A Salutogenic Perspective on Nature-Based Solutions in Ljubljana

Developing the Concept of Collective Sense of Coherence

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Abstract

Cities are the centres of human activity, making them both a source of environmental stressors and the origin of opportunities to enhance collective health and wellbeing. Nature-based solutions (NBS) represent such opportunities; they are solutions inspired and supported by nature that help build resilience and simultaneously provide environmental, social, and economic benefits. This study explores NBS in the Slovenian city of Ljubljana, the European Green Capital 2016 and home to ten NBS and a lot of urban nature. Using the theory of salutogenesis, the main objective is to explore the reciprocal relationship between NBS and collective health and wellbeing in this city. This is done through the exploration of shared environmental threats and stressors, the perceptions of general and resistance resources offered by NBS, their potential to contribute to a collective sense of coherence (SOC), and the effect of this collective SOC on residents' perceptions and treatment of their environment. Utilising qualitative methods including expert interviews, cognitive mapping focus groups, and individual interviews, shared perceptions of residents of Ljubljana are explored and subsequently analysed through framework analysis. The findings show that NBS contribute to health and wellbeing in a variety of ways, offering resources to cope with environmental stressors, thereby contributing to manageability, comprehensibility, and meaningfulness. NBS are also found to contribute to a *collective* SOC, a contested and underdeveloped concept within the theory of salutogenesis. The discussion of this study approaches a definition and presents a model that describes how a strong collective SOC allows the collective to respond to collective stressors in a salutary way by providing and internalising resources on a collective level. This is done through collective action, enabled by a strong presence of social cohesion, social inclusion, and social justice. The conclusion establishes a reciprocal relationship between NBS and collective health and wellbeing and demonstrates the relevance of NBS to health promotion and sustainable development.

Keywords: salutogenesis, health promotion, healthy cities, urban nature, urban ecosystem services, sustainable cities

List of Acronyms

EC	European Commission
EEA	European Environment Agency
ES	Ecosystem service(s)
GRR	Generalised resistance resource
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
NBS	Nature-based solution(s)
SDGs	Sustainable Development Goals
SIKT	Norwegian Agency for Shared Services in Education and Research (Kunnskapssektorens tjenesteleverandør**)**
SOC	Sense of coherence
SOCC	Sense of community coherence
SRR	Specific resistance resource
UES	Urban ecosystem service(s)
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organisation

Chapter 1: Introduction

1.1 Nature-Based Solutions

The Ottawa Charter for Health Promotion from the World Health Organisation (WHO, 1986) states that "health is created and lived by people within the settings of their everyday life; where they learn, work, play and love." For many people, the settings of their everyday life are urban environments; over half of the world's population and nearly 75 percent of Europeans live in cities and towns (Eurostat, 2023; Ritchie & Roser, 2018). Cities are the centres of human activity and therefore play an important role in climate change mitigation and adaptation, both as the source of most global greenhouse gas emissions and simultaneously as settings highly vulnerable to global warming and sea level rise (UN Habitat, n.d.). In Europe, the largest impact of climate change will likely be experienced in urban areas, with heat stress, flooding, and extreme weather events constituting the most significant threats (Kabisch et al., 2016). Besides climate change, urban environments are exposed to various forms of environmental pollution, with air and noise pollution leading to major health problems (WHO, 2011, 2022). Ensuring cities are resilient and capable of dealing with these threats is not only essential to their survival but also presents opportunities to improve residents' health and wellbeing more broadly. Local governments and urban architects are thus turning towards nature for inspiration and holistic solutions to these problems, increasingly implementing so-called nature-based solutions (NBS). The European Commission (EC) stimulates the implementation of NBS and defines the term as follows:

> Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions (EC, n.d.).

The EC is one of many international organisations that recognises the importance of NBS. Various UN institutions and many other international frameworks, including the 2030 Agenda for Sustainable Development, the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and the Paris Agreement have also adopted NBS in their publications (Liu et al., 2021, p. 11). At the 2019 UN Climate Action Summit, China and New Zealand promoted NBS on the global stage as joint leaders of a NBS coalition,

developing *The Nature-Based Solutions for Climate Manifesto*, which identified NBS as an important global action (Nature-Based Solutions Coalition, 2019). One of the leading international organisations to promote NBS is the International Union for Conservation of Nature (IUCN), which works on a global scale to protect, manage and restore ecosystems while addressing major challenges such as climate change, local economic development, health, and biodiversity (IUCN, n.d.b). Furthermore, over 130 countries have already included NBS in their national climate plans. Within Europe, the EC aims to position the European Union as a leader in NBS research and innovation policies and funds many relevant projects, such as NATURVATION (EC, n.d.). One of the outputs of this project was the Urban Nature Atlas, a collection which currently holds over a thousand NBS in cities in Europe and beyond (Almassy et al., 2018; Pinter & Almassy, 2022; EC, n.d.). This atlas shows a great number of NBS that have already been implemented throughout Europe and other parts of the world. The focus of this research, however, will be on one specific European city with a relatively high number of NBS: Ljubljana.

This study will explore the NBS and their relationship to residents' health and wellbeing in the city of Ljubljana, the capital city of Slovenia. Located on the Ljubljanica river between the Alps and the Karst, Ljubljana is a relatively small capital, with a population of around 290,000 (City of Ljubljana, n.d.). The city was named European Green Capital in 2016 and is proud of its abundance of urban nature and its "green soul" (EEA, 2017; Ljubljana Tourism, n.d.). The City Administration actively promotes healthy lifestyles, with a focus on healthy diet, exercise, and decent housing, and a large majority of citizens in Ljubljana rate their quality of life as good and state to be satisfied with their health (Leskošek et al., 2016). After being awarded the title of European Green Capital, the city has continued to carry out projects and committed to sustainable development by adopting a development vision for up to 2045 (Ficko et al., 2015; Žirovnik et al., 2021). As of 2023, the Urban Nature Atlas shows ten NBS projects in Ljubljana (see Appendix A), which address a range of challenges, including but not limited to environmental quality, water management, cultural heritage, effective and inclusive governance, climate action, and health and wellbeing (Pinter & Almassy, 2022). The NBS vary in size and scope, and some consist of urban architecture measures whereas others involve social events and activities. Arguably the most impactful NBS was the implementation of the Ecological Zone in the city centre, where large portions of the Old Town were closed for motor vehicles, cycling was promoted, new bridges were built to connect the riverbanks, and additional greenery was introduced. Several of

Ljubljana's NBS will be discussed in this study, with the main focus being on the Ecological Zone, as participants shared most opinions and experiences about this NBS

As can be seen in the table in Appendix A, the topic of this study is highly relevant for the sustainable development agenda and directly related to multiple Sustainable Development Goals (SDGs). Urban NBS aim to address a variety of societal and environmental issues all at once and therefore touch upon many SDG targets, particularly those of Goal 11: sustainable cities and communities. Target 11.5 aims to reduce the impacts of climate disasters through adaptation, and target 11.6 covers mitigation, aiming to "reduce the adverse per capita environmental impact of cities" (UN, 2021b). Many NBS involve green spaces, which are covered by target 11.7. Moreover, target 11.3 calls for inclusive and sustainable urbanisation and target 11.4 to protect and safeguard cultural and natural heritage. Synergies exist between these and several targets of Goal 3 (good health and wellbeing), for instance, non-communicable diseases and mental health (target 3.4) and air pollution and WASH (target 3.9), as well as all targets of Goal 13 (climate action) (UN, 2021a, 2021c). Furthermore, a series of additional SDGs are potentially relevant to NBS, depending on the intervention, including goals 2 (zero hunger), 6 (clean water and sanitation), 10 (reduced inequality), 14 (life below water), 15 (life on land), and 16 (peace, justice, and strong institutions).

1.2 Problem Statement and Objectives

NBS are often at the centre of synergies like those between sustainable cities and health and wellbeing, which is what makes them so compelling to both researchers and policy makers. Ljubljana is a city with a lot of urban nature and many NBS, but the impacts of these NBS on health and wellbeing have not been studied yet. The latest "health profile" of the city was created in 2016 and does not mention the effects of NBS or even of urban nature (Leskošek et al., 2016). In the academic literature, however, the potential health benefits of NBS have been studied extensively, though less is known about the reciprocal nature of the relationship between NBS and health and wellbeing and perceptions of long-term outcomes. The theory of salutogenesis, a strengths-based approach which allows more nuance than the prevalent sick/healthy dichotomy, may offer valuable insights into these issues. The salutogenic model (see theoretical framework) has only loosely been applied to cities and urban planning and, as suggested by an extensive literature review, never before to NBS. This new application therefore provides an opportunity to build upon certain elements of the

theory, especially the settings approach and the described yet undefined concept of a collective sense of coherence. Developing these elements further will provide new insights into collective health outcomes and the reciprocal relationship between NBS and health and wellbeing.

To structure this thesis, several research objectives have been formulated. The main objective of this study is as follows: *To explore the reciprocal relationship between nature-based solutions and collective health and wellbeing in Ljubljana.* This will be achieved through the following sub-objectives:

1. *Explore shared perceptions of environmental threats and stressors.*
2. *Explore shared perceptions of a) general resources and b) resistance resources offered by NBS.*
3. *Explore how NBS may contribute to a collective sense of coherence.*
4. *Explore how the (potential) collective sense of coherence affects how urban residents perceive and treat their environment.*

This thesis is organised into several chapters. First, the existing literature on NBS and their relation to health and wellbeing will be critically discussed in the literature review. This is followed by a theoretical framework, in which the theory of salutogenesis, its relevance to NBS, and the related concepts will be explained. The next chapter will discuss the methods, research design, and data collection of the study, followed by its ethical considerations. The results of data collection will then be presented in the findings chapter, using quotes and insights from the interview and focus group participants, and will subsequently be elaborated upon in the discussion, which is structured around the research objectives and focuses on the development of the concept of a collective sense of coherence. Finally, the conclusion will summarise the main research outcomes, describe their academic and societal implications, and provide policy recommendations and avenues for future research.

Chapter 2: Literature Review

2.1 Nature-Based Solutions in the Context of Cities

In the academic literature on nature-based-solutions (NBS), there is no consensus on an exact definition or on the boundaries of the concept. For some authors, NBS can be applied to any kind of ecosystem, whereas for others, NBS are mainly set in urban contexts, bringing solutions from nature into the city (Eggermont et al., 2015; Escobedo et al., 2019). The definition formulated by the IUCN (n.d.a), for example, considers NBS actions that can be applied to both "natural and modified ecosystems" and has a strong focus on biodiversity. The EC's definition for NBS, on the other hand, does not explicitly mention biodiversity but understands NBS as "living solutions" that are able to tackle social, environmental, and economic challenges simultaneously in a sustainable manner (EC, n.d). For the EC, NBS are mainly relevant in urban contexts, which is illustrated by the fact that the majority of NBS in Europe are implemented at the city level (Liu et al., 2021). This study, a case study of the city of Ljubljana, will therefore follow the definition of the EC as well; NBS are "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience" (EC, n.d.).

2.2 Nature-Based Solutions and Related Concepts

Liu et al. (2021) argue that the lack of one unified definition of NBS is not necessarily a problem. The concept of NBS is related to and overlaps with several others, including urban forestry, green and blue infrastructure, ecological engineering, and (urban) ecosystem services (Escobedo et al., 2019; Liu et al., 2021; Tan et al., 2020). All these concepts and approaches are utilised to address complex issues faced by urban areas that are related to urbanisation, environmental degradation, and climate change. According to Liu et al. (2021, p. 17), NBS could serve as an overarching concept for all these terms, while Escobedo et al. (2019, p. 10) view NBS as the most recent paradigm in a list of metaphors that all share a similar origin in urban forestry. NBS distinguish themselves through the transdisciplinary approach that aims to provide pragmatic solutions to a whole array of environmental and societal challenges (Cohen-Shacham et al., 2016; Escobedo et al., 2019). They supply a range of ecosystem services (ES), or, more suitable to this study, *urban* ecosystem services (UES), defined by Tan et al. (2020) as "aspects of ecosystems that are generated from natural capital in combination with human-derived capital, and that contribute, directly or indirectly, to human well-being in urban areas" (p. 7).

2.3 Nature-Based Solutions and Health and Wellbeing

The positive relation between health and urban green spaces has long been well-established (De Vries et al., 2003; Gulsrud et al., 2018; Kabisch et al., 2016; Maas et al., 2009; Panno et al., 2017; Santamouris et al., 2018; Van den Bosch & Ode Sang, 2017). Different types of UES can be conducive to human health in various ways: socio-behavioural ES can alleviate stress, encourage physical activity, and promote social interaction and cohesion, whereas regulating ES improve environmental quality by regulating temperatures, reducing noise pollution, and preventing flooding (Cohen-Shacham et al., 2016; Van den Bosch & Ode Sang, 2017). Although the EC's definition of NBS does not mention health and wellbeing explicitly, many NBS frameworks include a wide array of health and wellbeing indicators to measure the effectiveness of NBS (Cohen-Shacham et al., 2016; Kabisch et al., 2016; Raymond et al., 2017a, 2017b). Some measure the effect of NBS on health and wellbeing by looking at pathogenic factors, such as the decline of cardiovascular disease, respiratory disease, obesity, depression, or simply all-cause mortality or physician-assessed morbidity, whereas others measure salutary factors, including physical activity, relaxation, improved mental health, and opportunities for children to explore (Kabisch et al., 2016; Maas et al., 2009; Raymond et al., 2017a; Van den Bosch & Ode Sang, 2017). A combination of salutary and pathogenic indicators in a single framework is also not uncommon.

2.4 Participation in Nature-Based Solutions

Other important indicators related to collective health and wellbeing are participation, social cohesion, and social inclusion. There is general agreement in the literature that community participation is an important contributing factor to the effectiveness and legitimacy of a NBS (Gulsrud et al., 2018; Kabisch et al., 2016; Liu et al., 2021). Engagement with nature and place-making are found to have positive effects on health and enhance social cohesion and resilience (Van den Bosch & Ode Sang, 2017). However, there is a lack of studies that describe the reciprocal relationship between nature and participation. Cárdenas et al. (2021) claim to be the first to explore this relationship and provide insight into the positive impact that participation has on participants' perception of nature and motivation to undertake sustainable actions. They find a positive feedback loop, in which participation provides a circular benefit towards nature (Cárdenas et al., 2021, pp. 8-9). Individuals, communities, and societies benefit from participation through improved mental health, a

sense of achievement, and empowerment, while, at the same time, NBS benefit from increased stewardship, support, and protection.

2.5 Social Justice and Nature-Based Solutions

When considering collective health and wellbeing, the issue of socio-environmental justice cannot be ignored (Escobedo et al., 2019; Wolch et al., 2014). Although green spaces are especially important for children and lower socioeconomic groups, and the lack thereof impacts these groups most severely, the distribution of green spaces often disproportionately benefits more affluent communities (Maas et al., 2009; Wolch et al., 2014). In addition, providing more green spaces in disadvantaged neighbourhoods sometimes leads to displacement through a process of eco-gentrification, a problem referred to as the "green paradox" (Kabisch et al., 2016; Wolch et al., 2014). These issues have a negative impact on wellbeing and social cohesion, a relationship that has not been studied much, which is the reason for many authors to call for the inclusion of social justice as an indicator when studying, implementing, or evaluating NBS (Escobedo et al., 2019; Kabisch et al., 2016; Zwierzchowska et al., 2019). Cárdenas et al. (2021, pp. 10-11) find that benefits of engaging with NBS through participation processes do not necessarily decrease much with increased distance from the NBS. This implies that residents living in less-advantaged neighbourhoods with limited access to nature could greatly benefit from participation programmes.

2.6 Knowledge Gaps in the Literature

Although a clear link between NBS and health and wellbeing has been established in the academic literature, there is still a lack of insight into the combined benefits provided by NBS to address environment, health and wellbeing, and social cohesion simultaneously (Liu et al., 2021; Van den Bosch & Ode Sang, 2017). Various authors therefore argue for a holistic approach that takes into account co-benefits, synergies, and trade-offs of NBS in urban ecosystems, covering the environmental, social, and economic benefits together (Liu et al., 2021; Raymond et al., 2017b; Van den Bosch & Ode Sang, 2017). The knowledge gap that still exists concerns synergies and trade-offs between the various benefits, the reversed relationship between NBS and health, and the contribution of participation to social cohesion and social justice. This study seeks to contribute to filling this gap by exploring the various relevant relationships and feedback loops between NBS and health and wellbeing. Especially the relationship between NBS and *collective* health and wellbeing requires further investigation, to which the concept of collective sense of coherence could contribute. The

theoretical framework that will subsequently be presented aims to contribute to filling the knowledge gaps by applying the theory of salutogenesis.

Chapter 3: Theoretical Framework

3.1 Salutogenesis

3.1.1 Health on a Continuum

Antonovsky (1979), the founder of the theory of salutogenesis, posed the question: 'what creates health?'. This focus on health instead of disease, on salutary factors rather than risk factors and vulnerability, was hugely influential and has changed the course of health promotion (Eriksson & Lindström, 2008). Rather than a health/disease dichotomy, Antonovsky (1996a) understood health on a continuum, with "ease" (health) on one side and "dis-ease" (breakdown) on the other. One could be anywhere on this continuum and move up or down it, based on how they deal with stressors. Stressors could be, contrary to pathogenic beliefs, salutary, neutral, or pathogenic, depending on how the person copes with tension. Thus, if one deals well with a stressor, it could actually lead to improved health; a move on the continuum towards "ease." Salutogenesis will serve as the theoretical framework for this study. Although the aforementioned concept of wellbeing was originally not adopted by Antonovsky (1979, pp. 67-69), this study, like many others, will adopt it, following Dodge et al.'s (2012) definition: "when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge" (p. 230)

3.1.2 Resistance Resources and the Sense of Coherence

Central to Antonovsky's theory are two concepts: the sense of coherence (SOC) and generalised resistance resources (GRRs). The SOC represents to what extent a person experiences life as comprehensible, manageable, and meaningful (Antonovsky, 1996a). Most studies that utilise salutogenesis as a theoretical framework discuss or measure the individual SOC. The objective of this study, however, is to also explore whether a *collective* SOC exists and how it might be conceptualised. A GRR is any property of a person, group, or the environment that can facilitate coping with tension and thus contribute to a stronger SOC. Antonovsky predicts that a stronger SOC contributes to a move on the continuum towards health. GRRs are therefore important in achieving good health and thus important to identify. Reversely, a stronger SOC also facilitates the effective application of GRRs, as a reciprocal relationship exists between the two concepts. Besides GRRs, there are also *specific* resistance resources (SRRs). These are resources provided by a government or development actor that are activated specifically to deal with a particular stressor in order to facilitate coping with

tension (Mittelmark, Daniel, Urke, 2022). The SOC, GRRs, and SRRs are all key concepts in the salutogenic model of health that will be applied in this study in the context of cities.

3.1.3 Salutogenesis in the Context of Cities

Although the salutogenic model was developed by Antonovsky as a descriptive model only, it has since evolved into a foundation for intervention, aimed at improving lives (Mittelmark, 2021). Until recently, the model has mainly been applied to individuals, even though Antonovsky also includes groups and even "society" in his mapping sentence defining GRRs (Antonovsky, 1979, p. 103). Two exceptions are the concepts of community SOC and national SOC, though these merely describe a sum of individual SOCs (Sagy & Mana, 2022). The aim of this study is to explore and develop the concept of a *collective* SOC, one which would not be based on the SOC of a sum of individuals but on the SOC of a collective within a certain setting, using the concepts of social inclusion, social inclusion, social justice, and participation as found in the NBS literature. Bauer (2022) discusses the settings approach in relation to salutogenesis. While health promotion is readily applicable to everyday settings like cities and neighbourhoods, the connection with salutogenesis has only loosely been made. Capolongo et al. (2018), for instance, formulate ten key points for achieving salutogenic cities but do not apply the salutogenic model at all. The strongest element of the salutogenic model in the settings approach are GRRs, and identifying GRRs can help develop a setting-specific SOC (Bauer, 2022, p. 278). This can be done effectively in the context of cities; "the city setting, with [its] inherent resources and processes, provides inhabitants with a set of experiences that potentially affect SOC" (Maass et al., 2022, p. 365). Environmental resources, or UES, which NBS provide, can become GRRs and strengthen the SOC when internalised. The salutogenic model thus serves as a theoretical framework that "allows us to link environmental resources to health outcomes and to the development of a strong sense of coherence" (Maass et al., 2017, p. 173).

