BUILDING BLOCKS FOR A COMMUNITY

Student ID : 1327187

A Research Project submitted in partial fulfillment of the requirements for the degree of Master of Architecture (Professional).
With David Turner and John Hewitt. Unitec Institute of Technology, 2012.

“We architects don’t control the city; we can only aspire to intervene”

ABSTRACT

The traditional New Zealand dream of the ‘quarter acre Pavlova paradise’, a standalone suburban dwelling, is fast becoming unsuitable on the basis of our steadily growing population, shifts in urban demographics, changing lifestyle preferences and rising costs, both ecological and economic. Increasingly complex patterns - of employment and thus commuting patterns – suggests that the injection of pockets of residential intensification within the inner city through the redevelopment of current industrial/commercial zones, or ‘Brownfield’ sites, is a justified planning strategy. In recent practice this has been supported by urban planners and architects alike.

This project explores the challenges faced by architects when designing high density housing in the Auckland region. It investigates ways in which architectural form can generate community and serve as a catalyst for social interaction. Working alongside the 2050 master plan and addressing issues of privacy, sustainability and intensification, the study considers how these issues influence the possibility of social interaction within a regenerating community in the 21st Century. The study explores the potential of higher density housing as a contributing factor in the repair of the community of Arch Hill, a suburb on the fringe of Auckland City, caught between two fingers of infrastructure, Great North Road and the North Western Motorway. Recognising the significance of existing fabric as an expression of the present community, the study explores the integration of two existing 1930’s villas into a modern high density scheme, using the school to redefine the spatial core of the neighbourhood.

From research it has become clear that there is a lack of information about creating communities in high density housing developments in Auckland. This Project investigates the role communities and social interaction play in the development of high density housing form, in pursuit of objectives of social and economic sustainability in inner city intensification.

ACKNOWLEDGEMENTS

It is a pleasure to thank all those who have made this research project possible.

I give a special thanks to my supervisors for their encouragement, guidance and invaluable support throughout the year.

To my fellow classmates in the Master of Architecture (Professional) programme, I thank you for making this a memorable and enjoyable year and wish you the best for the future.

I would like to thank my friends, and a special thanks to my girlfriend, outside the programme for keeping me grounded and supporting me throughout my studies.

Finally, I owe thanks to my family for allowing me to take over parts of the house with drawings, and for your continuous support not only through this year, but through the duration of my studies. Without you it would not have been possible to come this far.

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1 INTRODUCTION

1.1 PROJECT OUTLINE

Urban sprawl has had a significant impact on the development patterns of Auckland's urban regions brought about mostly through the construction of major routes of infrastructure, connecting small urban centres to each other. This connection, an ambitious goal, has instead created segregated regions dividing existing social networks. Intensification of the city will be the development tool used to re-align Auckland with a healthy pattern of growth. As outlined in the 2050 master plan for the Auckland region, intensification will be the key initiative to achieve the goal of the'world's most liveable city' as the housing capacity of developable land is significantly exceeded by the number of housing units required. Current strategic planning theories have identified medium-high density housing as the means to achieve Auckland's goal. Intensification through high density development combats the issues created through urban sprawl, and gives rise to new architectural possibilities.

This architectural project is to formulate a high density housing typology for a 21st Century city in New Zealand. It will focus on the accommodation of the growing population in desirable and sustainable housing catering to individual needs while enhancing a sense of community. At the same time "affordability" will be a focus in future developments of high density housing schemes throughout the country: the model developed in Auckland will inform solutions to similar problems in other New Zealand cities.

The research basis for this project uses a combination of conventional research and research by design. The project's methodological approach combines research and analysis with planning and design. The brief has been subject to numerous amendments throughout the design development as the scope of research widened. Analysis of literature and research for design was integrated with research by design throughout the project's duration.

The region of Arch Hill on the fringe of the Auckland CBD is the context in which this project is to be developed. Located between Great North Road and the North Western Motorway the site has strong links both to Newton and Ponsonby and the wider context of Grey Lynn. The site is currently in use for light industrial commercial activities in low density developments that rely heavily on automobile accessibility from Great North Road. Using the initiatives outlined in the Auckland City Council Master Plan for 2050, the scheme has been structured

to redevelop the existing site and replace existing functions with that of residential. The hypothetical brief is that over time this block will be seen as a prototype for similar high density live/work neighbourhoods, creating pockets of high density residential development within a dominant industrial sector. It is intended, through design development, and coupled with environmental and social sustainability, that a sense of community will be created throughout the neighbourhood. The outcome of the project is defined as the production of an urban design scheme for the whole site, on the basis that this project is be to the first in a series of similar developments, with detailed architectural designs for the high-density dwellings and open spaces.

Relocation/ redesign of existing buildings within the site boundaries was an idea that emerged mid-way through the master planning stage of the project, with initial intent to clear all areas of the site for new development. Doing so meant that the project had been restricted in formal possibilities, but in ways that opened new possibilities to achieve the functional qualities that emerged in the process of design. This re-use allowed for a sustainable approach to be achieved through the reduction in the amount of embodied energy produced during the construction process, and time and cost involved in the new build. Significant alterations to the site boundaries and thus the extent of the site itself were ongoing throughout the project: a definitive site boundary was not clear until quite late in the piece. This process involved decisions of retaining the existing street layout, scope of the site and required proximity to local amenities, and integrating the existing Newton Central Primary School into the housing scheme. Drawing on the traditional ideal of community, the school is to be seen as one of the central elements in the formation of the community, along with configurations based on churches, and community facilities such as libraries and health centres.

With this objective, it is intended that synergies between high density and community are identified; incorporating the principle that sharing some of the spaces and facilities not only reduces expenses for occupants, but enhances social sustainability by community unified action. It is argued that creating a “pride of place” through the design and delivery of good quality homes can enhance the life of those that dwell within them. As social research in Australia has suggested, social sustainability can be achieved when people are provided with high quality, affordable and environmentally sustainable housing.

1.2 RESEARCH QUESTIONS

The project was forged from the question, *'How can the high density typology be used in the development of 21st Century New Zealand cities to build socially interactive communities?'*

This question implies that community and social interaction can be developed through the development of a high density architectural form. Community/social sustainability is a key concept in the project direction. This project however, also aims to incorporate environmentally sustainable concepts in the development of individual units, and of the whole. The social purpose is defined as achieving an urban environment in which people can live together comfortably in shared common spaces whilst having their own private space to retreat to, becoming essential to the social value of community.

Although dense urban living is widely practiced and accepted overseas, it is a relatively new proposition in New Zealand. European countries, particularly England, the Netherlands, and Germany are traditionally advanced in this type of residential development, and Australian cities (to counter the same problem of low density suburban sprawl) have been encouraging higher density housing since the 1970s. In New Zealand the paradigm of the single detached house forms the stereotype and is becoming unsustainable as the only model for urban dwelling in a city that continues to increase its population at a high rate of growth. As an urbanized nation, New Zealanders need to actively move towards higher density living, and it is for New Zealand architects to actively develop high quality alternatives to the 'quarter acre pavlova paradise'[1].

The project in this study needs to produce a solution which is aesthetically pleasing and that demonstrates that dense urban living is a viable and feasible solution for housing current and future generations of New Zealanders. The end goal is to show that this type of living can be achieved in New Zealand and that it can be an attractive alternative to the singular dwelling.

[1] G J Duff ,'The development of house styles in New Zealand 1840-1990', 150 Years of Housing in New Zealand 1890-1990, *New Zealand Real Estate Vol 41*, No.8.(1990), pg 11-20.

1.3 RESEARCH OBJECTIVES

The total objective of this project can be seen as a collaboration of the following:

Objective one:

To implement planning policies and strategies, set out by both the Auckland City Council and the New Zealand Ministry for Environment, to a site in real world context.

Objective two:

Formulate an innovative solution to the issues of density through high quality design of urban housing typologies; the result creating an aspiration of all future development projects.

Objective three:

To develop an innovative high quality urban form that creates a variety of public spaces for a variety of interactions.

Objective four:

To create a multi function development that retains and continues to build on the existing character of the region, whilst rebuilding a community through the incorporation of modern ideals.

1.4 DEFINITIONS

Social Sustainability

Sustainable communities are not only created through sustainable practices. More importantly they are created by the people living in them.

"When we build let us think that we build forever" [2] John Ruskin quoted in Rudlin and Falk 1999.

Social sustainability is not about survival. We should be aiming higher than this, creating neighbourhoods which enhance the quality of life. By promoting neighbourliness within a community people will want to live there and the place will be sustained.[3]

"Sustainability is an overriding social value, influenced and complemented in turn by the provision of choice, safety and a sense of community or neighbourliness."[4]

In accordance with the following statement this project's outline for the provision of social sustainability is to create a...

"development that is compatible with harmonious evolution of civil society, fostering an environment conducive to the compatible cohabitation of culturally and socially diverse groups while at the same time encouraging social integration, with improvements in the quality of life for all segments of the population."[5]

[2] David Rudlin & Nicholas Falk, *Building the 21st Century Home; the sustainable urban neighbourhood*, (Oxford: Architectural Press, 1999), pg 227.
[3] Sally Lewis, *Front to Back; a Design Agenda for Urban Housing,* (Oxford, Burlington: Architectural Press, 2005), pg 41.
[4] Ibid., pg 41

[5] Mario Polese and Richard E Stren. *The social sustainability of cities: diversity and the management of change*, (Toronto: University of Toronto Press Limited, 2000), pg 15-16.

Environmental Sustainability

In essence environmental sustainability means something that can be sustained, and can be thought of as getting more, from less, for longer.[6] There is a need to shift thinking about sustainability from years to generations, as decisions about urban forms made by this generation will continue to have lasting effects on following generations.[7]

"One generation plants the tree; another gets the shade" Chinese Proverb.[8]

Architecturally sustainable urban development involves integrating the requirements of environmental management, social equity and economic opportunity into all decision-making. Sustainable urban development is not a fixed state, but rather a process of change in which

"the needs of the present without compromising the ability of future generations to meet their own needs." [9]

[6] Morgan Williams, *The Cities and their People: New Zealand's Urban Environment*. (Wellington: Parliamentary Commissioner for the Environment, 1998), pg 14.
[7] Rudlin and Falk, *Sustainable Urban Neighbourhood*, pg. 116.
[8] Ibid., pg. 116.
[9] World Commission on Environment and Development, *Our Common Future*, (Oxford: Oxford University Press, 1987), pg 43.

Community

The concept of 'community' is one frequently debated, and is commonly open to two different interpretations:

"The first interpretation of community involves the idea of physical environments where 'community' can be 'built'."[10]

"The second, involves interest groups with a common purpose"[11]

In today's world, community is neither easily designed, nor necessarily place-based, but built by the actions of people over time.[12] It seems to be mutual interest rather than geographic location that inspires people to join together. Lewis (2005) indicates with her summary of 'community':

"Communities cannot be built. People create communities, and these communities grow and change over time. Places, however, can be built. And, it is the role of designers to make sure that these places are not designed for single communities but encourage neighbourliness...neighbourliness is sustainable." [13]

[10] Lewis. *Front to Back: a design agenda for urban housing*, pg 40.
[11] Ibid., pg 40.
[12] Ibid., pg 40.
[13] Ibid., pg 41.

Within the context of a 21st Century city, like Auckland, this idea of community evolves further when considering the impact of 21st Century technologies on the traditional ideals of a community. Virtual Communities, created through the widespread use of the Internet, are places where conviviality is found and where community is built and sustained. 'It is now possible even to have supportive and intimate relationships between people who will never see, smell, touch, or hear each other'.[14]

A sustainable community is defined as

"one in which diversity is tolerated and encouraged, where sharp spatial separation or isolation of income and racial groups is non-existent, and where residents have equal access to basic and essential services and facilities"[15]

[14]Lewis. *Front to Back: a design agenda for urban housing*, pg 40.
[15]Timothy Beatley and Kristy Manning. *The ecology of place: planning for environment, economy and community*, (Washington DC: Island Press, 1997), pg 36.

High Density

One of the enduring themes behind the search for more sustainable urban forms is that of the density of development, higher densities are seen as a significant component in achieving this sustainable urban form. In this context higher density housing is defined as 'mass housing' in the sense that the client is anonymous, and the designers and builders are dealing with the 'architecture of large numbers'.[16] Housing New Zealand Corporation (HNZC) defines high density as:

"Multiple-unit housing where density is greater than 1 unit per 80m2[100dph] of the site area"[17]

HNZC acknowledge that typically, high-density housing is centrally located in apartment buildings. A sustainable urban density has been described by Friends of the Earth as 69 Units per hectare with 275 people per hectare, on the assumption of 4 bedrooms per house hold.[18] 70 dwellings per hectare (dph)[19] is considered to be the base level for high density housing developments according to the East Thames Groups, and as such will be the base level for this project.

[16] David Turner, "Urban Housing in New Zealand: Designing for Flexibility in Medium Density Housing", *Dense Living Urban Structures 1, (2003), pp 61-67,* pg 62
[17] Housing New Zealand Corporation. *Design Guide: Housing at higher densities*, (Housing New Zealand Corporation, 2005), pg. 3.
[18] Rudlin and Falk. *Sustainable urban neighbourhood*, pg. 163.
[19] East Thames Group, *Delivering successful higher density housing: A toolkit* – Second Edition, (East Thames, 2008), pg 4.

1.5 JUSTIFICATION FOR RESEARCH

Housing is the 'most significant built form in the urban landscape and its success in achieving a sense of place is one of the bedrocks of social continuity'.[20] The dream of owning one's own home, the 'quarter acre pavlova paradise'[21], is infused into the New Zealand lifestyle, but is one that ultimately needs to adapt to a future orientated vision. There are now compelling social, economic and environmental arguments which suggest a higher density with more compact housing form[22]. This is much like what we see occurring in New Zealand now - specifically Auckland.

Auckland is experiencing a wave of medium density housing resulting from 'regional planning strategies to increase urban densities in traditionally low density areas, in response to recent and predicted rates of population growth'[23]. The Auckland Regional Council plans to control urban expansion and aims to house 70% of all population growth over the next 40 years within the existing metropolitan limits.[24] In 1998 it was recorded that the population growth of Auckland City 'averages 2.5% (per annum) and had done so for the last 25 years'[25]. In 2012 Auckland's population reached 1.5 million, and is expected to reach 2 million people by 2030 as suggested by Paul Spoonley, a sociologist from Massey University[26]. This yearly population growth is putting pressure on our limited resources and is increasing the need for additional housing production to meet future demands.

