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GREEN SKILLS FOR CITIES

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Parco de Mä

Reimagining one street at a time

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1. Introduction.

Genoa, the capital of Liguria and a historical port city in northern Italy, is one of the most remarkable and picturesque cities in Europe. Nestled between the Ligurian mountains and the azure blue sea, Genoa boasts a unique and captivating blend of natural beauty and cultural richness.

With a history dating back to ancient times, Genoa's strategic location on the Mediterranean coast made it a prosperous centre of trade and commerce. During the Middle Ages, the city became one of the most influential trading powers in Europe, and its wealth and influence extended beyond its borders. Genoa's historical legacy is evident in its many examples of mediaeval, Renaissance, Baroque, and Gothic architecture, which can be seen throughout the city's winding streets and picturesque piazzas.

Despite its rich history, Genoa's fortunes declined in the modern era, and the city faced a series of challenges including economic decline and urban decay. However, in recent years, the city has undergone a transformation, revitalising its historical landmarks and cultural offerings, and embracing new technologies and innovations to promote growth and development.

Fig. 1. Aerial view of Genoa city.

Today, Genoa is a vibrant and thriving city, renowned for its beautiful architecture, rich cultural heritage, and thriving port. Its many museums, galleries, and cultural institutions attract visitors from around the world, while its bustling markets, delicious cuisine and waterfront promenades offer a unique glimpse into the city's past and present.

According to the ministerial decree of April 2, 1968 (Art. 3. Rapporti massimi, tra gli spazi destinati agli insediamenti residenziali e gli spazi pubblici o riservati alle attivita' collettive, a verde pubblico o a parcheggi) every citizen should have at least 9 square meter of areas for public spaces equipped for park and play and sports in the surrounding area[1]. Currently in Genova only 6.3 square metres of green space per inhabitant is present[2] while the average in Italy is 32.8 square metres. Smog levels are still too high in Italian cities and especially far from the regulatory limits set by the European Union for 2030[3]. Air pollution is considered by 47 percent of Italians the number one environmental emergency, according to the Coldiretti/Ixè survey[4]. It is therefore necessary to intervene in a structural way by rethinking the development of cities and encouraging the development of greenery and parks with elements best suited to the climatic and environmental conditions of individual territories. With this project a possible approach to resolve these issues is proposed.

[1] https://www.gazzettaufficiale.it/eli/id/1968/04/16/1288Q004/sq
[2] https://www.coldiretti.it/ambiente-e-sviluppo-sostenibile/smog-citta-fuorilegge-con-soli-328-mq-di-verde-a-testa
[3] https://www.legambiente.it/wp-content/uploads/2021/11/Rapporto_Malaria_2023.pdf?_gl=1*1l4olyj*_up*MQ..*_ga*Mjk0MjIzODc1LjE2ODQxNTc5NDc.*_ga_LX7CNT6SDN*MTY4NDE1Nzk0NS4xLjAuMTY4NDE1Nzk0NS4wLjAuMA..
[4] https://www.coldiretti.it/ambiente-e-sviluppo-sostenibile/smog-citta-fuorilegge-con-soli-328-mq-di-verde-a-testa

Fig. 2. Major urban concerns of the city of Genoa.

Genoa faces challenges against planetary emergencies such as climate change and natural disasters. The two major issues that Genoa has faced over the past decades are the fluvial flooding of the Bisagno river and a drastic rise in the urban heat island effect in the city due to heavy concentration of built environment. From 2010 to 2021, 21 extreme weather events have occurred in Genoa, including severe flooding that devastated parts of the city and disrupted rail and road infrastructure[5]. The triggering cause of these events are often heavy rainfall that occurs in a short amount of time causing the subsequent overflow of the Bisagno stream and other waterways involved.

[5] https://cittaclima.it/wp-content/uploads/2021/11/CC21_Rapporto-DEF.pdf

2. Site Analysis.

Foce, a neighbourhood in Genoa, Italy, is a vibrant and diverse area with a rich history and a range of attractions. Located near the sea, it offers picturesque views and easy access to the waterfront. Foce is characterised by its lively atmosphere, with regular cultural events, art exhibitions, and live performances taking place in the area. The neighbourhood's architecture reflects its history, featuring a mix of traditional buildings and modern structures. The river Bisagno passes through Foce below SS1 highway before merging in the Liguarian sea.

Fig. 3. A city map of Genoa.

Located between the Foce and Albaro neighbourhoods, via Casaregis occupies a site that reflects the contrasting characteristics of its surroundings. Despite residential buildings lining both sides of the street, the area suffers from a dearth of commercial establishments and a lack of vibrant leisure activities. Moreover, the site is devoid of vegetation, with a noticeable absence of trees along the street and walkways. However, the site encompasses 320 car parks, 150 motor parks, and 6 waste bin locations. These parking facilities serve the needs of local residents as well as visitors who come to enjoy the nearby seafront area.

Fig. 4. Site images of Via Casaregis

The new waterfront development plan by RPBW for Levante aims to provide a mixture of functions and permeable open spaces capable of infusing the context and creating opportunities for meeting and socialising. The Urban Park, covering 16,000 square metres, forms the link between city and port and it represents the point of arrival from the main boulevards. The park provides mineral and green areas while opening generous views toward the sea. Along it, the Seafront Promenade extends the cycle-pedestrian paths and restores the pedestrian potential of the seafront.

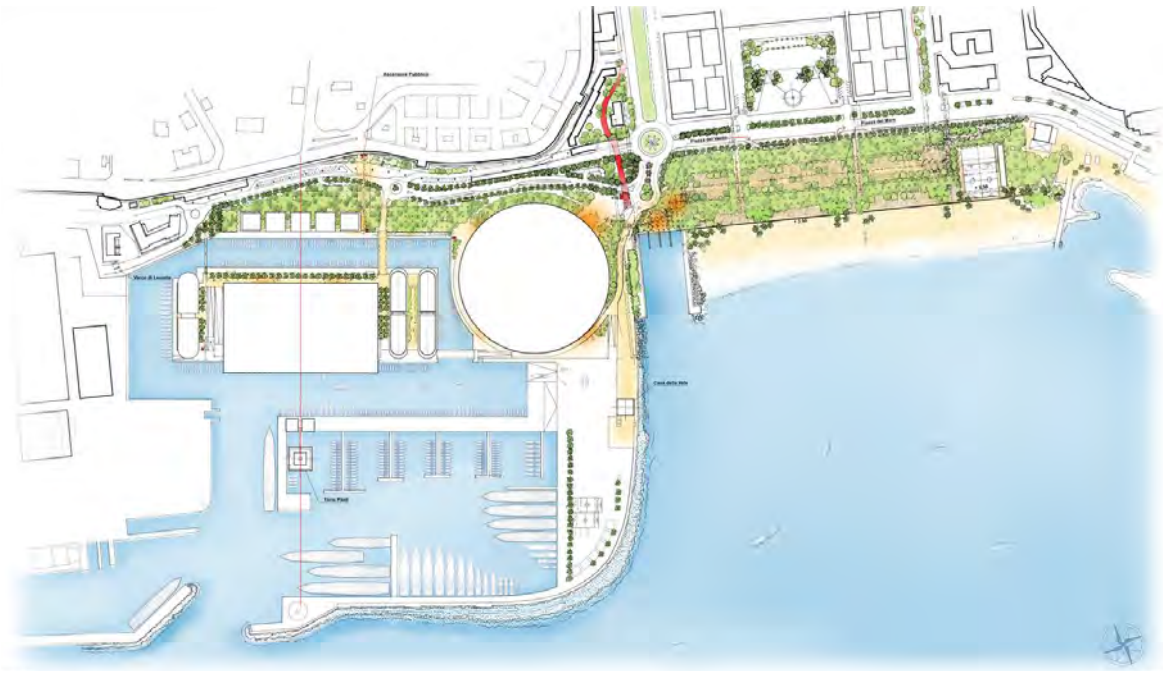


Fig. 5. Seafront Master Plan

This new urban space will attract more residents and tourists and hence adds more importance on how via Casaregis must be reimagined as the transition space between the seafront and the Foce neighbourhood. The context surrounding the site is primarily residential, with retail spaces at the street level and a few commercial buildings scattered around. Additionally, there are several places of worship in the vicinity. Vegetation is predominantly found in the Albaro neighbourhood, mostly in the form of private green spaces. There is a notable disparity in the availability of green areas between Foce and Albaro, which can be attributed to the correlation between income levels and property prices in the respective neighbourhoods.

