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THE DESIGN OF NATURE-BASED SOLUTIONS: LEARNING FROM PRACTICES OF REGENERATIVE TRANSFORMATION

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Author's declaration

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Furthermore, this dissertation contains no materials previously written and/or published by another person, except where appropriate acknowledgment is made in the form of bibliographical reference, etc.

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Nature-based solutions (NBS) have gained popularity within mainstream sustainability research agendas due to efforts to coordinate global responses to urban sustainability challenges. Their potential is promising: by applying an ecosystem services approach inherent in NBS to urban development, they simultaneously provide social, economic, and environmental benefits, and they help operationalize regenerative urban development. Urban NBS are diverse in scales and forms (from green belts to urban parks at the macro scale or rain gardens at the micro scale). As NBS, these green solutions are portrayed as means to the use of the urban environments' capacity to deliver ecologically sound and socially desirable outcomes not only *with* but *for* nature. Still, at present, urban NBS are often temporary, fragmented, and used in an ad-hoc way. One of their major criticisms is that realizing NBS in practice can be detached from their theoretical promise. As a result, NBS can deliver below their actual potential, limiting their contribution to the challenge of urban transformation. Delivering below potential is intricately connected with the way urban spaces are designated and designed, reflecting user practices, culture, and lifestyle, and the understanding that NBS must serve humans and the natural environment alike. This dissertation explores the mutual interplay between NBS and the 'designed' features of the urban environment: how NBS can be amplified through strategic design considerations and enhance the 'urban' with human well-being as its integral part. I examine the design of NBS to understand the consequences of applying specific design frameworks and argue that a broad range of design factors affect their application and potential impact on regenerative urban transformation beyond sustainability. I apply Mang and Haggard's (2016) 'three lines of work' tool to construct a holistic design framework that represents critical dimensions that influence the creation and implementation of NBS for urban transformations. It was intended to guide design projects to develop regenerative synergies within their immediate and larger context. The 'three lines of work' comprise the 'spheres of influence' of a design project exerted across three dimensions: 1) the motivations behind the actions (design approaches), 2) the capacity and capability of the community to deploy the project (design processes), and the contribution to the regenerative capacity of living systems (design outcomes). Through a multidisciplinary case study analysis, the research highlights the role of design in conceptualizing, adopting, and implementing urban NBS and how the critical design dimensions influence these efforts in making their regenerative potentials happen. Qualitative, empirical evidence is gained from nine case studies in three cities (Győr, Hungary; Milan, Italy; and Melbourne, Australia). Through this assessment, I demonstrate the relevance of the interconnected design dimensions for embedding NBS into urban environments, thus, affording a transformed urbanity with different experiences, usages, and actions. Furthermore, by exploring the design framework of NBS, I provide a systematic and critical reflection on current urban design-based placemaking practices. I argue that a *radical repurposing* of the urban space is necessary where streets, buildings, homes, and open spaces can be redesigned into regenerative, living ecosystems.

Keywords: nature-based solutions, urban design, regenerative design, placemaking, urban transformations

Acknowledgments

Disillusioned from corporate design consultancy work, I started this dissertation research to channel my time and energy toward a topic that can be regenerative both professionally and personally. Initially, the concepts explored in this thesis were driven more by a personal passion for sustainable design but soon, they challenged me to critically rethink how design could make sense today as we move toward an uncertain future. Our environment is warming up and running out of resources, while pollution and permanent waste are accumulating. My immediate environment in Hungary and the cities I visited in Italy and Australia are all exhibiting signs of vulnerability, tested by floods, droughts, rains, wildfires, heatwaves, or the social-economic effects of pandemics. Meanwhile, the design practices, together with the frameworks and professional attitudes simply are not rigorous enough to respond to the impending 'new normal.' Changing the way we think about design and urbanity will not solve these problems at once, but it is a task long overdue. My aim was to address parts of this challenge with this research. Writing this dissertation has been incredibly rewarding, and I am eager to apply and expand my ideas in the hope of infusing nature-basedness into the coming design endeavors.

The intensive start of my Ph.D. journey was possible thanks to the NATURVATION project. Taking part in it provided an important context for the study and a valuable opportunity to meet established scholars in a friendly atmosphere. I can hardly thank my supervisor, Prof. László Pintér, for helping me find my way into the world of NBS and sustainability science. Without his help, I would not have ended up on this path that included lots of learning, exciting research, and the finalization of this thesis. Furthermore, this project would not have been possible without the insightful comments and guidance of my research committee, Prof. Katalin Szende, and Dr. Sander van der Jagt. Their questions and ideas continuously inspired me to extend the research in intriguing ways.

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Table of Contents

List of Tables

List of Figures

1. Introduction

> The environmental crisis is a design crisis. … It is a consequence of how things are made, buildings are constructed, and landscapes are used. Design manifests culture, and culture rests firmly on the foundation of what we believe to be true about the world (Van der Ryn and Cowan 2013, 24).

The development trajectories of humanity have transformed the physical environment to levels of unsustainability up to critical tipping points, amplified by the interacting Earth system processes (Lade et al. 2020). Moreover, these fundamental processes (such as atmospheric, geologic, hydrologic, or biospheric phenomena) are now altered by humans to the degree of inducing a new geological epoch, the Anthropocene (Crutzen 2002; Waters et al. 2016; Zalasiewicz et al. 2017). As part of the Anthropocene, we transform the Earth into increasingly urban: the most significant wave of urban growth in speed[1] and scale[2] is underway. Massive urbanization is one of the most critical implications of this transformation, threatening the environmental, social, and economic sustainability of cities and the quality of urban life. However, changing the approach to urban design and development can be a key driver in reducing human impact on the environment (Riffat, Powell, and Aydin 2016).

The way cities are built is partially unplanned, albeit not accidental (Barnett 1982; Carmona and Tiesdell 2007). In part, today's urban environments represent planning paradigms of the post-industrial revolution rooted in the human dominance of nature and the belief in unlimited growth (Steffen et al. 2015). The degradation of our environments, and therefore, the quality of urban life, is connected to design questions. As the opening quote of Sim Van der Ryn, architect and an early proponent of environmental design, states, ultimately, design embeds worldviews,

[1] For example, possibly only 40% of urban areas that are projected to exist by 2030 have already been built by 2011 (Seto et al. 2011).
[2] The global urban population grows by 1 million people weekly, and we are converting areas of land worldwide for urban development (UN 2014). The urban volume is estimated to double in a few decades; in addition to change in population and land use, urban processes, lifestyles, and investments are transforming cities (Boone et al. 2014).

mirrors social-political environments, and manifests in daily life. It reflects people's capacity to negotiate problems and understand the interrelations of the complex socio-technological systems. This statement hints at the underlying assumption that design dimensions are an influential factor in the developments defining the quality of the urban environment and, consequently, its effect on the natural world and peoples' lives. A better understanding must inform urban design frameworks of their possibilities and constraints in maintaining or transcending prevailing paradigms in theory and practice.

Recent advancements in coordinating global responses to sustainability challenges (UN Habitat III 2017; Kabisch et al. 2016) have led to the formulation of the nature-based solutions (NBS) concept, providing multifunctional solutions for resilient urban futures (EC 2021; Bush and Doyon 2019). The International Union for the Conservation of Nature (IUCN) defines them as "actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (2016, xii). NBS are diverse in scales and forms: they combine concepts such as ecosystem services, ecosystem-based adaptation, ecological engineering, and green infrastructure (Wild, Henneberry, and Gill 2017).

The popularity of NBS as a research topic is demonstrated by the intensity of academic publications (Bayulken, Huisingh, and Fisher 2021). The mainstream sustainability literature is foremost concerned with developing NBS typologies and showcasing their multifaceted potentials and benefits on the societal, economic, and environmental dimensions of sustainability (EC 2015; Brink et al. 2016; Nesshöver et al. 2017). Others highlighted the potential of NBS in urban areas to support the functions of urban infrastructures, to mitigate and contribute to adaptation and resilience against the impacts of climate change (Scarano 2017; Dorst et al. 2019; Haase et al. 2014; Kabisch et al. 2016) and other complex sustainability challenges (Pauleit et al. 2017; Raymond et al. 2017; van der Jagt et al. 2019). Even though the application of NBS has been discussed from urban planning perspectives regarding, for example, urban resilience (Bush and Doyon 2019; Mcphearson et al. 2014), NBS are also critiqued for not consistently delivering the most value for urban transformation (Escobedo et al. 2019; Krauze and Wagner 2019).

The various urban challenges NBS can potentially address are interconnected on a global scale,[3] however, they are universally albeit variously experienced at the local level. Universal problems (such as air pollution, deteriorating built infrastructures, or urban sprawl) disturb everyone. At the same time, the circle of persons who have agency in resolving them is much narrower than those of the affected. Additionally, the benefits of acting are also experienced locally (Levien 1979). The challenge of exploring the design and implementation of NBS indicates a research problem within the local scale of urbanity. Here, *urban design* is primarily concerned with harmonizing the urban community and its ecosystem through an integrated human settlement development process based on a whole-system approach (Palazzo and Steiner 2011).

The notions of city and urban are interrelated, and in general terms, they refer to the *urban environment* as the platform of everyday life and experiences. It comprises "streets, alleys, buildings, squares, bollards: everything that can be considered part of the built environment" (Gehl and Svarre 2013,2), as well as the natural or semi-natural 'green-blue infrastructure' composed of vegetated areas and water surfaces. On the one hand, its design must support human health and experience,[4] with attention to the physical, cultural, and social identities that define a place. Thus, the design of urban NBS entails a diverse set of basic requirements within the focus area of *placemaking*, which is a collaborative, community-centered approach to

[3] In contrast to universal problems, global problems (such as climate change, epidemics, or warfare) affect everyone, but finding resolutions requires everyone to agree and act. Moreover, the benefits of acting take effect on a global scale, relatively longer (Levien 1979).

[4] How people experience the movement from one place to another, the accessibility of services, the feeling of safety, enjoyment or belonging impacts not only their comfort but the wider understanding of health (GDCI 2016).

creating healthy urban spaces to which people can connect (PPS, 2007). On the other hand, urban design must integrate biodiversity-responsive measures (Chan et al. 2016) into design objectives and actions to mitigate human impacts on the natural environment and nurture a healthy coexistence (Cole 2012). In short, the quality of urban life – both for humans and non-humans – depends deeply on how cities are shaped (Sussman and Hollander 2021).

Many interchangeable notions and concepts are related to urban sustainability. For example, the European Environmental Agency uses the concept of *urban environmental sustainability* (EEA 2021) to revitalize and improve urban livability while reducing environmental impacts and maximizing economic and social co-benefits. This challenge is entangled with "the way cities are designed, managed, and inhabited based on a deeper social, ecological, technological, and political understanding of urban sustainability and of the urban experience" (Childers et al. 2015, 9). Concurrently, the opportunities are also highlighted by the concept of *sustainable urban transformation* (SUT), situating cities as a source of possibilities for sustainability, concerned with resources and energy, and the integration of economic, social, and environmental spheres (Ryan et al. 2016). However, several critics raise concerns about the limits or misuse of sustainable development or sustainability,[5] leading to misinterpretation and weakness in accounting for environmental integrity (Lippert 2004; Cheever and Dernbach 2015). Moreover, as Dennis Meadows argues (2012), it might be already 'too late' to address the reality of climate disruption solely on sustainability terms.

A different approach to urban development is outlined by the concept of regeneration, which applies an ecological worldview (McHarg 1969) to focus on designing solutions that work at the biophysical level. Within the scope of *regenerative development*, the desired outcome is a

[5] The hegemonic concept of sustainability originated from decades-long discussions of sustainable development since the 1987 Brundtland report. Thus, in broad terms, sustainability and sustainable development are interchangeable notions (Lippert 2004).

living environment where the "ecological, social, and economic systems are continually nourished" (Plaut et al. 2016, 2). Regenerative development processes contribute to urban transformation by enabling the potentials of living systems to emerge and evolve towards increasing states of health and well-being (Hes and Santin 2017). At the urban scale, the concept of *regenerative design* (Cole 2012; Mang and Reed 2012a) is particularly suitable for exploring the design possibilities and constraints connected to NBS. In this context, urban regeneration indicates 'solutions' to enhance or reestablish degraded or lost urban ecosystems, which then can be sustained. Regenerative urbanism explicitly addresses the design of urban forms accommodating both humans and nature for "the overall transformation of cities" (Madanipour 2006, 191), enabling the conditions for an ecologically and socially sound relationship between the two (Palazzo and Steiner 2011). However, regenerative urban design is a complex, multidimensional concept, generally missing from the contemporary urban landscape (WFC 2014). It is challenging to implement, and established references are sparse for diverse urban planning challenges (Hand et al. 2017). It is not widely used, and theory is lacking about the nature of urban design approaches linked to regenerative planning (Haaren et al. 2014).

In the design of the urban environment, regenerative design solutions and transformation theories can meet in real-time experiments, functioning in test mode for developing ideas and potentially triggering transformation mechanisms - when managed the right way under the right circumstances (Kemp, Rip, and Schot 2001). I consider urban NBS as examples of such experiments, offering a relatively novel approach to the design of urban spaces. Their *rhetoric* integrates environmental and social sciences to bring about a different perception of valuing nature, where NBS are used *intentionally* to address particular urban challenges for the benefit of people and communities (Bulkeley et al. 2017). For example, urban parks can help to amplify climate change adaptation efforts by buffering heat islands and extreme rainfall effects and could support biodiversity protection, space for recreation, aesthetic desires, educational activities, and spiritual needs (ibid). NBS, in a theoretical sense, are means for urban transformation, addressing regenerative goals using the built environment, while in a practical sense, they are part of an agenda that requires new scenarios for urban environments and ways of living.

However, NBS as a theoretical concept can be distant from the actualized designs (Fors et al. 2015), limiting their uptake in planning and practice. At present, instead of being widespread and connected, urban NBS are fragmented, marginal, and spatially uneven. According to Kabisch et al. (2016), their ad-hoc usage is due to NBS being 'lost in translation' between the scientific assessment of ES and the local, socio-cultural context, implicating a lack of understanding and management to deliver the most value for the urban transformation agenda. Additionally, as Ferreira et al. argue, “expectations regarding the implementation of NBS are detached from the real challenges faced through their implementation” (2020, 18). One of the main reasons for their non-systematic use and the gaps between expectations and implementation is that “NBS are not self-evident – they have to be imagined, designated, practiced and realized in particular urban conditions and their wider contexts” (Bulkeley et al. 2017, 6). These arguments call for a closer examination to interconnect the theoretical conceptions and the practice of embedding them into urban environments: design-relevant knowledge and findings. They are nested in disciplinary boundaries, between academia and practice, or science and design. Thus, the challenge is to mediate the “gap between the *rhetoric of the potential* of NBS and *their implementation*” (Bulkeley et al. 2017, 2). Via this dissertation, I aim to answer the overarching research question: *How can the design framework of NBS contribute to reducing the gap between NBS’s ‘rhetoric of potential’ and their implementation and impact on achieving urban regeneration?*

Exploring the gap between the rhetoric of the potential of NBS and their implementation highlights a research opportunity where theoretical aspects could advance design practice for realizing urban NBS. My research attends to this gap by 1) demonstrating the relevance of three interconnected design dimensions for embedding NBS into urban environments as a regenerative place-making strategy: outcomes, approaches, and processes, which together form the *design framework of urban NBS*, and 2) analyzing how the NBS design framework can be configured to contribute to unfolding the regenerative potential of urban NBS.

The nature of the research problem requires an interdisciplinary dialogue, which I apply in this dissertation, to show that a broad and diverse range of design factors affect the application and potential impact of urban NBS. Furthermore, I document and analyze how the design dimensions of NBS contribute to the sustainable, even regenerative, transformation of the urban environment. In this dissertation, I explore the mutual interplay between NBS and the 'designed' features of the urban environment: how NBS can be amplified through strategic design considerations and how, in turn, NBS enhances the 'urban' together with human well-being.

I derive the design framework of urban NBS from Mang and Haggard's (2016) regenerative design tool called the 'three lines of work,' which they created for guiding design projects to develop regenerative synergies within their immediate and larger context. In this framework, the 'spheres of influence' of a design project are located across three levels: 1) the motivations behind the actions (which can be expressed in the applied design approaches), 2) the capacity and capability of the community to deploy the project (expressed in design processes), and the achieved health of the living systems (manifesting, among others, in design outcomes). Applying the three lines of work for urban NBS design provides a holistic take on the critical dimensions that influence the creation and implementation of NBS for regenerative transformations. Therefore, I study how the *design process* of NBS – guided by specific *design approaches* – contributes to unfolding their regenerative potential and how the NBS *design outcome* allows for or 'affords' a different urbanity with different kinds of experiences, usages, and actions. I focus on three sub-questions, all formulated with an exploratory purpose, to tackle the three dimensions:

1. *How do the design outcomes of urban NBS indicate a transformed, nature-based urbanity?*
2. *How are design approaches applied for urban NBS, and how can they guide regenerative transformations?*
3. *How do design processes of NBS contribute to the regenerative transformation of urban space?*

By focusing on these aspects, I situate NBS as interventions in complex urban environments, where the interplay between technology, nature, and humans influences how urban nature performs (i.e., the NBS). I am not concerned with finding solutions for all the possible problems when designing NBS. Instead, I aim to explore the main features of the design dimensions – the explicit connections between concepts, practices, and modes of governance specific to design – that may help realize their hidden potential in the regenerative transformation of the urban space. By exploring the design framework of NBS, I provide a systematic and critical reflection on current urban design-based placemaking practices. I aim to demonstrate that the achieved form, performance, and contribution of NBS are dependent on design structures and processes. In a sense, my results are meant to structure thinking about the design and development of urban environments in ways that prompt a *radical repurposing* of the urban space*:* where streets, buildings, homes, and open spaces can be turned into NBS.

Additionally, via this dissertation, I joined NATURVATION, one of the major pan-European research projects focusing on NBS. It was funded by the European Commission and connected 14 European institutions in urban development, geography, innovation studies, and economics.

By adopting a transdisciplinary approach, the project sought to understand the effects and implications of NBS on urban challenges, specifically, what NBS can achieve in cities.

I explore the design framework of urban NBS through a multi-case, multi-site qualitative case study analysis (Yin, 2017). I inspect nine NBS cases and their regenerative and transformational implications in relation to the applied design framework. My theoretical viewpoint is formed from conceptual advancements in the intersection of design theories and regenerative urban transformation. Building on Donella Meadows' (1998) work on ‘leverage points,’ Carmona’s (2014) theory on the urban design process, and Mang and Reed’s (2016) practical implications for regenerative design, I conceptualize NBS as instruments of placemaking strategies, part of an integrated approach towards urban regenerative transformation.

The findings are based on data from multiple sources to uncover the details of the design frameworks of NBS. Primary data was gathered through semi-structured interviews, combined with secondary data gained from desk research as well as place-responsive methods such as observation during field visits. Additionally, the field visits provided opportunities to complement and triangulate the primary data with ‘walking interviews,’ participation in workshops, guided tours, on-site lectures, or events organized at the NBS sites. The transcripts of the interviews were combined with the observations, notes, field diary, and articles and documents from the desktop research and literature review. The accumulated data was processed, then coded, and assessed in two stages: first through in-case analysis to write city-specific ‘working papers,’ followed by a cross-case analysis that forms the body of the analytical chapters.

The dissertation's structure is described as follows. Chapter two presents the literature review investigating the strategic use of NBS as deliberate design interventions in urban regeneration processes. Here, I establish the analytical and methodological basis for exploring the design framework of NBS. I trace the connections between urban design, sustainability, and regenerative design and point to the gaps in the intersections of these fields, which I address via the sub-research questions.

In Chapter three, I detail the conceptual foundations providing a structure for positioning NBS as instruments of placemaking strategies, part of an integrated approach to urban regeneration. I specify the analytical framework for exploring the design dimensions of NBS: 1) outcomes (the actualized design manifesting in the outcomes, as features and consequences continuously affecting human and more-than-human life), 2) process (shaping the capabilities embedded in the outcomes), and 3) approaches (highlighting how designers and participants act within these processes based on their perspective of the world). I present the interpretive research approach, with consequent implications on the methodological framework and methods to be applied.

Chapter four summarizes the baseline data and characteristics of the nine NBS cases in Győr, Milan, and Melbourne. Their structural and institutional backgrounds are presented, and their performance regarding urban challenges as site-specific conclusions is assessed. Furthermore, the cases are explained from a placemaking lens to provide analytical clarity for further analysis.

The subsequent three chapters are arranged according to the analytical themes. Chapter five examines the *design outcomes* dimension through a placemaking lens to account for the nature-based outcomes from a human-centered and more-than-human-centered view, with a reflection on how urban design-based placemaking expressions enable social and environmental interactions. Chapter six analyzes the significance of the *design approaches* that shape NBS as they orient the further design elements and activities, affecting the emergence of feasible outcomes. Chapter seven turns to analyze NBS *design processes* to present the connections between design activities, the achieved outcomes, and the transformative potential of urban

NBS. It reveals opportunities embedded in the design of NBS, which support shifts towards urban sustainability and regeneration.

Finally, based on these three analytical chapters, I discuss theoretical and practical implications derived from the empirical evidence in Chapter eight. I highlight the connections between the design framework's three dimensions and the unfolding of the regenerative potential of a place. Additionally, I discuss the compilation of the *NBS design framework* to challenge the basic assumptions, beliefs, and practices connected to urban design and development. In the conclusions section, I synthesize the main findings and theoretical contribution, complemented with a methodological reflection and recommendations for further research.

2. Literature review

> In this age of mass production, when everything must be planned and designed, design has become the most powerful tool with which man shapes his tools and environments (and, by extension, society and himself) (Papanek 1972, ix).

The theoretical foundations and practices emerging from urban ecology and regenerative urbanism are still expanding, and NBS represent a relatively new concept in the spectrum of sustainability topics. In this literature review, I inspect the links between urban studies, NBS, and design theories to contextualize the materials covered by this research and develop its theoretical and methodological foundations. I start the literature review with a synthesis of scholarly arguments supporting that urban design is critical for the widespread application of NBS in urban environments. However, while other societal or political factors also affect the success of these endeavors, urban design actions can also fail in activating the regenerative potential of a place if they are not tailored to the needs of human and non-human communities. Thus, to bridge the gap between the 'rhetoric of potential' and the implementation of NBS, their development must be aligned with the principles of regenerative design, a concept that is part of a long tradition in urban design studies.

In the following section, I establish the starting position of this research by justifying the study of NBS from a regenerative place-based view. The consecutive sections will dive deeper into the conceptualization of the constituent concepts. First, I discuss the role of NBS and design in urban regenerative transformation. Then, I present the urban planning roots of sustainable and regenerative design, followed by the general design theories, which form the base for studying the design framework of NBS as a place-making tool for regenerative transformation. Finally, I specify the elements composing a design framework and the core design dimensions (outcome, approaches, and processes) and argue that they must be explored holistically to examine the design aspects of NBS.

While studying NBS from multiple perspectives is a popular topic currently (see Section 2.1.1), their design angle is relatively unexplored. However, applying design theories to investigate NBS provides a deep understanding of the complexities of their creation. Studying the design dimensions can demonstrate how design phenomena are intertwined with actualizing the various contributions and benefits of NBS and are a key factor in reaching urban transformation, which I will elaborate on in the analytical chapters.

2.1. NBS as means of transforming the urban place

A critical point in regenerative development is to reach beyond reducing and mitigating the negative environmental and socio-cultural impact of urban spaces, processes, and their support systems. Instead, the aim is to (re)build capacities, capitals, and resources through the (re)design of the very structures and consumption processes that, in their past and current form, result in degeneration and unsustainability (generally concerning the grey infrastructure in cities, for example, streets, roads, buildings, open places) (Lyle 1996). Regenerative design can address this challenge by accounting for both the biophysical and the social spheres and focusing on community engagement and *place-sensitive design* (Cole 2012).

Space in the urban environment is regarded as a limited, precious resource. Therefore, competing interests determine the use of space, and the allocated space for nature is often crowded out by business and development interests. Moreover, Lefebvre's (1974/1991) work on the production of space explains that spaces can be different according to their degree of *participation* in nature. Some embrace nature, while others can reject it or even destroy it. The urban space becomes a place - a focal concept in urban design (Carmona et al. 2003; Carmona 2019) - when it “is a usable space, a space that serves a real purpose” (Cilliers et al. 2015, 591).

Thus, a place is enriched with unique features "that people want to live, work, play, and learn in" (Wyckoff 2014, 5).

Moreover, place is a central element in sustainability science (Kates et al. 2001) and urban regeneration agendas because of "its living context, the unique socio-ecological system," in which the built environment is intently contributing to the regeneration of the larger system "that it is a part of and depends on" (Mang and Reed 2012, 18). In short, "places matter most," as the title of Francis Tibbalds' (1992) article states. A distinct urban design canon is concerned with urban design as a form of, and driver of, *placemaking*: creating quality places (Carmona and Tiesdell 2007).

Placemaking activities focus on meeting basic human needs, on people's experience within a *space*, and transforming it into a *place* with distinctive social and cultural values. It is an inherently people-centered concept for the planning, design, and management of public spaces in cities. It contributes to a sense of place and community ownership by emphasizing the relationships between individuals, communities, and urban space by enabling and empowering people to create attractive, sociable, healthy, and green streets and places (Wyckoff 2014). Therefore, all forms of placemaking are based on public and stakeholder engagement within the design and development process of the projects and activities (Wyckoff et al. 2015) which is also a crucial feature of NBS (Ferreira et al. 2020). Placemaking has a significant community design dimension, especially when the focus is on the design of public spaces: parks, open spaces, sidewalks, streets, and semi-public spaces, such as the spaces in buildings with public functions.

There are four *types* of urban design-based placemaking processes that all improve urban life quality (Wyckoff 2014). The first type is *standard placemaking*, concerning urban practices aiming to upkeep quality places through basic maintenance and necessary incremental improvements. This type of placemaking describes the universal understanding of the term that the Project for Public Spaces (PPS) mainly advanced. It typically happens between strategic phases, as a series of phased steps or iterations, and depending on the available budget, the process can be planned or uncoordinated (Lew 2017). Public, non-profit, and private sectors participate in standard placemaking processes through various projects and activities. Public engagement can happen through the local authorities' efforts or the landowner or external experts' involvement.

The second type, s*trategic placemaking*, refers to larger-scale developments, usually realized based on a top-down approach with a significant level of investment by governments or private developers within a relatively short period. It can act as a catalyst in re-defining a neighborhood, district (or even a city) and thereby attract other new developments and people (Lew 2017). It is a targeted process for achieving a particular goal, such as a mixed-use development of downtowns, revitalizing residential sites, or establishing nodes along key corridors intersecting dense urban areas. However, strategic placemaking generally includes low levels of civic involvement (Gasperi et al. 2016), even though engagement is critical for NBS design and development (Ferreira et al. 2020).

The third type, *creative placemaking*, contributes to creating vibrant and exciting places through arts, programming, and events. Creative placemaking is often applied as an integrated approach to other placemaking practices. These practices can give alternative perspectives to urban planning and community-building while stimulating local economies. The emphasis is on the role of art and cultural activities in helping communities shape their environment to strategically animate places and spark economic development (Markusen and Nicodemus 2014).

Lastly, *tactical placemaking*[6] practices are associated with temporary or experimental (often low-cost, low-technology) interventions. For example, the urban design tactic called 'urban acupuncture'[7] presents an alternative to conventional development processes through targeted but highly flexible initiatives that help regenerate urban spaces. The tactical approach is identified as the form where citizen engagement most often happens concerning NBS implementation (Gasperi et al. 2016). However, the success of these organic processes is tied to some degree of direction and strategic design and planning (Lew 2017), in which case they can create ways to change or improve their environment and pave the way for more substantial investments (Ferreira et al. 2020). Another important feature of tactical placemaking practices is experimentation and adaptive management by testing various concepts through low-cost solutions starting at the street, block, or building scale. When successful, these experiments serve as proxies to build public support to which policymakers and local authorities can commit and provide resources.

These four placemaking types (standard, strategic, creative, and tactical) describe different mechanisms according to the objectives and results. They signify the placemaking activities' relationship to physical form, land uses, and functions, or the consideration of social opportunities in creating places. Nevertheless, the categories have discernible overlaps, and different types of placemaking can be used consecutively or sequentially (Wyckoff 2014). Moreover, a place can go through different phases of placemaking processes throughout its lifecycle.

At a practical level, the design and development of NBS comprise integrating green spaces into the built environment, guided either by professional design and planning or through organic,

[6] The term is inspired by Lydon and Garcia's book, *Tactical Urbanism: Short-Term Action, Long-Term Change* (2015).
[7] The first use of the term 'urban acupuncture' is attributed to Catalan architect and urbanist Manuel de Sola Morales.

universal human endeavor. Nature in the urban context is most commonly referred to as green space[8]: parks, urban forests, or gardens are usually considered as such vegetated types of open space. Similarly to NBS, urban green spaces can be applied on different scales (such as landscape, city, neighborhood, and street), with different accessibility (public, private, or mixed). Furthermore, urban green space and green infrastructure (a network of green spaces) incorporate various functions concerning urban inhabitants, signifying human influence and reliance on urban nature. This understanding shows that human involvement and design are necessary to develop urban green spaces.

However, in the recent literature on urban green spaces, the operational use is not widely reflected. Therefore, one of the distinctive characteristics of the conceptualization of NBS is the focus on the functional and viable aspects of urban nature. Even though developing NBS with a placemaking perspective is not a prerequisite, establishing urban NBS involves strategically considering the functional aspects of urban nature for social-economic benefits. This social aspect positions NBS in close connection with placemaking processes, as they offer means to improve urban places, traditionally from the perspectives of people and the community.

Nevertheless, introducing green spaces or NBS in urban environments is not always coupled with placemaking actions (Cohen et al. 2018). Moreover, 'green planning' or 'green placemaking' practices (see Gulsrud, Hertzog, and Shears 2018) that engage with a broader environmental agenda are not widespread (Bush, Hernandez-Santin, and Hes 2020). In short, the design and integration of NBS into urban places do not necessarily entail a place-responsive strategy, and at the same time, placemaking is often overly anthropocentric (Fincher et al.,

[8] Taylor and Hochuli (2017) collected the most used terms concerning green space research. They found that the term 'greenspace' is also used for 'blue space,' 'green area,' 'greenery,' 'green belt,' 'green environment,' 'green network,' 'green infrastructure,' 'green roof,' 'urban green,' 'nature,' 'parkland,' 'urban forest,' 'urban parks,' 'urban garden,' 'urban farm,' 'walkable area,' and 'woodland.'

2016). This is not surprising, although, by definition, for NBS a balanced human and nature-focused placemaking would be required. Instead, natural elements and ecological systems are arguably often overlooked and not considered equal parts or users of space (Hes et al. 2020). Therefore, to bridge this gap, it is critical to apply an integrated conceptual framework to urban design-based placemaking actions, and the assessment of such projects must consider both sides: the human and the ecological (Bush, Hernandez-Santin, and Hes 2020; Pineda-Pinto, Frantzeskaki, and Nygaard 2021). This implies expanding the place-making concept to species other than humans. In addition, the ecological effects of design must be combined within placemaking analysis. Otherwise, the *regenerative potential* of a place cannot be recognized or activated (Mang and Reed 2012a).

However, the creation and production of urban environments often happen without consciously recognizing the qualities and additional values that can be actualized through an urban design process (Carmona and Tiesdell 2007). Either because the design does not align with the urban socio-ecological system or because the normative[9] understanding of design is limited. As a result, the achievements are restrained, with hidden potentials, manifesting in shortcomings, missed opportunities, and gaps between what is possible and what gets built.

My thesis research aims to address these issues by framing the application of NBS as a tool for the regenerative transformation of the urban place, with an integrated design approach aligning human communities with the environment to sustain both over time. However, for a complete picture of how and why these connections can work, first, a deeper look into the potential

[9] There are two approaches to engage with design theory and methodology: descriptive and normative approaches (Behdad et al. 2013). Descriptive approaches typically concern codifying or formalizing current practices, theory, processes, or methodology. They deal with the question 'how do we design' in a descriptive fashion. Normative approaches seek to improve the existing processes or practices to develop new methodologies to answer the question 'how should we design'. However, there are significant overlaps and synergies between these two approaches. For example, in this dissertation, I aim to develop a holistic understanding of the design framework for NBS design, while I also critically assess the existing methods to improve on best practices.

contributions of NBS is necessary. I provide these details in the following sections and highlight their potential to fulfill regenerative outcomes.

2.1.1. The benefits of urban nature

The potential of NBS is promising: they simultaneously provide social, economic, and environmental benefits and are associated with sustainable urban development (Bayulken and Huisingh 2015; McCormick et al. 2013; Connop et al. 2015; EC 2015) and regenerative development (Xiang, Wang, and Deng 2017). For this reason, research on NBS is a primary topic in the EU Research and Innovation policy agenda, with a dedicated focus area on 'Smart and Sustainable Cities with NBS.' Projects such as NATURVATION, OPPLA, CLEVER Cities, Nature4Cities, GREEN SURGE, Urban GreenUP, or ThinkNature provide a growing evidence base on how to mainstream NBS (Somarakis, Stagakis, and Chrysoulakis 2019).

One of the most critical aspects of NBS is their strategic and operational application based on recognizing the value of nature's ecosystem services (ES)[10]. The concept of ES is built on the multiple, varied benefits that the natural environment (such as a healthy ecosystem) provides to humans (Costanza et al. 1997), the overall functioning of the Earth systems, and the role that biodiversity plays in producing them (Haines-Young and Potschin 2010). These ES include contributions such as the natural pollination of crops, clean air, extreme weather mitigation, and human mental and physical well-being (see Table A6 in Appendix A). NBS in urban environments concern these functional and viable aspects of urban nature to *intentionally* apply them to issues[11] such as water management (urban drainage, water retention, excess water),

[10] The concept of ecosystem services was introduced into the global environmental governance discourses in the early 2000s, providing a rationale for nature protection largely grounded in economic logic (Costanza et al. 1997).
[11] The urban sustainability challenges categorized by NATURVATION are provided in Table A7, Appendix A.

changing temperatures (heat waves, heat islands), and health and well-being (air quality, recreation) (Kabisch et al. 2016).

Likewise, NBS are framed from multiple angles, following the multiple co-benefits they provide. NBS are constructed and "realised in ecological, technical, social, economic and political terms" (Bulkeley et al. 2017, 4). They are studied through the dynamics of innovation, or business and finance models, from a governance angle or how NBS provide different services and values and to which urban challenges they respond. Their innovative potential is recognized (Kabisch et al. 2016), and their role in creating opportunities for promoting sustainable consumption behaviors is highlighted (Brown, Farrelly, and Loorbach 2013).

However, implementing NBS in cities can lead to counterproductive results if the biological and physiological conditions important for their functioning are not considered. For example, if the planting design is not based on local, resilient species which can form self-sustaining plant communities. In that case, maintenance costs may increase significantly (as opposed to the NBS rhetoric that they are often cost-effective solutions). Moreover, NBS can produce unwanted side effects without careful attention to their long-term social impacts. For example, the co-benefits that citizens receive from NBS are not always equally beneficial for all communities. Improved or increased availability of urban green spaces can lead to higher land prices and rent, and individuals' willingness to pay higher prices also increases (Willis and Garrod 1992; Gill et al. 2013). These mechanisms generate green or eco-gentrification: the displacement of population groups due to environmental reasons (Dooling 2009; Checker 2011). Therefore, some scholars argue that improving the environment is beneficial only if the places are kept ‘just green enough’ to avoid displacement (Wolch, Byrne, and Newell 2014). However, designing NBS to be ‘just green enough’ does not reflect the essential concept of NBS. Instead, new collaboration models that integrate various parties (all stakeholders) into the design and planning processes must gain ground to counteract green gentrification processes (Kabisch, Qureshi, and Haase 2015).

2.1.2. Catalyzing the potential of NBS through design

Currently, NBS are relatively underutilized and undervalued by governments and decision-makers (Frantzeskaki et al. 2017). The multifunctional aspect of NBS is one of their core strengths, however, it poses a significant challenge at the same time. Furthermore, the successful functioning and survival of NBS over time are dependent on ecological, social, and economic factors, presenting considerable obstacles (and opportunities) to their systematic implementation. In this section, I present these in relation to design questions.

One of the main reasons for NBS' limited uptake is that outside the related research fields and in society, acknowledging ES and nature's contribution to people is insufficient, especially for cultural services (see Table A6, Appendix A) (Fink 2016). Understanding the regenerative potential of NBS and that the benefits could exceed the costs is fundamental to their implementation and balancing the social-ecological needs with economic viability (Mell et al. 2013). For example, the connections with other themes such as regional development or climate change adaptation must be considered (Merk et al. 2012). Although decision-makers' awareness and a sense of urgency play an essential role in developing NBS (van der Jagt et al. 2020), lack of knowledge and cognitive factors, such as uncertainty, can prevent the adoption of NBS.

Moreover, knowledge about citizens' (as end-users) preferences is crucial throughout the development process of NBS. Their implementation must reflect user practices, culture, and lifestyle (McCormick et al. 2013; Ferreira et al. 2020), which are mediated and realized through urban design and innovation activities. These people-related aspects present important questions about how the intended audience's needs, motivations, and interests can be considered and how they are represented or involved throughout the design and implementation process.

In recent formal and informal discussions around NBS, several voices have argued that expectations regarding the implementation of NBS are detached from the real challenges faced through their development. In short, what is designed is not necessarily what is implemented (Ferreira et al. 2020). Bush and Doyon (2019, 7) also noted "key gaps and omissions" in current urban design and planning processes concerning the implementation of NBS, requiring further analysis.

One of the reasons behind the gap between the conceptual design of NBS and their implemented results comes from the ’fuzziness’ of design processes (Sanders and Stappers 2008), where a logical chain of actions is difficult to understand (Albrechts 2006, Boyd-Davis and Gristwood 2016). A clear understanding of the complete design process and the consequent requirements for the various participants and actors would be beneficial when designing urban spaces with NBS. Moreover, the composition of the design elements and the normative quality of the design process can result in outcomes that fail to deliver the projected benefits because, in the end, design is the expression of a human intention. The intention, just as the design outcome, is shaped by understanding the design potential entangled in the wider, systemic context, which defines the design's target and the conditions of success.

This points to the importance of understanding the capabilities and processes required by designers (Ceschin 2014), which, in the case of NBS design, must stem from an integrated approach with a dual social-ecological focus. Furthermore, ecological equity and prioritization questions should be included in design concerns in order to create nature-based and regenerative places (Pineda-Pinto, Frantzeskaki, and Nygaard 2021; Bush and Doyon 2019). Therefore, the design of NBS must serve humans and the natural environment alike as equal parts (Bush, Hernandez-Santin, and Hes 2020). The key is to simultaneously address human needs and the functioning of the biophysical urban environment.

Designing for human and non-human species highlights the dominant oversight of the natural world in design questions, which stem from a valorization of nature outside of what it is to be human (Ingold 2012). This shifted understanding produced the overarching dominance of human-centeredness in design and other areas of life (with design implications that I will detail and discuss throughout this dissertation). However, the 'more-than-human' concept helps to expand and challenge traditional binaries of human and non-human, or human and nature. Various scholarly fields started to engage with this concept to question previous doctrines and overcome divisive binaries through cross-disciplinary investigations in science-technology-and-society studies (Franklin 2017), environmental humanities (Kohn 2007, 2013), geography (Philo 1995), or planning (Houston et al. 2018). In the field of urban design (Forlano 2016), more than only acknowledging the entanglements between humans and non-humans, the challenge is to follow up with inclusion and participation, with consequently amended standards, guidelines, principles, and approaches.

In the NBS literature, the more-than-human issues are only an emerging topic, albeit a promising one (Maller 2021) to counter the inherent human-centeredness of NBS. Even though the more-than-human[12] extends to other, non-living natural elements, such as water features or stones, in this dissertation, I also use the term 'non-human' or 'non-human nature' to refer to 'others' than humans in general and indicate the genuinely wider scope that design should take.

The significant gaps between theory (or rhetoric) and practice and expectations versus implementation highlighted in this section entail the focus of this research. Addressing these would represent a step forward in understanding the potential of NBS in activating regenerative impacts and how to incorporate the regenerative paradigm into designing urban NBS, aiming to serve 'more' than humans. This points toward conceptualizing and studying the design

[12] Interestingly, the same term is applied to a strikingly different philosophy: human-machine or human-computer interaction (Coulton and Lindley 2019).

framework of urban NBS, comprising both the social practices involved in making nature-based places and the theoretical understandings that guide these practices. First, however, I will discuss the theory of critical figures contributing to the foundations of urban design and regenerative urbanism to understand the background and evolution of current practice and knowledge in these fields. Second, I will explore previous and contemporary approaches to urban design and ecological thinking to understand change, its drivers, and the trajectories that have emerged over time.

2.2. Designing the urban: the roots

Cities are complex social, spatial, and legal constructs. They are sites of human development with much higher population density than in the surrounding countryside and, therefore, a more substantial degrading impact on nature. In the urban space, various norms, views, and ideologies evolve and vice versa: the built structures alter and shape the invisible social and cultural patterns that influence our understanding of the world (Birkeland 2002). As Donella Meadows (1998, 1999) explained, one of the potentially most impactful leverage points for change is the paradigms around which the systems[13] (such as a city) are constructed.

Integrated town-planning processes were present as early as the Middle Ages, revealed through the lens of cultural geography (Abel 2017). Evidence shows that the formal structure of many towns was willfully planned, characteristically around a fortress, and extended to the village or the city. However, planning took on a new dimension when colonization and the industrialized cities of the 19th century had grown at a tremendous rate. The early 20th century's modernist planning culture in European cities tried to mitigate the consequences of the industrial age.

[13] In Meadows' definition, a system is "an interconnected set of elements that is coherently organized in a way that achieves something" (Meadows 2008, 11). There are many 'structures' which can be considered as a system: form an organism to an organization (such as a family, a company or a country), or a population, an economy or a city.

Nevertheless, today's urbanization-related environmental problems, health, and social effects are closely linked with that heritage, remaining relevant until the 1980s. The pioneer of the modernist canon was the Swiss-French architect, Le Corbusier (1887-1965). In 1923, he published an essay collection*, Towards a New Architecture*, praising the rational, planned city built from concrete and steel with highways and high-rise buildings. Modernist architecture considered the city from a functionalist perspective to develop the physical frameworks and infrastructure for the conveniences and comfort of people. Le Corbusier's program was highly influential. Many notable architects have adopted the modernist perspective globally, contributing to the cityscapes we can see today, including Walter Gropius, Frank Lloyd Wright, Mies van der Rohe, Arne Jacobsen, Oscar Niemeyer, and Alvar Aalto.

Early theories of sustainable design and building with the ecology of space were already present during this era. For example, Ebenezer Howard (1850–1928), the first modern urban planning theorist, published his book, the *Garden Cities of To-Morrow* in 1902, envisioning urban settlements with the mutual benefits of a town and country, protected by greenbelts, offering an alternative model to the overcrowded industrial cities (Miller 2010). His ideas induced the garden city movement, spreading from the United Kingdom to mostly colonial and post-colonial cities during the early 20th century. However, the remaining garden cities of today are only remnants of an urban design experiment, and the movement received implicit critiques for leading to the suburbanization and degradation of the countryside (Miller 2002).

Concurrently, sustainability thinking started to appear in the broader area of design. Most importantly, Buckminster Fuller (1895-1983), the multi-talented systems theorist and inventor, argued for the need for a ‘comprehensive designer’ whose practice deals with systemic aspects of sustainability (Fuller 1969). In architectural design, the Austrian artist and architect, Friedensreich Hundertwasser (1928-200) was an early proponent of a new style of architecture practiced in harmony with nature and humans. Nevertheless, these directions remained marginal in practice and were regarded only as additional to design. By the middle of the 20th century, sprawling cities and artificial cityscapes became ordinary due to extensive urban expansion (Bruegmann 2005). Simultaneously, environmentalist voices with heavy critiques of modernist architecture and urban development also emerged (Gehl and Svarre 2013, Carmona and Tiesdell 2007). In the next paragraphs, I review the (now) classic texts, which were the first to understand and address the complexities of urban life. I present how changes in planning perspective led to a reform in the urban realm: connecting the built environment to people's quality of life and ecological processes.

The significance of these earlier works lies in their role in establishing urban design's status, and many later theorists directly refer to them. One of the most influential authors in urban studies was the American-Canadian Jane Jacobs (1916-2006). She published her book in 1961, *The Death and Life of Great American Cities*: a provocation and alarm to planners and politicians; "an attack on current city planning and rebuilding" (Jacobs 1961, 1). Jacobs raised awareness of working with the synergy of life and space to make a city lively and safe. Her 'eyes on the street' concept, connecting safety and design of cities, laid the ideological foundation for a specialized dimension of urban design that later developed as 'public life studies,' pioneered by Jan Gehl. Another key motivator was Gordon Cullen (1914-1994), a British architect and urban designer who published *The Concise Townscape* (1961). Cullen questioned modernist planning by taking a strikingly different perspective: looking at the relationships among all landscape elements, where a series of coherent elements and spaces construct the urban environment. In his 1969 book, *Design with Nature*, Ian McHarg (1920-2001) extended the role of a specific element, *nature*, in urban planning endeavors and synthesized the means to understand its role in design: thus, introducing the concept of ecological planning. The conceptualization of the city as an ecosystem and the relationship between nature and the city was further described in the American urban planner Kevin Lynch's

(1918-1984) book, a *Theory of Good City Form* (1981). He developed a normative theory of city form about how human values can shape cities' physical structures by taking an ecological view.

The 1960s was also the era when theorists explored design connections with livability, well-being, and human behavior in urban environments. Shifting from the modernist, abstract way of planning, architects and planners sought to understand what creates place-specific harmony in cities. Lynch published his most influential book, *The Image of the City* (1960), showing how city form was essential in shaping human perceptions and behavior. Christopher Alexander (1936-2022), a widely influential British-American architect and design theorist, presented one of his primary works in the 1977 book, *A Pattern Language*, where he introduced one of the first theories about the attributes of human-centered design. Alexander argued that people are the most knowledgeable about their own needs in any planning process, being the subjects of planning practices. He demonstrated the relationships between geometrical and social behavior patterns to show how the built form can accommodate human activities, thus describing a universal *'pattern language.'* Furthermore, he argued that addressing people's daily needs and preferences is the only acceptable way to build for any domain or scale (Alexander 1979).

These critical writings substantially influenced urban studies, environmental psychology, sociology, and economics. Their theories and works fostered the formation of current *urban design* practice. Additionally, they laid down the basics of making environmental quality and the correspondence to basic human needs commonplace in the field (Laurence 2011; Pavesi et al. 2012). The specialized urban design sub-domain of *regenerative urbanism* most strictly integrates these concerns (Lyle 1996). In Section 2.4, I will present the theories of urban design and regenerative urbanism with which I will work within this thesis. However, in the next section, I will first explore how design is understood with the help of key texts providing foundational design theories. Then, I will inspect how knowledge is associated with design and how the related design structures and components can be studied. Finally, I will concretize the design framework of urban NBS, on which the next research steps are based.

2.3. Design science or science of design?

The radical changes in the middle of the 20th century presented above induced the *dematerialization* of design (Dubberly 2017). As the design field evolved from the traditional disciplines of apparel, communication design, architecture, product design, transportation design, and graphic design, the focus shifted from physicality to the connections between the fields. As a result, design became a fundamental factor in business and innovation management by incorporating insights from other disciplines such as social sciences, engineering, and business management (ibid). During this process, the designer's role and responsibility also shifted. Part of the designer's job became to focus on understanding users, their values, and experiences instead of following pre-defined strategies.

The evolution of design consequently catalyzed an ongoing debate about the *process, theory, and methodology* of design (Jones 2002), profoundly questioning design's ability to reach beyond a collection of rules and recommendations for practitioners to present measurable, verifiable, and replicable knowledge. Many have challenged and rejected various interpretations of design science: notoriously Christopher Alexander. Alexander was initially a proponent of design science. However, he made a critical distinction between the role of methods in science and design, corresponding with Gregory's (1966) argument that "science is analytic, design is constructive" (quoted in Cross 2001, 2). If "scientists try to identify the components of existing structures" and "designers try to shape the components of new structures" (Alexander 1973, 130), then the methods used in design are not for validating results but for the practice itself. Donald Schön (1983) similarly challenged the design science movement from the same perspective, claiming that professional designers deal with 'messy and problematic situations' as 'reflective practitioners.' Concurrently, Rittel and Webber voiced the *wickedness* of the design problems, consequently the design space, in contrast to the rigid engineering definitions.[14] A wicked problem is "unique, ambiguous, and has no definite solution" (Rittel and Webber 1973, 161), and the design process dealing with these complexities cannot be definitive.

Eventually, the debate was concluded: the scientific applications of design methods and the attempts to scientize design (i.e., acknowledge design as a scientific field) were rejected (Cross 2001). Instead, theorists settled that design is neither science nor art; it is most close to what Bruce Archer called a 'third form of knowledge' (quoted in Boyd-Davis and Gristwood 2016). However, a fruitful outcome of the criticism appeared as a shift in design theory endeavors to focus on the contribution of design *to* science, resulting in the formation of a new field, the *science of design*, which:

> includes the study of how designers work and think, the establishment of appropriate structures for the design process, the development and application of new design methods, techniques, and procedures, and reflection on the nature and extent of design knowledge and its application to design problems (Cross 1984, vii).

Thus, the study of design is considered the subject of science and scientific activity (Gasparski 1990). Simultaneously, entanglements between science and design became more noticeable after the 1970s when transdisciplinary[15] orientations emerged in scientific research (Klein 2014). In addition, various contemporary branches of sustainability science integrate design knowledge, such as design for sustainable transitions (Gaziulusoy and Brezet 2015), transitions design (Irwin, Tonkinwise, and Kossoff 2015), or systems thinking (Buchanan 2019).

[14] Rittel and Webber (1973) also claimed that it was, in fact, science that was not equipped to handle the open-ended problem spaces of *wicked problems*, suited only to tackle *tame problems*.

[15] Transdisciplinary science is driven not by specific disciplinary paradigms but by the need to address the world's most pressing issues and builds on engagement and co-design in the social and knowledge sphere (Hirsch Hadorn et al. 2008).

Design is a complex notion, used both as a verb and as a noun[16] and conceptualized around design activities related to the design process and outcomes (Ralph and Wand 2009). Therefore, design is *intentional*, meaning that it is never accidental but *anticipatory* because the specification of the design object[17] sets the required or desired outcome(s) and consequently defines the process and the methods to be used (Rittel and Webber 1973). In short, design and designing are process-based, where the activities are defined, managed, and executed based on specific goals and targets.

'Design knowledge' is independent of other professional domains (Cross 2001). Design practice builds on multidisciplinary scholarship and standards. This is due to the nature of design problems, which are not isolated from the complex systems entangled in relationships with the environment and ecosystems. Therefore, design professions have developed specific ways to deal with problems: shape and structure complexity by integrating different knowledge types.

Designers simultaneously utilize the documentable information of *explicit* knowledge that is readily verbalized and easily transmitted visually, the *implicit* knowledge of learned skills, and most importantly, the informal *tacit* knowledge ingrained through experience over time. Tacit knowledge is difficult to capture, document, or put into words. Thus, it has been traditionally neglected in formal knowledge bases. Nevertheless, it can be exported or embodied in or by the environment, objects, and artifacts, often realized in the form of design prototypes and

[16] However, these notions are independent of the specific field of application: the descriptions are suitable for diverse purposes, such as building a house, creating software, designing a vacuum cleaner, or nature-based solutions (Erl 2008).
[17] Moreover, the object of design is not only the physical but also the interconnected digital and cultural materials that are subject to the same processes and methods. Richard Buchanan's framework (Buchanan 2001) on the 'four orders of design' includes *symbols, things, action, and thought.* The things shaped by design are not only two-dimensional printed materials and three-dimensional objects or environments but behaviour, action, and thought (in the form of organizational change, policy, and systems - consequently, patterning also exists in the political, organizational, logistical, and cultural context of design).

visualizations. For example, in the case of urban NBS, the experience gained from building various urban greening projects might guide the designers in ‘knowing’ how different spaces can afford various human-nature interactions or display inviting and inclusive qualities. Similarly, communities who have been traditional stewards of urban places often carry intimate knowledge on how to tend to the local ecosystem or how disturbances might affect these. Therefore, exploring and leveraging the local, tacit knowledge is crucial for understanding the design of urban NBS and bridging the gap of experience in planning for systemic solutions (Wamsler, Luederitz, and Brink 2014).

Integrating the different types of knowledge characterizes design knowledge, which Nigel Cross famously referred to as 'designerly ways of knowing:'

> [It] is of and about the artificial world and how to contribute to the creation and maintenance of that world. ... inherent in the activity of designing... in the artefacts and... in the processes, ...and can also be gained through instruction in them (Cross 2001, 5).

In other words, the design outcome embodies the internalized knowledge gained during the design process. Realized NBS designs thus reflect the designer(s) understanding of the challenges to be addressed, the characteristics of the social, economic, and ecological circumstances in which the NBS is embedded, the anticipated interactions and use patterns, and many more aspects connected to the creation, development, and sustainment of an urban NBS.

Exploring the characteristics of the ‘designerly ways of knowing’ gives insights into the universal activities of human creation, and such endeavors have been the subject of years of research. Empirical demonstrations argue that professional designers think and work in specific ways, differentially from others, even though the designer's knowledge is not different epistemologically. This ‘way of knowing’ is fundamentally based on the intimate understanding of processes,[18] methods,[19] experiences of craftsmanship,[20] and patterning. It is not about automatically following a method or process step-by-step. Instead, it is guided by the knowledge of *patterns*. Through experience, designers develop conceptualizing, framing, and solving problems, dealing with defined and emerging constraints. Designers create models for patterning *in the problem* (solving the design problem) and *around the problem* (context of the exploration) (Kolko 2010). To illustrate, patterning around the problem entails a continuous iteration of actions ('moves'), reflection, and adjustments. Donald Schön (1984, 1), philosopher and urban planning scholar, describes patterning as follows:

> The designer asks himself 'What if I did this,' where 'this' is a move whose consequences and implications he traces in the virtual world of a drawing or model. Making a design move in a situation can serve, at once, to test a hypothesis, explore phenomena, and affirm or negate the move. In each function, the evaluation of the experiment depends upon what Geoffrey Vickers has called 'the designer's appreciative system.'

In the case of a place-based design intervention, which urban NBS entail, the design decisions or moves may be about the site's accessibility features, physical linkages, and the afforded social functions and activities, or the design features influencing image and comfort qualities. It could equally be about the types of planting, the choice of saving or removing previously existing vegetation on the site, or purposefully creating a habitat for biodiversity and the naturalness of the site. Furthermore, design decisions underpin how the urban environment

[18] For designers, the process is through which boundaries are applied to problem spaces by methodically applying various tools such as protocols, scripts, maps, blueprints, and canvases. It is a rigorous and dependable mechanism, when done right, leads to desirable and appropriate outcomes. It will always have results, which the common saying of 'trust the process' underlines (Kolko 2013).

[19] The countless methods aim to describe design in a structured, and systematic way. Design firms and schools periodically publish their methods, for example IDEO's 51 'method cards', the d.school's 'bootcamp bootleg' containing 37 methods, frog design's, 'collective action toolkit' with 30 methods or *IBM*'s 'IBMDT method cards', or the 'Place Diagram' of PPS (Figure 79 in Appendix D), listing the methods to improve the design, features and activities in public spaces.

[20] Design students form tacit skills necessary for visual decision making through acquiring craftsmanship. Their visual acumen and fine motor skills ('muscle memory') are developed through focusing on tedious tasks. Craftsmanship forms the 'designerly' skills used by practicing designers, which is relevant even in the age of digital design (Kolko 2011).

enables and facilitates social and nature interactions, for example, by activating biophilic design patterns (see more details in Section 5.4.3 in Chapter five).

Pattern knowledge prompts the designers' moves: tacit knowledge gained from accumulated experiences. Even so, these patterned moves can seem to be intuitive rather than calculated, logical decisions. They are not arbitrary decisions based on trial and error but decisions formed by the context of a problem, informed by similar problems and solutions. Instead, patterning develops critical thinking about pattern selection, use, and adaptation. Through pattern knowledge, experienced designers have a set of immediately (and seemingly effortlessly) available moves that they apply by 'muscle memory' for the particular problem space. This ‘appreciative system’ allows designers to evaluate the appropriateness of design decisions and how the moves impact the emergent design solution.

It is important to note that tacit knowledge and the application of patterned moves are not unique to a ‘gifted few’ or professional designers. Being a designer only means they are trained to apply tacit knowledge and integrate it with other types of knowledge. Tacit knowledge is abundant in traditional local cultures, craftspeople, and communities of makers, producers, and developers. Design theories concern the universal activity of design, which everyone practices in basic forms when intentionally creating or modifying something based on a set of goals. NBS, too can be realized by professional design firms (involving, for example, landscape architects, architects, and urban designers) or communities or enthusiasts without a former design background.

In this section, I summarized how the complex phenomenon of design can be studied and what kind of knowledge can be revealed based on such an endeavor. In the next section, I continue the review with a closer examination of how urban design and regenerative urbanism developed. This angle also highlights the systemic engagement of urban design with the different aspects of urban sustainability.

2.4. Regeneration through urban design

The term urban design started to appear in the mid-1950s (Lang 2005). It was used first formally in 1965, at the first *Urban Design Conference* held by Harvard University. A new academic field, Urban Design, was announced as "the part of planning concerned with the physical form of the city[21]." The primary role of its practitioners was also stated: "the urban designer must, first of all, believe in cities and their importance and value to human progress and culture" (Pavesi et al. 2012, 2). However, the interpretations of urban design remained relatively vague and turbulent for a long time. Moreover, a formal and universally accepted definition did not emerge to legitimize this discipline. Many diverse notions[22] existed in parallel, and urban design received the mocking nickname of a 'mongrel' discipline (Carmona 2014).

Simultaneously, other scholars and practitioners were occupied with concretizing the scope of urban design. For example, Kevin Lynch interpreted urban design as working with "the form of possible urban environments" (Kevin Lynch 1981, quoted in Carmona and Tiesdell 2007, 13). Thus, the sphere of urban design started to consider the totality of the urban environment and the related fields of inquiry grew necessarily more comprehensive. Incrementally, urban design became "the art of relating structures to one another and to their natural setting to serve contemporary living" and "the process by which the urban environment comes about" (Lang 2005, 1). Consequently, as urban design theorists drew legitimizing theories from a more extensive and more diverse intellectual pool, it became commonly accepted that the production

[21] The proceedings were published in *Progressive Architecture* that year, quoted in Pavesi et al. (2012).
[22] Francis Tibbalds collected a series of explanations and definitions for urban design definitions, ranging from "everything that you can see out of the window" to "the interface between architecture, town planning, and related professions," or "the physical design of public realm" (Tibbalds 1988, quoted in Palazzo and Steiner 2011, 1).

of urban environments and spaces requires a multidisciplinary background in connection to a range of subjects from:

> …architecture, community and regional planning, engineering, landscape architecture, ecology, law, real estate development, economics, and other specialties that feed its capacity to analyze, understand, interpret, and intervene in the city (Palazzo and Steiner 2011, 8).

Another critical step in diminishing the ambiguity around urban design was to clarify how the term applies to both process and product-related aspects of the activities. (This question is also a common source of confusion concerning design in general, which I discussed in Section 2.3.). Therefore, Ali Madanipour's definitions of urban design provide a complete synthesis, where urban design is:

> …the multidisciplinary activity of shaping and managing urban environments, interested in both the process of this shaping and the space it helps shape. Combining technical, social and expressive concerns, urban designers use both visual and verbal means of communication and engage in all scales of the urban socio-spatial continuum. Urban design is part of the process of the production of space (Madanipour 1996, 117).

Madanipour's quote highlights the multidisciplinary aspect of the required knowledge, which concerns understanding and working both with the *process* of designing and the *subject* of the design activity: the urban space.

The legacy of urban theorists presented in Section 2.2 was paramount for developing the contemporary urban design movement: New Urbanism. This canon promotes inclusive, place-based, sustainable, and compact city design (Larsen 2005) and acknowledges the need to combine the design of urban environments with ecology (Calthorpe, 1993). Furthermore, since the 1980s, attention to ecological urbanism has inspired the concepts of green cities (Low et al. 2016), ecocities (Register 2006), or sustainable cities (Jenks and Jones 2008), focusing on creating urban sustainability from social, economic, and environmental aspects, aligning explicitly with the reasoning of introducing NBS into urban environments. Concurrently, increasing awareness is reflected in the work of urban historians investigating urban green spaces from a long-term perspective (Clark 2006).

Regenerative urbanism entails the comprehensive conceptualization of principles and strategies for a design paradigm reversing the degenerative effects of the industrial, linear land-use practices. Robert Rodale introduced the term *regenerative* in the 1980s with reference to renewing and regenerating agricultural resources. To 'go beyond sustainability,' he applied it to express complex living systems' basic principle of continuing organic renewal (Cole 2012). The term *regenerative design* was coined by John Tillman Lyle, landscape architect and environmentalist, which he applied in the books *Design for Human Ecosystems* (1985) and *Regenerative Design for Sustainable Development* (1996). He described regenerative design as the prerequisite to achieving the development of ecological, social, and economic systems. Lyle argued that simply minimizing the degradation, the doing-less-harm attitude, is not enough: development must benefit surrounding ecosystems and communities. Moreover, current research identifies the regenerative design approach to potentially delivering the most considerable positive outcomes for human societies and culture, ecosystems, and the built environment (Jenkin and Zari 2009). Therefore, regenerative design presents the next step compared to the place-based and sustainability-focused philosophy of New Urbanism, as it makes an explicit claim to design not only *with* but *for* nature (and communities).

The *Center for Regenerative Studies* (which Lyle founded in 1992) carried the conceptual and practical advancement of regenerative design, most notably by Bill Reed, founder of the Regenesis group (Mang and Reed 2012a). Reed and his colleagues developed a conceptual model to illustrate the regenerative paradigm, where the concept of *sustainability* occupies the middle ground as a state of equilibrium (see Figure 1 on the next page). A design solution is *restorative* when it returns social and ecological systems to a healthy state. It is *regenerative* when it enables systems to evolve further by promoting "conditions for environmental, social and economical regenerative growth" (Brown et al. 2017, 8).

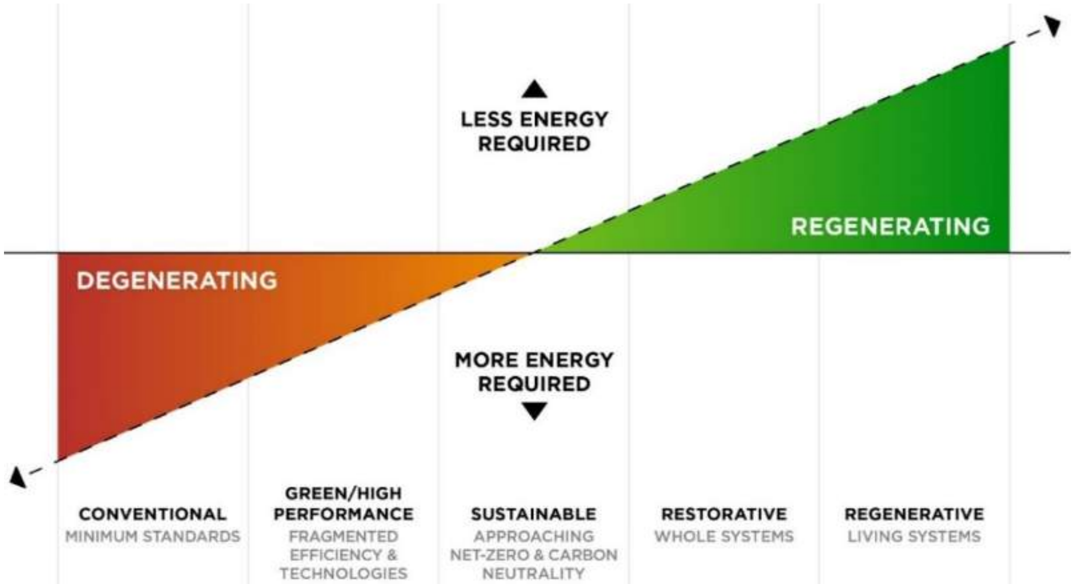

Figure 1. The Regenerative Design Framework by Bill Reed (2007). Source: Alessi 2021.

Applying the regenerative paradigm to urban development presents a shift of worldview: from the traditional understanding of sustainable development,[23] which grounds environmental decisions in financial and economic modes of reasoning, to a new one which is modeled by natural processes, thus: seeing humans, human developments, social structures, and cultural concerns as an inherent part of ecosystems (Jenkin and Zari 2009). Regenerative development "investigates how humans can participate in ecosystems through development, to create optimum health for both human communities (physically, psychologically, socially, culturally and economically) and other living organisms and systems" (ibid, 42). The main difference between sustainable and regenerative development is that *living systems* define the economic system in a regenerative economy: circular resource and energy use patterns maintain the production and consumption flow in symbiosis (Fullerton 2015). A 'living structure' refers to

[23] The primary aim of sustainable development, as described in the 1987 Brundtland Report, is to satisfy fundamental human needs without undermining the stability of the natural system.

built environments that exhibit ‘life’ in architectural design. According to Alexander (Alexander 2002; Jiang 2019), objects, artifacts, and buildings can be alive through symbiosis with nature: thus becoming biologically alive. Such living structures that embrace nature naturally attract people, animals, and plants to live within and around them, advancing the structure’s evolution.