The plaguing effects of urban sprawl are not confined to Auckland: many Australian and North American cities are approaching their geographical growth limits. As a city expands beyond its coping limits the issues of congestion, poor public transport, and the loss of community are apparent. Residents are pushed further and further away from the social hubs through new developments with the factors that drew people to the fringe disappearing. Giles-Corti (2011) argues that increased population

[20] David Levitt, *The Housing Design Handbook: A Guide to Good Practice*, (Abingdon: Routledge, 2010), pg 1.
[21] Duff 'The development of house styles in New Zealand 1840-1990', 150 Years of Housing in New Zealand 1890-1990, *New Zealand Real Estate Vol 41*, No.8.(1990) pg 11-20.
[22] Bruce Judd, *Designed for Urban Living*, (Canberra: The Royal Australian Institute of Architects, 1993), pg 33.
[23] Turner, *"*Urban Housing in New Zealand: Designing for Flexibility in Medium Density Housing.*"* pg 61.
[24] Auckland Regional Council, *Auckland's Growth: Residential Intensification*, http://www.arc.govt.nz/auckland/aucklands-growth/residential-intensification.cfm (Accessed on March 21, 2012)
[25] Turner, "Urban Housing in New Zealand: Designing for Flexibility in Medium Density Housing", pg. 61.
[26] New Zealand Herald, *Auckland's population to hit 2 million in less than 20 years?*, http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10782319 (Accessed on May 15 2012).

density can be a way of solving global concerns about 'rising levels of obesity and inactivity, climate change, population growth, declining oil supplies and rising fuel prices'[27], associated with urban sprawl. With the partnership of housing at higher densities and urban intensification two of Auckland's 'least liveable attributes - traffic congestion and poor public transport networks, can be avoided'[28]. Higher residential densities must be accepted and promoted; the day of the sprawling suburb is over. [29]

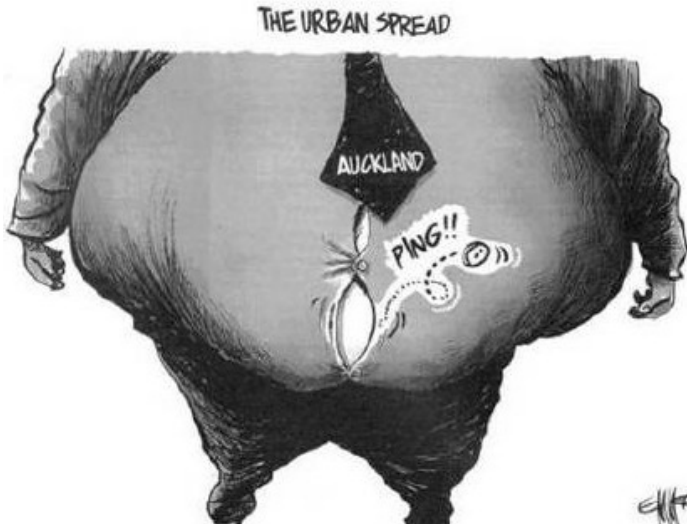


Figure 1: Urban Spread Diagram

[27] Karen Witten, ed., *Growth Misconduct? : avoiding sprawl and improving urban intensification in New Zealand,* (Wellington: Steele Roberts Aotearoa, 2011), pg 14.
[28] Witten, *Growth Misconduct?*,pg 79.
[29] Judith A Davey, *Medium Density Housing and its Place in the Urban Environment*, (Wellington: Town & Country Planning Division, 197), pg 2.

The architectural aspect of this project is to focus on housing design and how to produce high quality living environments for the development of community and social interactions. Through the medium of high density housing, the growing population can be housed using land efficiently, and increase application of available technologies within residential developments.

Negative connotations often surround higher density housing developments and are often seen as a 'transitory and inferior housing type'[30] in both Australia and New Zealand. Poor design decisions of past schemes and fears that intensive housing projects will become the slums of the future[31] are to blame, and can be changed by producing schemes that are designed not from a developer point of view, but from a point of view to enrich the lives of those who live there. This is the purpose of architecture, and the ultimate purpose of this project. High-density housing shall become a widely accepted housing typology of the future on the basis that it creates partnerships between affordability and sustainability, both social and environmental. This project seeks to generate a solution which can be used as the catalyst needed for changing current attitudes towards this housing typology.

[30] Judd, *Designed for Urban Living*, pg 34.
[31] Richard Dunbar and Philip McDermott. *Improving the Design, Quality and Affordability of Residential Intensification in New Zealand*, (Centre for Housing Research Aotearoa New Zealand, June 2011), pg 7.

1.6 SCOPE AND LIMITATIONS

Although the intention of the project is to create a socially interactive community, the issues associated with a social housing scheme are set in political, ethical, and social fields of research which are not of importance in this project. This project is orientated towards the formulation of a mixed community, where a broad spectrum of people is designed for. The people intended as occupiers of this scheme do not require assistance from the government in acquiring ownership of a unit, which separates the project from the field of social housing.

Community forms a central element in the process of providing social housing, so it is expected that this project draws on precedent exemplars of social housing. The project is still intending to be affordable for those in a lower income bracket, but it is not the aim of this project to create a scheme based on financial assistance being required for occupants. Operational costs of the development are expected to be reduced through the integration of sustainable technologies and practices into the scheme. It is expected that the project will make use of a Tenant Managed Organisation (TMO) to monitor the daily requirements of the scheme, additionally building a community through the involvement of occupants in ensuring the development is maintained. This form of ownership creates a sense of pride and belonging for residents and could see them turn the area into their lifelong home.

High-rise housing is respected for its ability to achieve high density living arrangements within a smaller plot of land than its suburban counter parts. What is not often realised are the social implications of housing people, primarily families with young children, in a high-rise structure that has no pedestrian connection to the ground. The ground plane is where social interactions occur - the chance encounter. By removing living functions from the ground and placing them above it we also remove the possibility of social interactions, and therefore the possibility of community. It is on this basis that a high-rise typology will be excluded from the project.

This project will also exclude any research/analysis on supply issues, as there is no expectation to solve these issues currently occurring in the Auckland region. This is a matter beyond the architectural solution

that this project seeks to generate, and as such it needs to be noted that research/analysis into the broader urban economy, land ownership, property development, urban land use, and construction technology will not be included in this project.

What this project does look at are the ways in which higher density housing can become an acceptable alternative to traditionally low density detached dwelling of the suburbs. It also investigates ways in which shared spaces can encourage social interactions, and how a common value or sense of belonging can build a sustainable community of residents within a mixed use neighbourhood.

2 METHODOLOGY

2.1 METHODOLOGY OVERVIEW

The project's methodological approach developed freely, intertwining research and analysis with planning and design throughout the duration of the project, taking aspects from conventional research and from research by design. Adaptations to the brief have been made throughout the process, in order to reach an answer to the definitive research question, aims and objectives. Research fields investigated in the project were determined by key attributes of the scheme; social sustainability issues, where the provision of safe communities create quality neighbourhoods; environmental sustainability and how various features and strategies can be used to reduce energy usage; and the need for community in housing schemes, particularly those at high density. Combining investigations into literature and current practice with the process of generating design solutions, the project was then able to use those ideas/solutions generated to direct further research into practice and theory.

2.2 DESIGN CRITERIA FOR HIGH DENSITY HOUSING

A number of important references, from New Zealand and Australia talk in general terms about housing at higher densities and state specific design criteria and guidelines that aim to control these types of developments. Commonalities can be seen between guidelines sourced from both New Zealand and Australia. Data was collated into thirteen important design principles which the project aimed to reach in order to serve as measure for its success. International and local examples of medium-high density housing were able to be critically examined through the information collected in the list. During this evaluative process successful and unsuccessful design elements became evident, and as a result fed information back into the project. Through the evaluation of these design principles a design brief began to formulate. The application of these design criteria became the justification for selecting the site.

(The full set of criteria can be found in Appendix B)

2.3 CASE STUDY SELECTION AND ANALYSIS

An overview of case study examples was an essential part in the generation of a starting point for the design process of the project. The design principles discussed in the previous section formed part of a critical and evaluative process applied to case study examples both local and international. Due to the requirement of higher residential densities and intensification of their already dense urban environments Australia, the United Kingdom, and European countries, particularly the Netherlands and Germany, have developed high density living as a necessary architectural typology. Their advanced knowledge and experience in the area make these examples a critical resource for New Zealand developments. As such - precedent examples where sourced from the United Kingdom, European countries, and Australia in association with local examples to gain an in-depth understanding of this architectural form.

Due to similar demographics, climate and built environments, Australian exemplars were seen as points of reference during the initial design stages. The architectural style, dwelling layout, site, and density of such schemes made them comparable to local examples. International schemes were selected through a different process, as the typology has been developed to a higher level through necessity. Examples were chosen on the condition that they achieved something not present in New Zealand examples. High density, building form, sustainable technology, and social sustainability formed the characteristics that schemes were selected for.

BedZED (2002), in London, is an exemplar selected for its sustainable aspirations that are in line with the aims of this project. Schemes sourced from across the Auckland metropolitan region provide a varied range of local examples. These local schemes provide a background to the current standard of medium-high density housing schemes around Auckland City. These studies are not model examples or award winning schemes, but they were chosen to investigate density, house type, and the architectural quality of the schemes as well as their apparent successfulness in creating social interactions. Each case study was analysed based on the characteristics discussed in *Criteria Required in the Design of High-Density Housing* (See *Project Development* for full set of criteria). Information collected from these studies has helped to establish an architectural solution based on investigation into architectural precedents.

Considered Case Studies:

>Addison Development
>Beaumont Quarter
>BedZED
>Habitat 67
>Latitude 37
>Odhams Walk
>Talbot Park
>Earthsong

Figure 2: Outlook across Beaumont Quarter

Figure 3: Terraced housing units at Talbot Park

Figure 4: Common space between units, Addison Development

2.4 SITE SELECTION IN THE WIDER CONTEXT

Site selection was based on a combination of field and research findings along with the evaluation of existing developments. From an early stage of the project it was determined that the site for development would be located along one of Auckland city's historical ridge roads. Once the genesis for building development in Auckland, starting at the peak then flowing downwards, it seems fitting that with the need for a new housing typology to emerge we go back to the root of development. Karangahape Road and Ponsonby Road were identified as early possibilities, and their close proximity to Auckland's CBD, and public transport routes was seen as a desired characteristic, previously unrealised. The close proximity to public transport played a key role in the site selection process, as an urge to lessen reliance on the car and the necessity to own one. The 2050 master plan for Auckland City proved a crucial element in the site selection process, as it outlines areas of intended intensification, extended infrastructure networks, and proposed public transport systems. With sustainability, both environmental and social, being a key aspect of this project, it was important to ensure the location of the scheme was going to fit into the current context, but more importantly that of the future. The high density, mixed-use urban model has been strongly advocated in the pursuit of the sustainable city, and is dependent on good local accessibility for residents to the services and facilities that they use on a day to day basis[32]. As such, easy access to local amenities such as public transport, work places, shops, community facilities and other everyday services have been key features in the search for a suitable site, and were deemed to be required within the radius of a five minute walk. Other facilities, such as weekly services, were deemed to be required within the radius of a ten minute walk[33]. The location of essential community amenities, schooling and churches, formed a critical element in the evaluation of suitable sites and narrowed down the possibilities in association with proximity to transport routes. Areas identified as suitable locations were Grey Lynn, Newton, and Ponsonby. Each region was selected due to their proximity to community facilities and services as well as transport systems and close proximity to the Auckland's central business district (CBD).

[32] Mike Jenks and Nicola Dempsey, eds. *Future forms and design for sustainable cities*, (Oxford: Architectural Press, 2005), pg 313.
[33] Leon Krier, *The Architecture of Community*, (Washington: Island Press, 2009), pg 140.

2.5 SITE ANALYSIS OF ARCH HILL

Arch Hill emerged as an area of great potential for a development of this typology. Its close proximity to the regions identified in the previous section allow for connections to occur between them, and inspired this project to develop as a central element connecting the surrounding areas and creating its own community which reinforces the ones existing. Using principles formulated in preliminary research the next step was to analyse the surroundings of Arch Hill. This analysis primarily focused on the Northern section of Arch Hill, as focusing on the southern section would locate the scheme at an inconvenient distance from the CBD. A wider understanding of the existing neighbourhood, its characteristics and its adjoining amenities was gained from this process, and further analysis was ongoing throughout various stages of the design process. This continued analysis resulted in refinements to the project direction. Thorough investigations of existing buildings on the selected site led to a decision to retain/relocate existing functions to preserve some of the characteristics present on the site.

2.6 DESIGN EXPLORATION

Master planning and design work were ongoing throughout the processes of initial research. Case studies and site analysis helped to gain a higher understand of the elements involved with the site and with the project itself. The master planning process included the location of existing amenities in the area, as well as public transport nodes. The different zoning and densities of the surrounding context were acknowledged as part of this process, and influenced decisions made about the location of buildings on the site. Possible pedestrian and vehicle movements were analysed at this stage to gain an understanding of how the site connects to surrounding areas, and to how occupants may move through the site if it was to be cleared of buildings. Design exploration was a process of constant trial and error, through the medium of sections, plans, and 3D computer models, with the aim of producing an architectural solution. Research was explored to aid in design and design was used as means of investigating the findings. The presentation of design solutions were expressed through a combination of sketching, computer modelling, hard line drawing and physical modelling.

3 CURRENT STATE OF KNOWLEDGE

3.1 Managing urban growth in Auckland

The Auckland region is home to approximately one third of New Zealanders, and is thus the largest urban district in the country.[34] In its early years Auckland grew in a compact manner dependent on limited transport networks. Continuing into the 20th Century up until the Second World War public transport served as the main tool for Auckland's urban development.[35] New Zealand car ownership expanded to become the second highest per capita in the world, behind the United States[36] in the period leading up to the Second World War. This saw private transport become the dominant means of moving people and goods and had two significant effects on Auckland; a steady withdrawal in public transport usage, and a wider area of urban development.

