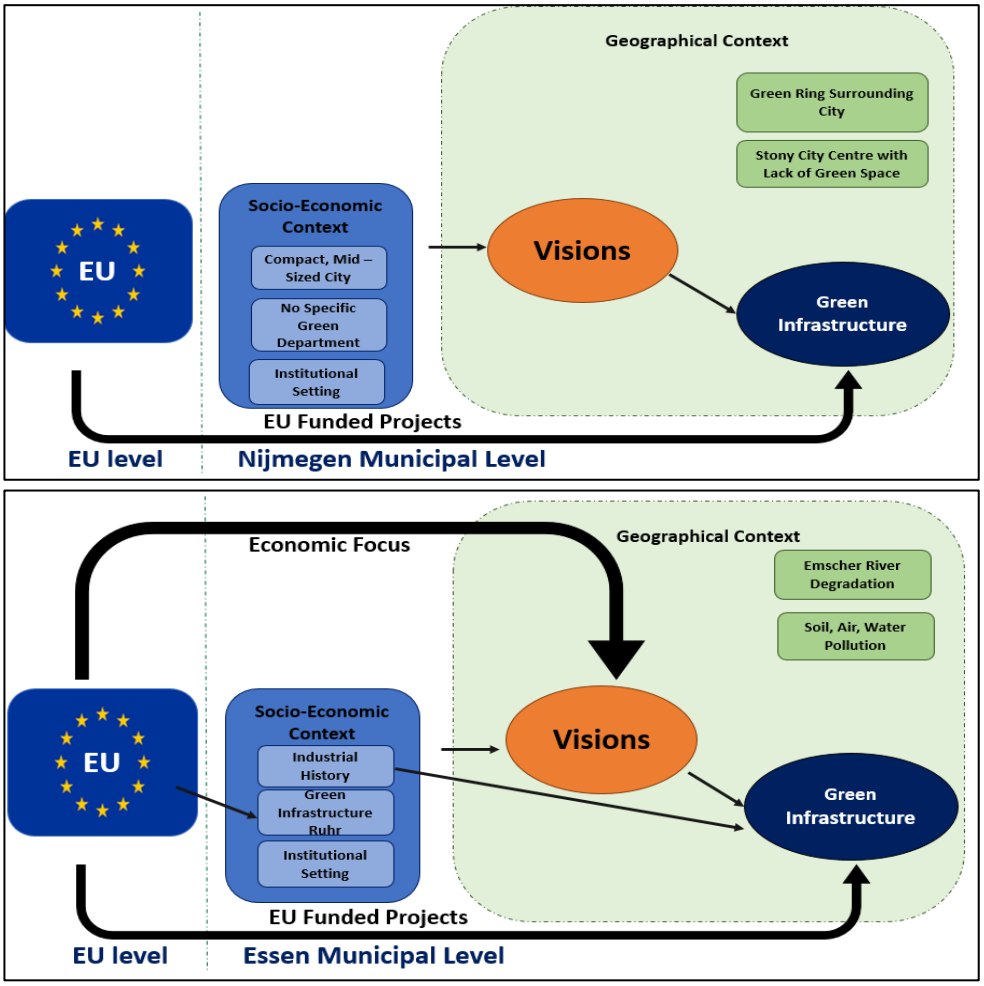

Figure 20: The conceptual frameworks for Nijmegen and Essen.

7.1 The Role of Visions for Green Infrastructure Development

Figure 20 shows that in both cities, there is a direct link between the visions and the resulting green infrastructure, represented by the black arrows. However, it is evident that Nijmegen and Essen have developed different guiding visions. While Nijmegen's green infrastructure is guided by various visions, each with their own desired set of outcomes and achieved through various projects, in the case of Essen, and indeed the Ruhr area as a whole, green infrastructure is developed in line with one integrated and holistic vision, operationalised into two, joint aims (table 11). The effects of this are twofold. In the case of Nijmegen, having multiple visions, operationalised into different aims has resulted in the creation of green infrastructure projects driven by vastly different desired outcomes. For example, the 'we are green, healthy and in movement' project aims for public health promotion through access to green space, whereas ECOPOLIS seeks ecologically sustainable urban development in the Waalsprong. While it is true that these goals are not conflicting, they do appear to be somewhat disconnected. Furthermore, one respondent from Nijmegen stated that 'the biggest challenge we face is that we need to develop a long-term vision'. This perhaps indicates that Nijmegen is aware of the apparent benefits of having a unifying, holistic vision guiding all green infrastructure projects. Further, this could be interpreted to mean that Nijmegen's visions are bound in the short-term perspective.