From practical aspects, a development becomes regenerative when the process fully considers the place: the local community and ecosystem in which it is situated. This means that rigorous assessments of the site are necessary (biophysical and material flows) and engaging the community in meaningful ways within the design process to develop shared goals and their sustainment over time (Mang and Reed 2012a). This also allows the designers to understand the cultural context, engage stakeholders outside of traditional design and development fields (Cole et al. 2012), create partnerships, and utilize stories for learning and deepen the connection to place (Mang and Reed 2012a). Thus, a harmonious co-development between the community and the ecosystem can result in living structures with better functions than before the project (for example, a neighborhood producing more energy than they use, restoring water catchment functions or soil quality through planting, or creating institutional partnerships across communities for education and cross-fertilization). Pamela Mang, Ben Haggard, and their colleagues at the Regenesis group summarized these practical aspects of regenerative design in their book *Regenerative Development and Design: A Framework for Evolving Sustainability* (2016). They condensed the tenets above into three key guiding ideas: 1) 'regeneration as enabler of evolution,' 2) 'working in place,' and 3) 'developmental processes.' The first one expresses that regeneration is one of four different natures of work: 'operate, maintain, improve and regenerate.' These levels are not hierarchical but interdependent and interrelated. The levels of 'operate' and 'maintain' contain what already exists, and the levels of 'improve' and 'regenerate' concern the potentially developing but not yet manifested. At the 'regenerate' level, the inherent potentials of a place are addressed to restore the relationships of living systems within the larger systems, enabling them to "evolve by expressing their latent potential in the form of new value in the world" (ibid, 30). All levels are essential for living systems to sustain under evolving, interdependent conditions. Therefore, realizing regenerative design means aligning actions supporting regeneration from the current 'level of work': either at the operate, maintain, improve, or regenerate levels. Their second guideline, 'working in place,' stresses the importance of the unique character of a place, which can serve as a starting point for creating strategies to develop the natural, cultural, and economic capacities of a place. Thus, a place-based approach enables a regenerative project to act as a nodal intervention nested within the local community and ecological systems to have a transformative impact. Lastly, their third guideline, condensed as 'developmental processes,' expresses one of the most important aspects of regenerative practice. It states that the design process can provide space and means to expand the capacities and capabilities of stakeholders: locals, designers, participating institutions, or businesses.

Even though Mang and Haggard (2016) developed their ideas on regenerative design and development in general, their work applies to the urban design field. Urban design can contribute to the regenerative paradigm by fostering processes that cultivate "the capacity and capability in people, communities, and other natural systems to renew, sustain, and thrive" (Plaut et al. 2016, 2). In this sense, the role of an urban designer is to coordinate the relationships and give urban forms that accommodate both humans and nature for "the overall transformation of cities" (Madanipour 2006, 191) into "sustainable, even regenerative cities" (Palazzo and Steiner 2011, 21). Furthermore, conceptualizing NBS as urban interventions within the regenerative urban design framework would establish the conditions and "the capacities of people to design, create, operate and evolve regenerative socio-ecological systems in their place" (Cole 2012, 4). Thus, by definition, the design and implementation of urban NBS require the joint consideration of human and the more-than-human biophysical systems on the conceptual and practical levels.

However, regenerative design is a relatively underused approach in urban design (Hes and Santin 2017). There are still considerable challenges and limitations constraining the transition from conventional, business-as-usual, and even sustainable practices. On the one hand, it remains questionable how the regenerative paradigm can meet or transform the intensive energy demand and material flows of megacities at scale (Kennedy et al. 2015). On the other hand, its application requires an integrated whole-systems approach and a different methodology in thinking and interactivity, acknowledged and adopted by all urban development and design professions. Even though it is the shift in mindset, from minimizing or compensating damage to creating benefits, which makes the concept of regenerative design novel and powerful (Cole 2012), it is also a significant challenge (Figure 2). This is because the underlying structures and mental models are the most inaccessible (and potentially most impactful) leverage points for change (Meadows 1998).

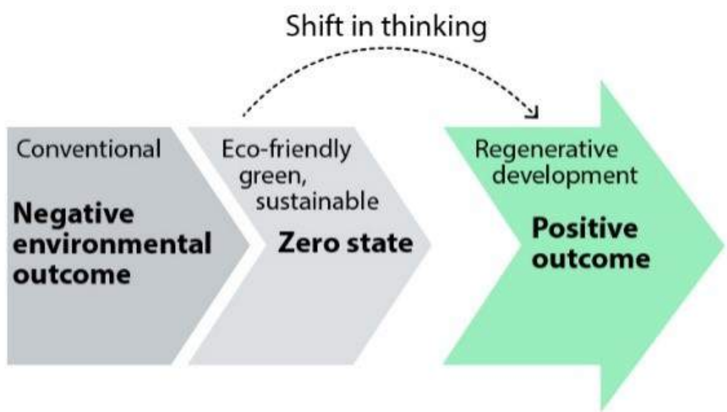

Figure 2. A shift in sustainability thinking. Source: Brown et al. 2017.

Consequently, applications of regenerative design are still evolving, even though the conceptual and practical foundations for regenerative development and design were already laid in the 1990s. Theoretical contributions to regenerative practice vary between focusing on the conceptual grounds that distinguish it from the traditional sustainability paradigm (du Plessis 2012) to discussing the human and cultural aspects that define it (Hoxie, Berkebile, and Todd 2012). Additionally, cases of regenerative design tend to be realized in peri-urban or rural environments (Mang and Reed 2012a), and there is a lack of evidence for regenerative projects realized in dense urban environments (Clegg 2012).

Moreover, practical criticism of regenerative design is often brought up to question the measurability of results or the ability of the concept to guide design processes. Therefore, several guiding frameworks were proposed to facilitate the adoption of regenerative design. For example, the REGEN framework, designed by the US Green Building Council (USGBC), guides a multi-stakeholder system thinking and a process of designing from place (Svec, Berkebile, and Todd 2012). However, it was developed specifically for architectural designs at the building scale only. In contrast, the LENSES framework proposed by the Rocky Mountain Institute (Plaut et al. 2012) is a multi-scale framework, applicable from buildings to large-scale urban planning, incorporating the natural, social, and economic 'triple' bottom line to highlight connections between them. LENSES can be used to complement other rating systems and tools because it only applies descriptive metrics to allow for flexibility and contextually appropriate solutions. Similarly, the Perkins+Will framework is a question-based framework to guide a regenerative design process (Cole et al. 2012). These frameworks are all descriptive, not prescriptive, as typical sustainability standards, because, as Mang and Reed (2012a) argue, the place-based nature of regenerative design is contrary to the mechanization attempts through standards and metrics. Thus, design efforts of this nature must consider the use of appropriate methods to assist the design process and measure results.

For widespread adoption of regenerative urban design based on urban NBS, examples of successful projects must be accessible in all possible varieties, together with guiding frameworks applicable across NBS forms and scales. Working examples and demonstrations facilitate a transformation in urban development toward the mainstream application of an integrated design process that incorporates systems thinking, transdisciplinary collaboration, and human dependence on natural capital recognition (Xie et al. 2020). Urban NBS are particularly well suited to advance this regenerative paradigm shift because their conceptualization and practical implementation pinpoint the role of design in producing living environments, objects, and artifacts, with the potential for long-term, radical change. Furthermore, urban NBS are positioned within a transdisciplinary problem space where the participation of several different actors is necessary for their creation, implementation, and maintenance. Consequently, they offer a broad platform for nature experiences and knowledge sharing across disciplines (van der Jagt et al. 2020). Finally, conceptualizing and studying NBS as designed urban structures can expose how underlying worldviews and knowledge structures are embodied in or by the environment (Raskin et al. 2008, Tabara and Chabay 2013).

The reviewed literature suggests that while NBS could enable regenerative development, their conceptualization, design, and implementation pose a complex challenge. This implies that a concrete structure is needed to holistically organize all relevant aspects and components that describe the design of NBS, which can help specify how it affects and shapes people's lives and the environment. Therefore, in the next section, I present the composition of a framework to provide a conceptual basis for examining the design of NBS (elaborated in the next chapter).

2.5. Composition of a design framework

The importance of analytical frameworks cannot be understated. In a recent talk, Dave Snowden[24] explained that a framework is generally used to create a typology, a way of looking at things from different perspectives to *make distinctions*. By making those distinctions, new understandings can emerge. For example, a streetscape radically changes visually and

[24] Snowden (2018) is researcher in the field of knowledge management and the application of complexity science.

functionally once rain gardens or Sustainable Urban Drainage Systems[25] (SUDS) are applied instead of regular pipes. A street with SUDS is no longer a standard street. Instead, it becomes something different, which provides more for humans (supports climate change adaption through cooling and flood protection, creates attractive open spaces) and more for non-humans (promotes biodiversity, habitat, pollination). When SUDS are implemented, the street typology is also changed, which is powerful because the ordinary is transformed.

A typology, or framework, prompts ways of looking at things from multiple perspectives, while a model seeks to represent the world. Recent research (Dorst et al. 2019; van der Jagt et al. 2020; Frantzeskaki 2019) on NBS stresses the importance of NBS design and governance to replicate them in the long term. Undoubtedly, lessons about their effectiveness and implementation must travel wide and far. However, creating recipes or models of NBS for "easy replication into other locations" (Frantzeskaki, 2019, 108) is challenging from a design perspective. General models for NBS are also helpful; nonetheless, there are limits to their application because they require localization as place-based interventions. The complexity of design may deem some solutions too contextually bound to be replicable in a simple, mechanical way (ibid).

Design scholarship engages with the phenomena of 'design' and 'designing' by investigating different aspects or dimensions to design. Generally, three core design dimensions are distinguished, the outcomes, approaches, and process, which compose the design framework (see, for example, Erl 2008 or Mang and Haggard 2016). My main research question concerns the overall situation of how certain design structures bring about regenerative change. However, each dimension (outcomes, approaches, and process) offers its specific contribution to the main

[25] SuDs are a type of NBS designed to manage rainfall: store and transport surface water, slow runoff down, allow water to infiltrate into the ground, or be consumed by the vegetation.

questions, thus, they must be elaborated on individually. In the next section, I describe how the three dimensions relate to the gaps formulated in the review.

2.5.1. Outcomes

NBS result from design activity[26] made into a real-world actualized design through design outputs (drawings, plans, images, instructions) with real-world consequences, which are the *design outcomes* (Figure 3). The distinction between outputs and outcomes is essential, as outcomes allow us to focus on the *results* of the design intent (what the design was trying to achieve) and not on an evaluation of good or bad design outputs. The actualized designs have social, ecological, and economic outcomes and impacts (Love 2014), just like NBS have social, ecological, and economic benefits. Moreover, the outcomes can affect everyone and everything in relation to the actualized designs: individuals, stakeholders, communities, and non-human nature.

Figure 3. Design output, actualized design, and design outcomes. Source: Love 2014.

When analyzing design outcomes, the concept of affordances can be used from a practical angle. Perceptual psychologist James J. Gibson's theory of affordances links to the ecological understanding of the human perception of space. Affordances are "what [an environment] offers

[26] The cases included in the thesis became NBS through different paths. Their development can be characterized by a generic process of intentional design relating either to professional activities or the organic processes of urban adaptation and change (Carmona et al. 2003), described in Chapter four.

the animal, what it provides or furnishes" (Gibson 1979, 127). It means that the relational properties of the environment enable certain behaviors and experiences. There are potential physical, emotional, cognitive, and social affordances (Mehan 2017). These affordances lead to different activities only if the individuals utilize them, and that depends on the individual's abilities and the environmental features together. Exploring affordances can highlight how the realized NBS design affords certain things for human or non-human species.

In theory, a carefully planned NBS provides citizens multiple benefits and enables them to perceive the urban space, its functions, and potentials differently. Therefore, studying the outcomes of NBS can offer an understanding of how NBS as design interventions provide opportunities for communication and interaction by urban dwellers, according to the design intent. In this thesis, I will study these aspects with the sub-question (Q1): *How do the design outcomes of urban NBS indicate a transformed, nature-based urbanity?*

2.5.2. Approaches

Schön (1984) extended the idea of 'wicked problems' (see Section 2.3) and argued that in complex environments, the problem setting itself is a way to inform the designer about the suitable approach to conduct the process. Hence, the design approach expresses the design intention: "since every specification of the problem is a specification of the direction in which a treatment is considered" (Rittel and Webber 1973, 161). In short, approaches are specific philosophies about the design with particular discourses and values attached. Common approaches are, for example, 'human-centered design,' 'participatory design,' 'co-design,' 'service design,' 'critical design,' 'speculative design,' 'social design,' or 'ecodesign.'

Design approaches support the goal of design and navigate design activities suited to specific problem spaces and situations. Therefore, approaches not only concern a philosophical level of interest. They also set the requirements, constraints, and standards[27] to be met. For example, design processes for the same object but following different approaches can lead to distinguishably different results, even if the designs are carried out within the same contextual (legal, regulatory, economic) constraints (Giacomin 2014). Thus, the design of a new shoe can celebrate the latest technological or manufacturing advancements, comply with circular or cradle-to-cradle design rules, or be a most ergonomically and customer-friendly product. Likewise, an urban greenspace can present a solution primarily aimed at improving people's well-being or that works for advancing the wider human and non-human community holistically (i.e., NBS).

Approaches can differ based on different schools of thought and among practicing designers. Moreover, they can complement each other (Holm 2006). As presented in Section 2.4, the regenerative approach is particularly suited for urban NBS. However, NBS are not necessarily realized along with regenerative principles, or other approaches might be simultaneously applied or even be more dominant, resulting in the incomplete unfolding of their potential. In the following paragraphs, I detail the two most common approaches that are likely to appear in NBS designs instead of (or beside) a regenerative approach.

Centering the human in design

Along with the theoretical advancements, design practice has evolved. In the 1960s and 1970s, participatory design was adopted from socio-technical studies, and ethnography got embedded into design practice (Sanders 2008). The study of human factors and ergonomics emerged due to design work for the military, which also raised the interest of scientists in discourses about

[27] On the practical side, the realization of the goal and the related design characteristics is mainly guided by the 'design principles,' providing guidelines and practices. Furthermore, 'design patterns,' as a re-usable form of a solution (Alexander 1979), domain-related 'best practices' and 'design standards' can strengthen adherence to design paradigms. Design standards are enterprise-specific formalities. For example, specific human-centered design processes can even be led and evaluated by the ISO 9241-210 (Ergonomics of human-system interaction / Human-centered design for interactive systems) standard.

design (Dubberly 2017). Cognitive scientist Donald Norman re-contextualized Gibson's theory affordances into a design methodology to understand the needs and interests of the 'user' (Norman 1988). He brought the user's perspective to the attention of designers and introduced the term *user-centered design.* This methodology placed user experience benefits over user testing and humanized the more socio-technically focused participatory design methods on responding to user needs.

Through methods adopted from the behavioral sciences (Sless 1997), the user-centered design methodology evolved to respond to broader societal contexts (Ylirisku, Vaajakallio, and Buur 1991), resulting in a humanistic approach that is called *human-centered design* (HCD). In the meantime, the design practice 'dematerialized' and infused the business, management, and socio-technical fields. The focus shifted to "discovering insights and turning them into innovations, ... and to design thinking" (Dubberly 2017, 5). Empathy and understanding of user needs, values, and experiences became the starting point and the main goal of the design process, prioritizing the human element in today's technological dominance.

The HCD approach is based on carefully identifying stakeholders and contexts of use to facilitate the understating, probing, and classification of the interactions between people and their environments. It concentrates primarily on the meaning that the design (either a product, system, or service) offers to people by uncovering first "questions of motivation, discourse, and learning" before working on the means of implementation (Giacomin 2014, 5). The goal is to create "physically, perceptually, cognitively and emotionally intuitive" characteristics for the design objects, "followed by progressively more complex, interactive and sociological considerations" (Giacomin 2014, 8). In short, HCD is essential for navigating the complexity of socio-technical innovations. Thus, nature-based designs must also rely on HCD knowledge and know-how on some level.

Centering sustainability and regeneration in design

Simultaneously with the advancements of HCD, the sustainability paradigm became more integrated with design practice. Nevertheless, sustainability and design remained a contested pairing similarly to the concept of sustainable development. Sustainability measures are often suppressed to improve production processes and products, services, or infrastructures or positioned below the functional, ergonomic, or economic features, without considering consumption and behavior patterns (Manzini 1999). However, sustainability should be the core attribute of all design endeavors, and there should be only *this kind of* design (Sanders 2015). In theory, all the rest falls into the unsustainable category, making sustainable design an oxymoron:

> This means that every design and every aspect of a design must be judged in terms of its sustainability…There is only: design for the marketability of sustainability, design for sustainable manufacturability, design for sustainable use, etc. (Tonkinwise 2015, 294).

However, until there is unsustainable design, Tonkiwise's above statement remains only a wish, and the oxymoron of sustainable design is irrelevant. Victor Papanek was one of the first designers to expose the conflicting relationship between design and sustainability. In his visionary book, *Design for the Real World* (1972), he wrote:

> There are professions more harmful than industrial design, but only a very few of them. And possibly only one profession is phonier. Advertising design, in persuading people to buy things they don't need, with the money they don't have, in order to impress others who don't care, is probably the phoniest field in existence today (Papanek 1972, 1).

Papanek's critique of how we produce, consume, and discard design was paired with an agenda for his vision of design's actual responsibilities, translated as *socially and ecologically responsible design*. Unfortunately, however, his ideas did not find fertile ground among his contemporaries, contributing only later to the rise of eco and sustainable design in the 1990s;

and urban agriculture, the slow food, and slow cities movements in the early 2000s (Rawsthorn 2011).

'Sustainable design' became a diverse arena describing design tools and frameworks to be used in all sub-disciplines, with complementary approaches (for example, green design, sustainable design, restorative design, cradle-to-cradle, bio-inspired design, ecological design, regenerative design). Scholars have classified the overlapping approaches under the term 'Design for Sustainability' (DfS) approaches and grouped them on four innovation levels[28] (Kelley 2015; Chick and Micklethwaite 2011; Thorpe 2007; Fuad-Luke 2006; Ceschin and Gaziulusoy 2016). Ceschin and Gaziulusoy's research demonstrates the shift in DfS approaches focusing on industrial product or service-related issues to system innovation and large-scale socio-technical transformations. Jenkin and Zari argue that regenerative transformation can happen "in a building-by-building, or development-by-development way… or concepts could be applied to neighborhoods, larger developments, sections of cities, suburbs or whole new towns" (2009, 38). It concerns all scales and urban forms, just as NBS.

Design for NBS entails potentially changing or inspiring new paradigms. NBS are, in a way, actualized visions of a new urban system (in the form of a transformed building, street, urban development project, or neighborhood), indicating the specific activities, strategies, and decisions required to achieve the goals. However, there is only a partial understanding of the approaches used during the urban NBS design process. Therefore, I will study these design aspects through the following sub-question (Q2): *How are design approaches applied for urban NBS, and how can they guide regenerative transformations?*

[28] Ceschin and Gaziulusoy (2016) identified DfS approaches of four levels, based on their connection to specific environmental or social aspects of sustainability: 1) Product innovation level, 2) Product-Service System innovation level, 3) Spatio-Social innovation level, and 4) Socio-Technical System innovation level.

2.5.3. Process

Designing is an iterative process aiming to generate a conceptual solution based on a set of criteria or requirements. It is composed of divergent (analytical) and convergent (synthesizing) stages (Dubberly 2017). Overall, these activities form a cyclical process fitting to select, organize, and evaluate data to reach clarity.

Understanding the design process is the cornerstone for reliable, professional design practice or related theoretic endeavors, and gaining knowledge of the design process has been at the forefront of discussions in design studies. Herbert Simon, political economist, and computer scientist, profoundly impacted design studies with his research on optimizing processes. Simon described designing as a systematic process and argued that problems could only be 'satisficed' but not solved (or resolved), and "to understand them, the systems had to be constructed, and their behavior observed" (Simon 1956, 20). His central idea places the representation of the problem – through the design process – in the center, which by a systemic treatment leads to solving the problem. Even though his perspective ignores the critical impact of subjectivity, experience, and judgment[29], Simon's rational problem-solving concept "is still a dominant paradigm in the field" (Dorst 2006, 55). Due to his work, the contemporary application of design as a logical and systematic procedure became widespread, aiming to explore interactions with the artificial, human-made environment. Today, an array of variations of the four-step process[30] are generally used across the broad design disciplines (Cross 2001). One of its most

[29] The systemic view of design later was amended by Horst Rittel, who called for the understanding of designing as 'an argumentative process' (Rith and Dubberly 2007). Certainly, design is not carried out regardless of external conditions on a *tabula rasa*. Instead, various contextual constraints (for example, legal, regulatory, economic) determine requirements and standards (Giacomin 2014), and the designers' practical experience (in the form of tacit knowledge) determines the course of design processes and activities.

[30] In general, the four steps are: 1) analyzing the current situation; 2) framing the situation and representing it in a model; 3) reconfiguring the model to improve the situation, and 4) realizing the model in a tangible form - making something (Dubberly 2017).

general representations is the *Double Diamond* model developed by the UK Design Council in 2005 (Figure 4).

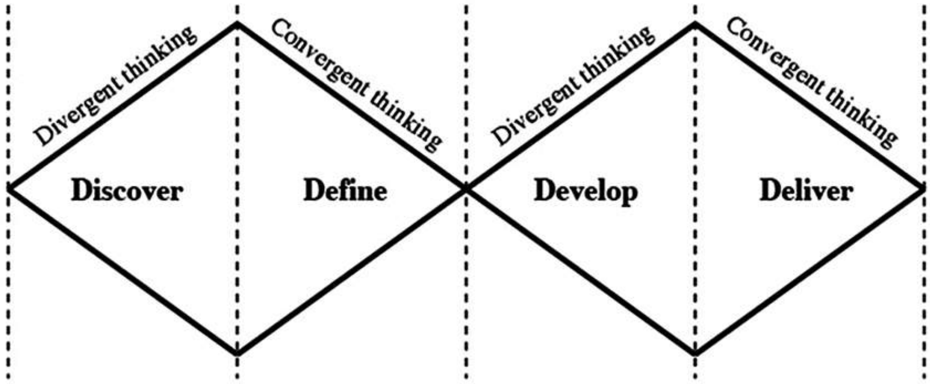

Figure 4. The Double Diamond Process. Source: Onarheim and Friis-Olivarius 2013.

It is a common misconception that design is a problem-solving process (see the conflict of 'wicked problems' in Section 2.3). Instead, it is a 'knowledge creation' model (Nonaka and Toyama 2003). The design process corresponds to how the flow of tacit and explicit knowledge is internalized during the learning process, bringing unconscious patterns to conscious understanding through articulation in an iterative and cyclical structure (ibid). Therefore, "designing is creating knowledge" and "design organizations are learning organizations" (Dubberly 2017, 4). For example, according to Schön (1983), design is a conversation with 'materials' and 'situations,' and this process must respond to the particular conditions of the design problem or object. Designers learn what eventually gets embodied in the designed outcome through these conversations. This means that, as Horst Rittel argued in *The Universe of Design* lectures[31], the design outcome comes from the internalization of knowledge gained about what had been learned and experienced through a "series of experiments, a trial-error process directed towards a goal, a first-order feedback loop" (Dubberly 2017, 3). Thus, when new understandings emerge or the information changes, so can the design, creating a new loop

[31] A series of lectures given at UC Berkeley in 1963, reprinted by Routledge in 2010.

for exploration and experimentation (Archer, Baynes, and Roberts 1992). This implies that during the design process of NBS, knowledge is created or transmitted about the different conceptualizations and functioning of the urban space. Therefore, exploring the design process of urban NBS would provide an understanding of the design means and opportunities that make NBS a transformative instrument. I will address this research opportunity with the help of the sub-question (Q3): *How do design processes of NBS contribute to the regenerative transformation of urban space?*

In this section, I summarized how design is interpreted and appears on different dimensions, affected by specific factors. The 'intention,' 'the environment,' and the 'object of design' (physical or not) are always present before the design process, designating the goal of the design endeavor (Ralph and Wand 2009). Based on the purpose or targets, the design process is defined, managed, and executed, guided by design approaches, leading to manifested design outcomes. Studying the design framework of urban NBS (outcomes, approaches, and process) provides a step forward in understanding the structural conditions affecting the unfolding of their regenerative potential. Moreover, as I highlighted in this review, further insights are needed to incorporate the regenerative paradigm into planning practice, which I intend to address via this research.

3. Conceptual framework and methodology

This chapter serves a dual purpose: to present a conceptual framework by uniting the critical concepts around the design of NBS and establish a methodology to examine structural conditions that narrow or widen the gap between the 'rhetoric of potential' and the regenerative contribution of urban NBS. The conceptual foundations outlined provide a structure for exploring and analyzing the design framework for NBS and, consequently, the ability of design to influence NBS potential. This framework is one of the original contributions of this research as there are currently no similar, integrated frameworks serving this purpose. It can be readily deployed, understood, and integrated into the general design processes undertaken by urban actors (for example, operating within urban development processes, urban designers, landscape architects, investors, communities, and others). Moreover, this framework can be helpful both for guiding the design process of NBS and assessing the actualized designs.

Before presenting the framework, in Section 3.1, I provide an overview of how the various contributions of NBS can be explicitly conceptualized at the intersection of design theories and regenerative urban transformation and how they connect to induce transformative change. This sets the application of NBS in urban spaces as a form of placemaking that holds the opportunity for a transformation aligning human needs with the functioning of the biophysical, non-human nature. The implication is that a place-based lens would be essential for studying the research questions in this thesis.

Therefore, I adopt a place-based lens for researching the design framework holistically across the design dimension in the sub-sections: outcomes, approaches, and process. In Section 3.2, I discuss the application of the research epistemology and the strategic steps outlined in the research design. In Section 3.3, I justify applying a case-oriented approach in this research, followed by explaining the case selection process. In Section 3.4, I clarify how data collection aligns with all dimensions of the conceptual framework. In Section 3.5, I present data collection methods and analytical tools applied according to the theoretical framework.

3.1. Ends and means of a transformation

There are different ways of assessing the potential benefits and values of NBS from ecological, socio-cultural, and economic perspectives. Moreover, their contribution is explored concerning various sustainability challenges in the urban domain. To strengthen the synergies between this dissertation and NATURVATION, I adopt the framework developed by NATURVATION to conceptualize and classify NBS cases (Bulkeley et al. 2017). The NATURVATION project applies '*the ultimate ends – ultimate means'* conceptual framework formulated by Daly (1973) and developed further by Meadows (1998) to ground the various evaluative frameworks of NBS (Figure 5).

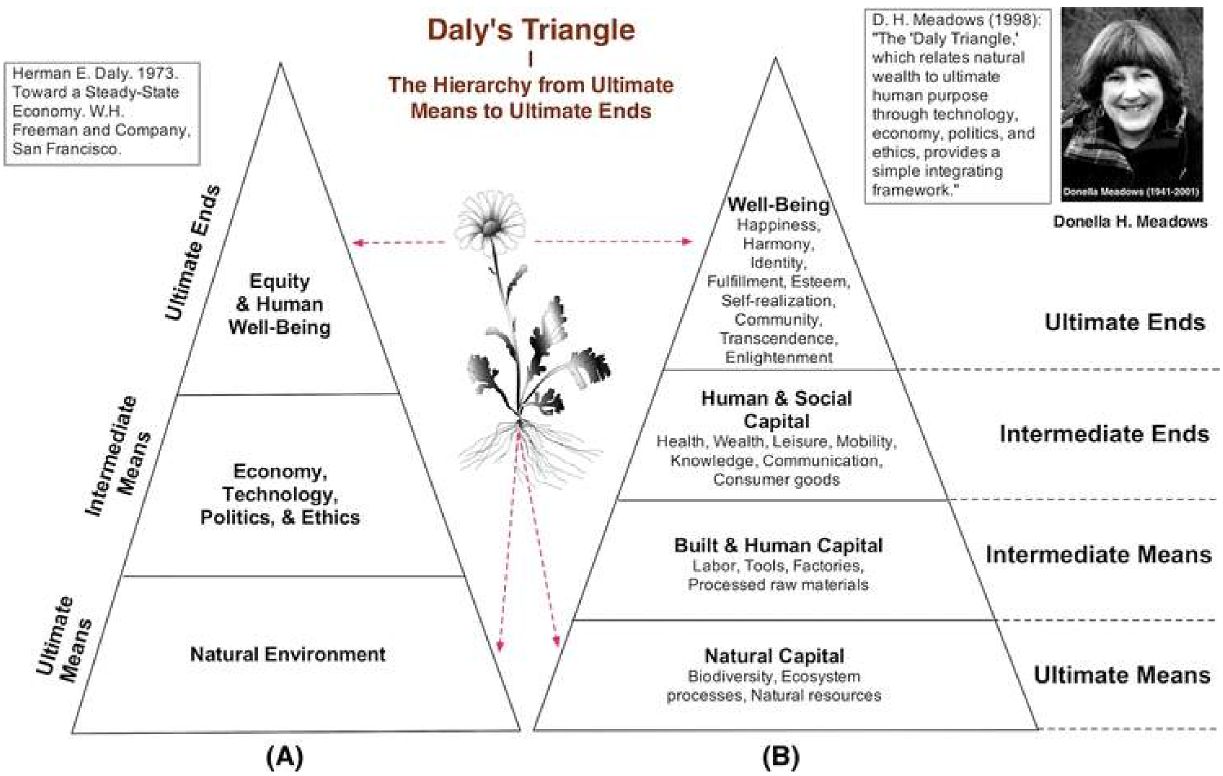

Figure 5. Daly's Triangle (Daly 1973; Meadows 1998). Source: Wu 2013.

While not explicitly developed for this purpose, the 'Daly triangle' accounts for the multiple valuation dimensions of NBS in an integrative way. It makes the relationship between people and the planet explicit: the nested hierarchy of dependence between the ecological, socio-cultural, and economic dimensions of the value of nature. In Daly's triangle, the ultimate means (natural capital) provide the basis for all human life and activity to achieve the ultimate purpose (to improve human well-being), and NBS, too, are the source of well-being in the urban environment. Daly's triangle has been a source of inspiration for various research endeavors, which further developed the original concept to counterbalance the human-focused representation of hierarchy and linearity. For example, in Pinter et al.'s (2013) report, *Sustainable Development Goals and Indicators for a Small Planet*, the linear hierarchy is turned into a circular diagram to express the inseparability of humans (human aspirations and fulfillment as ultimate ends) and the ecosystem (resources of the biosphere as ultimate means) (Figure 6).

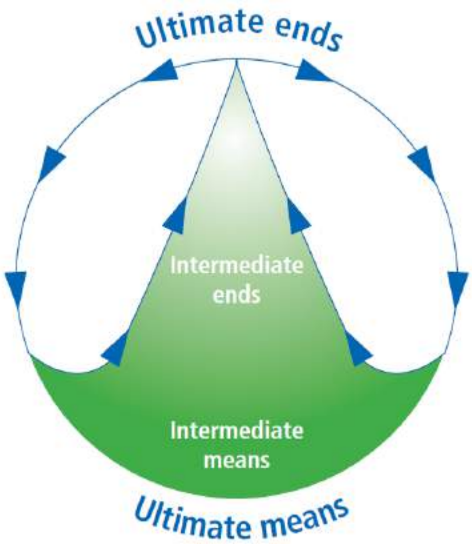

Figure 6. Circular representation of the means-ends framework. Source: Pinter et al. 2013.

Similarly, NATURVATION complemented Daly's triangle with the ecosystem services cascade model (de Groot et al. 2010; Haines-Young and Potschin 2010) to associate natural capital with ecosystem structures and functioning. Moreover, this updated framework assigns governance a key role in shaping the use and deployment of the NBS, highlighting the need to connect multiple perspectives to the process (Figure 7).

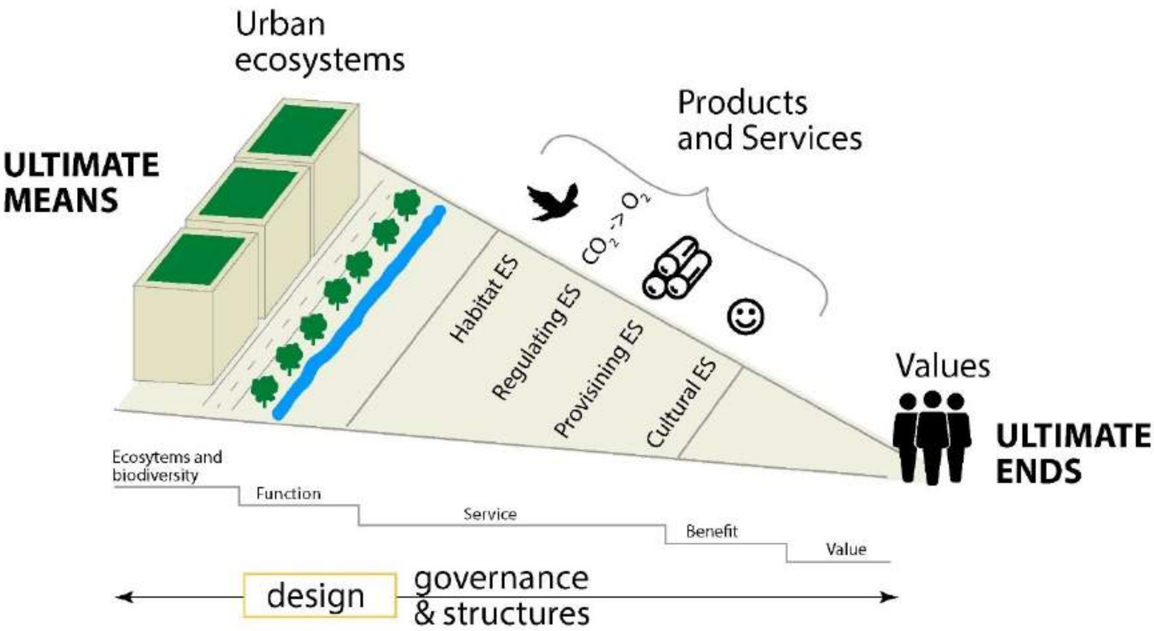

Figure 7. The conceptual diagram of the ends-means framework of Daly and the ecosystem services cascade of Haines-Young and Potschin (2009) adapted for NBS. Source: Pinter et al. 2013; Bulkeley et al. 2017.

The role of urban design is not registered in the original figure of NATURVATION. However, Carmona (2016) argues for understanding design governance as a distinct sub-field of urban design, where the means and processes of designing the built environment shape the outcomes based on defined public interests. Therefore, I added 'design' to the NATURVATION figure to imply that the achieved form, performance, and contribution of NBS are also dependent on design structures and processes – which I will study and analyze in this dissertation.

A critical premise in the conceptualization of NBS is that they are applied intentionally to work across multiple issues to exercise their multiple and cumulative benefits. It is assumed that achieving specific, desired outcomes through purposeful design is possible. However, while conditions can be set to support capacities and steer actions that produce immediate results, outcomes emerge as they are disposed to evolve on broader spatial and temporal scales. It is not a linear relationship between cause and effect. In short, outcomes are not designed, only the process is. Design is more like navigation towards outcomes through testing and adjustments (i.e., patterning), a tactical tool that could provide a compass similar to adaptive management (Lee 1993).

Still, for a (sustainable) future using NBS, the design intentions and capacities must be aligned to specific, regenerative outcomes. For example, Donella Meadows' (1998, 1999) work on ‘leverage points’ (the scale of places to intervene in a system according to their effectiveness) uncovered that all leverage points must be simultaneously addressed to bring about change in complex systems. In other words, to design for outcomes, the deeper leverage points (with higher transformative impact but harder to address with design) such as 'philosophies' and 'emotions' or ‘knowledge' must be similarly engaged as the shallower leverage points, such as 'experience' and 'material change' (Angheloiu and Tennant 2020) (Figure 8).

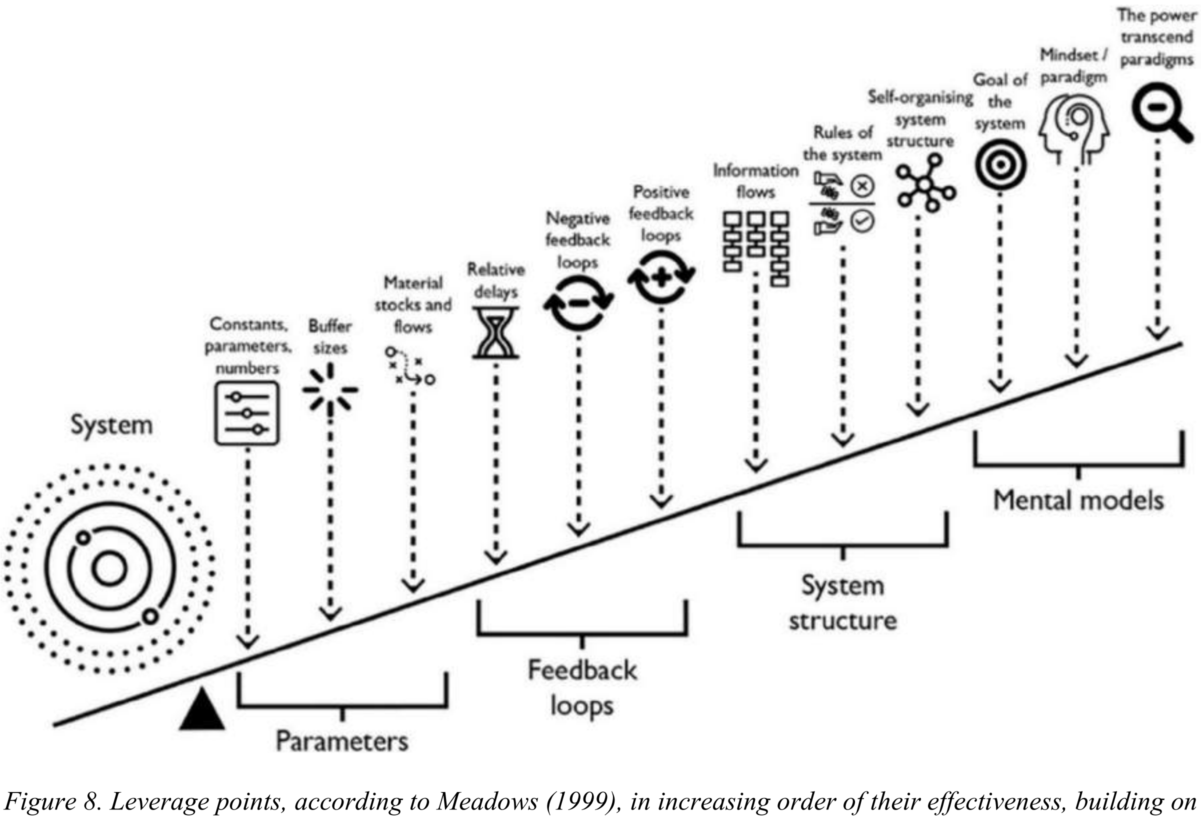

Figure 8. Leverage points, according to Meadows (1999), in increasing order of their effectiveness, building on Fischer and Riechers (2019). Source: Angheloiu and Tennant 2020.

Thus, to connect the ultimate means and the ultimate ends (through a range of leverage points), first of all, a change in mindset is required to orient the focus on “designing solutions that work at the biophysical level, within inherently nested systems, and across scales including the … mind and the heart of people” (Hes and Santin 2017, 2). With this goal (and the ultimate means) in mind, the aim of design also changes to support the co-evolution of human and natural systems in a partnered relationship (Cole 2012). Consequently, planners, designers, developers, and other stakeholders must (re)learn how to co-design with the environment, where the ecological systems provide the basis for design (Plaut et al. 2012). This way, the act of designing becomes 'regenerated' and a catalyst for positive change.

In the context of regenerative design, Mang and Haggard (2016) conceptualized a framework called the 'three lines of work' for practitioners. I applied the 'three lines of work' framework to the three universal dimensions I outlined in the previous chapter to formulate the conceptual framework of this thesis. The 'three lines' represent the design dimensions that can influence an NBS’ ability to bring about transformative change, acting and connecting the deeper and shallower leverage points required to support and sustain regenerative development (Figure 9).

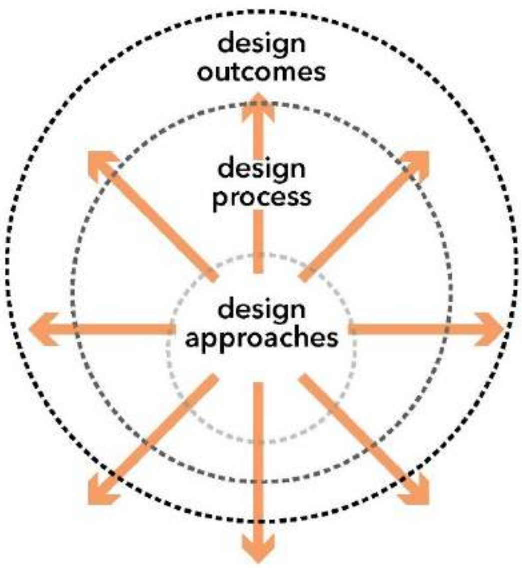

Figure 9. The three lines of work in regenerative design. Source: Mang and Haggard 2016 (with amendments).

I adopted the ‘three lines of work’ framework as follows:

1. “The work of the designed Product”: The first and outermost line is the actualized design (product, building, or environment), manifesting in the *design outcomes dimension* as consequences and impacts continuously affecting human and non-human life.
2. “The work of the design Process”: The second line shaping the outcomes embedded in the first line is the *design process dimension*.
3. “The work of the Designer”: The third is the line of the designers[32], acting based on their perspective of the world, manifested in the *design approaches dimension.*

According to Mang and Haggard (2016), all three lines (or dimensions) must be addressed for achieving transformative change because their integration is what *design* entails. This understanding composes this thesis's central proposition that NBS's potential for regenerative transformations requires regenerative actions across all three dimensions. Therefore, the main research question concentrates on the dimensions together, to which I refer as *the design framework of NBS*: *How can the design framework of NBS contribute to reducing the gap between NBS's 'rhetoric of potential' and their implementation and impact on achieving regenerative transformation?*

The following sub-sections specify *how* a place-based view can be attached to the conceptual elements of the design dimensions to study the sub-research questions of this dissertation. The components of the conceptual framework align the inquiry of the design dimension with specific notions of place, urbanity, and nature and guide data collection and analysis. Even though the order of the ‘three lines’ is set as outcomes-process-approaches in Mang and

[32] I refer as designers to all professional designers or developers and communities who participate in the universal activity of design, as specified in Section 2.3.1.

Haggard's framework (2016), I organize the contents differently in this dissertation. First, I address the outcomes, then the approaches, and lastly, the process dimensions. This change is necessary because, in the analytical chapters, the presentation of outcomes can be followed by assessing the mental frames, thus connecting the consequences to the approaches. Then, the working mechanisms of the process dimension intertwining the other two are demonstrated as a binding structure for the whole design framework.

3.1.1. Outcomes dimension

In Mang and Haggard's (2016) framework, the 'line of the designed Product' focuses on how and what a project can create to improve the health and value of a system. For example, how a design project can increasingly benefit the surrounding ecosystem and its inhabitants and how it contributes to providing space for species to thrive. In addition, they focus on how a design project can be integrated within the community by providing jobs and business opportunities, offering workshops and training (for example, in permaculture, organic or biodynamic agriculture), and launching partnerships. Moreover, it is the 'line of the product' in which a project's efforts to raise visibility and status within the community or uncover the attached history can be highlighted.

Similarly, the proposition behind studying the design 'outcomes' of NBS is that the realized design features of any artifact, environment, or system embed information about how it is to be understood and utilized by people, leading to the emergence of specific behaviors or actions. This implies that a carefully designed NBS can inform citizens about the many aspects of their benefits and related impacts. Moreover, it can enable them to perceive and use the urban space in ways that help achieve impacts in sync with regeneration. In other words, the relevance of NBS in everyday urbanity is communicated and enforced through design.

However, places not only have physical characteristics but are also a product of the imagination and have a public, shared significance (Cilliers et al. 2015). Formed either through standard, strategic, creative, or tactical mechanisms, the quality of urban life reflects the results and consequences of placemaking efforts, although their abstract description might be challenging. These outcomes manifest through transmitted images, enabled activities, and the designed physical forms. Lew (2017) organizes these *expressions* of placemaking according to *tangible, intangible,* and *mixed* elements. Examining NBS through the lens of placemaking expressions leads to understanding how human-centered and nature-focused qualities are conceptualized and delivered. Moreover, such an exploration can communicate the intangible and experiential qualities that contribute to thriving nature-based places and successful designs.

Therefore, to study the question: *How do the design outcomes of urban NBS indicate a transformed, nature-based urbanity?* I will take the analytical lens of placemaking expressions. Lew (2017) provides a detailed list of *intangible* expressions (such as branding, marketing, and storytelling) through which the perceptual characteristics are influenced, as well as a range of use-related 'people's practices,' the *mixed* expressions (for example, programs and events). However, Lew's conceptualization of the *tangible* expression is limited to people-centered physical attributes, for example, facilitating people's movement, and does not include the attributes influencing outcomes for nature. Therefore, next to accounting for *tangible expressions* from a human-centered perspective[33], I extend the frame of analysis to the *tangible expressions* accounting for the non-human[34]. I will inspect if the physical structure is designed based on the conscious consideration of the non-human and how physical and geographical

[33] The human-centered placemaking perspective is captured by the Project for Public Spaces' (2016) Place Diagram (see Figure 81 in Appendix D), containing the universal, key qualities (*Sociability*, *Uses & Activities*, *Comfort & Image*, *Access & Linkages*) making places social, lively, comfortable and accessible.

[34] The nature-based placemaking perspective is captured in the concept of *biophilic design patterns.* It builds on the precedents of Alexander's 'pattern language' (Alexander 1977) (also see chapter two), derived from the timeless and universal entities called patterns that people rely on when designing their environments. A range of biophilic design patterns enables different nature connections in urban settings, which Browning, Ryan, and Clancy (2014) decoded into an overarching framework (see more details in Table 31 in Appendix D).

features are considered to bring forth nature connections. Ideally, these expressions and the related outcomes should be tracked for a more extended period to account for systematic change. However, such a longitudinal assessment is outside of the scope of this work.

3.1.2. Approaches dimension

Practical experience sets the foundation of successful design activities, but it also requires explanatory principles and models (Friedman 2000). Understanding the underlying design approaches is necessary to predict or measure the outcome or success of decisions. This contains an understanding of the human context where NBS are used: the needs of human beings served by the design act and the socio-technical, economic, and environmental circumstances in which the design is situated. The proposition behind studying the design approaches of NBS comes from the understanding that the guiding approaches are embodied in the realized design outputs and physical environment: they express culturally and temporally specific worldviews. Thus, when ecologically oriented approaches, such as more-than-human-centered design, are present during the design cycle, diverse configurations of social-ecological practices and positive human-nature interactions are enhanced and facilitated throughout the design process.

For NBS, a socio-ecologically embodied approach is fundamental (Ostrom 2009), which supports sustainability learning and transformation: in people's thinking, practices, outcomes, and the possibilities of a different urbanity. Therefore, when such approaches are applied (for example, purposefully articulated at the beginning of the design process), they are reflected in consequent actions and outcomes. To answer the question: *How are design approaches applied for urban NBS, and how can they guide regenerative transformations?* I will inspect if there are traits of emergent more-than-human-centered approaches in NBS design, providing an alternative to the dominant human-centered approach.

Structurally, this question is an integral part of the *process dimension* because setting guiding values and principles typically occurs at the beginning of the design process (Carmona 2014). However, their application affects the entire NBS design cycle and the other design dimensions because values and guiding philosophies (manifesting in approaches) constitute a system's deeper leverage points. Moreover, Meadows (1998) noted that these are most difficult to change but have the most transformative potential. Therefore, the approaches dimension must be addressed with a specific emphasis, and I dedicate a separate chapter to discussing the related results.

3.1.3. Process dimension

The proposition behind studying the process dimension is that the design process incorporates mechanisms so that the values, principles, and approaches prevail throughout the full design cycle, thus keeping the cohesion or integrity of the core design idea (which is then reflected in the design outcome). Therefore, to study the question: *How do design processes of NBS contribute to the regenerative transformation of urban space?* an analytical lens is needed to "compare outcomes with processes of delivery" (Carmona 2014, 4). The urban design process (UDP) framework, developed by Carmona (ibid), describes types of self-consciously designed schemes as well as non-self-conscious schemes of urban adaptation and change, or what he calls the 'place-shaping continuum.' The framework includes two key contextual factors: 1) the history and traditions of the place and 2) the policy context directing the design/development ends. These factors influence the place-shaping process, presented in four phases: 1) design, 2) development, 3) use, and 4) management. Therefore, the analysis of the process dimension will be structured around the assessment of the contextual factors and the four phases. Additionally, the overall NBS design cycle will be inspected to understand how it embeds opportunities for learning about and caring for NBS.

The theoretical framework of this study draws insights from sustainability science, design theories, and urban studies that all inherently build on interdisciplinary traditions and thus provide a holistic perspective on NBS as a result of design decisions. In this section, I condensed the relevant theories and perspectives into a layered framework (Figure 10) to ground the conceptual base of the research, which consequently defines the research approach and applied methodology, which I detail in the following sections.

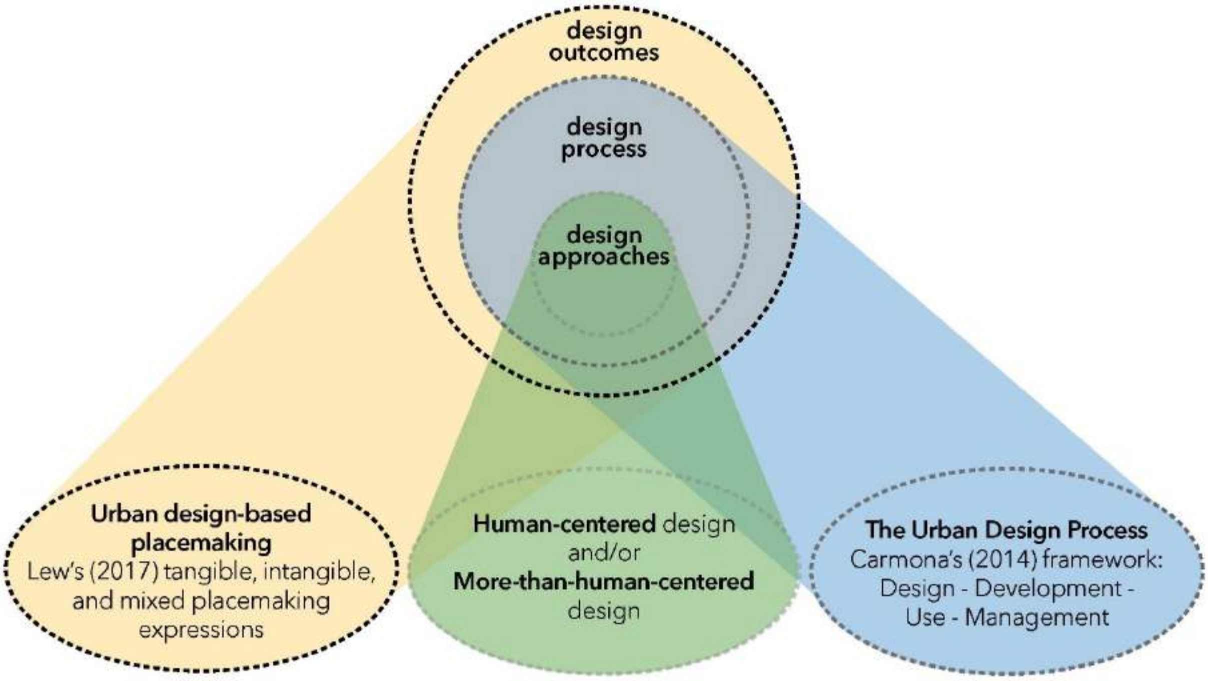

Figure 10. Analytical frameworks applied to the design dimensions. Prepared by the author.

3.2. Research design

People's perception of reality is entangled in the complexity of life. It is important to recognize that the importance or 'achievements' of NBS can be understood differently by actors affected by multiple contextual factors. Moreover, different interpretations of design and designing exist. Consequently, it is critical to adopt a research approach acknowledging different possible interpretations of phenomena (Yin 2013). Applying such an approach during data collection ensures that additional insights emerge, consistent with the exploratory nature of the research.

Therefore, this research is positioned within the *interpretivist research* tradition to benefit from an epistemology that allows multiple methods to reveal and discuss different angles of the same ontological understanding. The interpretivist research philosophy encourages exploring the complexities of phenomena in their unique context (Pham 2018): it allows flexibility to interpret the different design factors affecting NBS in different domains and cities. Interpretivism defines further aspects of the research design: it provides the core methods for data collection and analysis, traditionally in the form of interviews and observations, complemented by using secondary data. The physical space, the designed objects, the activities of people around or with them, and the plans, words, or texts shaping urban sites can all be interpreted and analyzed as data in localized, place-based contexts.

A research design fitting to the aims of this thesis was developed to gain empirical evidence of the processes and approaches used to achieve specific NBS design outcomes (see Figure 11). Moreover, it had to guide the systematic assessment of the critical design dimensions to reveal challenges, benefits, or drawbacks. Therefore, a *qualitative, comparative case-study* approach was identified as most suitable to explore the research questions, as it enables the collection of detailed qualitative information, the comparison of different contexts, and the exploration of connections and relationships (Perry & Bellamy, 2011).

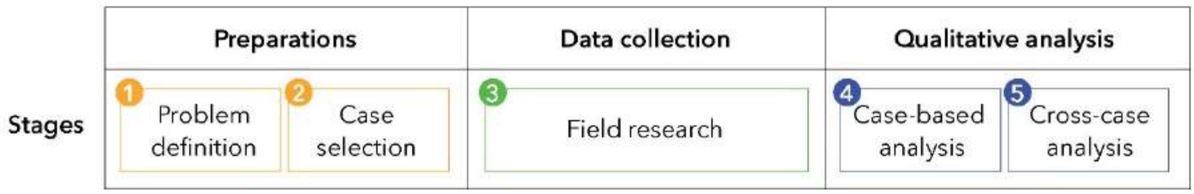

Figure 11. Research design. Prepared by the author.

The research followed a five-step process: 1-2) preparations and case selection; 3) data collection; 4) single case study description and analysis; and 5) comparative analysis. After the data collection stage, the contextual details and the selected NBS cases' design process were mapped out and explained in the form of descriptive case studies in city-specific working papers. In the last stage, the cases were analyzed according to the conceptual elements expressed through the research questions. The following paragraphs provide a general overview and the specification of each step, followed by a description of the methods.

Empirical data was collected for nine NBS cases located in three cities: Győr in Hungary, Milan in Italy, and Melbourne in Australia. Primary data were derived from semi-structured interviews, complemented with data generated from observational and place-responsive methods during site visits (detailed in Section 3.5). I studied each site in person during a *field research* period of two months in each city. Research notes taken during guided tours, relevant events, talks, and conferences further extended the findings. Additionally, an extensive study of documents, reports, and public statements by key project stakeholders supported the analysis.

The results were first interpreted to analyze and describe the NBS design dimension for each case separately. The nine cases were brought together in three *working papers* (Győr, Milan, Melbourne) to provide a holistic presentation of the cases, supplemented with contextual information about the cities. The working papers contained details concerning the NBS' placemaking outcomes, design characteristics, and development process.

The comparative analysis of the cases presents the main contribution of this research, discussed in Chapters 5-8. The subjects of the comparative analysis are not the individual NBS sites but the concepts applied to the research design, detailed in the following sections. I do not reflect on each analytical concept across all cases. Instead, evidence is brought from the different empirical cases of how the related analytical category manifested in one or the other, how it enhanced or constrained the course of development of the NBS, including their potential for regenerative transformation.

3.3. Case selection

The research follows a qualitative case study approach (Yin, 2009), where a *case* is defined as a single NBS in a particular city's mixed-use environment. The unit of analysis is the design framework comprising the design approaches, process, and outcome, thus providing a functional boundary. The nine cases are studied to advance the understanding of the design dimensions of NBS and their capacity for supporting regenerative transformation. In addition, I decided to include multiple cases in the research because they provide a greater spectrum of representation of social and urban phenomena: in this case, NBS designs (Yin 2017). Thus, similar or contrasting findings between different cases may contribute to more robust conclusions.

To be comparative, the cases should be situated within comparable contextual parameters for identifying and analyzing similarities, differences, or patterns. Having clear parameters helps to overcome the contextual limitations of a multi-site case study, as it can set criteria for selecting relevant yet diverse cases (Stake 2006). Therefore, I designed the selection framework to leave space for exploring diverse contexts and settings. The goal is not to compare best practices but to expose the plurality of design frameworks. The following paragraphs discuss the multiple-criteria framework guiding the case selection, moving from broader to specific parameters. First, I present the cultural and personal constraints and opportunities that prompted the city selection choices. Then, I justify the case selection results based on the sites' location, connection to NATURVATION, and relevance to local culture.

The analysis is based on selected *NBS cases* and not the cities, however, their overall context is critical. City selection criteria are derived from the theoretical framework and the research questions: the city must have a distinctive design culture and dedication to urban greening or regeneration efforts. I included two European cities and one Australian city in the research. I positioned my research to be conducted in countries associated with predominantly European[35] cultures, where NBS design and development have possibly previously documented sources or are connected to already established institutions. Additionally, practical issues must be considered in the city choice, as a critical constraint in designing qualitative case-study research is the language of communication. Interviews must be conducted, and information must be available in a language within the professional capacity of the researcher. In my case, the choices were English, Hungarian, French, or Italian.

The geographical focus was further enforced due to the bias in evidence concerning the application of NBS. NBS have been a priority topic in several *Horizon Europe Research and Innovation* projects, the EU's key funding program for research and innovation between 2014 and 2020, which raised interest in NBS and their applicability to urban challenges. The related funding opportunities have led to various projects dedicated to researching different aspects of NBS (see Section 2.1.1) and the promotion of the NBS concept through multiple agents and programs (such as C40,[36] Resilient Cities,[37] or ICLEI[38]). Consequently, many NBS projects have been identified across Europe with detailed information. Most notably, the NATURVATION project's database, called Urban Nature Atlas (UNA), explored over 100 European cities and collected over 1000 urban NBS examples. Since its launch in 2018, UNA is currently the largest NBS database (and presently features 80 cases outside of Europe).

[35] Although design is universal and placemaking occurs worldwide, most of the literature on urban design and placemaking is based on scholarly and practical experiences in North America, Europe, and Australia (Anderson et al. 2017; Lew 2017). The attention bias against the Global South (regions of Latin America, Asia, Africa, and Oceania) must be remedied by focused research efforts because the local cultural, social, and economic contexts for urban design and placemaking can be different from a Western perspective (Friedmann 2010). Such knowledge would contribute significantly to understanding the different community challenges, needs, and solutions in relation to designing urban NBS.

[36] C40 is a global network of mayors of nearly 100 cities joining a collaboration to address the climate crisis.

[37] The global Resilient Cities Network brings together over 200 'resilience officers' committed to working towards urban resilience.

[38] The International Council for Local Environmental Initiatives (ICLEI) is a global network active in more than 125 cities, grouping around 2500 local and regional governments committed to sustainable urban development.

This research aligned its goals with NATURVATION. To strengthen the common research aims and connections and take the opportunities presented by the already collected work on NBS, I narrowed the case selection to cities within the scope of NATURVATION. Altogether, I ranked potential cities based on their recent efforts in urban greening, being part of NATURVATION, and European culture, where I speak the language. According to these criteria and the practical constraints, I selected the following cities: Győr in Hungary, Milan in Italy, and Melbourne in Australia. Győr is a URIP (Urban-Regional Innovation Partnerships)[39] member in NATURVATION, and the other two cities are also part of the NATURVATION framework: cases from Győr, Milan, and Melbourne are included in UNA.

The UNA contains a selected number of NBS in the three cities, and based on its database, I compiled a preliminary list of nine NBS for each city. UNA features NBS selected systematically according to a set of criteria to ensure the representation of diverse urban and environmental conditions. The NBS included in UNA are characterized and categorized based on spatial scale, the addressed urban challenges and achieved impacts, and financial and institutional setup (Almassy et al. 2018). Thus, the pre-selection ensured that the chosen examples comply with the conceptual and actual definition of NBS: they respond to urban challenges while providing specific ES benefits. Additionally, the main drivers and enablers behind the NBS implementation are also detailed in UNA, such as the types of governance and policy and financing arrangements.

After the preselection, I later reduced the list to three NBS cases per city with the help of local partners at the beginning of the field research (see Appendix B). However, in the case of Melbourne, only a partial list of local NBS was made readily available by UNA. Therefore, I

[39] Six cities across Europe were included in the NATURVATION project as partner cities. Each of them established ‘urban-regional innovation partnerships’ across the urban government, business, and civic sectors dedicated to the research of NBS.

collected the nine NBS examples following the same methodology used for the UNA selection process [40] to provide the baseline assessment of the social, ecological, and economic perspectives accordingly.

I decided to select and study *three* NBS in each city to generate a diversity of cases and draw general remarks and comparisons within the local context of a given community while focusing on the particularity of each case (Figure 12). For selecting the cases, a critical factor was to choose NBS situated in *mixed-use spaces,* where different types of urban functions, services, and usages are present (for example, commercial, educational, entertainment, residential and recreational uses).

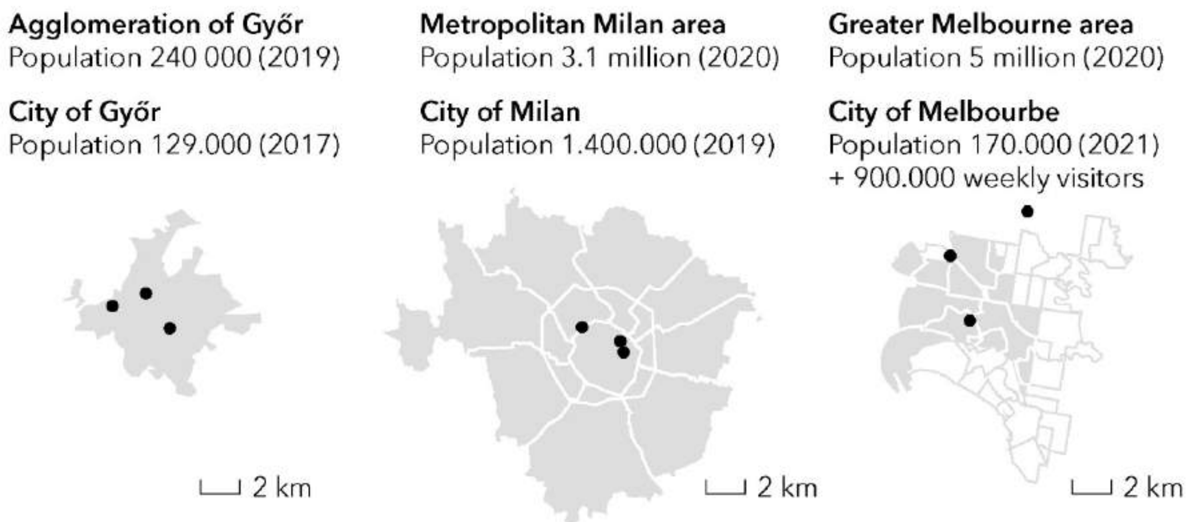

Figure 12. Location of the selected NBS sites. Prepared by the author.

Mixed-use spaces can upgrade the quality of urban environments by serving and enhancing a variety of uses and activities, such as employment, parks and urban green areas, cultural and educational institutions, waterfronts, stations, and service points (Dovey and Pafka 2017). In

[40] I participated in the case selection process for UNA during the fall of 2017. Data was collected through discourse analysis from secondary sources, and a two-step validation process ensured compliance with NATUVATION's criteria (Almassy et al. 2018).

mixed-use spaces, NBS must respond to multi-functional space and usage criteria. Consequently, NBS might not be the sole focus of the design; instead, the design considers services, strategies, policies, plans, initiatives, or events. In other words, I was looking for cases where the development of the NBS was assumed to follow a 'designerly' approach (Cross 2001). Thus, to the extent possible, I chose NBS examples that were holistically directed through a design process or methodology by reflecting a distinctive intellectual and practical design culture (for example, in urban design, landscape architecture, or other related fields), focusing on urban design sustainability problems in the broader context.

The 'orientation discussions' facilitated the last step of the selection process. I conducted these with local experts at the beginning of the field research stages (who were also critically important in finding additional contacts for interviews, see details later in Section 3.6.2). They drew my attention to other potential NBS examples and helped me evaluate my NBS cases' suitability based on their local knowledge. The selection of the three sites in each city was finalized once I visited the NBS in person (see Table 1 and Figure 12 above). In some cases, I had to rule out examples that looked interesting only on paper or those which turned out to be in locations not frequented by many people.

Table 1. Selected cases per cities

City	City case 1	City case 2	City case 3
Győr	Bercsényi grove	Kuopio park	School gardens of Győr
Milan	Biblioteca degli Alberi di Milano (Library of Trees)	Bosco Verticale (Vertical Forest)	Parco Portello (Portello park)
Melbourne	NaturePlay playground	Medibank Place	Centre for Education and Research in Environmental Strategies (CERES)

3.4. Data collection

Data collection for this research was based on multiple sources of information to be triangulated in the analysis phase (see the key research data in Appendix B). I used a combination of interviews, desk research, and observational methods to explore representative patterns of NBS design in the approaches, process, and outcomes dimensions (Figure 13). Templates for data collection, note-taking, and reporting were used to manage the main findings systematically and ensure internal validity throughout the research.

