THE CITY AS A MULTISPECIES RESERVE

STRATEGIES FOR COHABITATION IN TORINO

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ABSTRACT

La perdita di biodiversità rappresenta una delle sfide cruciali della nostra epoca. L'urbanizzazione detiene una quota significativa di responsabilità in questa crisi, in quanto motore dei cambiamenti nella destinazione d'uso del suolo, della frammentazione e della distruzione degli habitat naturali. Con il continuo espandersi delle aree urbane, il modello tradizionale di sostenibilità si è rivelato inadatto ad affrontare tale emergenza. Invece di affidarsi a rimedi tecnici mirati esclusivamente alla mitigazione degli impatti e all'efficienza energetica, è necessario attuare un cambiamento trasformativo. Un nuovo paradigma incentrato su giustizia, equità e responsabilità, in cui l'architettura prenda le distanze da pratiche estrattiviste e diventi un'opportunità per forgiare un rapporto diverso con la natura, contribuendo attivamente alla sua rigenerazione.

Sebbene spesso considerate deserti biologici, le città celano un eccezionale potenziale di conservazione per gli attori more-than-human. Questa ricerca indaga strategie pratiche e strumenti progettuali per trasformare gli ambienti urbani in ecosistemi vibranti, in cui tutti gli esseri viventi possano prosperare e coesistere. Invece di chiedersi cosa la biodiversità possa fare per le persone, questa tesi riflette su ciò che il progettista possa fare per la biodiversità. Attraverso la lente del design multispecie, il lavoro esplora il potenziale dell'architettura nel creare le condizioni affinché la vita possa emergere, rispondendo ai bisogni degli stakeholder non umani.

Per raggiungere questo scopo, la ricerca si articola in due linee d'azione complementari: una strategica e l'altra operativa. Partendo da un inquadramento teorico, si esamina una serie di casi di studio a livello urbano e architettonico. Alla scala urbana, vengono analizzati i piani per la biodiversità di Parigi e Barcellona per individuare gli obiettivi e gli strumenti adottati per promuoverne la presenza in città. Alla scala architettonica, vengono valutati progetti specifici in base alla loro capacità di favorire l'insorgere della biodiversità, di affrontare l'agency degli attori non umani e il loro ruolo nel plasmare l'ambiente costruito.

Le informazioni raccolte vengono poi sistematizzate per fornire linee guida strategiche per la città di Torino. Si propone un abaco di elementi progettuali per adattare l'habitat urbano alle necessità degli attori more-than-human, affiancato da un insieme di indicatori utile a valutare le qualità rigenerative degli interventi.

Infine, il quartiere San Donato funge da caso di studio esemplificativo per la trasformazione del tessuto urbano torinese: un masterplan di quartiere delinea le principali azioni di progetto, mentre cinque scenari di trasformazione illustrano come le tipologie spaziali ricorrenti all'interno del tessuto edilizio esistente possano essere adattate per supportare sia gli abitanti umani sia quelli non umani.

The loss of biodiversity represents one of the defining challenges of our time. Urbanization bears significant responsibility for this crisis, driving land-use changes, fragmentation, and the eradication of natural habitats. As urban expansion continues, the traditional sustainability model has proven inadequate to face this crisis. Rather than relying on technical remedies aimed merely at impact mitigation and energy efficiency, a transformative change is required. A new paradigm centered on justice, equity, and responsibility, in which architecture distances itself from extractivist practices and serves as an opportunity to forge a different relationship with nature, actively contributing to its regeneration.

Though often dismissed as biological deserts, cities conceal an exceptional conservation potential for more-than-human actors. This research investigates practical strategies and design tools for transforming urban environments into vibrant ecosystems where all living beings can thrive and coexist. Rather than asking what biodiversity can do for people, this thesis reflects on what the designer can do for biodiversity. Through the lens of multispecies design, it explores architecture's potential to create conditions for life to emerge, responding to the needs of more-than-human stakeholders.

To achieve this, the research develops along two complementary lines of action: strategic and operational. Building on a theoretical framework, it examines a series of urban and architectural case studies. At the urban scale, the biodiversity plans of Paris and Barcelona are analyzed to identify the goals and tools used to foster urban biodiversity. At the architectural scale, specific design projects are evaluated for their ability to enable the emergence of biodiversity, addressing the agency of non-human actors and their role in shaping the built environment.

The gathered information is then systematized to provide strategic guidelines for the city of Torino. An abacus of design elements for adapting urban habitat to the needs of more-than-human stakeholders is proposed, alongside a set of metrics to evaluate the regenerative qualities of design interventions.

Finally, the San Donato neighborhood serves as an exemplary case study for the transformation of Torino's urban fabric: a neighborhood masterplan outlines the primary design actions, while five transformation scenarios illustrate how recurring spatial typologies within the existing building fabric can be adapted to support both human and non-human stakeholders.

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THE GLOBAL STATE OF BIODIVERSITY

Biodiversity is defined by IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) as "the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities, and ecosystems". It refers to the richness of life forms, from animals to plants, from microorganisms to entire ecosystems. Biodiversity can be evaluated at different levels: the diversity among and within species, the diversity of ecosystems, and ecological processes. The higher the number of species hosted and the ecological processes carried out in an ecosystem, the better the ecosystem's health and resilience (LPR 2024).

The Living Planet Report is produced by the WWF and the Zoological Society of London (ZSL) biannually to track the state of biodiversity at a planetary level. The latest report was published in 2024 and paints an alarming picture. The Living Planet Index monitors variations in the relative abundance of wild vertebrate species over time. This indicator doesn't measure the increase or decrease in the absolute number of individuals in wild species, but the average changes in the population of the monitored species, which means that some species may have increased their population, other may have decreased it or kept it stable, but on average (regardless of the dimension of the populations) there has been a decrease of 73 % globally between 1970 and 2020.

Addressing the biodiversity decline and loss is about preserving life and complexity on Earth. Doing it now is fundamental to avoid permanent damage: if human pressures on ecosystems continue to grow, the risk is that the cumulative effects of these activities could trigger rapid, inevitable, and irreversible changes that could compromise life on Earth as we know it. Avoiding these tipping points is imperative for the sake of all living beings (LPR 2024).

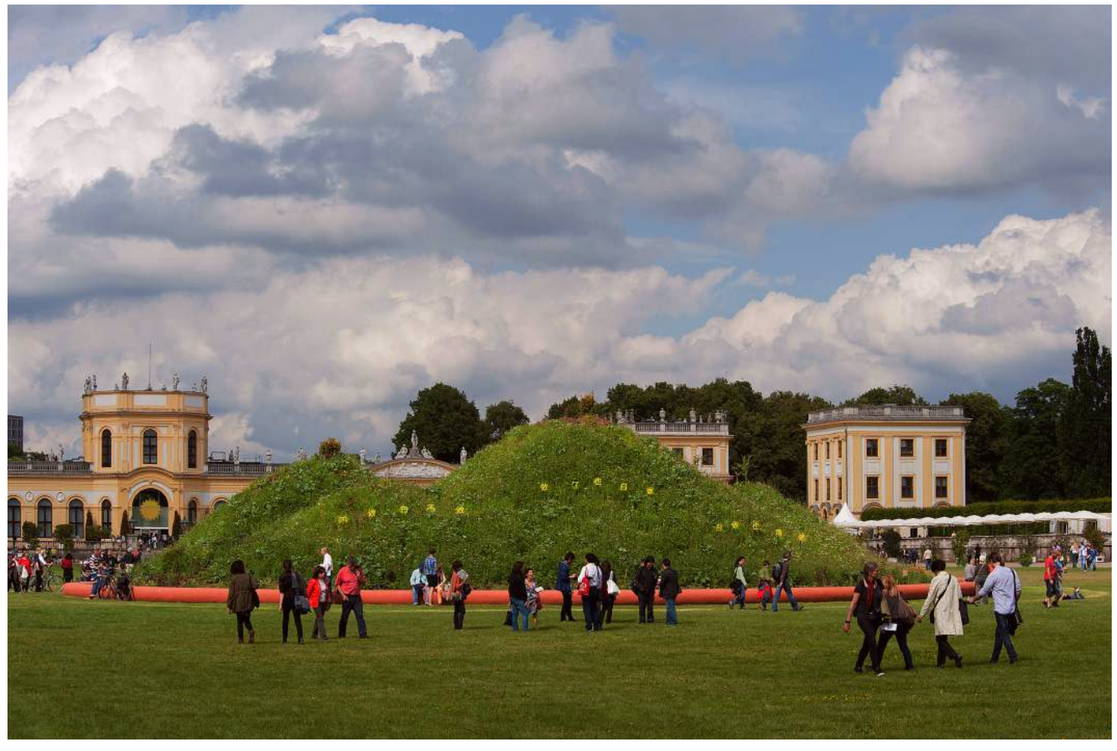
Architecture and the building sector in general are among the main contributors to the loss of biodiversity. But since it shapes how we live our lives, the root of a possible paradigm shift could come from the same source that threatens to destroy life. If we can manage to trigger positive, regenerative impacts through design, a possible way out of the current degenerative loops may be foreseen.

THE EFFECTS OF URBANIZATION ON BIODIVERSITY

Currently, half of the global population lives in urban areas, which cover around 3 % of the terrestrial surface. By 2050, the share of people living in cities is projected to rise to 70 %, with a consistent expansion of urbanized areas (Spotswood et al. 2021). This will put further pressure on the already stressed ecosystems, as urbanization processes usually entail the removal of vegetated surfaces to make room for infrastructure, production facilities, and dwellings, and the introduction of deep pressures on the natural environment, which come in the form of pollution, changes in land use, fragmentation, and simplification of the habitats (McKinney 2008). Determining once and for all the effects of urbanization on nature is no simple matter. What's clear is that cities create an *environmental gradient* in the landscape, meaning they generate a discontinuity between the urban settlement and its surroundings in terms of hydrology, microclimate, air temperature, atmospheric chemistry, resources

Photo by Nils Klinger

Doing nothing garden
Part of the exhibition *dOCUMENTA (13)*
Song Dong, Kessel 2012



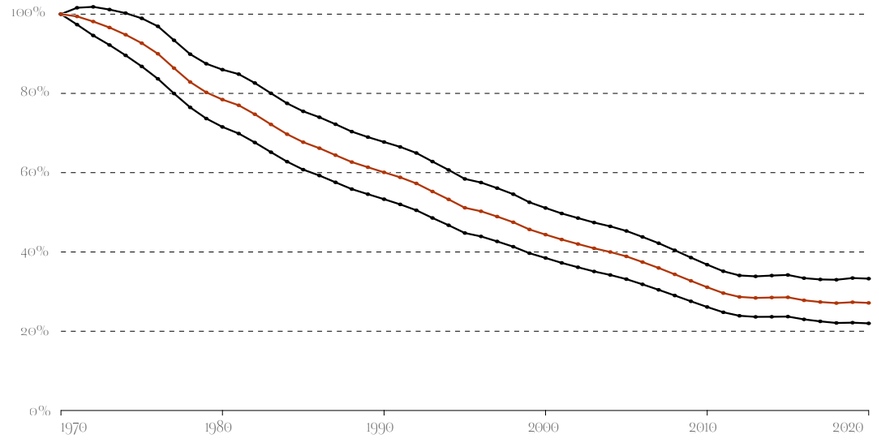
and nutrients availability, ... (Spotswood et al. 2021). The critical loss of habitats and the decreased quality of the remaining carry serious consequences for species richness and abundance: it has been observed that intense levels of urbanization are associated with the greatest decline in biodiversity (McKinney 2008).

A further change resulting from urbanization is the introduction of alien species, which can occur accidentally or intentionally for cultivation, ornamental purposes, or other uses (McKinney 2008). On the one hand, the integration of non-native species can increase overall species diversity: in the context of moderate urbanization, species richness tends to be even higher than in the surrounding area, as supported by the *intermediate disturbance hypothesis* (McKinney, 2008). On the other hand, the introduction of alien species can be detrimental to native species, further disrupting ecosystem equilibrium as they compete for resources with local species and "reducing the biological uniqueness of local ecosystems" (McKinney, 2009). Parallel to the extinction of indigenous species, a concerning phenomenon due to the anthropic introduction and consequent spread of alien species is the tendency to the homogenization of biotas across urban areas (Aronson et al. 2014): researchers found that (all over the world, regardless of latitude and local climate) community evolutionary distinctiveness is lower in urban settings than in rural areas (Ibáñez-Álamo et al. 2017).

The urbanization trend in combination with scarcity of land creates pressure for an expansion driven by price rather than environmental considerations and this can lead to changes in the structure and function of urban ecosystems and the services provided.

European Commission 2011

The path towards the unavoidable is traced: current trends are leading us towards a dangerous tipping point that, once reached, could completely transfigure and undermine the livability of our planet. Veering the direction of evolution away from economic growth towards principles of justice, equity, and responsibility should become imperative.



Living Planet Index
LPR 2024

01

THE SUSTAINABILITY FRAMEWORK

It would be unfair to omit the efforts undertaken by the international community, and specifically the EU, to address the biodiversity crisis and reverse the alarming trajectory humanity is on. On the one hand, Europe has managed to create a vast network of protected areas that has limited biodiversity loss, so much so that its LPI shows a smaller decrease than the values estimated for the other continents. On the other hand, the EU has set strict and ambitious sustainability goals to reduce the harmful pressures on ecosystems from anthropogenic activities. The concept of sustainability was first elaborated by the UN Brundtland Commission in 1987 and expressed in the report Our Common Future as "meeting the needs of the present without compromising the ability of future generations to meet their own needs".

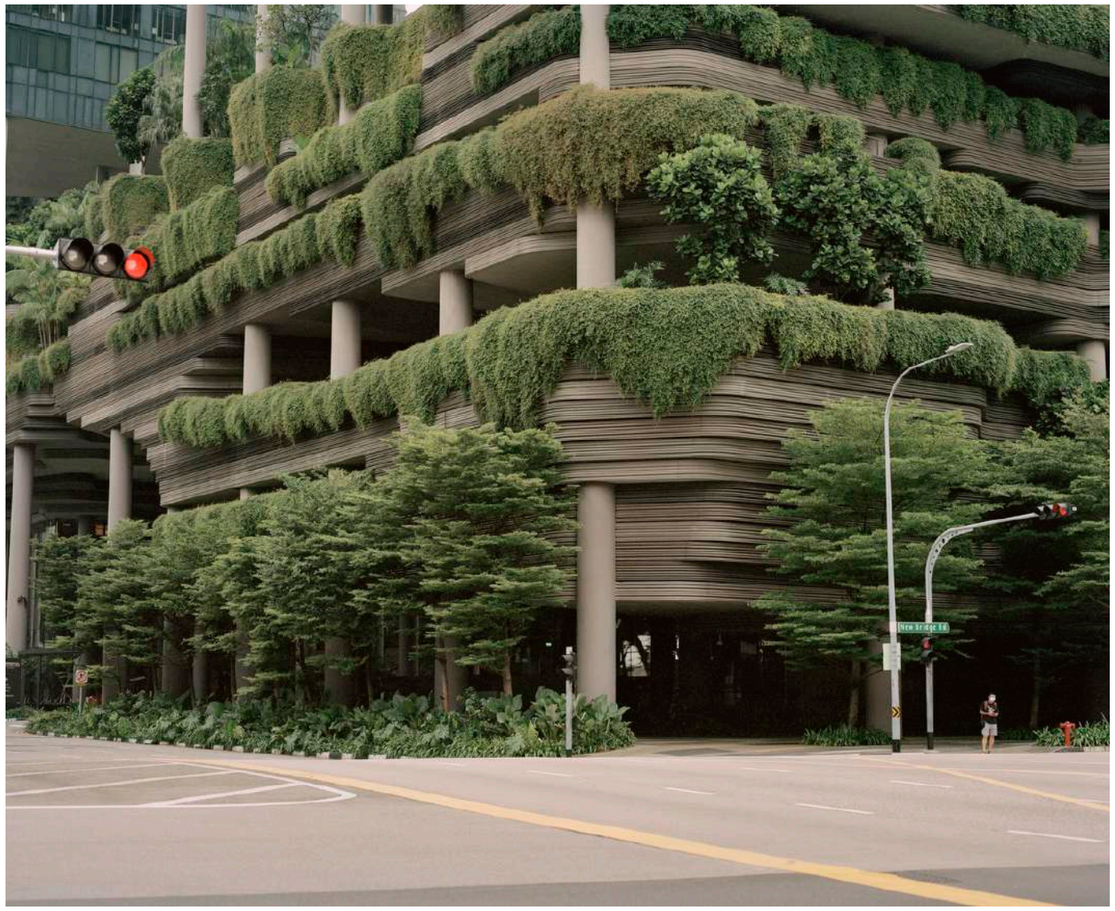
This ambitious goal was adopted by the international community and pursued with varying levels of enthusiasm, but what's clear is that the foundations of the measures implemented over the years remain firmly anchored in the perpetuation of the current economic model, centered on growth and consumerism. At the core of such resolutions is the belief in the possibility of decoupling economic growth from its environmental impact, thereby still increasing global GDP while containing and reversing anthropogenic pressures on ecosystems through technological advancements and engineered solutions. The echoes of the technicist approach can be heard in the instruments adopted to face the crises, technical in nature, addressing almost exclusively human well-being and being short-term oriented: among the tools expected to correct the trajectory we are moving along are the Nature-based Solutions.

NBSs are conceptualized as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes through locally adapted, resource-efficient and systemic interventions". (EU Commission 2015)

Inspired by natural processes, NBSs are devices and solutions useful for tackling a multiplicity of societal challenges: improving human health and well-being, restoring degraded ecosystems, enhancing sustainable urbanization by implementing energy efficiency and reducing anthropogenic emissions, developing climate change adaptation and mitigation, and improving risk management and resilience (Bush & Doyon 2019; Davies et al. 2021).

They do that through the provision of ecosystem services (ES), which are fundamentally defined as the "benefits that humans derive, either directly or indirectly, from the functions of ecosystems" (Bush & Doyon 2019). The Millennium Ecosystem Assessment (2005) introduced the concept to the world of policymaking and popularized the categorization of services into four groups: provisioning, regulating, cultural, and supporting. The first category refers to the products that can be directly extracted from nature, such as fresh water, raw materials, and energy. Part of the second group comprises processes that regulate and moderate natural phenomena, such as water filtration, carbon sequestration, disturbance prevention, and temperature and humidity regulation. Cultural ecosystem services refer to the intangible benefits that living systems provide us, such as recreation, aesthetic experiences, psychological well-being, spiritual connection, and a sense of place. Finally, the supporting ecosystem services provide the foundation for ecological processes and the delivery of all the

Photo by Zed Nelson
Part of the exhibition *The Anthropocene Illusion*
Mile End Arts Pavilion, London 2025



other ES: among the most relevant, it's worth mentioning nutrient cycling, soil building, and habitat provision (Brzoska & Spāģe 2020; Pedersen Zari & Hecht 2020)

The concept can prove valuable when assessing the ecological performance of a building, beyond its aesthetic qualities: linking design elements and strategies to the ES provided can help change the role of the built environment from a mere passive and destabilizing entity to a positive and constructive actor for the ecosystems (Pedersen Zari & Hecht 2020). ES may help raise awareness of nature's contributions to our daily lives, emphasizing the multiple entanglements of human existence with ecosystem processes and sparking a different relationship with and attitude towards the more-than-human entities that support us and our activities in so many ways. But our idea of nature informs our relationship with it and the way we approach nature-based interventions: current European policies reveal a utilitarian perspective on nature, considered a tool to increase human well-being and address societal challenges through ecosystem services provision, a medium to pursue economic growth and increase productivity (Lemes de Oliveira 2024).

The tendency to quantify ES, often in monetary terms, belongs to the same performance-based narrative: while helpful to compare design alternatives or to facilitate the communication between environmental experts and decision makers (Brzoska & Spāģe 2020), the evaluation of ES often appears limited in its ability to truly reflect the complexity of living systems and the reciprocal influence between humans and biophysical processes (Elderbrock et al. 2020).

The concept of ecosystem services is "fundamentally anthropocentric and grounded in an economic approach that as a result excludes the intrinsic values of nature and non-human species, potentially leading to commodification of nature, and exploitative human-nature relationships". (Bush and Doyon 2019)

The sustainability framework is widely recognized by institutions, but parts of academia have been questioning its actual efficacy in the face of the crises that shake our world. Its adequacy is doubted by many, as is its ability and willingness to spark real change in the dominant narrative centered on growth and consumerism. The same experts advocate for a complete change of paradigm, aiming at re-positioning human beings within ecosystems, on par with more-than-human entities.

In recent decades, environmental discourse has created in the public's mind a broad equivalency between ecological responsibility and energy efficiency. This equivalency is false: while efficiency is necessary, it is not sufficient, and rebuilding "efficiently" often simply adds to the extractive load rather than decreasing it.
Space caviar

EU BIODIVERSITY STRATEGY FOR 2030 DEDICATED SHEET

The strategy was developed in the context of the Green Deal with the aim of halting and reversing biodiversity loss in the EU. It's a long-term plan that sets a clear direction and outlines a vision to pursue, in which the interests of people, the planet, and the economy are prioritized. Within this framework, nature is seen as fundamental to human psychological and physical well-being, to coping with climate change, and to building resilience: it is an essential and strategic asset in our lives. It is also understood as a critical resource for the continent's economic growth, consistent with the belief in the possibility of decoupling growth from environmental impact. Experience has shown that what is good for nature is also good for the economy. This is why the Biodiversity strategy carries so much weight within EU policies, specifically the Green Deal, as it offers significant opportunities to enhance the competitiveness of the economy.

The strategy recognizes the link between biodiversity and the climatic crises: they fuel each other, and this interconnection means that the identified solutions also overlap: NBSs are seen as fundamental to both restoring damaged ecosystems and slowing climate change.

The strategy is articulated around four pillars:

1 PROTECTING NATURE

The aim is to establish a larger EU-wide network of protected areas on land and at sea by extending the Natura 2000 network (and creating ecological corridors between protected sites to prevent species isolation, allow their mobility and enhance ecosystem health in the context of the Trans-European Nature Network). The goal is to put at least 30 % of the land surface and 30 % of the sea under some form of protection. In addition to the legal designation of new protected areas, member States are required to set site-specific, realistic conservation objectives and allocate the necessary resources.

2 RESTORING NATURE

Part of the Biodiversity strategy is the enforcement of a nature law that aims to restore degraded ecosystems and address the main drivers of biodiversity loss. The plan acknowledges the lack of binding regulations and seeks to fill this normative gap by implementing a Nature Restoration Law that establishes legal requirements for assessing ecosystem health and for implementing ecosystem restoration. Specific attention is directed towards those ecosystems with the highest potential for carbon storage and disaster prevention, i.e., the areas that offer the greatest potential for ecosystem service provision.

The plan sets specific and quantitative goals in a multitude of fields, recognizing the complexity of the problem and the importance of adopting a comprehensive approach when tackling nature loss:

• Agriculture: 10 % of agricultural land should be transformed into a high-diversity landscape, and the use of pesticides should be reduced by 50 % by 2030, to give back space to wild animals and plants. Further targets aim to reverse the decline of pollinators by restoring degraded ecosystems and reducing the use of fertilizers and chemicals (the importance of pollinators is quantified at €3.7 billion in annual agricultural revenues).

• Urban areas: urbanization is a critical driver of soil sealing: in the land competition for securing the few available plots in urban areas, biodiversity usually gets penalized. The goal is to stop and reverse soil degradation and erosion, as soil is of significant environmental and economic importance. Promoting the integration of green infrastructure and NBSs in urban planning is another important goal set by the plan: cities with over 20 000 inhabitants are encouraged to develop urban greening plans to increase access to green areas, improve connections between green spaces, and prevent harmful practices that affect biodiversity.

• Natural habitats: specific targets are set to improve the health and resilience of forests through afforestation and reforestation programs; to restore waterways (for a total length of 25 000 km) to a free-flowing state; to remove barriers and promote the restoration of floodplains, wetlands, and marine ecosystems (which are thought to have important impacts both in socio-economic terms for local communities by improving tourism and recreational activities, and in environmental terms by promoting water regulation, flood protection, and habitat recovery); and to manage invasive alien species, which represent a serious threat to local species (the goal is to decrease the number of Red List species they threaten by 50%).

3 ENABLING TRANSFORMATIVE CHANGE

Beyond setting quantifiable goals, the strategy seeks to address perceptions of the problem, disseminate knowledge about biodiversity issues, and develop technical and financial tools to implement concrete measures. The EU engages in the support of industries and businesses that seek to realize NBSs (creating opportunities for employment and innovation), in delivering the economic resources necessary for the enactment of the biodiversity strategy (with a big share of the budget allocated to climate action used for NBSs and biodiversity initiatives), and in the widespread integration of biodiversity goals in many European policies. Furthermore, it commits to promoting research and innovation in green solutions as alternatives to grey solutions, and to raising awareness of biodiversity loss and sustainability practices through education and skill development that support the green transition.

4 SUPPORTING BIODIVERSITY GLOBALLY

The strategy included the introduction of measures to tackle global biodiversity loss and enforce the elaboration of global targets. At that time, COP15, where the Kunming-Montreal GBF was drawn up, hadn't happened yet: during the conference, the EU played a fundamental role, alongside its international partners, in shaping global commitments.

EU NATURE RESTORATION LAW 2024
DEDICATED SHEET

The law aims to reinforce the EU legal framework to counteract biodiversity loss. The new regulation not only addresses the restoration of degraded ecosystems but also seeks to help achieve the EU objectives on climate change adaptation and mitigation, enhance food security, improve people's quality of life, and boost the economy. It imposes a set of legally binding obligations for all EU member states, covering both already protected areas and other heavily degraded ecosystems, such as forests, agricultural lands, and urban settings. The aim is to fully recover the ecosystem services these habitats can deliver for our well-being and prosperity. To achieve these goals, it's important that all member states outline a clear implementation path and adopt a strategic approach detailing how they intend to meet the restoration targets. They'll have until September 2026 to draft their national restoration plan (including designating the areas in need of restoration, the measures to reach the goals, the timetable for their implementation, and the monitoring tools to assess their effectiveness). Monitoring tools will be determined at the European level, building on existing indicators and data sets or on innovative methodologies still to be defined, though for some of them, member states will autonomously set the satisfactory levels to achieve. Reports will then have to be submitted every three years on the measures implemented and the overall progress on the strategy.

Habitat restoration is seen as an investment: despite the elevated cost of implementing such a strategy, the benefits are estimated to be 8-10 times the initial investment. The costs of inaction are also estimated to be significantly higher.

When it comes to specific restoration goals, the Nature Regulation provides seven specific target fields:

1. RESTORING TERRESTRIAL, COASTAL, AND FRESHWATER ECOSYSTEMS

The regulation sets an ambitious goal to act on already protected areas to enhance their quality (and fully recover their ecological integrity), and also gives specific attention to areas where habitats are no longer present. Member States are required to map such areas and assess their condition to determine which to prioritize. Restoration measures then need to be implemented, in the first case on at least 30 % of designated areas by 2030 (giving priority to Natura 2000 sites), 60 % by 2040 and 90 % by 2050; in the second case on at least 30 % of the designated area by 2030, 60 % by 2040 and 100 % by 2050.

2. RESTORING MARINE ECOSYSTEMS

The goals are the same as target 1, but they address the marine environment.

3. RESTORING RIVER CONNECTIVITY

The European nations will identify and remove artificial barriers to restore the health of ecosystems degraded by anthropogenic interventions and reset the natural flow of water along 25 000 km of rivers.

4. Restoring pollinator populations

In accordance with the EU Biodiversity Strategy, by 2030 Member States need to halt the decline and enhance the diversity of pollinators, which are essential indicators of ecosystem health.

5. RESTORING AGRICULTURAL ECOSYSTEMS

The goal is to enhance biodiversity in agricultural landscapes, in order to increase food security, systems resilience to climate change and environmental risks. Specific attention is also given to the farmland bird population and organic soil restoration (which considerably contributes to reducing greenhouse gas emissions: the focus is put on drained peatlands and their restoration).

6. RESTORING FOREST ECOSYSTEMS AND PLANTING THREE BILLION TREES

The target seeks to implement measures to actively expand forest cover throughout Europe and improve the quality of these ecosystems by enhancing biological diversity, thereby increasing their resilience. The range of ecosystem services they provide is immense: clean air and water, protection from soil erosion, provision of construction material, climate regulation, and carbon storage.

7. RESTORING URBAN ECOSYSTEMS

The goal is to stop the loss of both green spaces and tree canopy coverage in urban settings by 2030, and to measure increases in these quantities from 2031 onward by identifying areas where restoration measures should be implemented. In urban contexts, greenery provides fundamental habitats for biodiversity and essential ecosystem services for people (CO_2 absorption, UHI mitigation, water flood control, cultural services, to name a few).

To fund these initiatives, the goal is to dedicate €20 billion per year to nature protection and restoration through public and private investments. For its part, the EU commits to dedicating a *significant proportion* of the budget allocated to climate action to biodiversity and NBSs (strengthening the link between biodiversity and climate crises). In light of the current political climate and international events, the attention once dedicated to the New Green Deal (further enhanced by the Covid-19 pandemic) has quickly faded. Resources once allocated to the green transition may be redirected to defense.

02

MSJ FOR A PARADIGM SHIFT

The IPBES recently released a foundational report on the root causes of biodiversity loss: a possible way out of the crisis must be sought by addressing the foundations of the paradigm that led to the current situation. The report identifies three underlying causes of biodiversity loss:

1. The progressive separation between humans and the natural environment, which led to considering them two distinct entities. As a result of this disconnection, a new exploitative and destructive relationship emerged, in which human beings extract more natural resources than the ecosystems can handle in the name of progress and economic growth.

2. The uneven distribution of consumption patterns and environmental impacts on a global scale: a small share of the population, notably the wealthiest and the most powerful, is mainly responsible for nature's decline.

3. The prioritization of short-term goals, which is incompatible with the pace of ecological processes. Consumer culture, the rise of individualism, and the measure of progress exclusively through economic growth all originate from this same mentality.

The report advocates a transformative change that challenges the status quo represented by the circumstances listed above and introduces a new set of values grounded in equity, inclusion, justice, human-nature interconnectedness, and responsibility. It's a testament to the possibility of fostering a valuable alternative to the perpetuation of extractivist practices against the Earth and the exacerbation of the nature-culture dichotomy.

The unregulated urbanization processes play a significant role in fueling disconnection from nature: the diminishing of natural habitats has led to what academia calls the extinction of experience. With alienation and detachment from ecosystems come indifference and carelessness towards the multiplicity of life forms (Visintin 2022).

The moment in which many have identified the seed of this separation is the scientific revolution of the 18th century. It's not a goal of this research to thoroughly investigate the history of this relationship, nor to explore the historical and philosophical contingencies that informed its evolution, but it's useful to observe that many identify in the mechanistic and reductionist approach introduced by the scientific revolution a turning point in recent history: the world is perceived as separate and outside from us humans, and its underlying logics can be simplified and studied following the directions of the scientific method. Such an approach holds significant repercussions on our consideration of the environment: people have risen above it, assuming a position of dominance that affords them the right to dispose of nature's resources as they wish.

The current dominant paradigm suggests that the primary purpose of nature is the provision of raw materials and environmental services for the benefit and enjoyment of humans. Under this paradigm, humans are not part of nature, but rather nature exists to be conquered for gain on the basis that short-term human growth and progression will provide benefits in the future that are able to compensate for abstraction and destruction now. Also known as the Technocratic Paradigm, this approach is prefaced on most of humanity perceiving that technological advancements will be able to overcome current and future threats to human populations. Parker and Simpson 2020

This approach still informs our view of the world; it's rooted in the social and cultural

norms that reinforce unhealthy and disruptive consumption patterns and measure success through profit and material accumulation (IPBES 2025). Over time, multi-species justice and approaches, relational thinking, and co-evolutionary intentions introduced claims about the intrinsic value of nature, in contrast to traditional ES approaches and the commodification of nature. An alternative view of nature has emerged: for a long time suspended between its understanding as wild and pristine (separate from us and autonomous) and its consideration in mere utilitarian terms as a useful means for enhancing human well-being, nature can also be valued for its relational and intrinsic qualities (Lemes de Oliveira 2024).

There is no one-size-fits-all solution nor a tested recipe that enables transformative change. What's clear is that both civil society and institutions play a fundamental role by co-creating alternative visions for the future that can change people's values and sensitivities and by promoting brave policies that formalize and enact the longed-for change. The responsibility of design lies in enacting this change: responding to the needs of more-than-human entities, providing the resources for nature to thrive, facilitating the unfolding of ecological processes, and promoting interactions with nature by providing access to it are at the core of what a biodiversity-sensitive design seeks to accomplish (Visintin 2022).

MULTISPECIES JUSTICE

Multi-species Justice (MSJ) offers the theoretical premises upon which incisive measures for the protection of life in urban areas can be based. MSJ considers more-than-human entities and ecosystems as bearers of rights; it recognizes their intrinsic value, not because they serve a purpose for humans but simply by existing (Wijsman 2025). MSJ considers not only the rights of humans and animals but also extends its scope to plants, forests, rivers, soils, and broader systems. Recognizing other-than-humans as subjects of justice means including them among the community of decision-makers and acknowledging their agency. The latter being understood by Western society as *intention* and *language use* has long been perceived as a human prerogative (Callon & Law 1997). But in the context of MJS, more-than-human agency is understood as the ability to have an effect on the world, not just as a contributor to ecosystem functions or subordinated to a means but justified in their own right (Raymond et al. 2025). It's important to acknowledge that such considerations, just recently investigated by researchers and sporadically introduced in policy documents, stem from Indigenous cultures: the appropriation of this knowledge by academia can be interpreted as a novel form of colonialism; thus, a careful and ethical handling of such concepts is imperative (Raymond et al. 2025).

Once the agency and moral significance of multispecies others are recognized as part of the collaboration and co-shaping of shared space, it provides the political space to include the interests and needs of multispecies others in decision-making processes.
Raymond et al. 2025

MSJ holds important consequences in the way we conceive our cities: by overcoming the anthropocentric bias that governs all aspects of society, including governing institutions, it raises the question of who the city is planned for and opens up to the possibility for urban settings to become positive drivers of change and to promote the flourishing of

Photo by Flavio Chiroi
Renaturation of the river Aire
Atelier Descombes & Rampini, Geneva 2015



all life forms.

The evidence presented thus far may lead to the conclusion that urbanization represents a threat to biodiversity, which is a statement hard to refute, but it paints an incomplete picture of the complex relationship between cities and nature. Some species actually thrive in urban contexts and adapt well to new circumstances (Spotswood et al. 2021). When it comes to investigating the impacts of the built environment on more-than-human actors, it would be unfair to omit the benefits that the city has to offer, especially when its surroundings are highly transformed and disturbed. The availability of resources, both produced by human activities and provided by the remaining habitats, is one of the many opportunities provided by urban settlements: in the latter case, changes in phenology can even make them available at unique times throughout the year (consider for instance phenomena like urban warming or practices like irrigation, which might alter the life cycles of species) (Spotswood et at 2021).

When the surrounding environment becomes highly homogenized because of farming practices or other disturbances, the city becomes a source of habitat heterogeneity where a diversity of species can find refuge. MSJ could provide recognition to novel habitats in cities not currently protected by regulations (Raymond et al. 2025): public and private gardens, riversides, brownfields, cemeteries, ... are just a few examples of the multiplicity of unconventional habitats that can support life (Soanes et al. 2018), whose importance for species assemblages is often undermined and wrongly deemed insignificant in their socio-ecological value (Pineda-Pinto 2025). A less evident way in which urban settings can benefit biodiversity is through preadaptation to climate change. Cities notoriously present different environmental conditions than their surroundings, such as higher temperatures: evidence was found of adaptation to these conditions with a resulting increase of genetic diversity and ultimately a better resilience to climate change. In this regard, researchers suggest that species adaptation could prove useful for tolerating future climate conditions and for potentially colonizing rural areas if rural communities were found unsuitable to bear the renewed environmental conditions (Spotswood et al. 2021).

Cities are not incompatible with biodiversity: being a concerning threat for the perpetuation of life is not an excuse for inaction, for giving up on policies and strategies with conservation in mind, for surrendering the idea of building communities in which both humans and non-humans can thrive. There is certainly a need for a shift in the way cities are conceived in relation to biodiversity: conservation cannot be limited to protected areas; the safeguarding of the natural environment and its ecological processes cannot be contained within the boundaries of closed reserves (nor the existence of these enclave can be the pretext to justify the exploitation and the transformation of every square inch of land outside of them).

Moreover, current biodiversity conservation policies prioritize endangered and native species but fail to do justice to non-threatened ones. Their tendency to focus on more charismatic species (notably mammals) in their protection goals, while ignoring non-charismatic ones, underscores the need for a change in protection strategies and the urgency of overcoming speciesist mentality and extending justice principles beyond humans (Raymond et al. 2025). Similarly, the focus on native species as a conservation principle reveals a bias fueled by the arbitrary notion of pristine nature: non-native species are sometimes harmless and hold conservation value; thus, co-habitation is possible (Raymond et al. 2025).

Another assumption MSJ wants to challenge is the neutrality of science. How we know affects what we know: ecological knowledge is believed to objectively assess how NBS can benefit biodiversity, but it completely disregards "the cognitive and emotional capacities of animals and their well-being. [...] No longer can we view ecosystems as collections of passive resources or lifeforms as mere data points. Instead, we are being called to recognize them as active participants in their own right, capable of experience, response, and relationship" (Wijsman 2025).

Cities are capable of hosting biodiversity, but only in rare, isolated cases is the topic addressed strategically (Visintin 2022). In this sense, architecture plays a delicate and fundamental role: it both reflects specific values and practices and shapes our relationship with the environment. A design that cares for nature is an opportunity to build a different attitude towards nature.

We need to change systems, lifestyles and imagination to abandon siloed, anthropocentric, Modern thinking and avert the worst devastation in the offing. Design, in its extreme functionality and service to big industry, is both the handmaiden of devastation and a possible means of changing this fate. We need to redesign design.
Akama et al. 2020

Reforming existing NBS can be a way to introduce gradual change in policies and dominant systems. Multi-species justice advocates for everyone affected by urban transformation to be involved in decision-making processes: the matter of how is far from resolved (Raymond et al. 2025).

REFRAIMING NBS

A reframing of NBSs can embody ways of introducing relational thinking and eco-centric views into urban planning. This requires a narrative shift to overcome human exceptionalism and include more-than-human actors in the public discourse. NBSs can serve as a metaphorical Trojan horse for hacking the normative framework and explicitly promoting the presence of other-than-human actors in urban settings. Their insurgency would then not be ignored or left to chance, but would be willingly encouraged. Acknowledging the non-charismatic other-than-human species as legitimate city dwellers means formally promoting the coexistence of species, including ours, and ultimately fostering a different relationship with nature.

As stated above, NBSs often use nature to improve human living conditions, but the needs of biodiversity itself are disregarded; MSJ can broaden its scope to include the needs of other living beings. Simple acts such as tree planting on urban avenues (mostly realized with monocultures), when implemented with the aim of enhancing biodiversity (for instance, through diverse planting), not only can increase the resilience of habitats, but support a multitude of species through the provision of food, shelter, breeding site, nesting material, etc. ... (Maller 2021) Gentle management of vegetated areas, consisting in the reduction of maintenance operations, is another simple way of acknowledging and enacting the shared nature of the urban space: giving them time to exist and develop is a way of fostering both care and involvement towards other-than-human entities (Pineda-Pinto 2025).

More-than-human thinking can attune NBSs with ecosystem dynamics and biodiversity needs, more than proposing technological

fixes. It allows them to support non-human beings by fostering participation in decision processes, awareness, and empathy. The attention shifts from function to functioning, from ecosystem services to ecosystem capabilities, moving beyond the benefits these entities can grant us to focus on realizing their full potential. Operating with respect to multispecies justice is no simple thing: it requires us to go beyond rationality, de-center our perspectives, nurture care and responsibility towards the actors we share the world with (Pineda-Pinto 2025).

Architecture has always had the role of enclosing and protecting from external pressures: transforming the means of architecture and the built environment to promote the thriving of ecosystems offers an exciting new realm of possibilities for the discipline. But implementing NBSs doesn't come without risks. While NBSs can have a transformative impact and change perceptions of nature (Lemes de Oliveira 2024), they also risk triggering opposite reactions. A documented danger posed by NBS is the reinforcement of existing urban inequalities through the preferential implementation of green infrastructure in wealthier neighborhoods. Similarly, the phenomenon of green gentrification, in which the development of green amenities leads to the displacement of lower-income residents, exacerbates social justice problems. An unfair and uneven distribution of environmental assets in cities may thus give rise to antagonisms towards these solutions and further exacerbate human disconnection from nature (Maller 2021).

That's why the implementation of NBSs must be properly managed to balance different stakeholders' needs, reduce conflicts, and reach appropriate compromises (since satisfying someone's desires may come at the expense of someone else's).

THE ROLE OF URBAN POLICIES AND THE BARRIERS TO NBSS' MAINSTREAMING

Urban policies, as the instruments our society uses to regulate the logic of the built environment, hold significant strategic importance in the effort to foster a different, healthier relationship with natural components. They represent an opportunity to mainstream NBSs and to trace the path towards multi-species co-habitation in urban settings (Bush & Doyon 2019). By acknowledging human dependency on other species and ecosystems and by recognizing the agency of more-than-human entities, different worldviews can be embraced, novel conceptions of the public space can be enacted: by overcoming the current utilitarian and materialistic view of nature, cities can truly become a shared space where cultivating a positive human-nature relationship (Bush & Doyon 2019). It offers the opportunity to move beyond traced pathways and standardized methods, to undermine established power relationships, and to experiment with new processes and practices.

Many pieces of legislation around the world already show signs of incorporating more-than-human thinking: this's the case of the Bolivian Law of the Rights of Mother Earth, which recognizes the natural world as a sacred entity with inherent rights and mandates the preservation of its harmony to ensure its regeneration. Other policies adopted in New Zealand and India attribute personhood to natural entities such as rivers or glaciers, granting them not only legal protection but also the right to defend themselves in court, on a par with people. More-than-human thinking is nothing new to Indigenous knowledge and ontologies, which acknowledge the deep and symbiotic connection between humans and nature: such a balance, once broken by crossing environmental thresholds, leads to detrimental consequences.

Introducing such concepts into European policies is much harder, given the distance from these cultural prerogatives, but the implementation of revised NBSs is believed to be able to overcome the difficulty and inadequacy of the institutions to tackle the problem of biodiversity loss through proper, incisive policies. Despite this, the mainstreaming of NBSs remains limited for a multiplicity of reasons. Beyond the financial constraints and concerns about the reliability and effectiveness of nature-based solutions, a major concern is the knowledge gap between researchers and practitioners: on one side, there is a lack of knowledge and limited awareness of their potential to solve urban challenges; on the other, there is a comprehensible overreliance on technical knowledge and standardized engineered solutions (in contrast with the context-sensitive green infrastructure) (Davies et al. 2021; Dorst et al. 2022).

Insufficient policy development and the lack of integration of NBS at local levels of government are further challenges mentioned by Davies et al. (2021): the difficulty in moving from vision to implementation is heightened by the shortage of practical and methodological instruments for implementing, funding, and organizing such solutions.

The competition for urban space is another factor that hinders the implementation of nature-based solutions: the scarcity of vacant space exacerbates tensions and conflicts with other sectors that deliver urban functions (a problem further exacerbated when cities pursue densification goals). When concerns about environmental impacts arise, technological sustainability innovations are often prioritized over NBS (Dorst et al. 2022).

It's negative feedback, a disruptive loop in which the diminishing of natural components in urban settings (with the consequent habitat loss and fragmentation) reduces opportunities for interaction with nature and leads to ecological illiteracy, which in turn diminishes the sense of care towards nature and promotes further exploitation and extractivist practices. Another interesting reason for the decrease of natural areas in cities was proposed by Colding et al. (2020): he refers to a baseline shift, which consists in considering the current state of things as the normal and undegraded one, ultimately leading to further occupation of natural remnants (it's a form of generational amnesia and it may explain the inaction towards the environmental crises) and finally a lack of strategic view in urban planning. Alfred E. Kahn talked about the tyranny of small decisions: a number of resolutions intended to quickly solve problems and promote economic development that over time produce undesirable outcomes from a socio-ecological point of view.

And finally, the fundamental barrier for NBSs mainstreaming is synthesized by the words pronounced by António Guterres, current UN Secretary-General, during the COP25: "Political will is still lacking; political will to put the brake on the carbon and fossil fuel industry and to shift taxation. We must stop digging and drilling and take advantage, instead, of the possibilities provided by renewable energies and nature-based solutions". The politicization of such themes arguably represents the main obstacle to the inclusion of NBSs and ultimately MSJ principles in operative policies and legislation. The identification of such ideas with a specific wing of the political scene hinders recognition of the universal character of these proposals and the implementation of resolutions that move towards

Photo by Jann Monel
Still Alive - Rocaille vivante
Part of the exhibition *Ripensare il paesaggio. 7 giardini per la biodiversità*
Wagon Landscaping, Aglié 2023



extending justice beyond the boundaries of human entities.

The actions taken to implement the coveted transformative change need to address the various challenges that prevent the shift in the dominant paradigm at once, while also addressing the roots of the problem. The strategies proposed by the IPBES (2019) deal with preserving those enclave in which a balanced and mutually flourishing relationship between humans and nature persists, extending legal protection to biodiversity and natural entities by acknowledging the rights of nature and its intrinsic value, creating spaces in which human beings can co-evolve with nature; exposing the exploitative and disruptive practices in those sectors that drive biodiversity loss; overcoming the custom of measuring growth by economic value to promote metrics and set goals centered on quality of life, equity and justice; questioning social norms and established practices through alternative narratives and worldviews in order to highlight the interconnectedness of all living things and foster an ethics of care towards nature.

It's important to notice that what is stated comes directly from the IPBES, an intergovernmental platform comprising 94 national governments that cooperates with the United Nations: it aims to provide insights and directions rooted in science that could be useful to implement adequate policies on biodiversity conservation and development, with specific regard to human well-being and sustainable development. All of this to say that the recognition of the necessity and the urgency of a revolution in the logic that governs the status quo transcends political affiliations and should be treated as a universal goal.

I argue that the introduction of multi-species justice concepts and goals in urban policies can play a pivotal role in encouraging the creation of cities where all forms of life can thrive. Through reframing nature-based solutions to include the needs of all stakeholders affected by urban transformation processes, and their mainstreaming into high-level policies and local strategies, a concrete change in people's awareness of the biodiversity crisis can be achieved, and the alienation from nature reversed. The obstacles mentioned above are difficult to break down; architecture can play an important role in these efforts, and multispecies design offers an opportunity to compensate for the lack of appropriate methodological tools for integrating MSJ perspectives into the design world. It does not pretend to solve all conflicts, but it can represent a viable path for the inclusion of both ecological knowledge and nature's rights in the design process.