Fig. 6. Land Use pattern around via Casaregis

Fig. 7. Ecological Assets around via Casaregis

The area surrounding the site exhibits a high ratio of built to unbuilt spaces, leading to a pronounced urban heat island (UHI) effect. A noticeable contrast is observed when comparing the Foce and Albaro neighbourhoods, primarily due to the discrepancy in vegetation. This suggests that introducing additional greenery could help mitigate the UHI stress. In terms of water management risk, the area is predominantly impermeable, raising concerns about fluvial flooding from the Bisagno River that runs beneath the S22 in Foce. Furthermore, the coastline faces a significant threat from rising sea levels. These factors highlight the importance of addressing water-related challenges in the vicinity. Implementing measures to enhance permeability and flood resilience, such as creating green spaces and improving drainage systems, can contribute to better managing these risks.

Fig. 8. Urban heat island effect around via Casaregis

Fig. 9. Flooding risk around via Casaregis

3. On Site Dialogue.

To better understand the needs of the community living in the area we had several interviews with people we met on site. This allowed us to have an insight of the living quality in the area, people's concerns and wishes from different perspectives.

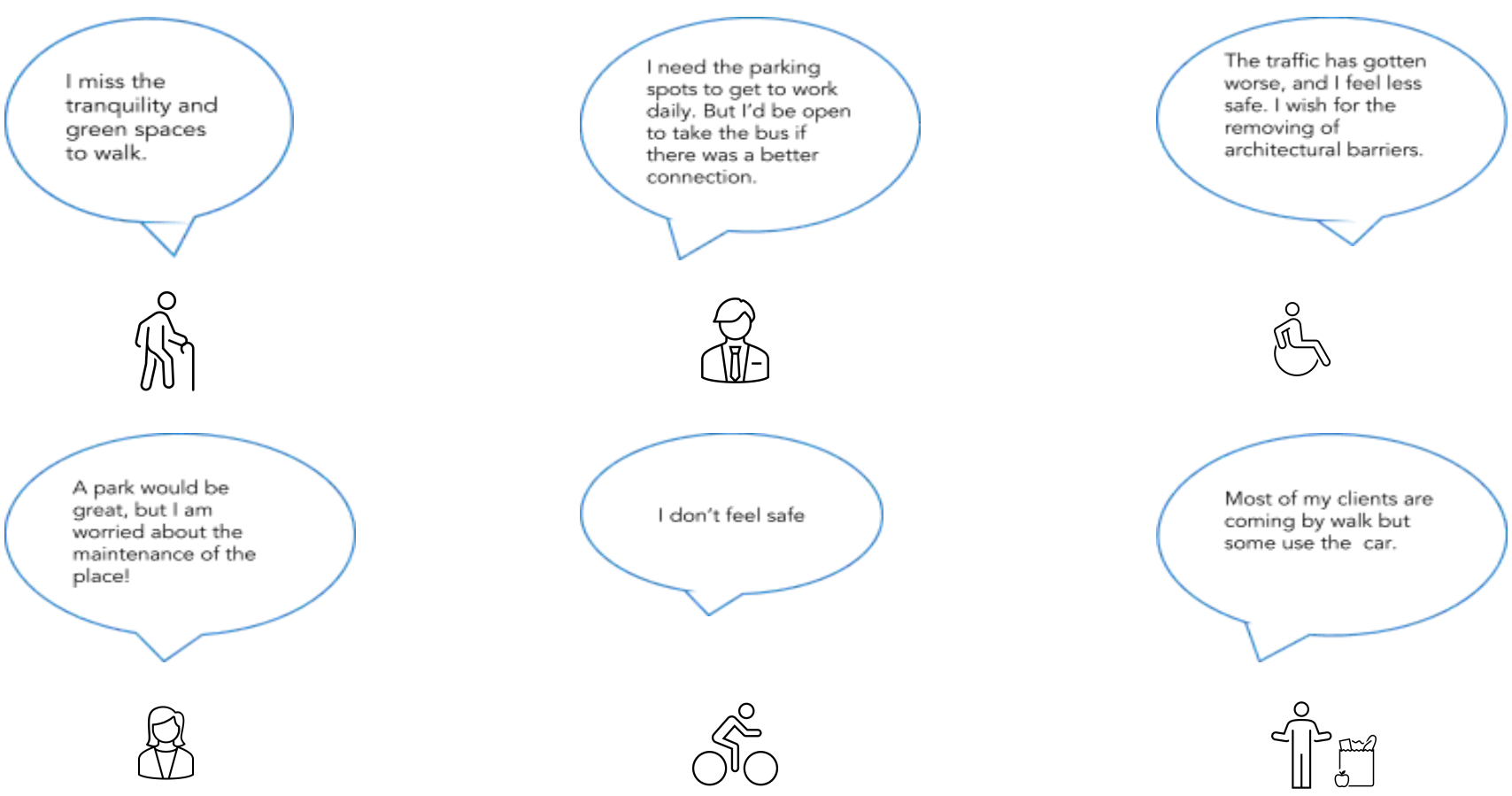


Fig. 10. Site interview with people from different socio-economic demography.

4. Proposal.

The main design intent is to give back space to the community living in and using the area. The design is based on the goal to increase health and well being and mitigating heat. Therefore reducing car dependency plays a major role. Furthermore, the design aims to include people by creating a sense of community, promoting inclusiveness and generating a wider user base for local retail.

4a. Design objectives.

Fig. 11. Design Objectives

1. Improving Health and Well-being:
   Enhance the physical and mental health of residents by prioritising pedestrian-friendly infrastructure, creating green spaces, and promoting active transportation options like cycling and walking. Incorporate elements that encourage social interaction and community engagement.

2. Improving Accessibility:
   Develop a well-connected and inclusive environment by improving public transportation networks, enhancing pedestrian and cycling infrastructure, and ensuring barrier-free access for people with disabilities. Promote seamless connectivity within the neighbourhood and with surrounding areas.

3. Circular Initiatives:
   Implement sustainable practices that minimise waste and resource consumption. Incorporate circular economy principles by integrating recycling systems, promoting reuse and repurposing of materials, and incorporating renewable energy sources. Foster a closed-loop system within the neighbourhood.

4. Reducing Car Dependency:
   Create a shift toward sustainable transportation modes by prioritising public transit, pedestrian infrastructure, and cycling networks. Promote car-sharing services and electric vehicle charging stations. Implement traffic calming measures to reduce car speed and create a safer environment for non-motorized transport.

5. Boosting Local Economy:
   Support local businesses and stimulate economic growth by creating vibrant public spaces and commercial opportunities. Foster a diverse mix of retail, restaurants, and services to attract both residents and visitors. Encourage entrepreneurship and collaboration among local businesses.

6. Mitigating Heat with Nature-Based Solutions:
   Integrate nature-based solutions to combat the urban heat island effect. Increase greenery by planting trees, creating green roofs, and implementing vertical gardens. Enhance natural shading and cooling through landscaping and water features. Prioritise permeable surfaces to manage stormwater runoff and reduce flood risk.

4b. Design strategies.