3.2 Applying Salutogenesis to Urban Nature-Based Solutions

The salutogenic model is based on the assumption that everyone experiences stressors, which can either promote health, or deteriorate it, depending on how they are managed. NBS aim to mitigate and adapt to stressors induced by a variety of challenges, which consist predominantly of exogenic stressors on the group level (Antonovsky, 1979). NBS combat stressors with general or focused UES that can be turned into GRRs or SRRs, which can help individuals and groups prevent tension from being transformed into stress,

and thus contribute to stronger SOCs. The theory of salutogenesis and NBS share a holistic approach and a salutogenic perspective on health. Although some evaluations of NBS use pathogenic indicators, the general NBS approach can be considered salutogenic. NBS often aim to tackle multiple challenges at once, and residents' health and wellbeing is an important one, which can be achieved in synergy with other goals. This makes the study of NBS in a salutogenic framework so compelling; NBS offer opportunities for a wide range of GRRs and SRRs, contributing to health and wellbeing on a collective level in a myriad of ways.

Chapter 4: Data and Methods

4.1 Research Design

The research design for this study utilises a qualitative approach, situated in the constructivist paradigm. As the aim of this research is to explore people's perceptions of their own health and wellbeing, the constructivist, also interpretative, approach is the most suitable for the research objective. This study seeks to develop a deep understanding of its participants' collective but subjective feelings and experiences, of which social context is a central component. This is in line with the purpose of social scientific research as understood in the constructivist paradigm (Neuman, 2014). The topic of this study, people and their perceptions of their own health and wellbeing and environment, is best investigated using qualitative methods and expressed in non-numerical data. In the study of salutogenesis and especially the SOC concept, quantitative methods are more common, but qualitative salutogenic research is expanding and offers new opportunities for the development of the field (Vaandrager, 2022, pp. 565-566). Qualitative analysis, the most common research method in the constructivist paradigm, is thus the research method applied in this study. The research design involves a case study of the city of Ljubljana, where many different NBS projects have been implemented. Applied here is the instrumental case study as described by Stake (1994, as cited in Punch, 2014, p. 121), in which one city is studied to provide insight into a wider issue of NBS and health, and to build on the aforementioned theory of salutogenesis.

4.2 Study Area

The study area is the city of Ljubljana. Ljubljana is a city in which NBS are part of the city's environmental policies as well as its approach to encourage healthy lifestyles among its residents. There are many NBS projects dispersed across the city. At the start of this research project, the study area covered only one of these projects, namely the so-called Ecological Zone in the city centre of Ljubljana, which consists of a whole series of policies and green measures. However, during the data collection process, participants provided copious amounts of data related to other NBS and related projects as well, and the decision was made to also include these data in the research, extending the study area to the whole city of Ljubljana. The amount of attention that participants devoted to each of these projects determined their prioritisation in the final discussion.

4.3 Methods of Data Collection and Participants

4.3.1 Expert Interviews

Data collection was done through the use of two types of in-depth interviews and two focus groups. The first form of data collection, the interview, is a prominent data collection method in qualitative research (Punch, 2014). The first type of interview was conducted with professionals in the field of urban planning and local policy design to provide insight into the topic of NBS in Ljubljana and their envisioned and demonstrated effects on health and wellbeing. Halperin & Heath (2015, p. 300) describe the aim of these so-called expert interviews as generating data that offer specialised knowledge on a particular issue, rather than on the thoughts and feelings of the individual. The participants for these expert interviews were selected based on their relationship to the implementation and evaluation of NBS and/or health and wellbeing in the city of Ljubljana. They were recruited directly by email, following research into the relevant city departments and other stakeholders, and contact was established both through direct responses and referrals.

The four expert participants included the Senior Advisor of the City Administration's Department of Health and Social Care, the Senior Advisor of the Department of Development Projects and Investments Office, the Sustainability Manager at Ljubljana Tourism, and one of the city's Deputy Mayors, who is city architect and responsible for urban design, environmental protection, and sustainable mobility. Three interviews were conducted via video call and the fourth participant answered questions in written form. With exception to the latter, a semi-structured interview style was used and probes were asked where relevant (see appendix C for the interview guide). The interviewees were able to provide valuable insights into the desired, predicted, and actual effects of NBS projects, as well as experiences concerning the practicalities of implementation. They offered their expertise on health, urban planning and architecture, project management and citizen participation, and sustainable development and tourism in Ljubljana. Audio recordings were made of the interviews, and transcripts of these recordings composed the final data obtained from these interviews. Some participants also provided secondary data such as local policy documents and reports from the City of Ljubljana, some of which are utilised in the introduction and discussion of this study.

4.3.2 Cognitive Mapping Focus Groups

The expert interviews were followed by two focus groups. Focus groups can be considered a type of group interview, usually involving around six to ten participants "who are interviewed together in a flexible and exploratory group discussion format" (Halperin & Heath, 2015, p. 301). The group of participants are selected based on a particular shared attribute, in this case the fact that they live in Ljubljana, and rather than being asked to respond to a list of questions, the group is asked to discuss a topic or theme, in this case NBS and health and wellbeing. For this study, a specialised type of focus group was conducted, using the method of cognitive mapping. This method led to the generation of data in the form of cognitive maps (see appendix E) and transcripts of the participants brainstorming, discussing, and presenting these maps. The focus groups were originally planned to take place in person, in a space provided by the City Administration of Ljubljana, but a Covid-19 infection forced me to create an online alternative. In the end, the two focus groups were conducted over video call, assisted by the software Miro, an online whiteboard that allows users to simultaneously brainstorm through the use of virtual sticky notes, text, and arrows.

In the process of creating the cognitive maps, participants brainstorm, discuss, and collaborate to create cognitive maps with sticky notes and arrows, indicating cause-and-effect relationships and feedback loops between concepts and ideas (Faria et al., 2018). In this study, the steps of the cognitive mapping process developed as follows. First, participants brainstormed about the given topic by writing as many ideas and concepts as they could think of on virtual sticky notes. The ideas were then organised around themes or by separating causes and indicators on one side and impacts and results on the other. Subsequently, causal links were included by connecting the sticky notes with arrows, and pluses and minuses were added to these arrows to indicate the nature and strength of the relationships. The finished map was finally reflected on and presented by the group.

This study utilised two cognitive mapping groups to explore causal links and feedback loops between NBS and the collective health and wellbeing of a group of residents of Ljubljana. The participants were presented with the question of how the NBS in Ljubljana interact with health and wellbeing and vice versa but they were never directly asked about theoretical concepts like GRRs or comprehensibility, manageability, and meaningfulness. Over the course of 90 minutes, the participants collaborated to create a map, which they then presented at the end of the discussion. The brainstorming process and the final presentation of the map were audio-recorded with permission of the participants, and notes were taken during

the process. The collected data consist of the transcript of the recorded discussions and presentations as well as images of the two final cognitive maps (see appendix E).

Each focus group was comprised of two residents of Ljubljana who regularly interact with the NBS in the their city. They provided insight into their everyday interactions with the urban nature in Ljubljana and their experience concerning their own health and wellbeing and relationship to nature. Multiple avenues were utilised to recruit the relevant residents of Ljubljana. I reached out to local community centres, city district authorities, NGOs, the University of Ljubljana, and contacts within city administration, which I had obtained through the previously conducted expert interviews. In addition, I posted recruitment messages on various Facebook and Telegram pages. Some bias may have originated from these sources of recruitment, since the open invitations likely attracted people with an interest in the topic of urban nature. At the same time, this fact allowed for the collection of rich data from enthusiastic participants in the focus groups. The low number of participants – four participants across two focus groups instead of six to ten participants in one focus group – was a result of a combination of challenges that arose during the recruitment process, which I elaborate upon further in the limitations section of the discussion chapter.

For cognitive mapping, the groups ideally had to consist of a variety of people from different contexts and with different knowledge and value systems. Thus, a heterogeneous group of people was recruited, composed of people who have been living in Ljubljana for most of their lives as well as people who only recently moved there from elsewhere in the country or from abroad. Ages ranged between around twenty and fifty years old, and a mix of different occupations and socio-economic statuses were present to represent the demography of the city of Ljubljana. Unfortunately, because no men were available for the focus groups, all participants were female. To minimise the bias created by this gender imbalance, one more in-depth interview was conducted with a male participant after the focus groups. Finally, as I was not fluent in Slovene, the focus groups were conducted in English, Europe's lingua franca. Even though a majority of Slovenians speak English, especially in the capital city of Ljubljana, this criterion most likely excluded some potential participants, possibly creating unwanted bias.

4.3.3 Individual Interview

Following the focus group, one more in-depth interview was conducted with to fill any knowledge gaps that were left after the focus group discussions and to provide more

insight into individual and male perceptions. Whereas the expert interviews generated data concerning the envisioned goals and implementation of NBS, and the focus groups focused on shared experiences of health and wellbeing and the mapping of their reciprocal relationship with NBS, this second form of in-depth, semi-structured interviews provided more detail about the participant's personal experiences and opinions regarding NBS and health and wellbeing. This functioned both as a form of triangulation and a way to enrich the data previously gathered in the focus groups. The interview guide was structured in such a way that it included questions about each of the major themes of the identified framework and covered all of the study's research objectives (see Appendix C).

4.4 Data Management

The collected data in the form of recorded in-depth interviews and the focus group sessions were transcribed, anonymised, and subsequently uploaded in the software Nvivo, where the data were coded. These data, in combination with the cognitive maps from the focus groups, were then analysed together according to the method of framework analysis. The recordings as well as any other sensitive personal data were stored in UiB SAFE and deleted at the end of the project.

4.5 Data Analysis

The collected data were analysed through framework analysis. Some regard this type of analysis as a technique used within content analysis, while others classify it as a method of its own (Moerman et al., 2016). Framework analysis relies on a theory or framework to which the researcher connects data and subsequently reduces the data through summarisation and synthesis. It is a powerful and flexible method with the benefits of a dynamic, transparent, yet systematic process, which has been applied successfully in the study of policy issues and social problems (Goldsmith, 2021). Characteristic of framework analysis is its focus on the observation and accounts of participants, making it appropriate for this research design with focus groups and interviews (Srivastava & Thomson, 2009).

Framework analysis is conducted through five steps: data familiarisation, identifying a thematic framework, indexing, charting, and mapping and interpretation (Srivastava & Thomson, 2009). These steps were executed rigorously, contributing to the quality of the study. First, I familiarised myself with the data through immersion, making notes about key ideas and forming an understanding about the major themes, as recommended by Goldsmith (2021). In framework analysis, frameworks can be identified both inductively or deductively.

The framework for this study was established through a combination of the two. First, the focus group and interview data were analysed inductively by creating codes based on the contents of the transcripts, already starting the indexing process. Subsequently, these codes, functioning as sub-themes, were placed within the existing theoretical framework of salutogenesis. The main concepts of this theory, such as stressors, manageability, comprehensibility, and meaningfulness, in combination with important concepts found in the literature, such as social inclusion, cohesion, and justice, served as the main themes in the analysis. In the following step, the data were summarised through charting. The outcomes of the previous steps were combined in a large matrix (see Appendix F), in which the discovered patterns were mapped, covering all the relevant data per theme. In addition, two code maps were created to visualise the connections between the main themes, subthemes, and codes. The final step, interpretation, involves description, creation of typologies and categories, mapping linkages, and developing explanations, which will be presented in the findings and discussion chapters that follow.

4.6 Trustworthiness of Research

Trustworthiness in qualitative research can be ensured through four strategies: credibility, transferability, dependability, and confirmability (Shenton, 2004). Credibility, perhaps the most important criterion, assesses how well a study's findings represent reality. This can be achieved through thick description and triangulation. Thick description entails a detailed description of the phenomenon under scrutiny (Shenton, 2004). Triangulation is used to establish the extent to which the same findings can be observed from different sources and can significantly increase the trustworthiness of data (Yin, 2016, pp. 160-161). In this study, triangulation was done by collecting different forms of data from multiple sources, through expert interviews, focus groups, and another in-depth interview. In addition, various supporting documents were utilised to provide context and verify participants' claims. These different types of triangulation contribute greatly to the credibility of this research.

Transferability describes the extent to which study findings can be applied beyond the context in which the study was conducted (Malterud, 2001). This could also be achieved through triangulation, a detailed description of the context of the study, as well as a detailed description of the studied phenomenon, all of which this study aimed to deliver (Shenton, 2004). In addition, study findings were contextualised within the existing literature, aiming to further contribute to its transferability. Dependability is concerned with the extent to which a

study would obtain similar results if it was repeated under similar circumstances with the same methods and participants (Shenton, 2004). To make comparable future repetitions of the study possible, transparency and detailed descriptions of the research design and process of this study are provided (Skovdal & Cornish, 2015). The interview guides for the interviews and focus groups also significantly contribute to dependability. Finally, confirmability assumes inevitable bias in the researcher but aims to limit its influence on the study as much as possible (Shenton, 2004). Reflexivity of the researcher is key in achieving this and will be discussed in the following section.

4.7 Role of the Researcher

The researcher is expected to demonstrate awareness of their own bias and how it might affect the study (Skovdal & Cornish, 2015). Tracy (2010) describes self-reflexivity as "honesty and authenticity with one's self, one's research, and one's audience" (p. 842) and regards it as an important method to realise sincerity. It encourages the researcher to be honest about their strengths and shortcomings and reflect on how the participants might view them as interviewer and how this could affect the data. During this study, I took care to reflect before, during, and after each step, and kept notes concerning possible biases and their potential consequences. As a foreign student conducting the expert interviews, the participants showed interest in my thesis and used it as an opportunity to proudly present their work in the City Administration. They were not afraid to be critical, which was evident from interspersed negative remarks, but generally spoke positively about the city of Ljubljana and their work. During the focus groups, participants responded to me as a foreign student with curiosity, but this did not appear to influence the data that they provided much. Some used the focus group as an opportunity to speak out about issues that bothered them and were happy to be able to share their views with an outsider.

When conducting the interviews for this study, I tried to follow good practices as described by Yin (2016), hoping to reduce the effect of bias by speaking in modest amounts but using probes to keep the conversation going, being as nondirective as possible, staying neutral, in responses and probes as well as in expressions and body language, maintaining good rapport with the participant, using an interview guide, and starting analysis already during the interview. Regarding the focus groups, the amount of direction I provided during the group discussions was carefully considered, as this could influence the type and quality of

data obtained (Stewart et al., 2007). Here too, staying neutral and maintaining good rapport with the participants was essential.

4.8 Ethical Considerations

4.8.1 Ethical Issues

Ethical issues have arisen throughout the research project. The interviews and focus groups took up valuable time of the participants, which was carefully considered and weighed against the benefits of their participation. To cause a minimal amount of stress on the participants, I tried to be as flexible as possible with the scheduling of the individual interviews. Sensitive data such as the interview and focus group recordings were handled with the utmost care. They were stored in UiB SAFE and deleted at the end of the project.

4.8.2 Informed Consent and Participants' Rights

Arguably the most important ethical consideration in this study was informed consent. It was essential that the participants agreed to participate in the study while fully knowing what they were agreeing to, and that they were aware of their rights of anonymity and confidentiality. Consent forms (Appendix D) were used to ensure this, and all other considerations related to informed consent were put in writing. I ensured that these rights were protected at all times. The focus group participants were not anonymous to me, but since their personal details were not relevant to the study, these were not disclosed and their anonymity was ensured to everyone else. An exception were the expert interviews, as the participants' job titles were relevant for the reader's understanding of the data. This was explained and agreed upon in the consent forms which the participants signed. All data were stored in a secure device to ensure confidentiality.

4.8.3 Instances of Ethical Clearance

Since sensitive personal data were collected in this study, namely the recordings of the interviews and focus groups, SIKT was notified of the research and granted approval for data management procedures (see Appendix B). I also contacted the University of Ljubljana and the City Administration of Ljubljana asking whether further ethical clearance was needed from any local or national authorities in Slovenia, but both institutions assured me that this was not the case, as long as participation was based on informed consent.

Chapter 5: Findings

5.1 Introduction

In this section, the results of the data collection and analysis will be presented. After analysing the focus group and interview data both inductively and deductively by applying the method of framework analysis, various patterns were found that will be discussed in a structured manner according to several main organising themes that find their roots in the theory of salutogenesis. These organising themes are also displayed in the matrix and code maps in Appendix F and G. It should be noted that even though the main focus of this research is the several NBS in Ljubljana, data that involve comments on the urban nature more generally or projects in the city that participants regarded as relevant to the conception of NBS will also be presented here and included in the discussion. Within this chapter, direct quotes from participants are presented in italics for clarity. The quotes are not attributed to specific participants, unless this is of importance to the understanding of the viewpoints, as is often the case with information coming from expert interviews.

Following the objectives of this study, the first theme introduces the shared urban perceptions of environmental threats and stressors in Ljubljana, which includes stressors independent of NBS, stressors that can be mitigated by NBS, but also stressors caused or enhanced by NBS. The second main theme revolves around resources offered by NBS, which can be divided into general resources and resistance resources. After presenting the resources that residents of Ljubljana use to mitigate the effects of stressors, the focus will shift to the way in which these resources contribute to residents' health and wellbeing. This analysis is based on Antonovsky's SOC, subdivided into the concepts of manageability, comprehensibility, and meaningfulness. These will first be described on an individual level, as is common in the salutogenesis literature, and then expanded upon to explore the potential existence of a *collective* SOC, emphasising concepts and ideas especially relevant to NBS, such as participation, social inclusion, social cohesion, and social justice. Finally, data will be presented on the relationship between health and wellbeing and urban residents' relationship with their environment, indicating a possible reciprocal relationship.

5.2 Stressors

To explore the relationship between NBS and health and wellbeing, first, the stressors that influence a person's health and wellbeing need to be established (see theoretical framework). Stressors can be internal or external, and social or environmental. The focus in

this study is on external and environmental stressors, as these are most relevant in the city context, and thus most prevalent in the data, though other types of stressors may be touched upon as well. Environmental stressors can be both natural and man-made, both of which will be discussed in this section.

The main natural stressor mentioned by participants was heat stress. The heat in the city was described by participants as "*extreme*" and "*overwhelming*" at times. "*It is really hot; in the city centre it can be 50 degrees in the daytime in the summer.*" Heat stress was mainly mentioned in combination with comments on trees and green spaces providing shade to mitigate this effect. Two participants also alluded to heat stress by expressing their discontent with the lack of swimmable water in Ljubljana, saying that this could be an effective way to escape the heat in summer. One interviewee even described the poor water quality as a stressor in itself. Not everyone agreed with this, however, as a focus group participant who recently moved here praised the river for how clean it looked. This was met with the counterargument that as long as the river is not swimmable, it is not clean enough. Another natural stressor concerning water was mentioned by the City Administration's Senior Advisor for Development Projects, who described that they are working on solutions against flood risk on the outskirts of the city. They added that the Ljubljanica river is quite well-protected and "*usually in the city centre it was never flooded*," which could explain why floodings were never mentioned as a problem by any of the focus group participants.

Participants had more to say about man-made stressors, the most common of which was pollution, in various forms. This included water pollution, as described above, but also noise pollution, light pollution, and, most frequently mentioned, air pollution. Participants had a lot to say about air pollution and did not all share the same opinion, some being satisfied with the current air quality while others still experience smog as a true threat to their health. One thing they agreed upon, however, was that the air quality in the city has been improving and that it is significantly better since the ban on cars in the city centre. Most positive comments on air quality were made with regard to the city centre itself, whereas most complaints dealt with pollution as a result of the traffic around it. The Ecological Zone was thus effective in decreasing air pollution in the city centre, but as one of the experts explained: "*After closing an area for cars, the remaining motor traffic moved to the near adjacent streets so worsening the situation there*." Nevertheless, most participants agreed that the overall air quality has become better, with some participants referring not only to the

changed traffic situation as a cause but also to the relatively recent shift from coal to gas or electricity as a heating source in most households.

Other types of stressors were reduced as a consequence of the implementation of the Ecological Zone as well. The Senior Advisor of Development Projects listed some major stressors from before the pedestrianisation of the city centre:

> *It's not just cars, that you're always looking around you "from which direction is it going to come?" but there is also noise pollution, and there is also smell, and also, you know, cars are- you're sitting and having some coffee and it's, really, you don't feel the coffee, you just smell the car.*

There is a general consensus among both experts and residents that the Ecological Zone reduced both air pollution and noise pollution and that stressors like chaotic and unsafe car traffic were eliminated completely by the ban on motorised vehicles. However, some participants also mention new stressors that came into existence as a result of the pedestrianisation. New types of noise pollution have heightened, especially related to increased tourism and hospitality. The Deputy Mayor explained: "*The arising footfall of tourists crowded the car-free area, especially inn gardens began causing the most disturbing sound load for local residents.*" Finally, some participants mentioned noise pollution caused by machinery and light pollution from street lighting as stressors.

