# A Home Among the Gumtrees

Reimagining suburban Sydney for a hotter future

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LUND
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**Title: A Home Among the Gumtrees.**
**Reimagining suburban Sydney for a hotter future.**

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Maria Rasmussen
Ivan Tan

I also want to thank Olympia Newman-Andrews for being my eyes on the ground through her photography.

*Give me a home among the gumtrees*
*With lots of plum trees*
*A sheep or two, a kangaroo*
*A clothesline out the back*
*Verandah out the front*
*And an old rocking chair*

Excerpt from 1974 song titled
'Give Me A Home Among the Gumtrees'
by Wally Johnson and Bob Brown

*Photograph: Olympia Newman-Andrews*



# Preface

This thesis started with a desire to delve into the impact that natural disasters have on small communities in an Australian context, how climate change exacerbates their effect and the role that design can play in mitigating the impact on people and the natural environment. Initial research into bushfires, drought, floods, and heat landed this project in Western Sydney, in an area not far from where I grew up. Throughout the process, the project evolved into a dissection of the way that Sydney's sprawling development worsens the effect of extreme heat in the suburban landscape, creating unliveable and unhealthy neighbourhoods unfit for the future.

The suburban sprawl on the fringe of Australian cities is seen elsewhere across the globe. Heralded at the "Great Australian Dream" in the 20th century, homeownership and a quarter acre block of land were synonymous with success, social status and the ultimate way of living. Today, this model of development is unsustainable for the growing population and scarce availability of land in cities such as Sydney. Promoting car-centric mobility, worsening the urban heat island effect, and creating social isolation, this dream has quickly become a nightmare.

So my question became, what does suburban living look like in the hotter future climate of Western Sydney? How can design work to retain the positive attributes of the Australian way of living, but with a sensitivity to the land, to our communities, and an appreciation of our limited resources? My design solution rests somewhere between nostalgia for the dream of a home among the gumtrees and criticism of this short-sighted way of housing growing communities.

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*Photograph: Olympia Newman-Andrews*

# Part 1 - Research



## Research Questions

How does extreme heat impact the health and lives of those living in Sydney's West?

How can design assist in mitigating the effects of extreme heat in suburban Western Sydney?

How can design foster community cohesion to increase resilience and the capacity to withstand extreme heat events?

How can suburban housing be reimagined to promote healthy and sustainable living for the future?

# Australia

## Introduction

Australia is the smallest continent and one of the largest countries on earth. It has a population of 25.5 million people, with a density of 3 people per square kilometer, and 80% of the inhabitants living within 50km of the coastline. This is impressive when you consider that the country spans 4,000km from East to West and 3,200km from North to South (Twidale, 2021).

The country has been referred to as "the Oldest continent" and "the Last Frontier", and some 60,000 years before Europeans sailed to the south Pacific, Aboriginal Australians had arrived on the continent from Asia. The Aboriginal people had transformed the continent prior to colonisation through the use of fire and had established robust settlements, with vast agricultural systems and land management techniques (Twidale, 2021).

In the 20th century Australia was widely perceived as Anglo-celtic, however today it is home to more than 270 ethnic groups, with more than one-fifth of the population being born overseas (Ride, 2021).


## Climate change

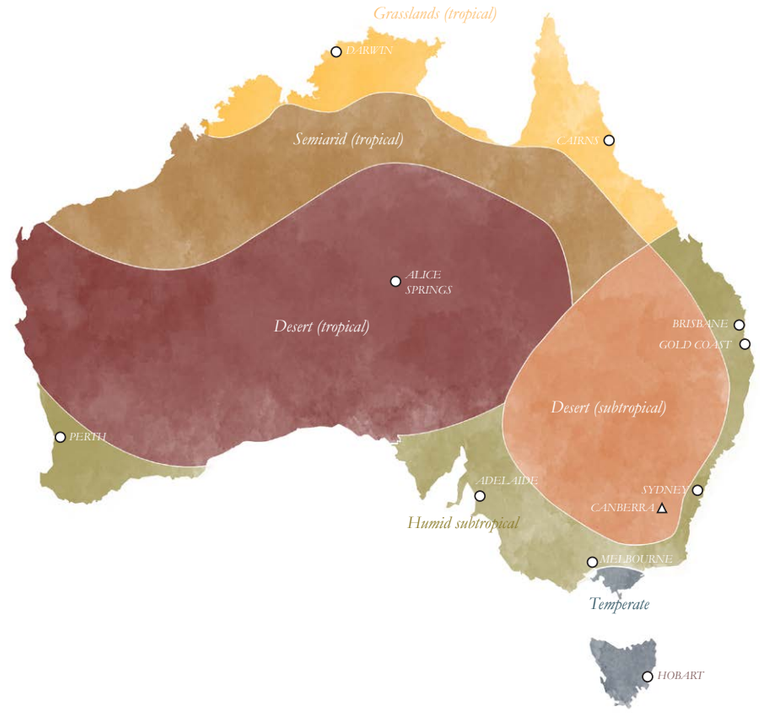
Australia is mostly an arid country, but is comprised of many climates; from a temperate cool climate in the south, a humid subtropical along the south east and west coastlines, to a desert centre and tropical arid and grasslands north. This variability across the country accounts for its diverse landscapes and rich ecology (Paun, 2018).

Australia is the second most vulnerable country to climate change in the developed world, after Israel, as determined by the physical impacts, fatalities, damage costs and people affected (Paun, 2018). Australia's climate and weather are changing in response to a warming global climate, and this manifests in several ways including:

- Temperature: since records began in 1910, Australia's climate has heated on average by 1.44 ± 0.24 °C as a result of global warming (CSIRO, 2020).
- Fires: the severity and frequency of fire weather has been increasing across Australia since the 1950's due to temperature change, relative humidity levels and the fuel moisture content (CSIRO, 2020).
- Rainfall: Australian rainfall is highly variable, however long-term trends are evident in a shift towards drier conditions across the southwest and southeast. Short-duration extreme rainfall events are becoming more intense however, creating the risk of flash flooding; particularly in urban environments. (CSIRO, 2020)

Climate change is affecting the magnitude and severity of extreme weather in Australia already. The impacts of compounding extreme weather and climate conditions are leading to disastrous conditions for many communities. This has been proven most recently in the spring and summer of 2019 where record breaking low rainfall coincided with extreme heat leading to severe drought, heatwaves and bushfires across the country (CSIRO, 2020).

Observations, reconstructions and climate models paint a consistent picture of ongoing, long-term climate change interacting with underlying natural variability (CSIRO, 2020). Associated changes in weather and climate extremes—such as extreme heat, heavy rainfall and coastal inundation, fire weather and drought—have a large impact on the health of communities and ecosystems.



## Natural Disasters and Heat

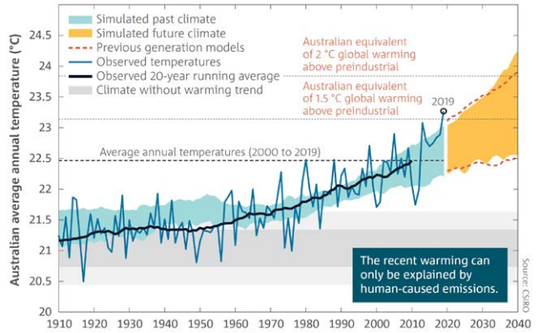
Heatwaves kill more Australians each year than all other natural disasters combined; bushfires, cyclones, earthquakes, floods and severe storms. Dubbed the 'silent killer', there have been 4555 heat-related deaths since 1900, and climate change is set to worsen this into the future (Hughes, 2016).

Extreme heat affects Australian communities, ecosystems and the broader economy; exacerbating droughts, floods and fires each year. Nine out of ten of the hottest years in Australia have occured since 2005, with 2019 being the hottest on record. Since 1950 every decade has been warmer than its predecessor, meaning that most years are now warmer than almost any observed in the 20th century (CSIRO, 2020).

Australia's climate has heated by over 1 degree since 1960, and in this period of sixty years there has been a rise of very high monthly temperatures from 2% of the time, to 12% of the time. Similarly, there has been a rise of hot nighttime termperatures from 2% of the time to 11% of the time (CSIRO, 2020).

Looking forward into the 21st century, Australia will warm substantially. The magnitude of this warming however, is highly dependent on what emissions scenario plays out. By 2030, the Australian annual average is projected to rise by 0.6 - 1.3°C above the climate of 1986-2005. The median projected temperature increase is 4 °C by 2090 (CSIRO, 2015).

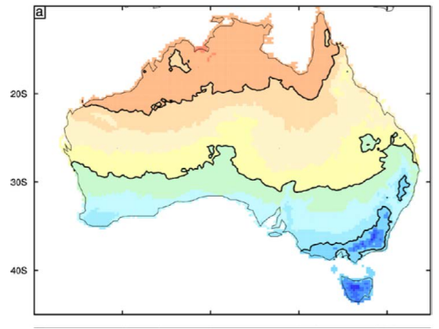
This climate data is a wakeup call that the country will soon become unliveable if substantial action is not taken now.



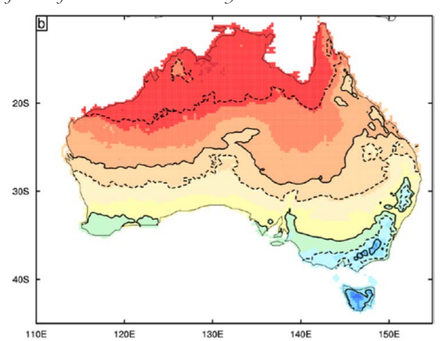

*Australian average annual temperature projections in °C*

*Source: CSIRO, 2020*

*a. The climate in 2015*

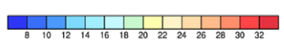


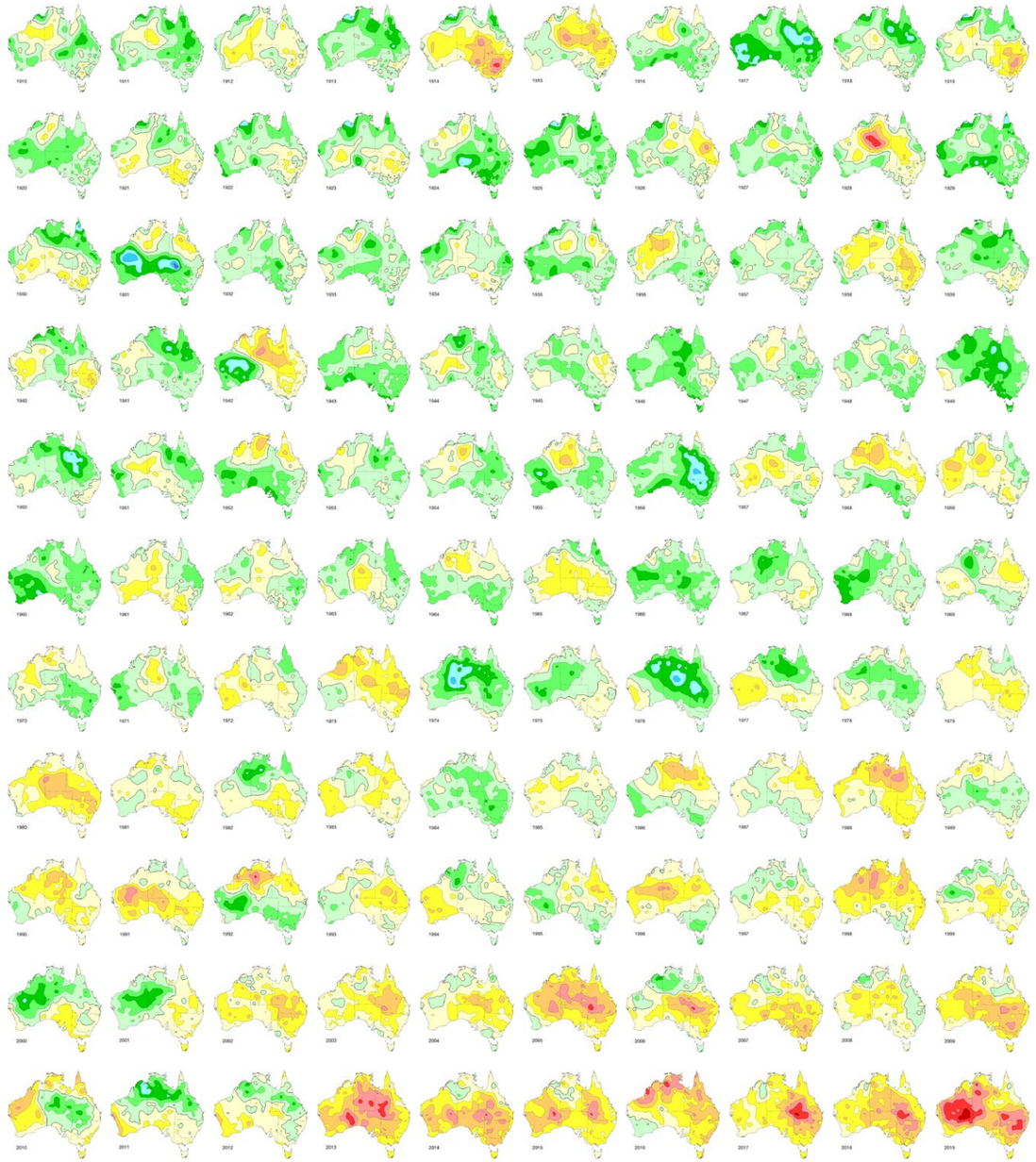

*b. Projection for the late 21st century*




*Annual mean temperature in °C*

*Source: Whetton, P. et al., 2015.*



*110 years of mean temperature anomalies since 1910 : 12-monthly temperatures in °C*

*Source: Australian Bureau of Meteorology, 2020*

# Western Sydney - Heat

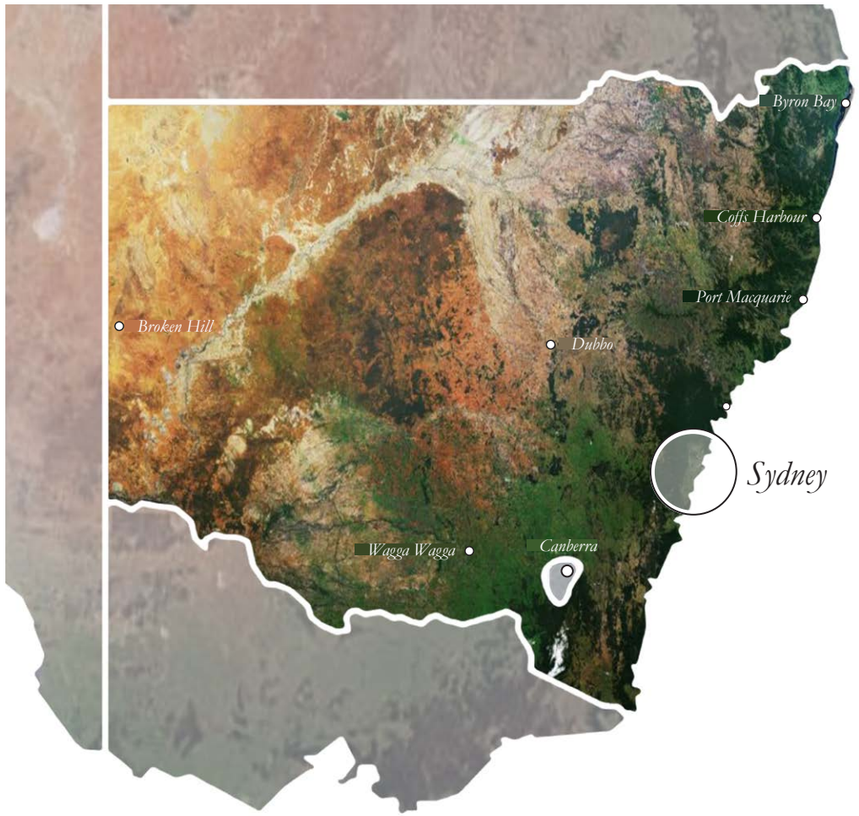
## Introduction

Sydney is the capital of the most populous state in Australia, New South Wales. With a population of 5.23 million, the city is spread wide along the coast and inland towards the great dividing range, separating the ocean from the "country", or more rural desertscapes.

At the furthest West point of the city of Sydney at the foot of the mountains is what is referred to as "Greater Western Sydney". Synonymous with landscapes of park and bushlands, waterways and agriculture, this area is also one of the fastest growing populations in Australia, and the third largest economy in the country (Greater Sydney Commission, 2018).

The region is already experiencing the intensification of extreme heat where the reality of climate change is being compounded by careless urban planning, short sighted development and its rapidly growing population. In fact, few places in Australia are suffering as severly as Sydney's west (Climate Council, 2021).

*"There are seven major categories of threat: sea level rise and storm surges, river flooding, extreme rain events, life threatening heat, drought, wildfire, and food shortages. These forces will affect all urban design decisions, about where to build, when to build, and what to build."*
*Jonathan Barnett, 2020*




*New South Wales*


*Sydney's Districts*

## Sydney's West - Present and Future

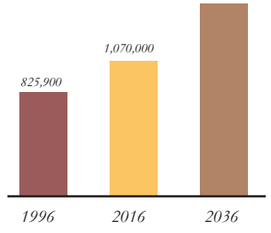
Sydney is a metropolis of three cities, the famous 'Harbour City', Sydney, the 'Central River City', Parramatta and the 'Western Parkland City', Penrith. Over the next 20 years Penrith is set to transform due to the development of a Western Sydney airport and 'aerotropolis' centre, as well as new rail links with the potential of creating a Western economic corridor and links to cities regionally (Greater Sydney Commission, 2018).