The principles of tactical urbanism and participatory urbanism are pivotal in realising the objectives delineated earlier for the site via Casaregis.

Tactical urbanism entails the implementation of temporary or small-scale interventions aimed at promptly improving the urban environment. Within the context of the design objectives, tactical urbanism serves as a means to swiftly test and assess diverse strategies and ideas before committing to extensive and permanent modifications. It facilitates flexibility, adaptability, and valuable insights gleaned from the outcomes of these interventions. For instance, temporary installations of street furniture, pop-up parks, or bike lanes can be deployed to evaluate their impact on health, accessibility, and the reduction of car dependency. Feedback garnered through tactical urbanism can effectively inform subsequent design decisions, providing invaluable insights into the most efficacious approaches.

Fig. 12. Use case of Participatory and Tactical urbanism.

Participatory urbanism places paramount importance on the active engagement of local residents, businesses, and stakeholders in the urban design process. It acknowledges the invaluable knowledge, experiences, and aspirations held by these constituents regarding their neighbourhood. In the case of via Casaregis, fostering community involvement through participatory methods such as workshops, charrettes, and public consultations ensures that their voices are heard and their needs are effectively accounted for. This participatory approach fosters a sense of ownership, bolsters community cohesion, and augments the prospects for successful implementation and long-term sustainability of the proposed design interventions. The input and ideas shared by participants significantly contribute to refining the design objectives and shaping the ultimate outcome in a manner that authentically reflects the distinct character and aspirations of the community.

By effectively amalgamating tactical urbanism and participatory urbanism, the design process acquires a dynamic, responsive, and inclusive character. It enables iterative enhancements, empowers the local community, and significantly enhances the likelihood of achieving the desired objectives pertaining to improving health and wellbeing, enhancing accessibility, fostering circular initiatives, reducing car dependency, stimulating the local economy, and mitigating heat through nature-based solutions.

Fig. 13. Vision for Via Casaregis

4c. Masterplan.

Fig. 14. Proposed Master plan for Via Casaregis.

A tactical urbanism approach can be employed to allocate approximately 20 percent of the existing parking space within the area for the creation of versatile and multi-use recreational activity spaces. This strategic intervention aims to gradually challenge the prevailing habit of residents parking their cars in this specific zone. By repurposing a portion of the parking area, the intention is to visually and tangibly demonstrate to the community the potential of public spaces as valuable assets for their personal enjoyment, rather than solely as car storage. This innovative tactic serves as a catalyst for shifting mindsets and fostering a sense of ownership and engagement with the communal environment. As residents witness the transformation of formerly underutilised spaces into vibrant recreational hubs, they are more likely to be inspired and motivated to explore alternative means of transportation and to embrace the myriad opportunities presented by the newly repurposed areas. Through this tactical urbanism endeavour, the community is encouraged to re-envision the use of public spaces, embracing a paradigm shift that emphasises the cultivation of a vibrant, people-centred neighbourhood.

The second phase of the project entails a comprehensive transformation of the central street parking into an enchanting urban forest and park, designed to serve as an idyllic oasis amidst the urban fabric. This visionary undertaking aims to create an expansive green space that not only mitigates the urban heat island effect but also fosters a deep connection between the community and nature. By replacing the conventional streetscape with lush vegetation, tranquil walkways, and inviting recreational amenities, the project seeks to offer an immersive experience where residents can unwind, engage in physical activities, and cultivate a profound appreciation for the natural world.

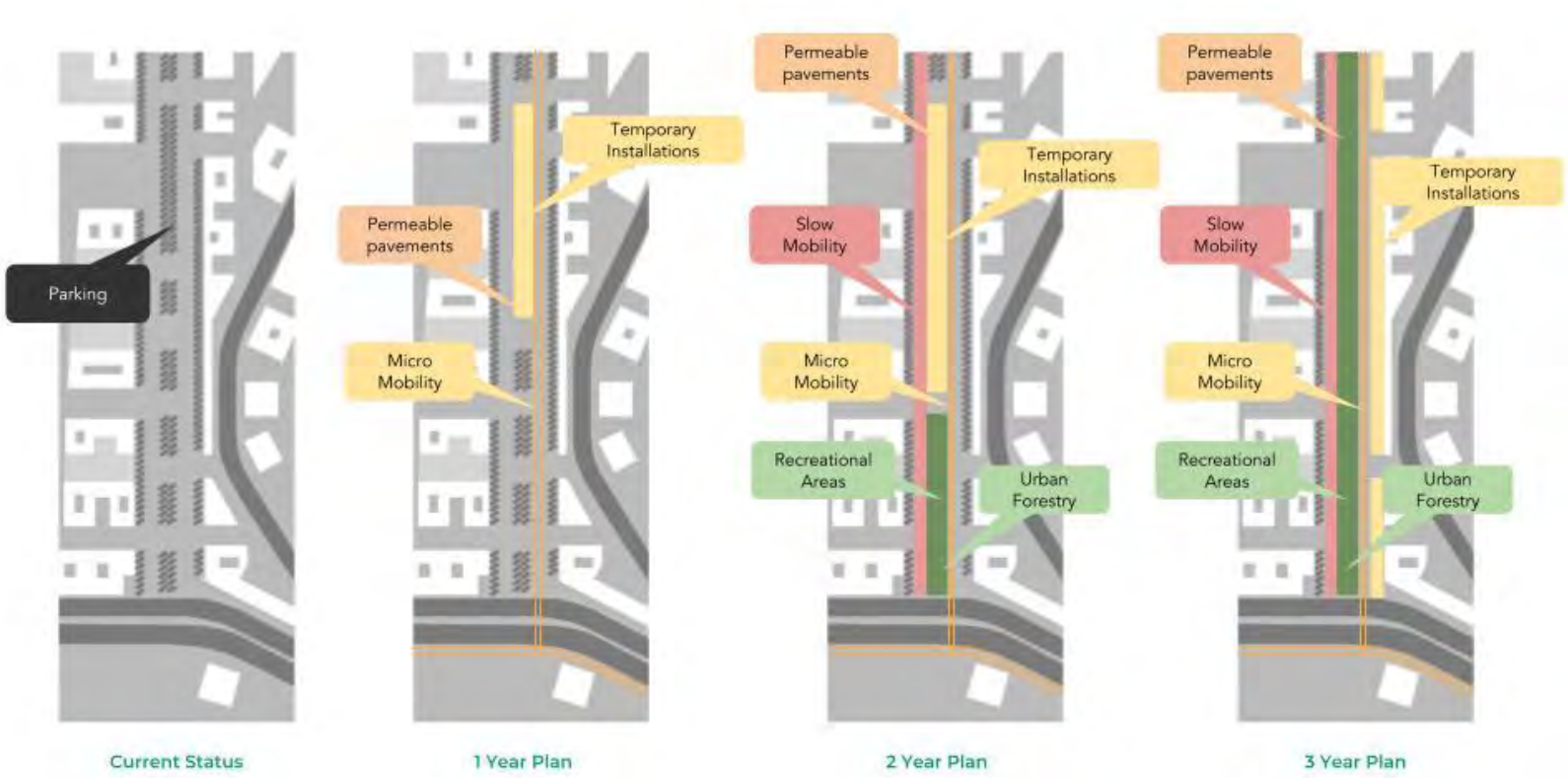


Fig. 15. Proposed phase plan for Via Casaregis.

The third phase of the project is centred around an ambitious endeavour that involves reclaiming and reallocating half of the street space to address crucial environmental, social, and economic factors. Through this transformation, various innovative strategies will be implemented to promote sustainability and enhance the overall livability of the neighbourhood.One significant aspect of the third phase involves the integration of permeable pavements. These porous surfaces allow rainwater to infiltrate the ground, reducing stormwater runoff and replenishing groundwater resources. By adopting permeable pavements, the project aims to mitigate flooding risks, enhance water management, and promote ecological balance within the community.