5.3 Resources provided by Nature-Based Solutions

NBS provide many different resources that can be used to avoid or combat stressors and thereby increase a person's health and wellbeing, including general environmental resources, GRRs, and SRRs (see theoretical framework). For this study, environmental resources and GRRs are most relevant, as these are most commonly supplied by NBS and the city of Ljubljana, and most frequently discussed by participants.

The Ecological Zone, being the initial focus of this research, was by far the most frequently mentioned NBS, as participants talked about a wide variety of resources offered by the collection of policies and measures it introduced. Besides mitigating stressors like air and noise pollution and unsafe traffic situations, the transformation of the city centre gave rise to a host of new opportunities to enjoy city life. Street festivals and open-air events could now be hosted in the city centre, and the rearrangements "*opened up the space where [residents] can move, stroll, seat, gather, and enjoy free and safe*." The redesigned riverbanks were mentioned a lot as a new space where people gather and engage in social interaction. *There is*

much more place for cycling, for walking, for just sitting next to the riverbanks. One participant who had only been living in Ljubljana for one month describes: "*I feel way more active since like I got here […] it's so enjoyable to walk, especially in the centre. So it's really helping my physical wellbeing*." Its effects on wellbeing became particularly evident during the pandemic, as the Deputy Mayor explained: "*Especially in the period of the complete lockdown people were forced to get out to stay just in their vicinity or to use public spaces in their surroundings where they could keep a safe social distance*." The municipality also offered a SRR upon the creation of the Ecological Zone. For the elderly and those with mobility issues, who could now not travel by car anymore, the Kavelir was introduced, a number of small electric vehicles that drive people from one side of the city centre to the other for free. This service was much appreciated even by participants who did not make use of it, one describing the vehicles as "*cute*."

Green spaces, especially parks, were mentioned by virtually all participants as a great source of general resources and GRRs, and participants described a whole range of different purposes and ways in which they contribute to their health and wellbeing. Many participants described the effect of green spaces on their mental health, elaborating on how they use them to relax, wind down, and escape everyday life.

> *I would say that the green zones help me personally, because I can have an escape way of some sorts in Ljubljana as well. When I'm learning for example, and I need just a place to relax, I can go there, just sit on a bench and just enjoy nature, a little bit more cleaner air as well, I see some more animals there like birds and so on so forth. And that has truly, as I said, a therapeutic effect to people.*

One participant often visited Tivoli Park, the biggest park in Ljubljana, to meditate. This park was also a popular place for participants to socialise and to connect with nature by observing birds and other animals.

> *I feel the city of Ljubljana has really got the parks down, because you can see parks all around the city, in which you can walk through, kind of enjoy the nature, the birds. […] And also Park Tivoli is truly big. It's used by a lot of people to walk their dogs, to just hang out. In the summer, a lot of people go here with drinks and carpets and they enjoy themselves there.*

Other participants described green spaces as great places for exercise, both because of the many walking paths and the fitness supplies installed by the municipality. Furthermore, green areas are utilised by participants to escape the aforementioned heat stress. "*Two thirds of the*

city of Ljubljana are basically green areas, parks, forests, so basically places where you can take shelter in the summer months when the heat is overwhelming." The city also provides SRRs in parks, namely through initiatives that incorporate outdoor activities into their programmes, for example for the elderly or those who suffer from mental health issues.

Other NBS and related projects that function as GRRs to residents of Ljubljana include urban gardens and Library under the Treetops. The Senior Advisor of Development projects explained that the urban gardens throughout the city have proven quite popular. Not only does it provide locally grown food, which another focus group participant also described as very important, it fosters social connections as well: "*There are people who didn't know each other, but they started talking there, they get picnics also*. *You have the same interest and then you very quickly find the common ground on different areas*." Another project called Library under the Treetops was described by two participants as being a great initiative for people to read more while enjoying being outside. "*It also kinda makes people sit together even if they don't talk to each other.*" Finally, although not technically a NBS, the shared bicycle system, called BicikeLJ, was praised by many experts and participants alike, as well as the overall bicycle-friendliness of the city. "*Another positive aspect it's like how bike friendly the city is. Like the bike lanes and like the service of bike sharing is provided. It's cheap. It's everywhere. It's easy – extremely easy to use*." "*It gives me the possibility to kind of explore a little bit more, go back at night home, considering that there is no buses and I live in kind of like outside the centre*." "*It's also like helping me to be more active and move around the city in an easier way.*"

5.4 Sense of Coherence

The aforementioned resources contribute to greater health and wellbeing in multiple ways. The findings related to this process will be presented according to the three components of the SOC: manageability, comprehensibility, and meaningfulness (see theoretical framework), all of which were found to be affected by NBS in Ljubljana.

5.4.1 Manageability

The introduction of the Ecological Zone gave a boost to manageability of life in the city centre in a multitude of ways. Before pedestrianisation, there were many stressors and fewer resources to deal with them. The participants who had experienced the city centre before 2006-2007 all agreed that the Ecological Zone significantly increased comfort and safety in the city centre, and participants who had moved to Ljubljana after the

transformation also stated that they experienced high levels of comfort and safety here. "*From like a student newbie-in-the-city point of view, it makes the city feel safer, like especially the centre, like, I don't know, it feels like more than most, a safe place where you walk, get distracted, there's no cars*." One of the experts recounts: "*Our mayor always wants to say that the city centre, this ecozone, is like a room at your home where you feel comfortable and not being endangered by anybody*." Besides safety and comfort, the Ecological Zone provides convenience, as participants describe it as easy to move around; this includes less-mobile residents and tourists as well, for whom the Kavelir is available. Most participants find this to be true for the whole city, with one major exception being the bus system. While most experts spoke neutrally or positively about the buses as an alternative to cycling or driving, several focus group participants complained about bad connections and poor organisation of the bus system. One participant turned it into something positive: "*I also don't quite enjoyed the buses, but this is actually pushing me to use more the bikes. […] the negative aspect of the public transportation makes me like live a healthier life in the city*."

The transformation of the city centre, including pedestrianisation and the revitalisation of the river banks, also led to an increase in tourism and had an effect on Ljubljana's economy. The Deputy Mayor describes: "*As expected, the improved quality of open-air life along the river fostered sociability and stimulate economic revival of the place*." Before the introduction of the Ecological Zone, shopkeepers and restaurant owners feared for the loss of customers if people were no longer able to reach them by car, but the Deputy Mayor explained that the opposite happened.

> *Owners of restaurants see more benefits taking into account the extension of their gardens, especially, when right at the beginning, the footfall in the area increased enormously. […] traffic restrictions opened the place for restaurants gardens, which revived most the city life, enabling the city tourism to flourish.*

The effects on manageability for the residents were diverse. The Sustainability Manager of Tourism Ljubljana described that some residents are writing about "*a mass of tourists, that they cannot move*," that "*the prices are higher than it was*," and that "*Ljubljana is becoming like Disneyland*," but they also pointed out that there are positive aspects to the rise in tourism: "*A lot of people also employed because of that and we develop some things, the awareness is raising, the cultural parts are renovated, and so on...*" Interestingly, none of the focus group or individual interview participants mentioned tourism as a cause for better or worse wellbeing, but rather as a positive consequence of NBS, describing the bicycle system

as tourist-friendly or stating that the high number of trees make the city more friendly for tourists.

Green spaces in the city also support manageability in many ways, by regulating the environment and offering a variety of resources to cope with tension and live a healthier life. Green spaces, and trees specifically, improve air quality, attract pollinators, provide shadow, and alleviate heat stress. "*There are so many trees and nature in the city. Especially Tivoli Park. I feel like it's way colder than the rest of the city. So it kind of may give some relief of the weather*." Furthermore, larger green areas were said to offer resources for a healthier life, such as opportunities for exercise, socialising, and relaxation. The fact that in Ljubljana these areas are numerous and easily accessible adds to their potential to enhance its residents' manageability. "*I really like in Ljubljana that the green areas are really really near to the centre and you can enter the green areas so fast*." "*There are lots of […] green areas that enable us to interact with the nature and […] they are in some cases very well equipped, so they actually present also nature-based exercise on the doorstep of the city*."

5.4.2 Comprehensibility

Comprehensibility was not a major theme in the focus group discussions but was implicit in the understanding that NBS provide resources. In addition, comprehensibility – or a lack thereof – was commented on negatively with regard to infrastructure. Despite the fact that the pedestrianisation of the city centre resulted in a safer and slower area in which pedestrians can move around more easily, something which all participants agreed on, the changes also caused some confusion. This was especially felt in the shared spaces, where pedestrians, buses, and cyclists share the roads. A focus group participant explained:

> *This is something new introduced to the citizens of Slovenia. So I think that there is still confusion in pedestrian area. […] We are not used to mix the traffic. So it means that everybody is not organized. We are, I don't know, pedestrians don't take care of cyclists and vice versa.*

The Sustainability Manager at Ljubljana Tourism also elaborated on this: "*There are some rules saying that right in the city centre you can cycle with [the same] speed as you can walk, but sometimes this doesn't really work. […] It can be better arranged*." Other comments on comprehensibility concerning infrastructure in Ljubljana included the poor organisation of the bus system, walking paths not being marked well, and traffic lights with long waiting times and insufficient time for pedestrians to cross. Furthermore, the waste separation system was described as confusing and "*not user-friendly*," discouraging people from recycling

properly. Positive comments regarding comprehensibility were made as well, especially with regard to bicycle lanes and the BicikeLJ system. When asked about NBS and comprehensibility directly, the individual interview participant commented that nature "*makes us better comprehend the real life, because it makes us calm down, stop and look at trees, birds and so on so forth, for a moment, and it slows down the pace of life to a bit. So we are more in the moment*."

5.4.3 Meaningfulness

Participants described many ways in which NBS enhance meaningfulness. The city's image, the appearance and identity of Ljubljana, are generally regarded as highly positive, especially with regard to NBS. The Ecological Zone serves as a great example since the city centre and its old town largely decide the city image of Ljubljana. The Deputy Mayor explained: "*Pedestrianisation contributed a lot to the architecture of the city to enrich its identity. The most important cultural benefit is the new image of the place, where architecture is exposed, and where a sense of freedom and relaxation is felt*." A focus group participant who moved to Ljubljana a year and a half ago concurred: "*Every time I went to the city centre, like the old town, somehow I always felt so happy just walking around there, how beautiful it looks like. And for some reason I feel like home here*." According to some participants, a contributing factor to the city's attractiveness is the fact that it is clean and well-maintained. "*I think it appears to be clean, so this kind of like, since it drives someone on its own to like be respectful of the same place and keep it clean*." The most frequently mentioned factor, however, is the abundance of greenery, which is said to make the city appear more friendly. "*So this is something that I think it's really a rich element and we have a lot of forest. Forest is really very strong in the city and it is also very well kept. We take good care of it*." This image is also extended to tourists visiting the city, as the Sustainability Manager at Ljubljana Tourism states that they "*promote [urban nature] as a special part of the city*."

> Green spaces also create meaning on a deeper level, as one interviewee philosophised: *We need a sort of nature element because it brings us certain elements that are missing from our lives and cities. They bring us home as they kind of connect us with our inner selves, they make us improve ourselves. So I think it gives a certain amount of meaning also to our lives.*

The intrinsic value of nature became especially evident when participants discussed biodiversity. They described how they enjoy observing animals, and how simply looking at birds, bees, and flowers had a positive effect on their wellbeing.

> *I see birds everywhere. I don't know if that's any different to other cities, but I like observing them and this is also nice in Tivoli […] they have also birds there and swans and ducks and they have their nests there. And well, it's nice that there is a possibility of seeing all this nature inside the city.*

The same participant described how they enjoyed watching nutria in the Ljubljanica river, to which another participant responded: "*Many people feed them and they feed them with very good vegetables, carrots and salad. […] People are getting used to them and children are getting to know the nature and how, you know, they're very connected to them*."

Besides biodiversity, meaningfulness is also created through social interaction, for which NBS and other green spaces provide plenty of opportunity. As explained before, most participants agreed that NBS and green areas in general provide valuable spaces and situations that foster social interaction. Not only does it bring Slovenian citizens together, it also functions as a meeting space for different cultures.

> *I have went to clubs in the past and then we just went to a park and we met Erasmus students from I don't know, Australia, Norway, and other countries, and we just for like, for half an hour, exchanged some experiences. I think this opens minds to people about different cultures and so on so forth, which makes you a more open person.*

Other NBS also allow for engagement in meaningful educational activities such as learning how to grow your own food and take care of bee colonies. The Ecological Zone offers space for engagement with arts, music, and sports as well: "*Reoccupied public places, available for everyone, offer possibilities for street festivals, performing open-air cultural events, summer festivals, sports events*." Finally, another category of meaningful activities is participation, which will be elaborated on in the next section.

5.5 Collective Sense of Coherence?

In this section, four main concepts from the NBS literature will be utilised to present the data relevant to the exploration of a potential collective SOC: participation, social inclusion, social cohesion, and social justice. The discussion chapter that follows will then further elaborate on the concept and on the question how NBS may contribute to a collective SOC.

5.5.1 Participation

Participation enhances meaningfulness on the individual level, through the provision of positive choices, but also has the potential to improve wellbeing on a larger scale. Two types of participation were mentioned by employees from the City Administration, mainly with regard to the implementation and improvement of NBS: political participation and community participation. During the planning and implementation of the Ecological Zone, which would have a large impact on many residents and their daily routines, citizens were closely involved in the process through the framework of the European project Civitas Elan (ELAN, n.d.). Citizens were also allowed to vote on the closure of certain streets. In the beginning, there was a lot of resistance against the ban on cars, but as the municipality slowly introduced the measures in a step-by-step manner and residents experienced the benefits, support grew to the point where the pedestrian area is still expanding today. "*It's been a decade now and none of us can really imagine cars ever staging a comeback in the city centre*." Other avenues for political participation involve open meeting opportunities with the mayor which occur several times a month, and the possibility for citizens to submit ideas and initiatives to the municipality. These initiatives often involve requests for more greenery and several of those have been implemented.

Focus group participants did not speak much of political participation, and few had actually participated in community initiatives like the ones described above. When they spoke about participation in NBS, this predominantly meant using green spaces or participating in NBS projects set up by others. They explained how they participated in the Library under the Treetops project or walked the Bee Path for example, both of which were described as "*super*" initiatives. However, some participants admitted that they never actively participated in initiatives and events like these, but merely acted as a user of NBS and other green spaces by simply visiting the park or enjoying the Ecological Zone.

5.5.2 Social Inclusion

Social inclusion is extremely important to the municipality, stressed several employees of the City Administration. Many examples were given by these experts but also by other participants who supported this statement. Besides encouraging citizens to participate in political processes and local initiatives, the municipality actively tries to include vulnerable groups in NBS. The elderly are supported by the Kavelir in the Ecological Zone, playgrounds with NBS are designed for children, immigrants are included in sustainability projects of the tourism office, mental health programmes encourage participants to make use

of green spaces, and an accessibility project transforms tourist attractions to become more accessible for people with disabilities. In addition, the City Administration actively promotes the mixing of social groups by ensuring the city centre consists not only of shops and restaurants, but also of offices, NGOs, and other types of institutions. University faculties are spread out across the city in order to avoid students being separated from the rest of society. Participants of focus groups and the individual interview stated that the low price of the BicikeLJ bicycles (3 euros for a year's membership) and the free accessibility to green spaces contribute to social inclusion as well. As the Sustainability Manager of Ljubljana Tourism stated: "*Nature-based solution means that every space of the city is for us*."

5.5.3 Social Cohesion

As previously established, NBS create opportunities for residents to come together and meet new people. NBS, like the urban gardening project, LIVADALab, and the various bee projects, connect people via a shared interest in nature, and parks and the Ecological Zone in the city centre provide spaces for people to relax and socialise, enhancing social cohesion.

> *In Ljubljanica, so for example, there are green zones as well, along Ljubljanica, where people meet in the evening and there's just the atmosphere which is quite recognizable and quite friendly. When you go through it, where people just see each other, everybody's having a great time, and thus it lubricates social interactions to a better degree, I would say.*

A significant degree of social cohesion and a shared sense of identity was illustrated by the fact that many participants, both experts and focus group participants, expressed pride about Ljubljana's urban nature and its status as a European Green Capital. On multiple occasions, comparisons were made between Ljubljana and other less green European cities, often accompanied by statements that these cities could learn something from Ljubljana and its many green spaces. Various experts believed that the large turnout to city events, such as the Ljubljana marathon, the remembrance walk, and the spring cleaning event For a More Beautiful Ljubljana, is an indicator of high social cohesion in Ljubljana as well.

Negative comments concerning social cohesion were made as well. One focus group participant felt like Ljubljana is losing its social identity as a result of Slovenians from outside the city coming into the city with different habits, *"not [using the city] as a place for actual living*." The Senior Advisor of Development Projects commented on this trend as well:

> *We have around 140,000 cars coming inside Ljubljana every day […] A lot of jobs are here, of course we completely understand it, but we would also like to keep people inside Ljubljana and give them the opportunity to enjoy also cultural life, also evenings, and so on. Not just work here and then go in the village but enjoy the good area and the greenery.*

The previously-mentioned focus group participant argued that more emphasis should be put on relationships between people: "*We just see the environment as this environmental issue, not the social issue*." According to this participant, Ljubljana is not socially mature enough to make optimal use of its nature-based resources. "*So the interaction, even though the environment allows it, the social component does not actually support it*."

5.5.4 Social Justice

Social justice was an important topic in the implementation of several of Ljubljana's NBS, most prominently the Ecological Zone, as the Deputy Mayor recalled:

> *The carefully planned participation strategy had the greatest impact on changing the travel habits of residents who were forced to replace their personal cars in front of their homes for walking, cycling and using special transportation services. Compared to other residents they felt deprived.*

Therefore, the municipality introduced several compensation measures, including cheap parking in a city-run underground garage near the pedestrian zone, access for delivery vehicles every day between 6 and 10 a.m., and the Kavelir service. "*Local residents are satisfied with the compensation for lost parking spaces. The majority are satisfied with the changes in their surroundings, especially with the new cityscape with additional green arrangements.*" Equality and social justice were also considered in the planning of the urban gardens by placing similar-looking wooden sheds in all the gardens throughout the city, "*so that it looks that one does not have a house on the garden, the other one doesn't even have a shed*."

This equality between neighbourhoods is an important topic for the City Administration, yet not all focus group participants experience it this way. Although the open access to Ljubljana's green spaces is appreciated by all, some felt that certain areas receive less attention and investments than others.

> *I feel like there is a strong difference regarding like how green the areas are, depending on- like, the centre is really green. The area we also live in, I think Bežigrad, […], like it feels really different, that there is less attention to environment.*

In addition, two participants complained about rent prices having skyrocketed in the city centre, forcing one of them to find housing elsewhere in the city.

> *The quality life is changing as well for all the normal people in the city centre because of the Airbnb and foreigners, who are rich foreigners, they are buying the properties and the rents are going up. So a lot of people have to move to suburbia and a lot of flats in old Ljubljana and also where you are, […], are for the rich people.*

5.6 Relation to the Environment

In this final section, findings will be presented on the relationship of participants and residents of Ljubljana more widely with their urban environment, followed by a presentation of data that may support or reject the existence of a reciprocal relationship between health and wellbeing and the environment, which will then be discussed further in the next chapter.

5.6.1 Residents' Relation to Their Environment

Several participants stated that Slovenians traditionally have a strong connection to nature. Especially in the expert interviews, this relationship was emphasised, often as an explanation for the many green spaces in Ljubljana.