The data of the latest 2016 census in Australia and projections demonstrate a fast growing population in Greater Western Sydney that is set to increase by 70% by 2036, and by 206% for those aged 85 years and above. It also elucidates the dependence on cars for commuting, which is usually out of the district, aswell that a vast majority of the population are living in single detached housing (Greater Sydney Commission, 2018).

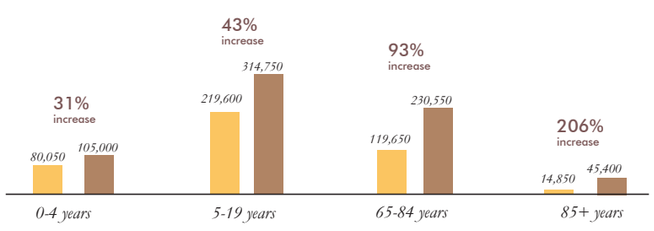
Situated 55km from Sydney City, Penrith is Greater Western Sydney's metropolitan epicentre set for growth in the coming decades. The Local Government Area (LGA) includes 29 suburbs of urban, periurban and rural land at the foothills of the Blue Mountains and bordering the winding Nepean River (Pfautsch, 2020).

Penrith is also ground zero for extreme heat in Sydney's west, in fact on January 4th 2020, it was the hottest place on Earth at 48.9°C (Purtill, 2021).

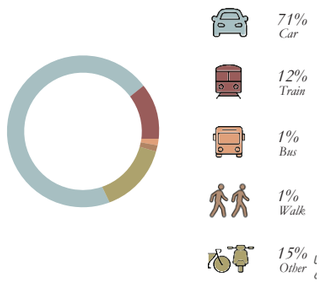
*Western City District*




*Population growth by age (2016-2036)*




*Journey to work*




*Western Sydney*

*Housing type*

81% detached house

19% medium rise and apartments

*Resident workforce*

49% work locally

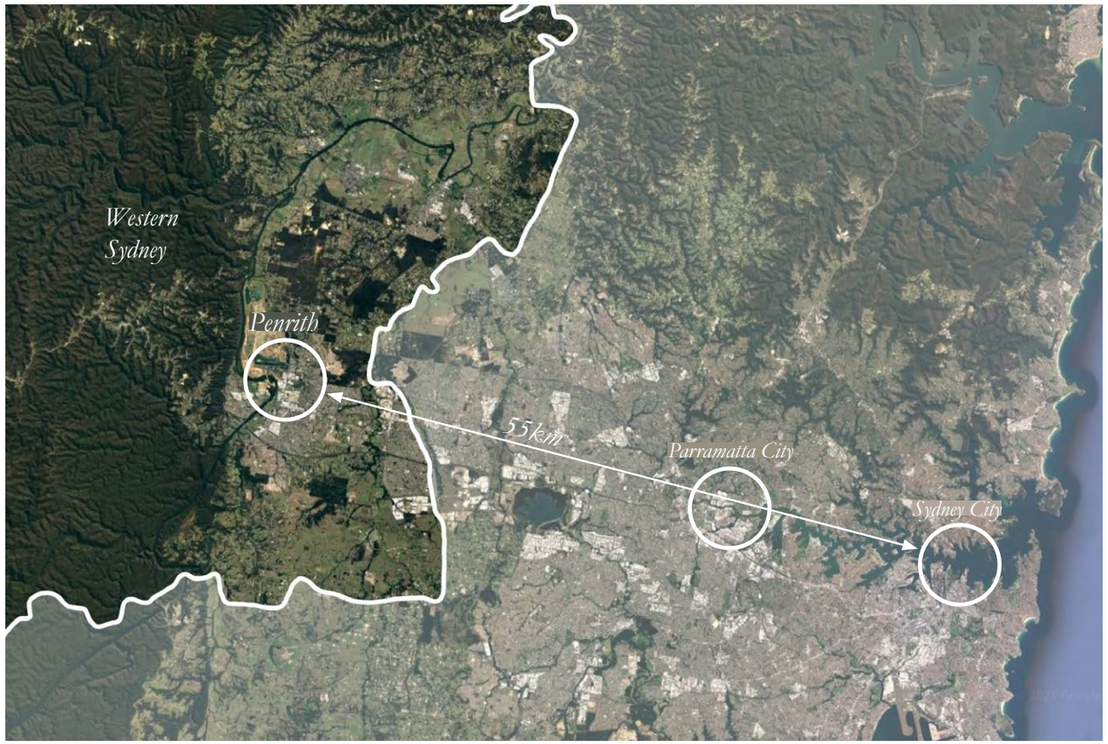
*Sydney City*

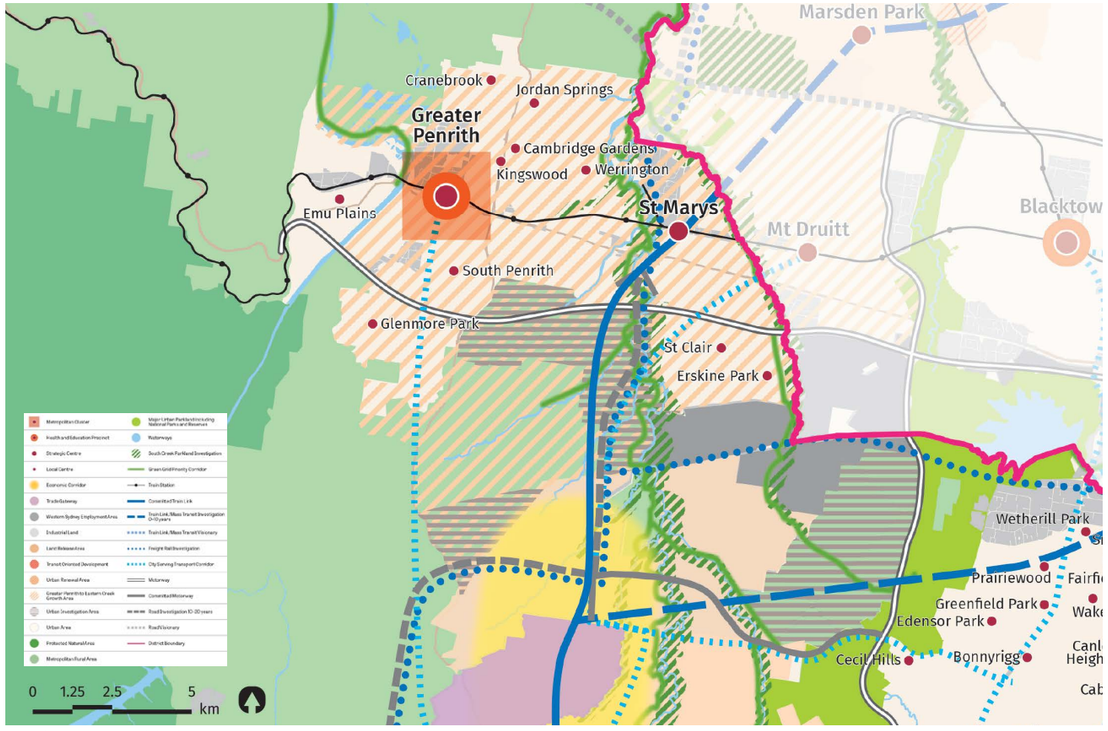
59% detached house

41% medium rise and apartments

91% work locally

*Source: Greater Sydney Commission, 2018*




*Source: Greater Sydney Commission, 2018*

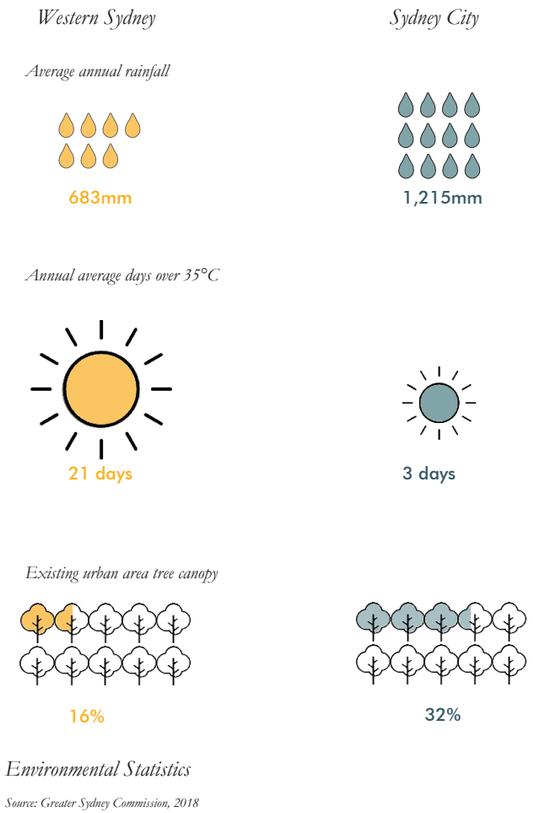
## The Urban Heat Island Effect

The effects of extreme heat are already being seen in Penrith, and they are compounded by poor infrastructure and housing design, a lack of tree coverage and high populations of vulnerable people. On this vast floodplain of tightly packed houses the heat settles on stretches of black bitumen and bakes the concrete (Purtill, 2021).

*"The mercury gets close to 50 degrees Celsius here in summer — and that's just the ambient air temperature. The radiant heat from bitumen carparks can push 80°C. The surface temperature of playground equipment has been measured at 100°C"* (Purtill, 2021).

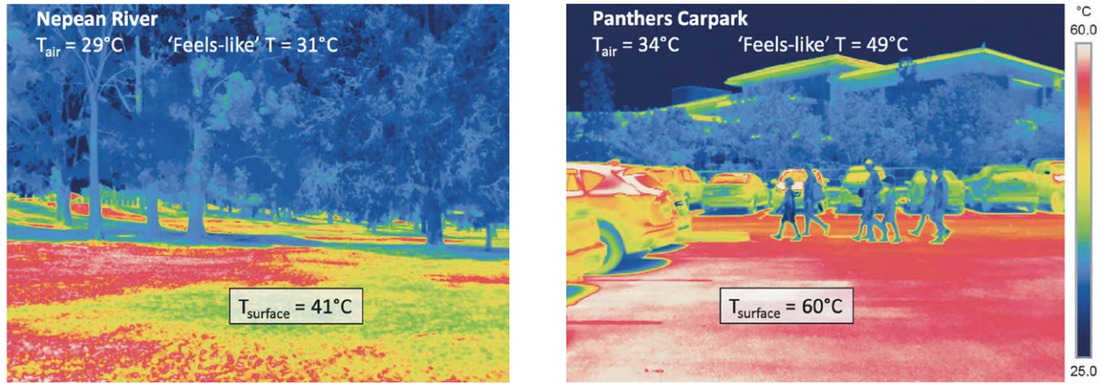
The combination of the process of global warming, the geomorphologic processes of the region, the synoptic climate and the conversion of greenfields to grey infrastructure in greater Penrith creates an Urban Heat Island (UHI) that primarily effects the most vulnerable, according to heat mapping conducted by Western Sydney University (Pfautsch, 2020). The intensity of the UHI effects are predicted to increase in Penrith. This extremity of heat disasters poses a real threat to the health of local human and animal populations, and adds pressure on the urban infrastructure and supply networks for electricity and transport (Santamouris et al, 2017).

It's the buildings and roads and other sealed surfaces, which cover 80% of some suburbs, that are so damaging (Pfautsch, 2020). Their hard surfaces generate more heat than people can withstand, and it's heat that is guaranteed to be magnified by more thoughtless urban sprawl. Hard surfaces act like sponges, absorbing heat from the sun during the day and releasing this stored energy during the night. The heat leaks out throughout the night, preventing suburbs from cooling down to safe levels and thus placing the health of residents at risk (Pfautsch, 2020).




*Environmental Statistics*

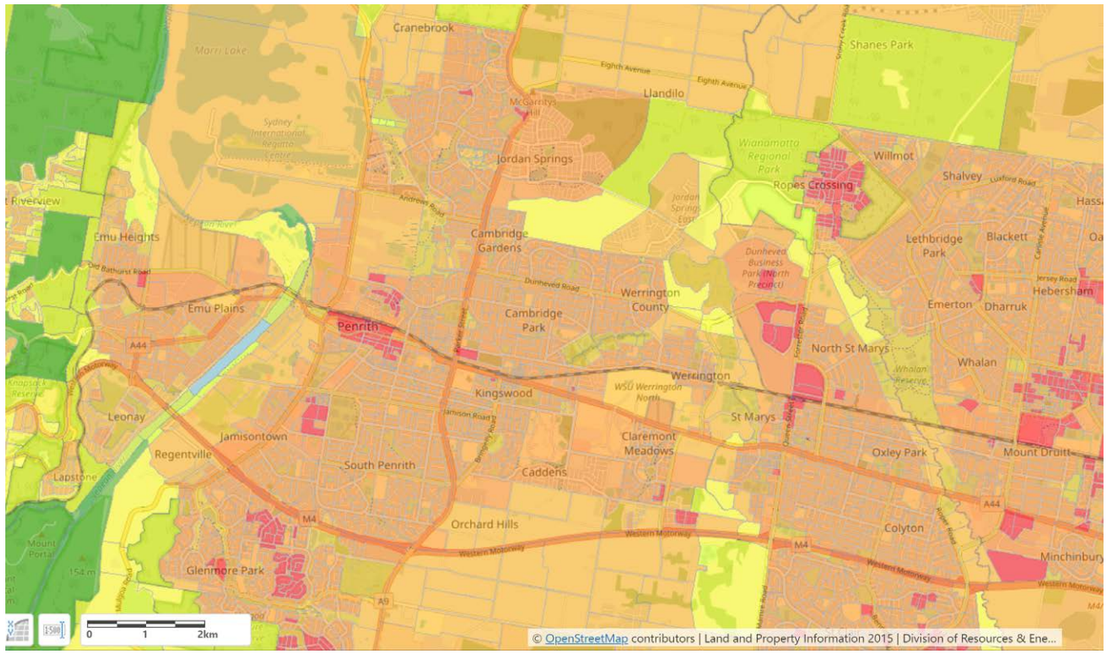
*Source: Greater Sydney Commission, 2018*




*Thermal Images Comparison*

*"Thermal images of surface temperatures and added information on each location's air and black globe or "feels like" temperature. Data were recorded simultaneously on 10 January 2020 around noon in the Trench Reserve near the Nepean River and the Penrith Panthers Carpark off Mulgoa Road in Penrith. The combined effects of clear differences in surface and air temperatures lead to a very different human thermal experience, represented by nearly 20°C difference in "feels like" temperature."*

*Pfautsch, 2020*




*Urban Heat Island Mapping Penrith Council*

*Source: SEED Open Street Map*

*The urban areas are recording up to 10 degrees hotter than surrounding greenspaces, illustrating the Urban Heat Island effect. This is especially clear over Penrith centre, and some other areas including the recently completed housing developments at Ropes Crossing and Glenmore Park.*

- *Cooler than baseline*
- *0-3 degrees warmer*
- *3-6 degrees warmer*
- *6-9 degrees warmer*
- *Warmer than 9 degrees*

## Health implications

Extreme heat events pose a real threat to the health of the local population. Heat is often dubbed a 'silent killer' because many deaths are often overlooked or recorded as related to something else. The health impacts include both direct heat illness such as heat exhaustion and indirect illness such as heart attacks (Hughes, 2016).

Thermoregulation

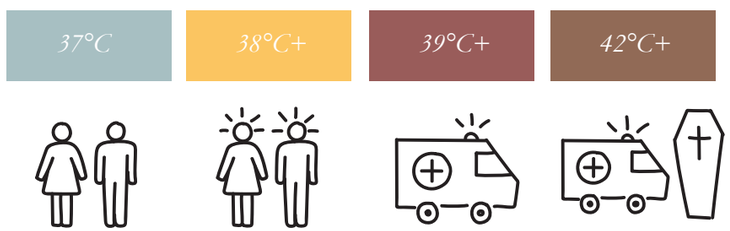
To stay healthy, we need to keep our body temperature within the narrow temperature range of around 36.5 - 37.5°C. To achieve an optimal body temperature, humans use thermoregulation which is a process of psychological and behavioural responses to return the body to a state of equilibrium, or homeostatis (Britannica, 2013). In cold weather, this can be through the processes of shivering to produce heat to keep our organs at optimal temperature. In hot weather, our sweat glands release sweat that cools the skin as it evaporates and circulation increases to the skin where excess heat can be released. (Manning, 2020), (Britannica, 2013).

Heat illness, therefore, is caused by the body's inability to regulate its core temperature as a result of conditions in the external environment. Anyone can be affected by heat illness, and it is often the fit and healthy at the highest risk if they persevere with physical activity in the heat. This is a life-threatening emergency and can cause severe injury or death if not treated quickly (Hughes, 2016).