"The rapid expansion of the motorway network, combined with a lack of emphasis placed on public transport, was the beginning of a soon-to-be-dispersed urban area."[37]

The Auckland Region has a historic growth pattern of doubling in population approximately every 30 years and it is anticipated that future growth will follow this pattern. As 1999 growth projections suggested, Auckland's population could reach 1.6 to 2.2 million people by 2050, increasing the population by an average of 20,000 per annum. Around 700,000 dwellings will be required to house a potential population of two million people. This points to a need to accommodate a further 200,000 dwellings, in addition to the existing housing stock and capacity under current policy.[38]

[34] Statistics New Zealand, *2006 Census: QuickStats About Auckland Region*, http://www.stats.govt.nz/Census/2006CensusHomePage/QuickStats/AboutAPlace/ (Accessed April 12, 2012).
[35] James Watson, *Links: A brief history of Transport and New Zealand society.* (Wellington: GP Publications, 1996) quoted in Joshua Warne, *The Architectural Impact of Urban Intensification A study of medium density housing in the Auckland region*, (Masters Thesis, Unitec, 2011), pg 7.
[36] G. Bloomfield, "Urban Tramways in New Zealand 1862-1964". *New Zealand Geographer* 31, (1975): p99-123 quoted in Joshua Warne, *The Architectural Impact of Urban Intensification A study of medium density housing in the Auckland region*, (Masters Thesis, Unitec, 2011), pg 7.

[37] Auckland Regional Council, *A Brief History of Auckland's Urban Form*, http://www.arc.govt.nz/auckland/built-environment-and-land-use/a-brief-history-of-aucklands-urban-form.cfm (accessed April 29, 2012), p 15.
[38] Regional Growth Forum. *Auckland Regional Growth Strategy 2050: A Vision for Managing Growth in the Auckland Region*, (Auckland: Auckland Regional Council, 1999), pg 15.