On the other hand, Essen does have one overarching vision. This results in all green infrastructure projects being designed and developed in such a way as to contribute to this vision, and its joint aims. It could be suggested that having one vision, operationalised into two interrelated aims results in better coordination of action; all green infrastructure projects are designed to achieve the same desired outcomes, and as such there is little potential for conflicts to arise. Furthermore, it could be suggested that through having one vision, projects are better coordinated, and perhaps reinforce each other. This is evident in the examples of the Grüne 14 project and the 'new ways to the river' project. Here, the foundations laid by the Grüne 14 project provided a foundation for the 'new ways to the river' project, and the latter championed and extended benefits achieved in the former. This illustrates how having one vision can lead to the greater accumulation of benefits, through more targeted action.

Table 11: Selected projects, visions and aims in each Nijmegen and Essen.

	Nijmegen				Essen
Vision	A sustainable city prepared for the future	A liveable, healthy city		Social cohesiveness & health	***'To see and use the structural change in economy and society as a unique potential and challenge for sustainable urban development'***
Aim	Ecologically sustainable urban development	Health promotion through the development of green infrastructure		All residents have access to green within 300m of home Connecting green areas Increase quality of life	Increase quality of life Increase attractivity (financial & economic)
Projects	ECOPOLIS	New Green Policy Plan	'Green, healthy & in movement'	Access to green space	Green Infrastructure Ruhr Emscher Landscape Park New Ways to the River Grüne 14

7.2 The Importance of Contextual Factors in Shaping Visions

As EGCA winners, Nijmegen and Essen act as role models to other cities. However, it has become clear that these cities approach the concept of green infrastructure in different ways, each creating a vision which is bound, and influenced, by the unique contextual factors at play. Thus, this project has provided two examples of how frontrunner European cities champion green infrastructure to achieve a pre – determined set of desired outcomes, in line with their characteristic starting points. Nijmegen is the first medium sized EGCA city, and it is hoped will act as a role model for other medium sized cities. Essen is the first EGCA city to have 'an industrial past' (European Commission, 2017), and as such it is hoped will provide an example for other European cities which are undergoing structural changes.

Understanding why these cities took different approaches to the development of visions, and the possible influence behind this, in terms of the role of contextual factors and EU influence is paramount to answering this research question. One possible explanation could be that Essen has used green infrastructure as a planning concept for longer than Nijmegen has (table 12). The history of the use of green infrastructure falls under the umbrella of the city's history, and as such is a contextual factor. Given its longer use of the concept, it follows that Essen has had longer to develop a contextually appropriate, holistic vision. Additionally, the GIR project was a collaboration between Essen and all other Ruhr cities. Thus, coordinating actions on this scale necessitated a clear, overarching vision, operationalised into actionable and applicable aims. On the other hand, Nijmegen developed multiple

visions, each in response to, and addressing, certain 'issues', for which green infrastructure could provide a solution. This is visible through the desired aims of these visions (table 11). For example, the vision of developing a 'sustainable city, prepared for the future', is in direct response to the threat of climate change, and the need for the city to become climate resilient in the future. The fact that this vision was embodied through the project ECOPOLIS in the Waalsprong development, which is on the northern bank of the Waal and at risk of flooding due to its low elevation, demonstrates how this geographic contextual factor was paramount in driving the need for a vision addressing climate resilience in this area.

Table 12 collates the information presented in section 4 pertaining to the contextual factors in Essen and Nijmegen. The unique combination of these contextual factors in the two cities provides, to some extent, a basis for the development of visions guiding the development of green infrastructure.

Table 12: The application of the contextual factors to Nijmegen and Essen.