> *I must say that Ljubljana is a really green city […] Slovenians are all, you know, connected with nature. So it was always very natural to have a lot of trees or grass or, I don't know, some green parts of the land where we can spend our free time.*

When discussing parks, this participant also commented: "*It's not so hard to explain or to put inside, because it's so natural for us.*" Another expert agreed: "*It's quite important for [residents] to have greenery*," and then explained that "*Ljubljana people are quite, very, sensitive if we have to cut the trees down*," even if they are sick. One of the focus group participants perfectly exemplified this:

> *They say that they are not healthy anymore. And so they are cutting them and they will put new small ones. But we, as a local, we see the trees. We know that this is not true. This is a big lie. This is a big business for them. It's only a business. So let's cut the old trees that we will put new ones, small ones, without any shadows. We will need another 20 years to get the shadows, and on […] the other hand, they are trying to tell us that global warming is going on, that we need to cherish and keep all the old trees because of the big tree gives you less heat. You got my point? So this is my health and wellbeing problem lately in in Ljubljana.*

Besides trees and green spaces, that the statement was made that "*in Ljubljana, we are famous for loving to garden*." A focus group participant explained the traditional importance of the local food supply in Ljubljana:

> *What I like really in the city is that we still have this strong local food supply. It is traditionally present so we have it here and we have these central markets with local food and we have a lot of […] farms, and this is really strong connection.*

Moreover, it was stated that "*Ljubljana is quite connected with the bees and with honey*," which becomes evident from the many well-received NBS and other initiatives related to bees in the city. A focus group participant expressed the importance of pollinators to them: "*If I see the pollinator, that means that I will have food. And if I see the pollinators and I know that this is very healthy, healthy place to be*."

Still, when it comes to residents taking care of their environment and general awareness about environmental issues, mixed opinions were presented by focus group participants. Some said that most residents are quite aware of environmental issues, in line with the data presented above, and two participants who came from abroad were particularly impressed with how clean and well-maintained Ljubljana is. Slovenian participants were more critical, however, as one of them complained that some residents still burn their plastic waste and that, especially among the older generations, awareness and respect for the environment is lacking. "*But younger generations, especially children that are taught about this selection of waste and everything from the kindergarten onwards, it is completely different. So they are actually teaching their parents to do good*." They also commented that residents are now picking up after their pets, which did not happen much before. Overall, the participants of this study all seemed to value their environment and were conscious of their role within it, as best summarised by one interviewee: "*We take good care of the environment - the environment will take care of us*."

5.6.2 A Reciprocal Relationship?

Determining whether a reciprocal relationship between NBS and health and wellbeing exists involves exploring whether the statement above is also true in reverse. If the environment contributes to an individual and/or potential collective SOC (*takes care of us*), would that contribute to residents taking better care of their environment? The clearest example of impacted behaviour on an individual level was provided by a focus group participant: "*The fact that it's so well-maintained […], this kind of like pushes you to keep a higher standard when walking in the city, being in a park. I think that's also how it's*

influencing my behaviour." This appears to be true for spending time in green areas as well, as appreciation for nature increases when more time is spent within it. One interviewee described this phenomenon, using their hobby, mountaineering, as an example. "*I truly look forward to going to mountaineer every Sunday, every week, because it's given me such health effects, and thus I value nature a bit more as well as this activity*." They then confirmed that it works the same way with NBS in the city. When experts were asked about this relationship, they were hesitant to speak for all residents, but focus group participants generally agreed; a clean, well-maintained city centre and an abundance of urban nature and biodiversity makes residents further appreciate their environment, interact with it more, and take better care of it.

There were also indications that political and community participation contribute to an enhanced relationship with nature. Experts explained that when the municipality started implementing various NBS, residents and communities responded by calling for even more greenery. The aforementioned citizens' initiatives often involved requests for more trees and green spaces. "*We have a lot of initiatives where should we plant new trees, for instance, in the neighbourhood, because [residents] see it really on the micro level, what they are missing over there*." Another expert repeated this: "*We also have feedbacks as suggestions where more to have some areas transformed and created as forests, public green spaces and so on*." After experiencing the benefits of NBS, residents also took matters into their own hands to realise even more urban nature in their direct environment:

> *I know that some communities, where there are a block of apartments, they connected among themselves, and started to arrange their spaces in front of their buildings. So really, in their local local, where they actually live, that was for sure a consequence of the whole city's strategy.*

Another expert describes more community initiatives:

> *[…], so they also redesigned the whole park in front of their school for instance. Then on the city market, we have a special, where usually it was a drinking fountain but it was just grass in between. And one of the citizens came up with the idea that she would help plant a little herbal garden, where also citizens can take the garden and she would take care of it.*

The reciprocal nature of this relationship between the health and wellbeing and residents' perception and treatment of their environment will be discussed along with the other findings in the following chapter.

Chapter 6: Discussion

6.1 Introduction

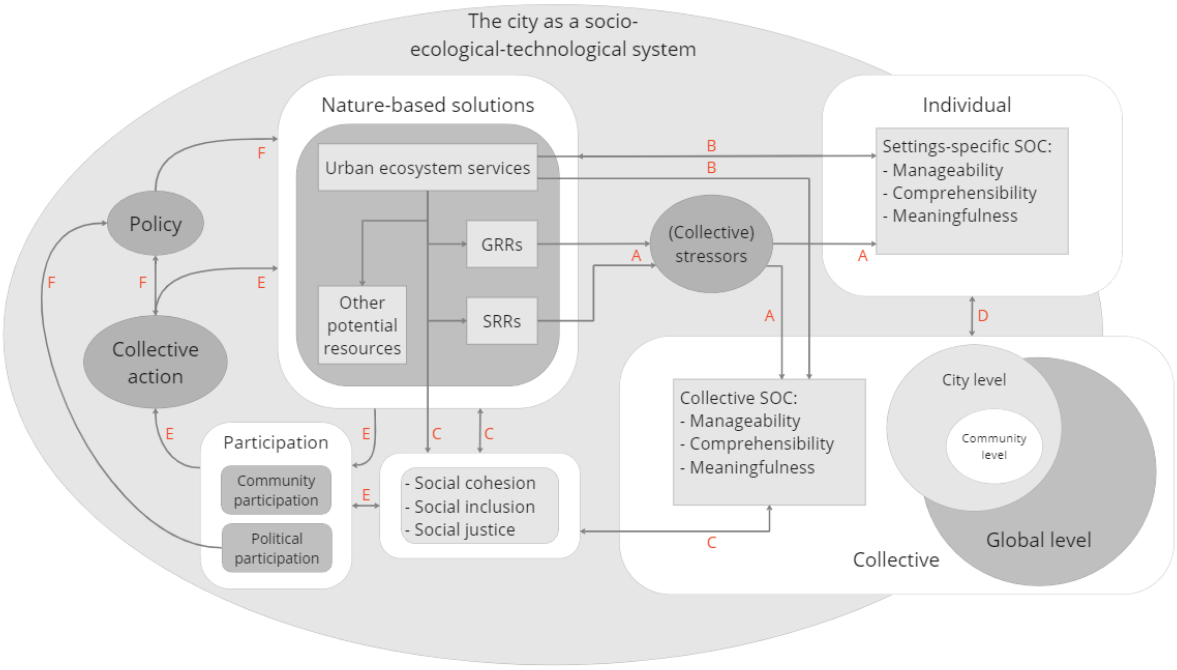
In this chapter, the findings presented in the previous chapter will be discussed in depth, applying the theory of salutogenesis and discussing additional literature for contextualisation. The discussion of this study's findings could have taken several directions due to the richness of the collected data. In-depth discussions could be written purely on the parks of Ljubljana, walkability and the effects of pedestrianisation, or successful planning and implementation of NBS. However, the findings also provide a rare opportunity to build upon the theory of salutogenesis and especially to develop the concept of a collective SOC, which will be the main focus of the following discussion. Using the salutogenic model, including elements such as the setting-specific SOC and the collective SOC, the city of Ljubljana will be approached as a social-environmental-technological system. Within this system, NBS provide UES, which can be utilised by individuals and the collective as GRRs and SRRs. The concepts of social cohesion, social inclusion, and social justice form the basis of the discussion on the collective SOC, after which participation and collective action will be discussed to explore the reciprocal relationship between NBS and collective health and wellbeing. Figure 1 summarises the relationships and feedback loops between these concepts within the city as a social-ecological-technological system. Reference will be made to elements from this model throughout the chapter and an expanded version can be found in Appendix H.

6.2 Stressors in the Urban Environment

The first objective of this study is to explore shared perceptions of environmental threats and stressors in Ljubljana. In salutogenesis theory, stressors do not necessarily impact health and wellbeing in a negative way. Negative effects can be minimised and even positive effects can be generated, enhancing health and wellbeing, when the right resources are available that are then used effectively to deal with the stressor. Despite a dearth of salutogenic research on environmental stressors in the context of cities, the findings can be compared with those of studies conducted in fields such as climate resilience and urban planning. Doing so leads to no real surprises, as the stressors identified in this study in Ljubljana are commonly found in cities all over the world and well-known both in academia and policymaking. Natural stressors like heat stress and flooding are exacerbated by climate change and are therefore an important topic in the climate resilience literature as well as a

Figure 1

Model depicting the collective SOC in a settings approach using the city as an example



critical target for NBS. Air pollution, pollution of urban blue spaces, and noise pollution are challenges with which most cities struggle, just like unsafe and chaotic traffic situations. As evidenced by the findings of this study, the vast majority of stressors were found to have diminished to a certain extent or even disappeared altogether as a result of the implementation of NBS and related measures (see Figure 1, A).

Important to note is the collective nature of all the stressors listed above. Antonovsky (1996b) described these types of stressor: "a given stressor […] poses a threat (or challenge) to a definable collective. On the other hand, the stressor can only be coped with successfully by a collective" (p. 177). Although many of these stressors have been addressed in Ljubljana, and are being coped with by the collective, this mostly happened on the hyper-local level, sometimes moving the stressor from one location where the NBS were implemented to another location nearby. This shows the importance of assuming a systems approach to NBS, as is often called for in the NBS literature, considering the city and its environment in its entirety and tackling challenges making use of potential co-benefits and synergies between solutions and weighing trade-offs carefully (Liu et al., 2021; Raymond et al., 2017; Van den Bosch & Ode Sang, 2017). Overall, the evidence from the expert interviews shows that the City Administration of Ljubljana is already approaching most of its NBS and climate

resilience projects with a holistic perspective, which is demonstrated once more by its current participation in the EU Mission of 100 Climate-Neutral and Smart Cities and as a Pilot City in the NetZeroCities Programme (EC, 2022; NetZeroCities, 2023). The strength of the synergies and co-benefits generated by this holistic view became apparent when several experts clarified that the main reason for the implementation of most NBS in Ljubljana was climate resilience, and that improved health and wellbeing was simply an additional benefit. Nevertheless, participants were able to list a great number of resources provided by NBS that they believed improve their health and wellbeing, which will be discussed in the following section.

6.2 Resources Provided by Nature-Based Solutions

The second objective of this study involves the exploration of perceptions of the general resources and resistance resources offered by NBS in Ljubljana. Each NBS mentioned in the data was associated with multiple resources that held the potential to improve residents' health and wellbeing. Especially the Ecological Zone, being one of the largest NBS in Ljubljana regarding surface area, and Tivoli Park, technically not a NBS but containing all the supporting natural benefits, were found to supply a wide variety of resources ranging from combatting stressors like air and noise pollution and heat stress to creating more opportunities for social interaction, exploration, and exercise. Even smaller NBS projects, such as the urban gardens, which appear to have the one simple benefit of growing local food, were found to generate benefits ranging from increased social cohesion to providing meaningful educational activities. Comparing these health outcomes to the NBS literature shows that virtually all resources identified in this study have been listed as potential benefits of NBS before, though the focus of these findings is slightly different (Raymond et al., 2017a). Interestingly, almost all of the health and wellbeing benefits reported by the non-expert participants of this study were expressed from a salutogenic perspective, despite them not being familiar with the theory nor having the researcher mention or explain the concepts. Participants spoke about urban nature contributing to their health and wellbeing in various ways but hardly about it curing or preventing disease. This is a divergence from many studies on urban nature and living environments that focus mainly or solely on physician-assessed morbidity and other pathogenic health outcomes (Maas et al., 2009; Van den Bosch & Ode Sang, 2017) and even from studies that provide a more balanced list of pathogenic and salutogenic health indicators (Kabisch et al., 2016; Raymond et al., 2017a).

The salutogenic nature of the findings demonstrates the adequate fit of the theory of salutogenesis to the topic of NBS and the importance and applicability of the settings approach within this theory. Although there is a strong established connection between the settings approach and health promotion, the salutogenic model, including its concepts of stressors, GRRs, SRRs, and SOC, has hardly been applied to settings like cities or living environments more generally (Bauer, 2022).This study, however, demonstrates that these concepts can be applied effectively to a case like the city of Ljubljana. One of the main challenges in doing so involves determining which environmental resources, or UES (see literature review) qualify as GRRs and SRRs, and which are simply other potential resources. Since GRRs are any characteristic of a person, group, or the environment that can be used to avoid or combat stressors and thereby increase a person's SOC, it would seem like most resources described by the participants fit the description. However, whether environmental resources become GRRs depends on whether or not residents make use of them – internalise them – which is not always easy to determine (Maass et al., 2017, p. 172). Throughout the data, the line between general resources and resistance resources is blurry. In some instances, participants clearly indicated that they make use of a resource, stating for example that they utilise a park for meditation and a bicycle to get around more easily, but in other cases they acknowledged the benefits of nature only when asked about it, indicating no active use of the resources, and making their potential to contribute to the SOC seemingly weaker at that point in time.

The fact that not all benefits provided by urban nature are purposefully sought out by residents is not a weakness of NBS, however, but rather a strength. As described in their definition, NBS "simultaneously provide environmental, social and economic benefits and help build resilience" (EC, n.d.). The versatility and sheer number of UES that are offered by NBS, which is illustrated once again in the findings of this study, is what makes them so attractive to policymakers and effective in combatting urban challenges. Not only do they have the potential to tackle issues of climate change and human wellbeing at the same time, even when considering wellbeing independently, they offer a wide array of resources. From a salutogenic perspective, this could mean that a person visits a park, for example, to escape the heat on a hot summer's day. The park then becomes a GRR, because she utilises it in order to find relief from a stressor, namely the heat (Figure 1, A). However, spending time in the park could deliver a host of additional, perhaps unintended, health benefits. As previously established, these include relaxation, social interaction, opportunity for physical activity, and

enjoyment of a rich biodiversity. Thus, while the person in the example came to the park to escape the heat, she might find herself feeling more happy and relaxed, she might run into some friends, or simply feel healthier because the air she breathes is cleaner and she moves around more than she otherwise would (Figure 1, B). This perfectly exemplifies the strength of NBS and simultaneously demonstrates how a stressor can in fact lead to a move up the salutogenic scale if the tension they cause is dealt with in a constructive way.

6.3 The Sense of Coherence

6.3.1 Setting-Specific Sense of Coherence

A move up the salutogenic scale toward the "ease"-end of the continuum occurs when the aforementioned resources alleviate stressors, preventing tension from being transformed into stress, and thus ultimately contribute to a greater SOC. Simultaneously, a strong SOC empowers a person to utilise resources effectively and turn them into GRRs. This process involves the three components of the SOC: manageability, comprehensibility, and meaningfulness (Eriksson, 2022, p. 65). Manageability is the behavioural component that involves the belief that resources needed to cope with stressors are available; comprehensibility is the cognitive element that describes how well an individual believes to understand the world around them and thereby the challenges within it; and finally, meaningfulness entails the wish and motivation to cope with challenges (Eriksson, 2022, p. 66). The stronger these three components are, the stronger an individual's SOC. The ways in which NBS contribute to manageability, comprehensibility, and meaningfulness in Ljubljana have been described in the previous chapter based on shared perceptions of individual participants. Although participants disagreed on minor details and prioritised different aspects of NBS in their answers, there was a general consensus about NBS contributing positively to their health and wellbeing. This is in line with the previously-described settings approach. The findings of this study do not only evidence the relevance of urban nature to the individual's SOC, but they also contribute towards an understanding of what Bauer (2022, p. 278) describes as the *setting-specific* SOC. This setting-specific SOC is context-specific as it varies for one person across settings and therefore depends upon setting-specific resources, such as those offered by NBS in Ljubljana.

The relationship between the individual SOC and the settings-specific SOC can be better understood when looking at settings as social systems (Bauer, 2022, p. 279). Antonovsky adopted systems theory thinking as well, describing individuals in interaction

with their environment and context (Eriksson, 2022, p. 91). However, a missing link remains in this salutogenic system – namely the social or group element. Tan et al. (2020) developed a conceptual framework linking natural and human-derived capital to human health and wellbeing through the provision of UES (Figure 2). As described earlier, the findings of this study have shown how NBS provide a wide range of UES, all of which could be classified as either natural capital or human-derived capital. The natural elements of NBS described by participants include biotic components such as trees and other green spaces and the presence of a rich biodiversity, which generate UES such as climate regulation and nature recreation. Human-derived capital is supplied by NBS in the form of built and financial capital, for example the updated infrastructure in the Ecological Zone and investments from the City Administration, but also human capital, cultural capital, and social capital, which will be elaborated upon in the next section. Through the provision of UES, generated by all these forms of capital, benefits to human society are achieved, which contribute to urban sustainability and liveability. These, in turn, connect back to the input of capital through a feedback loop of policies, practices, and norms.

Figure 2

Conceptual framework linking capital to human well-being through the provision of UES, adopted from Tan et al. (2020, p. 6).

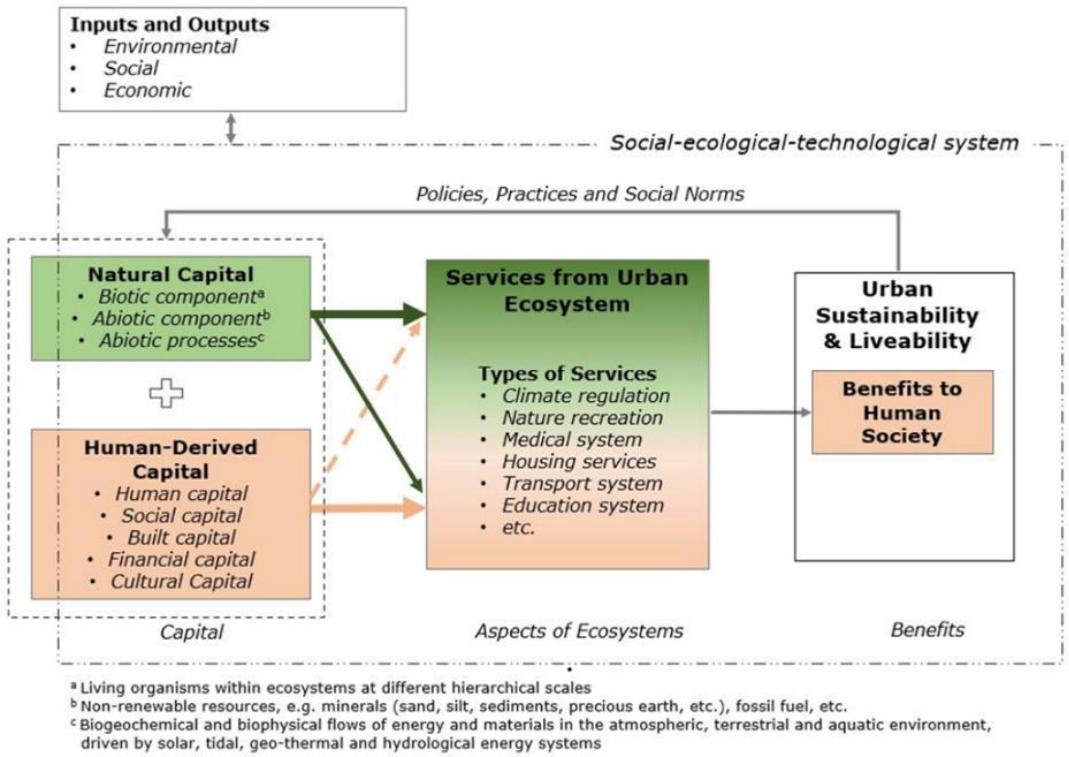


Fig. 3. Conceptual framework linking natural and human-derived capital to human well-being through the provision of services from urban ecosystems. The green arrows of different thickness represent varying levels of natural capital input to generated UES, and the beige arrows reflect input of human-derived capital. The dotted line indicates an indirect input, and solid line indicates a direct input. The colour gradient from green to beige denotes that UES is produced through a combination of capitals, and the extension of capital outside urban boundary indicates cross-scale flows of capitals to produce UES.