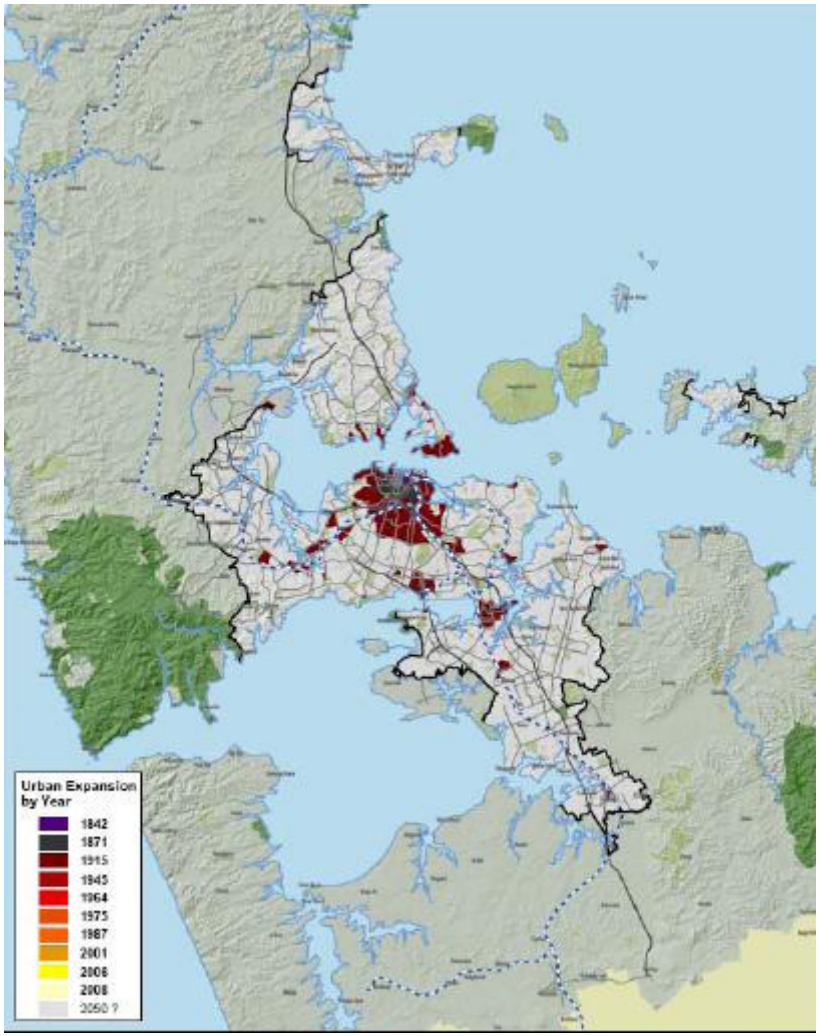


Figure 5: Auckland Settlement 1915

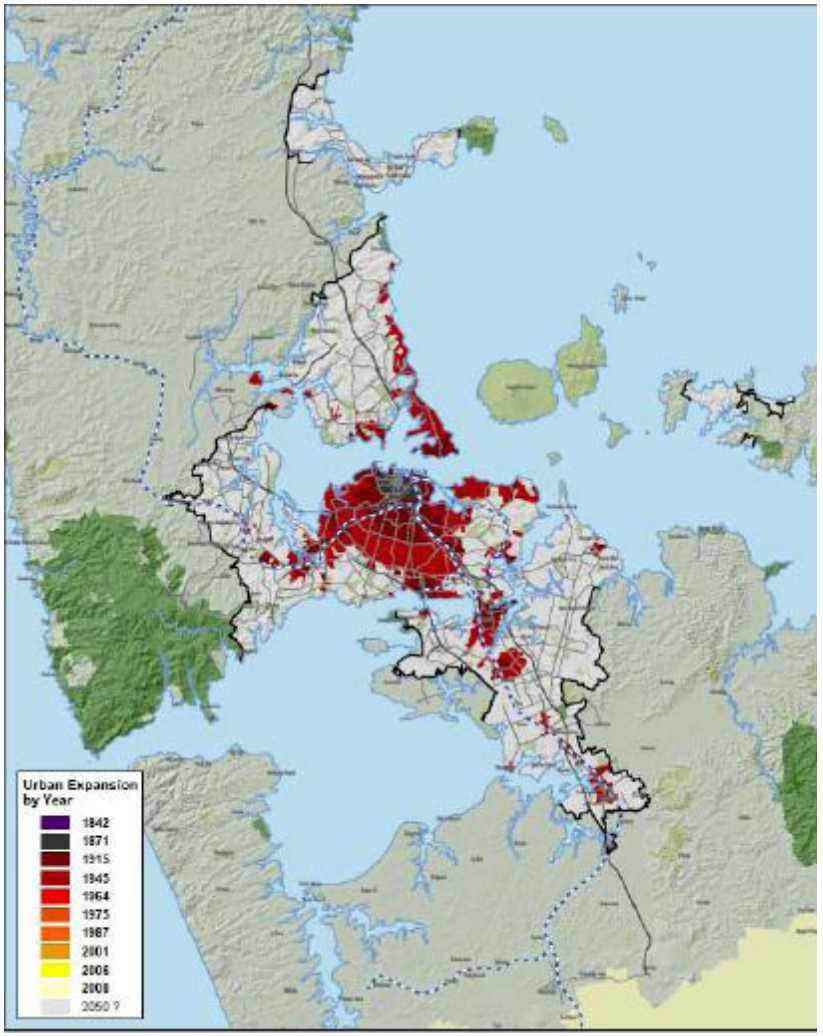


Figure 6: Auckland Settlement 1945

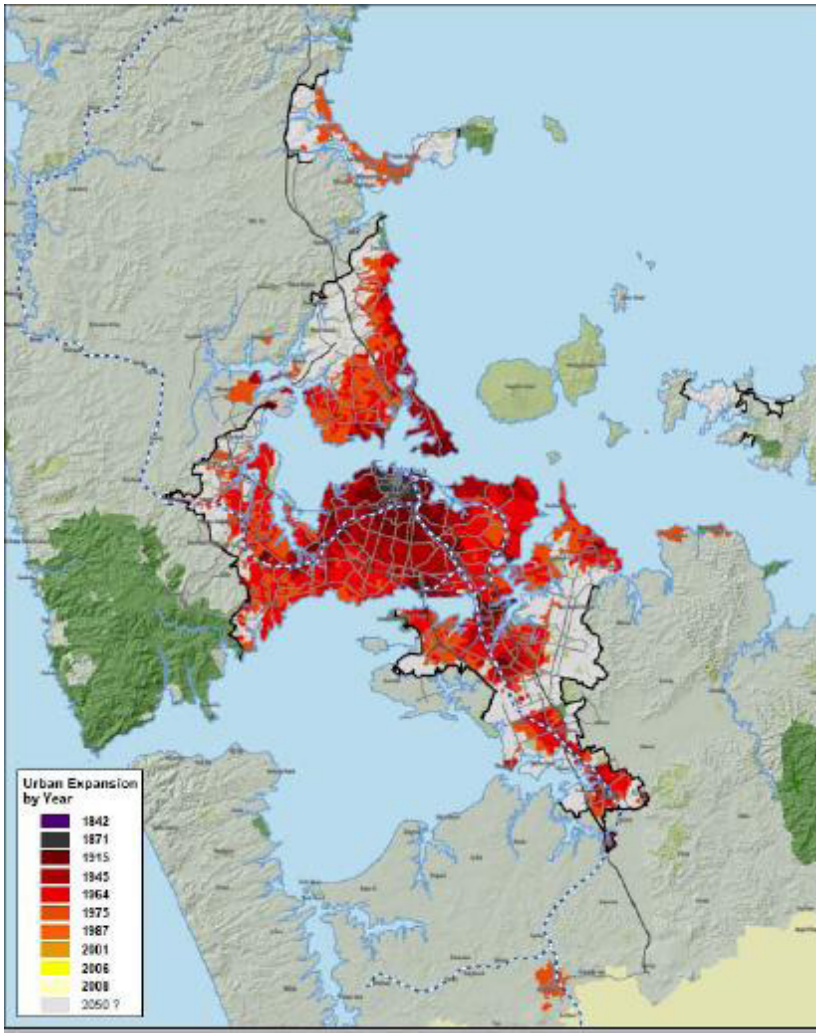


Figure 7: Auckland Settlement 1975

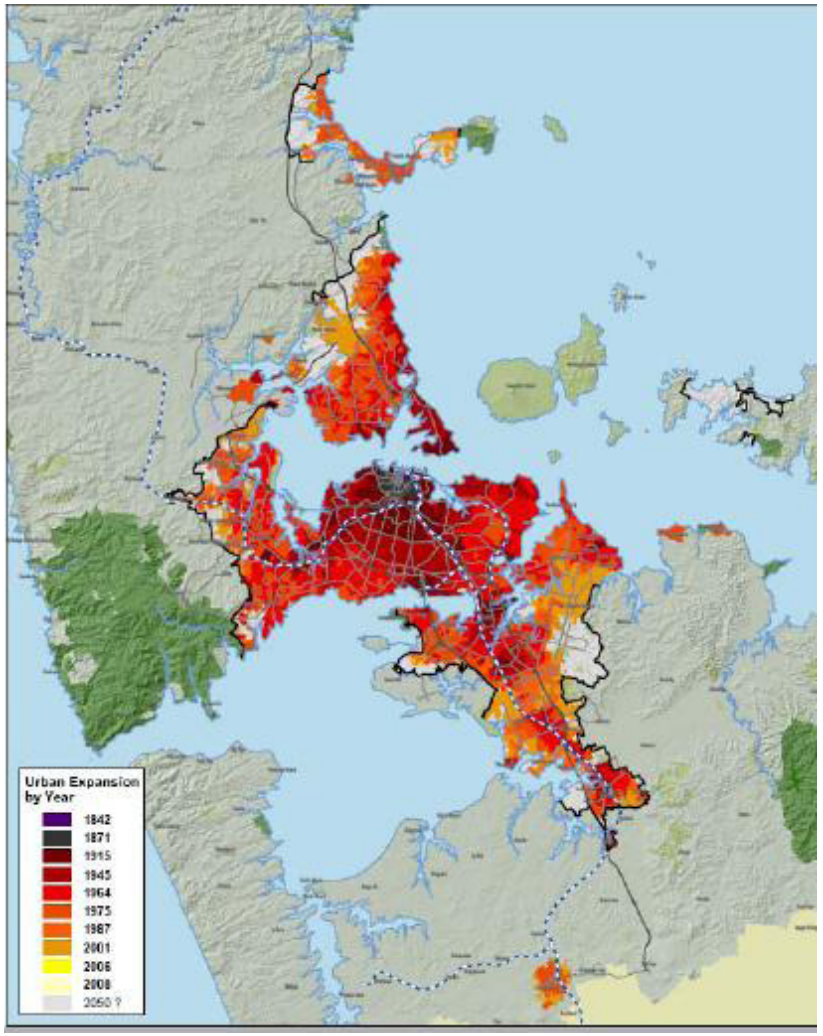


Figure 8: Auckland Settlement 2001

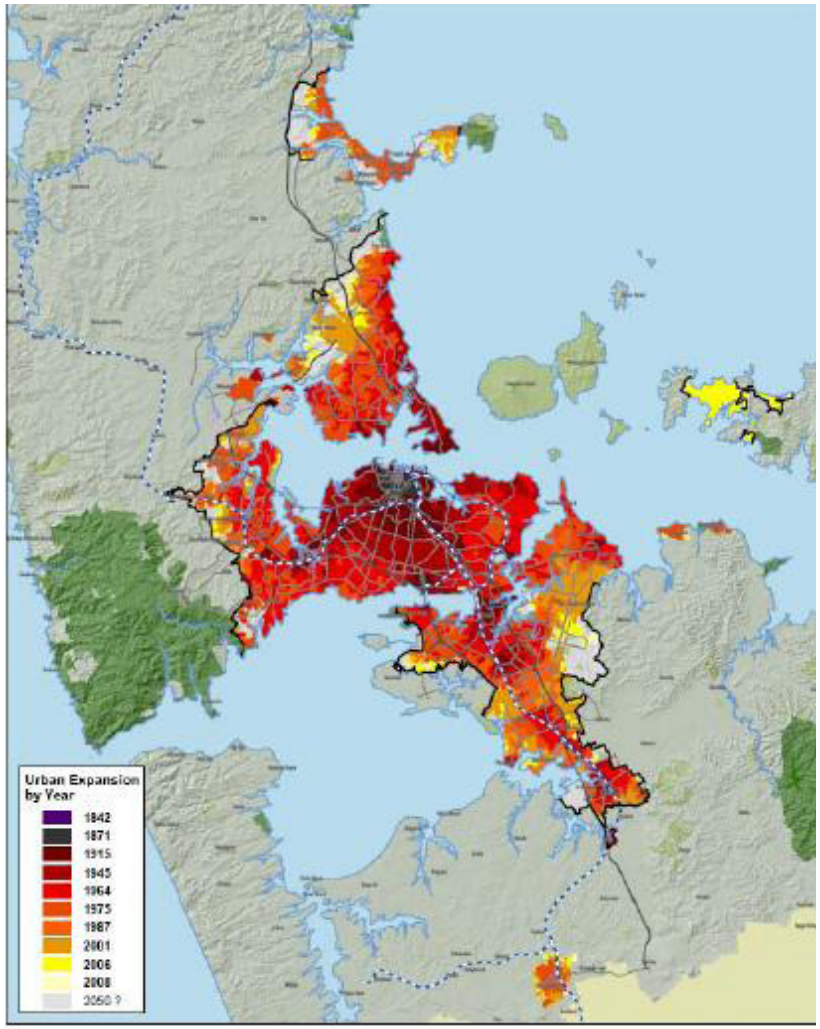


Figure 9: Auckland Settlement 2008

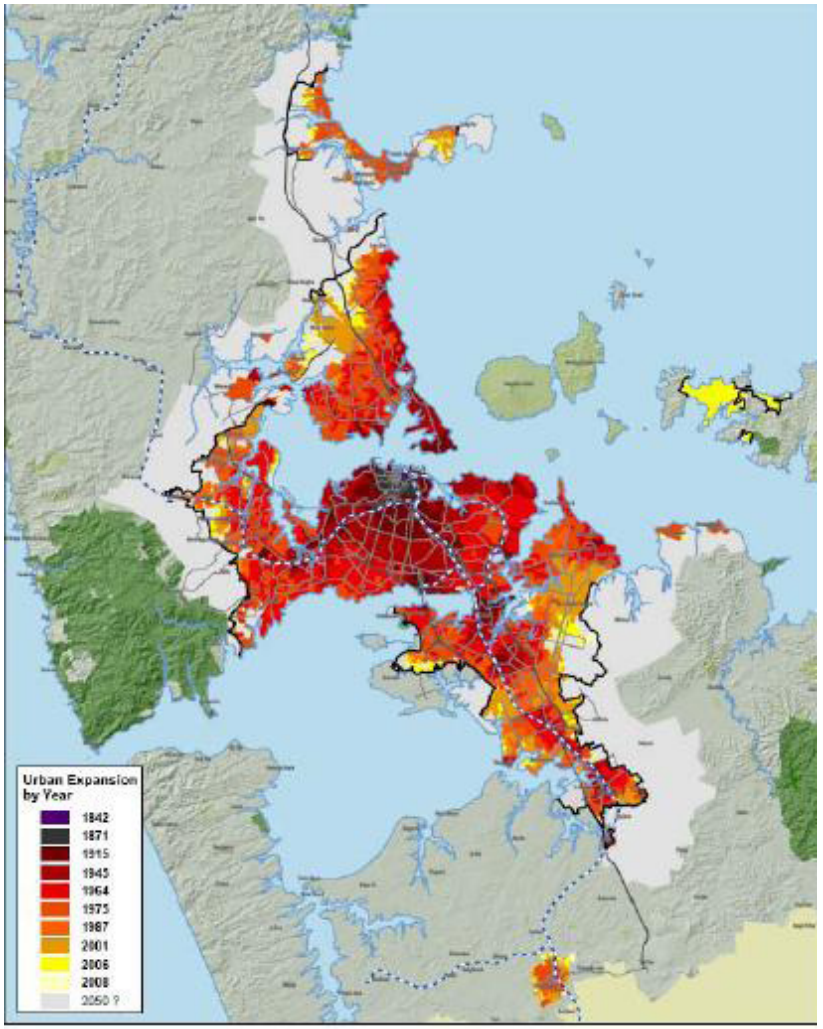


Figure 10: Auckland Settlement 2050?

Successful growth management recognises the fact that growth is an inevitable issue that must be dealt with. Existing built up centres with good quality public transport, vacant land within the existing metropolitan area, infill development and redevelopment will be a focus of future growth and provide future housing possibilities.

The Auckland Regional Growth Strategy has set outcomes in order to manage growth efficiently and avoid its impacts. A number of outcomes in the strategy can be directly implemented in this project and include the following:

>Access and Transport Efficiency
>Sustainable Use of Resources
>Urban Amenity
>Safe, Healthy Communities
>Housing Choice / Affordability
>Physical and Social Infrastructure
>Open Space

(Refer to Appendix C for the Full statement of desired regional outcomes to be achieved in a Regional Growth Strategy)

"Exactly like an individual who has reached maturity, a 'mature' city cannot grow bigger or spread out (vertically or horizontally) without losing its essential quality"[39]

Auckland's current growth pattern is placing pressure on the region's physical and social infrastructure, the economy and the environment. Having previously dismissed the proposal of population limiting, The Auckland Regional Council had the growth options of relaxing the boundaries of urban development entirely, or increase the urban density. It was concluded in the Auckland Regional Growth Strategy that a mixture of the two options would be best suited for Auckland. Concentrating on intensification, the Auckland Regional Council plans to control urban expansion and aims to house 70% of all population growth over the next 40 years within the existing metropolitan limits.[40]

"Future development will be focused around centres that are liveable, walkable places with a wide range of jobs, businesses, housing, recreation and other services and facilities, connected along major corridors with high quality public transport." [41]

[39] Krier, *The Architecture of Community*, pg 134 .
[40] Auckland Regional Council, *Auckland's Growth: Residential Intensification*, http://www.arc.govt.nz/auckland/aucklands-growth/residential-intensification.cfm (Accessed on March 21, 2012).
[41] Regional Growth Forum. *Auckland Sustainability Framework: an Agenda for the Future*, (Auckland: Auckland Regional Council, 2007), pg 24.

The site selected for this project, in Arch Hill, located along one such corridor.

A more compact urban form encourages development at higher densities. The Auckland Regional Growth Strategy defines intensification as *"an increase in density (of dwellings, activity units, population, employment etc) over current density of a given area".*[42] Minimising urban sprawl and thus encouraging intensified growth can have positive impacts on the community, between neighbours, increasing energy efficiency and improving housing affordability and choice. Intensification is argued to improve access to services, facilities and jobs, by placing people close to public transport and within walking distance of many of their needs.[43]

A significant increase in residential intensification and multi-unit dwellings is promoted by the Auckland Regional Growth Strategy stating that in 50 years time, more than a quarter of the population (more than 500,000 people) could be living in multi unit housing.[44]

[42] Auckland Regional Growth Forum, *A Vision for Mananging Growth in the Auckland Region; Auckland Regional Growth Strategy: 2050*, pg 77.
[43] Catherine Syme, Victoria McGregor and David Mead, *Social Implications of Housing Intensification in the Auckland Region: Analysis and Review of Media Reports, Surveys' and Literature* (Auckland: 2005), pg 5.
[44] Auckland Regional Growth Forum, *A Vision for Mananging Growth in the Auckland Region; Auckland Regional Growth Strategy: 2050*, pg 3.

The relatively recent and rapid ascension of medium to high density housing in New Zealand has been met with considerable backlash in the media and from the public.[45] Commonly, intensified housing is associated with poor design quality and low amenity contributing to a negative public perception thus lowering the acceptance of this housing form. It is important that we begin to change the public's attitude toward increased density living. It is the aim of the architectural project described in this document to change current attitudes toward intensive living by producing a high quality scheme meeting the needs of the residents and the neighbourhood.

New Zealand society has undergone substantial demographic change in the last 20 years, and will continue to do so. The implications of these demographic dynamics are such that small households (1-3 persons) are increasingly becoming the norm. Yet the status quo planning controls do not reflect

[45] Kathryn Scott, Angela Shaw and Christina Bava. *Liveable Communities, Healthy Environments or 'Slumification' in Glen Innes. Auckland, New Zealand*, pg 3, http://www.learningsustainability.org.nz/Publications/scott-etal_2006_liveable-communities-healthy-environments-slumificatino-glen-innes_submitted.pdf (accessed April 10, 2012)
[46] Matthew Paetz, "Reconsidering Density: Alternatives for New Zealand". *Planning Quarterly*, June 2007, pg 23.
[47] Statistics New Zealand, *National Family and Household Projections: 2006-2031 update*, July 2010, pg 7.

these changes.[46] There has been a steady decline in the average number of people per household with 3.7 people in 1951, 3.0 people in 1981, and 2.6 people in 2006 and is projected to be 2.4 people by 2031.[47] Similarly Australia has also encountered significant demographic changes resulting in a desperate need to provide responsive housing forms.

(See Appendix A for Projected Family Types Graph)

Households dropped from an average of 4.5 persons in 1911 to 2.6 persons in 2006, and continue to decline, with 2.3 persons projected by 2026.[48] What these statistics show is that the traditional nuclear family is becoming a rarity, with more people living with un-related adults and couples delaying or forgoing having children to establish a working career. Housing forms have failed to reflect these demographic shifts with house sizes in Australia increasing from 162m2 in 1985 to 239m2 in 2006.[49] In order to grow efficiently and in accordance with the new demographic patterns what we need are flexible types that make it possible to react to changing life circumstances by simple means.[50]

[47] Statistics New Zealand, *National Family and Household Projections: 2006-2031 update*, July 2010, pg 7.
[48] Andrew Gorman-Murray and Robyn Dowling, " Making home in contemporary Australia", *Architecture Australia* 100, No 3 (2011), pg 45.
[49] Ibid., pg 45
[50] Christian Schittich, (Ed). *In Detail: High Density Housing: Concepts, planning, construction*, (Basel: Birkhauser, 2004), pg 9.

Instead, inflexible and mismatched to needs, most of our housing is built and sold as a commodity for financial gain, prone to the same blandness, packaging and marketing techniques as take-away food.[51]

In the Auckland region, higher than average house prices have become a result of significant demographic change over previous years. Coupled with this change in demographics is a significant shift in the way we live in our homes. Statistics New Zealand have projected that couples without children will account for the majority of population growth, projected to have an average increase of 1.7% per annum with 253,000 more couples without children in 2031 than in 2006.[52] One person households are projected to increase by an average of 2.0% a year from 363,000 in 2006 to 602,000 in 2031.[53] As a result it seems inevitable that the cost of a new single family home will continue to rise and will be beyond the means of more and more households. At the same time increasing travel costs will make long distance commuting less acceptable. This will encourage inner city housing and all types of redevelopment.[54]

[51] Graeme Robertson (ed), 150 Years of Housing in New Zealand 1890-1990, *New Zealand Real Estate Vol 41*, No.8.(1990) pg 11-20.
[52] Statistics New Zealand, *National Family and Household Projections: 2006-2031 update,* July 2010, pg 4.
[53] Ibid., pg 4.
[54] Davey, *Medium Density Housing and its Place in the Urban Environment*, pg 105.

3.2 Defining Housing

There are clear-cut differences between houses and housing. "Houses", designed individually, are usually developed for the actual owner/occupier of the building form, allowing the architect/designer explicit details of how the building will be used. Inversely, "Housing" is almost always designed with little participation/collaboration by/with the future occupiers. Towers (2005) describes this distinction as follows:

"Externally the house has to address all directions, making the most of relationships between indoors and outdoors while at the same time creating a visual impact that reflects the prestige of its owner and the aspirations of its designer. What it does not have to do is pay much attention to its neighbours. In the design of housing, on the other hand, neighbourliness is the first principle."[55]

Housing integrates multiple dwellings on site, usually connected to each other, resulting in relational problems that are not often encountered through the design of one-off houses.

The success of a housing project can be determined by the quality of principle design issues; privacy issues of sound, visual intrusion, odour transmittance, relationships to services and amenities, quality of private and public space. Higher density levels provide great social potential due to inhabitants living in closer proximity than in detached house types. They are thus more likely to interact with each other. Higher density residential buildings exist not in a vacuum, but as part of an urban network, a context[56], and as such have the potential to define and organise space. As Towers (2005) explains, *"... the complexity of housing design lies not in the planning of individual houses, flats, and maisonettes but in the way they interact".*[57]

[55] Graham Towers, *At Home in the City: An Introduction to Urban Housing Design*, (Oxford: Architectural Press, 2005), pg 1.

[56] Bernard Luepen and Harald Mooij, *Housing Design: A Manual,* (Rotterdam: NAi Publishers, 2011), pg 9

[57] Towers, *At Home in the City*, pg 2.

3.3 Defining Environmental Sustainibilty

New Zealand as a whole suffers from uncomfortable homes during the winter. On average they are 6°C below World Health Organisation recommended minimum temperatures.[58] New Zealand has one of the highest winter mortality rates in the developed world with 1600 more people dying in winter than in summer. A key contributor to this is cold, damp and mould indoors affecting the health of 25% of our households.[59] Heating these homes is difficult and wastes unnecessary energy with nearly a third of New Zealand's electricity used domestically.[60]

In addition to our excess heating requirements, New Zealanders are using excess treated and reticulated water for non-potable use. The national average for treated water consumption is 241L per person, per day, while only 5L per person, per day, is required for potable use.[61]

The research in the following paragraphs forms a foundation upon which we can begin to utilize a range of features and technologies that will help our homes become more energy efficient and most importantly healthier and warmer to live in.

Figure 11: Current consumption rates

[58] Beacon Pathways Ltd, *Why Our Homes Should Be Smarter*, http://www.beacon-pathway.co.nz/being-homesmart/article/why_our_homes_should_be_smarter# . (accessed August 2, 2012).
[59] Ibid., (accessed August 2, 2012).
[60] Ibid., (accessed August 2, 2012).
[61] Ibid., (accessed August 2, 2012).