Anyone can be affected by heat however there are several other factors that influence the mortality rates of a population (Hughes, 2016)

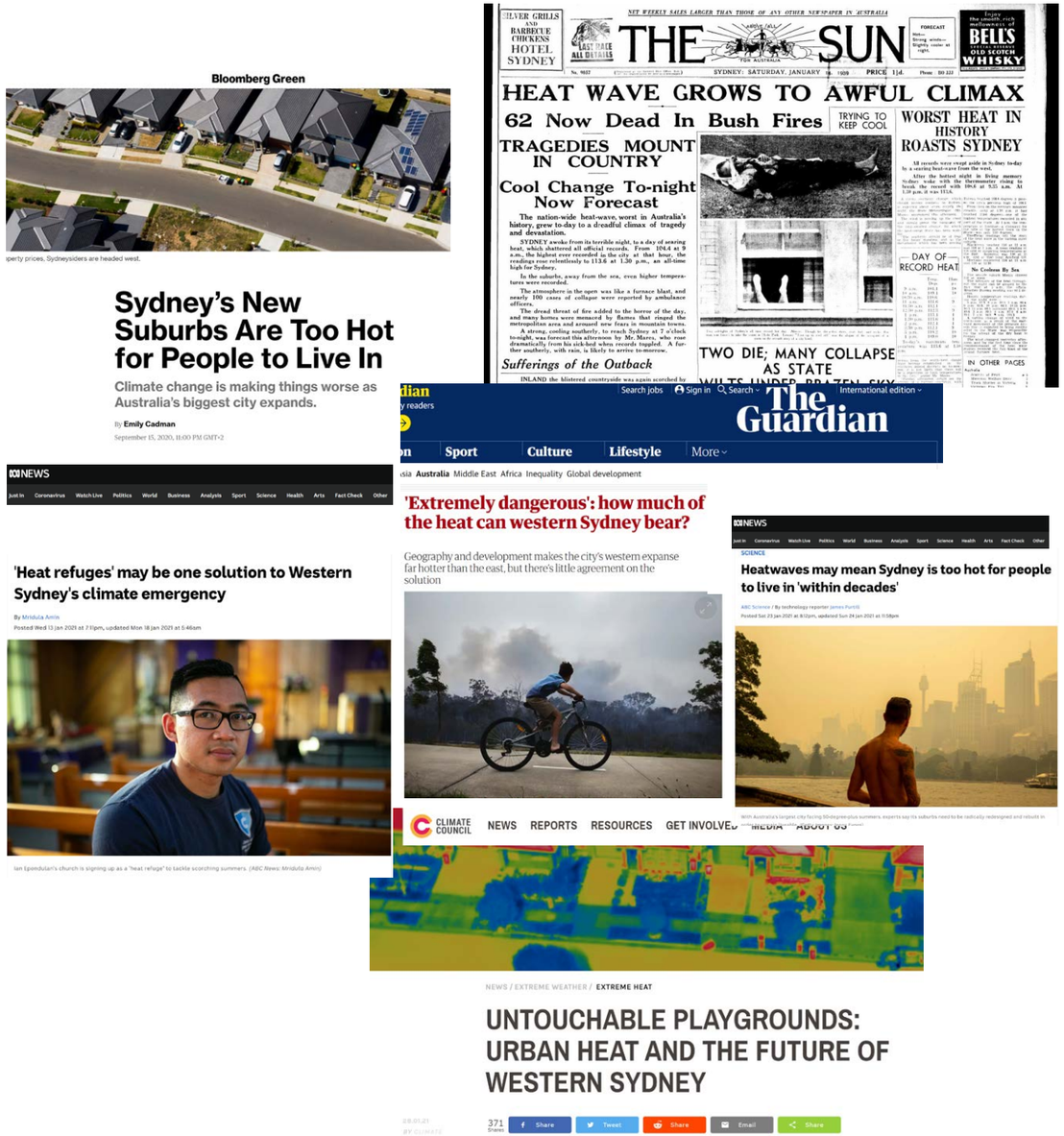
- Age: The elderly, particularly those over 75 and the very young, younger than 5 are most vulnerable
- Illness: Those with existing health problems, such as kidney, heart, liver or lung diseases are at risk
- Disability
- Lower socio-economic or marginalised communities
- Social isolation
- Homelessness
- Outdoor workers
- Gender: Men are overrepresented in heat-related deaths
- Obesity
- Level of acclimatisation
- City-dwellers: impacted by intensified temperatures due to UHI effect
- Access to airconditioning

Western Sydney GP Kim Loo, the NSW chair of advocacy group, Doctors for the Environment Australia, has been a vocal proponent of the health impact of heat in the community. Concerned for vulnerable groups such as the elderly and sick, she speaks of the "domino effect" heat is having where *"If you can't exercise when it's too hot, you'll becoming unfit, if there's no cool spaces to gather, you become increasingly isolated"* (Amin, 2021). As a doctor, she says, there is only so much you can do in primary care when the environment around you is fundamentally changing (Amin, 2021).




*Internal body temperature effects*

*Source: 2011 Climate Commission*




*News articles on the issue*

## Urban Sprawl and Social Isolation

The changing climate and urban sprawl are facilitating a kind of feedback loop, where the consequences of each further accelerate negative effects on the environment and the community. Urban sprawl is often characterised by homogeneous low-density residential housing that comes about due to the need to accommodate a growing population, the desire for increased living space and cheaper housing prices (Taylor, 2019).

The negative consequences of this development are clear however and include:

- Unwalkable neighbourhoods
- Dependence on cars
- Increased energy consumption
- Pollution and traffic congestion
- Decline in community identity
- Social isolation
- Destruction of wildlife habitat, natural areas and biodiversity

In the context of Penrith, urban sprawl is a tangible issue. Despite it being one of the fastest growing urban populations in Australia, the current building codes and regulations facilitate sprawling housing developments that are not equipped to meet the challenges of a hotter future.

The grey infrastructure that services sprawling developments multiplies the effects of environmental degradation, the severity of heat in the suburbs and impacts the quality of life for those who live there. Damage to native ecosystems accelerates the enhanced greenhouse gas effects as carbon sinks such as mangroves are built over in favour of hard impermeable surfaces, contributing to the UHI effect and increasing the likelihood of floods. (Climate Council, 2021), (Santamouris et al, 2017).

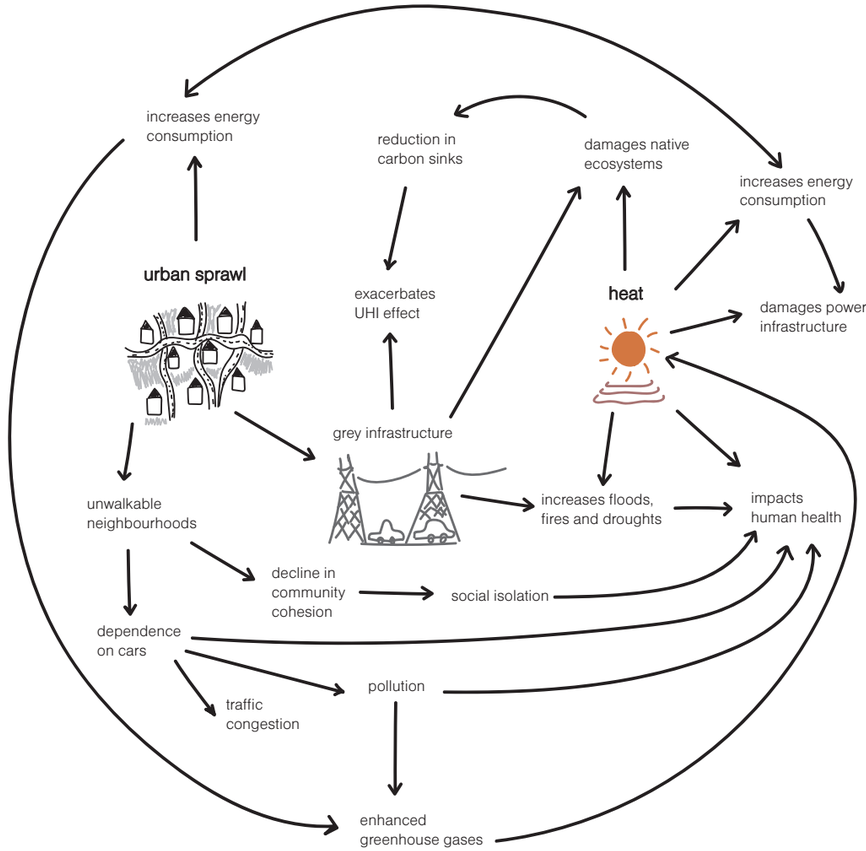
Further to this, long commutes are commonplace where residential and commercial areas are split, and the dependence on cars results in traffic congestion and reduced public transport services. This affects wellbeing by robbing people of time for social activities, exercise and preparing healthy food (Taylor, 2019).

Extreme heat events affect both the demand for power, and the supply. Every degree above 35°C results in an extra demand of about 100 megawatts, equating to energy for 100,000 homes (Bachelard, 2019). Electrical equipment such as generators, power lines and transformers all have optimal operating temperatures, above which they start underperform or fail. Solar and wind turbines are not exempt, the infrastructure simply can't handle the heat (Bachelard, 2019).

Air conditioning is the key trigger for power meltdowns in heatwaves, exposing vulnerable groups such as the elderly who are told to stay inside their homes or otherwise risk their lives. Such solutions proliferate the social isolation already experienced in these sprawling communities that lack identity and clear support systems. Sole dependence on the electricity grid for staying cool exposes the fragility of our built environment, and how ill equipped large parts of the housing stock are to deal with the threat of prolonged and more extreme heat.

*"Before, we might have had one unit running [per house]. But now houses have multiple units and they're running flat out... They're changing the demand in the system, and that demand can all arrive between 3pm to 5pm – and that's a very significant challenge." Glenn Platt, CSIRO energy research director. (Bachelard, 2019).*

*Cycle of Cause and Effect*



## Community Resilience

Looking toward a hotter future for Australian communities it is urgent to shift the focus from disaster response or 'building back better' in the wake of an extreme heat event, to investing resources in disaster risk reduction and in the creation of a resilient built environment. This is critical to protect communities of people, their livelihoods, health, socioeconomic assets, and ecosystems and to strengthen their resilience (United Nations Office for Disaster Risk Reduction, 2009). To 'build forward better', risk reduction requires a two-pronged approach. The first is mitigation, reducing the emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere. The second is adaptation, looking at how to reduce our vulnerability to the harmful effects of climate change and to make the most of beneficial opportunities that arise. Where mitigation strategies fall short of emission containment targets, climate resilience and adaptation will be key to lessen the impact on communities in the short and long term (NASA, no date).

Resilience is defined by the United Nations Office for Disaster Risk Reduction (UNISDR) as *"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions"* (2009). The ability of our cities, urban and suburban areas to absorb the impacts of and adapt to climate change requires more than robust physical infrastructure, or a resilient built environment. Building climate resilience lies in the spatial, social, and ecological systems that make up communities (Trogal, 2019). And while climate change is a global issue, socio-environmental resilience can be practiced at a range of scales, from individuals and households, to neighbourhoods, civil society groups, and government structures (Trogal et al., 2019 p.241).

At the scale of the neighbourhood, architects and planners can make a transformative impact in facilitating community resilience building. This is achieved through supporting an open design process that, much like in post-disaster reconstruction, can act as a tool for socially engaging the community, stakeholders, and multilevel institutions to empower and connect citizens together in the process of developing an adaptable built environment (Andriessen, 2020, p. 132). It is through participatory processes and also through creating a framework for people to meet and share where connections among a community are supported, and where 'social capital' is strengthened. Social capital is defined by trust, collaboration, and cooperation between neighbours, and it is often richest at the local level (Trogal et al, 2019). In the climate of natural disasters, social resources are the foundation for resilience and recovery as much as any material resource, and design professionals have the tools by which to facilitate their growth (Lerch, 2017, p. 13).

Creation of quality spaces that enrich people's lives and that facilitate collaboration and interaction in urban and suburban environments support the intangible connections among a community. Housing and neighbourhood design has the potential to shape the way we live; how we spend our time, how we play, meet with one another, and experience our environment. By fostering shared spaces that allow for the allocation of common resources and the exchange of knowledge between individuals in a community we can strengthen collective identity and foster resilience (Trogal et al., 2019, p. 241)

Shared space can range in scale from small community garden plots to shared amenity spaces in housing developments to networks of pedestrian and bicycle friendly pathways, with the common intention for people to connect, and equally as importantly, to reduce pressure on our ecological systems. Our neighbourhood blocks are essential in our efforts to move away from the rigid built environment of the 20th century, towards more flexible and adaptable urban infrastructure systems, and building design. The potential of making small and medium sized enterprises more adaptable to environmental stressors creates stronger communities on the micro scale and builds inter-scalar social and ecological resilience on the macro scale (United Nations Office for Disaster Risk Reduction, 2009).

The application of these principles in the design of the built environment will be explored further through the design proposal in the next section of the report, which focuses on our current housing model in suburban Western Sydney, and how we can propose alternatives for housing that is a place of safety in environmental crisis, as well as a tool by which to strengthen community cohesion.

*Photograph: Olympia Newman-Andrews*

# Part 2 - The Australian Dream

# The Australian Dream

The so-called "Great Australian Dream" has meant different things to different people over time, however for the best past of the last century it has meant buying a house. Until the turn of the 20th century home ownership was a way to attain suffrage, and was perceived as path toward being a proper citizen (Bluett, 2017). During the 20th century it has been closely associated with democratic ideals, and has also been a symbol of social status, perpetuated in the wake of World War II as something for the baby boomer generation to aspire to (Bluett, 2017). This would help to stimulate economic recovery, and solidify the notion of home ownership as an Australian way of life for generations to come.

In the years following WWII, 70% of Australians owned their own home, giving shape to extremely low density cities occuping vast swathes of land, according to urban design Peter John Cantrill (2017). Sprawling cities like Sydney were expedited by the availability of motor vehicles, cheap oil prices and a burgeoning economy. In the early twentieth century, the Australian house was used as a place to grow your own food. This was quite unusual for the time; other countries located their farmland outside of town centres, but in Australia the house and agriculture were kept together, establishing the so-called quater-acre block (Cantrill, 2017).

Originally the Australian dream was comprised of a single storey detached house on a quater acre block with a garden that featured a hills hoist clothes line and a barbeque. In pursuit of a lifestyle in the great outdoors, and with room to grow a family the dream encouraged embracing a certain lifestyle that included single-generational nuclear family living, separation between residential and commercial precincts and a domesticity that placed emphasis on material wealth accumulation that manifested in second cars, swiming pools, ownership of beach houses or annual overseas holidays (Bluett, 2017).

The yard for growing your own food was slowly paved over to accomodate second car garages and media rooms in sprawling family houses. As the availability of land diminishes, so do the plot sizes of new housing developments in suburban areas where buyers are still being sold the dream lifestyle, but the reality is much different. The runaway sprawl that comprises Australian suburbs encourages car-centric mobility, creates social and cultural dead-zones, necessitates the destruction of local environment for land acquisition and consumes exuberant amounts of energy and resources to maintain. Coupled with the average household sizes decreasing, and the price of housing increasing much faster than the average Australian can earn to pay for them, home ownership is looking more and more like a relic of the past. So how can suburban living be reimagined for the future? One solution is denser living...

*Australian Dream Collage*

*Photo: Brook Mitchell / Getty Images*


*Source: Dr Sebastian Pfautsch*

*Source: Andrew Merry / Getty Images*

*Photo: Toby Zerna*

# The Case for Medium Density

What is the compromise between the detached suburban dwelling and the urban highrise? Without endless habitable land available, the alternative to urban sprawl, is to build vertically. However, it is clear that both low density and high density can create isolated environments. In Australia there is a stigma surrounding dense living outside of the inner city, however the potential benefits of medium density living are immense.

Often overlooked for low or high density developments, it's this missing middle scale that could be seamlessly integrated into the suburban Australian landscape to make urban life easier, more attractive and more comfortable.

## Affordability - Easing of Property Prices

The Australian housing market is at its least affordable ever when compared to average wages. A house in the 1960's was worth 2x the average annual income. Today that moderately priced house is worth 7x the average yearly income, or 11x in Sydney. In fact, Sydney and Melbourne are both ranked in the top 5 least affordable cities in the world (60 minutes Australia, 2019).

By creating denser suburban developments it is possible to fit more dwellings per acre, creating a greater number of options in the market and decreasing pressure on demand. Infrastructure costs per capita decrease as density increases, making apartments and townhouses more affordable options than detached or semi-detached dwellings, and lend themselves to affordable housing policies and collective living more easily.

## Car Free Mobility

In denser neighbourhoods the development of public transport infrastructure such as buses, trams and trains become more economically viable, as does the creation of well connected pedestrian and bicycle paths. Higher density areas typically have lower rates of car ownership, meaning less congestion and pollution, promoting an active healthier lifestyle.

## Built Footprint / Greenspace

Medium density blocks are economic in terms of space, material, energy and time. With a smaller built footprint on the land there is more space for green and blue spaces throughout the neighbourhood. This helps to cool the environment, increase biodiversity, improve liveability and with stormwater management. The everyday experience of being connected to nature is a key factor in long term health and well-being, and with more room for nature and greenspace residents will encounter the seasons and their local environmnets more frequently,

## Boosts Local Economy

One of the challenges to living well is the physical separation of every day life; where living, working, production, education and shopping precincts are unconnected (Sim, 2019) . Denser living allows for the integration of these components as there are more people to support commercial, cultural and institutional facilities. Mixed medium density developments of dwellings, workplaces, businesses and services will ensure there is a thriving local economy. This integration of all facets of life in one place allows people to live more locally, giving back time back to the residents.