Tan et al.'s (2020) framework describes cities as social-ecological-technological systems, in which NBS and environmental resources contribute to human health and wellbeing, just as predicted by the settings approach in salutogenesis. UES can be utilised as GRRs, SRRs, or serve as other resources, which could contribute to greater wellbeing by strengthening the SOC. The system's elements not yet clearly described by the theory of salutogenesis, however, include the social and cultural forms of capital, how UES lead to benefits to human society as a whole, and how this in turn leads to policies, practices, and social norms contributing to a greater supply of capital. In short, the collective component present in Tan's model is lacking in the theory of salutogenesis. For salutogenesis to accurately describe health and wellbeing in settings such as cities, a collective SOC concept is required to bridge the gaps in the interaction between individuals and their environment. Antonovsky himself believed that his theory could be applied to the collective and called for more research on a potential group-level or collective SOC, yet the large majority of salutogenesis research still utilises the concept of individual SOC (Eriksson, 2022, p. 91; Hochwälder, 2022, p. 576; Mittelmark, Bull, Bouwman, 2017, p. 45). Many authors have identified challenges in defining a collective SOC, and despite his calls for further research, even Antonovsky (1996b, p. 177) was not convinced of the concept, stating that "to say that 'the collective thinks, feels, perceives' is, I believe most problematic. What is clear to me is that it merits very hard work." With some hard work at its foundation, this study aims to add to the understanding of a collective SOC and dares to argue that the concept is in fact relevant, distinctive, and useful, especially in a settings approach to salutogenesis.

6.3.2 The Collective Sense of Coherence

The main criticism and reason for salutogenesis scholars to avoid developing the concept of collective SOC is the fact that in most conceptualisations, the collective SOC is simply an aggregate of a number of individual SOCs (Antonovsky, 1996b; Bauer, 2017). One of the few developed group-based SOC concepts, the community SOC or sense of community coherence (SOCC), faces the same critique. What distinguishes the SOCC from the individual SOC is that it does not measure whether the whole world is perceived as manageable, comprehensible, and meaningful ("global orientation to the world") but it rather relates to a specific "in-group" (Sagy & Mana, 2022, p. 227). Thus, what makes the community SOC *collective* is not the subject, as this remains the individual, but the object, that which is perceived by individuals as manageable, comprehensible, and meaningful, in this case the community. While this is useful to determine, as will be elaborated upon further

along in this section, this is not the focus of the collective SOC as understood in this study. The findings on social inclusion, social cohesion, and social justice indicate that the resources NBS provide and the way they influence the participants have repercussions on the individual, community, city, and even on the global level. Therefore, in the conceptualisation of a collective SOC, group boundaries are not as relevant as they are for the established SOCC. What matters instead is the way in which the collective perceives and utilises their environment, whether that is a street, community, city, or the global environment. Moreover, although social relations are an essential element in the settings approach, a strong collective SOC is not solely based on in-group relations but signifies an improvement in collective wellbeing as defined from a health perspective (a concept long recognised by a variety scholars and policy makers outside of salutogenesis; Evans & Prilleltensky, 2007; Institute for Collective Wellbeing, 2023; Marujo & Neto, 2017; Roy et al., 2018).

To determine how NBS contribute to a collective SOC, and thereby fulfil the third research objective, a closer examination of the findings on social cohesion, social inclusion, and social justice is required. Kawachi and Berkman (2000) define social cohesion as "the extent of connectedness and solidarity among groups in society" and understand the concept as a "collective, or ecological, [dimension] of society, to be distinguished from the concepts of social networks and social support, which are characteristically measured at the level of the individual" (p. 235). This conceptualisation will be followed in this study and is closely connected with the concepts of social inclusion and social justice. Kawachi (2010) describes the connection between social cohesion and salutogenesis: "By enhancing the capacity of communities to preserve and maintain health, social cohesion sits squarely in the assets based model of health" (p. 167). This link (Figure 1, C) also becomes apparent in the findings of this study. In Ljubljana, NBS provide opportunities for easy, frequent, and meaningful social interaction. The Ljubljanica river banks, the abundance of parks and green spaces, community gardens, city events, and many other locations and initiatives provide spaces for people to meet, interact, and get to know each other, increasing the social cohesion in the city and its communities. Furthermore, social cohesion was visible on a more abstract level, rooted in the shared identity of Ljubljana's residents. This identity includes collective perceptions of their relationship with nature, illustrated by the shared pride in the city's status as European Green Capital and further shown in the perceived importance of locally grown food, green spaces, and beekeeping. Social inclusion, a closely related concept, entails that everyone can share in the benefits of social cohesion. The NBS in Ljubljana are designed for

all residents to use and participate in and special attention is paid to the inclusion of vulnerable groups. SRRs such as the Kavelir and special programmes for the elderly and people struggling with mental health to go out in nature ensure that everyone can enjoy the resources offered by NBS, which in turn enhances the social cohesion in the city and its communities.

Social inclusion does not only benefit the individuals directly involved in the special programmes or the social interactions by the riverside, but also affect the collective as a whole. This is exemplified by the positive attitude towards these resources by focus group and interview participants who did not directly benefit from them themselves. Indications of NBS's effects on collective wellbeing include the Kavelir service being described as "cute" by a participant who had never used it, the bicycle system being called tourist-friendly by a permanent resident, and walking paths being complained about for not being marked clearly enough for first-time visitors by a participant who knew the area like the back of their hand. This indicates that with increased wellbeing of visitors and tourists in Ljubljana, as described by the setting-specific SOC, the collective wellbeing of the city's residents increases as well. This also illustrates how the boundaries of the collective are not relevant for the concept of collective SOC; the collective can consist of anyone in Ljubljana at a given moment, including visitors and tourists, or just the residents themselves, but the effects on health and wellbeing are significant within this setting. In addition, the findings also provide negative examples of the importance of social cohesion and inclusion. The confusion experienced in the shared space of the Ecological Zone, where buses, cyclists, and pedestrians at times struggle to coexist, as well as the discomfort experienced from commuters who do not involve themselves in social life in the city, show the importance of the social component within an environment and why NBS need to provide not only natural and built capital but also social capital in order to maximise their benefits to human society (Tan et al., 2020). Social capital is a contested concept but is understood in this study as a subset of the notion of social cohesion, following Kawachi and Berkman's (2000) definition: "Those features of social structures […] which act as resources for individuals and facilitate collective action" (p. 235). The example above illustrates how a lower collective SOC ultimately hinders internalisation of environmental resources, thereby further weakening the collective SOC. This is supported by the theory of social capital as well: "The stock of social capital is self-enhancing and cumulative. Where a high level of social capital prevails, new social equilibria

with high levels of cooperation, trust, reciprocity, civic engagement and collective health emerge" (Häuberer, 2011, p. 57).

As previously established in the literature review, social justice, or socio-environmental justice, is fundamental to the discussion of NBS and collective health and wellbeing. A clear example of this in the findings is the implementation process of the Ecological Zone in Ljubljana. Leading up to the pedestrianisation of the city centre, there was a lot of resistance from residents who were used to drive their car up to their front door. Banning cars in this area would therefore require a significant change in habits, resulting in the Old Town residents feeling deprived. The compensation measures introduced by the City Administration to ensure social justice for these residents contributed to the eventually successful adaptation to the lifestyle changes. Residents inside and outside of the city centre grew accustomed to the new situation to the point where today, the large majority are satisfied, enjoy its benefits, and would not want to return to the old situation.[1] This example illustrates the interplay between the individual and collective SOC and the role of social justice within it (Figure 1, C, D). Whereas individual wellbeing was negatively affected for a small group of local residents, whose manageability and comprehensibility suffered from the changes, over time, their "sacrifice" enhanced the manageability, comprehensibility, and meaningfulness of the collective in a significant way. This illustrates the importance of social justice and the role that city administrations play in ensuring it when they implement NBS for collective wellbeing. When social justice is lacking, the collective SOC suffers. This is supported by the findings on eco-gentrification. As forewarned in the literature, the introduction of NBS can cause rent prices to increase, thereby forcing households who cannot afford the new prices to find housing elsewhere (Kabisch et al., 2016; Wolch et al., 2014). The findings present support for this, with one participant describing their own experience of being forced to leave her apartment in city centre and another describing that the changing demographic of residents in the city centre deteriorated the quality of life there.[2] This social justice issue does not only affect the wellbeing of the direct victims of eco-gentrification who are forced to relocate, but it also reduces social cohesion due to the consequential changes in the social fabric of the area and thus negatively affects the collective SOC.

[1] One survey demonstrated that *"*94% of respondents support the pedestrian zone*"* (Kotler et al., 2019, p. 11).
[2] It is beyond the scope of this study to determine to what extent the increased rent prices in Ljubljana's city centre were a direct consequence of the implementation of NBS. Presumably, there were many other contributing factors. This, however, does not take away from the negative effects experienced by the participants of this study and the implications for their collective wellbeing.

To properly define the collective SOC, its connection to related terms must be clarified. Bauer (2017) questions whether the concept of collective SOC has additional conceptual value or explanatory power "beyond established concepts of social relationships such as social capital, social cohesion, connectedness, social inclusion/exclusion, sense of community, and collective action" (p. 156). Based on the findings of this study, these existing concepts are not alternatives to the concept of collective SOC but rather elements within the model that explains the collective SOC in a settings approach. Concepts such as social cohesion and social capital can be considered GRRs, and collective action is the mechanism with which resources are used to strengthen the collective SOC, thereby moving the collective towards the ease-end of the salutogenic continuum (Vaandrager & Kennedy, 2022, p. 351). This process lies at the foundation of the next section, in which collective action and its consequences for collective health and wellbeing will be discussed using this study's findings concerning participation. By combining the theories of salutogenesis, urban ecosystem services, and collective action, the model in Figure 1 shows how NBS contribute to both the individual and collective SOC in a certain setting, and the role that the related concepts discussed in the current and the following section play in this process. As the topic of this study is NBS, the model depicts NBS as the source of UES, but the model can be generalised to suit any urban setting by replacing NBS with UES, or, in a non-urban setting, with ecosystem services in general, which are defined as "benefits people obtain from ecosystems" (Millennium Ecosystem Assessment, 2005, p. 53). For a purely salutogenic model, this element could be distilled to include GRRs, SRRs, and other resources only. Based on the presented model, a description can be formulated demonstrating what a strong collective SOC does, thereby approaching a new definition for the collective SOC: A strong collective SOC describes how the collective responds to stressors to the collective in a salutary way by providing and internalising resources on a collective level through collective action, enabled by a strong presence of social cohesion, social inclusion, and social justice, resulting in a collective move towards greater wellbeing.

6.4 The Reciprocal Relationship between Health and Wellbeing and Nature-Based Solutions

The discussion so far has established the effect of NBS on the individual and collective SOC and presented a new model to illustrate this process (Figure 1, A, B, C, D). The interaction between UES provided by NBS and the two types of SOC has been described, as well as the importance of social cohesion, social inclusion, and social justice.

The final objective of this study is to explore a potential reciprocal relationship between collective health and wellbeing and the way in which residents relate to their environment. This would indicate a feedback loop between NBS and the collective SOC. In other words, the question is whether a greater collective SOC could affect how residents perceive, treat, and make use of NBS and urban nature. The theory of salutogenesis suggests that a stronger SOC facilitates a more effective application of GRRs, as the two concepts are interdependent, which could suggest that a reciprocal relationship between NBS and health and wellbeing exists as well (see Figure 1). Tan et al. (2020) also show this relationship in their framework (Figure 2), where "urban sustainability and liveability" contribute to natural and human-derived capital by means of policies, practices, and social norms. The findings of this study support the existence of this feedback loop, and thus a reciprocal relation between collective SOC and the environment. High levels of social cohesion, inclusion, and justice lead to greater participation and thus collective action, which in turn contribute to the internalisation, provision, and maintenance of the resources used to improve health and wellbeing. This process is shown on the left side of Figure 1 and is indicated by the letters E and F.

A strong connection between Slovenians and nature was described in the findings. Residents of Ljubljana feel strongly about the importance of green spaces and other natural resources in their environment. The fact that Ljubljana generally offers a lot of these resources makes residents feel protective over them when threatened and results in them demanding even more greenery. The engagement of residents becomes apparent in the findings on political participation and community participation, both resulting in collective action (Figure 1, E), which is found to be relevant to health promotion in a variety of ways (Kawachi, 2010, 169). Collective action comes in two forms: "a reactive form referred to as resilience and a pro-active form referred to as community action" (Vaandrager & Kennedy, 2017, p. 160). Community participation often involved residents taking matters into their own hands and coming together to create their own local urban greenery, either small-scale among residents of a block of flats or in larger projects involving entire schools and communities. The NBS event For a More Beautiful Ljubljana, in which residents collectively clean and green the city, is an event organised by the City Administration but participated in voluntarily by a large group of residents representing different communities, demonstrating their engagement with their own environment. Political participation related to NBS in Ljubljana was found in the form voting, informal meetings with politicians, political activism against the loss of trees and green space, and formal citizens' suggestions for planting more public

trees, parks, and gardens. Through these political channels, residents can influence policy related to the implementation and maintenance of NBS (Figure 1, F). All these examples show how through collective action, nurtured by a strong collective SOC, residents of Ljubljana protect, support, and develop the urban nature in their environment, either directly through community action or by influencing policies. These findings support Cárdenas et al.'s (2021, p. 9) theory on the circular benefit of participation in NBS (Figure 3). NBS provide benefits to individuals and the collective, as previously discussed, while participation results in higher motivation to support and protect these NBS. The findings from this study take this theory a step further with the findings that NBS lead to a desire for more NBS, thereby going beyond the circular model of Cárdenas et al. (2021) and imagining one that continually spirals upwards instead.

Figure 3

The circular benefit of participation in NBS, from Cárdenas et al. (2021, p. 9)

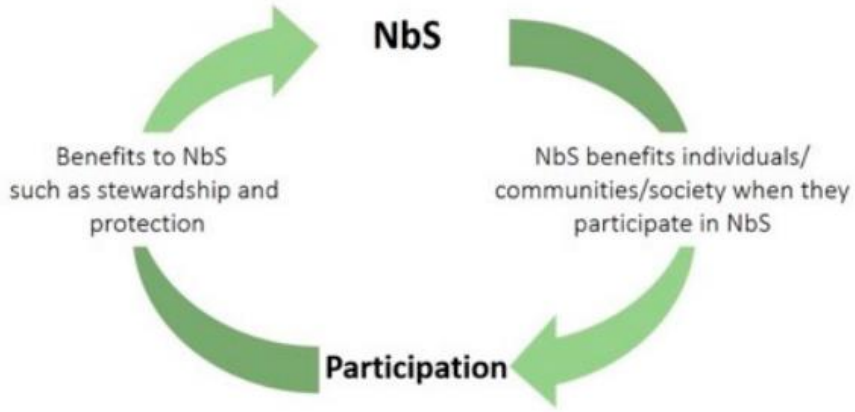


Figure 2. The circular benefit of participation in NbS. Individuals, communities, and society benefit by their participation with NbS in improving their mental health and giving them a sense of achievement and empowerment. At the same time, NbS benefit through improved support, monitoring, mainstreaming, and protection.

A strong collective SOC is indicated by a high presence of participation, which results in the collective action required to protect, maintain, and enhance NBS, so that they in turn can provide the resources that will further strengthen the collective SOC. This same feedback loop can be observed for the individual SOC, where an interplay occurs between the individual and the collective SOC (Figure 1, D). The fact that Ljubljana is so clean and well-maintained was also found to bring about a feeling of collective responsibility to keep it that way, compelling individuals into doing their part to keep the city neat and tidy. Moreover, some types of NBS-related projects are initiated by individuals but generate resources that

add to the collective health and wellbeing of the whole city. An example of this is the initiative to create a herbal garden in the market square of Ljubljana. Anyone passing by benefits from this, either through the active use of the herbs or simply because the garden improves the environment aesthetically. Similarly, not all residents are equally involved in local politics, but policy suggestions from an active few could lead to important changes in the city that could benefit the collective. These findings suggest that a stronger individual SOC or the collective SOC of a small group could create benefits for a larger group and even a whole city, enhancing its collective SOC on the larger scale even further. It must be noted that participation in NBS does not necessarily have to be active for it to generate a reciprocal effect. Although the results suggest that active participation achieves higher returns, they still demonstrate a circular benefit for passive users of NBS. Spending time in natural environments seems to make residents appreciate nature more, consequently making them want to spend more time in nature and take better care of it. This has consequences not only for the direct environment but generates a greater appreciation for nature more generally, extending appreciation and care to the global climate and environment as well.

6.5 Implications for Nature-Based Solutions

The overarching objective of this study involves the exploration of the reciprocal relationship between NBS and collective health and wellbeing in Ljubljana. Based on the findings and discussion presented in this study, it can be concluded that 1) NBS in Ljubljana offer a great range of resources that have the potential to enhance both individual and collective health and wellbeing, and that 2) a reciprocal relationship exists between health and wellbeing and NBS, generating mutual benefits for the environment and its users. The findings indicated, however, that in some cases simply introducing a NBS or a new green space was not sufficient, but that social cohesion, inclusion, and justice, and participation, were necessary to make the benefits extend to the collective. The experts of the City Administration of Ljubljana seemed to be aware of this and all stressed the importance of communication and participation regarding the implementation and maintenance of NBS. NBS are thus not a panacea for health and wellbeing in urban environments but have a high potential to contribute to it, especially in combination with their other benefits to climate change mitigation and resilience. Caution must be observed when applying these findings beyond the context of human health and wellbeing, however. NBS and the related terms used in this study, ES and UES, are anthropocentric concepts that are useful when discussing effects on human health but could be limiting when looking for benefits to the entire

ecosystem, in which case ecocentric approaches are encouraged (Coffey, 2016; Eggermont et al., 2015). Nevertheless, these views can be complementary and NBS could play a constructive role in connecting the two approaches. After all, the findings of this study suggest that human health and environmental health are reciprocally linked.

6.5.1 Nature-Based Solutions and Global Development

The findings of this study indicate a significant contribution of NBS to several SDGs, as predicted in the introduction and supported by Pinter and Almassy's descriptions (2022, see Appendix A). Although the potential of NBS to contribute to the SDGs has been widely recognised, the literature on NBS still calls for more research on the synergies and trade-offs of the different benefits of NBS (Liu et al., 2021; Raymond et al., 2017b; Semeraro et al., 2022). The findings and discussion of this study have implicitly touched upon these, but it is useful to describe the connections between benefits in terms of the relevant SDGs. As previously mentioned, NBS have the potential to contribute to many different SDGs, with goals 3 (good health and wellbeing), 11 (sustainable cities, and communities) and 13 (climate action) consistently mentioned as directly relevant to NBS, and goals 2, 6, 10, 14, and 15[3] named as potentially relevant, depending on the type of intervention (Cohen-Shacham et al., 2016; Liu et al., 2021; Semeraro et al., 2022). In this study, especially goals 3, 11, 13, 15, and 16[4] have clearly been demonstrated to work positively together in the NBS in Ljubljana. Even where trade-offs were expected, such as in the case of the Ecological Zone, they did not develop as such. The pedestrianisation of the city centre was initially feared to harm economic growth (SDG 8) by discouraging customers from reaching shops and hospitality but seems to have had the opposite effect, actually facilitating economic growth through increased footfall of locals and tourists. The finding of the manifold synergies supports one of the main arguments with which proponents promote NBS, namely their ability to tackle a variety of issues within a single intervention or project. This is not to say that trade-offs do not exist – several have been found in other studies (Raymond et al., 2017a) – but in this case study, the co-benefits of NBS are strong and clearly outweigh the negatives. Based on the findings of this research, therefore, it can be concluded that the NBS in Ljubljana effectively contribute to the 2030 Agenda for Sustainable Development.

[3] Zero hunger, clean water and sanitation, reduced inequalities, life below water, and life on land, respectively.
[4] Good health and wellbeing, sustainable cities and communities, climate action, life on land, and peace, justice and strong institutions, respectively.

6.6 Limitations of the Study

6.6.1 Data Collection

This study is subject to certain limitations, which may have influenced the previously presented findings and discussion. Limitations regarding participants have been briefly covered in the methods chapter and can mostly be traced back to the difficult recruitment process. A combination of time constraints, unresponsive participants, and illness led to a smaller sample of focus group participants than originally anticipated and one with an uneven gender balance. These issues were partly resolved by splitting the originally planned single focus group into two separate sessions, conducting the sessions online, and having an extra in-depth interview for triangulation purposes with a male participant after the two sessions. In the end, the amount of collected data was satisfactory, but the small number of participants per session meant that interaction between participants, which could have shed more light on their shared and collective experiences, was limited. Finally, the fact that participants for both the interviews and the focus groups were required to speak English may have excluded residents of Ljubljana with, for example, lower education levels or those of a higher age group. Relevant data especially on social justice may have been overlooked because of this.