		Nijmegen	**Essen**
Geographical Factors			
Natural Ecosystem & Landscape characteristics		- Developed on the southern bank of the Waal river - Surrounded by 'green ring' - Low – lying, use of natural water storage ponds	- Bound by the Emscher river to the north - Bound by the Ruhr river to the south
Local Climate [17]		Cfb Climate	Cfb Climate
Socio – Economic Factors			
City Size [18]	**Population**	170,774	582,624
	Area (km²)	57	210
	Population Density	3000 inhab/km²	2770 inhab/km²
Development History		- Underwent massive expansion after WW2 until the 1980s - Lack of green space in the city centre - Neighbourhoods on west side of Maas – Waal channel are characteristically greener - The Waalsprong development marks the first time the city boundaries expanded north of the Waal	- Mining and steel production, more concentrated in the north, have had a marked effect on the city's development and distribution of green infrastructure - Mining activities stopped in the south 100 years before the north, as such the south went through structural change 100 years before the north

[17] See table 2
[18] See table 2

		- Currently characterised by a poor, industrial north and a wealthy, green south - The A40 highway acts as a socio-economic equator
Institutional Organisation	- No longer a specific department for green - Expertise is spread among departments - Green infrastructure has been used a planning concept for the past 5 – 10 years	- Many projects are done on a regional scale, the Ruhr area - Green Infrastructure Ruhr, a 5-level concept for developing green infrastructure in collaboration with the Ruhr area - Green infrastructure has been used as a planning concept for the past 25 years

In both Nijmegen and Essen, the development history of the city, as a contextual factor, has shaped the distribution of green infrastructure in the city (figure 20). In Nijmegen, the concentration of factories in the west of the city resulted in this area being characterised by high density building and less open green space. Similarly, the development history of Essen resulted a disparity in the prevalence of green infrastructure between the densely populated, polluted north, and the wealthy, green south. To illustrate this, figure 20 shows a direct arrow leading from the 'industrial history', as a socio – economic factor, to the green infrastructure in Essen. This arrow represents the spatial disparities in green infrastructure distribution in Essen, as a direct result of the city's development history, as a socio – economic contextual factor. This arrow 'bypasses' the visions, in that the historic distribution of green infrastructure occurred regardless of visions, and instead as a direct result of patterns of city development. It was decided not to draw a similar arrow in Nijmegen's contextual framework. Although there was a similar effect of industrial development at the expense of green in one neighbourhood of the city, the area affected in Nijmegen is much smaller, given the smaller scale of industrial activity here. In Essen, and indeed the Ruhr area as a whole, the industrial past of the city had a profound effect on the social, economic, and environmental fabric of the city. However, in Nijmegen the same cannot be said. Therefore, by having this arrow exclusively in Essen's framework, this highlights the scale, and lasting influence, of this industrial history.

In both cities, there is evidence of green infrastructure projects addressing the disparities in green infrastructure distribution caused by the cities development history. Nijmegen places a particular emphasis on developing green infrastructure in areas which are currently 'underserved', and on connecting green areas with the intention of creating a city – wide network. Likewise, projects, such as the Grüne 14, focus explicitly on qualifying the north in terms of green, and connecting this historically under – greened area to the rest of the city.

However, despite these similarities, the visions behind these aims and projects differ. As has been discussed, Nijmegen appears to have developed its numerous visions in direct response to challenges, whereby green infrastructure could act as a potential panacea. On the other hand, the Ruhr area developed its vision in direct response to the challenges created by its industrial history. In this case, the socio – economic context of the city, characterised by the economic, social and environmental degradation caused by the cessation of heavy industry had a direct influence on the development of the areas vision. Perhaps it could be stated that the contextual factors in Essen have played a more

prominent role in the development of the guiding vision than is the case in Nijmegen. Indeed, the Ruhr areas vision directly addresses the unique socio – economic history of the area when referring to the 'structural change'. In Nijmegen however, this level of direct influence of the socio – economic context of the city is not apparent in the resulting vision. Table 21 also shows that the concept of green infrastructure has been used for significantly longer in Essen than in Nijmegen. This, as an aspect of the institutional organisation, could also go some way as to explain how Essen has had longer to develop an appropriate and applicable vision.

7.3 The Role of the EU

As has been demonstrated, both cities have different characteristic histories, and as such employ green infrastructure in different ways to address specific needs or desires for the city. By extension, it could be hypothesised that the visions, and indeed development of green infrastructure are primarily driven by the municipality or regional authority, and as such the specific city characteristics play a larger role in dictating the subsequent green infrastructure development than do more general EU targets or strategies.

