Reviving Streetscapes: Designing Biodiverse Streetscapes.

Creating Homes in Cities for Those Without.

A Guide to Designing Biodiverse StreetScapes

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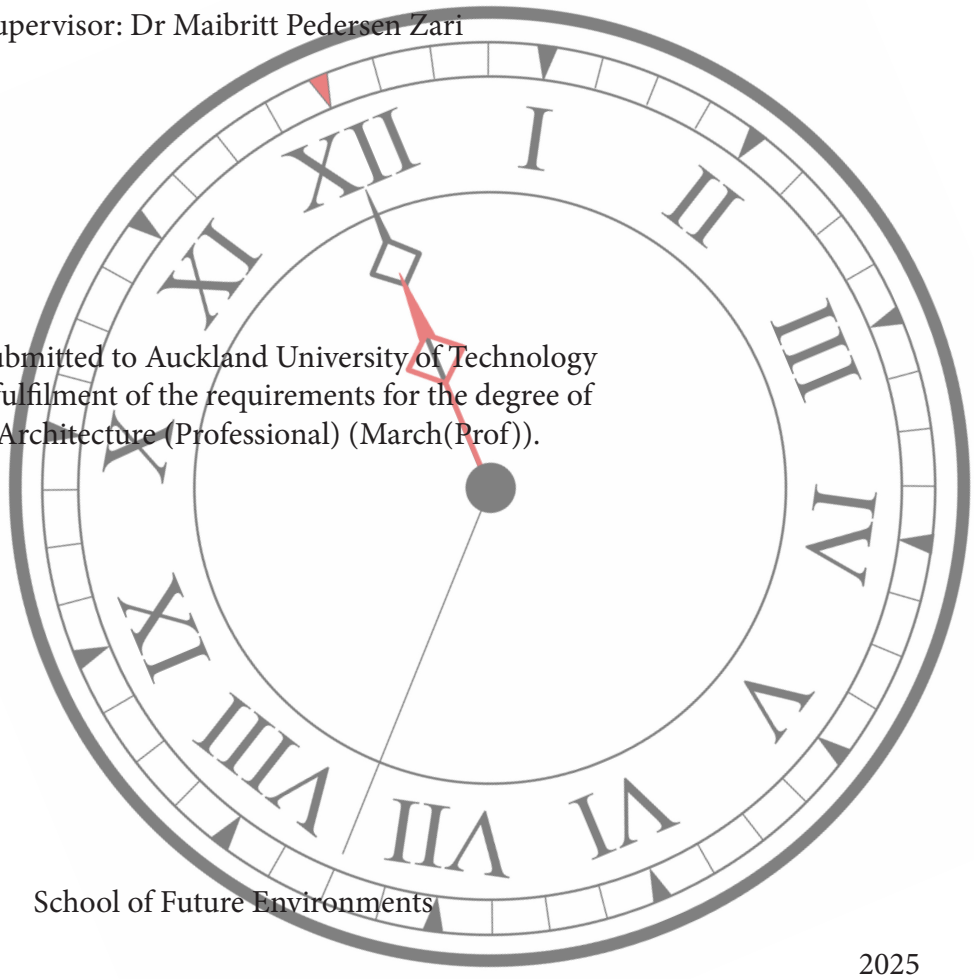

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I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.



0.1 Abstract

This thesis explores the idea that streetscapes can support native biodiversity. The world is currently experiencing a biodiversity crisis, a situation partly driven by habitat loss resulting from the expansion of the built environment. This suggests that architecture may play a role in mitigating biodiversity loss through the integration of green spaces, particularly in dense inner-city areas. The aim of this project is to determine how dense urban streetscapes can be designed to support native biodiversity.

To achieve this, a three-strand streetscape design framework was developed, drawing on existing frameworks and precedent studies to identify three key elements of streetscape design: individual, collective, and ecological wellbeing. This framework was used to critically analyse the existing conditions and to design a biodiverse streetscape for Queen Street in Auckland's CBD. The design illustrates the potential for increasing biodiversity-supportive green space within streetscapes through features such as green roofs and walls, canopy gardens, and green corridors. The proposed design could also theoretically support native biodiversity by creating specific habitats for target species.

0.2 Acknowledgements:

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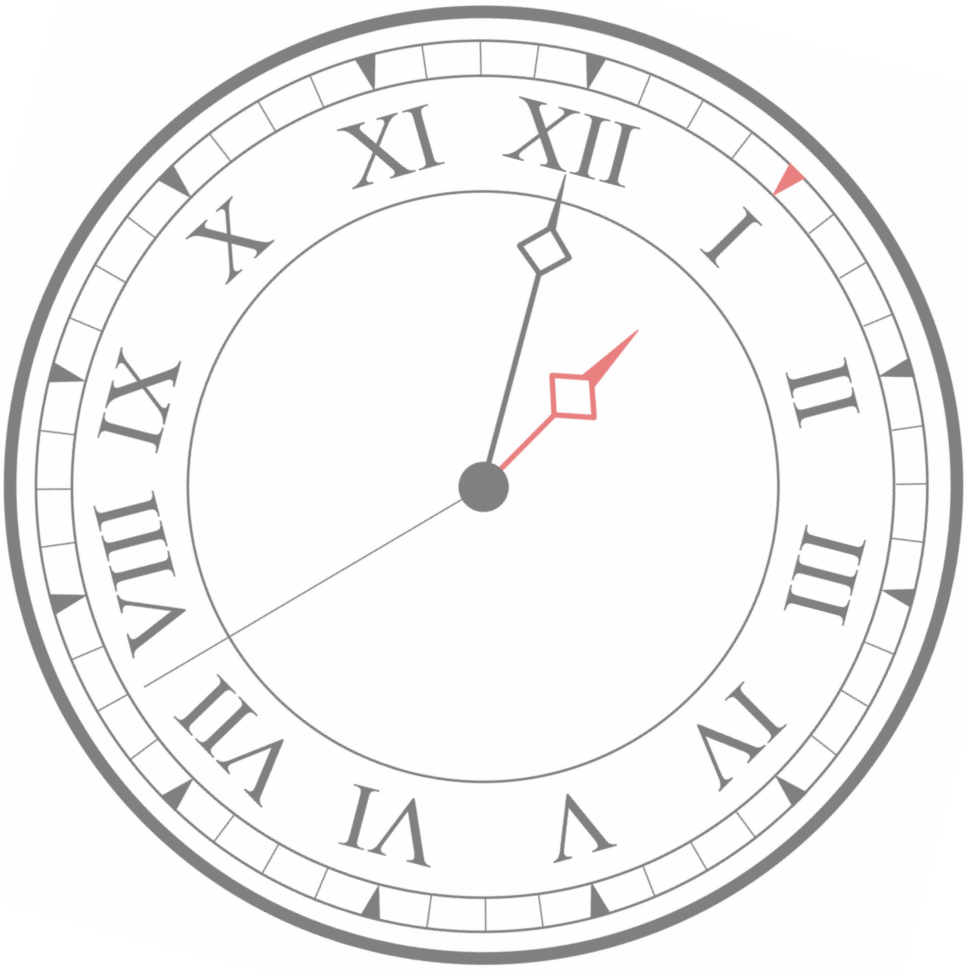
01
Introduction

This section discusses the research topic, its importance and relevance to architectural and urban design, outlines the research aims and objectives, and defines the research question



1.1 BackGround

Why is a focus on biodiversity in cities important?

The world is currently facing a biodiversity crisis. Humanity is dependent on biodiversity (Pedersen Zari, 2018). Biodiversity supports ecosystem stability (Chapin III et al., 2000), and therefore the ecosystem services that benefit humans (Pedersen Zari, 2018). Ecosystem services are the benefits that ecosystems provide to humans, other species, and the ecosystem itself (Department of Conservation, 2020). Examples of ecosystem services include food and water provision, climate regulation, water regulation, and pollination (Elmqvist et al., 2015).

Biodiversity loss reduces ecosystem stability, which leads to a decline in ecosystem services and can negatively affect the ability of all species, including humans, to thrive and survive (Worm et al., 2006). Biodiversity also contributes significantly to urban environments, improving physical and psychological health, as well as cultural wellbeing. It connects to identity through the concept of cultural keystone species (Kilpatrick et al., 2017), such as birds like the kererū.

This is particularly relevant in Aotearoa New Zealand, where mana whenua (the Indigenous people of a particular area) have a deep connection to the land. Currently, a wide variety of non-native plants are more commonly used across Aotearoa, particularly in urban environments (Rodgers et al., 2023).

Other negative impacts of biodiversity loss include reduced food security and adverse effects on the economy and livelihoods (Department of Conservation, 2020).

Humans have contributed to the current biodiversity loss, partly through the domino effect caused by urbanisation — the growth of cities and increasing populations within them (Huang et al., 2018). This domino effect leads to city expansion, which requires more resources and increases demand for food, resulting in habitat loss due to the clearing of land for food production and resources (Huang et al., 2018). Urbanisation is less of a factor in New Zealand, as the country is not urbanising at high rates, although cities are still expanding (Huang et al., 2018). The introduction of invasive species and pollution are also contributing factors, but the main cause is land-use change from natural habitats to crop and grazing lands for human food production (Pedersen Zari, 2018). Climate change increasingly affects biodiversity and ecosystems, impacting their function, size, structure, and important mechanisms such as lifecycle timing (Gitay & Watson, 2002). Urbanisation has both direct and indirect effects on biodiversity: directly, through habitat loss caused by urban expansion, and indirectly, through the increased demand for food driven by growing city populations (Department of Conservation, 2020).

Some biodiversity loss is attributed to the built environment through urbanisation. Although only approximately 3% of the world's land surface is occupied by cities (Ruth & Coelho, 2007), more than half of the global population lives in urban areas, a proportion that is steadily increasing (Eigenbrod et al., 2011). Urbanisation leads to habitat loss and fragmentation—the breaking up of areas of habitat—as well as altering local climates through the urban heat island effect (Grimm et al., 2008). Urban spaces also contribute to increased chemical, light, and noise pollution (Grimm et al., 2008). This results in a reduction of species and genetic diversity within plant and animal populations in urban environments (McKinney, 2006). Ecosystem services and ecological functions are also being lost (Radford & James, 2013).

1.1 BackGround

Urban environments are currently experiencing adverse effects due to climate change, compounded by rising temperatures caused by the urban heat island effect, which is a direct result of how dense inner cities are developed (Corburn, 2009). The urban heat island effect can negatively impact urban dwellers, including health and economic consequences (Corburn, 2009). These effects could be partially mitigated through the inclusion of more green and blue spaces within cities—'green' referring to vegetation-based infrastructure and 'blue' to water-based infrastructure (Pedersen Zari et al., 2022). Further reductions in these impacts can be achieved through new designs and retrofitting to increase urban vegetation on and around buildings (Garrard et al., 2017). Adding more urban vegetation will help, in part, to reduce the negative impacts the built environment has on the natural environment (Garrard et al., 2017). This suggests that part of the solution could lie within architecture. This is increasingly evident, as most of the impacts urbanisation has on biodiversity are long-lasting and difficult to reverse (McKinney, 2006).

Humans are also negatively affected by biodiversity loss within cities, leading to a general lack of connection to nature in urban settings (Newman & Soderlund, 2015). Studies have shown that people experience benefits such as stress reduction, reduced mortality, and even improved cognitive development in children when in regular contact with greenspaces (Shanahan et al., 2015), or in spaces with views of, or some connection to, 'nature' (Pedersen Zari, 2019). These effects have been studied extensively, and built environment designers have utilised these findings to contribute to the field of 'biophilic design', which is based on the theory that humans have a natural connection with nature (Newman & Soderlund, 2015). In recent years, design has become more disconnected from nature, creating a world suited to human 'needs'; however, this trend is counteracted by biophilic design. Critics argue that cities are not designed with mental health and wellbeing in mind and, therefore, are not designed for humans (Newman & Soderlund, 2015).

There is a need for more urban design frameworks that link urban design to biodiversity at different scales (Garrard et al., 2017; Pedersen Zari, 2019). This is because the current approach to designing for biodiversity or sustainable design in cities typically focuses on urban greenspaces, such as parks. Buildings are generally designed as individual objects rather than as part of connected biodiverse cityscapes, which include buildings as potential green spaces. This approach helps create cohesive collections of buildings, rather than treating them as isolated entities. The use of green and blue infrastructure addresses biodiversity loss as well as the overarching issue of climate change (Pedersen Zari et al., 2022). Employing green and blue infrastructure at a street or urban scale significantly enhances the benefits they provide, such as cooler temperatures, carbon sequestration, and reduced stormwater runoff (Pedersen Zari et al., 2022).

In South Korea's Ulsan City, it was concluded that even a 1 km^2 increase in green space could have significantly reduced flood damage (Kim, 2021). This also highlights the importance of introducing more green spaces within floodplains, as they are more effective than those outside them (Kim, 2021). When considering biodiversity, natural habitats are essential; however, it is becoming increasingly difficult to support biodiversity with these habitats alone (Pedersen Zari et al., 2022). Due to the density of populations and land use in cities, there is limited space to create natural habitats at ground level (Pedersen Zari et al., 2022). This is where infrastructure such as green walls and roofs becomes more important. Green roofs and walls have proven their usefulness in terms of insulation properties (Pedersen Zari et al., 2022).

1.1 BackGround

Green walls and roofs not only cool buildings but also help mitigate the urban heat island effect, thanks to the properties of plants (Assimakopoulos et al., 2020). They absorb and reflect sunlight in a way that differs from traditional building materials (Assimakopoulos et al., 2020). Additionally, they absorb water into the soil, which then evaporates back into the atmosphere (Assimakopoulos et al., 2020). In a case study in Athens, Greece, it was reported that building surface temperatures dropped by up to 11°C due to the installation of a green wall (Assimakopoulos et al., 2020).

Connectivity is essential because neither plants nor animals are confined to just one site or building. Connected habitats, such as biodiverse streetscapes, enable flora and fauna to survive and thrive more effectively in cities (Pedersen Zari, 2019). Humans are no different. People do not experience cities one building at a time. The experience of walking down a street is much richer — the smell, appearance, sound, temperature, and feel are just a few examples of how streets are experienced as connected streetscapes over time (Pedersen Zari, 2019). This is why cities need to begin developing into environments that remain habitable as the climate continues to change (Pedersen Zari et al., 2022). Cities designed to support wildlife will also be better equipped to support humans in this continually changing climate.

So, if cities were designed as collective streetscapes rather than as individual buildings, would there be an obvious increase in biodiversity — not only on the street but also in the surrounding buildings? This question forms the key focus of this research. Such an approach would help cities adapt to climate change by creating more habitats with healthier ecosystems (Pedersen Zari et al., 2022), cooling the city (plants cool through evapotranspiration and by shading high-mass materials such as footpaths, roads, and buildings) (Assimakopoulos et al., 2020), and decreasing immediate stormwater runoff during rain events. Increased vegetation also helps purify air and water in cities (Pedersen Zari et al., 2022), which is important for countering some climate change impacts. This research seeks to create a framework to improve the design of urban streetscapes for biodiversity. It uses Auckland's CBD — specifically Queen Street — as a case study to experiment with through design, to see how and if the devised framework is effective or useful.

1.2 Research Problem / Opportunity

Due to the current biodiversity crisis, it is crucial to slow the rate at which biodiversity is being lost. This could be achieved through the introduction of biodiversity to areas that have not traditionally supported it. Urban environments, in particular, provide an opportunity, as research has shown that biodiversity can have positive direct impacts on human wellbeing (Shanahan et al., 2015).

To increase biodiversity in cities, we should first focus on streetscapes rather than individual buildings. This approach allows for easier integration with other green spaces, creating connected green corridors that facilitate the movement of fauna between suitable patches of habitat. When increasing the quantity of habitat for biodiversity, quality is equally important. Native vegetation will have a more significant impact on biodiversity outcomes than simply planting fast-growing species or those that require minimal maintenance.

Therefore, the 1.3 Research Question

"How can dense inner-city streetscapes be designed to support native biodiversity?"

1.4 Research Aims & Ojectives

The aim of this research is to develop a framework that supports the design of biodiverse streetscapes, expanding their purpose beyond incidental thoroughfares to intentional spaces that enhance ecology, biodiversity, and human well-being.

The objectives are to:

-- Analyse existing greenspaces, blue areas, and proposed nearby green links around the design site to devise how to create steppingstone habitats as buildings or whole streets between suitable habitats.

-- Compare and analyse different existing frameworks for design for biodiversity to devise a new one.

-- Compare and analyse existing streetscapes to find whether they will be able to support native biodiversity and what the best methods are to increase biodiversity.

-- Analyse different blue and green infrastructure technologies and nature-based solutions that could be used to create biodiverse streetscapes.

-- Test the framework and design for biodiversity strategies on an existing urban streetscape (Queen Street) through design.

1.5 Methodology

This thesis employs a design-led research methodology. Design-led research is a method that combines the structure of research through design and research for design (McRobert, 2018). Design-led research is structured around the key elements: initiate, discover, interpret, ideate, refine, and implement. These have been translated into five key elements for this project: discovery, interpretation, iteration, testing, and developed design. Using this method, the design can be crafted using not only knowledge gained but also real-world constraints (McRobert, 2018).

For this project, a theoretical framework acts as a guiding and reflective tool to ensure consistency. It establishes a standard for developing an appropriate response to the research question on designing biodiverse streetscapes while also examining existing streetscape design frameworks (Groat & Wang, 2013).

The methodology has been divided into four distinct phases:

Research Phase: This phase forms the foundation of the entire thesis. It establishes the aims and objectives of the project and guides the necessary research.

Research through Design Phase: In this phase, design is explored concurrently with learning about the topic. This may involve site visits and initial reflections on the site. The key focus is designing while researching and reflecting on the site.

Design Phase: The main design phase involves conducting the majority of design experiments. These experiments inform the research into various design strategies and technologies, which are then used to develop the final concepts.

Design Reflection: This phase involves further developing the final design concept based on all previously gathered information to achieve the best possible outcome. Once complete, the outcome is reflected upon using the Theoretical Framework, which itself is also subject to reflection.

1.6 Methodology Diagram

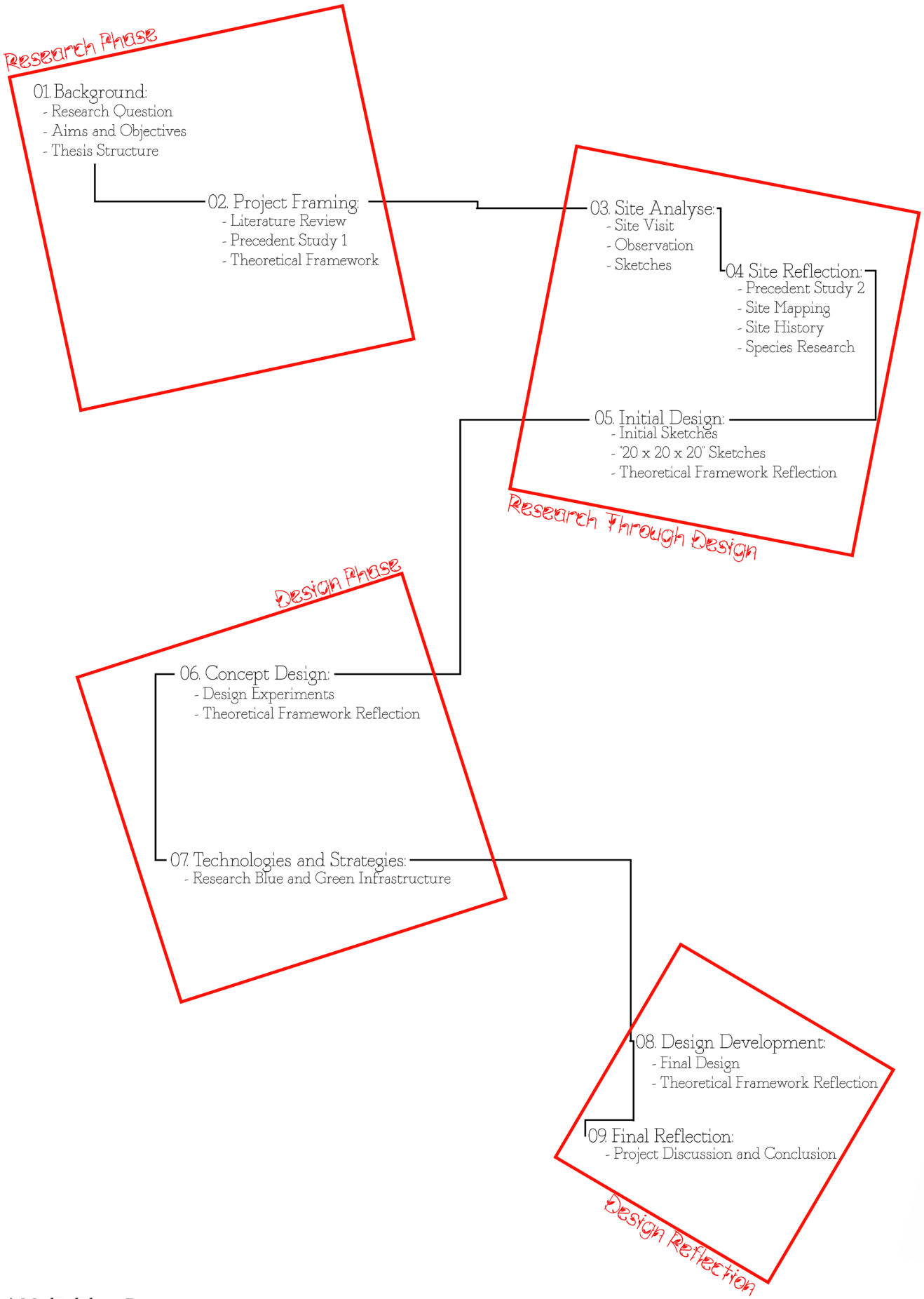
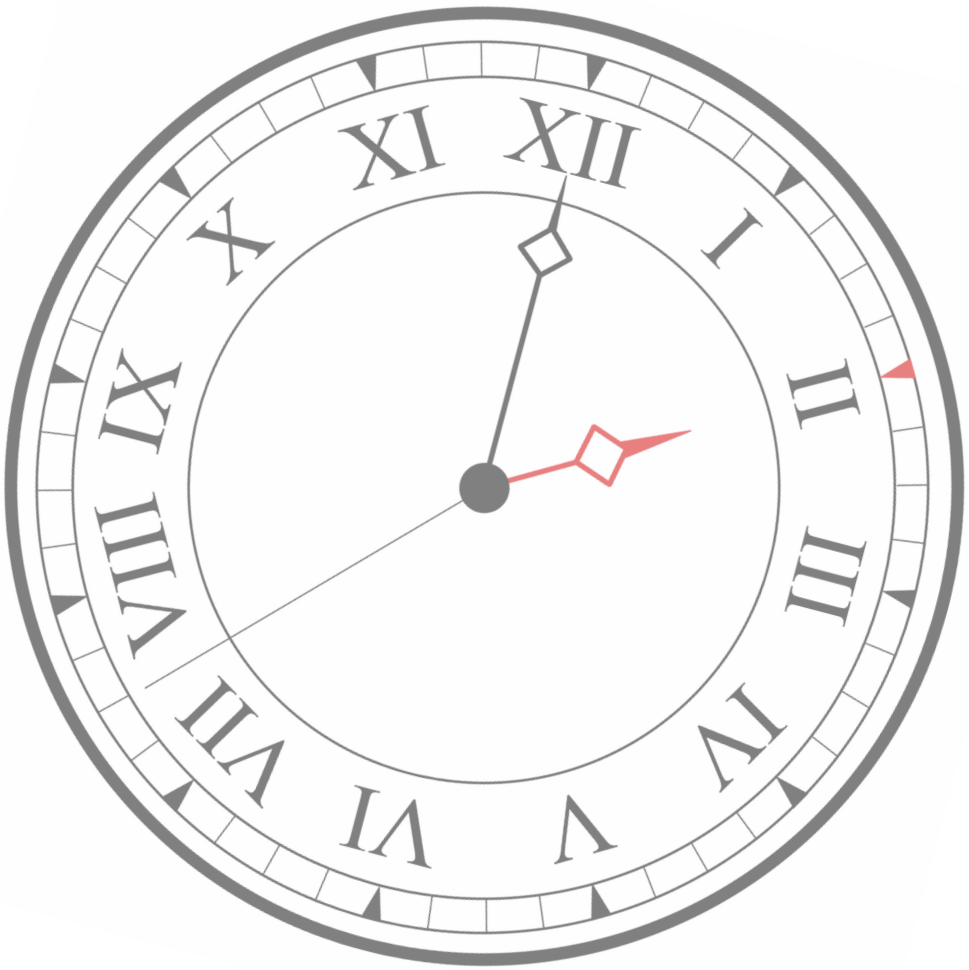


fig 1) Methodology Diagram

Project Framing
02

This section aims to frame the main research for this project. This will be achieved by examining various literature on biodiversity and streetscape design, as well as analysing precedents related to the subject matter. Findings from this will be used to create a theoretical framework for designing with biodiversity in mind. Using this framework, precedents will then be analysed to build the foundation for the project's design.



2.1 Literature Review

In a street, the primary users are people and vehicles. In the case of Queen Street, vehicle access is mostly restricted to buses and emergency services, meaning the primary users are pedestrians. Therefore, the needs of the people using the street must be addressed throughout this thesis. Queen Street is also a culturally significant area, not only featuring a river guarded by a taniwha (a powerful creature or spirit) beneath it and numerous heritage buildings, but also hosting various street performances. As a result, culture plays an equally important role in the character of the street.

As this research explores biodiverse streetscapes, it is important first to understand what biodiversity is and how to increase the biodiversity of a space.

Biodiversity can be categorised as life on the planet, whereas ecosystems are the systems, spaces, and conditions created by this life. These ecosystems define how species interact with each other and how life interacts with abiotic elements such as water, soil, air, and climate. In many worldviews, these abiotic elements are also considered 'alive' or, at microscopic scales, contain life or possess an energetic essence, such as 'mauri' in Te Ao Māori.

Biodiversity within urban environments creates an opportunity for people to reconnect with nature and the benefits it brings (Garrard et al., 2017). To achieve this, existing urban green spaces, if present, must be maintained, and new green spaces introduced (Garrard et al., 2017). Animal species must be encouraged to move to new spaces and the spaces between them, which could be facilitated through infrastructure designed for animal movement (Taylor & Goldingay, 2012). This often involves wildlife crossings, such as tunnels and bridges, which are being designed specifically due to the displacement caused by urbanisation worldwide (Ponsford, 2022). Concurrently, threats like weeds and pests must be removed or minimised (Ikin et al., 2015). Ecological functions need to be supported and enhanced, which could be done by assisting target species or increasing pollinator habitats (Garrard et al., 2017). Target species are those that meet a particular set of criteria for their intended purpose (Gollasch et al., 2020). Some of the target species for this project are birds like the fantail and kererū, which have been chosen for the benefits they bring to the site. There also need to be opportunities for human–nature interactions and relationships, as human engagement (will and care) is necessary for conservation and regeneration to be successful (Cooper et al., 2007). It is also essential to create opportunities for people to develop an interest in biodiversity (Nassauer, 1995). These five objectives (outlined below) are a summary of Garrard's original Biodiversity Sensitive Urban Design Framework (BSUD), developed further in 2021 into five new principles based on the original (Garrard et al., 2017).

2.1.1 BSUD Framework's Five Principles:

> "1. Maintain existing and create new resources for nature. Develop areas of low ecological value to avoid habitat loss. Use native plant species and encourage resident-led wildlife gardening to create habitat for native species. Look for opportunities to add novel habitats such as habitat walls and other green infrastructure.
>
> 2. Support animal movement across the landscape. Establish habitat connectivity corridors through public and private land, taking care not to spread invasive weeds or pests. Again, think outside the square as novel approaches such as road underpasses might be needed.
>
> 3. Reduce threats to and disturbance of nature. Landscape with indigenous plants and establish pet containment programs to reduce the impact of weeds and exotic predators. Plant vegetated swales and rain gardens to mitigate runoff and nutrient loads. Reduce light and sound pollution through the use of sound barriers and temporary road closures and by dimming streetlights.
>
> 4. Protect natural cycles and ecological communities. Reduce the disruptions of Urbanisation by providing adequate resources for the native species you want to support, protect pollinator habitat, and plan for things like fire and flooding.
>
> 5. Create opportunities for positive interactions between people and nature. Facilitate public engagement and local stewardship of biodiversity by providing "cues to care" and creating opportunities for positive interactions with nature."
>
> (Garrard et al., 2017), (The Threatened Species Recovery Hub, 2021)

This framework was designed to increase biodiversity within urban areas, primarily by increasing vegetation and protecting existing biodiversity so it can grow over time. For any of these designs to succeed, pest control will be essential. The spaces need to be free of invasive weeds or potential disease vectors, and the animals must be able to move throughout the spaces and between them without the threat of predation.

Both the original and new BSUD frameworks include a principle centred on supporting the relationship between people and nature, emphasising the important role humans have in protecting biodiversity from further loss. For this reason, the relationship between humans and nature should be represented within the framework that this research aims to create. Therefore, to facilitate this important relationship, the design should purposely create opportunities for human-nature interactions. This can be understood as design towards a 'Biophilic City'. Biophilia refers to a person's love of, and attraction to, the living world—a term first introduced by psychologist E. Fromm in 1961 (Eckardt, 1992) and popularised by biologist E.O. Wilson (Wilson, 1986). This work later contributed to the creation of the concepts of biophilic design and biophilic cities, which involve a cityscape purposely designed to create human-nature interactions and support the relationship between humans and nature (Beatley, 2011).

2.1.2 The 14 Patterns of Biophilic Design:

When designing biophilic cities, Pedersen Zari (2019) identifies three overarching categories in her Biophilic Urbanism Framework. These categories are "Nature in the City," "Nature Activities," and "Nature of Spaces and Places." For streetscape design, only the first category is applicable.

Category one, Nature in the City, is primarily based on the principle of increasing greenspace and urban vegetation—for example, by adding parks, green walls or roofs, street trees, edible gardens, and green corridors—which aligns with the first principle of BSUD. There is also mention of habitat provision, which corresponds with BSUD. More interestingly, two points are raised about non-visual and virtual nature, as well as sensory stimuli. These points are also present in the Fourteen Patterns of Biophilic Design devised by Terrapin Green (Browning et al., 2014), both seemingly referencing Beatley and another early figure in the field of biophilic design, Kellert, who, as early as 1993, was writing about biophilia with E.O. Wilson (Kellert & Wilson, 1993). Sensory stimuli will be beneficial in enhancing the positive experience of streetscapes, as we do not experience streetscapes with just one or two senses. This point emphasises the wellbeing benefits of sounds and movement that may be unexpected, such as birds chirping or leaves falling, which can bring temporary delight or provide small but necessary distraction (Pedersen Zari, 2019).

"Nature in the Space:
1) Visual Connection with Nature.
Being able to see natural elements.
2) Non-Visual Connection with Nature.
Being able to hear of feel the essence of natural elements.
3) Non-Rhythmic Sensory Stimuli.
Connections to nature that can be perceived as arbitrary or random.
4) Thermal & Airflow Variability.
Changes with the air temperature or movement that mimics nature.
5) Presence of Water.
Being able to see, hear or touch water.
6) Dynamic & Diffuse Light.
Mimiciling natural lighting, through movement and fluctuations in intensity of lighting or shadows.
7) Connection with Natural Systems.
Being able to notice or experience the changes of seasons as a sign of a healthy ecosystem.

Natural Analogues:
8) Biomorphic Forms & Patterns.
Using natural patterns, textures or contours.
9) Material Connection with Nature.
Using natural materials or elements that relfect the local ecology.
10) Complexity & Order.
Creating a spatial hierarchy similar to what would appear in nature.

Nature of the Space:
11) Prospect.
A far view which isn't obstructed with the idea of surveillance or planning.
12) Refuge.
A safe space away from possible environmental conditions or the flow of activity, protecting the user particularly from above and behind.
13) Mystery.
Spaces with partly obscured views or interventions which draw people further in the environment.
14) Risk / Peril.
An unknow threat which is accompanied be a safeguard"
(Browning et al., 2014)

The fourteen patterns of biophilic design need to be analysed in terms of their applicability to streetscape design. Following this, they can be consolidated into a framework to guide the design of urban streetscapes.

Enhancing the wellbeing of biodiversity (i.e., non-human life) is a central focus of this research. However, in urban streetscapes, the primary users—humans—must also be considered. This is particularly important given that the selected site for the design experiments is Queen Street in Auckland's CBD, which experiences high pedestrian traffic on a daily basis. Queen Street also has a rich human and ecological history, both of which must be meaningfully integrated into the design process.

2.1.3 Physical Design Elements of Streetscapes:

It is important to understand the essential elements of streetscape design to create an effective, biodiverse streetscape.

When designing streetscapes, the needs of pedestrians, drivers, and business owners must be prioritised.

Road Design (Curbs, Medians, Crossings)	Curbs provide safety for pedestrians by creating a barrier between the street and the footpath. Ramps in the curb should be included at every intersection or street crossing to allow people with strollers, bikes, or wheelchairs to cross the road safely (Daley et al., 2003). Medians are important for providing safety to street users, such as offering a safe space for pedestrians to pause or separating opposing traffic lanes. They can also enhance the streetscape's aesthetic through planting or street furnishings (Toronto City Planning, 2006). Street crossings are essential for pedestrians to cross roads safely. This safety could be improved by using special paving to increase drivers' attention.
Sidewalks	Having an area for people to walk is essential for streetscapes. These areas should provide people with a safe and comfortable space that is also visually appealing. They should be designed with appropriate street furnishings, planting, and lighting (Toronto City Planning, 2006). Street corners are generally larger areas than the sidewalk, creating more space and opportunities for community social interaction. This can be achieved through street furniture such as benches. Street corners should be used to create safe spaces to wait to cross the road, through shelters or by decreasing the distance needed to cross the road (Otak Inc, 2007).
Bus Stops	All bus stops should have clearly visible bus stop signs and arrival displays, as well as benches and sheltered spaces to protect users from the sun or rain (Spellman, 2008).
Bicycle Facilities	Streets typically have designated spaces for cars, but there should also be bike lanes to encourage cycling rather than driving. Bike lanes help ensure the safety of not only cyclists but also drivers and pedestrians using the street. The inclusion of bike racks is important to provide cyclists with a safe place to stop and remain within the streetscape. To encourage people to visit local stores, bike racks should be placed closer to the buildings than to the street.
Wayfinding	Wayfinding is important in any streetscape. This can be easily addressed through signage, which needs to be visually clear and long-lasting. Creating a visual guide through the street makes the environment more comfortable and easier to navigate (Architectural Resources Group, 2002).

2.1.3 Physical Design Elements of Streetscapes:

Trash Areas	Rubbish bins should be placed along the street for pedestrian use, particularly near bus stops, seating areas, traffic lights, and street corners.
Greenery (Trees, Planters, Green Strips)	Street trees or green strips enhance pedestrian safety by providing a buffer between the road and the footpath, while also improving the aesthetics of the area. The more planting within the street environment, the greater the reduction in traffic noise, contributing to a more comfortable experience for pedestrians (Otak Inc, 2007). Planters can also serve as a buffer between the road and the footpath, but they must be positioned so as not to obstruct pedestrian flow. This is particularly important at street corners, where visibility for drivers must be maintained. Planters can also be placed outside buildings to create a more inviting atmosphere, and similarly, near seating areas to enhance the overall environment (Otak Inc, 2007).
Street Furnishings (Benches, Tables, Public Art)	Street furniture such as benches, tables, rubbish bins, signage, and light posts should follow a consistent design throughout the street, with complementary colours and styles (City of Vaughan et al., 2010). Seating areas create an enjoyable atmosphere for pedestrians, encouraging them to use the street for more than just a thoroughfare (Otak Inc., 2007).

fig 2) Physical Elements of Streetscape Design

2.1.3 Physical Design Elements of Streetscapes:

Most elements of a streetscape revolve around pedestrian safety and appeal. Therefore, it is important that pedestrians can effectively use and enjoy the space for it to be considered a successful design. To ensure the space is accessible and enjoyable for everyone, many factors must be considered.

People come in all shapes, sizes, and ages, and may have varying disabilities. This includes individuals using strollers or wheelchairs, and those with low vision, hearing impairments, and other needs — all of which require more specialised design solutions. Universal design refers to design that accommodates all people (Aslaksen et al., 1997).

The Centre for Universal Design at North Carolina State University developed seven principles of universal design (Aslaksen et al., 1997), which are summarised as follows:

Equitable Use	Usable and marketable to anyone.
Flexibility in Use	Usable to anyone no matter their individual abilities.
Simple and Intuitive Use	Users can understand how to use the space without needing any particular knowledge.
Perceptible Information	All necessary information is efficiently communicated to the user no matter the conditions or the user's abilities.
Tolerance for Error	Accounts and plans for any potential accidents or hazards.
Low Physical Effort	Efficient with minimum cause for fatigue.
Size and Space for Approach and Use	Size, space, reach and use no matter the user.

fig 3) Universal Design Principles (Aslaksen et al., 1997)

2.1.4 Te Aranga Māori Design Principles:

When considering both design for biodiversity and streetscape design, humans play an important role in each. This means that biodiverse streetscapes should be designed for both human and non-human users. Human users may have as strong an influence on the design of biodiverse streetscapes as biodiversity itself. Therefore, it is important to consider the collective needs of people in this design process.