6.6.2 Findings

As is common with qualitative studies, the sample of participants was too small to draw conclusions based on the findings for the whole population (Shenton, 2004, p. 69). The experiences described by the participants of this study cannot be generalised to the whole population of Ljubljana, and similarly, the findings for the city of Ljubljana cannot be transferred to any other city. Generalisability was never the aim of this study though, as its value lies in its thick, context-specific descriptions and its application of and contribution to the theory of salutogenesis. Through detailed description of the studied phenomenon and its context, ample use of both empirical and theoretical literature, and transparent descriptions of the research methods, I aimed to ensure transferability and dependability of the study. Besides participants and location, time of year is an important consideration regarding the context of this study. Data collection took place in winter, which may have led to an underestimation of the effect of NBS on health and wellbeing, since people generally spend less time outside in winter than in summer, when warmer weather allows for more outdoor activities. Alternatively, it may have led to the romanticisation of urban nature, since many participants drew examples from memories of warmer times when they described their interactions with nature.

6.6.3 The Understanding of the Concept of Nature-Based Solutions

Another limitation lies within the conceptualisation of NBS. As was briefly touched upon in the findings, participants generally interpreted the term "nature-based solutions" quite broadly. They included any type of urban nature in their answers that they considered relevant, making the boundaries of the concept slightly blurry in the data. Participants often made sweeping statements about how they use green areas or nature in general, making it difficult to assign their answers to specific NBS. Nevertheless, for the purpose of this research, it matters not so much which NBS offer which resources, but the fact that NBS in general have the potential to offer certain resources, thereby contributing to greater health and wellbeing. Even if the green spaces described by a participant are not officially listed as a NBS in Ljubljana, as long as they can inform and are relevant to future implementations of NBS, they contribute to the understanding of the relationship between NBS and health and wellbeing and the development of the concepts of the settings-specific and collective SOC.

6.6.4 The Collective Sense of Coherence – A New Theoretical Concept

A final limitation is related to the development of the concept of a collective SOC and the extension of the salutogenic model to include this concept. Although the potential relevance of a group-level SOC has been discussed before in the salutogenesis literature, a definition of the concept collective SOC has not been formulated before (Antonovsky, 1996b; Bauer, 2022; Hochwälder, 2022; Mittelmark, Bull, Bouwman, 2017; Sagy & Mana, 2022; Vaandrager & Kennedy, 2022). I attempted to approach one based on the findings of this study and existing literature on settings-specific and community SOC in combination with existing theories and frameworks involving environmental resources, social cohesion, and collective action. I entered uncharted territory, lacking support from similar studies conducted in this field resulting in a first attempt to describe the collective SOC and include it in a new model. Many studies will need to be conducted in a variety of contexts in order to test and evaluate this theoretical model. From there, new issues are expected to arise, which is not necessarily a limitation in itself, but simply a part of the theory-building process necessary to improve the proposed model.

Chapter 7: Conclusion

7.1 Research Objectives and Main Conclusions

The main objective of this study was to explore the reciprocal relationship between NBS and collective health and wellbeing in Ljubljana. This was done through the exploration of shared environmental threats and stressors, the perceptions of general and resistance resources offered by NBS, their potential to contribute to a collective SOC, and the effect of this collective SOC on residents' perceptions and treatment of their environment. The main conclusions drawn from the achievement of these objectives will be summarised in this section. Starting with the environmental threats and stressors found in Ljubljana, these were often found to be stressors to the collective, and included natural stressors as well as man-made ones, though climate change makes the line between these two blurry. The stressors found in Ljubljana, such as heat stress and various kinds of pollution, were similar to those found in many cities across Europe and those previously described in the NBS and urban health and resilience literature. Ljubljana is home to many different NBS, each offering a range of UES, which can be subdivided into GRRs, SRRs, and other potential resources. Especially the Ecological Zone in the city centre of Ljubljana and the many available parks and green spaces, most notably Tivoli Park, offer a wide array of resources that residents utilise and enjoy. In the context of a city, where most stressors and most resources offered by NBS are collective, it is difficult to determine which resources are general resources that benefit anyone without requiring active use, and which resources are resistance resources that can be internalised to cope with specific stressors. However, as both types of resources were found to contribute to manageability, comprehensibility, and meaningfulness, and thus to enhance health and wellbeing, this versatility simply demonstrates the strength of NBS.

Having established the contribution of NBS to individual health and wellbeing by using the salutogenic concept of SOC, findings related to participation, social cohesion, social inclusion, and social justice were discussed to explore their potential contribution to a *collective* SOC. This concept is contested in the salutogenesis literature and a clear definition does not yet exist. The discussion in this study approaches a definition, by describing the process with which a strong collective SOC leads to increased collective health and wellbeing: A strong collective SOC describes how the collective responds to stressors to the collective in a salutary way by providing and internalising resources on a collective level through collective action, enabled by a strong presence of social cohesion, social inclusion,

and social justice, resulting in a collective move towards greater wellbeing. This process and the connections between its individual elements were mapped out in a model showing how NBS contribute to a greater collective SOC and vice versa (Figure 1). The model shows feedback loops indicating the reciprocal nature of the relationship between NBS and (collective) health and wellbeing. Through collective action, fuelled by community action and political participation, residents support and maintain NBS and urban nature and are able to influence policy to increase the provision and protection of green spaces. This study found a strong connection between the residents of Ljubljana and their urban nature and indicates that more time spent in or surrounded by (urban) nature fosters positive perceptions and treatment of the environment, making residents want to spend more time in nature and take better care of it.

7.2 Implications and Recommendations

The conclusions of this study have significant academic and societal implications. Academically, this study is one of the first to apply the salutogenic model to a city context, and to use qualitative methods in doing so, laying the groundwork for more studies of this type to follow. The approach to a definition of the still underdeveloped concept of collective SOC also serves as a foundation for future salutogenesis scholars to build upon this theory element. The definition and conceptualisation could be extended by further developing and including the concepts of collective manageability, collective comprehensibility, and collective meaningfulness. Opportunities and challenges for future research also involve the quantitative measurement of the collective SOC, which is difficult given the fluid boundaries of what composes the collective. This study also further developed the settings approach to salutogenesis. By combining the concepts of the setting-specific SOC and the collective SOC, the city of Ljubljana could be studied as a social-ecological-technological system, demonstrating the importance of systems thinking and a holistic perspective on health. This also resonates with the calls in the academic literature for a holistic approach to NBS, taking into account synergies and trade-offs of the indicators and resources offered by NBS. The findings of this study indicated mainly synergies between the various benefits of Ljubljana's NBS, with benefits reinforcing each other, demonstrating the efficacy of NBS to simultaneously provide environmental, social, and economic benefits. Different types of NBS should be studied in the future to establish whether NBS that provide different types of resources from the ones discussed in this study provide the same synergistic benefits. Similarly, studies like this one should be repeated in different cities to explore whether the

findings diverge in different contexts. Future studies could be conducted in cities of different sizes, in different countries and continents, with different climates, and with more culturally and socio-economically heterogeneous populations.

The positive findings regarding NBS have consequences in practice and policy as well, as they indicate the usefulness of NBS for achieving healthier cities and simultaneously contribute to a variety of SDGs, including health and wellbeing, sustainable cities and communities, and climate action. This study found that spending time in natural environments and involvement in NBS makes residents appreciate nature more, consequently making them want to spend more time there and take better care of it. This is an important finding for local policy makers and urban architects. Although many health benefits of NBS have been previously established, this research shows the importance of considering social factors as well when implementing NBS. Part of the reason for the success of Ljubljana's NBS, especially the Ecological Zone, can be attributed to the attention that was paid to social cohesion, social inclusion, and social justice. A lack of these was found to impair the efficacy of NBS and consequently impact wellbeing negatively. This demonstrates the importance of involving citizens and stakeholders in the planning for new NBS projects, something that the City Administration of Ljubljana understood. NBS not only require these social elements to work in everyone's benefit, they simultaneously provide the resources that can contribute to social cohesion, social inclusion, and social justice. NBS thus present great opportunities for collective health, as long as they are approached from a holistic perspective, simultaneously taking environmental and social factors into account. Practically, this research confirmed once more what many other studies have demonstrated as well; as an urban resident, spending time in nature and surrounded by greenery is a great way to improve your own health and wellbeing. Moreover, the findings of this study suggest that doing so also positively impacts the health and wellbeing of the collective, the health of your direct environment, and, by extension, the health of the global climate and environment.

Changing the world is a walk in the park.

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Appendix A: Table with Nature-Based Solutions in Ljubljana

Ten NBS in Ljubljana, adapted from Pinter & Almassy (2022)

Projects	Short description	Type of NBS	Key challenges
Ecological zone in Ljubljana city centre	The city centre was closed for traffic, the number of green spaces increased, five bridges were built to connect river banks, cycling was promoted, and electric vehicles were introduced to transport elderly, disabled, and tourists.	• Grey infrastructure featuring greens • Parks and urban forests	• Climate action for adaptation, resilience, and mitigation (SDG 13) • Green space, habitats and biodiversity (SDG 15) • Environmental quality • Regeneration, land-use, and urban development • Health and wellbeing (SDG 3)
For a more beautiful Ljubljana: spring cleaning	Colleagues from the City Administration and volunteer citizens clean up the city and plant trees, and the Ljubljanica river is cleaned.	• Grey infrastructure featuring greens • Parks and urban forests • Blue infrastructure	• Green space, habitats and biodiversity (SDG 15) • Environmental quality • Inclusive and effective governance (SDG 16) • Cultural heritage and cultural diversity
Let's help the bee in the city	Beehives were set up on a shopping mall, a teaching apiary was set up for primary school children, and honey plants were distributed to citizens to plant in their gardens or balconies.	• Nature on buildings • Grey infrastructure featuring greens	• Green space, habitats and biodiversity (SDG 15) • Cultural heritage and cultural diversity • Sustainable consumption and production (SDG 12)
Development of Public Orchard and Nectar Garden	Public orchards were created, intended for citizens and visitors to the city, intended for education, recreation, self-sufficiency, and re-connecting with nature. Insect hotels and bird feeders were placed to promote biodiversity raise awareness.	• Grey infrastructure featuring greens • Parks and urban forests • Community gardens and allotments	• Green space, habitats and biodiversity (SDG 15) • Regeneration, land-use, and urban development • Social justice, cohesion and equity (SDG 10) • Health and wellbeing (SDG 3)

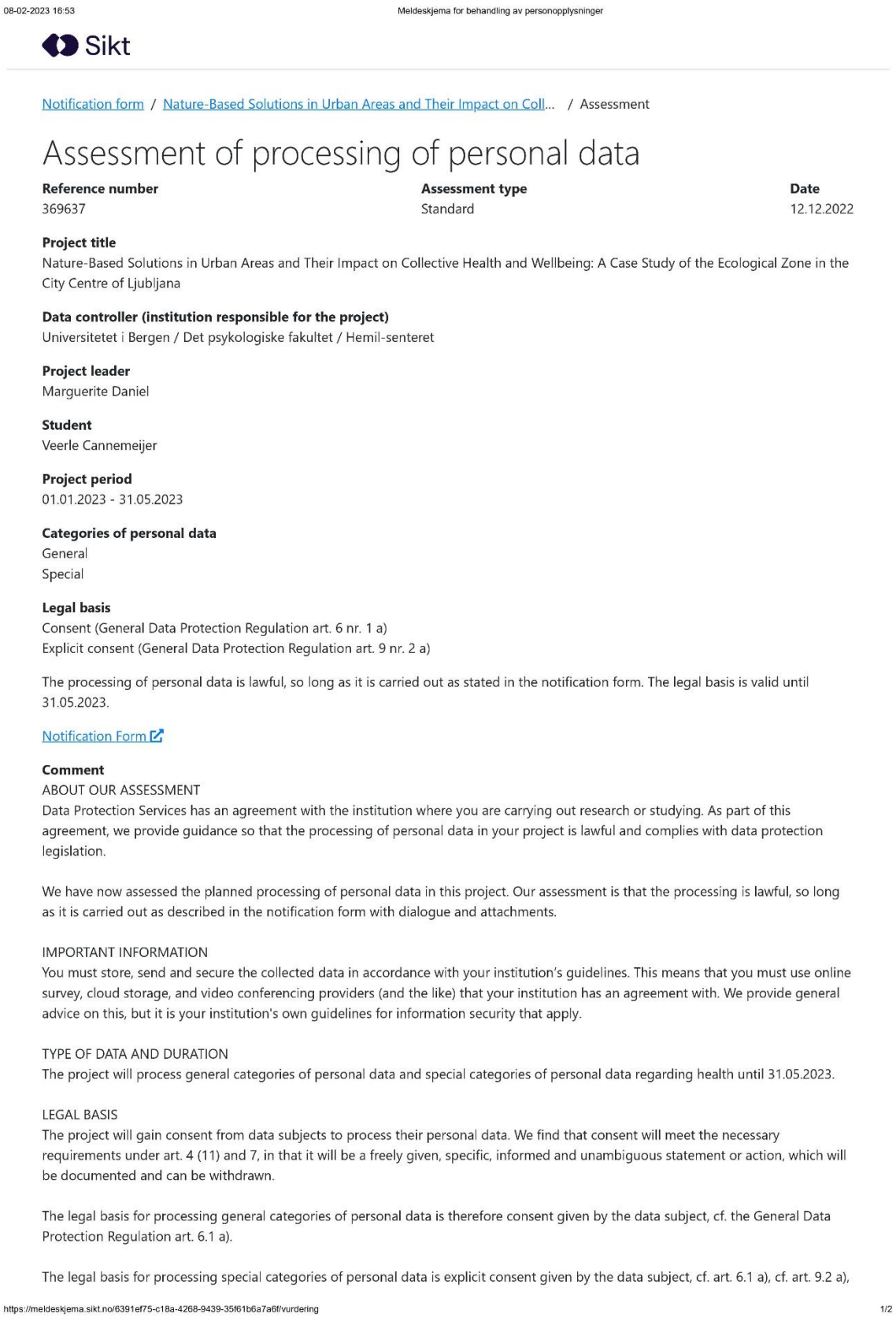
			• Economic development and employment (SDG 8) • Sustainable consumption and production (SDG 12)
LIVADALab: greener and more inclusive Ljubljana	In this initiative, citizens, the municipality, NGOs, and green space developers and managers came together in a participatory planning process and used project-based learning to improve Ljubljana's green spaces and their range of ecosystem services.	• Parks and urban forests • Community gardens and allotments	• Green space, habitats and biodiversity (SDG 15) • Regeneration, land-use, and urban development • Inclusive and effective governance (SDG 16) • Social justice, cohesion and equity (SDG 10)
Ljubljana Bee Trail	The Bee Trail was created to promote bee-keeping in the wider area of Ljubljana and develop bee-keeping in the urban core, while awareness is raised among citizens.	• Grey infrastructure featuring greens • Parks and urban forests	• Green space, habitats and biodiversity (SDG 15) • Social justice, cohesion and equity (SDG 10) • Cultural heritage and cultural diversity
Ljubljanica Connects	To improve connectivity between Nature 2000 sites, barriers to fish migration in the Ljubljanica river were removed, habitats restored, water management infrastructures improved, and a water monitoring system was put in place.	• Blue infrastructure	• Water management (SDG 6) • Green space, habitats and biodiversity (SDG 15) • Inclusive and effective governance (SDG 16)
Revitalisation of Rakova Jelša	The previously degraded Rakova Jelša area was revitalised by cleaning it up, adding recreational areas, street furniture, and various green spaces.	• Parks and urban forests • Community gardens and allotments	• Climate action for adaptation, resilience, and mitigation (SDG 13) • Green space, habitats and biodiversity (SDG 15) • Environmental quality • Regeneration, land-use, and urban development

			• Health and wellbeing (SDG 3)
Revitalisation of Sava river banks	The former waste site on the banks of the Sava river was transformed into an inclusive recreational area. Additions included a horse riding area, picnic space, a large children's playground, an animal farm, and illuminated biking and pedestrian paths.	• Grey infrastructure featuring greens • Parks and urban forests	• Green space, habitats and biodiversity (SDG 15) • Environmental quality • Regeneration, land-use, and urban development • Health and wellbeing (SDG 3)
Urban Gardening in Ljubljana	A long-time closed construction site in the city centre was opened up to develop communal gardens offering opportunities for education and recreation.	• Community gardens and allotments	• Green space, habitats and biodiversity (SDG 15) • Inclusive and effective governance (SDG 16) • Environmental quality • Social justice, cohesion, and equity (SDG 10) • Health and wellbeing (SDG 3) • Economic development and employment (SDG 8) • Sustainable consumption and production (SDG 12)

Appendix B: Approval for Data Management Procedures

Figure B1

SIKT (previously NSD) assessment of processing of personal data



08-02-2023 16:53 Meldeskjema for behandling av personopplysninger

Sikt

Notification form / Nature-Based Solutions in Urban Areas and Their Impact on Coll... / Assessment

Assessment of processing of personal data

Reference number	Assessment type	Date
369637	Standard	12.12.2022

Project title
Nature-Based Solutions in Urban Areas and Their Impact on Collective Health and Wellbeing: A Case Study of the Ecological Zone in the City Centre of Ljubljana

Data controller (institution responsible for the project)
Universitetet i Bergen / Det psykologiske fakultet / Hemil-senteret

Project leader
Marguerite Daniel

Student
Veerle Cannemeijer

Project period
01.01.2023 - 31.05.2023

Categories of personal data
General
Special

Legal basis
Consent (General Data Protection Regulation art. 6 nr. 1 a)
Explicit consent (General Data Protection Regulation art. 9 nr. 2 a)

The processing of personal data is lawful, so long as it is carried out as stated in the notification form. The legal basis is valid until 31.05.2023.

Notification Form

Comment
ABOUT OUR ASSESSMENT
Data Protection Services has an agreement with the institution where you are carrying out research or studying. As part of this agreement, we provide guidance so that the processing of personal data in your project is lawful and complies with data protection legislation.

We have now assessed the planned processing of personal data in this project. Our assessment is that the processing is lawful, so long as it is carried out as described in the notification form with dialogue and attachments.

IMPORTANT INFORMATION
You must store, send and secure the collected data in accordance with your institution's guidelines. This means that you must use online survey, cloud storage, and video conferencing providers (and the like) that your institution has an agreement with. We provide general advice on this, but it is your institution's own guidelines for information security that apply.

TYPE OF DATA AND DURATION
The project will process general categories of personal data and special categories of personal data regarding health until 31.05.2023.

LEGAL BASIS
The project will gain consent from data subjects to process their personal data. We find that consent will meet the necessary requirements under art. 4 (11) and 7, in that it will be a freely given, specific, informed and unambiguous statement or action, which will be documented and can be withdrawn.

The legal basis for processing general categories of personal data is therefore consent given by the data subject, cf. the General Data Protection Regulation art. 6.1 a).

The legal basis for processing special categories of personal data is explicit consent given by the data subject, cf. art. 6.1 a), cf. art. 9.2 a),

https://meldeskjema.sikt.no/6391ef75-c18a-4268-9439-35f61b6a7a6f/vurdering 1/2

cf. the Personal Data Act § 10, cf. § 9 (2).

PRINCIPLES RELATING TO PROCESSING PERSONAL DATA
We find that the planned processing of personal data will be in accordance with the principles under the General Data Protection Regulation regarding:
- lawfulness, fairness and transparency (art. 5.1 a), in that data subjects will receive sufficient information about the processing and will give their consent
- purpose limitation (art. 5.1 b), in that personal data will be collected for specified, explicit and legitimate purposes, and will not be processed for new, incompatible purposes
- data minimisation (art. 5.1 c), in that only personal data which are adequate, relevant and necessary for the purpose of the project will be processed
- storage limitation (art. 5.1 e), in that personal data will not be stored for longer than is necessary to fulfil the project's purpose

THE RIGHTS OF DATA SUBJECTS
We find that the information provided to data subjects about the processing of their personal data will meet legal requirements for form and content, cf. art. 12.1 and art. 13.

So long as data subjects can be identified in the collected data they will have the following rights: access (art. 15), rectification (art. 16), erasure (art. 17), restriction of processing (art. 18) and data portability (art. 20).

Please note that if a data subject contacts you about their rights, the data controller has a duty to reply within a month.

FOLLOW YOUR INSTITUTION'S GUIDELINES
Our assessment presupposes that the project will meet the requirements of accuracy (art. 5.1 d), integrity and confidentiality (art. 5.1 f) and security (art. 32) when processing personal data.

When using a data processor (questionnaire provider, cloud storage, video call etc.), the processing must meet the requirements for the use of a data processor, cf. art. 28 and art. 29. Use suppliers with whom your institution has an agreement.