MULTISPECIES DESIGN

A multiplicity of different approaches address the problem of the incorporation of nature's rights into the design process: animal-aided design, biodiversity-sensitive urban design, reconciliatory design, multispecies design, ... They all hold their own specificities, but they share the urgency to move on from human exceptionalism and evoke a paradigm shift in the design field that can reflect a relational worldview.

From now on, the term multispecies design will be used in this research to refer to approaches that seek to include the needs of more-than-human living beings in the design process. They are considered fundamental components of the design brief and therefore capable of influencing the final output; they are not considered a limitation but rather an opportunity and a source of inspiration.

Photo by José Hevia
Reggio School
Office for Political Innovation, Madrid 2022



Multispecies design is used here as an umbrella term that includes practices aimed at protecting nature and fostering biodiversity in traditionally anthropic urban settings (Metcalfe 2015).

Designing for other-than-human entities presents significant difficulties for us human designers, including the impossibility of communicating directly with non-human stakeholders due to obvious biological and physiological differences that prevent such communication (Gatto 2021).

The distance separating us from other living entities cannot be an excuse for inaction or for perpetuating further disruptive and extractivist practices. Multispecies design is an exciting new field worth exploring despite its current limits; only through trial and error can the process be refined and perfected. At the foundation of multispecies design stands the reorientation of old priorities and the deconstruction of humans' role as rulers over nature. This stands in deep contrast to current trends in urbanization that follow old logics of land exploitation and nature's destruction.

There are a few elements that stand out in multispecies design and that differentiate it from ordinary design processes:

DESIGNING FOR NON-HUMAN CLIENTS

When it comes to understanding the needs of more-than-human subjects, it's always unclear what kind of information is fundamental to guarantee their survival. Understanding the life cycle of a species (along with its evolving needs throughout its lifespan) is necessary to design a suitable habitat and ensure the existence of stable populations. For instance, when installing bee hotels or artificial bird nests, the reproduction site is recreated, but no thought is given to meeting food needs or other necessities. Designing for a species' survival is a matter of relations: the target species is an umbrella species whose survival depends on the presence of all the organisms it interacts with throughout its life cycle. Further precautions include ensuring that the target species' food is available at a suitable distance and that adequate protection from predators is provided (Hauck & Weisser 2015).

The different features of a minimum habitat for a species to thrive make up the critical factors that ensure their survival: they include factors related to the microclimate (such as minimum and maximum temperature, ideal levels of humidity, exposure to sunlight, etc. ...), the species it depends on for food and other purposes, the maximum bearable levels of disturbances, ... It is not easy to identify these critical factors: the species are observed in their natural habitats and by comparing the latter with similar environments in which the species is absent, it's possible to determine the critical factors with a moderate level of accuracy. Nevertheless, given the abundance of attributes and variables in a habitat, it's not simple to precisely identify these elements. The certainty of a feature's relevance comes from its introduction into the studied environment: if the habitat becomes habitable for the species, then the factor is truly critical. This operation is relatively simple for vegetal species, but much more complicated for animals: such a workflow can contribute to theoretical research and (through trial and error) help determine the critical factors for the studied species (Hauck & Weisser 2015).

This scientific knowledge doesn't need to be the only source of information for the designer: first-hand interactions, observations, and the collection of photographic material

and artifacts are useful practices for empathizing with non-human clients and reducing the distance separating humans from other living beings. Interviews with experts and researchers who can speak on behalf of the species affected by the design, as well as ethnographic studies aiming at gathering stories and site-specific knowledge that can inform the design, are equally important (Metcalfe 2015).

DESIGNING FOR REPRESENTATION

Taking other species into account during the design process is also a matter of representation. Making nature's presence more prominent in urban areas is a political statement; it's an antidote to human dominance. Giving visibility to biodiversity helps recognize humans and more-than-humans as equal stakeholders who share and co-inhabit the same environment (Metcalfe 2015).

We are not likely to care for or about the life forms we cannot see
Beatley & Beakoff 2013

DESIGNING FOR POSITIVE INTERACTIONS

Protection is different from separation, and when fostering biodiversity in cities, it's crucial to design positive interactions between humans and other-than-humans. When these meetings occur, our reactions are influenced by the landscape, culture, shared beliefs, and stories, so that empathy, conflict, affection, respect, disgust, unease, and other feelings might arise. The role of design lies in the opportunity to shape encounters in ways that are enjoyable, useful, and empowering (Metcalfe 2015). Increasing people's environmental awareness is not just a matter of proximity but of involvement, of creating a sense of place, memories, and meaning through interaction with local ecosystems, so that shared experiences and participation can both foster stewardship and social cohesion (Andersson et al. 2014).

DESIGNING FOR ASYMMETRICAL INTERFACES

At the core of multispecies design are what Metcalfe calls asymmetrical interfaces, objects, and structures used by both humans and more-than-humans, which is why they should be able to satisfy different needs simultaneously and be interacted with in different ways by different stakeholders. Among the critical issues that might arise is the emergence of problems of dependency on design objects by wild animals: these objects hold significant domesticating power that increases the risk of undermining animals' ability to provide for themselves in terms of food, shelter, or other aspects of their life cycle. A possible solution is to create objects that behave like natural resources and mimic nature's patterns and variability. Another concerning phenomenon is anthropomorphism, which arises from a misinterpretation of animal needs and ultimately results in the creation of artifacts that are appealing to the human eye but completely ignored by (or worse, dangerous to) other living beings.

DESIGNING FOR COMPLEXITY AND EMBRACING THE UNCERTAINTY

Another fundamental principle when designing for biodiversity is that complexity increases the opportunities for more-than-human entities to thrive: diversity of plant species, textures, niches, ... all serve the purpose of enhancing the opportunities for life to emerge. Designing for and with nature means embracing the uncertainty, coming to terms with the fact that there is no final output, but only an open-ended process on which little control can be exercised: man-made systems become extensions of the ecosystems, they align with the cycles of life, with the flow of energy and materials, with the natural changes that occur over time (Metcalfe 2015).

MANAGING CONFLICTS

Designing for a multiplicity of actors will generate possible trade-offs among socially and ecologically desirable outcomes. Which species to favor and which one to exclude? Which aspects of the design generate conflicts? How does the design align with principles of social equity? It's up to the designer to find a synthesis between the project's needs and those of the target species.

03

.01 URBAN CASE STUDIES

In the following paragraphs, two European cities will be taken as case studies and their policies aiming at fostering biodiversity in urban settings analyzed. In the light of multi-species justice and multi-species design, each biodiversity strategy will be examined to determine which consideration of nature they hold, which visions for their future they propose, which goals they set, and which resources they put in place to reach said goals.

The cities chosen as reference for the elaboration of future scenarios in the context of Torino are Paris and Barcellona. The two cities were selected because they recently elaborated important documents that introduce clear and ambitious objectives in the field of urban nature, and adopt a strategic vision for the greening of their urban environment. They reveal a clear and consistent commitment towards such topics: despite the historical character of these important urban settlements, the political will to adapt the public space in order for it to effectively answer current challenges and the consonance between the different actors involved in the management of urban processes made the transformation of urban space possible. Urban fabric is not intended as a static and immutable body but as dynamic matter that needs to change over time in order to keep the whole organism alive. Such changes are not left to chance nor enacted by private stakeholders with ulterior motives but properly governed for the public sake. Through the Paris Plan Biodiversité 2025-30 and the Barcelona Nature Plan 2021-30, the two cities prove to have a strategic and conscious vision for their green infrastructure. The motives and means for fostering biodiversity are different but the result is similar. One seeks to enhance the green fabric to maximize the provision of ecosystem services, the other seems to recognize the intrinsic value of nature, and both understand the city as an integrated system whose health depends on the correct functioning of each and every one of its interrelated components. The green fabric is one of them and people's health is highly dependent on nature's health. Nature's rights are rarely mentioned directly but the integration of ecological principles for supporting natural processes are in both cases addressed.

PARIS

TREE CANOPY COVER	21 %
GREEN SPACE COVERAGE	24 %
GREEN PUBLIC AREAS	15 %

INSIDE URBAN BOUNDARIES

- URBAN GREEN
- WOOD
- HEATH
- WATER
- URBANIZED AREAS

OUTSIDE URBAN BOUNDARIES

- WOOD
- HEATH
- FARMLAND

1:100 000

PLAN BIODIVERSITÉ 2025-30

The plan proposes a clear, long-term vision for the city of Paris: a desirable scenario in which the urban environment is shared between humans and non-humans, and the urban fabric is made livable for all living creatures. It draws on the recognition that our relationship with ecosystems needs to change, as well as on our consideration of the urban environment in terms of ecological relevance and conservation value. The city is not a biological desert:

La ville est au cœur des enjeux de connaissance, de sauvegarde, de valorisation e de renforcement de la biodiversité, elle n'est pas un désert de vie, bien au contraire. Une ville avec plus de nature est une ville plus perméable, plus résiliente, mais aussi plus accueillante pour l'ensemble du vivant.

The strategy recognizes that the crucial driver of biodiversity loss is habitat fragmentation: the isolation of wild animals impoverishes ecological value; anthropogenic pressures and climate change further undermine ecosystem health. As we know, urbanization plays a fundamental role in this process. Paris has decided to flip the narrative and view all interventions in the urban fabric as opportunities to foster biodiversity and restore natural cycles. The city has embarked on a greening journey to strengthen the biological network that permeates it. People are afforded an essential role in this process: they are defined as the architects of structural change, the catalysts and enablers of the longed transformation.

Under this point of view, little agency is afforded to Nature themselves: the power to enact any substantial change is in the hands of human beings. Even when dealing with biodiversity, the driving force on which the thriving and the failing of more-than-human life depends is embodied by human activities and will.

The Plan Biodiversité also understands the link between biodiversity and the climate crisis and realizes the overlap between a biologically rich environment and a resilient one. The thriving of nature is associated with the thriving of people; enhancing biodiversity is both a moral imperative and a matter of livability and social justice: access to the benefits that nature objectively affords to citizens should be equally distributed among neighborhoods. The strategic documents therefore propose a model that reconciles social development with ecological sensitivity and respect for all living things, a vision in which peaceful coexistence among multi-species actors is envisioned and pursued.

The elaboration of the plan has been led through a participatory process and subjected to a public vote. It's important to note that biodiversity topics are embedded in many strategic documents of the city: Plan arbre, Plan climat, Plan d'amélioration de l'environnement sonore, Plan Parispluie, Plan alimentation durable, Plan parisien de santé environnementale, Stratégie de résilience and Plan local d'urbanisme bioclimatique.

CONTENTS AND QUANTIFIABLE GOALS

The strategy proposes guidelines to orient the administration's choices. It is articulated around three main axes: 1. Extend the knowledge on biodiversity and expand/support ecological areas and processes; 2. Change the narrative and consider biodiversity as a valuable asset for the city, a resource, a fundamental component of the city's heritage. Biodiversity must become a guide; the design must be an occasion for fostering it; 3. Raise awareness and cooperate for biodiversity: setting up public-private collaboration to finance initiatives, organizing programs to spread knowledge and foster a different sensitivity towards nature, and training new expertise.

The plan is very practical: the 20 themed objectives fall under five focus areas.

1. PLANTING HEDGEROWS

The idea is to provide adequate habitat for animal species by both offering refuge and allowing safe movement among natural reservoirs. Strengthening the ecological fabric both inside and outside public parks also means providing cooling during summertime and allowing water percolation through soil permeabilization. Part of the strategy is implementing low-pruning management systems to enhance habitat health and respect natural cycles. Public participation is also fostered through specific planting initiatives.

2. ENHANCING THE ECOLOGICAL VALUE OF THE SEINE

The river Seine represents an important ecological corridor not only for the city (it connects the two largest natural reserves in Paris) but also for the entire region. This corridor plays a fundamental role in the lives of multiple aquatic and avian species as a habitat and migration route. The administration is working to enhance water quality and make it swimmable and usable for its inhabitants. In parallel, the intent is to demineralize and renature the riverbanks wherever possible.

3. RENATURING THE EXISTING GREEN LUNGS OF THE CITY

They represent a true reservoir of biodiversity, hosting a variety of habitats and species. The focus here is on strengthening and regenerating the natural heritage, limiting the anthropogenic pressures, and appropriately managing the natural component. The concrete measures center on reducing car circulation and renaturing spaces once dedicated to cars (namely, the streets that cross and fragment the bois); diversifying forest populations by planting new trees from the regional pool; and creating new lakes, ponds, meadows, and hedgerows to enhance habitat complexity.

4. ASSESSING THE BIODIVERSITY FOOTPRINT OF THE CITY

It translates into building a complete inventory of the city's natural components and developing knowledge of the biological diversity that characterizes the municipal area. But it also translates into measuring the anthropic impacts on the environment, including pollutant emissions, the volume of water withdrawn, and the deforestation rate. The calculation of the Singapore Index is intended to give meaning to the information collected and therefore measure the city's performance in ecological terms.

5. DEVELOPING BIODIVERSITY IN THE CITY DISTRICTS

The intent is to enhance the opportunities to host biodiversity and bring it where it's needed the most, so that the benefits bestowed can be enjoyed by everyone, despite of their

income, gender, race, ... Multiple initiatives to transform the public space are organized and tailored to the necessity of each neighborhood: streets greening, roofs and walls naturing, common gardens creation, education initiatives, ...

Among the quantifiable goals set by the plan, it's worth mentioning:

- Transforming at least 200 school streets by introducing biodiversity and granting access to nature to every Parisian student (either inside the school or close to it)
- 25 % canopy cover
- 10 m² of vegetated surface per inhabitant
- Creating 5-8 new pedestrian and green streets in each city neighborhood
- 30 % of permeable and vegetated surface
- Encouraging local greening initiatives
- 500 m minimum of planted hedgerows in each city district

77 indicators, spread across the 20 thematic areas, measure progress in efforts to increase biodiversity in the city.

PUBLIC SPACE AS A MULTISPECIES INTERFACE

Biodiversity is understood as a structural component of the urban fabric. It's not just a valuable asset that enhances the city livability and mitigates climate change, but an intrinsic element of the urban web. It is described as part of the city heritage, a rightful inhabitant whose presence inside the border of Paris has been undermined by urbanization processes and that is now afforded a renowned attention. Through the Plan Biodiversité, nature regains centrality among the priorities of the administration: the public space becomes the setting where an harmonious co-existence between humans and more-than-humans can be fostered:

Ce nouveau Plan biodiversité 2025-2030 vise ainsi à permettre une harmonie entre une expression spontanée des processus écologiques et les activités humaines de notre ville.

When nature is given the possibility to reclaim the public space, the opportunities for people to connect with the other living organisms that populate the city increase and a different relationship with them can be fostered. The goals of introducing nature into the urban fabric and converting school yards and streets in nature oasis promoted by the plan serve exactly this purpose. Setting up education programs at all levels of education as well as fostering participation to natural space managing initiatives similarly aim at raising awareness on environmental issues and creating occasions to experience first hand ...

ECOLOGY AND MORE-THAN-HUMAN WELL-BEING

The plan is not just about increasing the presence of greenery in the city, but also enhancing its health. Strengthening the ecological fabric is intended both as increasing ecological connectivity through hedgerows and trees planting, and as managing the biological urban components with respect to ecological principles and species needs. This sensitivity is reflected by the initiatives implemented: extending and connecting natural habitats for promoting animal mobility, decreasing anthropic pressures through collateral programs (for instance the promotion of soft mobility and the pedestrianization of numerous streets), introducing diversity and complexity when intervening on or creating natural habitats in order to increase their resilience, promoting low pruning to minimize interference with ecological processes.

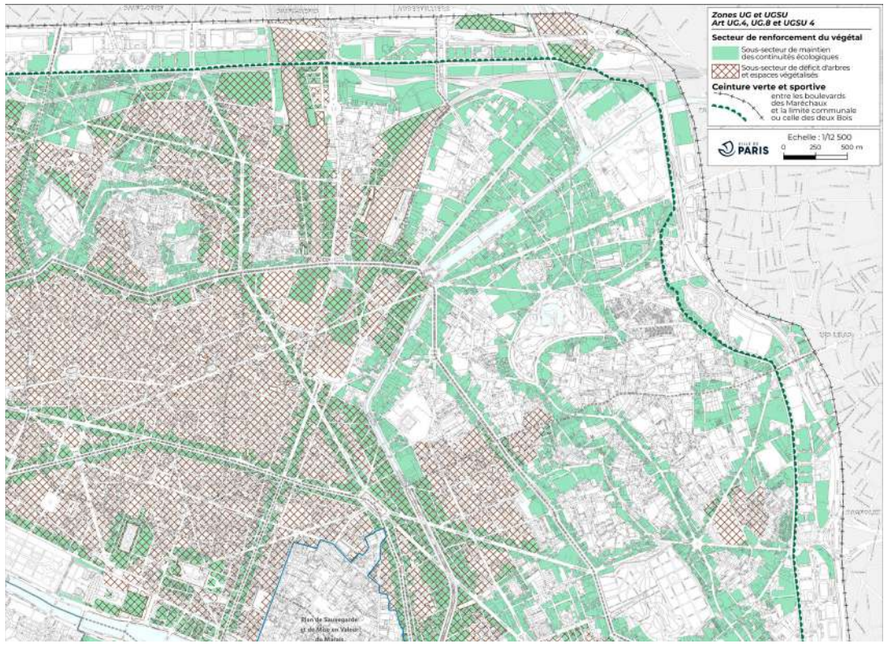
Alongside with the enforcement of these important actions, the plan intends to measure the effectiveness of such measures over time. Following the creation of a precise inventory of the green and blue fabric, the intent is to monitor the evolution of populations of protected species and invasive species that could undermine the health of local ecosystems. Similar studies are planned to be carried out to track the progress in reducing anthropic pressures directly linked with biodiversity loss (noise and light pollution, air quality, soil consumption).

SPATIALIZING THE STRATEGY

The Plan Biodiversité itself doesn't include any map that precisely locates the envisioned interventions, nor contains any normative requirement necessary for reaching its ambitious goals. The bioclimatic Local Urban Plan (PLUb) represents the planning instrument the biodiversity strategy relies on in order to enact the longed change. The PLUb (officially published in 2024) was elaborated to face the multitude of challenges that affect the city and to lead Paris towards a better future. Among the challenges it is called to addressed is the biodiversity loss: under this point of view, it seeks to integrate ecological objectives into urban planning and make the built environment a source of support for living things. In addition to the environmental requirement every intervention on the urban fabric must comply to, the PLUb precisely draws on the city plan the ecological corridors that cross the urban environment, coherently with the areas and paths identified at a regional level by the Schéma Régional de Cohérence Ecologique. The city is crossed by a green network that hosts rich flora and fauna: its ecological continuity is strengthened through a series of major interventions promoted by the public administration and a number of small, progressive changes implemented by the private property owners. Indeed, all plots that fall in the Sectorisation végétale (which follows the deployment of the green corridors) are subjected to stricter and more demanding requirements in terms of biodiversity regeneration.



Plan Local d'Urbanisme
bioclimatique 2024
OAP Biodiversité et adaptation
au changement climatique
Ville de Paris



Plan Local d'Urbanisme
bioclimatique 2024
Secteur de renforcement du
végétal
Ville de Paris

PLAN LOCAL D'URBANISME BIOCLIMATIQUE

The *Plan local d'urbanisme bioclimatique* (PLUb) is Paris's answer to the climate and biodiversity crises. It's both a normative and strategic document that aims at making the urban environment more livable for humans and more-than-human species. The planning document ties together a multitude of urban challenges, aiming to make the city affordable for everybody, enhance the city's green fabric, address social justice challenges, and advance the 15-min neighborhood model.

It's a zoning plan that defines which activities can be built where, which rules the erection of new buildings must follow (with precise architectural prescriptions and environmental requirements). Every intervention must comply with the *règles environnementales du PLU bioclimatique*, which introduce strict environmental requirements for these projects from different perspectives: use of renewable energy, reduction of carbon emissions, enhancement of thermal and energetic performance, use of low-carbon materials, internal comfort, and naturalization of free space and buildings.

The document recognizes that Paris is composed of a compact, dense, mostly mineral space that places significant pressure on the city's natural component. Biodiversity is recognized not solely for the functions it provides to humans but as an inherent component of the city: as stated in the PADD, the built fabric (public space, walls, roofs, abandoned spaces, courtyards, ...) offers an extraordinary opportunity for renaturation. In accordance with the Plan biodiversité, every plot and urban parcel is considered an opportunity to support biodiversity and natural processes and to consolidate and enhance the existing ecological reservoir and corridors.

The city surface is divided into 4 categories: *zone urbaine générale* (which covers most of the municipal surface), *zone urbaine de grands services urbains*, *zone urbaine verte*, and *zone naturelle et forestière*. Within the UG, the map Sectorisation végétale identifies the areas where specific greening dispositions are applied: these areas correspond to the ecological corridors highlighted in the OAP Biodiversité and traced in coherence with the higher-scale regional plans. Specifically, all new constructions and refurbishments require a higher share of vegetated surfaces (for both the open spaces and the buildings).

As stated above, the protection and enhancement of biodiversity is at the core of the plan: every intervention must entail the preservation and the reinforcement of nature's presence, in compliance with ecological continuity at a larger scale. Every major intervention (whether it's new construction or a renovation) with a surface area exceeding 150 m2 must comply with the OAP Biodiversité disposition. Among the main notable dispositions of the *Règles environmentales*: the obligation to keep existing trees (with some exceptions); the inclusion of a share of open space which must, whenever possible, host a variety of plant species (divided between trees, shrubs and grass) whose minimum number is regulated and determined by a mathematical formula, and their relative position disciplined; the need to make gates and property borders permeable to small animals in order to ensure biological continuity; the requirement to choose at least 50 % of new tree and shrubs among the regional species (listed in the *Règlement*) and the prohibition to plant invasive species; the requisite for every new construction, renovation, superelevation, extension to reach a minimum score in the indice de végétalisation, which makes it necessary to include in these projects green roofs and/or walls.

Furthermore, every new building or renovation project in the UG zone will be approved on the condition that it exceeds the base-level requirements in at least two of the following three topics: biodiversity, programming, and energy efficiency. This demand falls under the *dispositif de valorization des externalités positives des projets*, which allows designers to choose, based on the characteristics of each project, which field to focus on.

LES CHEMINS DE LA NATURE

It's mostly an archive of the ecological resources of the city: it comprises a map of the green and blue networks that cross the city and connect the different biodiversity reservoir, specific sheets dedicated to local flora and fauna, invasive exotic species, the priority habitats. The latter is particularly interesting: first of all, a clear definition is offered and their role clearly explained (they represent the setting where species interactions occur, where the resources to complete their life cycle and fulfill their needs can be found, including food, reproduction sites, free movement). It's a classification method elaborated by the municipality in collaboration with experts and tailored to the Parisian environment: it's a different type of classification than the CORINE Landcover (which doesn't suit the urban environment, where artificial components can't be found). The priority habitats are considered fundamental to enhance biodiversity, for their capacity to host local fauna and attract wild animals. The more habitats that can be found in a certain setting, the more it can contribute to its good ecological functioning. These sheets contain a brief description of the habitat, a selection of plant species that can be found (both protected species and invasive species), the possible threats that may undermine its ecological functionality or their existence, the animal species that it hosts (and which role the habitat plays in their lifecycle), both the protected ones to encourage and the invasive one to limit, some recommendations on the correct management. These sheets represent a critical resource for the designers who want to integrate biodiversity in their projects: they offer important information for the preservation, improvement or even creation of these habitat in the urban fabric, by facilitating the identification of a vegetation palette in accordance with the objectives of the Plan Biodiversité 2025-30

COPROASIS

It's a municipal program, where citizen get technical and economic assistance in their intent of greening their co-property. Among the possible interventions, the creation of green roofs and walls, the greening of internal courtyards, the permeabilization of soil, the installation of water collection systems. The applicant gets € 5 000 for feasibility studies and an 80 % coverage of the project costs (up to € 30 000).

BARCELONA

TREE CANOPY COVER	29 %
GREEN SPACE COVERAGE	35 %
GREEN PUBLIC AREAS	11 %

INSIDE URBAN BOUNDARIES

- URBAN GREEN
- FOREST
- HEATH
- WATER
- URBANIZED AREAS

OUTSIDE URBAN BOUNDARIES

- FOREST
- HEATH
- FARMLAND

1:100 000

NATURE PLAN 2021-30

The plan acknowledges and draws from previous international resolutions such as the CBD Global Biodiversity Framework (2022) and the latest EU Biodiversity Strategy. The vision proposed by the Nature Plan for the city's future sees biodiversity (understood as the totality of living beings) integrated into the urban fabric, managed according to ecological principles and with the involvement of citizens. The health of ecosystems is closely interrelated with the health of human beings: a quality environment, in which life in all its expressions is fostered and protected, benefits people's quality of life. Both the utilitarian value of nature as a provider of ecosystem services and its intrinsic value are acknowledged: the alteration of nature is detrimental to human beings, but its preservation is also seen as a moral imperative. This tension recurs throughout the different chapters of the strategy: on one side, the biophilic character of human beings is addressed at length (in the sense that the presence of nature in cities is linked to people's physical and mental health), and the usefulness of nature to face urban challenges (for instance climate change) often mentioned; on the other, urban nature is seen as part of the Earth precious heritage and its improvement is considered a challenge to face not only in quantitative terms but also in qualitative terms.

The Nature plan was redacted following a participatory process. The first phase involved expert groups that participated in the development of the previous plan. In the second phase, members from different administrative departments participated in the discussion. Specific actions and projects to be implemented were then defined, and the draft was finally presented to the citizens, with their proposals collected.

CONTENTS AND QUANTIFIABLE GOALS

20 actions make up the plan, which will be carried out through 100 projects and rotate around four main directions:

1. DEVELOPING THE CITY'S GREEN INFRASTRUCTURE

The plan aims at extending the presence of biodiversity in the urban fabric by implementing the Greenery Model, a thematic map that precisely identifies areas where green infrastructure needs strengthening. Its goal is to maximize the provision of ecosystem services and to expand the number of citizens who can benefit from them: in this sense, it stresses the importance of improving access to urban nature and the capacity to mitigate and adapt to climate change. It's a matter of social and environmental justice. It also promotes the application of the Greenery and Biodiversity Charter in new projects for the construction of new buildings or the rearrangement of public spaces. It contains important ecological principles for designers regarding soil, water, and plants.

2. CONSERVING AND IMPROVING BIODIVERSITY HEALTH

It encourages the ecological management of the city's natural heritage to support the flourishing of flora and fauna. The goal is to consolidate biodiversity within the urban fabric and improve the quality of the habitat it hosts. Among the main actions promoted are the planting of new trees and shrubs in public parks, the installation of honey bee hives, and the diversification of plant species. Further efforts are directed towards the decrease of anthropogenic impact in terms of noise, light, and air pollution on urban fauna, and the implementation of biodiversity-sensitive management practices such as stopping the use of pesticides, identifying and controlling the spread of invasive species, and enforcing low-pruning methods.

3. FOSTERING CITIZENS' INVOLVEMENT

With and for city residents: this is one of the principles underpinning the plan. The goal is to promote citizens' involvement in initiatives related to biodiversity conservation and management to foster social cohesion and communicate the value of urban nature. The administration commits to organizing dedicated educational programs, providing tools and guidance on best practices, and encouraging private greening initiatives.

4. DEEPENING THE KNOWLEDGE ON URBAN NATURE AND MANAGING MUNICIPAL EFFORTS

There is no improvement without understanding: through the creation of a dedicated Biodiversity Observatory, the plan aims to deepen our knowledge of species' needs and the relationship between human health and nature. Specific studies seek to create databases and monitor fluctuations in urban biodiversity to shed light on the effects of climate change on urban fauna and flora and to assess which plant species can be better integrated into buildings and public spaces.

Last but not least, the commitment to implementing the Nature Plan is reflected in the incorporation of the strategy themes and goals into municipal policies and operational programs. Among the most notable are the Tree Masterplan 2017-30, the Urban Agricultural strategy 2019-30, and the Superblock program (which will be presented later).

Among the quantifiable goals set by the plan, it's worth mentioning:

- 1 m^2 more greenery per resident
- Increasing the naturalized area by 100 hectares
- Creating 10 new biodiversity shelters
- Doubling the number of citizens involved in nature activities
- Implementing 40 new projects as part of the "All hands to greenery" program

DEMOCRATIZING ACCESS TO GREEN AREAS

The strategy seeks to develop Barcelona's green infrastructure, with particular attention to social and environmental justice. Green spaces are scattered throughout the urban fabric and distributed unevenly among the neighborhoods: while, on average, every citizen is afforded 7 m2 of green surface (excluding the contribution of the Natural reserve of the Sierra de Collserola), the value varies widely across the city. The plan is driven by the noble intent of democratizing access to biodiversity shelters. Proximity to such areas is considered a fundamental right of citizens because of the multiple benefits they provide: strengthening the presence of greenery where it's needed most is one of the challenges the plan intends to address. Contextually, biodiversity is seen as a way of promoting the social and economic development of an area; hence, nature and its experiences become a fundamental aspect for the regeneration of disadvantaged neighborhoods.

ADDRESSING THE BIOPHILIC CHARACTER OF HUMAN BEINGS

The strategy stresses how the state of the environment affects our health: this refrain recurs multiple times throughout the document. The health of ecosystems is closely interconnected with human well-being: when nature thrives, people benefit. The preservation of nature is both necessary and desirable: its positive impact on human mental and physical health is scientifically proven, and it's therefore considered an asset to our well-being. The benefits that nature affords humans in urban contexts go beyond effects on our mental stability and physical health: they address food security and basic resource provision, climate change mitigation, and the creation of a sense of belonging. It's also an economic matter: the municipality estimated that the deficiency of green spaces, the lack of physical exercise associated with low access to public parks, and the exposure to air pollution due to high traffic volumes produced a health cost of €20 million for the municipality of Barcelona.

Nature has to be something that city residents are prescribed.

Lastly, the plan reminds how the actions that improve the resilience of biodiversity are also beneficial for us, reiterating the narrative by which a thriving nature is convenient for human citizens: extending the surface of green areas and enhancing their connectivity improves the livability of public space, reducing the anthropic pressures that undermine the stability of natural habitats (namely noise and air pollution) has positive impacts on our health, filling the deficiencies of green spaces in the neighborhoods where it's needed the most increases the share of citizens that benefit from the ecosystem services provided.

SPATIALIZING THE STRATEGY

The core of the plan is represented by the Greenery Model, which spatializes the opportunities and priorities of greening in the urban fabric. The green infrastructure is understood as a network that tightens social cohesion, mitigates the effects of climate change and provides ecosystem services. Given the benefits afforded by the natural habitats, the intent is to improve the accessibility to these areas so that a fair and equal distribution of the services is achieved, and to extend and strengthen the green fabric in order to enhance the resilience of the ecological components. In the construction of the Greenery Model map, the identification of the areas on which concentrating the greening efforts was therefore led by giving priority to those blocks with fewer green areas per residents or fewer green cover, by connecting the various existing green segments to reduce fragmentation, by introducing greater diversity and complexity in existing natural reserves to extend these nodes in their surroundings and enhance their ecological performance.

SUPERBLOCK PROGRAM

Launched in 2015, the program aims to address contemporary challenges in environmental sustainability, climate resilience, and mobility. It represents the operational core of the various strategies developed by Barcelona's municipality for the city's regeneration and climate adaptation, namely the Barcelona Climate Plan 2018-30, the Nature Plan 2021-30, and the Urban Mobility Plan. It is therefore fundamental to achieving the goals the city set for carbon neutrality, climate adaptation, increasing green spaces, and traffic management. The interventions take into account entire neighborhoods, and specific attention is given to environmental and social justice by focusing on access to green spaces, social participation, and economic development.

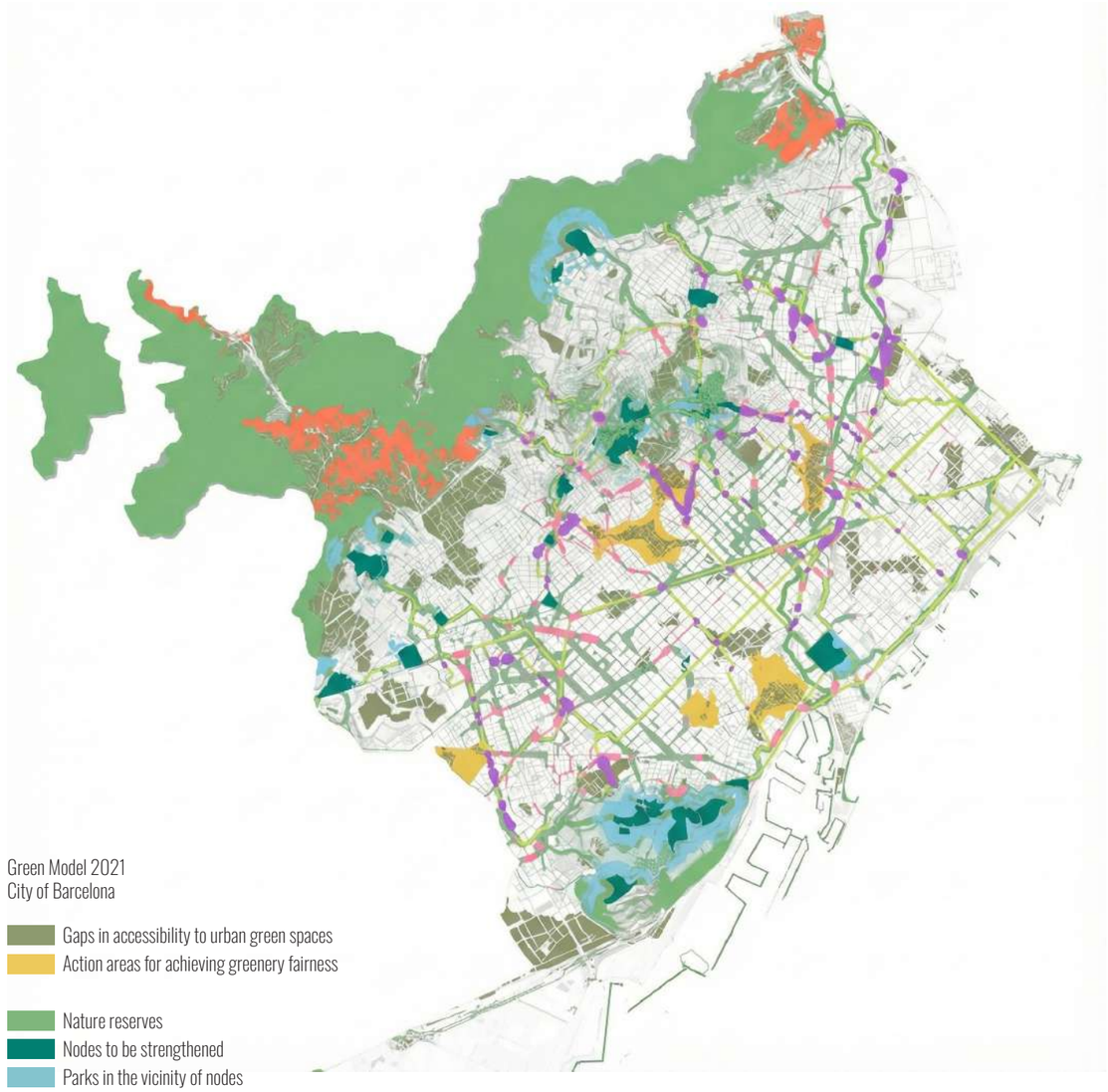
Neighborhoods undergo a process of transformation that aims at diversifying the uses of public space, reducing the presence of cars, and prioritizing pedestrians and green areas through structural and tactical interventions: the role of urban streets is reimagined, the circulation of cars is limited, as well as the negative externalities associated with it (notably air and noise pollution). The Superblock program is a tool developed by the administration to regenerate neighborhoods by reappropriating public space toward a human-centered model that addresses 21st-century challenges. Climate adaptation, participation, and slow mobility are considered fundamental to triggering positive, transformational change that places humans and their well-being at the center.

The Program is conceived to address three types of vulnerabilities: 1) environmental, with a focus on green areas accessibility, pollution reduction, and resilience to climatic shocks (heatwaves, water scarcity, floods); 2) social, to make sure that everybody can benefit from the intervention despite of their age, gender, income, ability, ...; 3) economic, where specific attention is given to the development of local economy and to avoid displacement of residents and commercial activities for gentrification phenomenon.

In terms of design solutions, the Program (in line with the identified needs of each neighborhood) acts on the street network, introducing exclusively pedestrian streets and streets where vehicles, bikes, and pedestrians coexist. Primary roads accessible to all types of vehicles and public transportation still ensure necessary connections to other areas of the city. Tactical and structural interventions then aim to materialize the long-desired change in the public space: limiting the share dedicated to cars offers people the opportunity to reclaim the space between the buildings. With the aid of temporary or structural design elements, the introduction of greenery and NBSs is promoted, and diverse uses and social interactions are encouraged.

The Superblock program is carried out in close collaboration with local stakeholders, associations, and community members. The participatory process aims to collect and address residents' specific concerns, enhance the effectiveness of the implemented measures, and build trust within the community. This way, each intervention is tailored to the local needs and vulnerabilities. Such working methods are key for behavioral change towards a reappropriation of public space and different mobility patterns: when the community is involved in the design process, it's easier to accept and embrace the novelty.

Funding is a fundamental aspect of the program: economic support is granted directly by the municipality or the national government, and further assistance can come directly from the EU or international financial



institutions (the ECB co-funded the Program with a €100 million loan to the city of Barcelona).

The impacts of the Superblock program are then assessed in the last phase: 36 indicators were chosen to track over time the effects the project has on people's lives. The investigated fields are four: public space (pedestrian priority area, number of furniture, playground areas,...), mobility (bicycle traffic, pedestrian-only area, road accidents, ...), environmental quality (green area, number of trees, noise levels, air quality, permeable surfaces, ...) and socio-economic dynamics (percentage of foreign population, average rental and purchase housing prices, ageing index, ...). The information collected is then aggregated to provide a clearer picture of sustainable mobility, local economic development, use of public space, livability, environmental quality, and neighborhood diversity.

GREENERY AND BIODIVERSITY CHARTER

The document serves as a reference guide for designing green spaces using ecological principles. The Charter acknowledges the need to change how such spaces are conceived and managed; therefore, it offers guidelines to maximize the ecosystem services they provide and to implement the Nature Plan's resolutions. The document is divided in two parts: the first one lists the possible elements to take into account when approaching the design of green spaces, the second one focuses on the structural components of the natural environment (soil, water, greenery).

The charter invites the designer to adopt new and different perspectives when conceiving their projects: it proposes possible considerations that can significantly alter the design process and impact the final outcome. It encourages planners to use any opportunity to introduce nature into the urban fabric, prioritizing NBSs that support and reproduce natural processes while simultaneously increasing urban comfort, reducing resource consumption, and preserving natural heritage. Dealing with living matter means dealing with the passage of time, atmospheric agents, the specific climatic conditions of a place, and global warming. It requires accounting for the pace and rhythms of natural cycles in phenology and distributional changes, the area's maintenance patterns, and future climate conditions, which could profoundly affect the ability of species populations to endure over time. It demands considering the project in a relational way, as part of a broader system and complex landscape, to identify its current and potential role in the city's green network and its social and built fabric. The charter asks the designers to cross the perimeter of their field, to step into the realm of ecology so that the role of biodiversity can be reimagined: not just an afterthought or an accessory but a foundational and essential component of design.

The Charter also offers guidelines on the elements that form the foundation of a greenery project: soil, water, and vegetation. Each one of them is associated with 10 system criteria that define the ideal conditions in which nature can thrive. Soil is defined as a dynamic matter that interacts with other components of the environment (water, air, living organisms, ...) and changes its properties and composition. It supports vegetation and forms a living ecosystem. Good functional soil regulates water flow, supports the lives of various flora and fauna species, and produces biomass. Soil functionality must be guaranteed even in urban settings, and since different plants require different soils, soil diversity generates habitat diversity (topography variation, substrata addition, granulometric and chemical diversification can help support a wide variety of living beings). Water is a fundamental resource for a living ecosystem. The current climatic conditions have made this resource increasingly scarce; therefore, careful and efficient management is imperative to control the risk of flooding, prevent potential shortages, and foster biodiversity. Proper systems can be implemented in the urban fabric to tackle these challenges: increasing infiltration, slowing water runoff, and promoting efficient irrigation systems are among the main goals. Vegetation is key for fostering biodiversity in urban settings and enhancing their resilience to face climate change. Complexity and diversity in species and shapes play a fundamental role in creating functional habitats. And since each element of the habitat can carry out its role and thrive only in relation to other species, continuity and diversification are at the core of green design.

03

.02 ARCHITECTURAL CASE STUDIES

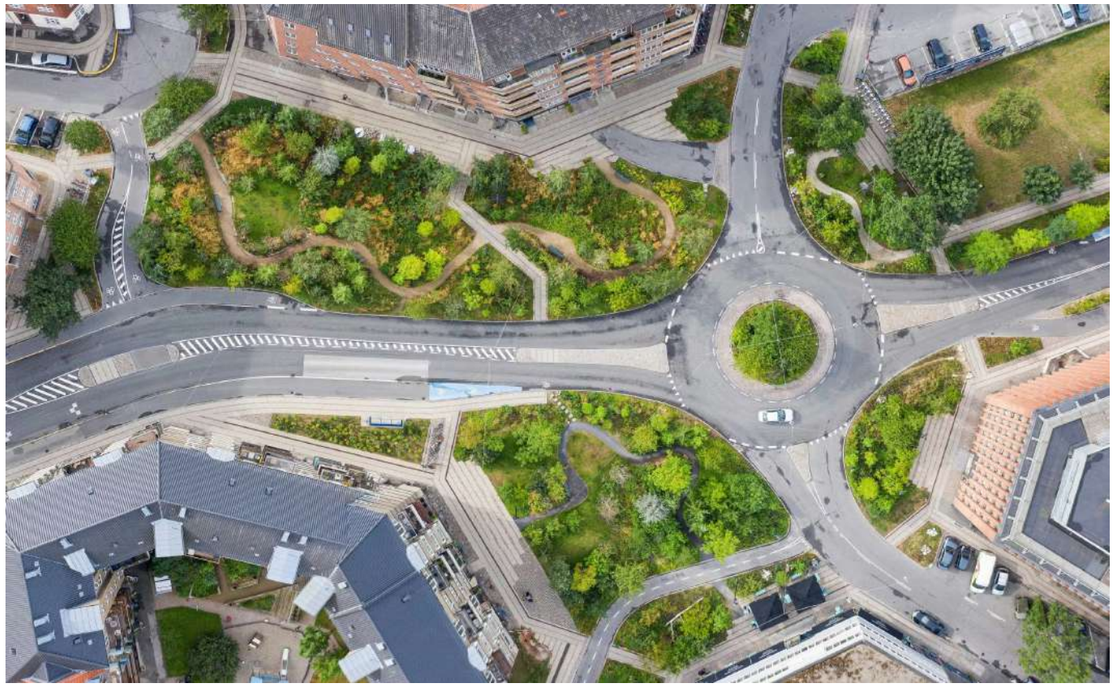
The following pages are dedicated to the analysis of several paradigmatic case studies. The selected works exhibit an experimental character from multiple perspectives.

Three main criteria guided the selection process. First, the integration of the individual architectural intervention within a broader strategy to consolidate the city's ecological fabric. Thus, the role that the site-specific design assumes within a wider strategic vision of halting biodiversity loss is investigated, while simultaneously observing how it responds to the climate change challenges affecting its urban context. Second, the way the designer approaches the inclusion of nature. Case studies were chosen where the green fabric was not merely applied as an afterthought to a completed building for aesthetic purposes. These examples treat the natural element as a driving force behind the concept: not a mere functional tool, but a generative component capable of influencing the dynamics of the design process. Third, the final aesthetic outcome of the intervention. Proposals were sought that aim to make the ecological dynamics carried out by their living components clearly evident. In these instances, nature does not appear pristine and untouched: its workings are highlighted rather than hidden, and the unfolding of ecological processes becomes the underlying motif of the visual rendering. Conventional aesthetic parameters are challenged, and an alternative idea of urban nature is proposed, aiming to prompt a genuine reflection in the observer regarding their own relationship with the natural world.

Some of these cases are analyzed in depth; others are simply gathered and cited, as they serve as useful inspiration for the subsequent development of concrete design tools.

SKT. KJELD'S SQUARE

SLA
COPENHAGEN 2019

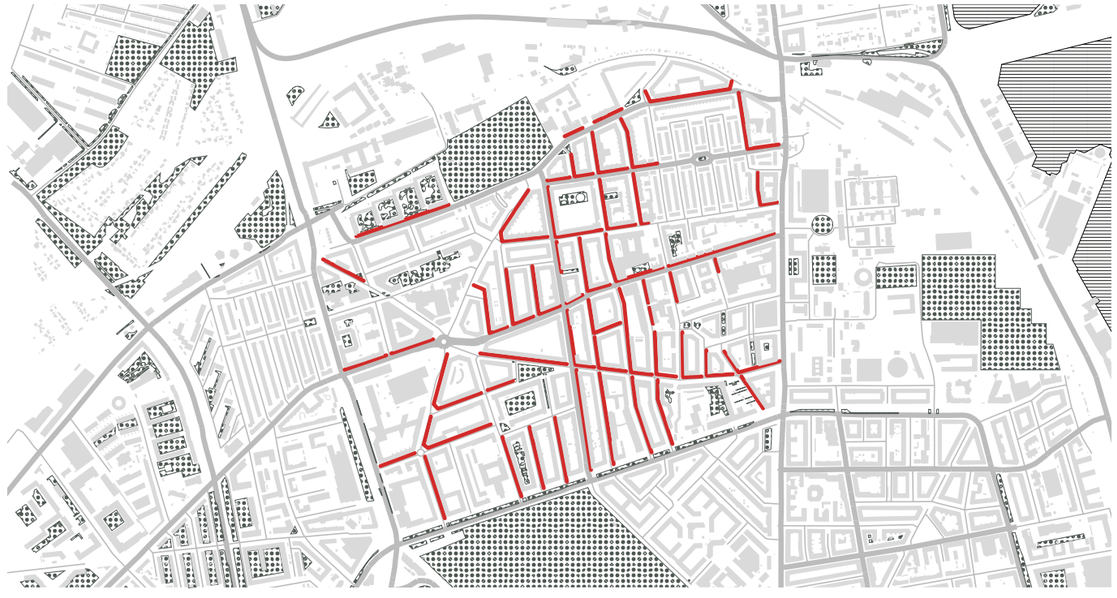


The project is part of a broader vision for the climate adaptation of Sankt Kjeld's neighborhood. In 2011, Copenhagen was hit by a violent storm: 150 mm of rainwater fell on the city in a few hours, the local sewer system couldn't withstand the sudden pressure, and €800 million in damage was recorded. The event led to the adoption of bold climate adaptation policies and measures to address the city's vulnerabilities and effectively manage the expected increase in extreme events due to climate change. A new plan for the neighborhood was therefore implemented to boost its resilience. Urban challenges were seen as occasions to foster social and ecological development. The street network was analyzed, and fields of intervention were identified: the administration concluded that the public space could be reimagined without compromising the neighborhood's mobility and accessibility. By narrowing the streets by 20 %, more space could be dedicated to biodiversity, NBSs, and slow mobility, without reducing the number of parking spaces or undermining the roads' functionality. Retention plazas, biological corridors, and green courtyards were deemed fundamental for enhancing the area's climatic resilience and livability: green, permeable solutions were seen as more viable and effective than hard, technical, and highly engineered ones.