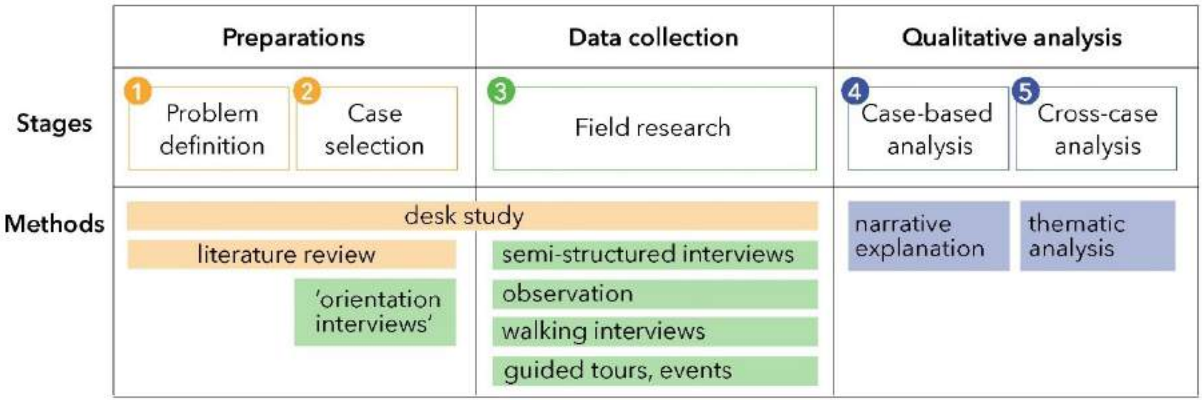

Figure 13. Research design and methods. Prepared by the author.

3.4.1. Desk study

A desk study through secondary sources was performed as a preliminary task before conducting interviews and site visits. Questions around the contextual settings and baseline information were explored to gain a sufficient understanding of the socio-economic and political situation of the NBS in the local context and its development background, to uncover data gaps, and to clarify the context of primary data. Additionally, the desk study was used to identify potential interviewees and inquiry strategies.

Primarily, I collected publicly available documents online, produced by or concerning the firms and organizations involved in creating the NBS cases (see details in the 'Baseline information' tables in Appendix C, in the rows: Project Owner, Developer, Manager, Contributor, Designers, Landowner, or Industry Framework). In most cases, I found detailed project documentation in the form of strategic and project plans,[41] evaluations, conceptual design, technical plans, studies, or progress reports studies at the websites of local governments and the companies or organizations directly involved in creating the NBS. These documents proved to be an essential data source for the instrumental descriptions of the designed places and the ex-post analysis concerning the design process of the NBS cases and the implementation and maintenance activities conducted or planned. Furthermore, communication materials (reports and press releases) revealed the developments' inherent details that I acquired the same way as described above. I also collected policy documents on the cities' territorial governance, urban planning, and design. In addition, I received materials from the interviewees (documents and photos). I consulted local newspaper articles and thematic blogs to learn about the citizens' and critics' opinions on the NBS cases or the related development. The collection of documents, available online or received via interviewees, accompanied the field research stages, continuously building the database.

3.4.2. Semi-structured interviews

Semi-structured interviews provide primary data for the thesis with key stakeholders, conducted between January 2019 and January 2020 (see Tables B9,13,17 in Appendix B). For each NBS case, approximately three-five informants were interviewed, altogether 40. The average length of the interviews was 47 minutes.

Key informants were selected and approached in several steps. First, 'orientation discussions' (not counted in the interview list) were organized to find possible contacts with the help of local

[41] *Strategic plans* are used as frames of reference for long-term schemes and are decision-orientated with high-level abstractness. P*roject or operational plans* determine the short-term, material-orientated course of action with a high level of concreteness (Faludi and van der Valk 1994).

expert groups[42]. Through 'snowball sampling' (Given 2008), they provided additional references who guided me to persons I could purposefully address to gain primary data on the NBS' design and the site's development process. The interview participants were identified based on their involvement with the NBS design process (the creation, implementation, or maintenance of the NBS and their urban space), held important positions, or were considered experts with an intrinsic and local knowledge of urban planning and design. As the cases were based on meeting multi-functional space and usage criteria, the background of key stakeholders differed case by case. The pool of informants included landscape architects, project leaders and researchers of participating architect firms, representatives of the developer companies or civic activists, and NGO employees operating in the environmental policy realm.

The interviews were semi-structured, guided by open-ended questions that allowed for an understanding of the participants´ backgrounds, role in the process, or their relationship to the NBS and the area. As introduced in Section 2.1.1, NBS are used as an umbrella term to cover multiple related concepts (such as green infrastructure or ecological engineering). In everyday conversations, these are often interchangeable notions. As a result, a lack of familiarity with the exact notion of NBS may still exist. Therefore, during the interviews, the similarities between the concepts were emphasized (Yin 2013, Creswell 2017), and the questions were structured to investigate both the contextual aspects and factual circumstances of the NBS design dimensions.

Interview participants were informed about the goals and nature of the research and how findings would be used before the interview with the help of an information leaflet that they

[42] For the cases in Győr, researchers from the Hungarian Academy of Sciences' Centre for Economic and Regional Studies helped me find potential contacts. Experts from the Rinverdiamo Milano ('Let's re-green Milan') Action Lab of the CLEVER Cities oriented me to find interview partners for the Milan cases. For the cases in Melbourne, scholars from RMIT University's Centre for Urban Research, and scholars of the Monash Sustainable Development Institute, and Swinburne University's Centre for Urban Transitions guided me.

received online. This contained information on confidentiality and anonymity and indicated that participation was voluntary without any remuneration, and participants had the opportunity to withdraw from the study at any stage of the research process. This process was done online via emails to allow time to clarify any questions or concerns regarding the research process or the participation requirements and to receive written consent for their participation. During the interviews, research goals and means were discussed again, and participants were assured that they could refuse to answer questions.

Participant anonymity was ensured throughout the research process. Participants were not named or directly referenced: no notes or transcripts identified the respondents directly. Instead, a code (a combination of a number and the city where the interview took place) referred to participants. Additionally, the research involved observational methods in public spaces, where obtaining consent from every individual on the field would have been unfeasible. However, I made sure that no details were recorded (for example, on photos) that could identify specific individuals. Moreover, since the study took place mainly in public spaces, the observed individuals would expect to be observed by strangers, thus, the research did not pose any additional distress to people.

Of the 40 interviews, 35 were performed in person, four by telephone, and one on Skype. Before the interviews took place, the informants received an interview guide to reflect on the topic or ask explanatory questions. This served to gain potentially more valuable insights as it allowed participants to meditate on the topic beforehand (Yin 2017), which was crucial in Milan, as English was the second language of the interviewees.[43] Moreover, the semi-structured style also encouraged participants to speak freely. Therefore, I applied this approach to create the

[43] The Melbourne and Milan interviews were conducted in English, while the Győr interviews were in Hungarian and translated to English after transcription.

ambiance of a discussion, naturally allowing space to ask further questions that could provide additional insight into new themes mentioned by the participant.

3.4.3. Place-responsive methods

The primary data collection process was complemented with additional techniques from 'public space-public life studies'[44] for a more *place-responsive* approach to the research (Carmona, 2010). For each NBS, field visits were conducted for direct observation and 'walking interviews' at the studied sites. These methods were added to the research design to examine the interplay between public life and public space (Haas 2008), for example, to register details and nuances of people's interaction with the NBS. Additionally, the site visits provided opportunities to examine how formal or informal programs and events related to the sites are handled or how the NBS are presented and interpreted by those who designed or managed them. For this reason, where possible, I took part in workshops, guided tours, on-site lectures organized at the NBS sites, and even at some conferences that were within the scope of the research (see the lists in Tables B11,12,15,16,19,20 in Appendix B).

The site visits consisted of *direct observations* during the field research periods. I spent approximately 5.5 hours at each site divided over three to four visits, with an average of 1.5 observation hours per occasion (see the lists in Tables B10,14,18 in Appendix B). The observations were systematic to capture information about the interaction of people with their environment and users' likes and dislikes throughout the analysis. From the array of tools discussed by Gehl in How to Study Urban Life (2013), I used 'looking for traces,' 'photographing,' and 'diary' for recording and systematizing direct observations in urban spaces. 'Traces' are messages about human activity. They can be mapped or photographed to capture

[44] Public space-public life studies are a specific dimension of urban design, pioneered by Jan Gehl, and used systematically since the 1960s in cities of different scales and cultures (Gehl and Svarre 2013).

the use or misuse of the space, and the artifacts around the NBS. For example, litter, graffiti, or any marks of human activity would count as a trace. I used photography to document situations where urban life and urban form interact or fail to interact. Finally, I kept an observation diary to register details and nuances about the site visits and related activities for subsequent assessment.

Furthermore, I took the opportunities presented by the various site-level events I attended (such as workshops, open lectures, or guided tours) to conduct *walking interviews.* Moreover, some of the interviews were conducted with this approach. Walking interviews consist of taking a walk in the chosen urban environment or route and observing the surroundings, during which meanings and connections to the environment occur to the participants naturally due to the multi-sensorial elements of human experience (Carmona 2010). Therefore, qualitative data can be gained from incidental conversations or semi-structured interviews during the walks. With the application of the walking interviews, my goal was to balance my understanding of the place with others' views and perceptions or notions of comfort and image of the space.

The additional place-responsive techniques helped to saturate the findings further. However, due to the nature of the field research, potential confounding variables must be acknowledged. For example, there is the possibility that the weather or specific events affected the number of visitors and their behavior at the NBS sites. Therefore, I aimed to ensure that the general weather conditions were similar across cases and data collection periods. In each city, observations were carried out in 'good weather,' considered suitable for a range of outdoor activities, and in 'bad weather' conditions with lower visitor frequentation (see the observation data tables in Appendix B). Other potentially confounding factors are the events and guided tours used as part of data collection, as those could affect usage of the spaces or lead to activities performed by the users of space that are different from the usual. However, the data obtained from these place-based techniques primarily provided information for the research complementing the core insights obtained from the interviews.

Finally, to account for this risk of case studies' limited ability to generalize results to a broader context (Creswell 2017), the applied conceptual and methodological framework provided a solid structure to reproduce in-depth case studies in other contexts. I did not focus on specific types of urban NBS, thus, the open, exploratory, cross-sectorial methodology allowed me to derive universal design aspects. In the next section, I present how I engaged with a comparative approach for these cases to define key differences and similarities to gain viewpoints on regeneration according to the composition and richness of the applied design dimensions situated within local cultures and histories.

3.5. Data analysis

From the data collection perspective, a system was required to manage data about the NBS cases in the fullest form possible and in a structure that can be used to analyze the cases based on the conceptual elements defined for the design dimensions. For this purpose, I adopted Mark Francis' critical framework (2001), explicitly created for studying urban planning case studies, which I restructured around the three analytical dimensions. The redesigned guide contains four main parts (presented in separate tables) that the following sub-sections will explain in detail: 1) context and baseline information and 2) the three design dimensions: outcomes, approaches, and process.

3.5.1. Exploring the wider context and baseline information

Assessing the basic characteristics and contextual data sets up a baseline for the cases to be measured or positioned next to each other. The aim is to build a common base for presenting the results and familiarize the place-based key qualities of the NBS to ground the rest of the research. This part is critical because it establishes the NBS as an output of *urban design-based placemaking* practices.

Therefore, first, the *basic characteristics* of the NBS cases must be defined, starting with the typology of the studied NBS concerning the urban form and the addressed urban challenges. Furthermore, key information on the NBS's implementation context or institutional setup must be specified, including the location, status (timeline or time of completion), scale, urban space or land use, and budget and costs. Next, baseline data collection must include exploring *contextual factors* influencing the development of the NBS. Carmona (2014) specifies in the UDP framework that an overview of the place's historical processes and legacy structures is necessary together with stakeholders' relationships and governance structures because these factors are equally important in shaping placemaking outcomes as the process-related ones. Therefore, an overview of historical changes in society, economy, and politics is necessary and to gain familiarity with local notions of heritage, the characteristic processes of place, and the natural context. Additionally, the power relationships that lend agency to the structural process must be assessed by inspecting the initiating organization, management set-up, applied participatory approaches, or community involvement type and breadth. Table 2 presents the guiding questions for exploring these aspects of the research. The contextual data concerning the NBS cases were explored primarily with desk study and validated via key stakeholder interviews and academic and non-academic literature analysis.

Table 2. Guiding questions and required information for the inquiry of baseline NBS data. Source: Francis 1999 (with amendments)

Focus points	Description
Institutional setup	Location, size, space, or land-use type Budget and costs Timeline Project owner(s), client, designer(s), consultant(s) Type(s) of public participation and partnerships

Design elements, specification	What are the key design entities and characteristics?
Goals and Requirements	What are the key goals (social, ecological, aesthetic)? How were the goals set? Who defined them?
Constraints	What are the underlying challenges of the site? What are the technological or other constraints?
Urban history	Historical perspective of the site's development What are the social, ecological, or economic connections to the site, and how were they considered during the development of the NBS?
Actors and partnerships (Institutional)	Who are the main actors who took part in the (different) development (phases)? Who are the key partners who helped this process? Who influences a project's decisions and outcomes? Why? How does this change during the project?

3.5.2. Exploring the design dimensions

Various conceptual elements must be assessed to explore the three design dimensions. In a sense, the goal was to explore the design and development circumstances in their entirety, together with the consequences. For the outcomes dimension, I used key stakeholder interviews and desk study to uncover the perceived and measured transformative impacts of the NBS cases and how the results are communicated (Table 3). Furthermore, data gained from walking interviews, guided tours, and non-participant observation were essential to complement the details with additional academic and non-academic literature analysis.

Table 3. Guiding questions and required information for the inquiry of the design outcomes dimension. Source: Francis 1999 (with amendments)

Focus points	**Description**
Perception	What does the place look like? How does it work? How does it feel?
Associations	How is the place perceived and valued? How did design contribute to it?
Heritage and traditions	How is the history of place treated or viewed by the project team? Are there traditions or built or cultural heritage specific to the space?
Impact on community	How does this project serve the community? What is its social relevance or significance? What is its social impact and meaning?

Environmental sensitivity and impact	How does this project serve the environment? What are the environmental impacts? What is its contribution to sustainability in a broader sense? Restorative or regenerative aspects
Impact on profession	How does this project serve the design profession? What does the project contribute to the professional knowledge base, to design theory and practice?
Public opinion, communication	Critiques by experts, users, review committees, design critics, and journals. Has been any controversy associated with the projects? If so, has this been resolved? How?

The approaches dimension was analyzed based on the key design motivations, such as articulated principles or methods used for framing the design goals[45] (Table 4). I uncovered these questions through semi-structured interviews. Key stakeholders referred to using certain principles or guidelines that I could investigate deeper with additional desk study and academic and non-academic literature analysis.

Table 4. Guiding questions and required information for the inquiry of the design approaches dimension. Source: Francis 1999 (with amendments)

Focus points	**Description**
Intentions	What motivated the project? What are the issues or problems the NBS is trying to address?
Guiding visions	Approaches, principles, guidelines, and standards used.
Areas of design focus	What kind of time horizons were considered and why (short-term, long-term)? What are the ambitions of the project (moderate, significant, or radical change)?

Questions around the process dimension cover the place-shaping phases of the urban design process defined by Carmona (2014) (see Table 5 on the next page). The above methods were combined to inspect the process-related chain of events and circumstances.

[45] For example, evidence for the use of HCD approaches can be present in the articulated design principles and objectives or in the methods applied during the design process to gain insights from individuals (such as cultural probes, ethnographic methods, observations) and techniques to co-design with all related actors.

Table 5. Guiding questions and required information for the inquiry of the design process dimension. Source: Francis 1999 (with amendments)

Focus points		**Description**
Roles of key participants		What are the roles of the designer and other professionals (for example, urban designer, architect, landscape architect, botanist)? What are the roles of key stakeholders? Clients? Users? Who leads the team, or who is the project owner? What is their role at the beginning of and during the project?
Design process	Design phase	How were the goals translated into form? Did the goals change during the project? If so, how? What kind of data and information sources were used to develop the project? Was there a preliminary research phase? If yes, what type of research was used? What are the characteristics of the design process? How did participatory or citizen engagement activities happen connected to the design phase?
	Development phase	What are the characteristics of the implementation process? How did the composition of the project team/key participants change during the development process? How did participatory or citizen engagement activities happen connected to the development phase?
	Use phase	How is the place used? What traditions are connected to the site or its usage? Who uses it? Who does not use it? How does it change/develop over time?
	Management phase	How do management and maintenance work? What are the problems and costs of managing and maintaining? How participatory or citizen engagement activities are connected to the management works of the NBS?
Responses to problems		Is there a system for monitoring and assessment? Were other additional problems solved or addressed?

3.5.3. Data processing and analysis

The interview content was recorded and transcribed verbatim. The transcribed text was combined with the researchers' observations, notes, field diary, and desk study material (strategic and policy documents, plans, and additional materials) to ensure data triangulation. I used NVivo, a widely adopted qualitative data analysis software, to code and organize this data set to ensure a rigorous and consistent coding system for analysis. NVivo also allows managing visual sources and recording notes or comments about the images. Thus, the pictures (or areas of the photos) can be coded directly.

The accumulated data was processed, coded, organized in tables, and assessed in two main stages, as set in the research design. First, I used a structural approach (Braun and Clarke 2013, 2021; Byrne 2021) to code the materials according to the concepts identified for the design dimensions (see Tables 2-5). These pre-defined structural themes served to guide the process of segmenting, labeling, categorizing, and compiling the data to capture the main concepts and relationships within the data set (Creswell 2017). Thus, a holistic, in-case analysis was performed for each NBS, resulting in three city-specific 'working papers.'

This preliminary analysis using case study reports was necessary because the cases first had to be interpreted in their entirety to identify the core narrative of the cases with the linear chain of actions in order to perform the cross-case analysis. I used the technique of *narrative explanation building* (Yin 2009) to prepare the case studies as a significant part of the data was gained from people telling the story of the NBS and how they enacted them. Using narratives is especially suited to analyzing processes as the surface features of narrative data are helpful for description. When applied to deeper structures that are not directly observable, such as the design dimensions, they support inspecting structural features. I chose this type of analysis to process and present the entire life cycle and contextual factors of the cases, with a baseline assessment of their design process, including the consequent placemaking outcomes and applied approaches. The three city-specific 'working papers' are not included in the thesis due to their lengths (approximately 100 pages each). Therefore, only the writing paper template is provided in Appendix B (Figure 78).

The cross-case comparison was made based on a *thematic analysis* of the data to examine different perspectives (Given 2008): in this case, the plurality of design factors was organized across the three dimensions (outcomes, approaches, and process). It is a theoretically flexible interpretative approach allowing to capture main concepts and relationships within the data set and to identify and analyze themes or patterns (Creswell 2017, Braun and Clarke 2013). For example, my goal was not to understand where the word regenerative appears in the interviews and documents but to understand the themes attached in its context. In thematic analysis, codes are often developed from the combination of theory-driven (deductive) and data-driven (inductive) approaches. Similarly, I used pre-defined theory-driven themes (based on the conceptual framework) and data-driven themes in this analysis stage, which were organically produced around a relative core commonality. For the 'theory-driven' codes, I used hypothesized themes based on theory prior to data collection, which then I compared with evidence to support these from the data in the form of codes. For Q1, this involved codes that explored the design outcomes based on the framework of placemaking expressions. For Q2, the breakdown of design approaches was not guided by a pre-defined framework but based on the theoretical grounds discussed in Section 2.5.2. For example, I focused on the concept of human-centered design approach, thus I coded for this concept to analyze the themes within conversations about the theoretical topic. Finally, for Q3, codes were based on Carmona's urban design process framework (2014). However, to allow a reflective and thoughtful engagement with the data (Braun and Clarke 2019), I also used data driven codes that had not been captured by the theory-driven codes. For example, the concept of relevance or the lack of it was not within the initial scope but arose from the data organically.

4. Case contexts and place-based assessment

This chapter presents the baseline data and characteristics of the cases in a condensed way, explicitly focusing on the performance of the NBS concerning urban challenges: their ecological, social, and institutional effects on their local, or in some cases, global context. In addition, the contextual factors are also described: historical processes, legacy structures, stakeholder dynamics, and how local developmental processes define and continue to influence their formation and results.

The case descriptions are grouped according to the cities and contain an introduction to histories of neighborhood development processes based on the cases' locations. Additionally, I apply a placemaking lens in the case descriptions to highlight the importance of NBS's place-based nature, which involves even not traditional places, such as buildings. They all have social-economic and environmental relevance due to their connections to place. They demonstrate the uses of placemaking as a community, economic, and infrastructure development tool to different degrees. This points out that urban places with NBS are made using multiple types of placemaking processes, both consecutively and additively, forming a sense of place for NBS.

4.1. Győr cases

Győr, although much smaller than Milan or Melbourne, is a city with vital regional importance (see Figure 14 on the next page). It lies halfway between Budapest and Vienna and is close to Bratislava. Surrounded by these three capital cities, Győr is situated in one of the most critical traffic and logistics corridors of Central Europe (Somfai 2019). In addition, it is an important economic, cultural, and sports center and one of the most dynamic cities in the country due to the concentration of the automotive manufacturing industry (Rechnitzer and Kecskés 2015; Lux 2015; Géczy and Komlósi 2016).

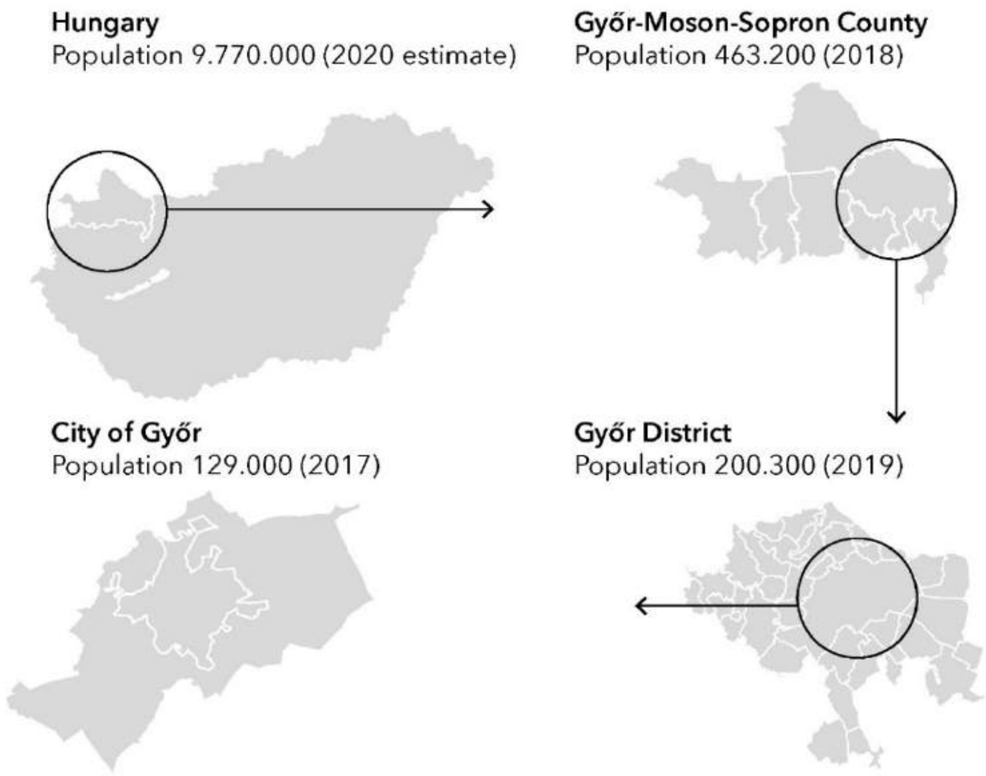

Figure 14. Contextualizing the City of Győr on a local, regional, and national scale. Prepared by the author.

Győr has the highest and fastest-growing GDP per capita area in Hungary outside of Budapest. It is one of the few examples where the population is stagnant (and not declining). Győr had seen many changes since Roman times when it became a significant settlement named Arrabona. It continued to have important ecclesiastic, commercial, and military functions in the Middle Ages, especially during the 16th-17th centuries when it was redesigned as a fortress to protect Vienna from the Ottomans (Winkler 2014; Csapó, Kozma, and Lenner 2016). By the 18th century, Győr became a merchant town, then a factory city by the 19th century. After World War II, the large-scale communist block-building housing projects left a mark on the cityscape, just as it happened with most Eastern-European cities. However, in the 1980s, the planned restoration of the historic city core began, and in 1989 Győr won the Europa Nostra Prize for monument protection. The Baroque city center was reconstructed, and the inner-city center became a pedestrian zone. The urban fabric has another peculiarity: it is at the confluence of three rivers; Moson-Danube, Rába, and Rábca. For this reason, Győr is called 'the city of rivers,' naturally promoting a connection between the rivers and the city (Somfai 2019), an advantage that is consciously used to make Győr more livable. Moreover, due to being a URIP city, research on NBS activities had already taken place with many available materials.

The three cases are all situated in downtown Győr. Specifically, Bercsényi grove is in Sziget-Újváros suburb and Kuopio park is in Adyváros (Figure 15). Therefore, the subsequent sections detail the key contextual information of the suburb Sziget-Újváros in Section 4.1.1, with the description of Bercsényi grove, followed by presenting Adyváros in Section 4.1.2, with the assessment of Kuopio park. The School gardens of Győr are dispersed across the city center and are embedded in educational institutions rather than in certain suburbs. Their case is presented in Section 4.1.3. Tables 21, 22, and 23 in Appendix C provide the baseline data of the cases.

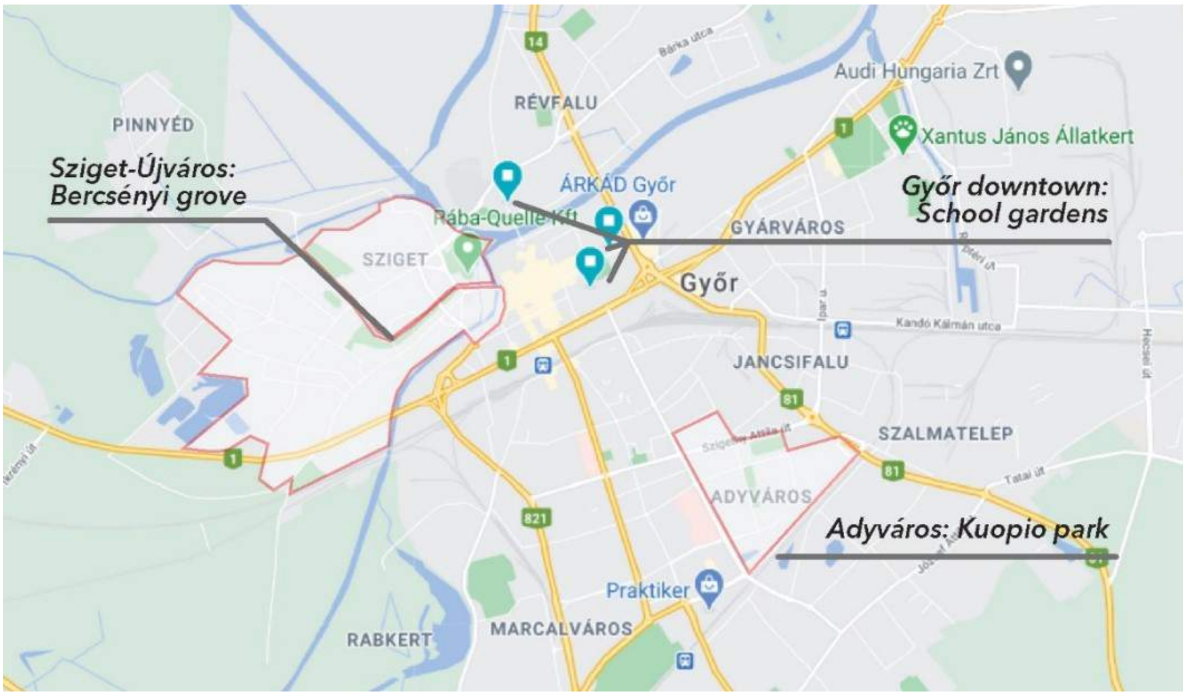

Figure 15. Location of the cases within Győr. Prepared by the author.

4.1.1. Bercsényi grove

Sziget and Újváros are two historically and administratively distinct suburbs of Győr. However, they are connected by the Bercsényi grove (discussed in the following sub-section), and people commonly refer to them as one neighborhood: Sziget-Újváros (#Gy05 Document). Additionally, the development of the grove has a significant impact on the life of both suburbs; thus, I present both.

Sziget ('Island') got its name due to being bordered by rivers on all sides. The suburb's former village character gradually developed industrial aspects as industrialization accelerated by the turn of the 19th century. First, the oil factory was founded, followed by the pasta factory, two vinegar factories, and rum and liqueur factories. After World War II, typical residential panel blocks were built during the socialist People's Republic era, ignoring the area's historical structure. Nevertheless, the urban form and street network of Sziget largely retained its original character, and today it is characterized by narrow, winding streets and large blocks of unbuilt areas (Csapó, Kozma, and Lenner 2016). However, the 1989 regime change brought about a significant social and demographic shift in the area and left its mark on land use. As a result, the industrial plants and factories ceased their activities, one after another. A residential park was established on the former dairy farm site, and almost all the oil and biscuit factory buildings, including those of architectural heritage value, were demolished (#Gy01,04 Document).

Újváros ('Newtown'), contrary to its name, is one of the oldest parts of Győr, referring to the medieval suburbs, newly settled in the 15th century outside the county stronghold (ibid). It was the first inhabited area outside the city walls after the Middle Ages. By the 1800s, grain-carrying boatmen settled alongside the already rooted community. Significant developments followed, and Újváros became one of the most vital parts of Győr, composing 39% of the total population.

Five denominations (Lutheran, Israelite, Reformed, Roman Catholic, Orthodox) lived side by side[46]. The temples and most of the area's historic buildings were built between the 18th and 19th centuries. By the 19th century, Újváros was a prominent, affluent district populated by wealthy merchants, artisans, and retailers (Géczy and Komlósi 2016).

However, after World War II, the – and the bombings - communist takeover stopped the centuries-old tradition and development. The workshops, factories, shops of artisans, and merchants were nationalized, eliminating their independent existence. The district had already suffered a severe blow by the deportation of more than a thousand Jewish citizens in 1944, most of whom had never returned. As a result, the population was impoverished, former homeowners were forced to give their apartments to the state, and eventually, industrial workers took over the cheap rented housing. During the decades of socialism, the state barely invested in conserving the neighborhood and the surrounding buildings, and their condition gradually deteriorated (Géczy and Komlósi 2016).

Consequently, the former landlords and their descendants moved out of the neighborhood. In their place, the city council relocated people of lower social status, mainly of Roma origin. The situation stabilized after the regime change in the 1990s. The Roma population's migration into municipal rental housing continued to a lesser extent than before. By the turn of the millennium, the population had declined significantly, and many moved out of the area. After a long period of deterioration and stagnation, the first steps towards renewal came only in 2013, when among other significant neighborhood elements, Bercsényi grove was renovated (#Gy02,05 Document).

[46] It is a unique religious-cultural phenomenon that in the inner part of Győr-Újváros, there are churches of five different denominations a few hundred meters apart. To celebrate this, since 2006, the 'Five Churches Festival' has been held every year in May, during which local and foreign representatives of religious, classical, and pop music give concerts for five days in the five churches.

Bercsényi[47] grove (hereinafter shortened as BG) is situated near the historic core in the northwestern part of Győr. At the turn of the 19th century, the grove and its surroundings were a sparkling, lively, central part of the city. However, due to the cessation of water transport and the developing industrialization, the area's importance declined significantly from the 1930s. By the second half of the 20th century, it had almost wholly degraded and became socially and physically neglected, remedied only in 2013.

BG sits lower than the surrounding areas because the Rábca, one of the tributaries of the river Rába, used to flow at the site, separating two parts of the city: Újváros and Győrsziget. It was formed after the river regulations, which led the Rábca into its current bed in 1906 when the old riverbed and its inundation area were filled (Figure 16).

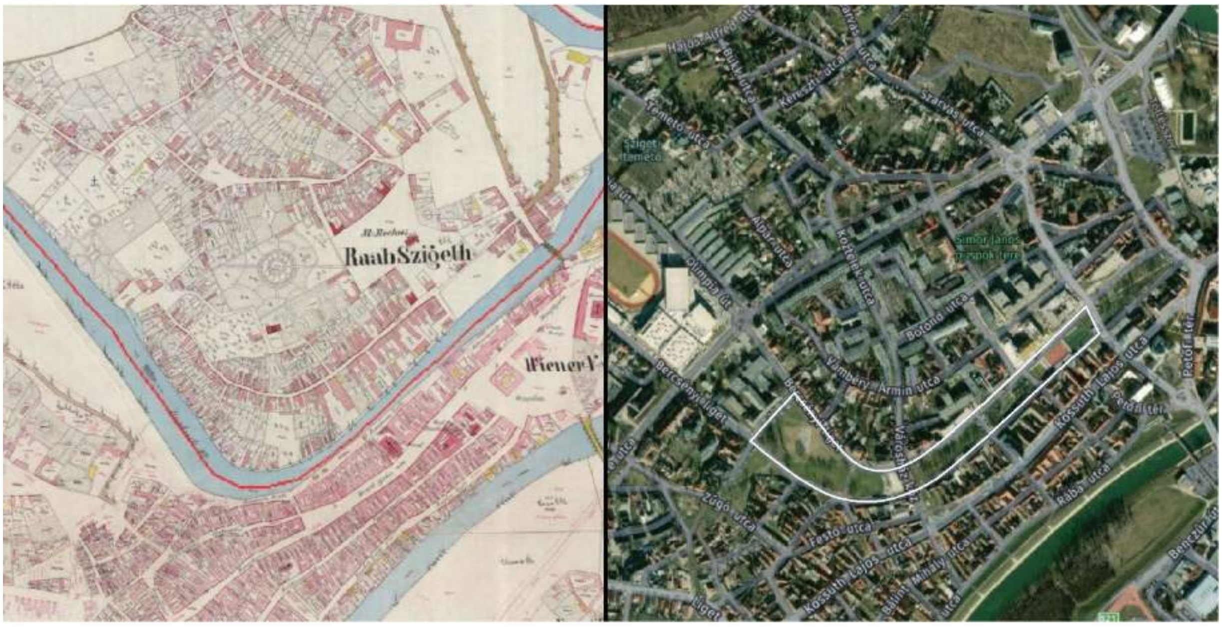

Figure 16. Synchronized view of Győr's cadastral map ca. 1856 and today. Source: Arcanum.com

[47] The grove was named after Count Miklós Bercsényi, who was one of the leaders of the Rákóczi War of Independence (1703-11), the first significant uprising against the rule of the Habsburgs over Hungary. A bust sculpture commemorates Bercsényi's legacy in the grove.

Large-scale plans designed by Ármin Pecz (1820 – 1896), an early representative of Art Nouveau gardening in Hungary, were set to landscape and utilize the abandoned riverbeds in Győr,[48] but they were never executed (Nágel-Fischer 2008). Instead, natural processes continued filling up the riverbed, and it remained uninhabited for about 30 years. However, after the 1930s, much of its area became utilized. The upper and lower sections were filled, trees were planted, and a road network was established. The green space was named Bercsényi grove, and it developed into a precious and important structural element of the district due to its public park and fortification functions. However, after World War II, the area was gradually impoverished, and a neglected, stagnant stage took place.

The role of BG as a continuous green space has remained largely unchanged, according to the town planning concept of the last nearly 30 years (#Gy01 Document). The goal was to recognize it as an important element of the urban fabric and to restrain construction intentions as much as possible.[49] However, at the same time, the neglected condition of the grove (due to, for example, a habit of illegally dumping rubbish in the grove) and its proximity to the city center made the area increasingly valuable to politicians and investors, presenting an opportunity for construction (#Gy02 Respondent; #Gy03 Document). The maintenance and renovation of the area had been delayed for a long time. However, after eliminating the dismantled large-scale industrial sites, in 2013, it became the focus of attention when BG was regenerated within the

[48] Pecz presented his designs, 'Landscaping the Rábca riverbed in Győr' ('A győri Rábca meder parkozása'), at the 1910 Budapest International Horticultural Exhibition. He envisioned eight interconnected gardens on 16 hectares by partially filling up the area today composed of BG and the Bercsényi Secondary Vocational School territory. The plan consisted of a geometrical, symmetrical, and landscape-like design, considering transport between the city's two parts.

[49] Gábor Aczél, a defining figure of the Hungarian and Győr architectural scene, assessed the area's previous development plans. The 1984 detailed zoning plan ('Részletes rendezési terv') already established BG as the most important green space element of Sziget-Újváros. It designated the entire parkland with a public park and fortification functions and determined the content of the later settlement structure plan and the regulatory plan. As a result, the 2002 regulatory plan conserved the green space function, although a new road further cut the coherent green belt. The structure plan ('Szerkezeti terv') approved in 2006 contains the elements proposed by the 2002 regulatory plan: rehabilitation interventions along the former riverbed and the construction of Bercsényi Promenade as a joint flagship project of Sziget-Újváros (#Gy05 Document). However, the 2007 development action plan overrode the structural plan adopted shortly before. A housing construction was envisioned at BG, together with a new cultural center, placed in the grove.

framework of the Újváros Rehabilitation program[50] (#Gy02 Document). Within the grove, a park for recreational use, a playground, and a road regulations parklet for kids ('KRESZ park') were established to serve the neighborhood's development and the improvement of its livelihood (see Figures 17, 18).

Figure 17. The rehabilitated parts of the grove: playground in the first basin and the road regulations parklet in the third basin.

Figure 18. The rehabilitated parts of the grove: football field and open-air gym court in the second basin.

[50] As a result of the urban rehabilitation plan, 40 social housing units bordering BG were rebuilt, the facade of the Kossuth Lajos Elementary School and the Roman Catholic Church's roof structure was renewed. Five shops were established on Kossuth Street, thus, supporting the rise of private capital so that the district could once again become a trading district of Győr. Additionally, a police station was set up to enhance public security. Infrastructure developments have been complemented by several social rehabilitation programs, primarily to improve public safety and health and environmental awareness. However, they have also received regular screenings from the support framework (#Gy02 Document).

The strategic placemaking interventions of the rehabilitation project had a straightforward market-oriented approach. They were meant to facilitate the program's long-term goal: to rebuild Újváros after decades of decline, change wrong stereotypes, and regain its rank. The development was intended to stimulate private capital, investors, and construction companies:

> It was not a secret goal to operate the rehabilitation program to act as an engine for private capital and investments to appear. The renewal of the Bercsényi grove also serves this purpose, as it is located between Újváros and Sziget. Therefore, it can function as a kind of recreational ground within this area (#Gy06 Respondent).

The results arrived quickly due to short-term actions (such as the renewal of selected residential and public buildings and the rehabilitation of the Bercsényi grove into a physical connector, a meeting point, and community space between the two areas) and various community participation activities and public forums. Housing estate developments appeared along the rehabilitated zone, Figure 19), and Sziget and Újváros are expected to be reclaimed step by step (#Gy06 Respondent).

Figure 19. Ruined and renovated buildings along Kossuth street and real estate advertisement.

However, there is an inescapable problem that halts the Sziget-Újváros rehabilitation process: the spreading run-down of the neighborhood and the high degree of segregation of the Roma population (#Gy05,06 Respondents). According to #Gy06 Respondent, “the real problem is that the kind of community that used to live here [such as bourgeoisie and merchants] cannot be brought back. So, trade did not develop [as it was expected]". Therefore, even though the rehabilitation program also allocated resources to revitalize the grove along with educational and recreational functions, it is still regarded mainly as a "utilization of an existing green space that is maintained as a green space" (ibid).

Not only in its immediate but the broader context, BG is an essential green space system element in the settlement fabric of Győr. The Rába riverbend is part of the NATURA 2000 network, a habitat protection area of high priority. The former Rábca branch and the Rába used to form a unified ecological system, in which the Rábca functioned as an ecological corridor. With the elimination and partial incorporation of the riverbed, this direct connection to the rivers' ecology was lost, but the conditioning and climatic effect of green surfaces and foliage remained. The horseshoe-shaped public park is a feature to be preserved and forms an integral part of the green surface axes along the watercourses that cross the city (#Gy01 Document). The grove's beneficial effects are further enhanced by groundwater running underneath the grove that is still likely interconnected to other underground streams. After the demolition of the vegetable oil plant's chimney[51] (near BG), traces of a water reservoir were found at a depth of 2.1 meters

[51] The history and ordeals of the Győrsziget Oil Factory are summarized in the design tender written for its rescue (Horváth 2019). Its importance comes from being the city's and Hungary's first steam-powered oil plant, founded in 1851. It had many owners throughout history until the privatizations of the 1990s, which brought about its end. Production ceased, and the machines were sold. In 2002, the municipality imposed a ban on the area's alterations for implementing new utilization functions. Hotel construction, camping park, cultural center, many different plans were born. In 2007, the oil plant buildings were demolished, however, the development plans were abandoned due to the investment company's offshore affairs, and the property became bank-owned (#Gy06 Document). By 2012, homeless people had moved into the highly neglected area, and the former factory site was used by many as a landfill. Due to the European Youth Olympic Festival (EYOF) in 2017, condominiums were built on the site, first used as the Olympic village of EYOF. The factory did not disappear without a trace at that time. The owners left the colossal factory chimney (which functioned as a vast heat recovery reservoir) to be integral to the planned building complex. The factory chimney should have been given heritage protection because of its engineering and monumental value as a cityscape element. However, it never officially received this rating. The investor decided to demolish the chimney because they believed its preservation and maintenance would cause severe financial damage and risk (#Gy02 Respondent). Professionals and university professors nationwide petitioned to save the chimney, and a design contest was also announced in 2017 to allow investors to choose from a broader range of plans. In the end, the chimney was demolished in 2018, and one of the last mementos of Győr's industrial past was lost.

during soil mechanics investigations, presumably the remnants of the original Rábca aquifer. "So, from the dead Rábca, there is probably a water stream flowing to the Bercsényi grove to this day" (#Gy02 Respondent). Consequently, the constructions had to take care to avoid the veins of the 'ghost river.'

Although the rehabilitation program objectives did not consider specific climate adaptation functions, the grove provides such benefits. For example, the grove's shape allows for effective rainfall retention as the surface water flows into the deeper grove (Figure 20). Nevertheless, the primary consideration was keeping and enhancing the greenery (#Gy06 Respondent). Accordingly, the tree colony was partially regenerated, with additional tree and shrub planting, enhancing the grove's climatic benefits.

Figure 20. The two ends of the grove.

However, the financial support gave means to revitalize only half of the grove, which did not fully activate the park's potential to be(come) an eco-efficient green corridor (#Gy01,07 Respondents). Contiguous green spaces can have a beneficial climatic effect on urban environments when the area is relatively compact and covers at least 3-4 hectares, which is already achieved in the case of BG. Therefore, if the entire eight hectares of the grove were revitalized into a suitable, efficient green corridor, it could have more considerable effects

(#Gy01 Document). Moreover, strategic park areas and greening strips linking the waterfront with inner neighborhoods can also affect climate conditioning. This feature could be developed at BG due to its historical legacy. However, there are no plans yet for regenerating the grove's other part (Figure 21). As the local municipality sees it: "[the other half of the grove] is already a less densely populated part, and much more expansive. Beyond parking, there is now no function that would be worthwhile or necessary to embark on" (#Gy06 Respondent).

Figure 21. The "unused" parts of Bercsényi grove.

4.1.2. Kuopio park

Kuopio park is located in Adyváros district, approximately six kilometers from the city center. Adyváros ('Adytown,' named after Endre Ady, one of Hungary's greatest lyric poets) is a quickly developing part of Győr. In 2016 it was chosen as the country's favorite housing estate in an online competition launched by 24.hu (2016), a national news portal.

Adyváros was the first modern housing estate development in Győr, a product of the 'house-factories' during the communist era (Csapó, Kozma, and Lenner 2016). The neighborhood was developed between 1968 and 1979 when ten-story panel blocks were installed with four-story row houses (see Figure 22 on the next page). The development primarily served the housing needs of the worker class and immigrants settling in Győr to work at the industrial sites. The main consideration was to meet the quantitative demand, be quick and economical, and not provide quality housing (Józsa and Kulcsár 2014). Architects had to follow a specific program based on the town planning plan and the associated installation density, and the residential areas were designed with leisure, educational, and commercial facilities. For this reason, there are various service providers within the blocks, such as grocery shops, pet shops, post offices, locksmiths, stationer's shops, fashion stores, mechanics, bank kiosks, bakeries, flower shops, or bars - and most importantly - enclosed green spaces such as Kuopio park.

Figure 22. The Munkásőr street (today, Kodály Zoltán street) and the space of Kuopio park in 1972. Source: Kozma 2019.

However, due to generational development, the area is now one of the most densely populated parts of the city[52]. Consequently, parking problems became the most urgent issue because the residential car fleet has grown over the decades to the extent that the district can no longer serve

[52] The population at the last census was approximately 17,500 people (HCSO 2012).

properly. This issue significantly affected Kuopio park's development course, as detailed below.

Kuopio park (hereinafter shortened as KP) is enclosed between ten-story housing blocks in Adyváros. It got its name to honor Kuopio, a small Finnish town that became the twin town of Győr in 1978. The trees were planted during the 1960s simultaneously with the housing estate development, and they are now fully grown, forming a valuable green area (Figure 23). Although the site is relatively small, approximately 1.8 hectares, its intrinsic values for the neighborhood's well-being are recognized as a green buffer zone among buildings (#Gy04 Respondent).

Figure 23. View of Kuopio park made with Google Earth. Prepared by the author.

The park has been undergoing continuous, phased renovation since 2013. Part of its area gradually got updated with new amenities. Small-scale and low-cost developments happened almost yearly. For example, the water fountain was renewed, tree plantings and lawn renewals took place, and several amenities were installed, such as benches, drinking wells, a bike-sharing station, a book-sharing point, and a public art piece (see details in Appendix C). However, these revitalization projects lacked an integrated approach and social engagement practices, without which placemaking cannot achieve the desired activating effects, even if there are otherwise dedicated, regular space maintenance works. Moreover, these measures did not address the ingrained parking problems accumulated over the decades. Consequently, when a larger-scale strategic, transformative intervention was projected to relieve the growing parking tensions at the cost of the park's tree colony, even the locals agreed, indicating a lack of recognition and an absent or lost 'sense of place.'

The justification behind utilizing half of the park for parking was that the regular developments concentrated only on half of the park. The other half, containing the large, shady trees, remained neglected (Figure 24).

Figure 24. Deteriorating street furniture in the grove of Kuopio park.

Although this allowed the trees to grow undisturbedly, the deteriorating stage of the park led to emerging negative stereotypes, portraying a place for drunkards and junkies. Details from a group conversation support this claim (#Gy11 Respondents):

> I have fantastic childhood experiences from the 1990s. We lived about 1.5 minutes away from KP; we used to go to the playground. Then, later when I was in high school, its condition deteriorated significantly. Whereas in the

> center of all the panel blocks, that part should be kept in a much better shape because otherwise, it would be very much helpful.
>
> There is money for novelties ... But it is never allocated for maintenance, to keep the whole park and the existing things in order. A green area is only good if it is kept in order. No one cares about it.

In this half of the park, all that changed since the housing estate construction is that the trees developed fully, and the south side of Kuopio park became a small, dense grove between the buildings (Figure 25). The trees contain wild plum species and almond trees (#Gy04 Respondent; #9,10 Gy observations). Currently, eroded desire paths[53] cross through the park's woody part, which is also a designated dog litter area. This part has not received any attention during previous renovation works. Only a mud collector pit for swallows was placed.[54]

Figure 25. Shady trees on hot summer days in Kuopio park.

The grove side, although not tidy, is of great value, as such densely grown, mature groups of trees are rare in the urban environments of Győr. However, the protection of these values should be communicated more clearly to a larger audience (Arrabona Városvédő Egyesület 2016) to show that it could potentially be a refreshing, lively ‘central park’ of the housing estate with a designated rehabilitation area, providing space for sports, leisure, and recreation (#Gy10

[53] Path spontaneously formed due to the erosion caused by human or animal traffic.
[54] gyor.hu (2020)

Document). In contrast, the local municipality instead wanted to use this area of KP to offer a solution to alleviate the area's parking tension by installing a one-story open structure parking plate, indicating a lack of priority for the already existing NBS (#Gy03,04,06 Respondents).

The parking situation is indeed problematic around the neighborhood (Figure 26). Today, the streets enclosing the park are service streets in a traffic-reduced parking area with a significant surface parking capacity. Simultaneously, the transient traffic looking for a parking space is considerable, and the current set-up cannot manage all parking needs (#Gy05,07,10 Documents; #Gy05,6,7,11 Respondents).

Figure 26. Kuopio park: a little grove between the buildings.

The seriousness of the parking problems is also indicated by the fact that locals did not oppose the proposal. However, while the need to tackle the district's parking problems was widely acknowledged, there was no preliminary needs assessment or research. A social dialogue took place only regarding the finished plans. The critiques were manifold on a professional level, starting from being an inefficient and unreasonably costly solution[55] (#Gy05 Respondent).

[55] The establishment of the Kuopio parking plate (for 156 new parking spaces) was planned as an investment of close to HUF 750 million (~2.3 million EUR), to be financed by the local government of Győr from its resources. A parking plate was also set to be built next to the Petz Hospital near Kuopio Park to provide about 300 new parking spaces. A sum of 441 million HUF (~1.3 million EUR) was allocated, supported by national funds. The

Moreover, as summarized in the Arrabona Local Patriot Organization's study (2016), the planned construction would have destroyed the existing, precious green space, thereby seriously damaging the delicate ecological balance that ensures clean air. Ultimately, it would have been detrimental to the resident's quality of life. The project was meant to amend the loss of green area by installing a public park on top of the parking plate, with bushes and smaller pre-grown trees (#Gy03 Respondent). Nevertheless, this would have been a weak attempt to account for the ecological loss.

Nevertheless, the project design arrived in the final design stage and even received a building permit when the municipality finally changed its approach due to the economic burden (#Gy06 Respondent). The city's road management organization was commissioned to target the root problem and develop an integrated traffic environment with a parking scheme. They presented a new plan that completes the task of increasing parking capacity while preserving the park and utilizing the space's potential to create a quality public place, reflecting not only the car owners' needs but those of the larger community (#Gy10 Document). Thus, KP remains mainly in its current form. However, its case illustrates how easily green space functions can be sacrificed to solve other problems.

4.1.3. School gardens of Győr

Generally, school gardens are cultivated for education and recreation purposes. Through regular, curated, and interpretive activities, these gardens are cared for by a community of children (mostly kindergarten and primary school). School gardens as individual sites are relatively small interventions, especially compared to the other cases included in this thesis. For this reason, the 'School gardens of Győr' case is built on the combined findings from three sites

two parking plates presented the most expensive development plan in the history of Adyváros since the construction of the panel blocks, costing 1.2 billion HUF (~3.6 million EUR).

to present a wide variety of methods and practices relevant to the design of these types of NBS. The three sites are:

- 'Apáczai' garden of the Széchenyi István University's Apáczai Csere János Faculty: 'practice garden' used in the teacher training program;
- 'Öveges' garden of the Öveges Kálmán Elementary School: 430 children aged 6 to 14 (#Gy13 Document);
- 'Tulipános' garden of the Tulipános Elementary School: 520 children aged 6 to 14 (#Gy12 Document).

Teacher training in Győr has a long tradition of involving school gardens in the education program. They appeared first in the late 18th century as a new subject (#Gy11 Document). School gardening grew from the practical guidance of agriculture and horticulture, which was taught with 'practice gardens.' Many school gardens were built at this time, and the school garden movement reached its peak between the two world wars. Thus, in connection with the teacher training founded in Győr (as second in Hungary), in 1884, there was already a school garden in the main yard of the Teacher Training College (Széchenyi István University, Apáczai Csere János Faculty) (Halbritter 2016a). Students cared for an orchard, vegetable, and rose garden. In addition, they kept bees and chickens and even tried silkworm breeding. However, school garden activities gradually declined after World War II and eventually ceased to exist, first due to the severe bombings of the city during the war. Additionally, the communist dictatorship's efforts to put the peasantry in a dependent position contributed to this situation. Finally, the intensification and mechanization of agriculture resulted in declining demand for agricultural and horticultural work (ibid).

The revival of the Győr school gardens was brought about by the movement of environmental education that unfolded after the regime change in 1989. Within this context, the Apáczai Csere János Faculty has become an important educational and methodological center for forest pedagogy. Restarting the Faculty's pre-war school garden was among the long-term plans, accelerated by a 2012 study trip to Cuba (ibid). The study group saw firsthand how urban horticulture and school gardens played an essential part in overcoming the nation's food crisis. Thus, in the spring of 2013, they dug up a small patch in the College's courtyard (at the former school garden, later used as a parking lot) to be used as a school garden again (Halbritter 2016b). Since then, school gardening has become part of teacher training again. Students (who are, in a sense, future teachers) help to create new gardens and explore further possibilities through research and networking.

School gardens are typically kickstarted by tactical placemaking processes, building on 'lighter, quicker, cheaper' (LQC) practices (PPS 2015), prioritizing use over design and capital-heavy investments to utilize the community's creative energy. Guided by an adaptive management approach, such 'light development' strategies can help cope with uncertainties, catalyze learning processes and apply iterative improvements. In the studied **School gardens of Győr,** the gardens' realization was a joint effort of interested teachers, students, and parents who established them despite a lack of resources[56]. Moreover, the Apáczai teaching garden is built and operated deliberately at minimum costs to show that it is possible to manage a lush and engaging garden environment with almost no financial resources (#Gy08 Respondent; #1 School gardens guided tour). The teaching garden's design demonstrates using recycled materials and handcrafted solutions to compensate for the required construction materials, harvest seeds for the next growth cycle, and compost green materials to gain soil. Additionally, as the gardens grow, teachers, parents, and the whole student body develop the garden spaces with donations of plants and tools (#Gy09,10 Respondents).

The reinstalled school-gardening training had a catalytic role in building a local community of school garden enthusiasts and institutionalizing school gardens on the national scale (#Gy08,9,10 Respondents). Strategic interventions and greater organizational efforts followed

[56] Even a 200 EUR sum to kickstart the operation of a school garden is a struggle to allocate for many schools (#Gy08 Respondent).

the success of the community-initiated projects. With the establishment of the Iskolakertekért Alapítvány (‘Foundation for Hungarian School Gardens’, hereinafter referred to as IKA) in 2015, the national school garden movement experienced a boom. School gardens were established in more than 1100 educational institutions in Hungary, with more than fifty percent of which in the last ten years (Figure 27).

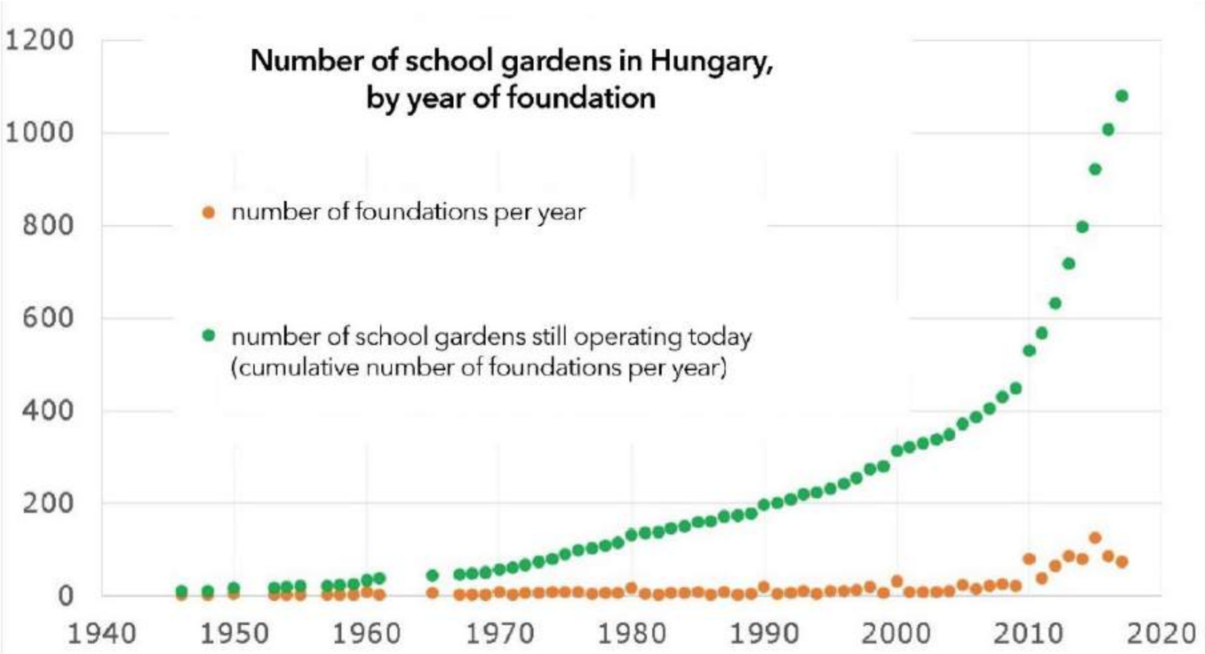

Figure 27. Number of school gardens in Hungary, by year of foundation. Source: iskolakertekert.hu

IKA's mission is to support starting new school gardens and ensure knowledge transfer and the spread of good practices nationwide and across Hungarian-inhabited areas abroad (#Gy08 Respondent). Furthermore, IKA facilitates cross-scale linkages connecting schools to public and private bodies for funds and donations. Most importantly, IKA brought together the national school garden development program in collaboration with the Ministry of Agriculture. The program secures financial support for 'beginner' and 'advanced' gardens (#Gy14 Document), thus significantly contributing to the viability and feasibility of the movement. The funds can be used to open new gardens and develop existing ones. For example, the Tulipános School gradually expanded its garden territory with the help of funds. Consequently, they engaged more participants in garden-related topics and activities, such as renovating larger parts of the yard with an ecological approach, planting trees, and caring for insects, birds, and other small animals as part of school gardening activities (#Gy10 Respondent).

The school gardens of Győr are mainly used in afternoon study group activities, with groups of 15-20 kids (#Gy09,10 Respondents). Garden leaders also encourage other colleagues to use the garden for interdisciplinary lessons in environmental, biology, or physics classes. However, integrating these activities into the specific subject curriculum is not established yet (#Gy09 Respondent). In the case of the Apáczai trainer garden, groups of college students use the garden with groups of kids participating from the surrounding schools.

When the schools started the gardening activities, the success was immediate. In general, it was reported that the outdoor classroom and the hands-on tasks turned all kids into active participants in the learning process (#Gy09,10 Respondents). However, it affected most impressively the real mischievous kids who were challenging to manage during the lessons. They were actively engaged during the gardening and became the most enthusiastic participants. Additionally, as expressed by #Gy10 Respondent, “parents like kids to chirp outside, rather than sitting in the daycare and pressing their phone. But even the 8^{th}-grade kids, as the weather gets good, they come over and help by themselves”. As #Gy08 Respondent explains, school gardens' main benefit is that they "teach for life."

Experts and scholars agree that school gardening helps with learning and teaches about work and responsibility, planning and regularity, adaptation, and collaboration (Pettifer 2019; Maller 2009). In addition, it helps develop cooperation, problem-solving skills, spatial vision, and perseverance. Therefore, children are involved in the garden's design, implementation, and maintenance tasks which are also part of the educational practices related to school gardens and can be seen as a form of creative placemaking activities. For example, they repeatedly build parts of the garden and other artifacts such as bird feeders or insect hotels.

> They get small educational booklets, including what and how to do, what grows well with other plants, etc. Then they get a bed, for example, two-three kids together. They decide what to go for (and, of course, based on what seeds we have). They have autonomy in that... And if they make mistakes, they can learn from them. We also try to teach them how to make the garden beds straight and orderly, developing their fine motor skills (#Gy09 Respondent).

Respectively, school gardening sensitizes kids to respect and appreciate nature and its connections to health and wellbeing. Children get to know several plants and beetles and learn to use tools (Figure 28). They get to know the processes in nature, the natural cycle, composting, and humus formation.

Figure 28. Schoolkids tending the garden of the Tulipános School. Source: with permission from the Facebook page of the Tulipános School's eco group.

After a year or two, they begin to see the soil, the weather, flora, fauna, and people in a system. But, most importantly, they experience what it means to grow, care for edible plants, and see the fruits of their work:

> When the pumpkin seeds planted in May turned into actual pumpkins in the autumn, and they really hung there, they almost didn't believe it! Then we made a bird feeder from the pumpkin. They loved it. They also really like it when they can take anything home, crop or flower or whatever (except for green tomatoes, that didn't work out, it's not for kid's taste), but they fought for tomatoes (#Gy09 Respondent).

In general, undemanding, resilient crops are used in gardens, as most children are novice gardeners, and the experience of success is essential. Radish, lettuce, beans, peas, onions, and flowers (sunflowers, tulips) are planted strictly from organic sources. Students also learn about soil and food health and food safety. School gardens are sometimes used to produce yields for trade or promote agricultural careers (#Gy08 Respondent; #3 School Garden Basics Subprogram). Most importantly, their actual impact is in awareness-raising and education, reaching over the schools: more and more kids' families compost at home, and children bring plants on their own to plant in the garden or take them home to continue the activities (#Gy09 Respondent).

4.2. Milan cases

Milan is the second-largest Italian city by population, and as the 'Italian economic capital,' it is the country's most important financial market (see Figure 29 on the next page). Situated in northern Italy, it had a strategic position since Roman times. Political struggles between powerful families characterized Milan during the Middle Ages until the House of Sforza conquered the city and made Milan of the leading cities of the Italian Renaissance. At the unification of Italy in 1871, Milan was already the dominant commercial center of northern Italy, which position was stabilized after the post-World War II economic boom.

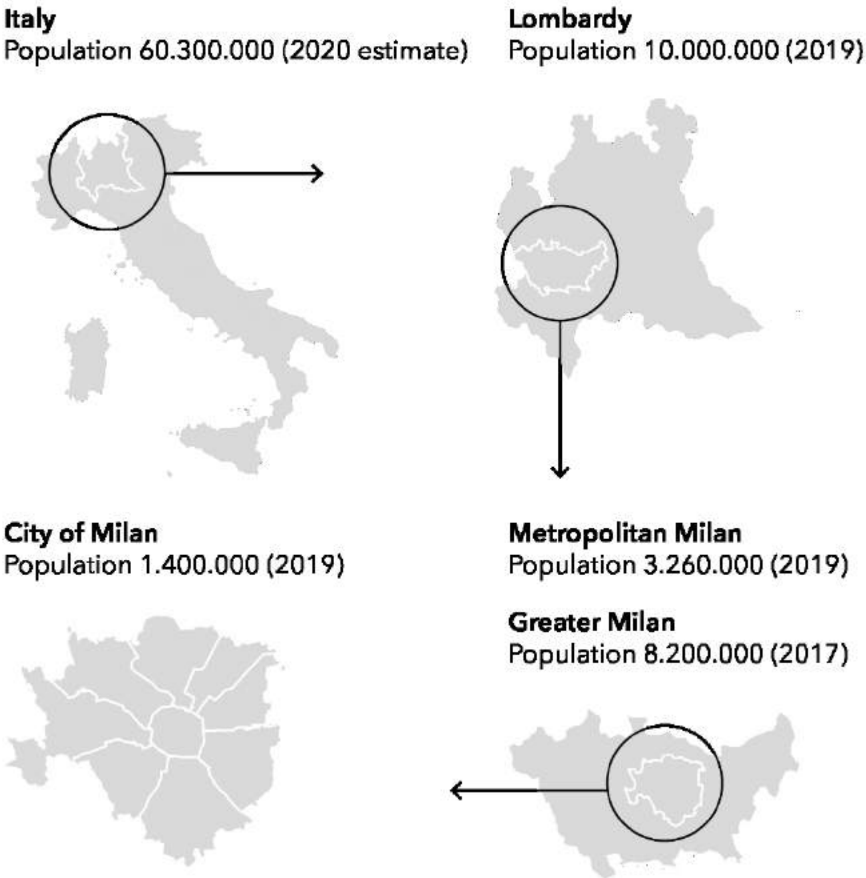

Figure 29. Contextualizing the City of Milan on a local, regional, and national scale. Prepared by the author.

The 1950s' heavy industrialization also established its role as the center for design and architecture and made Milan the 'capital miracle' (Foot 2001). However, significant environmental challenges followed the boom. Additionally, from the 1980s onwards, the city experienced a decline in textiles, automobile, and steel production, coupled with a loss of strategic coordination (due to nationwide political scandals connected to corruption and a financial crisis) (ibid). By the 1990s, the deindustrialization produced a progressive land-use change in the urban areas, leaving large territories abandoned and deteriorating and leaving the city with an enormous amount of industrial waste and unused railroad tracks on a territory summing up to 600 hectares (Galbraith 2007). Simultaneously, traffic and noise pollution and climate challenges (significant heat weaves in summer and acute flooding in winter) aggravate the city's livability and health issues (Johnson, Cattaneo, and Breil 2016). Air quality problems were intensified to an extreme level that made Milan (together with Turin and Brescia) the second most smoggy city in Europe in 2008 (ISTAT 2010, EEA 2019), also worsened by the city's geographic location[57].

Still, Milan today is a city with vibrant and improved urban life (Legambiente 2018), catalyzed by several large architectural and urbanist projects realized since the early 2000s. This renewal of Milan, 'il nuovo rinascimento' is seen to be connected to the hosting of the Expo 2015 world fair (Bergaglio 2019, #3 ICON Design Talks, #M01,02,06 Respondents), which the city took as an opportunity to realize a series of strategic urban redevelopment projects and investment in service-related revenue sources including tourism, logistics, transport, fashion design, finance and banking (#M12 Document). Moreover, to address livability issues, the latest changes to Milan's territorial plan for 2030 set urban greening as one of its top priorities. The city committed to endorsing large-scale re-urbanization projects with a high emphasis on greening and environmental sustainability (Boros and Mahmoud 2021). Another main factor was to elevate the vision of Milan as an international and European smart capital, a center for design, art, and cultural events (CM 2018b).