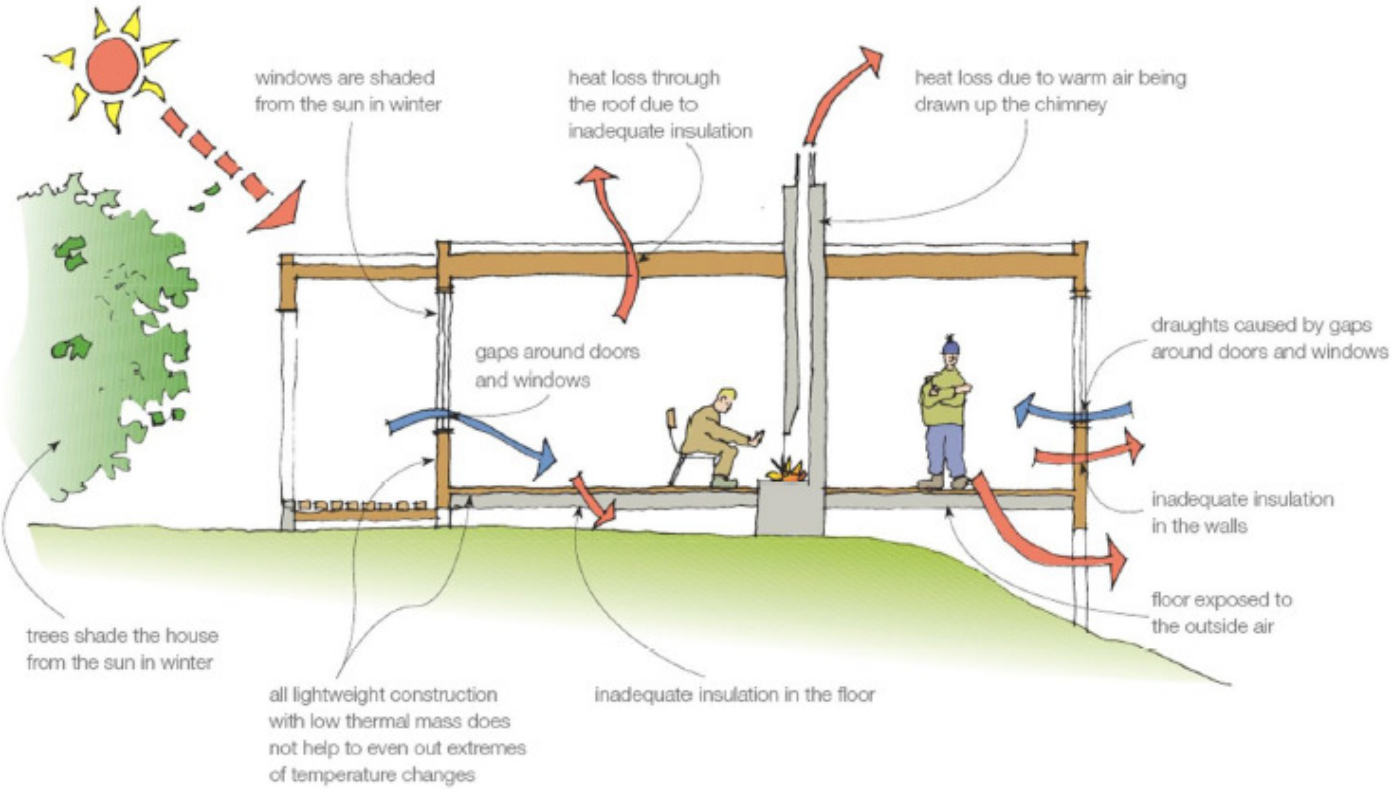


Figure 12: Why our homes are cold

3.3.1 Achieving Sustainability in this project

In this project, four sustainable design features have been incorporated with an aim at producing dwellings which run more efficiently. The dwellings are expected to have lower operation costs, and more importantly have a positive impact on the health of residents.

Figure 13: Green Wall system

Figure 14: Photovoltaic panel at BedZED

Figure 15: Community vegetable garden

1. Conserving Energy

Conserving the amount of energy that we use in our homes is one way we can make long term savings associated with running costs. Our energy demand increases each year as our population and economy grow - we are using about 2% more energy each year. Making the most of our energy efficiency opportunities means we can reduce this growth in energy demand.[62] *"Energy efficiency is not about going without – it is about getting more for your money and stopping waste."* [63] Energy efficient designs aspire to achieve one of the following goals:

Getting more output from the same energy
Getting the same output from less energy
Getting more output from less energy

(For further discussion about Conserving Energy see Appendix E)

Auckland's ecological footprint is 4.8 times the region's land area. An ecological footprint is the land needed to support Auckland's consumption! V

Figure 16: Auckland's ecological footprint

[62] EECA; Energy Efficiency and Conservation Authority, *Efficient and renewable energy,* http://www.eeca.govt.nz/efficient-and-renewable-energy/energy-efficiency-and-conservation (accessed August 6 ,2012).
[63] EECA; Energy Efficiency and Conservation Authority, *Ecca Energywise; Why Be Energy Efficient*, http://www.energywise.govt.nz/. (accessed August 6 ,2012).

2. Energy from renewable sources

Renewable energy - i*s just as it sounds energy that is self-restoring. Examples include wind, solar energy, hydro energy and bioenergy from biomass (biological materials that store energy from the sun).* [64]

Non-renewable energy - *comes from fossil fuels like oil and gas. Once it's used - it's gone.*[65]

Space and water heating are the two biggest consumers of energy within New Zealand homes. The optimization of our renewable energy sources can successfully achieve energy savings in these areas, and ultimately contribute to healthier and more comfortable homes.

This project will investigate passive design strategies in partnership with energy generation techniques to utilize renewable energy in the home to reduce the space and water heating energy consumption.

(For further discussion about Energy from renewable sources see Appendix E)

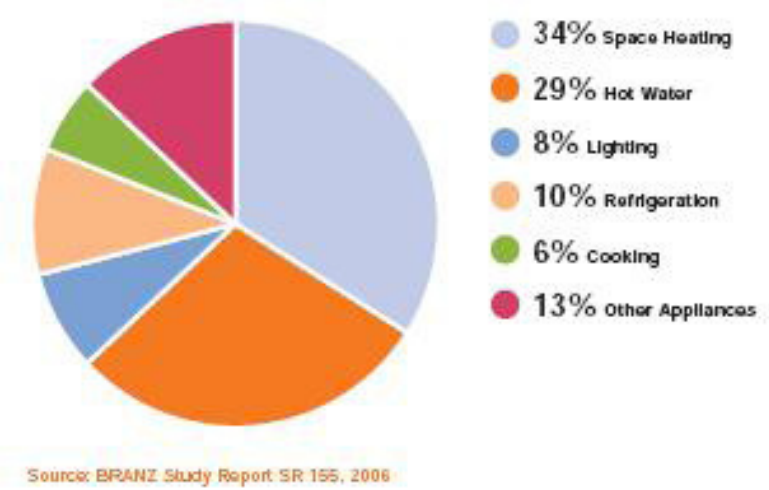


Figure 17: Heating requirements for a New Zealand home

[69] http://www.eeca.govt.nz/efficient-and-renewable-energy/renewable-energy
[70] Ibid., (accessed August 6 ,2012).

3. Water Management

"In New Zealand, we're surrounded by water. It's easy to think of it as a free resource - one that will never run out. But that isn't entirely the case. Increasingly, towns and cities are facing water shortages."[66]

Limiting the amount of water via the mains supply is one method of controlling water usage in the home. Additional means of water conservation are rainwater collection and storage, and grey water recycling.

(For further discussion about Water Management see Appendix E)

Figure 18: Rainwater collection tank at Earthsong

[66] Smarter Homes, *Water*, Department of building and housing, http://www.smarter-homes.org.nz/water/ (accessed on August 12, 2012).

4. Material Selection

"Building materials account for about half of all material use worldwide and about half the solid waste generated".[67]

Sustainable architecture needs to recognise that building materials have *"an environmental impact at every step of the building process – from extraction of raw materials to processing and manufacturing, transportation, construction and eventual disposal at the end of a building's useful life".*[68] Careful material selection throughout the design and build process can ensure low environmental impact, efficient use and minimisation of waste generated, which ultimately will deliver a sustainable building that is cost-effective and comfortable to occupy.

New Zealand has established statutory requirements that promote sustainable development through the ways buildings are designed, constructed, and used. Under the Building Act 2004 designers, builders, local authorities and building owners must consider:

>Minimising waste during construction
>Using sustainable materials
>Using safe and healthy materials
> Energy conservation and efficiency of materials and systems
>The durability of materials[69]

[67] Branz, *Level;Material Use*, http://www.level.org.nz/material-use/ (accessed August 8, 2012).
[68] Ibid., (accessed August 8, 2012).

[69] Branz, *Level;Material Use*, http://www.level.org.nz/material-use/ (accessed August 8, 2012)

"Stabilised Rammed Earth is a high performance, cost effective building material. It is suitable for both modern and traditional construction. It can be used in many different ways in buildings including load bearing walls, thermal mass, acoustic insulation and aesthetic impact. It is both durable and beautiful."[70]

Rammed Earth walls are an environmentally friendly alternative to using concrete as a building material, and contribute to the construction of sustainable buildings within New Zealand. This product is produced as vertical wall panels, and can be used as a horizontal floor element, catering for a wide range of applications.

Figure 19: Rammed earth wall construction

Walls are constructed by ramming a mixture of earth, gravel, sand, silt and clay into place between formwork. For a stabilised rammed earth element 7-10% cement is added to the mixture to provide additional strength and durability.[71] External rammed earth walls are a minimum of 300mm thick to ensure structural performance of the product, Earthsong uses 350-400mm walls. Due to their thickness rammed earth walls have high thermal properties, which make it an effective insulator to prevent heat loss through the building fabric. The interior space requires less energy to maintain a comfortable indoor living environment during the winter months, and therefore allows the space to remain cool during the summer. Similarly to concrete, rammed earth can provide thermal mass to a building by being utilised as a floor slab.

Other benefits of using rammed earth building systems include: increased acoustic performance; Earth is incombustible so is suited fire rated applications; load bearing; easily worked and fast construction; cost effective; pest proof; and can be applied to variety of applications. Rammed earth materials can be sourced locally, giving the resulting product a low embodied energy compared to concrete construction.

[70] Terra Firma, Earth Building Company, *Rammed Earth*, http://www.earthhomes.co.nz/rammed-earth/ (accessed on August 13, 2012).

[71] Terra Firma, Earth Building Company, *Rammed Earth* http://www.earthhomes.co.nz/rammed-earth/ (accessed on August 13, 2012).

3.4 Defining Social Sustainibilty

"Engaging with the community for the long term is a key aspect of designing and delivering good homes and places that are sustainable."[72]

The quality of life within a neighbourhood is largely defined by the social value of sustainability; with choice, safety and a sense of community generating the greatest influence. Through the process of design, every housing scheme strives to achieve an environment that is responsive to the changing needs and desires of the occupants.

Choice, safety, and community have become core ideas in defining social sustainability for this project.

Choice

"Planning for mixed communities allows people with varying economic power to choose between a variety of different buildings, locations, and neighbourhoods in which to live."[73]

In modern society, as with past societies, it is those with economic authority that have freedom to make choices about how they live, work, play and travel. As expected those with lower or limited economic value are disadvantaged as their ability to make choices throughout their lives is governed by their financial limits. The above quotation indicates how social and economic equality can be addressed within a city through the provision of choices for living and working for all types of people. Diversity is seen as the primary generator of urban vitality because it increases interactions among multiple urban components.[74]

"Diversity is likely to be found where there is a mix of more than one housing type, including owner vs. renter occupied and single family vs. multifamily housing."[75]

[72] Lewis. *Front to Back: a design agenda for urban housing*, pg xv.

[73] Lewis, *Front to Back: a design agenda for urban housing*, pg 39.
[74] Emily Talen, *Design for Diversity, exploring socially mixed neighbourhoods*, (Oxford: Elsevier Ltd, 2008), pg 35.
[75] Ibid., pg 25.

Safety

"Safety and security needs to be dealt with at a variety of different levels; in the home, in the immediate space around the home, on the routes to and from work or local facilities, and in the streets and spaces of the wider neighbourhood."[76]

In housing developments, occupant safety is reliant on the vitality of the public realm, which is in turn reliant on pedestrian activity through permeable and legible networks. There needs to be a clear and obvious distinction between public and private spaces within neighbourhoods of high density as it becomes difficult to control people moving through the site. Developments of mixed-use communities, similar to the one described in this project, where live, work and play facilities are combined, are well suited to active surveillance tools due to increased pedestrian movement.

"Safety will be both effective and sustainable when a place ensures safety from homes, to streets, to neighbourhoods."[77]

[76] Lewis, *Front to Back: a design agenda for urban housing*, pg 41.
[77] Ibid., pg 41.

Community

"Communities are not built, but transformed and developed by people over time. Single tenure communities should be avoided. Places of mixed use shall prevail in order to achieve a sense of community, where people of all types can successfully and happily live together."[78]

A good sense of community adds positive benefits to a development with research indicating that developments with high levels of social connectedness tend to have higher residential satisfaction than those without.[79] Neighbourly relations is said to be even more important in higher density developments due to the proximity of neighbours with, Helpern (1995) stating that:

"If a person is in frequent social contact with his or her neighbours, then the objective quality of the dwelling makes only a small difference to the level of residential satisfaction. If, however, a person (in the same area) is not in frequent social contact with neighbours, then the objective quality of the dwelling makes a very large difference to residential satisfaction."[80]

[78] Lewis, *Front to Back: a design agenda for urban housing*, pg 41.
[79] Hazel Easthope and Sarah Judd, *Living Well in Greater Density*, (Sydney: Shelter NSW, 2010), pg 21-23.
[80] David Halpern., *More than Bricks and Mortar? Mental Health and the Built Environment*, (London: Taylor and Francis Ltd, 1995), pg 113.

A developed sense of community has significant impacts of the success of high density schemes, noting that social interaction increases the likelihood of good communication, improved feelings of safety and security, and tolerance when resolving conflict.[81] The extent to which this involvement and support will occur among residents is dependent on the type of place created. Social relations can be bound by diversity, not similarity,[82] suggesting that the ideal of community is closely related to the idea of choice within a high density housing scheme. The spaces created between building forms play a more significant role in the defining of a community than the buildings themselves, as it these spaces that will form the background for any and all social interaction.[83] This concept draws on Jane Jacobs' proposition that a sense of community, and also its actual existence can be enhanced with built forms that increase social interactions. Social processes do not occur on the head of a pin, by definition people live and breathe in and through space.[84]

Figure 20: Privacy and community balance

[81] Mulholland Research & Consulting, *Perceptions of Privacy and Density in Housing: Report on Research Findings prepared for the popular housing Group*, (London: Mulholland Research & Consulting, 2003), pg 17-18.
[82] Emily Talen, *Design for Diversity, exploring socially mixed neighbourhoods*, (Oxford: Elsevier Ltd, 2008), pg 27.
[83] Jane Jacobs, *The death and life of great American cities*, (New York: Vintage Books, 1961)
[84] Andrew Sayer, *Method in Social Science: A Realist Approach*, (London: Hutchison, 1984), 148, quoted in Alexander Cuthbert, *The form of Cities, Political economy and Urban Design*, (Oxford: Blackwell Publishing, 2006), pg 1.