The area remains a roundabout, but the space dedicated to cars is reduced. A new urban forest is introduced and designed to give people the opportunity to fully experience nature and its processes. Local species were chosen to realize this green corridor connecting the nearby parks of Fælledparken and Kildevældsparken. Priority is given to slow mobility and recreational activities: new bicycle lanes are added, and new paths and meadows are created within the dense vegetation to give the impression of being surrounded by wild nature rather than buildings. The perception for those who cross the site is similar to that of a natural grove, with thriving and diverse biodiversity that provides shelter from the effects of the heat island. Local habitats were studied (specifically those found in Utterslev Mose, Kongelunden, and Amager Fælled, in the surroundings of Copenhagen) and recreated to simultaneously create an unusual environment for an urban setting and give humans the experience of local habitats. In the monotone and repetitive fabric of the city, Sankt Kjeld's Square introduces the complexity and diversity of nature.

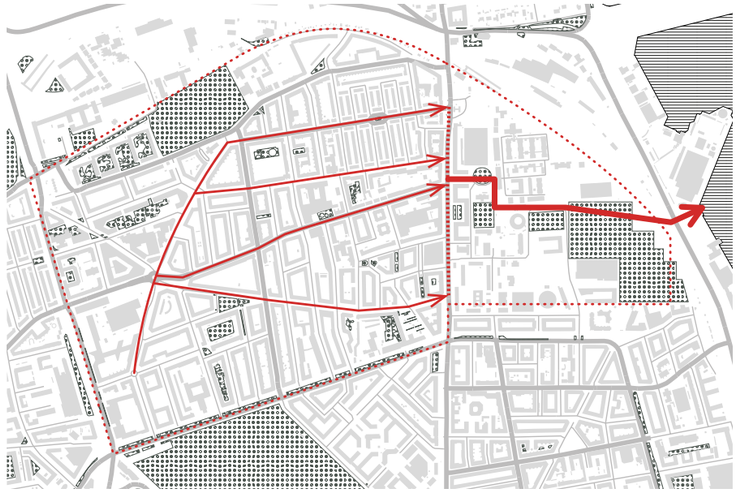
Rainwater becomes a powerful inspiration for the design. A careful stormwater management system was developed using nature-based solutions. The new naturalized area was designed to handle 30% of rainwater locally in the green areas, whereas during cloudbursts, excess water is directed towards the harbor through pipes and surface corridors. Where in the past it was channeled into the sewage system, today the permeabilization of the soil, the redirection towards rain gardens, and the introduction of water collection

Sankt Kjeld's neighborhood - Climate district
Third Nature (re-elaborated by the author)





The project creates a biological corridor that connects two existing parks
Third Nature (re-elaborated by the author)



Water management plan
Third Nature (re-elaborated by the author)

- Water catchment area
- Main water channels
- Water collection pipe
- Tunnel towards the harbour

systems allow it to remain for the most part within the site's boundaries and be used to water the plants.

Special gutters are located along the perimeter of the green areas: during summer, they allow the storage of rainwater (and its reuse to water plants on site), and during winter, they prevent run-offs (mainly consisting of salted water, to prevent the formation of ice) from filling the underground tanks and harming plants through irrigation.

The intervention gives a new identity to the once-grey road: it creates a sense of place and belonging in the neighborhood and increases the area's livability. It has become a real urban space that improves residents' well-being by reducing air and noise pollution and the urban heat island effect, and by providing a social area for people and supporting biodiversity.

The conception of the project wouldn't have been possible without the involvement of ecologists and naturalists, who helped the design team create the habitats. 43 local species were selected and planted across the 39.400 m2 site, for a total of 586 new trees. The management of the greenery is based on low-maintenance techniques: nature is intended to be left to grow wild (it's not only cheaper but also enhances the ecological value of the entire area).

The architects aimed to create a natural environment inspired by the remaining local habitats, to restore natural cycles (weakened and altered by overwhelming anthropogenic pressures), and to design a self-sustaining environment for the enjoyment and functional use of human beings. The project therefore highlights the aesthetic and functional aspects of nature. By addressing the challenges climate change presents, it seeks to make the benefits nature affords us more evident, so that a different relationship with it can be fostered. Through the reintroduction of local plant species, the project strengthens the neighborhood green network by connecting nearby parks, enabling better fauna mobility, and enhancing the quality of the green fabric.

But the risk is reducing nature's introduction in urban contexts to a matter of style and functionality, something to observe and take advantage of. There is no desire to reposition ourselves, to question our role in biodiversity loss, or to change the dynamics of interaction with more-than-human entities: nature remains a setting where to find nothing more than peace and solace.



Photo by SLA



Photo by SLA



Photo by SLA



Photo by Mikkel Eye



Photo by Mikkel Eye



Photo by the author

TIDAL PARK

DE URBANISTEN
ROTTERDAM 2024



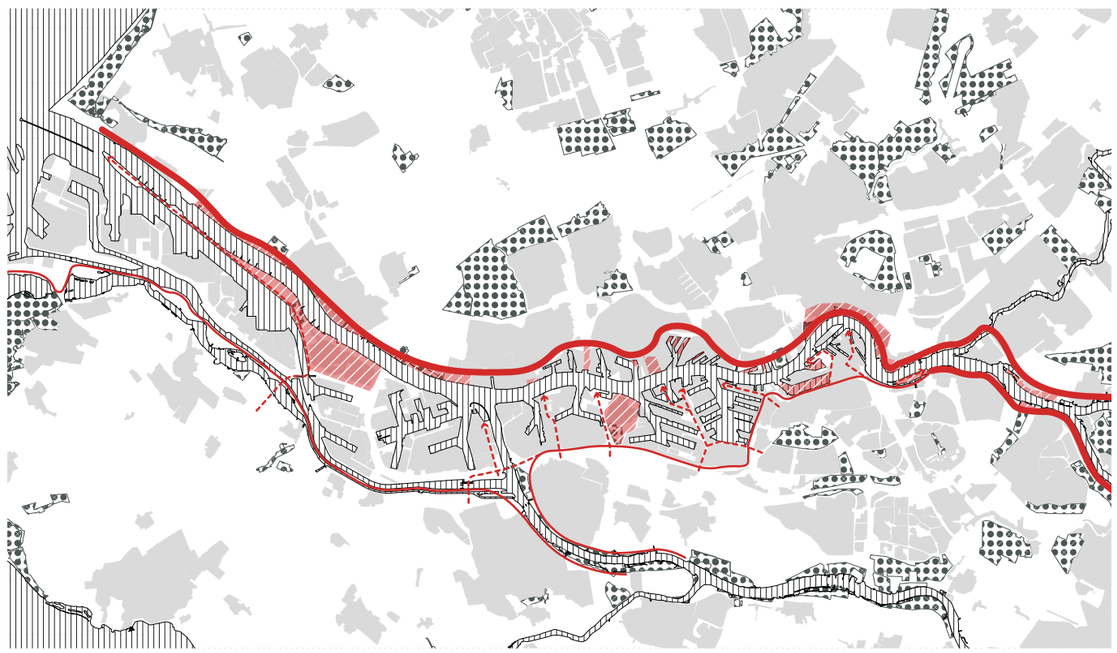
Rotterdam is located at the estuary of the Meuse River, where a dynamic ecosystem once covered the area: the sea to the west and the river's confluence from the east create a salinity gradient from salt to fresh water, supporting a rich habitat. Tidal activity further enhances the region's complexity and vitality, providing a home for a multitude of species. This rich ecosystem has been progressively replaced, transformed, and anthropized over time. The creation of what has become the biggest European port came at the expense of the living organisms that populated the area: the docks that enabled the region's economic development caused the soil to become impermeable and severely impaired the river's structure. The consequences of such indiscriminate transformation are starting to show, with altered water cycles, the loss of ecological value, and the general difficulty in facing the effects of climate change. Severe rainfall and the threat of sea-level rise have led the city to reconsider its relationship with water, elaborating a vision for the future of Rotterdam based on the restoration of tidal dynamics, the reconstruction of old ecosystems, and the implementation of a multitude of interventions to effectively manage water flows. It's a matter of identity for a city built on water and now threatened by the same element that allowed its development.

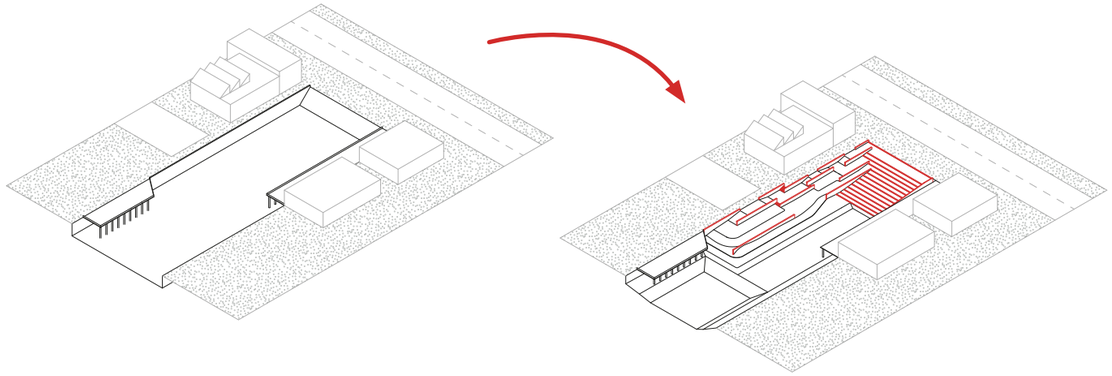
The chosen project is part of a broader vision to transform the Rotterdam docks facing the Meuse River. They represent the interface between water and land and, as of today, 70 % of these borders consist of hard quays. The ecological potential of such areas is immense, and the administration has recognized it: in 2017, it approved the "River as Tidal Park" program, a regional strategy that aims at mending the wounded relationship between city and river. It offers useful guidelines for local stakeholders and designers seeking to bring the strategy's vision to light. Among the interventions considered are the renaturation of the riverbed, the creation of tidal parks to enhance urban resilience to water fluctuations, the de-paving of hard surfaces to allow rainwater to be absorbed and released slowly, and the creation of retention basins to store water in case of cloudbursts.

The dock where the design is located was once a grey industrial harbor, with concrete walls overlooking the water, making it impossible to reach the river directly. The project seeks to recreate the tidal habitat that once covered the area, allowing people to actually access the water and species to resettle in the area: big volumes of sand and gravel were brought on site to shallow the riverbed and expand the contact zone between soil and water, therefore enabling organisms to colonize the new environment.

Linear metallic gabions were installed on site and filled with recycled mate-

River as a Tidal Park Vision
De Urbanisten (re-elaborated by the author)





The site before and after the intervention
Diagram by the author

rials coming from the demolition of artificial quays. The rock walls provide structure to the newly formed shore and prevent sand runoff from the site caused by tidal movement. Deep steps were also created on the north-eastern side of the area and covered with textured cobblestone flooring. The orthogonality of the artificially installed elements contrasts with the spontaneous emergence of more-than-human life-forms: the cracks and crevices between the rocky elements that fill the gabions and coat the terraces offer the proper setting for mosses and algae to develop. Alongside the spontaneous vegetation that grows over time, some plant species were installed on site in order to give it a finished look from the beginning.

The tidal movement that characterizes the site, where water rises and falls by 1.5 m twice a day, alternately submerges and uncovers the lower side of the area. The latter then becomes temporarily accessible and visible, offering human dwellers the possibility to experience and witness more evidently the rhythm of natural processes. The project was defined by the architects as a nature-sensitive design that creates the setting for different species to coexist. It goes beyond a sustainable approach to embrace the uncertainty, it rejects a performance-based stance and creates the initial conditions for life to unfold and for a spontaneous expression of nature to emerge. It moves past the needs of human beings and wonders what the design can do for other-than-human entities.

The intervention also enhances the area's climatic resilience: the hard quays are replaced with porous surfaces that allow the infiltration and slow release of both rainwater and tidal water; they act as a sponge, protecting the coast from storms and floods.

Tidal Park by De Urbanisten is the first step towards a complete reimagining of the city's relationship with water and a re-evaluation of its ecological value. Indeed, the park is conceived as a place to stay, a spot for recreational activities where a different relationship with nature can be fostered, one based on respect and attunement. The former concrete pier used for logistics has been converted into a vibrant public space where people and non-human entities can find solace. The project's configuration is designed to attract and host local flora and fauna: the diverse soil is intended to provide multiple animal species with the habitats they need to feed, rest, and reproduce. The creation of terraces at varying heights (and therefore depths), with different textures and roughness levels, along with the new sand shore, offers the perfect environment for the settlement and growth of diverse organisms. With the passing of time, nature's agency will become increasingly visible, and it has already been observed that the renatured pier has become home to a multiplicity of species: wading birds, oystercatchers, kingfishers, common terns, eels, ...



Photo by De Urbanisten



Photo by De Urbanisten



Photo by De Urbanisten



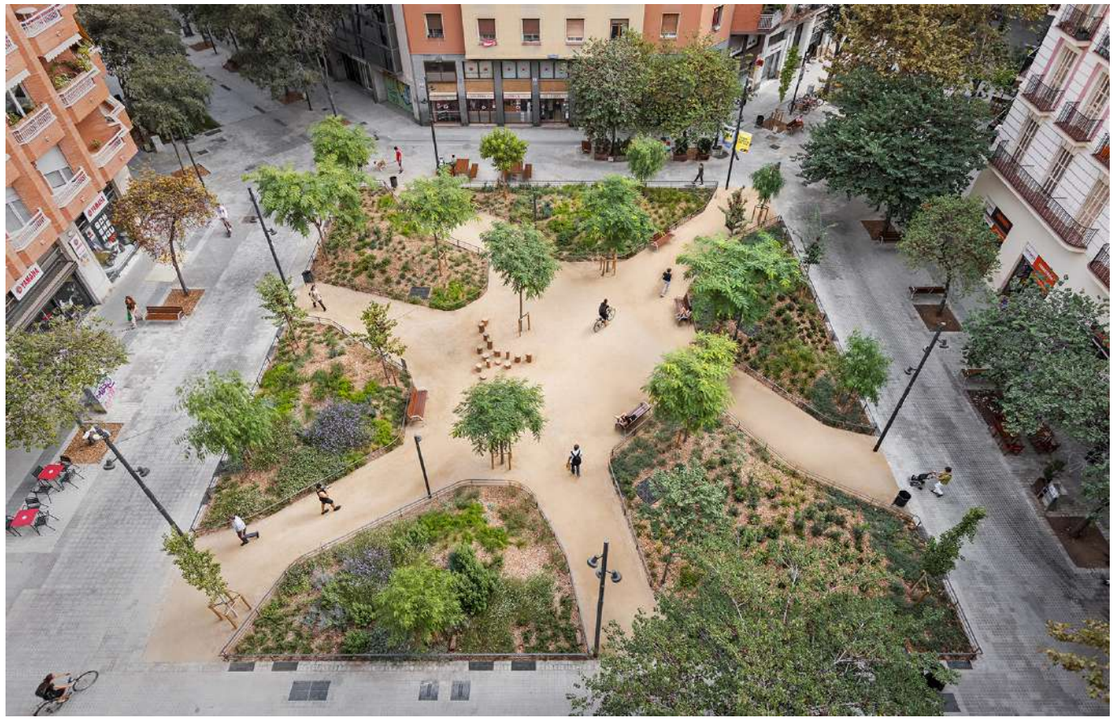
Photo by De Urbanisten



Photo by De Urbanisten

PLAÇA ROCAFORT

08014 ARQUITECTURA
BARCELONA 2023



The project, completed in 2023, was part of the Ejes Verdes plan, a municipal program that aimed to introduce profound changes in the Eixample district, designed by Ildefonso Cerdà in the second half of the 19th century. The goal was to significantly improve the quality of public space by pedestrianizing one in every three streets, with the contextual integration of nature and green areas. Of the 21 green axes envisioned, by 2023 four streets and as many squares had been converted. It's a profound shift in the city's conception of mobility: it reduces the space afforded to cars in favor of soft mobility. Another important premise the plan is based on is enhancing the accessibility of green streets and squares, ensuring that every resident of the Eixample district is never more than 200 m from a green street or square.

The Ejes Verdes plan enacts the goals of the Superblock program by creating green corridors that cross the city, bringing nature back to the heart of the urban center, and advancing the same objectives of public health and social equity that Cerdà's plan was built upon.

The plan acknowledges the lack of green spaces in urban areas as a factor undermining people's quality of life and aims to address this issue by transforming trafficked streets. The benefits of proximity to nature are well recognized: lowering stress levels, encouraging physical activity, and supporting cognitive development in children all contribute to improving public well-being. Integrating nature into public spaces also aims to provide a tangible and comprehensive response to the challenges of climate change. Reducing the urban heat island effect, absorbing air pollution, and retaining water all help make urban areas more livable. Ultimately, these initiatives offer opportunities for people to reclaim public spaces, creating areas for social gatherings and recreation that foster social interactions and strengthen connections with nature.

The architects transformed the street crossing into a garden square. The asphalt that covered the intersection was replaced with permeable soil and biodiverse flower beds. The center of the square now hosts a variety of local species, carefully chosen so that their water and sunlight needs are compatible with the resources offered by the site, and in accordance with aesthetic criteria (species with different blooming periods and different heights and crown diameters were selected). The pedestrian flows are managed by cutting six paths through the central square-shaped core of the plaza, in continua-

Ejes Verde Plan
Municipality of Barcelona

- Green areas
- Green axes
- Green pedestrian axes
- Future green pedestrian axes
- Realized square





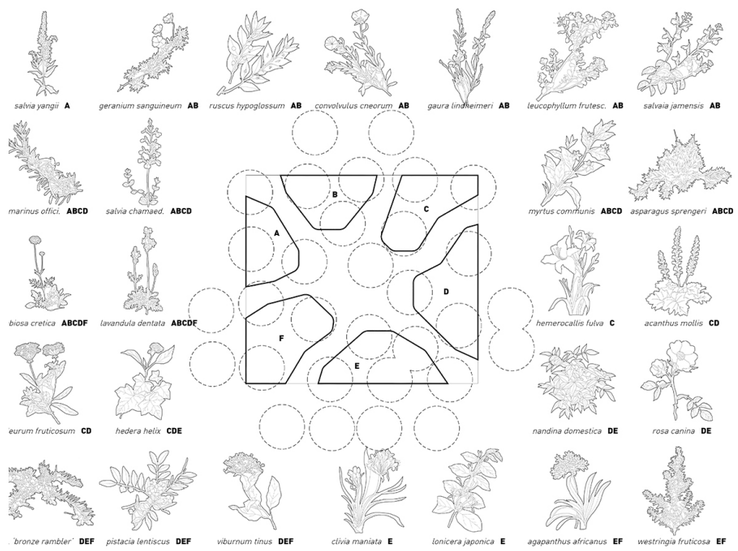
The water percolates the soil and feeds the underground aquifer
Section by 08014 Arcquitectura

tion with the existing surrounding walkways. The new paths are realized in decomposed granite, whereas the area along the perimeter of the square was covered with the iconic Barcelona panot tiles. The two areas are separated by a drain canal made of the same cobblestones, brought to light when the asphalt was demolished and carried away.

The six new naturalized areas are characterized by different substrata and topographies to host different plant species. Their permeable surface allows water to percolate: the presence of infiltration wells, where water is conveyed, serves to feed the underground aquifer, from which the irrigation water is drawn. In the event of overflow, excess water is redirected to the sewer system.

The rearrangement of the mobility network offered the opportunity to enhance the ecological relevance of the square and the surrounding street axis. The plaza restores a lost sense of urbanity, as the seating and gathering corners along its perimeter reveal its true nature as a space not just to pass through, but also to stay in.

An accurate selection of vegetal species was carried out for the creation of the urban garden. The chosen specimen are compatible with the hot and dry climate of the city
Drawing by 08014 Arcquitectura







Photos by 08014 Arcquitectura



Photos by Pol Viladoms



Photos by Pol Viladoms



Photos by Pol Viladoms



Photos by Pol Viladoms

JARDIN DES JOYEUX

WAGON LANDSCAPING
PARIS 2016



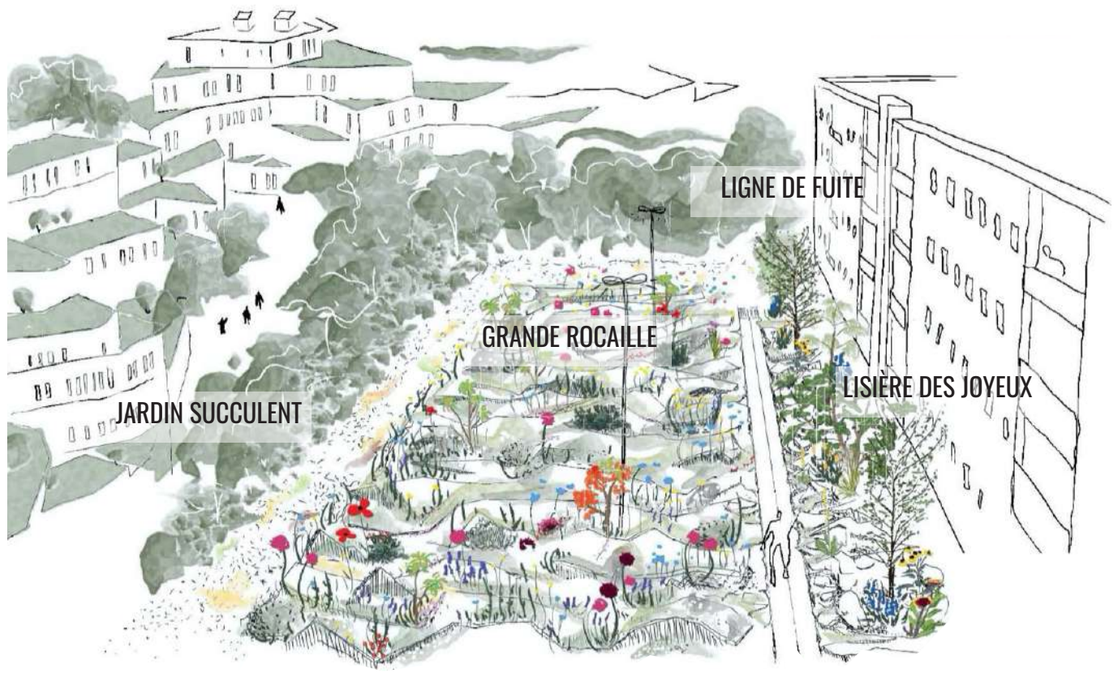
The project is located in Aubervilliers, a commune situated in the northern banlieue of Paris. The intervention takes place in the context of La Maladrerie, a brutalist social complex realized in the 1980s and conceived by the French architect Renée Gailhoustet. The former parking lot began its transformation in 2016, when the first impulse to create the garden was given.

In 2015, the asphalt that once covered the parking lot was removed, and the site was fenced to prevent vehicle access. The following year, the municipality contacted Wagon Landscaping to arrange the abandoned plot. The tight budget was the driving force behind the project: removing the asphalt would have exhausted the budget, so the architects decided to leave it in place and build on top of it. No material left the site; debris was recycled and reused. To make the new surface more conducive to life, 38 m3 of new soil from outside the plot was added to fill the gaps between the cracks. Similarly, the tight budget didn't allow for laying any pipe or other support system: the vegetation needed to grow on its own.

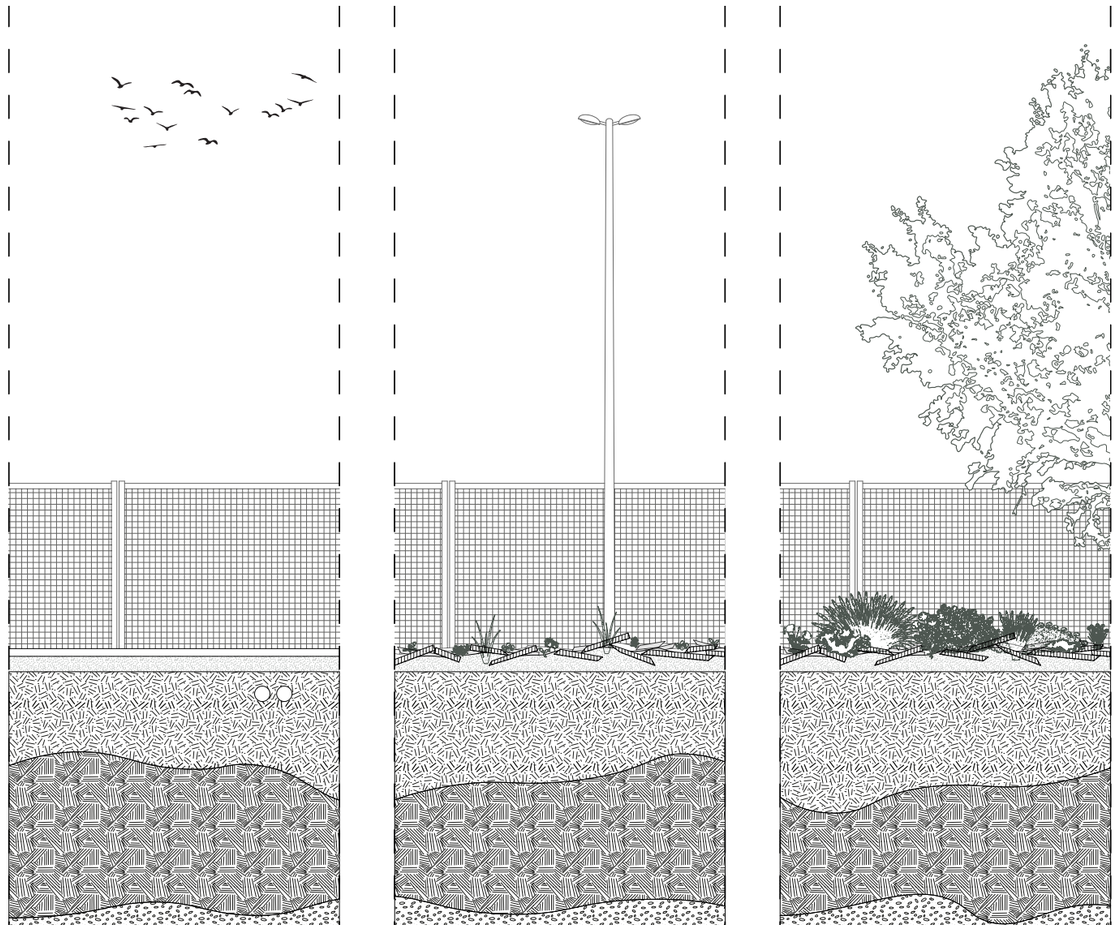
The uneven and sterile surface acted as inspiration for the transformation of the parking lot into an alpine rock garden, rich in ornamental plants and capable of withstanding the harsh environmental conditions of the site, characterized by water scarcity, low-quality soil, and consistent temperature variations. These were the criteria used in choosing the species to plant: they weren't necessarily picked from the pool of local vegetation, but were selected for their suitability to the specific conditions of the location and their mutual compatibility.

The new inhabitants of the site belong to more than 150 different species and were organized in four different sectors: the *jardin succulent* along the external perimeter of the plot, made of gravel and populated by sedum plants, a type of succulent plants which can survive with little soil; the *grande rocaille*, which covers the central and biggest part of the plot, hosts a colorful multitude of shrubs, perennials and seeding; the *ligne de fuite*, which allows water collection and provides a safe path for the exploration of the garden; the *lisière des joyeux*, a narrow vegetated stripe planted with bushed and trees that physically and visually marks the border between the building and the garden.

The construction site lasted 5 days and involved 7 people. Since the conclusion of the project, no watering has been conducted, nor has any new planting been undertaken. With the exception of rare and punctual interventions led each year by the landscape architects, the garden was left to evolve naturally over time: the asphalt was slowly buried under vegetation and organic matter, and new plant species were brought on site by birds and the wind. The architects actually define the intervention as a low-tech landscape project for the simplicity of the operations led and the artisanal quality of the process.



Tridimentional sketch of the site showing the different areas created by the architects
Illustration by Wagon Landscaping



The three sections represent the main stages in the temporal evolution of the site: first conceived as a parking lot, the area was then fenced and the asphalt torn down. New vegetal species were planted in 2016: since then they've been growing and colonizing the area.
Drawing by the author

Despite the project's straightforwardness, realizing the rock garden required specialized expertise in ecology, gardening, and habitat creation.

The garden evolves over the years: it makes evident the succession of the seasons, as it follows their alternation. Every year, organic matter settles on the ground and helps form the base for the growth of new vegetation the following year. It creates a sense of place and addresses the emotional component of design: an old, inaccessible parking lot is converted into a thriving garden full of life. "La violence visuelle de l'ancien parking est nettement adoucie", says one of the residents (aubervilliers.fr).

The Jardin Joyeux is also beneficial in mitigating the heat island effect: despite the bitumen being left on site, the green cover successfully mitigates the phenomenon. Furthermore, the creation of interstices and the introduction of dirt help retain water and prevent runoff.

The intervention acted on a completely uninteresting concrete slab, revolutionizing the perception of the plot. The site was given an initial impulse by installing small plants and scattering seeds, but then it was left to grow. Time is the real architect and maker of the park, as the project seems to echo the words of the architect who conceived La Maladrerie: Mon architecture sera terminée quand elle sera recouverte de verdure.



Photo by Wagon Landscaping, April 2016



Photo by Wagon Landscaping, October 2016



Photo by Wagon Landscaping, October 2017



Photo by Wagon Landscaping



Photo by Wagon Landscaping



Photo by Wagon Landscaping, June 2020

PIXEL PARK

STUDIO VULKAN
ZURICH 2014



The garden is located on the rooftop of the recently completed University of the Arts in Zurich West. Since 1991, Zurich has adopted strict policies for implementing green roofs: under these norms, during new construction or the refurbishment of an existing building, every flat roof not used as a terrace must be greened. Such a resolution is enforced with the specific intent of protecting biodiversity and partially compensating for the environmental damage and habitat loss caused by the construction of the new building, thereby preserving the city's green infrastructure.

The greening of Zurich's building rooftops must comply with strict and precise requirements so that the implementation of such solutions doesn't come down to the simple application of green surfaces. The substrate must be, for instance, al least 10 cm deep and it must provide local variations so that at least 10 % of the total surface is 20-30 cm thick; only local species should be planted and invasive ones thoroughly avoided; the pool of planted species must be sufficiently diversified (when the rooftop surface exceeds 1000 m2, at least 30 different plant varieties must be scattered across the garden and quantitively balanced so that no single species recurs more than 30 % of the times). These demands reveal a peculiar ecological sensitivity in the attempt to reconcile urban development with the protection of biodiversity and the reduction of environmental damage.

Pixel Park falls under these cases of unconventional, biodiversity-sensitive green roofs. Wooden boxes containing the plants were installed on the roof and arranged in a pixel-like landscape. The plants were chosen from the regional pool of species and according to the site's specific conditions, particularly climate and water availability.

The species were grown elsewhere and then carried on-site in the same boxes they had been grown in. This allowed for a quick installation, providing from the beginning a garden ready to be experienced and used. The temporal dimension is here expressed and displayed by the slow rotting process of the wooden boxes: with time, these organic containers will decompose, the single pixels will disappear and merge into gentle dirt mounds.

The project doesn't pretend to mimic a natural environment; instead, it creates a new urban ecosystem with a unique aesthetic. It introduces a new topography that reflects the artificial nature of the installed ecosystem and the anthropic character of the context in which it was created. Left to naturally evolve over time, the aesthetic quality of the garden is not expressed through permanence, but through the slow process of transformation: the display of natural dynamics is at the foundation of a project that intends to distance itself from the recreation of pristine natural environments, in order to embrace the beauty of decay.



Photo by Daniela Valentini



Photo by Noemi Chow



Photo by Noemi Chow



Photo by Daniela Valentini



Photo by Daniela Valentini

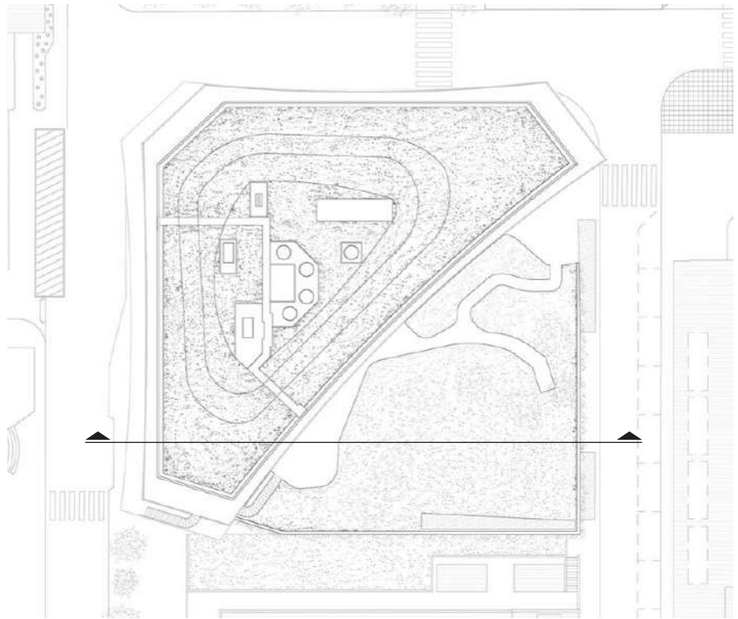
SIÈGE DE L'AP-HP

CHARTIERDALIX
PARIS 2022

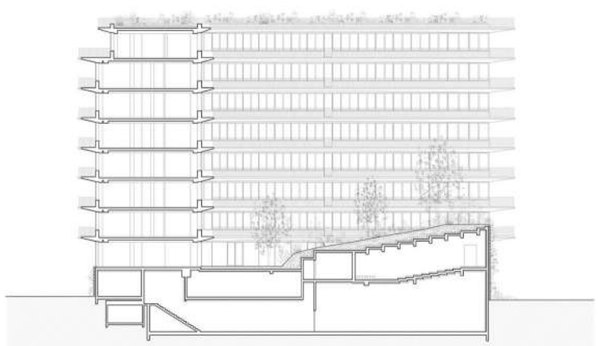


Located in the 12th Arrondissement, the project comprises a 10-story office building with a small amphitheater topped by a lush garden. Half of the plot's area is vegetated, creating a communal space for social gatherings where the hospital's employees can relax. The garden features an ensemble of native species from the Ile-de-France region, arranged to recreate four specific, complementary biotopes: a mixed woodland, a wet meadow, a shrubby forest, and a mesophilic meadow. The species were planted on a thick layer of soil, with a depth of 50 to 250 cm, across the auditorium. Similarly, the building's rooftop was covered with 20-60 cm of soil and planted with low-maintenance, low-water plants.

What truly makes the project stand out among the multitude of green buildings is the concrete wall surrounding the auditorium. The adopted solution is the result of a years-long research project led by the office to create a living wall capable of supporting biodiversity. This 390 m2 vertical surface is made of three different layers, each one fulfilling a different function: the inner layer constitutes the structural core of the wall (it both sustains the outer layers and isolates the indoor rooms); the middle one is filled with the substrate where plants can take root and find nourishment; the outer surface is perforated in order to host different plants.

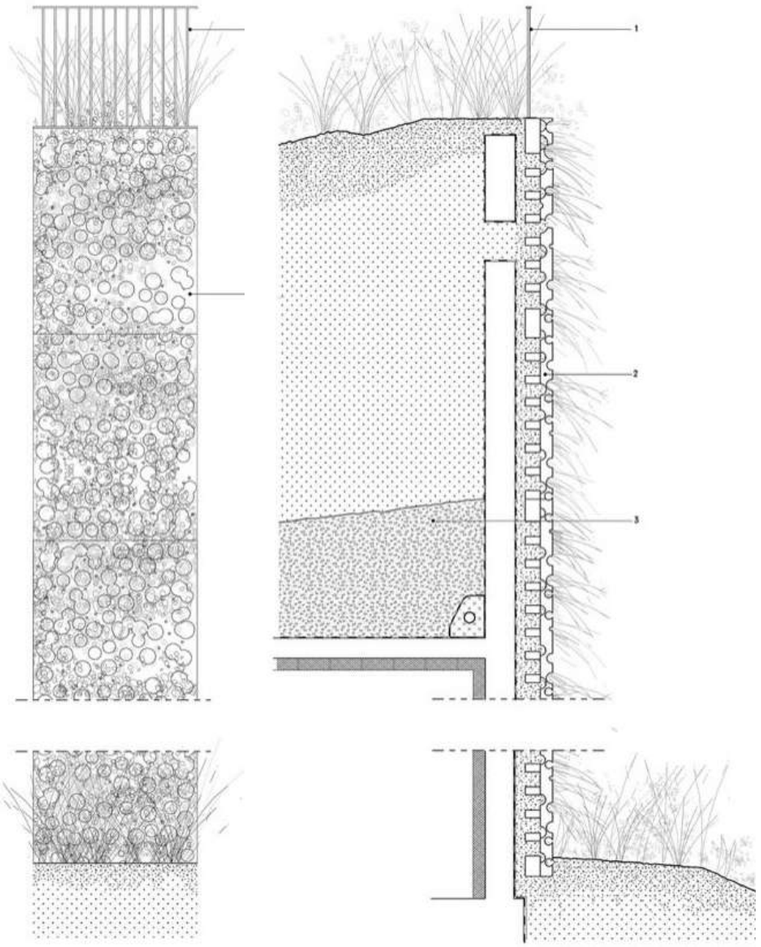


Plan by ChartierDalix



Elevation by ChartierDalix

The load-bearing wall is coated with perforated concrete panels, which ensure the continuity of the substrate from groung to roof
Elevation and section by ChartierDalix



The reason this solution stands out is that it ensures continuity of the substrate from the ground to the roof through the wall, allowing for easier nutrient flow and providing more room for roots to develop. The surface layer acts as an insulating material, protecting the soil hosted in the cavity from thermal shocks and evapotranspiration. Additionally, it enables water to condense and be retained in the cavity, allowing plants to be watered by capillary action.

The final result is a biodiverse wall hosting approximately 40 species, selected from indigenous specimens and arranged according to sun exposure and humidity levels. Similarly, this patented solution was tested with different materials: prototypes made of bricks or stone were built, demonstrating its versatility.

The project embodies the philosophy that drives the architecture studio responsible for developing this innovative prototype: the integration of biodiversity into buildings and the hybridization of nature and the city. It enacts a paradigm shift, avoiding the implementation of a productive, controlled green wall and daring to propose a life-supporting solution that allows different species to colonize and occupy the building. It's not simply an aesthetically pleasing device but an ecological interface, a self-sustaining ecosystem that showcases the living and evolving nature of the organisms it hosts.



Photo by Takuji Shimmura



Photo by Camille Gharbi



Photo by Camille Gharbi



Photo by ChartierDalix

PERMEABLE WALKWAYS

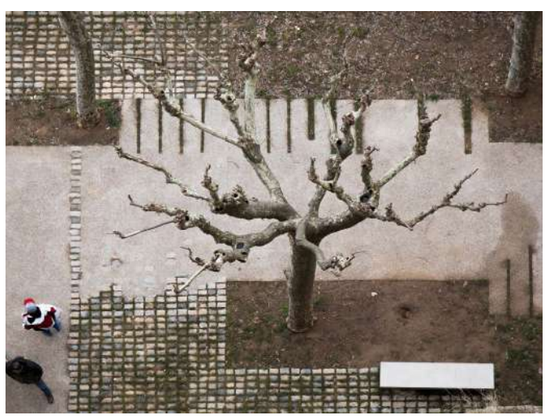


photo credit: Carles Enrich

CAL METRE'S PATH
Carles Enrich Studio
Gironella, Spain, 2017



photo credit: Adrià Goula

PASSEIG DE ST JOAN BOULEVARD
Lola Domenech
Barcelona, Spain, 2011

VERTICAL ECOLOGICAL STRUCTURES



photo credit: Riccardo de Vecchi

EARTH SEA PAVILION
Studio ossidiana
Bruges, Belgium, 2024



photo credit: West8

MÁXIMAPARK
West8
Utrecht, Netherlands, 2013

URBAN RENATURING INTERVENTIONS



photo credit: Dave Burk

WILD MILE
Skidmore, Owings & Merrill + Urban Rivers
Chicago, USA, 2021



photo credit: Daniele Cavadini

ORTO FRA I CORTILI
Piuarch
Milan, Italy, 2015



photo credit: SLA

GRØNNINGEN-BISPEPARKEN
SLA
Copenhagen, Denmark, 2020-24



photo credit: Mikkel Eye

SILKEBORG PEDESTRIAN STREET
SLA
Silkeborg, Denmark, 2019-22

WILDLIFE SHELTERS



photo credit: Riccardo de Vecchi

THE BIRDS' PALACE
Studio ossidiana
Amsterdam, Netherlands, 2021



photo credit: Sarah Wigglesworth Architects

MELLOR PRIMARY SCHOOL
Sarah Wigglesworth Architects
Stockport, UK, 2015



photo credit: Julia Larikova

NESTING FACADE
K. Dörfler, J. Larikova, N. Ebert, Y. Wang
Technical University of Munich, Germany, 2025



photo credit: Stupendastic

INSECT HOTEL AT PARC VALLMORA
Batlleiroig
Barcelona, Spain, 2017

URBAN FURNITURES



photo credit: José Hevia

FUNDACIÓN GINER DE LOS RÍOS
amid.cero9
Madrid, Spain, 2015



photo credit: unknown

AQUÍ Y AHORA. JARDÍN RADIAL
Jerónimo Hagerman
Città del Messico, Messico, 2009

COMMUNICATION STRATEGIES



image credit: Chris Woebken

BAT BILLBOARD
Jeremijenko and Woebken
2009

04

.01 BIODIVERSITY ASSESSMENT

This portion of the thesis is dedicated to developing urban and architectural strategies for Turin, a city with unique characteristics that simultaneously faces challenges common to many European urban areas. An analysis of the Turin urban context is presented below, aimed at providing as comprehensive an overview as possible of the urban ecological component. The gathered information has been organized into the following areas of focus:

1 Habitat status – This examines the extent and location of natural components within Turin's urban fabric, alongside a measurement of the fragmentation level of the urban green network.

2 Native biodiversity – Verified observations made by citizens have been collected and systematized to build a knowledge base of the animal and plant species present in the territory.

3 3-30-300 rule – Reference is made to the rule developed by researcher Cecil Konijnendijk, which offers city administrations a concrete target to ensure ecosystem resilience and an equitable distribution of green areas within city limits. According to this principle, every home should have a view of at least three trees, every neighborhood should achieve at least a 30% tree canopy cover, and finally, every citizen should be guaranteed access to a high-quality green space within 300 meters of their residence.

4 Urban pressures – This investigates the main anthropogenic disturbance factors affecting the non-human actors inhabiting the city.

A rather uneven picture emerges regarding the distribution of greenery: although, on paper, Turin features a solid percentage of green spaces, higher than that of many European capitals (including Paris and Barcelona), most of these areas are concentrated on the hills along the right bank of the Po River. Consequently, a significant portion of Turin's neighborhoods, particularly those near the city center, suffers from a shortage of green spaces. The compact building fabric certainly poses an additional challenge in the effort to restore space to nature within the city, acting as both a physical boundary and a major source of pressure.

HABITAT STATUS

PROPORTION OF FUNCTIONAL SOIL



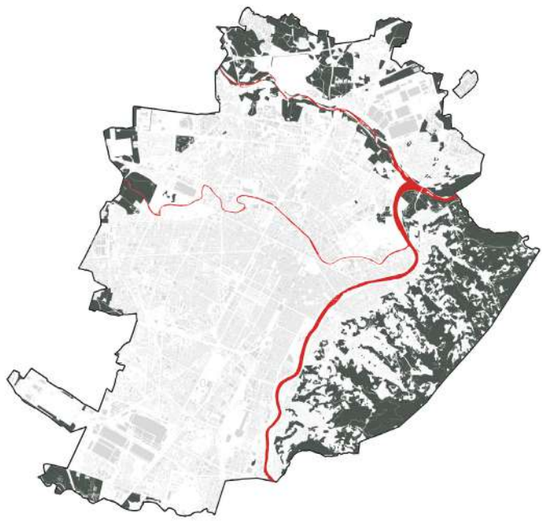
This parameter indicates the percentage of permeable soil present within municipal boundaries. The calculation includes water bodies and vegetated surfaces: these encompass urban, hillside, and river parks, wooded areas, small neighborhood parks, tree-lined rows, and urban gardens. The indicator provides a purely quantitative result, which is somewhat approximate as it ignores information regarding the quality or spatial distribution of these areas. In any case, it is considered an important parameter capable of monitoring the potential evolution of the urban fabric.

With an area of approximately 48 km², Turin's green areas occupy 37% of the surface; adding another 3 km² of water bodies brings the percentage of functional soil to 39%. Considering only public recreational areas that are usable and accessible to citizens, the area is reduced to 11 km² (corresponding to 8.5% of the city territory).

FUNCTIONAL SOIL: 39 %

Source: Piano Strategico dell'Infrastruttura Verde, Città di Torino, 2020

PROPORTION OF NATURAL AREAS



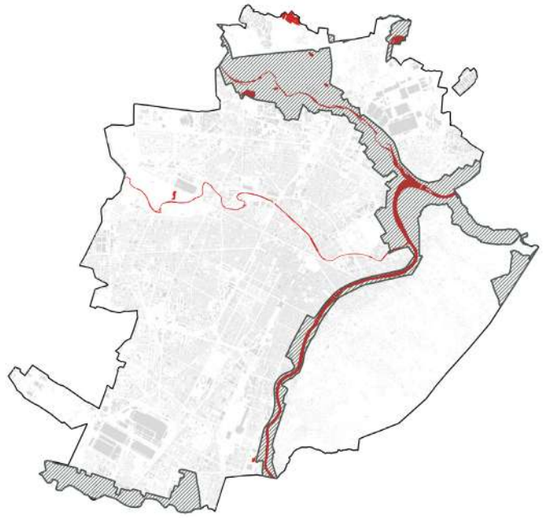
In this case, areas considered are those occupied by natural habitats and minimally altered by anthropogenic action: these are reserves of local biodiversity where ecological dynamics are carried out with minimal human interference. These include wooded areas, meadows, natural ecosystems within urban parks, and habitats reconstructed by humans and dominated by native species.