When thinking about human users, understanding cultural factors is crucial. None of the frameworks examined have addressed the potential cultural significance of a site. As Aotearoa New Zealand has unique cultural conditions—particularly in relation to plants, animals, and elements such as water—and because the test site, Queen Street, holds cultural importance, this is an essential factor to consider.

In Aotearoa New Zealand, a framework has been developed to enable designers to more effectively take Te Ao Māori world views into account, particularly in the Auckland context. The Te Aranga Māori Design Principles were created in collaboration with Mana Whenua to help ensure that their values and needs are understood and appropriately addressed in design, with a set of specific outcomes. This framework was developed over an extended period to enhance the presence and participation of Mana Whenua in design work (Te Aranga Principles, 2020).

The first development of the Te Aranga Principles involved more than 40 participants who convened at Te Aranga Marae in Flaxmere in 2006 (Hoskins et al., 2008). The aim of this hui was to design a "National Māori Cultural Landscape Strategy" (Hoskins et al., 2008). Since then, the principles have been further developed over the years into what are now the Te Aranga Design Principles, which are currently implemented mainly by Auckland Council and some privately owned businesses (Auckland Council, 2020).

> "Te Aranga Māori Design Principles:
>
> Mana – The status of iwi and hapū as mana whenua is recognized and respected.
> Whakapapa – Māori names are celebrated
> Taiao – The natural environment is protected, restored, and/or enhanced.
> Mauri Tū – Environmental health is protected, maintained, and/or enhanced.
> Mahi Toi – Mana Whenua significant sites and cultural landmarks are acknowledged.
> Tohu – Iwi/Hapū narratives are captured and expressed creatively and appropriately.
> Ahi Kā – Iwi/Hapū have a living and enduring presence and are secure and valued within their rohe.
> (Te Aranga Principles, 2020)"

Of the seven principles identified in the Te Aranga Māori Design Principles, two relate to the protection of the natural environment, linking them to both the BSUD and biophilic design frameworks. This illustrates the close connection between humans and the natural world, which in Te Āo Māori are viewed as one and the same. It suggests that most frameworks centred around human well-being in relation to design support the theory that biodiversity and nature contribute to people's physical and mental health. Some even propose that it also supports cultural health (Kilpatrick et al., 2017), a view openly supported by Taiao and Mauri Tū.

2.2 Biodiverse city policy precedents

2.2.1 Singapore City in Nature

Project Name: Singapore Green Plan 2030
Architect / Designer:
Creation Date: Greening Plans Started as Early as 1960's
Location: Singapore

The Grean Plan sets out Singapore's sustainability goals for the next 10 years.

Some of the main goals of the Green Plan are:
- Plant 1 million more trees
- Quadruple solar energy deployment by 2025.
- Reduce the waste sent to landfill by 30% by 2030
- At least 20% of schools to be carbon neutral by 2030
- All newly registered cars to be cleaner-energy models from 2030
(SG Green Plan, 2024)

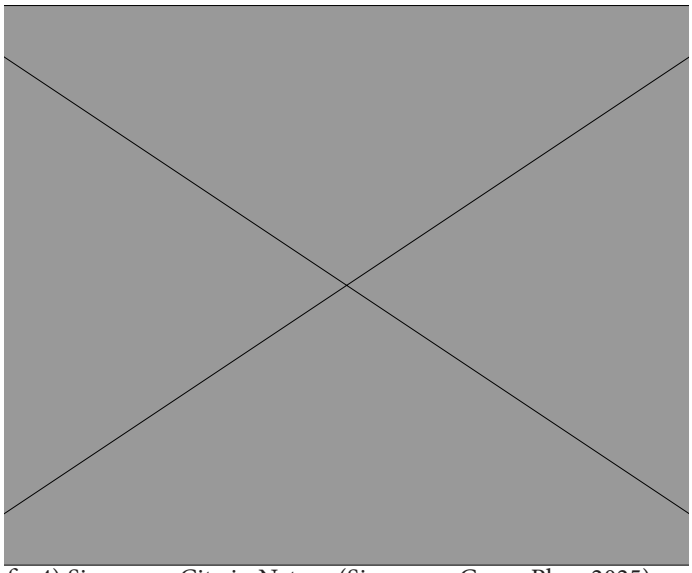


fig 4) Singapore City in Nature (Singapore Green Plan, 2025)

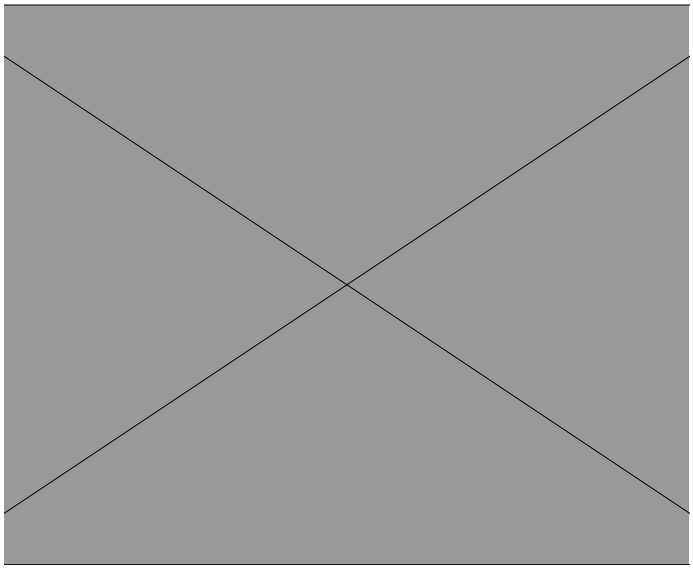
Singapore is planning to continue developing more parks and green spaces throughout the city. The aim is to create a city where everyone lives no more than ten minutes from a green space (SG Green Plan, 2024). Some of these parks are intended to be interactive, creating learning spaces for people to learn about the native wildlife of the area that can be viewed within the park (NParks, 2023). Singapore is also working on expanding its public transport system; this includes adding more electric vehicles to its fleet to gradually phase out the current non-electric options, as well as expanding the rail network and adding more cycle lanes to the roads (SG Green Plan, 2024).

Singapore also plans to improve energy efficiency within buildings, aiming to decrease the amount of energy used and the greenhouse gases released (SG Green Plan, 2024).

Reflection:

The Singapore City in Nature project is on a much larger scale than this project, but there are many lessons that can be learned from it. As this thesis project relates to biodiversity and streetscapes, the goals around green spaces are the most important. The key aspect to be taken from Singapore and applied to this project is the strong commitment to creating more green spaces and parks throughout the city, as well as developing areas where people can learn about native wildlife. This important connection should be incorporated into the theoretical framework.

2.2.2 Melbourne Biodiversity Streetscape:



Project Name: StreetScape Biodiversity Case Study
Creation Date: August 2018
Location: Western end of Clown Street in South Yarra Melbourne Australia.
(City of Melbourne, 2020)

Fig 5) Melbourne Biodiversity Streescape (City of Melbourne, 2018)

The University of Melbourne worked with the City of Melbourne to test a plant palette design to increase streetscape biodiversity in urban environments (City of Melbourne, 2020). This plant palette created a list of different types of plants that ecologists selected based on their horticultural attributes and their biodiversity implications (City of Melbourne, 2020). The plant palette includes a variety of plant types, such as groundcover species like grasses, and shrubs, mostly comprising native species (City of Melbourne, 2020). The plant palette was implemented in four different streets: Clowes Street, South Yarra; Docklands Drive, Docklands; Park Street, Parkville; and Arden Street, North Melbourne (City of Melbourne, 2020). The ecological and biodiversity outcomes were tested, and the four streets were then compared with other streets used as controls (City of Melbourne, 2020).

Reflection:

Melbourne's Biodiversity Streetscape project showcased a very interesting tool — the plant palette. This is a tool that could be helpful in all biodiversity-based projects, once adjusted for specific locations. As this project aims to increase the native biodiversity of Queen Street, including native animal and plant species, using a plant palette to create a database of suitable native plants will help organise the different layers of plants needed, from groundcover to taller trees.

2.2.3 Green Link:

Project Name: The Green Link
Architect / Designer:
Creation Date: 2020 Master Plan -
Location: Auckland CBD



Fig 6) Auckland Counils Green Link

The Green Link aims to create a network that connects major green spaces within the Auckland CBD, such as Albert Park and Victoria Park (Auckland Council, 2020a). To achieve this, linear parks are being developed along streets to connect these spaces and combat habitat fragmentation. Victoria Street is one of the proposed routes (Auckland Council, 2020a). Through this initiative, the Council hopes to add more trees and plants within the city and create additional spaces for people to enjoy (Auckland Council, 2020). Another proposal involves reopening the air raid shelter tunnels underneath Albert Park to create a walking and cycling path linking connecting streets such as Victoria Street East and Beach Road (Auckland Council, 2020b).

Reflection:

The Green Link aims to connect green spaces within the CBD, which would complement this thesis project by exploring the notion of creating stepping-stone habitats to ensure that the species targeted (particularly birds) can move to and from the surrounding green areas more effectively. As Queen Street is located between Victoria Park and Albert Park, the linear park planned for Victoria Street will run straight through Queen Street at the intersection of Victoria Street and Queen Street. This design-led research project could therefore align with the current Green Link proposal to create a biodiverse streetscape right in the centre of the Green Link.

2.3 Theoretical Framework: The Biodiverse Streetscapes Design Framework

A theoretical framework generally serves to establish a foundation for the theory behind writing. It is a tool used to guide and reflect. More literally, it is a summary of concepts and theories based on published knowledge used to build a new structure and provide a basis for analysing new research (Kivunja, 2018). In this design-led research thesis, the theoretical framework functions as a bridge between the findings of the literature review and the design work itself, positioning the work within the broader context of knowledge and practice. This is achieved by using the theoretical framework devised here to critically review and reflect upon relevant precedents before critiquing and refining the design work.

Given the various elements of streetscape design that have been identified, the framework consists of three key aspects: how groups of people experience the streetscape; how individual humans experience the streetscape; and how non-human entities experience the space. These three elements form the 'three strands' of the streetscape design framework, which are named collective wellbeing, individual wellbeing, and ecological wellbeing. Each of these three strands will have 'three principles', all of which follow the same formula: increasing quantity, improving quality, and creating or reinforcing relationships.

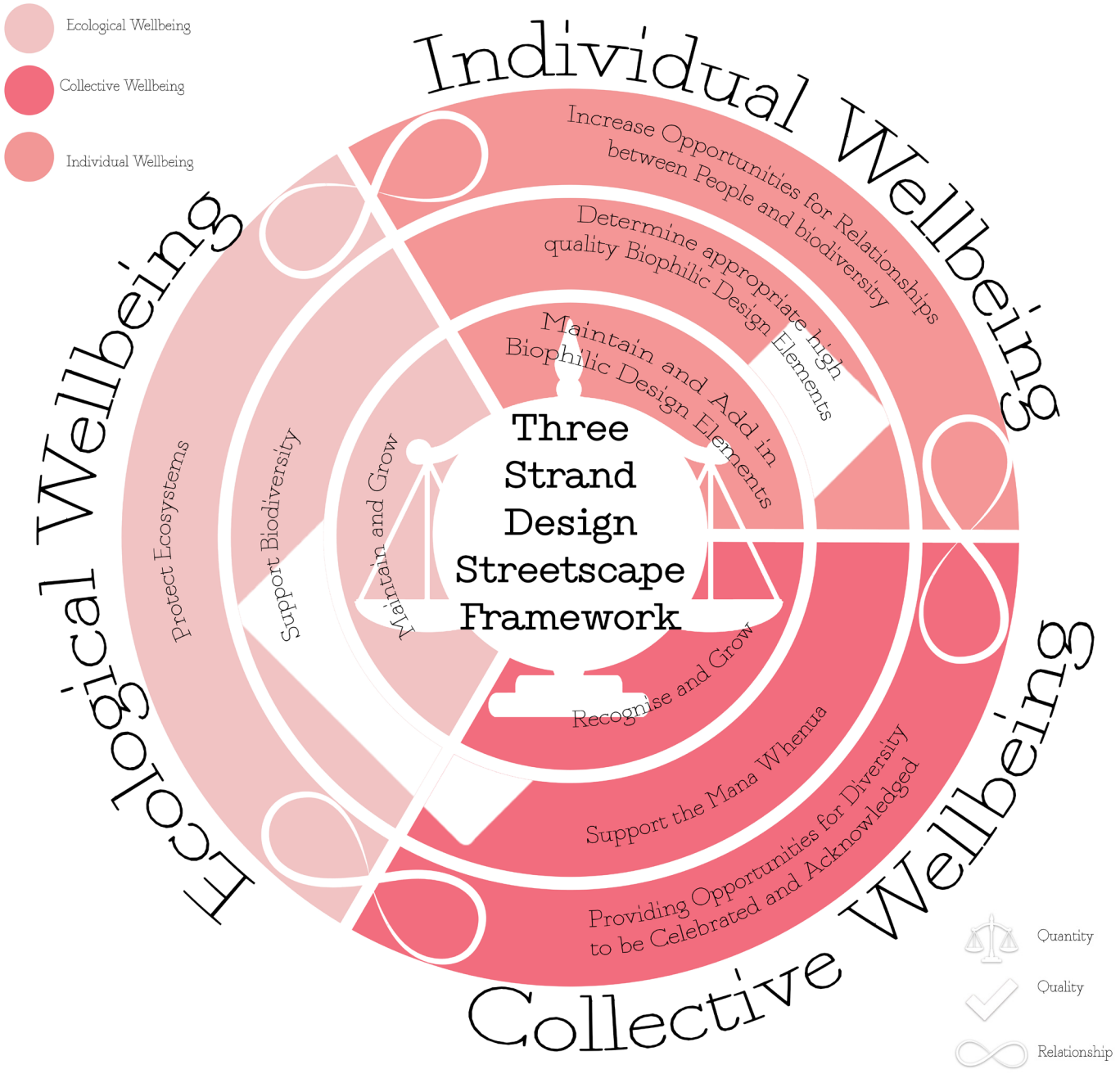


Fig 7) Three Strand Streetscape Design Framework Diagram

2.3.1 Collective Wellbeing



Fig 8) Three Strand Streetscape Design Framework Collective Wellbeing Diagram

The collective wellbeing strand considers groups of people and their cultural identities. The principles within this strand follow the formula of increasing quantity, improving quality, and creating or reinforcing relationships.

Increasing quantity refers to identifying existing cultural groups within the area and supporting their wellbeing through growth. This can be achieved by providing safe or engaging spaces for people to meet and gather, or by inviting them to be part of decision-making regarding the site.

For the quality principle, the focus is on supporting mana whenua (the Indigenous people of the site) by ensuring the site expresses and reflects their cultural values and narratives, thus improving the quality of the space. This can be done by creating dedicated spaces for mana whenua and appropriately integrating cultural design elements such as planting, artwork, place names, motifs, and stories into the site.

The relationship principle that supports the collective wellbeing strand focuses on the connection between cultural values, narratives, stories, expressions, and the living world. Improving this relationship can be achieved by creating interventions that highlight cultural values in the living environment, creating spaces to celebrate, understand, or strengthen these relationships.

2.3.2 Individual Wellbeing



Fig 9) Three Strand Streetscape Design Framework Individual Wellbeing Diagram

The individual wellbeing strand considers a person's needs and what makes a place enjoyable to be in. The formula of increasing quantity, improving quality, and creating or reinforcing relationships is followed.

Increasing quantity in this strand involves adding elements of biophilic design and ensuring that any existing elements are properly maintained. This can be achieved by introducing vegetation, water features such as koi ponds, or nature-related artworks and sculptures.

Improving quality in this strand focuses on enhancing the quality of those biophilic design elements, particularly in relation to creating a sense of identity for the site. Adding biophilic design elements improves the quality of the space in terms of human wellbeing, but being thoughtful and purposeful can transform spaces that might otherwise feel unapproachable. This can be done by creating sheltered areas and using natural materials or natural forms for street furniture or decorations. Screens and façades can also play a significant role; creating screens or façades that move or interact with light can be beneficial for people (Kellert et al., 2008).

The relationship principle related to the individual wellbeing strand focuses on the connection between humans and biodiversity. This is important because most of the example frameworks studied (see Section 2.1) focus solely on the wellbeing of biodiversity. Biodiversity wellbeing is a key part of this research, but by also supporting this relationship through design, an interest in biodiversity and nature conservation will hopefully be better fostered in people, especially children (Louv, 2005).

To support this relationship, edible gardens or urban orchards can be added, along with more walking paths surrounded by nature. Creating learning spaces to teach people about biodiversity, or allowing them to interact more directly with nature, will also help strengthen this relationship.

2.3.3 Ecological Wellbeing



Fig 10) Three Strand Streetscape Design Framework Ecological Wellbeing Diagram

The ecological wellbeing strand considers the needs of the non-human elements, including birds, lizards, bees, invertebrates, plants, and ecosystems themselves, within the context of Aotearoa. The formula of increasing quantity, improving quality, and creating or reinforcing relationships is followed.

The principle of increasing quantity in this strand involves adding more green space, planting more trees, and protecting the existing green spaces or elements on the site. This can be achieved by planting street trees, creating rain gardens, and adding green walls or roofs to buildings.

Quality in this strand focuses on creating an environment that supports the growth of key native animals and plants, while ensuring as much connectivity as possible between the site and surrounding green spaces. This can be done through carefully selected plantings, bird feeders, nesting boxes, water sources, insect hotels, linear green spaces, green walls and roofs, and potentially some fruit trees.

The relationship that ecological wellbeing aims to protect is the connection between the various elements of the ecosystem present at the site. This can be achieved through pest- or predator-proof designs to protect target native species, or by introducing weed mats and more frequent weeding maintenance to prevent the establishment of harmful species in the current ecosystem. Connecting green spaces will also support the health of the ecosystem.

The three strands of the biodiverse streetscape design framework—collective wellbeing, individual wellbeing, and ecological wellbeing—each have three principles to guide design related to quantity, quality, and relationships. For this project, the ecological wellbeing strand will be the focus, as the project's scope is to increase biodiversity within streetscapes. Future design explorations should investigate all three strands.

2.4.1 Victoria Street, Auckland, New Zealand

Project Name: Te Hā Noa Victoria Street
Architect / Designer: Auckland Council?
Creation Date: Original Plan made in 2012; completion scheduled for 2025.
Location: Victoria Street Auckland CBD.

(Auckland Council, 2024, 2020b)

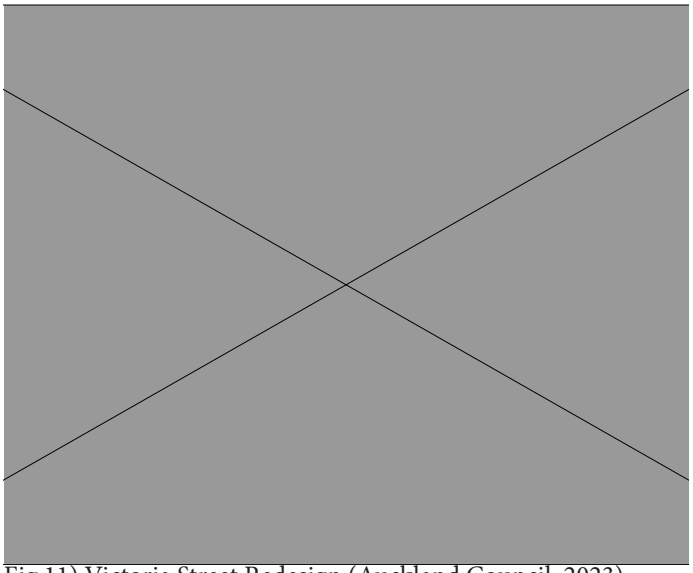


Fig 11) Victoria Street Redesign (Auckland Council, 2023)

The redesign of Victoria Street is part of Auckland Council's Green Link plan (see section 2.2.1) and aims to create a more attractive street experience by widening footpaths, increasing shaded areas and seating, as well as introducing new public art (Auckland Council, 2023). Artwork and design reflecting Te Āo Māori will be featured throughout the street to represent its cultural values and the slightly wider location (Auckland Council, 2023). The street will also include new native planting and separated cycle lanes to help create a safer environment (Auckland Council, 2023).

Critical Reflection:

In terms of collective wellbeing, Te Hā Noa Victoria Street incorporates Māori designs and artwork, reflecting the cultural context of the street. For this project, Auckland Council actively engaged with mana whenua during the establishment of the project and in determining its outcomes (Auckland Council, 2023). Through this collaboration, the street design project was gifted the name Te Hā Noa, which will hopefully be featured in the final streetscape design. Street furniture incorporating elements of Te Ao Māori, as well as two commissioned artworks, were also included (Auckland Council, 2023). Incorporating cultural design elements into the street furniture could be a valuable detail to bring into the Queen Street design. Having similar designs in both Victoria Street and Queen Street would create continuity and a strong sense of place.

Regarding individual wellbeing, Te Hā Noa Victoria Street is widening footpaths and creating new cycle lanes to improve pedestrian safety. There will also be new street furniture, such as seating, artwork, and a water fountain (Auckland Council, 2023). The aim is to create a space where people want to linger, rather than simply pass through, as is often the experience in the Auckland CBD. However, there is definitely more that could be done. For example, there are no plans for new sheltered areas. The plan relies on trees to provide shelter, but they are not as reliable a structure to protect people, and a large number of trees would be required to effectively serve as shelter. This is also a flaw with the recently widened footpaths on Queen Street. Because there is no covering over the expanded part of the footpath, people tend not to use it when it's raining.

2.4.1 Victoria Street, Auckland, New Zealand

Regarding ecological wellbeing, Te Hā Noa is planning to plant more than 20 large native trees (Auckland Council, 2023). There will also be tiered garden beds shaped to reflect Maungawhau / Mount Eden, representing some of Auckland's history. These will be planted with native bushes and plants (Auckland Council, 2023). Using native trees will increase the likelihood of native birds visiting the site, which means the street is increasing biodiversity, although there are other ways to ensure an active presence of birds, insects, and other creatures. Interestingly, the plan seems to involve patches of greenspace along the street rather than creating a green corridor—a continuous section of vegetation spanning the entire street. This appears to be a missed opportunity or oversight, because the spaces between these patches of vegetation are unlikely to be used unless there is a reason to, such as seating or tables, which could have still been incorporated within a green belt.

The Te Hā Noa Victoria Street project strongly aligns with the aims of this thesis. Te Hā Noa Victoria Street proposes to increase native planting, create safe places for people, and better express the cultural identity of the street. These three objectives essentially represent the key strands of the biodiverse streetscapes framework. This means the Te Hā Noa Victoria Street project can become a standard or exemplar that this design project must aim to match or exceed. The Queen Street design will have at least one major difference, as it is focused specifically on increasing biodiversity, so the strategies implemented within the design will work towards that more intensively.

2.4.2 La Rosa Reserve Stream Daylighting

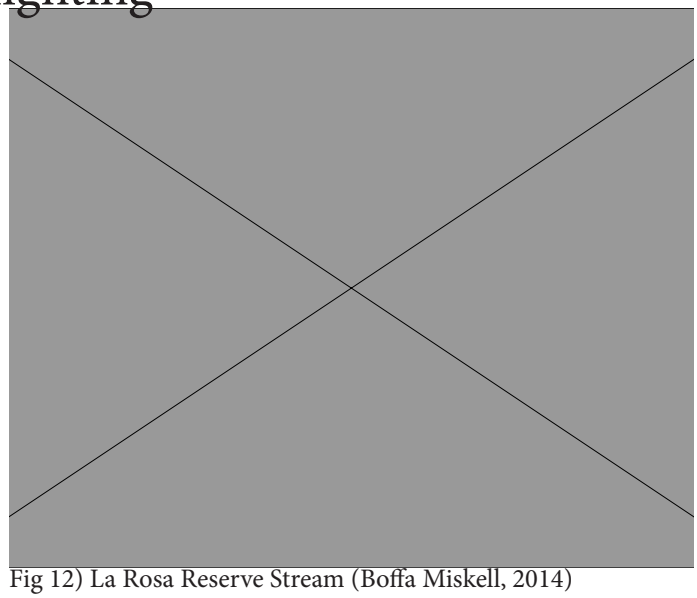


Fig 12) La Rosa Reserve Stream (Boffa Miskell, 2014)

Project Name: La Rosa Reserve Stream Daylighting
Architect / Designer: Boffa Miskell (BML)
Creation Date: Built in 2014
Location: Green Bay, West Auckland, New Zealand
(Boffa Miskell, n.d.)

The daylighting of the La Rosa Reserve stream restored a previously buried watercourse by removing the culverts it had been diverted into, creating a sizeable 200-metre-long open stream that runs through the reserve. This project improved the ecological condition of the reserve by daylighting, which establishes new ecosystems. Along with the daylighting, a few thousand plants were introduced, resulting in 0.25 hectares of planting between the stream and the surrounding land to help restore the stream, using some bioengineering techniques (Boffa Miskell, n.d.).

This project aimed to improve the ecology of the river and the site itself, as well as the cultural and community values associated with the site (Boffa Miskell, n.d.).

Critical reflection:

In terms of collective wellbeing, the La Rosa Reserve Stream daylighting involved iwi in both the project's design and planned outcomes. The reserve also gained new community artworks, which the iwi helped create. Having iwi involvement ensures that cultural elements are incorporated appropriately and that their voices are heard, directly relating to the quantity principle of the framework. The stream itself strengthens the relationship, especially knowing iwi were part of the design process. This supports the connection between cultural values, narratives, and stories expressed in the living world.

Iwi participation in the design process also responds to the quality principle, as having a say in elements like the artwork allows the expression of cultural views or narratives. However, there is likely more that could have been done to demonstrate the cultural connection through the site, such as using te reo Māori on signage.

For individual wellbeing, the La Rosa Reserve stream daylighting project benefits the community. It not only enhanced the reserve but also sparked new interest in it, becoming an outdoor learning experience for surrounding schools. The project has also fostered a renewed interest in ecological study within the community, as they now maintain the stream and conduct surveys.

For ecological wellbeing, this is clearly the project's main focus. The daylighting of the stream creates new ecosystems and relationships, complemented by extensive new planting that supports the health of the reserve's existing ecosystem. Although the project centres more on ecology than biodiversity, therefore there was no specific intervention aimed directly at supporting biodiversity. The improved ecology nevertheless supports biodiversity better than before, but targeted biodiversity actions were not undertaken.

2.4.3 Wellington as a Biophilic City

Project Name: Biophilic Cities Network
Architect / Designer:
Creation Date: Partnered since 2013
Location: Wellington, New Zealand
(Wellington, n.d.)

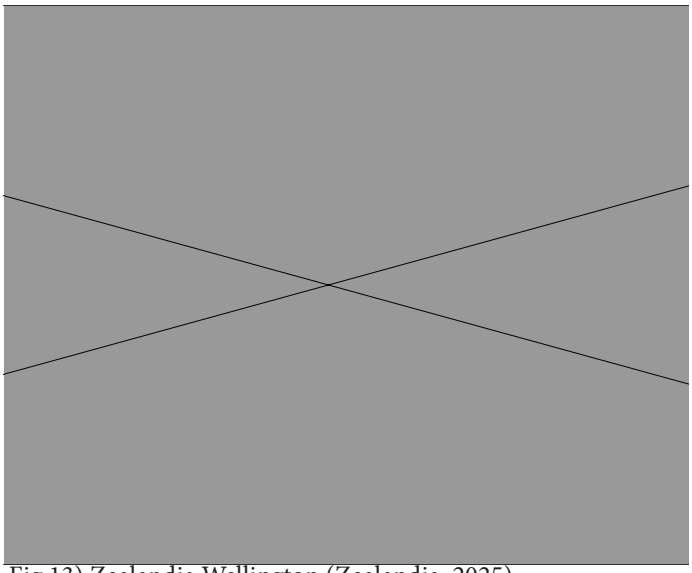


Fig 13) Zealandia Wellington (Zealandia, 2025)

Wellington has been part of the Biophilic Cities Network for many years, since 2013. The city features numerous parks, community gardens, and is home to Zealandia, an ecosanctuary that spans 225 hectares of land (Astruc, 2017). Due to Wellington's location, nestled between steep hills and an ocean harbour, there is an increased potential for enhancing biodiversity and improving ecosystems (Astruc, 2017).

Critical Reflection:

In relation to collective wellbeing, not much is discussed regarding cultural identity within Wellington in terms of the biophilic cities framework. There are, however, initiatives that could be implemented in biophilic design to positively impact cultural identity, such as incorporating cultural artworks in public spaces. For example, using Māori signage or expressing cultural significance within park spaces could enhance this connection.

Regarding individual wellbeing, Wellington strives to provide spaces where the community can engage with nature. Waitangi Park, for example, offers areas for recreational activities, as well as short walking paths near the reed beds, which help strengthen the relationship between humans and non-humans (Astruc, 2017). There are also approximately 30 community gardens in Wellington, some of which are edible gardens. Additionally, the city's many parks contribute to an enjoyable environment for walking through the urban landscape (Astruc, 2017).

In terms of ecological wellbeing, much is being done to improve Wellington's ecology. For example, Waitangi Park is partially a constructed wetland that filters around 10% of stormwater entering the park, which comes from the culverted Waitangi Stream running down Kent and Cambridge Terraces – similar to the river beneath Queen Street. The stormwater is filtered through vegetation and gravel layers before entering the harbour (Astruc, 2017). The abundance of urban green space in Wellington, although decreasing (ref), contributes positively to the overall ecological wellbeing of the city. The most notable green space is the ecosanctuary Zealandia (Astruc, 2017). Zealandia has already reintroduced 18 native species to the Wellington area and has set plans to continue restoring the ecosystem for the next 500 years (Astruc, 2017).

Wellington is a great example of how the three principles of the ecological wellbeing strand work together. They've not only created more green spaces and established a sanctuary to restore native wildlife, but they've done so in a way that contributes to the health of the ecosystem. This precedent specifically looks at Wellington as a biophilic city, and does not address what Wellington is doing as a city to express its cultural significance. This highlights the need for more frameworks that incorporate both ecological and cultural values as a connected whole.

03
Site Analysis

To increase the biodiversity of a site, its typology must first be understood.

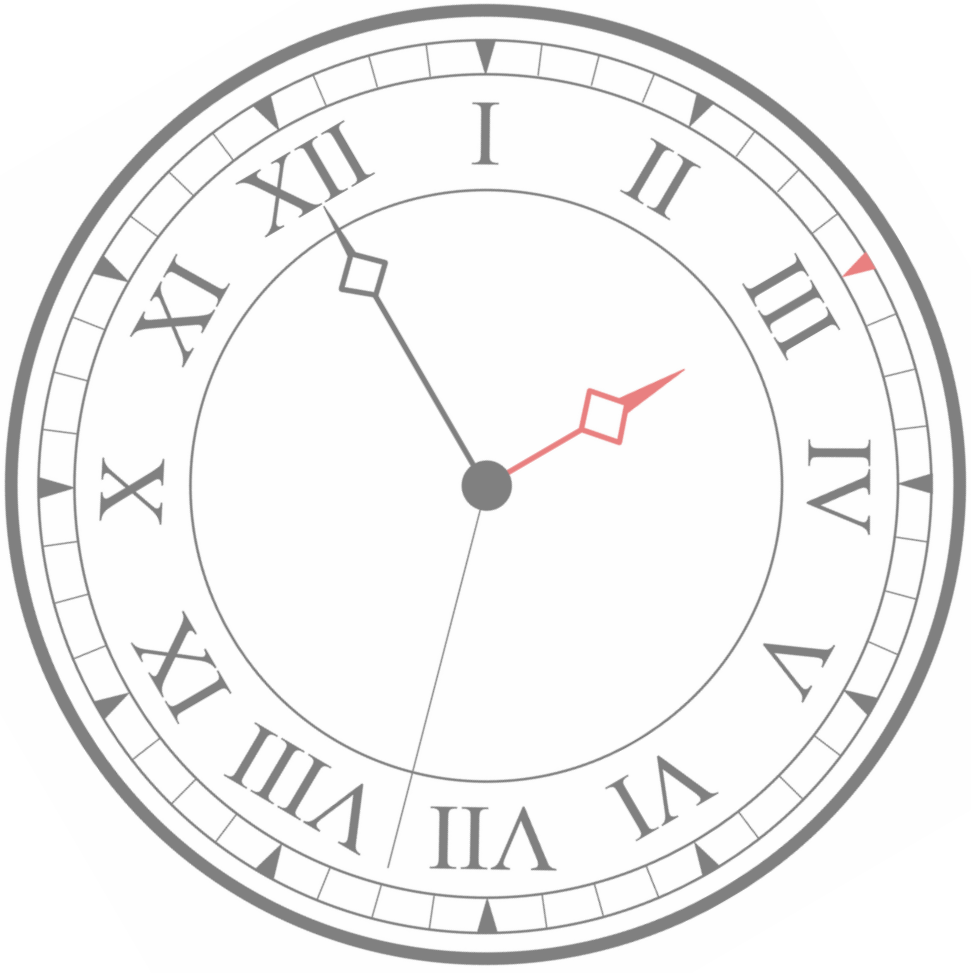
This section explores the past, present, and future of Queen Street, the chosen site for this experiment. It investigates the current typology by analysing existing green spaces and historic values. The street experience will be examined through site visits.

For this thesis, Queen Street has been selected in its entirety to showcase the streetscape, but the focus will also be on smaller areas to identify specific interventions, such as building design, pocket park design, and a more detailed examination of the streetscape.

Each factor (history, ecological and climate typologies, and occupation and use) is important for different reasons. History reflects the site's more natural state, highlighting the best possible vegetation and animals that can be reintroduced to the site.

Typology is significant because it indicates what can currently be supported on the site, from plants that can withstand the prevailing wind or sun, to how water movement will change with planting.

The space must still serve its intended purpose, which, for most streetscapes, is primarily to move people through the area. Therefore, people must still be able to effectively navigate and use the space.



3.1 History

Queen Street used to be the main street of Auckland, and perhaps still is. It has a rich history for many reasons, including being the first street in New Zealand to be paved (Leigh, 2016). The Te Wai Horotiu stream running beneath it and the historical buildings that line the street also contribute to its significance. Around one-third of all the buildings on Queen Street are classified as heritage buildings, making a portion of the street unsuitable for green roofs or green walls. This presents a challenge for the biodiversity-driven redesign of the area.

Queen Street has a deep history, but it is a history with two sides. One side is celebrated and preserved, while the other remains hidden beneath the surface. This raises the question of who decides which part of history is deemed more significant than another. As outlined in the theoretical framework, culturally significant sites should be celebrated and properly acknowledged, yet on Queen Street, this is not the case. This, coupled with the Auckland Council's proposed green link running straight through the centre of Queen Street, makes it an ideal test case for the framework.

Heritage Map Building Map

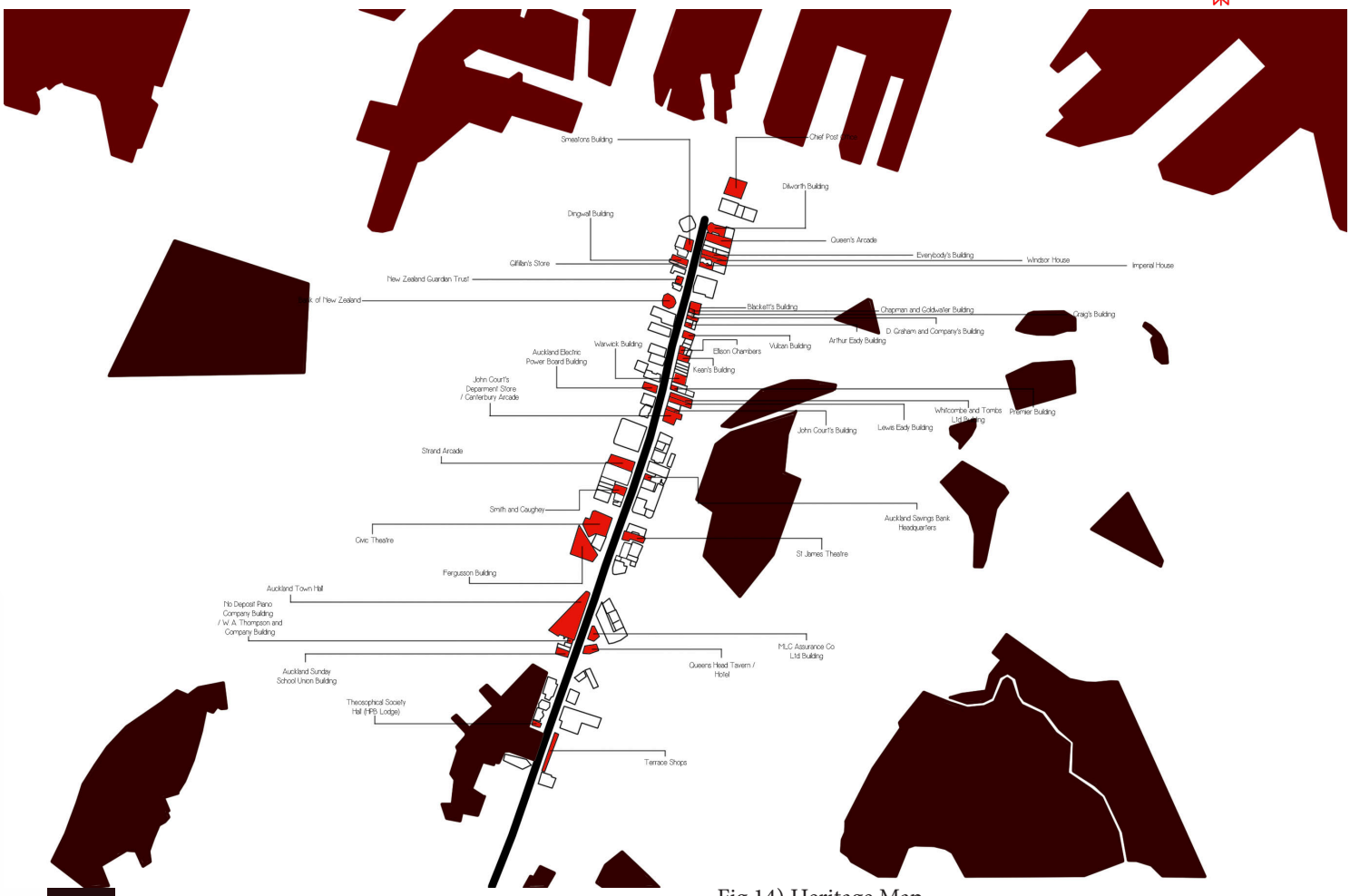


Fig 14) Heritage Map

Key:

Green Space

Harbour

Heritage Buildings

All of these buildings were constructed between the late 1800s and the early 1900s, but what about the things that came before that?