Mixed Use Development

"Achieving a mix of uses is a key dimension of sustainable high density urban housing, providing facilities and amenities for residents and a varied and active public neighbourhood."[85]

The combination of residential and non-residential functions within a development helps to create a socially and environmentally sustainable community. The live-work dwelling is a dominant housing typology within a mixed-use scheme, providing opportunities for residents to work from home whilst ideally still being in close proximity to the city. Mixed communities which promote a variety of uses increases choices of experience for users, and is sustainable in terms of dealing with social dynamic environments.[86]

Mixed-use becomes important in the development of higher density housing as,

"A more vibrant urban realm results from the intensification of use and increased activity that a mixed use development brings to a town centre. As well, development in central locations helps to concentrate and contain growth, thereby reducing urban sprawl."[87]

Mixed-use developments provide economic and social advantages that single use development do not, such as:

>Meeting increased demand for accommodation close to town centre, amenities and services
>Creating an interesting, vibrant street life by bringing together a diverse range of people and activities
>Increasing demand and support for local businesses
>Reducing transport costs in terms of time, money, and energy consumption.
>Creating a safer environment by combining facilities used at different times of the day
>Catering to people's changing live / work needs.[88]

[85] Lewis, *Front to Back: a design agenda for urban housing*, pg 66.
[86] Ibid., pg 43.

[87] North Shore City Council, *Good Solutions Guide for Mixed Use Development in Town Centres*, (Auckland: North Shore City Council, June 2005), pg 11.
[88] Ibid., pg 8.

Various council strategies outline social values which have influenced aspects of producing a socially sustainable community. A mix of dwelling types, along with a close-knit pedestrian network to a range of local amenities ensures a choice of occupants is always provided. Numerous transport options are available to occupants, with bus routes close by, and the possible implementation of a future rail network which will provide train stations within convenient walking/cycling distance.

Security in this design has been governed by the architecture as increased densities provided enhanced natural surveillance. Dwellings have been designed to ensure overlooking of public spaces and walkways. Security lighting positioned along all routes through the site, entry points, and in shared parking areas further enhances resident safety while occupying the interior spaces of the site.

"Achieving a mix of uses is a key dimension of sustainable high density urban housing, providing facilities and amenities for residents and a varied and active public neighbourhood". [89]

For this project the idea of a mixed use community becomes a core design element in the hope of developing a scheme that is socially and environmentally sustainable whilst providing a high quality of lives for residents. Housing units are aimed to include a variety of occupants such as: young couples, young families, solo parents, single working professionals, as well as elderly occupants. Therefore, a mix of tenure, household type and life stages will need to be designed for in the development of this project in anticipation of continuous evolution.[90] Successfully achieving social sustainability will mean addressing the needs of all types of people, and the avoidance of social segregation.

[89] Lewis, *Front to Back: a design agenda for urban housing*, pg 66.

[90] Lewis, *Front to Back: a design agenda for urban housing*, pg 25.

4 PROJECT CONTEXT

4.1 FUTURE DEVELOPMENT IN ARCH HILL

It's my backyard is a website created by the Auckland city council, with the intent of painting a picture of how the Auckland isthmus could develop through area plans under the future planning framework. The following issues are included in the framework: How and where growth and development should occur; respecting the historic urban landscape; preserving our natural environment; developing high quality urban areas; and retaining our unique character and identity.[91]

The Western Bays area is home to some of the city's oldest suburbs and several iconic regional attractions. Preserving the area's natural and heritage values, while making the most of its residential and business land; are important factors that Future plans in this area are looking at.[92]

Arch Hill is included in the Western Bays area plan which outlines the outcomes that the council would like to see happen in the area between now and 2050. The following are the outcomes relative to this project:

> Retaining the area's sense of place, including its heritage housing and traditional town centres
> Ensuring that business land is well used, and creating more at Pt Chevalier and Jervois Road
> Fostering vibrant town centres where people can live, work and enjoy the area's amenities and the nearby city centre
> Developing Great North Road as a transport corridor, with better, more frequent public transport services.[93]

[91] Auckland City Council, *It's My Backyard*, http://www.itsmybackyard.co.nz/area-plans/eden.asp. (Accessed May 20, 2012).
[92] Auckland City Council, *It's My Backyard*, http://www.itsmybackyard.co.nz/area-plans/western.asp. (Accessed May 20,2012).
[93] Auckland City Council, *It's My Backyard*, http://www.itsmybackyard.co.nz/area-plans/western.asp. (Accessed May 20,2012).

Figure 21: It's My Backyard Western Bays Area Plan

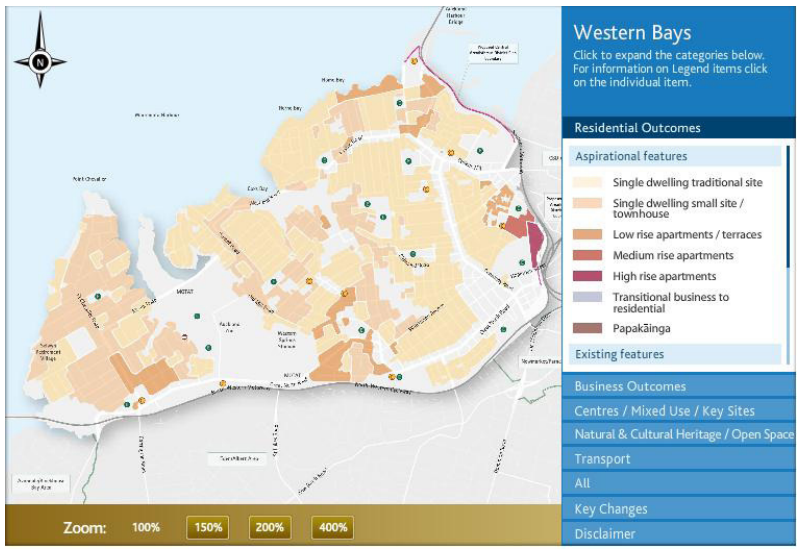


Figure 22: Its My Backyard Residential Outcomes

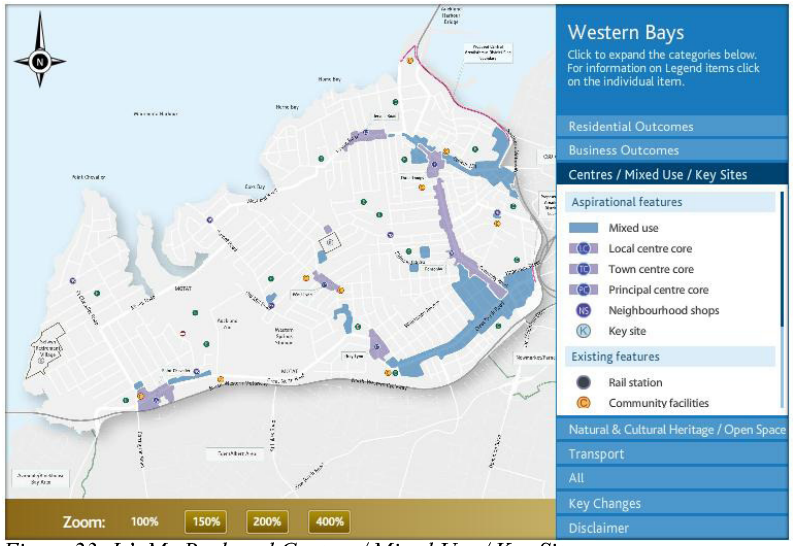


Figure 23: It's My Backyard Centres / Mixed Use / Key Sites

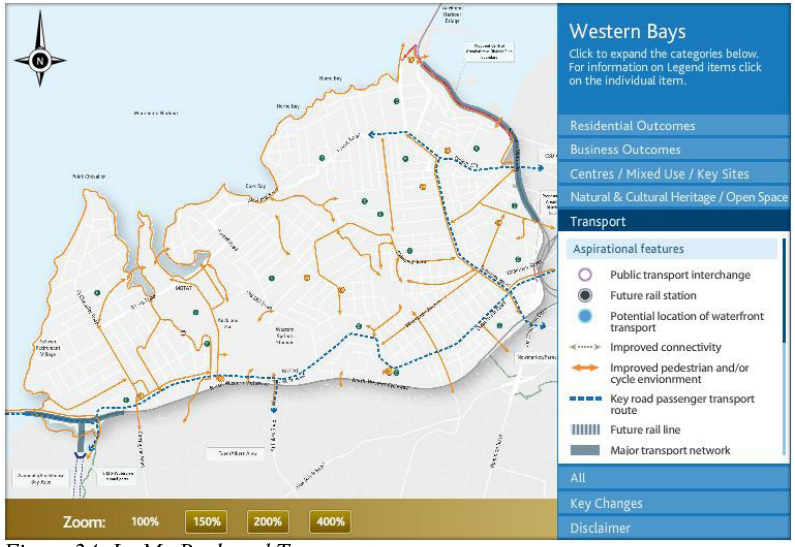


Figure 24: Its My Backyard Transport

The Auckland City Council master plan for 2050 indicates the direction of growth that the Council would like to see in the following years, with the goal of becoming the 'world's most liveable city'. Built around numerous assumptions the master plan outlines eight transformational moves, which address the following factors: planning for growth; poor connections to surrounding urban villages; disconnected waterfront; a transport network under strain; incomplete pedestrian and open space networks; and destinations few and far between[94].

Three of these eight transformational moves apply directly to this project and are outlined below:

The master plan identifies Great North Road (City Fringe to Surrey Crescent) as an urban growth corridor and recognises that future developments will need to provide 'adequate, flexible accommodation to meet a range of needs and increase the desirability and affordability of the city centre as a place to live'[95]

Figure 25: Master Plan 2050 East-West Stitch

Figure 26: Master Plan 2050 Growth and the City rail Link

Figure 27: Master Plan 2050 City to the Village

[94] Auckland City Council, *Draft City Centre Master Plan*, (Auckland City Council, September 2011), pg 39.
[95] Ibid., pg 42.

4.2 SITE ANALYSIS

Site selection

It was essential to find a site within convenient access of local amenities such as public transport, work places, shops, community facilities and other everyday services. It was expected these services could be found within a five minute walking distance, with other, every week services, located within a ten minute walking distance.

A number of residential suburbs along the ridge roads of Ponsonby and Karanghape were assessed in order to find an optimal site, where the desired features mentioned above were mostly satisfied. Looking into the areas of Grey Lynn, Newton, and Ponsonby, Arch Hill was identified as encompassing the greatest number of features essential for the successful development of a high-density housing scheme. Two sites within the region of Arch Hill, and one from Ponsonby were identified for comparison.

After an in depth investigation by means of a physical exploration, and Google Earth analysis of the area, it was found that Site A presented greater opportunities for the brief of this project. This site is bounded by the four streets; Burns, Monmouth, Waima, and Great North Road. The site lies within the context of light industrial activities and situated across the road from Newton Central Primary school on the Waitamata Ridge line.

Figure 28: Suburb of Grey Lynn within Auckland Region, Site shown blue

Figure 29: Site shown blue within Arch Hill neighbourhood

Figure 30: Site shown blue

Figure 31: Site Analysis

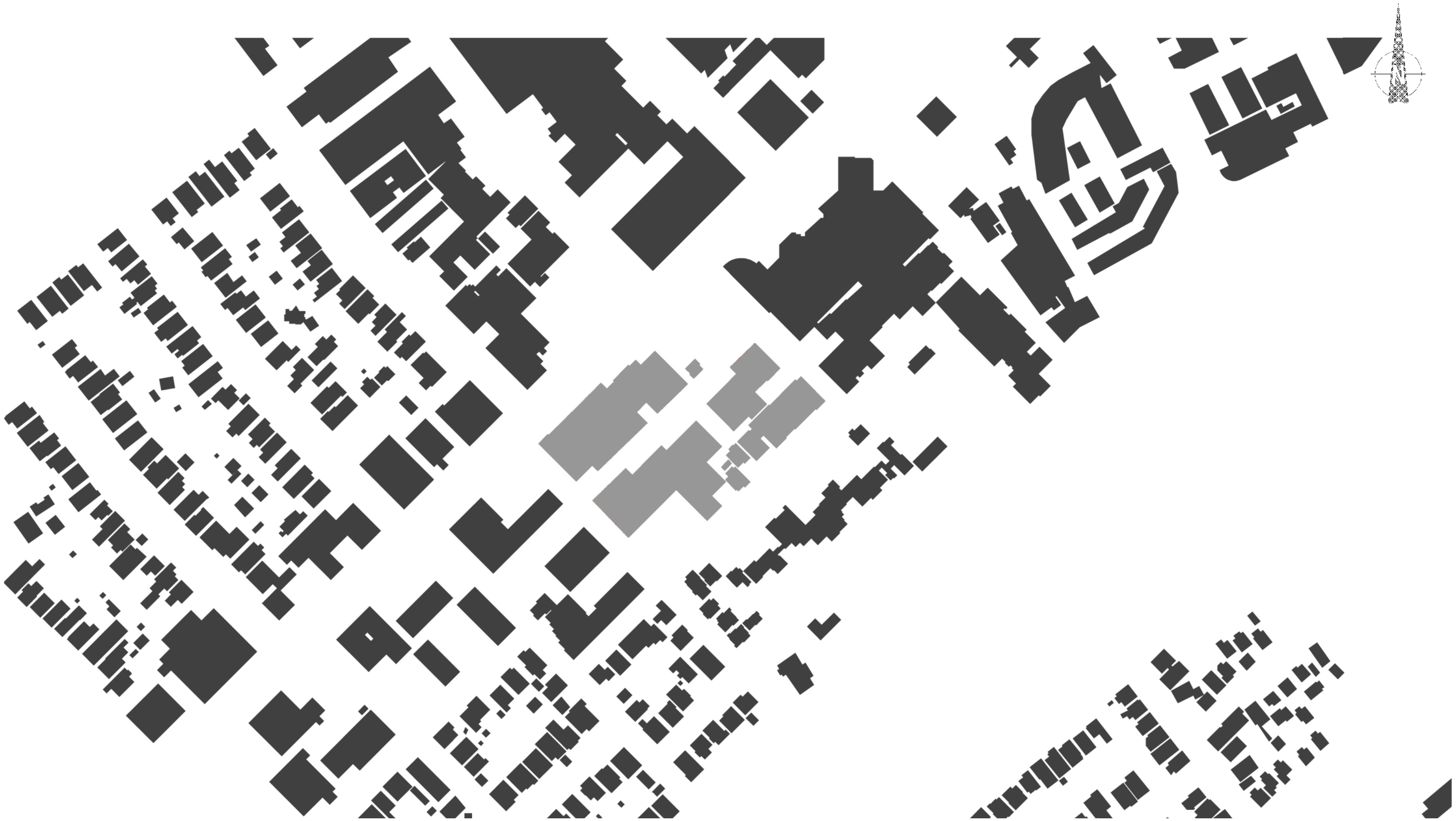


Figure 32: Exisitng figure ground image of imediate context, Site shown grey

Figure 33: Figure ground image showing extent of works

Site information

Arch Hill and surrounding areas enjoy a high level of ammenties such as schools, parks and community facilities, making it well-suited to accommodate residential growth.[96] The following section outlines the existing features of the area. Newton Central Primary School (Figure 34 & 35) is situated along Monmouth Street between Waima and Burns Street. With the slope down to the North-Western Motorway, the school is tucked below road level. It is mostly built out by commercial usage of surrounding sites, yet provides opportunities for the formation of a community.