Natural areas occupy a surface of approximately 24 km², corresponding to 19% of the entire municipal territory. This is a rather high percentage, given the presence of extensive wooded zones corresponding to the Turin hills and river zones.

NATURAL AREAS: 19 %

Source: Piano Strategico dell'Infrastruttura Verde, Città di Torino, 2020

PROPORTION OF PROTECTED AREAS



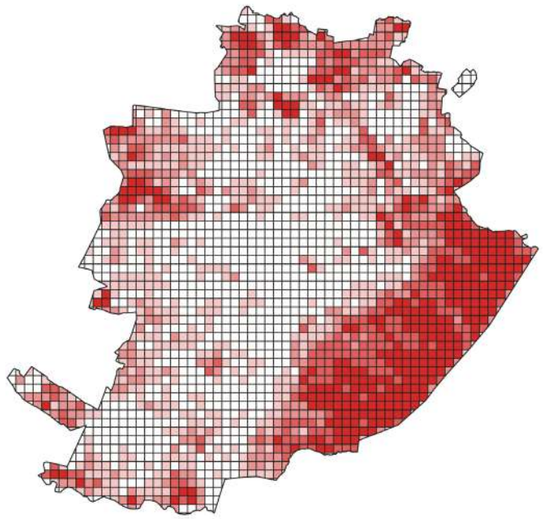
The indicator measures the share of natural areas situated within the municipal territory that are subject to protection. The city of Turin hosts several Natura 2000 network sites, specifically a Site of Community Importance (SCI) and a Special Protection Area (SPA). The river zones are also protected as part of the Po Park, classified as at-risk areas according to the Hydrogeological Asset Plan, or included within the Regional Ecological Network.

To date, protected natural areas occupy an area of approximately 17 km², corresponding to 13% of the total city surface.

PROTECTED AREAS: 13 %

Source: Piano Paesaggistico Regionale, Regione Piemonte, 2017

EFFECTIVE MESH - CONNECTIVITY MEASURE



Effective Mesh Size measures the fragmentation of the ecological fabric in an anthropized context such as an urban environment. Connectivity between habitats is a fundamental characteristic for ensuring their resilience. Mathematically, EMS measures the probability that two points chosen at random within the municipal territory fall within the same green area. High EMS values indicate that the city's ecological fabric consists of large green areas where wildlife can move freely without encountering barriers. Lower values translate to a fragmented fabric, characterized by a high number of small, isolated patches. To obtain more accurate measurements, the territory was subdivided into a fine-grained grid (with 250 m square pixels) that highlights the level of connectivity of each pixel to the green network, thus suggesting possible areas for intervention.

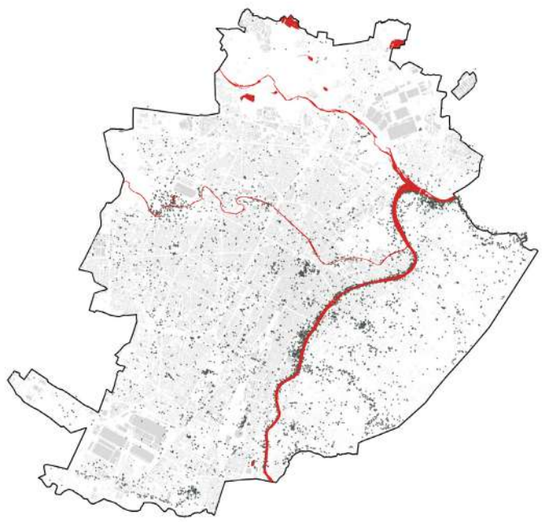
The global EMS value obtained is equivalent to 38.957 m². Future surveys will be able to verify the effectiveness of measures implemented to combat the fragmentation of the ecological fabric.

EMS VALUE: 38 957 M2

Source: Author's own elaboration

NATIVE BIODIVERSITY

NATIVE VASCULAR PLANT SPECIES



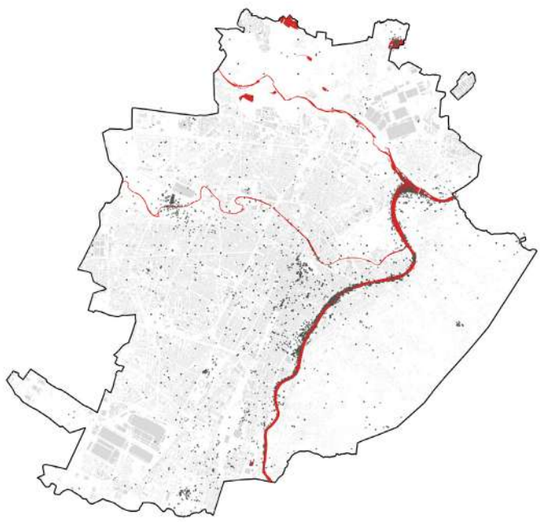
The indicator aims to monitor the number of plant species present in the Turin territory and their trends over time. Once a baseline value is established, future monitoring will allow for the evaluation of the effectiveness of measures implemented by the administration to increase biodiversity in the city (whether they be renaturalization, greening, or natural habitat reconstruction operations).

654 species have been observed in the last 5 years in the Turin territory. The information was obtained through the portal of the Global Biodiversity Information Facility (GBIF), an intergovernmental organization that collects and makes accessible data regarding life forms on Earth. Invasive alien species were excluded from the list of observed species (see the dedicated indicator for further information).

654 SPECIES OBSERVED

Source: gbif.org
DOI: 10.15468/dl.bt7xzp

NATIVE BIRD SPECIES



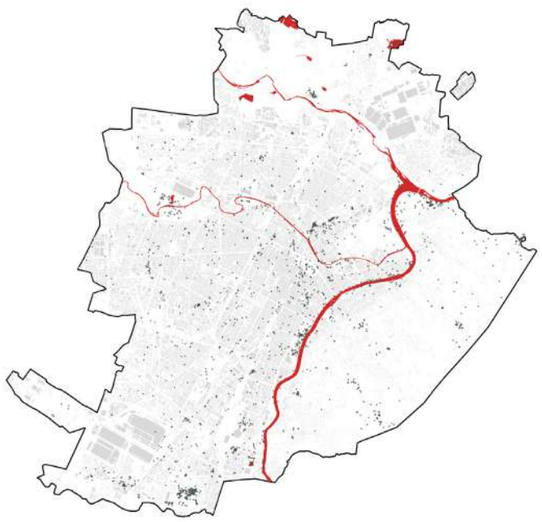
The indicator aims to monitor the number of bird species present in the Turin territory and their trends over time. Once a baseline value is established, future monitoring will allow for the evaluation of the effectiveness of measures implemented by the administration to increase biodiversity in the city (whether they be renaturalization, greening, or natural habitat reconstruction operations).

223 species have been observed in the last 5 years in the Turin territory. The information was obtained through the portal of the Global Biodiversity Information Facility (GBIF), an intergovernmental organization that collects and makes accessible data regarding life forms on Earth. Invasive alien species were excluded from the list of observed species.

223 SPECIES OBSERVED

Source: gbif.org
DOI: 10.15468/dl.r57d34

NATIVE ARTHROPOD SPECIES



The indicator aims to monitor the number of arthropod species present in the Turin territory and their trends over time. Once a baseline value is established, future monitoring will allow for the evaluation of the effectiveness of measures implemented by the administration to increase biodiversity in the city (whether they be renaturalization, greening, or natural habitat reconstruction operations).

476 species have been observed in the last 5 years in the Turin territory. The information was obtained through the portal of the Global Biodiversity Information Facility (GBIF), an intergovernmental organization that collects and makes accessible data regarding life forms on Earth. Invasive alien species were excluded from the list of observed species.

476 SPECIES OBSERVED

Source: gbif.org
DOI: 10.15468/dl.puj3du

3-30-300 RULE

GREEN AREAS ACCESSIBILITY



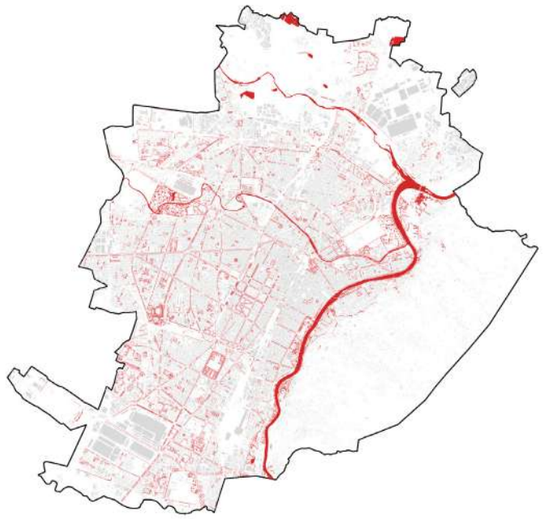
This indicator is not strictly concerned with biodiversity, but rather addresses the relationship between humans and nature. Improving accessibility to green spaces—and thus extending the urban ecological network—means not only increasing the share of the population benefiting from the ecosystem services offered, but also educating people about coexistence with and respect for non-human life forms.

To date, approximately 89% of the population lives within 300 meters of a recreational green area. This is a very high figure, but one that still offers room for improvement, especially in certain peripheral areas of the city and specific portions of the compact central urban fabric.

POPULATION LIVING WITHIN 300 M FROM A GREEN AREA: 89 %

Source: urbanlabtorino.it

PROPORTION OF TREE COVER



According to the 3-30-300 rule, developed by researcher Cecil Konijnendijk and widely recognized by the scientific community, urban centers should aim for a minimum tree canopy cover of 30%. Extensive tree cover not only contributes to significantly reducing the urban heat island effect, improving the livability of urban habitats, but also provides fundamental support for local biodiversity, particularly bird and insect communities. High levels of tree cover imply proximity between tree crowns and the generation of green corridors usable by certain animal species.

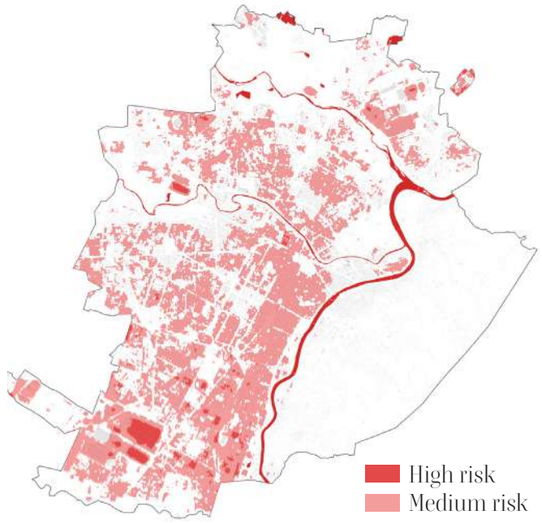
The Turin territory is characterized by a tree cover of 19%, far from the 30% target. Furthermore, none of the city's neighborhoods individually reach this ambitious goal.

TREE COVER: 19 %

Source: L. Battisto et al., *Spatializing Urban Forests as Nature-based Solutions: a methodological proposal*, 2024

URBAN PRESSURES

URBAN HEAT ISLAND



The Urban Heat Island effect occurs most frequently in urban centers. Due to the nature of the materials they are built with—mostly dark in color, which absorb and retain heat, releasing it at night—temperatures are several degrees higher than in the surrounding countryside.

Turin's territory is classified as being at high (2%) or medium (44%) risk. It is clearly evident that the at-risk areas are concentrated near large industrial zones and correspond to the compact urban fabric, where green areas are scarce.

HIGH RISK: 2 %
MEDIUM RISK: 44 %

Source: Piano di Resilienza climatica, Città di Torino, 2020

[1] Source: gbif.org
[2] Source: Piano di Resilienza climatica, Città di Torino, 2020

INVASIVE SPECIES

Invasive alien species threaten ecosystem stability and the survival of local species. Not all alien species are invasive: only those invasive species listed in the List of Invasive Exotic Plant Species of Piedmont, attached to the Regional Strategy for Combating Invasive Exotic Species, were included in this calculation. For reasons of simplicity and data accuracy, only vascular plants were considered.

From the list of species observed in the territory (retrieved from the GBIF.org portal), those flagged as invasive by the Piedmont Region were manually identified. To obtain the proportion of invasive species, it was observed how many of the 100 most recurring species appear on the regional "Black List." Since 15 of the 100 most recurring species are flagged by the Region, it is considered realistic to approximate the proportion of invasive plant species present within municipal boundaries at around 15%.

PROPORTION OF INVASIVE SPECIES: 15 % [1]

GREENHOUSE GAS EMISSIONS

Greenhouse gas emissions entail serious consequences for biodiversity: on one hand, they accelerate climate change, contributing to making cities increasingly inhospitable to life; on the other, they directly alter the characteristics of remaining natural habitats, causing imbalances in ecological dynamics. Aiming for a reduction in emissions within limits tolerable for biodiversity is of fundamental importance.

The latest official report on CO_2 emissions dates back to 2019. It certifies a 47% reduction compared to values recorded in 1991 and highlights the sectors most responsible for emissions—namely residential (37%), tertiary/service sector (32%), and transport (27%)—thus identifying the priority areas for intervention. In 2023, in conjunction with the approval of the Sustainable Energy and Climate Action Plan, the goal was set to reduce climate-altering emissions by 68% by 2030.

GHG EMISSIONS REDUCTION SINCE 1991: 47 % [2]

From the analysis of the main strategic and regulatory documents adopted by the Municipality of Turin for the management of its green fabric, a complex picture emerges. Although there is a growing focus on sustainability, structural criticalities persist, linked to a fragmented, highly anthropocentric vision that is predominantly focused on the metropolitan scale to the detriment of the urban one.

In the planning documents, a clear separation between protected areas and the urban fabric is observed. Habitat protection is perceived as an exclusive issue of the former, so much so that the Green Guidelines contained in the PTCP (Piano Territoriale di Coordinamento Provinciale) completely exclude urban green areas from the ecological network

Conservation efforts are concentrated at the margins of the municipal territory (river corridors, protected natural areas, and historical royal estates). Emblematic examples of this approach are the Progetto Corona Verde (1997), which aims at the integrated management of marginal areas to reconcile nature and culture, yet predominantly favors tourist use; the Regional Ecological Network—consisting of Special Protection Areas, Sites of Community Importance, and river corridors—which carefully evaluates the ecological functionality of the metropolitan territory for afforestation and restoration interventions, while ignoring urban areas; and the CIRCA Catalog, which identifies intervention areas for the municipalities of the Metropolitan City but completely omits the city of Turin.

At the municipal level, strategic and regulatory documents show a lack of a systemic vision and a strong anthropocentric approach. The Green Regulations (Regolamento del verde) aim to protect and develop the ecological fabric, introducing positive measures such as the use of native species and species diversification. However, a fundamental contradiction is found: the provisions are often justified by aesthetic reasons and landscape consistency. The desire to keep the city's historical layout intact heavily constrains intervention possibilities, hindering the maximization of real environmental benefits.

The Piano Regolatore Generale (PRG) and the Building Regulations show the intention to integrate the fight against climate change, but they lack significant binding tools. Currently, the only concrete reference is the energy-environmental annex, which merely sets minimum values for building performance and offers voluntary incentives (reduction of development fees) for those who exceed them. The major interventions envisaged by the PRG remain confined to the proximity of already protected areas, such as the hills and river corridors.

Turin has adopted more recent documents oriented toward adaptation, but their language and purposes remain purely instrumental to human needs. These include:

Climate Resilience Plan (Piano di Resilienza climatica: It analyzes the vulnerabilities of a compact and highly urbanized city, highlighting the increase in heatwaves, drought periods, and the intensification of flooding. It proposes solutions such as the revision of the PRG, hydraulic invariance (stormwater neutrality), the construction of engineering works, and the application of Nature-based Solutions (NBS).

Strategic Plan of Green Infrastructure (Piano strategico dell'infrastruttura verde): It marks a step forward in the analysis of the ecological network. It sets goals for resilience and climate justice, placing a strong emphasis on ecosystem services. It evaluates the benefits of greenery in monetary terms, ranging from carbon storage and thermal regulation to health, sanitary, and recreational benefits.

The dominant approach in these documents is technocratic and functionalist. Nature is viewed almost exclusively as an infrastructure useful for combating heat islands or managing extreme weather events. The consideration of the demands of more-than-human actors is entirely missing: redevelopment interventions do not follow design processes that identify the needs of other species, which makes it difficult to reverse the decline in biodiversity without a profound ethical shift.

Although the goals of habitat restoration and combating ecological fragmentation are declared and coherent, a strong disconnect between theory and practice is observed. The design solutions (NBS, urban afforestation, land reclamation) are known, and the intervention areas have been identified, but there is a lack of an overall vision, coordination between operations, and clear, measurable goals. There is an absence of operational guidelines on how to implement green infrastructures while respecting living ecological dynamics, often relegating redevelopment to mere street furniture interventions or the insertion of built elements.

Based on the critical issues that have emerged and drawing inspiration from the biodiversity plans of cities like Paris and Barcelona, the drafting of a Masterplan for Turin becomes necessary. The goal is to grant nature the necessary space within the built environment, building an ecological network that supports non-human actors and promotes coexistence among species.

Following this analyses a set of strategic and operative tools will be presented in the following pages in order to integrate the shortcomings of the existing policies, with the objective of strenghtening the urban green network e fostering the emergence of more-than-human life in Turin's urban context.

04

.02 URBAN STRATEGIES

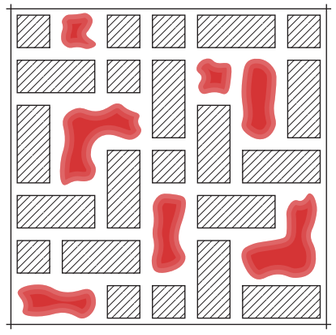
The in-depth analyses of the biodiversity plans for Paris and Barcelona, alongside the critical issues identified through a careful review of the strategic and regulatory documents adopted by the Municipality of Turin, have led to the development of several overarching strategies to grant nature the space it deserves within the urban fabric.

A map of the city of Turin is proposed, in which the developed urban strategies are spatially mapped. The aim is to extend, strengthen, and regenerate the city's green fabric, building an ecological network that supports the presence of non-human actors within the built environment and promotes peaceful coexistence among species. The large tree-lined avenues (characteristic of Turin's urban morphology) act as the backbone of the proposed network, serving as vital ecological corridors capable of connecting existing urban parks.

The map also identifies publicly owned green areas, where it is deemed essential to promote conservation and consolidation efforts: as previously noted, merely designating an area as a green space is not enough to guarantee support for biodiversity. It is therefore necessary to assess the quality of the existing greenery on a case-by-case basis, implementing measures where needed to diversify species, increase the structural complexity of the surfaces, and mitigate as well as reduce anthropogenic pressures.

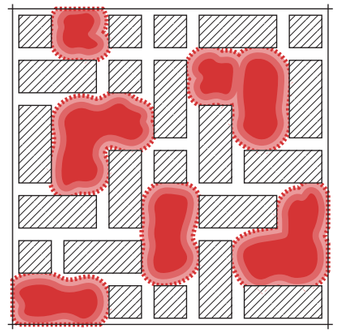
Building upon these linear and area-based elements, an extension of the network into the surrounding urban fabric is envisioned, identifying priority spatial zones to serve as starting points for expanding the green infrastructure. The underlying logic is straightforward: rather than highlighting nodes that are inherently isolated from the network, the strategy branches out from the existing ecological fabric (tree-lined avenues, public parks, riverbanks) to propose new spatial zones where the establishment and development of nature can be fostered.

Here on the opposite page, the main urban strategies derived from the previous analyses, and applied in the definition of Turin's green masterplan, are briefly presented.



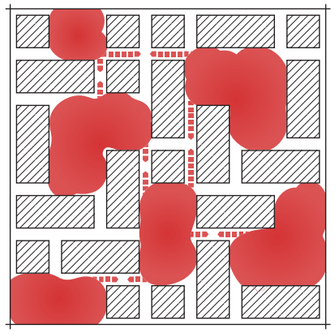
CONSOLIDATE

Urbanization poses a serious threat to biodiversity. Urban contexts are places where the human component has largely replaced the biological one. Prioritizing the interests of biodiversity means, first and foremost, safeguarding remaining green areas, regardless of their size: any park, shelter, or ecological niche, however small, must be protected. Faced with the pressures of real estate speculation, fighting land consumption must become a real priority for urban centers—especially for a city like Turin, where the slow and steady decline in population makes the transformation of the few remaining open spaces even more unreasonable.



EXTEND

Prioritizing the needs of non-human actors means, above all, dedicating space to them. Combating land consumption does not simply mean preventing new areas from being subtracted from nature, but ensuring that zones with low ecological functionality are regenerated and reintegrated into the ecological network. Existing green areas constitute the essential starting point for developing strategies aimed at increasing a city's ecological fabric: extending these "green lungs" contributes to creating new opportunities where the more-than-human can thrive and where deeper human/non-human relationships can be cultivated.

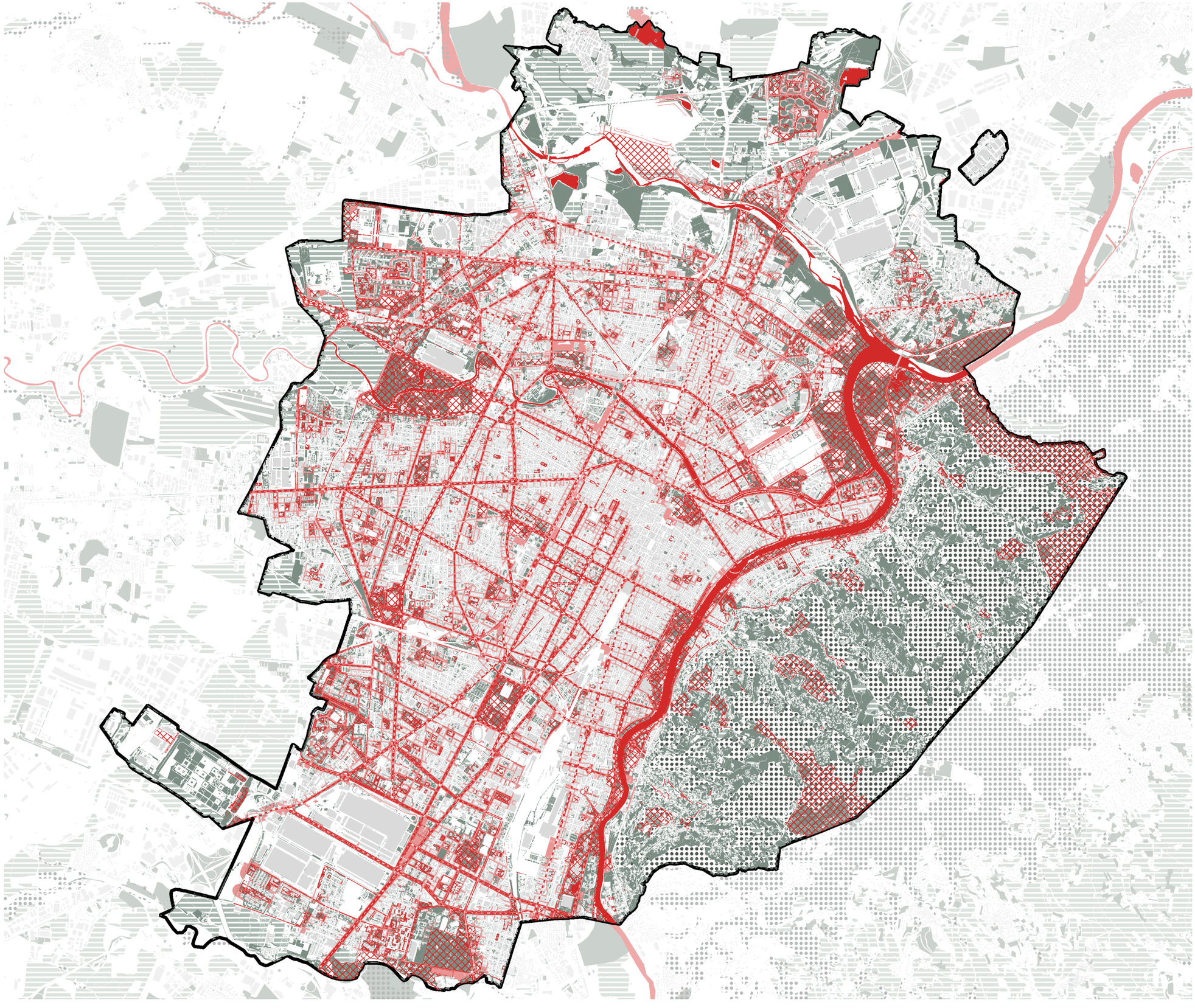


CONNECT

The construction of ecological corridors is of fundamental importance in fighting ecosystem impoverishment. Where the advance of urbanization causes the fragmentation of residual habitats, preserving and creating corridors between existing green areas aims to sustain wildlife mobility, support genetic diversification, and generally increase ecosystem resilience. To date, only river zones are formally recognized as ecological corridors; the possibility of extending similar green infrastructures into the compact fabric of the city requires a shift in the conception of public space and the built environment—from an "open-air museum" (untouchable and defined, in respect of the historicity of places) to "living matter" (mutable according to contingent needs).

CONSOLIDATE
EXTEND
CONNECT

WOODS
RECREATIONAL GREEN AREAS
FARMLAND
WATER
BUILT FABRIC
MUNICIPAL BOUNDARY



1:50 000

04

.03 DESIGN TOOLS

Based on the analyzed case studies, a series of architectural devices have been developed to help designers integrate nature into their projects. These tools provide concrete solutions for incorporating the needs and demands of more-than-human actors directly into the design brief.

The design abacus is preceded by the definition of a series of design principle, extrapolated from the careful assessment of the previous design projects. These suggestions aim at facilitating the elaboration of a design proposal that successfully supports more-than-human actors and their needs.

Afterwords, a dedicated factsheet has been created for each device, describing how it supports non-human species while simultaneously addressing the climate, social, and environmental challenges faced by urban areas. Each factsheet also highlights the related urban strategy and the expected outcomes in terms of supporting nature.

Furthermore, a summary chart links each urban strategy to its corresponding architectural tool. The expected design outcomes from implementing these instruments are grouped according to the broader challenges facing the city of Turin. The chart is structured as a two-way matrix: on one side, it illustrates how urban strategies address local issues through these physical devices; on the other, starting from the overarching goals of improving the quality and resilience of the ecological network, it traces back to the respective sub-objectives and the tools required to achieve them.

DIVERSIFY

Monoculture makes the urban ecosystem vulnerable to the risk of spreading diseases and impoverishes the range of ecological dynamics performed. An improvement in habitat quality can be achieved through species diversification, understood not only as variety (i.e., specific species) but also as typology (introducing and combining a multiplicity of local trees, shrubs, and herbaceous plants). This allows for increased resistance to climate change and supports a wider range of animal species. In summary, focusing on the diversification of existing species is an effective measure that administrators can adopt to improve the resilience of the ecological network—a selfless act that, in its simplicity, can bring great benefits to biodiversity.

COMPLEXIFY

To support more-than-human life, we must create opportunities for it to take root and thrive. Where urbanization introduces monotony and repetition, replacing living soil with impermeable surfaces unsuitable for life, biodiversity requires complexity to emerge and complete its life cycles. In this sense, the introduction of structurally complex and three-dimensional surfaces, textures with various levels of roughness, niches, and protrusions is of fundamental importance; all to provide living organisms with breeding grounds, shelters for protection against external threats, and food reserves. Only by consciously reintroducing the variability of natural habitats can we make cities suitable for the development of life.

HOST

The safeguarding and development of biodiversity primarily concern the creation of places where wildlife can establish itself. This is not solely about habitat reconstruction (which is often difficult to achieve in urban settings), but also involves introducing structures capable of directly hosting wildlife and encouraging their settlement in anthropogenic contexts. Through the installation of insect hotels and birdhouses, the creation of niches and shelters, and the arrangement of diverse plant species, the aim is to make room for a natural world that is too often shunned, ignored, marginalized, or destroyed.

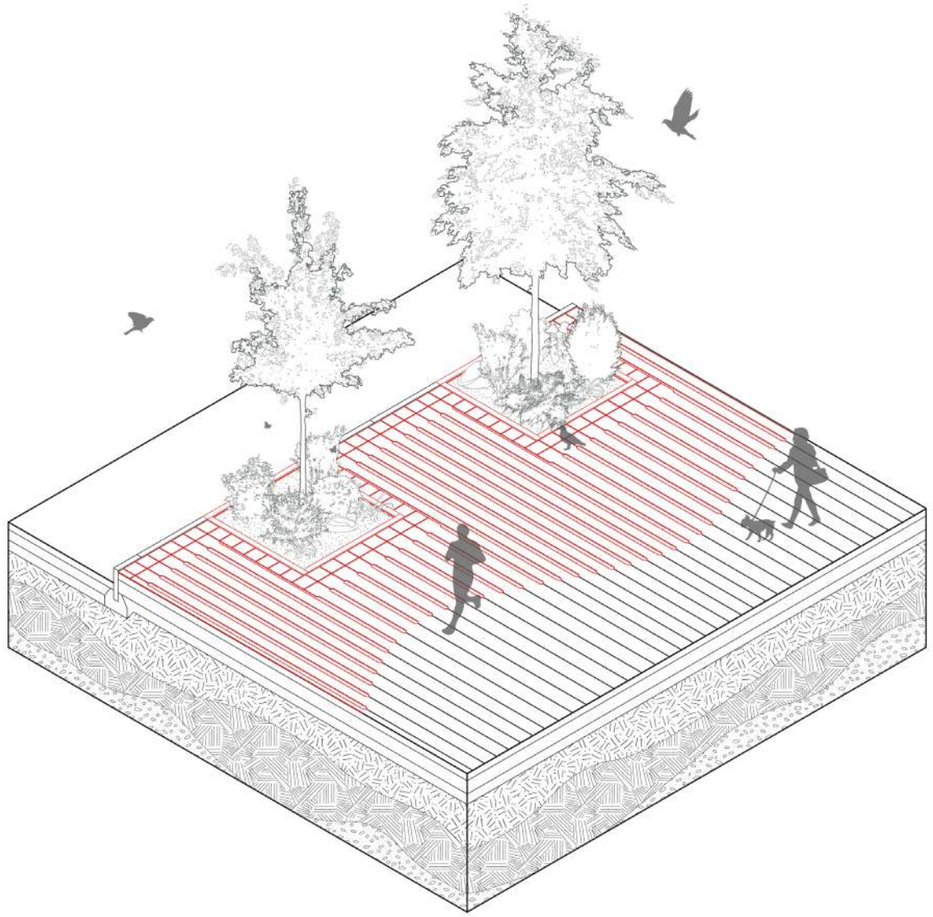
ENGAGE

The role of a regenerative project is not limited to supporting biodiversity; rather, it works toward rebuilding a positive relationship between humans and nature. It involves people in managing the ecological fabric, fostering awareness, and communicating the ecological processes at play. The project's educational function emerges as central, contributing to the development of a renewed awareness regarding nature's role in our lives, the negative impacts of our lifestyles, and the habits and needs of non-human species. The concept of proximity is fundamental in preventing the "extinction of experience," alienation, and neglect toward other forms of life. Making the presence of more-than-human actors evident highlights the shared nature of urban space, offering other life forms the opportunity to reclaim anthropogenic environments.

SUPPORT

Providing nesting sites is not enough to support urban biodiversity. The goal of prioritizing the safeguarding of life requires intervening in the built environment so that non-human actors can complete their life cycles even within urbanized contexts, cohabiting alongside humans. From the availability of food to the creation of refuge areas, and from reducing anthropogenic pressures to ensuring protection from predators, the needs of urban flora and fauna must be carefully considered to guarantee their survival. Therefore, on one hand, space is restored to biodiversity, while on the other, active measures are taken to limit the anthropogenic disturbances that make urban environments hostile.

PERMEABLE SURFACE



URBAN STRATEGY

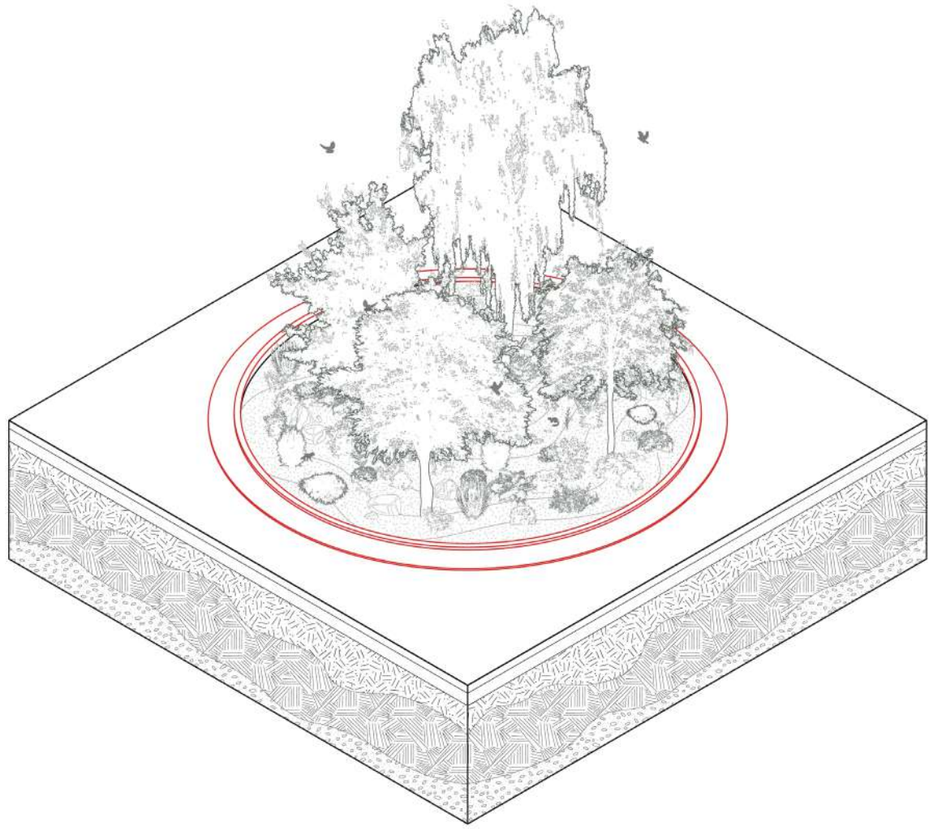
CONNECT

DESIGN OUTCOME

Water percolation
Aquifer recharge

These are highly effective alternatives to traditional paving systems, which are often made of continuous asphalt or concrete. They significantly reduce water runoff by allowing water to percolate into the lower soil layers. These systems are constructed using either porous materials or non-porous discrete elements laid with gaps between them, allowing fluids to infiltrate the ground and vegetation to grow. They typically consist of three layers: a base layer of draining gravel, a middle layer of soil, and a top layer where the paving elements are installed. They are commonly used for pedestrian pathways, bike lanes, parking lots, and, less frequently, low-traffic vehicular roads.

VEGETATED ROUNDABOUT



URBAN STRATEGY

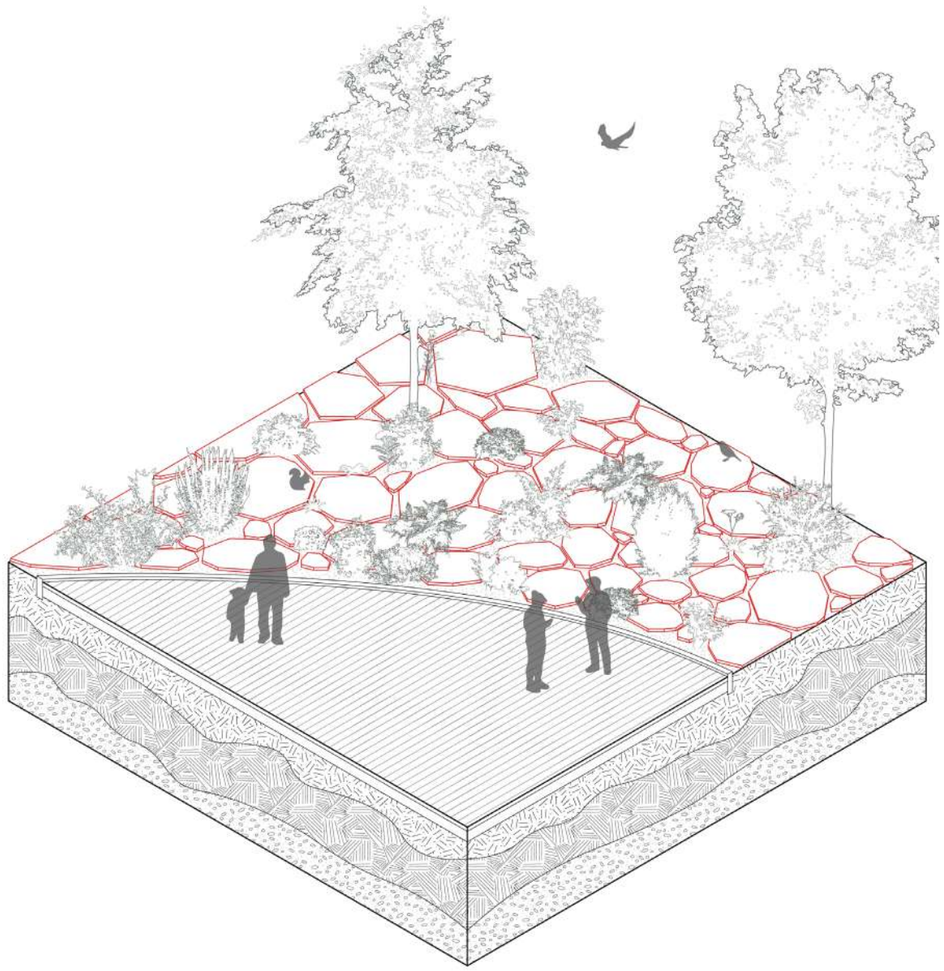
CONNECT

DESIGN OUTCOME

UHI mitigation
Water percolation
Air pollution regulation

The goal of expanding space dedicated to nature in the city can be achieved by transforming underutilized or inaccessible spaces such as roundabouts, traffic islands, and the interstitial gaps scattered throughout the urban fabric. Returning these areas to nature and increasing the percentage of permeable urban surfaces can yield enormous benefits for climate resilience (combating the heat island effect and improving stormwater management) and the expansion of green infrastructure. They can play a vital role in connecting existing natural oases, acting as stepping stones between green areas that insects and birds can use to navigate the urban environment.

CRACKED SURFACE



URBAN STRATEGY

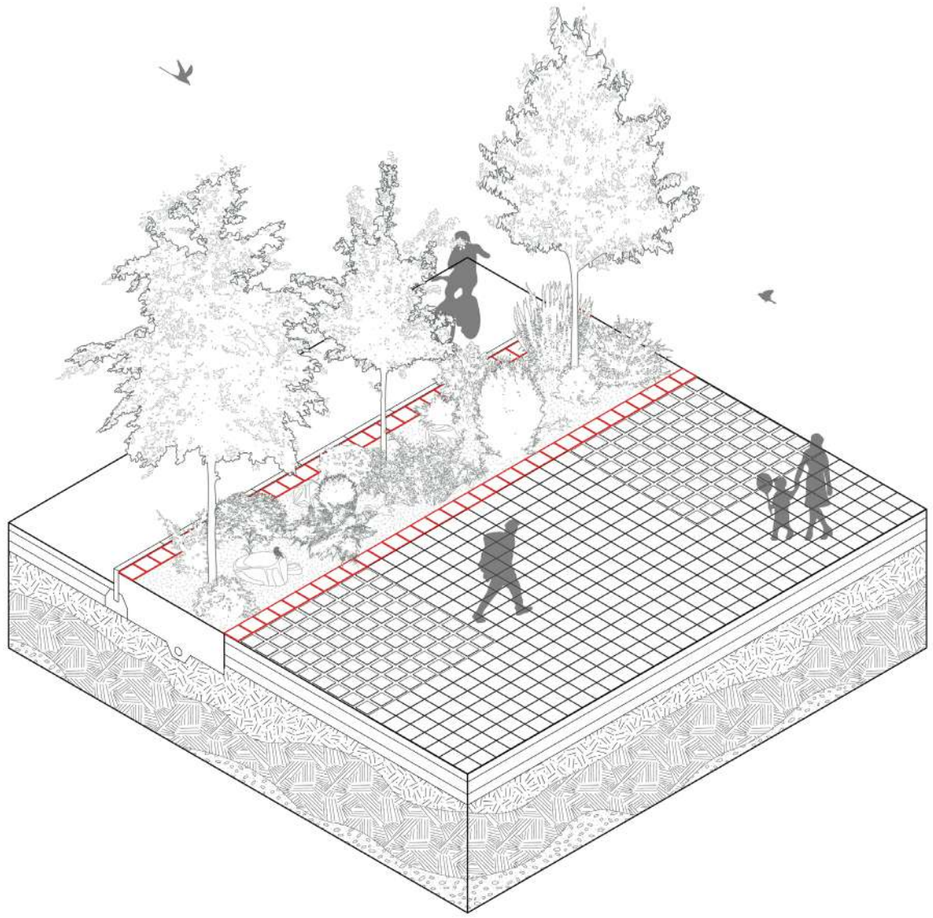
EXTEND

DESIGN OUTCOME

Water percolation
Structural complexity

This is a practical measure for transforming large, asphalt-covered areas. The intervention involves demolishing the superficial layer of asphalt and introducing varying amounts of earthy substrate to the site. This improves surface permeability, reducing pressure on the stormwater drainage network, and positively impacts the heat island effect thanks to the resulting vegetation growth and shading. A major advantage of this solution is that no material needs to be removed or disposed of: the rubble and debris are integrated directly into the design. Because of the uneven terrain and associated safety concerns, access for people is limited, meaning these areas are designed for the exclusive benefit of non-human actors.

VEGETATED CORRIDOR



URBAN STRATEGY

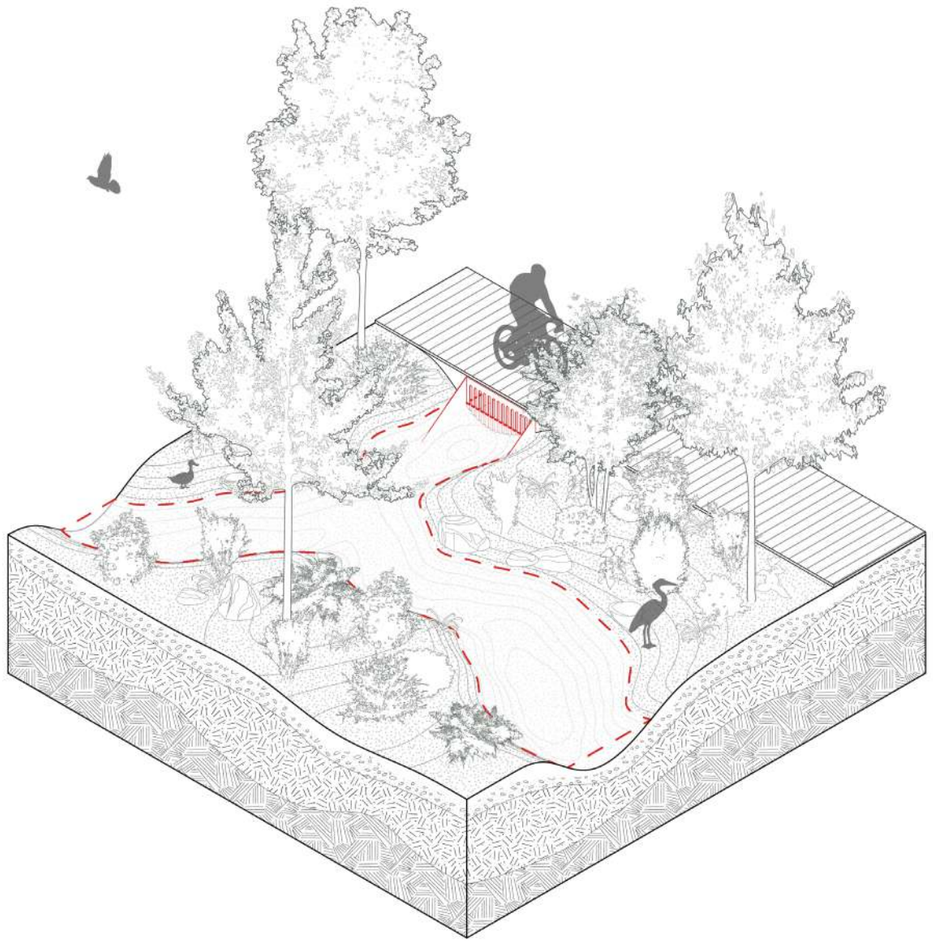
CONNECT

DESIGN OUTCOME

Water percolation
Shade provision
Space to host vegetation

Beyond the well-known benefits that protecting and developing natural areas bring in terms of climate resilience, creating ecological corridors is particularly important for supporting biodiversity. They connect urban green areas (combating fragmentation), enable the mobility of animal species, and prevent their isolation. Riverbeds often serve as the most critical natural corridors within cities, offering a continuous vegetated path for fauna to move safely. Further interventions aim to integrate streets and avenues into the city's overarching green infrastructure.

WATER COLLECTION SYSTEM



URBAN STRATEGY

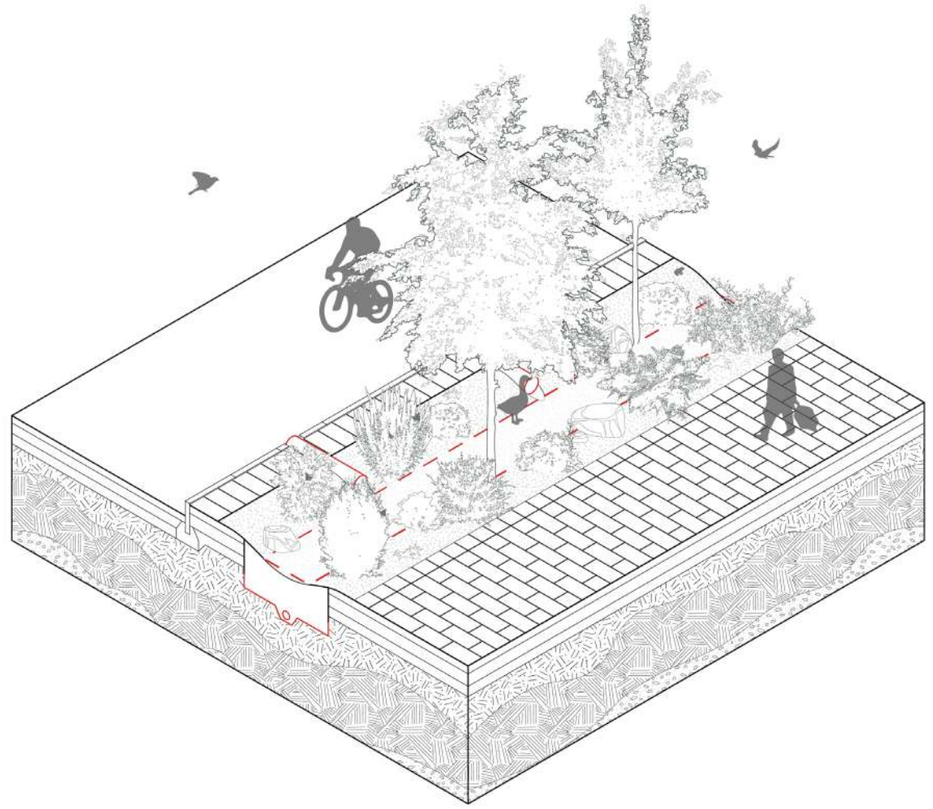
CONSOLIDATE

DESIGN OUTCOME

Drought regulation
Water reuse

During intense rainfall events, specific channels convey water toward collection systems located below the ground surface. These systems fill up before the water is eventually redirected to the sewer system. The collected water can be reused for irrigating green areas, especially during dry spells, sustaining the recreated habitats even through prolonged droughts. Thus, they not only help reduce rainwater runoff—ensuring that the water falling on the site remains within its boundaries—but they also actively support the life growing there.