River Map

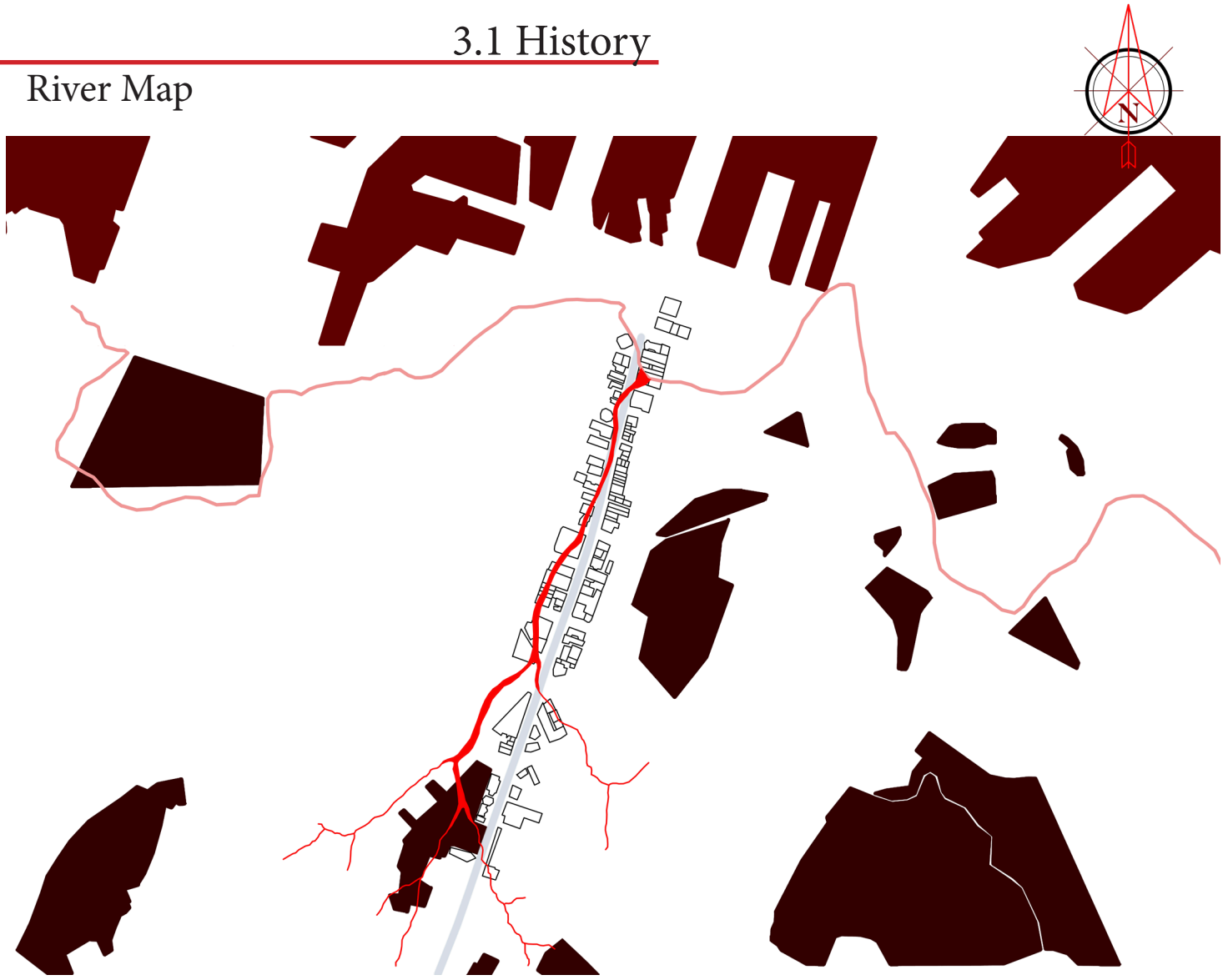


Fig 15) River Map

Green Space

Harbour

Waihorotiu River

Original Shoreline

Key:

This map shows the path the Waihorotiu River once flowed down and where it was discharged into the harbour at the original shoreline.

Long ago, there was a river, once the heart of the city – the Waihorotiu – guarded by the taniwha Horotiu (a legendary mythical creature), after which the river was named. Later, in 1852, it was renamed the Ligar Canal after the then-second Surveyor-General. Now, it lies suffocated and buried beneath the surface, entombed in a coffin of bricks.

This once-thriving river, fuelled by a waterfall (which would have been where Aotea Square now stands), flowed all the way to the harbour, which was much closer than it is now, as seen by the original shoreline, passing through Queen Street. Over time, the river was severed from its wetlands and waterfalls, its life source. Instead, the decision was made to culvert the water beneath the street, effectively abandoning the river.

3.1 History
River Representation:

The Myers Park splash pad, built in 2016, was created in place of the original paddling pool, which was constructed in 1915. It now pays homage to both the pool and Horotiu, the taniwha of the Waihorotiu River. This is done through the poem written by Hone Tūwhare, which is carved into the splash pad: "STOP, your snivelling Horotiu, come rain, hail and flood-water, laugh again" (Horotiu Haiku, 2017).

This is significant because the Te Waihorotiu River once ran under Myers Park, flowing out to the Waitematā Harbour.

In 2024, a new interactive art piece was installed beneath the Myers Park underpass, designed to help "describe the memory of water" (Waimahara, 2024). This artwork responds to its surroundings— the environment, weather, and people. Specifically, if one were to sing either of two specially written waiata into the microphone, the installation hanging from the underside of the underpass would display changing light patterns and sounds. The waiata, Waimahara and Waiora, were written to "encourage reflection on water consciousness and its significance to human life" (Waimahara, 2024).



Fig 16) River's Tomb

Contour Map



Fig 17) Contour Map

Key:

- Green Space
- Harbour
- Contours

Queen Street is approximately 1.7 km long and, in some places, 27.5 m wide. The street was originally four lanes wide, measuring approximately 12.8 m. However, most of the street now has only two lanes, measuring approximately 7 m wide. The footpaths are roughly 5 m wide, with the remaining space used for car parks, seating, or planting. With the newly widened footpaths, the extra space has been allocated for a cycle lane and new bus stops.

Queen Street is also located on a hill; the entire street slopes down towards the harbour.

3.2 Present Day

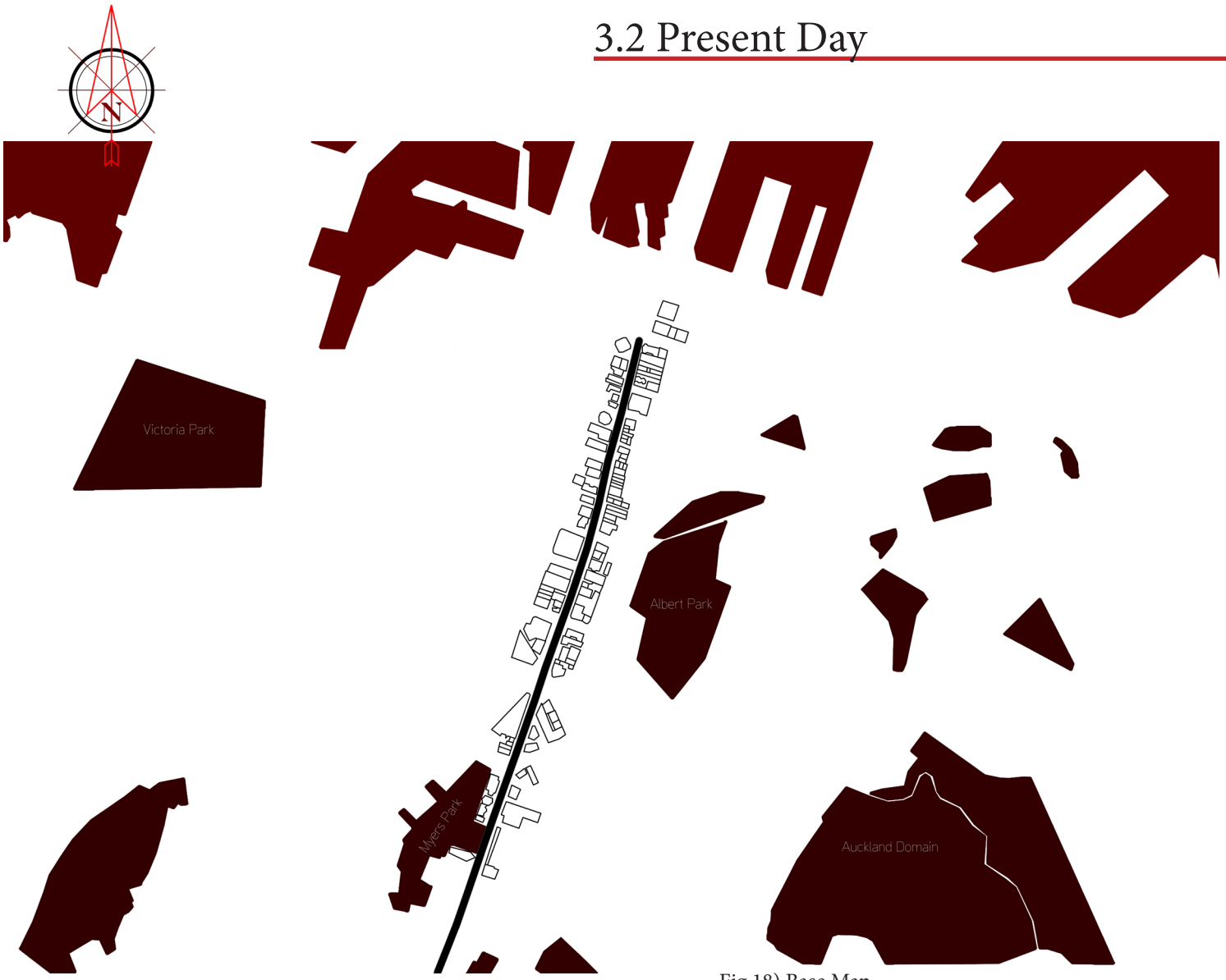


Fig 18) Base Map

Key:

Green Space

Harbour

The nearest green space to Queen Street, measured from their closest points of contact to create the shortest possible distance, is Myers Park, which is approximately 30 metres from the street. The next closest is Albert Park, at around 154 metres, followed by Auckland Domain and Victoria Park, both just under 800 metres away from Queen Street. These distances were measured using Geo Maps.

When designing for biodiversity, it is important to consider the location of existing green spaces and determine the distances between them and specific sites. This is because urbanisation often causes fragmentation of green spaces, separating habitats and making it difficult for species to move between locations, as the distance is sometimes too great. The distances between green spaces partly determine whether target species can access the site (for example, whether a bird can fly that far, or if a lizard can physically reach a new green space). If distances are too far, 'stepping stones' can be introduced. Stepping stones are smaller patches of green space that can link existing green spaces, making it possible for different species to travel between them across the city. This means that 'stepping stone' green spaces or micro-parks may need to be considered for the project.

In Albert Park, bird species such as the kingfisher, tūī, house sparrow, silvereye, song thrush, and fantail, among others, can be observed (Albert Park Checklist, 2024). Native trees such as the tōtara, kauri, and cabbage tree can also be found in Albert Park (Albert Park Checklist, 2024).

In Victoria Park, some of the same bird species can be seen, including the tūī, kingfisher, sparrow, and fantail. However, Victoria Park is also home to the kererū, bellbird, swallow, and some species of ducks (Victoria Park, NZ, 2017).

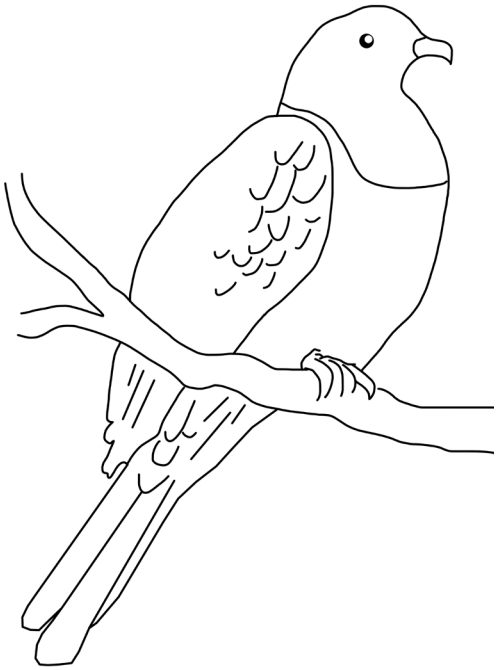


Fig 19) Sketch of kererū

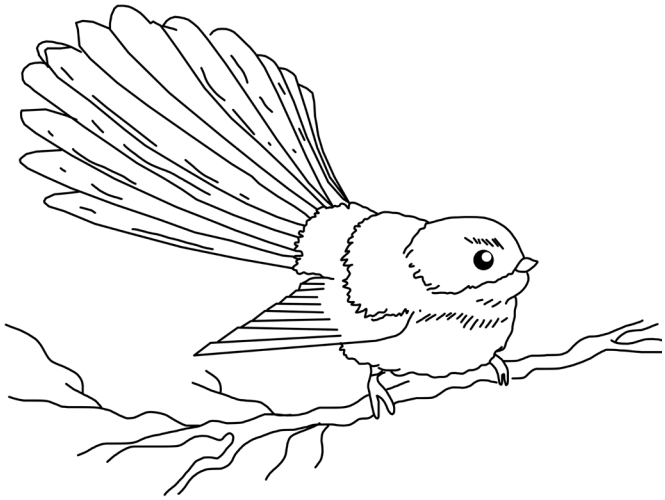


Fig 20) Sketch of fantail

3.2 Present Day
Sun Path

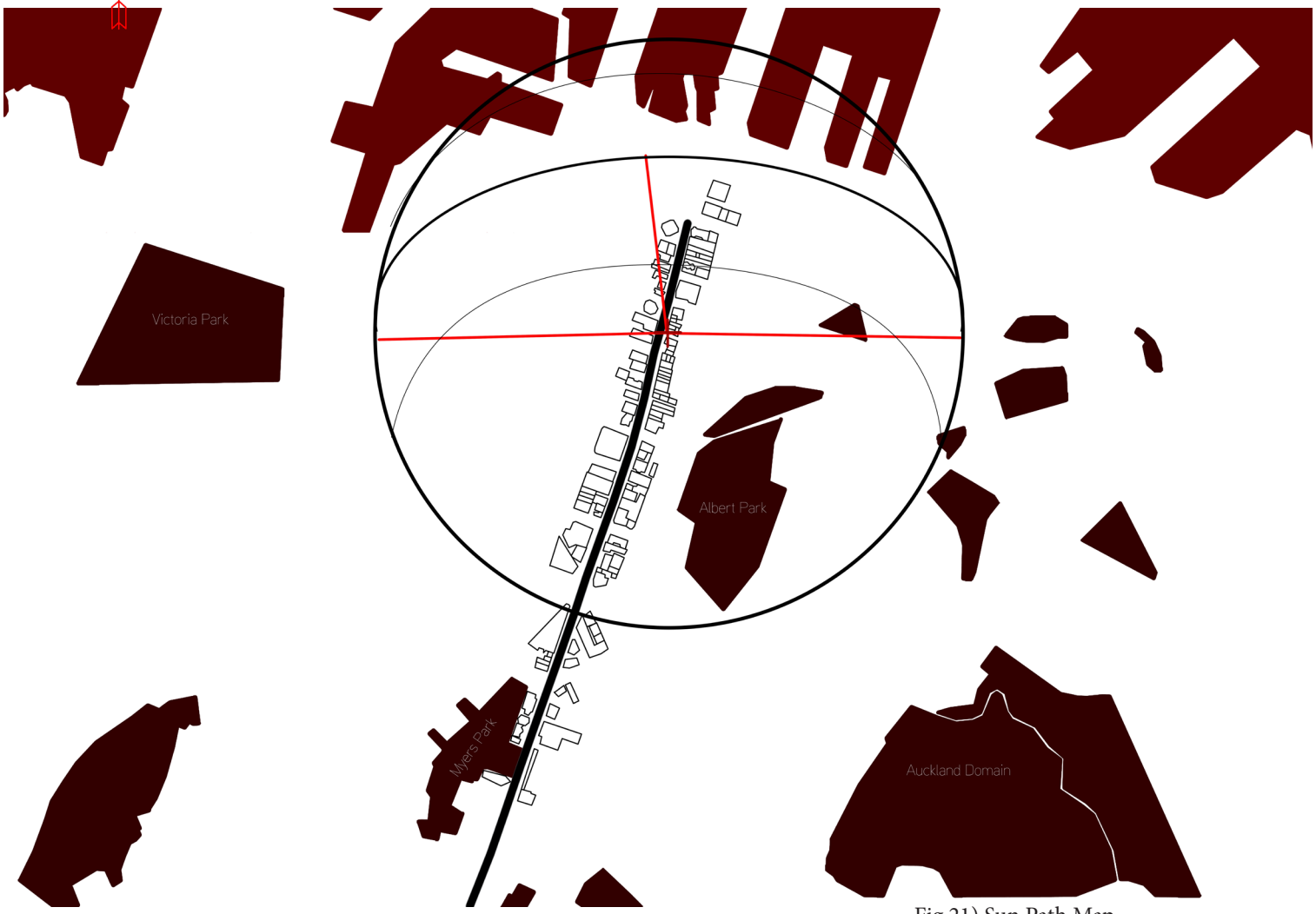


Fig 21) Sun Path Map

Key:

Green Space

Harbour

This map shows the sun path over Queen Street. The street itself is aligned along a north-south axis, so during the middle of the day, sunlight floods down the centre of the street. The street currently doesn't have many skyscrapers; most of them are located on the west side, with the SAP building being one of the tallest at 29 storeys.

Auckland's prevailing winds are mostly southwesterlies (Chappell, n.d.). This, combined with Queen Street being right next to the harbour, means the street experiences strong winds. As Queen Street ends at an intersection outside Britomart Plaza, which is an open space, there is no shield or buffer between the street and the harbour. This results in the street becoming a wind tunnel on windy days.

Although Auckland's CBD is the densest city in New Zealand (Greater Auckland, 2017), it isn't completely covered in skyscrapers, which makes it possible to sustain gardens and plants that prefer sunlight over shade, as well as varieties that don't require much sun. This suggests it would be feasible to cultivate an environment where birds and other animals can thrive. Additionally, due to the cityscape, it is more beneficial to have rooftop gardens, which can receive more sunlight throughout the day compared to the street below. There is also a need for proper coverings to shield from the direct sunlight the street is likely to receive during the middle of the day. This should be explored during site visits to ensure the individual health and safety of people. This will also create opportunities to design different lighting patterns on the street, enhancing the personal experience within the area.

3.2 Present Day
All Water Elements

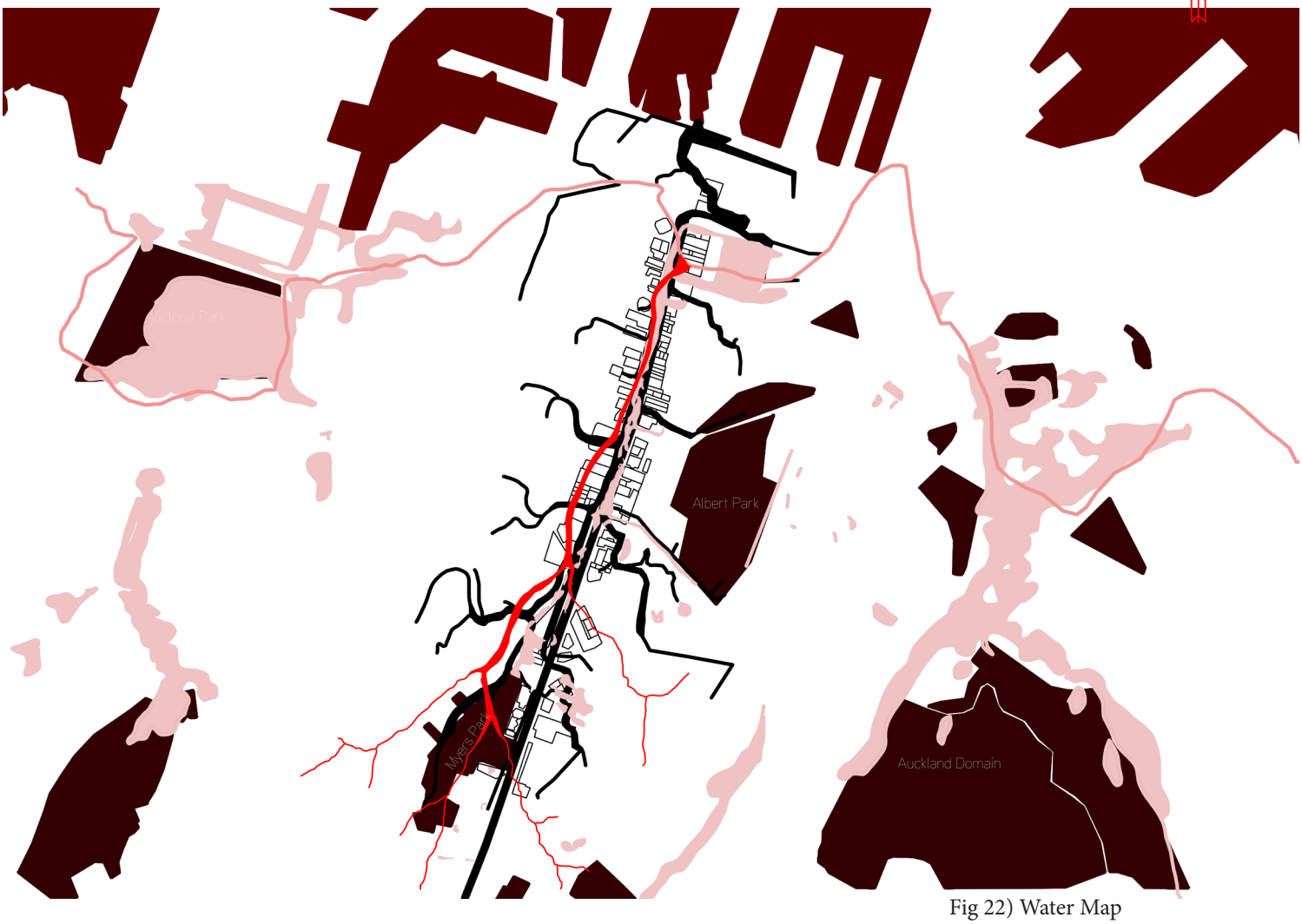


Fig 22) Water Map

Key:

- Green Space
- Harbour
- Waihorotiu River
- Original Shoreline
- Overland Flow Paths
- Flood Plains

This map illustrates how water will affect the site. It shows that the movement of water through the site reflects how it once flowed through the river. However, because the river is no longer present, the water has spread further. This also indicates that the street has a high risk of flooding, particularly at the lower end of Queen Street, with the intersection at Fort Street being especially vulnerable due to its downslope position, where water is shown to pool.

Water plays a crucial role in any design, but it is even more significant in streetscape design. Assessing the stormwater system, potential flood zones, and existing water flows is essential to understanding how the site will be affected and how design strategies might help mitigate these challenges.

Since the water follows the same path the river once did, it suggests that reinstating the river could be a potential solution to the flooding problem. If the river were still present, the water would naturally pool there. Fort Street, in particular, presents an opportunity for design interventions to mitigate the flooding that occurs in that area.

In Queen Street, water plays an even more significant role than usual. As far back as the 1800s, a river once ran from a wetland—now Aotea Square—down to the original shoreline of the Waitematā Harbour, near the Guardian Trust Building. This river was known as Te Wai Horotiu, named after its taniwha, Horotiu.

Myers Park has a detention tank to help prevent flooding around the Town Hall.

Queen Street experiences frequent flooding because it sits in a natural valley, and much of the surrounding area lacks adequate stormwater management. As a result, excess water flows towards Queen Street, contributing to flooding, particularly at the intersection of Queen Street and Fort Street.

3.2 Present Day

Site Visit: Observations:

-- Windy: Due to the waterfront being at the end of the street, a lot of wind drifts up the street from the ocean.
-- High Foot Traffic: As the main commercial street within Auckland's CBD, there are always people around.
-- Nowhere for Rubbish: All the businesses leave their rubbish bags for collection all over the street's footpath.



Fig 23) Queen Street Collage 1

Queen Street is one of the most populated streets in the Auckland CBD, with a seemingly constant flow of foot traffic. The street itself is lined with clothing, footwear, and jewellery stores, while various restaurants and eateries can be found on the smaller streets branching off Queen Street. There is also a strong cultural presence, with a constantly rotating array of street performers, including singers, dancers, artists, traditional musicians, and magicians.

In recent times, the street has undergone significant changes. Footpaths have been widened to accommodate more pedestrians, e-scooters, and bikes. New permanent art features have also been introduced, paying homage to the history of Queen Street by naming the widened footpath after the Waihorotiu River. Vehicle restrictions have been implemented to improve safety, and new planter boxes have been installed, featuring plant species that were once part of the wetlands in upper Queen Street.

3.2 Present Day Observations:



Fig 24) Queen Street Collage 2

Despite housing many shops and attracting large crowds, the street has few rubbish bins and lacks designated spaces for businesses to dispose of their waste. As a result, storefronts leave rubbish bags along Queen Street for collection. While the council continues to introduce more plants, they are always placed in individual planter boxes rather than integrated green spaces, limiting the opportunity for vegetation to grow and spread.

Auckland has a significant homeless population, and many individuals can be seen on Queen Street daily. As the busiest pedestrian street in the city, it is also an inhospitable environment, often cold and windy. Due to its direct alignment with the harbour, the street becomes a wind tunnel on blustery days. Additionally, flooding is a persistent issue, particularly at the lower end of the street near the original shoreline.

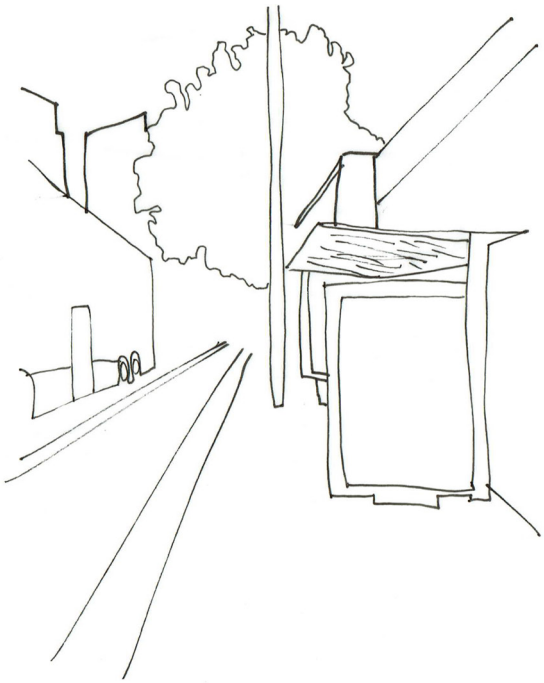


Fig 25) Sketch of Queen Street 1

3.2 Present Day Observations:



Fig 26) Queen Street Collage 3

To fundamentally improve Queen Street, these issues must be addressed. Increasing the amount of green space and vegetation will enhance biodiversity while also assisting with stormwater management and flood mitigation if strategically designed. A higher density of trees and vegetation will also contribute to noise reduction and help slow wind speeds along the street.

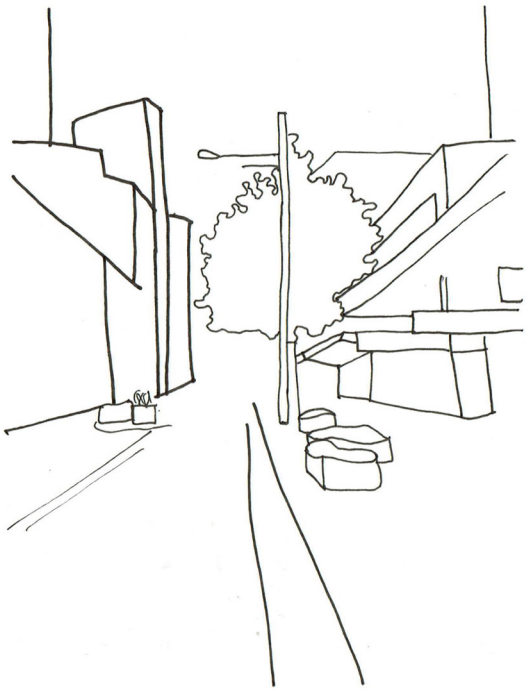


Fig 27) Sketch of Queen Street 2

3.3 Future Plans

The Auckland Council is proposing to create a Green Link throughout the CBD. This proposed Green Link runs through Queen Street but does not include the street itself. This means that this thesis project could theoretically work alongside and complement the Council's initiative.

The Green Link aims to connect most of the green spaces within the CBD (Auckland Council, 2020b). This could potentially reduce the need for stepping-stone green spaces. The route runs from Victoria Park down Victoria Street, through some side streets, across to Albert Park, connecting to the Auckland Domain, and extending to a new green cluster the Council is planning to create.

A key goal of the Green Link is to connect Victoria Park with Albert Park. To achieve this, the Council intends to transform Victoria Street into a green street, which will run through Queen Street and connect directly to Albert Park on the other side.

This creates an interesting opportunity at the intersection of Queen Street and Victoria Street. Additionally, if the possibility of daylighting the river in this area is explored, there is potential to create an intersection of both green and blue spaces.

Key:

- Green Space
- Harbour
- Green Link

Auckland Council's Green Link

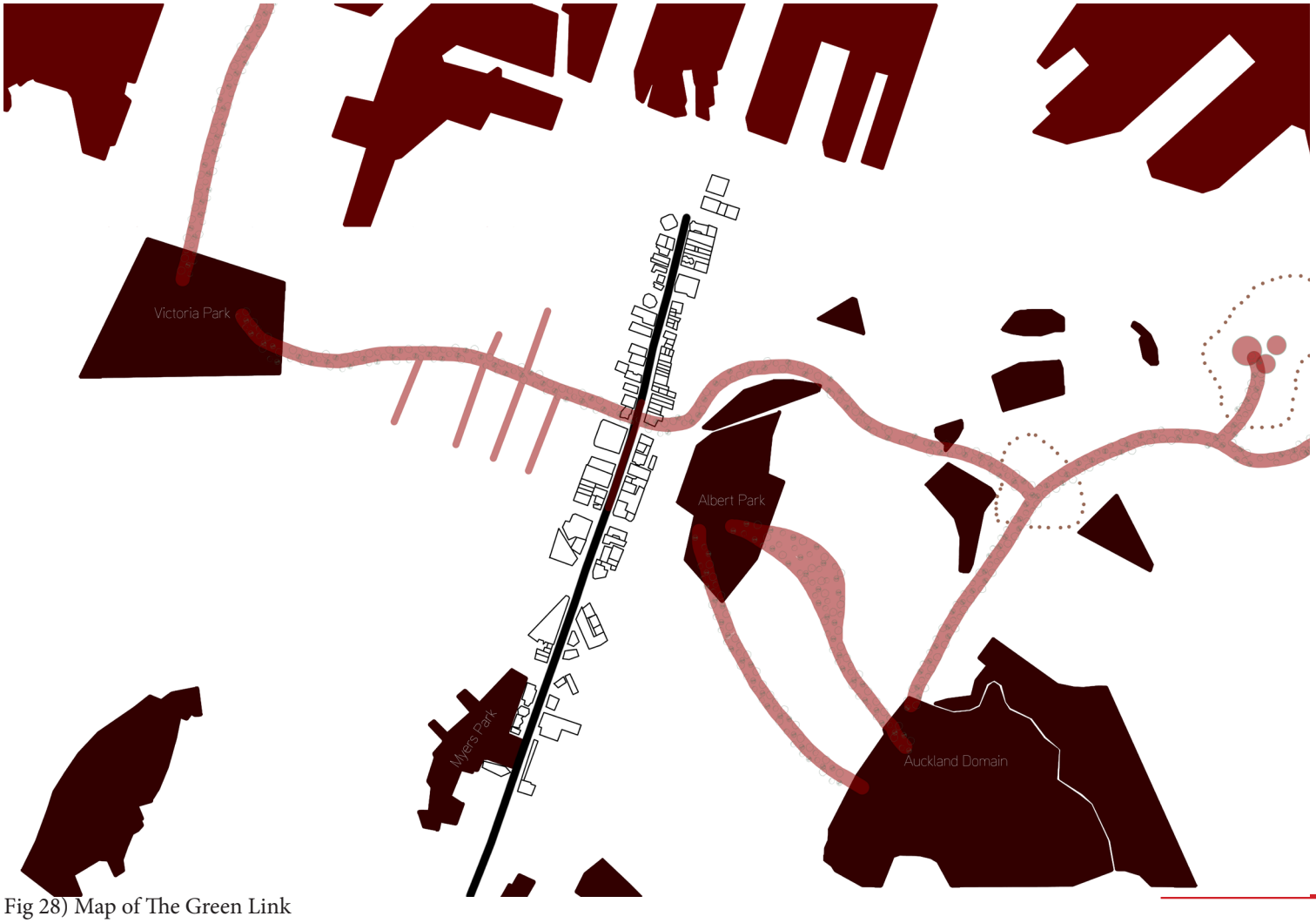


Fig 28) Map of The Green Link

3.4 Indiviual Site 1: Pocket Park:

At the intersection of Fort Street and Queen Street, Auckland Council has created a "pocket park" to provide more space for people to sit and gather. It features tables and chairs on artificial turf, along with planter boxes containing trees and plants. However, as a pocket park, it has the potential to offer much more.

A pocket park is a scaled-down version of a traditional park, typically located in dense urban areas where green spaces are scarce or not easily accessible to the public (The Trust for Public Land, n.d.). Pocket parks provide both environmental and social benefits. Environmentally, they can help manage stormwater, cool the city by reducing the urban heat island effect, and provide habitat for native wildlife (The Trust for Public Land, n.d.).

From a human wellbeing perspective, pocket parks foster community connections and social interactions. Access to green spaces has also been shown to improve overall mental health, as discussed earlier (section 1.1) (The Trust for Public Land, n.d.). Additionally, pocket parks are a valuable urban solution, as they can be created in underutilised or abandoned spaces, such as vacant lots or disused parking areas (The Trust for Public Land, n.d.).





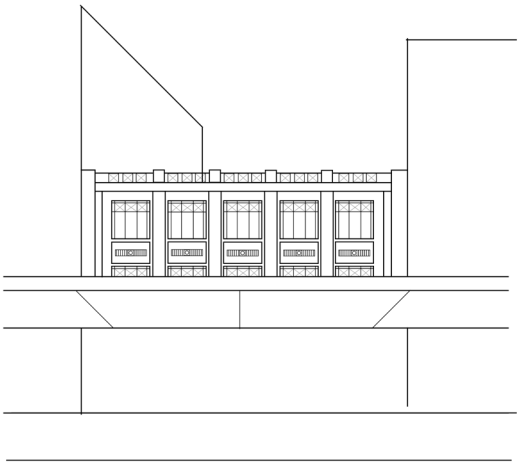






Fig 29) Photos of Fort Street Pocket Park

3.5 Indiviual Site 2:
The Kean's Building



Originally Kean's Jeans in 1912 (New Zealand Fashion Museum, 2017), this now-heritage building stands empty following the recent closure of Sephora, which vacated the space midway through 2024. Located at 152 Queen Street, it sits on the lower half of the street.