The school is directly across the road from the proposed site, and provides the existing community with a well maintained and desirable education environment for children. There are open areas of grass, a playground, swimming pool and paved areas for other outdoor activities located within school grounds.

Figure 34: Newton Central Primary School

Figure 35: Play area of Newton Central Primary School

[96] Auckland City Council, *Future Planning Framework*, (Auckland City Council, 9 September 2010), pg 125.

Main bus routes run along the busy Great North Road (refer to aerial image under Site Location section) allowing easy connections to Auckland's CBD, Grey Lynn and Point Chevalier. There is a high traffic volume along this road which means noise is an issue when designing housing that directly fronts the street. A foot bridge at the end of Waima Street (refer to *Site Selection* section and Figure 37) provides a connection to Newton, and convenient access to Mt Eden train station.

Future public transport connections are important to consider during the development of this project, and were influential features in the choosing of the site. The Auckland City Council's master plan for 2050 outlines an inner-city rail network that will provide greater connections to the CBD for the fringe suburbs. As indicated additional stations are to be located at the junctions of Symonds Street and Newton Road, and Queen Street and Karanghape Road; both of which are within a 10minute walk from the site.

Figure 36: Bus stop directly across the road from site


Figure 37: Footbridge looking North towards site

Figure 38: Proposed inner city rail network, Site highlighted blue

At the junction of Great North Road and Ponsonby Road there is a small group of local shops (Figure 41) which include an Indian restaurant, a dairy, a second hand furniture shop, and a bar, all conveniently located within a short walking distance of the site.

Figure 39: Retail along Ponsonby Road


Figure 40: Retail Complex to the North of the site

Other local facilities for residents include a dance studio, which is located on Newton Road next to a bar. Ponsonby and Karanghape Roads also have groups of local shops (Figure 39), which include dairies, restaurants, bars, and fashion shops. The areas are well kept and tidy, but could do with some tidy-up renovations to make it more inviting to residents, and are adequate for local shopping. A Countdown supermarket has been proposed on the corner of Williamson Ave and Pollen Street. *(See figure 31)*

Figure 41: Corner Great North Road and Ponsonby Shops

An important feature of this area is that it is central to three parks. Western Park (Figure 42) is located to the north of the site, with an edge on Ponsonby Road. The park seems to have plenty of visitors throughout the day. Grey Lynn Park (Figure 43) is situated to the north west of the site, made up of three football fields and is dedicated to the local rugby club with clubs rooms positioned to one side. The park is large and features basketball court and playground. Basque Road Reserve (Figure 44) is located to the south east of the site, on the other side of the North Western motorway. All of these park areas are child-friendly, but do not seem to cater to the elderly. There is also vehicle access to all of these parks.

Figure 42: Western Park connection to CBD

Figure 43: Grey Lynn Park

Figure 44: Basque Road Reserve

The final key feature of this area is the Unitarian Church (Figure 45) which is located next to Western Park along Ponsonby Road. This community facility provides a common meeting place, and is within convenient walking distance of the site.

Figure 45: Unitarian Church along Ponsonby Road

Within the residential suburb of Arch Hill there are well maintained traditional villas typical of the New Zealand suburbs (Figure 46). Some have been modernised through renovation to match today's standards, making parts of the neighbourhood a desirable place to live.

Figure 46: Existing Villas on site, typical of surrounding area

Redundant industrial spaces[97] are the dominant building elements within the neighbourhood. Therefore it was practical that the commercial/industrial land currently on the site be reallocated to residential use. A redesign of this area was appropriate to find a link between the industrial/commercial businesses and the residential use of the surrounding land.

To support this argument for the removal of the existing structure a brief analysis into the existing site coverage was undertaken to provide a means of comparison. It was recognised that a successful scheme would provide more green space and less building area than the existing situation.

Existing

Building footprint 7,594m^2

Greenery and open space 1,739m^2

Overall site coverage 87.3%

New proposal

Building footprint 6,624m^2

Greenery and open space (Green roof included) 4,051m^2

Overall site coverage 71%

[97] These spaces can be seen as redundant on the basis of a shift in technology within the field of their function. Commonly light weight construction, these industrial spaces cannot be upgraded affordably to house new technologies in order to keep the business profitable. Earning the term redundant as the estimated upgrade cost outweighs the value of the business.

Further Site Analysis

As the design process progressed, a decision was made to retain foundations and structure of the existing Villas on site. Initial decisions made regarding this concept were to leave them where they are, but as design ideas were developed and explored it became evident that the relocation of these Villas provided greater possibilities in generating a successful architectural solution. The final decision was made to push the buildings closer to the school in an attempt to bring the school into the scheme, and rotate the buildings by 180 degrees to allow them to front the public space. Re-using existing buildings in the new design gives the surrounding community a sense of connection, whilst preserving the existing community. The sustainability of the project was enhanced through building recycling and re-use. Further site analysis was undertaken at this stage of the process. The decision was made during the design process that an attempt would be made to either relocate the existing warehouse structures on the site, or re-house the functions in new buildings. An early decision was made to build over Putiki Street which runs parallel to Great North Road, as doing so allowed for a holistic scheme and higher density to be achieved, along with an improvised access to Newton Central Primary.

5 PROJECT DEVELOPMENT

5.1 Design Criteria for High-Density

At the beginning of the project there was a period of research collection used to gather general criteria appropriate for the development of a high-density housing scheme. Common criteria were found running throughout literature in Australia, United Kingdom, and New Zealand. The information was collated into a set of design criteria to be achieved by this scheme. The list of criteria though general, has common applications and helped in the initial phases of the project as a way of evaluating existing schemes and as a basis for finding a suitable site onto which a high-density housing scheme could be placed.

A full list of the criteria researched can be found in *Appendix B*. The following is a summary of key points found in the literature:

Urban Design

Urban design is to achieve more diversity, density, and affordability through a return to a mixed use typology to achieve high levels of residential amenity.

Environmental fit/Community

Continuity of character between new developments and the existing urban fabric is crucial to a scheme that is well integrated into an existing urban fabric. New developments should seek to utilize surrounding local amenities without over pressuring them.

Sustainability

Designers must consider the social, economic and environmental aspects of sustainability when developing new projects and how these new schemes can reduce material consumption, use resources more efficiently and use renewable rather than non-renewable resources, while reducing urban sprawl. For a development to be sustained, it must meet the ongoing needs of the occupants for flexibility of use, privacy, cost effective environmental controls and minimisation of ownership costs.

Future Use

It is becoming increasingly relevant to consider how a building's purpose may change over time. Designing housing units which front the street allows easy adaptability, and providing units for living and working along busy streets are just two strategies.

Safety/Security

Safety is especially important when designing high density living environments, where there are significant amounts of shared space and people living in close proximity to one another. Increased housing densities can be both a positive (increased surveillance by on looking neighbours) and negative (easier for intruders to go unnoticed) for security.

Waste management

In a higher density housing development each dwelling should have spaces for the storage of refuse and recycling bins. Central refuse collection points need adequate ventilation and easy access for both residents and removal contractors.

Privacy

The issue of privacy with increased density developments must be considered for both the residents and neighbours. A clearly defined hierarchy of public, semi-private and private outdoor spaces is needed in order to maintain privacy, whilst giving each individual unit visually protected outdoor space.

Building elements

When designing for an existing urban fabric it is important that the building forms respond to their neighbourhood. The scale of the building should generally be in keeping with the territorial local authority's policy for the precinct or zone.

Dwelling layout/design

The size, number and layout of rooms in high density group housing are subject to more demanding constraints than the detached house. Clarity and definition of entry, circulation efficiency, flexibility of room use and furnishing, and appropriate solar orientation are some of the factors to consider.

Identity, variety, diversity

Identity can be achieved by providing opportunities for personalisation and increased variety of dwelling units. Creating variety in urban housing form is essential to achieving individual identity, and maintains a sense of diversity.

Pedestrian access

People will naturally follow the easiest, direct route between two points. It is essential to provide clear and convenient access for both residents and visitors, which is simple to follow and easily visible. These routes should be safe, have good lighting and are preferably overlooked by adjacent buildings for security.

Vehicular access and parking

Designing appropriate, efficient, conveniently located and aesthetically pleasing car access and storage with high levels of safety and security is a great challenge, but is a necessity for high density housing communities. Vehicular movement at the pedestrian level must consider the safety of those pedestrians. Successful developments will ensure that pedestrian activity dominates the ground plane.

Landscaping/ openspace

With larger shared space there is greater emphasis on the quality of landscaping. Both hard and soft landscaping need to be integrated into the overall design. Communal spaces should have clear reasons for their existence and create specific activities. Access to, and oversight of these spaces is important, as their use is conditional on these spaces being safe, robust and pleasant.

5.2 Case Studies

A number of case studies were analysed in the process, the majority of which are situated in the Auckland region. International examples were also studied, and they embrace significant values which have influenced the design of this project. The following is a brief outline of these examples. The international examples are wider ranging than New Zealand examples. European countries, Australia and England have been designing higher density living for many years, and as such the typology is common place and of a high quality.

Beaumont Quarter

Location: Beaumont Street, Freemans Bay, Auckland
Construction: 2001-2010
Dwellings: 250 (Terraced and Apartment)
Density: 105 DPH (net)

Figure 47: Overlooking Beaumont Quarter

Summary

Beaumont Quarter in Auckland City is a high end housing solution. The scheme is located on a former gas-works site previously owned by the Auckland Gas Company, and is considered prime inner-city land with a close proximity to the CBD, public transport and a range of amenities. Integrating the existing buildings into the new development as office spaces and residential facilities helps the scheme to achieve a high quality urban environment which features secure parking.

The scheme is mixed-use, including approximately 250 houses and apartments, studio workspaces and work-from-home spaces, amenities and facilities. At a density of 105dph, this scheme is comparable to the one being designed in this project. The mix of dwelling types is clearly evident when walking through the development, combining high density apartments with lower density terraced houses.

Since its completion, Beaumont Quarter has become an exemplar of medium density housing, featuring in several council design guidebooks and publications. What can be utilized from this housing development are design ideas for using space, creating public and private areas, and balancing these attributes with a high density.

Figure 48: Terraced Housing and Public Space at Beaumont Quarter

Figure 49: Existing Gas Works building

Figure 50: Internal Pedestrian Street

Figure 51: Terraced Housing

BedZED

Location: Beddington, London
Construction: 2002
Dwellings: 82 Houses, 17 Apartments
Density: 128 DPH (net)

Figure 52: Village square at centre of BedZED Development

Summary

BedZED in London has been chosen as one international example for the development for this project. The Beddington Zero Energy Development (BedZED) is the United Kingdom's first and largest zero energy development.[98] It was designed to create a thriving community in which people enjoy a high quality of life, while living off the earth's natural resources.

The BedZED Development design meets very high environmental standards, with a strong emphasis on roof gardens, sunlight, solar energy, reduction of energy consumption, and waste water recycling.[99] The scheme consists of 82 houses, 17 apartments, and 1,405m2 of workspace proving that high levels of sustainability can be achieved at a multi unit scale where energy is produced from renewable resources, and sets a benchmark for this project. By allowing people to live and work at the development the environmental impact was reduced drastically as the need for a car became minimal.

[98] inhabitat, *Bedzed: Beddington Zero Energy Development in London*, http://inhabitat.com/bedzed-beddington-zero-energy-development-london/ (accessed on July 8 2012).
[99] Ibid., (accessed on July 8 2012).

BedZED limits private car ownership with the aim of promoting public transport.[100] By supplying essential amenities close by, either within the development or within a short walking distance, or public transport the scheme achieves this goal.

This project aims to borrow ideas used in this development and explore how they may be incorporated into a New Zealand context. What BedZED does create, is a mixed-use community that in turn is highly sustainable. Earthsong in Ranui, Auckland is currently the only New Zealand exemplar which is on par with the development in Beddington.

Figure 53: Linking bridges at BedZED

Figure 54: Rooftop courtyard gardens

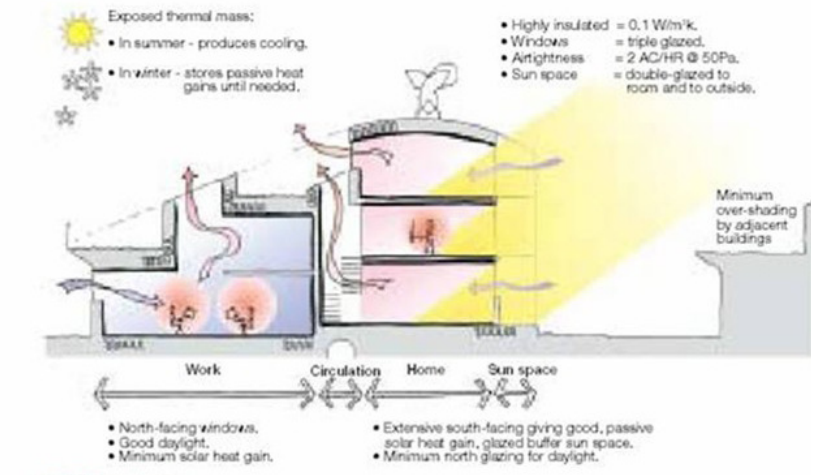


Figure 55: Building physics of BedZED

[100] Sian Bennett, "URBAN VILLAGE: Exploring Synergies between Affordability and Sustainability" (master's thesis, Unitec, 2009), pg 82.