To ensure that these requirements are met you must follow your institution's internal guidelines and/or consult with your institution (i.e. the institution responsible for the project).

NOTIFY CHANGES
If you intend to make changes to the processing of personal data in this project it may be necessary to notify us. This is done by updating the information registered in the Notification Form. On our website we explain which changes must be notified. Wait until you receive an answer from us before you carry out the changes.

FOLLOW-UP OF THE PROJECT
We will follow up at the planned end date in order to determine whether the processing of personal data has been concluded.

Good luck with the project!

Figure B2

Email response to inquiry about ethical clearance from the City of Ljubljana

Dear Mr Cannemeijer,

our municipality gladly assists researchers with their work.

In order to conduct an interview with a member of the city administration of the City of Ljubljana, which relates to the work area and tasks of the city administration, you do not need additional ethical clearance from the City of Ljubljana. If the questions will concern personal data, the data protection provisions (GDPR) must be followed. We would also like to add that the easiest way to answer expert questions (especially when it comes to data) is in writing.

With kind regards,

[redacted]

direktorica Mestne uprave

Mestna občina Ljubljana

Adamič-Lundrovo nabrežje 2, 1000 Ljubljana

T: 01 306 1335, F: 01 306 1206, http://www.ljubljana.si

Mestna občina Ljubljana

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Appendix C: Interview Guides

Interview guide expert interviews

Could you briefly describe your connection to the Ecological Zone?

Could you tell me about the purpose of the Ecological Zone?

How do you believe this purpose is being fulfilled?

What specific solutions does the Ecological Zone offer?

In what ways does the Ecological Zone interact with citizens' health and wellbeing?

How do (or did) citizens contribute to or participate in the project?

What is the outcome of such participation?

How do you feel this project contributes to a) social cohesion and b) social justice?

Could you tell me about any unintended consequences from the project – positive or negative?

Could you talk about potential problems that you have found with this project?

What do you take away from this project for potential future projects?

Interview guide focus groups

How do nature-based solutions in Ljubljana interact with your health and wellbeing and vice versa?

Interview guide individual interview

What kind of environmental stressors / threats to your health and wellbeing do you experience in Ljubljana?

Which resources that the city of Ljubljana offers do you make use of to improve your own health and wellbeing?

What aspects of these nature-based solutions do you make use of to improve your health and wellbeing?

In what ways does this improve your health and wellbeing?

In what ways have you participated in these nature-based solutions?

From your experience, how do you believe the NBS in Ljubljana influence social inclusion?

From your experience, how do you believe the NBS in Ljubljana influence social cohesion?

From your experience, how do you believe the NBS in Ljubljana influence social justice?

How would you describe your relationship with your environment here in Ljubljana?

How do you believe your health and wellbeing influences how you treat your environment?

To what extent did this interview make you think differently about the urban nature in your city?

Appendix D: Informed Consent Forms

Informed consent form expert interviews (via videocall)

Are you interested in taking part in the research project

"Nature-Based Solutions in Urban Areas and Their Impact on Collective Health and Wellbeing"?

This is an inquiry about participation in a research project where the main purpose is to explore the relationship between nature-based solutions and collective health and wellbeing. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project
Nature-based solutions are actions to protect, manage, restore, and create ecosystems that address various challenges related to climate-adaptation, biodiversity, and human health and wellbeing. This study will focus on nature-based solutions in Ljubljana, specifically the Ecological Zone in the city centre. The main objective of this study is to explore the reciprocal relationship between nature-based solutions and collective health and wellbeing in Ljubljana. This will be achieved through the following subobjectives:

- Explore shared urban perceptions of environmental threats and stressors.
- Explore shared urban perceptions of a) general resources and b) nature-based solutions.
- Explore how a collective sense of coherence affects how urban citizens perceive and treat their environment.

This research is a master's thesis for the master Global Development Theory and Practice.

Who is responsible for the research project?
The University of Bergen is the institution responsible for the project.

I, Veerle Cannemeijer, the student researcher, will be supervised by Professor Marguerite Daniel from the Department of Health Promotion and Development.

Why are you being asked to participate?
You are being asked to participate, because you are involved with the health and wellbeing of the citizens of Ljubljana. Therefore, we believe that your expertise could be relevant to our research project.

What does participation involve for you?
Taking part in this project would involve participating in an in-depth interview in which you will be asked to share your knowledge and experiences regarding nature-based solutions and wellbeing in Ljubljana. This interview would take approximately 45 minutes and will be audio-recorded.

Participation is voluntary
Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made

anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data
We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- Only I, the student researcher, and my supervisor will have access to the personal data.
- I will replace your name and contact details with a code. The list of names, contact details and respective codes will be stored separately from the rest of the collected data. The data will be stored on a research server and only accessed via a secure device.

You will not be recognisable in publications. Your name and age will not be made public. However, your occupation and relation to the nature-based solution project will be disclosed.

What will happen to your personal data at the end of the research project?
The project is scheduled to end in May 2023. Personal data, including recordings, will then be deleted.

Your rights
So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?
We will process your personal data based on your consent.

Based on an agreement with the University of Bergen, Data Protection Services has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?
If you have questions about the project, or want to exercise your rights, contact:

- University of Bergen via Marguerite Daniel (Marguerite.Daniel@uib.no) or Veerle Cannemeijer (vca007@uib.no).
- Our Data Protection Officer: Janecke Helene Veim (Janecke.Veim@uib.no)
- Data Protection Services, by email: (personverntjenester@sikt.no) or by telephone: +47 53 21 15 00.

Yours sincerely,

Marguerite Daniel Veerle Cannemeijer

(supervisor) (student)

Consent form

I have received and understood information about the project *Nature-Based Solutions in Urban Areas and Their Impact on Collective Health and Wellbeing* and have been given the opportunity to ask questions. I give consent:

- to participate in an interview

I give consent for my personal data to be processed until the end date of the project, approx. 31 May 2023.

(Signed by participant, date)

Informed consent form written expert interview (via email)

Are you interested in taking part in the research project

"Nature-Based Solutions in Urban Areas and Their Impact on Collective Health and Wellbeing"?

This is an inquiry about participation in a research project where the main purpose is to explore the relationship between nature-based solutions and collective health and wellbeing. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project
Nature-based solutions are actions to protect, manage, restore, and create ecosystems that address various challenges related to climate-adaptation, biodiversity, and human health and wellbeing. This study will focus on nature-based solutions in Ljubljana, specifically the Ecological Zone in the city centre. The main objective of this study is to explore the reciprocal relationship between nature-based solutions and collective health and wellbeing in Ljubljana. This will be achieved through the following subobjectives:

- Explore shared urban perceptions of environmental threats and stressors.
- Explore shared urban perceptions of a) general resources and b) nature-based solutions.
- Explore how a collective sense of coherence affects how urban citizens perceive and treat their environment.

This research is a master's thesis for the master Global Development Theory and Practice.

Who is responsible for the research project?
The University of Bergen is the institution responsible for the project.

I, Veerle Cannemeijer, the student researcher, will be supervised by Professor Marguerite Daniel from the Department of Health Promotion and Development.

Why are you being asked to participate?
You are being asked to participate, because you have been involved in the planning/creation/evaluation of a nature-based solution in Ljubljana. Therefore, we believe that your expertise could be relevant to our research project.

What does participation involve for you?
Taking part in this project would involve responding to questions in written form via email.

Participation is voluntary
Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data

We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- Only I, the student researcher, and my supervisor will have access to the personal data.
- I will replace your name and contact details with a code. The list of names, contact details and respective codes will be stored separately from the rest of the collected data. The data will be stored on a research server and only accessed via a secure device.

Your name will not be made public. However, your occupation and relation to the nature-based solution project will be disclosed, possibly making you recognisable.

What will happen to your personal data at the end of the research project?
The project is scheduled to end in May 2023. Personal data will then be deleted.

Your rights
So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?
We will process your personal data based on your consent.

Based on an agreement with the University of Bergen, Data Protection Services has assessed that the processing of personal data in this project is in accordance with data protection legislation.

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- Data Protection Services, by email: (personverntjenester@sikt.no) or by telephone: +47 53 21 15 00.

Yours sincerely,

Marguerite Daniel (supervisor)	Veerle Cannemeijer (student)

Consent form

I have received and understood information about the project *Nature-Based Solutions in Urban Areas and Their Impact on Collective Health and Wellbeing* and have been given the opportunity to ask questions. I give consent:

- to participate in a written interview

I give consent for my personal data to be processed until the end date of the project, approx. 31 May 2023.

(Signed by participant, date)

Informed consent form focus groups

Are you interested in taking part in the research project

"Nature-Based Solutions in Ljubljana and Their Impact on Collective Health and Wellbeing"?

This is an inquiry about participation in a research project where the main purpose is to explore the relationship between nature-based solutions and collective health and wellbeing. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project
Nature-based solutions are actions to protect, manage, restore, and create ecosystems that address various challenges related to climate adaptation, biodiversity, and human health and wellbeing. This study will focus on nature-based solutions in Ljubljana. The main objective of this study is to explore the reciprocal relationship between nature-based solutions and collective health and wellbeing in Ljubljana. This will be achieved through the following subobjectives:

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I, Veerle Cannemeijer, the student researcher, will be supervised by Professor Marguerite Daniel from the Department of Health Promotion and Development.

Why are you being asked to participate?
You are being asked to participate because you are living in Ljubljana. Therefore, we believe that your opinions and experiences could be relevant to our research project.

What does participation involve for you?
Taking part in this project would involve participating in an online focus group in which you will be asked to share your opinions and experiences regarding the nature-based solutions and wellbeing in Ljubljana together with approximately three other individuals. Using the software Miro (which you do not need to be familiar with), you will engage in brainstorming and mapping on an online whiteboard.

The focus group will take approximately 90 minutes and parts will be audio recorded.

After this focus group, you may be asked to participate in an in-depth, one-on-one interview to follow up on what has been discussed in the focus group and to share more about your individual experiences. You can always refuse this.

Participation is voluntary
Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data
We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

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- I will replace your name and contact details with a code. The list of names, contact details and respective codes will be stored separately from the rest of the collected data. The data will be stored on a research server and only accessed via a secure device.

You will not be recognisable in publications. Name, age, and occupation will not be made public.

What will happen to your personal data at the end of the research project?
The project is scheduled to end in May 2023. Personal data, including recordings, will then be deleted.

Your rights
So long as you can be identified in the collected data, you have the right to:

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Yours sincerely,

Marguerite Daniel (supervisor)	Veerle Cannemeijer (student)

Consent form

I have received and understood information about the project *Nature-Based Solutions in Urban Areas and Their Impact on Collective Health and Wellbeing* and have been given the opportunity to ask questions. I give consent:

- ☐ to participate in a focus group
- ☐ to participate in an individual interview (you can always change this answer later)

I give consent for my personal data to be processed until the end date of the project, approx. 31 May 2023.

(Signed by participant, date)

Informed consent form individual interview

Are you interested in taking part in the research project

"Nature-Based Solutions in Ljubljana and Their Impact on Collective Health and Wellbeing"?

This is an inquiry about participation in a research project where the main purpose is to explore the relationship between nature-based solutions and collective health and wellbeing. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project
Nature-based solutions are actions to protect, manage, restore, and create ecosystems that address various challenges related to climate adaptation, biodiversity, and human health and wellbeing. This study will focus on nature-based solutions in Ljubljana. The main objective of this study is to explore the reciprocal relationship between nature-based solutions and collective health and wellbeing in Ljubljana. This will be achieved through the following subobjectives:

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Why are you being asked to participate?
You are being asked to participate because you are living in Ljubljana. Therefore, we believe that your opinions and experiences could be relevant to our research project.

What does participation involve for you?
Taking part in this project would involve participating in an online one-on-one interview, in which you will be asked to share your opinions and experiences regarding the nature-based solutions and wellbeing in Ljubljana. The interview will take approximately 30 minutes and will be audio recorded.

Participation is voluntary
Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

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Yours sincerely,

Marguerite Daniel (supervisor)	Veerle Cannemeijer (student)

Consent form

I have received and understood information about the project *Nature-Based Solutions in Urban Areas and Their Impact on Collective Health and Wellbeing* and have been given the opportunity to ask questions. I give consent:

- ☐ to participate in an individual interview

I give consent for my personal data to be processed until the end date of the project, approx. 31 May 2023.

(Signed by participant, date)

Appendix E: Cognitive Maps

Figure E1

Cognitive map focus group 1

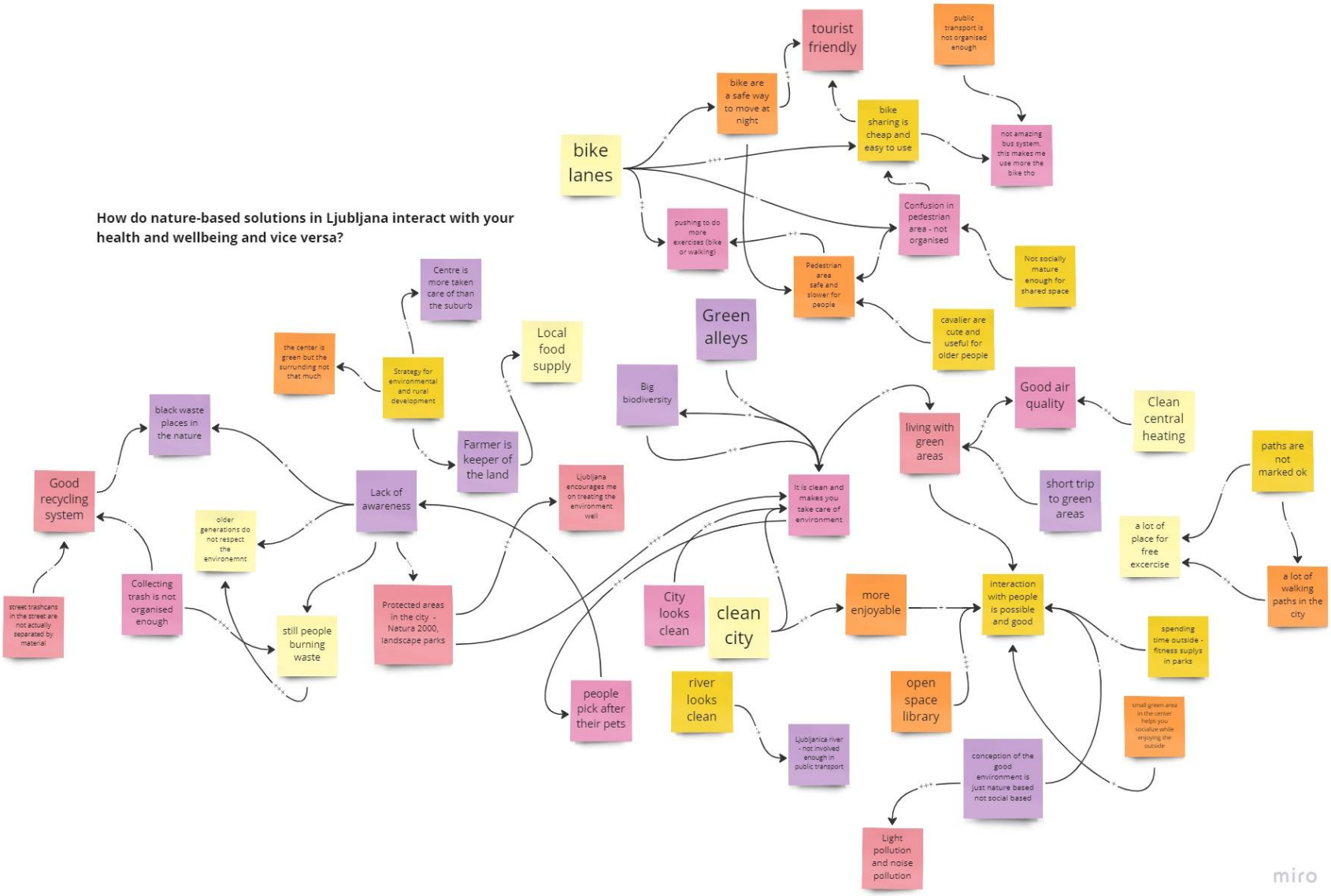
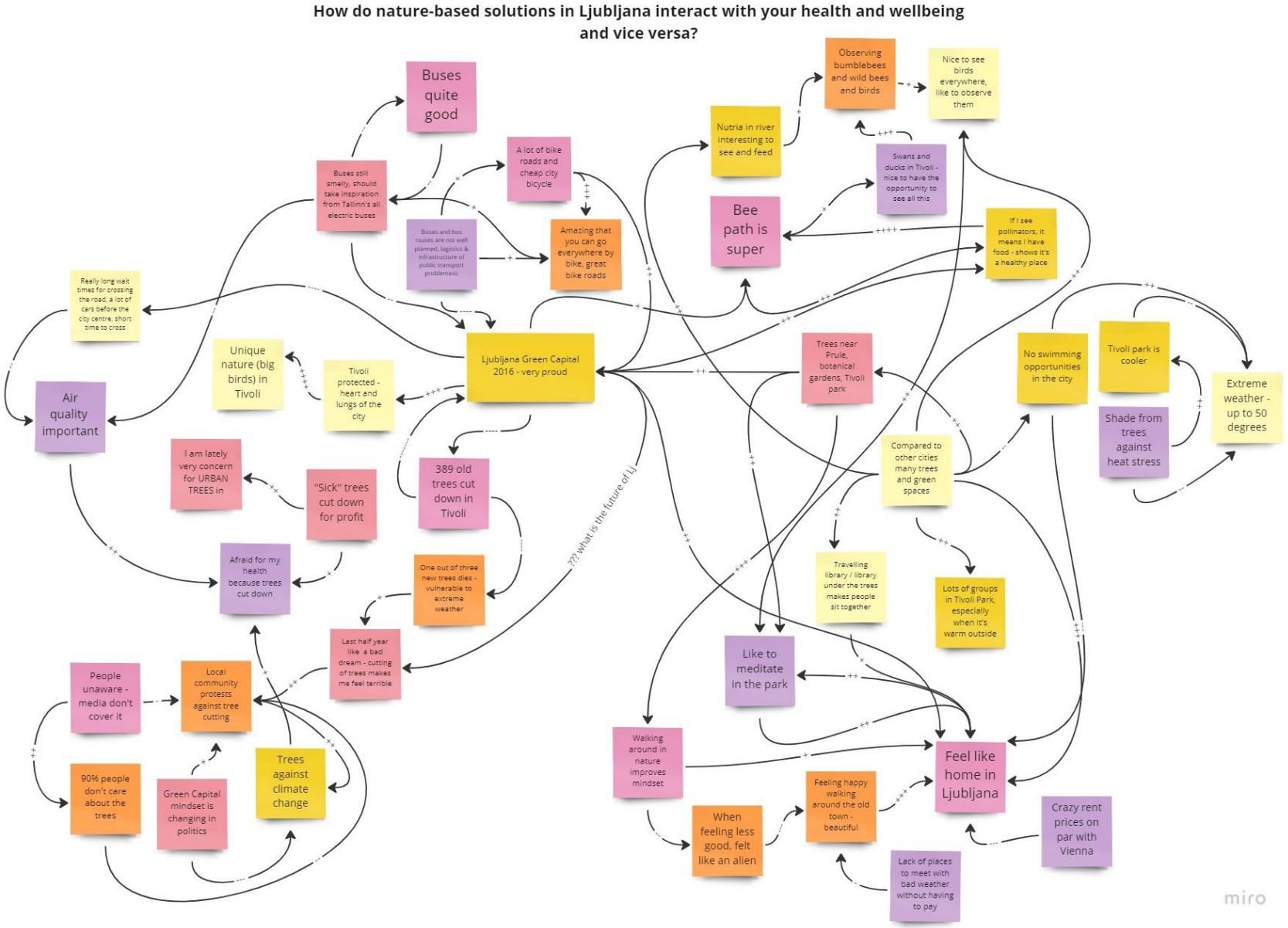


Figure E2

Cognitive map focus group 2



Appendix F: Data Analysis Matrix

Matrix including codes and ideas grouped under main themes (continued on next page; Excel file viewable here)