The three Milan cases are all situated around the city center. Bosco Verticale and the Biblioteca degli Alberi park are in the suburb of Porta Nuova, and Parco Portello is in Portello (see Figure 30 on the next page). Therefore, the subsequent Section 4.2.1 details the key contextual information of Porta Nuova and the Biblioteca degli Alberi park, followed by the assessment of Bosco Verticale in Section 4.2.2. In Section 4.2.3, I present the regeneration background of Portello district and the case of Parco Portello. Tables 24-26 in Appendix C provide the baseline data of the cases.

[57] Because of the position of the Alps, the city gets very little wind, the air stagnates, and not only the pollutants get blocked but the urban heat as well. As a result, the city is warmer with six Celsius degrees at night than in the outer areas, and yearly it can end up in 35 tropical nights (#M07 Document).

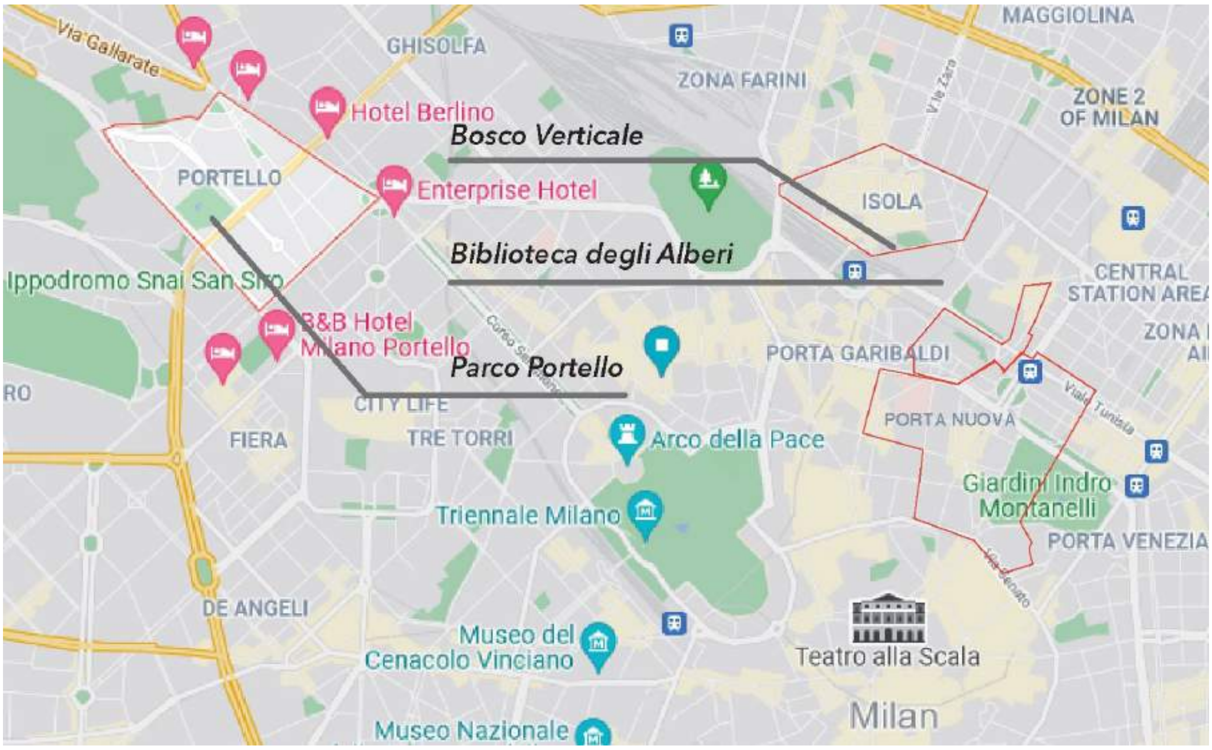

Figure 30. Location of the cases within Milan. Prepared by the author.

4.2.1. Biblioteca degli Alberi di Milano (BAM)

The Porta Nuova[58] area underwent the most extensive mixed-use urban regeneration process in Milan (and Europe) between 2005 and 2017. The 300,000 square meters regeneration project was guided primarily by urban greening and sustainability goals, with an investment totaling more than two billion EUR (#M04,25 Documents). It is represented by two flagship projects: Biblioteca degli Alberi park (detailed in this Section) and Bosco Verticale by Stefano Boeri Studio (described in Section 4.2.2). Porta Nuova means 'New Gate,' and it was born from the complete regeneration and merging of three suburbs: the Porta Garibaldi train station and its surroundings (see Figure 31 on the next page), Varesine's former station and railyard, and the working-class residential neighborhood, Isola.

[58] Previously, the Porta Nuova regeneration area was the Garibaldi-Repubblica area. Porta Nuova used to refer to two historic city gates and an adjacent pre-existing neighborhood, all of which are outside the now-called Porta Nuova district.

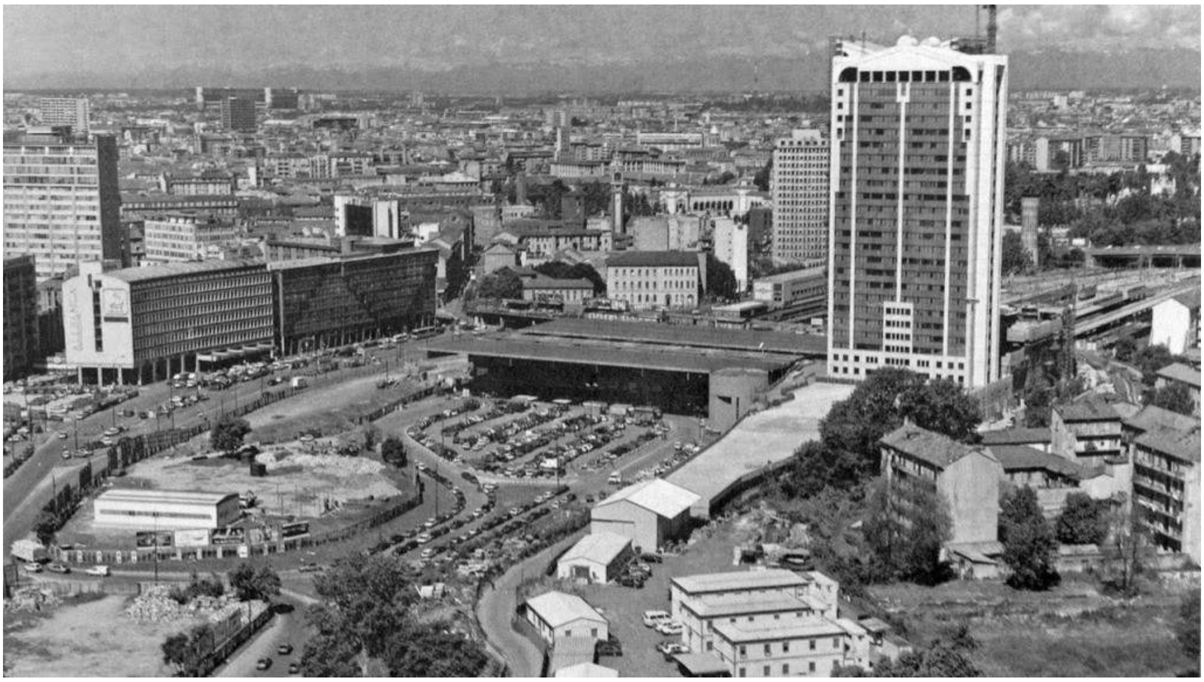

Figure 31. Garibaldi Repubblica in 1993. Source: Urbanfile 2014.

Isola had a particular role in the regeneration project. It sits in Milan's inner core, next to main transport hubs, only one and a half kilometers from the Milan Cathedral (#M04 Document). Its name means 'island,' as the former working-class and industrial part of the city used to be isolated from the rest of the city due to its location between railways and train stations. The area became derelict after the de-industrialization of Milan, experiencing decades of urban decay and poor connectivity (Bergaglio 2019). However, due to the unique profile and history of the place, it has been a point of interest both for public and private real estate developers.

Isola's gentrification started in the 1950s following the authorities' attempts to open up the area (Brizioli 2015). Several aborted development plans tried to develop a business district in and around Isola that locals resisted. However, the top-down pursuits generated a growing interest in real estate strategies in Isola and the surrounding areas (Brizioli et al. 2013). A partnership between the American real estate developer Hines and the Italian investor Catella (later COIMA) embraced the project in 1997. In 2003 they started acquiring properties from small landowners, and by 2005 they gained approval to start the developments through Hines Italia, their joint venture. Hines Italia became the Porta Nuova project's investor developer and was responsible for its long-term management. Locals resisted again, especially against the proposed demolition of the historic factory building and art incubator, Stecca degli artigiani, where Stefano Boeri's Bosco Verticale was planned to be built (Ferreri, Pesavento, and Theis 2012). Despite the opposition, the Stecca was demolished in 2007, and Hines proceeded with master planning the area. The partnership envisioned reconnecting the three parts of the city as a natural continuation of the existing neighborhoods and creating a business-residential district focusing on sustainable development. Boeri was commissioned to create the development's new master plan in coordination with Pelli Architects and Kohn Pedersen Fox Associates, to integrate the adjacent neighborhoods, rebranded as Porta Nuova Garibaldi, Porta Nuova Varesine, and Porta Nuova Isola. Numerous (altogether 25) Italian and international architects and urban specialists were involved in the works (#M04 Document). The synchronized developments transformed the urban quality of the area architecturally and socially as well (Figure 32): pedestrian areas were increased by 65%, cycling paths by 70%, and green areas by 40 % in the entire neighborhood (#M01,04 Document).

Figure 32. An aerial view of BAM shows the park's spatial structure, June 2018. Author: Volpi 2018.

However, the transformation has been critiqued for lack of concern for the surrounding, traditional Italian environment and ignoring the historical heritage of the site. Furthermore, the new, modern high rises are not seen to provide a formal cohesion and are invasive to the physical orography of the city (Arcidiacono and Piga 2008). Critical voices were raised against the modification of the urban skyline, changing Milan's identity, and leading to the 'manhattanization' of the city. In addition, the new developments were critiqued for their commercial appearance, reflecting the vision of private developers, transforming the area into an exclusive and expensive part of the city, primarily owned by foreign actors. Indeed, both visually and culturally, Porta Nuova exemplifies the vision of an international city, but in line with Milan's efforts to create a European smart city brand where eco-visons guide the city's development (Beretta 2018). Hence, the Porta Nuova area hosts Milan's most important international actors, cultural and retail centers, art galleries, and attractive open spaces, contributing significantly to the local economy. Eventually, the internationalization of Porta Nuova was extended to the highest level; since 2015, the 100 percent interest of the Porta Nuova developments (28 buildings) belongs to the Emir of Qatar's investment portfolio (Festa 2016; #M36 Document).

Nonetheless, Hines Italia continues to manage the investment funds, and the property and project management responsibilities of Porta Nuova stay with COIMA. Therefore, the project's continuity is ensured, and other planning processes can utilize the gained experiences. Additional developments are planned over more than 400,000 square meters, of which 20,000 square meters is public space. This will complete the district's redevelopment into an urban regeneration corridor that forms a continuous system with other projects, such as the Apertura Martesana ('Reopening the Milanese canals') (CM 2018a). The reconstruction of the city's historic canals will allow the waters of the Martesana canal to permeate throughout the city, from the peripheries to the center. This new development focuses on creating a green grid complemented with cycle routes to offer a renewed urban quality.

The Biblioteca degli Alberi di Milano (meaning the Library of Trees of Milan, hereinafter referred to as BAM) is a new urban park with a central position located within the Business Innovation district (Figure 33). It demonstrates a radical transformation of the urban quality of a former industrial site through environmental and socio-cultural benefits that a botanically rich park generates. Furthermore, due to its location, BAM plays a strategic role in reconnecting the entire Porta Nuova area and mitigating its environmental problems (such as heat, water run-off, and greening challenges), in line with the city's Resilience strategy.[59]

Figure 33. BAM at the junction of three neighborhoods. Source: #M04 Document.

With a dimension of 9.5 hectares, BAM became the third largest park in Milan after Sempione and Porta Venezia parks, even though BAM’s tree cover density is much lower compared to the two historic parks. At BAM, 22 circular forests group 500 trees and are complemented with another 135,000 plants, including over 100 different species of shrubs, hedges, creepers,

[59] The Urban Resilience strategy of Milan put in place a mechanism of planting three million trees in Milan to boost the implementation of urban greening measures in dense contexts such as Porta Nuova (#M13 Document).

climbing plants, aquatic and ornamental plants, aromatic plants, and flowers (#M19 Document). The gardens designed by Piet Oudolf, author of the New York High Line, known for his wild-looking gardens, occupy almost 20,000 square meters in spectacular compositions, alternating blooms of bright colors throughout the year (Figure 34). The park is rich in botanical diversity, flowery meadows, and aromatic plants contribute to an urban ecosystem that facilitates the workings of pollinating insects. Moreover, there are dedicated species to feed birds and other urban animals.

Figure 34. Views of Bosco Verticale and Biblioteca degli Alberi.

The 'Library of Trees' concept originated from a novel approach built on the traditions of a botanical garden. The winning concept of the 'Porta Nuova Gardens International Design Competition'[60] was proposed by a multidisciplinary team led by Petra Blaisse's Inside Outside design studio from Amsterdam (#M20 Document). The design concept addressed the recovery and functional redevelopment of the Garibaldi-Repubblica areas by creating the park as a new junction in the middle of the mixed-use development. It offered a novel park experience through creative ways of understanding the plants, herbs, and flowers in a city. The idea was to link the green area to the surrounding retail, fashion, cultural infrastructure, offices, and residential

[60] The competition was launched within the Integrated Intervention Program of the Municipality of Milan (PII program framework) in 2004.

areas, thus channeling activity and interaction to the park. Additionally, its innovative management model provides a point of interest. BAM is a public park managed entirely privately while accommodating a range of different public life activities.

The creation of BAM complemented the regeneration of Porta Nuova with green space development and provision of habitat for urban flora and fauna, thus ameliorating local biodiversity. In addition, economic co-benefits are gained from increased tourism, retail, and services traffic, paired with socio-cultural benefits attributed to the urban natural elements and the various participative programs (Boros and Mahmoud 2021). Furthermore, the presence of the **Bosco Verticale** towers exalts these trends, although not by directly available public functions, but through the hybrid design's unprecedented – and unexpected (#M01 Respondent) – success and attraction. The towers stand at the edge of BAM and are visited by flocks of tourists as one of the top tourist destinations in Milan (Figure 35).

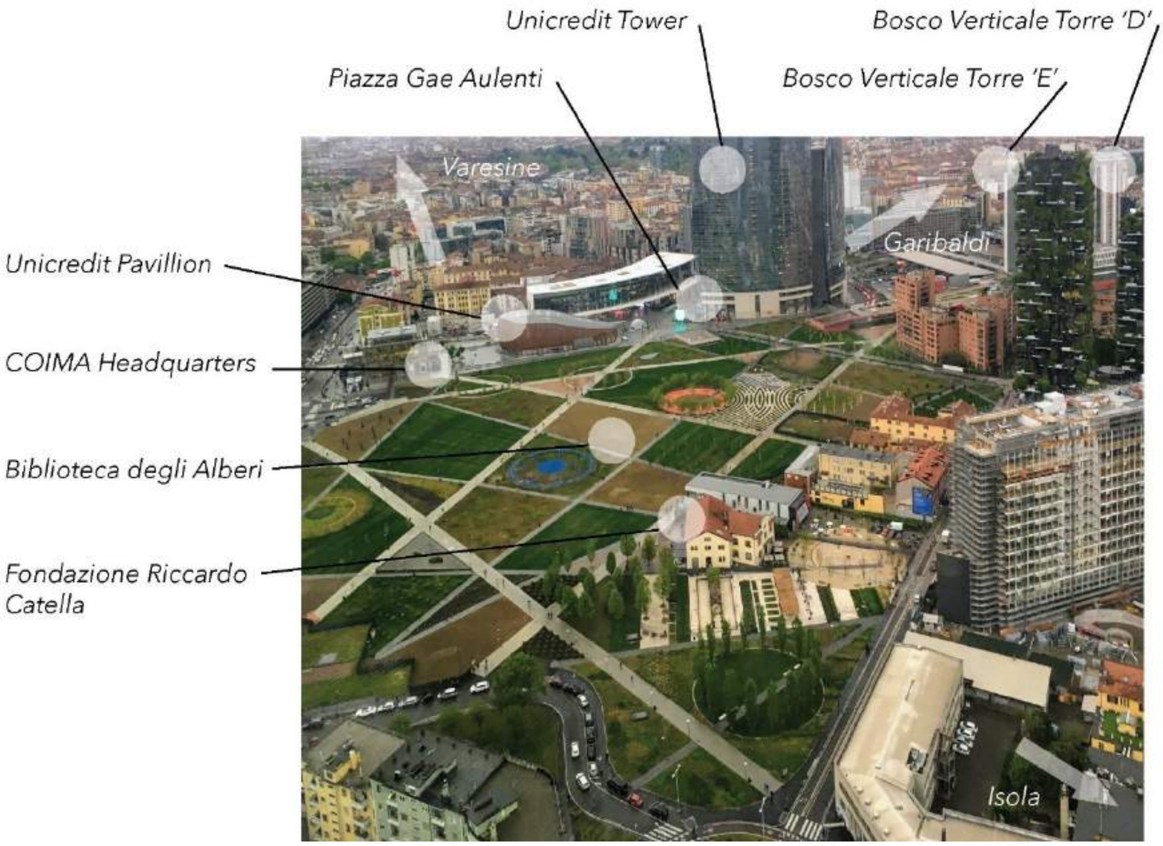

Figure 35. Aerial view of BAM shows the spatial structure and the pathways. Prepared by the author.

BAM's integrative role in Porta Nuova's buzzing urban economic system might seem contradictory. Certainly, the development's economic drive is clear, as #M06 Respondent expresses: "it is an investment… those investments end up creating long term value, not only for your investors but for all stakeholders". However, above all, BAM is a public park with prioritized social functions and connectivity aspects and a dedicated function to accommodate a range of different public life programs and activities, inviting people to participate. The park hosts a series of cultural and recreational programs through the intentional use of designed green patches while inviting people to reconnect with nature. The role of the programming is to provide sources for the financial sustainability for the park's care and management, which is significant, 4 to 10 times higher than of 'regular' parks (Traldi 2018).

BAM's community engagement programs are managed by the Fondazione Riccardo Catella[61] as part of COIMA's Porta Nuova Smart Community program. Before the developments, the Fondazione used a 'listening process,' a series of meetings to learn about the neighborhood's daily life, needs, and wishes and inform and involve citizens in the planned urban interventions (#M04 Document; #M06 Respondent). Through the management of various civic and cultural programs, they have contributed to improving the area even before the start of the regeneration project. However, Brizioli et al. (2013) have argued that their activities were directed as part of the developer's propaganda center to push through with the development plans.

Nevertheless, BAM has an unusual number of social programs and events (detailed in Chapter five), directing significant activity and interaction to the park and further amplifying the economic co-benefits gained from increased tourism and retail and services traffic generated

[61]The Fondazione Riccardo Catella is COIMA's foundation (the investor and developer behind the Porta Nuova regeneration project). The Fondazione was established in 2007 to study and promote best practices in territorial development, to integrate art, activities, and public spaces (#M04 Document). It manages the cultural and community programs as part of COIMA's Porta Nuova Smart Community program, and since 2019, it is also responsible for the park's maintenance (#M19,31 Document).

by the development. This strategic approach is complemented by various creative placemaking actions involving the locals. For example, in 2017, the Municipality of Milan and the Fondazione launched a competition for citizens to send aphorisms, sentences, and short poems dedicated to trees (see examples in the box below). More than 500 people participated, and the selected sentences, together with the author's names, are now applied on the paths of BAM with printed stainless-steel sheets.

> Always on the move, always in the race against time. In the park suddenly, you slow down with a hint of a smile. Marina, 46 years old
>
> The trees in the city are beautiful and look like castles; their shadows make me invent and together we continue to play. Viola, 7 years old
>
> *Translated verses from Biblioteca degli Alberi park, used as illustrations on the pavement.*

In another example, residents and tourists participated in the activities connected to Agnes Denes land artist's large-scale art endeavor to recreate her famous 'Wheatfield' installation at BAM (Senda 2015). People took part in the sowing and harvesting at the giant wheat field, and they could even take the produce home (see more details in Chapter five, Section 5.2.2).

4.2.2. Bosco Verticale

> Greetings to the maple trees, to the olives, to the ferns, to the evergreen shrubs and to the carnations growing to hundreds in its sky.
>
> Greetings to the tomtits and swallows that nest on its branches.
>
> Greetings to the thousands of ladybugs that eat the mites and to the mites that are likely to be eaten by thousands of ladybugs.
>
> Greetings to 480 people who live and dream in the sky woods of Milan.
>
> Greetings to Milan hosting the first Vertical Forest ever and to all of us who smile passing by.
>
> *Happy birthday Bosco Verticale, poem by Stefano Boeri (#M35 Document)*

Designed by Stefano Boeri Studio (Stefano Boeri, Gianandrea Barreca, and Giovanni La Varra), Bosco Verticale ('Vertical Forest') is a pair of residential towers, one of the most discussed current architectural designs (hereinafter referred to as BV). BV represents "one of the most extensively green tall buildings ever realized" (Giacomello 2015, 12), the "world's first forested skyscraper" (Varrato 2017). The project was completed in 2014, one year before the 2015 World Expo held in Milan, as part of the Porta Nuova regeneration project. The towers are at the edge of Isola, overlooking the Giardino De Castillia gardens, a smaller neighborhood park connected to BAM.

Boeri's firm focuses on 'urban forestry,' creating forests and other green spaces within cities. The towers are considered a pilot project, used as prototypes of a model for a sustainable residential building used for metropolitan reforestation. The studio calls it "an environmental survival project for the contemporary city," part of a 'Vertical Foresting revolution,' to reshape the idea of how buildings can serve society (Figure 36) (#M30 Document).

Figure 36. Views of Bosco Verticale.

The towers are claimed to contribute to urban densification and regeneration simultaneously, merging the concept of vertical urban densification to save the land and promote contemporary sustainable living and urban biodiversity. Each tower equals a 50,000 square meters residential area in the form of detached houses, and the towers' surface equals 20,000 square meters of forest (Boeri and Insulza 2009). However, the sustainability aspects of such buildings were questioned by architecture enthusiasts and experts alike (Capps 2015; Seghetti 2019). As science journalist Tim De Chant wrote on his blog:

> In reality, trees on skyscrapers will likely be anything but sustainable… A skyscraper that's built to support trees will require more concrete, more steel, more of anything structural (De Chant 2013).

Indeed, trees can be planted without having buildings attached to them, and vice versa. Even though the towers are LEED Gold[62] certified buildings, ensuring a high level of sustainability achievements, the overall footprint and cost perspective, including lifecycle costs and maintenance, is not negligible. The infrastructure sustaining BV's urban forest presents a significant cost increase compared to traditional buildings management (or conventional tree care) (Giacomello and Valagussa 2015).

Others highlighted that while the idea looks good on paper, the trees would not develop as in their natural habitat because the concrete planters can only provide a limited biophysical environment for them. Additionally, critiques raised attention to the contrast between the design renderings and the actual first look of the towers. These concerns were answered once the project was finalized. Indeed, after the project's inauguration, the trees were relatively small (Kohlstedt 2016). However, looking at them after five years, in 2019, the trees look good and

[62] LEED (Leadership in Energy and Environmental Design) certification is a globally recognized ranking of sustainability achievement covering all building phases (including new construction, interior fit-outs, operations, maintenance, and core and shell).

healthy, and BV has a positively lush appearance (#1-3 Milan observations). Thus, this issue instead captures the complexity of evaluating design plans with natural elements.

Aside from the questionable sustainability aspects, the achievement of BV lies in its representative ability. Following Stefano Boeri's philosophy, the 'democracy of green,' BV is an urban design with new standards for humans and other species (#M02 Respondent; #3 ICON Design Talks). Humans, plants, birds, and animals are to coexist and share space in balance: "in a Vertical Forest, per each human there are 2 trees, 40 bushes, 8 shrubs, 30 birds and butterflies" (Kucherova and Narvaez 2018). The Bosco Verticale towers represent a new, hybrid typology of the high-rise building that has aesthetically and functionally integrated greenery with traditional construction materials. Consequently, they have been featured as one of the first real-world examples of functioning urban NBS by various research consortiums (for example, Oppla, NATURVATION, or ThinkNature).

This idea is further enhanced in the studio's Wonderwoods project in Utrecht, where 200 bird boxes are integrated into the building structure to balance the ratio of habitats for species (#M02 Respondent; #M34 Document). Wonderwoods is also more open socially compared to BV. It has publicly accessible functions, such as a rooftop garden and an educational hub. Another Vertical Forest prototype, the Trudo Tower in Eindhoven, goes even further: the whole building is dedicated to social housing. These variations show the studio's experimental approach to adapting the model to different settings by combining urban and natural elements. However, each project needs a unique design to respond to local biodiversity and social and economic requirements (#M02 Respondent).

Due to the hybrid design, significant ecological results can be associated with BV. The towers hold one of the most intensive living green facades, characterized by dense vegetation that on flat land would equal an area of 20,000 square meters of forest per tower, four hectares altogether (#M30 Document). The two residential towers are completely covered with more than 900 trees (each measuring three, six, or nine meters) and over 20,000 plants from a wide range of shrubs and floral plants, distributed on the facade according to sun exposure. The deciduous species include beeches, yellow acacias, oaks, maples, ash trees, evergreen species, ferns, and ivy. This amount of greenery provides multiple benefits on an urban scale for the wider urban community, and on a building scale, for the building's owners and users.

On the urban level, the buildings' greenery contributes to developing a microclimate, removes CO_2 and dust particles, and produces humidity and oxygen (#M01,02 Respondent). These are standard features of urban forests and pocket parks that have been demonstrated to apply to Milan's town center by an experimental campaign by Buffoni et al. (2013), supporting the productive potential of trees and green barriers such as shrubs and hedges in removing airborne particulate matter. Furthermore, as the green facades feature more than 100 different plant and 20 bird species, BV creates a hotspot for urban biodiversity, and the presence of trees improves residents′ urban environment and quality of life (Belcher et al. 2018),

On the building scale, the greenery improves internal air quality and energy efficiency, providing air filtration, noise reduction, and health benefits. Giacomello and Valagussa (2015) studied the first year's climatic impacts of BV's green design and found that the facade temperature is three degrees lower during summertime due to the vegetation's vaporization. Furthermore, the plants' contribution to heat loss reduction due to the micro-climate is approximately two degrees Celsius (Greenroofs.com 2019).

Apart from the environmental benefits, BV's most significant contribution is inspiring and challenging the industry to address the most pressing urban development challenges. The Porta Nuova project and the city of Milan have utilized BV's success, attractiveness, and visibility. It became a symbol of the area's regeneration and Milan's new green solutions, an effort that the city is trying to redefine itself.

The company continues to advance the model and research the scientific, technical, economic, and social aspects of its designs, further developing the approach to fit into different contexts (Kucherova and Narvaez 2018). The Tour des Cedres in Lausanne (Switzerland), the Nanjing Green Towers (China), and the towers developed for Antwerp (Belgium) or Treviso (Northern Italy) showcase different versions of the evolution of urban 'treescapers.' Boeri even applies the model to a different urban scale in a completely sustainable and smart 'forest city' idea, to be realized first in China, as the Shijiazhuang Forest city (#M17 Document).

4.2.3. Parco Portello

Located northwest, the Portello regeneration project is one of the most critical areas of Milan's urban transformation. It is a new neighborhood developed on 24 hectares to re-use the former industrial area that once housed the Alfa Romeo and Lancia factories between 1906 and 1986 (#M32 Document). The master planning of Portello started in 1998 when the factories were shut down, commissioned by the owners of the supermarket chain, Iper Montebello (#M10 Respondent).

However, the redevelopment of the area has an earlier, complex history because several architects were concerned with the health and livability of the outskirts. After World War II, an experiential urbanization project designed by architect Piero Bottoni was realized as the QT8 district, [63] currently neighboring Portello. The development of QT8 was part of the reconstruction of Milan after the War's destruction. A compact, linear system of street blocks was created with a grid of green spaces. Bottoni used the debris from the bombings and the

[63] The name QT8 is short for 'Quartiere Triennale 8', referring to the 8th edition of the Triennale di Milano design exhibition in 1947, where Bottoni's plan was designed.

ruins of the Spanish city walls to create an artificial hill with an overall area of 37 hectares (#M03 Document). Named after her wife, Monte Stella, also informally called Montagnetta di San Siro ('Little Mountain of San Siro'), it became one of the historical landmarks of Milan and provided means to include urban green areas for sports and recreation.

Portello's strategic position came from its potential to connect the urban periphery to the center and include the previously unused or separated areas in the economic and social flows of the city. The new masterplan was finished in 2001 by Studio Gino Valle Architetti Associati, with the involvement of other professionals to realize the single amenities and buildings of the master plan. Gino Zucchi and Guido Canali worked on residential homes. Valle studio made the shopping center and office buildings, and Guido Canali also designed the nursery school. Charles Jencks and Andreas Kipar of the LAND studio designed the green areas and plazas, among which the most prominent is Parco Portello.

The traditions of Milanese architectural models of the 1950s inspired the creators (Bergaglio 2019): different shapes and architectural traits were used to re-value spaces within the urban structure. The masterplan redefined the area's functions to separate them into four sub-areas (#M28 Document): one for residential use with large internal courtyards, green spaces, and walkways; one for commercial use, entirely pedestrianized, another for house offices, and a public park (Figure 37).

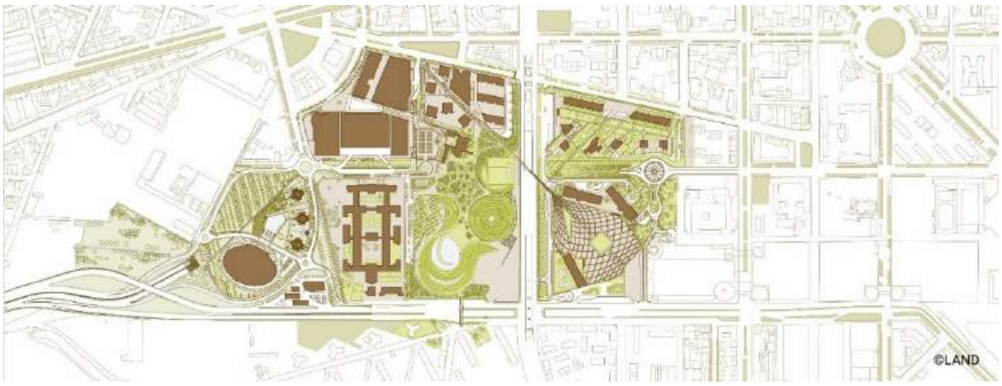

Figure 37. Portello masterplan. Source: LAND, 2005.

The architectural approach intended to free up spaces, make them accessible to the community and overturn the adverse effects of the proximity of the extensive road network. Thus, the Portello recovery has resulted in a low building index (0.7), especially compared to former practices, elevating the livability standards of the area due to the new pedestrian walkways and open spaces integrated into the historic district. However, severe construction delays held back the residential occupants from moving into the new buildings, aggravated by the economic crisis. Furthermore, other infrastructure plans, such as the one-kilometer-long underground tunnel development ordered to relieve traffic in the area, were questioned as the position of the neighborhood changed. Eventually, after eight years of construction and 106 million Euros spent (#M32 Document), the tunnel was finalized in 2014.

The transformation of the North-West area of Milan has been continued with the City Life project (Figure 38). A 36.6 hectares mixed-used development started in 2007, signed by top architects Zaha Hadid, Arata Isozaki, and Daniel Libeskind.

Figure 38. Map of Portello district and its neighbors.

However, these new developments created a dissonance of systems and scale around Portello (Bergaglio 2019). Portello is directly connected with City Life on its Southern borders, which became populated with contemporary towers and out-of-scale large infrastructure projects. At the same time, in the Western parts, its neighbor is QT8*,* with a compact, linear, and green-spaced grid.

The Parco Industria Alfa Romeo, or Parco Portello, is a public park occupying about seven hectares of the space where the Alfa Romeo factory once stood (Figure 39). The regeneration plan of the area placed the park in a strategic position. For almost a century, the massive factory was not visually or physically permeable to the citizens. Thus, demolishing the factory's walls opened the area both physically and perceptually (#M10 Respondent). Now it marks the access to the inner-city center, connecting, for example, people arriving in Milan from Malpensa airport or the Fieramilano exhibition center to the metropolitan system.

Figure 39. The site of Parco Portello in between the construction works. Source: PHOTO UP per IPER Montebello Spa, LAND, 2005.

In a broader context, the development of the park was part of the green space strategy Raggi Verdi ('Green Rays'), created in 2003 by Andreas Kipar's landscape architect studio, LAND (Landscape Architecture Nature Development) with AIM (Associazione Interessi Metropolitani). The green rays form a capillary system of open spaces that reach out from the dense city center towards the city's peri-urban territory, where abundant green spaces and recreational areas are available (#M24 Document). Therefore, the Green Rays project was set to activate existing brownfields, gardens, and parks strategically, and future new open spaces to be (re)built in the former industrial cityscape.

The strategy highlighted the embedded potential of neglected open spaces in creating a highly accessible open green system and contributing to slow mobility connections. Each of the eight 'rays' covers one of the city districts and Milan's radial urban structure and joins a proposed 72-km cycle ring and pedestrian mobility path in the outskirts (#M03 Document). In 2007 the strategy became the main Urban Green Plan, and in 2012 it was integrated into the Municipal 'Piano di governo del territorio' (PGT), the official urban plan of Milan. However, the strategy was only partially realized, as the 2012 PGT has been redeveloped, but Parco Portello was created along with ray number seven (#M10 Respondent).

Andreas Kipar, together with Charles Jencks, designed the park to establish links with the history of the place and reflect on the passing of time. Guided by Jencks' artistic practice, their narrative is expressed visually in a geometric system of circles, arcs, and half-moons used in the morphology of the park. Charles Jencks (1939 - 2019) was a renowned American cultural theorist and architectural historian[64]. He was originally an architect who switched to landscape design to become a leading figure in British landscape architecture. His landscape designs

[64] Jencks' most famous work is the Garden of Cosmic Speculation in Scotland. His design can be found across the United Kingdom, USA, Switzerland, China, South Korea.

belong to 'landform architecture,' where the designer uses the 'land' for architectural representation. Jencks' landscape work is characterized by hybrid landforms that mix sculpture and epigraphy, inspired by the universe, science, and nature (Figure 40) (Jencks 2011).

Figure 40. View of Parco Portello's landforms.

Jencks' sites are designed for symbolic exploration, contemplation, and 'slowing down.' As he expressed it:

> What is a green space, if not a place for slowness? The paths and symbolic forms that I create in my gardens are a way to allow people to relax in a green space (Charles Jencks quoted in de Molfetta, 2014).

In Parco Portello (hereinafter PP), three monumental landforms are positioned as green sculptures, helping people experience the designer's intentions. A system of circular lines, half-moons, and spirals defines the whole morphology of the site and the design of the main elements of the park. A system of paths called the 'Time Walk' guides the visitor across the park, offering the discovery of different views along the changing heights and from the top of the mounts (Figure 41). The green hills and the meadows alternate with gravel-paved areas, and blossoming tree groups are planted to mark the passing of the four seasons (#M24 Document).

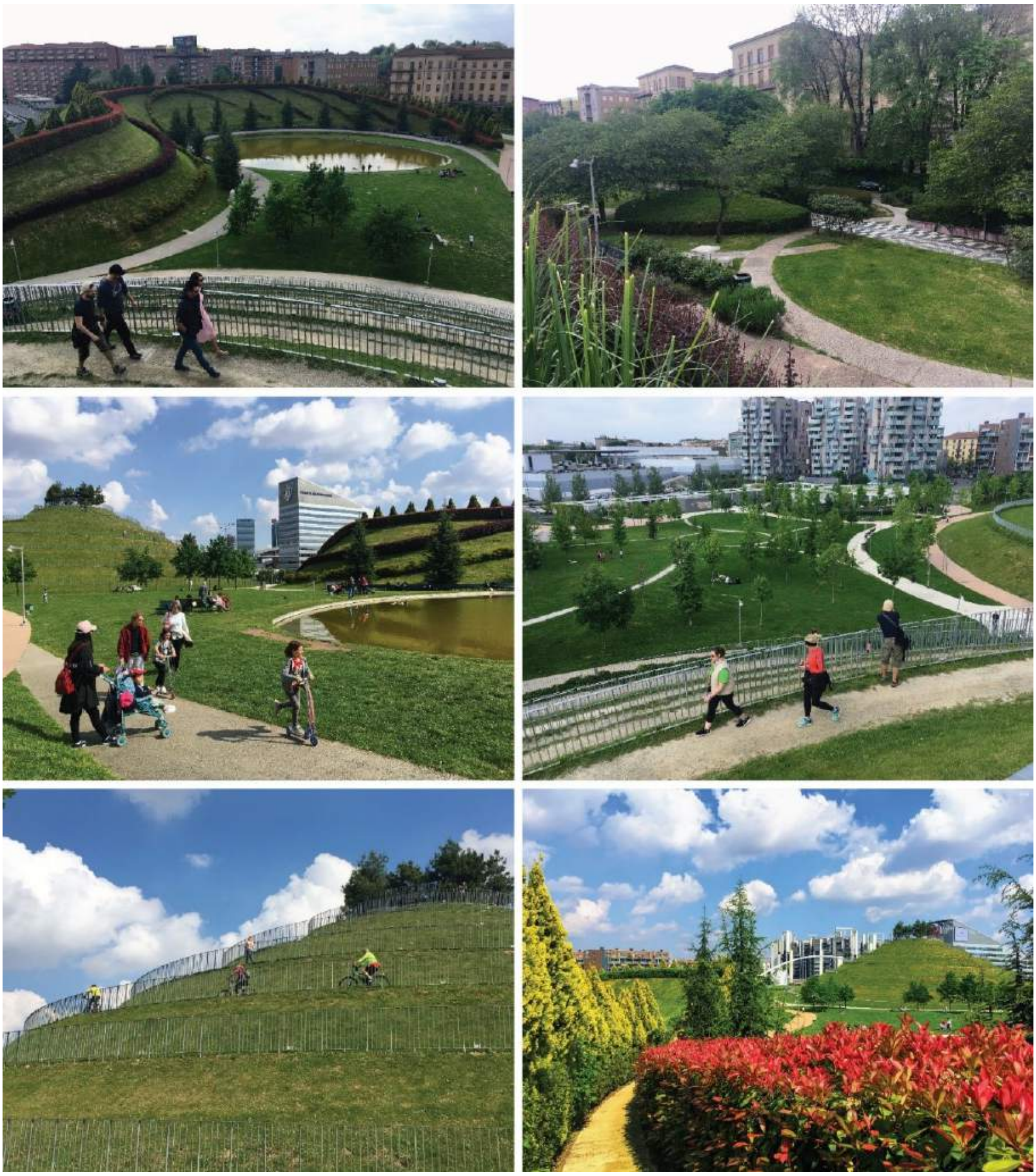

Figure 41. Details of Parco Portello.

The application of monumental landforms is PP's most spectacular design element. However, primarily, it was a strategic solution to solve the question of how to dispose of the materials coming from the construction of the new district. The chemically contaminated parts had been dislocated, but the excavated materials and the debris were used to create the three hills (after treating the soil for the new use in the park). As a result, the entire park is on a platform that is three meters higher in comparison to the street level. Furthermore, the size of the hills prevents the business of the city from entering the park. This way, PP is almost completely isolated from urban noises. It has an unusually calm and natural ambiance, while in fact, it is surrounded by high-speed roads (#4 Milan observation; #M10 Respondent).

> In the end, [the park] turned out to be an environmental device for the entire district… In this way, it was also an opportunity to create an urban oasis. If you stay in this park, it is very quiet, silent. And if you go on the bridges, you can see it is very loud because of the streets (#M10 Respondent).

Next to noise reduction, there are other important nature-based features in the park. For example, concrete was only used to build the surrounding wall around its territory. In the mounts, there is no concrete, only the reinforced soil. The park has impressive coverage of trees: 444 trees were planted, with 2,082 shrubs and 1,488 creepers, and 27,400 square meters are lawn areas. There are draining pavements employed for letting rainwater filter back to the ground. The small pond in the middle of PP uses a particular biological filter that does not require chemicals. The water is greenish yellowish, not blue, and is cleaned once a year (#M10 Respondent). Many species have different blossoms for enhancing biodiversity, providing a good asset for birds and insects. Among the most interesting plant species are maples, beeches, cedars of Lebanon, limes, oaks, tulip trees, and flowering cherry trees, blooming from November to March.

4.3. Melbourne cases

Melbourne is the second-most populous city in Australia and the state capital of Victoria (Figure 42). It is a commercial and financial center with a global port, situated between hot inland areas and the ocean. Before the British settlement in the 1830s, three aboriginal tribes[65] of the Kulin nation lived in the area of Victoria, with a population of around 20,000 (Presland 1994). The Wurundjeri occupied the Birrarung (Yarra River) Valley around the present location of Melbourne.

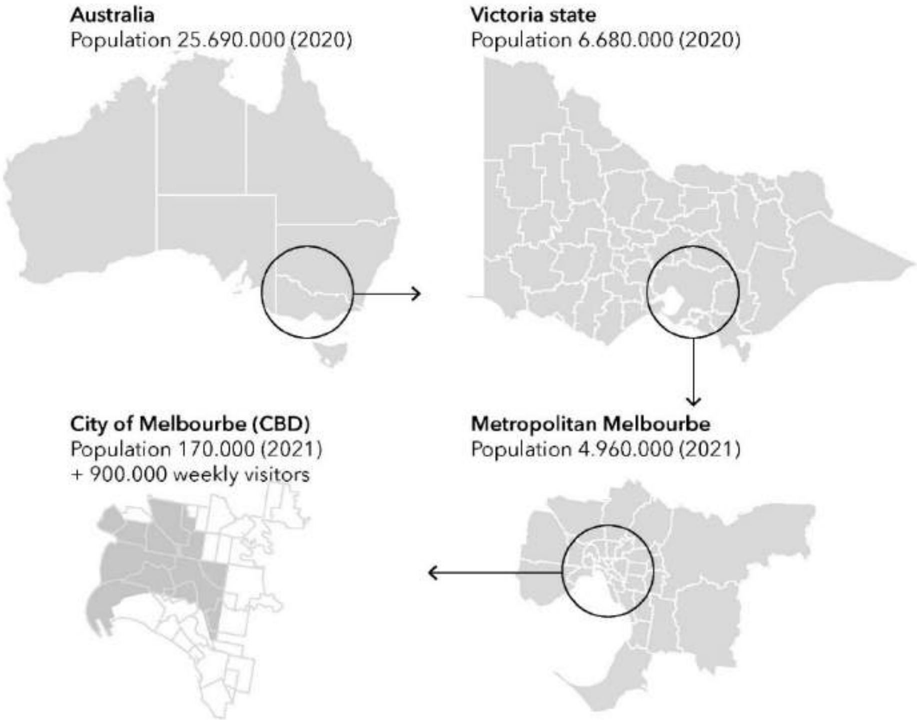

Figure 42. Contextualizing the City of Melbourne on a local, regional, and national scale. Prepared by the author.

The area was an important meeting, fishing, hunting, and cultivation place for the Kulin. Additionally, it provided a complex trading network for economic and social exchange among the different Aboriginal tribes. When the British colonizers arrived, the Wurundjeri allowed

[65] The Indigenous inhabitants of Victoria were the Woiwurrung, Boonwurrung, and Wathaurong of the Kulin people, an alliance of several language groups of Aboriginal Australians, whose ancestors had lived in the area for an estimated 31,000 to 40,000 years (Presland 1997).

temporary access to the resources of the lands, which the Brits interpreted as a symbolic act[66]. They became the 'landowners,' and the indigenous population was dispossessed, eventually forcibly resettled to reserves. Soon after, the settlement's rapid development boom was ignited when goldfields were discovered around the area. 'Marvellous Melbourne' was the destination for a vast influx of people. It became one of the largest cities in the world[67] (Blomkamp and Lewis 2019). However, housing was built outside the center, laying the base for the characteristic Australian suburban sprawl and future planning challenges. After World War II, Melbourne welcomed another influx of immigrants[68]. These inflows of cultures transformed the city's demographic profile and contributed to the multicultural character of its urban life.

However, the 1980s brought significant industrial and economic difficulties, and Melbourne declined. Additionally, the city's downtown was at risk of becoming empty due to suburban expansion, as development focused on the surrounding areas. Hence, the city's revitalization became the priority at state and municipal government levels. They implemented a set of interacting policy moves sustained for a considerable period to facilitate a consistent people-centric approach to urban planning, aiming to improve urban livability. Various 'soft' instruments, such as strategy documents, long-term plans, and a series of 'Places for People' strategies[69] were utilized to transform Melbourne's alleys, streets, and open spaces into places "designed and managed for people" (Gehl and Svarre 2013, 131). The consistent emphasis on good urban design was reinforced by the urban revitalization work of Rob Adams[70] at the City

[66] The exchange was recoded as Batman's treaty in 1835.
[67] Melbourne was Australia's largest city and was Australia's capital until 1927.
[68] After World War II, refugees arrived from eastern and central Europe, Italy, and Greece. The 1960s brought a wave of immigrants from Yugoslavia, Turkey, Hungary, and Lebanon. Lastly, significant Asian migration started in the 1970s. Additionally, a sizeable Muslim population settled.
[69] The revitalization efforts were realized through a long-term collaboration between the Danish architect and urban designer Jan Gehl and the CoM. As a result, streets were closed off to cars, bike paths were built, and public meeting spaces were created, contributing to a spectacular upgrade of public spaces that become known as 'the Melbourne Miracle' (Gehl and Svarre 2013).
[70] Rob Adams, architect, and urban designer is still currently the Director of City Design and Projects at the CoM. During his 35 years at the CoM, Adams was the leading figure of the revitalization of central Melbourne.

of Melbourne (CoM) since 1983 (and in 2019, he is still in his post). As a result of the interacting municipal and state government actions, since 1990, Melbourne's inner-city has been internationally acclaimed as one of the world's most 'liveable' cities. Moreover, Melbourne won this tile seven years consecutively, based on a rank of stability, healthcare, culture and environment, education, and infrastructure (EIU 2017).

Nevertheless, Melbourne's massive urban sprawl and population growth [71] still present significant issues, contributing to the City's sizeable urban footprint (one of the largest in the world). As a result, resource-use and carbon emissions continue to grow, just like the emissions per capita of Australia is one of the highest in the world (Le Quéré et al. 2017). Meanwhile, the heat-related human health and well-being risks constantly increase (Department of Climate Change, Australian Government 2009). Therefore, the CoM strives to improve the quantity, availability, and access to its urban nature in coordinated, strategic efforts to mitigate the effects of climate change and protect Australian wildlife habitat (Beatley and Newman 2013; CoM 2012; CoM 2017).

The three Melbourne cases are similarly in or close to the city center (see Figure 43 on the next page). Section 4.3.1 details the key contextual information of Parkville and the assessment of the NaturePlay playground. Section 4.3.2 presents the Docklands development and Medibank Place case, followed by introducing the East Brunswick suburb and the CERES case in Section 4.3.3. The baseline data of the cases are provided in Tables 27-29, Appendix C.

The City Design team at CoM won over 160 awards and delivered key policies such as the 'Postcode 3000' planning policy or the 'Urban Forest Strategy' (CoM 2012).

[71] The population growth forecasted in 2009 for 2031 is already close to reaching, fourteen years early and the municipality's residential population is expected to nearly double in the next 20 years (CoM 2017; CoM 2020).

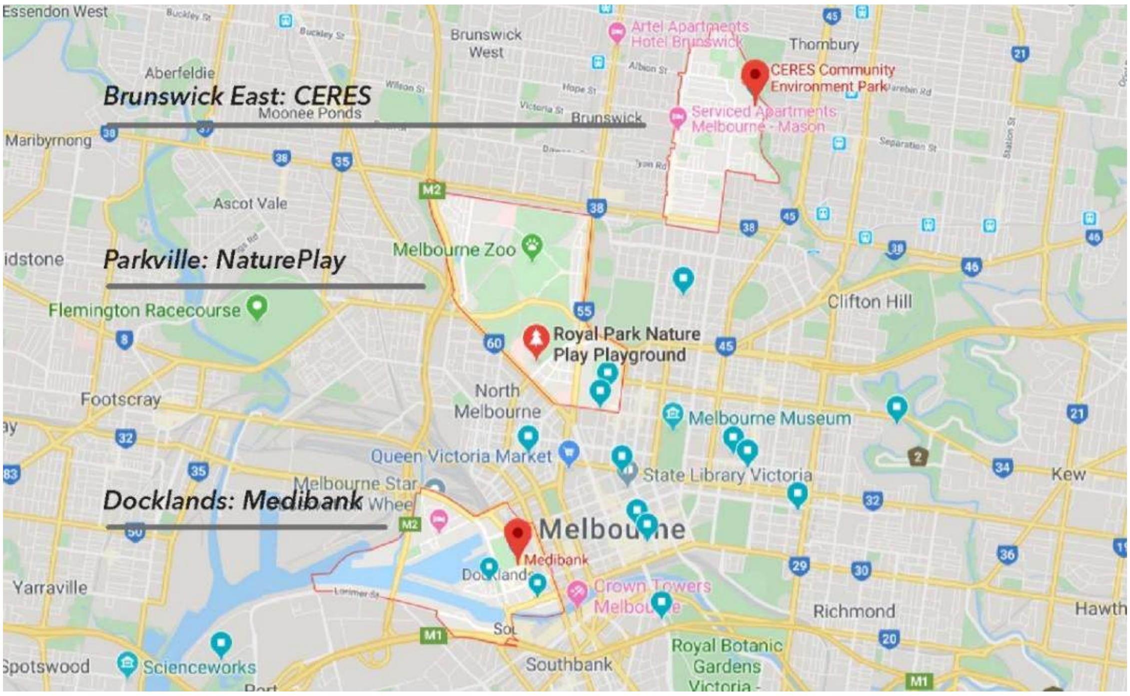

Figure 43. Location of the cases within Melbourne. Prepared by the author.

4.3.1. NaturePlay playground

In North Melbourne, Parkville is a peaceful, family-friendly inner-city, suburban neighborhood known for its wide, tree-lined boulevards and Victorian-era heritage houses (#Mlb28 Document). Parkville's most significant green space is the Royal Park, Melbourne's largest inner-city park, spreading 180 hectares. The Royal Park is also home to the Melbourne Zoo, sporting grounds (for example, the Royal Park Golf Course), and the recently developed NaturePlay playground. An extensive network of walking and bicycle tracks (and a tram line) encourages people to explore the wide native bushland with a view of Melbourne's Central Business District (CBD) skyscrapers in the background. The Park hosts valuable grassland and wetland areas, which provide a home to plenty of native plant and animal species. Furthermore, Parkville is home to many public institutions, schools, healthcare facilities, and university campuses.

Opened in 2015, the NaturePlay playground (hereinafter referred to as NP) is one of Australia's first public playgrounds that focuses solely on 'nature play.' The playground is a reinstated parkland located on a corner within the greater Royal Park, next to Melbourne's new Royal Children's Hospital. The new space also acts as a gateway for Royal Park, connecting inner-city children with nature, as the park is only three kilometers or a 15-minute tram ride from the CBD. It is a 'nature play' playground because it is the topography and landscape elements that provide play opportunities, not equipment (see Figure 44 and Figures 79-80 in Appendix C). Rock level changes, vantage points, the variation of open and enclosed spaces, planting, and materials to dig in are used (#Mlb04 Respondent).

Figure 44. Panoramic view of NaturePlay, with the city center in the background and the new hospital building on the right.

The 4.1 ha playground results from a partnership project between the CoM and the Victorian Department of Health and Human Services (#Mlb01 Document). In 2005, the Victorian State Government decided to relocate the Royal Children's Hospital into a new building in the previous one's immediate vicinity. Consequently, the parkland on the former hospital site had to be reinstated, but without any net loss of parkland, as it was set in the Royal Children's Hospital Land Act (#Mlb09 document). Keeping and rebuilding the park's integrity was a priority, so the playground blends seamlessly into the Royal Park's planting structure, and the parkland characters appear in the playground (see Figure 45 on the next page).

Figure 45. Children playing and exploring the playground.

The result is that rocky terraces, climbing ropes, and water games invite for play among the Royal Park's trees and grassland, encouraging 'kids of all ages' (explicitly indicated on the entrance board) to spend time outdoors, take risks and explore nature, thus experiencing unpredictable play. Additionally, the excavated excess soil from the construction was used to create a small hill next to the playground, offering dramatic views of the inner-city and other nature-based play, climbing, rolling, and exploring opportunities.

The positive results of involving the local community in the makings of places are presented in this case. These efforts concentrated primarily on establishing a genuinely welcoming place for all, transmitting its purpose and cultural heritage. The creation of the playground resulted from an extensive, one-year-long public and stakeholder engagement process that the designers used to learn about the community's opinions and ideas to shape the new development's high-level direction. Even the playground theme specification and the nature-based features were formed during this process. The local authorities conducted the community consultation actions in several phases, involving external consultants (I assess this process in detail in Chapter seven, Section 7.1). Finally, the design was finalized with the participation of several stakeholder groups such as children, Wurundjeri Elders, professionals from childcare centers, patients and staff of the Royal Children's Hospital, and specialists in child development. In the case of NP, utilizing the potentials of place are strongly connected to the broad and intensive public engagement throughout the playgrounds design and development process:

> In fact, one of the reasons this has been so successful was that we spent 12 months just on community engagement before we started any kind of design process. I am absolutely convinced that that was another part of the success of this project (#Mlb09 Respondent).

One of the results of this community-centered approach was that NP has features and spaces that invite and accommodate "children of all ages" (see the box below) and with different abilities, but more than that, it serves the whole community:

> We did not want other members of the public to not be using the play areas. And that has been one of the things that we have found has been incredibly successful with this is that people do not see it as a place for children. Actually, people see it as a park that they enjoy using. And so, you often see adults exercising there as well (#Mlb04 Respondent).

Womin-je-ka – Welcome to NaturePlay at Royal Park

This is a place for children of all ages to connect with nature and experience the unique qualities of the indigenous landscape of Melbourne.

This is a place to climb rocks and ropes, explore, create, climb trees and get dirty! Please respect the people, plants and animals in this very special place. Have fun!

Welcome message displayed on NaturePlay's wayfinding board

However, initially, not everyone supported the idea. Melburnians are passionate about Royal Park (#Mlb12,09,04 Respondents), and some argue to preserve the 'untouched' bushland and protect the integrity of the Royal Park. Moreover, the artificial hill was judged to be appalling: "it is very out of the landscape, it is not part of the topography" (#Mlb12 Respondent). Nevertheless, NP got built, and right after its opening, it won Australia's best playground award (#Mlb01 Document). Due to its planting diversity and natural, rambling quality, it is praised for its responsive design to the local heritage of the place, respecting the highly valued character of Royal Park, and its focus on multi-generational interaction, exercise, and connection with nature.

The playground space is rich in biodiversity: it has 1200 trees, 17,500 shrubs, tussocks, grasses, and climbers. The plant selection was driven to form plant communities that self-populate and to include various indigenous and native species, plants for educational and play opportunities, shade provision, and plant character/form/interest (#Mlb05,10 Respondents). As the aim was to re-create nature in the Australian landscape, the designers took inspiration from the seven Wurundjeri seasons of Melbourne, in accordance with Wurundjeri Elders, to reinforce cultural connections with the land and country and to encourage a more profound discovery of indigenous Melbourne (#Mlb05 Respondent).

This indigenous influence appears in the planting choices and the design of the play equipment (Figure 46). A particular area is dedicated to each season in the playground, with plant species and landscape elements that reflect the seasonal and cultural associations (#Mlb04 document).

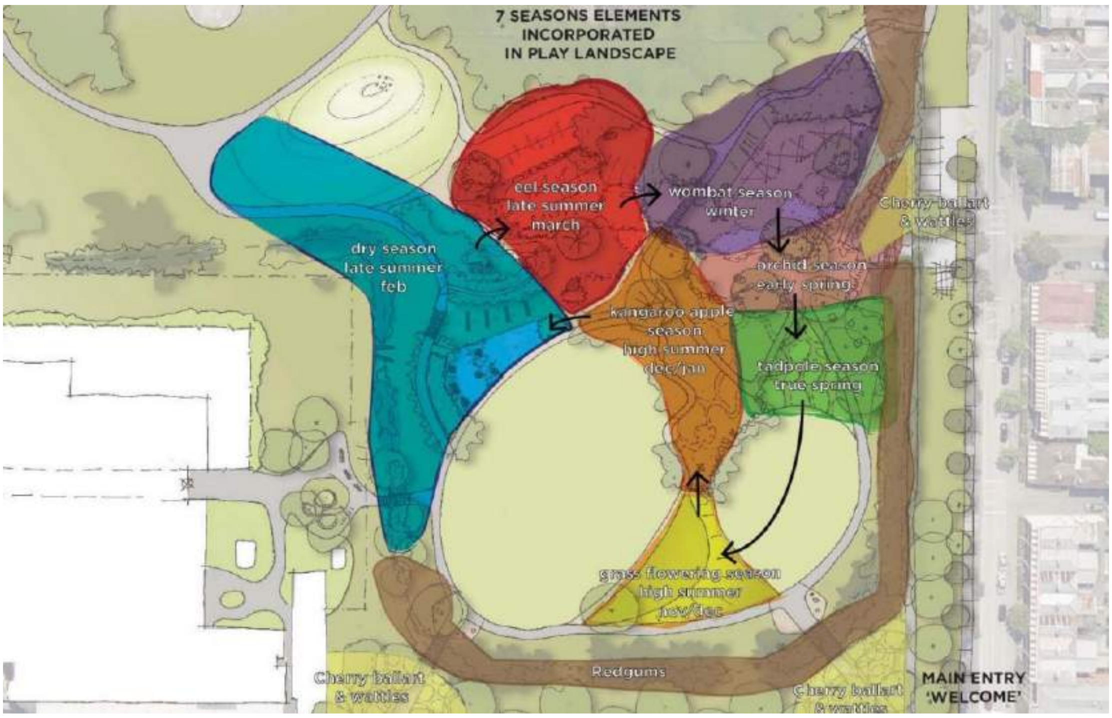

Figure 46. The seven seasons of indigenous Melbourne in the playground design. Source: #Mlb04 Document

For example, there are in-ground water fountains for Biderap, the late summer dry season, to celebrate water within the context of a dry climate. For Iuk, the eel season, which falls in March, there are a series of hoops forming an open tunnel reminiscent of eel traps. This is because Iuk signifies the season when "the eels come up through the rivers, and that is when food is abundant. Therefore, big gatherings of people can happen when you have got a large food source" (#Mlb05 Respondent). The calendar shows how people moved around and accessed different resources within the landscape, and "through the planting design and the spatial setup, we were looking for little signifiers that would tell you that stuff was happening… so that those stories can be verbally told over time" (ibid). Furthermore, the playground's entry spaces express a 'Welcome' transition into the Royal Park through the traditionally used plants in Wurundjeri 'Welcome to Country' ritual.

4.3.2. Medibank Place

Docklands is a suburb of 200 hectares of land and water, situated along Victoria Harbour, west of the city center. It is close to Melbourne's main transport networks, including Southern Cross Station. Docklands today is a modern mixed-use area with business, residential, commercial, and retail functions, offering a wide variety of dining and leisure activities. The suburb hosts major businesses such as National Australia Bank, ANZ, AXA, Bendigo Bank, Medibank Private, and Ericsson.

The development of Docklands has seen many turns during its history. Originally, the Wurundjeri and Boon Wurrung people of the Kulin nation were inhabitants of the land, a wetland area with a large salt lake. The first European settlers wanted to turn the land into a farming region, but the 'wasteland' was then turned into a powerhouse and industrial area with heavy boat traffic. The gold rush of the 1850s accelerated these processes, and Docklands became an area of wharves, warehouses, and railways. However, for modern-day large container ships, Docklands' harbors were inadequately small, and the area was waiting to be utilized.

In the 1990s, a joint city and state government policy document concluded that Docklands developments could be one of the projects that would attract the private sector and make Melbourne an appealing center for big business (Blomkamp and Lewis 2019). The construction works started in 1997, and in 2007 the Docklands suburb officially became part of the CoM municipality. The renewal resulted in the return of a significant waterfront area to the city. The completion of works is estimated for 2025, providing a home to 20,000 residents and 60,000 workers and doubling Melbourne's CBD size altogether. However, the initial developments were heavily criticized, mainly lacking green areas and pedestrian links (ibid). Moreover, the building cramming led to a wind-tunnel effect, further decreasing comfort and the area's urban quality. Still, newer developments, such as Medibank Place, responded to these challenges, providing relief to the heavily concreted urban surrounds through a 'living, breathing building' design.

Located between Southern Cross Station and Docklands Stadium, the 18-levels high Medibank Place is home to Australia’s second-largest health insurer’s headquarters. The building features a range of solutions promoting wellbeing and biophilia (see Figure 47 on the next page), focusing on public connectivity. A small park with edibles, green walls, green terraces, a multi-purpose sports court on the exterior, a demonstration kitchen, thousands of plants, and a bike ramp in the interior provide a healthy and active workplace experience (#Mlb15 Document).

Figure 47. Various green solutions at Medibank Place.

The opening of Medibank Place (hereinafter referred to as MP) marked a significant cultural change in the company's life, as it transitioned from a government-owned business enterprise to a privatized, publicly listed company on the Australian Securities Exchange in 2014. The vision of "a living, breathing, healthy building" is connected to Medibank's CEO (at the time), George Savvides (#Mlb03 Respondent). He wanted to express the company's mission to promote health practically and tangibly through the building and workplace design. This aim was grounded in research as well[72]. Therefore, Medibank decided to relocate the Melbourne staff to a new, healthy building at Docklands.

Additionally, the new building's design was set to express a commitment to revive the building's surrounding suburb in the Docklands, where the company was about to settle, which Savvides

[72] Medibank commissioned Allen Consulting in 2012 to investigate "Workplace Health: Australian Workers' Perspectives". The report showed that 44% of Australian employees think their physical and mental well-being is risked due to their workplaces, and 85 % consider that employers must invest in their employees' health and well-being.

critiqued heavily in the Docklands News magazine (2012) for being too sterile and inhumane. "It's all glass and steel and traffic jams and dusty pavements and cold, windy corridors… No trees, no birds, no grass, a lack of community but a plethora of structures," he complained at the time. The CEO decided to "put our design where our mouth is" (ibid) and commissioned a building design that is 'hard-wired for health' and available not only to Medibank's staff but to the public and people who work in the Docklands. In 2012 Medibank signed a ten-year lease on a 30,000 sqm structure, an office tower inside-outside greenery, and an adjoining park. The new building opened in 2014 and became the first existing building in Australia to be awarded the WELL Gold certification. It set a new benchmark for Melbourne's green building (#Mlb03 Respondent). Water and waste management and access to light were prioritized, with a critical focus on social sustainability. A rainwater harvesting system and gray water treatment system are installed on-site to reuse water. The extensive greenery is a major feature of MP's sustainability, supported by water-efficient fixtures and fittings and designed for high tolerance against droughts.

MP's design concept evolved from the motivation to achieve Medibank's goal, a vision for better health, and a holistic strategy. Therefore, the building reflects how specific spaces and designs can improve health and well-being beyond the technical aspects and advocate a green design. For example, a double stair system allows easy movement for people between levels with natural light penetrating. Thus, elevators are unnecessary, and this structure also functions as an active public space (#Mlb15 Document).

Interestingly, the most visible green elements, the green facades, are the least spectacular, especially compared to the initial renderings showing the whole building covered in lush green vegetation (see Figure 48 on the next page). The building is immense. Despite a significant amount of green coverage, the plants blend in the building's surface and cannot give a green feeling in proportion (#2Mlb observation). Even though the designer team had more extravagant greening aspirations, as it turned out, "you actually just cannot really grow anything on facades in the way you can see it in the tropics[73]" (#Mlb03 Respondent). However, this is a minor criticism because MP has important social benefits due to its connection on the ground plane with the public garden. Thus, a new and unexpected green aesthetic has formed, much needed in the Docklands.

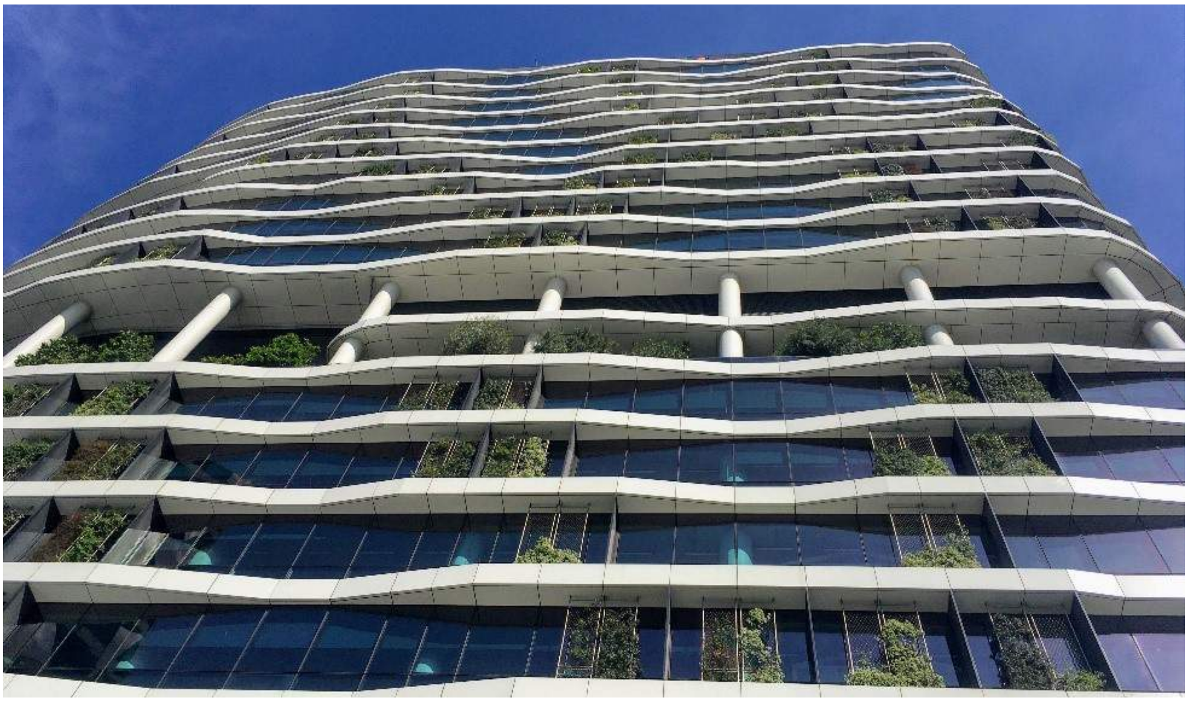

Figure 48. Green panels on Medibank's facade.