## Sense of Community

Medium density living brings people closer together quite literally, providing more opportunity for social interaction. This is the result of many of the aforementioned benefits of denser living, where less driving means walking to the bus or to a local cafe where you start to meet others living in the community who are also shopping or working local.


*"Medium-rise blocks can deliver both high density and human scale at the same time, better connecting people to the ground and each other." David Sim, Soft City*

# Case Studies

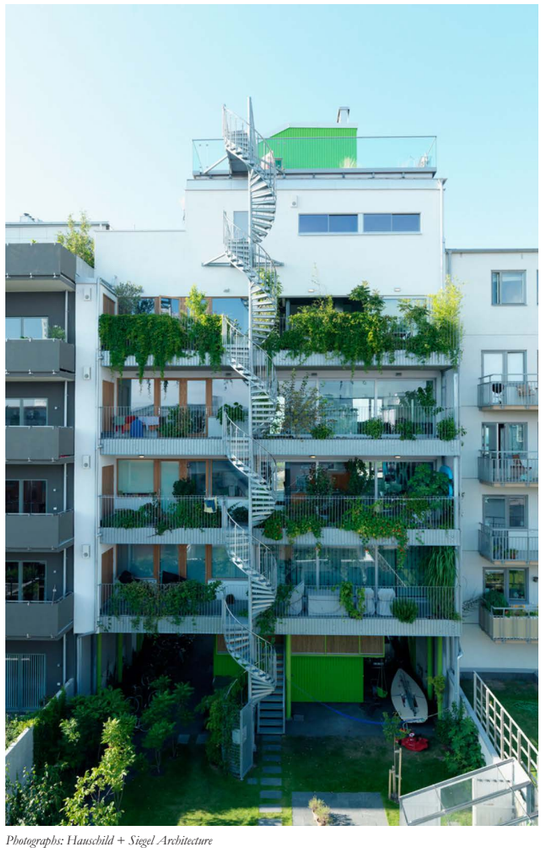
## Urbana Villor / Cord Siegel & Pontus Åqvist - Malmö

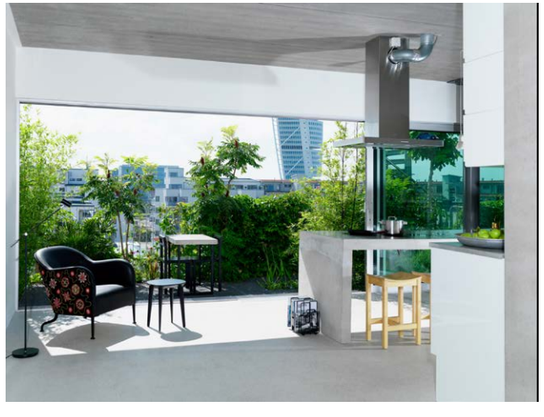
Urbana Villor in Malmö's Western Harbour, Sweden has been a source of inspiration in this project for both its process and the design outcome. The project was created by a group of friends who were looking to start raising families, but who questioned having to choose between a house in the suburbs, or an apartment in the city. Led by architects Cord Siegel & Pontus Åqvist, a Baugemeinshaft (building community) approach was taken by the group of friends. Urbana Villor is the result, marrying the best of both situations with proximity to urban life in villa-like apartments with green spaces to grow plants on balconies, the rooftop and the common courtyard. (Siegel, C, Åqvist, P., 2008).

The project was awarded the Kasper Salin Prize in 2009. Part of the reason description was as follows,

*"With the sustainability perspective as a starting point, a new form of collaboration between architecture and landscape has been initiated in this neighborhood house for living in a community around cultivation and greenery... The exterior facing the courtyard is characterized by balconies for local cultivation, and roof terraces facilitate the contact between the apartments' interior and the exterior environment..."*
(Siegel, C, Åqvist, P., 2008).

The largest influences in this project's design process have been the potential of apartment living to fulfil the desires associated with living in a house and the possibilities of the ways that balconies can be designed to meet the usual demands of a garden.





*Photographs: Hauschild + Siegel Architecture*

## Arkadia / Breathe Architecture, DKO Architecture - Sydney

Arkadia is situated in Alexandria in Sydney, Australia, and has been a good precedent for successful medium density housing. The architects sought to question the nature of multi-residential development in the context, and felt strongly about creating a sense of place. With an approach that integrated greenspace and communal areas, the project focuses on shared experiences among the residents.

It has also been a source of inspiration for it's ambition to promote a carbon free future, and the project itself was fossil fuel free. Arkadia was designed to minimise it's environmental footprint through low maintenance and low embodied energy materials, drought tolerant planting and by harnessing solar heat in winter with a thermally efficient envelope of almost half a million recycled bricks (ArchDaily, 2021).

The brick facade links to the industrial past of the site, which was formerly the NSW Brickworks Company, and from the area surrounding which is comprised of brick warehouse buildings and houses. This combination of sensitivity to the site, respect for the local environment and dedication to ecological and social sustainability has made Arkadia a good reference throughout this research (ArchDaily, 2021).

*Photographs: Sebastian Mrugalski, Tom Ross*

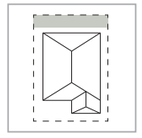
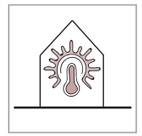
# The New Australian Dream

The new Australian dream is a home designed with the community and user in mind. Foregoing the homogenous copy and paste approach to housing developments of the past decades, it prioritises quality in design, construction and material rather than quantity of square meters. The modern Australian family is now marrying later, prioritising career success and valuing their time over material possessions, and in step with this housing needs to prioritise liveability, affordability and community over individualism. Older generations are also downsizing, further increasing demand for accommodation that affords a healthier, more relaxed lifestyle and access to amenities such as gyms and cafes aswell as essential services.

To live smaller means more space for communal spaces such as gardens, pools and recreation, it provides opportunities for social connectedness, for greater housing affordability and to live within the limited resources available for us. The new dream sustains through crisis and provides room for refuge, creating a safety net for the vulnerable. Living closer together would be living better in a more resilient built environment, equipped for the future.

*"The key difference between standard of living and quality of life, is, that standard of living comes down to how much money we have and how we spend it, whereas quality of life is about the time we have and how we spend it."*
*David Sim, 2019*



| The Old Australian Dream | | The New Australian Dream |
|---|---|---|
| *From reliance on cars* |  | *To using public transport, bikes, walking and shared cars* |
| *From a maximised building footprint* |  | *To a minimised building footprint* |
| *From cutting nature out* |  | *To inviting nature in* |
| *From reliance on fossil fuels* |  | *Toward more sustainable energy use* |
| *From hot living space* |  | *To cool, ventilated living spaces* |
| *From reliance on malls, churches etc for refuge in crisis* |  | *To providing refuge in crisis* |
| *From social isolation* |  | *To creating community* |
| *From grey, unsafe street spaces* |  | *Toward playful streets and courtyards that prioritise children* |

# Part 3 - The Site

# Context

## Penrith

Sitting at the base of the UNESCO World Heritage listed Blue Mountains and at the edge of the Nepean River, Penrith is characterised as a "Parkland City". It is connected via rail from Sydney City into the mountains, as well as by two large motorways. It is sitting on a floodplain that is susceptible to the overflow of the Nepean river and South creek and its tributaries. To the north East of the centre is my site within the Jordan Springs housing development.

*Penrith Lakes (former quarry site)*

*Blue Mountains (UNESCO World Heritage)*

*The Northern Road*

*Jordan Springs West*

*Jordan Springs East*

*Project Site*

*Approximately 6km*
- *Walk - 1 hour*
- *Bike - 20 minutes*
- *Public transport - 45 minutes*
- *Drive - 15 minutes*

*Penrith Centre*

*Nepean River*

*Western Motorway*

*South Creek*

*Railway*

*Great Western Highway*

# The Site

## Jordan Springs West

Nowhere are the aforementioned issues of runaway sprawl, homogeneous housing development and the impacts of heat more prevalent than in Jordan Springs. Still being completed, this 190 hectare development site has approximately 13,000 residents. On the site of the former Australian Defence Industries (ADI) this area is a bushland oasis in Western Sydney, however housing development in the area has threatened the diverse fauna and flora as well as significant Aboriginal archaeological sites.

The chosen project site sits on the southern edge of the development facing onto the surrounding Wianamatta Regional Park. This site was chosen for its proximity to the small central business area, to stormwater infrastructure and to nature.

## Legend

*1. Public school (recently constructed)*
*2. Kindergarten centre*
*3. Community centre*
*4. Restaurants and shops*
*5. Woolworths (grocery store)*
*6. Gym*
*7. Jordan Springs sale centre*
*8. Retirement village (recently constructed)*

*Bus stop*
*Park*
*Constructed lakes*
*Site boundary*
*Stormwater channels*

# The Site History

Zooming out a little, the site of the Jordan Springs development is Wianamatta Regional Park, which has a long and controversial history and has been the subject of intense debates across the community for the past decades. The 1535ha parcel of land is a cultural landscape layered over time with natural features, and complex values demonstrated by Aboriginal and non-Aboriginal archaeological evidence. This landscape was managed by the Darug people for thousands of years before it was settled by the British who incribed upon it the patterns of land separation for agriculture and homesteads that were inhabited until being amalgamated by the Commonwealth in WWII for the Australian Defence Industries (ADI) (Logan, 2011).

The site was established into an industrialised complex for munitions manufacturing, and continued to do so into the Korean and Vietnam wars. The ADI was decomissioned in the 1990's due to the consolidation of Australia's munitions industry, and the expansion of Western Sydney within a proximity that was deemed unsafe, and a joint venture was sought with the view to develop the site for residential use with Delfin Lend Lease being awarded the tender in 1994 (Logan, 2011).

Residents united in a grassroots movement against plans to develop the Wianamatta park due to the site having large areas of bushland of significant conservation value, as well as a highly diverse native fauna population including over 100 bird species as well as the last remaining wild emu and kangaroo populations in the Sydney area (Caldwell, 2001). Situated on the cumberland plain the parkland is distinguished by a mix of eucalypt woodlands and forest vegetation some of which are threatened or endangered as well as a number of freshwater habitats including wetlands, billabongs and creek tributaries (Logan, 2011). Despite efforts to have the entire site listed for heritage and environmental conservation, the land was sold to Lend Lease for development in 2004 with the premise to preserve heritage listed sites in a 900ha regional park (Logan, 2011).

The first phase of development was approved by the Blacktown City Council (as the site spans both Penrith and Blacktown council areas) in 2004, known as Ropes Crossing this is mentioned earler in this report research for it's high Urban Heat Island index. The Western precinct, known as Jordan Springs West and the location of this projects site was developed next, and the Central precinct, known as Jordan Springs East is currently being built.

It is interesting to note that a condition of this development was the requirement of including 70ha of employment land throughout the development expected to create 5,300 jobs. Recently however, 38ha of this land is under consideration as the developer is calling on the NSW government to rezone the land for 500 more homes as an alternative to the employment hub, a move that would support government initiative to boost the economy and construction industry during the COVID-19 pandemic (Feng and Thomas, 2020). The local community are protesting this new proposal for the Wianamatta regional park development, highlighting that the move is potentially trading thousands of long-term new jobs in the area for 252 temporary construction jobs (Feng, Thomas, 2020).

Currently the area is lacking infrastructure and job opportunities to continue developing housing without foresight. It is key that both housing, and commerce can develop simulatenously in order to provide more mixed communities into the future that can support the growth projected for the city of Penrith in the coming decades. Further to this, it is clear that the development of single dwelling houses in this context resulted in the clearing of substantial swathes of important ecosystem that had natural, cultural, recreational, research and educational value. It is the intention of this thesis to provide an alternative solution to the residential housing needs of the council area that requires less land, and provides more mixed use to boost the local economy.

*Dunheved homestead, early 20th century*

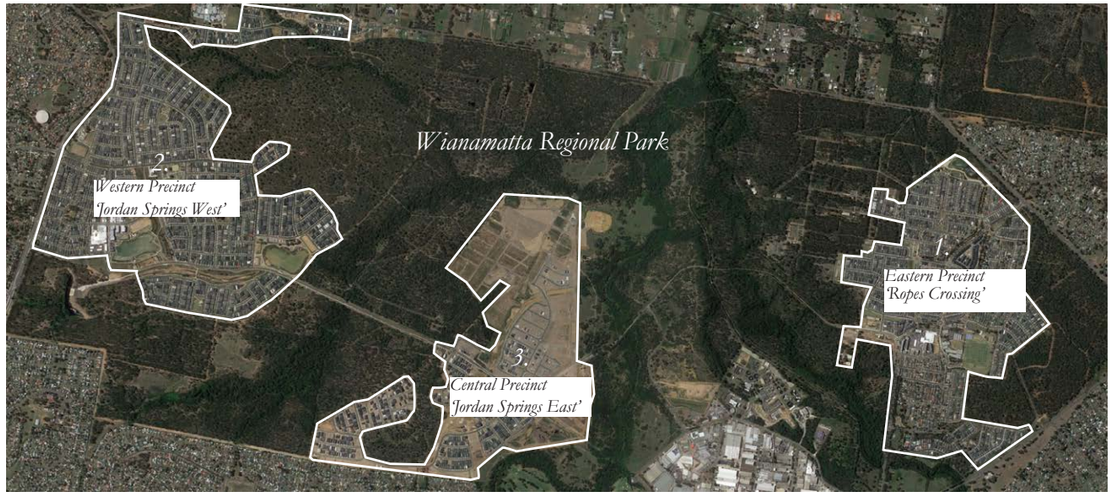
*Source: Lethbridge-King Family, copied by Jan Barkley Jack in 1988*

*Munitions factory, 1962*

*Source: Australian War Memorial*


*Community action*

*Source: Wianamatta Regional Park. Volume 3: Park Masterplan, 2013*




*ADI Site Map*

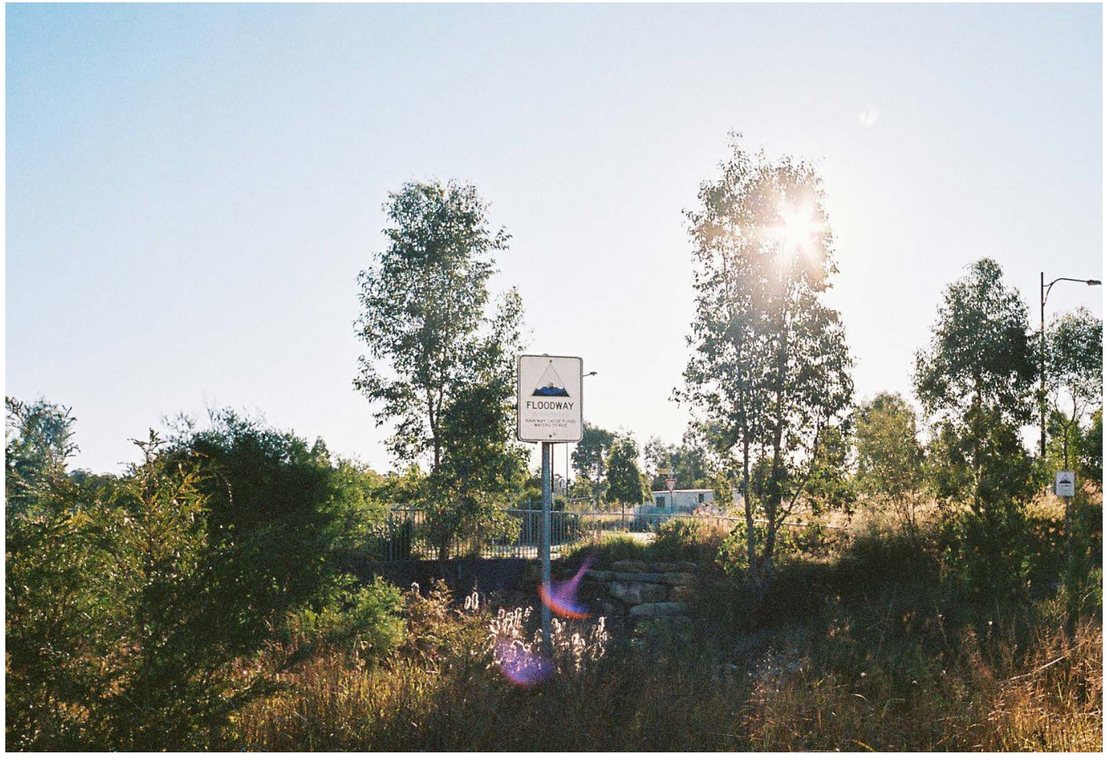
*Source: Wianamatta Regional Park. Volume 3: Park Masterplan, 2013*

## Jordan Springs Site Visit

Due to the pandemic, I was unable to carry out the site visit in person, however Olympia Newman-Andrews was able to go in my place in order to understand the spaces better and capture these photographs. She described the area as unpersonable, homogeneous and as lacking community and personality. She said that it was dissapointing that you were unable to access the bush despite the site sitting right next to it, due to a wire fence running the length of the road bordering the housing estate and bushland. She perceived that most of the areas were devoid of life despite it being a weekend.