BIOSWALE



URBAN STRATEGY

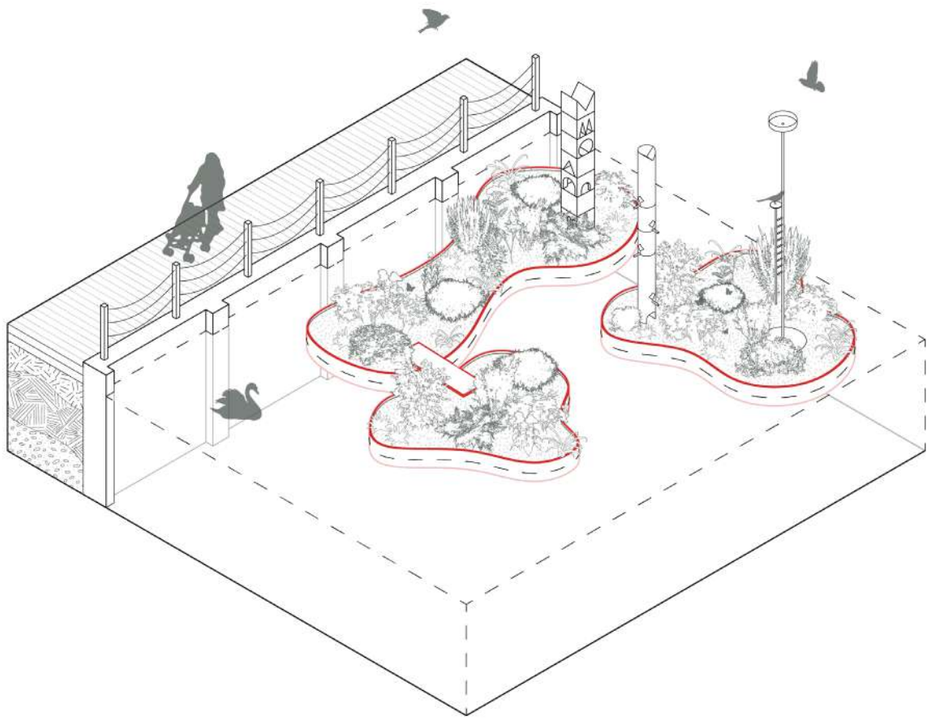
CONNECT

DESIGN OUTCOME

Water filtration
Water-flow regulation

These are vegetated soil depressions, or shallow open channels, into which water is directed during rainfall events. They have a linear layout and are generally located alongside the road network or sidewalks. These drainage systems help reduce and slow down rainwater runoff, which is not channeled directly into the sewer system but collected in these artificial channels. The stratigraphic composition of these structures helps purify the water of pollutants: the layers of vegetation, soil, and gravel act as filters, reducing the concentration of contaminants. They also play an important role in supporting biodiversity within urban contexts: not only do they introduce a variety of local plant species, but they can also form small ecological corridors that pollinators and other insects can use to move safely.

VEGETATED ISLAND



URBAN STRATEGY

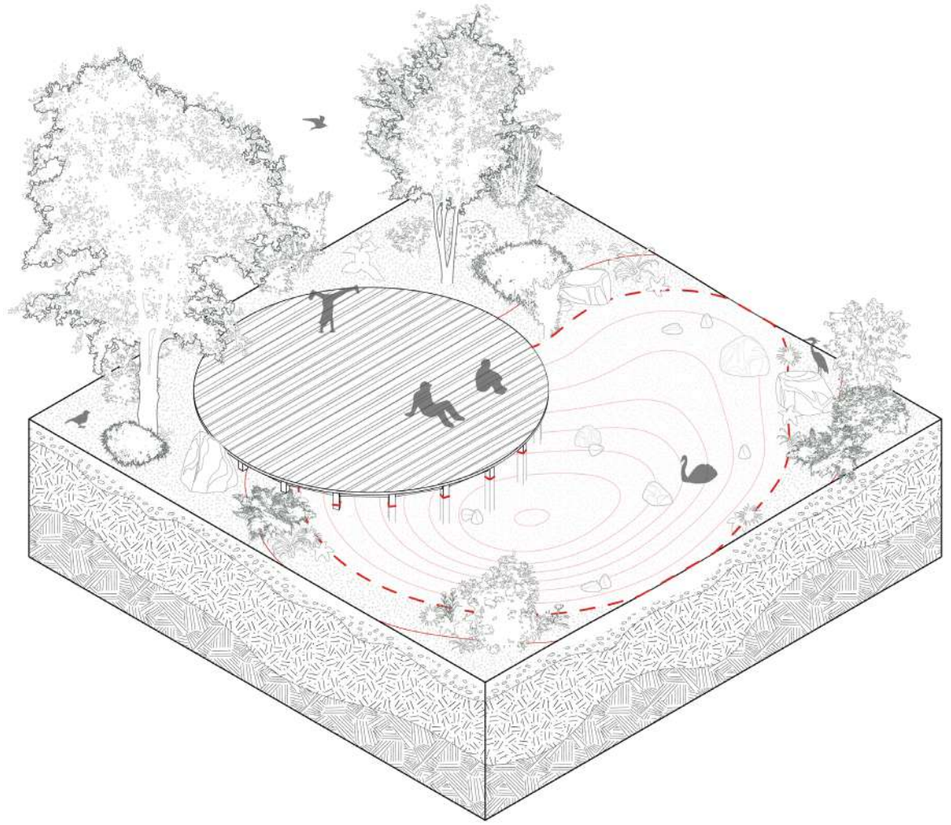
EXTEND

DESIGN OUTCOME

Structural complexity
Water filtration
Nesting site provision

Aquatic plants are grown on floating structures, mostly made of organic materials (such as coconut fiber or cork), which are connected to each other and anchored to the bottom to ensure the right balance of flexibility and stability. These systems are useful for cleaning contaminants from river or reservoir water, or for renaturalizing waterways. Introducing these floating islands increases the available surface area for flora to take root and develop, providing a habitat for urban fauna (mainly insects, birds, and fish). Lastly, the presence of these vegetated islands provides shading and reduces the portion of the water surface exposed to direct sunlight, helping to mitigate water heating and the urban heat island effect.

RETENTION POND



URBAN STRATEGY

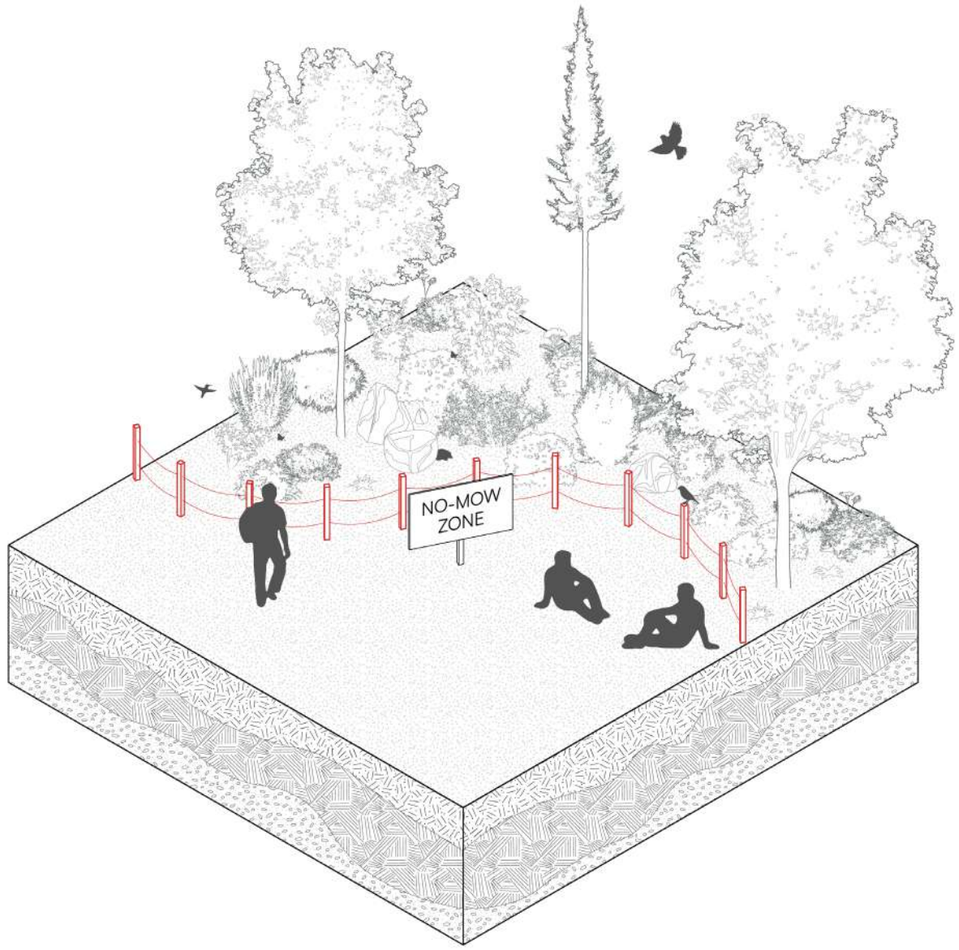
CONSOLIDATE

DESIGN OUTCOME

Aquifer recharge
Water percolation
Water filtration
Water-flow regulation

Retention ponds serve a similar function to bioswales, although they offer greater storage capacity during extreme weather events. They prevent rapid water runoff (helping to relieve pressure on the sewer system) and participate in water treatment by removing urban pollutants. Furthermore, they themselves constitute vital habitats for biodiversity and provide essential resources during droughts. These basins are created by excavating depressions in the ground; they generally feature a permanent volume of water surrounded by gently sloping banks, often covered with vegetation, which act as the primary water treatment mechanism.

NO-MOW ZONE



URBAN STRATEGY

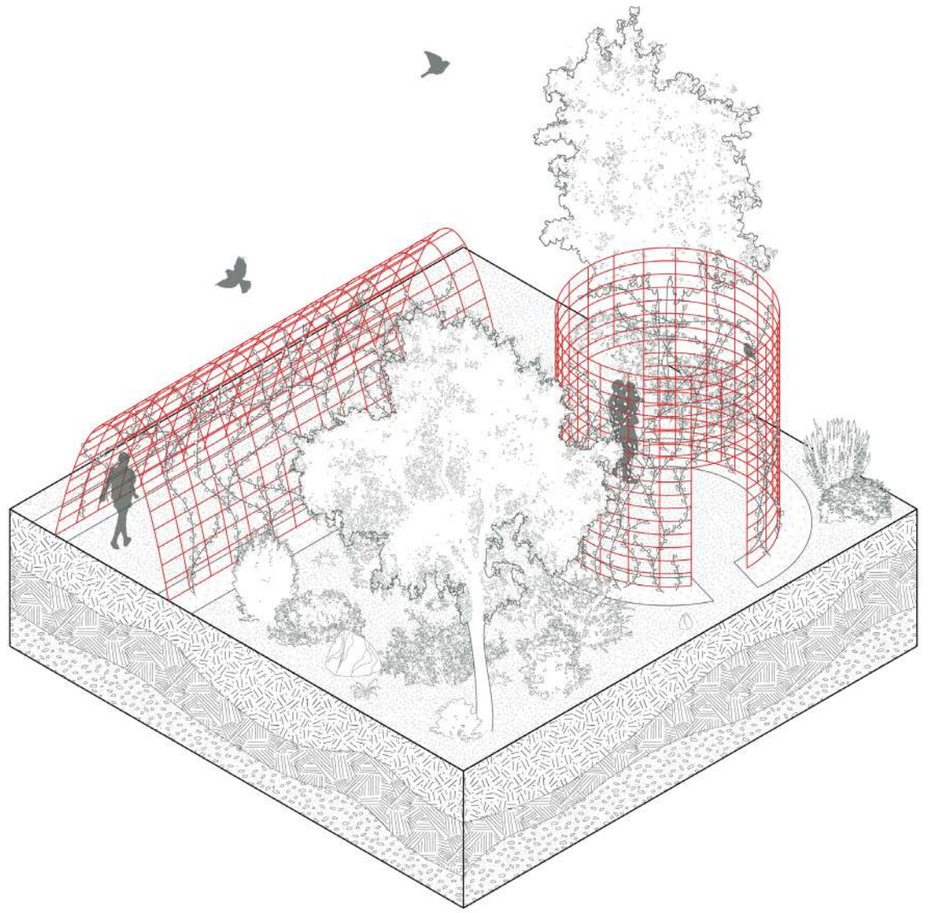
CONSOLIDATE

DESIGN OUTCOME

Niche provision for refuge
Structural complexity
Diversification of the vegetation layer
Humans ban

Within these areas, human intervention is restricted as much as possible, pruning is minimized, and maintenance operations are kept to a strict minimum. Consequently, ecological processes are left unaltered, allowing vegetation to complete its life cycle without external interference. This supports the needs of the city's fauna by providing food, nectar, and essential survival resources. During renaturalization efforts, the choice of species must therefore focus on specimens that can physically adapt to the project site once they reach maturity and finish growing, ensuring that extraordinary maintenance is not required. Human intervention cannot be entirely eliminated: continuous monitoring of these areas is necessary to prevent safety hazards and the spread of invasive alien plants.

PERGOLA



URBAN STRATEGY

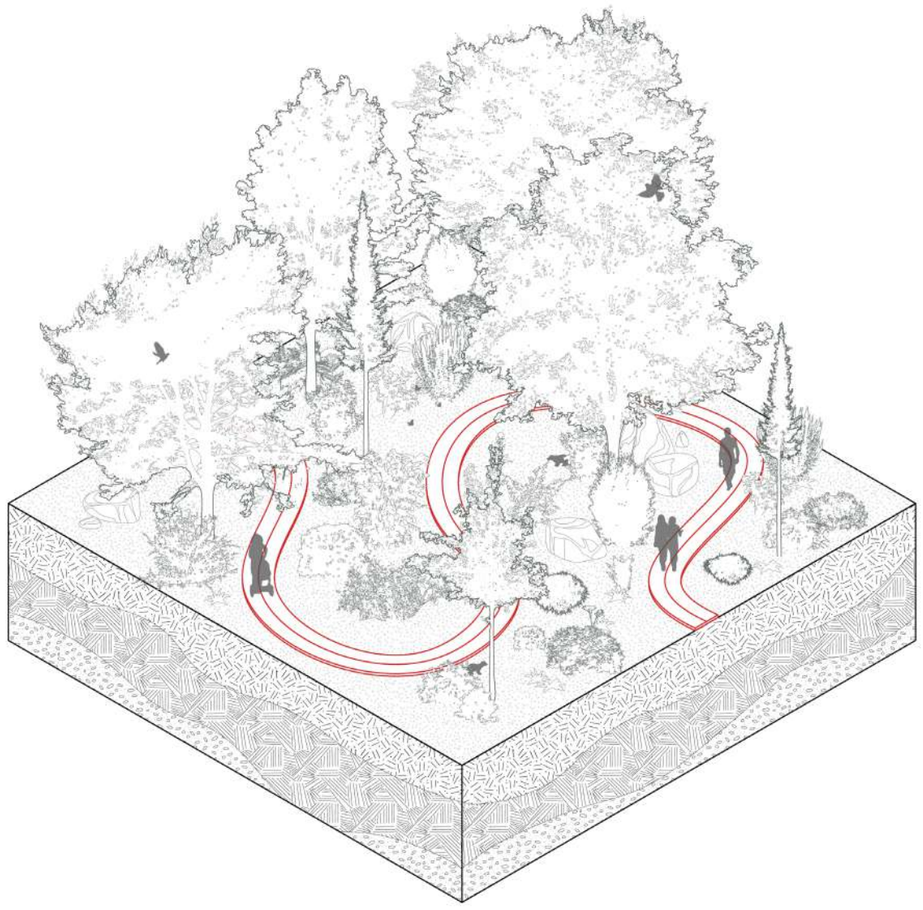
CONSOLIDATE

DESIGN OUTCOME

Space to host vegetation

These are metal or wooden structures upon which climbing plants can grow. These lightweight structures—easily adaptable and moldable into a wide variety of shapes—can be utilized in existing parks, streets, and urban squares to combat the urban heat island effect. The goal is not merely to improve the livability of public spaces and mitigate the climate change effects that will make urban areas increasingly hot, but to actively increase the presence of greenery in these areas. It enhances the structural complexity of often monotonous environments, multiplying the opportunities for non-human life to take root and thrive.

URBAN FOREST



URBAN STRATEGY

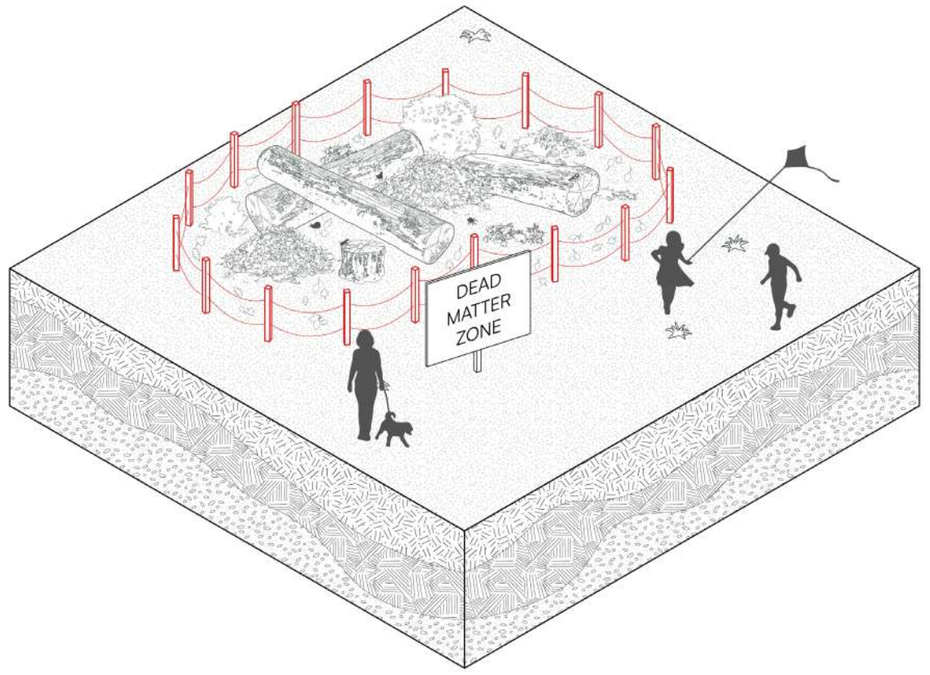
EXTEND

DESIGN OUTCOME

Carbon storage and sequestration
Air pollution regulation
UHI mitigation
Food and water provision
Diversification of the vegetation layer

These areas act as oases of biodiversity within the urban fabric. They contribute significantly to the well-being of not only people but also urban flora and fauna. Among their primary functions are mitigating the urban heat island effect, reducing air pollution, and regulating water cycles. Similarly, they play a crucial role in ensuring the safety of various animal species by allowing free movement, connecting different habitats and territories, and providing the necessary biological complexity and diversity for their life cycles to be completed without difficulty.

DEAD MATTER ZONE



URBAN STRATEGY

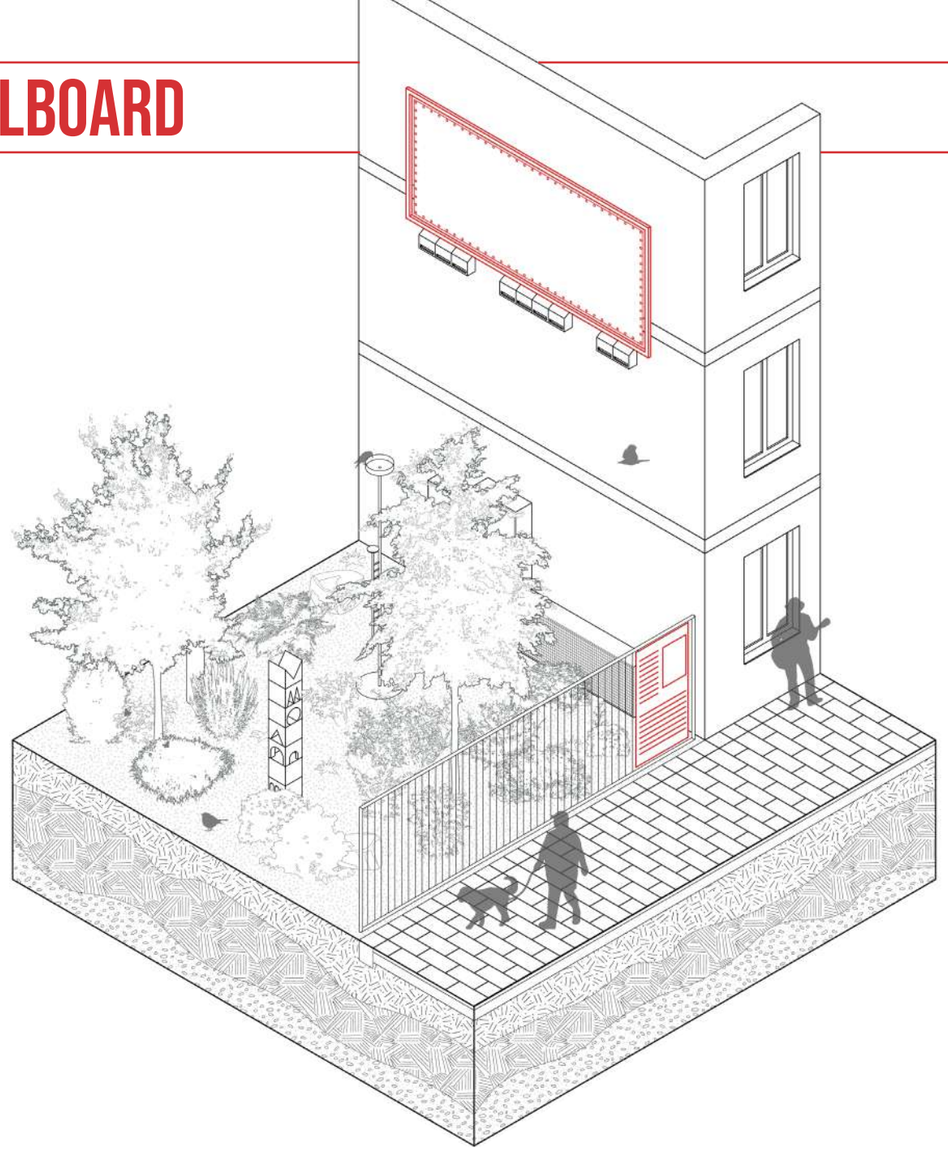
CONSOLIDATE

DESIGN OUTCOME

Waste management
Structural complexity

Dead trees or branches resulting from pruning are piled up in designated areas within urban parks. This is a highly cost-effective measure for promoting urban biodiversity: dead wood provides the perfect habitat for xylophagous (wood-boring) insects, while the resulting niches and cavities can shelter a variety of other species. The accumulation of dead leaves also facilitates the presence of invertebrates (which can, in turn, feed insectivorous birds) and provides refuge for reptiles and small mammals. Dead matter is thus not hidden but showcased, becoming an integral part of the urban landscape. Once again, the goal is not to conceal what is culturally deemed useless or degraded, but to grant it the space it rightfully deserves within the urban context.

BILLBOARD



URBAN STRATEGY

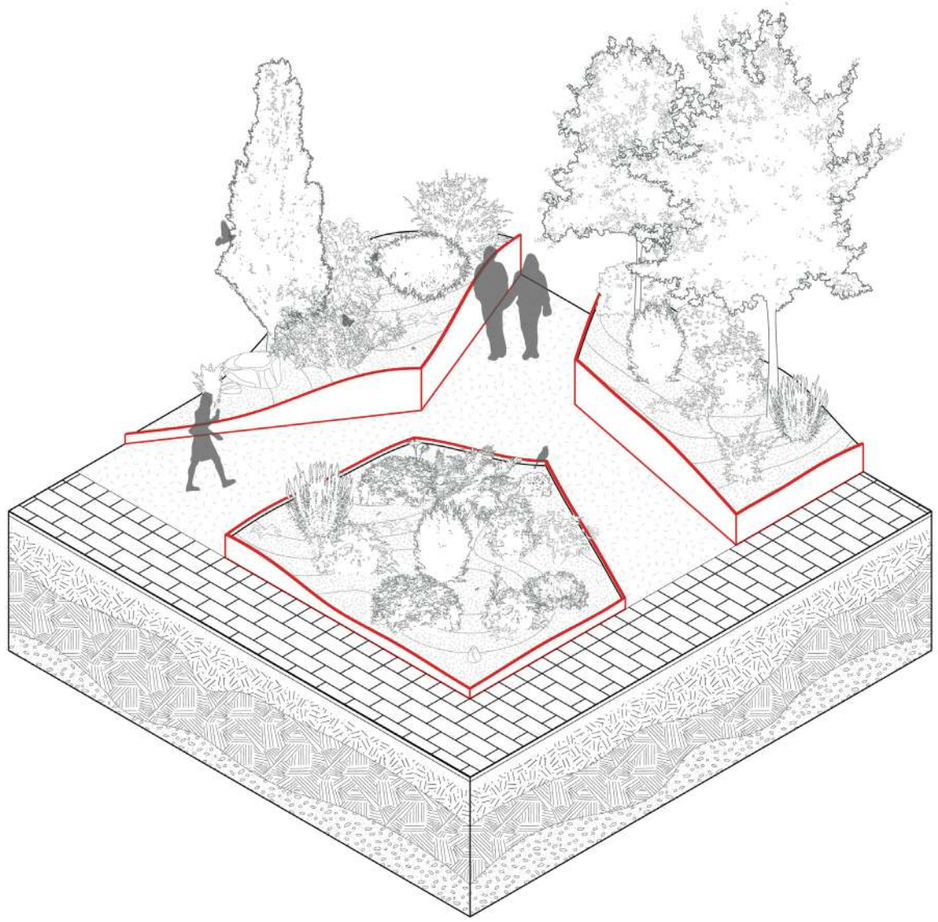
EXTEND

DESIGN OUTCOME

Environmental education

The inclusion of information panels accompanying urban interventions aims to communicate the project's intent, explain the ecological processes unfolding there, and ultimately enhance people's ecological sensitivity by informing them about what is happening right in front of them. In addition to their educational function, these panels can also take on an artistic and advocacy role—signaling the presence of non-human inhabitants within human-occupied spaces, and offering a shift in perspective that encourages people to reconsider their role and the impact of their personal choices on other living beings.

TOPOGRAPHY VARIATION



URBAN STRATEGY

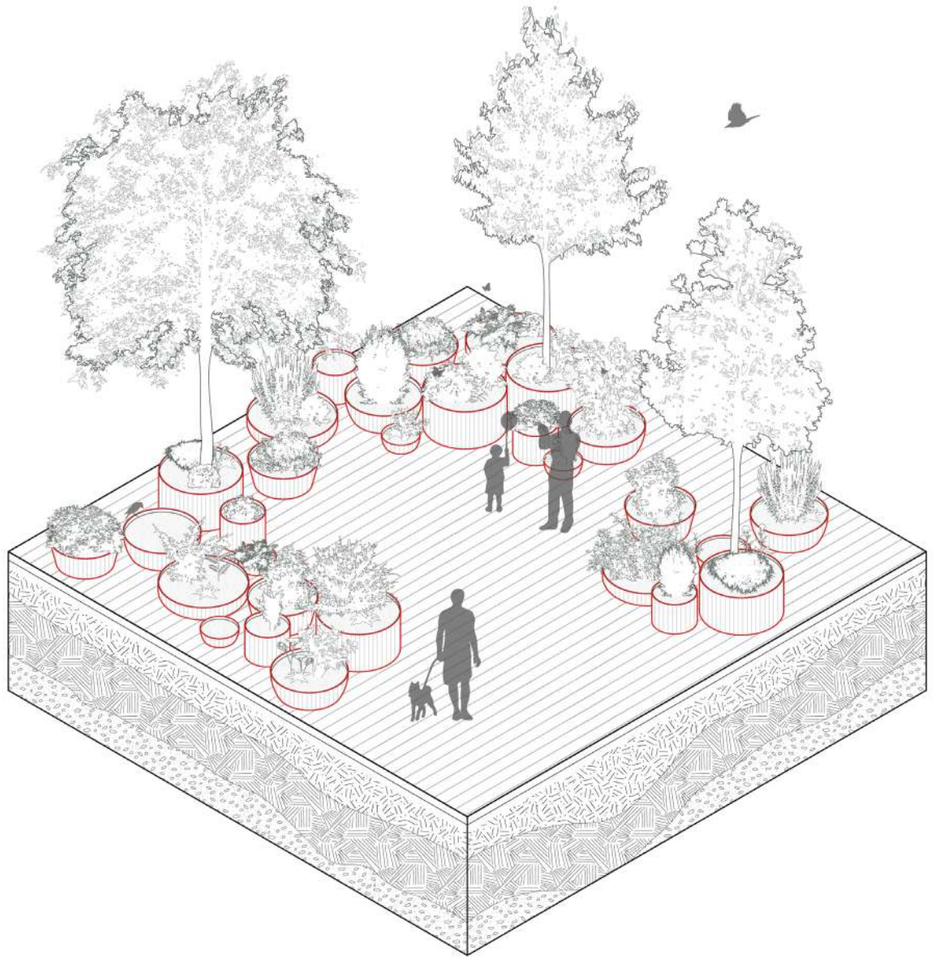
EXTEND

DESIGN OUTCOME

Structural complexity

Varying the terrain profile by introducing mounds and depressions is an effective measure for adding structural heterogeneity to existing parks and public spaces, which greatly benefits biodiversity. It facilitates the creation of niches and cavities that urban fauna can exploit for protection from predators and anthropogenic pressures (such as noise/light pollution, trampling, etc.). It creates a much greater variety of micro-conditions compared to a completely flat and monocultural landscape (offering different levels of moisture, sun, and wind exposure), thus enabling the establishment of diverse more-than-human communities. Furthermore, the presence of slopes helps channel water toward collection systems, where it can be stored and used for irrigation during dry periods.

URBAN FURNITURE



URBAN STRATEGY

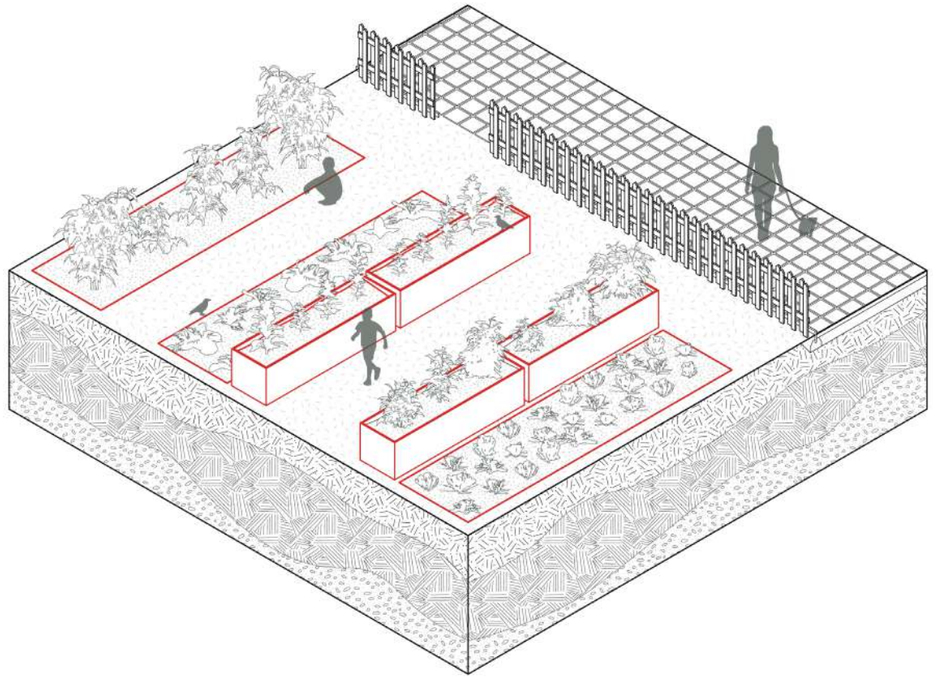
CONNECT

DESIGN OUTCOME

UHI mitigation
Shade provision
Ornamental quality

The advantage of this type of street furniture is that it allows for the easy introduction of plant elements into the urban fabric without initiating major construction sites. When large budgets are unavailable or planting directly in the ground is impossible (for example, due to underground utility networks), small trees and shrubs can be placed along city streets and avenues. This has a tangible impact on the continuity of the green network and the livability of these urban areas (creating opportunities for social interaction and improving climate resilience). The mobile and modular nature of these furniture pieces makes them adaptable to any circumstance.

URBAN GARDEN



URBAN STRATEGY

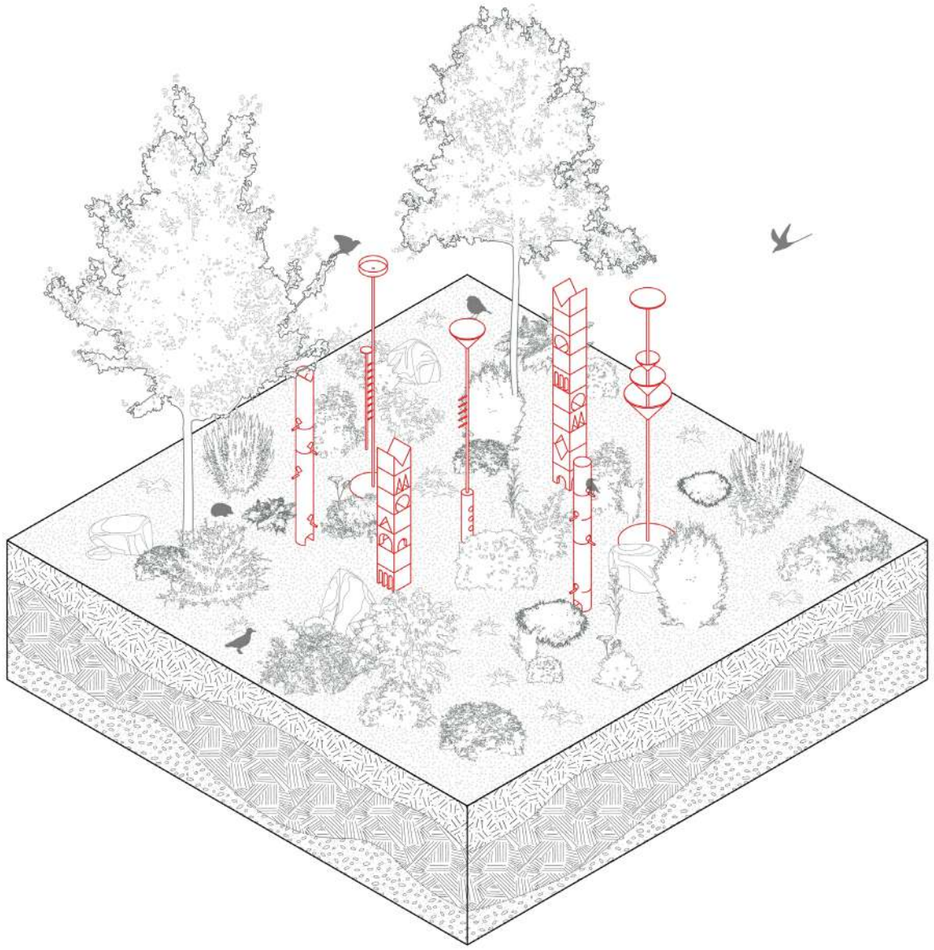
EXTEND

DESIGN OUTCOME

Environmental education
Community involvement
Nectar provision
Diversification of the vegetation layer

Cultivation activities carried out in urban contexts serve multiple purposes: they help improve food security, impact adaptation to climate change, support biodiversity, and foster social cohesion. Urban farming can be developed at a low cost and in various settings: on building roofs, in vacant lots, or in the courtyards of city blocks. These experiences go beyond the practical functions of food production and climate change mitigation; they help develop a sense of community and belonging. Involving people in agricultural activities brings them closer to nature, helping to build ecological awareness and knowledge, while simultaneously combating the progressive alienation from nature that increasingly affects city dwellers.

BIRD HOUSE



URBAN STRATEGY

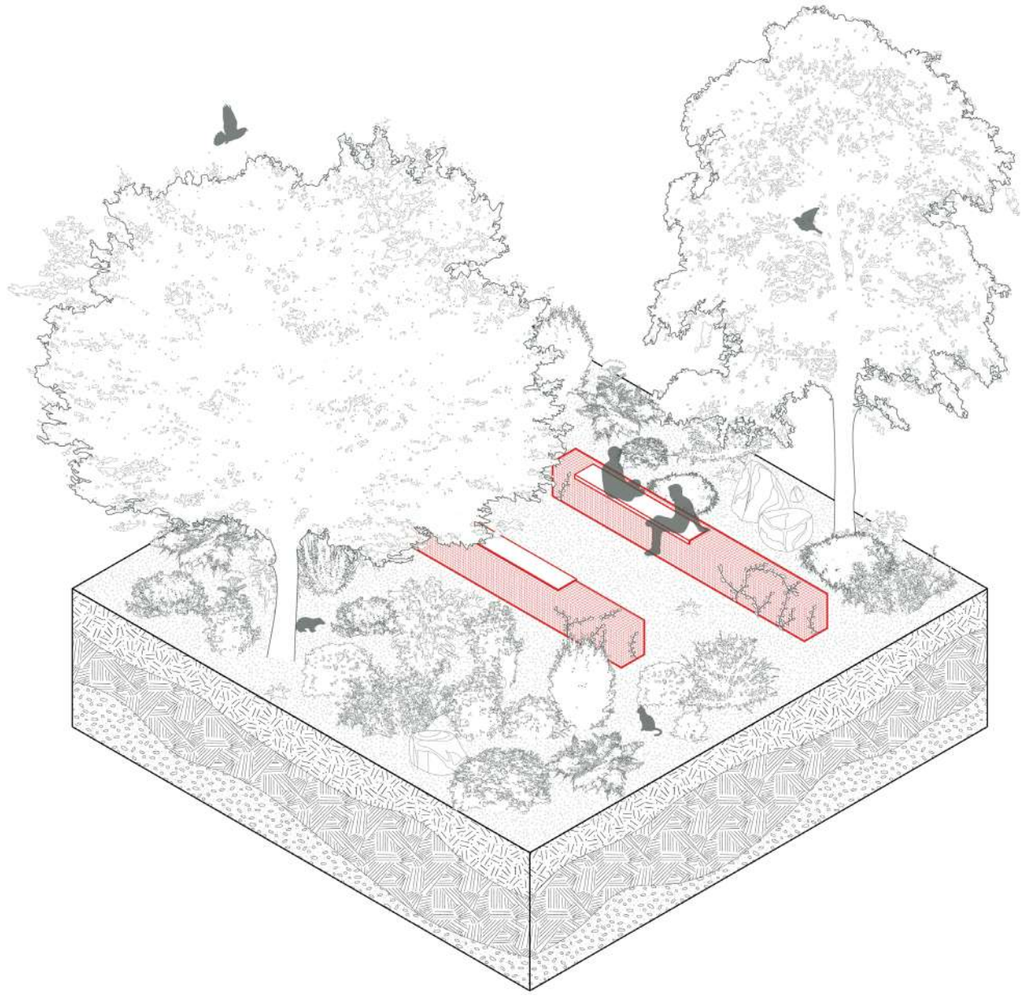
EXTEND

DESIGN OUTCOME

Pest control
Nesting site provision

These objects, which can be attached to building facades or tree branches, aim to provide nesting spaces for cavity-nesting species. Depending on the target species, the devices vary in size, opening shape, and installation height. Alongside these artificial nests, it is advisable to consider installing feeders and birdbaths to support wildlife needs during exceptional circumstances, such as extended droughts or periods when insects and fruits are scarce (notoriously during the winter months). It is important that their use remains occasional and limited to emergency situations, to avoid creating dependency and undermining the birds' ability to forage for themselves. For this reason as well, it is essential to build urban habitats with sufficiently diversified vegetation so that urban fauna can find the necessary resources to survive naturally.

METALLIC GABION



URBAN STRATEGY

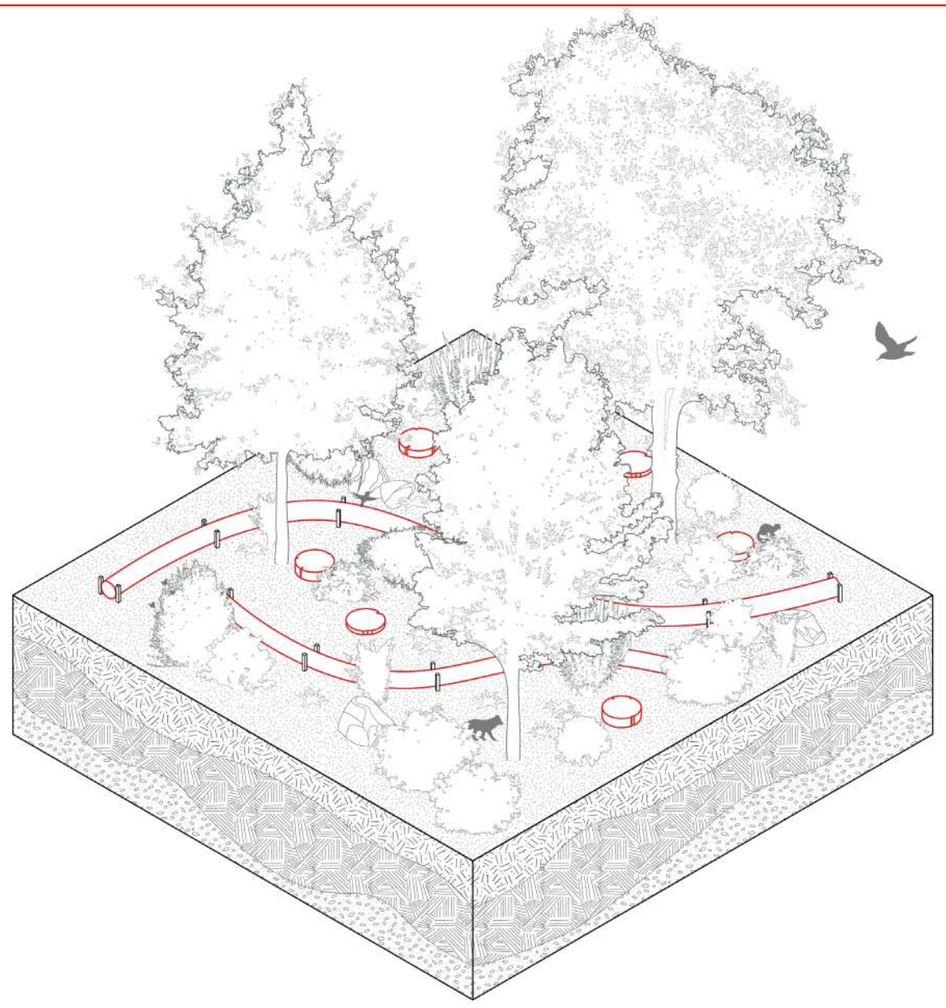
CONSOLIDATE

DESIGN OUTCOME

Space to host vegetation
Niche provision for refuge

These are baskets made from a mesh of corrosion-resistant galvanized steel wire, generally parallelepiped in shape, and filled with rocks and stones. They are frequently used to improve the stability of embankments and slopes or as retaining walls for earthworks. Given their irregular and porous nature, fragments of organic material and soil inevitably settle into the gaps between the rocks, promoting the growth of shoots and the colonization of the structure by plants and insects. The progressive integration of these devices into the surrounding landscape is anticipated, so that over time, they themselves become fertile surfaces for the emergence of life, far beyond their mere structural function.