The building and the workplace incorporate thousands of plants, animating the Docklands' greyness and ameliorating human health, well-being, and habitat for the city's biodiversity (CoM 2017b). On the exterior, significant foliage of plants covers approximately ten percent of the building's surface, mostly with native Australian species. At the Bourke Street entry, two large 25-meter-high green walls face the streets, providing home for 11,600 plants from a unique selection of 72 plant species withstanding the shady and windy conditions. Three sides of MP are covered with climbing plants, with the help of 520 modular planter boxes, and 16

[73] The interviewee referred mainly to Singapore's famous high-rise greenery: the landscaping solutions within buildings, sky terraces, and rooftop gardens.

green terraces (or roof gardens) are available for the workers, ranging in size from nine square meters up to 400, adding up to 640 square meters in total (#Mlb16 Document). The plants on the facades and the terraces were also selected to tolerate high winds and challenging temperatures (#Mlb13 Document). At the concourse level (at an elevation above street level), a 1500-square-meter pocket park is attached to the building, available for the public. This outdoor space hosts an edible garden and connects to an amphitheater with shops and cafes, contributing to an 'activated,' lively pedestrian environment around the building and within the neighborhood. The inside of the building includes 2300 plants, helping relieve stress, improve internal air quality, and separate work zones. From a fauna perspective, many birds nest using planter boxes, primarily lorikeets and an eagle. That was not a result of deliberate design, nor was it surprising, because "nature always finds a way" (#Mlb02 Respondent).

4.3.3. CERES

Parkville is bordered on the north by Brunswick, one of the suburbs of the City of Moreland. The Moonee Ponds and Merri Creeks balance the relatively flat area, which was utilized and managed for thousands of years by the Wurundjeri people before European settlers arrived in the late 1830s. Moreland was of the earliest built parts of Melbourne. Some of Victoria’s oldest buildings can still be found there. The suburb’s first European settlers were small-scale farmers and working-class people from England, Scotland, and Ireland who found employment in the quickly developing quarrying and brickmaking industries in Brunswick, the nation’s new ‘Birmingham.’ The area got populated with industry buildings and working-class housing, mostly in an unplanned manner that led to the development of a dense urban landscape with factories, clay holes, and quarry pits. The city’s industrial character was tempered by a change to textile and clothing production. However, by the 20th century, the industrial complexes had been closed and transformed into housing projects, and the pits were gradually filled in to provide parkland (#Mlb23 Document). A new flux of immigrants, predominantly from

Southern Europe and the Middle East, arrived in the second half of the 20th century, contributing to developing a vibrant, multicultural neighborhood. However, these social developments also led to employment and integration challenges, to which the creation of CERES was one of the local responses, detailed below.

The Centre for Education and Research in Environmental Strategies (CERES) is an environmental education center, an urban farm, and a social enterprise hub, occupying a 4.5-hectare regenerated site neighboring Merri Creek. It is a non-profit organization, "a living social enterprise" (#Mlb14 Respondent), composed of a 'federation' of 11 social organizations spread across four Melbourne locations, promoting local production, access, preparation, and consumption, particularly regarding food systems. While CERES is officially a public open space and the local Council owns the land[74] (#Mlb23 Document; #Mlb15 Respondent), it is also an autonomous organization (#Mlb21 Document). It operates a grocery delivery service, education outreach programs, and international partnership programs. Yearly, almost 500,000 people visit CERES and participate in diverse forms to meet their social and material needs sustainably (for example, buying house plants and accessories, meeting with friends for a coffee or meal, or participating in various programs and activities).

CERES illustrates how tactical placemaking processes can lead to long-term social-ecological change and the transformation of a whole area and how small-scale improvements in a phased approach can generate the revenue necessary for maintenance and management (#Mlb21 Document). CERES grew out of a community empowerment project into a progressive rehabilitation process. Today, CERES is a multi-functional environmental center, but its story

[74] The Council had attempted to develop a comprehensive master plan for the site in the mid-1990s (#Mlb15 Respondent). In consultation with CERES staff and the community, planning experts worked together to create a category for CERES under the Victorian planning scheme to ensure the project's continuity. However, that process was never completed, and CERES is still officially a public open space (#Mlb23 Document; #Mlb15 Respondent).

started in the 1970s when severe social and environmental issues were pressing the Moreland community. The unemployment in the area was high, especially amongst young, freshly immigrated, non-English speaking people. In addition, many light industrial facilities were closing due to a residential transition in that part of Melbourne (#Mlb14,15 Respondents). A group of residents, schoolteachers, and local government members began to explore ways to address these issues by developing programs for young people that promote environmentally sustainable living and create employment, which is present in the organization's fabric today (#Mlb15 Respondent). They requested access to land for growing vegetables and making compost, and in 1982 the Brunswick City Council (now Moreland City Council) granted them a lease of a barren, desolate 4.5-hectare land: a decommissioned rubbish tip that was once a bluestone quarry. The place was restored step-by-step, filled with various structures, activities, and users, leaning on tactical and creative placemaking practices connected to the community empowerment project:

> Absolutely everything that you see at CERES here today was created by the community. There was nothing here at all. There was one little hut for the quarry guy (#Mlb15 Respondent).

Through the joint effort of the local council and community over 40 years, CERES reached its current form by regenerating the previously abandoned and ruined land, and it became a unique sustainability education organization and a community engagement leader for social and environmental innovation. In the beginning, the local Council has been instrumental in establishing and sustaining CERES by providing substantial grant funding for many years (#Mlb23 Document). Some counselors, especially Mike Hill, strongly influenced how CERES developed (#Mlb01 Respondent). However, today, the social enterprise model gives the basis for the long-term resilience of CERES. It no longer relies on government funding (although they still receive some support as one of the Council's high-priority project improvements). Instead, CERES is 95% self-funded by providing environmentally focused services that range from educational and training programs in sustainable living to trade in organic food, permaculture plants, and sustainable timber. The social businesses fund CERES' community visitor center and the multipurpose demonstration site of sustainable living. A certified organic farm, an organic plant nursery, and a grocery operate at CERES, surrounded by classrooms, offices, cafes, meeting rooms, and venue spaces (Figure 49). In addition, sustainable technology demonstrations are spread across the site on various topics, such as energy alternatives, water conservation, innovative construction methods, recycling and reuse of materials, and nature rehabilitation (#Mlb18 Document). The main CERES site receives half a million visitors yearly, while the other locations, the school outreach programs, and the online services reach another million (#Mlb21 Document).

Figure 49. Life at CERES, from top left to right: the Merri Café; schoolkids gather for study trip; farmers market; people planting vegetables.

5. Design(ed) outcomes of urban NBS: from green spaces to nature-based places

> Perhaps it will be the city that reawakens our understanding and appreciation of nature, in all its teeming, unpredictable complexity (Jacobs 2004).

This chapter explores the relations between urban design elements and the manifested nature-based characteristics, based on the proposition that by design, NBS can transmit the many aspects of their benefits and affect how urban citizens understand the potentials of urban spaces in new ways. Here, I do not aim to assess and evaluate the social, environmental, and economic NBS *benefits*. Instead, I take the nine cases as functioning, actualized NBS with different contributions discussed in the previous chapter. In this chapter, I focus on the outcomes as consequences of the applied design elements (Figure 50) and how these give *relevance* to NBS from the perspective of the wider urban audience. The following research sub-question helps to explore these topics: (Q1) *How do the design outcomes of urban NBS indicate a transformed, nature-based urbanity?*

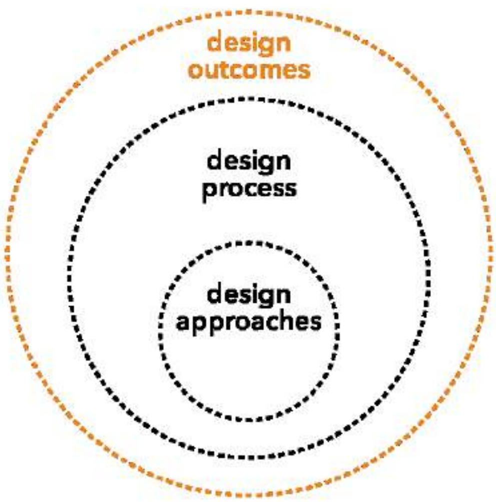

Figure 50. Dimensions of the NBS design framework. Adopted from the three lines of work in regenerative design. Source:Mang and Haggard 2016.

Design can transform concepts and ideas into people's language and reality to engage with them at the personal and emotional level. Tonkinwise (2013, 6) argues that "designers create artifacts as means, and the value of design is in what it enables to do, certain activities and experiences, certain futures possible and likely." This chapter aims to confirm that by design, a carefully planned NBS can 'speak' to people, engage them to come closer and learn about the functioning of urban nature, and ultimately form relationships that also need to be designed, enabled, and supported.

In Chapter four, I briefly reflected on the placemaking processes related to the cases, which all demonstrate to different degrees and results. The placemaking perspective helps conceptualize the human responses to urban design and assess the level of integration of an ecological focus. Furthermore, I discuss how urban design-based placemaking can provide affordances for non-human nature to balance the human-focused attention of placemaking.

This chapter's analytical lens takes inspiration from the concept of *placemaking expressions*. These are apparent through planned or enabled activities and designed physical forms, which Lew (2017) organizes around *tangible, intangible*, and *mixed* elements (see more details in Chapter three, Section 3.1.2). The consecutive sections are dedicated to assessing the various forms of placemaking expressions demonstrated by the NBS cases (Figure 51).

Figure 51. Structure of the chapter: intangible, mixed, and tangible placemaking expressions of NBS. Derived from Lew (2017) and prepared by the author.

Section 5.1. traces factors influencing the *intangible* elements or expressions: connected to a place's mental image, composed of perceptions and experiences of a place, shaped through stories, history, branding, or the media. Here, I focus on accounting for factors that shape mental outcomes: a nature-based image and identity. Then, I expand the discussion in Section 5.2 by examining 'people's practices,' the *mixed* expressions. At this level, I specifically concentrate on the use-related outcomes: participatory programs and activities which rely on the nature-based character of the cases. Finally, in Section 5.3, I explore the *tangible* tools or expressions that affect the physical characteristics of the built environment or the landscape, contributing to the mixed and intangible expressions. There is an abundance of design features concerning NBS that influence the sense of place and the potential activities in that space (for example, the height and density of trees and vegetation affect the level of perceived safety). I focus only on tangible examples that lead to the outcome of transforming urban spaces into nature-based places: that can change people's physical relationships with the environment, offering multiple ways for social and nature interaction. When analyzing the physical expressions, examples from humans' and the natural elements' perspectives are presented.

5.1. Intangible expressions for amplifying nature-based image and identity

Since Kevin Lynch's Image of the City (1960), the city's perceptual form or 'imageability' has been proven to support people to absorb information about the city, connecting the identity and structure of one's surroundings. The cases presented in the thesis display particular natural features that create the places' places' nature-based identities. The two building cases (Bosco Verticale and Medibank Place) are the most immediate examples, which the following paragraphs will detail.

Iconic buildings (buildings with distinguished characteristics) are potential city landmarks, symbolic devices with particular relevance as they strengthen an image through the representative values people attach to them (Jencks 2011). The cases of **Bosco Verticale** and **Medibank** show how iconic designs are strategically used as 'logos' in city branding (Hubbard 2006), marking the transformation of a neighborhood or even of a city. Regarding the BV towers, it is argued that the buildings are the demonstration pieces of the city's dedication to "clean up Milan's reputation of being the most polluted city in Italy" (Heinonen and Minkkinen 2016, 169) and (re)confirming its new, green city image, which their creator, Stephano Boeri, calls "BioMilano" (Boeri, Brunello, and Pellegrini 2011). Furthermore, BV had an instrumental part, together with BAM development, in 'reinventing' the Porta Nuova neighborhood (Boros and Mahmoud 2021) into a junction point for an affluent and sustainable city, a Milan that is turning green (Bergaglio 2019). BV became a landmark in Milan (#M03 Respondent), a new touristic hotspot (#M01 Respondent; #2 Milan guided tour), and is frequently used to illustrate the NBS concept in research projects and the media (#M01 Respondent). "It is one of the most 'selfied' buildings ever. It is viral. People love the building" (#M02 Respondent). Similarly, the **Medibank** building played a major role in bringing life to the Docklands' 'inhumane' environment by providing publicly accessible green spaces and various green coverages. MB has also been widely published as the 'healthiest building,' which generated high interest: visitors from all sorts of different organizations visit the building to learn about its design (#Mlb03 Respondent; #5 Mlb observation).

Not only buildings but, in general, urban green spaces play an important role in enabling citizens to reimagine the city as a green city. Creating unique green spaces that respond to the local climate, resources, and culture presents such opportunities (Braiterman 2011). Moreover, reclaiming abandoned, underused spaces holds particular branding capability as they are often *unimagined* as potentially vegetated, green spaces. Recreating them into vital green spaces gives new visions and a new understanding of what is and can be a usable urban green space. **BAM, Parco Portello,** and **CERES** exemplify cases of formally derelict, regenerated sites. They call attention to the remaking of urban areas, to *undesign*[75] the urban planning mistakes of the 20th century in the context of green cities and the emerging 'resilient cities.' Moreover, the turning of unimagined spaces applies to building rooftops and facades (**Medibank, Bosco Verticale**), the courtyards of schools and universities (**School gardens of Győr**), the interior of the workplace (**Medibank**): all the underrated or unexpected places (**Bercsényi grove, Kuopio park**) that hold the potential to be reconceptualized into NBS. However, 'green branding' can become a form of exploitation: there is a thin line between green marketing and greenwashing. I reflect on these aspects in Section 5.2. from the perspective of BAM and BV. Even though these developments are not considered greenwashing, there are arguments that the urban greening features were utilized to pave the way for the developer's expansion.

The conversion of urban spaces as NBS calls attention to the green city discourse currently crystallizing in urban development, used by the contemporary city to strengthen its green image. However, as the two building cases demonstrate best, NBS also represent a significant shift in approach, pushing the practice of urban design and architecture beyond the conventional (and often contradictory) practice of building 'green.' In architectural terms, 'building green' involves countless strategies, from the use of alternative energies, eco-materials to low-impact construction (Al-Kodmany 2014).

However, vegetation's strategic integration *into buildings* has been a relatively immature approach (Boeri and Insulza 2009). Without planting a single shrub, green architecture outcomes can be 'green,' complying with the latest environmental standards.[76] Part of Bosco

[75] Term borrowed from Cameron Tonkinwise (2013).
[76] The Bosco Verticale towers and Medibank also comply with the latest innovative and green design principles, marked by a range of esteemed awards and certifications. The Bosco Verticale towers have LEED Gold

Verticale's success comes from transforming what green architecture means. Boeri presented an alternative green architecture model with the Vertical Forest: a new typology of *living buildings*. Interestingly, BV has a relatively traditional form from an architectural point of view. Compared to many contemporary skyscrapers, it appears to be simple: a reinforced concrete structural frame holds a sequence of balconies in the typical style of Milanese architecture. The only truly innovative element of the project is the functional integration of trees into the building's structure and operation, "without compromise" (#M02 Respondent), thus transforming the towers from skyscrapers to 'treescrapers.'

Buildings have a particular role in shaping public spaces. Lefebvre (1974/1991) stated that they are cultural objects, giving material form to ideas and values, expressing and reinforcing a particular ideology. The vegetated, living buildings' apparent design features transmit a radically different understanding of urban greening and repositioning nature as a fundamental actor in shaping the urban space. Buildings with green roofs and facades or with green interiors *embrace* nature. However, in architectural designs, it is more common to reject nature. Sometimes architects even prefer to clear the public space around their works to display the building without trees blocking the view.

Boeri's treescrapers have created a new architectural language where natural features in the building design provide the basis for the towers' environmental strategy. Integrating natural elements is paramount in every part of BV's design and the exalted ecological and project reward that the widespread public and professional attention has generated. The living building typology is deeply *participating in nature,* as in living *with* nature. Therefore, the image of the towers is powerful. It transmits another understanding of how buildings can function or could appear. They generate a contrast to the other usual towers in the vicinity. The Torre Solaria is

certification. Medibank has a WELL Gold for the core and shell (the first existing building in Australia), a 6 Star Green Star (from the Green Building Council of Australia), and a 5 Star NABERS Energy rating certificate.

a high-rise building (also "green" with LEED Gold certification) located at the other end of BAM. It has an analogous structure to BV: it almost looks like it was the same building except without trees (see Figure 52). Because of BV, Torre Solaria seems naked (#5 Milan observation).

Figure 52. Bosco Verticale and Torre Solaria. Prepared by the author.

Particularly, in **Parco Portello**, Charles Jencks' landforming activity is a radical hybrid combination of urbanism and architecture with the landscape, crowned with gardens, sculptures, and epigraphs. His landforms, which aesthetically and structurally define the park, convey a complex symbolism[77] based on natural and scientific processes to make visitors

[77] For Jencks, the garden is a microcosm, and walking in a garden opens a gate to experience the universe in miniature (de Molfetta 2014). For example, the Time Garden is paved with a mosaic of black and white pebbles, shaping forms that draw the 28 days of the lunar cycle, the 365 days of the year, the waves of the heartbeat, and events of the universe. Additionally, the alteration of black and white evokes the beat of day and night. Meanwhile, the four stages of time, prehistory, past, present, and future are represented in circles on the ground, and engraved

decipher the smallest and largest attributes of the landscape (de Molfetta 2014) (Figure 53). All the park elements interact to create a rhythm of shapes, contours, and colors. Even the planting design of trees and bushes symbolizes time, with successive blooms for each season (#M24 Document).

Figure 53. Jencks' symbolism in Parco Portello.

Furthermore, most directly, the **NaturePlay** playground transmits an image and identity that is fully embracing, even blended with, nature. NP is located within the greater Royal Park of Melbourne: a place for imaginative nature-based play where landscape elements are used for play opportunities (see Figure 54 on the next page). Even though the playground reads as rather natural and scrambling-rambling, every piece of it (even the rocks) was carefully designed (#Mlb09 Respondent). The built features are merged into the surrounding landscape, adapting to the Royal Park's aboriginal character. In addition, the use of Melbourne's aboriginal seasons in the planting design reflects these aims. They appear in the wayfinding and informational signs and the decorations on the ground (#Mlb01,04 Documents).

drawings and puzzles complete Jencks' universe. The garden's path is divided by 12 steel sheets, referring to the months.

Figure 54. Still life glimpses from NaturePlay.

NBS can be a powerful instrument in creating awareness and promoting nature in the city. However, as 'sustainability displays,' they simultaneously ground debates around the negative implications of the 'green image.' For example, urban professionals have heavily critiqued **Bosco Verticale** for portraying the green terraces as if they could provide alternative means to the city's horizontal public spaces, even though it was never the designer’s intention. According to the architects, BV is but one element of an integrated strategy that works for the entire city. The towers fit as a prototype in trying (and proving) that something fundamentally different can exist:

> It is not about that we think we bring back nature with the trees on the tower. But we try to work on this issue with a vision for the existing city, for a new master plan, for new cities. You have to place Bosco Verticale in a broader vision (#M01 Respondent).

Nevertheless, apart from its status as the world's first treescraper, which attracts flocks of tourists to the area, a critical perception of BV is that it was built for the 'rich[78] and famous' (Biaggi 2016), a "privatized piece of green attached to an apartment" (#3 ICON Design Talks). Simultaneously, Boeri's architect studio has been keen to alleviate BV's 'exclusive' image by focusing their efforts on building different versions of the Vertical Forest project that are open for public use or dedicated to social housing (Kucherova and Narvaez 2018). Additionally, Boeri has not patented[79] the Vertical Forest concept and has been busy spreading the idea globally through talks and lectures.

Moreover, critics argued that BV, together with the **BAM** development, served as an investment instrument for redeveloping the Porta Nuova neighborhood into a luxury quarter, contributing to gentrification and the 'manhattanization' of Milan (Brizioli 2015). They redesigned the profile of the pre-existing districts into something new, "conveying prestige and visibility for those who occupy them, for investors and for the political class for which they form a symbolic instrument of power" (Bergaglio 2019, 26). In the meantime, BAM became a must-see destination, a hotspot, and a viewing platform for the whole development area (#3 ICON Design Talks). With direct and strong marketing efforts, the BAM brand was developed. It is described as a public space "where nature is the protagonist and a source of inspiration for the cultural, educational and wellness program designed for the 10 million people who visit the location on average in a year" (Interbrand 2019). The green framing embraces the retail stores, restaurants, and cafes around the park, infused with luxury: a Tesla store and a pop-up sports car expo space are mixed with large LED screens for advertisements, larger than the central statue at piazza Gae Aulenti (#1 Milan observation).

[78] Bosco Verticale's apartments are luxurious that only a few can afford: the average sell price is about 9.500-10.000 Euro per square meter (Greenroofs.com 2019).
[79] Thus, it is free to use and adapt the design solution by anyone. Boeri (2015) even published a guide to encourage the use of the idea: *'A Vertical Forest: Instructions Booklet for the Prototype of a Forest City'*.

The Vertical Forest towers are private residential buildings; however, they have a dominant public dimension, stressed by the architects (#3 ICON Design Talks). One of the most distinctive qualities of the design concept is the building's green usage, which is dedicated to the common good (#M30 Document). Even though the interiors are for private use, the exterior is for all city dwellers to benefit from and enjoy. Thus, the green facades are to be looked at by the public from a distance, facilitated by the smaller public spaces at the foot of buildings and from BAM, which is open to the public 24/7. BV primarily provides a view, even a 'spectacle,' capturing the gaze of passers-by (Galbiati 2017) and invites them to come close (Heinonen and Minkkinen 2016). Meanwhile, shops, cafes, and restaurants at BAM increase the possible experiences to enjoy or spend more time in the area.

The two building cases show that creating public places around green buildings further highlights the publicly accessible and enjoyable image of such NBS (Figure 55). For example, the small meeting place and a children's playground at the foot of BV are frequented by local families and tourists alike, with benches organized in a circle providing space to sit and relax while enjoying the view.

Figure 55. Traversable spaces around Medibank HQ.

In the case of **Medibank Place**, the choice to activate the area around the building and make it publicly accessible and traversable was an instrument to engage with Medibank's customers, the public, and the community more broadly (#Mlb03 Respondent).

> If we build these buildings like fortresses, then we are not allowing that degree of permeability or openness or even transparency to our shareholders and the people that insure with us or bank with us or whatever it might be (ibid).

5.1.1. History, heritage, and the stories we share

Like most urban places, the NBS in this thesis have a complex, sometimes difficult history. However, sustaining and sharing the historical connection contributes to building a sense of place. Therefore, this section aims not to analyze the narrative of the stories behind the NBS concept but to point out how stories are used to convey nature-based outcomes or connect nature-based attributes to the place. Additionally, it highlights that design solutions that relate to the historic core can potentially reinforce and expand the NBS' *relevance* to local cultures and can be used to explore the purpose and importance of natural areas in urban contexts.

Storytelling is a powerful tool with the potential to translate the pragmatic ways spatial development contributes to improving the quality of life in urban environments (Cilliers et al. 2015). **BAM** and **Bosco Verticale** tell the story of a significant urban regeneration process in Milan. The renewed Porta Nuova district marks Milan's recovery from the economic crisis. A central area, stagnant for decades after the transition of de-industrialization, now is a revitalized and extended, coherent urban landscape, where nature has a vital role in connecting elements for a nexus of people, flora, and fauna. Urban places with NBS present in situ opportunities to interpret nature's multiple meanings, simultaneously with different viewpoints on urbanity, not only for insiders such as landscape architects, park volunteers, or nature enthusiasts but also for the general, broader community. In the above cases, this is achieved by regular guided tours organized by the Municipality, local architect offices, or BAM’s management to share the development details of the park and the area (#1,2,3 Milan guided tours). Moreover, information signs with detailed explanations call people’s attention to get to the development’s background.

Connecting to the path through storytelling has long been argued to be crucial in planning (Throgmorton 2003) and community participation processes (Sandercock 2011). **BAM**’s development safeguarded mementos of the site’s historical structure: the Fondazione’s headquarter occupies a former railway house conserved to keep a continuity to the industrial past. The Stecca degli artigiani was another historic factory building, used as an art incubator from the 1980s. Despite local opposition, it was demolished during the regeneration project (Ferreri, Pesavento, and Theis 2012). However, a new building designed by Boeri Architects was included in the masterplanning of the area, and now Stecca 3 Incubator for Art stands at BAM, maintaining an industrial character and Stecca’s social and art-focused legacy.

Furthermore, in the early building days of **BAM**, right when the 2015 World Expo was held in Milan, the Fondazione commissioned Agnes Denes to re-create her iconic land art[80] within the 5-hectare perimeter of the future park (Senda 2015). In the original artwork, '*Wheatfield - A Confrontation’* (1982), Denes planted a two-acre wheatfield at Battery Park, a city landfill in lower Manhattan. The field was 'alive' for four months, only two blocks from Wall Street and the World Trade Center, facing the Statue of Liberty. Similarly, in Milan, she created a temporary art installation, transforming the construction site into an agricultural wheatfield, used as a revitalization and reanimation tool for the area to attract and host visitors to the Expo

[80] The artist's studio described the relevance and poignancy of the public art work in Manhattan: "Planting and harvesting a field of wheat on land worth $4.5 billion created a powerful paradox. Wheatfield was a symbol, a universal concept; it represented food, energy, commerce, world trade, and economics. It referred to mismanagement, waste, world hunger, and ecological concerns. It called attention to our misplaced priorities. The harvested grain traveled to twenty-eight cities around the world…The seeds were carried away by people who planted them in many parts of the globe" (Agnes Denes Studio 2013).

(while BAM was being built). On the one hand, the art installation responded to the Expo's central theme 'Feeding the Planet. Energy for life' with a sensory message to draw citizens' awareness to the land. Additionally, it presented a transformed urban landscape that spoke about the historic, local agricultural productivity, questions of ecological quality, and the appreciation of natural resources. The environmental installation was extensive in scale and public participation, getting locals involved in every stage of the project. Through the Fondazione's MiColtivo ('Green Circle') initiative, the wheat was sowed, reaped, and harvested by Porta Nouva residents and visiting tourists. The collected wheat and seeds were distributed among the participants.

The above examples illustrate how stories, especially in participatory processes, help place facts and information in context and translate it into human experiences. Particularly, BAM's nature-focused identity was shaped through the public's participation by storytelling in the planning and design of the place, which helped develop connections between the users of the space and the place. Such uses pinpoint the importance of stories related to nature's role and place in the urban space and people's lives, giving other means for turning the urban public spaces into the potentially most valuable assets: NBS.

Parco Portello is similarly a result of the continued reconstruction effort of Milan. However, it applies a different storytelling approach. It is a park with many reading levels: infused with symbolism from Jencks' artistic universe, translated into his designs' physical shapes (#M24 Document). The three circular hills inserted in the open space express the duality of time in its circularity and linearity and are merged with the place's cultural heritage. Together with a smaller garden called the 'Time Garden,' they refer to different eras of time: Prehistory, History, Present, and Individual time. Prehistory tells the story of the universe, characterized by spirals and menhir-like stone sculptures, and hosts a small lake. History, a memento of the Lombard industrial era, references Alfa Romeo (the park occupies the space of the former Alfa Romeo factory). The first two hills are S-shaped, while Present is perfectly conical, intertwined by a double spiral path, leading to the DNA helix sculpture at the top. The hills create a historical and cultural continuity with Monte Stella and Milan's post-world war era (see also Chapter 4, Section 4.2.2). At the same time, the vitality and dynamic nature of Alfa Romeo are recalled by the curved, spiraling shapes of the park. Engraved signs, drawings, and puzzles on the ground encourage the 'reading' of the park. Additionally, the pedestrian bridge leading to the park (Figure 56) and the nearby mall (Figure 57 on the next page) feature a series of boards talking about the history of the neighborhood and the designers and architects who contributed to its renewal (#4 Milan observation).

Figure 56. Entrance of Parco Portello: examples of boards featured on the pedestrian bridge. Prepared by the author.

Figure 57. Poster featuring the automotive history of Parco Portello at the Iper store

The Australian cases represent recent progress or rehabilitation while simultaneously calling remembrance of the first European settlers' hubris. Before the 1830s, all land belonged to various Indigenous peoples, the traditional 'custodians of the land,' and they too belonged to it. The role of stories is highlighted in these cases and illustrates how they support the process of making sense of the past and set directions for the future.

In the case of **NaturePlay**, the extended community consultation process preceding the design actions served to form a collective 'Ideas Plan,' from which the design brief was delineated (#Mlb04 Respondent; #Mlb05,06,09 Documents). The participation of children, community representatives, park rangers, and Wurundjeri elders allowed enacting the future place as these actors imagined it. Planning, in a way, "is constitutive and persuasive storytelling about the future" (van Hulst 2012, 301). The NaturePlay playground commemorated the connection with place through the reinstated aboriginal parkland character and by honoring Melbourne's Wurundjeri seasons in the playground's design. The story of the place is told with the help of information boards, explaining the aboriginal connections presented in the design (see Figure

58 and Table D30 in Appendix D). Moreover, park rangers (a public body of the City of Melbourne) provide various free environmental and educational programs to the community by using the playground space to tell their audience stories about local history (#Mlb10 Respondent).

Figure 58. Information boards at the NaturePlay playground's entrance points.

CERES is a success story[81] about the regeneration of the land. It proves that restoring and sustaining the local aboriginal heritage is possible by honoring the linkages with and within site through community work, education, and outreach. Its story is shared through organized site tours, workshops, programs, and festivals. Like the cases above, information signs are installed at various points on the site.

The Hungarian cases show that urban spaces (just like the other cases) are constantly changing. Eventually, they renew, despite long-standing difficulties. **The school gardens in Győr** are the

[81] During the Melbourne 'orientation interviews' (see Table 17 in Appendix B) that I conducted to collect information and list the potential NBS sites, CERES came up each time as a 'must' to be included in the research.

successors of a long-established teacher training tradition that originated in the late 18th century (Halbritter 2016b). Facilitated by IKA, the Foundation for Hungarian School Gardens*,* each garden that now belongs to the school garden movement shares its successes and stories with the other members through regional forums, newsletters, and national meetings (#Gy08 Respondent; #Gy14,15,16 Documents). **Bercsényi grove** is a living memorandum of significant changes that shaped Győr's historic core. The area transitioned from being the industrial and commercial determinant to impoverishment and decline, then revitalization. Surrounded by unique religious-cultural establishments and attributes of the city's original connections to the bordering rivers, the grove's story presents multiple opportunities to introduce place-responsive design elements. However, apart from the bronze bust of Miklós Bercsényi, there are no tangible or intangible placemaking elements related to the past in the grove. The connection with history in **Kuopio Park** is similarly obscure. It does not tell much about the Finnish twin-town background either.

The NBS connecting with local heritage exhibit the various ways local stories can be expressed. They apply an audience-centered approach in their marketing and programming (BAM, Bosco Verticale), or through the design of the physical space (Parco Portello, NaturePlay), through installing information signs, or even by integrating it into the operational core, like CERES or the School gardens in Győr. When there is a struggle or lack of indication to connect to local heritage in any way, a problem of *relevance* comes up. In her book 'The Art of Relevance' (2016), Nina Simon interprets relevance as a key that can unlock information, emotion, experience, and value – connected to community identity and meaning.

> With it, you can enter. The power of relevance is not how connected that room is to what you already know. The power is in the experiences the room offers… and how wonderful it feels to open the door and walk inside (ibid, 29).

Without relevance, the potential NBS outcomes result in a low level of use and place attachment, as seen in Bercsényi grove and Kuopio park examples. However, sharing the site's specific, even challenging histories adds new dimensions to the design by opening possibilities for more direct applicability of the NBS to the particular socio-cultural context. Furthermore, these place connections to NBS can invoke profound knowledge and understanding of the landscape and people's stake in nature, especially with mixed placemaking tools, which the next section details.

5.2. Mixed expressions for developing nature-based social events, programs, and art

Most placemaking activities involve people directly or indirectly (Cohen et al. 2018). These use-related elements act as connectors between the tangible and the intangible tools, detectable in everyday life of urban NBS. The following placemaking expressions account for how social events, programming, and art can attach distinctive nature-based characteristics and relevance to a place in the community's life. Moreover, they show how NBS attributes are activated to attract people to leisure and learning activities and how, in turn, these activities can provide financial sustainability to the NBS.

A typically mixed placemaking expression is the organization of social events, which BAM and CERES illustrate best from the cases, although from different perspectives. These regular events serve to establish a social connection with the place. **BAM's** events are managed using a top-down approach, directed by the Fondazione in collaborations and partnerships with several commercial actors. Numerous events and social activities are available for a broad audience in all seasons. Some are related to BAM's place marketing efforts to attract attention or establish wider recognition and specific brand associations: group workout sessions, free concerts, classical music, and dance performances illustrate this claim. But most importantly, particular events reflect the park's nature-based character, such as the open talks with designers, philosophers, or relevant writers and the guided botanical walks.

At **CERES**, events and activities are defined by the community's needs. Eight community groups use the site regularly (such as the Bee Group, Chook Group, or Community Garden Group) and many others for holding classes, community meetings, or resource sharing (#Mlb21 Document; #6,7,8Mlb observations). Furthermore, 'weed dating days,' various fundraisers, events for local small businesses, winter solstice and harvest festivals, regular farmers market days, and art exhibitions are offered to the community. CERES venues can also be booked for weddings or multi-day meetings for recurrent clients from the private, corporate, government, and education spheres (#Mlb21 Document).

Specific types of events that brand or *hallmark* the place can attach distinctive characteristics and relevance to the community's life (Ashworth 2009). Some cases illustrate such endeavors, where special events served to leave the first impressions marking the places' nature-based character. The inauguration of **Bosco Verticale** at the 2015 Milan World Expo is a typical example, where the new buildings presented one of the main attractions while spectacularly promoting the event's overarching sustainability agenda. Similarly, the opening of **Medibank Place**, 'the world's first health-based building,' marked the company's transition from a government-owned business enterprise to a privatized entity and, at the same time, communicated the company's determination to put their employees' health and well-being first. While in **BAM**'s case, Agnes Denes' installation at the 2015 Expo was the first event to set the nature-focused trademark on the site.

Programming as a form of placemaking is an important element that the urban design placemaking literature relates to creating tourism destinations (Richards 2014) and attracting people for 'things to do.' For example, the ‘Power of 10+’ concept (PPS 2009) suggests that there should be ten or more things that the places offer for people to do, such as meet others, eat and drink, shop, sit, watch people, play, listen to live music, enjoy art, or learn about history. Some of the NBS cases show the use of programming with particular success when activated through participatory programs and partnerships. These cases work on a level that provides reasons for people to do things while offering reflection and learning possibilities.

CERES is primarily a place for community-based learning activities[82]. School excursions, workshops about permaculture, gardening, cooking, different crafts, mindfulness, and sustainability serve this purpose. In addition, there are skills training in horticulture and environmental education. Community building days are organized to manage the site's facilities, tend the gardens, and do the planting (#Mlb20 Document). Moreover, from 2022, CERES offers a 'Nature-Based Leadership Training Program' designed to reconnect people with each other and their place. Concurrently, CERES aims to expand the framework for education and training programs, engage more people, even beyond the parks' and the country's borders, and explore new themes, such as circular economy, regenerative agriculture, spiritual ecology, and social enterprise. Furthermore, they manage and facilitate knowledge and skills exchange with other communities in India, Indonesia, Arnhem Land, Japan, Samoa, and Timor-Leste. The topics range from sustainable fashion and sustainable building to women in business, IT solutions for social impact, or various education themes for sustainability. CERES members, volunteers, students, and experts (due to academic collaborations) take part in the trips, but "the real focus is around building friendships" (#Mlb14 Respondent). Joint projects and partnerships are formed from the relationships over time (most significantly with Auroville in India), strengthening the social enterprises' viability and amplifying the impacts on the community.

Likewise, at **BAM**, residents and other interested parties have played an essential role in the design and management of the place. However, most importantly, in the case of BAM (as well as in CERES), the programming's role is to provide sources for the park's financial

[82] The activities are grouped around five sustainability education domains, developed for children and adults alike: Environmentally Beneficial, Socially Just, Economically Satisfying, Spiritually Nurturing, and Culturally Enriching (#Mlb21 Document).

sustainability, which is significantly (four to ten times) higher than of regular parks (Traldi 2018). The events and programming allow BAM to prioritize its social functions and connectivity while being an integral part of the buzzing urban economic system of the central business district. The Porta Nuova Smart Community or the MiColtivo programs, curated by the Fondazione, provide additional means to continue directly involving the citizens in the park's recurring building phases. Special open building days were organized after the opening, with the support of its main sponsors (BNP Paribas Italia Group, COIMA, and Volvo Car Italia), and for hosting laboratories in the vegetable gardens, involving over 2,700 people (#M19 Document). These activities are running continuously in the framework of MiColtivo, as the Fondazione is responsible for the management and operation of cultural programs, focusing on the involvement of residents for the next ten years (#M19, 31 Document).

The above cases demonstrate placemaking through events and programming connected to the sites' distinguished nature-based characteristics. The NBS narrative is enforced by reputations on social media, general news, and PR activities, leveraging the image and identity-building effects of 'nature-basedness.' Evidently, in these cases, the NBS associations are firmly linked to city marketing and place branding strategies. Still, they also work the other way, to show a designated and necessary space for using NBS within urban development. Kabisch et al. (2016) have highlighted the importance of recognizing NBS as such proactive investments within urban development processes, which must be supported by joint discussions between society, the public, and the scientific bodies. The cases presented in this section illustrate that paying attention to the comprehensive understanding of urban design (the creative application of programs and events) provides various opportunities to kickstart and maintain such conversations.

Art is universal across human cultures. Its various forms stem from ancient origins, even preceding language development in human evolution. Art is regarded as one of the defining characteristics of the human species that gave our species a major advantage in evolution: it allowed us to make abstract connections in entirely novel ways by using creations of the imagination (Hodgson and Verpooten 2015). Design and placemaking activities alike are intimately intertwined with various forms of art. Placemaking with art is categorized as a tangible tool according to Lew's (2017) classification. However, based on the findings, a distinctive mixed approach emerged as the cases signify art to engage citizens in various environmental activities.

> Because art gives you the possibility to see things in another way… By art, people are attracted, so they come, and then you also use this potential to show them something else. But you need something attractive to make them come to the place (#M10 Respondent).

The use of art in urban design and development is not a new practice. Kwon (2002) specifies *art in a public space* decorating the area and acting on the apparent physical level. The statues found in most public spaces, such as **Bercsényi grove** and **Kuopio park**, fall into this type. The land art of **Parco Portello** illustrates the category of *art as public space*. This site-specific artwork seeks a deeper integration between art and the urban environment, just like the park is said to act as an "environmental device for the entire district" (#M10 Respondent). At **BAM**, Denes' environmental installation with the connected participatory programs can be positioned between Kwon's (2002) second and third paradigm, *art in the public interest*, often used as a temporary program centering on social issues. The significance of the art intervention by Denes can be portrayed by the use of art to overcome development setbacks[83] while opening a window

[83] BAM's construction works were supposed to be ready by opening the Expo 2015 world fair. However, severe delays in implementation held back the development of the Expo sites and BAM alike. Simultaneously, one of the newest attractions was the freshly opened 'vertical forests' of Bosco Verticale. It was expected to attract many visitors, however, it sits on the corner of BAM, which was in the middle of construction works at that time. The Fondazione proposed to the Municipality that instead of leaving this huge area empty, with the use of art, it could be 'covered' while promoting the possibility of nature and urban agriculture in the city, with the involvement of citizens in all parts of the art project (#M06 Respondent).

opportunity to inform and involve the public in the creation of the park, thus sealing the nature-focused label of the place.

Another way that *art in the public interest* can enhance the possibility of gaining nature experiences is represented by **CERES**'s environmental activism, the **School gardens of Gyõr**, and, indirectly, **NaturePlay**. In these cases, the educational activities include developing new ways of thinking about nature and its role through creativity and action-based learning. A place-based and nature-based education offers possibilities for transformative learning experiences through nature play, gardening, or re-wilding.

These examples show what scholars have highlighted (Delconte, Kline, and Scavo 2016) that arts and culture-based interventions not only bring greater awareness and visibility to the investments (BAM) but can contribute to attracting further improvements in the built environments and the organizations (CERES, School gardens), and an increase of retail businesses and talented workforces in the area (BAM, Parco Portello). In these NBS cases, social benefits (creating vibrant inner-city neighborhoods with the community participating), economic benefits (i.e., stimulating the local economy), and ecological benefits coincide not least due to the creative forms of environmental activism fostered by arts. Furthermore, they illustrate that public engagement through art can create memorable place-based experiences for a broad audience, making ground for ecological learning in urban centers, even in the top-down cases.

5.3. Tangible expressions: transforming the urban space into NBS

The previous sections showed the agency of design revealed in the intangible and mixed tools that bring amplified awareness to the workings of natural systems and place-based knowledge. Here, I further detail the connections between nature-based outcomes and urban placemaking processes. First, I present how the physical form supports the social, human perspective of nature-based places. Then, I summarize how physical placemaking aspects can serve the non-human natural elements. Finally, I discuss the tangible expressions which show how the physical environment's design can change people's proximity to nature and shift the physical relationship to the environment. Altogether, this section accounts for the many ways urban design can revive a connection and relevance to nature: in urban open spaces, in schools, in architectural designs, and workplaces.

The previous sections underlined the distinctive social relevance of NBS. For activating the social features, adequate environments are required: to meet, linger or stand, connect with small or large groups, do sports, sit, and relax, even celebrate, feel connected, and be included in the community. Nonetheless:

> It is difficult to design a space that will not attract people - what is remarkable is how often this has been accomplished (Whyte 2012, 109).

Placemaking literature compresses universal knowledge on designing the physical space to enable and facilitate social interactions. For example, the Project for Public Spaces' (2016) Place Diagram (see Figure 81 in Appendix D) communicates the common elements of most successful places derived from practitioner knowledge and the organization's experience over the last forty years. The key qualities are:

- *Sociability*: a place for various interactions;
- *Uses & Activities*: a place where people can engage in meaningful activities;
- *Comfort & Image*: a place for easy and comfortable use;
- *Access & Linkages*: a place accessible to all.

These qualities affect the immediate human spatial experience in public spaces and indicate the importance of design solutions that capture embodied 'enactivism' or *affordances* (see details in Chapter two, Section 2.5.1). Looking at NBS from the perspective of what the designed environment affords gives a clearer understanding of the relations between urban design and human behavioral responses to the designed features and the place's intangible properties, such as programming, image, and branding. The urban NBS outcomes that enable meaningful participation in social activities have *physical features* that imply openness, sociability, inclusiveness, safety, accessibility, and visibility. The most critical factors are cleanliness and proper maintenance, accessibility, walkability, amenities facilitating social interactions (street furniture, picnic or barbecue areas, shelters), and information signs (Ferreira et al. 2020).

All the studied cases are relatively well maintained and have convenient access and connections to pedestrian walkways, public transportation, and even cycle paths. Naturally, some are more significant junction points, such as BAM or Medibank Place. What seems to be distinctively different between some of the cases is their *ease of access* and *approachability*. For instance, there are no restrictions to entering BAM or NaturePlay. They are open 24 hours without any gates or fences. NaturePlay is a children's playground, and it would be fitting to assume that for safety reasons, fences are needed. However, the morphology of the space (plants and rocks) provides natural boundaries and a safe environment. Even the idea of fencing the playground seemed absurd to the park rangers: "see, Melbourne has a policy that we do not really put up fences in our parks for any reason. Genuinely not" (#Mlb10 Respondent).

The effects of inviting versus less inviting features are observable at Bercsényi grove. The grove's first basin is reportedly the most popular (#Gy01,06 Respondents). It is a deep-lying area inhabited by old sycamores, chestnuts, and ash trees with high biological activity. It has no fence and can be used anytime. As a result of the social rehabilitation program, a playground area was set up. Additionally, the green area was wholly renewed: deciduous trees and evergreens were planted, and the grassland was refurbished. The site is supplemented with a public 'Green House,' which has a public toilet, water block, and changing room for the public and the maintenance staff. The second basin's sports court and the outdoor gym are similarly usually occupied. Nevertheless, one must comply with the house rules presented on large informational boards to enter. The third basin holds a KRESZ (road regulations) practice park for kids, almost empty during site visits. The second and third basins are fenced and closed for the night (Figure 59).

Figure 59. Entrance to the kids' KRESZ practice park in Bercsényi grove.

Moreover, different levels of connectivity and activation highlight the differences between the sites' physical designs. At BAM, the park's physical, geometric structure, the interlacing system of paths converted the area into a social, cultural, and commercial nexus, integrated into the surrounding retail, fashion, cultural infrastructure, offices, and residential areas. This kind of physical connectivity, integration, and activation of the nodes is missing in the current state of **Kuopio park** and **Bercsényi grove**. It shows a disregard for the opportunity through which placemaking can foster the circumstances for gaining economic benefits by attracting businesses and concentrations of people (Gehl and Svarre 2013; CBRE 2017), even though that was precisely the goal with the grove's rehabilitation program (#Gy06 Respondent; #Gy02 Document). Kuopio park is situated in one of the most densely populated parts of Adyváros (#Gy10 Document). It sits between ten-story panel blocks, surrounded by commercial, leisure, and educational facilities. Yet, life happens outside the park (see Figure 60 on the next page), which is mainly used for transient traffic (#2,3,9,10Gy observations).

Figure 60. People are meeting at the edges of Kuopio park.

However, it is worth noting that the planned interventions might change this in both cases. Bercsényi grove's segmented shape is due to its historical development. The regeneration project did not aim to change this structure, although reducing the segmentation would add extra ecological and use benefits (#Gy01,02 Respondents). Although the nearby schools, kindergartens, and residents use some of the park's amenities, since the grove's revitalization was also only half-done, it prevents achieving more considerable effects (#Gy01 Document). In contrast, there would be a possibility to remedy the shortcomings. As #Gy01 Respondent expresses it, it is never too late because the urban change is constant:

> There could have been several things to think about. For example, there should be a coherent corridor, because the uses are very separated now, physically… But it's not necessarily too late, and it can even be done later.

Bercsényi grove and Kuopio park are urban NBS examples with untapped potential. Indeed, there are underlying institutional and governance reasons for this situation. However, the design aspect is just as significant. As the quote starting this sub-section also illustrates, despite the considerable efforts to ameliorate the physical design of these places (see the budget spent for BG and KP in Table C21-22, Appendix C), outcomes can be unsuccessful. In these cases, the reason is a lack of consideration of the placemaking point of view.

One of placemaking's most significant critiques is being overly anthropocentric (Fincher et al., 2016). While placemaking literature endorses the use of nature to support human wellbeing as a form of green placemaking (see Gulsrud, Hertzog, and Shears 2018), non-human elements and ecological systems are overlooked and not taken into account as equal parts or users of the space (Hes et al. 2020). At the same time, the richness of relationships formed between place, people, and nature indicates a place's success in reaching its potential in social, ecological, and economic outcomes (ibid). Therefore, nature-based placemaking outcomes should direct the public's and related stakeholders' attention to nature's role in achieving successful places and the importance of designing solutions that provide for non-human nature. However, humans have become accustomed to keeping a distance from 'nature' in urban places. Therefore, urban places have a double role in providing for nature while offering comfort for humans in living alongside 'nature,' for example, allowing people to observe, meet, and appreciate them safely.

When examining the cases from this perspective, the efforts to create a remarkable level of botanical richness stand out in some cases, largely unprecedented in public parks and green open spaces. For example, the **BAM, Parco Portello,** and **NaturePlay** cases feature over a hundred different species of all kinds of plants: flowering and blooming species selected for enhancing local biodiversity, providing food and habitat for birds and insects, or educational opportunities and cultural associations. As one of the designers of the NaturePlay playground explained:

> I think beyond play, the complexity of planting in this project was really significant. At the time when we put plants through projects, it was pretty monocultural. So, you would choose five or ten species that worked well and that would get rolled out over the whole site. [NaturePlay playground] has hundreds of species and lots of plant communities that have been established to have flexibility to change over time and self-populate itself and colonize (#Mlb05 Respondent).

Most importantly, the plantings of NP are designed to look and function as they do in the wild: as communities. Indigenous, compatible species in interlocking layers create harmonious and resilient designs that require less maintenance (ibid). Even **Medibank Place** and **Bosco Verticale**, the two building cases, show uncommonly extensive usage of greens. Undoubtedly, the BV towers are strikingly different from other buildings with green facades or roofs. They display a more intensive green planting than most parks (the two towers together have more trees than BAM, for example, although relatively smaller trees). Furthermore, apart from the amplification of planting, the Australian cases (NaturePlay, Medibank Place, CERES) all have a high emphasis on using native species in the planting design, not only to enhance local biodiversity but also to reinforce cultural connections with the land and country, and to encourage a deeper discovery of indigenous Melbourne (#Mlb05,10,15 Respondents; #Mlb04,13,16,24 Documents).

Some of the cases contain an intentional allocation of space for non-humans. For example, in **BAM,** specific plants serve to feed the visiting birds (#1 Milan guided tour), and in **Kuopio park**, there is a small mud collector pit for swallows to help them find the nest-building material in the city. For the **School gardens in Győr**, a standard program is to build insect hotels and bird feeders to support the non-human visitors and inhabitants of the gardens as part of the educational activities (#Gy08 Respondent). In other NBS cases, the designed outcome's physical features *unintentionally* attracted non-human 'users' to occupy the space and make it their home. In **Parco Portello**, a significant community of frogs 'appeared' and made the small pond their own (Ghezzi 2019), which is now regularly observed and monitored by local ecology enthusiasts (#M09 Respondent). Soon after, a duck family followed, to the enjoyment of the kids visiting the park (see Figure 61 on the next page).

Figure 61. Info board about the frog colony and duck family at Parco Portello.

In **CERES**'s case, the restored ecosystem naturally contributed to the reappearance of the local flora and fauna. A major cornerstone marks the 1994 return of the Sacred Kingfisher bird to the Merri Creek (running along the edge of the CERES site), to its traditional nesting ground that they had abandoned due to the creek's contamination (see the explanatory board in Figure 62). The annual return has been celebrated every year for the past 25 years.

Figure 62. Board with the story of the returning king fisher at CERES.

In **both building** cases, birds started to use the human-made environment to find nesting places (#M02 Respondent; #M34 Document; #Mlb02 Respondent). This relatively new phenomenon is gaining more attention from the urban ecological community. Research shows that even endangered species can successfully adapt to raising nestlings in high-rises. Artificial nesting boxes can provide alternative wildlife conservation methods in cities (Reynolds et al. 2019). These outcomes were not the result of conscious planning but happened because “nature appears” (#M11 Respondent). Nevertheless, the experience has inspired the designers of BV: the new vertical forest 'prototypes' are designed to integrate birding boxes into space for the wildlife and support them in finding habitat in the urban area (#M02 Respondent; #M34 Document).

The ‘appearance’ of nature in the above cases reinforces the idea that designed features of physical environments can *participate* in nature: to enable[84] non-human nature to find its ecological niche and occupy its place in the urban environment. Viewing NBS through a design lens reveals a constructed or produced place that acts as an ecological niche and a social space for people simultaneously. For non-human nature, features like high biodiversity and relatively unmanaged land that allow for re-wilding bring the ability to create ecological niches. Increased natural elements lead to increased ecological services that can enable self-regulating biodiversity.

However, necessary physical structures and preconditions must be assured for the biological and physiological needs of non-humans and developing their baseline capabilities (Parker, Soanes, and Roudavski 2022). This implies a more nuanced understanding of interspecies design and accommodating nature’s ‘affordances.’ Moreover, these issues question the theoretical and practical understanding of design responsibilities towards other beings.

[84] Or, in contrast, the physical environment can restrict even punish certain uses and behaviors. The urban-design strategy that serves to prevent or deter certain behaviors purposefully is called ‘hostile architecture’. Examples include anti-homeless spikes, urban furniture designed to discourage sleeping or skateboarding, and bird control spikes installed on buildings, sometimes even on trees.

Of course, such urban spaces are never genuinely wild, but the relative wildness in 'undesigned' and unmanaged spaces is essential both for non-humans and humans. For the non-human, there are potential biodiversity conservation benefits (Rosenzweig 2005). For the human, since Wilson's biophilia hypothesis (1984), multiple studies have confirmed that *contact with nature* plays a fundamental role in human physical and mental health, wellness, and even happiness (Methorst et al. 2021).

5.3.1. Designed for connection: biophilic design patterns

Urban places with NBS congregate *biophilic design elements* (Beatley and Newman 2013) and provide means for bringing the concept of biophilia to life. NBS offer multiple entry points for potential *nature interaction patterns* - abstracted descriptions of human-nature interactions - that connect people with their environment, other species, and nature (Bush, Hernandez-Santin, and Hes 2020). For example, humans experience wildness via the large open spaces and wide vistas (such as mountains or water) through the experience of solitude and a sense of being outside of civilization. Nature interaction patterns include seeing, hearing, encountering wildlife, discovering, following trails, walking, or playing with dogs (Lev et al. 2020). In urban settings, the different nature connections are brought forth by *biophilic design patterns* related to physical, geographical features, and types of green space. The concept of biophilic design patterns[85] decodes how urban spaces' design facilitates and deepens these connections. It puts biophilic design in context with urban planning and architectural practices for interior and exterior applications (Browning, Ryan, and Clancy 2014). As landscape designers working at Andreas Kipars' studio (designer of Parco Portello) reflect:

> Our mission is to reconnect people with nature. Usually, our first aim is to bring nature into the city or wherever we are working and create a link with people...

[85] The concept of biophilic design patterns builds on the precedents of Alexander's 'pattern language' (1977) derived from the timeless and universal entities called patterns that people rely on when designing their environments (also see Section 2.2.1 and 2.3.1 in Chapter two).

so that the two of them can benefit from this symbiotic relationship (#M11 Respondent).

The NBS cases address nature's direct, physical presence: they are all inherently examples of biophilic design and cover different strategies for incorporating nature into the physical space. Following Browning, Ryan, and Clancy's (2014) classification, the related biophilic design patterns are detectable and grouped around three categories: *Nature in the Space, Natural Analogues*, and *Nature of the Space* (see more details in Table D31, in Appendix D). This section demonstrates the different biophilic design patterns in the NBS examples. Focusing on amplified nature interactions and connections does not necessarily equal placemaking. Instead, it covers the missing 'element' which can amend placemaking's usual human-centeredness by evoking biophilia and creating nature-centered physical designs which provide the foundations for transforming urban spaces to NBS.

The *Nature in the Space* category describes experiences through direct connections with natural elements. All cases demonstrate patterns belonging to this category, as all NBS work using natural components. The pattern of **'visual connection with nature'** is most apparent at Bosco Verticale, where nature provides a visual experience only (for the general audience). In contrast, the green solutions of Medibank Place act on multiple levels.

Patterns of **'non-visual connection'** and **'sensory stimuli'** are detectable in many cases. At BAM, the flowering meadows, vegetable gardens, and aromatic fields with sage, thyme, rosemary, lavender, and mint encourage visitors to smell, touch, and take a closer look at the plants. The urban and educational gardens (installed at BAM, CERES, Medibank Place, and the School gardens of Győr) provide the most stimulating natural environments, as they are places to taste and eat the produce. Moreover, they offer direct participation in the natural elements' maintenance that positively correlates to an increased sense of place (Petrovic et al. 2019) and place attachment (psychological and emotional connection to place) (Romolini et al.

2019). The **‘presence of water’** is another vital pattern offering various opportunities for nature experience that BAM, Parco Portello, Nature Play, and CERES utilize. The building cases utilize the patterns mostly connected to architectural and interior architecture use. The patterns of '**dynamic & diffuse light'** and **'thermal & airflow variability'** correlate with Medibank's health-based workspace strategy. The Medibank interior design is structured to allow fresh air and sunlight throughout the building. At Bosco Verticale, the use of natural features in the building design provides the basis for the towers' living building entity: the deciduous trees in full leaf give shade in the summer, reducing solar gain and cooling needs, while in winter, the bare branches allow the sun to warm the apartments, reducing the heating requirements (Boeri and Insulza 2009, 3).

One of the best cases to illustrate how the design facilitates nature connections and stimulates all senses is the NaturePlay playground. Native species are planted for educational and play opportunities. Thus, the playground has interesting plants to look at, smell, touch, or use, such as the rangers telling stories about local history (Figure 63). The rangers designed their educational programs to provide a nature experience in multiple ways: “most of all these plants are here for sensory applications, they smell nice, or we can use berries for finger painting” (#Mlb05 Respondent).

Figure 63. NaturePlay: honeyeaters and kangaroo paws, playground landscape, flowers used by park rangers.

There is a saying that good design is invisible (or unnoticed), but its impact is priceless. Even though there are indeed built elements, visiting NP made an impression that the playground was 'naturally' part of the surrounding Royal Park. What attracts attention is the abundance of nature. (between 'Grass Flowering' season and 'Kangaroo Apple' season). The distinct smell of gum trees was in the air, native banksias were already flowering, and kangaroo paws fully blossomed. Many of the typical Australian bird species represented themselves. Noisy miners, a honeyeater species, were hanging on the kangaroo paws eating the nectar, magpies and butcherbirds were sitting on the rocks, while flocks of crested pigeons and galahs (pink and grey cockatoo) were picking seeds from the ground. I could also spot sulfur-crested cockatoos and rainbow lorikeets (#1,10,11,12 Mlb observation).

Such rich sensory experiences were present at CERES, too. However, it is not a privilege of the exotic land 'down under.' The other case which was most affecting in a sensory way is Parco Portello. When approaching the site from Portello underground station, across the arc-shaped pedestrian bridge, which is the only access to the park from this direction, the mounts' site emerges, making the nearby buildings look small compared to the hills (Figure 64). It is enclosed between high-speed roads and newly built towers: the park does look like "an urban oasis" (#M10 Respondent).

Figure 64. Panoramic view of Parco Portello.

The contrast between the one side of the bridge and the other is apparent visually but is felt physically. The mounts shield the park from the outside world, the noise level is lower, and when walking on the narrow paths, it is almost completely quiet - a rare experience in Milan. Suddenly, traffic noise is replaced by birds chirping, and the air brings the smell of flowers from trees blooming almost all year long.

NaturePlay, CERES, and Parco Portello have a palpable (nature-based) ambiance that I could record only through the observation diaries and by taking hundreds of photos. Still, it is challenging to assess scientifically. What seems to underline my 'feelings' is the interconnection between the biophilic design strategies: the most robust *Nature of the Space* experiences are generated with the integration of *Nature in the Space* (detailed in the previous sub-section) and *Natural Analogues* patterns (Browning, Ryan, and Clancy 2014).

The design of **Parco Portello** enables such integration by using spatial configurations. It transmits Andreas Kipar's claim that "we need tangible nature" (#6 Andreas Kipar open lecture). The park's design recalls *Nature of the Space* patterns: when one walks the narrow paths leading up to the top of the mounts, it fits only one or two people (see Figure 65 on the next page), and the visitor is enclosed by the bushes, without any clue what will be there at the end of the path (patterns of **'mystery'**), while birds and lizards can be seen and heard hiding in the bushes. A clear view only appears once the top is reached, revealing a panorama of the mountains around Milan (patterns of **'prospect'**).

Figure 65. Narrow paths on the mounts of Parco Portello.

The park has large, open areas but smaller, intimate spaces where hiding young couples can be found at the top of the mounts or in the Time Garden, a 'Hortus conclusus' (an enclosed garden in Latin) (patterns of **'refuge'**). The park's morphology activates *Natural Analogue* patterns: the geometric system of circles, arcs, and half-moons, the change of heights and sights, or the variety of open and intimate spaces (patterns of **'biomorphic forms'**). The changing environment triggers a sense of exploration, with lots of things to discover. Jencks goes further: for him, bringing nature into the city is also a means to provoke people into a different state of mind, with the help of patterns of **'complexity and order'** that are activated in the hills' symbolism.

> What is a garden if not a miniaturization, and celebration, of the place we are in, the universe? (Charles Jencks quoted in Yurkewicz, 2010)

Similarly, at **NaturePlay**, *Nature in the Space* patterns are blended with *Nature of the space* and *Natural Analogue* patterns, manifesting in landscape elements to shape the space and provide nature-based play opportunities. **'Biomorphic forms'** are found amongst the playground elements that also reflect the pattern of **'material connection with nature.'** Like at Parco Portello, the excavated excess soil from the construction was used to create a small hill next to the playground, offering dramatic views of the inner city (Figure 66) and additional opportunities for nature-based play and climbing, rolling and exploring (**'prospect'**).

Figure 66. View of the NaturePlay playground and Melbourne skyline.

Notably, the play area's design allows a deeper exploration, engagement, and appreciation of the Royal Park, as NP 'interfaces' with the rest of the park and lures kids further into the bushland (**'mystery'**). Indeed, as we leave the edge of the playground, all sorts of assembled logs and little huts can be seen, traces and reminders of what kids have been building by themselves (**'refuge'**) (#11 Mlb observation).

> So, they are going to the playground then to the park. And… it gets more wild, more natural areas, and they start building little cubby houses. That is the way this sort of interfaces. That is what we are really trying to encourage, teach them to get out... the playground is great, but you have to get them out into the more wilder spaces to do some more nature play (#Mlb10 Respondent).

For the smaller kids to have the same experiences, the rangers keep a 'mess' in the middle of the play area (Figure 67), where they leave piles of branches on top of a lightweight steel frame to encourage the kids to weave them through the structure and create their own kind of enclosure (**'refuge'**).

Figure 67. Information board for the cubby in NaturePlay playground.

The practical implementation of **'risk'** patterns is best illustrated with NP's design outcomes. The urban environment implemented at the playground managed to incorporate and show the manifold benefits of how nature-based play provides for playfulness and children's development. One of the most critical aspects is *accepting risk*: kids learn to take risks that they can manage. The naturally uneven surfaces, play structures, rocks, and climbing structures all serve this purpose, prompting kids to be in motion, explore and engage with nature on their own terms. As the designers explained:

> The benefit of people learning through tripping or falling or learning how to be on unstable materials far outweighs the risk of someone falling... It is better that kids learn to manage risks as children, therefore, they are not risk-taking

> adults… Our job is not to avoid [risks] all, but to manage the impacts of those things through design (#Mlb04 Respondent).

Furthermore, the nature-based playground design provides graduated challenges for each age group and kids of different needs while encouraging playful interaction and social participation between children. The design is genuinely inviting to try out one's abilities and be adventurous. Even parents can be seen using the play elements themselves: upon the highest points of the climbing forest, which are the most challenging part of the playground (#12 Mlb observation).

> The climbing forest is really, really technically difficult. A lot of kids give up on that one. And it is fascinating. But I remember being here one day, and there was a boy, he was 11. He was just going up and back and up and back, challenging himself in a slightly more complex way each time he went. I reckon he was in there for nearly an hour. And that is fantastic. Physical activity is really good because it is developing so many of their movements. … And I think that they are missing that with some of the standard equipment in other parks (#Mlb09 Respondent).

The NBS showcasing a series of biophilic design patterns illustrate the unique aspect of design: how the physical look of things is translated through aesthetics and interactions into appreciable experiences. Furthermore, these tangible outcomes imply a new type of urbanity where the urban form is more socially and ecologically attentive to others than humans in its expression of creative potential.

Chapter conclusion

Design outcomes can dynamically change as the physical environment, or the social, environmental, and economic context, develops. Thus, the delineation of such effects is challenging. Still, analyzing the outcomes connected to the actualized designs presents a useful ground to consider the multiple facets of the NBS concept.

In this chapter, I demonstrated that NBS are place-based interventions. They have a physical structure and a mental representation embodied in people's minds and practices. This underlying, designed system comprises universal rules and leads to specific design outcomes.

Urban design-based placemaking offers several methods and tools for locals and other stakeholders to interact with NBS in various ways, and for the making of lively and sustainable places, community engagement and involvement are indispensable (Schlebusch 2015). This chapter has shown that building social relevance is crucial for NBS, making it possible for people to get to know their role, operation, and importance. Either through tangible or intangible tools, the design outcomes of NBS should express relevance to the local sociocultural context, fitting to the urban mosaic. Moreover, these outcomes should enable urban NBS to foster 'bio-cultural diversity' (Vierikko et al. 2016), contributing to relations between humans and non-humans and between people in their communities (Frantzeskaki 2019).

Concurrently, these design outcomes demonstrate that NBS (as urban forms) create a *blended urbanity* working for humans and non-humans. Viewing NBS as the natural expansion of urban places clarifies in practice the benefits of preserving nature holistically. As the cases illustrate, urban NBS supports and enhances biodiversity, even contributing to conservation efforts. Simultaneously, they provide space for seasonal and daily activities, special events, and guided tours: a platform for discussions and education. Such an understanding expands the designated function of urban places as *semi-natural* systems.