In Western Sydney housing developments like this are not rare, and entire swathes of grassland and rural area are being converted into similar estates as the city grows. The following proposal is aimed to be a solution for a different way of creating housing developments in Western Sydney in general, and Jordan Springs is the site of my intervention in this thesis.

These photographs were taken in late Autumn 2021, by Olympia Newman-Andrews.



FLOODWAY




1-6

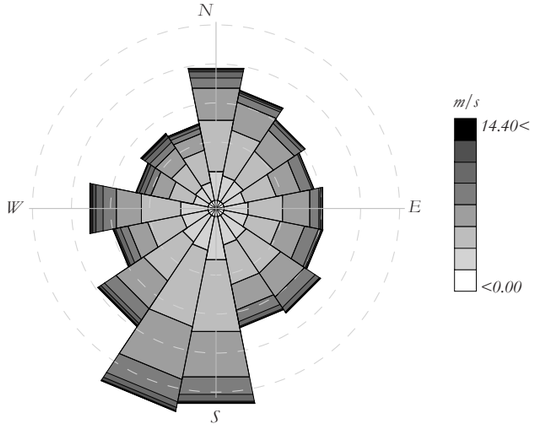
# Site Conditions

## Wind

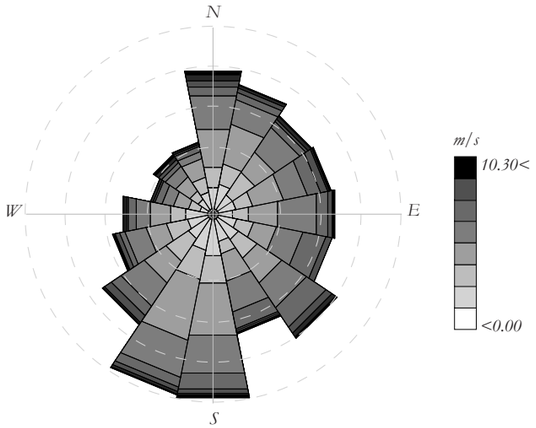
Wind intensity is usually reduced in locations away from the coast, however in Penrith's case the intensity is similar to Sydney City. In the region in general the mornings are calmer, and the afternoons face windier conditions.

The prevailing Summer winds come from the South in the morning and South-East in the afternoon, while the Winter winds mostly come from the South West. During Autumn and Spring the morning wind comes from both the North and South, and afternoon wind is coming from the North, East and Southerly directions.

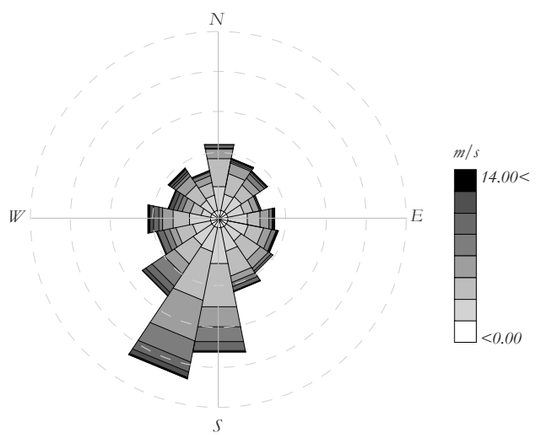
Designing for heat, it is particularly important to harness the Summer afternoon winds in order to provide an opportunity for the buildings to cool down for the evening.




*Yearly Wind Rose - January - December*




*Summer Wind Rose - December 01 - February 28*



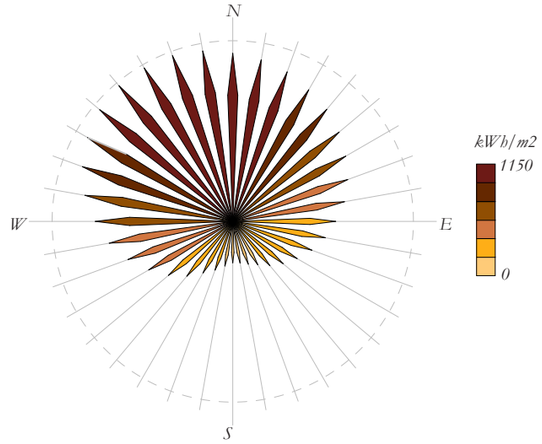

*Winter Wind Rose - June 01 - August 31*

*Source: Penrith Lakes Rgnl Park EPW*



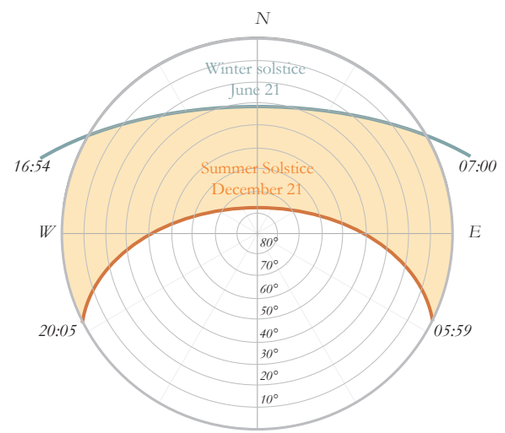
## Radiation

The most intense radiation annually comes from the North and North-West directions.




## Sun

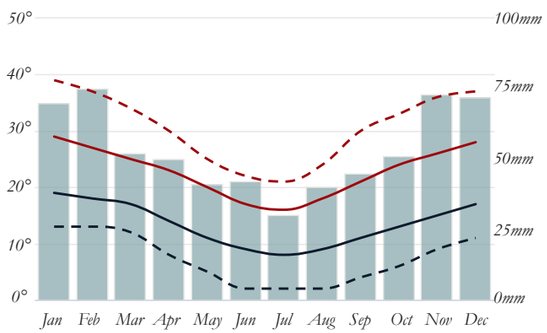
At the Winter solstice the sun sits at an altitude of 32° 43' to the North, and at the Summer solstice the sun sits almost directly overhead at 79° 29'.




*Source: Penrith Lakes Rgnl Park EPW*

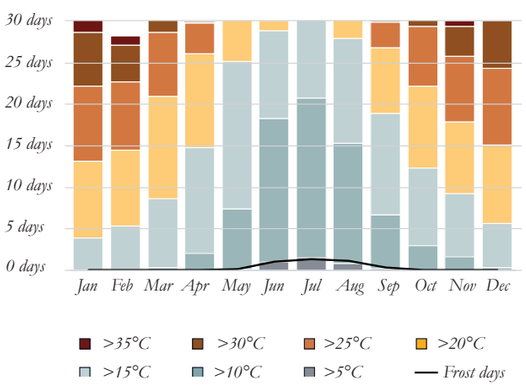
## Temperature & Precipitation

The temperature in Penrith is at its peak in January, and the highest rainfall is also around this time, with the wettest months being February and November. The driest and coolest month of the year is July. Penrith experiences cooler nights and hotter nights than the mean temperatures.




## Maximum Temperatures

The maximum temperatures per month are frequently greater than 35° in the Summer months, and reaching upwards of 20° in Winter months. As discussed previously however, there is an upward trend in these temperatures due to climate change.




Source: Penrith Lakes Rgnl Park EPW



## Infrastructure

The immediate area to the site is dominated by streets. There are some cycle and walking paths through the development however they are disconnected from one another and the roads take priority, often cutting them off.

### Legend

- Cycle path
- Footpath
- Road

# Who lives here?

The proposal is intended to be an alternate way of living for those who already live at the site. This means catering to the existing demographics, and also for the future projections for the area. It is important to understand how people are living in Jordan Springs, and to aid in this a comparison betweeen Penrith and the Greater Sydney area has been carried out to put the statistics in perspective.

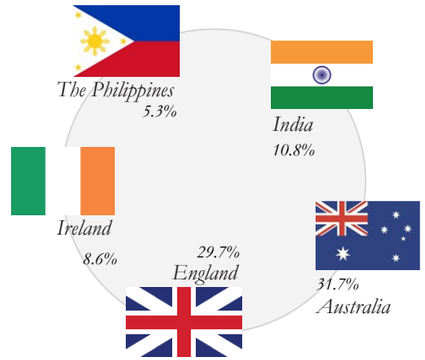
| | Jordan Springs | Penrith | Greater Sydney |
|---|---|---|---|
| *Couples with children* | 49% | 37% | 35% |
| *Lone person households* | 9% | 18% | 20% |
| *Medium and high density housing* | 6% | 19% | 44% |
| *Overseas born* | 31% | 22% | 37% |
| *Language at home other than English* | 30% | 17% | 36% |
| *Median weekly mortgage repayments* | $623 | $466 | $495 |

*Source: Australian Bureau of Statistics, 2011, 2016*



## Ancestry

Ancestry defines the cultural association and ethnic background of an individual going back three generations. Ancestry is a good measure of the total size of cultural groups in Jordan Springs regardless of where they were born or what language they speak. The top five most prevalent nationalities in Jordan Springs are Australian, English, Indian, Irish and Filipino.




*Median Age*

*34 years old*

*Average Household Size*

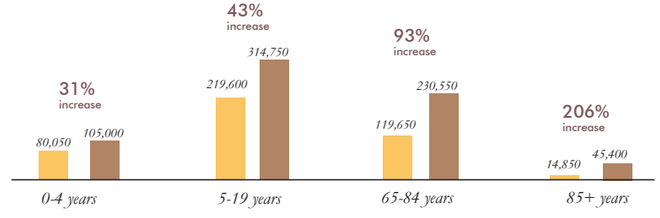
*3.13 people*

*Employment Rate*

*96%*

## Population growth by age (2016-2036)

The population projection data for Penrith council suggests that the older population from 65 and above is set to increase in the next decade or so. This may affect the median age, and percentage of families into the future.

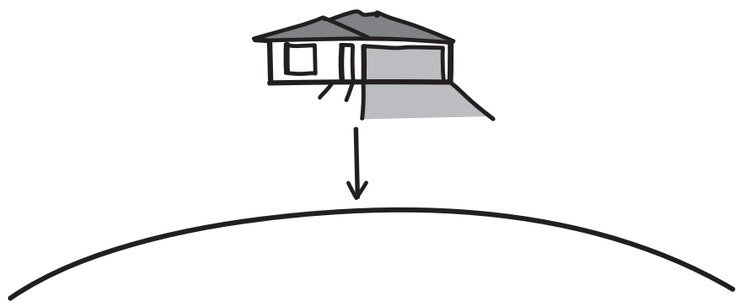



*Source: Australian Bureau of Statistics, 2011, 2016*

# Part 4 - The Proposal

# Design Strategy

The three key goals created from the research are to:
1. Improve liveability - by densifying to increase greenspaces, to provide refuge in extreme heat and to promote car free, walkable suburbs.
2. To foster community - to combat social isolation, build resilience and create a safety net for the vulnerable.
3. To design with nature - to create a comfortable microclimate, improve biodiversity, and sequester carbon to reduce warming.



*Improve Liveability*

Densify for more greenspace and less grey

Provide refuge spaces for extreme heat events

Promote car-free walkable and cyclable lifestyle

*Foster Community*

Combat social isolation

Boosts social capital and community resilience

Creates a safety net for the vulnerable

*Design with Nature*

Facilitates comfortable microclimate

Promotes biodiversity and improves health

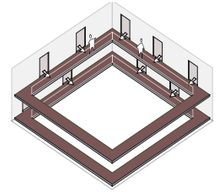
Sequesters carbon and reduces warming



# Design Toolbox

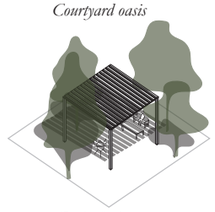
Translating the strategies into a design led to the formation of a design toolbox. The 15 "tools" help to realise the goals of community, liveability and sustainability within a new suburbia, and many of these contribute to several at once.

*Courtyard oasis*

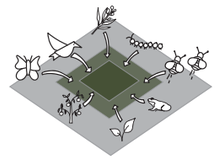


*Access galleries*

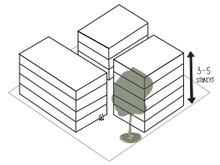
*Communal spaces*



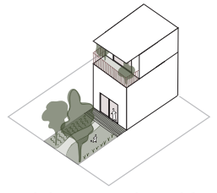
*Cool, shady spaces*



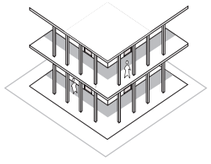
*Nature and biodiversity*



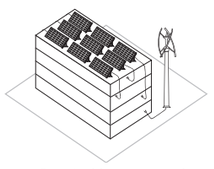

*Medium density*



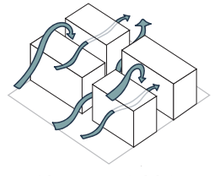
*Large balcony space and ground floor yards*



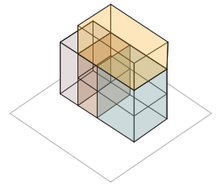
*Arcades*



*Sustainable energy supply*

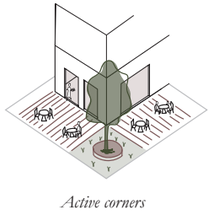


*Advantageous wind design*

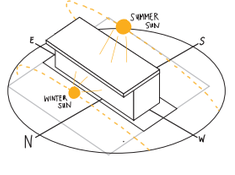


*Mixed apartment and terrace sizes*

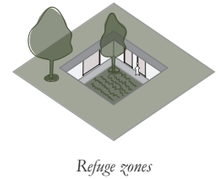
*Water for play, biodiversity, cooling and stormwater management*



*Active corners*




*Advantageous sun aspect*

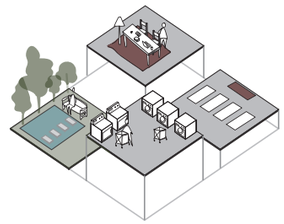


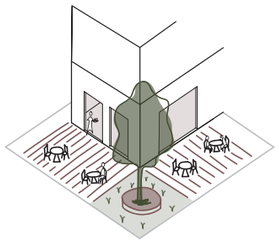
*Refuge zones*

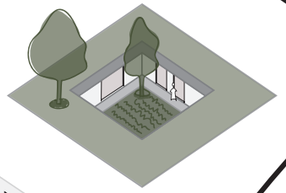
# Design Toolbox

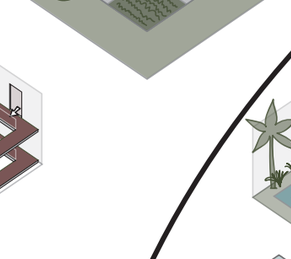
Several of the tools employed in this project work to simultaneously address the implementation of the design strategy to foster community, improve liveability and to design with nature.

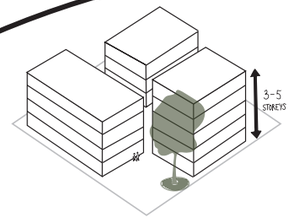
## Foster Community

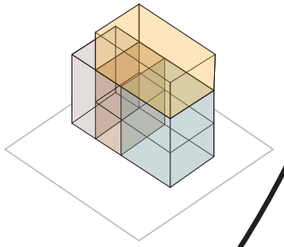


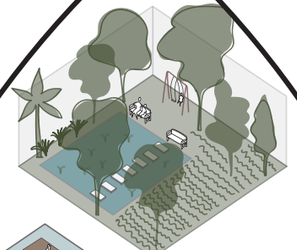


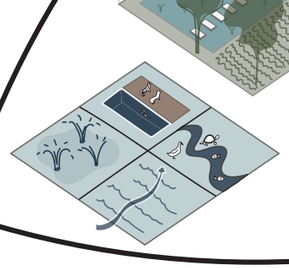


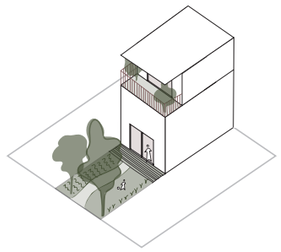


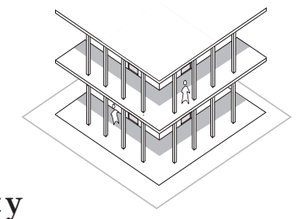


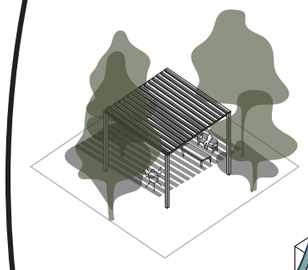


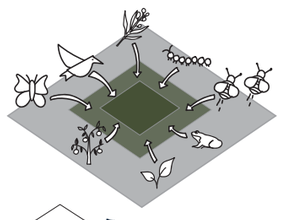


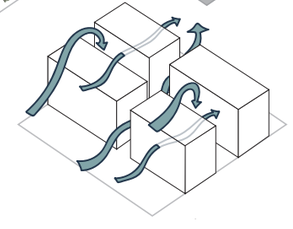


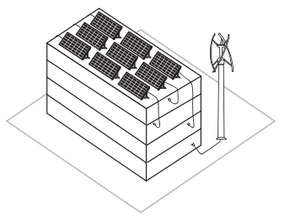


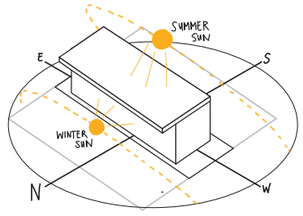
## Liveability












## Design with Nature

# Potential Schemes

Below is a series of schemes exploring the strengths and weaknesses of potential typologies. From this analysis, it was clear that the mid rise typologies offered the most benefits and opportunities to enrich community life and respond to environmental constraints. The deconstructed perimeter block in particular creates opportunities such as communal areas, inner city locations, greater green spaces and affordability, and also has the potential to take advantage of cross ventilation and sun access depending on their design and orientation.