ORGANIC MATTER



URBAN STRATEGY

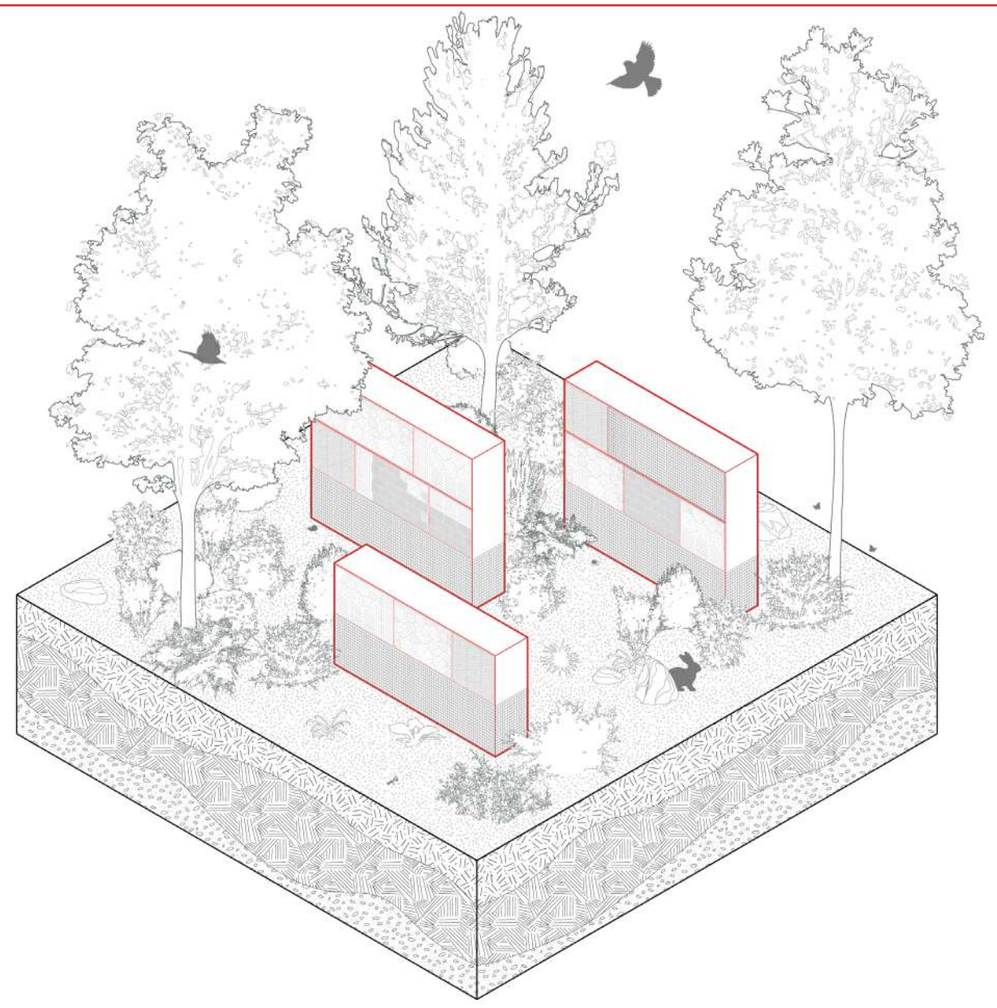
CONSOLIDATE

DESIGN OUTCOME

Niche provision for refuge
Diversification of vegetation layer
Space to host vegetation

The elements of nature resulting from ecological processes are often hidden because they are considered out of place or inconsistent with the Western ideal of a manicured and domesticated nature. Supporting biodiversity means restoring ecological components—normally removed or concealed for aesthetic reasons—to their rightful place in public spaces: dead trunks, fallen branches, decaying wood, or outcropping boulders. The beauty of this matter lies in its honesty and the range of possibilities it holds. Removing these components is not only a cruel human intrusion into ecological processes and a futile attempt to impose a specific aesthetic taste on non-human life, but it is also a missed opportunity for environmental awareness through physical and visual interaction with nature's components and processes.

INSECT HOTEL



URBAN STRATEGY

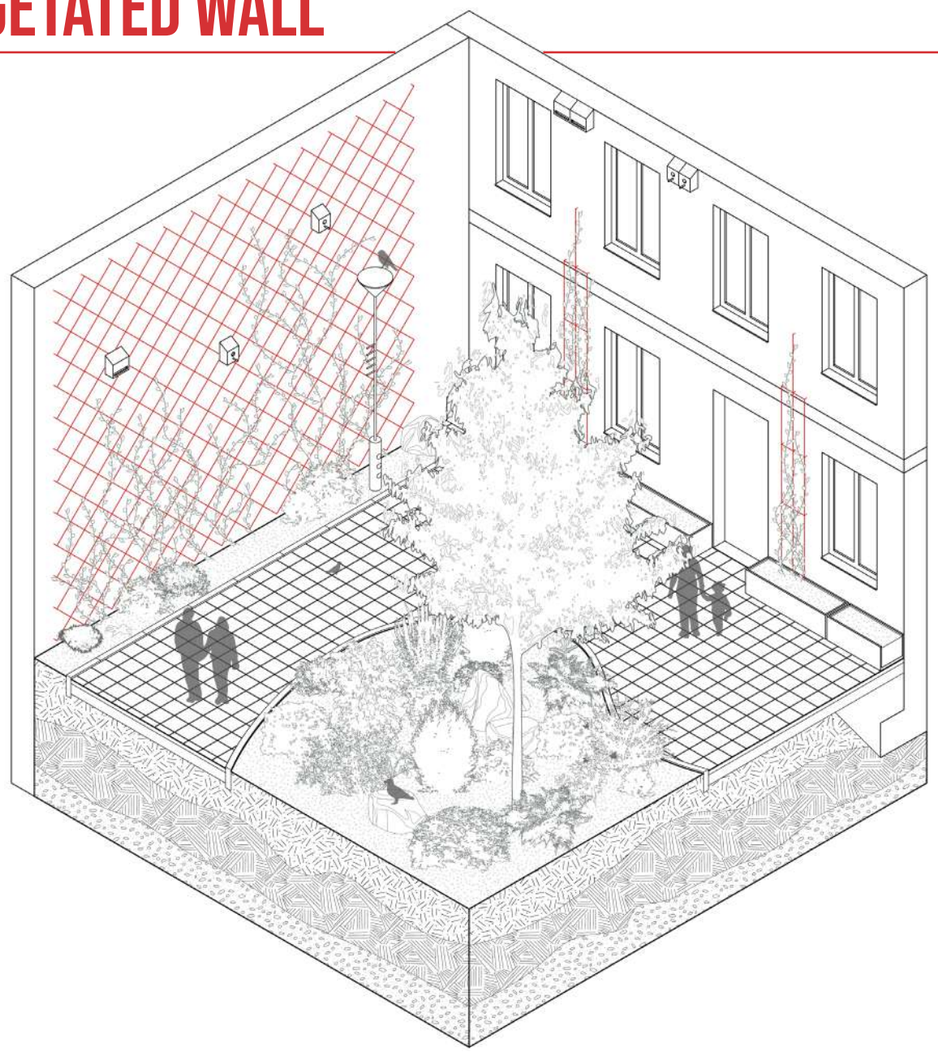
EXTEND

DESIGN OUTCOME

Insect attraction
Niche provision for refuge

These are structures made of different materials and characterized by cavities of varying sizes, designed to house various insect species (spiders, bees, wasps, ants, moths, etc.). These devices can be easily integrated into street furniture or the facades of existing buildings. Not only do they provide a refuge for insects, but they also contribute to a broader environmental education effort—highlighting the shared nature of urban spaces, signaling the presence of non-human species, and dedicating specific, human-made structures for animal use.

VEGETATED WALL



URBAN STRATEGY

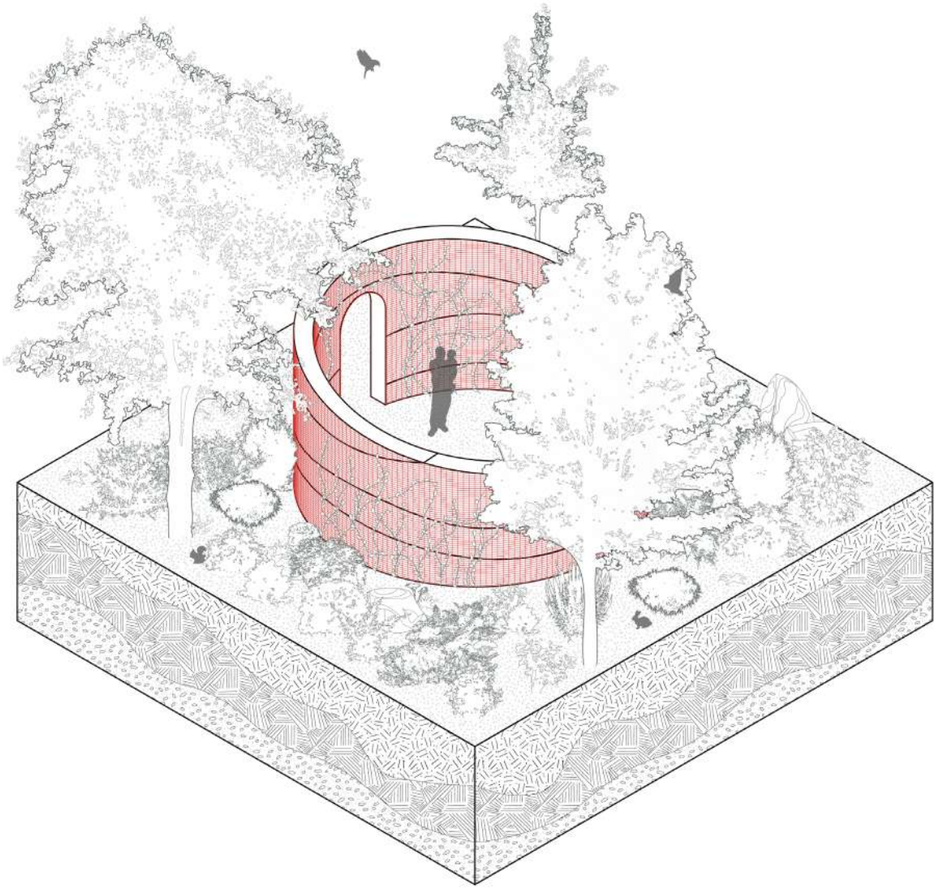
CONNECT

DESIGN OUTCOME

Carbon storage and sequestration
Evapotranspiration
Space to foster vegetation

The building's facade is covered by climbing plants that grow from the ground or from planters placed at the base of the wall. From here, they draw the nutrients necessary for their sustenance, growing upwards directly on the wall or anchoring themselves to external elements (such as wire trellises). It is an efficient way to cover large vertical surfaces while occupying a minimal footprint on the ground. Such systems are useful not only for improving the urban and internal thermal comfort of the building (by providing shade), but also for vertically connecting the vegetated areas at the building's base with green roofs, creating a safe corridor for insects and small mammals.

ORGANIC WALL



URBAN STRATEGY

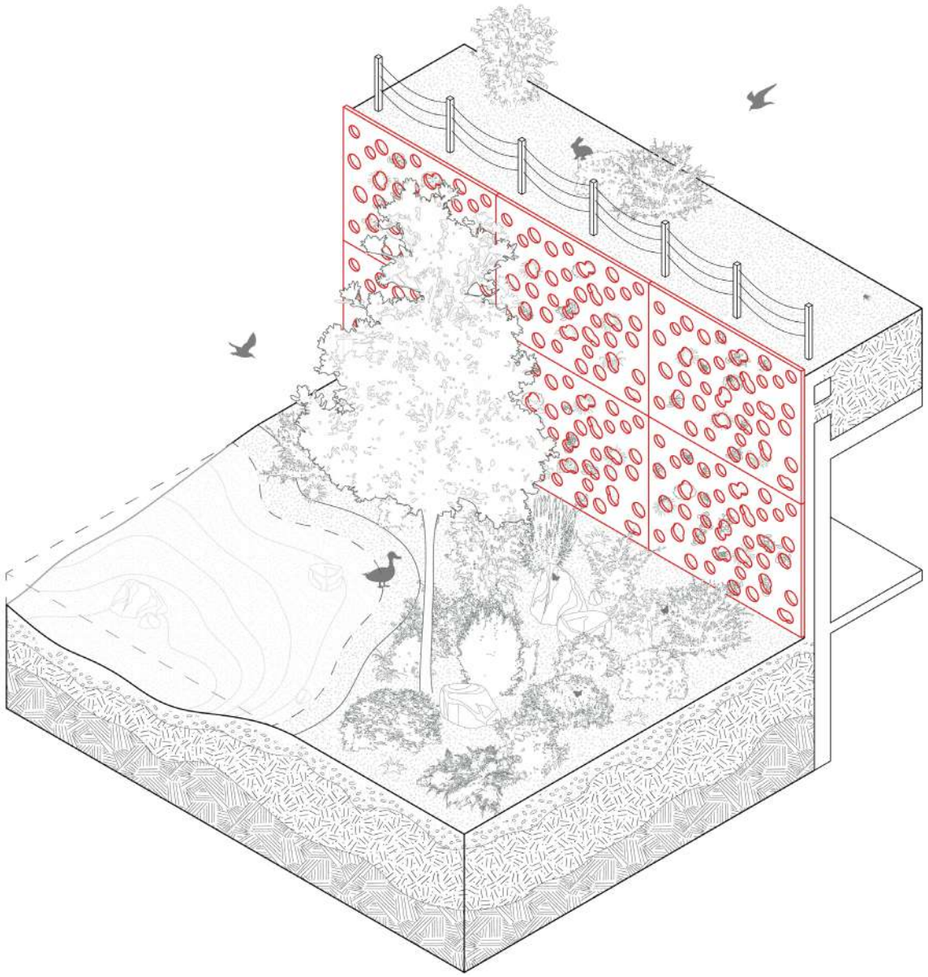
CONSOLIDATE

DESIGN OUTCOME

Substrate diversity
Structural diversity

These pavilions can be constructed using supporting metal meshes filled with various types of substrate or with the help of canvas bags containing fertile soil. The vegetation can be actively planted, or the colonization of the structure can be left to chance—waiting for plant life to sprout spontaneously from seeds carried by the wind and urban fauna. Their contribution to the development of biodiversity lies in providing the initial conditions for life to take hold. Such devices operate under a mindset profoundly different from standard Western thinking: creating structures specifically designed for nature, allowing nature to reclaim them without ulterior motives, challenges the idea of nature solely as a resource to be indiscriminately exploited.

LIVING WALL



URBAN STRATEGY

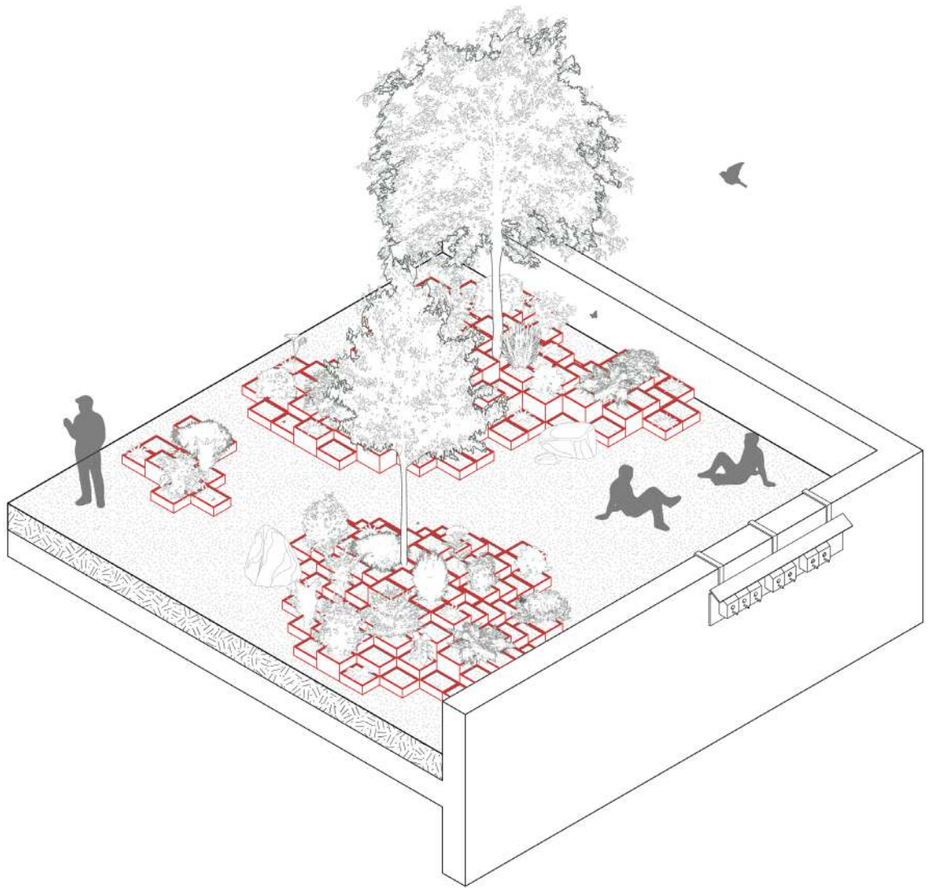
CONNECT

DESIGN OUTCOME

Carbon storage and sequestration
Pest control
Evapotranspiration
Space to foster vegetation

In this case, the vegetation does not grow along supports anchored to the facade; instead, the substrate is integrated directly into the wall, and the vegetation roots into it as if planted in the ground. Because of this, the system can accommodate a wider variety of plant species beyond just climbing plants. An irrigation system is integrated within the substrate to deliver nutrients to the plants, ensuring their survival. The system can consist of panels structurally anchored to the building's facade or be fully integrated into the technological package of the external envelope. Innovative solutions also make it possible to connect the ground-level soil with the green roof, ensuring continuity in the substrate and allowing small organisms and insects to move freely.

GREEN ROOF



URBAN STRATEGY

CONNECT

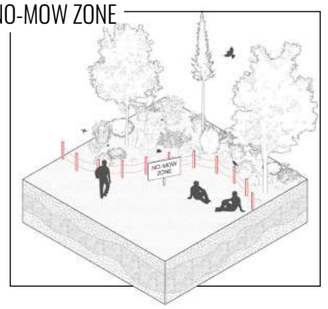
DESIGN OUTCOME

UHI mitigation
Space to host vegetation
Nesting site provision

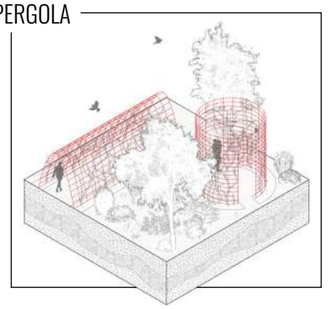
Building roofs can play a fundamental role in fostering biodiversity in urbanized contexts, extending and integrating the urban ecological network across often-unused surfaces. Green roofs can host a wide variety of plant species and attract diverse animal species (including pollinators, insects, and birds). Additionally, they play a crucial role in mitigating the effects of climate change by reducing the urban heat island effect and improving stormwater management. When properly designed (and structural capacity permitting), they can also be actively used by people for socializing, gardening, recreation, or outdoor physical exercise, encouraging the development of a positive relationship with nature.

NATURAL SETTINGS

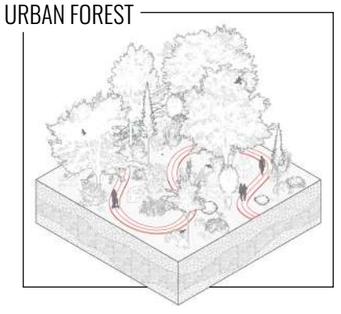
NO-MOW ZONE



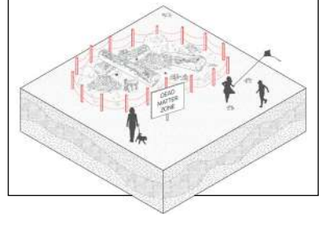
PERGOLA



URBAN FOREST

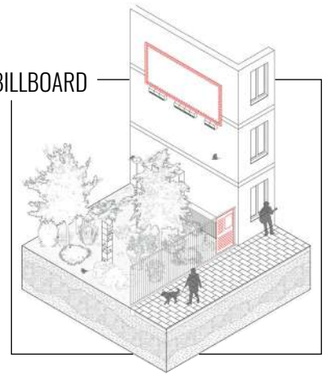


DEAD MATTER ZONE

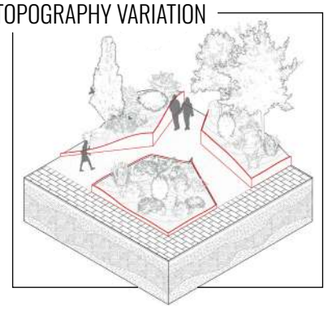


URBAN SETTINGS

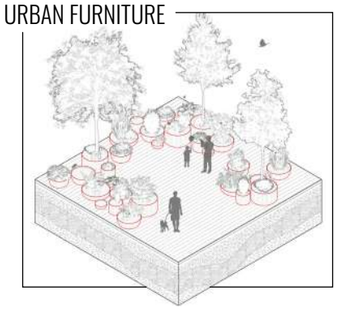
BILLBOARD



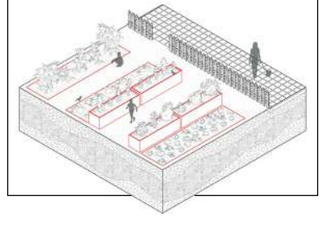
TOPOGRAPHY VARIATION



URBAN FURNITURE

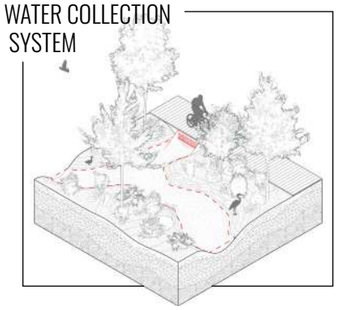


URBAN GARDEN

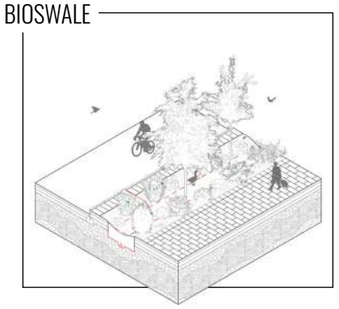


WATER FEATURES

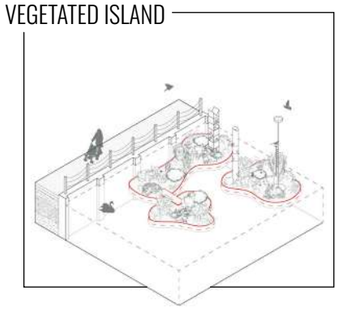
WATER COLLECTION SYSTEM



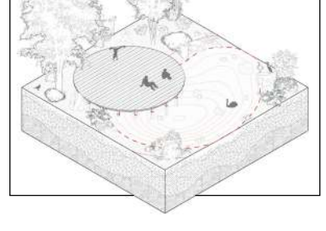
BIOSWALE



VEGETATED ISLAND

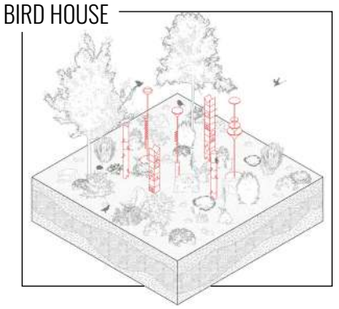


RETENTION POND

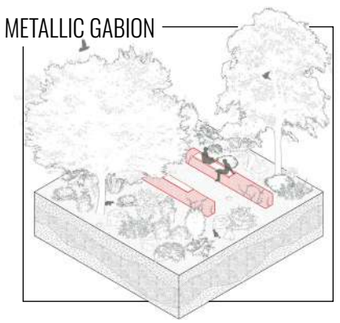


ANIMAL-AIDED FEATURES

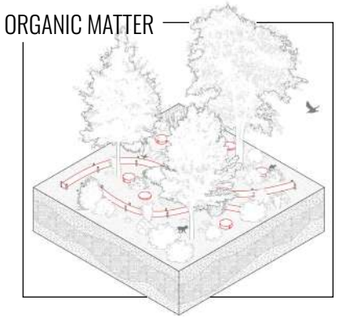
BIRD HOUSE



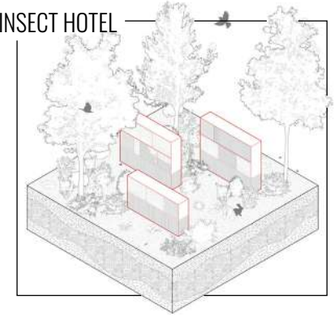
METALLIC GABION



ORGANIC MATTER

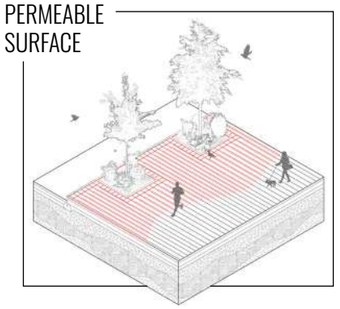


INSECT HOTEL

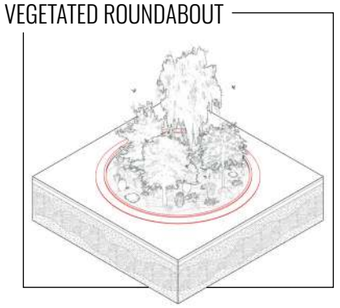


HARD SURFACES

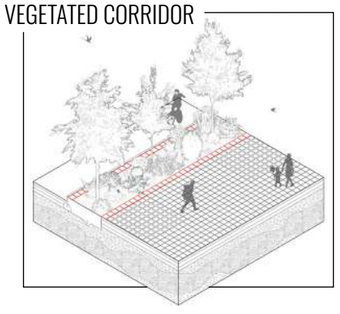
PERMEABLE SURFACE



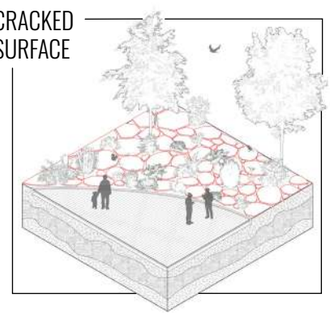
VEGETATED ROUNDABOUT



VEGETATED CORRIDOR

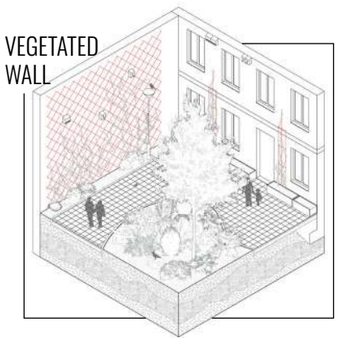


CRACKED SURFACE

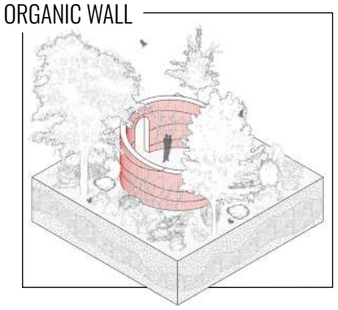


BUILDINGS

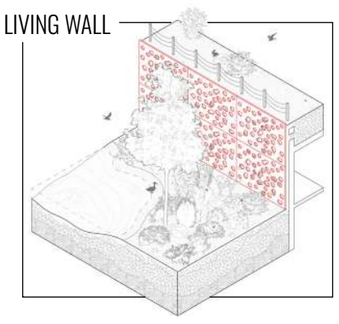
VEGETATED WALL



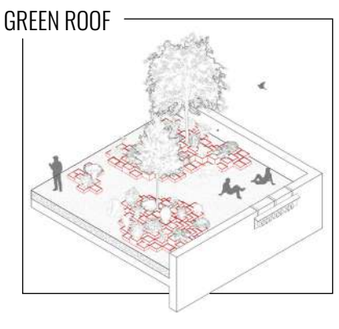
ORGANIC WALL

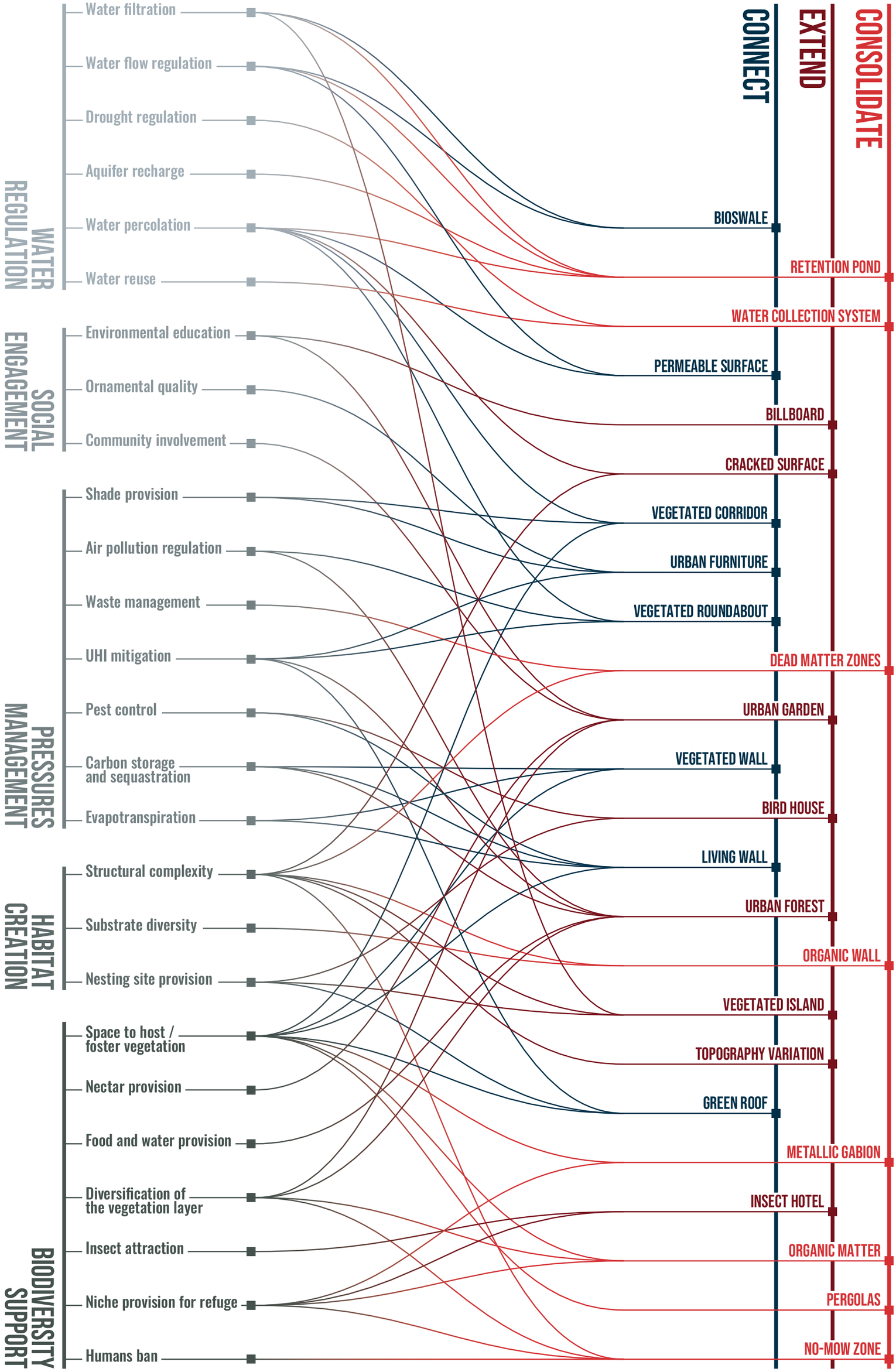


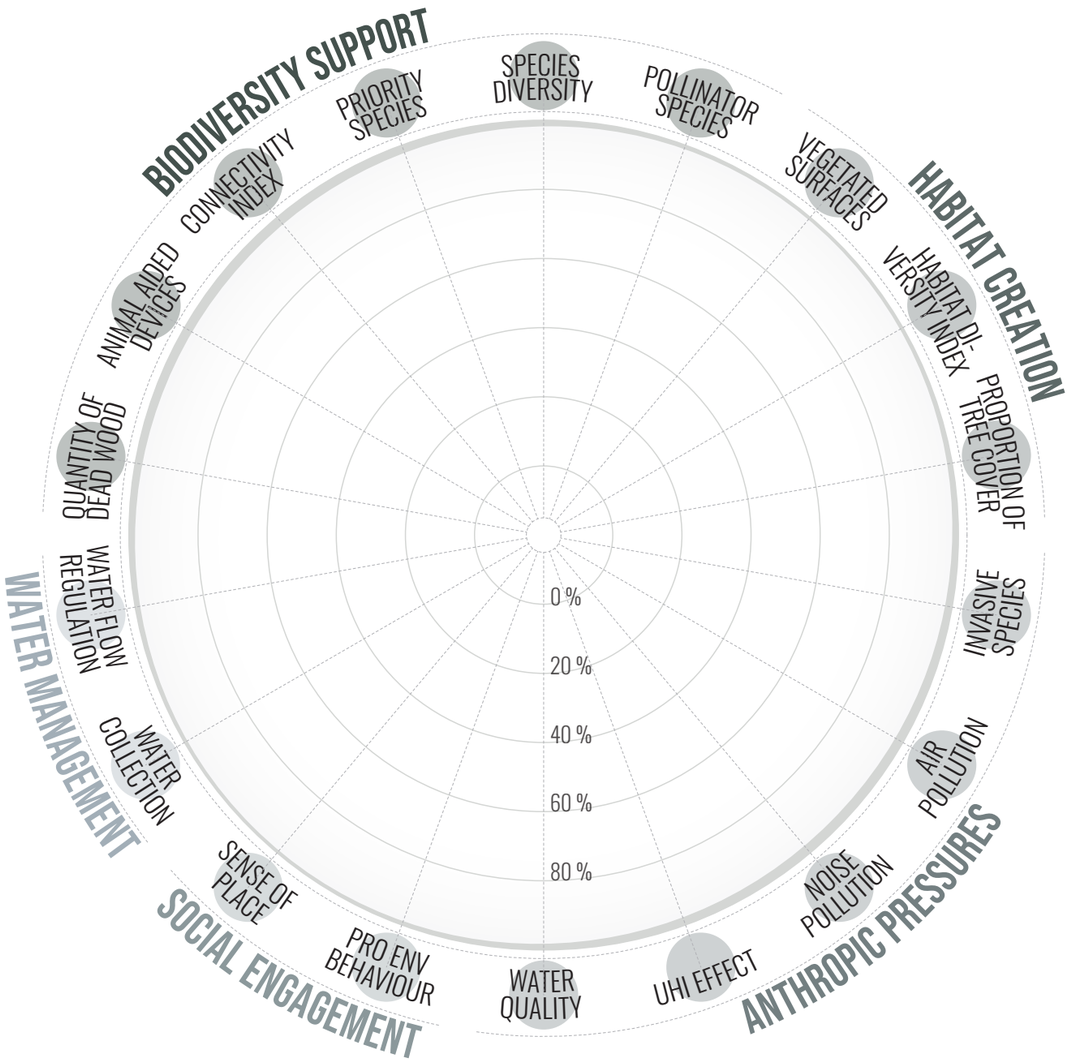
LIVING WALL



GREEN ROOF




WATER REGULATION
Water filtration
Water flow regulation
Drought regulation
Aquifer recharge
Water percolation
Water reuse
SOCIAL ENGAGEMENT
Environmental education
Ornamental quality
Community involvement
PRESSURES MANAGEMENT
Shade provision
Air pollution regulation
Waste management
UHI mitigation
Pest control
Carbon storage and sequastration
Evapotranspiration
HABITAT CREATION
Structural complexity
Substrate diversity
Nesting site provision
BIODIVERSITY SUPPORT
Space to host / foster vegetation
Nectar provision
Food and water provision
Diversification of the vegetation layer
Insect attraction
Niche provision for refuge
Humans ban
CONNECT
EXTEND
CONSOLIDATE
BIOSWALE
RETENTION POND
WATER COLLECTION SYSTEM
PERMEABLE SURFACE
BILLBOARD
CRACKED SURFACE
VEGETATED CORRIDOR
URBAN FURNITURE
VEGETATED ROUNDABOUT
DEAD MATTER ZONES
URBAN GARDEN
VEGETATED WALL
BIRD HOUSE
LIVING WALL
URBAN FOREST
ORGANIC WALL
VEGETATED ISLAND
TOPOGRAPHY VARIATION
GREEN ROOF
METALLIC GABION
INSECT HOTEL
ORGANIC MATTER
PERGOLAS
NO-MOW ZONE



04

.04 DESIGN EVALUATION

To synthesize a project's performance based on a set of identified indicators, the author developed a radar diagram that clearly illustrates the impact of a design in percentage terms, using concentric circles that indicate progress relative to a reference scale. The starting point, corresponding to 0%, is associated with a "business-driven" approach, i.e., one focused primarily on economic profitability, with no attention paid to environmental systems. The upper end of the graph, equal to 90%, represents the theoretical maximum threshold currently achievable for a regenerative project. This value does not coincide with 100%, recognizing that the integral regeneration of natural systems is still a work in progress, subject to future research and experimentation. The best-case scenario is therefore represented by a design proposal that enacts the regeneration of natural systems, such as biodiversity and water cycles, and mitigates negative anthropogenic interference.

Each axis of the radar diagram represents a key performance indicator selected for the project evaluation. The analysis of individual vertices highlights the strengths and weaknesses of the design proposal, while the overall area of the resulting polygon provides a summary measure of the project's impact and efficacy in regenerating natural ecosystems. In line with the main urban challenges highlighted in the previous matrix diagram, the 18 indicators are grouped into 5 themes to demonstrate the project's ability to address the corresponding urban problems.

In the following pages, each indicator is analyzed individually. For each one, a detailed description of what the performance indicator intends to measure is provided, followed by the calculation method (including, whenever possible, the corresponding formula or, more generally, the applied evaluation method), and, finally, the threshold beyond which the project can be considered regenerative.

ECOLOGICAL CONNECTIVITY

This indicator measures the level of fragmentation of the project site with respect to the local ecological network. The Mean Proximity Index (MPI) takes into account the distance between the lot and nearby green areas within a given search radius, as well as the surface area of these zones. Values close to zero suggest complete isolation of the area; conversely, the higher the MPI value obtained, the better the connectivity between areas, ensuring local fauna better possibilities to move safely and supporting ecosystem functionality and resilience. The calculation does not return a normalized and absolute value; however, it can be tracked over time, aiming for an increase in the site's connectivity with nearby areas.

CALCULATION

GIS software

REGENERATIVE THRESHOLD

Significant increase in the local connectivity measure

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

PROPORTION OF CONSERVATION PRIORITY SPECIES

In this case, the success of a project is measured by its effects on endangered species, countering the simplification and homogenization of living communities. The appearance or strengthening of communities belonging to species included in the IUCN Red List, or deemed at risk by local or national plans, determines the success of the project's actions. The indicator therefore tracks the trend of endangered species by monitoring their presence on the project site. An effective and cost-efficient way to record the progress made is through the active involvement of citizens, who are called upon to collect and share their observations using citizen science methods.

CALCULATION

$$PCPS = \frac{\text{number of cp species}}{\text{total number of species}}$$

REGENERATIVE THRESHOLD

Increase in PCPS value over the years

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

POLLINATOR SPECIES PRESENCE

The presence of pollinating insects such as bees, butterflies, and moths is an important indicator for assessing the health of an ecosystem, as it guarantees the reproduction of flowering plants and proper genetic diversity. In this case, the capacity of the implemented design solution to attract pollinating insects is evaluated by tracking their emergence and presence over time. Insects are naturally present in large parks and are highly mobile: for this reason, attracting these insects—which can use the site as a stepping stone between various green areas—is significant in terms of ecological functionality. This indicator relies on observations made by citizens, starting from the flowering season of floral species through to the autumn.

CALCULATION

Direct counting of species in project area

REGENERATIVE THRESHOLD

Increase in pollinator species over time

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

SPECIES DIVERSITY

This indicator represents a measure of a habitat's ecological diversity. Mathematically, it measures the probability that two individuals chosen at random from the biological community belong to different species. The Simpson Index (D) yields a value between 0 and 1, where 0 indicates zero biodiversity, while values close to 1 indicate high biological diversity. The calculation of this index is influenced not only by the number of observed species but also by their relative abundance: a site with a high number of species but with one dominant species will still have a relatively low Simpson Index; a site with good richness, where no dominant species are observed, will instead present a high index. To be considered regenerative, a project must present an index greater than 0.7.

CALCULATION

$$D = 1 - \frac{\Sigma\, n\,(n-1)}{N\,(N-1)}$$

n = number of individuals of one species
N = total number of individuals

REGENERATIVE THRESHOLD

D > 0.7

[P. J. Somerfield et al., *Simpson Index*, Encyclopedia of Ecology, 2008]

AAD DEVICES

The installation of such devices aims to support the presence of animal species within urban contexts. Insect hotels, birdhouses, bat boxes, etc., are all useful devices for reintroducing certain living beings into the city; depending on the target species, the characteristics of each will vary considerably. Integrating these objects into regeneration projects signals a specific attention toward the needs of non-human species. Planning the installation of such devices therefore becomes a fundamental requirement for any regenerative intervention, not only because it facilitates the establishment of animal species, but also because it emphasizes the shared nature of urban space by highlighting the presence of non-human actors.

CALCULATION

Include AAD devices on the project site and verify their use by local fauna

REGENERATIVE THRESHOLD

100 % of AAD devices are used by local species

[Author's own elaboration]

QUANTITY OF DEAD WOOD

Dead trunks play an important role within ecosystems. This refers to dead wood that is either still standing or lying on the ground: it constitutes the habitat for a multiplicity of microorganisms and animal species, and contributes to soil stability. Its presence on the project site is indicative of the ecosystem's health and the quality of the created habitat. Since there is no unanimous consensus on the minimum values of dead wood in a habitat, the indicator aims to not only verify the presence of dead wood but also to measure the volume present on the site, aiming for stability over time without net losses. Furthermore, it is symptomatic of a healthy relationship with nature's cycles: dead matter is not hidden because it is considered ugly or degraded, but is welcomed as part of the complex system of relationships and processes that governs nature.

CALCULATION

Direct measurement on site [m^3]

REGENERATIVE THRESHOLD

Quantity of wood remains constant or increases over time

[IUNC, *The Urban Nature Indexes: Methodological framework and key indicators*, 2023]

VEGETATED SURFACES

The purpose of this indicator is to measure the quality of the vegetated surfaces reintegrated into the urban fabric. To ensure the project's ecological quality, the Urban Greening Factor (UGF) is used; this is a value obtained from the ratio between the project area with a positive ecological impact and the total lot area. The calculation of the UGF includes not only the quantity of planned natural areas but also their quality, attributing a multiplication factor to each typology linked to the ecological value of the chosen surfaces. The intention is thus to promote the integration of natural elements in support of urban biodiversity and, conversely, to discourage the use of conventional engineered solutions that are harmful to the city's human (and non-human) inhabitants.

CALCULATION

$$UGF = \frac{\Sigma \text{ (factor x area)}}{\text{total project area}}$$

REGENERATIVE THRESHOLD

UGF > 0.5

[London Greater Authority, *Urban Greening Factor*, 2023]

PROPORTION OF TREE COVER

This indicator measures the percentage of the project area covered by tree canopies. A significant percentage of tree cover contributes to mitigating the impact of the urban heat island phenomenon, improving citizens' health, and, above all, supporting biodiversity by reducing ecological fragmentation in urban areas and providing habitats for various bird and insect species. This indicator is usually calculated on a neighborhood or urban scale and is therefore significant only for large-scale interventions, where the proportion of tree cover can effectively influence bird mobility and green area connectivity. Based on the current tree cover of the city of Turin and in light of recommendations provided by scientific literature, 30% tree cover results as an appropriate threshold for a regenerative project.

CALCULATION

$$PTC = \frac{\Sigma \text{ (factor x area)}}{\text{total project area}}$$

REGENERATIVE THRESHOLD

PTC > 30 %

[C. Konijnendijk, *The 3-30-300 Rule for Urban Forestry and Greener Cities*, 2021]

DIVERSITY INDEX OF HABITATS

The aim is to achieve an equilibrium among five different types of habitats, specifically bare turf, lawn/meadow, shrubs, trees, and built space. The calculation is performed before and after the architectural intervention to determine any increase in the value yielded by the index. The highest index values are recorded when habitats are distributed evenly across the site's surface. Thus, an equilibrium that guarantees resilience is achieved—rather than a situation where one of the five components dominates the others—so that the flora present on the site is sufficiently diversified to accommodate a wide variety of animal species. The vegetation is structured across multiple levels, managing to satisfy the needs of a multitude of species.

CALCULATION

$$D = -\Sigma^{5} (p_i \log_2 p_i)$$

p_i = proportion of each type of habitat

REGENERATIVE THRESHOLD

Increase in D value after project implementation

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

WATER FLOW REGULATION

This indicator measures the effectiveness with which a project slows, absorbs, or redirects rainwater compared to a conventional proposal. The purpose is to avoid overloading the water disposal network during intense rainfall and storm events. To be defined as regenerative, a project must guarantee that the entire quantity of water falling on the project site remains within its boundaries, avoiding rainwater runoff as much as possible. To this end, it is fundamental that a considerable amount of the site's horizontal surfaces be vegetated or otherwise permeable, so that water can reach and infiltrate the soil.

CALCULATION

$$Qp = C \times I \times A$$

Qp = Peak runoff rate [m^3/sec]
C = Runoff coefficient
I = Rainfall intensity [mm/hr]
A = Drainage area [m^2]

REGENERATIVE THRESHOLD

Qp = absorption capacity of project site

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

WATER COLLECTION

This indicator concerns a project's ability to satisfy its own water requirements independently, without drawing from the local water grid. The aim is to support the water needs of the site's human and non-human inhabitants through the careful use of available water resources and a closed-loop system. To be defined as regenerative, a project must be able to meet its own demand for potable and non-potable water (for irrigating vegetated areas) on its own: greywater reuse, as well as rainwater collection and storage, are some of the strategies useful for achieving this ambitious goal.

CALCULATION

$$WNM = \frac{\text{water collected}}{\text{water required}}$$

REGENERATIVE THRESHOLD

WNM = 1

[International Living Future Institute, *Living Building Challenge 4.0*, 2019]

SENSE OF PLACE

This involves developing a project in which the community can recognize itself, capable of reflecting the values of the people who inhabit the area and responding to their needs. The expression sense of place (SOP) lacks a single, unambiguous definition; however, it can be stated that it relates to the development of an emotional connection to a place and personal identification with it. The development of a SOP is linked to people's aptitude for protecting natural heritage and the development of pro-environmental behavior (Wolf et al., 2014). With the aid of questionnaires, the intention is to understand to what extent the intervention is capable, on the one hand, of grasping and enhancing the potential of a place while respecting its history, and on the other, of instilling a profound sense of belonging toward the transformed location.

CALCULATION

Structured inerviews with local community members or questionnaires

REGENERATIVE THRESHOLD

Increase in sense of belonging

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

PRO-ENVIRONMENTAL BEHAVIOUR

A fundamental aspect to be addressed with the implementation of a regenerative project is the sense of connection with nature that the project inspires. These are evidently highly personal, subjective, arbitrary, and difficult-to-measure aspects: reliance is placed on direct dialogue with people and the completion of questionnaires to understand a design intervention's effectiveness in stimulating a particular sensitivity toward nature (an emotional connection that influences world perception and the way of relating to it). It also measures its capacity to redirect personal choices in people's lives and to encourage them to reconsider their positioning and relationship with other living beings (as part of the same system). Themes of identity and participation are touched upon, measuring the extent to which the project has been able to foster a sensitivity consistent with environmental protection.

CALCULATION

Structured inerviews with local community members or questionnaires

REGENERATIVE THRESHOLD

Increase in PEB and environmental protection sensitivity

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

PROPORTION OF INVASIVE SPECIES

This indicator monitors the percentage of invasive species recorded on the project site out of the entire biological community. Invasive alien species threaten ecosystem stability and the survival of native species. Not all alien species are invasive: many species have been able to insert themselves into local habitats without undermining ecosystem functioning. To be defined as regenerative, a project must not only avoid the introduction of invasive species but must also monitor their potential emergence and provide for their timely eradication in order to protect the health of the created habitat.