This three-storey building has a width of 15 metres and a length of 27 metres. Retrofitting it presents a valuable opportunity for a new biodiverse intervention within Queen Street.

As a heritage building, there are certain constraints on what can be modified. While the façade cannot be altered, it appears that certain elements can be attached or anchored to the structure. Additionally, the building's interior can be reinforced during the redesign process to support a green roof.



Fig 31) Photo's of Kean's Building

3.6 Reflection

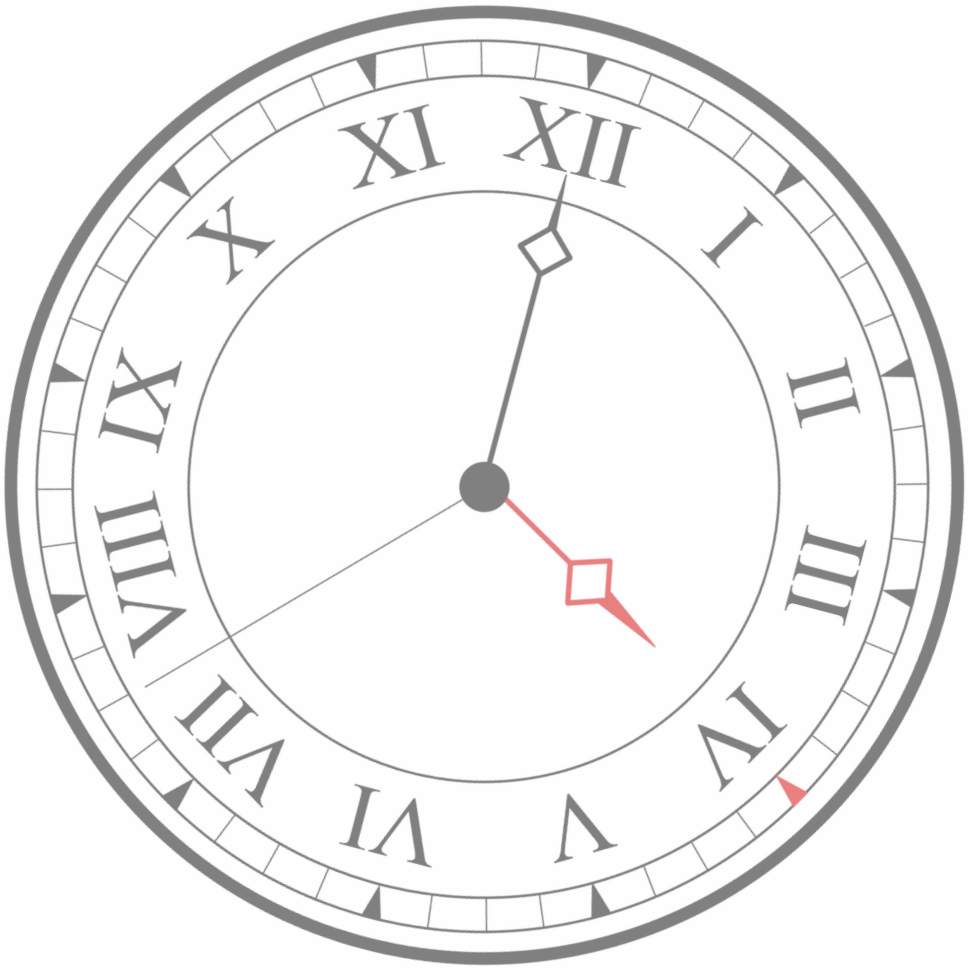
This site holds considerable historical significance, along with several ecological challenges, such as flooding. However, it also presents numerous opportunities.

The intersection of Queen Street and Victoria Street is a prime example. There is significant potential for design interventions in this area, particularly in enhancing biodiversity. Similarly, the Fort Street pocket park offers an excellent opportunity for a pond, which could help mitigate flooding issues that are likely to worsen in the near future.

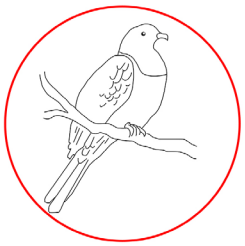
Environment
04

This section explores the various plant and animal species incorporated into this project. A selection of native target species has been chosen for introduction to the site. In addition, a variety of plants and trees has been selected based on their suitability for the urban environment and the needs of street users.

Understanding what these species require to thrive in an urban setting is essential. Factors such as their diet, shelter, and behaviour will inform design interventions. Additionally, it is crucial to identify the tree and shrub species necessary for the survival of local wildlife—primarily birds in this case—and to assess their feasibility for growth within Queen Street.



4.1 Target Species:



Kererū

Food & Habitat:
- Fruit from Native Plants
- Leaves

- Lowland Forests
- Urban Parks

Threats:
- Low Breading Rates
- Food Shortage due to Possums and Rats
- Cats, Rats and Stoats
- People

Habits:
- Seed Spreading
- Nest in Tree Forks



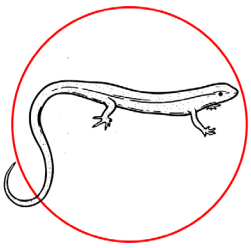
Fantail / Pīwakawaka

Food & Habitat:
- Insects (Moths, Flies, Beetles, Spiders)
- Small Fruits

- Parks & Gardens
- Farms & Orchards
- Forests

Threats:
- Cats, Rats, Stoats, Magpies and Mynas

Habits:
- Build Nest Out of Moss, Spider Webs, Hair and pieces of Wood



Copper & Ornate Skinks:

Food & Habitat:
- Insects (Spiders, Slaters, Beetles, Crickets, Flies)
- Soft Fruits and Berries

- Forest, Grasslands &

Threats:
- Cats, Rats, Mice, Magpies, Mynahs, Starlings & Kingfisher
- Habitat Loss

Habits:
- Like Damp Areas

Fig 32) Diagram of Target Species

To enhance biodiversity within Queen Street, native bird and lizard species were selected as the focus of this research. The chosen species are considered 'umbrella species'—a term referring to species whose conservation benefits broader ecosystems and other species sharing the same habitats (Ecological Connectivity Strategies, Boffa Miskell, 2021).

The selected bird species are the kererū and the pīwakawaka (fantail), while the chosen lizard species are the copper skink and ornate skink.



Kōwhai:



Tōtara:



Miro:



Karaka:



Hebe:



Tecomanthe Speciosa:

Fig 33) Diagram of Trees liked by Target Species

4.2 Fruit & Veg Map

The soil within the CBD is not ideal for supporting plant growth, as the dominant soil types—clay, rock, and fill—comprise various gravel-sized materials and clay (Manaaki Whenua – Landcare Research, 2024). Urban soils are typically degraded and compacted, making well-designed tree and planting pits, likely with imported soils, essential. This is particularly important when considering the incorporation of fruit and vegetable plants along the street.

Most of these plants will be placed in planters rather than planted directly in the ground, which will also assist with pest control.

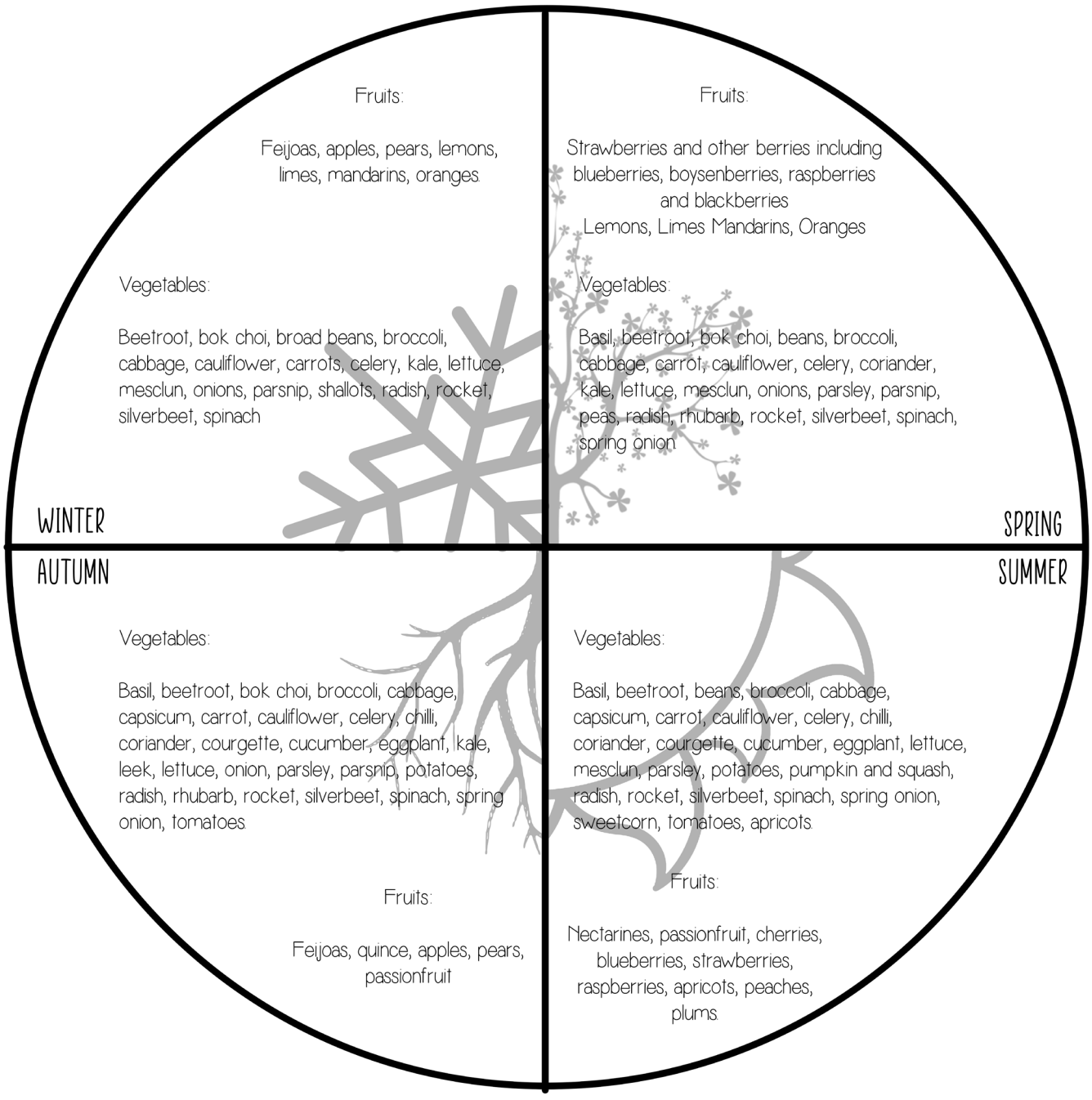


Fig 34) Planting Map for Auckland Based on Seasons

4.3 Plant Palette

The plant palette includes a variety of species across four categories: trees, shrubs and bushes, grasses, and groundcover. This diversity ensures the habitat is suitable for all target species. Many smaller species, such as the copper skink and ornate skink, are naturally shy and prefer to shelter under groundcover and logs. Several trees, including the kōwhai and miro, were selected for their appeal to birds like the kererū. Other plants were chosen for their suitability in specific design elements, such as green walls and green canopies, as well as being native species.

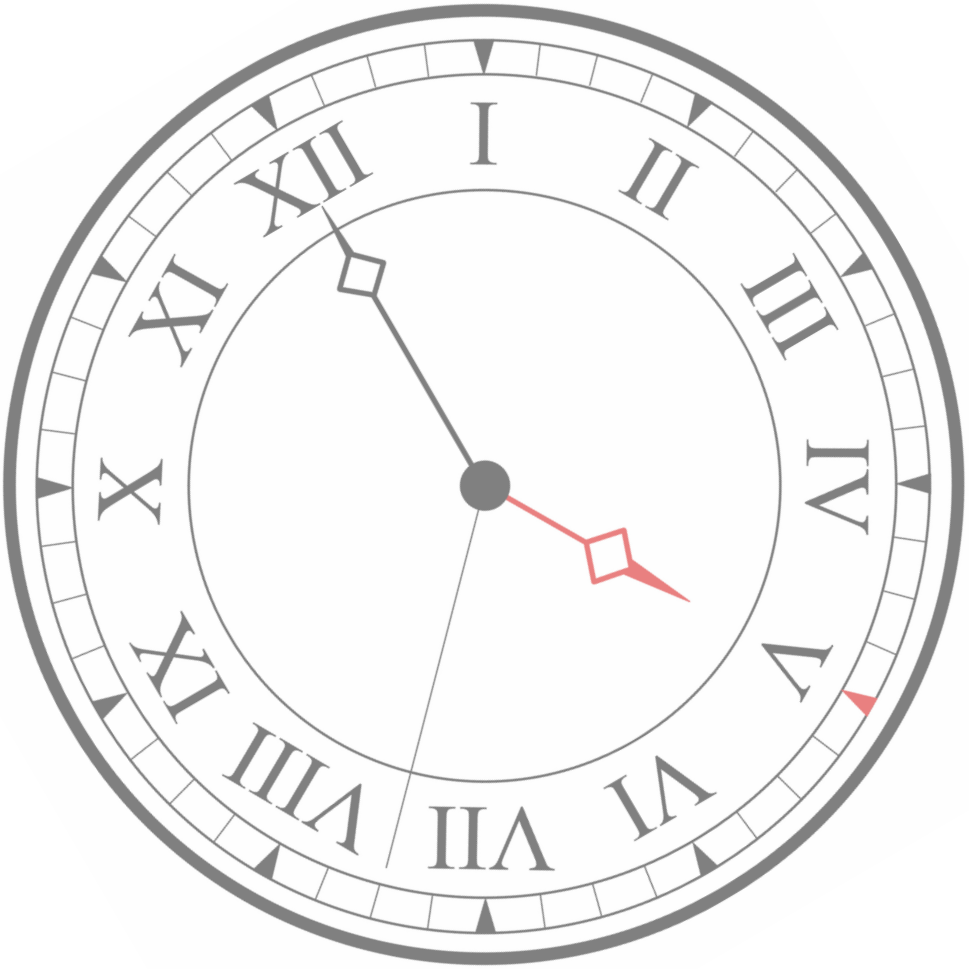
Type	Name	Use	Reason	Size	Water	Sun	Origin
GroundCover	Acaena purpurea	Green Belt / Canopy Gardens / Pocket Park		0.2m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Fuchsia procumbens	Green Belt / Canopy Gardens / Pocket Park		0.2m	Dry / Moist	Full Shade / Full Sun / Partial Shade	NZ Native
	Coprosma acerosa 'Hawera'	Canopy Gardens		0.2m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Scleranthus brockiei	River		0.1m	Moist / Wet	Full Sun / Partial Shade	NZ Native
	Lobelia angulata	River / Green Belt		0.2m	Moist Wet	Full Shade / Full Sun / Partial Shade	NZ Native
	Hebe 'Inverey'	Green Belt / Canopy Gardens		0.1m	Dry / Moist	Full Sun / Partial Shade	NZ Native
Grasses	Anemanthele lessoniana	Green Belt / Pocket Park		1m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Arthropodium cirratum 'Te Puna'	Green Belt / Pocket Park		0.6m	Dry / Moist	Full Shade / Full Sun / Partial Shade	NZ Native
	Carex comans 'Green'	Green Belt / Pocket Park		0.5m	Dry / Moist	Full Sun	NZ Native
	Festuca novae-zelandiae	Green Belt / Pocket Park		0.7m	Moist	Full Sun / Partial Shade	NZ Native
	Festuca actae	Green Belt / Pocket Park		0.4m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Pachystegia rufa	Green Belt / Pocket Park		0.7m	Dry / Moist	Full Sun / Partial Shade	NZ Native
Shrubs & Bushes	Corokia 'Yellow Wonder'	Green Belt / Pocket Park		3m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Hebe 'Oratia Beauty'	Green Belt / Pocket Park		1m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Carmichaelia glabrescens	Green Belt / Pocket Park	Attracts Native Bees	3m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Coprosma 'Roys Red'	Green Belt / Pocket Park		2m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Dianella nigra	Green Belt / River / Pocket Park		0.5m	Moist	Full Shade / Full Sun / Partial Shade	NZ Native
Climbers	Tecomanthe speciosa	Green Walls / Canopy Gardens	Flowers attract Pollinators	10m	Moist	Partial Shade	NZ Native
	Muehlenbeckia complexa	River / Green Walls / Canopy Gardens	Attracts Insects and Lizards.	2m	Dry / Moist	Full Shade / Full Sun / Partial Shade	NZ Native
	Clematis paniculata	Green Walls		2m	Moist	Full Sun / Partial Shade	NZ Native
	Carmichaelia kirkii	Green Walls / River		3m	Moist		
Trees	Leptospermum scoparium	Green Belt / Pocket Park	Attracts Bees, and works as nurse crop for native revegetation.	4m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Fuscospora fusca	Green Belt / Pocket Park		30m	Moist	Full Sun / Partial Shade	NZ Native
	Metrosideros excelsa 'Maungapiko'	Green Belt / Pocket Park		5m	Moist	Full Sun / Partial Shade	NZ Native
	Sophora longicarinata	Green Belt / Pocket Park	Attracts Birds, due to the flowers and nectar it produces.	5m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Podocarpus totara	Green Belt / Pocket Park	Atrracts Birds with the fruit it produces during March through to May, and attracts bees during October through to Decemeber due to its nectar.	15m	Dry / Moist	Full Sun / Partial Shade	NZ Native
	Prumnopitys ferruginea	Green Belt / Pocket Park	Attracts Birds with its Fruit.	15m	Moist	Full Sun / Partial Shade	NZ Native
	Corynocarpus laevigatus	Green Belt / Pocket Park	Attracts birds with its fruit, this fruit is also holds maori significance.	12m	Dry / Moist	Full Sun / Partial Shade	NZ Native

Fig 35) Plant Palette

4.4 Reflection

The species selected for this project are all umbrella species, which should help improve biodiversity and encourage other species to return to the site. All the trees and plants chosen are native species, aimed at supporting New Zealand's native biodiversity. While these species tend to grow more slowly compared to non-native species, they will offer greater long-term benefits to the biodiversity of the space. Regarding the edible gardens, the soil is not ideal for their growth, so they will need to be planted in planter boxes. This, however, is preferable as the boxes can be designed to be pest-proof.

05
Conceptual Design Work:



The first design experiments involved a strategy of creating a series of drawings quickly, in the form of a design charette or 'quick start' exercise. For the initial series of sketches, a variety of strategies were explored to maximise the amount of green space on and around Queen Street. The next series of design experiments focused on consolidating the best aspects of these nine sketches into more refined drawings. The final experiment combined all the best elements from the sketches into one cohesive design. This design was focused solely on green and blue space, so it does not take the other two elements of the Biodiverse Streetscapes Design Framework into consideration, which was developed alongside the initial conceptual design work.

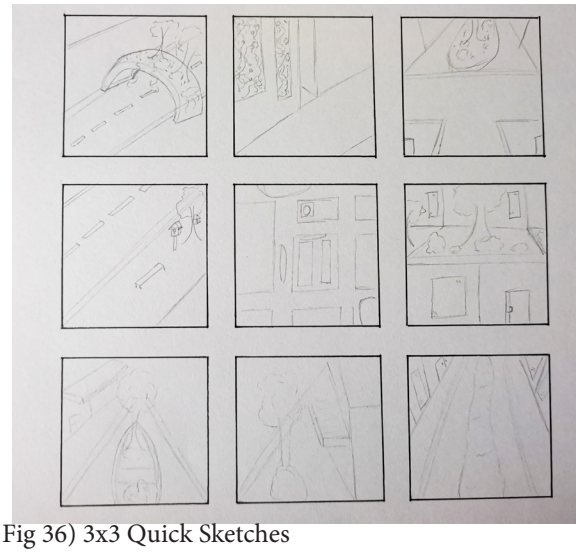


Fig 36) 3x3 Quick Sketches

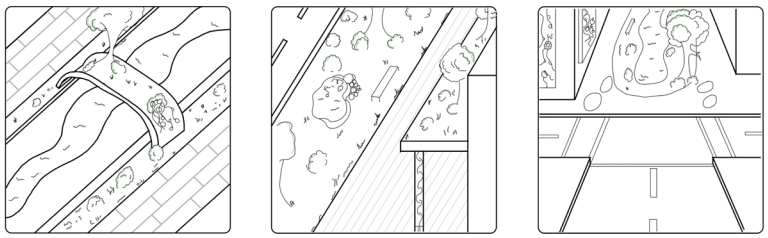


Fig 37) 3 Quick Sketches

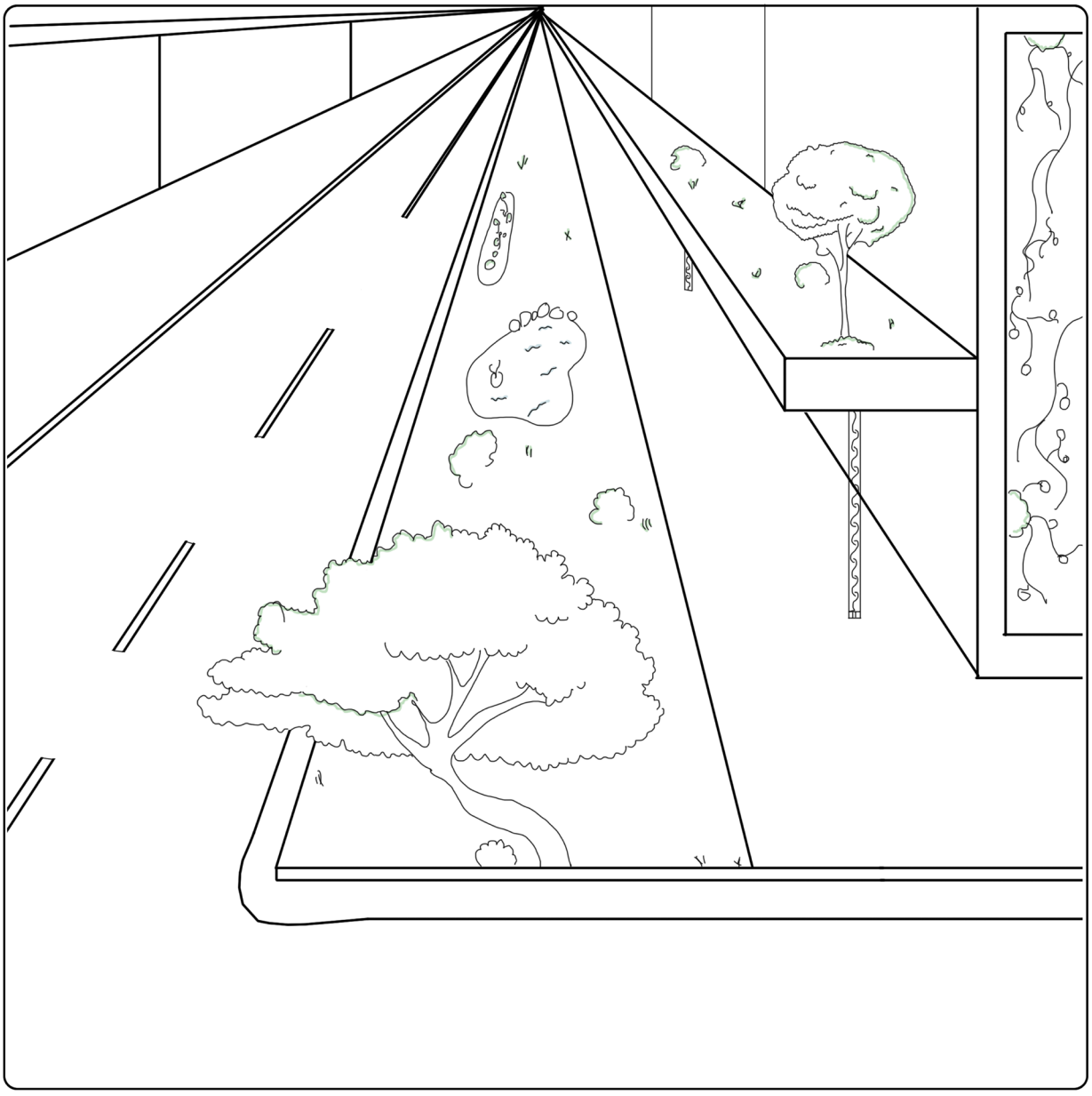


Fig 38) Final Quick Sketch

Key Comments from the Review:

How does the river begin and end? What is the relationship between the river and the harbour?

Does the river need to be daylit, or can there be a series of water-based interventions on the street instead?

Personal Reflection on the Review:

Overall, the comments received were very useful in helping to move my project forward. There was a lot of uncertainty I was beginning to form around whether what I was doing was feasible or even considered architecture. Key comments would be that I don't have to focus on designing a singular building as well as the streetscape—the streetscape can be considered architecture. Also, being less restricted, they seemed to like the idea of me exploring the possibilities that the river brings to the site, as opposed to worrying about how realistically the council would never allow the road to become unusable, mostly for safety reasons. The street is currently undergoing a change where cars aren't allowed to run on certain parts, only buses and emergency services.

Next To-Do:

-- Explore more ideas about the streetscape
-- Look at daylighting the river
-- Research the history of the site to find inspiration

5.3 Theoretical framework Design Experiments:

These design experiments took the three design points (the streetscape, the Kean's building, and the Fort Street pocket park) and explored what they would be like using the three-strand Streetscape Design Framework. The first set of experiments focused on ecological wellbeing. These designs centre around green space, with the importance of creating areas that support birdlife. The next experiment addressed collective wellbeing. This design focuses on meeting areas as well as outdoor seating within a small park. The final design experiment in this series explored individual wellbeing. This design emphasises the importance of visual stimulation, such as fireplaces, light screens, and flowing water.

Design Experiment 1: Maintain and Grow - Streetscape

Design Experiment Based on the First Phase of My Theoretical Framework:
This phase specifically examines the Maintain and Grow element of the Ecological Wellbeing Framework, with a focus on the streetscape aspect. The aim is to incorporate as much green space into the design as possible, enhancing the urban environment's ecological balance and promoting sustainable growth.
Targets: Green walls & Roofs, Green Belts, Rain Gardens, Bioswales , Urban Planting.



Fig 39) MG Building Facade Drawing

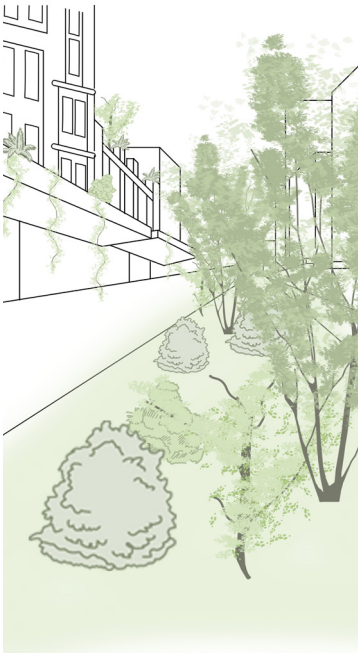


Fig 40) MG Street Perspective

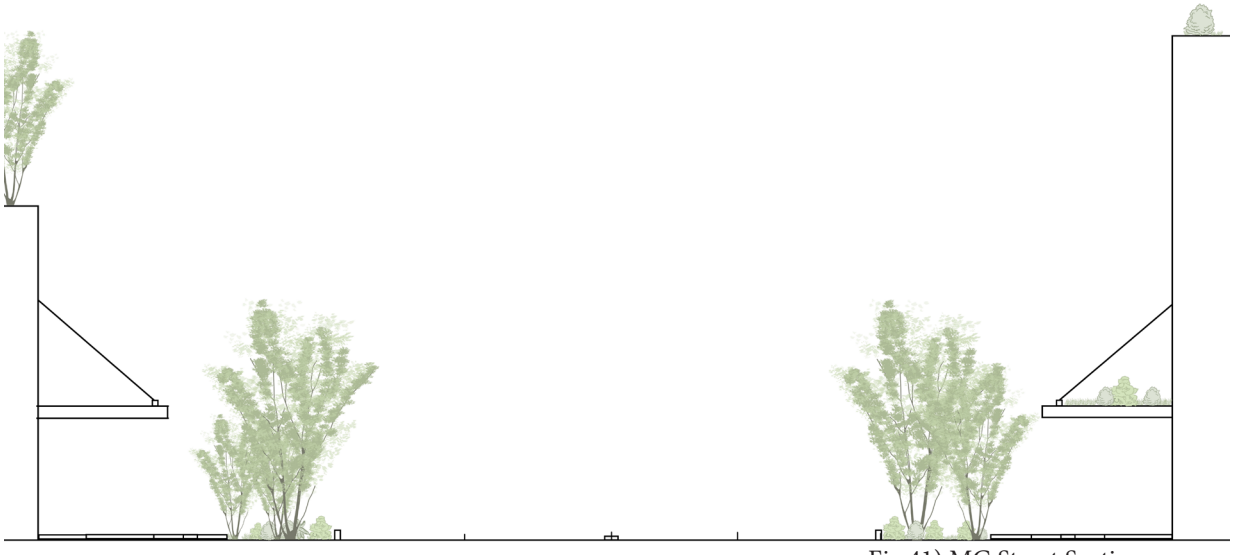


Fig 41) MG Street Section

Reflection:
This design experiments with integrating as many trees and plants into the street as possible. This includes a green strip running down the street, green roofs, and green-covered sidewalk canopies with climbing plants growing from them. However, there are limited climbing plants native to New Zealand, which is a shortcoming in this design. In terms of the framework, this approach significantly increases the amount of planting within the street, transforming the space from the occasional street tree and planter boxes to green belts and green roofs.

Design Experiment 2: Maintain and Grow - Building

Design Experiment based of the first phase of my theoretical framework, This one looks specially at the Maintain and Grow element of the Ecological Wellbeing Frame. From the Building aspect.
Adding as much green space into the design as possible:
Targets: Green walls & Urban Planting.

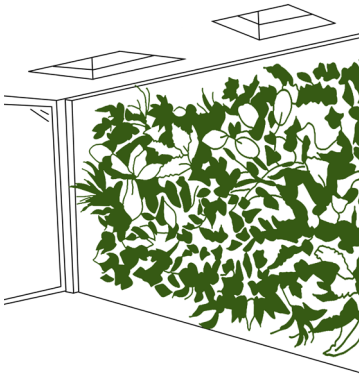


Fig 42) MG Green Wall Drawing

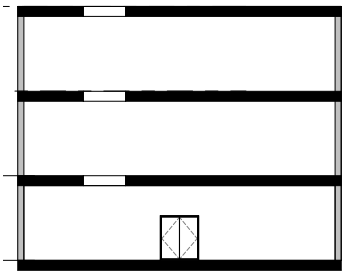


Fig 43) MG Building Section

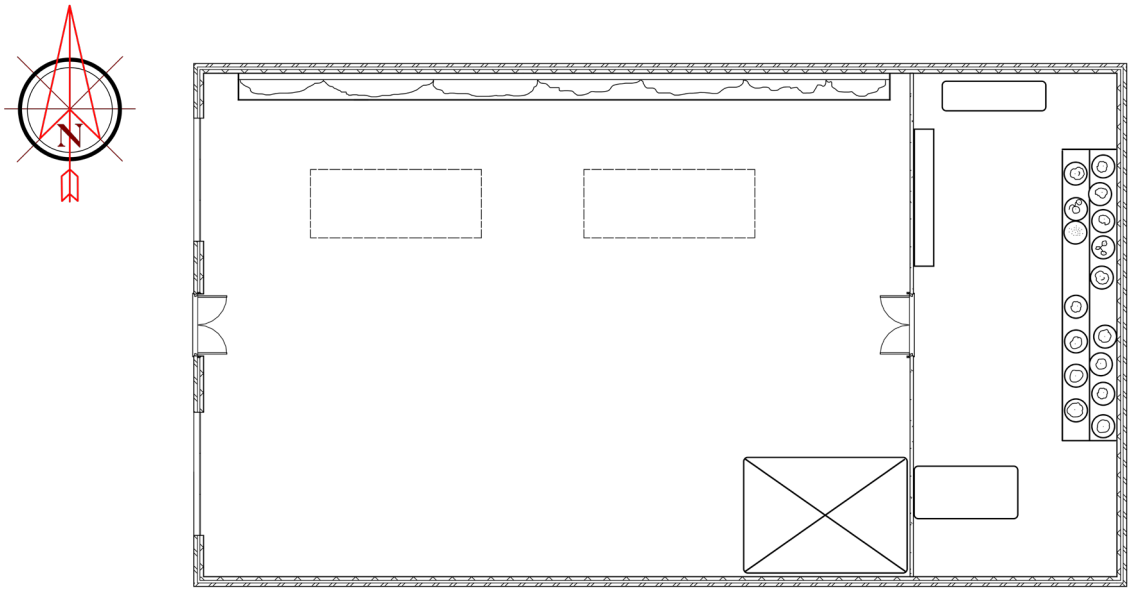


Fig 44) MG Building Plan

Reflection:
This design explores the concept of incorporating greenspace indoors, using green walls and plant pots. A plant nursery was also included in the back room of the design, intended either for growing plants to be sold or for later planting within the street.

Design Experiment 3: Support Biodiversity - Streetscape

Design Experiment Based on the First Phase of My Theoretical Framework
This experiment focuses specifically on the Support Biodiversity element of the Ecological Wellbeing Framework, with a particular emphasis on the streetscape aspect. The aim is to explore how adding elements that support and aid animals in thriving within the urban environment can positively impact the ecological wellbeing of the space.
Targets: Bird Feeders, Nesting Boxes, Bee Houses, Nectar Trees.

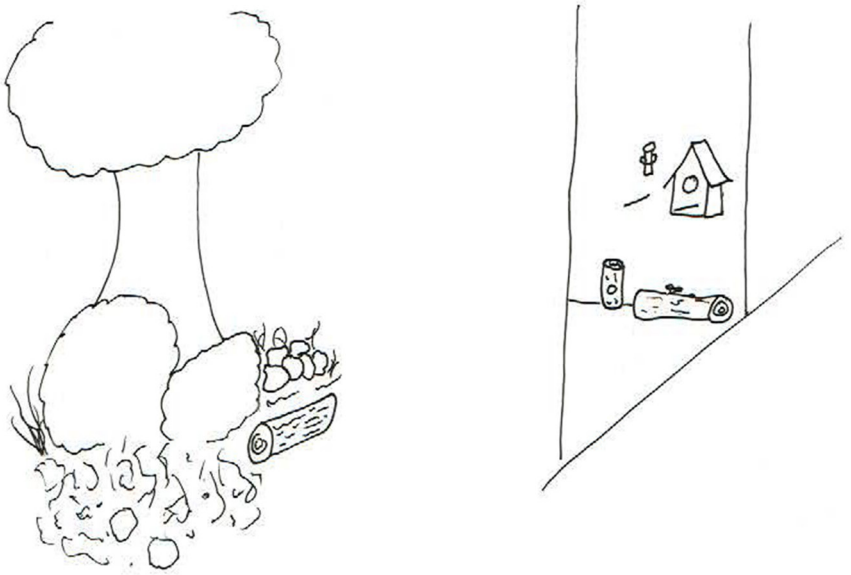


Fig 45) SB Nature Based Solution Ideas

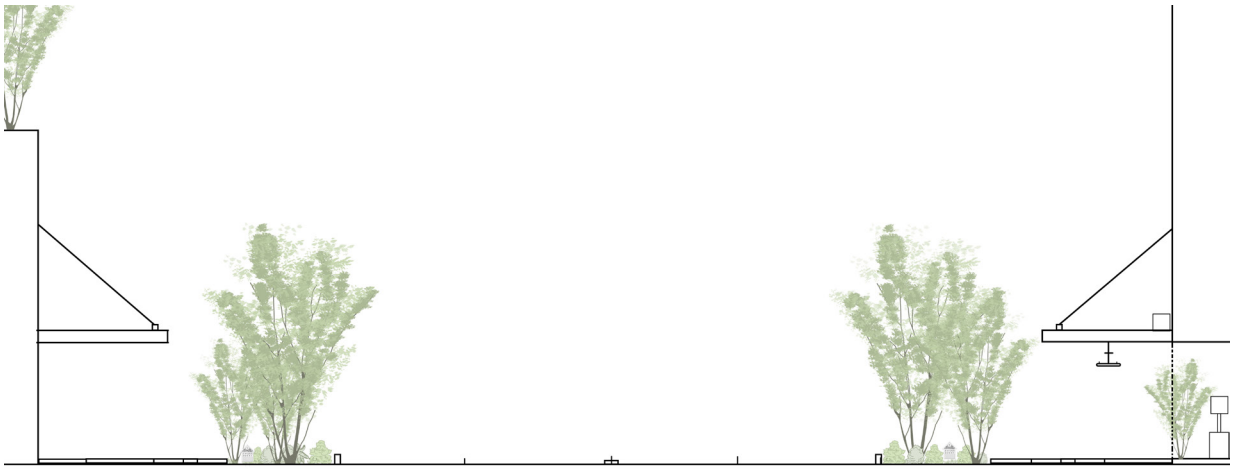


Fig 46) SB Street Section

Reflection:
This design experiment easily incorporated various strategies to support biodiversity on the site. It's simple to add bird feeders and nesting boxes into a streetscape, especially when the trees planned for the design are species that these birds will appreciate.