Stessors	Resources	Sense of Coherence		
		Manageability	Comprehensibility	Meaningfulness
Heat stress	Pedestrian area	Pedestrian area safe and slower for people	Pedestrian area safe and slower for people	City more friendly because there is no traffic
Bad water quality Ljubljanica, no swimming	Green alleys	Very dangerous and chaotic traffic situation before the ecozone	Public spaces are easier to move around	Sense of freedom and relaxation in city centre
Flood risk	Improved air quality	Public spaces made covid lockdowns easier to handle	Citizens still figuring out how to use shared space	Enough space in centre to enjoy city life
Air pollution before ecozone	Green areas	Increased safety in the city centre	Confusion in pedestrian area - too many cyclists	Cultural benefit is new image of the city
Smog	Spaces for street festivals and open air events	Benches and places to sit to feel open	Public transport (buses) not organised enough	Well-maintained city
Bad smells from cars before ecozone	Places to sit	Restaurants benefit from increased footfall	Confusing pubilc transportation	Clean city is more enjoyable
Buses are still smelly	Kavelir	Kavelir helps elderly	Traffic lights make pedestrians wait long and only give them seconds to cross the road	Tourism leads to development, awareness and renovation of cultural parts
Very dangerous and chaotic traffic situation before the ecozone	BicikeLJ	Enough space in ecozone for cycling, walking or just sitting	Bike lanes and bike sharing are easy to use	Monuments were threatened by the traffic before the ecozone
Busy roads and short time to cross, traffic moved from the ecozone	Local food supply (markets, urban gardens)	Mass tourism leads to rising prices and overcrowdedness	Walking paths in the city not marked well	Reoccupied public spaces for street festivals, open-air cultural and sports events
Scared about economy before implementation ecozone	Library under the Treetops	Ljubljana becoming like Disneyland	Confusing recycling system leads to people dumping black waste and not recycling	Improved open-air life along the river fostered sociabilty and economic revival
Increased tourism, too busy	Air corridor	Ecozone meant economic revival	Lack of awareness leads to people still burning waste	Restaurant gardens revived city life and tourism to flourish
Noise pollution ecozone (inn gardens)	Many trees, trees provide shadow and coolness	Ecozone moved the traffic problem elsewhere	9 extra bridges to connect promenades along the river	Good opportunities for interaction with people
Light pollution (too many bright lights)	Rich biodiversity	No places to swim in Ljubljana in summer	Nature makes us calm and slow down, making our modern fast-paced lives more comprehensible	Ecozone opened the space to move, stroll, sit, gather, and enjoy free and safe
Noise pollution (music, machines, etc.)	Walking paths	Cycling in the city centre improving health	Expectations ecozone exceeded, resistance to change turned into high satisfaction among residents	Walking in the city centre is more enjoyable
	Parks as anti-stressors, a place to relax	Bikes push to do more exercise		Beautiful Old Town makes me feel happy and at home
	Tivoli Park gives relief of heat stress, much cooler	Bikes are a safe way to move at night		Positive feedback ecozone
	Meditating in the park	Opportunity with public transport to reach green spaces		Easy to feel at home in Ljubljana because of the nature
	Park to enjoy nature, the birds, walk your dog, hang out, meet people	Should have more boat transport		Trees make the city friendly
	Fitness supplies in parks	Green areas great place for exercise		Green areas help you socialise while enjoying outside
	Green spaces used for various health programmes	More opportunities for exercising		People spend free time in green areas, which improves wellbeing
		Fitness equipment / sports islands		Greater chance for outdoor activities
		People running in parks improving health		Opportunity for participating in recreational events
		Not yet achieved 100% clean air		When trying to feel better/improve my mindset I like being in nature
		Working towards carbon neutrality		Very rich biodiversity
		Trees provide clean air, parks as lungs of the city		Talking more about biodiversity
		Cutting down trees threatens health by enhancing heat stress		Nice to observe animals: pollinators, insects, birds, river mammals
		Green spaces attract pollinators which are important for human living		Because of rich green spaces there are a lot of animals
		Parks have a therapeutic effect and work as anti-		Bees, bee path is super
		Green spaces offer relaxation and an escape from daily		Park to enjoy nature, the birds, hang out, meet people
				Nature helps us connect with our inner selves and makes us improve ourselves
				Proud of Ljubljana being a European Green Capital
				Bicycles give the possibility to explore
				Bikes are tourist friendly
				Nature isn't a fix-all solution, it's a way to improve what's already good
				Political participation
				Community participation

Collective Sense of Coherence				Relationship with the environment	
Participation	**Social inclusion**	**Social cohesion**	**Social justice**	**Relationship with the environment**	**Participation in this study (action research)**
Everyone can participate	Green spaces public and free to use	Green areas help you socialise while enjoying	Centre is more taken care of than surroundings	Slovenians are connected with nature	Outsider's view of the city more positive, locals more
Citizen participation is encouraged	City tries to involve vulnerable groups and not to exclude anybody	Good opportunities for interaction with people	The centre is green but surrounding neighbourhoods less so	Feels natural to have many green spaces	Realise we take nature-based solutions for granted
Civitas Elan	Kavelir for free for everyone	Pedestrianisation contributed to enrich the city identity	No degraded areas in Ljubljana	Sensitive if trees need to be cut down	Shows the whole picture of urban nature, which you usually don't consider
Positive feedback ecozone	LGBT+ events	comfortable and not being endangered by anyboday	Compensation for closing city centre, citizens satisfied	Community activists against cutting down trees	Not previously connected to the term NBS
Political participation	Accessibility project	Along Ljubljanica river people meet in the evenings people meet and social interaction is easy	Didn't want people having to pay to enter the city centre by car - discrimination	Citizens unhappy when green space needs to make way for buildings	Sees participation in study as an opportunity
Meeting the mayor	Kindergartens go and play in the woods	Almost everything the city does is with social cohesion in mind	Kavelir	Using European Green Capital as identity	A space to voice things, especially as a foreigner who can't participate much politically
Voting for closing streets to cars	Playgrounds with NBS	Restaurant gardens revived city life	Everyone can participate equally	Positive feedback to ecozone, no wanting to go back, still expanding	Learned about issue of trees being cut down she hadn't heard of before
Citizens' ideas and suggestions	Mental health programmes visit green spaces and use fitness and recreation equipment together	Urban gardens brought people together to get talking and have picnics	Mixed area, some of it more expensive	Protected nature areas and landscape parks encourage me to treat the environment well	I didn't learn a lot of new things but it was interesting and I gained something
Local commnuity initiatives	Many programmes for different groups of people use public green spaces	Urban gardens organised roundtables where people got to know each other	Rent prices going up pushing people out of the city centre to the suburbs, especially rich foreigners	strong connection between citizens and their food	I learned about some projects I haven't heard of before
Blocks of apartments created their own green spaces	Including immigrants in sustainability projects	Recreational activities with big turnout: Ljubljana marathon, path of friendship and comradeship	Parks are for everyone	Learn from biodiversity	My perceptions didn't change that much, maybe because of my countryside perspective
Bezigrad high school students designed a park	Lots of benches for people just to sit - to feel open	People hang out in the park, take drinks and blankets	New flats have their own exclusive parks around them for only the people living there	about and connecting with nature by watching them	Opportunity to speak up and discuss issues important to me
Herbal garden on market square	Bikes are cheap	Green spaces bring people together and break down social barriers	The same wooden sheds on every urban garden	Strong connection with bees	
Citizens are the heart of the city, and those that make the city	Mixed city - mixed buildings and people	Green spaces function like a meeting ground for all sorts of people, opens minds to different cultures		Residents plant bee-friendly plants at home	
For a More Beautiful Ljubljana	Mixing students throughout the city	For a More Beautiful Ljubljana		Ljubljana famous for love of gardening	
Residents not actively participating in NBS, mostly users of spaces	Mixed city centre, not just restaurants and shops but also offices, NGOs and companies	Being in nature through mountaineering helps me bond with my family		Slovenians are quite aware of the environmental questions and dilemmas faced in Slovenia and broader	
	Lack of space for creativity (graffiti)	Ljubljana not socially mature enough for shared space		Feel like we are not treating it well enough	
	NBS means that every space of the city is for us	Identity lost because of outsiders		waste, talking about environment = talking about waste	
	Beautiful Old Town makes me feel at home	Proud of European Green Capital status		Older generations do not respect the environment	
	Inclusion of stakeholders	Other cities can learn from Ljubljana		Lack of awareness leads to burning waste	
	NGO collaborations			Clean city makes you take care of environment	
				People pick after their pets	
				Conception of the good environment is just nature-based and not social-based	
				When we are healthier, we work better, and we can come up with better solutions for certain environmental and societal problems	
				"We take good care of the environment - the environment will take care of us"	
				Mountaineering (being in nature) relaxes me, gives me such positive health effects that I look forward to doing it again, making me value nature more - the same works for NBS	
				Citizens unaware of issues with trees being cut down	

Appendix G: Data Analysis Code Maps

Figure G1

Map of main analysing themes

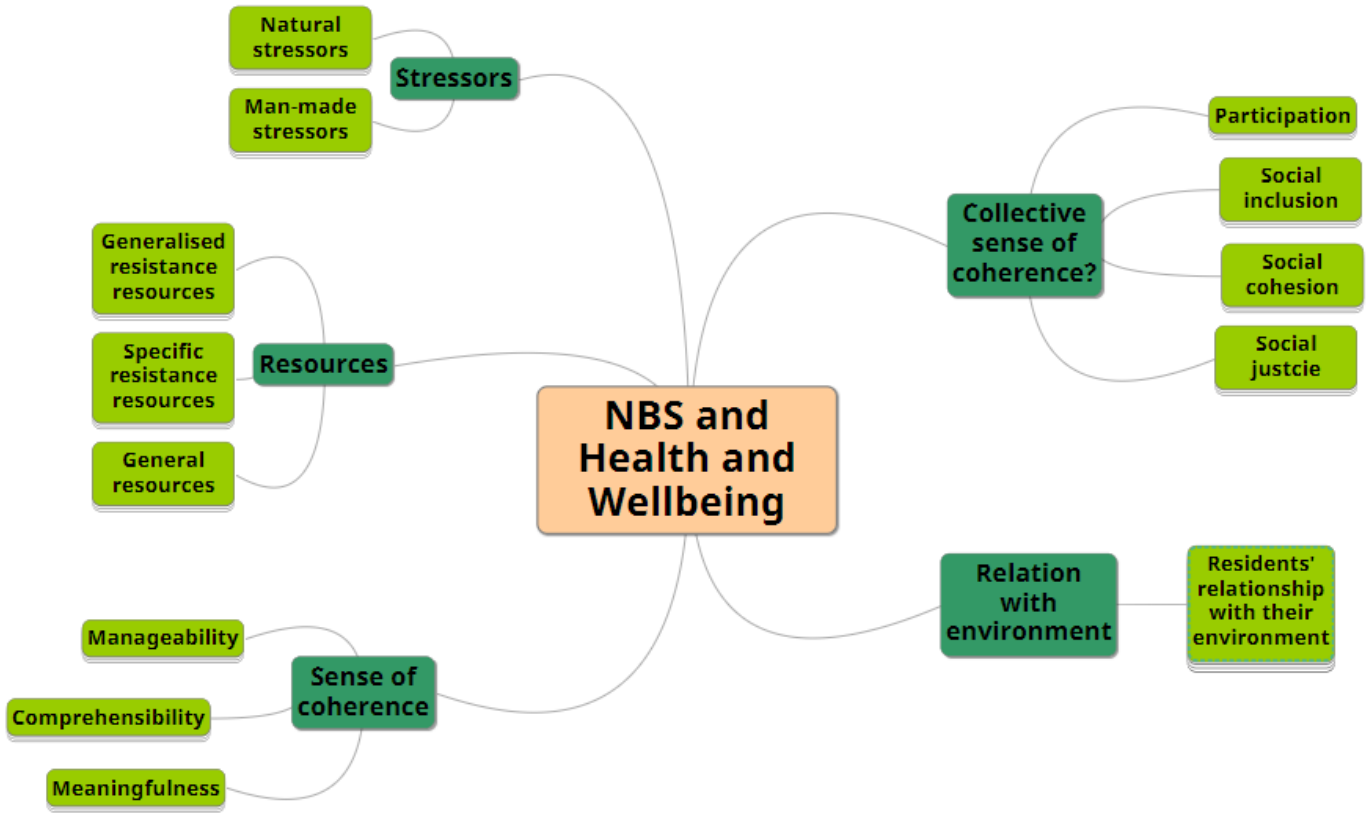
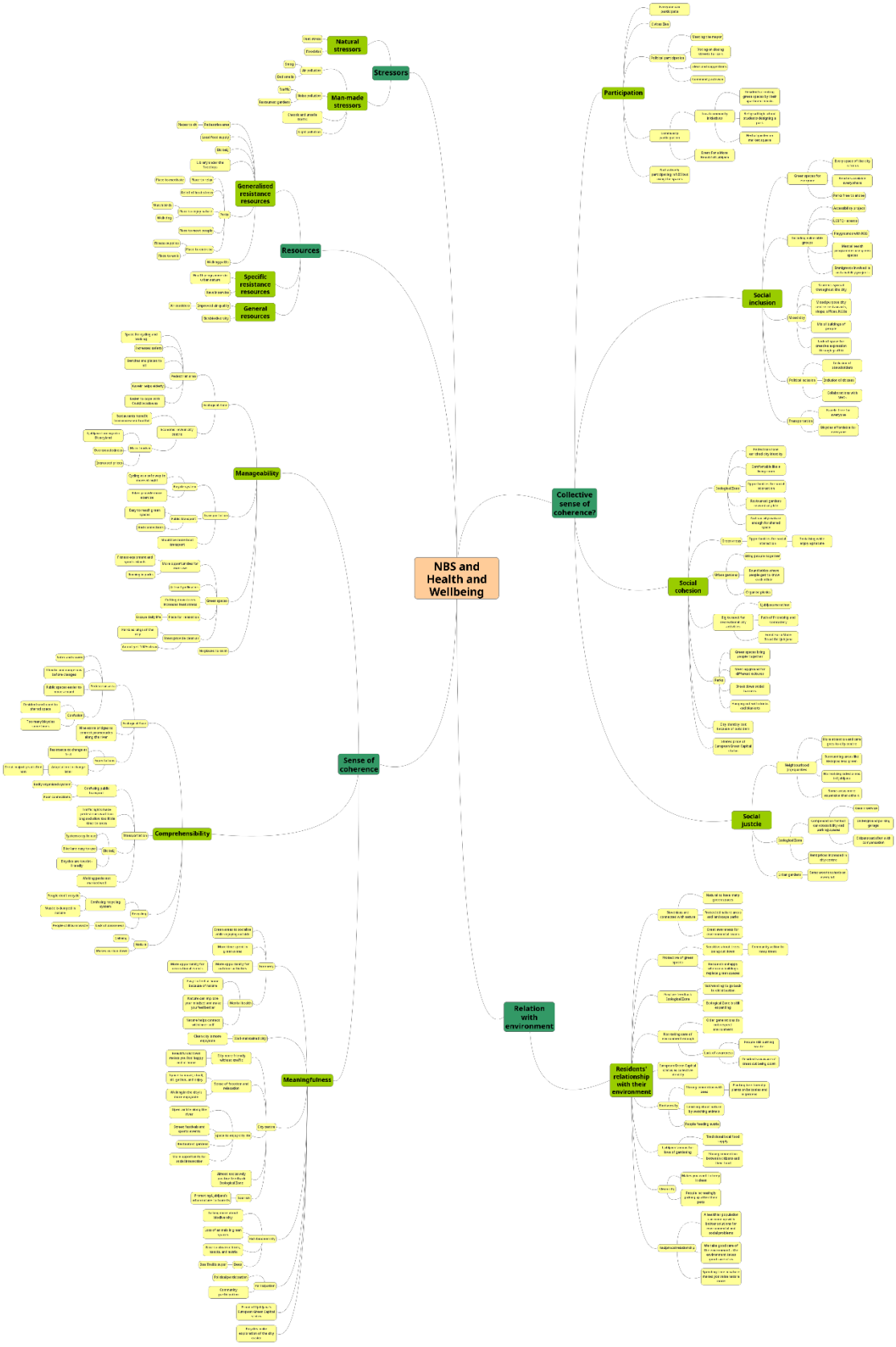


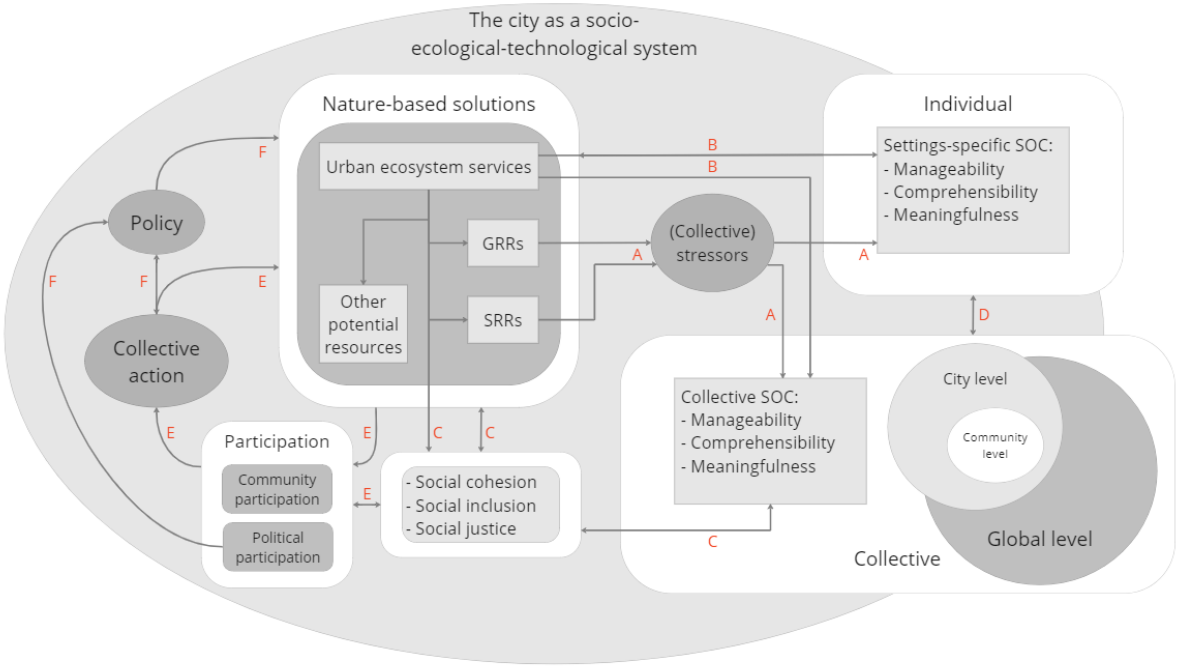
Figure G2

Map including main analysing themes and all subordinate codes (PDF and PNG file viewable here)



Appendix H: Expanded Model Collective Sense of Coherence

Model depicting the collective SOC in a settings approach using the city as an example



A. GRRs and SRRs offered by NBS can be utilised to deal with environmental stressors in a salutary way, contributing to the individual and collective SOC and resulting in a move towards greater health and wellbeing.
B. UES offered by NBS do not necessarily need to be actively used to deal with stressors, as is the case with GRRs and SRRs, in order to contribute to greater health and wellbeing.
C. NBS and the UES they provide can strengthen social cohesion, social inclusion, and social justice, which in turn improve collective manageability, comprehensibility, and meaningfulness, and thus contribute to a greater collective SOC. At the same time, a strong collective SOC can make internalisation of UES easier both for individuals and the collective (see arrow A) by using social cohesion, inclusion, and social justice as resources.
D. Although the collective SOC is not a sum of multiple individual SOCs, the two concepts are linked. A strong collective SOC can make the internalisation of resources easier for individuals through social cohesion, social inclusion, and social justice (see arrows A and C). At the same time, individuals with strong SOCs can generate resources that benefit the collective health and wellbeing of the city (see arrows (see arrows A and B).
E. High levels of social cohesion, social inclusion, and social justice lead to greater participation and thus collective action, which in turn contributes to the internalisation, provision, and maintenance of NBS. Certain NBS also encourage participation and collective action.

F. *Political* participation specifically, as well as collective action more broadly, can influence policies related to the introduction, implementation and maintenance of NBS. At the same time, certain policies can inspire or support collective action.

Appendix I: Photos of Nature-Based Solutions and Urban Nature in Ljubljana

Ljubljanica riverbanks with tourist boat

Fitness path with nature-inspired equipment

Local food market

Kavelir service

Congress Square free of cars

Bee Hives in Tivoli Park

BicikeLJ station

Urban gardens

Ljubljanica riverbanks

Shared space for pedestrians, cyclists, and buses

Man hugging tree in Tivoli Park

Bridges connecting the riverbanks