Based on the findings, I argue that using NBS in public and semi-public spaces can demonstrate the changing role of green spaces within cities, in the most successful cases, by showing and communicating the immediate effects linked with multi-faceted benefits of integrating nature into urban areas. Furthermore, the cases show the various ways nature gives the *foundation* for placemaking processes and activities, consequently in an array of social, environmental, and economic benefits.

These design outcomes underline that nature (the non-human) can be viewed as an *active participant* in a place whose appearance, connections, flows, and functioning define the character and sense of place (Bush, Hernandez-Santin, and Hes 2020). This way, the built environment indicates *a transformed, nature-based urbanity* where it can not only participate in nature but also amplify nature's role as one of the main actors necessary to be included in development processes. However, pitfalls and failures occur, in which cases the design outcomes result in unsuccessful urban forms without relevance and connection to their local settings, thus, not meeting their potential.

This chapter highlighted the role of the physical, designed characteristics of urban NBS, which are critical in affecting the quantity and quality of interpersonal and interspecies experiences, interactions, and perceptions**.** In the cases which demonstrate a combination of placemaking and renaturalization efforts, the design outcomes reflect the aggregated benefits gained from a blended human-centered and ecologically focused approach. This chapter concludes that, following Hes et al.'s (2020) arguments, for placemaking with NBS, it is urgently necessary that the design serves humans and the non-human natural environment alike without undermining nature's role for the sake of well-being and livability. The placemaking expressions analyzed in this chapter provide a developing, practical toolbox relevant to various professions needed to further develop for a fruitful cross-pollination between disciplines.

6. Between conflicting paradigms: analyzing the design approaches for urban NBS

The overarching goal of this thesis is to examine how design dimensions (outcomes, approaches, and processes) affect the unfolding and advancement of NBS. The NBS characteristics as the *outcome* of design activities show a human-oriented, ‘reawakened,’ or renaturalized urban nature with some consideration for the non-human (see the previous chapter). Still, they only reveal the direction of the design intent but not the ‘origo,’ the baseline statement, which can tell what the design was trying to achieve (Figure 68).

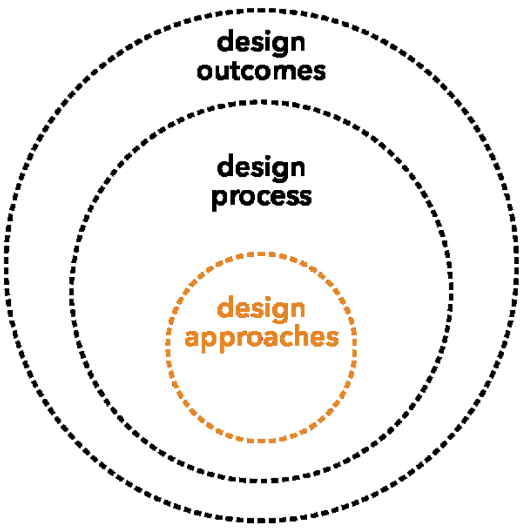

Figure 68. Dimensions of the NBS design framework. Adopted from the three lines of work in regenerative design (Mang and Haggard 2016).

Further differentiations are needed to define the guiding perspectives because NBS - although they appear to centralize and include 'nature' - are ultimately shaped by underlying intentions and motivations. Some of these intentions are demonstrably human-centered, focusing on how humans use and benefit from a particular place. However, these underlying design approaches have expanded to include, and at times, centralize, more-than-human interests in achieving NBS.

Design activities are inevitably contextualized. Distinct *values*, such as aesthetic, social, environmental, traditional, or gender-based values (Holm 2006), are attached to design *approaches* (seen as specific philosophies about the design). Thus, approaches reflect a particular era's challenges and cultural norms, varying as other movements and mainstream philosophies in history follow each other (Birkeland 2002). Moreover, different approaches can be used simultaneously to address problems, challenges, or situations. However, unpacking the dominant ones can reveal the "major determinants" (Bawden 2010, 96): the worldviews of stakeholders, designers, and participants involved in the design process. Thus, specific approaches can indicate that the design aligns with a particular worldview, affecting the involved practices and methods.

There is already a range of theoretical contributions articulating design principles connected to NBS,[86] and theoretically, the regenerative design approach is likely most suited to urban NBS design (see Chapter two). However, I am primarily interested in how and which approaches are applied in practice and contribute to regenerative urban change. Therefore, in this chapter, I investigate the starting point of the design activities to analyze: *How are design approaches applied for urban NBS, and how can they guide regenerative transformations?* To answer this question, I first present the findings and assess the values, principles, or models (Friedman 2000) of the NBS designs to deconstruct the motivation behind design decisions and judgments. Specifically, I concretize two different approaches related to NBS design: the human-centered and more-than-human-centered approaches. Then, I interpret the results in light of the broader impact on the design outcomes of realized NBS and, thus, urbanity.

[86] For example, the IUCN global standard for NBS (IUCN 2020), the regenerative design principles by the Regenesis group (Mang and Haggard 2016), or the principles of biodiversity sensitive urban design (BSUD) (Garrard et al. 2018) express nature-based design principles. Furthermore, Kabisch, Frantzeskaki, and Hansen (2022) formulated specific principles for the urban governance and planning of NBS.

In Section 6.1, I present the dominant 'human-centered' approach in the NBS cases and examine its implication for the design process. Then, in Section 6.2, I demonstrate a different, emerging approach guiding design actions focusing on the more-than-human. I also discuss how these worldviews represented through design provide means for fostering the ways of organizing human life, the relationship between humans and the environment, and reflecting human subjectivity. Then, in sub-section 6.2.2, I present a new conceptual framework integrating the key elements of a more-than-human-centered approach to urban design. Finally, in the last sub-section, I discuss how the presence of a more-than-human-centered approach in NBS design could contribute to regenerative urban transformation.

6.1. A human-centered view

The global effects of human activity on the physical environment are unquestionable: it is estimated that in 2020 the collective human-made mass, or 'anthropogenic mass,' surpassed the overall living biomass on Earth for the first time in history (Elhacham et al. 2020). Meanwhile, the Sixth Mass Extinction in the history of Earth's biodiversity is underway, and it is caused entirely by humans (Cowie, Bouchet, and Fontaine 2022). In effect, we have made the world our own. It is only fair to say that in the Anthropocene, almost the whole world is already a managed landscape. Even the definition of the word 'landscape' is human-oriented: "an area, as perceived by people, whose character results from the action and interaction of natural and/or human factors" (Council of Europe 2000, 3). Moreover, a people-centered[87] approach is argued to be necessary for working toward ecological and socially just outcomes, as highlighted even in conservation discussions (Fleischman et al. 2020).

[87] Discussions in the international development literature tend to use the term 'people-centered' to describe development approaches that aim to improve local communities' self-reliance, social justice, and participatory decision-making.

In the urban context, embracing human-centered design (HCD) means understanding the community's local, diverse, context-specific needs and translating these into urban design solutions. This approach can lead to more attractive places with more interest and relevance to people of particular local socio-cultural environments. Most cases studied in this thesis have a strong human-centered approach. Moreover, as recent scholarly investigations confirm, this is *typical* for delivering NBS in general (Pineda-Pinto, Frantzeskaki, and Nygaard 2021).

Through selected examples, the following paragraphs describe the cases' conceptual framings with humans deliberately centered in the design process, which is detectable from the principles or objectives defined at the early design stages. In the case of **Parco Portello**, Jencks's design principles, called the 'ten lessons,' were used as a reference point for the conceptual shaping of the park (de Molfetta 2014). The lessons were drawn from Jencks' observation of city parks. He underlined the prominence of users and how critical they are to the success of a public park, mainly referring to locals, women, and children (presented in Table E32, Appendix E).

Likewise, **BAM's** HCD approach is derived from the overarching goals of the Porta Nuova regeneration project, where the extended urban greening served as an urban connector and enabler to reshape the identity and experience of the former urban settings. The goal was to provide new points of attraction within the central hub of the new development (#M04 Document). The park's irregular, flowery meadows were created by the Dutch landscape designers Petra Blaisse and Piet Oudolf, the "father of spontaneous gardens" (#3 ICON design talks). It is a complex, natural, yet very urban and controlled landscape combined with programs and functions intended for people.

In the case of **Medibank Place**, the achieved design is the physical manifestation of the company's ambition, which they described as "pretty radical," to create the healthiest workplace: "a living, breathing, healthy building" (#Mlb03 Respondent; #Mlb16 Document).

Therefore, the Dutch Veldhoen+ Company's workplace design consultants were asked to prepare a high-level brief on how such values could be incorporated into the workplace. The company's specialty is designing for activity-based working (ABW), which was adapted to Health-Based Working (HBW) as an enhancement to reflect Medibank's mission. As #Mlb03 Respondent explains it:

> It is significantly different from a normal ABW program. Very focused on people's mental and physical health. ABW was very much about individual performance, that was often in financial institutions and banks. This [HBW] was trying to look at it slightly differently and say, but how do we keep people moving? How do we make sure their social connections are healthy? How do we make sure they are supported? How do we make sure the air quality is good? We tried to make it more holistic with a much broader sense of health and wellbeing underpinning it.

The health and activity-based focus resulted in a workplace that promotes human health in the physical, emotional, and social dimensions, for example, by encouraging movement across the office space to maximize physical activity and provide for various interactions. The applied NBS (the extensive use of greenery in the interior and exterior of the building) supports the HBW principles' physical manifestation but primarily serves human well-being, specifically of Medibank's workforce.

The other case where a particular group of people is at the center of the design is the **School gardens in Győr**, supporting children's development[88]. The Apáczai trainer garden is consciously designed to create a multifactorial play environment, following the architect Simon Nicholson's (1972) *Theory of Loose Parts*, principles of which are then advocated in the design guidelines spread through IKA. Nicholson's theory strongly impacted the development of childcare, playwork, and environmental education. The idea is that "in any environment, both the degree of inventiveness and creativity and the possibility of discovery, are directly

[88] The central learning and educational goals of school gardens are environmental and sustainability education; education for self-care and cooperation; health education, experiential pedagogy; reality-based, phenomenon-based, action-oriented learning; agricultural career guidance (#Gy17 Document).

proportional to the number and kind of variables in it" (ibid,6). "Loose parts" are materials people can interact with: moving around, altering or tinker with, and creating structures or forms. They are environments that offer opportunities for creative engagement.

> Here is an excellent example of [the theory of loose parts]. There were concrete cubes here, and the kids started building things from them. They made a wall, stacked the stones on top of each other, and stood upon it, playing to push the other out of there. They immediately started to play with such variable elements. They absolutely figure these things out by themselves (#Gy08 Respondent).

Nicolson applied his theory primarily to playground and school design and advocated for rescoping the static school environments, conceptually and physically, into settings that engage children's innate creativity. The School gardens' design intends to foster an environment where children can thrive through engagement with plenty of open-ended and real materials. Natural and artificial structures can serve this purpose, as the design features of the School gardens demonstrate. However, building on a place's nature-based character is more advantageous because nature genuinely provides these features with significant health outcomes (Maller 2009).

The **Bercsényi grove** and **Kuopio park** cases also show a predominantly human-centered focus, although no specific articulated design approach could be traced in these cases. However, Bercsényi grove's human-centeredness can be assessed indirectly because the renovation of the grove took place within the framework of the social city rehabilitation program (#Gy02 Document). Furthermore, in Kuopio Park's case, the primary motivation behind the redesign attempts was to remedy the area's parking problems (#Gy07,10 Documents).

The cases presented in this section correlate with a human-centered focus at their core. They show that NBS as design solutions make spaces more livable, enjoyable, creatively, and intellectually stimulating for people or certain target groups. Even if NBS are designed from an ecological approach, environmental considerations are primarily in the human interest.

However, the human-centered focus has many shortcomings, which the term itself implies. Approaching the world by centering each problem on the human perspective indicates that impacts and trade-offs are assessed based on distinct outcomes for ourselves, with less attention to (or ignorance) the broader impacts on more-than-human life. Whereas any change in the constructed urban environment inherently concerns the already existing ecology by sustaining or altering it. The urban landscape is "comprised of, shared, and made by animals, plants, fungi, microbes, atoms, and many other living and non-living beings, technologies and materials" (Maller 2018). This tension is also reflected by recent debates on related terminologies, for example, by those advocating for using the term 'nature's contribution to people' versus 'ecosystem services' (Ellis, Pascual, and Mertz 2019) or critiquing even the term 'nature's contribution' for perpetuating utilitarian environmentalism (Muradian and Gómez-Baggethun 2021). In short, the HCD approach renders a worldview where the non-human environment serves humans, and it has critical consequences.

One of the main problems is that anthropocentrism conserves design (and, in general, human actions) based on assumptions and beliefs without adequate reference to the social-ecological contexts in which the solutions would ultimately be integrated, resulting in unexpected or undesired effects and outcomes. Thus, an ecologically detached worldview and practice separate the information and knowledge about the diversity of non-human living systems from the information and knowledge of human societies (Tabara and Chabay 2013). Tabara and Chabay (2013) argue that this results in understanding (and meaning-making) that is inadequate for bringing about change. It is one of the reasons for the failure of widespread sustainability actions addressing ecosystem distresses (IPBES 2019), even though there is already much understanding and knowledge about the interplay between socio-technical and socio-ecological systems.

Consequently, from a design perspective, stressing the centrality of humans narrows and limits the 'play space': the scope of issues, how they are addressed, and the identification of desired or required outcomes. In a way, it even excludes life forms other than humans from the larger design arena. While ecological or green design concerns are naturally present among the design issues of NBS, a one-sided HCD approach can lead to an imbalance between actualizing design solutions for human interests at the expense of non-human nature. The half-done rehabilitation of **Bercsényi grove** illustrates this claim. Other than developing and renovating the park's social functions, such as providing space for recreation, play, and education, the interests of non-human entities were not considered to the extent of remedying the grove's physical fragmentation, even though that could significantly strengthen its ecological value and stability (#Gy01,05 Respondents).

Similarly, in **Kuopio park**, the smaller scale, regular improvements, and renovations (for example, tree plantings and lawn renewals, installation of amenities, such as benches, drinking well, and bike-sharing station) are concentrated only in half of the park. Meanwhile, the other half containing the large, shady trees was not only neglected but dedicated to providing space for parking to alleviate the area's parking tensions (#Gy03,04,06 Respondents). The plan was to turn the park area into parking by installing a one-story open structure parking lot. In exchange for the green space loss, a public parklet would have been created on top of the elevated parking lot, with bushes, smaller pre-grown trees, and amenities such as a promenade, resting islands with shadings, a playground, and a public toilet. The public procurement procedure was already underway, but "in the end, the construction price was so high that the city could not cover it" (#Gy06 Respondent).

Nevertheless, the economic burden seemed forceful enough for the city administration to change their approach: they defined a more cost-effective solution that did not touch the park’s existing vegetation. Instead, the new plan projects an additional parking level (located at the park's side, on the street, above the parking cars) accessible via a ramp. This idea recognizes environmental considerations and the road users' needs, increasing parking capacity while preserving the park (#Gy10 Document).

Kuopio park’s example demonstrates that there can be significant differences between two human-centered solutions concerning the extent of consideration of the non-human. Although both versions stem from an HCD approach, the existing vegetation (and the related ecological functions and benefits) would have been partially lost to meet human needs in the initial plan. In the final project, the difference is that not only that benefits to humans were prioritized in the design process, but also the pre-existing ecological values.

The **Kuopio park** and **Bercsényi grove** cases exemplify design solutions where ecological values are considered to different extents or based on different understandings of what is valuable in a natural urban place. Consequently, they demonstrate missed opportunities for improving or augmenting existing NBS designs. However, they also call attention to the potential of urban NBS, which has not been fully actualized for various reasons: their realization is pending.

Even at **BAM,** the lack of rewilding arises as a missed opportunity. Piet Oudolf's gardens at BAM are beautiful and rich in species, but are the product of a traditional way of thinking, as one of the contributing landscape designers expresses it:

> In a way, the park is an old concept. It is 15 years old. It is from a time when we thought that nature had to serve us, very literally: so, the trees give shade to people, they had to create the spaces that we wanted to have, etc. But I think, in the last years, I really feel that things are changing slowly, to also allow wilderness into our life, that we also crave for something that is unorganized in a way… And we become more and more conscious that you cannot just use [nature] for your own benefits, but if you really take it seriously, it will benefit you too (#3 ICON Design Talks).

Even though NBS with a human-centered approach can have a range of different valuable and beneficial outcomes (see chapter six), they still show drawbacks connected to a lack of focus on the more-than-human. It is not about a deficiency in architecture and urban design knowledge and capacities to work along with ecological terms - designing NBS is undoubtedly based on an environmental approach. Instead, the fault is in the reductionist human-centered lens, which renders the urban environment's 'form and function' fitting principally human desires and needs. Looking at the world from a human perspective is (epistemologically) inescapable, but it must be acknowledged. For design, it means a redefinition of the core of the design *intent*: in other words, reconsidering what is at the center of the design objective. Through any kind of design endeavor, the design objective can aim to embrace the complexity of socio-ecological systems or can be limited to primarily considering the development and short-term prosperity of human society.

6.2. Signs of emergent change

Recently emerging discussions about 'nature placemaking' (Bush, Hernandez-Santin, and Hes 2020), or the *more-than-human* perspective, provide entry points for integrating socio-ecological systems thinking in design, which incorporates but surpasses human-centeredness. Stefano Boeri's **Bosco Verticale** represents the more-than-human-centered (MHC) perspective, both in motivations and means[89]. Boeri's goal with Bosco Verticale and the following prototypes was to create "new spheres, where people, trees and animals can coexist in an environment of wellness" (CLAD mag 2017, 20). His approach to sharing the physical space is

[89] The Bosco Verticale case is controversial. It is an inspirational experiment with novel ideas and implementation. It is a LEED Gold certified green building constructed with high awareness on reducing its embodied carbon emissions. However, mitigating the construction emissions and the energy load of the operation with intelligent solutions and planting trees cannot counteract the inherent problem that the reduction of problems is only needed because of the building's existence. A building designed along MHC guidelines would follow a whole lifecycle-based, circular approach, including decommissioning. At the end of its lifecycle, it would be recycled without a trace. Nevertheless, I included the Bosco Verticale case here because it demonstrates the philosophical base of the MHC approach, however, its implementation does not entirely follow it.

based on a principle that he calls 'democracy of green' (#M02 Respondent; #3 ICON Design Talks), which prompts urban professionals to think about the equality of different species (human beings, plants, trees, birds, animals) in allocating space in urban developments. Pineda-Pinto, Frantzeskaki, and Nygaard (2021) highlight the issue of including ecological justice considerations in the design of NBS. They argue that while current research on NBS recognizes this need, in reality, NBS rarely explicitly relates to ecological justice dimensions. The vertical forest prototypes prove it is possible to follow through with the calling of the 'democracy of green' conceptually and technically. However, enabling policies would be indispensable to set the new industry standards.

> It is like [a] plastic bottle, so you know it is bad, but it is not that everybody is getting rid of that. The cultural change is yet to come (#M01 Respondent).

Although the MHC approach might sound novel and emergent, these approaches reflect a growing engagement with indigenous forms of ecological knowledge and patterns of nature use. For example, indigenous peoples worldwide practiced traditional polyculture land management techniques, currently recognized as agroforestry or permaculture. In Australian indigenous cultures, the interdependent relationship between individuals and their ancestral lands and seas is reflected in *'caring for country'* principles and practices. For First Nations people, *'country'* is the living environment beyond physical elements. It signifies a reciprocal relationship, fundamental to their identity and sustained by the environment and cultural knowledge. A quote attributed to Dennis Foley, a Gai-mariagal and Wiradjuri man, and Fulbright scholar, highlights the basis of the principle:

> The land is the mother, and we are of the land; we do not own the land rather the land owns us. The land is our food, our culture, our spirit, and our identity.

The indigenous inspiration of 'caring for country' can be found in contemporary applications for managing the urban landscape. For example, the principles are integrated into Melbourne's Nature in the City strategy (CoM 2017b). They can also be detected in **CERES**' design principles, guided by the motto: "Fall in love with earth again." CERES's primary design principle is "Touching the earth lightly in everything we do" (see CERES's design values and principles in Tables 33-34, Appendix E). The CERES design principles strengthen and share knowledge for land management rooted in belonging to the Earth.

Moreover, the principles are applied to guide the community activities and program organization. For example, during my field research in 2019, I took part in a weekend permaculture course[90] and I participated in a women's circle gathering titled *The Ways we Connect*[91]. We were near the end of 2019, and that occasion served to share in a circle 'the ways we connect to nature as women' and 'to deepen connection to the land.' Even though I was not from *that* land, it was a rewarding experience that opened deep reflections. These and similar CERES programs allow a broader audience to learn about indigenous principles and ways to connect to the land. Providing access for the public and local communities contributes to the promotion and protection of the cultural heritage of indigenous peoples against the processes of globalization and social transformation[92].

The 'caring for country' approach is also detectable in the design of NaturePlay, reflected in the design principles, which led to the specification of the design priorities. First, the priorities refer to creating a new park space (in the place of the demolished hospital) that maintains its Australian native landscape character, complemented with providing space for nature-based play (see the principles in Table E35, and the design priorities in Table E36, Appendix E). The design objectives, derived from the priorities, were then developed into the design solutions, incorporating the various opportunities that a nature-based environment provides for

[90] Led by Carol Henderson, Cultivating Community program at CERES.
[91] Brought together by Karla Riddell, founder of the Young Shaman Foundation. She runs women's gatherings in remote Australia with Indigenous elders.
[92] As indicated in the preamble of the 2003 UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (CSICH).

playfulness and children's development (see the design objectives in Table E37 and the play objectives in Table E38, Appendix E).

Interestingly, the connection to the land is similarly evoked in the **Győr School gardens cases**, albeit differently. In addition to pedagogy, play, community, and recreational opportunities, school gardens are also excellent sites for studying *folk horticulture* traditions. They evoke MHC principles by sustaining the historical heritage of traditional life support systems that rely on the symbiosis of the region's economic, cultural, and natural traditions, localized trans-generational knowledge, and the recognition of both human and more-than-human values. For example, the school gardens movement contributes to knowledge sharing about the care and preservation of heirloom landscape varieties or the use of herbs in folk medicine. Furthermore, the gardens display different ways to integrate that knowledge into the pedagogical programs: planting and caring for local plant varieties and familiarizing kids with nature symbolism and folk traditions. Children typically learn about the celebration of 'notable days,'[93] folk customs related to agriculture, heirloom tools, technologies, and folk handicrafts[94] (#Gy17 Document).

Although different in their specific solutions and results, the above examples illustrate NBS guided by principles aiming to reconnect humans with non-human nature within the frames of daily life. Even though these examples respond primarily to human problems, next to human-centeredness, another principle emerges that specifies solutions and fundamentally shifts the focus to a broader, more diverse, and less familiar audience. These cases indicate that considerations for the more-than-human are (re)entering design concerns.

[93] For example, September 29th is St. Michael's Day, a traditional fair day, which schools can celebrate with a 'market' for exchanging vegetables and fruits. November 11th is Martin's Day, which traditionally marked the end of the peasant year when the winter rest period begins. Schools can organize a garden-closing feast to celebrate. December 13th is Luca Day when sowing 'Luca wheat' was a produce-predicting tradition. The growth of wheat forecasted next year's crop. This habit can be evoked by sowing wheat in pots.

[94] IKA's suggestions include wool dyeing with plants, felting, cabbage pickling, sun drying of fruits, baking bread, learning about herbs, grape pressing, making corn malt, making toys from corn cobs, weaving, traditional composting (biodynamic composting with inoculation).

6.2.1. Focusing on the more-than-human

The ‘reawakened’ urban landscapes of NBS can remind us that nature is not “something that could be injected into cities” (Kaika 2017, 91) when we want to enhance our environments or lifestyles. Instead, an MHC design aims to reorient urban life into being part of the ecological system that has always been present, only made unrecognized due to the development of modernity. NBS with an MHC approach can be vessels to re-imagine and re-establish symbiotic relationships between humans and non-humans in their ecological, physical, technological, cultural, and policy domains.

Moreover, designing with the more-than-human in mind can even *amplify* the human benefits gained from ecosystem services. Even though certain species cause a nuisance to humans (such as wild boars or foxes in urban areas, pigeons, or rats), they may play an important ecological function and ultimately benefit humans. For example, mosquitoes are annoying to most people (even dangerous, under certain circumstances). However, they are also important food for urban birds. Negative and positive features are intertwined in a web of complex ecological interactions and cultural value functions. According to Maller (2018), in the urban context, many types of (if not all) non-human animal and plant species are advantageous for humans' physical, psychological, and mental health, all reciprocally affecting each other entangled in relationships.

Additionally, design for the more-than-human aims to include a non-human agency in the design process without excluding human interests (Ednie-Brown et al. 2020). This ‘change of scope’ in urban planning and design discourses raises *equity questions* crossing the boundaries of our species, to consider, for example, which species or populations have the right to inhabit or co-inhabit an ecosystem. We claim the right to displace ‘others’ (sometimes even people) when we build new structures or replace dismantled ones because the transformation is believed to be beneficial or is necessary for progress while potentially undermining our well-being.

6.2.2. Design for the more-than-human

The MHC approach goes beyond acknowledging that all design acts should be ecological at a fundamental level. Instead, it is about shifting the center of attention. It prompts the development of solutions consistent with the social-ecological conditions and regeneration requirements. However, no formal definition clearly articulates the values and premises of an MHC approach to urban design. Hence, I present the framing of the MHC approach to urban design into an integrative system, presented in Figure 69.

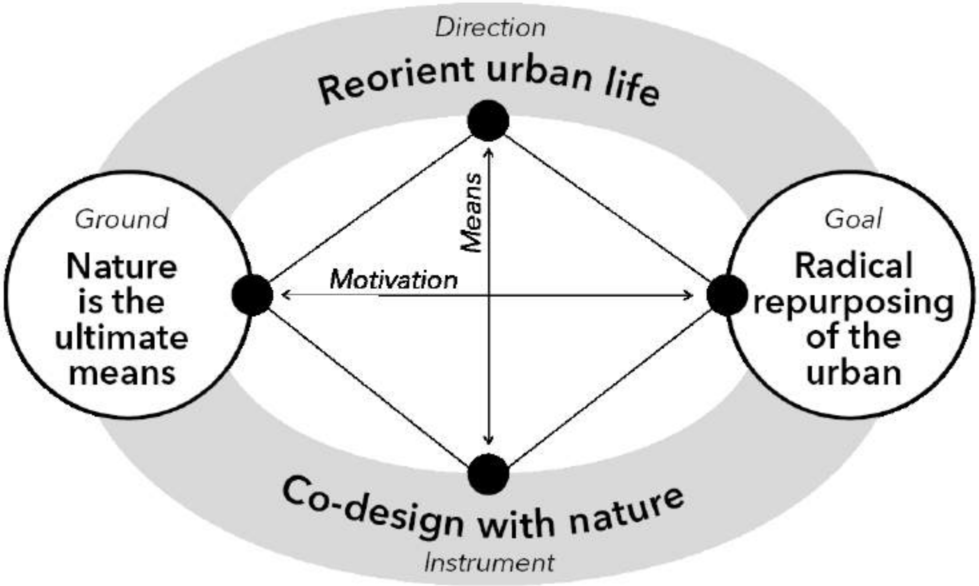

Figure 69. Framework illustrating the more-than-human-centered approach to urban design. Prepared by the author.

I took inspiration from Mang and Reed's (2012b) *Regenerative Development Tetrad (RDT) framework* to construct a figure with four dimensions, aligning the ground, goals, direction, and instruments of an MHC design. Originally, the RDT framework was developed to understand the dynamics of regenerative projects and make explicit the values created (see the background information in Appendix D). Based on the work of the Regenesis group and Lyle (see Chapter two, Section 2.2.3), the tetrad integrates the key elements, the 'four premises,' of regenerative design to frame regenerative approaches.

I adopted the logic of the RDT framework because it allows formulating an *MHC approach to urban design* similarly: by indicating methodologies and approaches from other ecological design systems, which the following paragraphs will detail. The first two dimensions define the baseline motivation, or ground, and goal (what and why questions) in an MHC urban design project. The other two dimensions relate to the instrumental and process questions: how does design induce results and sustain change towards urban transformation? The four dimensions and their relationships can result in various constellations and lead to a particular activity's success or failure. The tetrad makes it possible to envision phenomena or design activities and locate the factors that might actualize the possibilities. Additionally, it helps to evaluate the factors in light of their potential contribution to the quality of the design's outcome.

- **Ground: Nature is the ultimate means[95] (Meadows 1998).** The starting point for conceptualizing an MHC approach to urban design is the change of scope and center of attention in design activities: to widen the design space by including non-humans and embed nature in placemaking processes. An MHC approach acknowledges that a place's ecology and nature are the base elements for regeneration (health and viability for all life). From this position, a placemaking with nature can take place (Bush, Hernandez-Santin, and Hes 2020).

- **Goal: Radical repurposing of the urban**. The MHC approach magnifies the interconnectedness of humans and non-humans and provokes a different relation to the urban mosaic (Steele, Wiesel, and Maller 2019). It shows the potential of urban landscapes, regardless of the diverse forms and characteristics, in providing habitat, forms of nourishment, and protection for animal and plant species. Not only through the intended parks and green spaces but practically through any other form of urban infrastructure: the homes, offices and buildings, airports, cemeteries, railway banks, private gardens, roofs of high-rises, post-industrial sites, and the streetscapes. An MHC approach to urban development seeks to mobilize a process that continually works for the holistic co-evolution of human and natural systems (Mang and Haggard 2016).

[95] I conceptualize the relational values of NBS (the link between natural capital and human well-being) following Meadows' (1998) arguments claiming explicitly that the ultimate means are the natural capital providing the basis for all human life and activity to achieve the ultimate purpose: to improve human well-being (also see Chapter three).

- **Instruments: Co-design with nature.** Implementing urban designs with an MHC approach requires a change of role for designers to move away from thinking like a builder towards thinking like a collaborator in an ecosystem (ibid). Embedding nature into urban design and placemaking processes poses a challenge to all urban actors to work by including more-than-human participants (Bush, Hernandez-Santin, and Hes 2020). This requires the richest possible understanding of the evolutionary dynamics of a place as a starting point for urban development processes. In other words, identifying the potentialities of a place is necessary to work in partnership with a place and its processes and transform human presence into regenerative outcomes (Mang and Haggard 2016).

- **Direction: Reorient urban life.** An MHC approach to urban design identifies goals that support and increase humans' connectedness with nature within the ongoing coevolution of the built and natural environments (Mang and Haggard 2016). It aims to reorient urban life, to recognize it as an integral part of the ecological system that has always been present (only made less visible through the 'triumph of modernity'). By embedding or *re*-embedding nature in placemaking and providing opportunities for people to connect with nature, human meaning-making can be complemented by experiencing the complexity of the biophysical world (Tabara and Chabay 2013).

Of the NBS cases analyzed, CERES carries the most features for an MHC approach in action. Thus, I present the hypothetical application of the MHC approach outlined above through the CERES example. This exercise aims to test the tetrad framework's main elements and see if the MHC approach can be interpreted in concrete implementation.

Nature and the physical place provide the basis (*ground)* for all activities related to CERES and are guided by the motto already presented: "Fall in love with the Earth again." The regenerated place is at the center, integrating CERES' environmentally focused services (such as the educational and training center, the trade activities in organic food, plants grown in permaculture and sustainable timber, and the multipurpose demonstration site of sustainable living). In short, the more-than-human is fundamental to the functioning of CERES. The motivations (*goal*) behind the establishment of CERES were, on the one hand, to achieve regeneration: to transform the former urban landfill site and restore the natural processes that maintain the place. On the other hand, CERES also aimed to reconnect the formerly abandoned (albeit connected to deep indigenous heritage) land into the neighborhood's life and use it to provide practical ground for sustainable living while creating new jobs for locals. The idea (and practical functionality) of CERES is based on the reconceptualization of what urban spaces could be and should be used for, based on the co-development of humans and more-than-humans (demonstrated by CERES's almost 40 years of relationship with the place). The *direction* of the activities, afforded by the natural characteristics of the place, is set towards channeling the activities into the local production flows and connecting urban life to the access, preparation, and consumption of locally produced goods and services provided by nature. Lastly, the principal *instruments* of CERES are manifested in the fact that they manage all activities within the boundaries of the natural capacities of the place. In this case, co-design with nature means that the integrity of the natural site is respected and not exploited. The physical, natural environment is thus also a constraint, as it limits growth opportunities. Therefore, CERES expands by opening new sites in other urban locations and keeping the main CERES site only within limits.

6.2.3. Pathways to regenerative transformation

Urban structures outlive generations, and they might seem rigid and permanent, whereas, in fact, urban development patterns constantly change. Even if the change takes a relatively long time, it will radically alter the urban area, city structure, and buildings based on how we think about them and their role[96]. I have argued already in this thesis that the contemporary urban sustainability questions point to the need to rethink how to use the urban space and its role in human and more-than-human life. There is no simple way of creating regenerative cities. Discussing all practical, political, and ideological issues involved in this is beyond the scope of

[96] For example, after World War II, Le Corbusier's universal proportioning system, *Le Modulor* (1948 and 1955), which places human needs at the center of design and architecture, dominated urban design and architecture in most large European cities (Corbusier 2004). His system was based on the dimensions of an ideal man (as the anecdote says, a "handsome British policeman") to embody harmonious proportions and the human needs of the inhabitants in buildings. Le Corbusier's system contributed one hand to the spread of the idea that humans are the benchmark of all things and to the male-dominated thinking in architecture and urban design which influenced the size of city blocks, composition of streets and housing blocks. This worldview produced car-dominated cities (where the ideal man takes the car to and from work) with ring roads in between subways and high-level walkways accessed by steps. It did not account for the perspective of others: women, children, elderly, and disabled people. In the 1980s, due to emergent feminist voices, such as the London-based feminist architects' practice called Matrix (Grote 1992), gender issues, transparency and accessibility to non-experts entered to the practice of architecture and today, the accessibility-focused approaches of 'universal design' or 'inclusive design' is gaining ground.

this dissertation. Nevertheless, there is certainly a narrative altering the business-as-usual conception of the relationship between humanity and nature in the urban realm that points towards bringing back nature to the *everyday*, returning to the constraints of place, and focusing on the human scale.

However, nature in the city does not manifest as obviously as outside cities, and it will always be within the limits of urbanity. Urban nature-based places with an MHC approach transfer the outcomes of proactive strategic planning that does not just adapt but intentionally morphs the existing built environment to produce a qualitative difference in ecological life within the limits of that space. They provide a *reference point* orienting people to the living nature of cities: its vital role in livability. For example, CERES is an urban place where the social, ecological, and economic potentials are realized due to the balanced attention for human and non-human species. Consequently, the site is more natural, visually and functionally, evoking the connection to nature as a whole and allowing the urban dweller to experience it as a thriving ecosystem, otherwise exceptional or rare in the urban environment. More than that, NBS integrated within the functional fabric and structure of the city, such as CERES, demonstrate a (renewed) logic where NBS becomes part of the everyday urban landscape.

Salvador Dali famously prophesized that “the future of architecture will be soft and hairy” (quoted in Estévez and Urbano 2021), a motto that the biodesign[97] community is currently rediscovering. However, it can be interpreted that the transformation of urban life corresponding to the capacity of ecosystems is inevitable – with all its implications. As Matthews, Lo, and Byrne (2015, 15) state: “the human bio-physical environment is not an inert backdrop for human activities; rather, it has the ability to act upon humans in profound ways –

[97] Biodesign is the interdisciplinary field merging life-sciences (for example, botany, anatomy, bioengineering, even neuroscience), and art/design by incorporating the use of living materials (fungi, algae, yeast, bacteria, and cultured tissue) to explore new, sustainable materials, design solutions and technologies.

through disease, natural disasters, severe weather events, and the like.” The prerequisite of regeneration is the change of humans’ perceived role from being a manager of the place to the cohabitant of an ecosystem (Jenkin and Zari 2009). Developing NBS with an MHC approach requires understanding the life processes supporting all life that humans can actively co-create. The importance of the MHC approach lies here: these NBS produce an urbanity that accounts for the ethics and customs of a place belonging to all, human and more-than-human.

Chapter conclusion

This chapter highlighted the significance of the approaches applied in the design of NBS as they encompass further design elements and activities, affecting the possibly attainable outcomes. Their presence leaves a defining mark on the structure and operation of NBS and what they convey as design solutions in mainstream urban practice. The NBS cases analyzed predominantly express human-centeredness, guided by deliberate human-centered values and principles. However, the principles applied for creating the cases of Bosco Verticale, CERES, Nature Play, or the School gardens signify that creating urban spaces with NBS can bring the ecological focus required to serve ‘more’ than humans. They show traces of more-than-human centeredness, leveraging who and what is at the heart of the design to varying degrees and the consequences of the trade-offs.

Nevertheless, the shift in mainstream practices from human-centered to more-than-human-centered seems problematic due to the inherently and overly anthropocentric disposition of urban design. Even though the more-than-human perspective does not exclude humans from design concerns, it leads to a completely new paradigm, which, by definition, is incompatible with the current paradigm of human-centeredness. The necessity to move toward this new understanding is already well-articulated and supported. As Dr. Rebecca Hosking, regenerative farmer and campaigner, said, "[we are] kind of done with debates about it ... we need ways to experience our relatedness"[98], moreover, our symbiotic relationship. However, the MHC paradigm has been barely translated into concrete design principles, guidelines, and standards. It is still far from transforming the dominant paradigm of human-centeredness.

Shifting the center of gravity in the design and management of the urban space towards a socio-ecologically embedded approach is critically essential for reconceptualizing the urban as genuinely and inseparably 'natural' and, in general, for capably supporting NBS implementation (Bush and Doyon 2019). Furthermore, an MHC approach is better suited to facilitate sustainability learning and transformation than the worldview transmitted by the human-centered approach. Nevertheless, it requires an epistemological and ontological change toward utilizing social-ecological knowledge (Tabara and Chabay 2013). Concerning NBS, the multiple forms of knowledge are expressed in diverse configurations of the social-ecological practices connected to the making of nature-based places. Therefore, in the next chapter, I continue to analyze the procedures involved in creating the NBS designs to learn how the design *process* can incorporate relevant forms of knowledge in transformative ways.

[98] Quote from Rebecca Hosking's online talk, "Sharing the Land with All Life." at the 2021 Oxford Real Farming Conference.

7. Insights from analyzing the Urban Design Process of NBS

> Design does not create an artificial or cultural world separated from the environment, and this does not happen outside the embodiment of cognition. Design affects how we continuously create ourselves and the web of life in which we exist (Salazar and Baxter 2018, 457).

This thesis aims to gradually test the argument that, by design, NBS can be a regenerative and transformative instrument in the urban space: modifying the physical structures and the ways of urban life (involving social, cultural, organizational, and governmental change). The central proposition is that design can enable and comprehensively guide the transformation of urban spaces through the integration of NBS. Evidence related to design outcomes already supports this claim. However, it must be enhanced with a systemic view of how the outcomes are produced. In other words, here, I will analyze how design works: how ideas and concepts (regulations and policies) are translated and formed into place-based NBS projects (Figure 70).

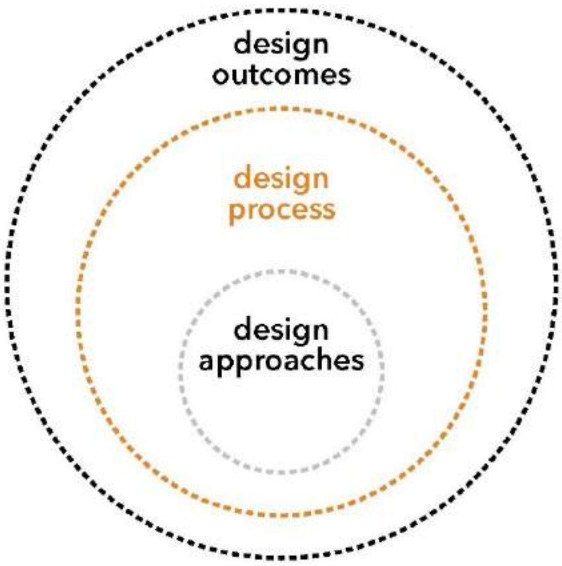

Figure 70. Dimensions of the NBS design framework. Adopted from (Mang and Haggard 2016)

The third research question targets this topic by asking: *How do design processes of NBS contribute to the regenerative transformation of urban space?* Thus, an analysis of the design process is necessary to see what we need to realize, undo and re-learn in this realm.

Furthermore, this chapter aims to present learnings on applying the MHC perspective to NBS design, facilitating synergies for urban regenerative transformation (Di Prete et al. 2021). I argue that the design process can support the prevalence of values, principles, and approaches – discussed in the previous chapter - throughout the full design cycle. Thus, when more-than-human considerations are present at the start of the design process, the cohesion or integrity of the NBS idea can be preserved, which is then reflected in the design outcomes. Derived from this claim, I argue that there are opportunities embedded in the design process of NBS which support the re-coupling of knowledge and meaning-making within the complexity of human and non-human systems, facilitating shifts towards urban sustainability and regeneration.

Several models depict urban design processes in the design and planning literature (Palazzo and Steiner 2011). For this thesis, Carmona's (2014) 'integrated framework of the urban design process' (hereinafter called the UDP framework) presents a valuable structure fashioned to assess design quality in the built environment. It accounts for the historical and contemporary 'context' for public space generation and regeneration while stressing that the 'process' factors ultimately explain how places are shaped. The research composing the backbone of this thesis was carried out accordingly (see more details on the research design in Chapter three, Section 3.2). The contextual factors presenting the history and traditions of a place, the contemporary policy context, and the composition of the main stakeholders are covered in Chapter four.

The following sections are structured to disclose the main features of the UDP: how, in general, urban NBS are created, managed, and used. Section 7.1 accounts for the characteristics of the early **Design phase** of NBS design processes. Section 7.2 details their **Development phase**, and Sections 7.3 and 7.4 present their **Use** and **Management phases**[99]. These analytical parts are used to build a systematic view of how design precedes and is involved in the day-to-day operations of urban change. Each section starts with summarizing insights specific to the particular design phase and continues with a reflection on how these design phases can be connected to urban regenerative transformation as part of the overall design process. Finally, in Section 7.5, I reflect on the overall design cycle and how design contributes to social learning and transformation (Figure 71).

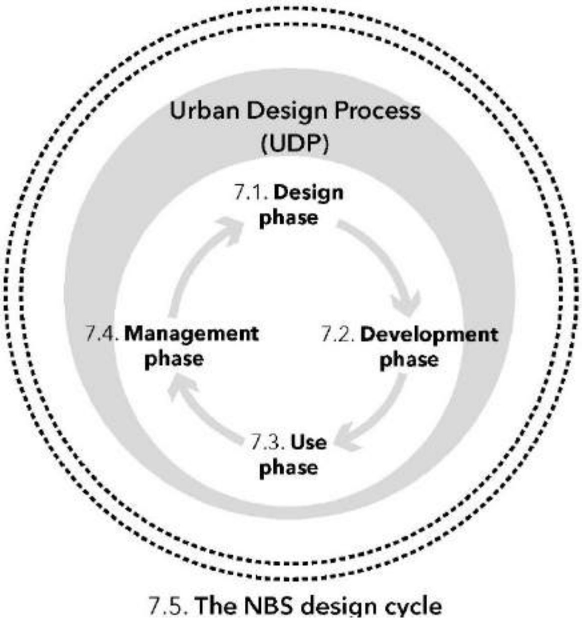

Figure 71. Chapter overview, based on Carmona's (2014) Urban Design Process, prepared by the author.

7.1. Shaping urban NBS through the Design phase: the idea of NBS

Within the Urban Design Process, the Design phase is used to mediate and define *strategies* for the public space, translated into solutions for creating spaces for use. Carmona (2014, 16-17) refers to the Design phase "as a cyclical, analytical, creative, and synthesizing process in which

[99] I use capitalization for the words design, development, use, and management when referring to the distinct phases of Carmona's Urban Design Process framework (2014).

design is ‘self-consciously’ used as the tool to ‘knowingly’ shape the future of places.” This generic phase can show empirical characteristics (using precedent, analysis, and previous experience) and rationalist (based on a set of goals) (Lang 2005), or most often, the mix of the two. It typically concerns the following related but distinctive agendas: establishing the **vision**, showing the design project's direction, shaping direct or indirect **trade-offs** and **constraints**, and setting the course of **value creation** and **innovation** (or lack of) (Carmona 2014).

In practical terms, the guiding values, principles, and objectives are typically articulated during this stage, affecting the possible design ‘moves.’ The formulation of approaches, principles, and guidelines I presented in the previous chapter (either HC or MHC) can be all located within this phase. The early Design phase is the timeframe where questions of sustainability and regeneration can be most effectively paired with the functional, ergonomic, and economic features. Consequently, it plays a critical role in articulating a project's ambitions concerning its contribution to sustainability, restoration, or regeneration.

For realizing NBS, ideally, the initial Design phase holds the space to align the design vision to spatial and temporal scales and trade-offs between functions, social equity, and species diversity (Bush and Doyon 2019). Making trade-offs is inevitable. However, addressing them early on is crucially important as sustainability goals are best achieved when they are already present in the conceptual phase. In architectural design, Kovacic and Zoller (2015) studied how the Design phase of buildings relates to their life cycle performance in terms of resources, energy consumption, and life cycle costs. (In their study, the Design phase is referred to as the Concept stage). They concluded that this stage has the most considerable optimization potential compared to the later design process stages at the lowest cost (see Figure 72 on the next page).

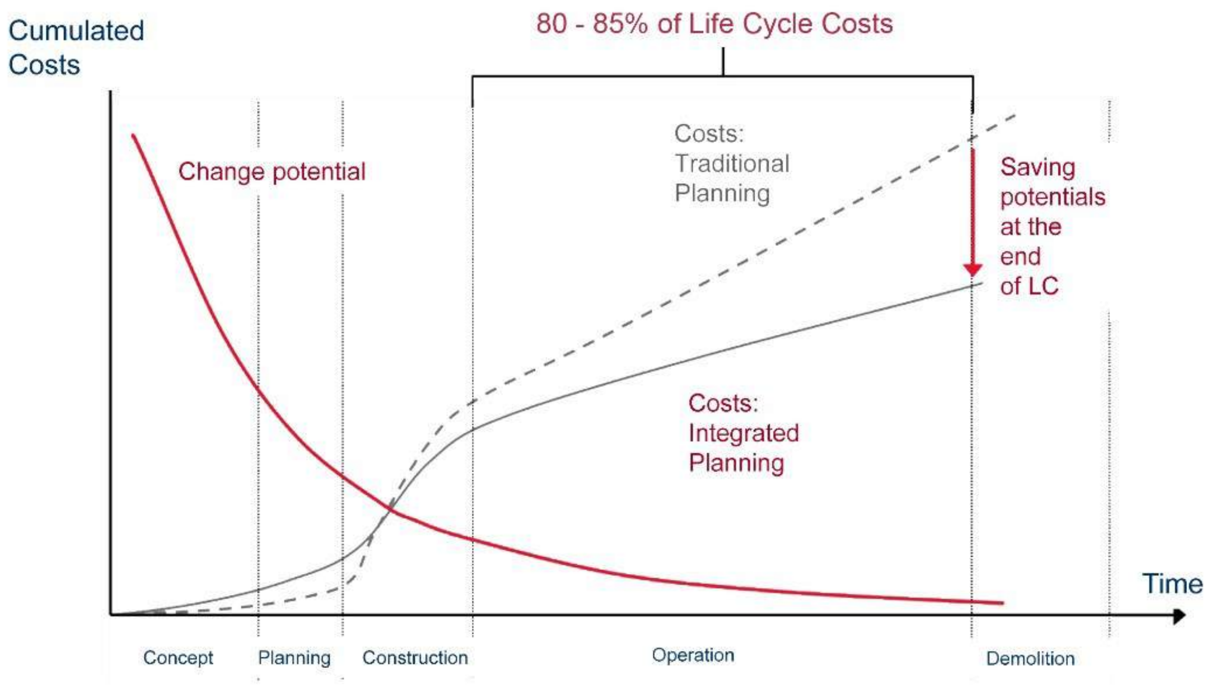

Figure 72. Cost development vs. change potential over building life cycle. Source: Kovacic and Zoller (2015)

In the subsequent design stages (Planning, Construction, and Operation – or as described in the UDP, Development, Management, and Use), the possibility for change rapidly decreases while costs (such as the costs corrections) increase significantly. Although this study concerns the building industry, according to Thackara (2006), 80% of the environmental outcomes of any design – products, services, processes, or the built environment - are decided at the design stage. Furthermore, Carmona's UDP theory also affirms that the potential design results achievable in the early stage are similar in the urban design field.

Due to historical and cultural reasons[100], design projects typically involve an abundance of stakeholders during the many stages of the whole life cycle (Fleurke 2009, Tiesdell and Adams 2011). However, the multifunctionality of urban NBS (i.e., their design and development affect several disciplines and involves multiple types of use at the same time) presents additional

[100] The rapid economic and social changes of the second half of the 20th century pressured the urban planning system to adapt to market and social dynamics. Consequently, the roles of the private sector and the citizens have become more critical (Ryu 2009).

layers of considerations across temporal, spatial, functional, and social aspects, and ecological equity and species-related features in terms of what and who are prioritized (Pineda-Pinto, Frantzeskaki, and Nygaard 2021; Bush and Doyon 2019). Therefore, the involvement of specialists and experts is necessary for the design of NBS, reinforced by current research advocating for transdisciplinary collaborations between ecologists, environmental scientists, and professionals dealing with the built environment (Dorst et al. 2019).

Most of the cases studied in this thesis confirmed these claims: a mix of diverse specialists with a decisive role could be found throughout the whole design process of the NBS, and their distribution and involvement changes during the lifecycle. This will be illustrated below by providing examples of the composition of specialists taking part in the initial Design stage. The consecutive sub-sections further detail the influences of this vision-shaping phase of the UDP.

BAM's and **Parco Portello's** design plans are highly influenced by collaboration with artists. Academic partnerships defined **Medibank**'s design vision and the initial steps of the **School gardens** developments in Győr. The strong involvement of horticulturists and botanists characterized **Bosco Verticale's** design phase, right from the beginning, to achieve a hybrid, living design (#M30,33 Documents). Botanist Laura Gatti provided technical consultancy regarding the selection, growth characteristics, installation, and treatment of trees. Further biological engineering was necessary to calculate the airflow and the structural stability of trees.

Similarly, in the case of **NaturePlay**, apart from the extensive community consultation process, an array of professionals has been invited to work together with landscape designers in the early Design phase. They ensured a deep professional grounding so that design outputs can incorporate and show the multiple benefits of a nature-based play environment for playfulness and children's development. As illustrated by #Mlb09 Respondent:

> We held a workshop for our landscape architects with a group of people who were not your usual people that designers get to, which really helped.

The participating experts included nutrition, health, occupational therapy, and play therapy specialists. Further participants also included nurses, disability consultants, visitor services of the zoo – "who really understand the people who come to this area" (ibid) – an early childhood teacher, a professor of pediatric exercise science, and a risk consultant.

Besides experts' participation, the community's involvement in shaping the NBS vision is crucial. It helps create connections and ownership of the place and positively transforms the sense of place (Frantzeskaki 2019). Furthermore, active engagement in the co-creation of urban NBS provides experiences between people and nature (see the examples of biophilic patterns in Section 5.4.3) and opportunities for learning through action. Therefore, a 'bio-cultural diversity (Vierikko et al. 2016) can be fostered synergistically with the MHC perspective.

Furthermore, another important characteristic of the vision-forming Design phase is that, in practice, it generally does not occur in a regulated, fixed order as design is not a linear process. Instead, the Design phase is actualized through *cycles and iterations* by which "solutions are gradually refined through a series of creative leaps or conceptual shifts" (Carmona et al. 2003, 54). Arriving at the final 'solutions' can happen through various timelines, depending on the utilized urban design-based placemaking approach (see Chapter four).

The most illustrative cases for both aspects are **NaturePlay** and **CERES**. They demonstrate in detail that arriving at a *design brief* is a continuous process of trial-test-change, involving imagining (thinking in terms of solutions), presenting, evaluating, and re-imagining (reconsidering or developing alternative solutions) (ibid). Moreover, community participation was a major factor in creating the design vision of both cases, more substantial than experts' participation.

NaturePlay playground's design brief was the outcome of a multiple-round iterative process. The original scope was formulated in 2010 by the Department of Health to compensate for the parkland lost due to the Royal Children's Hospital's move. Initially, the project was named ‘Return to Royal Park.’ An extensive, one-year community consultation process (deployed in two phases) was started in 2012 to gather 'voices,' opinions, impressions, and ideas from the community and form high-level principles and design objectives for the new development (#M05,06,07 Documents).

The first phase served primarily as a "blank paper for ideas" (#Mlb04 Respondent) to understand and map the community's values, ideas, and vision for the site, all distilled into the 'Ideas Plan' (#Mlb07 Document). The document was further informed by documenting the physical attributes of the site (topography, soil, drainage, and existing vegetation), the demographic information of visitors to Royal Park, information on the levels of use and demand for public open space, and Melbourne's policy framework including the Royal Park Master Plan (1998) and the City of Melbourne's Open Space Strategy (2012). The 'Ideas Plan' identified the fundamental design principles and related design elements that provided grounds for the second phase of community consultations. The central theme of the nature-based play was formed, together with the specification of the playground and the design objectives. Finally, the brief was developed, and the design team could specify the functions and elements, combined with technical information, refined into the draft schematic design (#Mlb09 Document). Lastly, the schematic plans had to go through three layers of approval (Melbourne City Council, Minister for Health, Minister for Environment and Climate Change).

CERES has a long history during which the site was built and developed step-by-step, filled with various structures, activities, and users until it reached its physical boundaries. The CERES team attempted to formulate a guiding plan for the park's design and development that was broadly followed (#Mlb15 Respondent). However, "the nature of CERES challenges the appropriateness of applying a conventional 'master planning' approach" (#Mlb24 Document, 1). A plan was needed to optimize a finite space for anticipated (but not defined) activities and growth trajectory while suiting CERES's circumstances and ethos, with creativity and experimentation at its core. The solution came from the community: to utilize CERES's collective values, principles, and objectives to create a flexible framework adequate to tackle the park's design challenges. A small team of board members and volunteers ran multiple, detailed participatory design processes with CERES' internal and external community to map the values and objectives attached to CERES (see Section 6.2) (#Mlb01,15 Respondents). The collation of values formed articulated design principles, translated into a practical, operational tool: the Strategic Spatial Framework Plan 2017. The document facilitates site development without being prescriptive; it allows 'planning for spontaneity' to stay flexible and respond to new opportunities and emerging challenges. The generic principles describe requirements for making proposals on physical change (buildings, work, uses): consideration for the context, the consequences, alert to physical constraints and limitations, and recognition of existing structures and activities.

The fact that the Design phase takes place in stages, through iterations with trials and tests, is characteristic of both professionally managed and organic settings. The design idea is refined with more details during the iteration rounds and adapted to the project's specific circumstances. This is how design concepts are formed, by *connecting knowledge to action systematically* (Schön 1984; Kolko 2010), thus presenting ground for place-based transformative learning when allowed through community engagement and participation.

Another established design method utilized in the early stages to control uncertainties is to look at precedents. **BAM's** design layout feeds on Piet Oudolf's earlier works, most notably, the greenway of the High Line, created on a historic freight rail line running above the streets of Manhattan and providing spectacular views of the city. **Parco Portello's** small mounts play an homage to Monte Stella and utilize the same method of managing non-transportable debris. For the design of **Bosco Verticale**, Stefano Boeri took inspiration from the Milanese architectural tradition, characterized in the late-19th century by ivy-covered buildings and rooftop terraces, and from the work of Hundertwasser (Boeri and Insulza 2009). The Hundertwasserhaus, realized in 1983 in Vienna, is one of the first apartment houses that host full-grown trees and bushes (250 altogether) and has become an expressionist landmark of the city.

Furthermore, in the case of **NaturePlay**, designers started to work out the details by first looking at a range of precedents to understand what kind of play space can be achieved while managing healthy and attractive vegetation (#Mlb04,05,09 Respondents). The Ian Potter Foundation Children's Garden at the Royal Botanical Garden (opened in 2004) and the Wombat Bend at Finns Reserve (opened in 2013) served as reference points for learning critical practices to help minimize the play structure's impact on plant growth (such as the importance of having sandy soil, and several small lawn areas that can be rotated) and optimize the plans for the anticipated use and maintenance needs.

NBS design is shaped and structured by methodically integrating implicit knowledge derived from precedents, documented information, and tactical knowledge gained from practical experience. Iterative rounds form a *knowledge creation process* by combining tacit and explicit knowledge flow in each round to a new level (Nonaka and Toyama 2003). *Designing* NBS means addressing social-ecological questions at a theoretical, conceptual, and concrete, practical level: connecting the human system of urban living with social-ecological systems dynamics. This implies considering a much wider range of essential conditions during the lifecycle of nature-based, living elements, not typical of inert structures made of steel, concrete, plastic, or glass. The NBS Design phase provides this extended, distinct space for *learning feedback* between knowledge and action (Tabara and Chabay 2013) about sustainability, restoration, and regeneration, which must be continued over time *in parallel* with other stages. Therefore, learning mechanisms must also be embedded in the other UDP phases.

However, as my results show, the design vision is primarily affected by the approaches guiding the flow of actions, what types of knowledge sources are utilized, and the diversity of participants in the Design phase, whose contribution also must be managed. In line with these findings, recent research emphasizes that catalyzing local and tacit knowledge in the entire cycle of planning of NBS is possible through collaboration between diverse types of stakeholders (Frantzeskaki 2019).

Moreover, it is highlighted that knowledge and mission should be broadly and inclusively communicated and shared (van der Jagt et al. 2020). As Tabara and Chabay (2013) specified, the multiple knowledge and information sources must be incorporated into these actions in a way that becomes *relevant* for sustainability and for the social system. For example, the utilization of local, cultural references and traditional knowledge and inspiration helped shape the design vision (and consequently, the outcome) of several NBS appropriate to their specific cultural context (CERES, NaturePlay, School gardens) while keeping the connection with local histories (see Section 5.2.).

There is a hazard of ignoring or overstepping these aspects in a hurried design phase. When the design plan is not responsive to the social or ecological circumstances, the connection to the places' innate potential will not emerge to its full possible extent (Kuopio park, Bercsényi grove). Moreover, the relevance of the nature-based place will not be developed in a way that it can transmit sustainability information and knowledge.

7.2. Shaping urban NBS through the Development phase: 'NBS-ness' negotiated

Generally, the Design and Development phases are integrated within the broader, ongoing process of urban design-based placemaking. The array of stakeholders (developers, planners, engineers, funders, occupiers), the leadership, and power relationships vary project by project. Similarly, the composition and relative influence of stakeholders change over time. Nevertheless, the common point is the design vision (discussed in the previous section) for **negotiations** and development propositions to find solutions for **financial, regulatory, contextual, and market** problems (Carmona 2014). Questions of **leadership** and **coordination,** consent, negotiations, **support**, **quality,** and distribution of resources commonly characterize this phase. At the same time, it simultaneously holds potential grounds for **obstacles** and distractions, hijacking the path towards ecologic restoration or regeneration. Concurrently, the analysis indicates that the Development phase is critical in maintaining the coherence and integrity of the NBS vision so that ecological and more-than-human values can prevail while providing additional opportunities for social and transformative learning.

The results can be grouped around characteristic elements that apply to the design of NBS in the Development phase. Implementing NBS is a complex challenge not only due to their living aspect and collaboration requirements. In addition, the solutions to be developed impact multiple (neighborhood, industrial, and city) systemic scales, and NBS must be developed accordingly. Taking inspiration from Janis Birkeland's (2002) *Design for Sustainability* sourcebook, NBS designs can be positioned at the 'level' of eco-architecture and urban design (see Figure 73 on the next page).

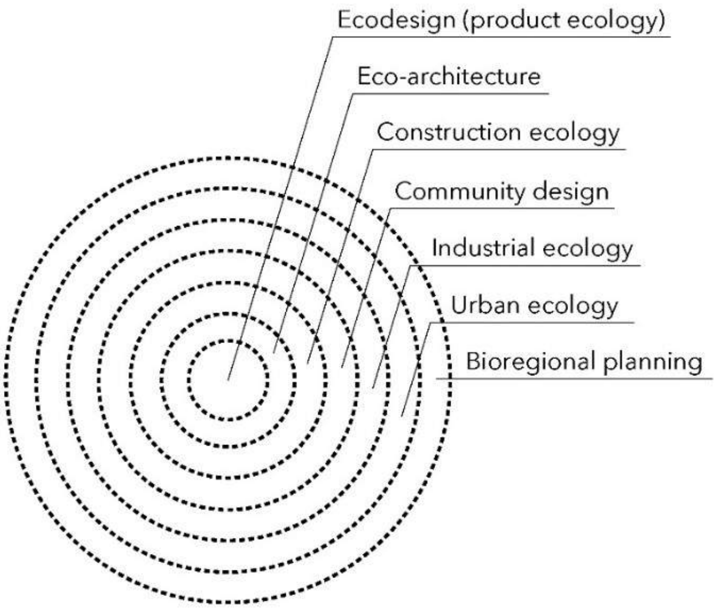

Figure 73. Ecological design fields at all scales. Source: Birkeland 2002 (with amendments)

They connect at other levels to construction methods, the local community at the neighborhood scale, and the larger industrial and urban ecology, even at a bioregional level. However, not all cross-scale connections are covered in this thesis, only the closest, larger levels of construction methods and the local community.

I analyze these two aspects separately because they directly affect NBS' ecological and social outcomes and impacts. The role of community involvement in the design and development of NBS is already explored by many. However, their development is also particularly influenced by the aspects of the construction, which have been explored less explicitly.

Architectural and urban design projects typically utilize several frameworks to comply with sustainability requirements at a technical construction level. For **BAM'**s development, one reference point was the internal sustainability framework of COIMA (#M06 Respondent), in line with the LEED standard. It ensured that sustainability measures were respected in all areas of the development, from the earliest procurement actions to the last phases of implementation. For example, contaminated soil was rehabilitated, and local ash trees were saved and replanted after construction. The park's irrigation system uses greywater for the cooling or heating systems of the offices and residences in the area, stored in a large aquifer. The footpaths and pavements of the park are built with concrete that filters the water, returning it to the soil with a draining capacity 100 times higher than conventional pavements, thus respecting the natural cycle of the water recharging (BAM 2019). The **Bosco Verticale** towers have LEED Gold certification, and **Medibank Place** has a WELL Gold certification. **Nature Play**'s development followed the Australian Standard for Playground Safety, and the **School Gardens of Győr** are guided by the organic gardening framework laid down by IKA.

There seems to be a strong drive on the part of designers to address the sustainability side of construction systematically. The MHC perspective does not appear here, or only indirectly, for example, regarding biodiversity rates, using biological or non-harmful materials, or rescuing displaced trees. Sustainability appears primarily in a technological sense, regulated through frameworks accepted by the industry. However, the relevance of such sustainability frameworks is questionable since LEED, WELL, BREEAM, and other built environment tools assess if the development contributed to improving *existing* conditions and not sustainability on a systemic level (Birkeland 2012). While they often demonstrate valuable environmental benefits such as those presented above and additional carbon emission savings, they are critiqued for overlooking many aspects of environmental sustainability and providing validity for developments at the expense of actual ecological benefits. Moreover, newly built concrete towers (such as Bosco Verticale or Medibank), however 'green' they are, require massive amounts of resources and energy to construct and operate, casting doubt upon their actual contribution to sustainability overall.

The regenerative or MHC perspectives have a weaker ground within current industrial development frameworks, presenting a critical task for future policy and decision-makers. However, developing working NBS requires knowledge of the human systems and conditions, simultaneously considering the multiple corresponding scales with knowledge of the social-ecological systems. What is still needed is help and facilitation in making that knowledge relevant and explicit to transform the connected professional communities into learning systems (Bawden 2010). "The green chain"[101] supporting the connection across industry disciplines is already forming (#M02,03,05 Respondents). For example, as #M03 Respondent expressed, concerning building green roofs in Milan:

> We organize different levels of training in order to co-train this profession together with the university. And also to work on the green chain. At this moment, we realize that there is not a real chain [behind building] green roofs because [those] who put isolation do not know 'greeneries,' and there are different sectors, and there are very few companies that do sort of general contractor of green roofs. It is important to increase the number of companies doing this, but it is also important for each sector to better know the other one. So that people who install insulation know that there is also the possibility to put some other layers of green layers and that traditional greenery managers or planters have to know that there are insulation companies.

As more NBS projects are realized, more actors connect to the NBS knowledge structure, and its components are manifold (from the worldviews of guiding approaches to the tangible outcomes). Thus, developing and implementing urban NBS provide multiple opportunities to communicate ecological or more-than-human values and learn about the socio-ecological side of the technical aspects of NBS design specifications, including construction, production, maintenance, and even regulations and policy implications, market and user preferences, and cultural relevance. However, different understandings will be formed only when different kinds of knowledge and ways of knowing are made explicit (Bawden 2010). This implies that integrating diverse information and knowledge sources is also critical to this phase. Indeed, developing NBS for implementation can be a burdening technological challenge beyond the usual green infrastructure development.

The analysis of the Development phase affirms that a successful implementation of NBS requires expertise in specialized green infrastructure design and management, especially when

[101] The term 'green chain' instead of 'green supply chain' is intentionally used here.

the NBS are less traditional or the design idea is a first of its kind. For example, to achieve **Bosco Verticale**'s hybrid design, the trees were purchased four years before planting them at their final spots. It took years of work to prepare the soil, irrigation, and engineering and train the trees for their life in the sky. The gravity loads of the trees and the soil, the dynamic loads of the wind, and its effect on the trees' stability and security had to be precisely calibrated. The trees were tested in wind tunnels to understand and predict local wind conditions around the towers' facades. Different plants needed plant containers with different dimensions to allow the trees' growth and flexibility, with safe water drainage and a root-resistant system. Security cables were added to keep the trees in place and prevent falling broken branches (Giacomello 2015). At **Bosco Verticale**, apart from the extensive green installations, the integrated environmental strategy of the towers includes gray water recycling and irrigation system, solar panels, and geothermal energy for heating and cooling, taking advantage of a large aquifer under the city (Giacomello and Valagussa 2015).