Additionally, the third phase emphasises the promotion of micro-mobility options, such as bike lanes and pedestrian-friendly pathways. By prioritising non-motorized transportation, the project encourages active mobility, reduces car dependency, and improves air quality. This shift towards sustainable transportation modes not only benefits the environment but also fosters a healthier and more vibrant community.

Circular initiatives will also play a pivotal role in the third phase. The project will explore and implement strategies that promote the circular economy, such as waste reduction, recycling programs, and the integration of renewable energy sources. By embracing circularity, the project aims to minimise waste, maximise resource efficiency, and contribute to the local economy.

Fig. 16. Current situation versus the proposal's plan (view towards north)

The figure shown above highlights the transformation from the current situation to the final one. It can be seen that a great part of the street is given back to the community, with a variety of nature based solutions, a safe bicycle lane and space for pedestrians.

This transformative phase represents a multifaceted approach that addresses pressing environmental challenges while enhancing social well-being and economic opportunities. Through the adoption of permeable pavements, micro-mobility options, circular initiatives, and other innovative measures, the project aims to create a resilient, inclusive, and sustainable neighbourhood that sets a benchmark for urban development. By embracing these forward-thinking principles, the community can enjoy enhanced environmental quality, improved mobility options, and a flourishing local economy, solidifying its status as a beacon of innovation and sustainability.

4d. Nature Based Solutions Technical Specifications.

To solve natural disasters like droughts, floods, biodiversity loss, and air contamination the implementation of nature based solutions is indispensable. Some of the biggest problems seen in the site and expressed by the residents were air quality, urban heat island effect, flooding and the lack of green spaces. While there are several solutions to these problems used nowadays, most of them affect the natural system even more, are very costly economically and environmentally or, aren't just nor discussed with the society. All of these nature based solutions use the ecosystemic services brought to the world by the different plant species, habitats and ecosystems created.

Nature based solutions have a great potential to make urban infrastructure more adaptable to climate change while at the same time, helping mitigate this phenomenon. An important part of nature based solutions is that it is a bottom-up scheme in which there have to be discussions with architects, engineers, botanists, economists and the people living on site to reach agreements about the development and maintenance of the nature based solution, then the political or economic financer can give the support of the project. As the nature based solution design depends directly on the specific site requirements and people's will to develop and maintain it, here are some NbS´s that can be useful in the site and that we recommend should be used for their potential benefits. It is also important to highlight that the management of this infrastructure (irrigation, transportation alternatives, new parking spots) should be planned while the works are being done on site at the surface level.

In the following list there are showcased some of the problems each NbS solves, a brief explanation of what it is, how it works and some important maintenance practices that need to be considered. It is important to notice that one particular nature based solution can work at the same time as several others, achieving a good balance between all of them is what is needed for them to be successful. Before any intervention, a profound study on the conditions of the soil, the air quality, society´s participation and the site´s hydrology need to be done to select the best strategies for the development and maintenance of the project.

1. Permeable surfaces.

Practically, all of the surface area in Via Casaregis is covered by impermeable pavement that makes water unable to infiltrate underground and increases runoff water. This generates water contamination (metals, chemicals, contaminants, etc. present in the pavement), increases the flood risk in strong precipitation events and exacerbates the heat island effect.

Fig. 17. Permeable surface used for a parking lot

Using permeable surfaces like ecological bricks or permeable pavement in the car road that is going to be left in the site will help increase the infiltration of water. Additionally to the car area, in the long term we expect this street to be covered by recreational areas and plants in 50-60% of its surface area. This will lower the temperature, improve the soil quality, its microbiome and of course lower the flood risk. It is important to have in mind the soil type when planning for the type of pavement for the streets to stay at the same level and prevent any subsidences that can affect traffic.

Regarding the maintenance of these infrastructure, these surfaces have to be cleaned from grass and other plants that may grow and block the water flow. Also, walkable areas need to implement an irrigation system (sprinkle irrigation, drop irrigation) that could work for the area. In drought seasons, the water from the Bisagno river could be canalised through pipes (filtering gallenes) that could deliver this water to the plants, in this way we can have a healthy soil, water retention and lower temperatures at the site all year long.

2. Flower gardens.

Biodiversity has plunged since the industrial revolution globally, many of the extinct species are big mammals with which we as a species compete for space. Nonetheless, there are other species being affected by the habitat destruction caused by our continued urbanisation. One example are the bees and other pollinators, that even though they have adapted to life in the city our design of nature based solutions in cities could help them even more. Biodiversity is the whole network of life, it is the structure that gives a sense and an order to the ecosystems we are part of. A recurring theme when interviewing the locals was that the city had no beauty anymore, it lacked green, but also red, blue, violet and other colours plants can bring into the mix. With this mix of colours, a short time will pass until we hear beautiful songs by birds, or taste great honey by the bees.

Fig. 17. Example of a flower garden, takes water and carbon dioxide while giving aesthetics, scents and food to pollinators

The pollinators (a section is included below on biodiversity) are the most benefited with this kind of solution. Birds, insects and even small mammals and reptilians will thrive within the flowers and fruits of these gardens maintaining a global balance in these important species. Flower gardens are perfect to attract pollinators, increase biodiversity, maintain a healthy soil and can help regulate temperature in microclimates. The community should base the choice of plants in the soil type, aesthetic value, and helpfulness to pollinators. Using these vegetated drainage systems also helps with the runoff water problem.

Some important aspects to have in mind for the maintenance of these structures is the irrigation, as explained before, but also if the garden is isolated from the rest of the ground or not. This decision must be taken depending on the species used in the garden, if they can stand the soil salinity, depth, nutrients, temperature and pH they can be planted on the soil. Otherwise there should be isolation from the tank the garden is grown on and the soil. It is also important to have in mind possible allergens produced by flowers and the planting of native species. For the caring of the gardens there could be city contractors that do the job, or even the community can come in and help the gardens when they are dirty or with undesired plants.

3. Aromatic gardens.

Similar to the flower gardens, some flowers also have lovely smells, but this kind of structure looks for a different response from the human observer to it. We are used to seeing a park as it is, with some trees, dogs, birds and maybe somewhere to play or just sit down. But for accomplishing a reconnection with nature we should also integrate our other senses to the experience of nature. Aromatic gardens should be grown by the locals in a way they grow plants with wonderful scents and give even more value and beauty to the park. Plants like basilico, rosemary, *Erica Arborea*, among others, can help bring this new reconnection experience from humans to nature, our main challenge for this century.

These gardens can help by mitigating flood risk, attracting pollinators, giving the place aesthetic value and giving consumables to people. Generating a new experience in every metre of a park, every corner of a city and every part of the world can help give back that sense of wonder people get when experiencing nature that has been lost since a long time ago. Plants also keep the environment moist, effectively lowering the temperature of the microclimate and capturing different air contaminants.

Some maintenance considerations include the irrigation alternatives we have and that were discussed in the permeable pavement section. Also having in mind the importance of good gardening (pruning, nutrient needs, water availability) techniques and practices is important for the health of the plants. There should be no use of toxic pesticides or other chemicals as people will be playing in it. There should also be a shop where people can buy the produce so not everyone can go by tearing apart the plants and causing a tragedy of the commons. The knowledge of cultivation should be exercised and taught here with mobile libraries and spaces for teaching.

4. Green corridor.

When thinking of an urban ecosystem, we have to think about how the different structures and beings are connected to each other. This is why a single nature based solution cannot fulfil much of its potential unless it is linked to other ecosystem structures or nature based solutions around the city. Green corridors are areas with green spaces and trees where nature can flourish and go around the different natural structures of the cities. These can also help mitigate the urban heat island, boost biodiversity, improve quality of life, aesthetics, air quality and even reduce the flood risk in certain areas of the city. Green corridors should connect different urban parks between them as our project aims to do in the majority of Via Casaregis which will connect to the waterfront park and in the future, we hope, to ecological structures around the city for example the mountains at the north.