Design Experiment 4: Support Biodiversity - Building

Design Experiment Based on the First Phase of the Theoretical Framework
This phase specifically examines the Support Biodiversity component within the Ecological Wellbeing Framework, focusing on the Building aspect. It aims to incorporate elements that enhance the environment, allowing animals to thrive within the space.
Targets: Bird Feeders, Nesting Boxes, Bee Houses, Conservatory.

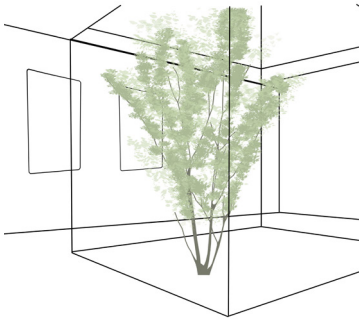


Fig 47) SB Building Courtyard Drawing

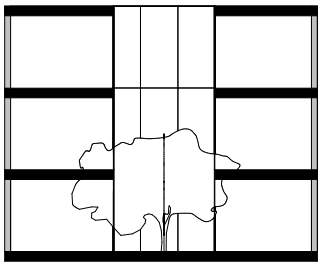


Fig 48) SB Building Section

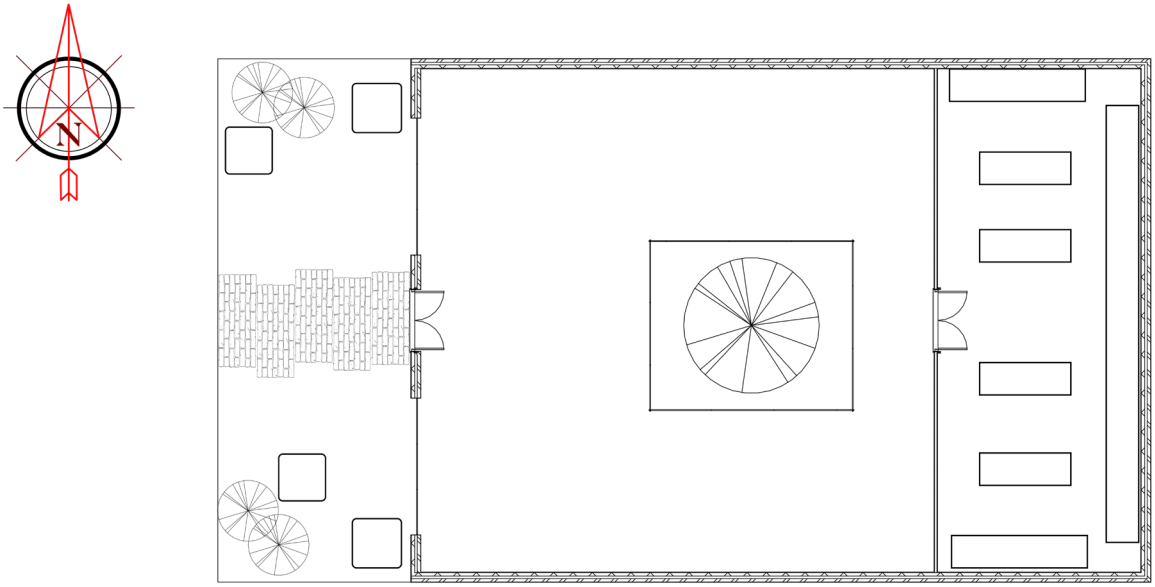


Fig 49) SB Building Plan

Reflection:
Supporting biodiversity within a building is more challenging than on the streetscape. As such, the design incorporates a courtyard, creating a space that blends indoor and outdoor environments, helping birds and insects feel more welcome.

Design Experiment 5: Protect Ecosystems - Streetscape

Design Experiment Based on the First Phase of My Theoretical Framework
This phase specifically focuses on the Protect Ecosystems element of the Ecological Wellbeing Framework, particularly from the streetscape perspective. The aim is to incorporate elements that not only support the existing ecosystems but also enhance them, alongside other proposed additions.
Targets: Connecting Green Spaces, Pest Proof Roofs, Protecting Plant Boxes.

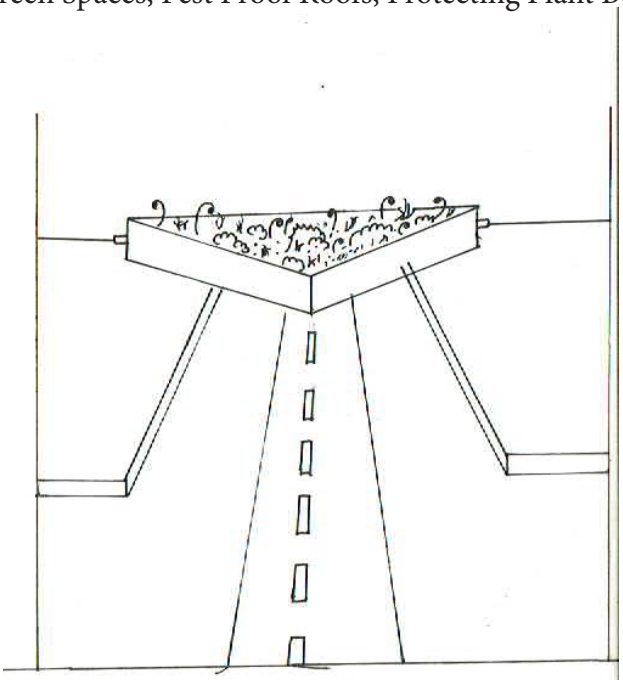


Fig 50) PE Hanging Gardens Drawing

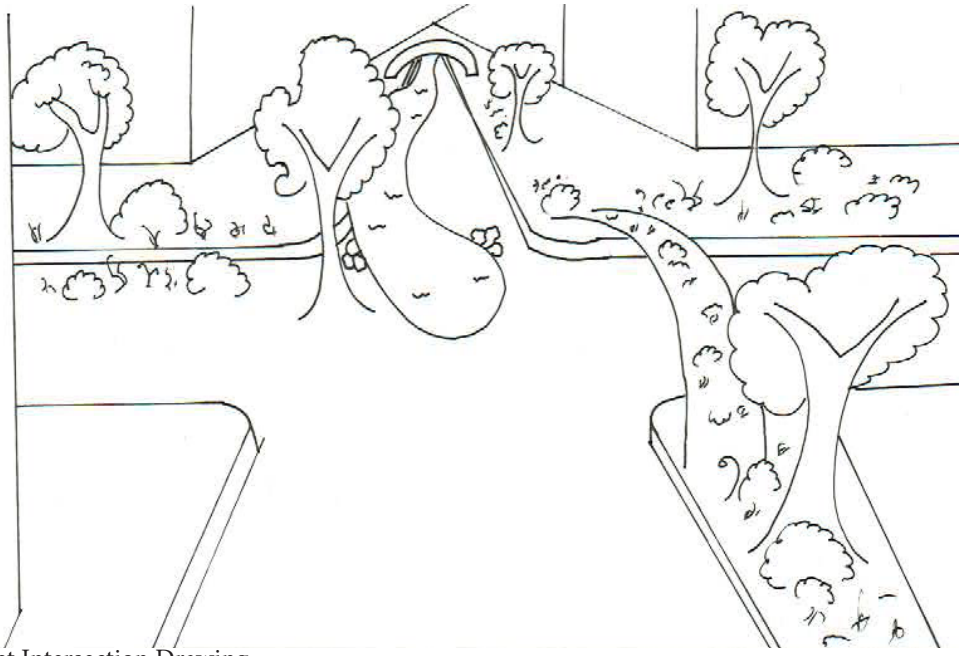


Fig 51) PE Street Intersection Drawing

Reflection:
As the design is integrated within the Green Link, it is already working to connect green spaces. To create a pest-proof design within the street, the edible planter boxes will need to be covered. With the current design incorporating green roofs and walls, these will also require protection. Therefore, using curved lips or edges along the roofs of the buildings will help deter pests.

Design Experiment Based on the First Phase of My Theoretical Framework
This phase focuses specifically on the Protect Ecosystems element within the Ecological Wellbeing Framework, with a particular emphasis on the Building aspect. The aim is to incorporate elements that will support and enhance the existing ecosystems, alongside the integration of other complementary additions.
Targets: Information about Pests, Pest Proof Design.



Fig 52) PE Plant Trade Stand Drawing

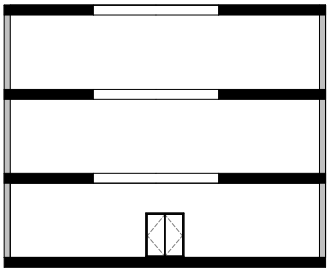


Fig 53) PE Building Section

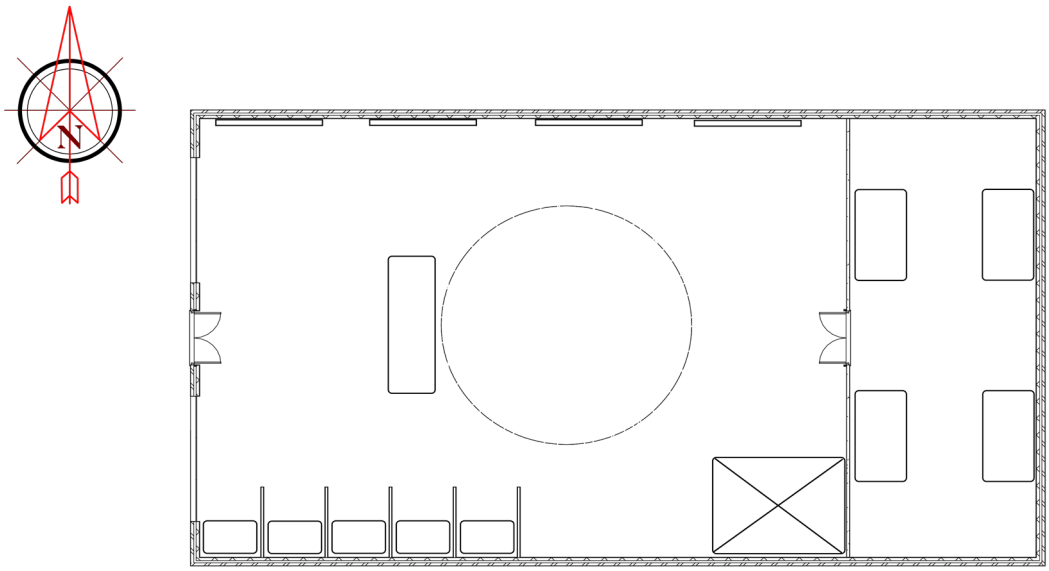


Fig 54) PE Building Plan

Reflection:
Within the building, it is more challenging to implement strategies that directly protect ecosystems. However, the building itself could serve as a space to educate people on how to protect the environment. This could include teaching about planting, biodiversity, and pest control.

Design Experiment 7: Collective Wellbeing

Design Experiment based of the second phase of my theoretical framework Collective Wellbeing.
Creating an environment that supports culture and cultural narratives.
Targets: Maori Street Names, Daylighting the River, Sculptures, Cultural Design Elements.

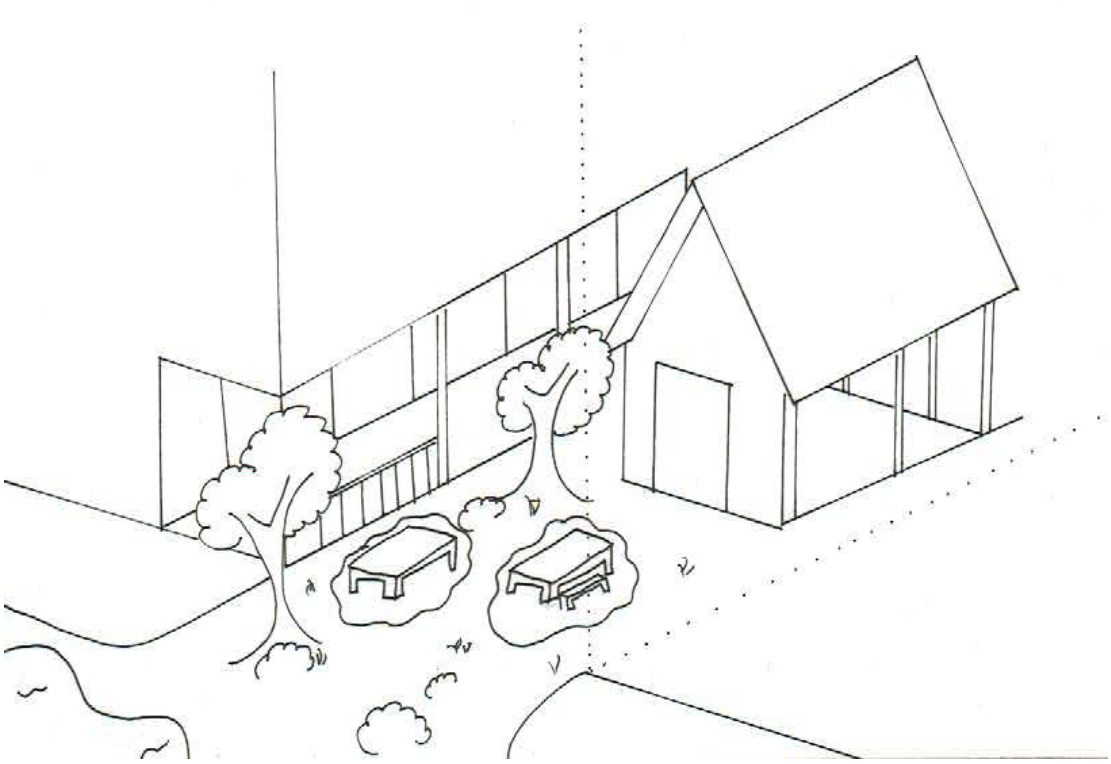


Fig 55) Collective Wellbeing Pocket Park Drawing

Reflection:
To represent the cultural aspects of the site, it is important to express what is culturally significant. In this case, that would be the Wai Horotui River, so daylighting the river becomes a key component of the cultural identity on Queen Street. If this project were to collaborate with mana whenua, the building and street's future could share a cohesive language of cultural design elements and artworks.

Design Experiment 8: Individual Wellbeing

Design Experiment Based on the Third Phase of My Theoretical Framework: Individual Wellbeing Creating an environment that supports human wellbeing, both mentally and physically.
Targets: Water (Koi Ponds, Water Features), Screens, Edible Gardens, Covered Areas, River Daylighting, Artwork, wooden furniture.

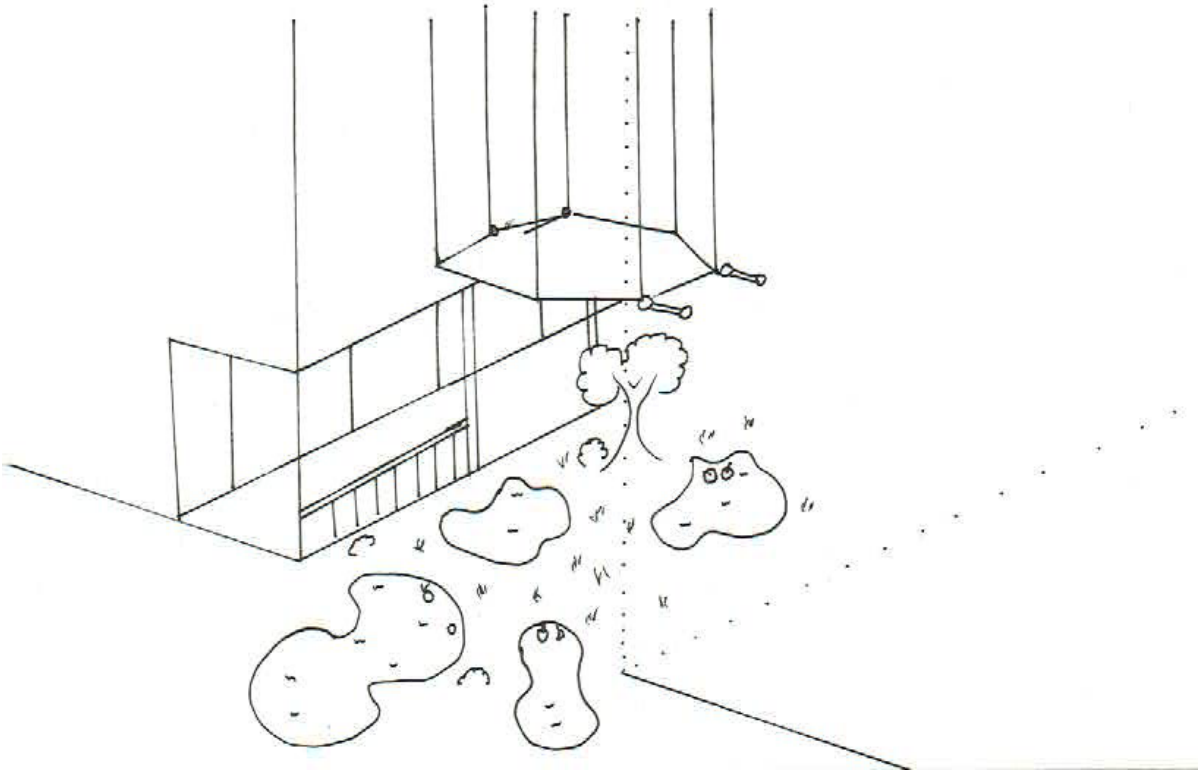


Fig 56) Individual Wellbeing Pocket Park Drawing

Reflection:
To incorporate water elements into the street, the river can still be daylit, with the addition of water fountains along the street. The gardens will feature edible plants, contributing to community sustainability. All street furniture will have a natural aesthetic, predominantly using wood as the main material.

Personal Reflection on the Review:

I was personally underprepared for this review. I hadn't made much progress with the design and had been stuck on what to do. Talking with the reviewers, I was able to come to many conclusions about where my work should be heading. It was officially decided that I should focus on designing a building, and that I need to be more eccentric in my decisions. I will move forward with daylighting the river to create a connection between green and blue infrastructure.

The new "aviary" design was received with mixed reviews. This might be due to the wording, or perhaps it really isn't worth pursuing this idea given all the other aspects I need to design for and around.

Next Steps:

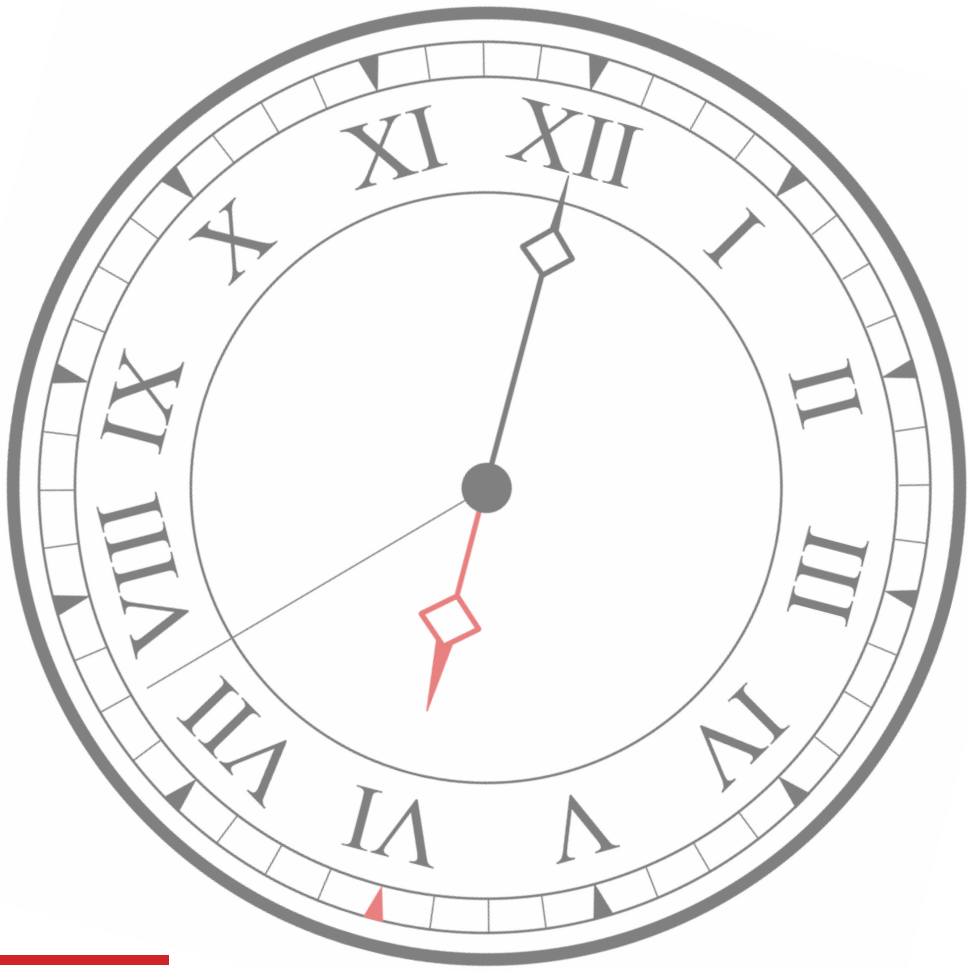
-- Flesh out a design for the building.
-- Proceed with daylighting the river.
-- Design how humans and birds could interact better than through the aviaries.

Design Strategies

06

This section explores the different strategies that could be applied to this project, ranging from practical installation technologies, such as green walls, to broader strategies like sponge cities. It also outlines the strategy designed to work harmoniously with the heritage building on the site.

To advance this design, various design strategies and technologies should be implemented:



6.1 Technologies & Strategies: Green

Green Walls:

Green walls, or living walls, are vertical gardens of vegetation on the exterior or interior walls of buildings. Due to the nature of these walls, they feature built-in irrigation systems, as the plants grow on the wall itself, as opposed to green facades, where the plants are planted at the base of the building and grow up the wall (Francis & Lorimer, 2011).

Benefits:
Visual Appeal
Increased Productivity
Decreased Aggression and Anxiety
Reduced Stress and Mental Fatigue
Improved Air Quality
Reduce Noise Levels
Decreased Building Energy Cost
(Green / Living Walls – NUWAO, 2014)

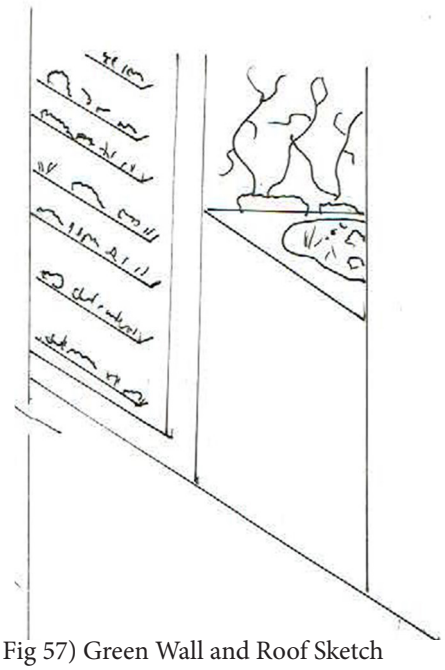


Fig 57) Green Wall and Roof Sketch

Green Roofs

Green roofs, or living roofs, are additions to the rooftops of buildings. They generally require higher-quality waterproofing, a root protection system, and a drainage system. The type of green roof depends on the desired plants. The larger the plants, the deeper the substrate required, which also means the heavier the load the building underneath must support (Oberndorfer et al., 2007).

Benefits:
Visual Appeal
Improved energy efficient of the building
Improved stormwater management
Natural water filters
Reduce stormwater runoff
Improve Air Quality
(Green Roofs/Living Roofs – NUWAO, 2014)

Green / wildlife corridors, bridges, belts

Green or wildlife corridors are designed to allow animals to move through urban and developed areas, helping to mitigate the effects of habitat loss caused by urbanisation, deforestation, and other environmental pressures. These corridors take various forms, ranging from green patches to bridges and tunnels. These bridges and tunnels help animals navigate roads safely. Other types of wildlife corridors include stepping-stone habitats, green belts, and pollinator paths (Gregory et al., 2021).

Benefits:
Decreased Biomass loss
Improved Air Quality
(Green / Wildlife Corridors, Bridges, Belts – NUWAO, 2021)

6.1 Technologies & Strategies: Green

Urban street trees / transport and infrastructure corridor planting

Street trees are trees planted and cared for within cities often along side roads or motorways.

Benefits:
Improved Air Quality
Decreased Temperatures
Improved Stormwater Management
Improved Wind Resistance
(Urban Street Trees / Transport and Infrastructure Corridor Planting – NUWAO, 2023)

Planting for biodiversity and urban habitat

Planting for biodiversity is an integral part of conservation and restoration strategies, aimed at creating habitats that protect species from pests and environmental threats. It also plays a role in preventing soil and coastal erosion, while improving the quality of soil, air, and water. Furthermore, it enhances ecosystem services. (Planting for Biodiversity and Urban Habitat – NUWAO, 2022)

Benefits:
Increase Biodiversity
Decrease biomass cover loss
Improve Air, water and soil quality
Decrease loss of Ecosystem Services
(Planting for Biodiversity and Urban Habitat. – NUWAO, 2022)

Urban Forests / Urban Ngāhere

Urban forest are planting trees to restore some canpoy cover which has been lost due to urbanisation.

Benefits:
Improved Air Quality
Decreased Temperatures
Improved Stormwater Management
Improved Wind Resistance
(Urban Forests / Urban Ngāhere – NUWAO, 2023)

6.1 Technologies & Strategies: Green

Vegetation-Integrated Buildings

Vegetation-integrated buildings are building that have plants in or around them, such as buildings with green roofs or walls.

Benefits:
Visual Appeal
Increased Productivity
Decreased Aggression and Anxiety
Reduced Stress and Mental Fatigue
Improved Air Quality
Reduce Noise Levels
Decreased Building Energy Cost
(Vegetation-Integrated Buildings – NUWAO, 2022)

Green / Urban Canopies:

Green canopies consist of tensile shade sails that can support vegetation. They provide shade and bring nature to commercial streets.

Benefits:
- New Landscape Possibilities, where space is limited there is still a possibility for nature interventions.
- Reduced Pollution
- Decrease in Temperature
- Increased Shade
- Improve Air Quality
- Improve Water Management
(Singular Green, 2023)

Precedent:

The goal of this project was to increase green space and nature connection within streets that are too small for planting trees. The aim was to create a green corridor through alternative means. The area throughout the street of Santa Maria, where the canopy extends, is approximately 201m (Singular Green, 2023).

The sails themselves are 4m long, using a seeded system called LeafSkin. Steel plates anchor the tensioning cables to the building facades, creating the supporting system to hold the sails up. There is a lattice beam running along the street, which supplies water to the sails. The drainage and electrical wiring also run along this beam. Each sail has two drip pipes for the irrigation system, which run along the sides of the sail. Water usage is maximised through the recycling of water through each of the sails.

The sails also provide an easy way to install lighting for the street below, all of which are motion-activated (Singular Green, 2023).

“This type of nature-based solution, such as green canopies, is a useful tool to bring added value to increasingly urbanised cities, helping to develop cities with a more sustainable and healthy approach” (Singular Green, 2023).

6.1 Technologies & Strategies: Green

Container Gardens

Container gardens are plants grown in planter pots, baskets, or any other type of container. They are especially useful in urban environments, as they are compact and easy to move. (Container Gardens – NUWAO, 2021)

Benefits:
Food security
Aesthetic Value
Reduced Temperatures
Increased soil quality
(Container Gardens – NUWAO, 2021)

Revegetation / renaturing

Revegetation is the process of restoring the vegetation of an area. This can be achieved through the use of seeds, seedlings, or even mature plants. (Revegetation / Renaturing – NUWAO, 2020)

Benefits:
Improved air, water and soil quality
Improved food security
Decreased temperature
(Revegetation / Renaturing – NUWAO, 2020)

River/stream rewilding

River rewilding is where plants are brought back to rivers and river edges to restore the ecology that was there.

Benefits:
Prevent Flooding
Improve Water and Soil Quality
Habitat provision
(River/Stream Rewilding – NUWAO, 2020)

6.2 Technologies & Strategies: Blue

Sponge cities

Sponge cities are urban areas designed with natural rainwater and stormwater management systems. This design allows cities to collect, store, and utilise rainwater (Sponge Cities – NUWAO, 2022).

Benefits:
Decreased Chance of Flooding
Decreased Temperatures
Improved air and water quality
Improve freshwater availability
(Sponge Cities – NUWAO, 2022)

Bio-retention systems / rainwater gardens

Bio-retention systems is the overarching term for all rain gardens, bioswales, biofilters, and any other sustainable stormwater management strategies. These systems are designed to mimic the way wetlands process water. This helps improve water quality by removing pollutants, effectively filtering it. The process occurs as the water passes through dense vegetation and some form of sand or filter media. In urban areas, bio-retention systems are typically placed alongside roads to filter incoming stormwater. (Bio-Retention Systems / Rainwater Gardens – NUWAO, 2023)

Benefits:
Reduce flooding
Reduce temperatures
Mitigate Urban Heat Island Effect
Improved Air Quality
Habitat provision
(Shafique, 2016) (Biswal, 2021).

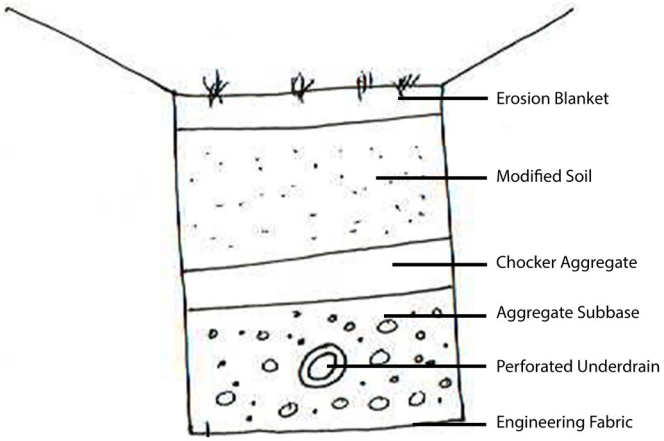


Fig 58) Bioswales Diagram

Bioswales

Bioswales are vegetated depressions that help manage stormwater runoff by collecting, slowing, and filtering water. They are particularly effective in dense urban areas. Generally, bioswales consist of native plants, gravel, and soil. Like most bio-retention systems, they are designed to mimic wetlands. (Bioswales/Swales – NUWAO, 2024)

Benefits:
Stormwater management
Reduce stormwater runoff
Improve Water quality
Reduced Temperatures
(Shetty et al., 2019)

6.2 Technologies & Strategies: Blue

Biofilters

Biofilters are trenches filled with filtering materials and vegetation. Like all bioretention systems, biofilters work to filter runoff water and remove pollutants before it enters waterways (Department of Water, 2011). They are particularly effective in urban environments when integrated with the main stormwater systems.

Benefits:
Stormwater Management
Reduced stormwater runoff
Improved water quality
Easily installed / retrofitted
(Biofilters – NUWAO, 2018)

Rainwater harvesting

Rainwater harvesting or collection involves gathering, storing, and filtering rainwater. This water is generally collected for drinking or household use; alternatively, it may be used for farms or to assist with the stormwater management system. The rainwater is typically collected from roofs via gutters and stored in a tank. (Rainwater Harvesting – NUWAO, 2020)

Benefits:
Freshwater Security
Improved Stormwater Management
Decreased Chance of Flooding
(Rainwater Harvesting – NUWAO, 2020)

River/stream daylighting

River daylighting refers to the process of restoring a natural river that has been covered or converted into pipes or culverts in urban areas (River/Stream Daylighting – NUWAO, 2024).

Benefits:
Decreased Chance of Flooding
Decreased Temperatures
Increased Water Availability
(River/Stream Daylighting – NUWAO, 2024)

6.2 Technologies & Strategies: Blue

Sustainable Urban Drainage Systems (SuDS) / Nature-based Stormwater Management

Sustainable drainage systems encompass a variety of water management strategies designed to address flooding, water pollution, and biodiversity.

Approaches to manage surface water that consider water quantity (flooding), water quality (pollution), biodiversity (wildlife and plants), and amenity are collectively referred to as Sustainable Drainage Systems (SuDS).

6.3 Technologies & Strategies: Biodiversity

Bird Safe Facades

Bird-safe facade design involves creating facades that are not overly reflective or made mostly of windows, to prevent birds from becoming disoriented and colliding with them. Some bird-safe facades incorporate louvres and screens (Façade Shaping and Designing for Bird Safety – NUWAO, 2021).

Benefits:
Increase biodiversity
Reduced building temperatures
(Szurlej-Kielańska et al., 2021).

Insect / bee hotels and nesting boxes

Insect hotels provide safe spaces for insects to create habitats within urban environments. Nesting boxes offer a secure place for birds to establish nests, free from predators.

Benefits:
Improved Food Security
Increased Biodiversity
(Insect / Bee Hotels and Nestingboxes – NUWAO, 2018)

Pollinator pathways

Pollinator pathways are spaces that provide safe passage for pollinator insects, such as bees. These pathways are typically created in parks or gardens, but can also be established in other vegetated areas (Harrison & Winfree, 2015). They are often made using native plants, as well as fruit or flowering trees, to support a range of species (Pollinator Pathways – NUWAO, 2015).

Benefits:
Improve Food Security
Decreased Loss of ecosystem services
(Pollinator Pathways – NUWAO, 2015)

6.3 Technologies & Strategies: Biodiversity

Urban Beehives

Urban Beehives are beehives placed and looked after within urban areas.

Benefits:
Improve Food Security
Habitat provision
(Urban Beehives – NUWAO, 2020)

Urban wildlife sanctuaries

Urban wildlife sanctuaries are designed to protect biodiversity, and they can vary in size and habitat, ranging from grasslands, wetlands, and forests to even marine environments.

Benefits:
Decrease temperatures
Improve Air Quality
Habitat provision
(Urban Wildlife Sanctuaries, 2025)

Pervious surfaces / Permeable Paving

Pervious or permeable surfaces are surfaces in which water can pass through. (Pervious Surfaces – NUWAO, 2016)

Benefits:
Decrease Chnace of Flooding
Improve Storm Water Magament
(Pervious Surfaces – NUWAO, 2016)

6.4 Heritage Building Rules

Due to the significant number of heritage buildings on Queen Street—roughly half of all buildings in the area—there are strict limitations on what interventions can be made to these structures. Heritage buildings are protected from alterations to their structure, and in some cases, even their façades cannot be changed. This means they are not able to support green roofs or walls. Therefore, it is important to categorise these buildings and determine what interventions can be applied to them.