Similarly, **Medibank Place**'s planting design was highly complex. It comprised several roof gardens, green facades, and large-scale living walls, which required an established green infrastructure design and management expertise. The aesthetic planting layouts correspond to growing conditions, tolerance to the specific environment, and exposure to the urban conditions. Moreover, the development had to overcome the gap between the green infrastructure design and the required construction expertise. The initially commissioned company, Junglefly, could not responsibly undertake the task. Fytogreen, a green infrastructure specialist company, took their place to provide research, develop the design, and construct the green facades, green roofs, and vertical gardens (#Mlb02 Respondent).

> The way that the original design had been done, it was the first of its type in this country and had not been thought through to a construction level. We always think about what is constructible. And so, we design for a series of things, plant suitability for space, wind, and light. And then we look for how are we going to

> put these things like up a hundred meters in the sky? By cranes. So, there is a specific technique that we developed (ibid).

The most complex challenge was making the green design facade plans real. The building's facades get intense wind exposure, making plant establishment hard on some sides and impossible on others.

> The process is important. We had to do the testing to make sure that we had confidence that would work [for the green façade]. The green walls were easy. We do them all the time. Green roofs were straightforward. But when you start doing green facades at this height, then. Because part of the exercise, [is that] you have to understand meters per second, uplift, storm events (ibid)

Additionally, assurance for success had to be provided both for the client and the builder. A one-year joint academic research preceded the green facade development led by the City of Melbourne. The aim was to select the species that fit the design constraints (#Mlb14 Document). The plants were pre-grown under safe and controlled conditions in Fytogreen's nursery 3-6 months before installation, in 520 planter boxes, with one-third of the climbing frames already attached. They were then transported to the site, lifted into position, and attached to the rest of the climbing frame (#Mlb13 Document). The planter system had to be installed from outside the building in a way that was done for the first time in Australia (ibid, #Mlb26 Document). Thus, Fytogreen also developed specially designed construction elevators for the works (#Mlb02 Respondent).

At **Parco Portello**, the use of large-scale, even monumental elements in the design was linked with the nature of the urban intervention. The transformation of the former factory land required the management of massive amounts of construction materials and excavated soil on-site, which the designers combined with their artistic interpretations. A reinforced concrete wall was erected to secure the stability of the entire project area, and the whole site was elevated to three meters above street level. The tree system was planted along the park's perimeter and on the slopes of the mounds. This solution isolated the inner meadows from the surrounding environment and protected them from traffic noise. The aims were two-fold. The first aim was to reduce the environmental impact of transporting the excavated materials and save costs. The second aim was to fully use the ecological potential that such a park could deliver to the entire neighborhood. Similarly, at **NaturePlay**, the site was excavated back to the subsoil to establish a new soil profile for the planting and ensure adequate drainage. The excess soil formed the mound at the end of the site to save transport and disposal costs.

The development of NBS can have a transformative effect on the local communities when it fosters the creation of a sense of place, especially when their development involves co-creation opportunities (Frantzeskaki 2019). For example, in the case of **BAM** and **NaturePlay**, co-creation activities were managed top-down and controlled by the design teams. In **CERES'** case, the social enterprise model is reflected in the site's design and development activities: they continue to rely on the community's strengths to ensure resilience and self-sufficiency (#Mlb14 Respondent). The site was developed step-by-step and filled with various structures, activities, and users directed by the community. Over time, CERES became a prominent part of the Moreland commune, reflecting that residents "feel very proud of having CERES within the council boundaries" (#Mlb14 Respondent). Another indicator of CERES' community success is that now CERES appears in descriptions of the district, and real estate ads refer to its proximity as a key advantage (Faithfull 2019). The development of the **School gardens** also happened gradually, through co-creation with locals and children (with help from the teachers, as these tasks are also part of the educational program related to school gardens).

There are diverse methods to involve people in co-creation, which I already discussed on the outcomes level through assessing placemaking expressions in Chapter five. These allow different levels of participation, popularized, and even made seem mandatory in current design projects aiming for social and environmental sustainability. However, handling citizen participation can be problematic when it becomes a cover-up, a window-dressing ritual when there is no assurance that people's concerns and input will be considered[102] (see the Kuopio park example). From another perspective, the downside of participation stems from the balancing nature of such activities. They might be seen as an attempt to adjust stakeholders' divergent interests instead of incorporating diverse values (Birkeland 2012) or as just a box-ticking exercise for urban development plans (#Gy02 Respondent).

Nevertheless, various forms of co-creation are necessary for realizing NBS (Ferreira et al. 2020), on the one hand, to handle societal issues or trade-offs of NBS designs and, on the other hand, to catalyze and transfer local, tacit knowledge. A *community-centered design* approach is revealed from the Development phase, advocated by research and practitioners alike (that the CERES or School gardens examples illustrate), where designers are facilitators and mentors, helping to bring together the resources necessary for communities to respond to development needs. It is a form of design intertwined with participatory processes to gather the ideas and viewpoints of different actors involved, with planners and practitioners acting as facilitators (Collier et al. 2013; Meroni 2008; Sangiorgi 2011). Community-centered design through co-creation or co-design does not take away from the designers' space and responsibility but supports innovation in the public sphere and society (Villari 2021). It becomes a strategy to generate appealing and socially acceptable NBS designs and handle their inherent complexity and uncertainty (Frantzeskaki 2019).

Such forms of empowering civil society through ways of deliberation and participation in the Development phase of NBS are present in the above-mentioned **NaturePlay, CERES, and School garden** cases, or also in the collaborative governance modes of **BAM and Parco Portello** (observable, for example, in the development and management of the urban gardens and the frog community), where the distribution of care and ownership is shared between

[102] Sherry R. Arnstein wrote about the layers of "manipulation" disguised as "citizen participation" in her publication, titled, *A Ladder of Citizen Participation* (1969).

several parties. The original human-centeredness of placemaking can develop into community-centeredness when these engagement forms are activated.

The Development phase provides the means to actualize and 'deliver' the design vision. The composition of active participants in the process changes: builders, technical experts, engineers, and construction managers occupy the key roles. However, keeping the course set by the design vision, guided by specific approaches during the construction, seems a challenging endeavor. Urban NBS are often realized by being bound to the more extensive construction system, and it is questionable if they contribute to sustainability in 'keeping the status quo' or, for example, contributing to even more carbon emissions through their construction. Industrial frameworks support building 'sustainability,' but they are still far from the regenerative and symbiotic endeavors of MHC design.

Meanwhile, the Development phase also reveals an additional approach: community-driven design. It applies to how the community's interests and needs can be brought to the fore during the design process in relevant ways. The community-driven design presents a valuable shift from human-centeredness, entailing the regenerative perspective synergistically. Furthermore, urban NBS developed in a community-driven approach can inject participatory ways into the knowledge formation process of design, thus enhancing learning and connecting to urban nature.

7.3. Shaping urban NBS through Use: NBS in action

In Carmona's (2014) framework, the Use phase refers to the synergistic processes of everyday use that continuously affect places. After completing a site, use profiles appear along with the flows of human and non-human activity and the site's development, leading to uncertainties and factors unattainable to predict fully. Nevertheless, it is a natural phenomenon that "unknowingly" shapes and reshapes the nature and character of urban places (Carmona 2014, 22). Carmona’s findings map several mechanisms through which use defines space: “the day-to-day **activities** and human **associations** in space, the commercial **amenities** this supports, and through processes of **adaptation** and **appropriation** to different uses over time” (2014, 22).

Nonetheless, Carmona's framework does not account for the flows of non-human activity in the Use phase. Similarly, general placemaking frameworks do not account for non-humans or the interactions between humans and non-humans. Therefore, in Chapter five, I aimed to present the NBS design outcomes both from the human and the non-human perspectives to underline the need to broaden the conceptual and practical understanding of designing for NBS. Some of the cases show varying levels of purposefulness in designing the space with non-humans in mind. However, the interviewees revealed that in most cases, the appearance of non-human species (as inhabitants or users of the space) results from the physical features unintentionally attracting them. Indeed, there is an inherent unpredictability in how NBS in urban landscapes develop as part of dynamic complex living systems such as cities (Alberti et al. 2003). Nonetheless, with anticipatory design, these changes and possibilities could be and should be accounted for to develop a ‘place’ for the non-humans besides humans.

The analysis of the Use phases underlines that even when MHC signs are present in the Design phases of NBS, the Use phases are instead based on a solid human-centered approach. Moreover, they show different levels of consideration for humans in the Use phase. NBS developed with a higher emphasis on placemaking rely on multifunctional spaces and a changeable layout that can support various cultural, commercial, and recreational uses. The cases developed without reasonable placemaking efforts consequently show lower engagement and less varied uses.

Furthermore, as spaces are occupied and used, incremental, physical changes occur along with social changes that can appear in new regulations, altered traffic flows, the different uses and ownerships of surrounding buildings and facilities, or even changes in the policy work of the public sector. For example, due to a series of fires in high-rise buildings in England (the Grenfell Tower fire in West London, 2017) and Melbourne (the Lacrosse building fire in the Docklands, 2014), Medibank's fire mitigation plans had to be updated (#Mlb02 Respondent). The designs of green walls, roofs, and facades had to be re-examined from a fire-safety perspective, and adjustments had to be made (such as the irrigation system) to comply with new requirements. During the COVID-19 crisis, BAM, like most public spaces, had to follow the pandemic restrictions, limit activities, and ensure that people gathered in limited numbers (facilitated by circles designed on the ground to avoid the concentration of too many people). While the impact of national-level institutional change might seem lightly related to affecting the 'Use' phase of NBS, these changes in framework conditions have potential implications for the Use and Management of NBS. Questions of limited or restricted access and maintenance could pose new challenges to sustaining urban NBS or experiencing the beneficial human-nature connections.

Looking at the NBS as an interim result of a (continuing) urban design process reveals that NBS are constantly changing, depending on the evolution of usage patterns, both those of humans and non-humans. Therefore, a forward-looking and forward-thinking design plan should readily support that both perspectives are represented. Studying precedents and good practices in the design phase (see NaturePlay or BAM) or establishing *reference points* and *working examples* (see the School gardens or Bosco Verticale) serve this purpose. For example, the use-mindful design of Nature Play ensured that only smaller adjustments had to be made after people started to use the playground. Additionally, the design team applied special steel hoops to indicate paths and protected areas that can be installed quickly or removed without disturbing the plant communities. The easy-to-use steel hoops got adapted in other municipal designs, indicating, on the one hand, the appropriateness of the design and, on the other, the need for such straightforward elements that can be applied to manage and channel people's usage of nature-based spaces.

Ex-post analysis of the Use phase of already functioning NBS can present the connections between anticipatory planning and the achieved outcomes. The cases studied in this thesis are mostly prepared for human use. Nevertheless, as understandings of urbanity change (not least due to NBS), expectations and requirements towards the functioning of NBS can change. Urban space can be creatively modified to support more-than-human considerations, practically at any time, within the constraints of semi-permanent physical features. A surprising example is the mud collector pit for swallows placed in Kuopio park to help the birds in the neighborhood to build nests within the urban landscape (where mud collecting sources are rare). The design plans can be (and should) be revisited once the place starts functioning to correct drawbacks and adjust the space in line with uncovered human or non-human needs.

7.4. Shaping urban NBS through Management: operational NBS

Use-related phenomena naturally exist, and they are not happening in isolation as almost all public spaces are managed through intentional plans within set infrastructures. Furthermore, management tasks present predictable issues for the long run, treated with topics of **control**, **investments**, curation and **stewardship**, and **redevelopment** (Carmona 2014).

Analyzing the Management phase of the cases confirmed that it is "as important as the Design phase, and in each one, there are different tasks" (#M02 Respondent). Therefore, it is essential to work out NBS' management and maintenance details together with the Design questions at the beginning of the UDP (such as aspects of maintenance, replanting needs, security, irrigation, drainage, roots, and canopy dimensions, transport, and planting of trees). As some of the cases illustrate, management questions even *precede* the actual Development phase.

During the Development phase, there were several goals for **Bosco Verticale's** building system to work according to the design plans. The tasks included defining the security system, the irrigation system, the drainage system, the available space for the roots of the trees, the available space for the canopy of the trees, how the pots are built, and how the trees are transported and planted in place. These issues can only be developed in a viable manner when maintenance aspects are integrated into the design ideas. Considering that the green elements of Bosco Verticale are as important a part of the design as the built structure, it was crucial to solving the issues related to plant life and maintenance. Involving the residents in maintenance tasks was seen as a risk "because otherwise after five years, you could have a 'void of green' because the people do not take care of the green on that apartment" (#M02 Respondent). "And then the maintenance to replace the trees is higher. So, you can imagine how it would be to replace 800 trees. It is better to have professional management for that" (#M01 Respondent).

Maintenance questions also arose early in the **NaturePlay** playground's design process. For example, the designers had to resolve "how [to] get the values of that kind of naturally growing, highly planted space in an area that was open all the time and [they] could not control all the use" (#Mlb04 Respondent). When the principles and direction for the park development were set, the design team started to work on management questions:

> …because we knew that [maintenance] needed to be one of the drivers for our decision-making so that we could be confident that we had all the right things in place for it to work (ibid).

Thinking about the place's ongoing maintenance needs and building a resilient landscape has driven the designers to include maintenance people, even contract managers, in the design process. The park's maintenance teams proved to be strong partners from that early phase, not least because they saw that their ongoing role would be a key part of the project's success. The process ensured that they understood the vision, the intention for space, and their responsibility.

Moreover, it helped to extend the idea of management to an idea of custodianship, to acts of proactive care rather than just a need to look after the place (#Mlb09 Respondent).

On the other hand, at **Parco Portello**, maintenance presents the most significant pain point in the ongoing processes of the park. Because of the mounds' layered structure, trees cannot grow on top, only bushes and hedges, which require regular care and pruning. However, gardening on the slopes is more complicated than on plain ground. Altogether the maintenance of the meadows creates more costs than the Municipality[103] can bear (#M10 Respondent).

NaturePlay's and Parco Portello's cases exemplify how the design of NBS can present either a 'solution' or a burden for the complications associated with green space management. However, changes are more difficult to effectuate once the implementation is completed, even if the learnings are made. For example, as #M10 Respondent reflected, the selection of other, more drought-resistant bush species or a change in the layout of plants covering the ground would require less intervention throughout the year, consequently would lead to cost and workload savings (#M10 Respondent). Indeed, designing urban NBS to save on maintenance costs is one of their most publicized design features, even if it is not always realized.

Furthermore, within the larger UDP, the Management phase (just like the Design and Development phases) involves various specialists, technical staff, and maintenance crew, whose costs and liabilities must be duly reflected in design solutions. In **Bosco Verticale**'s case, the designers developed several innovative and novel solutions to the newer designs with further development or variations (#3 ICON Design Talks). The deployment of 'flying gardeners,' as the studio branded the specialist plant care providers, is one of the most

[103] Iper Montebello, a large-scale distribution company operating supermarket and restaurant chains, has been responsible for managing the park in the first ten years after the opening (#M32 Document). The Iper Portello store was built as part of the urban redevelopment project. As a private investor, Iper was required by regulations to compensate the municipality for public services. Nevertheless, now, after ten years have passed, the city is in charge of the park's care (#M10 Respondent).

frequently mentioned solutions. While contracting flying gardeners for Bosco Verticale's urban forest management presents a novel approach, it is also a significant cost increase. Giacomello and Valagussa's (2015) study found that the time for pruning one tree in the vertical forest is five times higher than pruning a tree with the same characteristics at ground level. Compared to traditional tree care, the BV towers thus have prolonged maintenance which increased costs. Moreover, the buildings' electronic control and security system (24/7 reception with CCTV and plate recognition cameras) add to the expenses (Coffman 2018).

The places' continuous, dynamic development, renewal, and management needs became a central issue in most cases, highlighting the challenge of managing *growth* and its intimate connection to the maintenance of the sites. Due to resource or spatial constraints, some cases struggle to respond adequately to the arising needs. For example, at **CERES**, even though there are many ideas about the work they could do "around the physical site to make it more beautiful and more appealing, engage more people, make it a better demonstration of CERES's values" (#Mlb14 Respondent), they have to work within their means, which puts some projects on hold or hinders attending to all needs. However, at **BAM**, continuous growth is welcomed. Since BAM is considered an investment, the experiences gained refine COIMA's development model to be replicated in other sites in other cities (#M06 Respondent) and extend BAM in size and services. An additional 3,500 square meters of 'Events spaces' will be attached to BAM, outside the park, and in the pedestrian area. For an annual fee, sponsors will use the spaces for social, sports-oriented, and cultural events. With this extension, COIMA projects decrease the overuse of green areas and expand the park's maintenance funds (#M31 Document).).

The direct and indirect benefits generated by the multifunctionality of NBS are presumed to exceed their implementation and maintenance costs, even though the totality of their values is difficult to calculate (Kabisch et al. 2016). Moreover, they are expected to offer relief to the related workload. However, BAM's demanding, continuous, and intensive care and the time and cost-heavy maintenance of Bosco Verticale pinpoint the *centrality of management issues* within the ongoing urban design process. Even one of the less technical cases, NaturePlay, is one of the Municipality's most intensely maintained public spaces because of the level of use. However, more wilderness and less maintenance are not always a solution, as the problematic care of Parco Portello illustrates:

> For biodiversity, it is completely fine. Animals are even happier if you do not cut the trees and bushes… But I think the big mission we have to fulfill with all these studies on NBS is that they are supposed to deliver ecological ecosystem services. Also, economic ecosystem services are due to be delivered. So, NBS should be planned in order to reduce maintenance costs and facilitate the integration of a green system in everyday urban life (#M10 Respondent).

These issues highlight the effects of human-centeredness, as the management and maintenance needs in the above cases stem from the demand to meet expectations and perceptions of clean, safe, and well-managed urban places. However, maintenance settings are complicated to change within existing sites (see the case of CERES). Nonetheless, their cost-effectiveness and the non-costed benefits are important attributes (Ferreira et al. 2020) that should be communicated and expressed in the 'solution.' On the one hand, maintenance efforts can be repositioned as a social benefit and not a cost, considering that humans draw benefits from being exposed to nature (or disbenefits from not being exposed). For example, in the 'newer' versions of Bosco Verticale, residents can and must take care of part of the integrated greenery and participate in the ongoing upkeep of the vertical forest (similarly to the Hundertwasserhaus design). Compared to the restricted maintenance of the 'first prototypes,' it is presented as an opportunity. This point implies the need for a paradigm shift in the valuation and integration of NBS: shifting the focus on the non-human within the larger design process can bring in design aspects that compensate for the overflow of human-centeredness while presenting favorable changes for the long-term management of the places.

7.5. Realizing NBS from the abstract to the concrete: the design cycle of urban NBS

The discussion of the separate UDP phases aimed to depict the entire NBS design process to identify the design aspects influencing the regenerative (trans)formation of the urban space. This analysis discussed how urban NBS are envisioned, shaped, developed, implemented, used, and managed. This pragmatic design process of urban NBS includes creating the NBS idea through iterations, incorporating different knowledge sources and guiding perspectives (approaches) to address multiple outcomes, the co-development, and distribution of management responsibilities between participants, with considerations for uses by humans and non-humans. Based on the above, I apply further analysis to articulate how and why an adaptive, flexible design process is indispensable for working with these values and targets and how the integrity of the NBS vision can be maintained throughout the design cycle of the UDP. Additionally, the results suggest that public involvement in the complete design cycle of NBS can be facilitated to foster transformative social learning processes. Finally, I close this section by reflecting on the implications of these results on the spread and replication of NBS, which forwards the discussion to the topic of frameworks presented in the next chapter.

Adaptability and flexibility are essential notions in terms of the capabilities of NBS enhancing the resilience of space (Bush and Doyon 2019) when there are possibilities for alternative uses, reversibility of decisions, and adjustable implementation (H. Dorst et al. 2019). As the sections discussing the UDP phases detail, NBS are subject to different expectations throughout their design process. They must meet the demands of economic, industrial, and social communities and respond to current and emergent trends. A *flexible, adaptive* process is thus essential for creating NBS, especially considering that a community-driven urban design incorporates collaborative planning mechanisms with various actors.

However, some questions remain unsolved. On the one hand, it remains unanswered whether social structures are flexible enough to adapt to the often non-negotiable biophysical and biological realities of urban NBS. On the other hand, considering that NBS or non-human species cannot 'participate' in the process, the representation of their needs is mainly missing. Even though indirectly, design 'moves' related to enhancing biodiversity or establishing plant communities foster these 'directions,' and there are some emerging design props to include more-than-human voices in these conversations (such as the use of non-human 'personas'), the UDP in its current understanding is not prepared for this kind of 'flexibility,' which should be amended.

Apart from flexibility, keeping *cohesion* is one of the most important qualities that design can add to the capable implementation of NBS, meaning that the design vision prevails throughout all phases of the UDP. However, aligning diverse interests, opinions and needs poses a significant challenge to avoiding the fragmentation of the design concept and producing and maintaining cohesion throughout the process (Healey et al. 1997). Furthermore, long development periods are not uncommon in urban development: 5–10 years can pass from the concept phase to the inauguration of major redevelopment projects [104] (Hes et al. 2020). Therefore, keeping the relevance and validity, the cohesion of the design vision is fundamental. Urban designs must accommodate both present and future requirements while finding the right balance between stability and adapting to possible changes.

Such 'open-endedness' and flexibility are integral to a pragmatic *design process*, allowing for deciding on physical plans on an abstract scale, leaving various ways for elaboration on a concrete scale in later phases (Ryu 2009). Cohesion is injected into this 'open thinking system' by incorporating *references* in each process step. This makes the following choices coherent

[104] The realization of BAM took 14 years, from the design concept to inauguration. Bosco Verticale took eight years, and for Parco Portello, it took 11 years (see also Figure 45 in Appendix C).

while leaving further options open to flexibility, similarly to adaptive strategic sustainability governance models that utilize continuous monitoring for periodic adjustments (Volkery et al. 2006). The integrity of the NBS idea is thus maintained with the necessary openness for future changes.

As a 'modus operandi,' flexibility can be incorporated into the design process through guiding principles. For example, in **CERES**, the 'spontaneity' in design is one of the key principles they follow in everything they set out to do. This spontaneity of CERES (and the do-it-yourself actions of the School Gardens of Győr) are in close connection to the design philosophy of 'adhocism,' popularized by Charles Jencks and Nathan Silver's 1972 book (reprinted in 2013). Adhocism promotes everyday improvisations across design fields (for example, an empty bottle as a vase or candleholder, a dictionary as a doorstop) to approach any design activity by trial and error, adjustment, and readjustment rather than following a set of rules. Applied to urban design, spontaneity or adhocism gives space for adopting 'learning by doing' principles and involving transdisciplinary co-design approaches, ultimately learning to deal with uncertainties inherent in social-ecological systems (Ahern, Cilliers, and Niemelä 2014). For example, the CERES case shows how transforming the urban space into NBS happens through *experiments*, testing new ideas and trialing concepts (Bulkeley and Castán Broto 2013), and even new partners and institutions (Frantzeskaki 2019).

BAM's case illustrates a design strategy based on a functional and adaptable design system, which proved to be cardinal in the park's success. The design idea 'survived' by providing flexibility in applying park elements and themes, even when significant changes altered the site's layout during the development:

> [Here], you can see the original layout of the paths, which has changed over and over. You see, this section has been completely changed because we elevated the park with six meters. You can see how the concept of the paths, fields, and circles could be used in different ways, how it bridges streets, or how it can host

> a fashion show… all the fields how they would work. These are like the tools and ingredients of our park (#1 Milan guided tour).

As explained by the designers, the design vision of reconnecting the area into a social, cultural, and educational nexus was translated into the physical, geometric structure of the park through an interlacing system of paths (#1 Milan guided tour, #3 ICON Design Talks). The idea was simple: the crisscrossing paths form intersections, each of which became a uniquely themed field (planted differently, with a specific function or role), and the circular tree groupings reinforce the joints as architectural yet the natural structure of the park. The result is a patchwork of flowering meadows, educational gardens, aromatic gardens, and multi-functional lawns that can be easily changed or reconfigured (#M20 Document). Furthermore, this built-in flexibility ensured responsiveness to managing the ever-changing needs arising from the park's uses. BAM's case also shows that the configurative aspect of urban design can advance the conceptualization and use of NBS elements in all UDP stages: to elevate ecological capabilities and tackle uncertainties related to their application in development plans.

On a practical level, the main role of the urban design process is to *ensure and maintain flexibility* and keep the *cohesion* of the core idea during the process, from an abstract to a concrete scale (Ryu 2009). These two might sound like conflicting goals. However, they fit in design's 'open systems thinking' (Birkeland 2012). Moreover, this argument suggests considering a new role of urban design to generate resilient frameworks (with connections to different scales) to keep cohesion (the integrity of the NBS idea) and reach an agreement by showing possible solutions to further phases.

Chapter five demonstrated that the NBS design outcomes induce diverse nature interactions, experiences, and perceptions through physical structure and mental representation. They get embodied in people's minds and practices with established social relevance, making it possible to experience a blended urbanity working for humans and non-humans, expanding the understanding of urban places as semi-natural systems. In a sense, NBS are instruments for learning, helping people to see the world differently, essentially more embedded in the biophysical. However, the more significant challenge for sustainability learning (Tabara and Pahl-Wostl 2007) is to provoke people to do things differently: to develop agency and modify their actions and institutions with awareness of ecosystems' impacts and needs. One of the interviewed architects (#M03 Respondent) described NBS as “a platform for sharing,” where these different sides of urban development can find a common reference point. The urban professionals, private and public operators, the locals, volunteers, traditional owners of the place, and others participating in the various stages of the NBS design process are part of an informal community where social learning occurs. Learning aspects can be found during the entire NBS design process, and potentially all stages provide opportunities to activate and share learnings.

During the **Design phase**, the knowledge structure is typically related to preparing and exploring the topic. The aim is to map and utilize the available knowledge and information on the site’s history, usage patterns, community aspirations, and relevant key practices, for example, by looking at precedents (NaturePlay, Bosco Verticale, BAM), best practices, design guides, methods (School gardens), or in the launch of feasibility studies (Bercsényi grove). The conclusions and assumptions supporting the to-be artifacts (i.e., NBS) generated in the initial design phase are used to validate and establish arguments for the later stages of the process. Consequently, they provide grounds for a maintenance evaluation or tracking progress.

The **Development phase** presents opportunities to ‘activate’ tacit (design) knowledge, fine-tune the concepts, and realize them. For example, as the design brief of NaturePlay was developed, the Council’s in-house design team grew its knowledge about what it would take to deliver the project. As a result, they could adjust the needs and requirements on the go to identify the proper budget (#Mlb04 Respondent). In this phase, the various ways of community involvement provide grounds for exchanging knowledge and forming community practices connected to NBS (BAM, School gardens, CERES). Furthermore, learnings from experimentation are transferred and systemized due to collaborative intermediaries such as academia and research (Bush et al. 2017), as demonstrated in the case of Bosco Verticale (testing the validity of the 'idea' in wind tunnels), Medibank's (research on workplace health and plant selection), or the School gardens' (design students helped turn the schoolyard into gardens). The learning aspects in the Development phase call attention to the contribution of the specialized technical and engineering, financial or regulatory experts. Their innovations are an integral part of making the concepts a reality. Moreover, the 'solutions' can be readily adaptable to other projects (as seen with Medibank's specially designed construction boxes, Bosco Verticale's flying gardeners, or the steel hoops of NaturePlay). Additionally, the learnings acquired during the **Management** and **Use phases** serve to refine the NBS 'models' and work out the further developments or variations and the replication strategies (see the cases of BAM or Bosco Verticale).

A precondition for sustainability learning is to embody the understanding gained through experience, monitoring, and assessment: to connect actions to the new configurations of knowledge (Tabara and Chabay 2013). The analysis of the cases shows that design amplifying the social aspect of NBS aids the development of learning processes most significantly. Learning is inherently a social process (NAP 2018). It takes effect in social situations, influenced by interactions, cultural tools, and practices. Organized building days, participation in maintenance and care, workshops, seminars, and conferences present an array of opportunities for collective learning mechanisms directed towards the larger public or professionals related to the design and development of NBS. In this sense, NBS design needs to realize its inherent value to build social capital to contribute to ecological sustainability.

All phases of the urban design process can open ways for sharing knowledge and experiences through co-creation and participation opportunities that can be *continuous* in the later stages. For example, **NaturePlay**'s design process started with an extensive collective learning mechanism. Once the site was finished, the design team shared their experiences directed toward a professional audience during organized workshops and site walks, and the educational programs on-site were commencing for the locals. **BAM**'s participatory programs started at the development phase and have been ongoing since the site was inaugurated, with many events and programs directed to learn about the purpose of BAM, its design and development process for professional audiences, and the general public alike. Academic partnerships and collaborations with research also typically accompany the NBS' design process. The educational activities (**School gardens of Győr, NaturePlay**) or environmental activism (**CERES, Parco Portello**) connected to the NBS include developing new ways of thinking about nature and its role through creativity, action-based learning, nature play, gardening, or re-wilding.

Furthermore, as many experts and scholars agree, such activities foster early and later stage connections to nature and an action-oriented attitudinal change (Pettifer 2019). The School garden's case presents supporting examples of the effects of the multi-faceted environmental education and the evidence of learning impacting school children and the broader social fabric: the adult family members or others who get involved in the activities (Somosfalvi 2019). Moreover, IKA's training and networking activities contribute to school garden educators' ability to share knowledge regularly.

Lastly, the peculiarity of design processes is that the concepts and modes of delivery are subject to constant change, leading to newer versions as different issues or opportunities arise. For example, in the case of the Bosco Verticale 'prototypes', with every new design challenge "you see the same issue from another perspective. And understand how conceptually and technically it is possible to reach it” (#M02 Respondent). Thus, in the same way as businesses tailor their products to specific market needs, the design elements of NBS are altered and adapted to different spatial, cultural, and environmental contexts or governmental and client needs. As the designers of Bosco Verticale explain:

> ... that kind of integration creates a set of issues that you have to face and solve, and in every project it is different. Because the regulations are different, the needs of the client are different, the shape of the building is different, the internal apartments, the layout is different. So, everything is different and there is no standard answer for it. There is a set of issues that you have to deal with and in each case, there is a different answer (#M02 Respondent).

Therefore, the exact replication of NBS is unrealistic both in the case of high-profile design projects such as Bosco Verticale and the 'simpler' design projects such as the School gardens in Győr because there are "as many kinds of gardens as many schools" (#Gy08 Respondent). Instead of replication, the lessons are transferred around *adapting the concepts* to new conditions while keeping their core elements. For example, as #M06 Respondent details in the case of BAM:

> We are starting to get into secondary cities in Italy, smaller but that could have the capacity to take on - obviously on a much smaller scale - this [type] of responsible, sustainable development. For example, we are working with the city of Lucca and one of the local foundations to do a local regeneration project on one of their very large abandoned industrial sites. It would be one of the first times that a company like ours would go to a secondary or even a third-tier city as far as importance in economic development and be able to take on a project like that with sustainable development.

Similarly, in the case of BV:

> ... it was also a change in the idea, changing again to other prototypes starting from the Bosco Verticale: a Bosco Verticale for social housing, a Bosco Verticale with mixed-use, a Bosco Verticale with loggias instead of balconies. So, all these changes were very important and very good for us. [It took a] lot of effort, [it is] tailor-made, but on the other side, innovative. It is not a mere repetition of the Bosco Verticale, but it is [about] always innovating the first [concept] (#M02 Respondent).

The constant change and adaptation of the design are among the key aspects behind the Vertical Forest 'model', which illustrates that the design product, together with the outcomes, the approach, and the process, make up the framework to be used as a *scaffolding* for shaping and developing urban space. These findings align with recent research stating that reflexive or mosaic governance can strengthen urban NBS and reduce their vulnerability through an iterative process of learning and readjustment of both practices and the 'designing' bodies (van der Jagt, Kiss, and Hirose 2021; Buijs et al. 2019). However, when ready-made, standardized solutions are applied to the needs that arise, the multiscale benefits of the place remain untapped. In the Kuopio park and Bercsényi grove cases, options of 'could-have-beens' came up several times.

> It is quite difficult to create characteristic designs based on unique local features that highlight and strengthen local features in Hungary because the utilized templates are fairly uniformized (#Gy02 Respondent).
>
> We do not use design as a development force here in the Hungarian environmental design. Of course, there are good architects and landscape architects, but there is no demand for them. There are only demands for mass [designs], [since] it is much easier to design when you use typical solutions (#Gy01 Respondent).

Prioritizing universal solutions and affordability is a common pitfall for design solutions in general. However, when the extra design effort is spared to the detriment of creativity and innovation, creating spaces and cultures for imagining radical enough alternatives to the status quo is harder to attain. For realizing the regenerative potential of urban NBS a design *framework for discovery* instead of *modes of delivery* is necessary. A framework that enables discovery through built-in flexibility to adjust the processes and outcomes within the continuum of the urban change. Opportunities will be missed when the delivery comes before discovery and cannot be revisited (see Bercsényi grove or Kuopio park examples).

Chapter conclusion

The design and development of NBS is a multidisciplinary endeavor. It presents a ground to merge the interfaces of the different disciplines involved; between those who maintain and care for, who build (construction, engineering) the NBS, and those who design them: the architect, the landscape designer, the botanist, the gardener. Moreover, they are also part of the urban arena, bringing out the conflicts between those who use the urban space and those who govern them. The ex-post analysis of the entire UDP of NBS can present the connections between design conditions and the achieved regenerative potential of urban NBS. It calls attention to careful planning, with several takeaways for capably improving NBS designs and implementation.

The analysis showed that each phase of the UDP has a distinct and vital role in shaping the design contribution to sustainability, restoration, or regeneration. Furthermore, the analysis summarizes important insights about design deficits manifesting most at the Use and Management phases, which stem from the cases' predominant human-centeredness. However, lessons derived from the Use and Management patterns can be channeled continually into the overall design process to modify the NBS towards community-centeredness and fit more-than-human considerations. Simultaneously, lessons learned from the flaws and drawbacks and the uncovered human or non-human needs can continuously inform the Design and Development of NBS, which evolve, in parallel with the other stages, even in subsequent design cycles.

Shifting the focus on the non-human (the design approach) within the larger design process can bring in design aspects that counteract the overflow of human-centeredness while presenting favorable changes for the long-term use and management of the places. When the NBS are designed with a community-driven and more-than-human approach, they can perform as "a platform for sharing" (#M03 Respondent) about the multiple corresponding scales of the social-ecological systems. NBS that offer participation opportunities in the various design stages can help form an informal community ('the green chain'), facilitating social learning. Such NBS designs, through embodied knowledge and information, interactions, and experiences with the biophysical, can make knowledge relevant and explicit and provide possibilities to induce community learning.

8. The design framework of urban NBS: theoretical and practical implications

The proposition behind the main research question of this thesis is that certain 'compositions' of design can facilitate a shift in perspective, allowing the opening of new horizons for the use of innovations such as NBS to channel change in strategic directions towards urban regeneration. In the last chapter, I wish to return to and discuss the main research question of the entire dissertation, namely: *How can the design framework of NBS contribute to reducing the gap between NBS's 'rhetoric of potential' and their implementation and impact on achieving urban regeneration?*

The basic premise of this dissertation is that the ‘design of NBS’ is not simply linked to physical implementation: it is a terrain of complex interacting dimensions providing rich space to explore design issues, questions, and implications. Moreover, while design concerns universal problems, places are specific, producing cultural and natural peculiarities. Each place holds different opportunities and potential for nature-based placemaking.

As discussed in this dissertation at several points, its unique character presents the starting point for creating strategies to develop the natural, cultural, and economic capacities of a place. Achieving distinctive and regenerative places with NBS design can only happen through a place-sensitive approach. Consequently, NBS cannot be squeezed into general models uniformly suitable for all contexts (Dorst et al. 2019; Frantzeskaki 2019). Instead, a design framework should be utilized to think in nature-based process terms, with relationships, interactions, enabling (or obstructing) conditions, and outcomes aligned to a more-than-human worldview. This way, the NBS design framework provides a means to translate MHC principles into actionable tools for designers, planners, and architects, at all dimensions of the NBS lifecycle.

This chapter aims to show the connections between the framework's dimensions and the unfolding of the regenerative potential of nature-based urban places. None of the cases examined present the NBS design framework in its absoluteness, instead, all have stronger and weaker parts. However, putting together the strengths and well-functioning outcome-related characteristics brings together a picture of what a regenerative, more-than-human-centered NBS design framework looks like and what it can achieve. In Section 8.1, I summarize the main findings for the NBS design framework in each dimension (Figure 74).

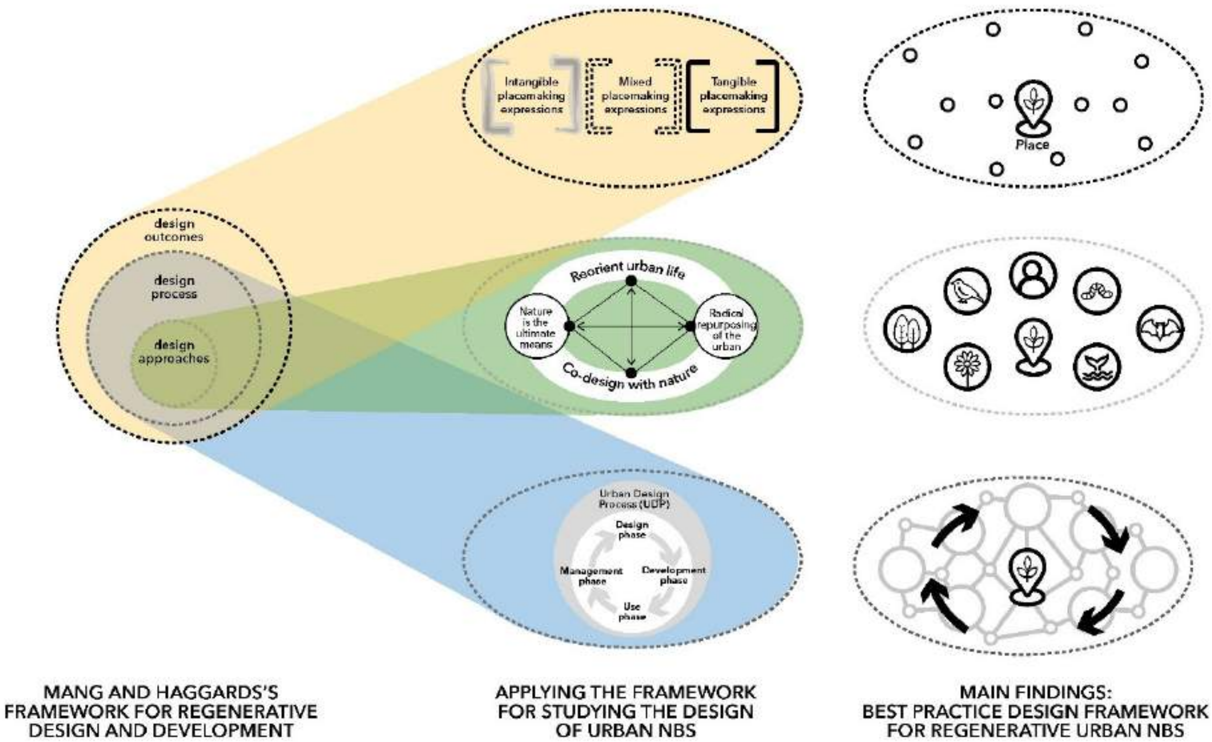

Figure 74. A visual summary of the conceptual lenses and the research findings. Prepared by the author.

Then, in Section 8.2, I reflect on the possibilities of shifting 'business-as-usual' urban design towards regeneration. I also discuss the necessity of elevating the potential of 'general' NBS to a higher regenerative level and illustrate how a best practice NBS design framework can help recognize and align the leverage points for regeneration scattered across the outcomes, approaches and process dimensions. However, first, in the next paragraphs, I list the key take-aways of this dissertation as an introduction to the following subsections, which will discuss the implications in detail.

The design consequences manifest as 'outcomes,' realized through tangible, mixed, or intangible placemaking expressions. The **design outcomes of NBS** can contribute to realizing the regenerative potential of place by utilizing a range of these placemaking expressions. They act as 'touchpoints'[105] between humans and nature, through which people can connect to place, thus, human-nature interactions, experiences, and knowledge transfer can occur in directed ways by design. For example, hearing or encountering wildlife, smelling or tasting plants, and learning about the co-habiting species or their role can be facilitated by the physical, practice-related, or intangible expressions. Furthermore, realizing design outcomes of urban NBS is based on using natural elements in placemaking processes and activities. Therefore, through these outcomes, NBS can demonstrate and communicate a kind of transformed urbanity where the built environment can 'participate' in nature. This can be done by the designed (branded) images that help spread the ideas across multiple platforms and by transmitting messages to citizens in understandable ways, thus, giving meaning and relevance to NBS in their local context. For example, at CERES, when the Sacred Kingfisher bird returned to the Merri Creek, they installed explanatory boards at the site to explain the significance of this event as it marked the regeneration of the river and its area. Moreover, they celebrate this event yearly to commemorate it and maintain its momentum through storytelling to make the place important to people. Additionally, such stories can assert influence not only locally, but also at higher

[105] In various design-related fields, such as marketing communications, service design, and interaction design, touchpoints are defined as the point of contact between a brand or business organization and its customers. Touchpoints are designed to provide target audiences with diverse ways to interact with the brand to reach engagement (for example, person-to-person, through a website, an app, or any form of communication) (Shostack 1984; Clatworthy 2011).

scales, which the case of Bosco Verticale or BAM shows, also making them important to businesses, helping to recognize NBS as proactive investments within urban development processes. However, to achieve regenerative design outcomes, the general human-centered placemaking toolkit used to create accessible, comfortable, versatile, and desirable places for people must be extended with awareness of the community- and more-than-human-focused regeneration requirements. The goal is to support the flourishing of all organisms and ecosystem processes and develop the abundance, richness, and diversity of human and non-human cultures. An overly one-sided human-centered focus on designing tangible and intangible outcomes can hinder the regenerative potentials of NBS as it ignores the multidimensional dependence of human wellbeing on the services of ecosystems.

Ideologies and worldviews are embodied in the physical environment by design due to the practices guided by diverse philosophies and principles: design approaches. The use of approaches is reflected in people's thinking, practices, consequent actions, structures, and outcomes. The **design approaches of NBS** can contribute to realizing the regenerative potential of place by a socio-ecologically embodied approach that directs organizing urban life, the relationship between humans and the environment, and human subjectivity towards a joint urban human-nature relationship. Inadequate focus on the more-than-human can lead to drawbacks and missed opportunities to amplify human and non-human benefits. For example, a planting design that ignores the local ecologies of place and serves only artistic purposes can create a place where species cannot self-populate and evolve. This can also lead to higher maintenance needs and costs and lower affordances for non-humans. Therefore, regenerative NBS design approaches should support human and non-human species by applying, for example, the more-than-human centered approach (MHC) or drawing inspiration from traditional, indigenous knowledge, culture, and practices that conceptualize human life as connected to the ecological system. However, the MHC approach needs to be adapted to the urban design context in order to design urban NBS with a regenerative approach, where the goal is the radical repurposing of urban space.

The urban design process (UDP) consists of the Design, Development, Use, and Management phases. The UDP of NBS offers a holistic view, highlighting that all phases of the UDP affect the ecological and social conditions of regeneration, thus the outcomes. Therefore, the **design process of NBS** can contribute to realizing the regenerative potential of place when each phase is driven by the MHC approach to urban design and entails opportunities for community involvement. For that, it is critical to see the NBS design cycle as a 'platform for sharing,' to involve specialists and professionals (such as horticulturists, botanists, ecologists, or hydrologists) who can provide NBS-related guidance, and enable sustainability learning at multiple (touch)points during the making of the NBS. Thus, this must be a flexible, reflective urban design process that is community-centered, open, involving multiple stakeholders to integrate a wide range of perspectives and mobilize the local community. It is also an adaptive process to anticipate and facilitate the continuous, dynamic development, renewal, and maintenance needs and accommodate the growth of the more-than-human and the collaborative planning mechanisms of community-driven urban design. Furthermore, the cohesion and integrity of the NBS design vision must be maintained during the entire process of developing and implementing urban NBS with regenerative design in mind. Therefore, the experiences and learnings derived from each phase should be channeled into the next one and to the new (re)design cycles to build on solid NBS designs that incorporate both human and non-human perspectives.

Within the UDP, the Design phase of the UDP is critical because questions of sustainability and regeneration must be paired early on with the functional, ergonomic, and economic features across spatial and temporal scales to address trade-offs between functions, social equity, and species diversity. For that, specialists, experts, locals, and people with traditional knowledge can bring in multiple types of knowledge and information sources to be incorporated into the design vision through various forms of involvement and co-design. Furthermore, precedents and experience should be utilized here to optimize plans for anticipated use and management needs. Thus, typical design shortcomings connected to the use and maintenance of green spaces can be minimized or eliminated.

The Development phase of the UDP is critical because the development and implementation of urban NBS are inevitably bound to the larger industrial construction system and commerce (developing cost-effective solutions to optimize management and maintenance needs). Thus, expertise in specialized natural infrastructure design and management is needed. However, NBS are often associated with sustainability or 'green' design frameworks but not with regenerative design frameworks, and the MHC perspective is often lacking in NBS development. Nevertheless, NBS developed with a community-driven approach can better utilize the potential to create socially appealing and publicly acceptable urban NBS.

The Use and Management phases of the UDP are critical because they emphasize the NBS designs' human-centered side due to responding to human needs (Use) and governance (Management). Therefore, considerations for the capabilities and flows of non-human nature should be included in these phases (provide habitat, shelter, and nourishment for non-human species). Furthermore, the conceptual toolkit of placemaking must be extended to the non-human, with practical implications for NBS implementation.

8.1. The design dimensions of regenerative, nature-based design

In this section, I describe the best practice NBS framework. Both its content and structure are derived from the analytical chapters of the thesis, which provided a step-by-step demonstration of how different design dimensions affect the establishment and operation of NBS. While there are many variables and interdependent factors, the NBS design framework is distilled into a simple diagram that integrates and aligns the three dimensions and clarifies their main aspects contributing to unfolding the regenerative potential of NBS (Figure 75). It marks the possible touchpoints (outcomes) for (re)connecting human and non-human relationships and flows (approaches) through the design, development, use, and management phases of the urban design (process), each critical for enabling the regenerative evolution of place. Finally, it signifies the place-based aspect of NBS design which provides the reference point in each dimension for developing regenerative potential. The next paragraphs discuss these claims in detail based on the separate dimensions.

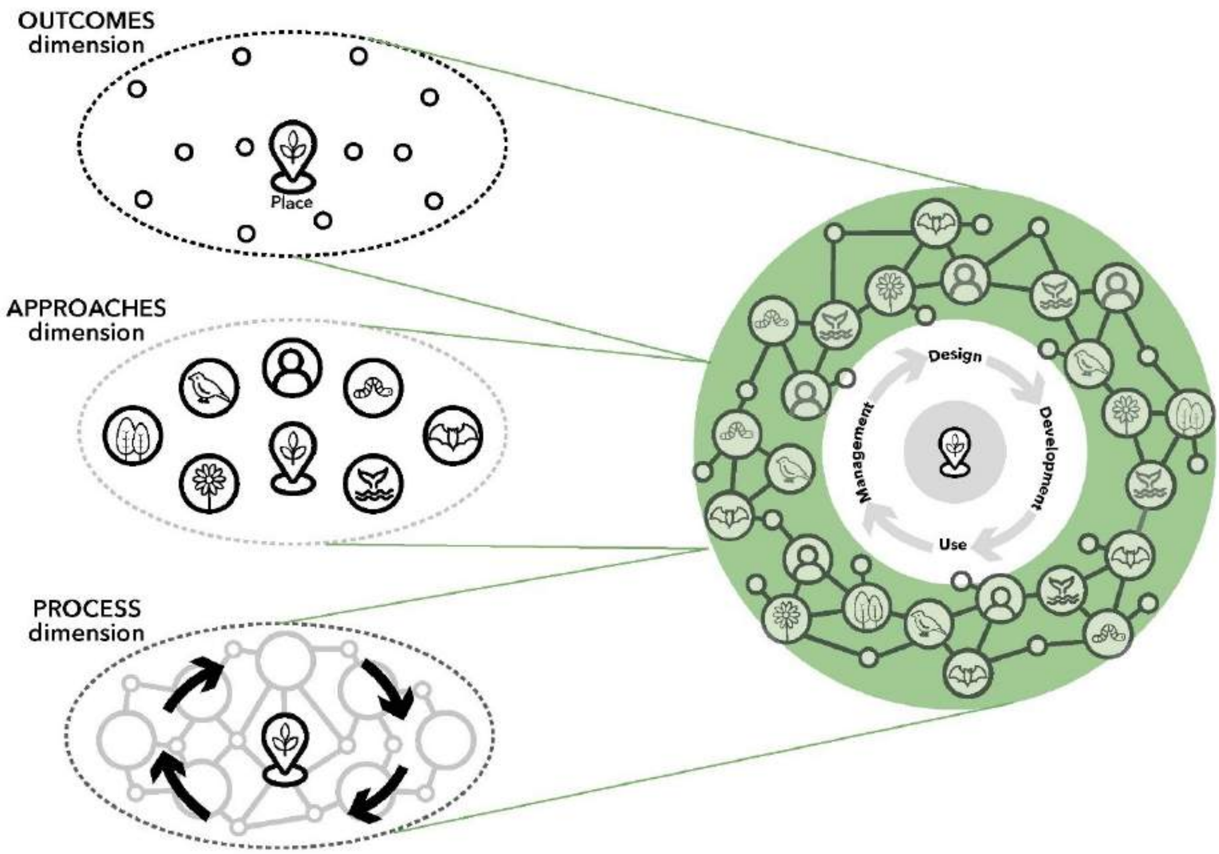

Figure 75. Channeling the key learnings of the design dimensions into a design framework for regenerative urban NBS. Prepared by the author.

The design-generated consequences of NBS manifest in the **outcomes** dimension, which can be most directly interpreted in comparison with the other two dimensions. The placemaking lens I applied in the analysis demonstrated that urban design-based placemaking concurrently works through shaping the physical structure and its mental representation. On the intangible level, regenerative outcomes manifest in the places' nature-based image and identity, which can resonate with people: by communicating the cultural and social connections, relevance, and benefits gained from such a place. On the mixed, people's practices level, regenerative outcomes are the enabled nature interactions, experiences, and learning, induced through participatory programs and activities. Additionally, the critical role of art and creative practices should be highlighted in channeling attention and bringing forth relevance and entanglements with and for urban nature. These are also dependent on the physical characteristics of the place, where the tangible outcomes are composing an urban environment supporting both humans and non-humans. Here, the cases showed significant differences in the quantity and quality of realized 'touchpoints' between humans and nature, whether through tangible, mixed, or intangible placemaking expressions. The information boards, amenities, events, and programs inviting people to participate in gardening or maintenance activities, educational programs, guided tours, and the images and information presented in the media are all examples of touchpoints through which people can connect to a place or understand its purpose.

The analysis confirmed well-functioning NBS cases to be place-based interventions with distinctive social relevance, where the nature-based outcomes emerge through placemaking expressions, which rely on the sites' nature-based characteristics. Therefore, I further argue that, in the case of urban NBS, the natural elements provide the foundation for placemaking processes and activities based on the diverse forms of nature's contribution to people. This points to the importance of design efforts aiming to reposition nature as a fundamental 'actor' in shaping the urban space. The built environment can *participate in nature*. Design solutions should communicate that message and enable one to experience it as such. However, as some of the cases (for example, Bercsényi grove) showed, the overly human-centered considerations for designing tangible and intangible features can hinder these opportunities and end up disregarding nature's role as an *active participant* in a place.

Cases with a well-orchestrated array of touchpoints show the possibilities of the many ways to connect people to urban nature through design (and highlight the unrealized but attainable potentials in cases that currently miss such outcomes). They communicate a kind of transformed urbanity, its value, and how to achieve it by embodying good practices in regenerative design. Additionally, desirable or powerful (designed) 'images' help spread the idea across multiple platforms and contribute to knowledge transfer. The principal architect of Stefano Boeri's studio in China commented on the spread of the design versions of Bosco Verticale:

> People see when they see. They only believe that it is working when it can be seen. We need [more than] examples, prototypes, and proofs (#3 ICON Design Talks).

Furthermore, while NBS designs have a primarily local outcome, they can assert influence on global trends through marketing, networks, and consultancies. One of the outcomes of the coordinated approaches to the promotion and management of NBS, like in the case of BAM and Bosco Verticale, was that they gained broader recognition in local and wider networks. Even if the NBS associations are firmly linked to city marketing and place branding strategies in these cases, they also show a designated and necessary space for using NBS within major urban developments. Kabisch et al. (2016) highlighted recognizing NBS as *proactive investments* in urban development processes, supported by joint discussions between society, the public, and scientific bodies. These NBS as 'investments' communicate the multifaceted nature-based benefits for the public and private sectors alike. Similarly, the regenerative business approach of the Regenesis group has been applied in various developments: from schools, farms, resorts, and parks to housing, commercial, and mixed-use projects and cities, neighborhoods, and community and regional economic development.

Compared to ‘conventional’ urban green spaces, nature-based places should offer amplified benefits (such as nature interactions and experiences) and provide the foundations for the regenerative transformation of the urban area (and the urban citizen). This implies a new type of blended urbanity where the urban form works for both human and non-human species, expanding the understanding of urban places as semi-natural systems. Such places can tell the history of the place, its regenerative or transformation journey, its relevance in local development, and information on the inhabiting species for which it provides habitat, protection, and nourishment.

Design solutions that aim to reach such outcomes depend on **approaches** that support the flourishing of all organisms and develop the abundance, richness, and diversity of human and non-human cultures. Therefore, the basic human-centered placemaking requirements must be extended toward a community-centered and 'more-than-human-centered' design. The results showed that explicit design principles and approaches were used in most cases, and where regenerative outcomes are present, they are based on guidelines embedded in the approaches. However, the worldviews embodied in the analyzed NBS also showed that while most NBS contain human-centered features, some are overly human-centered, sometimes clearly at a cost to non-human nature (such as the case of Kuopio park). Moreover, the lack of focus on the more-than-human leads to missed opportunities to amplify human and non-human benefits and build on the understanding of the complexity of human and non-human communities.

The MHC approach can guide urban regeneration by directing architects and designers to relate to the cohabited urban environment to integrate non-human agency in the design process without excluding human interests. Consequently, approaches applied for NBS designs must build on the more-than-human-centered perspective, for example, by drawing inspiration from traditional, indigenous knowledge and practices. These practices embody the interconnectedness of human and non-human systems and point to conceptualizing urban life as connected to the ecological system. However, since this type of design attributes the urban human-nature relationship and functions of urban space to a new or different interpretation, the MHC approach needs to be adapted to this context, where the goal is the radical repurposing of the urban space.

The new perspectives must influence the ingrained practices of the physical and governmental parameters of the urban systems. New understandings must be formed, meanwhile, other mental and physical structures, and work processes must be undone and re-learned. In this thesis, I applied Carmona's (2014) analytical framework to study the **urban design process** (UDP) of NBS. Analyzing how design 'works' offered a systemic view on how the outcomes are produced across the main phases of the UDP: 1) the creation of the Design vision, 2) its Development, and the 3) Use and 4) Management of urban NBS. This holistic view highlights that the MHC approach to urban design should play a definitive role in each of these phases. Therefore, it is critical to involve specialists and professionals to accompany the process from the first Design phase to prepare for the challenges of the Use and Management phases and deal with them on an ongoing, flexible basis, thus eliminating the typical design shortcomings. In addition, the regenerative goals of NBS design require the process (and approaches and outcomes) to be community-centered, primarily to be an open, multi-stakeholder process that can integrate a wide range of perspectives and mobilize the local community. Plus, each phase of the design process is an opportunity for community involvement (if it has not happened from the beginning). Therefore, sustainability learning is possible at multiple (touch)points during the making of the NBS.

The design principles, approaches, and guiding values are formulated in the first phase of the UDP to define and support the design vision. These can be developed together with the community (NaturePlay or CERES), defined by the leading designers (Bosco Verticale, BAM, Parco Portello, Medibank place, School gardens of Győr), or derived from meeting the goals of the larger development in which they are integrated (Bercsényi grove and Kuopio park). Therefore, the **Design phase** is of paramount importance in setting the overall orientation of the design, which also influences the consecutive process phases and outcomes. Additionally, this is the phase where questions of sustainability and regeneration are paired with the functional, ergonomic, and economic features across spatial and temporal scales to address trade-offs between functions, social equity, and species diversity. The design vision built in this phase needs to draw on precedents and experience to optimize the plans for the anticipated use and maintenance needs and the inevitable changes due to activities and growth to achieve flexible and adequate designs (as the NaturePlay case demonstrates). Specialists, experts, locals, and people with traditional knowledge should bring in knowledge and information sources in multiple co-design forms to be incorporated into the design vision in relevant ways for sustainability and the social system. The iterative mechanism of shaping the design vision through trials, tests, and adaptations, paired with community involvement, forms a knowledge creation process fitting to address social-ecological questions on a theoretical, conceptual, and concrete, practical level and provides space for a learning loop between knowledge and action.

The design vision is actualized and implemented during the **Development phase**. For NBS, this means that ecological, more-than-human, and social values must be articulated already in the Design phase. My research demonstrated that the development and implementation of urban NBS are inevitably bound to the larger industrial construction system. This implies that NBS must often comply with sustainability requirements at a technical construction level. Therefore, expertise in specialized green infrastructure design and management is required for the plans' commercial rationalization and for developing cost-effective solutions to optimize management and maintenance needs. However, specialized sustainability or 'green' design frameworks only reflect these technical aspects of sustainability and lack consideration for the MHC perspective or the overall social and ecological aspects of regeneration. Even though the Development phase of urban NBS offers various co-creation and participative opportunities to create a sense of place and transform local communities, urban NBS could potentially 'do more' if the frameworks would include regenerative measures. Nevertheless, urban NBS developed with a community-driven approach can better utilize the potential to create socially appealing and publicly acceptable urban NBS while opening the implementation of NBS to human-nature interactions and learning.

Studying the **Use** and **Management phases** can serve to analyze the NBS designs' human-centered side because these phases are inherently linked to responding to human needs (Use) and governance (Management). Naturally, these phases are expected to reflect human needs primarily. Nonetheless, in NBS design, considerations for the flows of non-human activity should also appear. However, they are typically not accounted for by general placemaking and urban design frameworks. My research showed that in most cases, the appearance of the non-human (as inhabitants or users of the space, for example, in the high-rise buildings or even in the artificial lake of Parco Portello) is the result of the physical features unintentionally attracting them. Apart from enhancing biodiversity through planting design, the physical space can be designed to provide even more: habitat, shelter, and nourishment for non-human species (in addition to tending to human needs). This highlights the necessity to extend the conceptual toolkit of placemaking to the non-human, with practical implications for NBS implementation (also see J. Bush, Hernandez-Santin, and Hes 2020).

Moreover, even though the continuous, dynamic development, renewal, and maintenance needs must be managed (and anticipated with apt design plans), nature-based design solutions should be flexible to accommodate the growth of the more-than-human (or evolution towards regeneration) in cost-effective ways. Such attributes should be communicated and expressed in the 'solution.' Therefore, a flexible, adaptive process is essential for creating urban NBS to accommodate nature's messiness. It must allow for modifications and adjustments at the later stages and for the collaborative planning mechanisms of community-driven urban design, which also require necessary flexibility. Simultaneously, keeping the cohesion of the NBS design vision during the whole process is fundamental. Additionally, the experiences and learnings from these phases should be channeled into the starting phase of new or redesign design cycles to build on forward-looking and forward-thinking designs based on both human and non-human perspectives.

By providing a complete overview, the NBS design framework encompasses a range of leverage points influencing NBS' ability to bring about transformative change across the three dimensions: through design outcomes, approaches, and process. Besides, it allows focusing on specific areas or phases and inspecting the originators and underlying reasons for the NBS' design successes or failures in each dimension. Similarly, as Donella Meadows' (1999) leverage points show that it is not enough to work on patterns of flows, as most of the proposed changes do (such as flows of materials, information, and economics), the NBS design framework should include the underlying structures and mental models that uphold and influence the patterns to transform. The mental models (assumptions, beliefs, and values constructing worldviews) are the most inaccessible and potentially most impactful leverage points for change because they represent the core of the systems constructed around them. Aiming for a regenerative urban transformation would work only by addressing the nested hierarchy of leverage points: the ideologies in design approaches, embedded in a physical reality of outcomes, and the processes and governance of the underlying urban system (see Figure 77 on the next page).

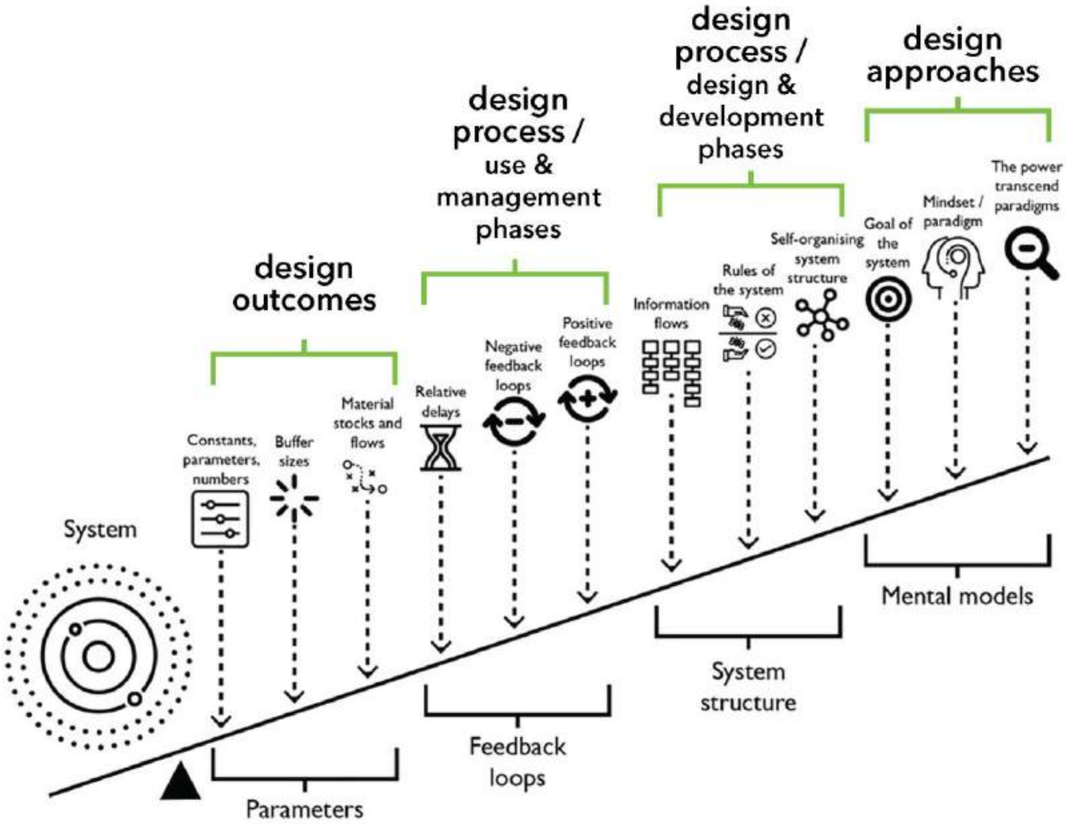

Figure 76. Leverage points applied to the design framework. Source: Angheloiu and Tennant 2020 (with amendments).

For example, the Bosco Verticale towers show a radically different approach to architectural design, building on the 'democracy of green' motto. The towers essentially question urban space distribution and equity allocation for humans and non-humans. The realized design reflects these ideas, visually showing something different than the ordinary. However, the design and development process of Bosco Verticale followed rather traditionally the sustainability requirements of green buildings. It did not consider the community-building aspects of regeneration (which the newer versions of Bosco Verticale already include). The outcomes reflect the achievements of the other two: the approaches and process dimensions. On the one hand, the new design generated widespread interest and the spread of the idea with unprecedented speed: the towers became a design phenomenon. On the other hand, because the development and management were only trusted to professionals, BV lacks social inclusion and community-building aspects.

A similar exercise shows the more harmonious design dimensions of NaturePlay or CERES. Both cases were guided by a design approach built on solid community-centeredness that complemented the ecological regeneration goals. The community and ecological sides' paired considerations accompanied all phases of the design process, from the design vision to development, use, and management. Consequently, the achieved outcomes manifest strong benefits both in social and ecological terms (and economical, mainly in the case of CERES).

8.2. An evolution from urban spaces into nature-based places

My empirical findings show that the regenerative potential of NBS can be enhanced through design. However, not all NBS have fully realized potential: they show different levels of 'achievement' concerning urban sustainability or regeneration. In other words, what is achieved is often only necessary but not sufficient. Therefore, in this section, I reflect on the possible ways to activate the higher potential of NBS, which requires overcoming barriers and biases obstructing these efforts both from a practical and a conceptual point of view.

First, organizational or governance barriers often restrict the implementation (or evolution) of urban NBS projects (Ferreira et al. 2020; Kronenberg 2015; Matthews, Lo, and Byrne 2015). Croeser et al. (2021) found that these limitations persist despite years of scholarship and accumulated knowledge on the barriers and how to overcome them through a range of theoretical lenses. While project champions conquer some typical obstacles, the most significant ones continue to obstruct NBS implementation. Moreover, these obstacles are often beyond the influence of project teams (due to understaffing, a lack of intra-organizational processes, or risk-averse organizational cultures).