The connectivity of our proposal can be better seen in the masterplan at the beginning of this section where we show Via Casaregis connected to the Waterfront project and other parks and potential green spaces nearby. The idea is not to make an urban forest, but to try to make life in the city for birds, insects, little mammals and even ourselves more natural and easier. In Via Casaregis there is already a big line of trees going from Corso Aldo Gastaldi until our site, where there is a parking spot, but with our intervention the line of trees will connect to the Waterfront and the sea.

For the correct development, maintenance and selection of the corridors there should be a study telling the streets and areas of the city that could be intervened and prioritised to become part of the ecological structure of the city. The trees planted need to resist the soil´s conditions, if this is not the case and a tree is going to be planted there needs to be isolation from the rest of the soil, in somewhat controlled conditions. The trees should be tall enough to let cars and trucks pass by the street, and cover with shadow the surface. Finally a good irrigation system, or a truck should be used to water the trees opportunately. The pruning of the trees should be done according to the good gardening practices as shown below and according to the gardeners knowledge.

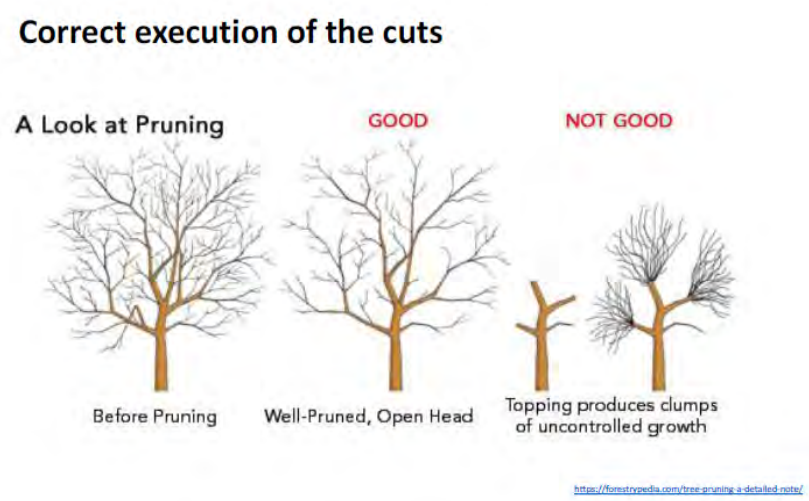


Fig. 18. Correct pruning techniques for giving shape to trees.

5. Green walls.

This type of nature based solution mimics the ability of plants and lichen to grow in vertical surfaces. In the site Via Casaregis, we have a lot of buildings at the sides of the roads. A way nature can use this space to help reduce the heat inside and outside buildings, clean the air from dangerous contaminants and even lower the flood risk is with green walls. These structures grow from the ground and cling to a vertical surface with the help of a structural support or only by climbing the wall. Green walls are not the same as vertical gardens, green walls interact with the soil making it more easy to be maintained and promote more biodiversity in the soil microbiome. Nonetheless, a mixture between the two could work, as shown in the figure below.

Fig. 19. Green wall covered with Hedera helix and vertical gardens

Green walls make spaces more aesthetic, colder in the inside and in the outside of the building, and can also work as shelter for different types of animals. Also, the water used by these plants comes from the floor, helping the water management and lowering the flood risk in the area. Green walls grow by themselves and are easy to be maintained, some practical maintenance practices are: trying to give shape to the green wall by eventual pruning, use walls resistant to humidity, give some kind of artificial structure in the surface of the wall, giving a shape and putting limit to the plants in doors or windows, planning the irrigation system before planting the plants and having in mind sun exposure of the particular wall.

6. Green roofs.

These structures are some of the most difficult to influence and maintain because the buildings in Via Casaregis are all private, meaning the building is out of limits for most of the citizens, sometimes inaccessible even for the people living in the building. Nonetheless, having in mind that the majority of the city of Genova´s superficial area is covered by roofs, we should take into account the great potential for water collection that green roofs could have if employed massively. This would solve the big runoff problem that Genova has in strong rain events. Another aspect that could be mitigated with the help of these green roofs is the absorption of sunlight heat by the plants in these roofs, lowering the heat island effect and capturing carbon dioxide while they grow.

Fig. 20. Green roofs example, showing the increased area covered by plants in a city when implemented

Green roofs have the potential of being a space where a community can be built, the people of the same building can join and create an urban farm, a garden or maybe just a place for relaxing and enjoying. With these new greenery, birds will have new shelters, insects will have new food and people will have an opportunity to reconnect even more with nature. Roofs can also work as a water collection structure for the irrigation systems used for the different nature based solutions in the area.

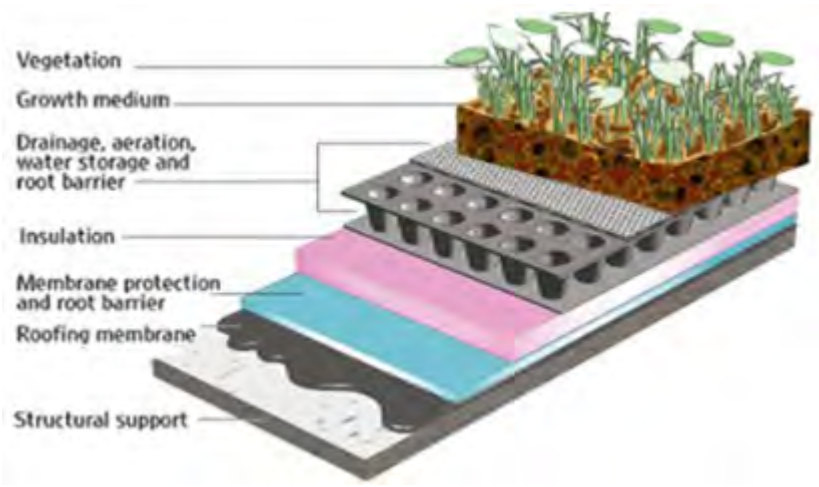


Fig. 21. Structural section of a green roof with all the important components to have in mind

Some important maintenance advices for these structure is to impermebilizate the roofs before building any gardens or putting soil on it, have an agreement with the community about the care of the roof and have in mind irrigation systems for drought seasons. It is also important not to plant very big trees on roofs as it could affect the structure of the building. Finally, plan the water collection and irrigation systems needed for each specific roof to optimise soil health.

Nature acts in a continuous way with different stages (Ecological succession), this is why for nature based solution planning we should have in mind the different stages and use this as an advantage. Previous to any intervention we should take different samples of soil in different locations and depths, measure soil characteristics (temperature, pH, salinity, etc.), environmental parameters such as air pollution (PM concentration, CO2 concentration, aerosols, etc.), air temperature, and hydrology; and analyse them for making a decision on species and nature based solutions selection. In the first months of the intervention plant the trees, care for them in controlled pots made for the tactical urbanism (the species who can resist) and plant others directly on the ground with some protective barrier if the soil conditions are not optimal. Start covering all the soil with shrubs, flower plants and other greenery to promote low soil temperatures, low runoff and high water content. In this stage also plan and incorporate the irrigation systems (drop systems, sprinkler system), that are going to be used on site. The possibility of using the nearby Bisagno river to generate filtering gallenes which can work as the sources of the irrigation water should be assessed.