CALCULATION

$$PIS = \frac{\text{number of invasive species}}{\text{total number of species}}$$

REGENERATIVE THRESHOLD

PIS < 1 %

[L. Chan et al., *Handbook on the Singapore Index on Cities' Biodiversity*, 2021]

UHI EFFECT

In the context of rising global temperatures caused by climate change, urban environments are particularly vulnerable to this phenomenon, given the abundance of heat-absorbing surfaces and emission sources. The expansion of the green fabric enables the contrasting of the urban heat island effect through shading and evapotranspiration. The indicator measures the reduction in air temperature resulting from the design action compared to surrounding urban areas unaffected by the project. The goal is to get as close as possible to the temperatures recorded in the countryside surrounding the city, achieving tangible benefits for the quality of life of urban life forms.

CALCULATION

Direct measurement on site

REGENERATIVE THRESHOLD

$T_{site} = T_{countryside}$

[European Commission, *Evaluating the impact of NBS: Appendix of methods*, 2021]

WATER QUALITY

This indicator tracks the impact of the design device on water quality, namely the changes in pollutant concentration following its implementation. Depending on the nature of the project, its goals, and the location of implementation, it will act through filtering, phytodepuration, or bioretention. Measurement occurs in situ by directly taking water samples (at regular intervals over a period of one year), which are then analyzed for specific pollutants depending on the project's purpose or the site's needs (phosphates, nitrates, heavy metals, etc.). A regenerative project aims to reduce the concentration of pollutants and bring them back within the permissible limits for the protection of biodiversity.

CALCULATION

Direct sampling of water on site

REGENERATIVE THRESHOLD

Significant reduction in water pollutants concentration (below safety threshold)

[IUNC, *The Urban Nature Indexes: Methodological framework and key indicators*, 2023]

NOISE POLLUTION

Prolonged exposure to high noise levels can have negative repercussions on the health of urban fauna. Noise sources can be manifold (vehicular traffic, proximity to railway tracks or airports, industrial activities, or construction sites): the architectural project can mitigate the effects of these sources by adopting morphological configurations that shield the site from excessive noise. However, the problem cannot be addressed solely locally, but requires the implementation of city-wide policies and measures. The indicator is limited to measuring sound levels in the field, ensuring they do not exceed the 55 dB limit for periods longer than 30 minutes (limits established to protect the health of living forms). Furthermore, it is possible to compare measurements taken before and after the project's realization to quantify the impact of the design intervention on this issue.

CALCULATION

Direct measurement on site

REGENERATIVE THRESHOLD

SPL < 55 dB for 30 minutes during noisiest time of a typical day

[IUNC, *The Urban Nature Indexes: Methodological framework and key indicators*, 2023]

AIR POLLUTANTS CONCENTRATION

Excessive levels of air pollutants cause negative repercussions on the health of living beings inhabiting cities. Pollutants can settle on plant leaves, hindering photosynthesis processes and plant growth, with significant repercussions on habitat quality, and thus on the health of the fauna living there. In this context, flora on the one hand contributes to improving air quality, while on the other, it suffers the negative consequences of poor air quality itself. The indicator therefore measures the concentration of harmful substances in the air to ensure it falls back within the safety limits, after the project's realization: Once again, to effectively impact this problem, punctual design interventions are not enough: city-wide and broad-scope policies are crucial for addressing the issue.

CALCULATION

Direct monitoring on site

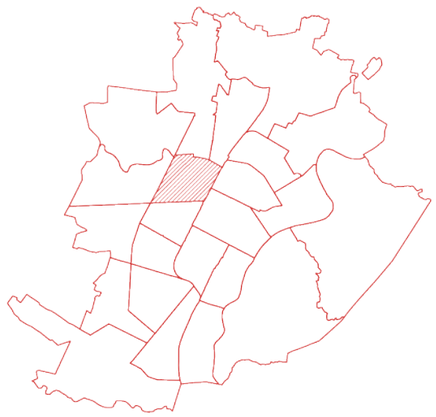
REGENERATIVE THRESHOLD

Significant reduction in air pollutants concentration (below safety threshold)

[IUNC, *The Urban Nature Indexes: Methodological framework and key indicators*, 2023]

05

.01 NEIGHBORHOOD ANALYSIS

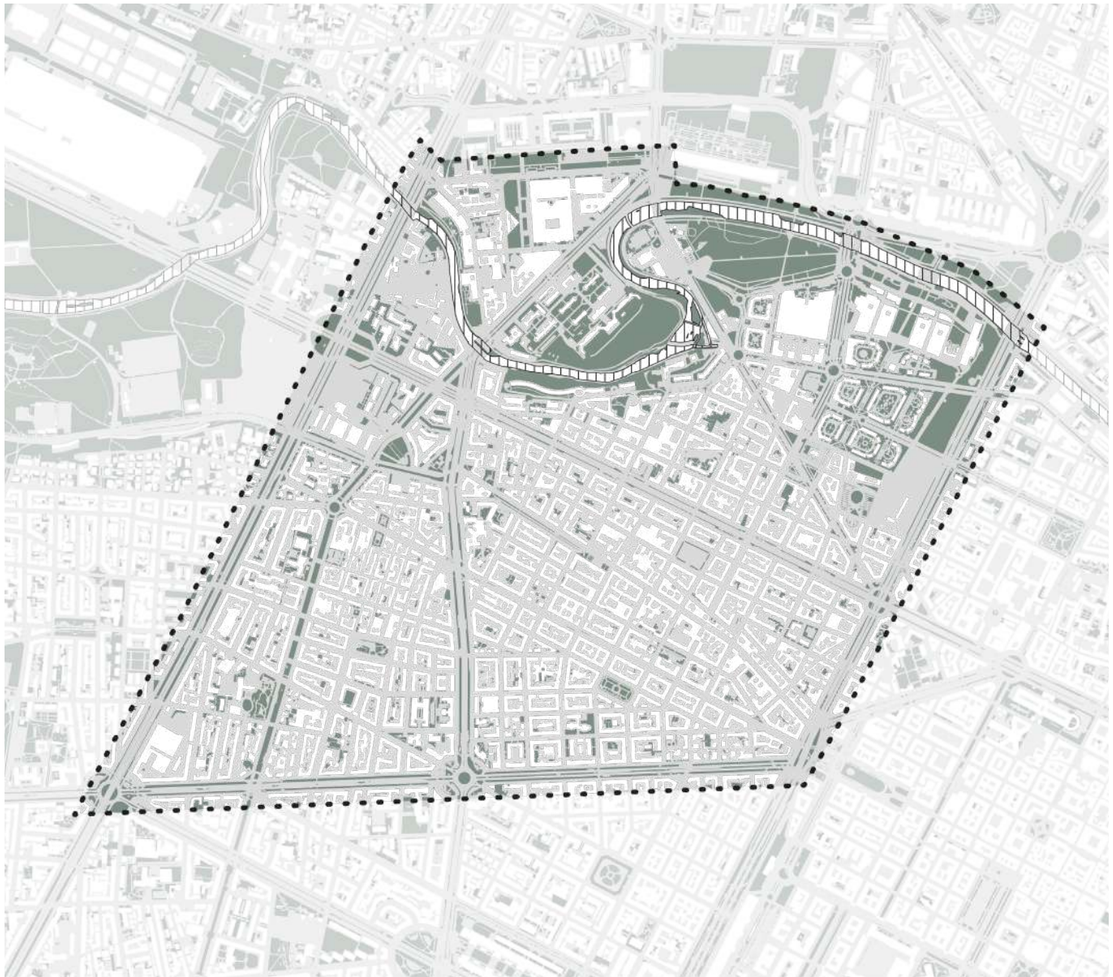


masterplan, which details and expands upon the interventions outlined in the previously presented general map.

This section of the thesis is dedicated to the development of concrete strategies to foster biodiversity in a specific area of the city of Turin. The decision was made to analyze the San Donato neighborhood, an emblematic area affected by the same issues that, more generally, concern the broader Turin context and which find their utmost expression here. This neighborhood is characterized by a compact building fabric (woven into a perpendicular grid, in continuity with the historic blocks of the city center) that, despite its proximity to the riverbanks of the Dora Riparia, presents a significant shortage of green areas and a high vulnerability to the urban heat island phenomenon. The presence of a struggling socioeconomic fabric was a determining factor in the choice of the area to be investigated, with the awareness that an ecological regeneration project, if well managed, can lead to an improvement in the living conditions of the resident population.

Below is an exploratory analysis of the neighborhood aimed at highlighting the main peculiarities and critical issues of the urban fabric. These analyses will be fundamental in the subsequent development of the design

GREEN AREAS

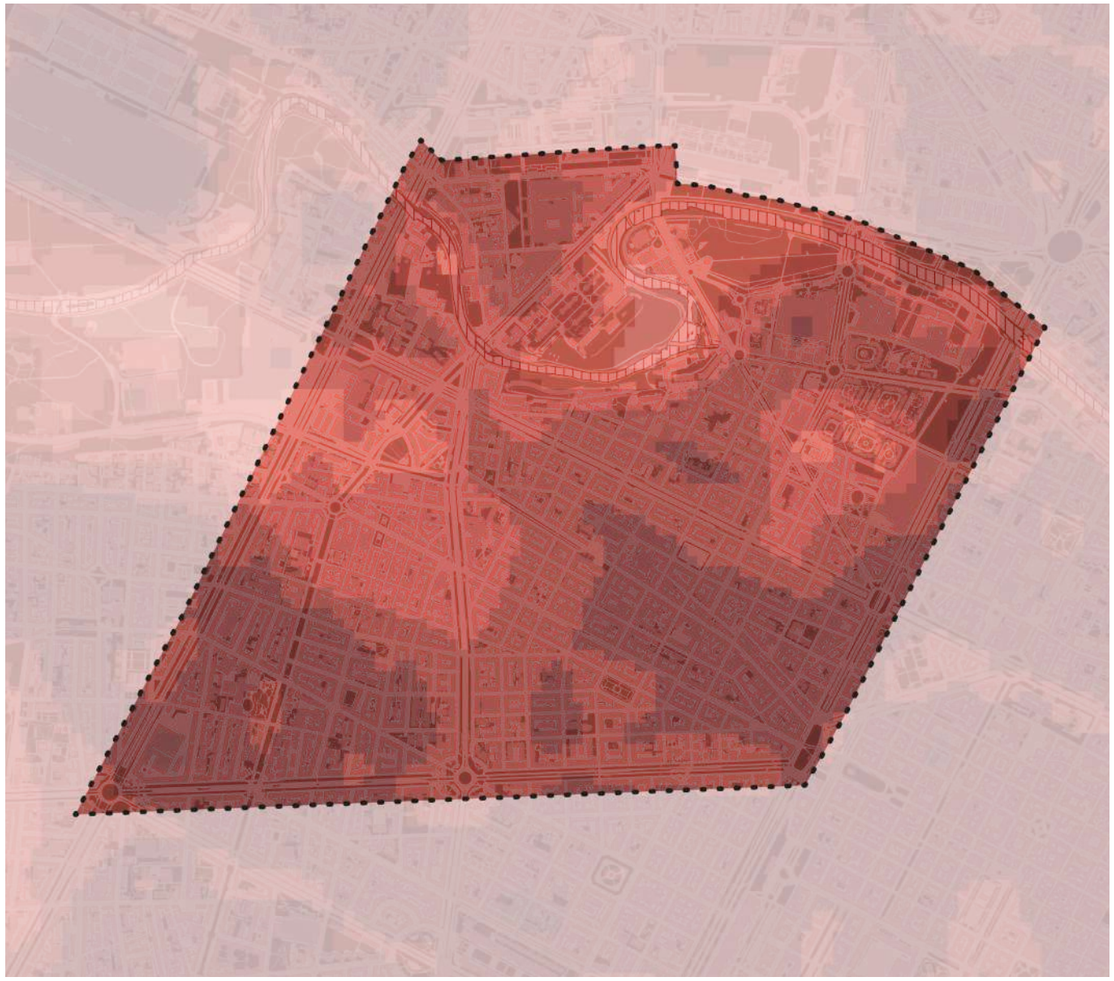


Source: Carta Tecnica, Città di Torino

Green spaces
Impermeable surfaces
Buildings
Water

The neighborhood is characterized by a shortage of green areas. Most of them are concentrated in the northern portion of the study area, along the Dora Riparia river: this is where Parco Dora and the Amedeo di Savoia Garden are located. Moving away from the river, the few available green spaces turn out to be the handful of public squares that carve out space among the neighborhood's blocks, which feature vegetated elements, albeit to varying degrees: this is the case of Piazza Amedeo Peyron, Piazza Risorgimento, and Piazza Barcellona. Finally, an important role is played by the large tree-lined avenues that skirt the neighborhood's perimeter and occasionally cut through the compact building fabric, providing breathing room to an urban area that would otherwise be almost devoid of vegetation.

LAND SURFACE TEMPERATURE

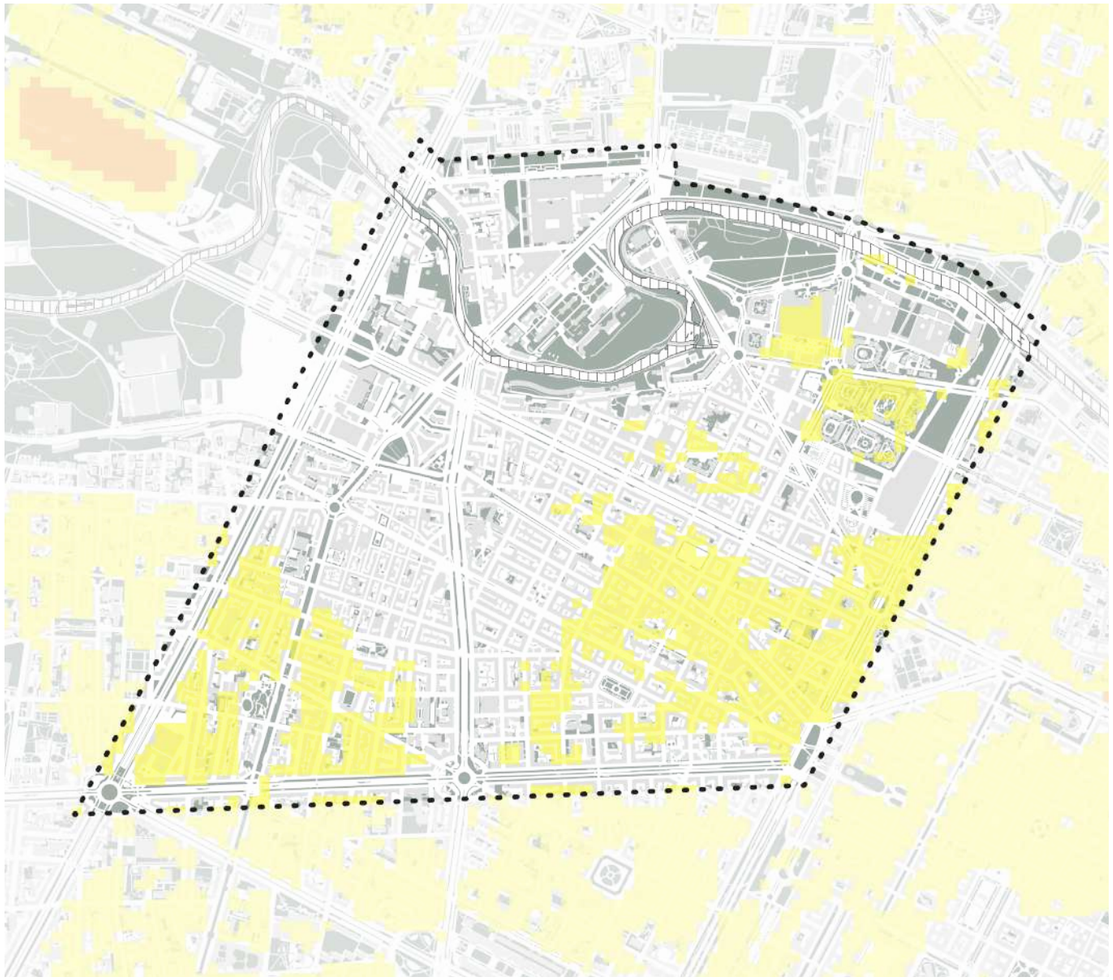


Source: Regione Piemonte

34 °C
32 °C
30 °C
28 °C
26 °C

The proximity of the Dora Riparia river and the presence of vast vegetated surfaces in the overlooking parks reduce the land surface temperature in the northern portion of the neighborhood. Moving southwards, their mitigation effect fades and the ground temperature increases drastically, especially in the south-western sector between Corso Lecce and Corso Tassoni, and the south-eastern sector around Via San Donato. These are highly urbanized parts of the city; the almost total absence of green areas and the excess of heat-absorbing surfaces aggravate the climatic conditions of these areas, making them particularly vulnerable to heatwaves.

URBAN HEAT ISLAND VULNERABILITY



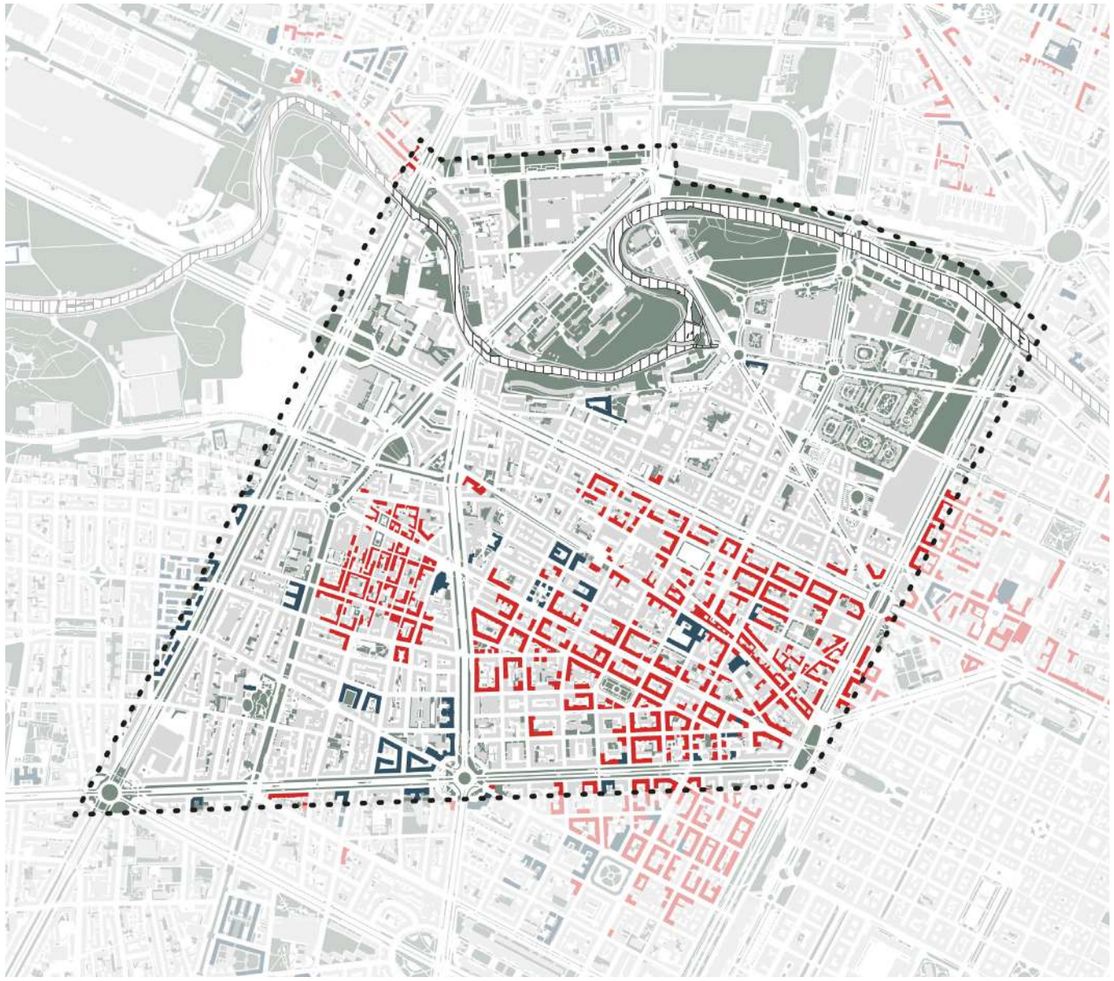
Source: Regione Piemonte

Moderate vulnerability

Green spaces
Buildings
Water

The map clearly highlights the positive role that green areas play in relation to the urban heat island (UHI) phenomenon: around parks and vegetated squares, the vulnerability of the building fabric to UHIs is reduced. The shading provided by tree canopies and the absence of heat-absorbing surfaces are decisive in tackling the phenomenon and improving the neighborhood's livability. The sectors most at risk, consistent with the land surface temperature map, are the blocks facing Corso Svizzera and Corso Lecce, and those located between Corso Regina Margherita and Via Luigi Cibrario in the south-eastern portion of the neighborhood.

HERITAGE-LISTED BUILDINGS



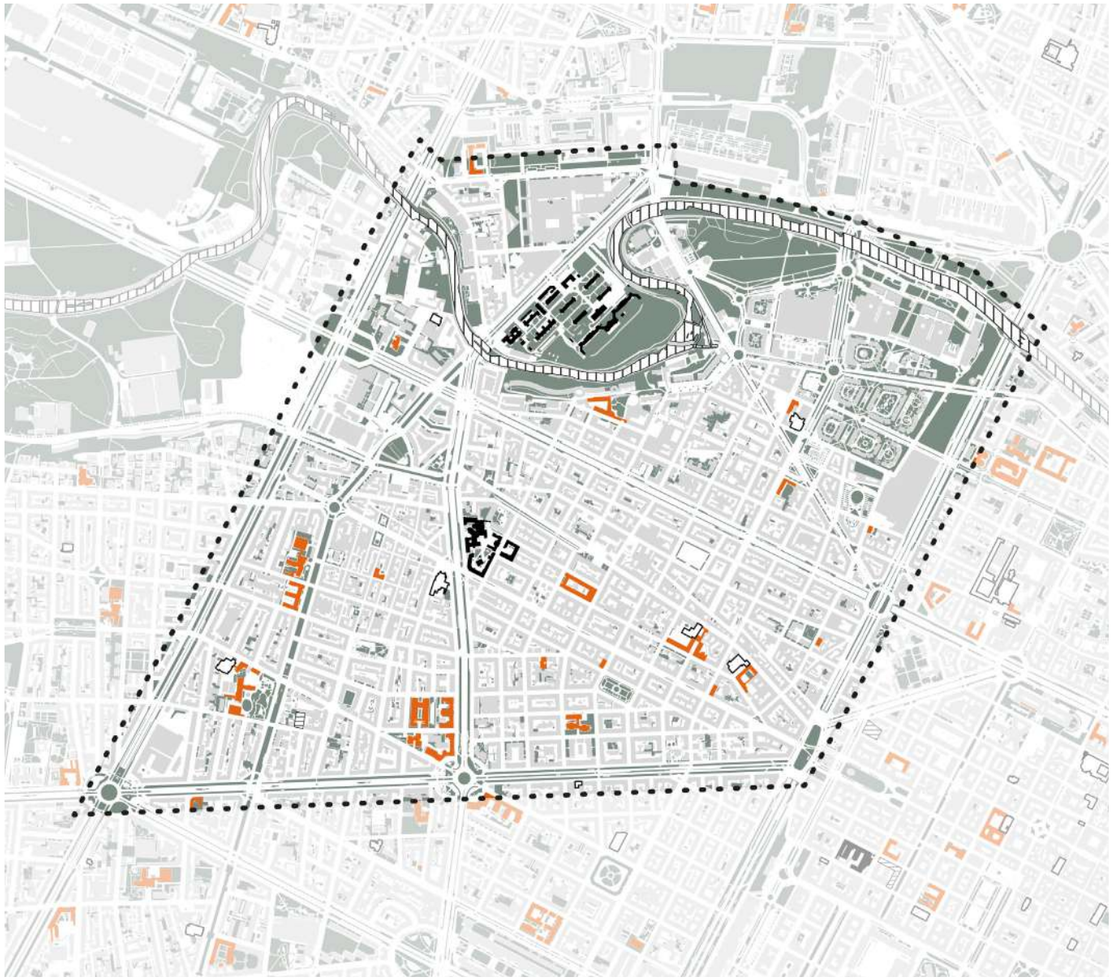
Source: Piano Regolatore Generale, Città di Torino

Edifici di particolare interesse storico
Edifici caratterizzanti il tessuto storico

Green spaces
Buildings
Water

A considerable portion of the neighborhood's buildings is subject to architectural constraints, as they are classified by the Master Plan as "Buildings of particular historical interest" or "Buildings characterizing the historical fabric." Many of these are the result of a subdivision program developed starting from the second half of the nineteenth century, which led to the construction of numerous Art Nouveau (Liberty style) residential buildings between the late nineteenth and early twentieth centuries. For these assets, possible interventions are limited to conservative restoration or conservative rehabilitation, aimed at recovering the existing building structures and maintaining the specific character of the neighborhood. Therefore, it is not possible to alter these architectural assets in any way, effectively reducing the available space for the necessary adaptations of the urban fabric in the face of the challenges posed by climate change.

PUBLIC UTILITY STRUCTURES



Source: Piano Regolatore Generale, Città di Torino

Educational complexes
Hospitals
Churches

Green spaces
Buildings
Water

The map highlights public utility structures: schools, hospitals, universities, and gathering places such as churches, entertainment facilities, and community centers. A heterogeneous distribution of structures within the neighborhood emerges, although some educational facilities are clustered into larger educational complexes. Some of these boast direct access to green areas—fundamental for the proper psycho-physical development of students—and access zones with wider sidewalks to allow gathering outside the building and ensure student safety from traffic at the start and end of classes, when crowds of students populate these spaces. Locating school facilities that lack or are deficient in these safety measures was crucial for the subsequent design phase.

05

.02 MASTERPLAN

The project map was developed with the aim of enhancing the presence of biodiversity in a highly urbanized neighborhood through the creation of a cohesive green network. The tree-lined avenues serve as a crucial foundation from which to consolidate the area's green fabric: in the absence of large vegetated surfaces or available area-based spaces, the controviali represent a viable starting point for this ambitious goal. Reallocating space away from cars—while still allowing vehicular and public transport traffic in the central portion of the road section—may seem like an unpopular and ineffective measure; however, it is essential for realizing the desirable vision of a more livable city for all, both human and non-human.

Existing green spaces are highlighted and categorized into those to be protected as they are—due to their spatial quality and the biological diversity they offer—and those to be consolidated, meaning they require improvement. Furthermore, residual spaces within the street grid have been identified—impermeable, bituminous surfaces often dedicated to parking—which could contribute to strengthening the ecological network.

Following the example of ongoing initiatives in Paris, the residential streets facing school complexes have been designated for greening: the goal is to improve student safety and ensure them direct access to high-quality green spaces. Finally, these streets become part of a secondary ecological network, useful for connecting the neighborhood's green spaces and creating ecological corridors that can be utilized by both humans and fauna for movement. In the construction of this green grid, the areas most susceptible to the urban heat island phenomenon and the urban centralities identified by the new Piano Regolatore Generale currently pending approval were also taken into consideration.

Subsequently, the identified intervention areas are grouped based on their morphology and divided into point, linear, and area-based interventions. Each of these is analyzed individually in dedicated factsheets.

EXISTING PUBLIC PARKS TO PROTECT

GREEN NETWORK TO CONSOLIDATE

STREETS TO VEGETALISE

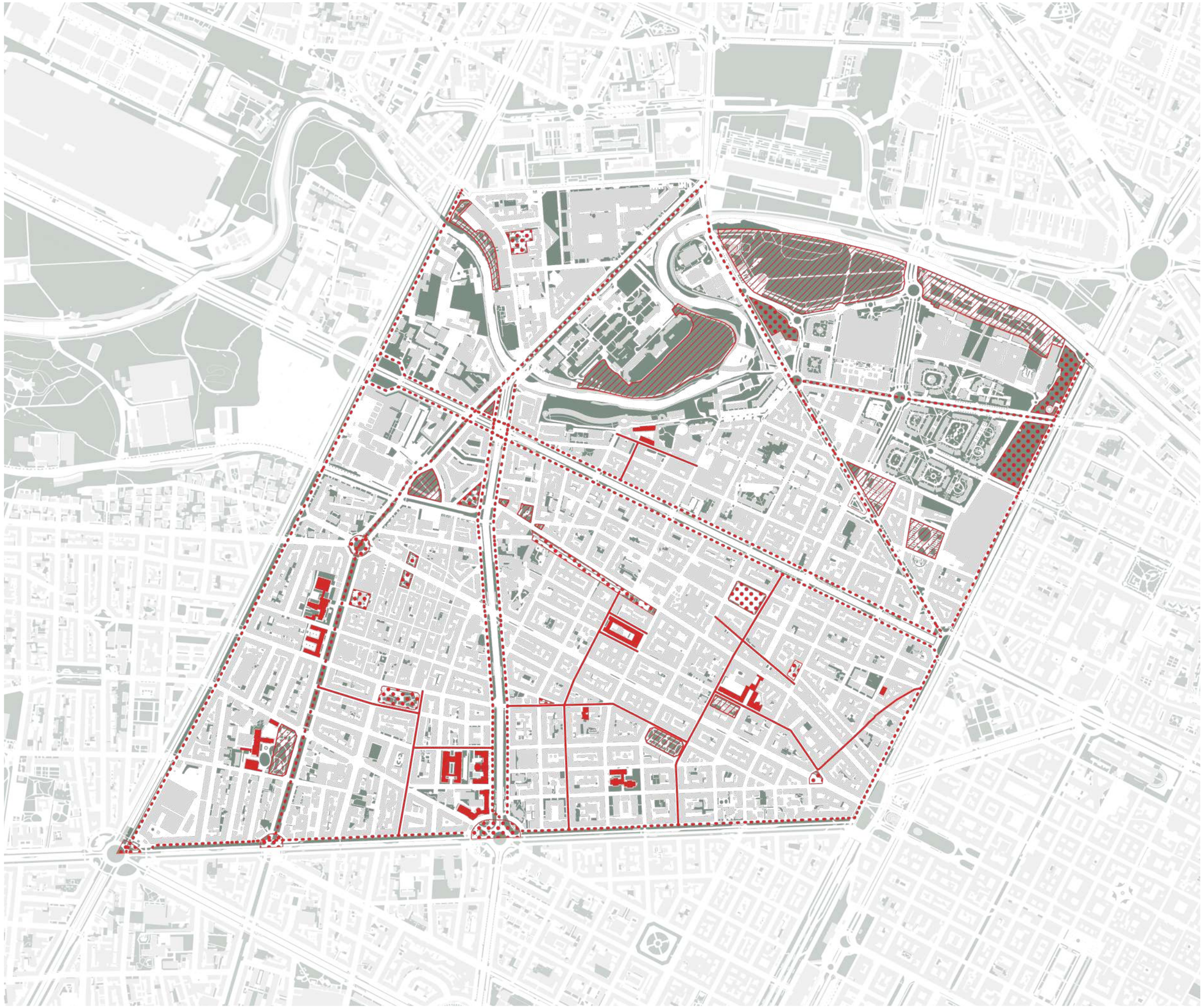
OPPORTUNITY SPACES TO VEGETALISE

SCHOOLS

GREEN AREAS

BUILDINGS

WATER



1:10 000

The following design scenarios are the result of a careful rethinking of urban space: no longer domains exclusive to automobiles, but shared spaces for encounter and interaction among different species. Within the urban morphology of the neighborhood, several recurring configurations have been identified, which served as the starting point for developing the intervention proposals. Five archetypal places were chosen: the building, the side service road (controviale), the neighborhood street, the liminal space, and the public square. Therefore, each of these does not represent specific locations within the San Donato neighborhood, but rather abstractions of the actual urban fabric, with dimensions and proportions consistent with the existing environment. The envisioned scenarios make up a design catalogue that the municipal administration and architectural designers can draw upon to develop concrete interventions on the built environment.

Among the main design operations, depaving interventions are planned, new uses for spaces reclaimed from cars are proposed, along with an intense renaturalization of formerly asphalted areas. Since these design proposals do not concern specific locations, the presence of underground utilities has not been factored in: actual interventions will necessarily require careful mapping of subterranean infrastructure to ensure that the design actions do not interfere with subsurface utility networks.

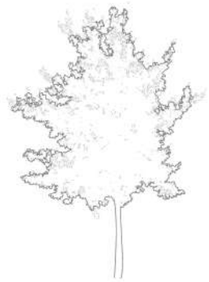
As is known, the city of Turin has a Green Regulation (Regolamento del verde) that governs every intervention on the city's ecological fabric. The introduction of vegetal elements was conceived in accordance with the regulation's provisions: the size classes of the introduced tree species, their dimensions at maturity, and the required setback limits from the street line and the building facade line were taken into consideration.

The choice of tree species used in the design scenarios primarily considered their adaptability to the changing climatic conditions of the Turin urban context. Indeed, a substantial increase in average annual temperatures is expected (on the order of 0.29 °C per decade, according to the most optimistic scenarios contained in the 2020 Climate Vulnerability Analysis commissioned by the Municipality of Turin), as well as an increase in the intensity and duration of heatwaves. For this reason, preference was given to species capable of withstanding rising temperatures and long dry spells. The geographic origin of the plant species, on the other hand, was not a determining factor in specimen selection: a catalogue of both native and exotic species (strictly non-invasive) was compiled, featuring plants that do not require large amounts of water to survive and that adapt well to tropical climates.

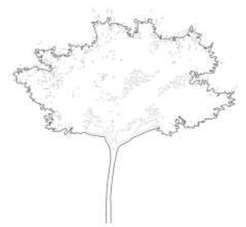
These imaginative visions intend to provide a clear direction to move toward: the difficulty of turning these ambitious projects into reality is not a valid excuse to abandon all attempts to transform our cities into places suitable for life, in all its forms.



PRUNUS PADUS



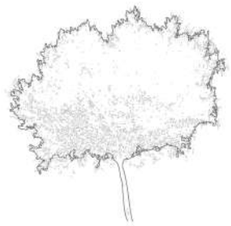
QUERCUS PETRAE



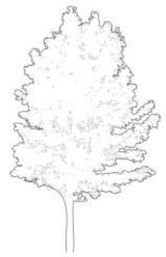
KOELREUTERIA PANICULATA



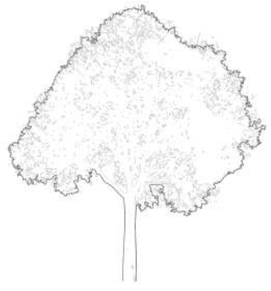
TILIA TOMENTOSA



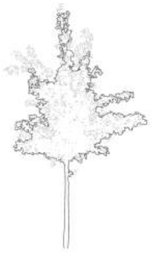
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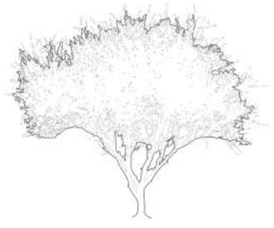
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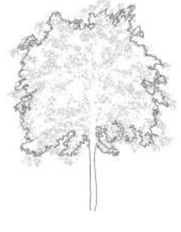
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ACER CAMPESTRE



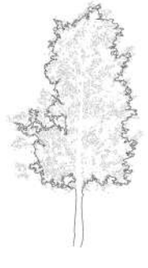
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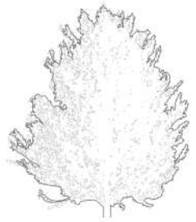
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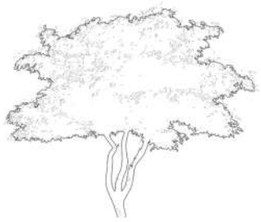
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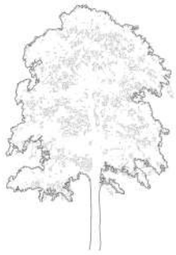
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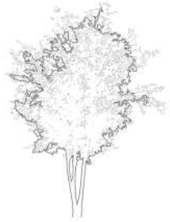
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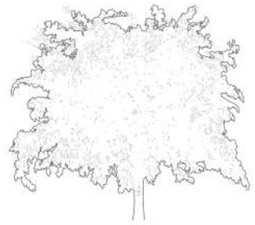
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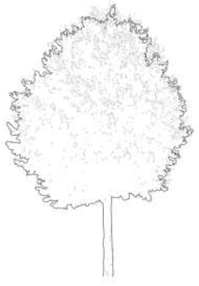
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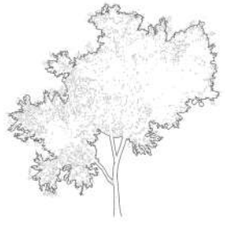
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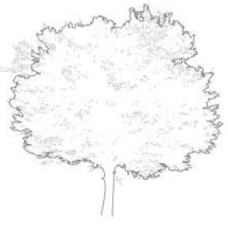
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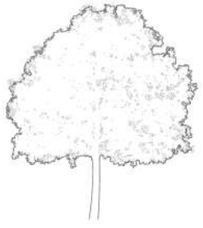
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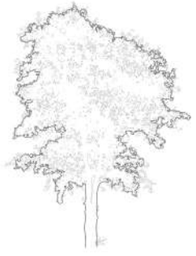
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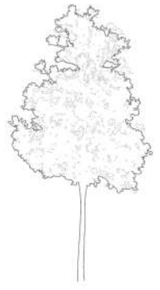
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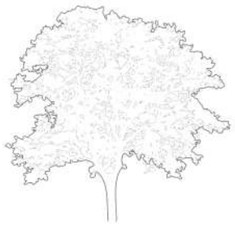
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ALNUS GLUTINOSA



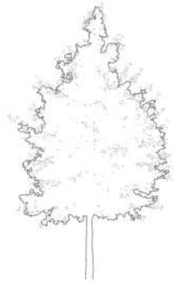
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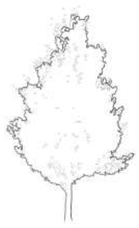
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ACER PSEUDOPLATANUS



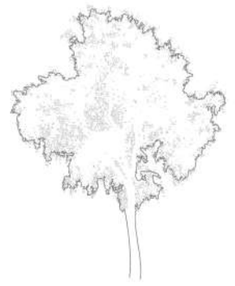
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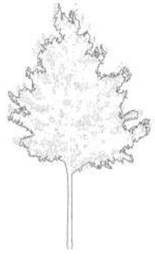
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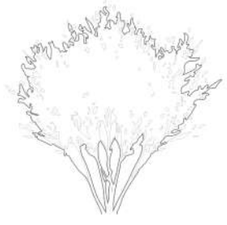
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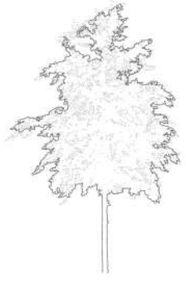
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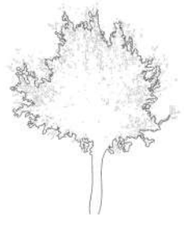
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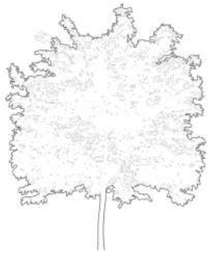
LAGERSTROEMIA INDICA



FAGUS SYLVATICA



CRATAEGUS MONOGYNA

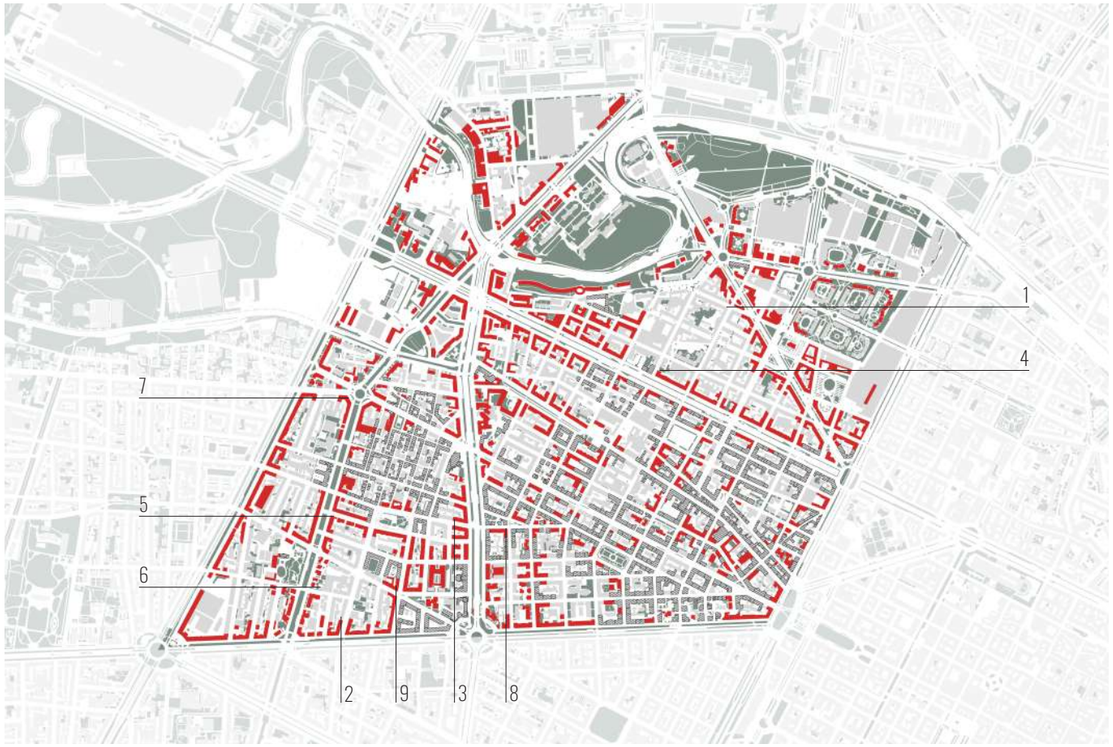


GLEDITSIA TRIACANTHOS



GINGKO BILOBA

POINT INTERVENTIONS



Priority buildings

Listed buildings

The buildings that make up the urban grid possess enormous untapped potential in terms of supporting biodiversity: beyond the horizontal surfaces occupying the space between buildings, the urban fabric features an almost unlimited amount of vertical surfaces that can be made habitable for the non-human actors inhabiting the city. The map highlights the buildings to be prioritized for renaturalization interventions: these are the buildings facing the nodes of the green network visualized in the project masterplan. While recognizing the importance of every single implementation, it is crucial that the implemented transformations fit into a broader network of interventions, avoiding the creation of islands disconnected from the ecological fabric, which would only provide a limited contribution to strengthening the resilience of the urban ecosystem. Buildings that are subject to preservation orders by the heritage authority (Superintendency) for reasons of protecting the neighborhood's historical character have been excluded.

The intervention integrates metal support elements onto the building facades, on which climbing species can grow freely, starting from the ground or from planters positioned at the base of the buildings. Flat roofs are then covered with vegetation, and the blind facades of the buildings are utilized to host support devices for birdlife and various insect species. This creates a safe vegetated corridor connecting the street level, the building roofs, and potentially the courtyards of the urban blocks.



1 - Via Ceva



2 - Via Digione



3 - Via Nicola Fabrizi



4 - Via Vicenza



5 - Via Bianzè



6 - Via Rosolino Pilo



7 - Corso Svizzera



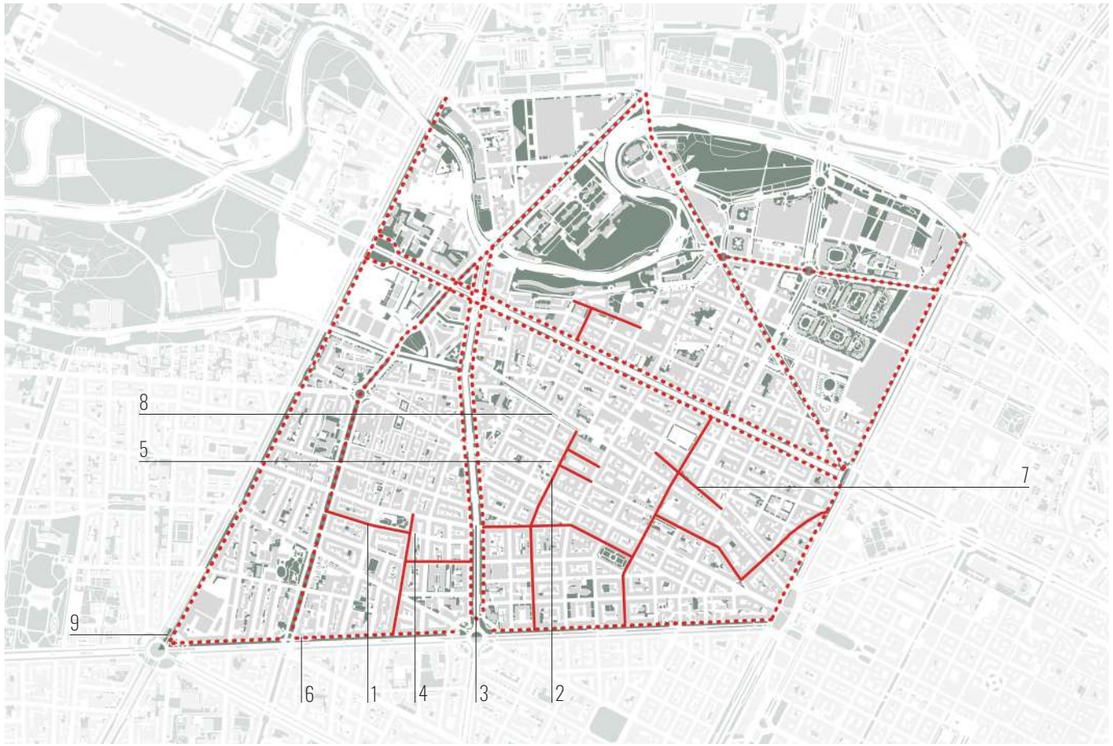
8 - Via Giovanni Migliara



9 - Via Rosta



LINEAR INTERVENTIONS



- Green network to consolidate
- Streets to vegetalise

The linear elements of the project masterplan constitute the backbone of the envisioned ecological network. To date, despite the extensive tree cover, these important thoroughfares are mostly impermeable, with ample space dedicated to car transit or parking. Only occasionally are these parking areas covered with permeable paving. The project involves the reclamation of the side service roads (controviali), with a consequent change in their designated use. These characteristic spaces of the Turin urban context are reclaimed by the city's inhabitants: the road surface is replaced by expansive vegetated areas, and new pedestrian paths are introduced, interspersed with places for gathering and inter-species encounters. In this way, vehicular transit is guaranteed in the central portion of the avenues (preserving their original function), while the corridors created alongside the roadway can be utilized by urban fauna to move safely between the larger green areas.

In support of this main network, a secondary network is created, composed of neighborhood streets that allow vegetation to penetrate deep into the built fabric. The selection of these streets was driven by two important objectives: to provide safe spaces for students along the access routes to school complexes, and to link currently isolated green spaces to the main green network. These streets are therefore closed to vehicular traffic and naturalized: with the exception of a central strip reserved for residents' vehicles and soft mobility, a significant portion of the road section hosts trees and vegetated surfaces.