However, both Nijmegen and Essen have arrows leading from the EU directly to green infrastructure in their conceptual frameworks (figure 20). These arrows represent that the EU was influential in the resulting development of green infrastructure, but not necessarily on the visions guiding green infrastructure projects. In the case of Nijmegen, the involvement in the EU – Interreg IVB-project 'Future Cities – urban networks to face climate change' resulted in the development of green infrastructure projects, with the specific aim of providing climate change adaptation measures. Thus, it is clear that the green infrastructure developed as a part of Nijmegen's involvement in the Future Cities project was done so in line with the overall vision of this project, to develop climate resilience and adaptation measures in European cities. However, it was decided not to draw an arrow from the EU to directly to the visions in the case of Nijmegen, as the involvement in the Future Cities project necessitated that the projects developed in Nijmegen comply with the overall aims, and vision. In the case of Essen, this direct arrow from the EU to the resulting green infrastructure similarly represents involvement in European projects through which green infrastructure was developed.

One the other hand, there is an arrow from the EU drawn directly to the visions in Essen. This arrow represents the fact that the focus on the economic benefits, which stand to be gained from green infrastructure in the Ruhr area were also partly informed by the attention placed on developing 'capital' in the EU Green Infrastructure Strategy. This is evident in the Ruhr areas development of the GIR 5 layered model. It could be stated therefore that Essen's green infrastructure visions are, at least in part, directly influenced in response to EU strategies, and as such reflect closer EU visions of green infrastructure than does Nijmegen. Furthermore, this example shows an impetus on the part of the Ruhr area to select aspects of the EU, economic – centric vision to inform its own GIR strategy. In the Future Cities example in Nijmegen, this level of independent selection of vision was not evident, thus justifying why there is no arrow directly from the EU to the visions.

Furthermore, Essen, in collaboration with the RVR, developed their GIR, 5-level concept in direct response to the 2013 EU Green Infrastructure Strategy. This is represented by the arrow going directly from the EU to the GIR, as part of the socio – economic context in Essen's conceptual framework (figure

20). The fact that this was developed in direct response to an EU strategy demonstrates that the EU played a direct role of the development of this concept.

In Nijmegen, the development of the new green policy plan will hopefully incorporate aspects related to the national Nature Conservation Act, which came into effect in January 2017. As stated, this Act was designed to be more in line with European Directives, namely the Habitats Directive, than its 3 previous counterparts. Therefore, it follows that if Nijmegen does indeed account for this Act in its new policy plan, then this will represent an influence of EU vision, depicted in the Habitats Directive, on the city's vision. However, as the policy plan is not yet complete, it remains unknown what degree of influence the Nature Conservation Act, as a driver for the incorporation of EU Directives will have. Therefore, at the time of writing it was decided not to include this as an arrow in the conceptual framework (figure 20), given that it is unknown if this shall directly, or indirectly, influence Nijmegen's vision ultimately.

Explaining why there was a direct influence of the EU in the development of visions in Essen but not Nijmegen warrants exploration. One possible suggestion for this could be related to the socio – economic context of the two cities, and in particular Essen's period of economic, social and environmental degradation. Since the 1990S, Essen, and indeed the Ruhr region as a whole, received funding in the region of 4 billion euros from the EU to propel its structural change, mainly from the ERDF. However, this money was only made available for projects which were in line with the stated aims of the ERDF, as products of its vision. Given this, it could perhaps be suggested that Essen has a greater history of developing locally applicable strategies which reflect the vision of European funding instruments. While it is true that the EU Green Infrastructure Strategy is not a funding instrument, it is likely that Essen has, over the past 30 years, become somewhat used to incorporating aspects of EU visions into their own, city – based visions. This level of EU influence on the development of visions in Nijmegen is unseen, and Nijmegen appears to be less aware of EU strategies and targets. An illustrative example was seen in Nijmegen's target for all inhabitants to live within 300m of a half-acre of green space, which is thought to have been developed in line with the EEA targets. However, this link was not present in city literature, and the origins of this target were unknown by most respondents.