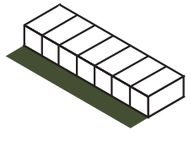
*Detached House*

\+

- *Yard*
- *Quiet*
- *Independence*
- *Solar access*
- *Family size*

\-

- *Energy demanding*
- *Car dependent*
- *Expensive*
- *Inefficient use of space*
- *Socially isolating*
- *Vulnerable to climate*



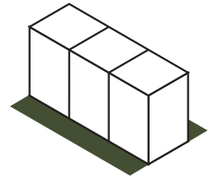
*Row House*

\+

- *Yard*
- *Independence*
- *Size*
- *Dual aspect*

\-

- *Energy demanding*
- *Expensive*
- *Inefficient use of space*
- *Vulnerable to climate*



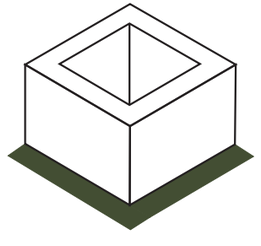
*Town House*

\+

- *Dual aspect*
- *Inner city locations*
- *Efficient use of space*

\-

- *Expensive*
- *Sun access restricted*
- *Cross ventilation restricted*
- *High land area use*



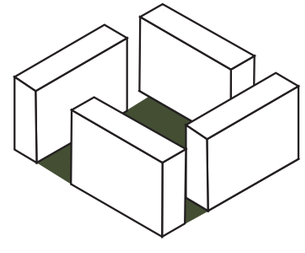
*Perimeter Block*

\+

- *Inner city locations*
- *Affordable*
- *Communal areas*
- *Private courtyard*
- *Community feeling*

\-

- *Cross ventilation restricted*
- *Facades without sun access*



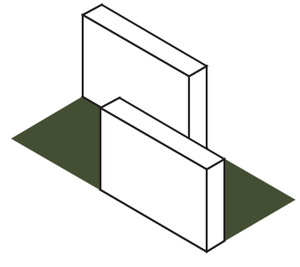
*Deconstructed Perimeter Block*

\+

- *Inner city locations*
- *Affordable*
- *Communal areas*
- *Semi-private green areas*
- *Cross ventilation*
- *Solar access*
- *Community feeling*

\-

- *Unclear private and public areas*



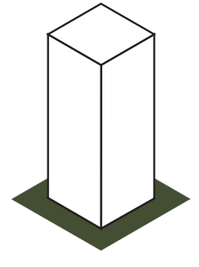
*Slab House*

\+

- *Affordable*
- *Cross ventilation*
- *Easy solar access*

\-

- *Unclear private and public areas*
- *Loss of human scale*
- *Lack of community*
- *Socially isolating*



*Tower*

\+

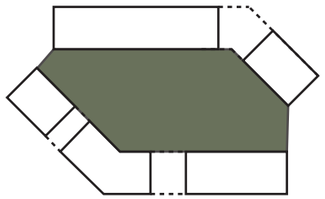
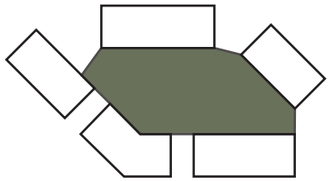
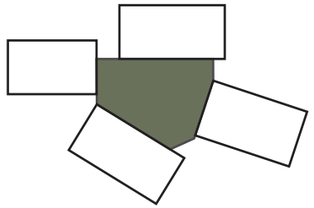
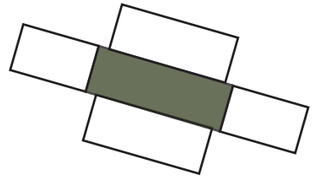
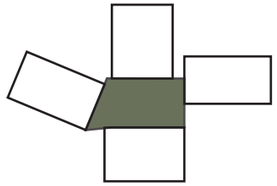
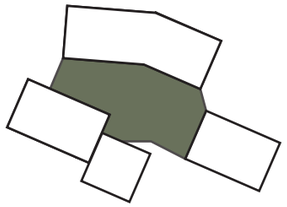
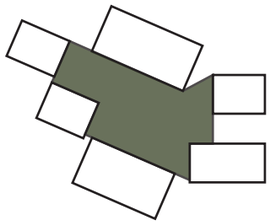
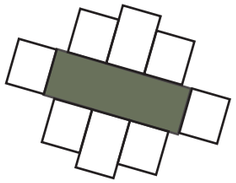
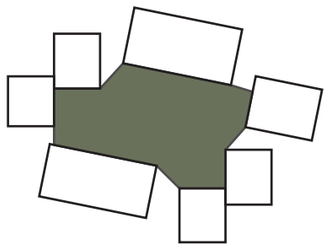
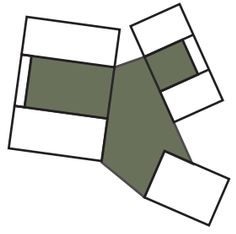
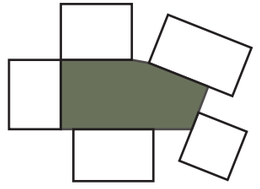
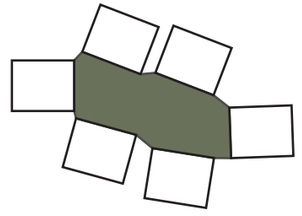
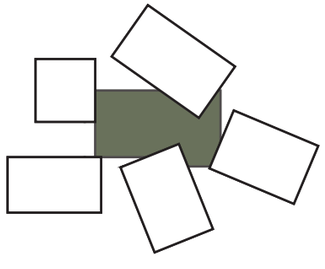
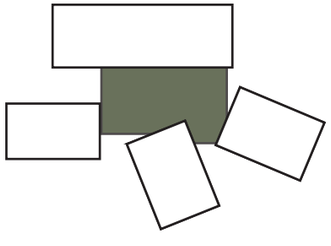
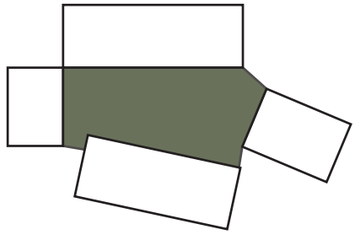
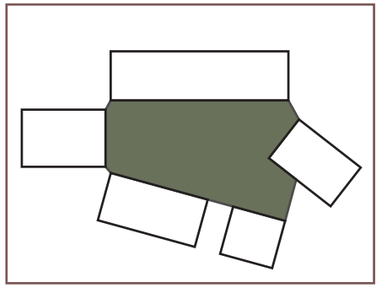
- *Well connected locations*
- *Affordable*
- *Views*

\-

- *Solar access*
- *Loss of human scale*
- *Isolated from context and community*
- *Cross ventilation*

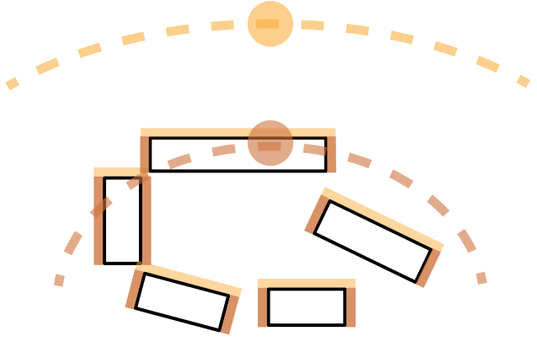
# Design Studies

At this point in the project I was exploring in what way the desired medium density or mid rise typology could take. I saw the potential of the courtyard, perimeter block but the site is in a context that requires cross ventilation to cool the space, and minimum exposure to the East and West to reduce radiation. These are some of the forms that were explored with their negative and positive qualities weighed up, the result was that most promising was the one highlighted in the bottom right.

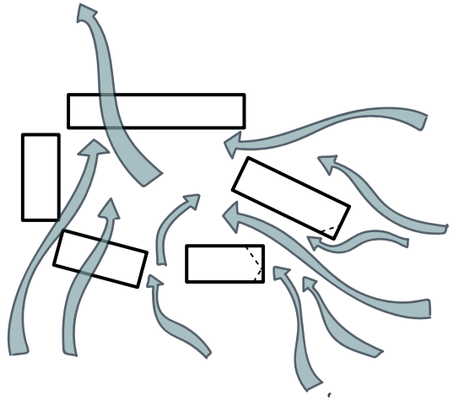

















# Design Process

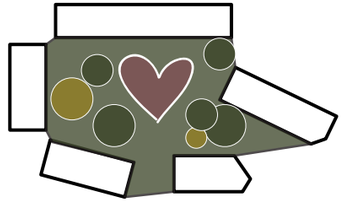
During this process I carried out a series of solar analyses and wind studies, as well as study of form in order to determine the block size and shape going forward.



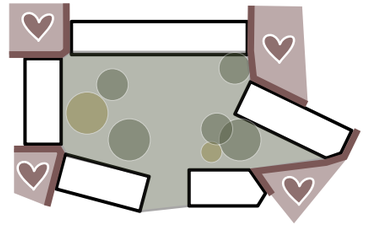
*Solar access- Elongated Northern and North Eastern facades to capture winter sun and minimise Summer rays*



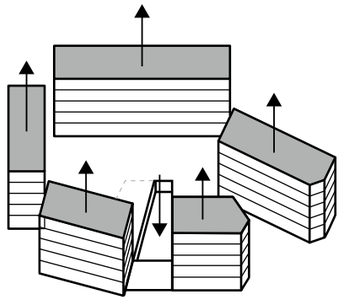
*Wind - Capture dominant wind flows through apartments and circulate through the courtyard*



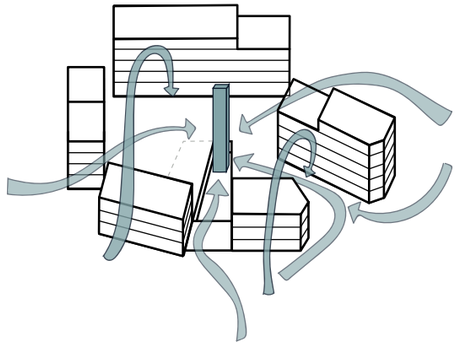
*Courtyard - Create shaded courtyard oasis for centralised community space and circulation*



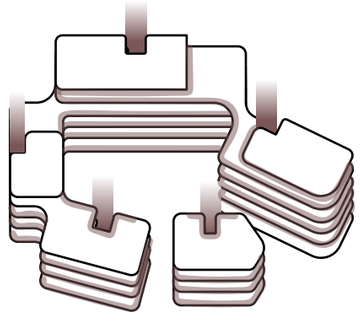
*Edges - Interesting activated corners for mixed precinct and passive surveillance*



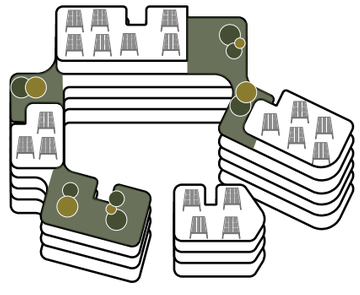
*Density - Build up to create density and shade and build down to create refuge space*



*Press down to allow wind flow through into courtyard, as well as solar access, smaller wind shadows and human scale*



*Circulation - create clear access points, and external circulation for interaction and appreciation of the surrounding environment*



*Green space - Activate rooftop green communal spaces for recreation and solar farms*


## Community plan

The proposed site plan consists of five separate deconstructed blocks with a large green space weaving between them and into the bush. With a focus on recreation, play and ecological sustainability the plan draws on the surrounding bush and water management systems to inform the layout, and keeps the road footprint to a minimum with a simple one way loop, whilst creating a variety of footpaths across the site for pleasant walking experiences. The development is mixed use with proposed businesses, learning spaces and exercise opportunities dotted across the site. In this way each block can offer something different to the site. The block to the top left was pursued for more detailed design.

# Existing and Proposed

## Built footprint comparison

The comparison between what is existing and proposed is stark when viewed side by side. The new plan is much more organic, responding to the conditions of the site, solar and wind whilst minimising the built footprint and increasing density. It was important in this urban plan that the natural environment was given space, and that it was integrated into the built environment.

| | |
|---|---|
| *Site size* | *5.7 hectares* |
| *Houses* | *118* |
| *Residents* | *Approx 350* |
| *Built footprint (houses/ garages)* | *Approx 2.5 hectares* |
| *Footprint % of site* | *43%* |



| | |
|---|---|
| *Site size* | *5.7 hectares* |
| *Apts* | *Approx 270* |
| *Residents* | *Approx 810 (2.2x the current residents)* |
| *Built footprint (houses/ garages)* | *0.8 hectares* |
| *Footprint % of site* | *14% (less than 1/3rd of existing footprint)* |

## Entry Perspective

On entering the site by foot you are met with a block that plays a little with the public and private spaces. Ground floor apartments open up into large front yards, while ground floor businesses spill out into a corner plaza space. There is a glimpse of the courtyard beyond, partially obscured by layers of vegetation, circulation and shading elements.

## Ground Floor Plan

*1. Entry*
*2. Commercial/ office space*
*3. Plaza, public space*
*4. Water play*
*5. Wind tower*
*6. Summer refuge*
*7. Ventilation shafts*
*8. Co-working library space*
*9. Play area*
*10. Communal toy box*
*11. Garden shed*
*12. BBQ area*
*13. Flower garden*

## Cafe

Looking back towards the block from a water play space for children, the fourth floor rooftop bridge frames a view of the courtyard. The vertical articulation of the circulation space is also clear, with greenery covering the facade.

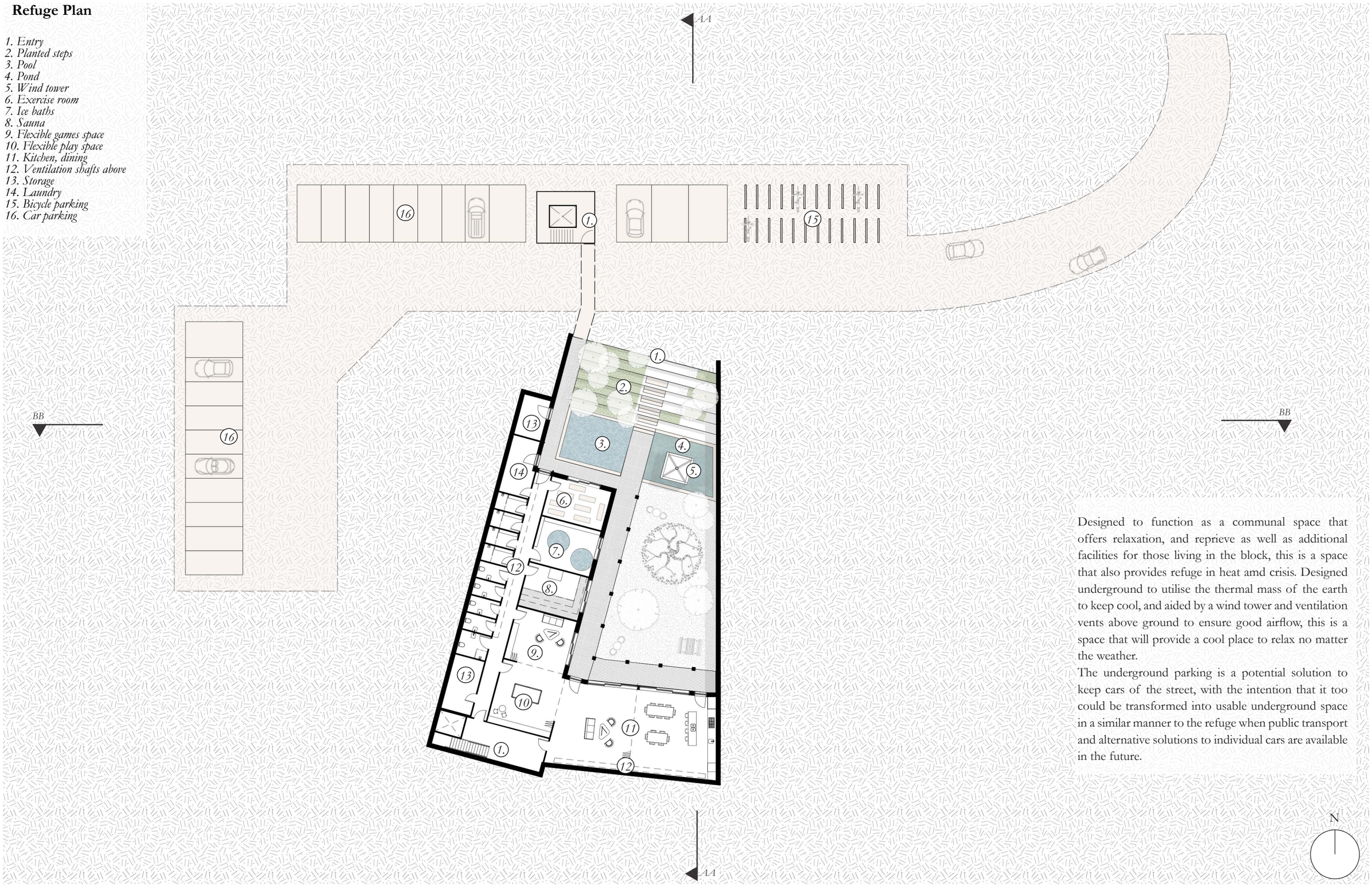


## Eyes on play


Living in the block allows you to have direct access to the courtyard from your front or back yard, and creates passive surveillance of and safety for children playing. The landscaping is wild and soft with moveable furniture elements, shading and native bushes, trees and flowers. It's an extension of the natural design seen at the site scale and a good place to meet the neighbours.