1 - Via Buronzo


2 - Via Jacopo Durandi


3 - Corso Alessandro Tassoni


4 - Via Vincenzo Nazzaro

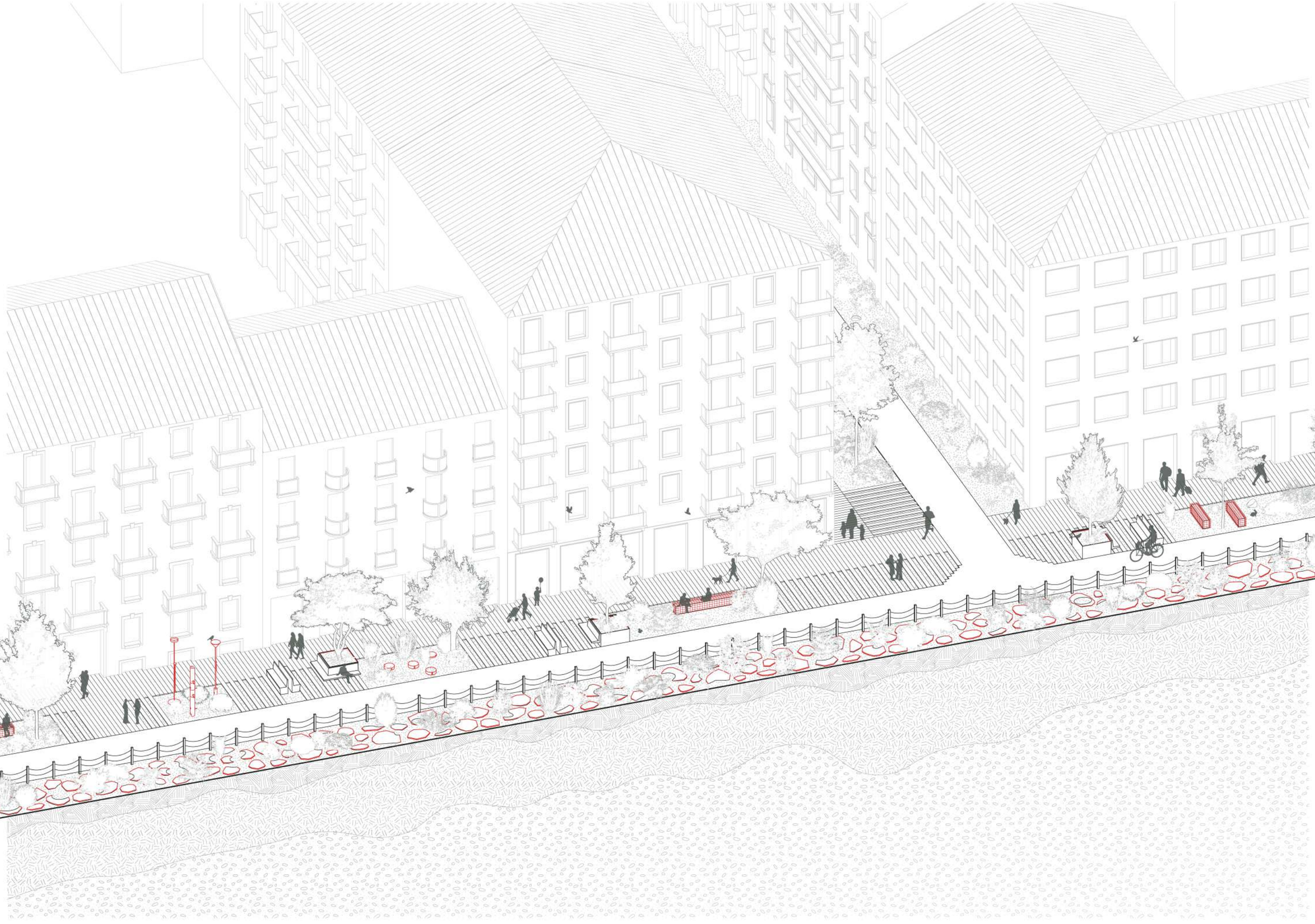

5 - Via le Chiuse

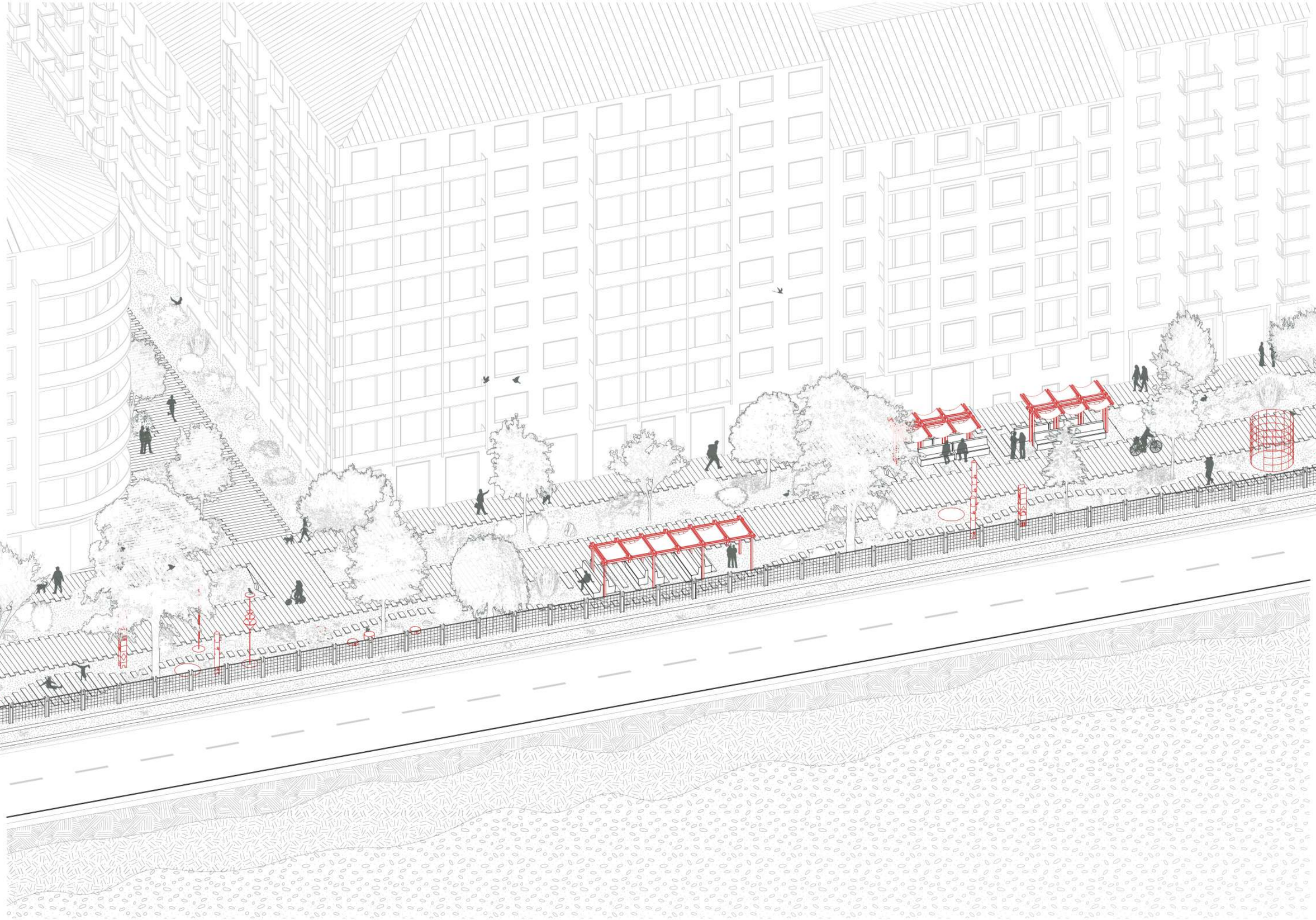

6 - Corso Francia


7 - Via Antonio Pacinotti

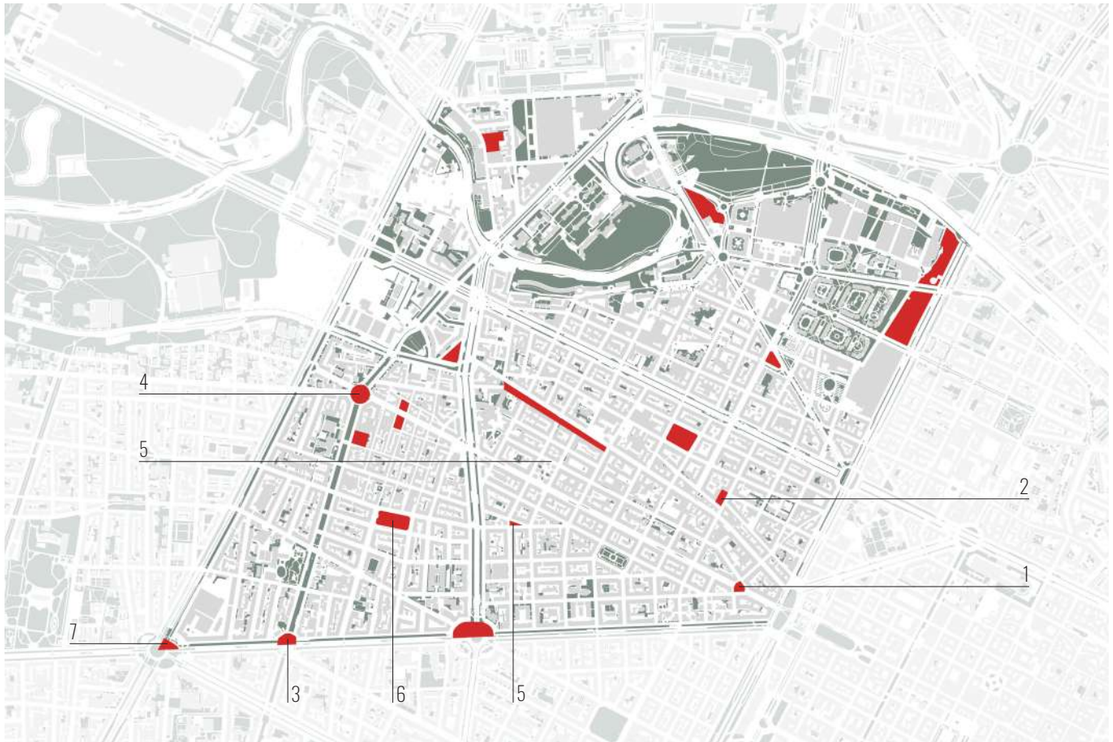

8 - Via San Donato


9 - Corso Lecce





AREA-BASED INTERVENTIONS



Opportunity spaces to vegetalise

Area-based spaces include the interstices at street intersections, neighborhood squares, and open spaces identified by the General Master Plan as “areas of transformation.” These places, varying in size and shape, assume great importance within the ecological network, serving as fundamental stepping stones in the connecting routes between the large urban green areas. Below, it is envisioned how these places can be adapted to host small urban forests, in support of biodiversity.

In particular, the residual spaces of the street grid, often dedicated to parking, are reclaimed from cars to create permeable and vegetated resting areas, where various urban devices are introduced to increase their structural complexity and encourage the emergence of life. Urban squares also constitute a break in the compact built fabric where large green surfaces can be introduced: the presence of a wide variety of plant species and complex permeable surfaces provides animal species with what they need to live and satisfy their needs. The presence of design devices dedicated to more-than-human entities underscores the shared nature of urban space, stimulating encounters between species and, potentially, prompting people to question their own relationship with nature.



1 - Largo Luigi Cibrario



2 - Piazza Innocenzo Vigliardi Paravia



3 - Largo Francia



4 - Piazza Giuseppe Perotti



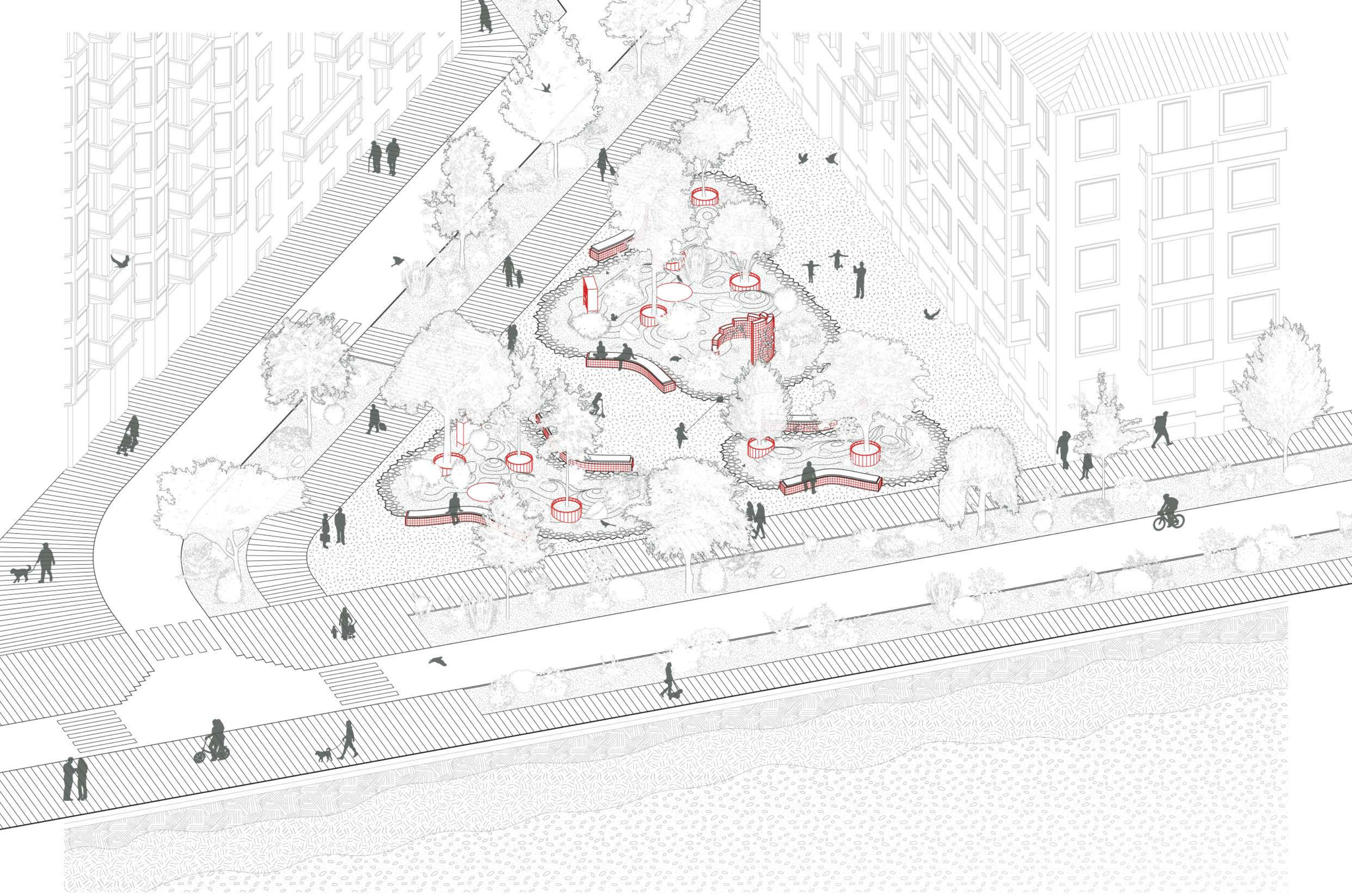
5 - Largo Giovanni Migliara

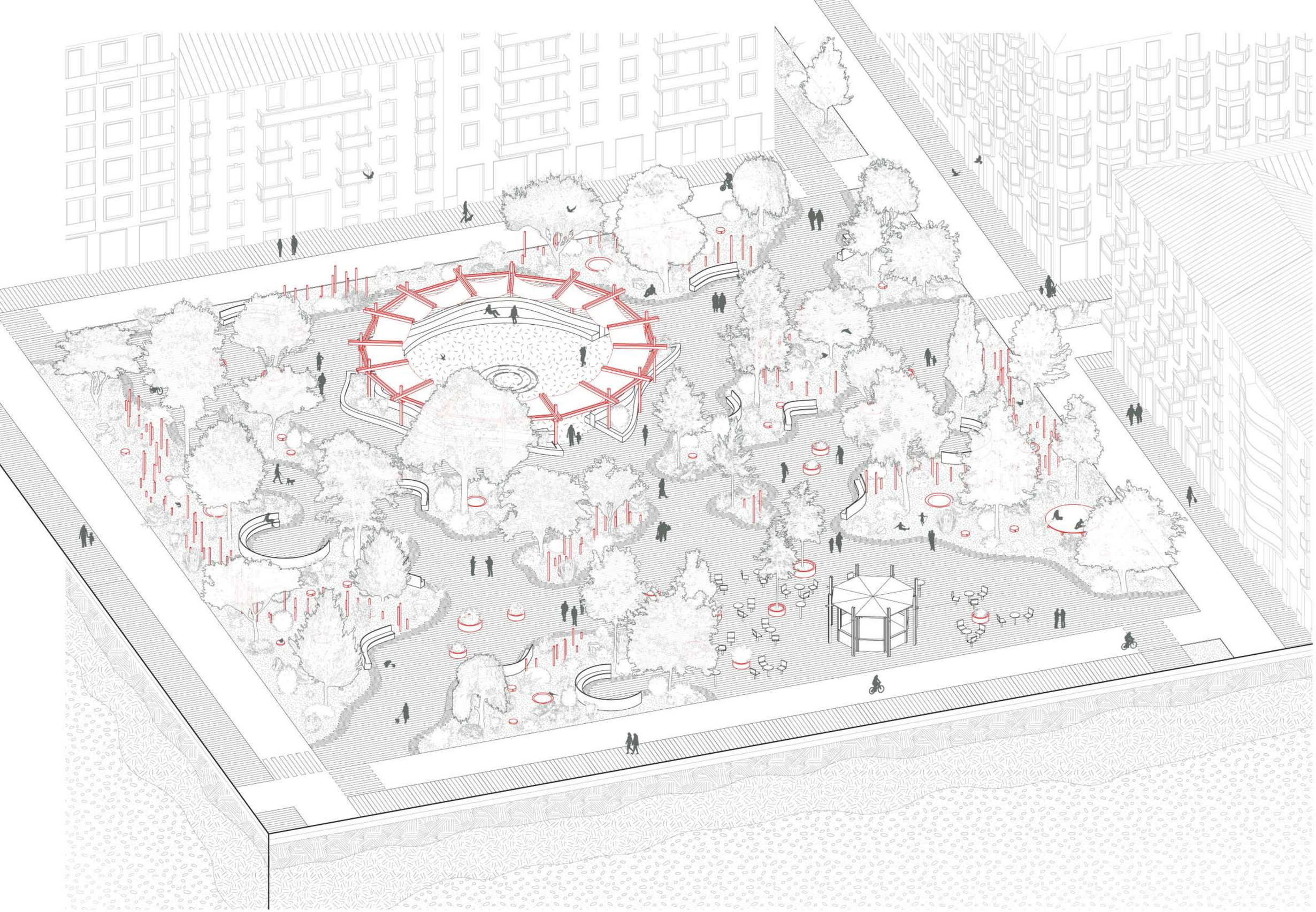


6 - Piazza Risorgiento



7 - Piazza Rivoli





05

.03 PIAZZA BARCELLONA

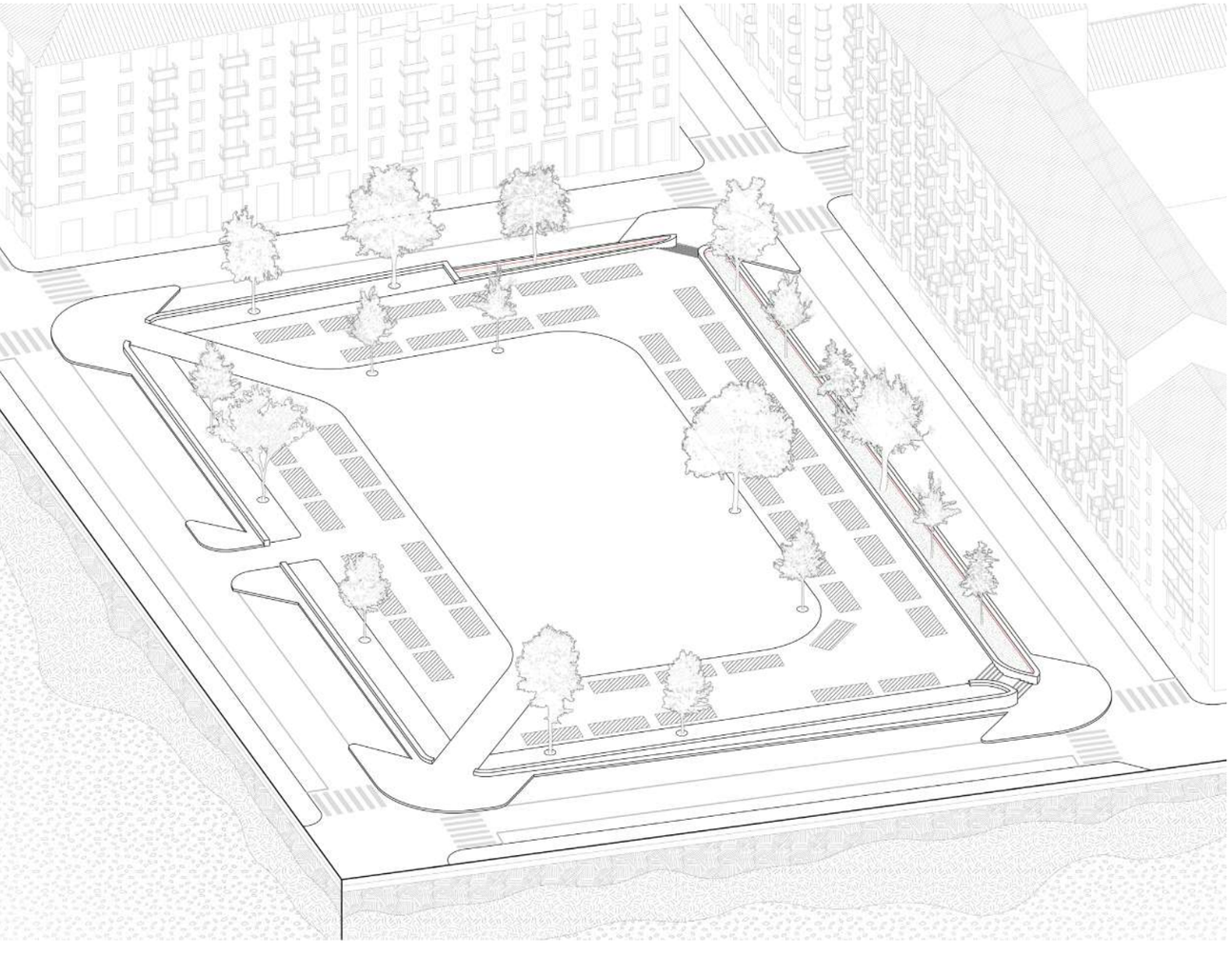


To conclude this thesis project, the acquired knowledge was applied to a real-world case study in the San Donato neighborhood. This is Piazza Barcellona, located in the south-eastern portion of the neighborhood, one block away from Corso Regina Margherita. It is part of the areas designated by the neighborhood master plan as "opportunity spaces to vegetalise."

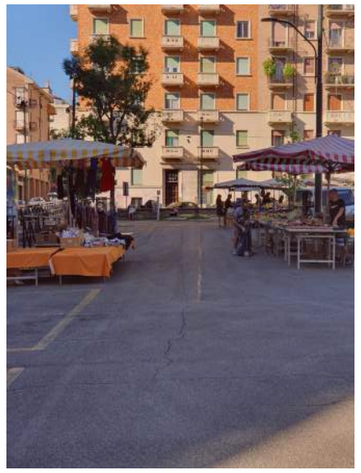
Currently, the square is configured as an almost entirely impermeable space, virtually devoid of vegetation, with the exception of a few tree specimens lining its perimeter. This lack of green areas is attributable to the fact that the square hosts a daily local market. The most recent intervention was carried out in 2015, involving the repaving of the market area and the planting of some trees. The arrangement of the market stalls was also modified, distributing them concentrically around a central area used for parking, thus reinstating the original early twentieth-century layout.

The proposed project maintains a similar configuration of the stalls, while introducing an urban forest in the center of the square and dense rows of trees along its perimeter. The introduction of these vegetated surfaces sits at the intersection of the intent to preserve the square's designated use—retaining a portion of the existing market stalls—and the desire expressed by citizens and the municipal administration to find new uses for the square outside of market operating hours. Justifying a substantial reduction in the number of stalls is the fact that, to date, only 21 of the 56 available spots are occupied on any given Saturday. Rather than attempting to resell the vacant concessions, it was decided to dedicate this space to biodiversity and adopt design solutions that enable new uses for the area.

PIAZZA BARCELLONA











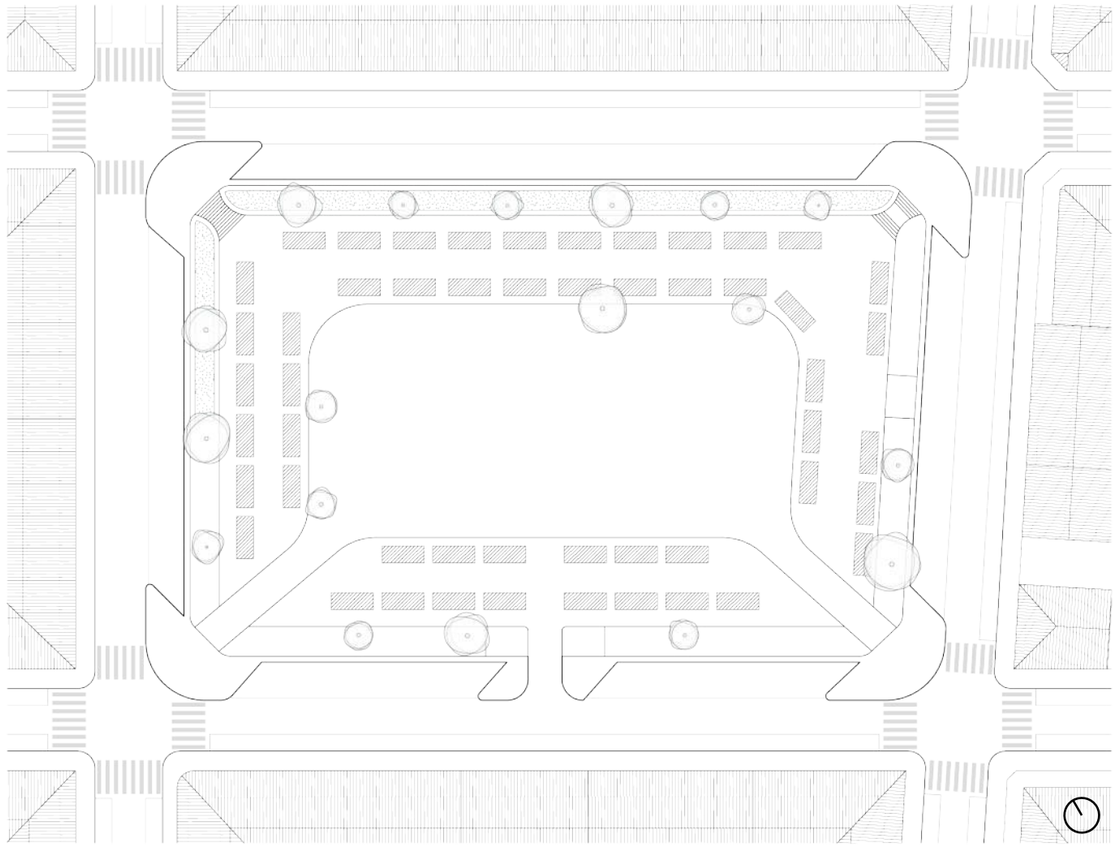




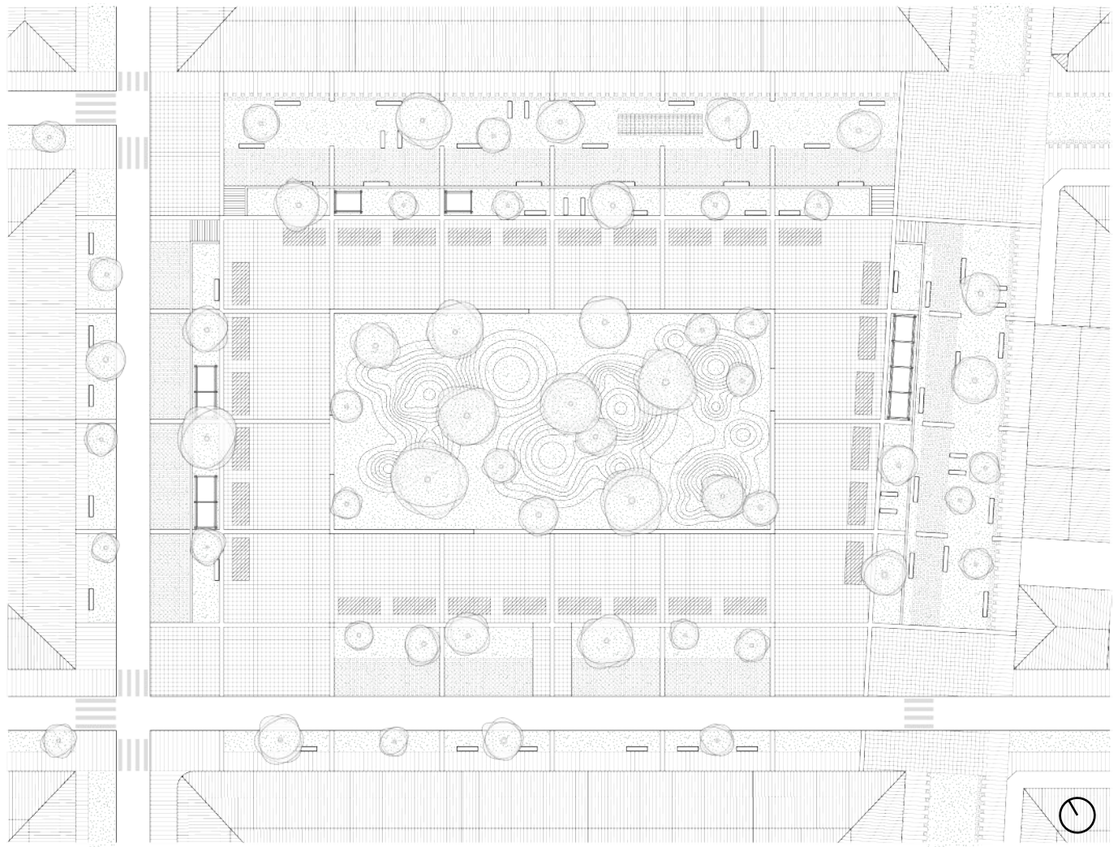


Photos taken by the author

EXISTING PLAN



PROPOSED PLAN



A comparison is proposed between the current state of Piazza Barcellona and the proposed project, including a quantitative evaluation of the effectiveness of the design intervention. Below are four easily calculated indicators that allow for the concise and effective visualization and systematization of some of the main changes made to the layout of the urban block in question.

Clearly, these quantities are insufficient to provide an exhaustive overview of the benefits and positive externalities that the neighborhood's resident community would derive from the intervention. Many aspects can only be evaluated upon completion of the project, while others cannot be numerically quantified (such as the creation of a sense of community and emotional attachment to the lived spaces). It is therefore not the author's intention to argue that the effectiveness of a project is merely a matter of numbers; at the same time, there is no intention to downplay the importance of quantitative indicators, which are highly useful for concisely describing an urban regeneration project.

PERMEABLE SURFACES 90%

Almost the entirety of the asphalt surfaces covering the square is replaced with permeable paving: in total, approximately 8,000 sqm out of the 9,200 sqm of the urban block are made permeable. In particular, the market area surrounding the central forest is covered with porous material that allows water to percolate into the underlying soil, improving urban drainage and reducing water runoff. The only exceptions are the two neighborhood streets bordering the block on its northern and south-western fronts: these vehicular transit axes remain impermeable, but are flanked on both sides by vegetated curbs or draining areas designated for parking.

VEGETATED SURFACES 32%

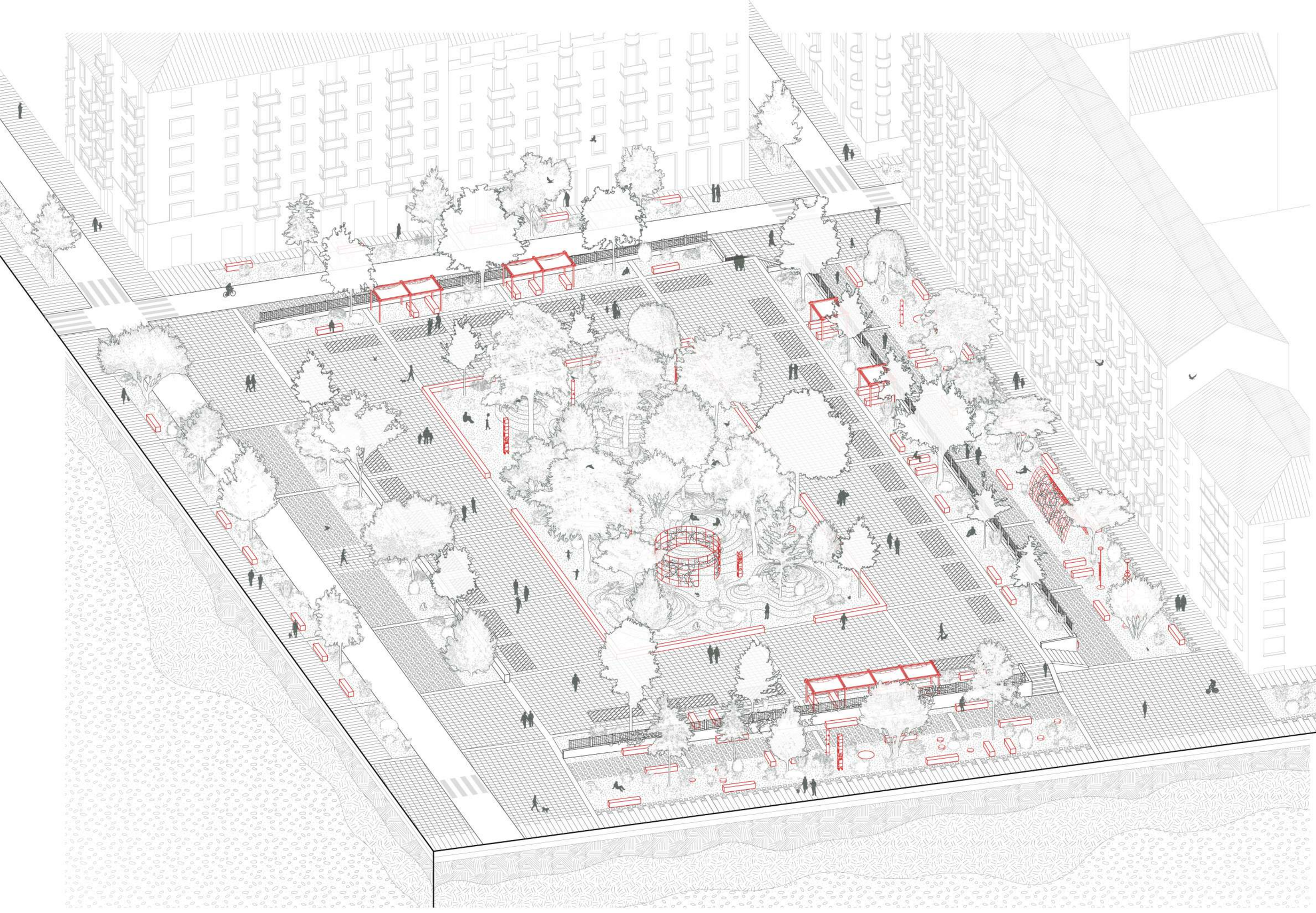
The extent of the vegetation-covered surface has increased tenfold, growing from 250 sqm to a total of approximately 3,000 sqm. This is made possible by the greening of the central portion of the square (through the introduction of a small urban forest for public use), alongside the creation of ecological corridors along the northern and south-eastern fronts. The latter occupy the space previously designated for car transit, which the project has pedestrianized and returned to the community. The intent to preserve the square's original designated use partially hindered the development of a more ambitious design proposal in terms of expanding the ecological fabric.

NUMBER OF TREES 56

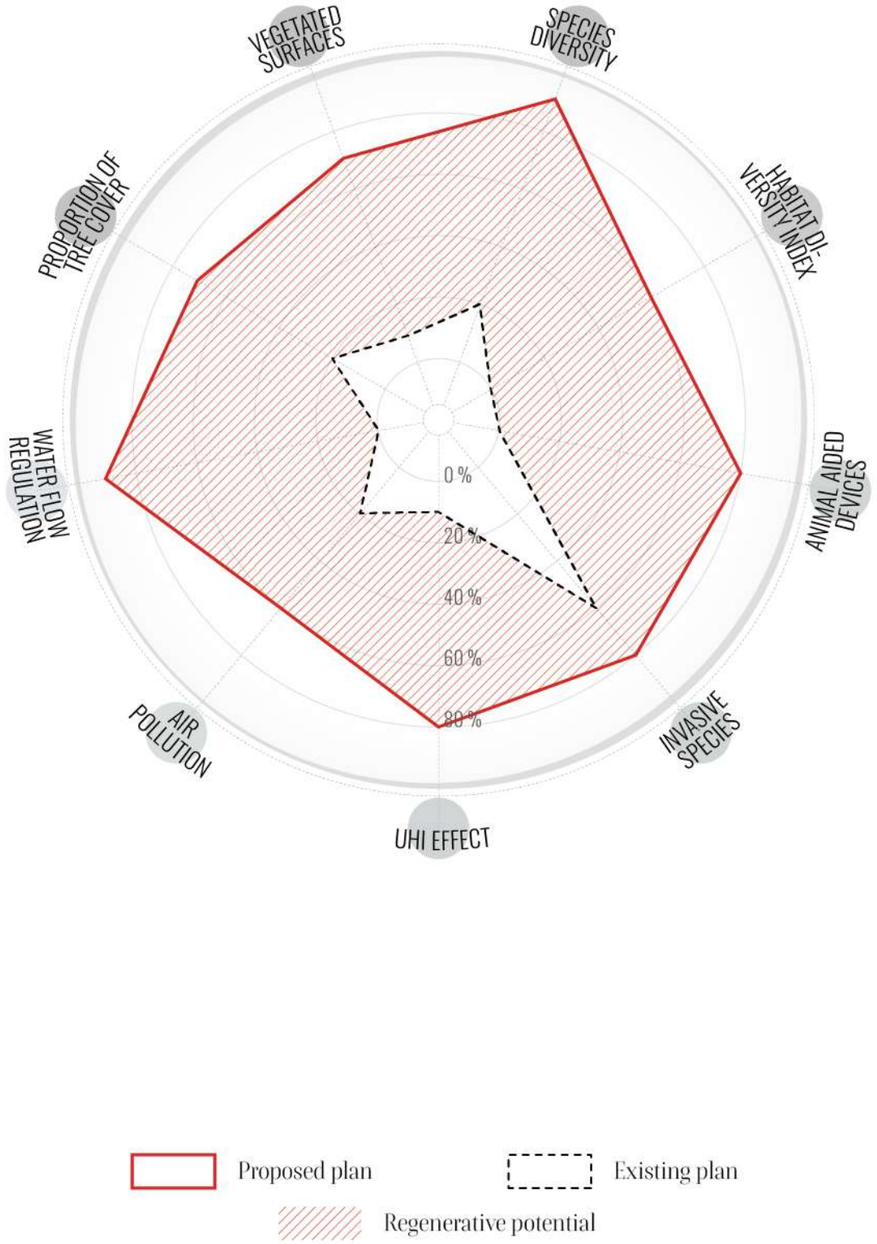
The project involves the introduction of 38 new trees, in addition to the 18 specimens already present in the square. The plant species are selected from the catalogue developed by the author, giving rise to a plant palette that includes about thirty different tree species. The layout of the new trees takes into account the limits imposed by the city of Turin's Green Regulation in terms of size and setbacks from street lines and buildings. Third-magnitude trees have therefore been placed along the ecological corridors outlining the square's perimeter, while the vegetated areas located at a distance of more than 8 meters from the building facades host a variety of first-, second-, and third-magnitude specimens.

TREE CANOPY COVER 25%

The tree canopy cover is quadrupled, aligning with the most updated livability standards. A vast surface area covered by tree canopies brings concrete benefits to local residents and urban fauna: the shading provided helps mitigate the urban heat island phenomenon, lowering the perceived temperature and creating climate refuges where one can find relief during increasingly frequent heatwaves. Furthermore, the presence of tree specimens—together with the vegetated surfaces and the introduced multi-species devices—substantially increases the structural complexity of the square, creating an urban ecosystem in which various forms of life can settle and thrive.



DESIGN EVALUATION



VEGETATED SURFACES

The project greatly enhances the vegetated areas in the square, without erasing the necessary space occupied by the daily market: overall, a 32% vegetated surface area is achieved. The intent to preserve the space allocated to the market stalls aims to maintain the original designated use, respecting its social cohesion function, although it partially reduces the natural regeneration potential of the architectural intervention.

TREE CANOPY COVER

The installation of new trees increases the amount of surface shaded by tree canopies, raising the total value to 25% and aligning with recently outlined standards. Similarly to the vegetated surfaces, the presence of the market spaces slightly reduces the natural regeneration potential of the architectural intervention.

HABITAT DIVERSITY

A variety of species are planted in the new square and arranged to enhance the necessary variety of habitats. Variations in shrubs, grass, trees, and soil topography introduce structural complexity that helps urban fauna settle and meet their needs.

INVASIVE SPECIES

The proposed project does not include the planting of invasive species that could compromise the stability of the created ecosystem. Over time, however, the emergence of invasive alien species cannot be ruled out: continuous monitoring of the area is of vital importance to halt the growth of such specimens at an early stage.

SPECIES DIVERSITY

Numerous trees from approximately 30 species are planted on Barcellona Square: monoculture is avoided to enhance the resilience of the new ecosystem and support a variety of different ecological dynamics.

AAD DEVICES

The installation of birdhouses and feeders, water retention ponds, and insect hotels is intended to encourage the emergence of more-than-human life forms. The numerous devices aim to attract local fauna by addressing their needs and necessities and restoring the ecological dynamics necessary for the new habitat to thrive.

WATER FLOW REGULATION

The project foresees the substitution of asphalt with a hard, porous material that allows water to percolate into the underlying soil. The numerous vegetated areas further enhance the project's capacity to manage heavy water flows, avoiding runoff and ensuring rainwater doesn't leave the project site.

AIR POLLUTION

It is anticipated that the extensive plant community—consisting of shrubs, trees, and lawn surfaces—will have a significant impact on the area's air quality. The pedestrianization of two of the four street axes bordering the square constitutes an additional effective measure to reduce the anthropogenic disturbances that the created ecosystem must handle.

UHI EFFECT

The vegetation provides abundant shade, giving solace to both human and non-human actors inhabiting the square. It is difficult to predict the project's actual effectiveness in combating the phenomenon; however, the presence of reflective surfaces that reduce heat absorption, combined with the shading provided by the vegetation, is expected to allow for a decrease in the perceived temperature on the order of a few degrees.

06

CONCLUSIONS

Ecco la traduzione della versione aggiornata della tua conclusione. Come richiesto, ho mantenuto intatte le parti che avevamo già perfezionato per garantirti la massima coerenza, e ho integrato le tue nuove, ottime aggiunte con lo stesso rigore accademico e stilistico.

Against the backdrop of a rapid decline in global biodiversity, urban centers rank among the primary drivers of this unprecedented crisis. To avert the perpetuation of extractive patterns toward nature, a complete paradigm shift in our approach to the built environment is required: this thesis embraces the conviction—which has emerged only in recent years—that architecture must assume a regenerative role from multiple perspectives, foremost among them the ecological one. This shift in perspective stems from a fundamental ethical principle: regarding the natural world as an independent subject, rather than a mere pool of resources to be exploited at will. Within this theoretical framework, a different vision of the city emerges: not merely a cluster of anthropogenic activities, but a shared space inhabited by various forms of life—a common ground for forging positive relationships between species while acknowledging and accommodating inevitable conflicts.

In the challenge we are facing to halt and reverse global biodiversity loss, there is no single, definitive solution. Each of the involved actors must play their part, policymakers and architects included. The technical tools developed thus far have proven inadequate or insufficiently impactful; for this reason, a paradigm shift is necessary, along with the adoption of a new value system based on ethical principles of multispecies justice, which re-evaluates the existing power dynamics within the human-nature relationship and aims to promote greater equilibrium.

The thesis work has carefully navigated between the strategic and design levels, recognizing that overarching plans cannot be implemented without concrete design tools, and conversely, that individual projects struggle to achieve their intended goals if they are not integrated into a broader action framework.

The analysis of urban biodiversity plans highlights the importance of having adequate regulatory tools to manage and expand the city's green fabric. Moreover, a necessary condition for triggering tangible changes is the presence of strong political will—an administration that considers green infrastructure a priority area of intervention. At the strategic level, a city-wide master plan was therefore developed, aimed at strengthening the resilience of the ecological network and expanding its dedicated areas. This strategic document embodies a different conception of the city: not a biological desert from which to expel any non-human entity, but rather the ideal setting in which to build a different relationship with nature, combat the extinction of experience, and reverse the progressive process of alienation from the very ecosystems of which we are a part.

Such an approach is not without its skeptics and detractors. The introduction of nature into challenging urban contexts in need of improved urban quality is often criticized and held responsible for gentrification phenomena, where the resident population is forced to abandon their homes due to an increase in the cost of living, driven by the heightened attractiveness of the regenerated areas. The phenomenon of green gentrification is an established and concerning reality; however, it cannot serve as yet another excuse to hinder the transformation of cities. One cannot confuse a symptom of the problem with the root cause of inequalities. In this regard, municipal administrations must do their part to limit speculative phenomena and protect the needs of the resident population.

In this thesis work, the intent was to demonstrate how nature must become an integral design material: not a decorative element, nor a mere expedient to increase the economic value of a property, but an essential component of the design process, capable of influencing its decisions and outcomes. The catalogue of architectural devices thus aims to show how ecological knowledge can shape space, and how including more-than-human entities among the beneficiaries of design actions tangibly impacts the morphology of the built environment. The possibility of expanding the range of stakeholders involved in the development of new design solutions for our cities represents, in this sense, a concrete opportunity for the designer. These design tools were subsequently employed in the development of design scenarios for the San Donato neighborhood, demonstrating how the pivotal places of the neighborhood's urban morphology (and, more generally, of the city) can and must be adapted to foster biodiversity, thus turning the city into a true multispecies reserve.

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