Organizational barriers are diverse and abundant, and design cannot address all of them. Nevertheless, the design process is a crucial factor in providing space and means to expand the capacities and capabilities of stakeholders: locals, designers, participating institutions, or businesses. This is one of the most important aspects of a regenerative practice that Mang and Haggard (2016) refer to in their regenerative design guideline as cultivating 'developmental processes':

> Local stakeholders are invited into a field of commitment and caring where they can develop understanding of their place and how it works as they step forward to serve as co-designers and ongoing stewards. Local institutions and ecosystems are seen as project beneficiaries, and it becomes an explicit project goal to improve their ability to do their work (Mang and Haggard 2016, 32).

One of the primary conclusions in Chapter eight is that each phase of the UDP provides different opportunities to engage the varied range of stakeholders and future users of space. For example, at NaturePlay, the maintenance crew was treated as a design partner already in the Design phase of the UDP. They participated in the Development phase by overseeing the construction. Ultimately, they became stewards of the place (in the Use and Management phases), responsible for the ongoing care of the park (see more details in Chapter seven, Sections 7.4 and 7.5). In a regenerative project, the 'developmental process' is opened for engagement, from the point of discovering the role of the project in realizing the potential of its place to the continuing care for the place (see the case of NaturePlay or CERES). This way, urban NBS becomes a stage for partnership, allowing continuous support for social and ecological aspirations that can help overcome organizational or governance barriers.

Second, NBS are often framed too optimistically given the business-as-usual operation of cities. Significant social learning and change are necessary to align urban design and development processes to advance a more-than-human-centered approach to urban structures, radically different from the ordinary. This is challenging due to ingrained perspectives of the 'urban' and 'design': understanding these concepts in a new sense. One of the foremost obstructing biases is that people assume that the state of the environment is the same as it has been in the more distant past (Kahn and Weiss 2017). Today, we are not questioning why horse-drawn carriages are not on the roads, whereas that was the norm relatively not long ago. Similarly, for about 140 years, 'parking' used to mean a street tree system, near which people used to 'park' their horses and carriages for shading (Richmond 2015). However, today we are not questioning the void of parks in parking[106], and we are not asking why lawns and ornamental trees define greenery in most parks or why streets that flood each year are sealed with concrete surfaces.

The above examples demonstrate how urban definitions and qualities can change relatively quickly, together with people's attitudes, norms, and expectations: without questioning the (new) ordinary. Similarly, there are impeding biases concerning the connections between design and human advancements that must be examined. For example, Adams et al. (2021) demonstrated a psychological phenomenon in problem-solving situations that applies to a range of universal conditions requiring creativity, such as in design or business areas or when solving a puzzle. They found that humans systematically tend to think about *additive* transformations and overlook subtractive changes (taking something away to solve the problem), even when the latter is the better solution. The authors imply that the bias to overlook subtraction might be one of the connections between the modern trends of unsustainable, rapid changes and overburdened people and the planet (both in biophysical and socio-economic terms). Moreover, favoring additive changes is also connected to clinging to the familiar (detailed in the previous section) because people tend to see all existing components as given and necessary. In other words, people like to think *inside* the box.

[106] Many other examples can illustrate the changing nature of urban norms, from increasing land use and the spread of the city to the increasing availability of different amenities. However, I chose the case of parking because I found it rather fitting (and ironic) in the context of urban NBS.

The transformation of tree parking to car parking was a *radical repurposing* of the urban space. Today, a radical and reverse change is necessary to *rethink* and *redesign* typical urban structures and amenities. In the urban context, the ordinary solutions of sealing all surfaces with concrete, building different structures when there is an 'opening' in the space, and the general association of progress with building and construction can portray the additive bias. Removing something instead of building triggers a backward perception. However, implementing urban NBS can work as cues (or best practices) for prompting what Adams et al. call subtractive changes outside the box (2021). Urban places with NBS transform (in a sense, dissolve) the grey infrastructure point by point, both physically (visibly and tactilely) and theoretically. Facilitating the inkling of degrowth or subtraction in design, for now, is a relative niche territory that Cameron Tonkinwise calls 'undesign' (2013). Concerning the urban space, undesign is about deconstructing the ways of urban design and development. This idea is present in the rewilding movement, where nature is left to do the 'designing.' Similarly, undesign is applied by the 'depavement' movement (pavement removal), 'guerrilla gardening,' creating temporary public parklets in street parking spaces, or river 'daylighting' (bringing formerly sealed urban waterways back to the surface). This way, urban structures are conceptualized as a source of materials for repairing the surrounding environment and not as the end of the design process. Designing urban NBS means making living structures with responsibility for the soil, natural flows, and processes that support the capabilities of urban plants and animals (Maller 2021).

However, this implies that a change must be reflected in the use and reuse of resources and the policies adopted for a multispecies design. In addition, the education of a new generation of urban designers and architects must be transformed. The technical and engineering schools must be infused with ecological knowledge to incorporate biophilic principles and radically inclusive (extended to non-human species) co-design methods to design for flexibility, deconstruction, and adaptive reuse.

In short, regenerative urban transformation with NBS requires that the applied design outcomes, approaches, and processes facilitate the subtraction or breaking down of built and mental structures. This would be a critical goal considering the narrow window of opportunity we have to reverse humanity's harmful effects on Earth. Nonetheless, urban environments are constantly changing structures that have been designed before, with the possibility to be redesigned for regeneration. New cues for subtraction and change (such as the application of undesign methods or NBS) are present in any urban design actions, which are only episodes in a "place-shaping continuum" (Carmona 2014, 6). Reaching back to Mang and Haggard's (2016, 28) argument that regeneration is *one* aspect of living systems, and the goal is to work *towards* regeneration, the other, equally necessary, NBS stages that 'operate,' 'maintain' or 'improve' living systems (presented in Section 2.4.1) are also highlighted. For example, many of the achievements of the green building movement apply to the 'operate' level. The repeated adaptations on the go or redesigns due to the intensity of use in the case of the already operating BAM or NaturePlay illustrate work at the 'maintain' level. The School gardens in Győr transforming schoolyards and the ecological design of Bosco Verticale and Medibank illustrate the level of 'improve' with such advancements or potential compared to regular green buildings working at the 'operate' level. Then, in the case of CERES, the initial regenerative work enabled the community and the municipal authority to realize the values of rebuilding the relationships with the site and the surrounding landscape ('regenerate' level). The trash-filled former quarry was transformed into organic farms, community gardens, community development spaces, and demonstration sites for sustainable living. CERES' effectiveness at the other (operate, maintain, and improve) levels are contingent on the initial regenerative level work that now sustains the social enterprises and educational programs and events involving thousands of residents, volunteers, and tourists.

Mang and Haggards's (2016) guideline can be a reminder that regenerative change can be induced each time an opportunity appears for redesigning urban structures, moreover, it allows for corrective measures and improvements on the go. Similarly, one must be aware of which level of work is needed at what stage of the NBS lifecycle, fit for repurposing the urban, and constantly adapted towards the regenerative level. Altogether, the highest regenerative level shows the possibilities for the other levels and helps practitioners design according to integrated strategies.

Frameworks help to see things from a new angle and create new typologies. Creating this framework is not about discussing NBS models or types (such as green walls, urban gardens, or city parks): plenty of publications and handbooks feature such content. Instead, it speaks of how NBS, through designed features, can influence the urban place and *vice versa*: how urban design affects the ability of NBS to reach its potential. In a sense, it is meant to structure thinking about the design and development of urban environments in ways that prompt a *radical repurposing of the urban space*. The framework expresses that the application of NBS is ultimately dependent on changes in a widely diverse range of dimensions of our continued relationship with the city: to succeed, we need to bring back nature to the everyday thinking, practices, and experiences of city life.

When a 'radical repurposing' or radical change is introduced systematically across multiple domains (social, ecological, economic, institutional, cultural, political, technological), then transformation is achieved (McCormick et al. 2013). In this context, urban NBS have a cross-sectoral role and opportunity to develop synergies pointing towards a necessary change in the dominant values, practices, and infrastructure. The design framework of NBS facilitates this integration by formulating and structuring a better understanding of the interacting changes reached through urban design that affect not only urban functions, local needs, uses and interactions but communities, institutions, businesses, and ecosystems.

As my results showed, the transformative agency of urban NBS is deeply embedded in space-specific social-ecological context. They respond to local settings and constraints and through community-oriented placemaking processes and narratives they can induce transformative change (Frantzeskaki et al. 2016). Even though the potential of urban NBS is bound to the local context, the design framework I deployed facilitates transferring insights from a local, case-based level and aligning them to a generalizable system to recognize and prioritize the leverage points necessary for change. Therefore, developing future urban NBS (or assessing already existing NBS for redesign) with this framework could be an essential step to align urban processes and actions into a mechanism for transformation, and, finally, to bridge the gap between NBS' rhetoric of potential and implementation.

9. Conclusion

In this dissertation, I engaged with convergent frames of thought in design studies, urban design, urban ecology, and sustainability science to explore the role and means of design in transforming urban spaces into regenerative, nature-based places (Figure 77). Building on Mang and Haggard's (2016) 'three lines of work' concept, I addressed the three dimensions of the design framework of NBS - the design outcomes, approaches, and process – each one with the help of a sub-research question separately. I applied the concept of regenerative design (Cole 2012; Mang and Reed 2012) to critically analyze the performance of urban NBS on these dimensions and study their design possibilities and constraints. In the analytical chapters, I showed that all framework dimensions exert an impact on unfolding the potential of urban NBS. Furthermore, I argue that in each dimension, a 'reorientation' is needed to address the perspectives of non-human nature in strategic design decisions.

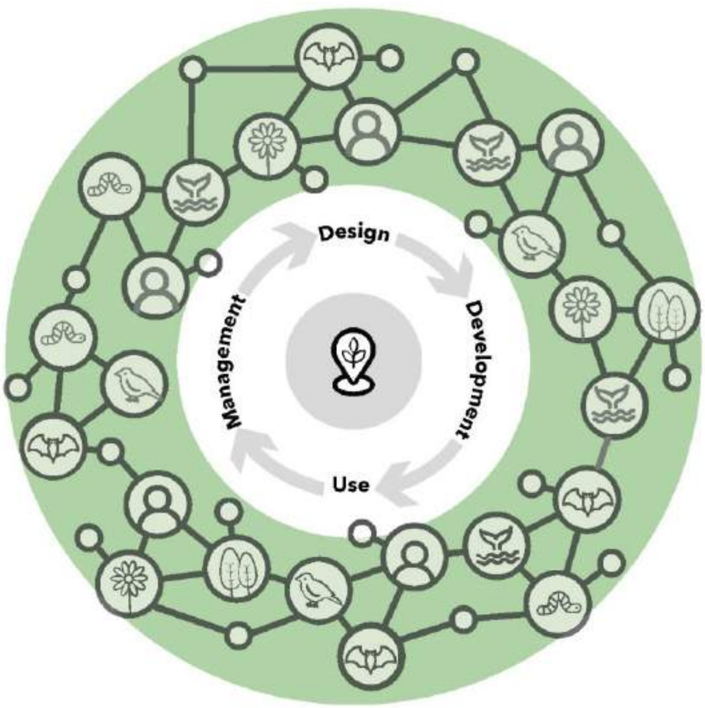

Figure 77. The NBS design framework. Prepared by the author.

The conceptual framework I adapted and devised for researching the design framework holistically across the design dimension is one of the original contributions of this dissertation. It serves as an instrument to navigate the interacting dimensions which define NBS. In addition, it demonstrates the complexity of NBS design and the need to devote adequate attention and resources to work on all three dimensions for implementing NBS.

I gained empirical evidence from nine cases in three cities (Győr, Milan, and Melbourne) on urban NBS. I used a qualitative, interpretive research approach involving semi-structured interviews, document analysis, and field research to execute the research, with complementary place-based methods. The applied conceptual and methodological framework provided a solid structure for in-depth case studies across different contexts. I did not focus on specific types of urban NBS, thus, the open, exploratory, cross-sectorial methodology allowed me to derive universal design aspects. I engaged with a comparative approach for these cases to define key differences and similarities to gain viewpoints on regeneration according to the composition and richness of the applied design dimensions situated within place-based, local cultures and histories.

I chose to work with a mix of qualitative methods to cover different axes of the social experience which constructs the design of NBS and to better understand the bigger picture from these different angles. This allowed me to view and relate to social phenomena in more than one way, thus contradictions in data could have occurred. However, when I encountered inconsistency, for example, in the interview data, it did not reflect that the chosen methods are fundamentally unreliable and invalid. Instead, these problem points reflected the existing messiness and tensions of social reality (Mason 2006) and allowed the creation of data linkages with the capacity to provide explanations.

Nevertheless, with a research design based primarily on interviews, reliability and generalizability of the data can be common issues (Yin 2013). The reliance on interviewee input exposes the data to the typical limitations of self-assessment approaches, such as limited generalizability to different conditions. Therefore, data sources and collection methods were triangulated to provide validity and a better approximation of the studied social phenomena. The insights were cross-checked with academic and grey literature and the place-responsive data.

Regarding the outcomes dimension, my analysis showed that the underlying, designed structure leads to specific, even regenerative design outcomes. Regenerative outcomes of urban NBS can manifest in physical structures, mental representations, and ways of interacting with them, facilitating connections between humans and non-humans and between people in their communities. This analytical lens highlights that place-based, social relevance is crucial for operating NBS and that design outcomes should be articulated to explicitly express this relevance of NBS to the local socio-cultural and ecological context. This way, the NBS can create a situated, blended urbanity working for human and non-human species while communicating the needs and benefits of designating urban places as semi-natural systems. In a way, most NBS and their logic come from adapting traditional, ever-existing land management practices that faded as modernity and human-centeredness developed. Today, the 'ordinary' must be reversed to recognize the position of NBS, both in a practical and theoretical sense.

The analysis of the approaches dimension highlighted their significance in relation to the larger design framework. Even though the application of design approaches (or principles and guidelines) is not connected to hard rules or absolutes in urban design, their direct articulation indicates a purposeful dedication to the values they represent. Then, they are utilized to serve as justifications for the moves and decisions applied later in the design process. One of the critical implications of this analysis is that NBS designs can be critically assessed by juxtaposing the conventional human-centered design perspective with the emergent MHC philosophy. Interestingly, human-centeredness is highly present within studied NBS designs. However, traces of MHC considerations are also present, which, in turn, should be amplified to realize regenerative, socio-ecologically embedded NBS designs. Therefore, I provided a novel framing of the MHC approach to urban design as a reference point for NBS designs working towards the radical repurposing of the urban space.

In the analysis of the process dimension, Carmona's UDP framework was applied to assess the means of NBS development and implementation in all significant aspects: the Design, Development, Use, and Management phases. It revealed that each phase embeds opportunities to shape the design contribution to sustainability, restoration, or regeneration. Moreover, in each phase, there are participation opportunities, fostering social and ecological learning through which the relevance of NBS in the local communities can be strengthened. However, a more direct articulation is needed to attach MHC considerations to each phase. This way, NBS can be considered a 'platform' for urban sustainability and regeneration shifts by directing attention to how humans relate to the environment, communities, and other species with whom the urban space is shared.

The NBS design framework presented in the previous chapter provides an understanding of the role and means of design to bridge the gap between NBS' rhetoric of potential and implementation. It is primarily intended for the attention of urban designers, planners, and architects, who directly define the physicality of urban spaces. It can help them see the explicit potential for regeneration in their work and its connection to environmental and social impacts. In addition, the framework communicates the underlying reasons and motivations to commit to working in this direction (approaches), the ways to induce regeneration through design (process), and the possible impacts (outcomes).

Nevertheless, as the regenerative design process requires a more highly involved design process than is practiced conventionally, it requires accessible tools accepted by the development industry. Therefore, the framework's details could be further enhanced with explicit guidelines to facilitate preparatory works, measurements, and assessments, the involvement of diverse stakeholders (for example, botanists, ecologists, and hydrologists), and the development of social practices and actions to foster collaboration and belonging. For example, a complete NBS design and development process roadmap could provide a step-by-step guide: from establishing equitable MHC design goals with accordingly adapted design tools (for example, biophilic placemaking expressions, MHC personas, journey maps, or blueprints) and setting clear criteria for success.

As a framework, it provides a comprehensive picture and insight into the main elements. It helps to familiarize the design of NBS within the general conceptualization and practice of urban design. However, understanding the fundamentals of regenerative, nature-based design should not (and would not) lead to uniformity in the related design activities. Design is influenced by different climates, cultural practices, and histories. As noted in Chapter three, this research is based on empirical evidence gained in countries with primarily European cultures within the Global North. Meanwhile, scholars of the Global South argue that significant empirical differences in Southern urbanization necessitate explicit research attention (Sheppard, Leitner, and Maringanti 2013; Randolph and Storper 2022). Even on their own, the three dimensions I examined in this dissertation combine in different ways and amplitude from case to case. This plurality of NBS design and the ways to actualize their regenerative potential would be further widened through studying NBS in the Global South, where NBS designs need to respond to different urbanization contexts. Therefore, a more large-scale and comparative urban design research could generate fresh insights into the empirics of the design of NBS, especially how those conditions and their empirical outcomes contrast with those of the historical North. This requires the application of general theoretical frameworks, such as the one I deployed in this dissertation. Engaging with these theories could involve significant gain of knowledge about and insight into designing NBS with regenerative impacts.

Additionally, a regenerative NBS design framework has general implications beyond the field of urban design and the nine cases. A nature-based approach should be applied within the overall framework of the green and smart city initiatives to be integrated with urban mobility, infrastructure development, and energy, information, and communication processes. For that, the everyday operations of schools, municipal institutions, community spaces, homes, housing, and commercial and business spaces must be transformed. This requires drastic shifts in policy, development practices, and consciousness.

Shifting cultural norms and ways of thinking to reach a fundamental change in the business as usual can seem utopistic. However, thinking in nature-based terms - aiming to create and sustain living structures within the everyday urbanity - could induce these changes when such knowledge and practices are widely accessible. Therefore, it is critical to engage in practical dialogues for driving cultural transformation and continued learning (across organizations, communities, businesses, and governments) - in which NBS can be a powerful instrument. My research has shown that the NBS design ideas and solutions can spread by purposefully using tangible, mixed, or intangible outcomes or through an open, multi-stakeholder process. For example, the learnings from designing, implementing, and operating BAM helped to refine COIMA's development model and replicate it to newer sites, as well as extend BAM in size and services - which was possible due to its flexible layout. Alternatively, the partnerships established during the design and development of the School gardens of Győr or CERES helped replicate the NBS at different new sites, increasing their cumulative regenerative effects.

Furthermore, my results show that sustainability thinking can be not only promoted through NBS but utilized to overcome the economic challenges of green financing through creative solutions by design. For example, the mutually benefitting partnerships and a network of connected social and business ecosystems enable BAM and CERES to sustain their multipurpose sites and reap the multiple benefits. Moreover, this physical and organizational structure could arguably enhance the currently underutilized potentials of Kupio park and Bercsényi grove. Furthermore, the cases of the School gardens of Győr and CERES demonstrate how community-initiated projects can develop their strengths, spread, and evolve into resilient organizations. Or the example of NaturePlay can show how conscious planting design can reduce the anticipated maintenance needs and costs. Finally, even advanced NBS can be financially supported by designs that produce distinguished outcomes, as the case of Bosco Verticale exemplifies. Therefore, understanding regenerative, urban NBS design is relevant not only to urban designers and architects but also to policymakers, project owners and investors, municipal or national bureaucrats, and community activists.

Recognizing that nature-based solutions can be viable (even profitable) from a business perspective would significantly contribute to their uptake. The recent expansion of the environmental, social, and governance (ESG) criteria for sustainable investing (UN 2004) already implies a growing business interest and commitment to protect the environment and mitigate risk in the long term. ESG factors cover a range of issues relatively new to the business-as-usual financial analysis, such as responses to climate change, water management, sustainable supply chains, or how they treat their workers. My findings can be relevant from this perspective because they illustrate how natural capital investment (i.e., implementing NBS) can materialize productive results and how design factors can affect that. For example, NBS, which are attractive to people, can boost eco-tourism and generate revenue from additional services. Even though this was not the central topic of my thesis, innovating the business of NBS through design is an important angle of this research work, with possible implications for the larger NATURVATION project.

Additionally, my findings suggest some potentially fruitful directions for future research. Realizing the regenerative potential of urban NBS ultimately depends on our relationship with the city and nature, recognizable in everyday thinking, practices, and experiences within city life. NBS can be seen as green-blue branches through which the natural and non-human can break into the city fabric and – with good design and governance – spread. However, a narrow understanding of applying design for urban regeneration can overlook critical aspects that could otherwise reduce common bottlenecks and result in NBS with hindered potential. Urban professionals (not just designers) must be trained accordingly: to facilitate the growth and manage the continuously evolving green infrastructure. For example, what are the new, provisional design resources that create opportunities and address challenges for designing a more-than-human urbanity? How to overcome the dominant narrative of human-centeredness, and can participation of the more-than-human truly happen?

Alternatively, exploring design synergies beyond the urban could present intriguing research possibilities. For example, how can MHC design gain traction within professional or commercial assignments, or how can these practices gain more legitimacy in design education and practice? Moreover, as regenerative design presents both constraints and possibilities for design, questions arise concerning the limits of design and designers. For example, can it be allowed for design or artistic intentions to overrule natural elements? If regenerative design is taken on board with all its considerations, the creative freedom to design might be challenged, with new limits and more strict consequences if violated. How can design and designers respond to these changes constructively? Exploring these questions may help move us towards a future where using NBS is commonplace within urban design tools and practices.

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Appendices

Appendix A – Background information for Chapters 1-2

NATURVATION uses the TEEB (2014) classifications of ES to systematically assess and evaluate the contribution of NBS.

Table A6. Ecosystem services of NBS. Source: Bulkeley et al. 2017

TEEB categorization	**Ecosystem services**
Provisioning Services	Food
	Raw materials
	Fresh water quantity
	Medicinal resources
Regulating Services	Local climate regulation (temperature reduction)
	Air quality regulation
	Coastal protection
	Noise reduction
	Carbon storage/sequestration
	Flood regulation
	Water purification
	Pollination
Habitat and supporting services	Habitats for species
	Maintenance of genetic diversity
Cultural services	Recreation and mental and physical health;
	Tourism;
	Aesthetic appreciation
	Inspiration for culture, art & design

To assess the impact of NBS in relation to urban sustainability challenges, the NATURVATION adopted the framework of the EKLIPSE[107] working group. They tailored it with an urban-centered approach to sustainability, inspired by the Sustainable Development Goals (ibid).

Table A7. Urban sustainability challenges

1	Climate action for adaptation, resilience and mitigation
2	Water management
3	Coastal resilience and marine protection
4	Green space, habitats and biodiversity
5	Environmental quality, including air quality and waste management
6	Regeneration, land-use and urban development
7	Inclusive and equitable governance

[107] Expert working group on NBS founded by the European Union.

8	Social justice and social cohesion (for reduced inequalities including gender equality)
9	Health and well-being
10	Economic development and decent employment
11	Cultural heritage and cultural diversity
12	Sustainable consumption and production

Appendix B – Key research data and background information for Chapter 3

Table B8. Use of abbreviations in the Appendix tables

G	General context
Győr case study site abbreviations	
BG	Bercsényi grove
KP	Kuopio park
SG	School gardens
Milan case study site abbreviations	
BAM	Biblioteca degli Alberi
BV	Bosco Verticale
PP	Parco Portello
Melbourne case study site abbreviations	
NPP	Nature Play Playground
MB	Medibank building
CE	CERES

Győr cases

Table B9. Győr cases: key informants. Interview dates: between 10.2019 – 01.2020

Informant	Expertise and organization	Case relevance	Type of contact
	associate professor, Hungarian Academy of Sciences, Centre for Economic and Regional Studies	orientation	In person
	Doctoral researcher, Hungarian Academy of Sciences, Centre for Economic and Regional Studies	orientation	In person
#Gy01	previous chief architect, associate professor, Department of Planning and History of Architecture, Széchenyi István University	BL / G	In person
#Gy02	architect and urban planner, former president of the Hungarian Urbanistic Society	G	In person
#Gy03	landscape architect, Kertművek	KP	In person
#Gy04	landscape architect, owner of Kertművek	KP	In person
#Gy05	senior project manager, C.T. & Partner	KP/ BL / G	In person
#Gy06	strategic team leader, Department of Urban Development, Mayor's office	KP / BL	In person
#Gy07	former forester, civic activist	KP / G	Telephone
#Gy08	associate professor at Széchenyi István University, founder of the School Gardens Foundation	SG	In person, phone, and walking interview

#Gy09	director, Kálmán Öveges Primary School	SG	In person, and walking interview
#Gy10	primary school teacher, eco study group leader, Tulipános Primary School	SG	In person, and walking interview
#Gy11	Adyváros residents (4 person)	KP / G	In person

Number of persons/organizations contacted: 28

Persons interviewed: 11(without orientation talks)

Average length of the in-person interviews: 48 minutes

Table B10. Observation log of the Győr cases

Date	Code	Day and time	Weather conditions	Case relevance
17.01.2019	#1 Gy observation	Thursday, 15:00-16:30 (1.5 hour)	N/A	NBS exploring
25.02.2019	#2 Gy observation	Monday, 11:00 – 11:45 (45 minutes)	Cold, cloudy weather ~6 C°	KP
18.03.2019	#3 Gy observation	Monday, 12:30 – 13:00 (30 minutes)	Cold, clear weather ~10 C°	KP
25.03.2019	#4 Gy observation	Monday, 13:00 – 13:45 (45 minutes)	Cloudy spring weather ~12 C°	BG
26.03.2019	#5 Gy observation	Tuesday, 15:00 – 15:30 (30 minutes)	Cloudy spring weather ~12 C°	BG
29.03.2019	#6 Gy observation	Friday, 10:00 – 11:00 (Öveges Primary School) (1 hour) Friday, 11:00 – 12:00 (Apáczai Faculty) (1 hour)	Sunny, nice spring weather ~ 16 C°	SG
05.07.2019	#7 Gy observation	Friday, 09:00 – 09:45 (Tulipános Primary School) (45 minutes)	Hot, sunny ~ 30 C° (already in morning)	SG
05.07.2019	#8 Gy observation	Friday, 10:00 – 11:00 (1 hour)	Hot, sunny ~ 30 C° (already in morning)	BG
05.07.2019	#9 Gy observation	Friday, 11:00 – 11:45 (45 minutes)	Hot, sunny ~ 30 C° (already in morning)	KP
11.07.2020	#10 Gy observation	Saturday, 14:00 – 15:00 (1 hour)	Warm weather with storm clouds ~ 26 C°	BG
12.07.2020	#11 Gy observation	Sunday, 11:00-12:00 (1 hour)	Warm, sunny ~28 C°	KP

Table B11. Guided tours in Győr

Date	Code and Details (organization)	Guide	Case relevance
19.02.2018	#1 School gardens guided tour: part of NATURVATION URIP meeting	Dr. András Halbritter, associate professor, Department of Science Education, Apáczai Csere János Faculty of Humanities, Education and Social Sciences, Széchenyi István University	SG

Table B12. Relevant conferences/open lectures/events attended: Győr cases

Date	Code and Title	Information, speakers	Case relevance
19.02.2018	# 1 NATURVATION URIP meeting	NATURVATION Project Coordination Group meeting	G
25.10.2018	# 2 NATURVATION URIP meeting	Gábor Aczél, chief architect Zsolt Révi, chief architect	G
25.06.2019	#3 School Garden Basics Subprogram ("Iskolakerti Alapozó Alprogram") closing event	Presentation of the results of the first phase of the School Garden Basics Sub-program. Organized by the Ministry of Agriculture, the Foundation for School Gardens, the Diocesan Caritas of Vác and the National Chamber of Agriculture.	SG

Milan cases

Table B13. Milan cases: key informants. Interview dates: between 04-05. 2019

Informant	Expertise and organization	Case relevance	Type of contact
	architect & associate professor at LABSIMURB / Dept. of Architecture and Urban Studies, Politecnico di Milano	orientation	In person
	architect & research fellow at LABSIMURB / Dept. of Architecture and Urban Studies, Politecnico di Milano	orientation	In person
#M01	urbanist & researcher, Stefano Boeri Architects	BV	In person
#M02	architect & project leader, Stefano Boeri Architects	BV	In person
#M03	project manager, Ambiente Italia	G	In person
#M04	researcher, Ambiente Italia	G	In person
#M05	architect, ROOFmatters	G	In person
#M06	marketing manager, COIMA & Fondazione Riccardo Catella	BAM / BV	In person
#M07	civic activist, Federazione dei Verdi	G	Telephone
#M08	independent designer	BAM / BV	In person
#M09	architect, LAND	PP	In person
#M10	architect & project manager, LAND	PP	In person
#M11	architect & managing director, Carlo Ratti Associati	G	Email

Number of persons/organizations contacted: 26

Persons interviewed: 11 (without orientation talks)

Average length of the in-person interviews: 52 minutes

Table B14. Observation log of the Milan cases

Date	Code	Day and time	Weather conditions	Case relevance
07.04.2019	#1 Milan	Sunday, 11:00-13:00 (2 hours)	Cloudy, rainy day ~ 14 C°	BAM, BV
09.04.2019	#2 Milan	Tuesday, 10:30 – 18:00 (5.5 hours)	Sunny, beautiful weather ~ 18 C°	BAM, BV
11.04.2019	#3 Milan	Thursday, 17:00 – 19:00 (2 hours)	Cloudy, rainy ~ 16 C°	BAM, BV

04.05.2019	#4 Milan	Saturday, 15:00 – 17:00 (2 hours)	Sunny, beautiful weather ~ 22 C°	PP
07.05.2019	#5 Milan	Tuesday, 11:00 – 12:00 (1 hour)	Sunny, bit cloudy weather ~ 20 C°	BAM, BV
11.05.2019	#6 Milan	Thursday, 17:00 – 19:00 (2 hours)	Rainy, bad weather ~ 14 C	BAM, BV
15.05.2019	#7 Milan	Wednesday, 13:00 – 14:30 (1.5 hours)	Sunny, bit cloudy weather ~ 21 C°	PP
25.05.2019	#8 Milan	Saturday, 13:00-14:00, 15:00-16:30 (2.5 hours)	Sunny, bit cloudy weather ~ 22 C	BAM, BV, PP

Table B15. Guided tours in Milan

Date	**Reference (organization)**	**Guide**	**Case relevance**
09.04.2019	#1 Milan guided tour organized by ICON Design Talks	Jana Crepon, partner and landscape architect, Inside Outside	BAM
11.04.2019	#2 Milan guided tour organized by the Fondazione Riccardo Catella	Official tour guide	BAM, BV, G
25.05.2019	#3 Milan guided tour organized by Milan Arch Week	Isabella Inti, architect, president, Associazione di Associazioni Stecca degli Artigiani	BAM, G

Table B16. Relevant conferences/open lectures/events attended: Milan cases

Date	**Reference (event)**	**Relevant speakers**	**Case relevance**
05.04.2019	#1 Rinverdiamo Milano, CLEVER Cities meeting	Maria Berrini, Ambiente Italia Emilia Barone, Comune di Milano Area Pianificazione urbanistica Generale Marco Pialorsi, Stefano Casagrande, Comune di Milano Area Pianificazione urbanistica Generale Lorenzo Bono, Inge de Boer, Ambiente Italia Carmen Salvaggio, Caterina Padovani, Comune di Milano Area Pianificazione urbanistica Generale e Area Ambiente Energia	G
09-14.04.2019	#2 Milan Design Week		G
09.04.2019	#3 ICON Design Talks: Biblioteca degli Alberi: Poetry, Planet and Repair - Designing Green Spaces for the 21st Century	Jana Crepon, Inside Outside, partner and landscape architect Thomas Piper, documentary filmmaker, made a film about Piet Oudolf's work (one of the designers of BAM) Carlo Ratti, architect and director of MIT Senseable City Lab Yibo Xu, Stefano Boeri Architects director Cristina Gabetti, Sustainability Curator, 'user' of BAM	BAM, BV
10.04.2019	#4 The politics of Design conference at Triennale Milano	Paola Antonelli (curator of MOMA) Bruce Sterling (science fiction author) Danah Abdulla (designer, educator, researcher) Jan Boelen (design curator) Claudia Chwalisz (OECD) Indy Johar (architect) Amelie Klein (design curator) Etienne Turpin (philosopher)	G

10.04.2019	#5 Festival dell'Ambiente e del Sostenibilità	Matteo Pedaso, science committee member, Green City Italia Valeria Pagliaro, urban landscape design director, LAND	G, PP
13.05.2019	#6 Andreas Kipar open lecture at Politecnico di Milano	Andreas Kipar, landscape architect, lecturer, co-founder of LAND	PP
25.05.2019	#7 Milan Arch Week: About a City - NATURSCAPES workshop, Fare la città con il verde	Antonio Longo, RE-Lambro Giorgio Zerbinati, Giardino San Faustino Marco Sessa, Giardino Lea Garofalo Susanna Magistretti, Cascina Bollate Carla Sofia Galli, Cascinette Cristian Zanelli, ABCittà Silvio Anderloni, Bosco in Città Lorenza Salati, Bosco Post Industriale/R84 Multifactory Mantova Gonçalo Canto Moniz, CES Universidade de Coimbra Marco Acri, University of Nova Gorica Guido Ferilli, IULM Kelly Russell, Fondazione Riccardo Catella Eugenio Morello, Politecnico di Milano Israa Mahmoud, Politecnico di Milano Antonella Bruzzese, Assessore Municipio 3 Comune di Milano Annarita Lapenna, Politecnico di Milano	G, BAM

Melbourne cases

Table B17. Melbourne cases: key informants. Interview dates: between 10.2019 – 01.2020

Informant	Expertise and organization	Case relevance	Type of contact
	Vice-Chancellor's Research Fellow, Centre for Urban Research, RMIT University	orientation	In person, email
	Professor/ARC Future Fellow, Centre for Urban Research, RMIT University	orientation	In person
	Associate Professor, Centre for Urban Research, RMIT University	orientation	In person
	Professor, Monash Sustainable Development Institute	orientation	In person
	Associate Professor, Centre for Urban Research, RMIT University	orientation	In person
	Professor and Director, Centre for Urban Transitions, Faculty of Health, Arts and Design, Swinburne University of Technology, Melbourne, Australia	orientation	In person
	Sustainability Lead, i2C (architecture firm)	orientation	In person
#Mlb01	Lecturer in Urban Planning, University of Melbourne	CE	In person
#Mlb02	Managing director, Fytogreen (ecological sustainable roof and vertical gardens building)	MB	In person
#Mlb03	Chairman, HASSELL (architecture firm)	MB	Skype
#Mlb04	Principal Strategic Design, Melbourne City Design Studio	NP	In person

#Mlb05	Senior landscape architect, Melbourne City Design Studio	NP	In person
#Mlb06	PhD Student, CUR, RMIT (former Green Infrastructure Project Officer at the City of Melbourne)	G	In person, and walking interview
#Mlb07	Former Senior Strategic and Service Designer, CityLab, City of Melbourne	G	In person
#Mlb08	Living Melbourne Program Manager, 101 Resilient Cities, City of Melbourne	G	In person
#Mlb09	Facilities Development and Contract Coordinator, Waterways and Recreation, City of Melbourne	NP	In person, and walking interview
#Mlb10	Park Ranger Education Services, Parks and City Greening, Capital Projects and Infrastructure, City of Melbourne	NP	In person, and walking interview
#Mlb11	Master student, RMIT, as CERES services user	CE	In person
#Mlb12	Local activist, founder of Friends Of Royal Park	CE	phone interview
#Mlb13	Post-doctoral researcher, CUR, RMIT, as CERES services user	CE	In person
#Mlb14	Global Trip Facilitator, CERES	CE	In person
#Mlb15	Managing director, CERES	CE	In person
#Mlb16	Science and Planning Manager, Nature in Cities program, Greening Australia	G	phone interview
#Mlb17	Founder and managing director, Farmwall (urban food production social enterprise)	G	In person, and walking interview
#Mlb18	Architect, co-developer of WestWyck EcoVillage and Community	G	In person, and walking interview

Number of persons/organizations contacted: 34

Number of interviews: 18 (without orientation talks)

Average length of the interviews: 40 minutes

Table B18. Observation log of the Melbourne cases

Date	Code	Day and time	Weather conditions	Case relevance
01.11.2019	#1 Mlb	Friday, 13:00-14:00 (1 hour)	Sunny, bit cloudy weather ~ 20 C°	Nature Play
01.11.2019	#2 Mlb	Friday, 17:00-17:45 (45 min)	Sunny, cloudy with wind ~ 20 C°	Medibank
01.11.2019	#3 Mlb	Friday, 14:00-15:30 (1.5 hours)	Sunny, bit cloudy weather ~ 20 C°	NBS exploring
06.11.2019	#4 Mlb	Wednesday, 15:00-17:00 (2 hours)	Cloudy, warm weather ~ 20 C°	NBS exploring
11.11.2019	#5 Mlb	Monday, 16:00-17:00 (1 hour)	Sunny, warm weather with wind ~ 20 C°	Medibank
17.11.2019	#6 Mlb	Sunday, 14:00-16:00 (2 hours)	Sunny, beautiful weather ~ 25 C°	CERES
23.11.2019	#7 Mlb	Saturday, 10:00-15:00 (5 hours)	Sunny, beautiful weather ~ 25 C°	CERES
27.11.2019	#8 Mlb	Wednesday, 11:00-12:30 (1.5 hours)	Sunny, warm weather ~ 20 C°	CERES
29.11.2019	#9 Mlb	Friday, 12:30-13:15 (45 min)	Sunny, warm weather with wind ~ 22 C°	Medibank
02.12.2019	#10 Mlb	Monday, 12:00-13:00 (1 hour)	Cloudy, windy weather ~ 19 C°	Nature Play

04.12.2019	#11 Mlb	Wednesday, 10:00-11:30 (1.5 hours)	Sunny, bit cloudy weather ~ 20 C°	Nature Play
14.12.2019	#12 Mlb	Saturday, 12:30-13:30 (1 hour)	Cloudy, warm weather ~ 20 C°	Nature Play

Table B19. Guided tours in Melbourne

Date	**Code and Details (organization)**	**Guide**	**Case relevance**
09.11.2019	#1 Mlb guided tour: System garden, botanic garden, and rooftop gardens tour of Melbourne University	Tim Uebergang, Curator of Horticulture, University of Melbourne	General Context
12.11.2019	#2 Mlb guided tour: Green your laneway program	Thami Croeser, former Green Infrastructure Project Officer at the City of Melbourne	General Context
24.11.2019	#3 Mlb guided tour: Royal Botanic Garden	Official tour guide	General Context
15.12.2019	#4 Mlb guided tour: Aboriginal Heritage Walk, Royal Botanic Garden	Uncle Den the Fish, aboriginal elder, poet and broadcaster, cultural educator at the Royal Botanic Gardens Melbourne	General Context

Table B20. Relevant conferences/open lectures/events attended: Melbourne cases

Date	**Code and Title**	**Information, speakers**	**Case relevance**
11.07.2019	#1 Terry Hartig open talk: "Nature Experience, Psychological Restoration and Health"	Terry Hartig, Professor of Environmental Psychology, Department of Psychology, Institute for Housing and Urban Research, Uppsala University	General Context
14-16.11.2019	#2 SDNOW Conference on Design, strategy, ethics, and futures in the Asia-Pacific	Speaker examples: İdil Gaziulusoy, Assistant Professor, Sustainable Design, Aalto University Lara Penin, Director of Transdisciplinary Design, Parsons Mathan Ratinam, Strategic Design Consultant Matiu Bush, Deputy Director, Health Transformation Lab, RMIT University Tristan Schultz, Founder & Co-Director, Relative Creative Ross Harding, Principal, Finding Infinity	General Context
17.11.2019	#3 The Ways we Connect ~ End of a Cycle workshop	Karla Riddell, founder and facilitator, Young Shaman Foundation	CERES
23.11.2019	#4 Gardening in Small Spaces workshop	Carol Henderson, community development worker and horticulturalist, Cultivating Community program at CERES	CERES
27.11.2019	#5 City of Melbourne's Canopy Green Roof Forum: Stories of Plants - An Aboriginal Perspective	Dean Stewart, Wemba Wemba-Wergaia man of Victoria, Aboriginal Tours and Education Melbourne A-TAEM Zena Cumpston, Research Fellow, Clean Air Urban Landscapes Hub, University of Melbourne	General Context
02.12.2019	#6 Gordon Walker open talk: "Energising Rhythmanalysis: rhythm thinking, climate change and low carbon transition"	Gordon Walker, Professor, Lancaster Environment Centre, Lancaster University	General Context

16.12.2019	#7 Lars Coenen open talk: "The Australian paradox: smart, resilient cities in a rich but dumb economy?"	Lars Coenen, the inaugural 'City of Melbourne Chair of Resilient Cities'	General Context

Working paper template: Cases in [City, Country] [Month, Year], [Case 1 Title], [Case 2 Title], [Case 3 Title]

1. Context

1.1. City portrait

- Brief history
- Major challenges or turning points/opportunities
- Challenges and opportunities
- Urban planning system/structure
- Stakeholder involvement in urban development interventions

1.2. Description, urban development history of the neighborhood connected to Case 1

1.3. Description, urban development history of the neighborhood connected to Case 2

1.3. Description, urban development history of the neighborhood connected to Case 3

2. Findings

2.1. Case 1

- Basic description and introduction, baseline characteristics
- NBS outcomes (ecological, economic, social)
- Placemaking outcomes
  - *Sociability*
  - *Uses and activities*
  - *Comfort & Image*
  - *Access and linkages*
- The urban design process phases
  - *Shaping through Design*
  - *Shaping through Development*
  - *Shaping through Use*
  - *Shaping through Management*

2.2. Case 2

- Same as above

2.2. Case 3

- Same as above

References

Appendix A – Glossary and List of Figures

Appendix B – Key research data and data tables examples

Figure 78. Working paper template. Prepared by the author.

Appendix C – Baseline data and background information for Chapter 4

Győr cases

Table C21. Baseline information of Bercsényi grove

Location	Győr, Hungary, Sziget-Újváros district
Urban space/land use type	Public park
Function	Civic
Responsibility	Public
Development timeline	2012-2014: Social urban rehabilitation program
Dimensions	8 ha (former riverbed) ~ 3 ha (with dedicated function)
Budget	~ 4.2 million EUR: total budget of the rehabilitation program ~ 314.000 EUR: renovation of the Bercsényi grove and the public areas
Budget source	grant awarded by the European Union and the Hungarian State under the 'New Széchényi Plan': 'Social urban rehabilitation in Győr-Újváros program' (project number NYDOP-3.1.1 / B-09-2f-2012-0001)
Project Owner	City Council of Győr
Developer	Agrifood Ltd.
Contributors	Consortium partners in the rehabilitation program: Győr Municipality of County City GYŐR-SZOL Zrt. (Győr Public Utility and Property Management Ltd.) City Central Directorate of Public Education Győr-Moson-Sopron County Police Headquarters Győr-Újváros Roman Catholic Parish

Table C22. Baseline information of Kuopio park

Location	Győr, Hungary, Adyváros district
Urban space/ land use type	Public park
Function	Civic
Responsibility	Public
Development timeline	2013-2014: renovation works (~8300 EUR) by Győr-Szol Zrt. 2014: parking plate design concept 2016-2019: further renovations and developments 2018: public procurement for the parking plate development 2020: the Municipality puts off the plan and formulates a new direction with new designs
Dimensions	~ 1.8 ha (green area: ~1.3 ha)
Budget	Parking plate plans ~2.3 million EUR (cancelled) New plans: unknown
Owner	City Council of Győr
Designers	Parking plate: Design (general plans): TSPC Ltd., Landscape architect: Kertművek Ltd. New design: Road Management Organization of the City of Győr
Contributing sectors	Building structure engineering, Mechanical engineering, Electrical engineering, Road and Traffic engineering, Fire protection, External utility, Acoustics, Water engineering

Table C23. Baseline information of the School gardens of Győr

Location	‘Apáczai’ practice garden, downtown Győr, Hungary ‘Öveges’ school garden, downtown Győr, Hungary ‘Tulipános’ school garden, downtown Győr, Hungary
Urban space/land use type	Schoolyard
Function	Educational
Responsibility	Public
Development timeline	2013 – Installation of the Apáczai practice garden 2015 - Foundation for Hungarian School Gardens 2019 - 1st and 2nd phases of the National School Garden Development Program founded by the Ministry of Agriculture 2020 - 3rd phase of the National School Garden Development Program
Dimensions	N/A
Budget	Resources to kickstart ~150-200 EUR
Landowner	School’s property
Developer and Management	School kids, teachers, volunteers
“Designers”	School kids, teachers, volunteers
Industry certification/framework	Foundation for Hungarian School Gardens helps with the dissemination of basic guidelines

Renovation steps of Kuopio park between 2013-2019, excerpt from the website of Ákos Radnóti, Deputy Mayor of Győr, municipal representative of Adyváros

2013 - Fountain renovation: the fountain, which had not been in operation for 15 years, was renovated, and the obsolete benches were replaced. Trees were also planted, and the drinking well was renovated. Cameras connected to the police for 0-24 hours were set up.

2014 - Tree planting: ten hornbeam trees shaped to dice were planted on the side of the main road, and ten spherical boxwood shrubs were placed around the trees. A grid turf was laid, and columned oaks lined were planted along with newly paved paths.

2016 - New irrigation system: an economical and modern irrigation system has been implemented in the park. The area was previously watered manually, which was replaced by an automated nozzle system. The irrigation takes place at night to not to disturb those in the park.

2016 - GyőrBike station: GyőrBike is Győr’s public bike rental system. A new station was installed at the corner of KP, one of the busiest parts of the district, as there are post offices, shops, schools in the area, and recently built bike paths.

2017 - New public art: there was no public artwork installation in Adyváros for 20 years, then the country's first glass mosaic sculpture was placed in Kuopio Park. The piece entitled Őrszem ('Sentinel') is the work of Péter Botos and shows a play of glass and light changes, different in each time of day. A camera ensures the security of the statue.

2017, 2018 - Further installation of **cameras** connected to the police took place.

2018 - Installation of **dog toilets.**

2019 - Installation of **community book sharing point:** a public ‘book sharing point’ was established in Kuopio Park. An old street phone booth was renovated and equipped with shelves and interior lighting. The project aims to allow the free exchange of books on a “bring a book - take a book” principle.

2019 - Flower boxes were mounted on the electric poles.

Milan cases

Table C24. Baseline information of the Biblioteca degli Alberi di Milano park

Location	Milan, Italy, Porta Nuova district
Urban space or land use type	Public park
Function	Civic
Responsibility	Public-private
Development timeline	Design: 2004 Project: 2008-2018 Inauguration: 2018
Dimensions	9.5 ha
Budget	14 million euros
Project Owner	Municipality of Milan
Developer and Management	From 2008 – Municipality of Milan From 2015 – COIMA SGR
Designers	Petra Blaisse, Piet Oudolf, Studio Inside-Outside
Contributors	Studio Giorgetta, Mirko Zardini, Michael Malzan Architecture, Irma Boom, Ro d'Or, Carve
Industry certification/framework	COIMA Res sustainability framework

Table C25. Baseline information of Bosco Verticale

Location	Milan, Italy, Porta Nuova district
Urban space or land use type	Residential towers (113 apartments)
Function	Private
Responsibility	Private
Development timeline	Design: 2006-2008 Project: 2008-2013 Inauguration: 2014 October
Plant surface dimensions	20,000m² (2 ha) / towers
Budget	65 million euros
Owner	COIMA S.g.r.
Developer	Hines Italia S.r.l.
Designers	Architectural design: Boeri Studio (Stefano Boeri, Gianandrea Barreca, and Giovanni La Varra) Landscape design: Emanuela Borio, Laura Gatti
Contributors	Manufacturers: AGB, Campolonghi, Cotto d'Este, Kone, Vimar, CYMISA Structures: Arup Italia S.r.l. Facilities design: Deerns Italia S.p.A. Detailed design: Tekne S.p.A. Open Space Design: Land S.r.l. Infrastructure design: Alpina S.p.A. Contract administration (DL): MI.PR.AV. S.r.l. Interior Design: Coima Image S.r.l., Antonio Citterio & Partners Project & Construction Management: Hines Italia S.r.l. Time & Tender Management: J&A Consultants S.r.l. General Contractor: ZH General Construction Company S.p.A. Main Contractor: COLOMBO COSTRUZIONI S.p.A.
Industry certification/framework	Gold LEED certified
Awards	Best Tall Building in Europe by the Council on Tall Building and Urban Habitat 2014

International Highrise Award (IHP) 2014 for the world's most innovative high-rise building by the City of Frankfurt am Main together with Deutsches Architekturmuseum and DekaBank
International Highrise Award 2014 for the world's most innovative high-rise
Best Tall Building Worldwide 2015 by the CTBUH in Chicago

Table C26. Baseline information of Parco Portello

Location	Milan, Italy, Portello district
Urban space or land use type	Public park
Function	Public
Responsibility	Public
Development timeline	Design: 2002 Construction: 2010 - 2013 Inauguration: 2013
Plant surface dimensions	7 ha
Budget	8 million euros
Owner	Municipality of Milan
Developer	Auredia S.r.l. / Iper Montebello S.p.A.
Designers	Charles Jencks with Andreas Kipar, LAND Milano S.r.l.
Contributors	LAND Milano S.r.l. Team: Giuliano Garello, Mauro Panigo, Alain Carnelli Collaborators: Margherita Brianza, Francesca Peruzzotti, Simone Marelli Reclamation design: Carlo Toscanini Geotechnical engineering: Sembenelli Consulting Structures: Sayni & Zambetti General contractor: Cantieri Moderni, Euroambiente

Melbourne cases

Table C27. Baseline information of Nature Play playground

Baseline information	Nature Play playground
Location	Parkville district, Melbourne, Australia
Urban space or land use type	Public park
Function	Civic
Responsibility	Public
Development timeline	2012: extensive community engagement process 2013 Jan.: schematic design approved 2013 Aug.: landscape construction commences, one full year of testing 2014 Dec.: construction completed; 3 months left for plant growth 2015 March: public inauguration
Dimensions	4.1 ha
Budget	3.4 million EUR
Project Owners	City of Melbourne Department of Health & Human Services
Developer and Management	City of Melbourne Urban Landscapes Managing Contractor: Lendlease
Designers	City of Melbourne City Design
Contributors	Project management for construction: City of Melbourne Capital Works External consultants: Civil (advice & design); Lighting/electrical; Play space (advice, review & audit); Structural; Hydraulic; Geotech/Soils, Quantity surveyor; Disability access consultant

Industry certification/framework	Australian Standard for Playground Safety, AS 4685
Awards	Australian Institute for Landscape Architects (AILA): Australia's best playground award

Table C28. Baseline information of Medibank Place

Location	Docklands district, Melbourne, Australia
Urban space or land use type	Commercial tower
Function	Commercial workplace, mixed-use retail, public park
Responsibility	Building: Private Integrated landscape: Public
Development timeline	2011: project start 2014: completed
Dimensions	<u>Building:</u> architectural height: 107 m 16 levels net lettable space - 46,000 m² (4.6 ha) workplace: 26,000 sqm (2.6 ha) workplace capacity - up to 2,610 people <u>Integrated landscape:</u> planted terraces: 640 sqm, in 16 roof gardens green façade: 1638 sqm, in 520 planter boxes park: ~ 1500 sqm green walls: 2 x 200 sqm
Construction value	~ 220 million EUR (350 million AUD)
Building developer/owner	Cbus Property
Contractor	Brookfield Multiplex
Designers	Building: HASSELL (architecture, interior design, landscape architecture and urban design) Workplace: HASSELL with Chris Connell Design, Kerry Phelan Design Office and Russell & George
Contributors	Fabio Ongarato Design, Veldhoen & Company, Landscape Consultant: Fytogreen
Industry certification/framework	WELL Gold: for core and shell (first existing building in Australia) 6 Star Green Star (Office as Built V3) from the Green Building Council of Australia 5 Star NABERS Energy rating
Awards	2015 WIN Awards - Winner - Workplace Interiors 2015 Interior Design Excellence Awards - Winner - Workplace Over 1,000 sqm 2015 Interior Design Excellence Awards - Winner - Sustainability 2015 Inside World Festival of Interiors Awards - Winner - Office Category 2015 Australian Institute of Architects National Awards - National Commendation for Interior Architecture 2015 Australian Institute of Landscape Architects (Victoria) Awards - Landscape Architecture Award for Urban Design 2015 Australian Institute of Architects (Victoria) Awards – State Award for Interior Architecture

Physical / Active Play	Cognitive Play	Social Play
Climbing Balancing Hanging Running Swinging Rocking Graduated play	Imagination Ordering Categorising Manipulating Constructing / creating Sensory Experience Problem Solving	Interaction with other children Interaction with groups Group games of imagination Dramatic role play Establishing rules Group construction Social participation

* Adapted from **The Good Play Space Guide**, published by *Department of Victorian Communities*

Figure 79. NaturePlay play objectives. Source: #Mlb09 Document.

Retreat & Enclosure Shelter, Screening, Open / Closure, Height,	**Patterns, Spaces & Levels** height & surface changes, varied scales	**Imaginative & Creative Play** Art, Sculpture, Treasure, Found objects, props for play	**Sensory Play** Sight, Touch, Sound & Smell	**Wildlife & Habitat**
• flax tunnels • tea tree tunnels • willow domes • weeping plants • openings within planted spaces • built structures • suggestion of enclosure • trees to climb multi-trunking shrubs	• mazes, spirals & labyrinths • grassy mounds • depressions & changing grades • differential mowing • turf-grass selection • planted patterns • contrasted surface materials • separation of space: fences, hurdles.	• built objects • topiary • living sculpture • recycled materials • interesting buds • flowers and fruit • nuts, seed pods • twigs, stems, bark and leaves	• tough easy to grow annuals • sunflowers • daisies & bulbs • seasonal colour • shrubs • plants to create structure • foliage colour & texture • succulents • water play	• existing vegetation • riparian vegetation • frog bogs & wetlands • ornamental ponds • existing trees & vegetation • aquatic plants • Dense planting that provides screening and definition of space

Figure 80. Themes for nature based play. Source: #Mlb09 Document.

Table C29. Baseline information of CERES

Location	Brunswick East district, Melbourne, Australia
Urban space or land use type	Environmental education centre, urban farm, and social enterprise hub
Function	Civic
Responsibility	Public
Development timeline	1960-70s: landfill site for household and construction waste 1982: establishment of CERES 1994: Kingfishers return to nest along the banks of the Merri creek
Dimensions	4.5 ha

Budget	95% self-sustaining (yearly expenditure ~14 m AUD, with a net surplus of 68000 AUD in 2019) (#Mlb21 Document)
Landowner	Moreland City Council
Developer and Management	CERES is not-for-profit organization, managed by a voluntary Board with representatives elected from the membership
“Designers”	CERES members, volunteers
Awards	Full list: https://ceres.org.au/about/awards/

Appendix D – Background information for Chapter 5

Table D30. Interpretation of the seven Wurundjeri seasons. Source: #Mlb04 Document

Guling	In Early spring the wattles and Yellow Gums flower and provide nectar. This is *Orchid season - ‘Guling’* and pockets of detailed planting in the entries will include native orchids.
Porneet	True Spring is a time of plenty. There is an abundance of flowers. Lomandra foliage can be harvested and used for weaving. This is *Tadpole season - ‘Porneet’* and hidden details of fauna (including lizards, snakes & tadpoles) which become active at this time of year can be discovered.
Buath Guru	The *Grass Flowering Season - ‘Buath Guru’* signifies the start of summer. Kangaroo grasses grow tall and set seed. Bats eat insects inflight (Balayang the ancestor is referred to as the bat).
Kangaroo Apple Season	The *Kangaroo Apple Season* enables interpretation of a range of flowering and fruiting shrubs and trees, hunting and gathering in mid-summer. Large gatherings took place when the food was plentiful. The adjacent open spaces could be used for community social activities such as Kooriobborees.
Biderap	This area is associated with the *Dry season - ‘Biderap’*, stormy weather, with contrast between wet and dry in late summer. The water elements allow for interactive play in hot weather and relief from summer heat. Detailing of the water elements can relate to the movement of eels along the watercourses and be described in the ground treatment.
Iuk	Later summer signals the time that temperatures start to cool and there is regrowth after long periods of dry. Fire danger is high and the contrast between dry and wet can be demonstrated with plants that are exploit fire for regeneration. This is *Eel season - ‘Iuk’* which is signalled when the Manna gums are flowering.
Waring	Winter is *Wombat season - ‘Waring’*, a time for burrowing & nesting, and when people built shelters from the cold. Plant growth slows and not much is fruiting. Woodlands provided sources of food with tree fern shoots and hunting of koalas & possums. The habitat tree and associated planting demonstrates the various shelter requirements and relationships for various birds, mammals and reptiles.

Table D31. Biophilic design patterns. Source: Browning, Ryan, and Clancy 2014

Patterns	Description
Nature in the Space Patterns	
Visual Connection with Nature	A view to elements of nature, living systems and natural processes.
Non-Visual Connection with Nature	Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes.
Non-Rhythmic Sensory Stimuli	Stochastic and ephemeral connections with nature that may be analyzed statistically but may not be predicted precisely.
Thermal & Airflow Variability	Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.

Presence of Water	A condition that enhances the experience of a place through seeing, hearing or touching water.
Dynamic & Diffuse Light	Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.
Connection with Natural Systems	Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.
Natural Analogues Patterns	
Biomorphic Forms & Patterns	Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.
Material Connection with Nature	Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place.
Complexity & Order	Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.
Nature of the Space Patterns	
Prospect	An unimpeded view over a distance, for surveillance and planning.
Refuge	A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.
Mystery	The promise of more information, achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.
Risk/Peril	An identifiable threat coupled with a reliable safeguard.

Figure 81. Place Diagram by the PPS. Source: PPS 2003.

Appendix E – Design principles, objectives, and background information for Chapter 6

Table E32. Design principles of Parco Portello: Charles Jencks' ten lessons. Source: de Molfetta 2014

1	High public use of a park can double the land value and cut crime.
2	The key of success is high use by women and children.
3	Most use by local people.
4	Intervisibility is most important for people to feel confident. That is the visibility to see into and out of the park, to feel safe.
5	Also many entrances and exits are needed for people to feel safe.
6	Management and scheduled events. The park must be managed well with scheduled events, for example: fashion shows, open-air films, stage events. These events give a sense of ownership and possession to the users.
7	Typical functions that help activate a public park: Open grill or restaurant or café, Kiosks, Children's play areas.
8	Local, small gardens within the main public park are of utmost importance, here we have three: residential garden, hospital garden, child's play area.
9	In these small gardens, movable chairs and lots of seats and tables should be provided.
10	A few highly visible attractors should be contemplated, for instance specifically commissioned sculpture at the four high points of the park.

Table E33. CERES design values . Source: #Mlb24 Document

'Touching the earth lightly'
Demonstrating, communicating, interpreting, teaching
Leading edge, innovative
Spontaneity, nimbleness, seizing opportunities
Experimenting, testing, exploring
Organic, evolving
Collaboration, connections, linkages
Enhancing lives with celebration, community & spirituality

Table E34. Design Principles reflecting CERES values. Source: #Mlb24 Document

'Touching the Earth lightly' in all we do	• Minimising resource and energy consumption, avoid or redress adverse impacts on natural systems, leave things better than we found them • Does this project utilise or initiate innovative low energy / recycled materials to reduce resource consumption? • Is it designed to minimise energy and water usage, or capture rainfall or run-off?
Demonstrating good practice in progressing sustainable living	• Sharing what we do with all who come into contact with CERES (specifically those visiting the park or exploring its story from afar) through demonstrating activities, exposing visitors to new experiences, models, interpretation (panels, on-line, Chook app, etc).

(both generally and through specific examples) to a diverse audience	• Aim for an 'educating' experience for all visitors, irrespective of the primary purpose of their visit. Aim to expose every visitor to, say, two additional experiences beyond the main reason for their visit (analogous to the Permaculture principle of multiple purposes for every tree planted). • How?: visibility, proximity, tempting exploration, providing information available in readily absorbed format, interactive engagement, etc. • Stimulate - then satisfy - curiosity.
A whole place	• Every component and activity at CERES should be considered part of a larger story, and richer for this, recognising that 'the whole is greater than the sum of the parts'. • Recognise that most actions have consequences (whether positive or negative) beyond their immediate intention. Managing these can maximise additional benefits and avoid or reduce adverse impacts or conflicts. • Modern management practice tends to segment elements for simpler allocation of tasks, often resulting in fragmented coordination and diminished quality of overall outcomes. CERES has the opportunity to demonstrate a model supporting richer outcomes and experiences.
Permeability	• Easier informal flows enhance incidental experiences and interest • Flexible (unguided and guided) flows through site; • Encourage exploration and 'accidental' exposures to wider experiences, • Resist (and retrieve) excessively large blocks without permeability • Work to create easy informal access between key destinations and access points.
Legibility	• Site is complex; difficult to create simple map (tangible or mental). Many visitors probably don't explore far. • Visual connections across the site can invite curiosity – keep open vistas (& routes). • Sub-conscious legible design techniques preferable to signage (that's soon out-of-date). • Consider distinctive features at key convergence points for orientation / reference • … but retain some 'mystery' enabling exploration and discovery.
Linkages within the site	• Urge component activities, elements and groups to be outward-looking • Aim to soften boundaries to facilitate more interaction and engagement
Linkages with surroundings – permeate into locality	• Strengthen visual links to Merri Creek and its corridor and vegetation. • Consider better physical connection to Merri Creek Trail (perhaps on eastern edge) • Leverage enhanced visits from Northcote/Thornbury (such as influencing detailed design of a likely new pedestrian bridge immediately north of CERES.
Unify rather than divide	• Hubs or clusters of activities rather than 'precincts' • Avoid rigid 'precincts' (and consequent boundaries), but … • Emphasise and cluster 'distinctive' pockets & themes within this • Encourage flows across & around site • Discourage inward-looking elements or exclusive allocation of large parts of the park • Encourage groupings and interaction among similar, connected elements
Common spaces	• Rather than being seen as 'gaps' between elements, common areas and walkways should feature as points of convergence, orientation, interaction & overlap. • Identify and reinforce these locations.

Collaborative, 'joined-up' design and decision-making	• Encourage early engagement and participation in the design process, reducing reactive responses late in the design and decision cycle. • Providing a demonstration model of collaborative, mutually supportive decision-making.

Table E35. NaturePlay: community inspired design principles. Source: #Mlb07 Document

1	Create a native park which complements the existing vegetation and landscape character of Royal Park.
2	Build a place which provides passive and active recreation opportunities for all members of the community including children, the elderly and people with a disability.
3	Create a sense of entry to Royal Park that is accessible and welcoming.
4	Design a place for creative and natural play.
5	Provide appropriate level of amenities to support the park users.

Table E36. NaturePlay: design priorities. Source: #Mlb07 Document

1	Australian Native Landscape Character
2	Entrances/Gateway
3	New Park Spaces
4	Nature Based Play Space

Table E37. NaturePlay: design objectives. Source: #Mlb09 Document

1	Create stimulating and creative play spaces that meets the needs of children, from toddlers up to the age of 18.
2	Allow children of different ages to play together.
3	Enable children to develop their skills and transition to more challenging activities.
4	Be accessible to children and carers of all abilities.
5	Invite children and visitors to find and create playful opportunities throughout Royal Park.
6	Provide high quality nature play experiences for a wide range of play activities, including active play, cognitive play and social play.
7	Create a setting and opportunity for programmed play activities.

Table E38. NaturePlay: play objectives. Source: #Mlb09 Document

The design should:
Establish Royal Park as a destination for imaginative nature-based play integrated with the surrounding landscape, using elements of the bushland landscape to provide a range of play opportunities.
Enhance the landscape character of Royal Park.
Create stimulating and creative play spaces that meets the needs of children, from toddlers up to the age of 18.
Allow children of different ages to play together.
Enable children to develop their skills and transition to more challenging activities.
Be accessible to children and carers of all abilities.
Invite children and visitors to find and create playful opportunities throughout Royal Park.
Provide high quality nature play experiences for a wide range of play activities, including active play, cognitive play and social play.
Create a setting and opportunity for programmed play activities.

Background information for framing the MHC approach to urban design

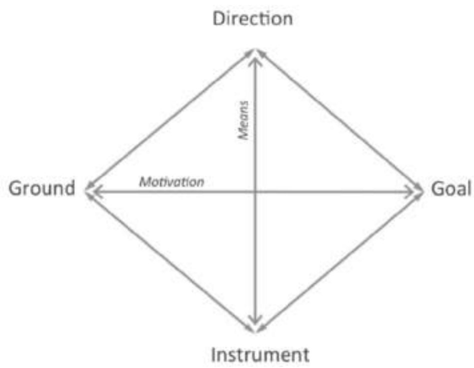

Figure 82. Tetrad framework developed by Bennett (1956). Source:Hes and Santin 2017.

British mathematician John G. Bennett developed a branch of systems science called systematics. It is a conceptual method to study multi-term systems, to understand complex wholes within which people are participants rather than observers. His framework provides an interpretive means for understanding activities directed toward a focused outcome (Figure 82). It is summarized by a diamond shaped tetrad. Each dimension in the tetrad represents different but complementary modes for examining any phenomenon. For example, (Seamon 2019) applied Bennett's tetrad to frame Christopher Alexander's conceptual and practical efforts connected to Alexander's *New Theory of Urban Design*. Concurrently, Bennett's framework served as the core foundation of the Regenesis group's work to developed regenerative processes and technologies, starting in the 1990s (Mang and Reed 2012, Hes and Santin 2017).