## Refuge Plan

1. *Entry*
2. *Planted steps*
3. *Pool*
4. *Pond*
5. *Wind tower*
6. *Exercise room*
7. *Ice baths*
8. *Sauna*
9. *Flexible games space*
10. *Flexible play space*
11. *Kitchen, dining*
12. *Ventilation shafts above*
13. *Storage*
14. *Laundry*
15. *Bicycle parking*
16. *Car parking*




Designed to function as a communal space that offers relaxation, and reprieve as well as additional facilities for those living in the block, this is a space that also provides refuge in heat amd crisis. Designed underground to utilise the thermal mass of the earth to keep cool, and aided by a wind tower and ventilation vents above ground to ensure good airflow, this is a space that will provide a cool place to relax no matter the weather.

The underground parking is a potential solution to keep cars of the street, with the intention that it too could be transformed into usable underground space in a similar manner to the refuge when public transport and alternative solutions to individual cars are available in the future.

## Refuge Perspective

Looking into the refuge space, there is a pool and a pond separated by a raised walkway. The circulation, like the rest of the building, is external but shaded. The central courtyard is designed to be planted and landscaped with hardy materials. Operable overhead pergolas create dappled light and break the overhead Summer rays.



## Courtyard Perspective

The courtyard on the raised ground floor plane is a dynamic space where daily movement and living occur. It is designed to be an extension of the living room for the residents.

## Levels 01-02 Plan

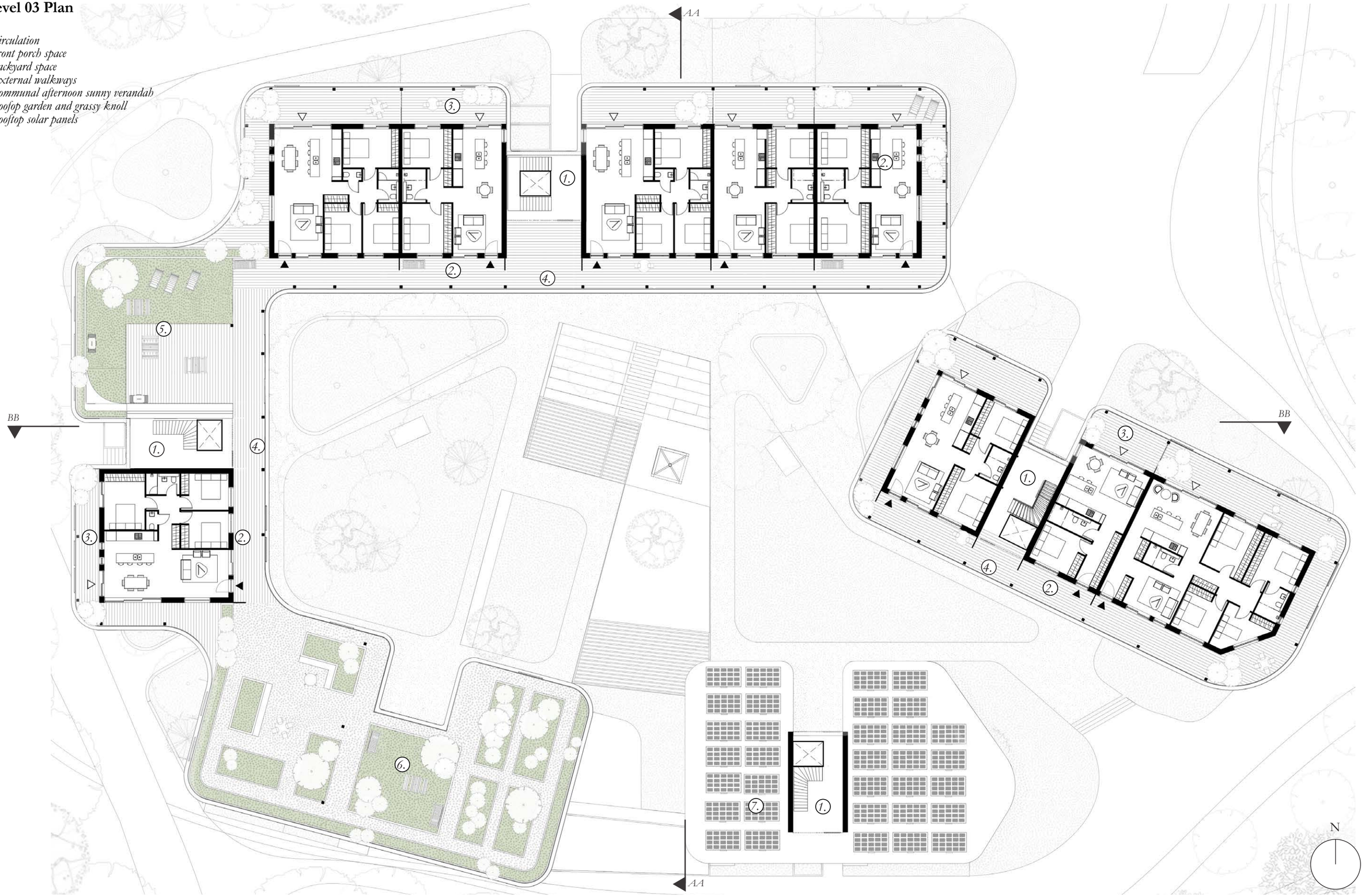
*1. Circulation*
*2. Front porch space*
*3. Backyard space*
*4. External walkways*

## Front Porch Perspective

The external walkways are designed to give each apartment a meter and a half ‘front porch’ to appropriate as the residents like, and to give privacy to the bedrooms. The idea is that you meet more easily with your neighbours, and residents move seamlessly between the outdoors and their homes as you would in a detached house.

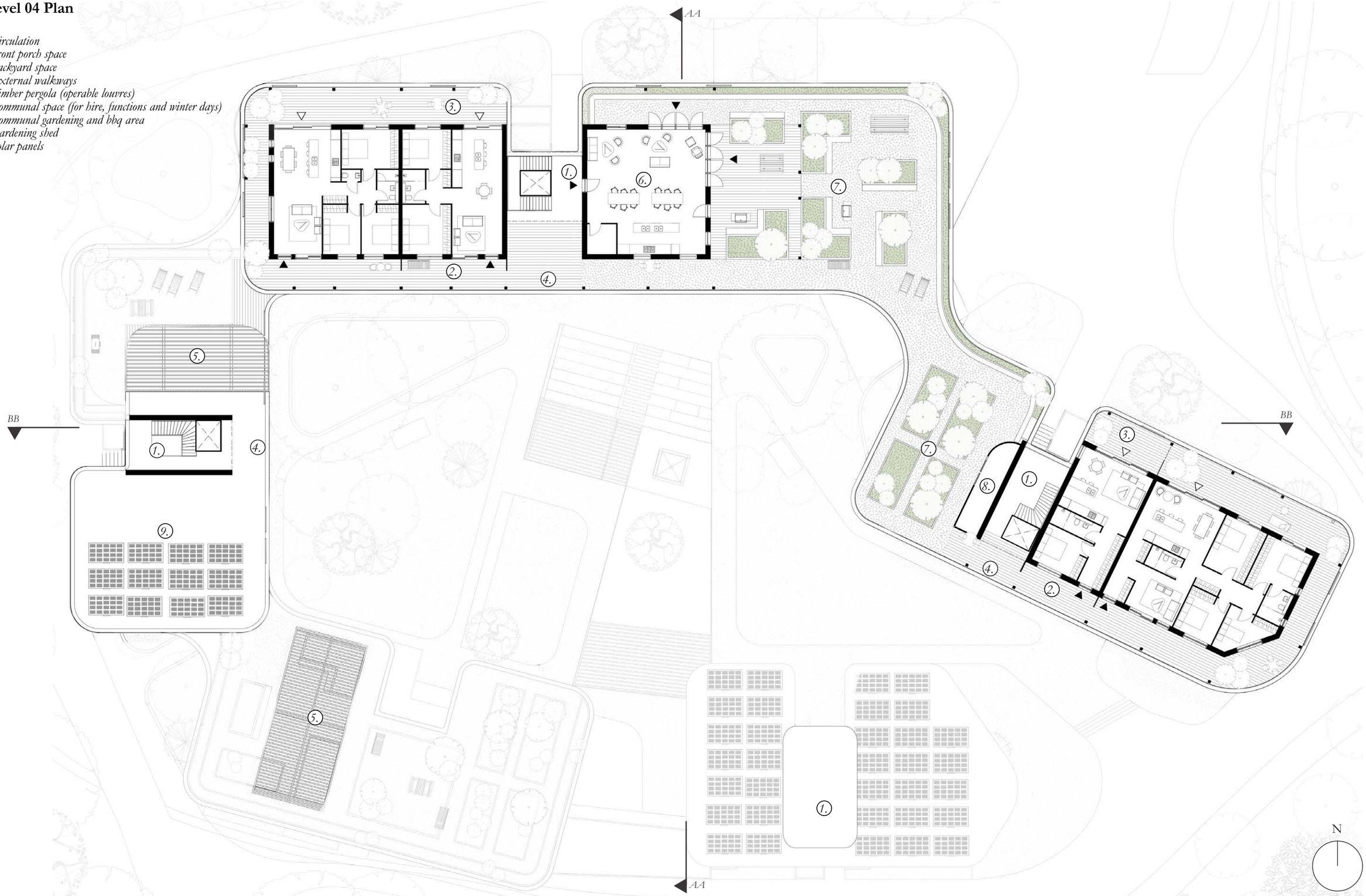
## Level 03 Plan

1. *Circulation*
2. *Front porch space*
3. *Backyard space*
4. *External walkways*
5. *Communal afternoon sunny verandah*
6. *Roofop garden and grassy knoll*
7. *Rooftop solar panels*



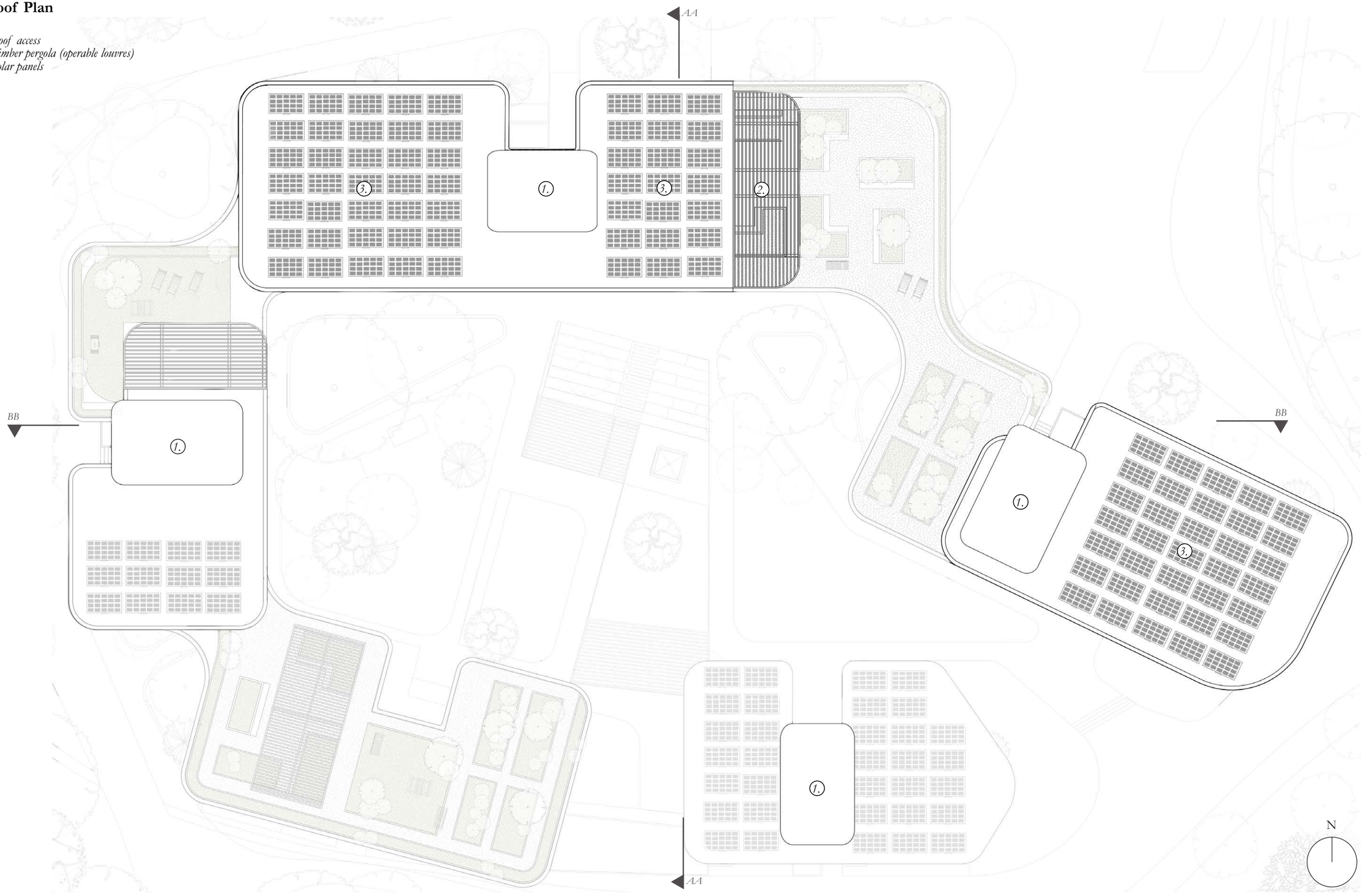
## Level 04 Plan

*1. Circulation*
*2. Front porch space*
*3. Backyard space*
*4. External walkways*
*5. Timber pergola (operable louvres)*
*6. Communal space (for hire, functions and winter days)*
*7. Communal gardening and bbq area*
*8. Gardening shed*
*9. Solar panels*



## Roof Plan

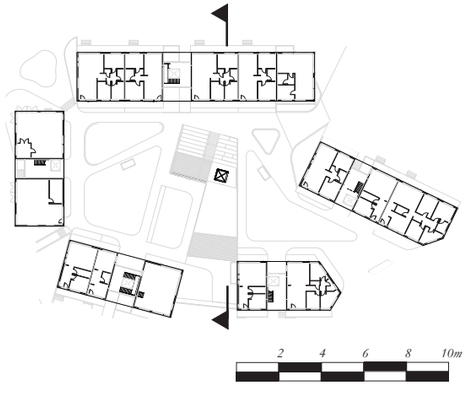
*1. Roof access*
*2. Timber pergola (operable louvres)*
*3. Solar panels*



**Rooftop Perspective**

The level 04 rooftop space can be used by larger groups for celebrations or gatherings, as well as urban gardening and local food production. The wide pergola and operable sun shades provide shelter and the planters create different outdoor rooms for smaller groups.

**Section AA**



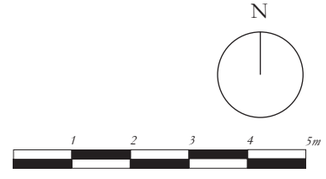
**Section BB**

2 4 6 8 10m

## Typical Apartment Plan


The living areas run the length of the 10m deep apartments with the bedrooms and private areas kept separate to living space. The apartments are compact but the rooms flow out into the balcony spaces which have planted of up to 300mm set into the floor structure for gardens.

## Typical Apartment Section

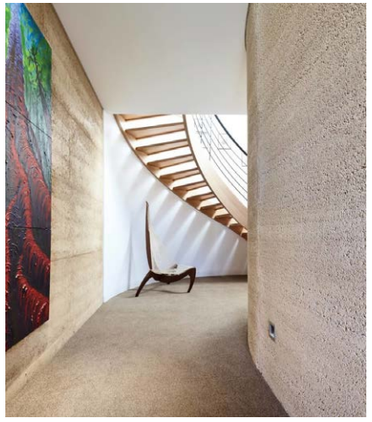



## Backyard perspective

The indoor-outdoor living spaces are designed with a minimal material palette, and they allow a seamless integration between the home and nature. Described as 'backyards' the intention is that the residents can use the built in planting spaces to create green spaces that buffer the sun and improve liveability.

# Material Strategy

The intention of the material choices is to use materials that are locally available, have a low C02 footprint, and that contribute to a cool, liveable place to live. The goal is to also create a building that is aesthetically pleasing, and fits in with its local environment well.