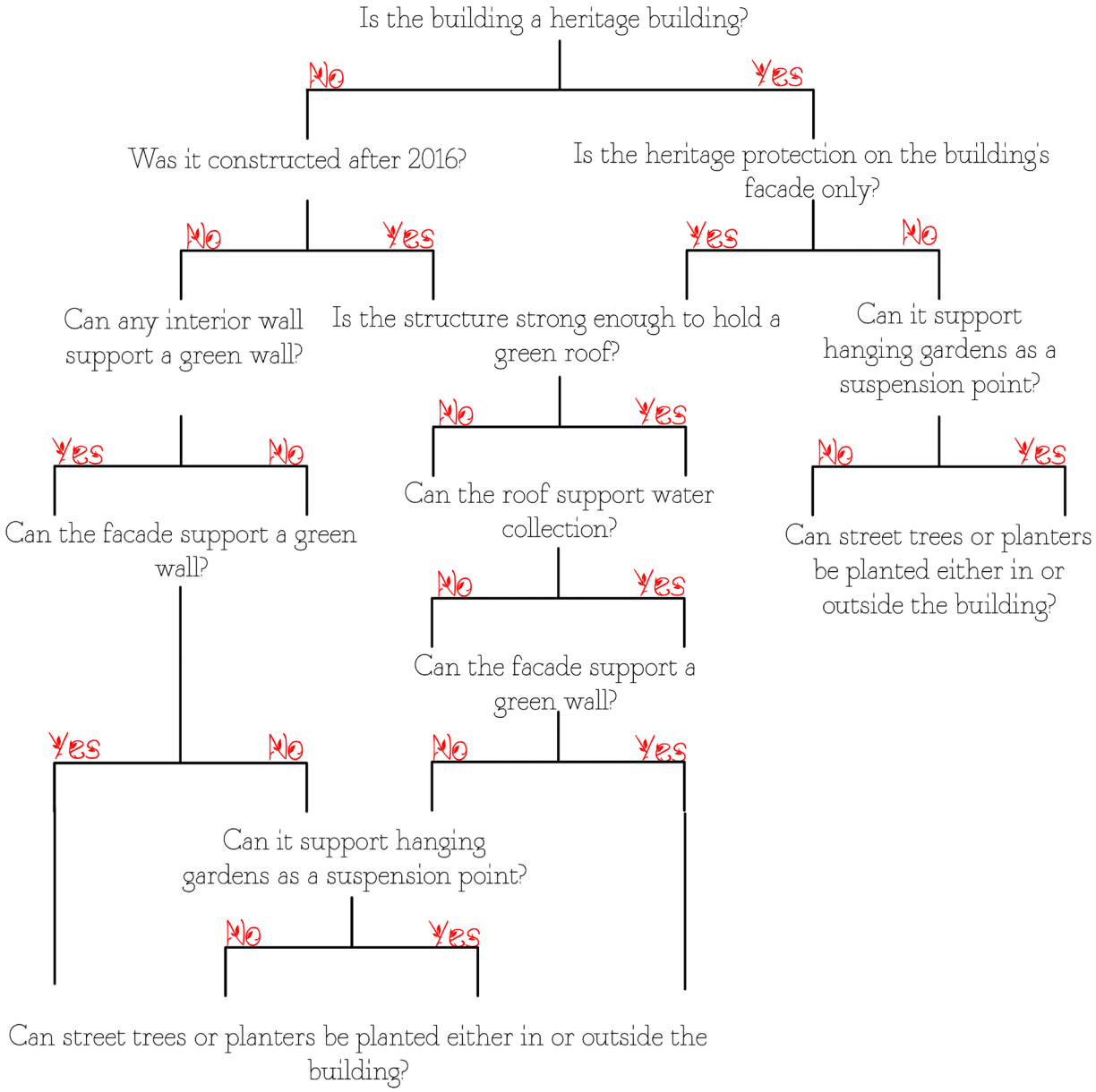
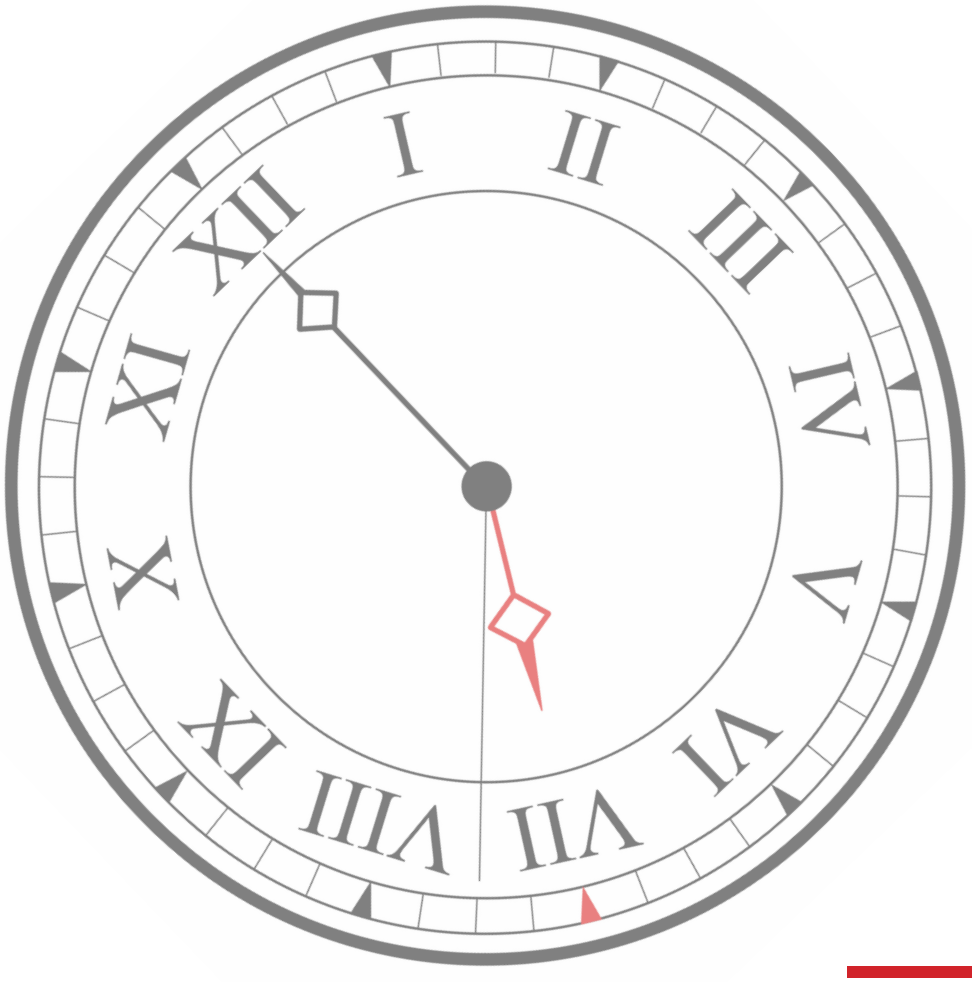


Fig 59) Heritage Building Rules Diagram

07
Final Concept

The final concept for this project aims to showcase an extreme example of how the limits of a bio-diverse streetscape might be pushed. It seeks to maintain the functionality of the space while also reintroducing native wildlife. The design also explores the relationships between the street and the footpath, as well as between the footpath and adjacent buildings.



7.1 River

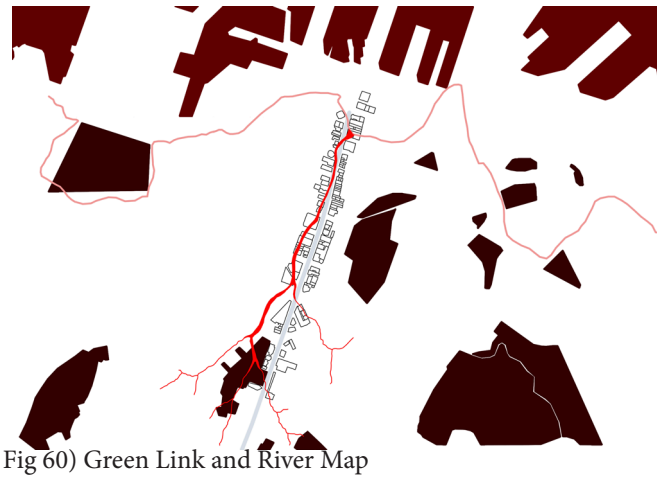


Fig 60) Green Link and River Map



Fig 61) Sketch of River in Queen Street

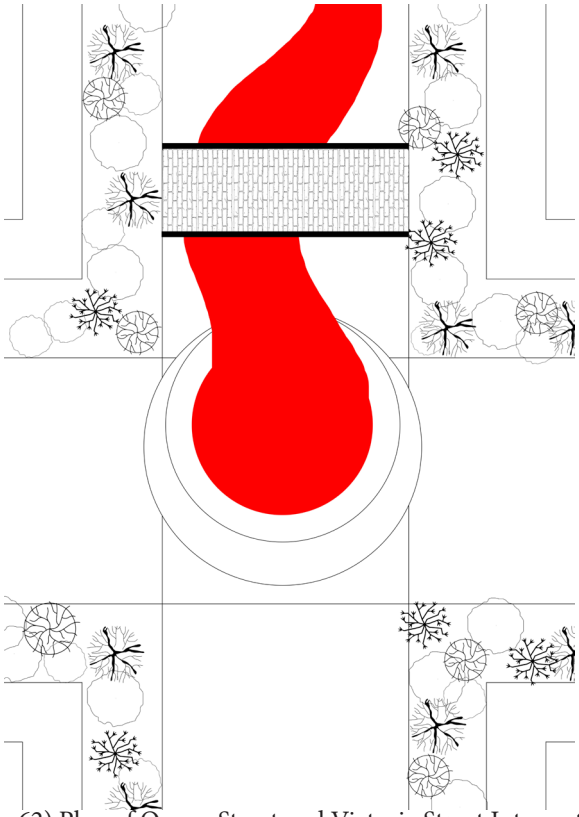


Fig 62) Plan of Queen Street and Victoria Street Intersection

A key feature of this design is the river, which begins at the Victoria Street and Queen Street intersection. This location is significant because it is where Auckland Council's Green Link passes through Queen Street. This creates an opportunity for a green and blue intersection, where the Green Link meets the river to form a unique pocket park. As the river lies a few metres lower than the road, stairs would be used to access the river level. These stairs could also serve as seating spaces. This design highlights the lush greenery in contrast to the rough, dull buildings.

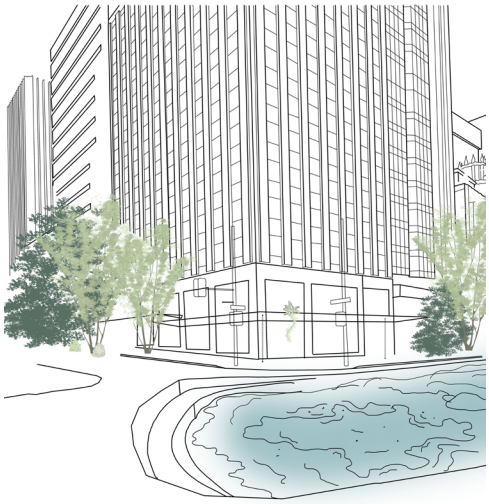


Fig 63) Sketch of River in Queen Street 2

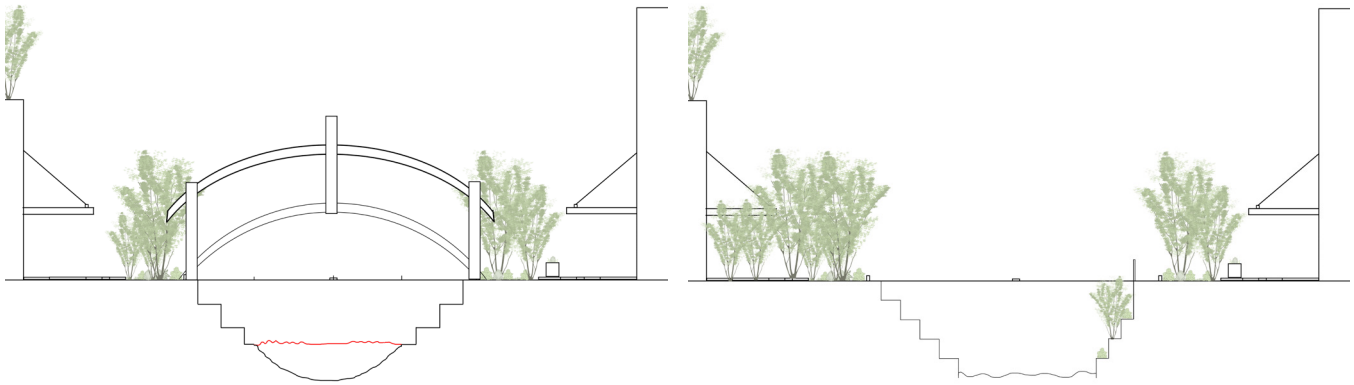
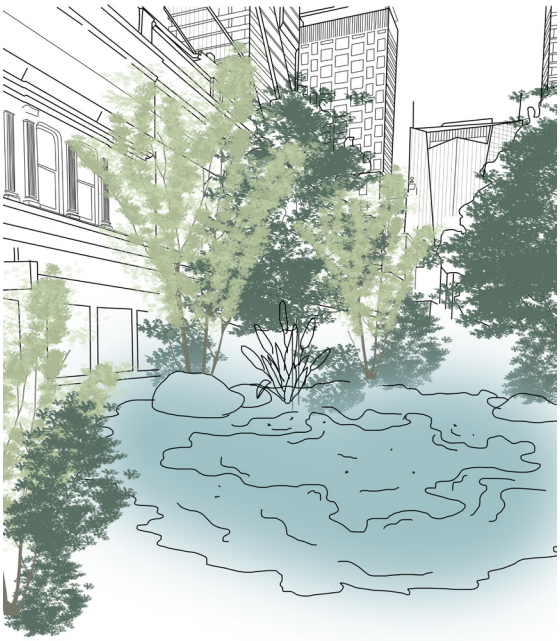


Fig 64) River Sections

7.2 Pocket Park & Streetscape



The pocket park, which is located at the intersection of Forst St and Queen St, is within a flood zone. To help prevent flooding and any potential damage in the future, I have designed the park to include a small pond. This pond will be surrounded by greenery, trees, grasses, and bushes, replacing the current turf. This change will help create a space that contributes to improved water management on the street.

Fig 65) Pocket Park Sketch



Fig 66) Photos with Trees on Queen Street

7.3 The Kean's Building

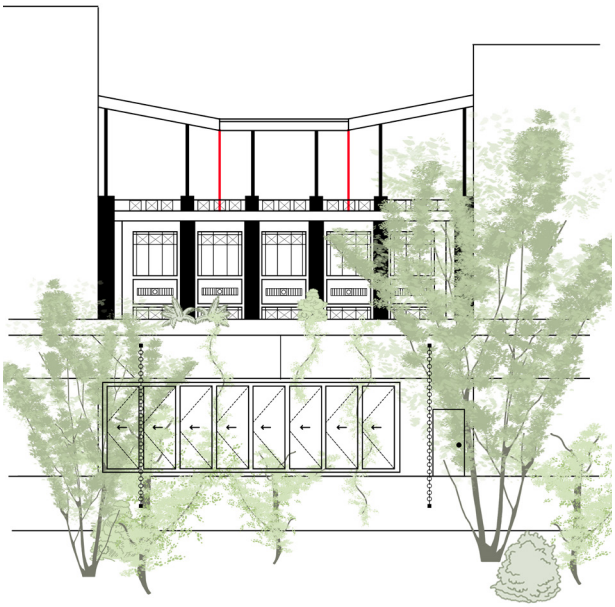


Fig 67) Facade Sketch of Purposed Kean's Building

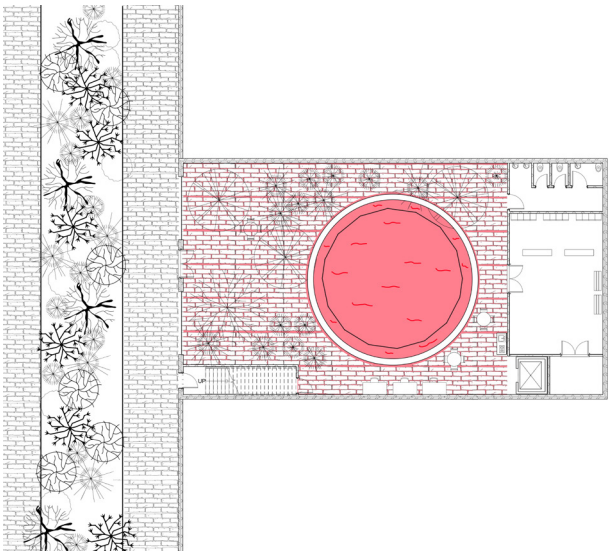


Fig 68) Ground Floor Plan of Purpose Scheme

The Kean's building will feature an angled canopy roof, which allows water to flow into the centre of the building, where it is directed into an enclosed tank that runs up the middle of the structure. The water then lands in a small pond at the centre of the ground floor. The flooring is also designed to allow this water to filter out into the surrounding plants, with any overflow directed into the green corridor.

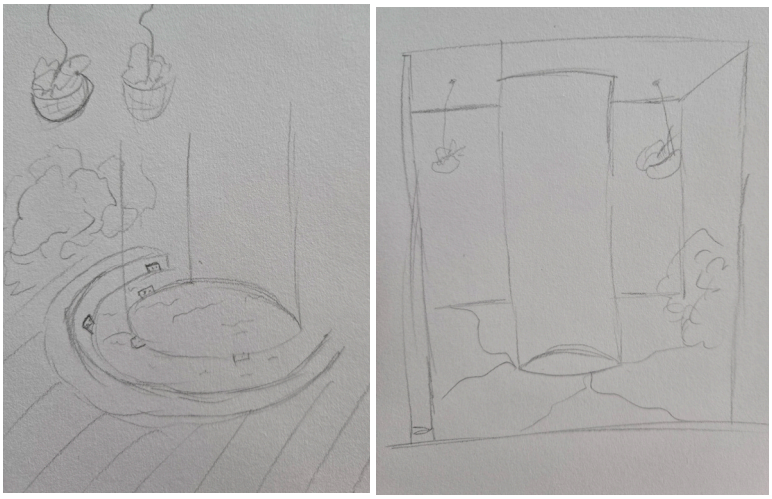


Fig 69) Sketchs of Water Tunnel



Fig 70) Detail Drawing of Water Tunnel

Ground Floor

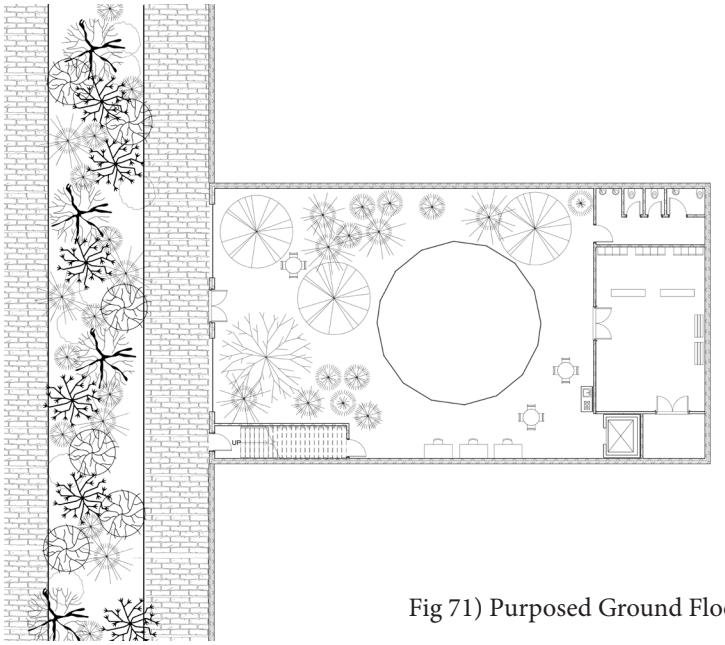
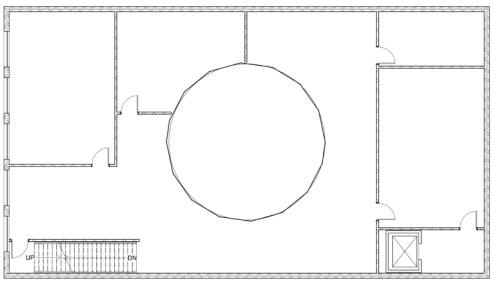


Fig 71) Purposed Ground Floor Plan

First Floor



The first and second floors are private areas for ecologists and researchers to use. The second floor is specifically a laboratory space.

Fig 72) Purposed First Floor Plan

Second Floor

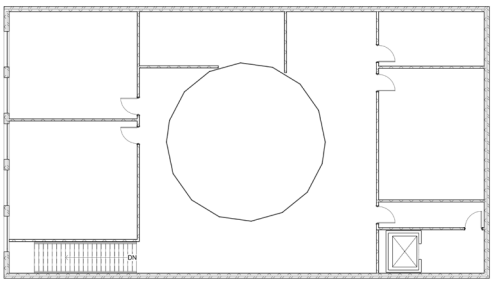


Fig 73) Purposed Second Floor Plan

7.4 Reflection

There are a lot of technical problems and aspects that haven't been properly organised. The programming for the building is still unclear, and the layout doesn't align well with the building's design. The first and second floors feel quite stale and uncomfortable, lacking the flow and vibe of the ground floor. The ground floor will also face several structural issues with the current organisation of the water and pond; it's unsafe to remove the floor and flood it constantly. The water tank also presents numerous challenges—it will be difficult to maintain and clean, and it could become a breeding ground for insects, which, in this case, is far from ideal.

The streetscape design is currently underdeveloped. The only consideration so far is the plan to daylight the river. There needs to be more detailed information about how this will happen and what the plan is for the rest of the street.

7.5 Final Review - Event 3

Personal Reflection:

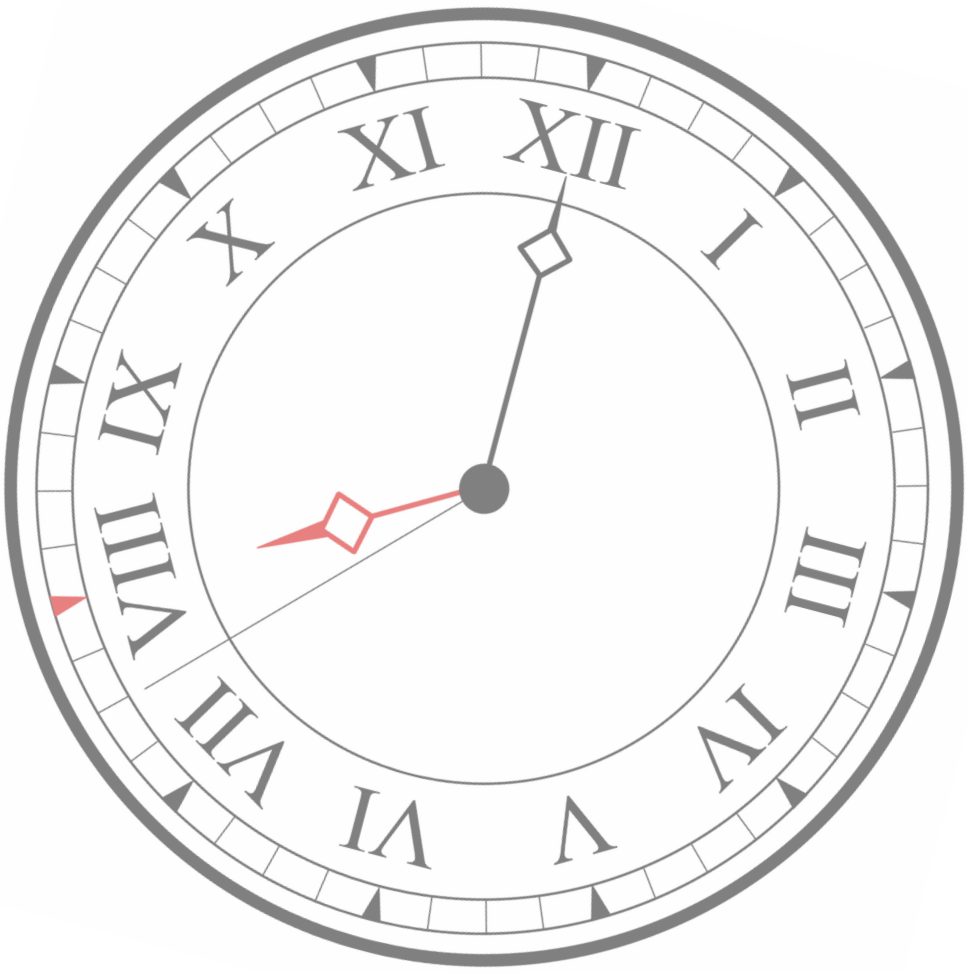
This review was more enthusiastically received, as it addressed the problems I'm trying to design for. A new thought for this project has arisen—namely, the conversation around heritage. Is it fair that heritage buildings are celebrated, while the river is left hidden, out of view? There is still much work to do. The style in which I design isn't currently considered thesis-appropriate, and I'm unsure how to overcome this challenge going forward.

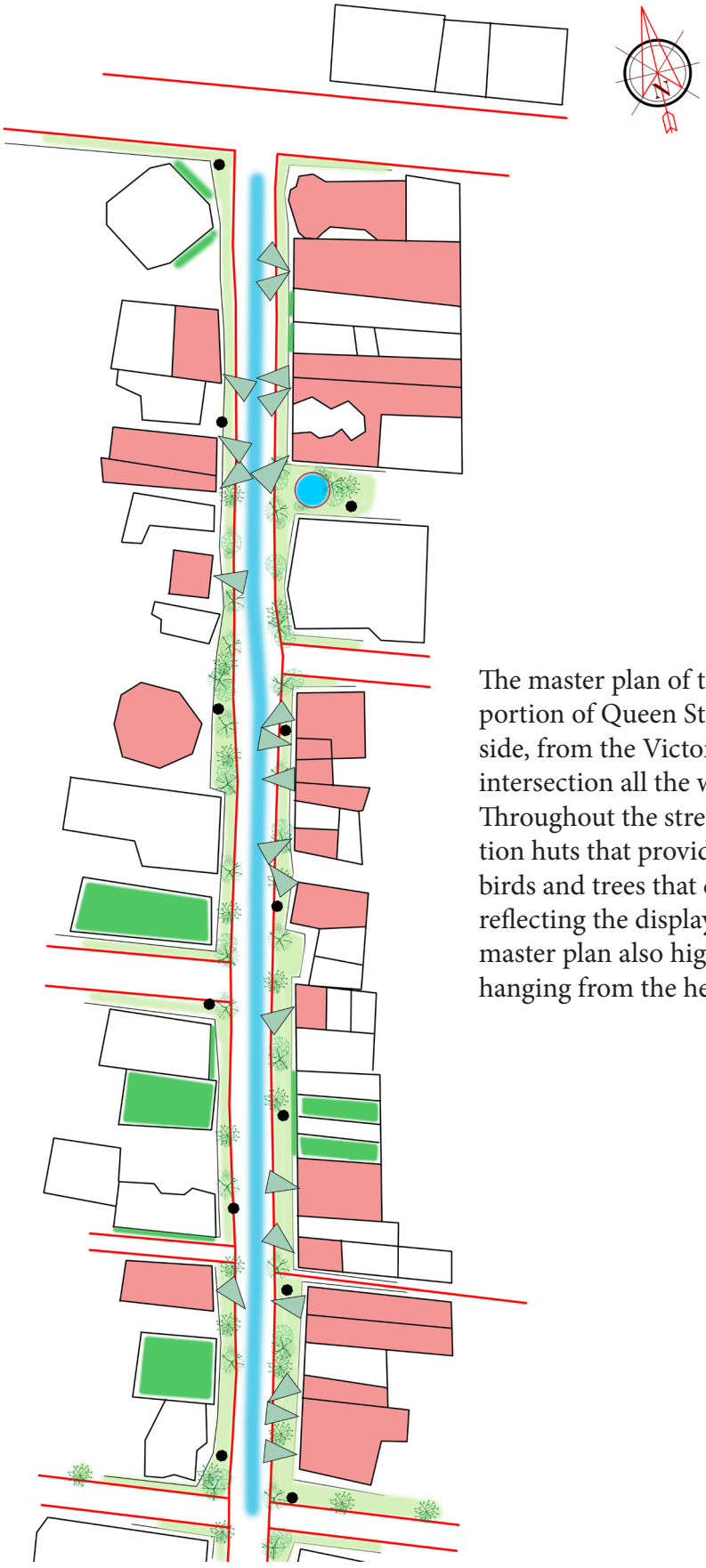
Next Steps:

-- Try to find a new design style.
-- Challenge the political perspective on heritage.
-- Experiment with model making.

Detailed Design
08

To develop this design, it needs to be completed. Starting with Kean's Building.





The master plan of the streetscape shows the portion of Queen Street that the river runs alongside, from the Victoria Street and Queen Street intersection all the way to the end of the street. Throughout the street, there are small information huts that provide similar details about the birds and trees that can be found along the street, reflecting the displays in the Bio Museum. The master plan also highlights the canopy gardens hanging from the heritage buildings.

Fig 74) Streetscape Master Plan

8.1 StreetScape - River

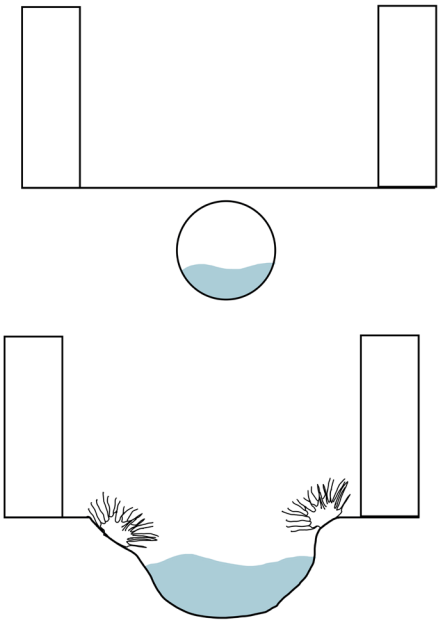


Fig 75) River Daylighting Diagram

TThe recreation of the Waihorotiu River is far more linear than it was previously, aligning with the surrounding environment. The river itself is quite deep, so it has been designed with stairs leading down to the riverbank, ensuring it remains shallow enough to avoid creating a safety hazard in the middle of the street. The steps are integrated with grassy banks to support the growth of river plants, enhancing the biodiversity within the river. These elements also provide space for the river to rise during extreme weather conditions, reducing the risk of flooding the street.

There are also a series of stepping stones and bridges throughout the river to ensure people can cross safely. The stones also help to slow the river and protect its ecosystems.

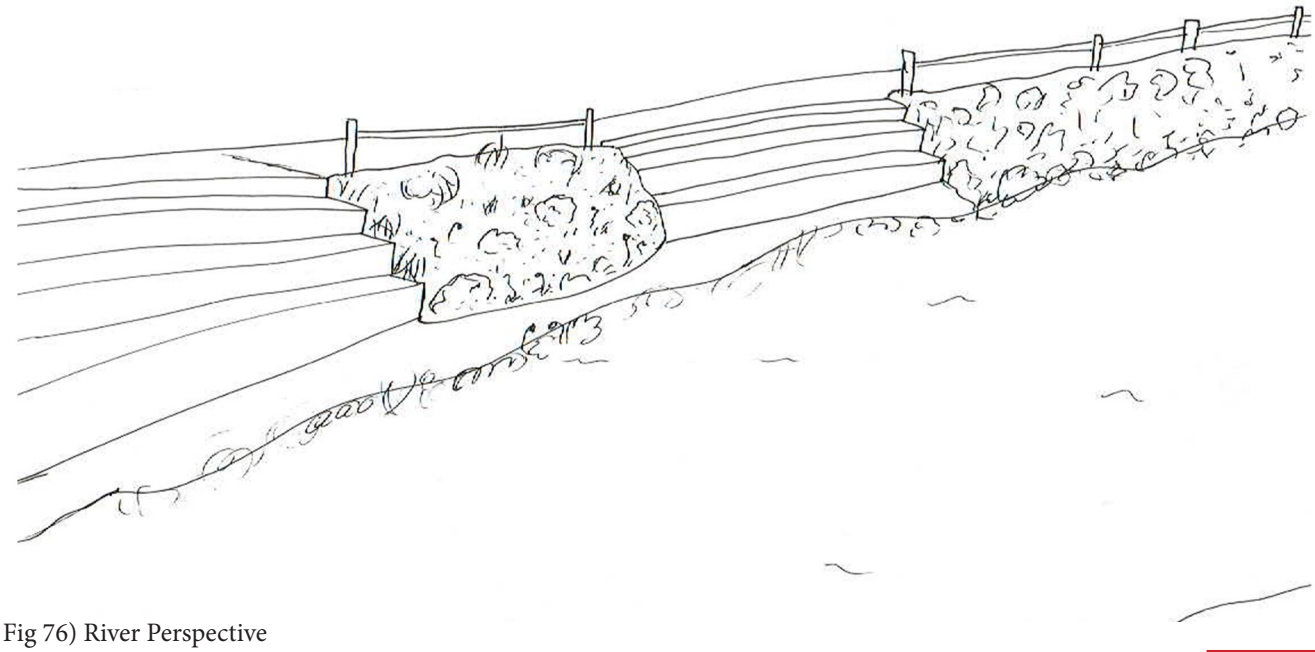


Fig 76) River Perspective

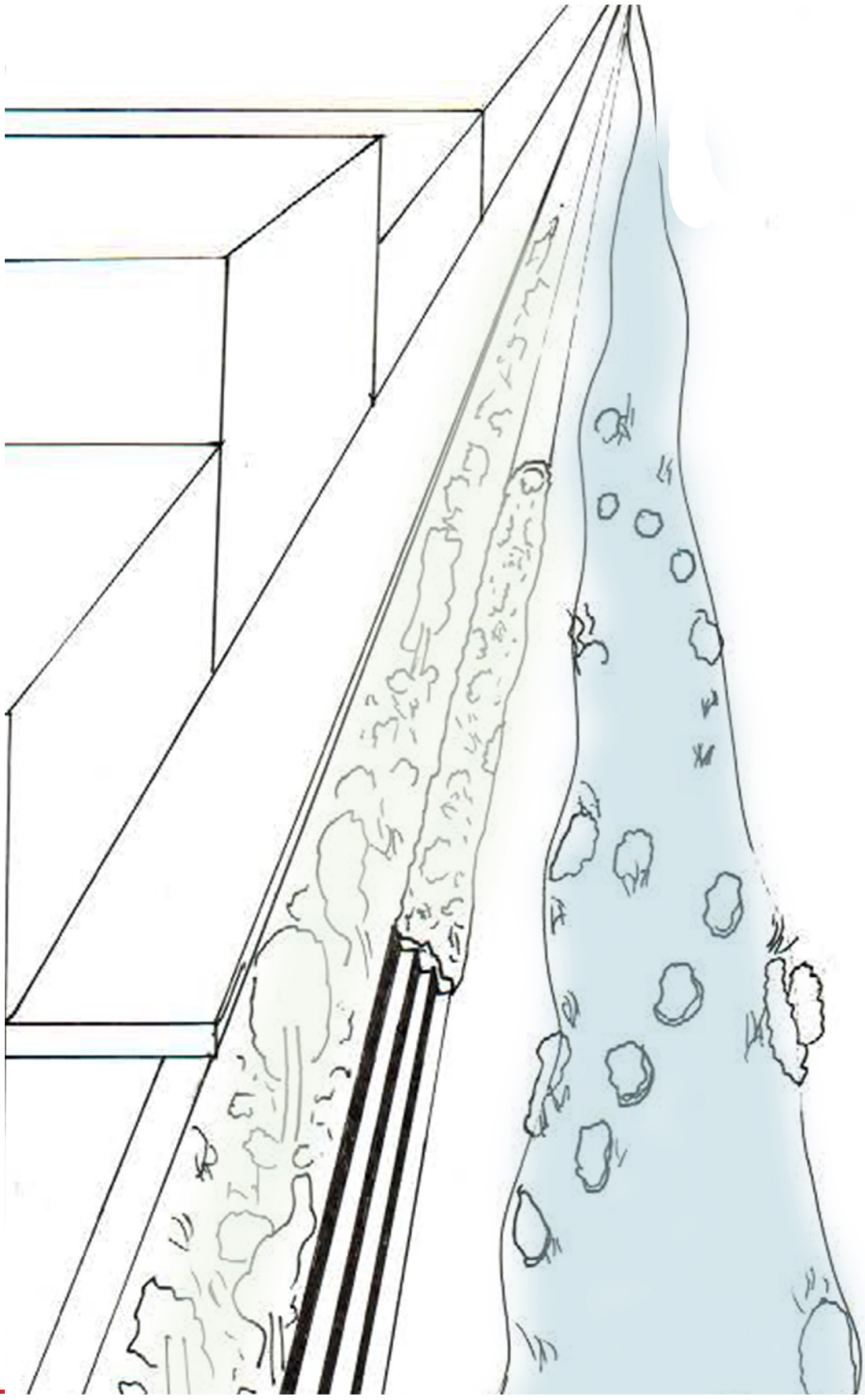


Fig 78) River Perspective 2

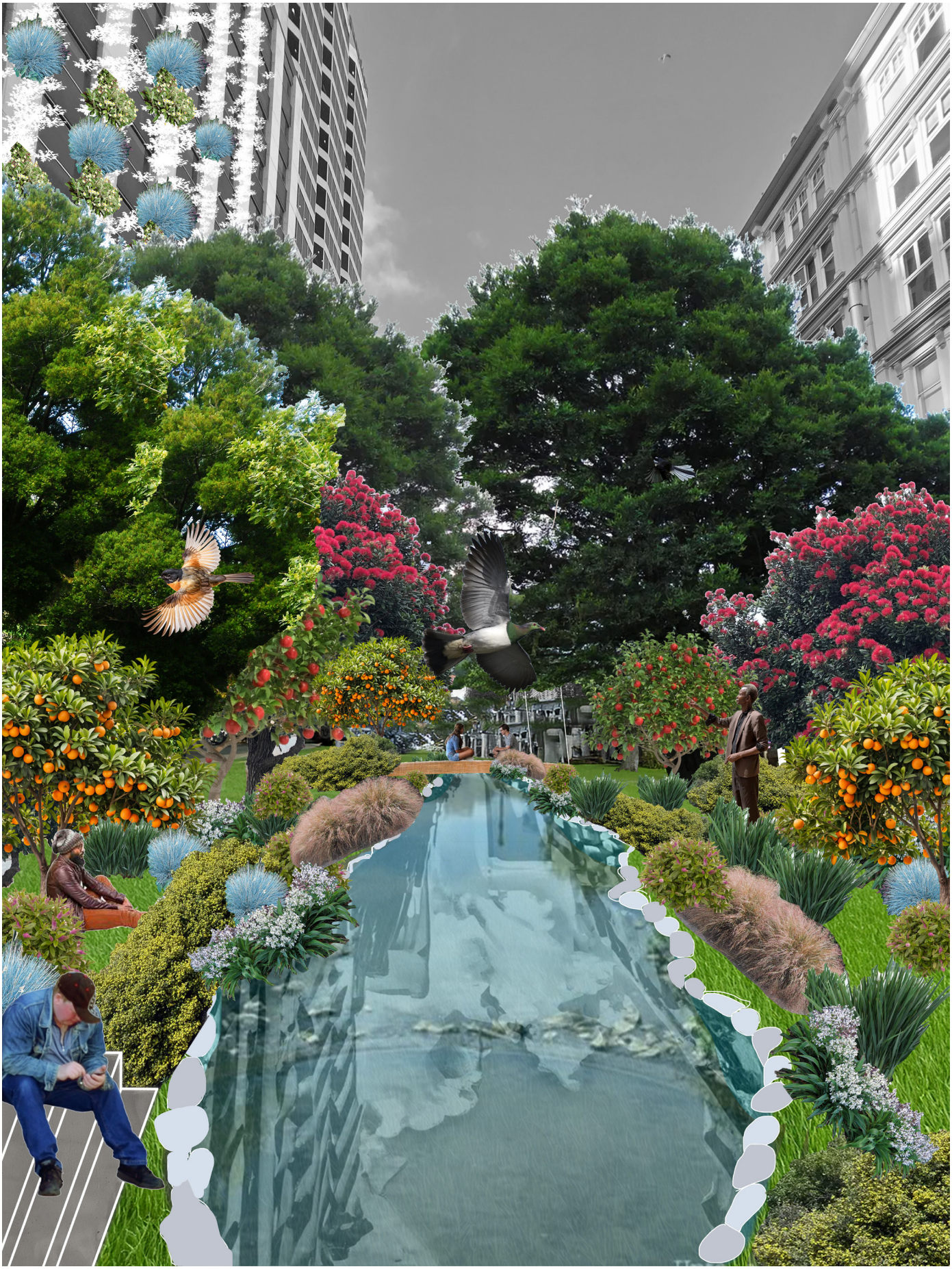


Fig 79) River Perspective 3

8.1 StreetScape - River Details

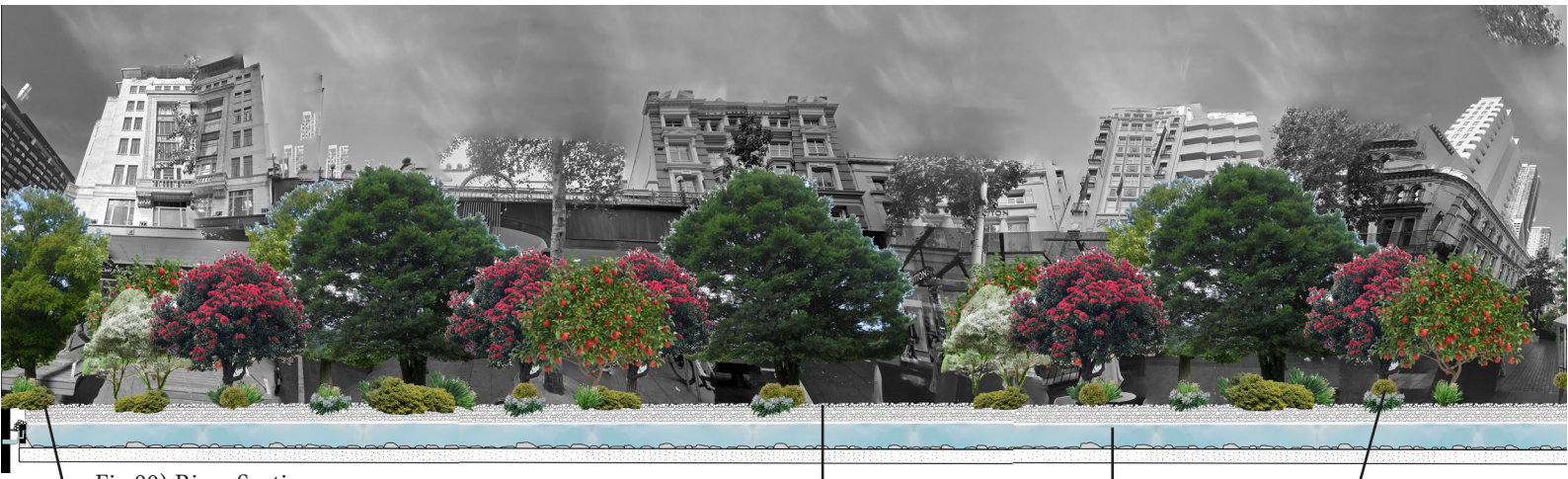
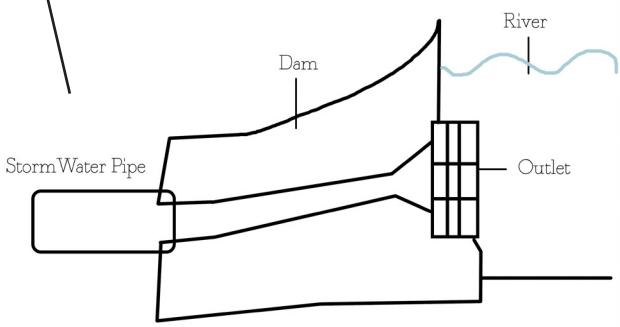