7.4 What Do Cities Stand to Learn from This Project?

The aim of this project was to explore the role of guiding visions on the development of green infrastructure, with a view to providing two clear examples of best practices which other cities can learn from.

Perhaps the most important thing that cities stand to learn from this project is the necessity in constructing visions which reflect, and indeed embrace, the geographic and socio – economic context of a city. Current literature has recognised the way in which visions guiding green infrastructure development should be developed in such a way as to enhance the natural environment and landscape characteristics, as geographic factors. Yet in both case studies explored in this project, the cities developed visions which also pay homage to their development histories, as socio – economic factors, and specifically the inherent challenges that this has caused for green infrastructure. The importance of including the development history, as a socio – economic factor, in the development of visions remains unseen in literature; most publications which address the role of socio – economic factors in the development of visions do so with reference exclusively on the socio - political landscape of the

city. The result of focussing on the development history of the city is a vision which is unique and specific, and this may indeed generate greater support by residents given that they can better relate to it. This was particularly evident in the case of Essen, where residents had direct experience of the 'structural changes' referred to in the vision, and as such this arguably made the vision more relevant, and accessible for residents. Therefore, other cities could take note of how both of these cities championed their development histories in their visions.

Finally, Nijmegen recognised the inherent challenges posed by having various visions guiding different projects, and indeed themselves stated the need for a holistic, unifying vision. Thus, for city planners, one important take home message from this thesis could be the importance of having fewer, yet more encompassing visions.

7.5 Limitations and Reflections of This Study

The limitations of a study are described as 'characteristics of design or methodology that impacted or influenced the interpretation of the findings from your research' (Price & Murnan, 2004). The decision to only interview policy makers and city or regional representatives could perhaps be brought into question. Indeed, in both Nijmegen and Essen numerous citizen led initiatives and participation projects are also involved in developing green infrastructure. In addition, it has been stated that the role of local government in leading green infrastructure projects is changing, '… in cities its very important who takes the lead ***[sic.],*** but must it always be the municipality? They are important and should be included, but as the leader, is that always necessary?' (Green Infrastructure Researcher, personal communication, 26.06.2017). However, it was decided to focus on the activities undertaken by the local government given their role in setting the agenda for green infrastructure in the city, and as such their role in setting the visions of green infrastructure development for the city. Furthermore, in order to gain a true appreciation of the role of citizens groups it would have been ideal to participate in meetings and activities, and conduct participant observation. However, as will be elaborated below, the researcher's inability to speak Dutch or German would potentially have hindered this.

Furthermore, it became apparent over the course of this study that different projects in a city can use different visions, and as such numerous visions can be guiding projects simultaneously. As discussed, the application of guiding visions with regards to urban greening and green infrastructure in particular currently remains a much-understudied field, although at the time of starting this project I did not realise just how 'understudied' it was! This posed particular challenges when selecting appropriate theoretical frameworks in which to contextualise this project. However, the counter argument to this is that it is hoped this project really does contribute something novel to the field. It could be suggested that this study could have taken an alternate approach to focus on the integrated vision for sustainable development in each city, and explore the role of green infrastructure therein rather than making visions of green infrastructure the empirical focus.

Finally, while not unforeseen, the fact that I do not have an understanding of written Dutch or German potentially posed a limitation to the depth of document analysis which could be conducted. While it is true that all documents pertaining to the EGCA are available in English, there were numerous city – specific policy documents which were available uniquely in German or English. From the Nijmegen case study, it could be speculated that the study would have benefitted from a deeper understanding and of the 2007 policy plan and the handbook of trees. While I am grateful to those who explained

the concepts therein, the length of these documents (58 pages and 77 pages respectively) meant it was impossible to understand every detail. Furthermore, the language barrier made it impossible to potentially analyse word choice therein which may have shown a nuance of a certain vision. The same could be said of the Green Infrastructure Ruhr document, and the two recently published national white books, which at present are only available in German.