*Hempcrete*

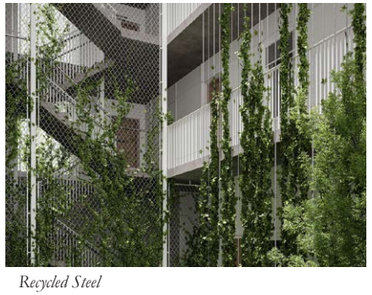
Used in this project for external walls and landscaping design
Hempcrete is a mixture of lime, hemp wood (hurd) and water petrifies into a bio-composite known as Hempcrete. Hempcrete has been chosen as it is an environmentally conscious building method. It absorbs atmospheric CO2 during the plant growth phase and continues to reduce atmospheric CO2 as it gains strength and matures (OzHemp, 2020).

Hempcrete is breathable, fire, mould and termite resistent and provides excellent insulation. It can be used as a filler around a timber frame, as a finishing plaster or to build freestanding walls similarly to rammed earth. Hempcrete regulates the temperature and humidity of a building and in some cases, completely eliminates the need for heating and cooling systems, resulting in huge energy savings. It has an R value of 2.4-4.8 per inch compared with 0.1 or 0.2 in concrete, however it has a compressive strength of 1 MPa, which is 1/20 of concrete, so it cannot be used for foundations (OzHemp, 2020).

*Sugargum Timber (Eucalyptus cladocalyx)*

Used in this project for structure, flooring, pergola details. This hardwood is available from recycled timber warehouses within proximity to the site.

Timber harvested from sugar gum has little defect and is prized for its durability. It is particularly suited to uses such as flooring and joinery. It also produces structural timber of very high strength and little defects for use in posts and beam construction. Sugar gum's durability also makes it ideal for exterior applications such as cladding, decking and outdoor furniture (WoodSolutions, 2020).



*Recycled Steel*

Used in this project for railings and the circulation areas facade, it is designed in thin balustrade elements to allow for plants to grow up and along it. It is intended that the steel is painted an ultra white colour to reflect heat, and preferably would be made of recycled steel.



# Vegetation

## Trees, bushes, flowers

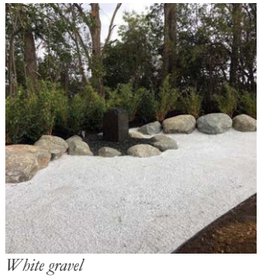
Vegetation in the design of the development is important to ensure it can withstand the harsh climate of the area. Native bushes and trees are best suited to these conditions, and in trying to create a kind of urban "oasis" hardy plants and flowers commonly found in the area will contribute to local biodiversity and to reduce the urban heat island effect. Other landscaping elements such as grasscrete and gravel are used for roads, parking and paths instead of traditional asphalt or bitumen hard surfacing techniques.

*Swamp foxtail grass*

*Liriope amethyst*

*Bottlebrush*

*Westringia fruticosa*



*White gravel*

*Grasscrete*

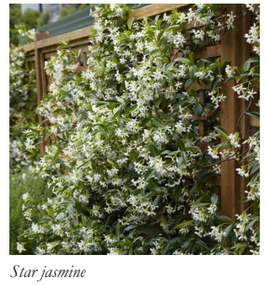
*Lirope muscari (lily turf)*

*Banksia*

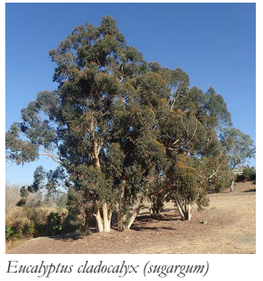
*Alloxylon flammeum (tree waratah)*

*Eucalyptus haemastoma (scribbly gum)*

*Lomandra hystrix*



*Star jasmine*



*Eucalyptus cladocalyx (sugargum)*

*Eucalyptus alba (white gum)*

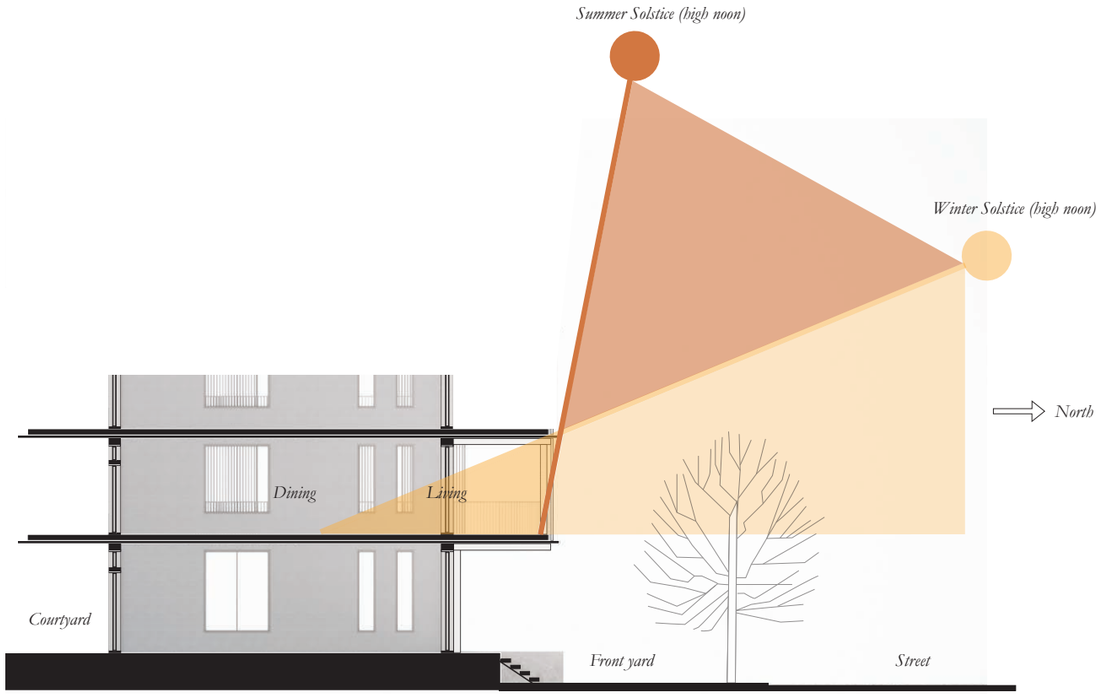
*Baeckea Clarence River*

# Thermal Comfort

There is a three tiered design approach to achieve thermal comfort that I have considered in the design of this project. These can be defined as heat avoidance, passive cooling, and mechanical cooling (Lechner, 2009). For the most part my focus has been on heat avoidance, and passive cooling with the view that mechanical ventilation and cooling devices should be the last resort.

## Heat avoidance

In the context of Penrith, designing to minimise heat gain is the first priority. Strategies at this level include shading, orientation, vegetation, insulation, colour choice and daylight. Though the emphasis in this project has been in heat mitigation, it is also important to note that the winters in this climate are quite cool, so solar gain and heat retention in these months is desirable.

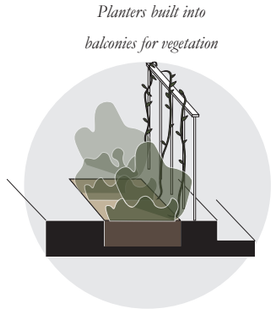



*Apartment Solar Section*

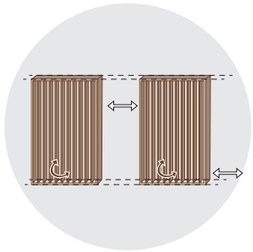
Wide overhangs are the first heat avoidance strategy, as they work to block high summer radiation, whilst allowing the penetration of the low winter sun.



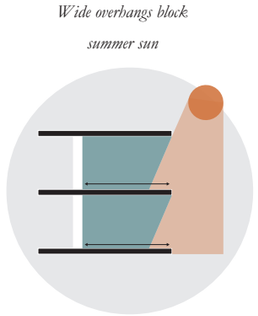
## Passive and Active Heat Strategies



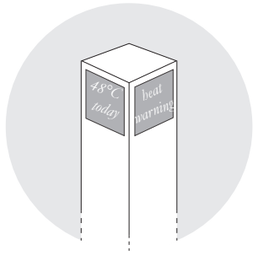
*Planters built into balconies for vegetation*



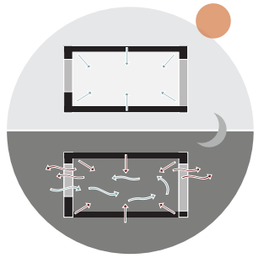
*Operable vertical sliding shading devices*



*Wide overhangs block summer sun*

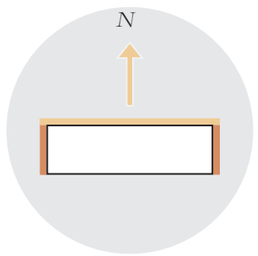



*Warning system informs residents in case of extreme weather events*



*Thermal mass keeps spaces cool during the day and night*

*Deciduous trees allow winter sun to penetrate buildings*

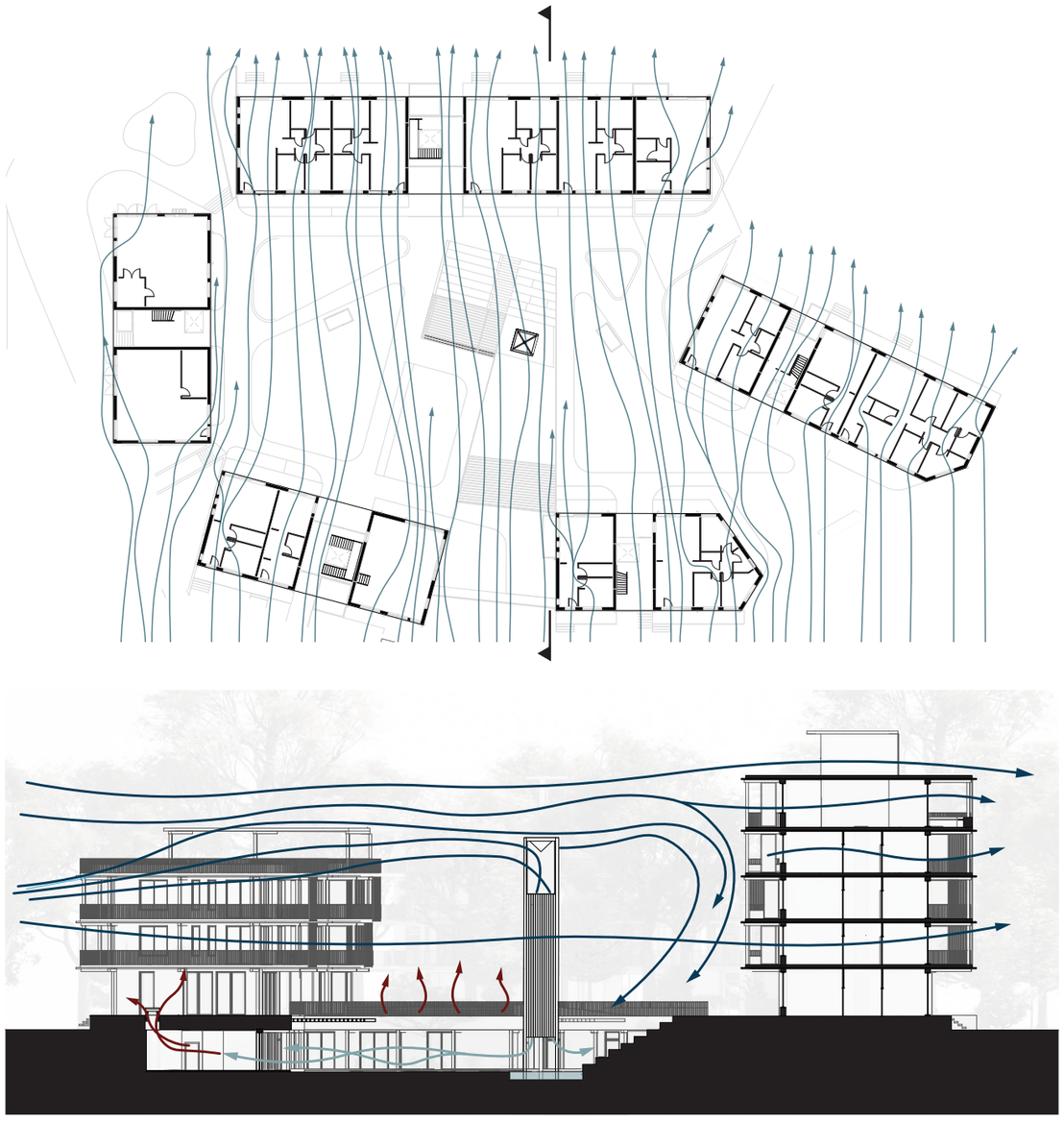



*Northern aspect creates desirable lighting and heating conditions*

*Light coloured roofs and flooring reflects radiation*

## Passive Cooling

As heat avoidance isn't usually enough to keep temperatures low enough to create liveable conditions during the Summer in Penrith, the second tier of response, Passive Cooling is used through the block. This is achieved through building cross ventilation, as every apartment has at least 2 facades with openings. It is also achieved through a central wind tower and ventilation shafts in the underground refuge to provide fresh air into the space. The buildings are oriented to capture the dominant summer wind flows.

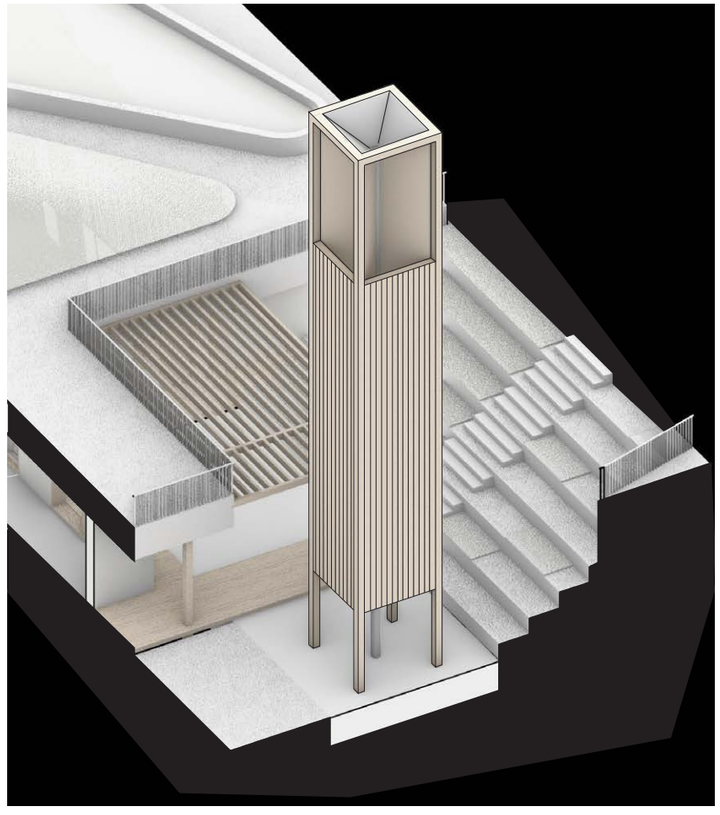


*Dominant summer winds*

## Wind Tower

The wind tower has two openings to the South-East and South-Westerly directions in line with the predominant Summer wind flows. On entering the tower the wind is funneled down into the sunken courtyard where the air flows over a pond at the base, cooling the air by evaporation in the dry months of the year. The air can then circulate through the underground refuge space in order to provide ventilation, and hot air can be released via ventilation shafts that penetrate the ground. This method of cooling has been used in hot climates for thousands of years, and though it is not traditionally used in an Australian context, it has a lot of potential when building underground and when creating neighbourhoods for extreme heat.

Simultaneously, the tower acts as a rainwater catcher and storage, with a funnel located at the top and a pipe running through the centre of the structure into an underground cistern that can be recycled through the block. Further to this, the North-East and Western sides of the tower that face away from the predominant winds function as a kind of message board with local weather conditions such as temperature and humidity, or weather warnings to keep residents informed. The time will also be displayed here, making this landmark a modern clocktower, repurposed for climate resilience.



## Summary of design elements

# Part 5 - Final Words

## Reflections

This project seeks to reimagine suburban Sydney for the future in a way that aligns with the imagination and dreams of the Australian people, and which is realistic about our limited resources. The design seeks to improve liveability, foster community and to integrate nature to create a development resilient to a warmer climate, and that provides shelter for the more vulnerable groups in the community. In this project I had the freedom to experiment, and did so with subterranean spaces, ventilation design strategies and material solutions for my own learning process. I also had the freedom to design without the restrictions that apply to new housing developments in Sydney, such as zoning and density and designed in a way that was aligned with the strategies identified to address the key issues raised in this project; heat, sprawl and isolation.

Perhaps my key takeaway from this project is the power of designing with density at a wider scale, due to the amenity, greenspace and infrastructure it affords. To draw the line at medium density however was important in this suburban context, to prioritise wellbeing, families and ecology. Although this project response was site specific, there is potential for the strategies, and climatic design solutions to be scaled, especially within other areas of greater Western Sydney. Only at a wider scale will the real impacts of the proposed design interventions be felt by the community.

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LUND
UNIVERSITY

**Title: A Home Among the Gumtrees.**
**Reimagining suburban Sydney for a hotter future.**

**Course: AAHM10 - Degree Project in Architecture**

**by Athena Newman-Andrews**

**Examiner: Johnny Åstrand**
**Supervisors: Maria Rasmussen, Ivan Tan**

**Lund School of Architecture, LTH, 2021**