In the next stages of the project, when the trees are bigger, start planting them in the ground (the ones in pots) for seeing a biodiversity explosion in the sense of pollinators, mycorrhizal symbiosis or habitants of the new shelters. In this stage the pavement should already be permeable for promoting water infiltration, there should be a healthy soil, compost should be ready to use and the community should decide where to plant the different plants. The new street layout should already be set because after trees are planted, they cannot move. Gardeners and community volunteers should fix the schedule for caring for the plants and manage the investment the city is making.

With a bottom-up based approach (community makes the decisions), continue the regreening of the street with other interventions such as urban farming, green walls and roofs, aromatic gardens, rain gardens etc. It is important to always have in mind the perspectives of the other species and not make only human centred decisions. Enhance connectivity of the whole urban ecosystem, more projects like this need to be made in the city with Via Casaregis being a pioneer. Centre the design ideas around the ideas of biodiversity and natural processes. Biodiversity is structural, of different species and genetic between the same species. Always try to recreate the natural process (natural selection, dead plants removal, etc.) for making the park more resilient to future changes.

Finally, it is important to say that a continued monitoring of the environment characteristics (temperature, humidity, soil salinity, soil minerals, soil microbiome, soil water content) should be mandatory to be able to analyse and adjust any nature based solutions to the necessities of the site. A way of valorizing the ecosystem services brought by the different nature based solutions is necessary for giving a value to the project and being able to do a benefit-cost analysis which will show how for these types of solutions the benefits outweigh the costs by a lot in the long term. Using emergy analysis, and experiences from other projects around the world we can have an idea of the value generated by these infrastructure. Nonetheless, the most important aspects of nature based solutions are the continued monitoring, maintenance, expansion of them throughout the city and the genoese society to embrace nature and work with it.

4e. Catalogue of Plants and Biodiversity

Importance of biodiversity for the development of via Casaregis

Some of the most critical issues in the area currently are the urban heat effect as well as noise and air pollution. This affects the health and comfort of the people passing the street of Via Casaregis. A high car dependency because of the lack of efficient public transport led to an increased traffic and need for parking in the area. With this also the safety of bikers decreased.

Why do we need to improve the biodiversity and plant variety on Via Casaregis ?

The improvement of biodiversity and plant variety on Via Casaregis has the potential of many advantages, including:

- Increase in property values
- Improved walkability
- Improved public health and safety
- Enhance community adhesion
- Reduced stress
- Improved air quality
- Mitigate heat and stabilise temperature
- Capture and clean stormwater
- Cultural value
- Carbon fixation

Selection criteria

Our goal is to offer different ecosystems so many species can thrive together. The proposal includes a variety of plant species that have been selected specifically to meet our design objectives.

This includes but is not limited to plants that :

- Are native to the area ;
- Thrive in salty soil ;
- Are flood and/or drought resistant ;
- Entice the different scents (smell,vision, food …) ;
- Offer shadow protection ;
- Provide shelter for pollinators ;
- Are easy to manage ;
- Have an aesthetic value (colours, textures) ;
- And many more.

Catalogue of Plants

Shrubs			
	"Strawberry tree" *(Arbutus unedo)* Evergreen shrub or small tree. Identifiable by its green leaves, its white flowers (from october to march) and its red berries. Native species to the Mediterranean basin. Likes full sun, temperate climate and stations sheltered from cold winds.	Alaterno *(Rhamnus alaternus)* Evergreen shrub typical of the Mediterranean, with small fruits of red-brownish colour. Loves warm and sunny areas and rocky, limestone soils, resisting well to the salt sea.	Japanese Pittosporum (*Pittosporum tobira*) Highly fragrant flowers have a distinct citrus scent that attracts pollinators. The flowers don't last for a long time, but the dark evergreen foliage is attractive all year long and the plant makes a great addition to a border or as a stand-alone plant. Do not cause seasonal allergies.
Perennials			
	Limonio ligure *(Limonium cordatum)* Perennial herbaceous plant with showy flowers that are pink, purple to white. This plant prefers soils of the coasts of the sea due to soil salinity. Native species to the Mediterranean basin.	Valeriana rossa *(Centranthus ruber)* Perennial plant native to the Mediterranean region, with unghi stems ending in flowers ranging from white to purple. The product nectar is much loved by butterflies, pollinators and attracts insects.	Rosemary *(Salvia rosmarinus)* Aromatic evergreen shrub. Native to the Mediterranean region. It can withstand droughts, surviving a severe lack of water for lengthy periods. Rosemary, both fresh and dried, has numerous cosmetic, decorative, medicinal, and culinary uses, besides its ornamental appeal.
Perennials			
	Basil (*Ocymum basilicum)* Genovese basil are cultivars of the sweet basil plant. The fragrant edible leaves are great in soups, stews, and other meat dishes. Basil also aids in repelling thrips, flies, and mosquitoes, but attracts pollinators.	Common sage (*Salvia officinalis*) Evergreen woody shrub that grows in dry and stony places. Known for its resistance . It has a long history of cultivation for culinary and medicinal purposes as well as for its distinctive scent and lovely purple flowers. Native species to the Mediterranean basin.	Common myrtle (*Myrtus communis)* This aromatic plant is native to the Mediterranean region. Drought tolerant and deer tolerant. Virtually disease and pest free. Easily grown in most, well-drained soils in full sun or light shade.Provide a sheltered location protected from cold winter winds. Great for wall-side and shrub borders .
Vines& climbers			
	Ivy-leaved toadflax (*Cymbalaria muralis*) Wild edible viney plant with small and magnificient purple flowers, it commonly grows in rock and wall crevices, and along footpaths. The leaves are evergreen, The flower stalk is unusual for seeking light until it is fertilised, after which it grows away from the light. Native species to the Mediterranean basin in hot climates.	Italian Ivy (*Hedera helix*) Vigorous, evergreen, self-clinging vine with glossy leaves. Very hardy and trouble-free, its main use is for green walls. Produces attractive orange to yellow, small, round fruits. Solid green ivies are highly tolerant of shade, while variegated ivies prefer part sun. Some care is required to make best use of the positive effects: Ivy covering the walls of an old building is a familiar and often attractive sight. It has insulating as well as weather protection benefits, dries the soil and prevents wet walls, but can be problematic if not managed correctly.	Bougainvillaea (*Bougainvillea glabra Choisy*) Bougainvillaea is one of the most beautiful flowering climbing plants because of its incredibly abundant and colourful blooms. It is suitable for warm climates, loves the sun and grows easily either clinging to masonry or on pergolas. As they are characterised by rapid growth, they can create a lush green area full of flowers and fragrance in a short time.

Trees			
	Chinotto *(Citrus myrtifolia)* Evergreen plant which develops an incredible wealth of white flowers and fragrant in bunch. Native species to the Mediterranean basin. The plant generates compact fruit, spherical and flattened at the base, the size no larger than a tangerine and bright green colour that turns to orange with time.	Olive (*Olea europaea*) The olive tree is an evergreen tree, able to counteract the effects of wind and water erosion and consequently limiting soil loss by stemming desertification. It represents a valuable biodiversity refuge for animal and plant species. Native species to the Mediterranean basin.	Tree heather (*Erica arborea*) Thrive in acidic soil. These large evergreen shrubs provide year-round structure and seasonal flowers, either as stand-alone specimens, in mixed borders or as informal hedges. They also provide shelter for wildlife, and their flowers are magnets for bees. They produce a lovely scent.

Table 1 Catalogue

Catalogue of Biodiversity

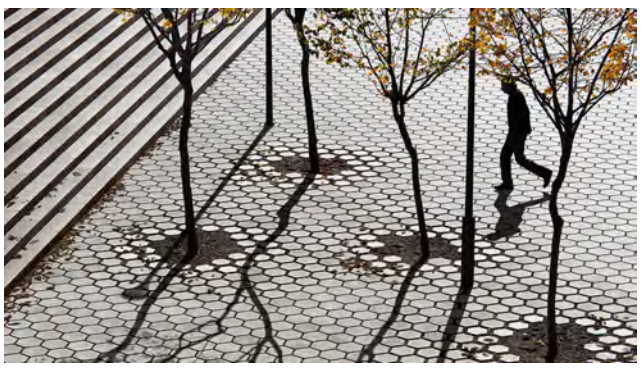
An increase in green urban areas would subsequently lead to an increase in fauna as well. This enhances biodiversity.