Reflecting on the process of this project, selecting case studies in 'foreign' countries provided brought with it both benefits and challenges. Given that I had never lived in either of these countries before, the local political environments, and institutional settings of both case study cities were new to me. This undoubtedly created hurdles. However, this also was a valuable learning process, and perhaps this project benefitted from me not having a greater understanding of one city's institutional organisation over the other. Finally, with hindsight, I did not realise how subjective the definition of a vision was when starting this project. It soon became apparent that different people class visions differently, and this posed challenges when collecting data for this project. Furthermore, while Essen had published 'vision' documents, this was not the case for Nijmegen, and so it became necessary to draw the visions out from other sources. I hope the operationalisation of a vision created for this project is clear and consistent, and if it does retain some ambiguity then let this reflect the ambiguity of the current state of visioning science.

7.6 Possibilities for Further Research

It is hoped that this study contributed valuable information as to how cities can harness their unique contextual factors and characteristic starting points to create an appropriate guiding vision for green infrastructure. During the course of this project, a number of points arose which warrant further investigation and could provide the basis for further investigations.

First, this study selected the two case study cities in part due their different sizes, where Nijmegen is classed as a medium sized city and Essen as a large city. However, no comparable small city was included in this city. As such, this study could perhaps have benefitted from the inclusion of a Green Leaf city, (the EGCA for towns and cities with populations between 20,000 and 100,000 inhabitants). Doing this would provide a third spatial level for comparative analysis. Building upon this, it would be interesting to see if there is evidence of a relationship between the size of the city and an awareness of EU targets and trends when a smaller city is included. Although difficult to prove empirically, it was suggested that Essen had a greater awareness of EU targets and strategies pertaining to green infrastructure development in part due to its larger size, and thus increased attention from the national government and the EU. An interesting starting point for further research could explore the role of city size on the role of green infrastructure visions, with an aim to see if larger cities do indeed closer reflect national and European strategies and targets. Alternatively, selecting cities of different sizes within the same country, as such subject to the same national policies and targets would provide another interesting possibility for further study.

Second, as mentioned in section 5.4, this study did not explore the role of citizens groups or initiatives. However, it is noted that in both Nijmegen and Essen these groups play a prominent role in green infrastructure development. The inclusion of citizen participation could be used as a starting point for further research.

One interesting point which was raised during interviews with numerous respondents was that different neighbourhoods pose different issues in terms of green infrastructure development. Based on the characteristic starting point of a neighbourhood, it follows that this calls for a certain vision, operationalised into aims and targets developed for a specific area. One particular aspect of this was seen in the comparison between applying guiding visions to existing neighbourhoods, compared to new developments. It has been stated that it is easier for new neighbourhoods to be designed in line with a vision, whereas retrofitting existing neighbourhoods can pose challenges. From this, a study which explored the sustainability visions guiding a retrofit project, and a new development, could provide for an interesting comparison.

Finally, this project touches upon the ways in which visions of green infrastructure are translated into policy, however a full elaboration of the process was outside the scope of this project. Given this, a further study could investigate the process by which policies are developed. As such, the policy arrangement approach could be used as a theoretical framework, as this defines how a specific policy domain is shaped in terms of 'organisation' (or structure) and 'substance' (or content) (Veenman, Liefferink, & Arts, 2009). Furthermore, this framework addresses policies from an institutional perspective, and as such an exploration of the existing policy arrangements within the framework of the Policy Arrangement Approach could provide an interesting basis for comparison between different cities.

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9 Appendices

9.1 Interview Respondents

Name	Position	Date of Interview
Informants		
Sybrand Tjallingii[19]	Developer of ECOPOLIS Concept	21.06.2017
Eveliene Steingrover	Green Infrastructure Researcher	26.06.2017
Annemieke Smit	European Green Capital Award Expert Panel Member (abbreviated to EGCA expert panel member)	26.06.2017
Nijmegen Case Study		
Ton Verhoeven	Water Policy Advisor	26.05.2017
Paul Goedknegt	Urbanist	29.06.2017
Henk – Jan Nijland	Green Policy Advisor	05.07.2017
Marloes Fleer	Public Spaces Policy Advisor	17.07.2017
Brigitte Gillissen	Overall Project Manager: 'Wij zijn groen, gezond en in beweging Nijmegen' (abbreviated to Overall Project Manager GGB)	28.07.2017
Rozemarijn Schoot	GGD Project Manager 'Wij zijn groen, gezond en in beweging Nijmegen' (abbreviated to GGD Project Manager)	28.07.2017
Essen Case Study		
Michael Schwarze - Rodrian	EU representative of the Regionalverband Ruhr (RVR)	12.07.2017
Sebastian Schlecht[20]	European Green Capital Award Project Manager (abbreviated to EGCA Project Manager)	10.08.2017

[19] Telephone interview was conducted

[20] Telephone interview was conducted over two sessions, 10.08.2017 and 11.08.2017.