Fig 80) River Section

River Rocks

Concrete Slab



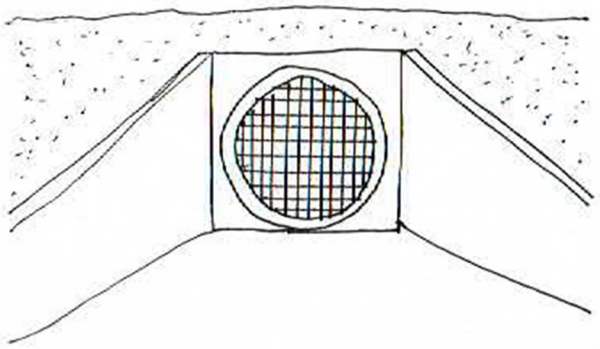


Fig 81) River Details

At the end of the river, a dam system is in place. This dam helps to maintain the water level at a high point and controls the amount of water being fed back into the stormwater system. The other end, where the river begins, is simply a cut with mesh to prevent anything unpleasant from entering or leaving the river. The river is built on a concrete slab for support, and the riverbed consists of a mix of stones to aid with water flow. As the street slopes downwards, it is likely that, if unobstructed, the river could flow fairly quickly.

8.2 StreetScape Bio Huts



Fig 82) Block Plan

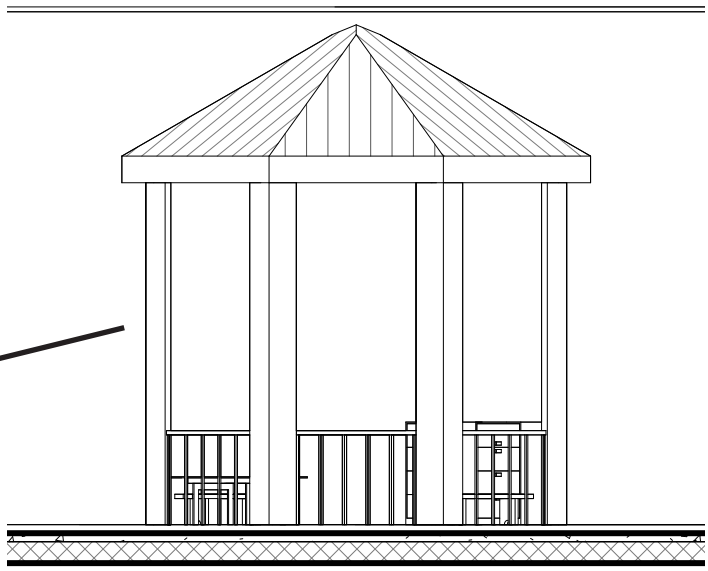


Fig 81) Bio Hut

The Bio Huts are spaces where people can observe the birds or trees, with information provided inside. They can also be used as sheltered areas for people to rest. The huts are equipped with bird feeders and water, which are stored at the Bio Museum.



Fig 82) Bio Hut Perspective

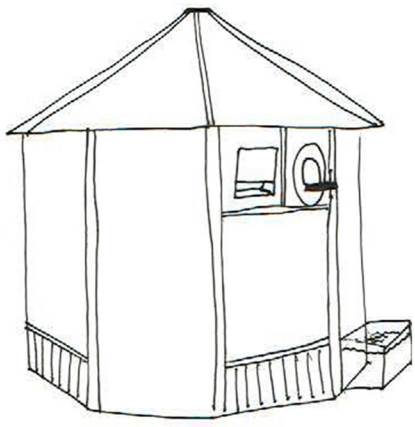


Fig 83) Bio Hut Bird Feeders

8.2 StreetScape Detail

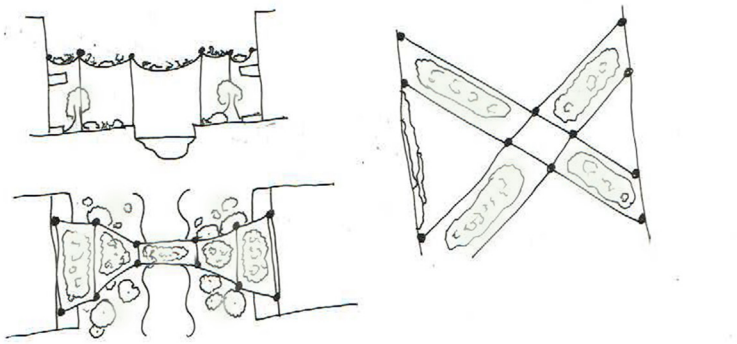


Fig 84) Orignal Canopy Idea

Due to the heritage buildings, there was always a need for an alternative way to incorporate greenspace. The first iterations of the canopy gardens aimed to expand the entire streetscape, which in some places on Queen Street is nearly 30 metres wide. This revealed several issues, primarily relating to weight and structure. Then I discovered the Singular Green urban canopies, which created much smaller canopies but had solved a significant problem: water movement. The canopy works with a drainage and water system that is attached to the building and feeds up to the garden.

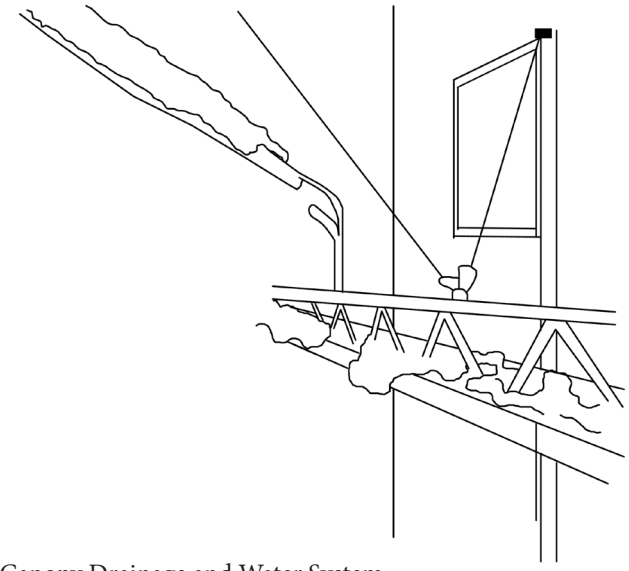


Fig 85) Canopy Drainage and Water System

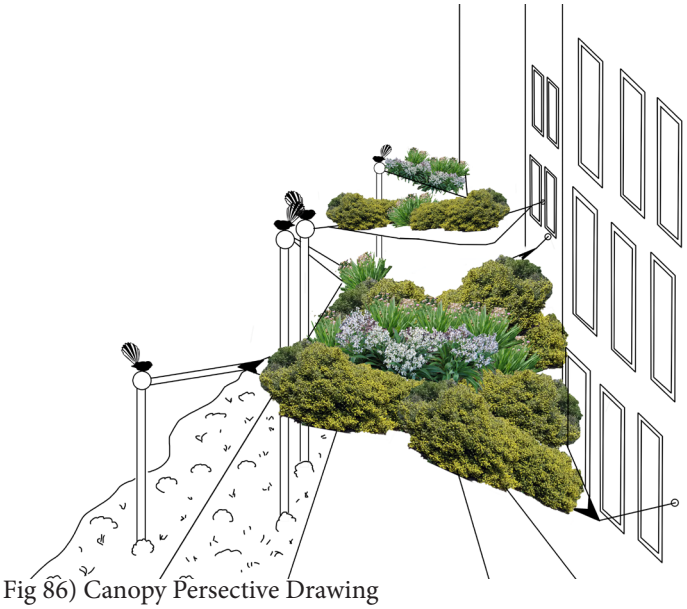


Fig 86) Canopy Persective Drawing

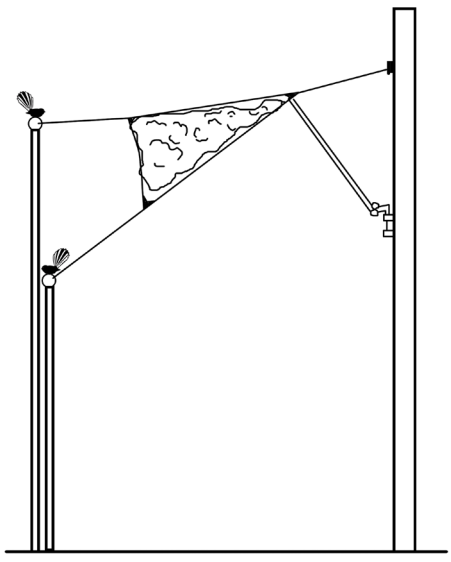


Fig 87) Canopy Drawing

8.3 Building Program

The ground floor of the building will primarily serve as a social space, with some computers and information boards placed throughout the room. Plants featured here will reflect those found along the adjacent footpath and streetscape, helping to draw people into the space. Towards the back, there will be a plant nursery, which will also function as a venue for talks. In the nursery, people will be able to buy or trade plants and seeds. This creates a learning environment where individuals can become more involved in the work taking place both in the building and on the street. The aim is to foster a stronger relationship between people and nature.

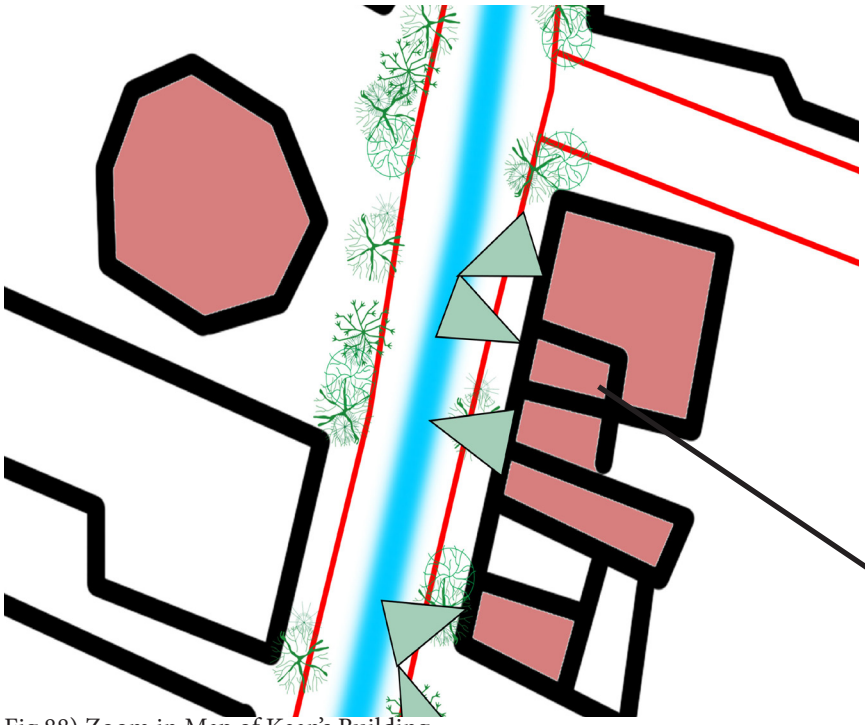


Fig 88) Zoom in Map of Kean's Building

This relationship will also be encouraged on the first floor. Although it will predominantly be a private space for ecologists and researchers, it will include a dedicated teaching room, accommodating students on field trips or members of the public.

The second floor will largely mirror the first, but will mainly be used as private laboratory space, with an additional lab available for teaching purposes.

The rooftop will also be accessible as a break area, suitable for eating or taking a rest.

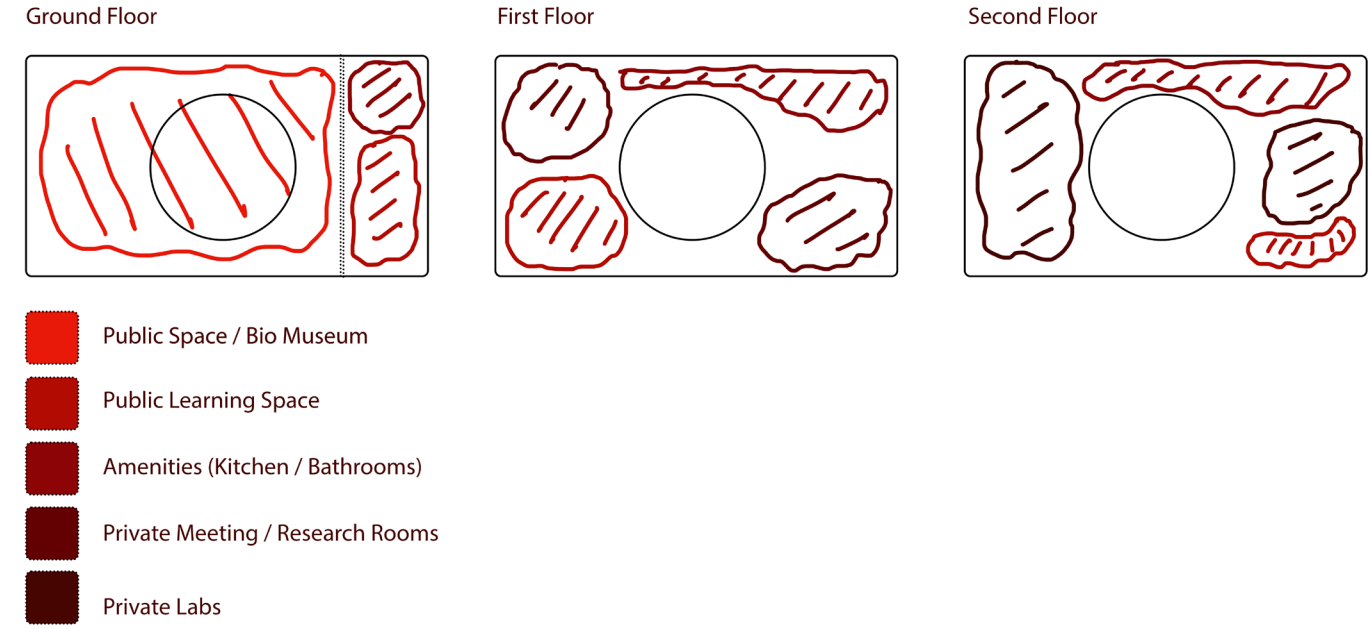


Fig 89) Program Map

8.4 Building Floor Plans

Structurally, the building is different. Instead of a water tank running through the entire building, there is now an open rain tunnel. The entry point at the roof has been reduced in size, with the gaps widening as you move further down the building towards the pond. The pond is now free-standing and can still be used to water the indoor plants, but this will need to be done manually.

The roof features a sliding door that can close off the rain tunnel in the event of high winds or heavy rain, protecting the interior of the building from potential damage. The first and second floors have also been redesigned to reflect the aesthetic of the ground floor and to better integrate with the circular pond and voids running through the building. This void also functions as a light tunnel, ensuring that the plants within the building receive ample sunlight.

Ground Floor

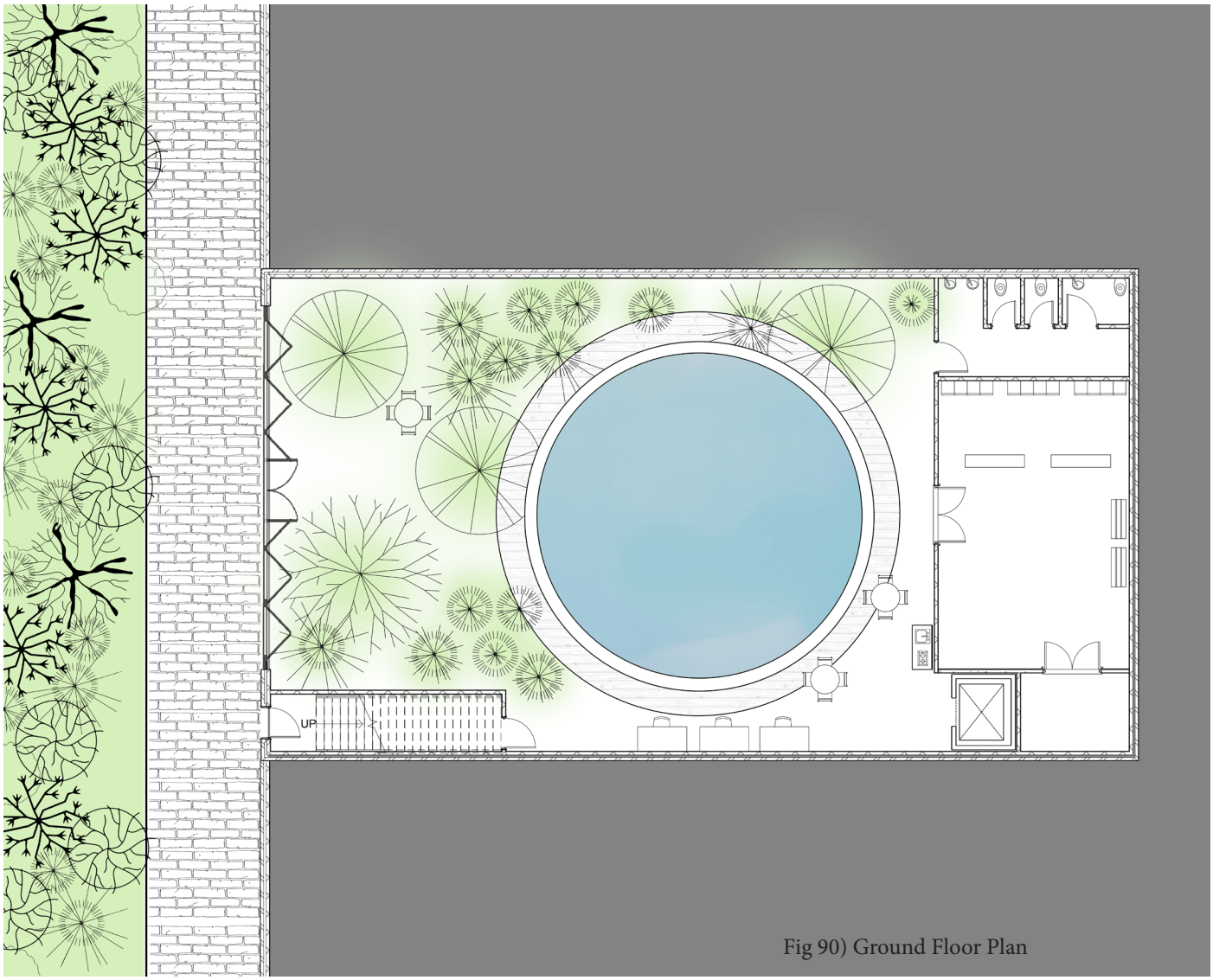


Fig 90) Ground Floor Plan

First Floor

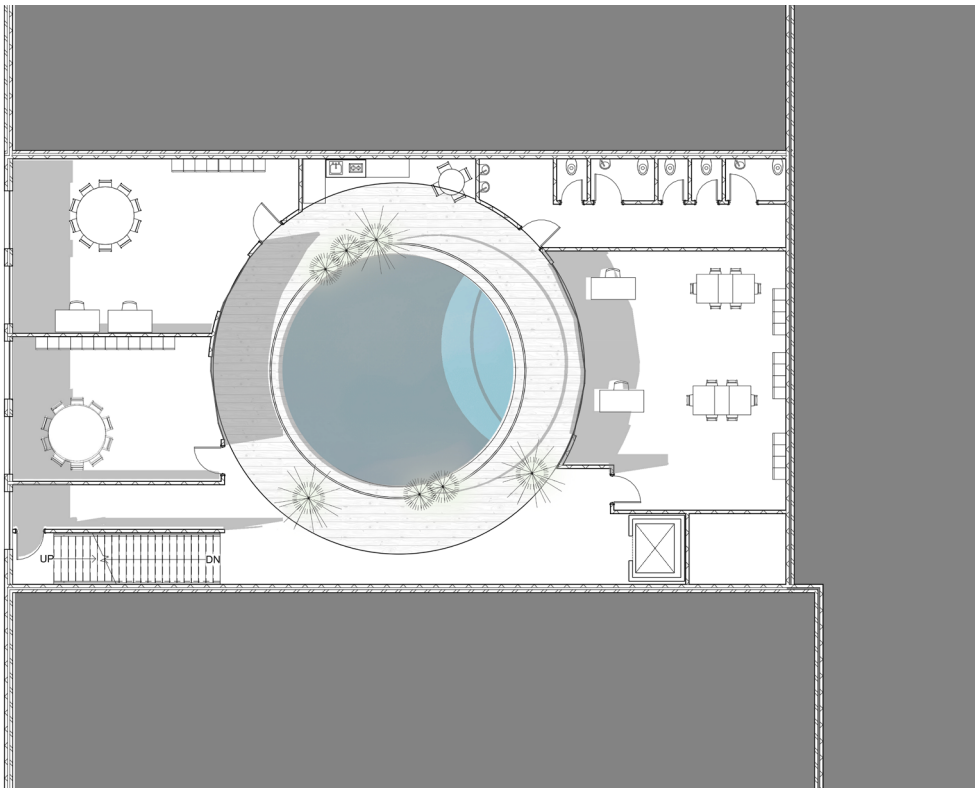


Fig 91) First Floor Plan

Second Floor

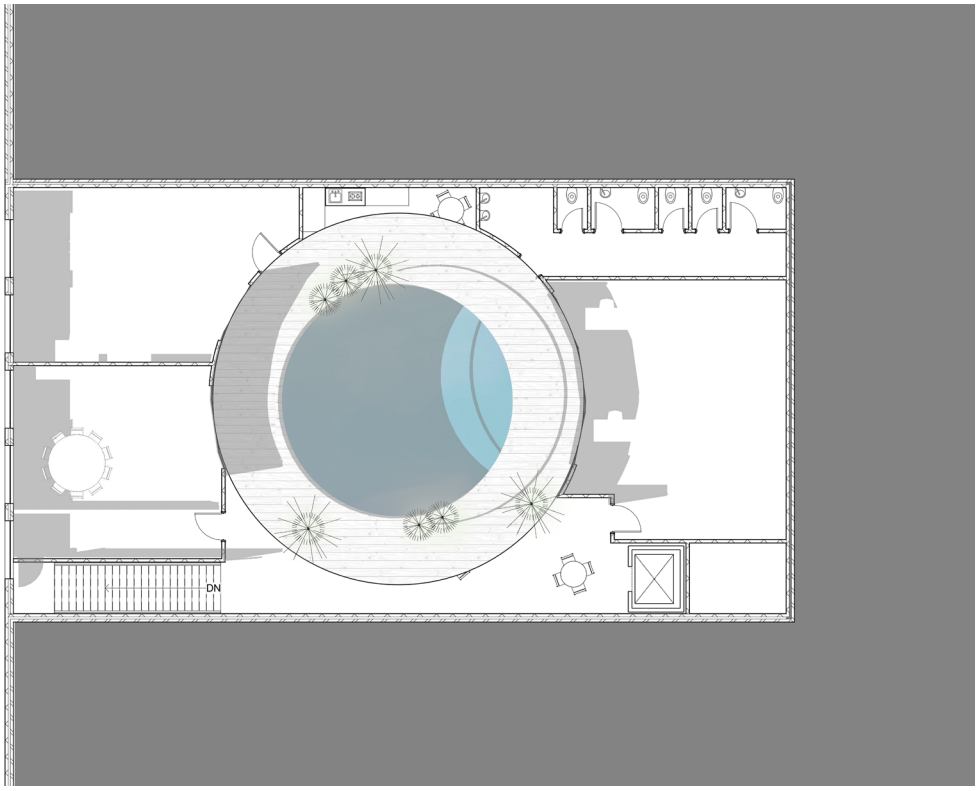


Fig 92) Second Floor Plan

8.5 Building Exterior

The exterior of the building remains largely the same, apart from the new canopy garden, which is anchored to the façade. As Kean's building is a heritage structure, it is not suitable for a green wall, nor is it strong enough to support a green roof.



Fig 93) Building Facade

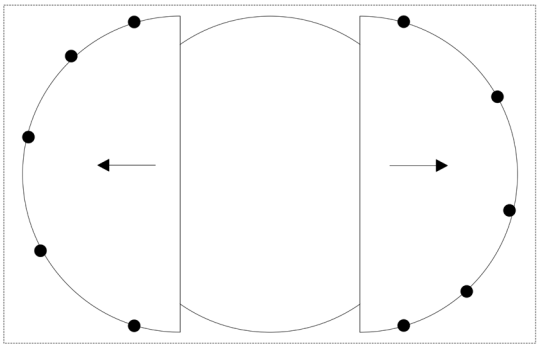
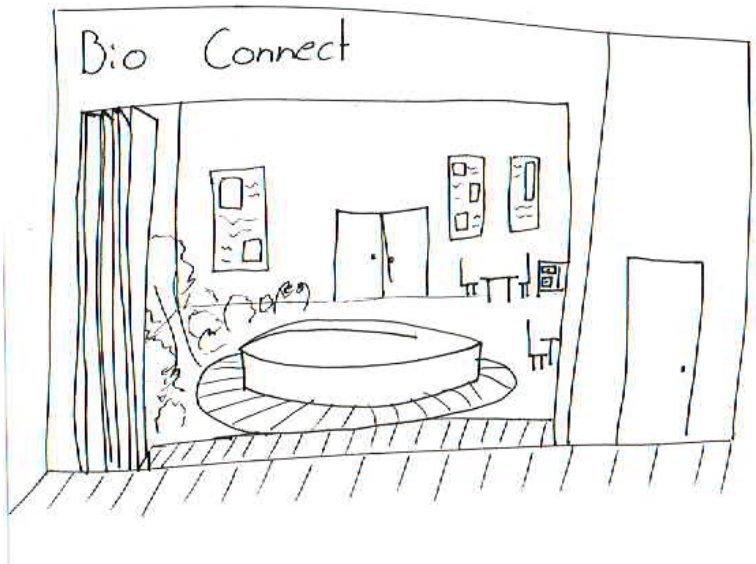


Fig 94) Building Roof Detail

The Bio Museum features a light well through the middle of the building, but this isn't just a typical light well – it's a rain tunnel. Open at the roof, it allows rainwater to fall through and land in the pond below. For this reason, a sliding door has been added to the roof panel, enabling it to be closed in the event of heavy rain.

To ensure the safety of people and objects inside, the hole in the roof is smaller than the openings further down the building. As you move down the floors, the hole gradually increases in size to allow more light to reach the lower levels. This ensures that the plants on the ground floor still have access to sunlight. This is crucial, as the building has windows only on the west side.



8.6 Building Detail

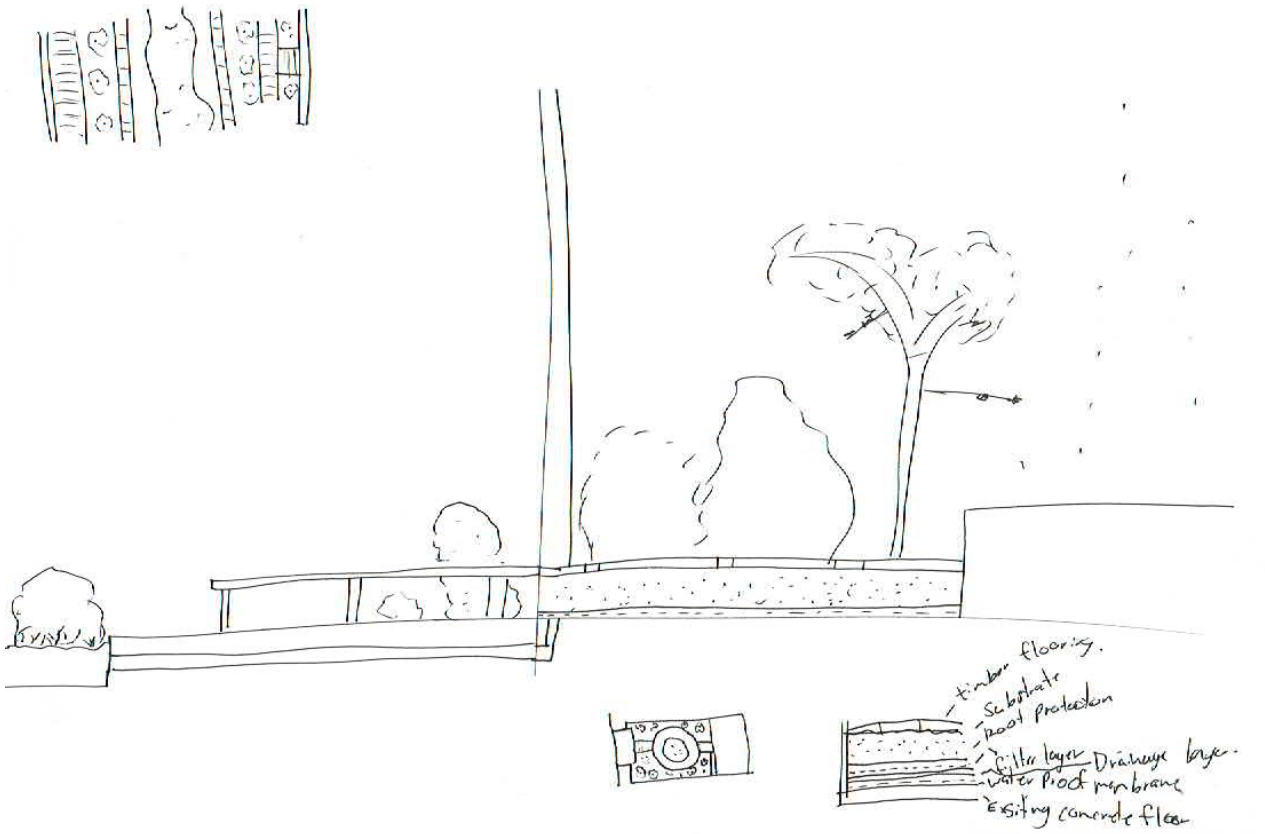


Fig 95) Building Flooring Detail

The ground floor of the building features an abundance of plants. To ensure the structure's safety, it was designed similarly to a green roof. The original concrete structure of the existing building was retained, with additional layers such as waterproof membranes, drainage, root barriers, and a filter layer added on top. This makes it possible to incorporate plant boxes with open bottoms, if needed. The building could also support a fully grassed floor, with only timber flooring around the pond and at the entrance.