		
Bees: For example the Regina nera Bee is a unique species known for its black colour and its ability to build complex nests. Bees are fundamental to pollination.	Butterflies: They are pollinators, are food sources for other insects and animals, and contribute to the development of plant life.	Bats : They are the main predators of a large number of insect species and help keep their numbers under control, limiting the damage done by a variety of pests to crops and forests. They play an important part in pollination.
		
Bugs: Bugs have utility in the ecosystem and food chain. Bugs are food for some species of birds and reptiles or amphibians. They also, though only partially, contribute to pollination.	Birds: Some of the most important roles include controlling insects that they catch on the fly or on plants or on the ground, even in the larval state.	Reptiles and amphibians Some reptiles are bioindicators for the quality of an ecosystem especially in terms of pollution. They feed on insects and themselves are hunted by birds and mammals thus being an important link in the food chain. 23% of amphibians and 19% of reptiles are included in the IUCN Red List of threatened species. It is therefore important to protect them and provide a space for them to live.

Table 2. Catalogue of biodiversity

4f. Case Studies.

To better visualise the project's essence, we provided below case studies analysis and solutions that we want to implement throughout via Casaregis.

Problematic	Inspiration and examples of solutions	Advantages of the solutions in our proposal
Managing flood and drought.	 *Philadelphia Water department, from the Green Streets Design Manual*	Stormwater planter : Can play an important role by minimising stormwater runoff, reducing water pollution and creating a greener and healthier appearance by retaining stormwater rather than allowing it to directly drain into nearby sewers. Stormwater runoff is used to irrigate the plants, and the vegetation in the planter box reduces stormwater through evapotranspiration. [6]
Urban heat island.	 *Flyt, Snohetta*	Permeable pavement : Alleviates the impact of flooding by allowing stormwater to filter through the soil below the paved surface, reducing the numerous environmental issues associated with water runoff. The soil particles filter rainwater percolate through soil on its way to surface waters and to groundwater. Has the potential to be multi-functional, the pavement itself can be used for parking space.[7]
Lack of meeting places, sense of community.	 *Plaza Superilla de Sant Antoni, Barcelona, 2019, Leku Studio*	Recreational opportunities with urban furniture : Added style and functionality to the immediate environment. By adding street furniture, organisations add value to their existing building by providing additional amenities to their employees and visitors, thus encouraging the local economy and businesses. Encourages socialising and creates a sense of community within the workplace. Street furniture entices people to sit, relax, and interact with each other, promoting a happy and healthy workforce. It also increases pride in the outdoor space and deters anti-social behaviour. Safety is also a hidden benefit for the people using outdoor spaces. Simple traffic management with the addition of barriers, bollards and intelligently positioned lighting for dark evenings, can improve security and peace of mind.[8]
Road safety & unclear sharing of the street.	 *Paseo de St Joan, Barcelona, 2011, Lola Domènech*	Promotion of micro mobility : Micro-mobility transportation systems can resolve road congestion because it provides a more compact transportation device that helps reduce the number of vehicles on the main roads. Since micro-mobility devices do not use engines and do not consume fuel, they do not emit as much carbon dioxide as cars. They also offer a low-cost personal mode of transportation. Micro-mobility infrastructures are also greener than regular road infrastructures because they can integrate nature more easily into its lanes.[9]
Lack of green spaces.	 *Congress Ave. Pocket Patios, Austin, dwg studios*	Integrated urban vegetation into a green axis : Access to green spaces contributes directly to public health by reducing stress, encouraging physical activity, improving the living environment and enhancing city-dwellers' feeling of wellbeing. The presence of urban vegetation reduces the urban heat island effect and helps to improve buildings' energy efficiency. Via carbon sequestration and the absorption or emission of pollutants, the presence of vegetation in urban environments is a major factor influencing urban air quality and noise control. The quality of an urban environment sends residents and visitors a strong message that can contribute to the region's social and economic development.[10]

[6] http://www.saveitlancaster.com/wp-content/uploads/2011/10/05_PlanterBox.pdf
[7] https://www.vbgov.com/government/offices/eso/Documents/permeable-fact-sheet.pdf
[8] https://www.externalworksindex.co.uk/entry/149464/Artform-Urban-Furniture/Benefits-of-street-furniture-in-commercial-projects/
[9] https://www.eltis.org/in-brief/news/benefits-micro-mobility-cities
[10] https://www.plante-et-cite.fr/data/beneveg_english_bd.pdf

5. Business model.

In order to evaluate the overall project a Business Model Canvas has been prepared with a visual representation of all the key components and factors that should be considered for a decision.

In this canvas have been highlighted the costs that should be considered, both the capital costs and also the operating costs for maintenance. Here are also considered all the positive effects that the proposed plan will have in the area. These benefits are addressed with various perspectives that go from the economical one, to the social and to the environmental one.