9.2 Interview Guide for Representatives of Nijmegen and Essen

This interview guide was used to conduct the semi structured interviews with representatives of Nijmegen and Essen. Not all questions were asked, instead a prior selection was made to ensure the respondent had ample time to develop their answers. Furthermore, many questions are similar, ensuring the most appropriate could be selected in line with the flow of the interview.

Introductions

1. Introduction to research and interview
    a. Introduce self and thesis, explain aims of research
    b. Explain reason for wanting to interview respondent
    c. Check respondent is ok with interview being recorded
    d. Any questions before starting interview?

2. Could you introduce yourself and briefly explain your role at XX?

Role of Green Infrastructure

3. What do you define as green infrastructure?
4. What is the current situation concerning green infrastructure in Nijmegen/Essen?
5. What are the motivations for developing green infrastructure?
6. Which aspects of green infrastructure are prioritised?
    a. Why? With what desired outcome?
7. Is green infrastructure designed/planned with a specific benefit in mind?
    a. What?
8. What are the barriers/ challenges to developing green infrastructure?
    a. What causes these challenges/barriers?
    b. What opportunities for overcoming these?

Visions Guiding Green Infrastructure

9. Is there a vision guiding the development of green infrastructure?
    a. What is this?
    b. Where did this come from?
    c. How has this been used?
10. How have these visions developed over time?
11. Have visions for green infrastructure been incorporated into various policies?
    a. In which domains?
    b. How?
12. Do your approaches differ in different neighbourhoods?
    a. What is the reasoning for having different approaches?
13. What time scale are these visions based on?

Relationship between city and the EU

14. Are you aware of EU targets/publications about green infrastructure?

a. If so, have these influenced what is happening in your city?
b. How?

15. Do you have projects which are integrated into EU projects?
16. Do you have any questions?

Concluding the Interview

17. Anything else you would like to add?
18. I really appreciate you taking the time to talk with me, thank you again

9.3 Interview Guide for Informants

Given the different roles of the informants interviewed as part of this project, a separate interview guide was developed in preparation for each of these interviews. Furthermore, these three interviews tended to follow the structure of this interview guide less, and as such could possibly be considered as non-structured interviews, although generally guided by the following questions.

Developer of ECOPOLIS Concept

1. Introduction to research and interview
    a. Introduce self and thesis, explain aims of research
    b. Explain reason for wanting to interview respondent
    c. Check respondent is ok with interview being recorded
    d. Any questions before starting interview?
2. Could you introduce yourself and briefly explain your role at XX?

3. What is the relationship between green infrastructure and ECOPOLIS?
4. How was the ECOPOLIS concept developed?

5. Anything else you would like to add?
6. I really appreciate you taking the time to talk with me, thank you again

Green Infrastructure Researcher

1. Introduction to research and interview
    a. Introduce self and thesis, explain aims of research
    b. Explain reason for wanting to interview respondent
    c. Check respondent is ok with interview being recorded
    d. Any questions before starting interview?
2. Could you introduce yourself and briefly explain your role at XX?

3. Could you introduce the European Project you were involved with?
4. Have you seen evidence of an implementation gap between what gets visioned and what actually is realised?
    a. Why?
    b. How can that gap be closed?

5. Anything else you would like to add?
6. I really appreciate you taking the time to talk with me, thank you again

EGCA Expert Panel Member

1. Introduction to research and interview
    a. Introduce self and thesis, explain aims of research
    b. Explain reason for wanting to interview respondent
    c. Check respondent is ok with interview being recorded
    d. Any questions before starting interview?
2. Could you introduce yourself and briefly explain your role at XX?

3. Do you find common themes among what cities want to achieve from their green infrastructure?
    a. Are there country/regional patterns?
4. What is important in making the final decision for the EGCA?
5. How is the history, starting point of a city taken into consideration?

6. Anything else you would like to add?
7. I really appreciate you taking the time to talk with me, thank you again