8.7 Building Sections

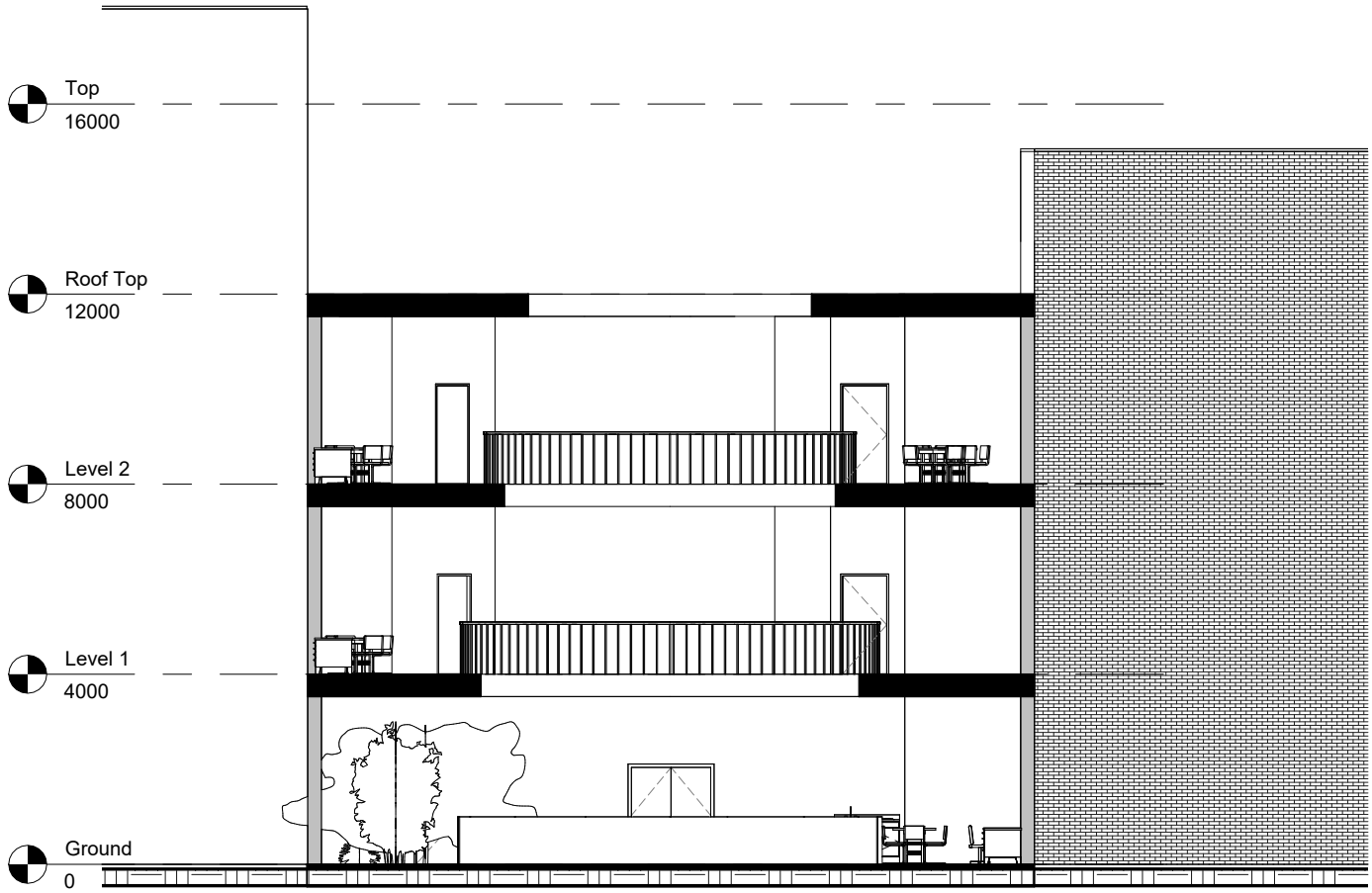


Fig 96) Building Section

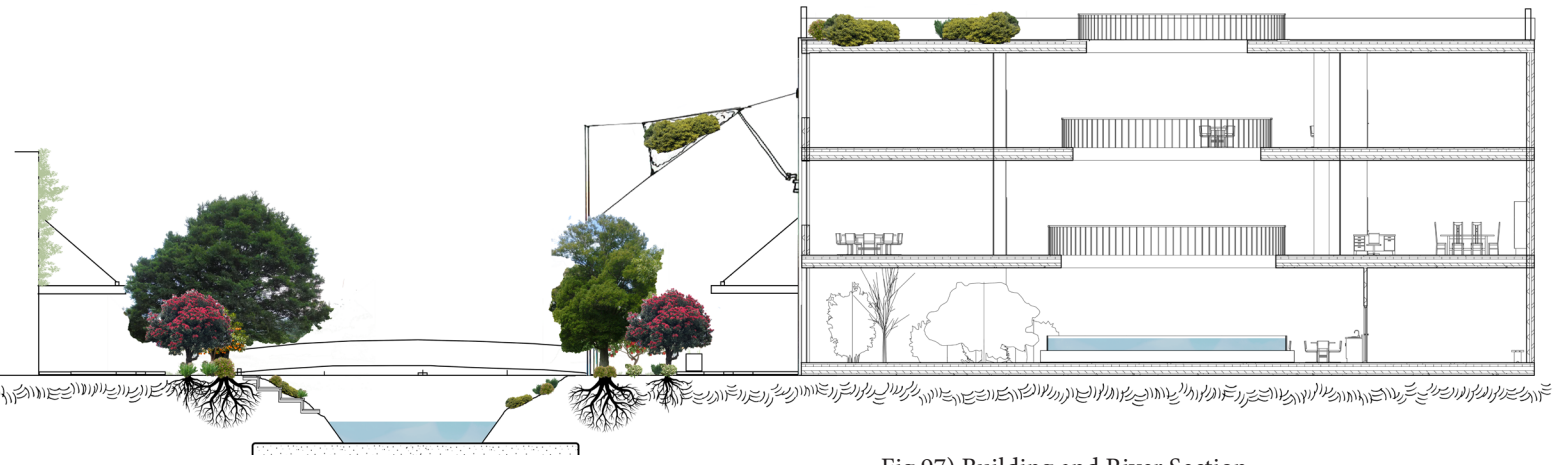


Fig 97) Building and River Section



Fig 98) Building Facade Perspective

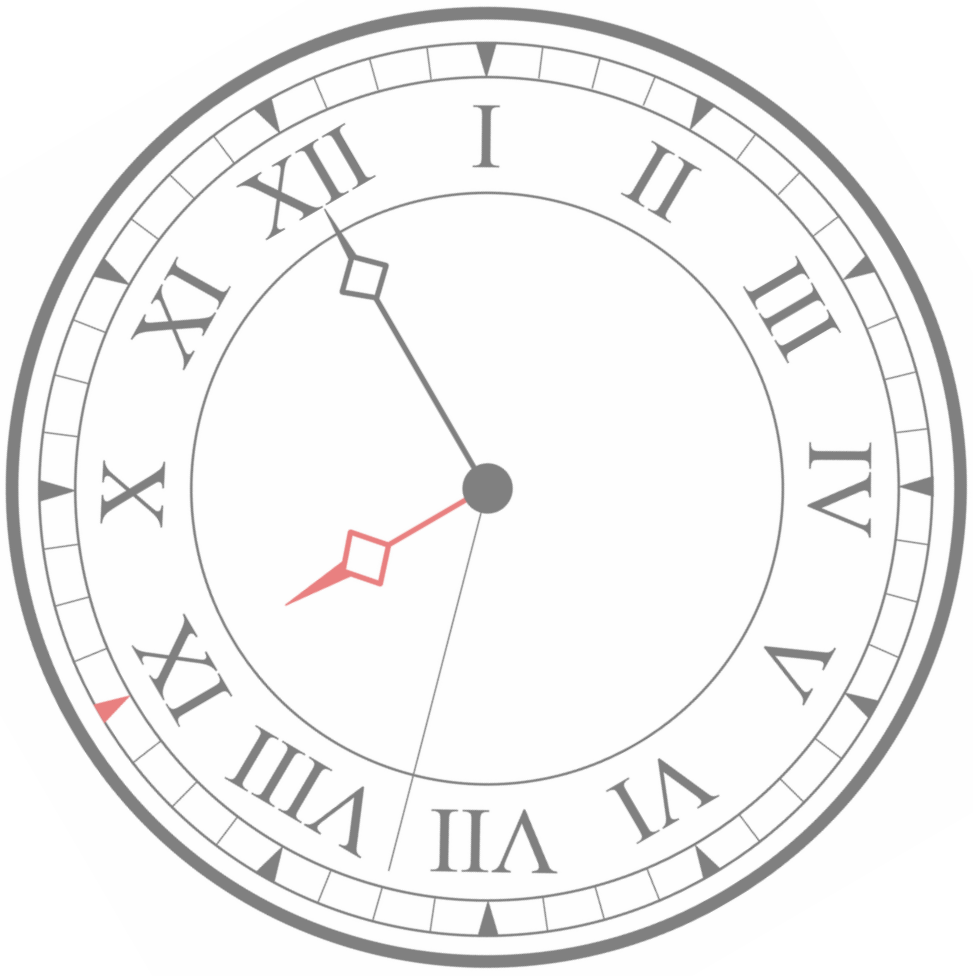


Fig 99) Building Facade Perspective 2



Fig 100) Building Facade and Hut Perspective

Critical Reflection
09



9.1 Design

In order to create a biodiverse streetscape, the criteria set out by the Biodiverse Streetscape Design Framework were: to increase the amount of green space while preserving existing green space; to create high-quality habitats for animals through features such as nesting boxes and insect hotels; and to protect, celebrate, and strengthen relationships between ecosystems, people, and biodiversity.

Green corridors, hanging gardens, green walls, green roofs, and planter boxes were all used to integrate more vegetation and create additional green space within Queen Street. The increased green space enhances the likelihood of birds and insects using or passing through the area from nearby parks. However, the heritage status of most buildings on Queen Street limited the expansion of green space, as green walls and roofs were largely not permitted. This posed a challenge because expanding biodiversity required connected habitats, particularly for insects, which would not travel long distances. To address this, canopy gardens were conceived, providing much-needed connections between the green corridor and the green walls and roofs on non-heritage buildings. These gardens opened up new possibilities for the street, not only by creating additional space for plants but also by providing shade for pedestrians and enhancing the street's aesthetics.

Selecting appropriate plants for the canopy gardens proved to be more challenging. The original design was developed overseas using custom-made components designed for specific plants that were not native to New Zealand. The simplest solution was to use ground cover plants that required minimal watering and could thrive in full sun. Alternatively, climbers could be used, but New Zealand has fewer native climbing species. In practice, plant selection would need to be carried out in collaboration with an ecologist and tested on-site.

The green corridor was designed with layered vegetation to provide better habitats for shy fauna. Many insect species are sensitive to human presence, making it essential to create environments where they feel secure, even in dense urban areas. While trees and plants were selected to support target bird species, additional support such as nesting boxes and bird feeders was also provided. This benefits both native and non-native birds that may not be drawn to the trees, ultimately enhancing overall biodiversity.

Bees are crucial for supporting the plant life within the site. In this regard, the green corridor can also function as a pollinator pathway, potentially fostering a self-sustaining bee population to support the street's vegetation. This project aligns with Auckland Council's proposed Green Link by working through the intersection of Victoria Street and Queen Street. This alignment makes the expansion of biodiversity more viable than if it relied solely on the surrounding parks. If the project were only connected to parks, additional green spaces would likely be required to bridge the gaps, as many species are unable or unwilling to travel long distances through urban environments.

A key oversight in the design was the lack of emphasis on weed mats or pest-proofing. While weed mats may not be necessary if ground cover is consistently maintained throughout the green corridor, pest control should be considered, particularly with the increase in trees—especially fruit-bearing ones—and vegetable gardens, which may attract unwanted species. Pest-proofing should be applied to rooftops as well as vegetable gardens. Overall, the design provides a strong foundation for a more biodiverse streetscape, which could be further refined through collaboration with ecologists and landscape architects.

9.1 Design

Barriers to Implementation

Significant barriers to implementing this proposed design lie in city policy rather than physical design. A key component of the street's redesign is the daylighting of the Waihorotiu Stream beneath Queen Street, which would require council and community support. The process of daylighting itself is not overly complex, but its location beneath a still-active road adds challenges. Although vehicle access is being gradually restricted, Queen Street remains vital for deliveries to businesses and emergency services. The feasibility of the design relies on the availability of alternative routes on the perpendicular streets.

The age of the streetscape also plays a crucial role in its retrofitting potential. Heritage buildings limit the ability to install green roofs or walls; however, alternative approaches, such as the canopy gardens explored in this project, provide opportunities to integrate greenery in a way that respects heritage constraints. The width of Queen Street is advantageous in designing a biodiverse streetscape, as it allows for increased linear green space at road level and potentially the incorporation of blue space, as explored in this thesis.

Integration with the Three-Strand Framework

Although this design primarily focuses on the ecological strand of the Three-Strand Streetscape Design Framework by targeting biodiversity, the other two strands—collective wellbeing and cultural significance—are also important. While these strands were not the primary focus, the project aimed to create a streetscape that aligned with all three.

Queen Street's rich cultural and historical context offers significant opportunities for strengthening collective wellbeing. The daylighting of the Waihorotiu was the key cultural connection in the design, but further integration of the river's narrative throughout the streetscape could enhance its cultural significance.

Auckland Council has increasingly acknowledged the Waihorotiu in recent years, incorporating its history into Queen Street's wayfinding elements and commissioning two art installations at Myers Park. These efforts align with the collective wellbeing strand by recognising the cultural heritage of the site. However, the wayfinding strategy has had limited success, as most people do not notice the patterns, and there is no on-site explanation of their meaning—information is only available online. In contrast, the recent Myers Park installation more directly acknowledges the river, creating an experiential tribute to its memory.

Even if daylighting the river is not feasible, there should be some form of physical water presence within the street as a direct reference to the Waihorotiu. This could take the form of rain catchers, water chains, or fountains, reintroducing a tangible water element to Queen Street.

Final Considerations

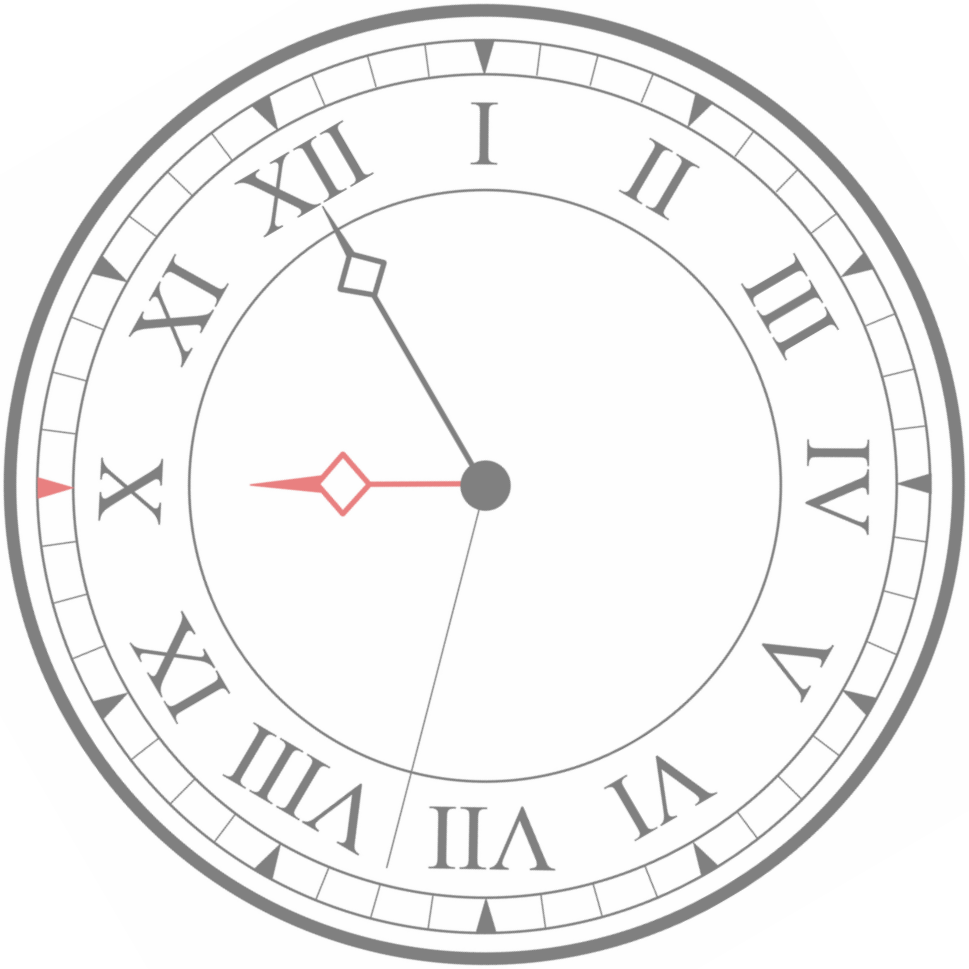
Auckland Council has been working to create more biodiverse spaces by increasing plantings to connect green areas across the city. However, the current approach lacks a clear ecological focus, as greenery is often added without specific conservation targets. This design serves as a strong starting point, demonstrating what a streetscape intentionally designed for biodiversity could look like.

Usefulness of the Three-Strand Streetscape Framework
The Three-Strand Streetscape Design Framework outlines the key elements of an ideal streetscape design. While this thesis focuses specifically on designing for biodiversity, it aligns with the broader goals of the framework. The framework is intended to create more effective streetscapes, which must address all the needs of the street to be truly successful.

Queen Street served as a valuable test case, as it is a busy corridor with both pedestrian and vehicle traffic, rich historical significance, and an ecologically sensitive setting. This is why the framework is not solely focused on biodiversity—it also incorporates the other two strands to ensure a well-rounded streetscape design.

However, a significant oversight within the framework should be addressed: the challenges posed by the physical site. This could be resolved either by creating a fourth strand or by expanding on these concerns within the ecological strand. Queen Street is likely to experience increased flooding in the near future, as indicated by current flood maps. This risk is further exacerbated by climate change, which is increasing the frequency of heavy rainfall events. While this design addresses these concerns through ponds and strategic planting, the framework itself does not explicitly acknowledge these critical issues.

10
Conclusion



10 Conclusion

Creating Biodiverse Streetscapes in Dense Inner-City Contexts

To create biodiverse streetscapes in dense inner-city contexts like Auckland's CBD, it is essential to consider key factors: the history and culture present on the site, the current climatic and ecological state, who is present (both human and non-human), and how the site is used or could be inhabited.

Each factor—culture, ecology, and use—is important for different reasons. Culture reflects the significance and human connection to the site. Ecology represents the natural state of the site and informs the selection of vegetation and animals that could be reintroduced. The space must also continue to serve its intended purpose, which, for most streetscapes, is primarily to facilitate movement. Therefore, people must still be able to navigate and use the space effectively.

In essence, creating biodiverse streetscapes is achievable, and it can be as simple as adding more green space and native vegetation. Auckland Council has made strides in improving its green spaces through the Green Link Plan, which aims to connect all green spaces across the city, thereby enhancing biodiversity. By integrating these connections into the streetscape, biodiversity in the entire area can increase. However, challenges arise when heritage buildings are involved, particularly regarding green roofs and walls. Alternative solutions, such as canopy gardens, provide opportunities to introduce biodiversity without compromising heritage value.

Key Findings

-- The Three-Strand Streetscape Design Framework proposed in this thesis can help create more meaningful spaces, making streetscapes more habitable for both human and non-human species. Key findings from the design-led research process include:
-- Biodiversity should be considered on a larger scale, not in isolation. While biodiverse streetscapes are site-specific, a broader understanding of the urban and ecological context is crucial to guide design. Designers must consider existing habitats, current species, and potential stepping-stone habitats before determining whether it is feasible to attract target fauna to the site.
-- Increasing biodiversity should start at the street scale, not with a single building. Streets should be connected to surrounding green spaces to form linked habitats, enabling biodiversity to thrive.
-- Water infrastructure, such as daylighting rivers or traffic rerouting, is complex. Designers should consider solutions beyond a single street, expanding their focus to entire city blocks or even larger scales, such as watersheds.

Transferability

The framework is designed for New Zealand, where culture plays a crucial role but is often underrepresented. As a result, the collective wellbeing strand is particularly relevant to New Zealand and Māori culture, which may not translate as effectively in other countries. However, culture is a fundamental aspect of all societies and should be both appreciated and acknowledged. While this framework is particularly suited to New Zealand, it can be adapted for other countries by incorporating their unique cultural contexts.

Increasing biodiversity can be relatively straightforward through measures such as planting more trees or creating green walls, as demonstrated in the proposed design. However, the real challenge lies in creating quality spaces where biodiversity can truly flourish. These spaces must focus on supporting specific species, particularly native ones, which will naturally enhance the overall biodiversity of the site. Another key challenge is securing the political will and financial support necessary to implement such a vision.

10 Conclusion

Final Thoughts

How can dense inner-city streetscapes be designed to support native biodiversity? The most important aspect of designing for biodiversity is understanding what species need. In this thesis, target native species were selected as a foundation for design decisions. Three key strategies for creating a biodiverse streetscape emerged:

1) Protecting existing green space.
2) Creating new, thoughtfully designed green spaces.
3) Strengthening relationships between ecosystems.

Achieving these objectives requires considering the broader challenges of streetscape design—most importantly, the needs of people. Ultimately, people are the most important part of a streetscape. For a streetscape to be successful, it must be designed to meet their needs. This is why the individual wellbeing strand was created. However, people do not act solely as individuals; they exist as part of a community, and cultural identity is a crucial aspect of many people's lives, especially in New Zealand. This is why the collective wellbeing strand is essential in creating a successful streetscape.

This brings us back to the foundation of this report—connectivity is essential. The connections between people, nature, and space are at the heart of this thesis and the proposed framework. Just like birds, humans are not confined to a single site; we move around, experiencing all that our world has to offer. That is why Queen Street should be designed holistically, not just through individual building interventions, but by viewing the entire area as a connected system.

Designing for humans in a way that benefits both our physical and mental health ultimately enhances the biodiversity around us—and contributes to the well-being of the planet as a whole.

If cities were designed as collective streetscapes rather than as isolated buildings, there would be an increase in biodiversity. But more than that—there would likely be an increase in people engaging with those spaces. Instead of treating streets as mere passages, people would stop and spend time in them, enjoying environments intentionally designed to be enriching and inviting.

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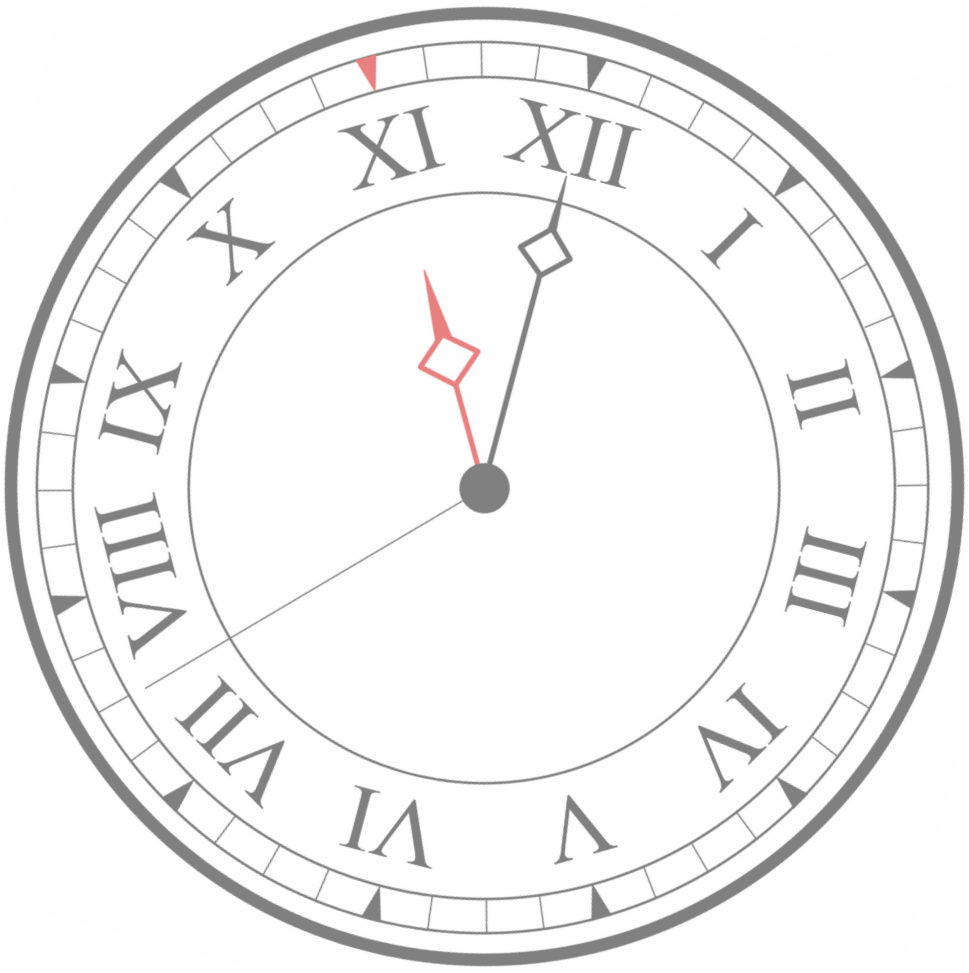

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All figures not attribute are authors own.

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Fig 4) Singapore City in Nature (Singapore Green Plan, 2025)
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Fig 5) Melbourne Biodiversity Streescape (City of Melbourne, 2018)
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Fig 11) Victoria Street Redesign (Auckland Council, 2023)
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Fig 12) La Rosa Reserve Stream (Boffa Miskell, 2014)
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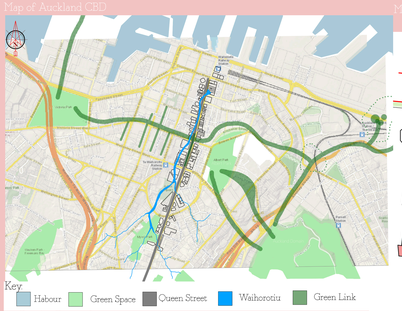
11.3 Appendix

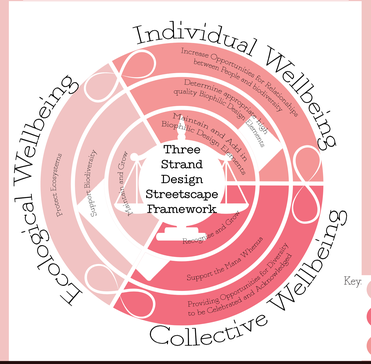
1)Final Presentation Pin Up

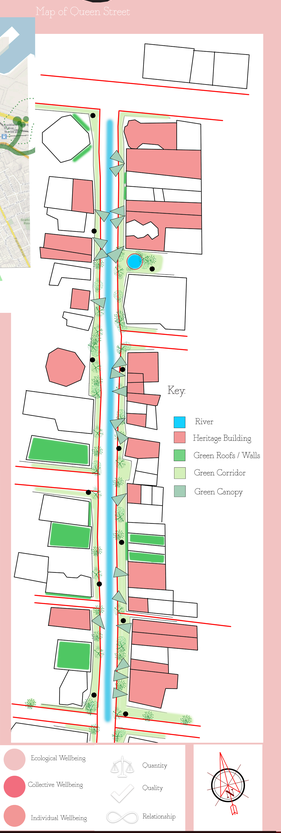
Reviving Streetscapes: Designing Biodiverse Streetscapes

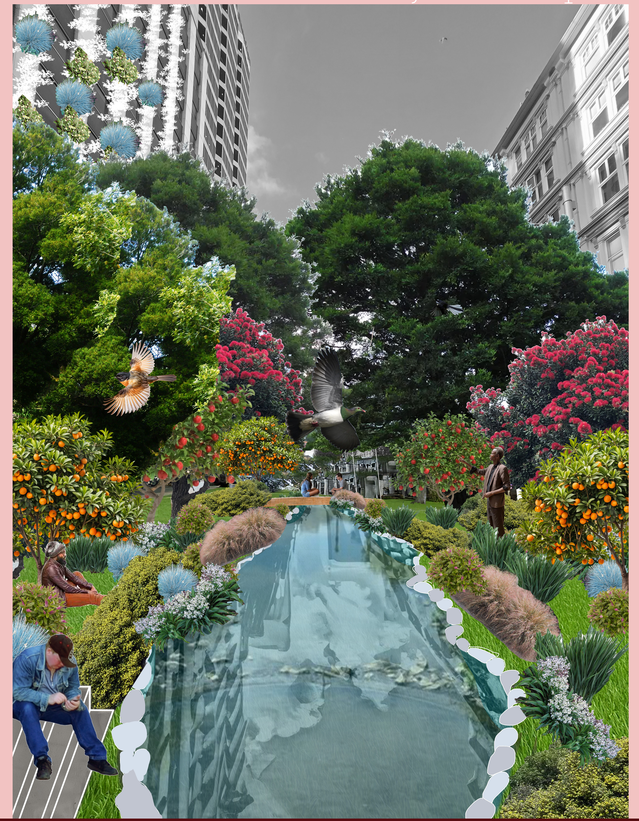
How Can Dense Inner-City Streetscapes be Designed to Support Native Biodiversity?

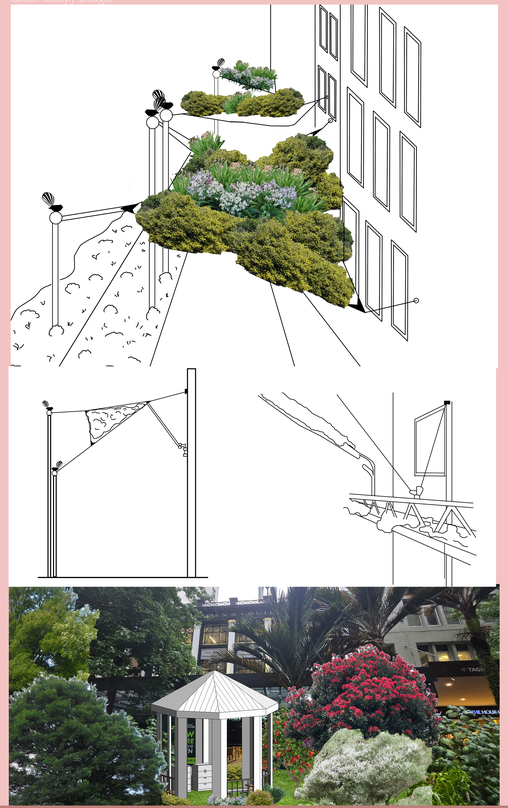


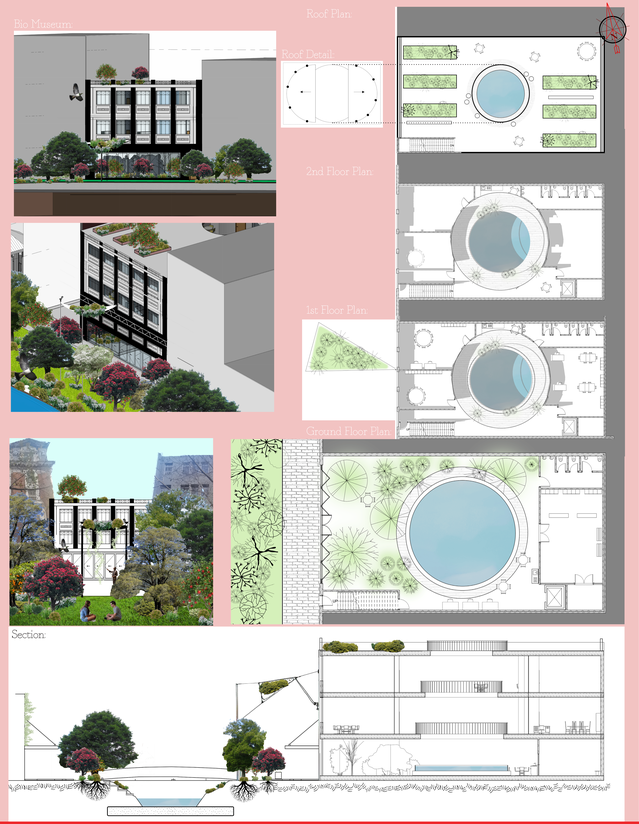












Context & Framing

Biodiverse Streetscape

Street Detailing

Biodiverse Architecture



2) Final Presentation Slide Show

Reviving Streetscapes:

Designing Biodiverse Streetscapes.

Context & Framing

11.3 Appendix





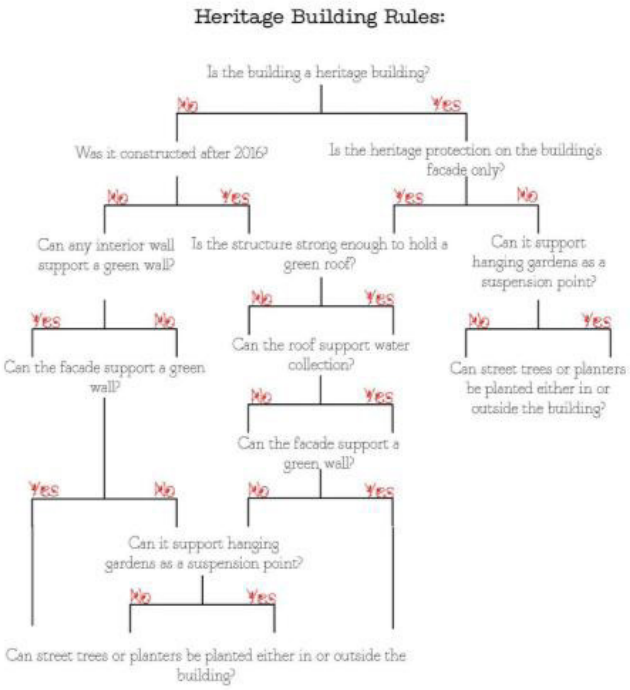

Individual Wellbeing
Quantity
Maintain and Add in Biophilic Design Elements
Keep existing biophilic elements while adding more where possible
Quality
Determine appropriate high quality Biophilic Design Elements
Identify the appropriate elements that will benefit the space
Relationship
Increase Opportunities for Relationships between People and biodiversity
Support the relationship between humans and non-human elements
-- Identify Exisitng Biophilic Elements
-- Window Glazing
-- Artwork (Nature Scenes)
-- Koi Ponds
-- Fire Places
-- Sculptures
-- Determind what the space is lacking and used for
-- Screens (Materials that move)
-- Woodwork
-- Footpaths made of Natural Materials or Natural Forms
-- Shelter Areas
-- Edible Gardens
-- Flowing Water (Rivers / Water Features)
-- Walking paths surrounded by nature


Collective Wellbeing
Quantity
Recognise and Grow
Recognise the exisiting cultural groups and help them grow / support their
Quality
Support the Mana Whenua
Express cultural landscapes, values and narratives in appropriate and creative ways.
Relationship
Providing Opportunities for Diversity to be Celebrated and Acknowledged
Supporting the relationship between cultural values, narratives, stories, expressions and the living world
-- Use Appropriate names (Through Signage or Wayfinding)
-- Allow Collective Decision Making in Design Processes
-- Create Spaces that are appropriate to cultural Needs
-- Intergrate cultural design elements
-Intergrate Narritives into the built enviroment
-- Celebrate the wider cultural heritage
-- Celebrate Water on the site
-- Show cultural values through interventions with the living world

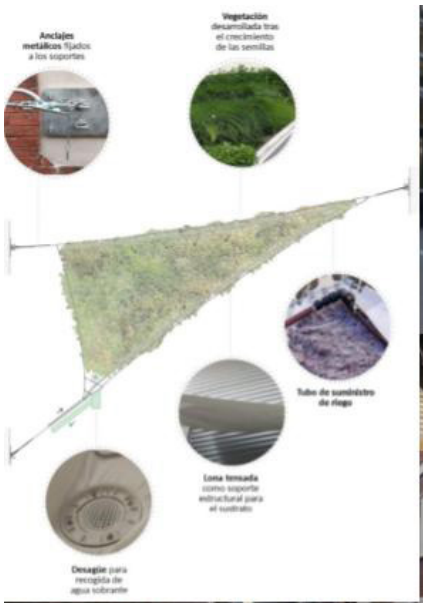

Ecological Wellbeing
Quantity
Maintain and Grow
Keep existing green space while adding more
Quality
Support Biodiversity
Support the growth of plants and animals
Relationship
Protect Ecosystems
Protecting the relationships between the different elements of the ecosystems
-Map Existing Greenspace
-- Pocket Parks
-- Green walls
-- Green Roofs
-- Rain Gardens
-- Street Trees
-- Urban Planting
-- Bird Feeders
-- Water Feeders
-- Fruit Trees
-- Nesting Trees
-- Rocks and Ground Cover
-- Insect / Bee Houses
-- Pest Proof Design
-- Weed Mats
-- Ground Cover Planting
-- Connected Green Spaces


Species
Kererū
Food & Habitat:
- Fruit from Native Plants
- Leaves
- Lowland Forests
- Urban Parks
Threats:
- Low Breading Rates
- Food Shortage due to Possums and Rats
- Cats, Rats and Stoats
- People
Habits:
- Seed Spreading
- Nest in Tree Forks
Fantail / Pīwakawaka
Food & Habitat:
- Insects (Moths, Flies, Beetles, Spiders)
- Small Fruits
- Parks & Gardens
- Farms & Orchards
- Forests
Threats:
- Cats, Rats, Stoats, Magpies and Mynas
Habits:
- Build Nest Out of Moss, Spider Webs, Hair and pieces of Wood
Copper & Ornate Skinks:
Food & Habitat
- Insects (Spiders, Slaters, Beetles, Crickets, Flies)
- Soft Fruits and Berries
- Forest, Grasslands & Sand Dunes
- Scrub, Under Logs & Rocks
Threats:
- Cats, Rats, Mice, Magpies, Mynahs, Starlings & Kingfisher
- Habitat Loss
Habits:
- Like Damp Areas
- Sun Basking

Biodiverse Streetscape



Street Detailing



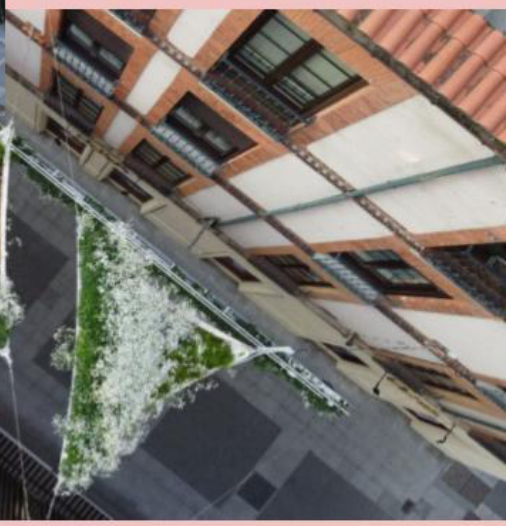






Green Shades





Biodiverse Architecture