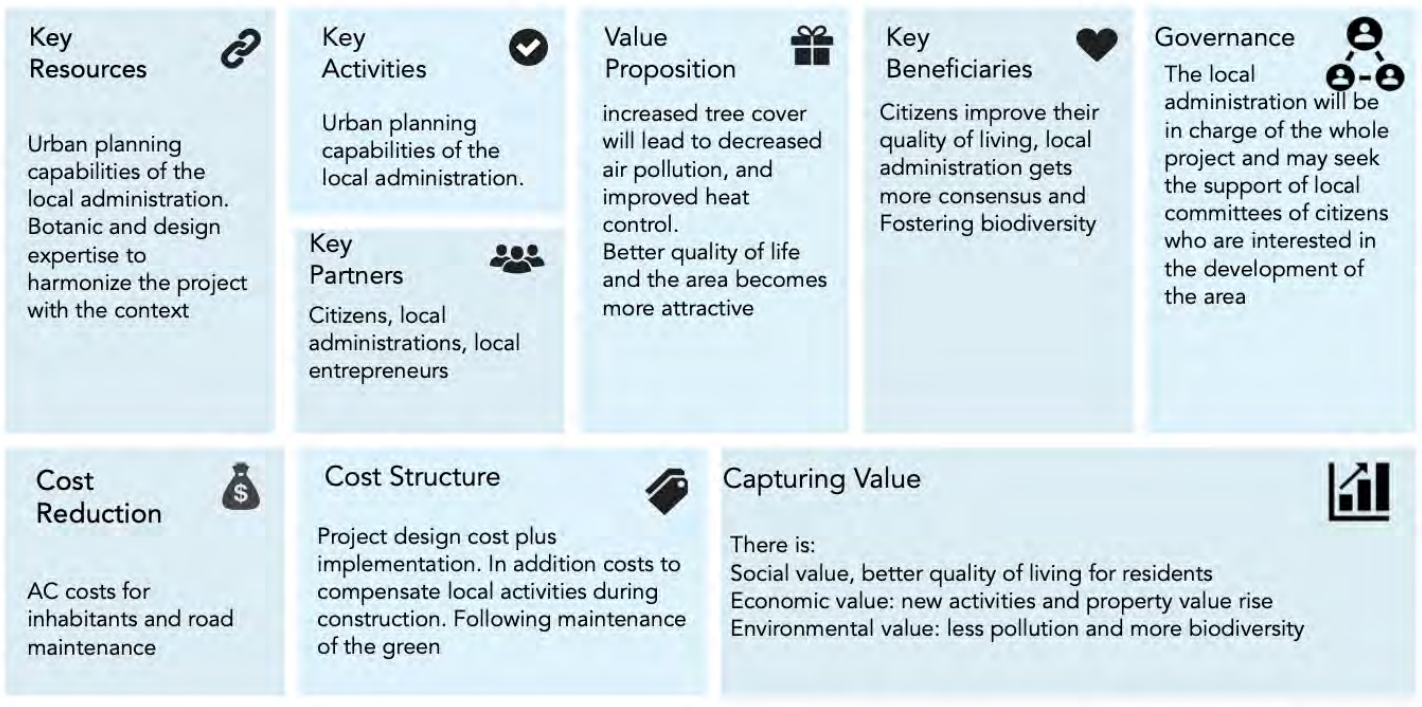


Fig. 21. Business model canvas

With regards to financing this project, it is important to split up the costs involved. Firstly, there are on-time fixed costs that come during the transitional phase. These do not only include re-construction, but it also entails the costs of planning, regulatory requirements, decision-making process and involving the neighbourhood. For some of these costs, European development funds could be used, including the European Regional Development Fund[11]. The different governments would have to come up with the one-time expenditures for regulations, planning and re-construction. The latter costs can be minimised if the constructions are combined with planned maintenance. This not only reduces cost, but also reduces hinder for the neighbourhood.

Next, there are fixed costs for non-public bodies. For example, local initiatives could be crowdfunded like the crowdfunding platform that is already in usage in the Belgian city of Ghent[12]. Here, citizens are involved by proposing ideas and financing them. This not only creates involvement during the development phase, but also creates long-term engagement between the citizens and the projects. Finally, new urban developments attract new businesses, and with that comes financing by the entrepreneur itself. In other words, the pretty terrace that is now possible can be financed through the restaurant owner.

Secondly, there are structural recurring costs that need to be considered. These mainly entail maintenance, which can be paid through the existing budgets for street maintenance. With a reduced amount of motorised (heavy) traffic, a decrease in costs can be expected. This anticipates the increased costs that come with the costs of maintaining the new green area. Additionally, through the involvement of the neighbourhood, the public costs of green maintenance can be limited.

Further revenue streams and savings arise in the short- and long term. An example is the involved neighbourhood that pollutes less on the streets, better life quality and new business opportunities. Furthermore, public-private partnerships could provide interesting opportunities to further enhance engagement between many stakeholders involved. Prime European examples could be the HafenCity in Hamburg[13] or the Barcelona Smart City Initiative[14].

[11] https://ec.europa.eu/regional_policy/funding/erdf_en
[12]https://climate-adapt.eea.europa.eu/en/metadata/case-studies/ghent-crowdfunding-platform-realising-climate-change-adaptation-through-urban-greening
[13]https://www.hamburg.de/contentblob/6714068/9d0a4ecb3444c626fa7b48857b85a32e/data/perspectives-on-urban-development-in-hamburg.pdf

[14]https://unece.org/fileadmin/DAM/ceci/documents/2016/PPP/PPP_for_Cities-Barcelona/MariaGalindo-PPPs_for_Urban_Transformation.pdf

6. Stakeholders Analysis and Business Plan

Fig. 21. Stakeholder Analysis

Appendix.

Overview of financing opportunities:

Expenses	Public	Non-public
One-time	❖ Infrastructure reconstruction. ➢ *May be combined with planned maintenance to limit costs* ❖ Campaign to get the public involved ➢ *EU funds for regional development*	❖ Crowdfunding to create the local initiatives ➢ *Also increases long-term engagement* ❖ Entrepreneurs financing their newly created businesses
Structural	❖ Maintenance can be paid through existing budgets. ➢ *Less intense traffic requires less maintenance* ❖ New city tax incomes from new business opportunities ❖ Long-term: better quality of life decreases public expenditures	❖ Involved neighbourhood takes care, results in less public maintenance costs ➢ *E.g. less garbage on the streets* ❖ Public-Private Partnerships ➢ *Gov. provides long term vision and regulatory framework while private partners provide resources*

7. Outcomes and Benefits

#Fig 18 Contribution to sustainable development goals

Implementing the chosen design strategies in Via Casaregis would contribute in meeting the sustainable development goals set by the UN in the 2030 Agenda for sustainable development in the following sectors:

- Goal 3: Good health and well-being: Due to the implementation of greenery, improvement of air quality, reduction of noise pollution, a sense of community, and enhancing accessibility.
- Goal 7: Affordable and clean energy: Thanks to micro-mobility, the increase of electric cars, car sharing, and reducing car dependency.
- Goal 8: Decent work and economic growth: Stimulating the local economy because new urban developments attract new businesses.
- Goal 11: Sustainable cities and communities: Through the involvement of the community, fostering circular initiatives and introducing greenery and micro-mobility.
- Goal 13: Climate action: Through improved air quality, biodiversity , and mitigating heat through nature-based solutions.
- Goal 15: Life on Land: Providing additional green spaces and introducing native plant species creates biodiversity and habitat for different animals.
- Goal 17: Partnerships: A public-private partnership could provide interesting opportunities to further enhance engagement between many stakeholders involved.

8. Conclusion

Cities are increasingly taking proactive measures to address the urgent challenges of sustainable development and contribute to the fight against climate change. Concepts such as “15 minute cities”, “sponge cities” and urban ecology can be useful in guiding the urban planners into thinking about nature based solutions and forgetting about the dichotomy of city and nature. Genoa must prioritise the creation of additional green spaces to comply with European standards while increasing the wellbeing and safety of its citizens. The current situation in Via Casaregis vividly demonstrates the consequences of car dependency, such as the heat island effect, air pollution, increased flood risk, and the lack of greenery and biodiversity.

The objective of this project was to identify suitable design strategies for Via Casaregis, focusing on nature-based solutions. Taking advantage of the ecosystemic services brought by these types of solutions we can help mitigate the problems identified on the site. To accomplish this, a comprehensive site analysis was conducted in collaboration with local residents, a practice that should continue throughout the development of the project. The approach involves monitoring environmental parameters, setting clear goals, formulating effective strategies and considering financial aspects.

A combination of tactical and participatory urbanism emerges as the key strategies to address the issues in Via Casaregis. Initially, 20% of the existing parking space will be transformed into multi-use areas for recreational activities, gradually increasing each year with the decisions being taken by the community and experts in the area. The subsequent phase focuses on converting central street parking into an urban forest and park, incorporating native species and nature-based solutions as the ones listed in the catalogue. The final phase involves reclaiming and reallocating half of the street space to address environmental, social and economic factors. It is important that throughout all these phases the community participates and becomes the main actor in this territory. Through the adoption of nature based solutions (permeable pavements, aromatic gardens, etc.), micro-mobility options, circular initiatives, and other innovative measures, the project aims to create an adaptive, resilient, inclusive, and sustainable neighbourhood that sets a benchmark for urban development in the city and the world. To ensure effective financing, various options were compared, considering both capital and operating costs for maintenance. Potential funding sources include the European Regional Development Fund, crowdfunding, private actors, and public-private partnerships, aiming to minimise the reliance on public funding.

Taking into account social, economic, and environmental factors, it was concluded that dedicating half of the street to residential use would provide the needed space for free and safe movement, while showcasing native biodiversity firsthand. This initiative would also contribute to enhancing micro-mobility within Genova, making the city greener for a more effective mitigation and adaptation to climate change, build community in the new natural spaces, mediate the reconnection of humans to nature, and being a space of innovative thinking where circular initiatives or other nature based solutions can be developed. All these while doing the bigger job of increasing human well being (better air quality, lower temperatures, lower flood risk), increasing biodiversity and greenery (native species), enhancing connectivity between natural ecosystem and urban ecosystems (mountains, parks and sea), fomenting the construction of similar nature based urban designs along the city and aligning the city with the UN sustainable development goals.