Odhams Walk

Location: Covent Garden, London
Construction: 1981
Dwellings: 102
Density: 154 DPH (net)

Figure 56: Odhams Walk areial

Summary

Odhams Walk is a housing development situated over retail premises in the heart of Central London, in Covent Garden and has been chosen as another international example for the development for this project. The scheme came about in the late 1960's addressing the shortage of quality housing in the area and is now a good example of a socially sustainable community. Odhams print works originally occupied the land which was considered prime development land after the second World War as the site offered an excellent location for both housing and shops.[101]

The scheme features an unusual design for its time, allowing for a variety of dwelling types, some with outdoor patios and gardens. 102 housing units sit above a podium of shops and parking that can be accessed at ground level. Housing units are connected by open walkways featuring ramped diagonal access across the site. The scheme permits interaction with residents whilst providing sufficient levels of privacy.

[101] Homes and Communities Agency, *Odhams Walk: a thriving community in the heart of the city*, http://www.homesandcommunities.co.uk/odhams-walk, (accessed on May 1, 2012).

The spaces created at Odhams Walk are dominated by pedestrian movement. The green spaces, although small, have created what one resident called 'his paradise'.[102] Through careful consideration during the design process, and numerous exchanges with residents Odham's Walk is a place where people want to stay. The residents are proud of their homes and their heritage, and take an active role in shaping its future.[103]

Good design, effective management, and consistent community help make Odhams Walk a sustainable community. Residents feel safe, and they take an interest in their neighbours and their own neighbourhood. These aspects of good practice should be remembered and built upon when considering the future sustainable communities.[104]

Figure 57: Ground floor retail

Figure 58: View into public space

Figure 59: Ground floor public realm

[102] Homes and Communities Agency, *Odhams Walk: a thriving community in the heart of the city*, (accessed on May 1, 2012).
[103] Ibid., (accessed on May 1, 2012).
[104] Ibid., (accessed on May 1, 2012).

Earthsong

Location: Swanson Road, Ranui, Auckland
Construction: 2001-2008
Dwellings: 32 (Terraced and Apartments)
Density: 32 DPH (net)

Figure 60: Outlook across communal gardens

Summary

Earthsong located in Ranui Auckland, is an innovative urban cohousing development, and a model of socially and environmentally sustainable urban living. The site was an old organic orchard, with apples, pears, citrus, kiwifruit, feijoas and other fruit, two old houses and several derelict garages and packing sheds. The founders of Earthsong were committed from the very beginning, in 1995, to building a neighbourhood that was socially and environmentally sustainable, that will serve as a model of a socially and environmentally sustainable community.[105]

A vibrant and active community lifestyle defines Earthsong, achieved through social interactions ranging from twice weekly common meals to casual interactions on the path. Defined as cohousing, Earthsong is a form of collaborative housing in which residents actively participate in the design and operation of their own neighbourhoods. Earthsong offers balance between privacy and community; allowing privacy levels to be altered, allowing opportunities for working and playing together. The project described in this document does not aim to create a cohousing scheme as it is not intended that the occupants will have input into the design process.

[105] Earthsong, *Earthsong eco-neighbourhood*, http://www.earthsong.org.nz/about.html, (accessed on July 7, 2012).

What this project does wish to emulate are the community values that are present among Earthsong residents.

As a medium density neighbourhood, 32 houses with a range of dwelling types and sizes ranging from 1 bedroom studios to 4 bedroom houses are located on site with land left aside for future development. Consisting of terraced and semi detached architectural forms the scheme provides each unit with direct access to a common area, and its own private exterior space, an idea that aligns with the project in this document. Similarly to the BedZED development and to the aims of this project, Earthsong was designed around people, cars have been pushed to one side, allowing the open spaces between buildings to be pedestrian only.

At the heart of the neighbourhood is the common house 340m^2 that is owned jointly by all the householders as an extension of their homes.[106] This community building provides the occupants with shared spaces including the large dining/ meeting hall, sitting room, large kitchen, and shared laundry.

Figure 61: Public frontage

Figure 62: Private frontage

Figure 63: Communal gardens looking towards units

[106] Earthsong, *Earthsong eco-neighbourhood*, http://www.earthsong.org.nz/design/buildings.html, (accessed on July 7, 2012).

5.3 Density

Housing at higher densities is becoming a vital urban housing typology in New Zealand cities. This typology has the potential to contribute to housing quality, choice and social interactions, while presenting an opportunity to increase urban density through efficient land use. The suburban lifestyle can be considered the central element of New Zealand culture, the quarter acre pavlova paradise.[107] Recently however it has become clear that this detached suburban housing model is less appropriate and affordable for an expanding population. The true worth of high-density housing is in its ability to maintain the advantages of detached suburban housing whilst increasing density.

The standard net residential density for suburban housing in New Zealand, measured in DPH, is approximately 10-12 units reflecting the ¼ acre section or 1,081m2 per unit of housing. This figure is lower than inner city suburbs of the early 20th century such as Grey Lynn which has a density between 16-20dph.

In New Zealand high density housing is not a clearly defined concept, however the medium density housing typology is, *"Housing at densities of more than 150m² / unit and less then 350m²/unit, or 30-66 dph".*[108] It can be assumed that any definition for a higher density housing typology would be in excess of this.

Dwelling density refers to the number of dwellings that occupy a given area and can either be expressed in net or gross terms. Net dwelling density represents the number of dwellings on the land occupied by the dwellings including internal public streets and incidental open spaces. Calculated using the site area belonging to the development, it is therefore a useful tool when measuring the comparative efficiency of land use between individual housing developments.[109] Gross dwelling density represents the number of dwellings on the land, plus local streets, open spaces, shops and service premises, primary schools, etc and is calculated using the site area plus half the width of the adjoining sub-arterial or arterial roads.

[107] Duff, 'The development of house styles in New Zealand 1840-1990', 150 Years of Housing in New Zealand 1890-1990, New Zealand Real Estate Vol 41, No.8.(1990) pg 11-20.

[108] Turner et al., *Best Practice in Medium Density Housing Design for Housing New Zealand Corporation* (Auckland: UNITEC New Zealand, September 2004). pg 22.

[109] Judd, *Designed for Urban Living*, pg 9.

Density, on its own, should not be used as a tool for assessing the quality of a residential development. This is because other factors in various configurations impact on the outcome – public open space, privacy, landscaping, architectural style, parking provision, and security etc. A comparative study can be made between this scheme, future developments and those of the past by providing a site density calculation for this project, as well as providing a means of investigating the land efficiency of the scheme by comparing it to existing building forms on the site.

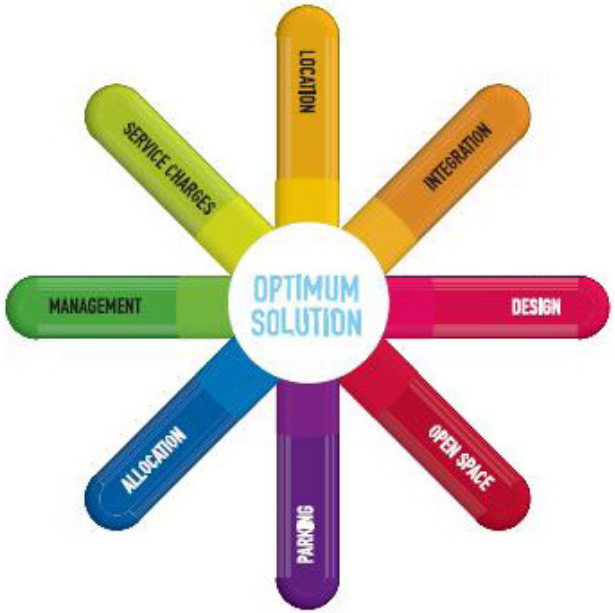


Figure 64: Density wheel

Site: The Total area for the site is 15587m2 or 1.56 hectare. With Auckland's best housing development, Beaumont Quarter, as a comparison with 70 DPH in the first phase. The capacity of this site is 110 units of housing or 144 dwellings @ 92dph (therefore defined as high density according to New Zealand Standards)

Using figures from Statistics New Zealand, *National Family and household projections 2006-2031*, this site accommodate approximately 360 people.

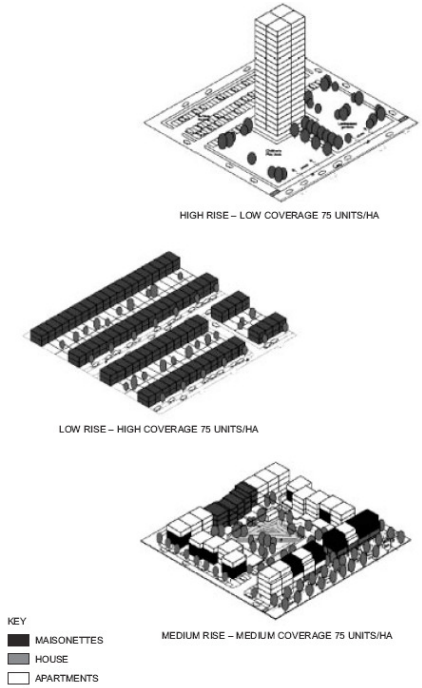


Figure 65: Density variations

5.4 Design Strategy

Proposed Function

Currently existing as an under-utilised commercial/industrial area, the Arch Hill site is to be redeveloped into a mixed-use, high density housing scheme in which a community is fostered. The proposed function aims to create a mixed environment where residential and commercial activities are integrated into the one scheme, providing living, working and recreational facilities. The need for specific amenities for residents as built-in components of successful and sustainable housing is now as widely recognised as it was previously ignored.[110] Various typologies and sizes of high density housing are to be developed in the attempt to cater for various living arrangements.

Building Programme

The two existing Villas sitting at the southern end of the site are to be relocated for use as a community building as larger concentrations of people create greater demand for communal facilities.[111] Their design is typical of the surrounding area and it is fitting to incorporate these buildings into a modern scheme that builds on the surrounding community represented by these two Villas. Each Villa will be rotated on the site so that their current street facades will be orientated towards the central public space. Villa A will be rotated to face true north as to create an axis for pedestrians through the site from the corner of Burns Street and Great North Road. Both Villas are to be lifted off the ground onto a raised decking area creating a link between the two buildings. A terraced garden for the use residents and also for the school is located between the rotated Villas and Newton Central Primary School. In partnership with the rotation of the Villas this terraced garden returns the Villas to their original state, that is facing north with a garden as a backyard used for growing food for the occupants of the house.

[110] Levitt, *The Housing Design Handbook: A Guide to Good Practice*, pg 110.

[111] Towers, *At Home in the City: An Introduction to Urban Housing Design*, pg 57.

All other buildings currently existing on the site are to be removed. As the majority are light weight portal construction; materials can be reclaimed for future building purposes or for relocating these structures elsewhere. The North Eastern edge of the site along Burns Street will be devoted to commercial/ light industrial (furniture making, fabric making, etc), with aims to reuse some structural material from the existing structures. Positioning these functions here relates to the surrounding commercial/light industrial functions, and due to the current low foot traffic area, retail opportunities are not wasted.

Great North Road is seen as corridor of development as part of the Auckland City Council Masterplan, with the intention to create better connections to the CBD. The street frontage in this programme is devoted to retail/commercial space in an attempt to return the street, currently dominated by the motor car, to a pedestrian environment. Retail functions will open directly onto the street, while commercial functions will be raised half a meter to create a privacy barrier between the workers and pedestrians. This main road is to be well lit and overlooked by residents above street level to ensure safety throughout the day. Landscaping and facade undulation will be important, as it will allow the pathway to be attractive, and help direct movement.

The junction of Great North Road and Burns Street is a critical element of the scheme. A building set back allows a space to be created between Great North Road and the facades, providing an opportunity for entrance into the site as well as outdoor functions given the Northern orientation. With continued height variations along Great North Road this space is to be lower than street level, creating an enclosing space, and marking a point of entrance for pedestrian movement.

Walkways through the site act as live-work avenues where retail and commercial space is provided on the ground floor integrated with residential spaces. All internal pathways are created as pedestrian only routes that are well lit and overlooked by residents to ensure safety. As this scheme is aiming to reduce the need for a privately owned vehicle, not all households will be allocated a parking space, and parking spaces will not always be conveniently located for everyone. It was felt that the most logical option for vehicle storage was underground car parking, which hides the cars and lets pedestrians dominate the ground plane. Some surface parking will be provided as visitor parking but will be minimal as Great North Road is a major transport route.

Four main dwelling typologies have been designed; all aim to provide private outdoor space. Each of the dwellings has space for home offices provided. This is not a requirement for all households, but it is critical that the 'workspace' provided is multi-functional, and can become an additional bedroom or living space at the owner's discretion. *Note: whilst some variations will occur, the key features will be constant.*

One bedroom flexi-house – This dwelling type utilizes the concept of living behind a place of work. A commercial/retail space occupies 1/3 of the floor area, with living facilities occupying the remainder. In a larger variation of this same concept, a two bedroom option is provided with two levels of living space, creating a double height office/studio space.

Courtyard House – Built around a courtyard allowing light into southern rooms, these three storey units contain two dwellings. The ground floor accessed unit contains three bedrooms and an office, suitable for families with two children. With access above ground, the second unit features two bedrooms, suitable for a couple with one or no children.

Two bedroom dwelling – This unit typology is the most common across the development, suitable for a couple who require a work from home office/spare bedroom or for families with one child.

Single bedroom dwelling – intended for occupation by elderly/disabled residents, these units feature one bedroom, and enough space for wheelchair access.

A *sense of community* is achieved by providing a range of dwelling types, so that a diverse group of people can all live together within a single development. Enhanced by providing live and work opportunities, people are active throughout the development during the day. Shared communal facilities also aid in socially sustaining the community.

Sustainability is achieved by incorporating strategies and features that will reduce energy costs in the home. Making smarter choices on material selection, use of energy efficient appliances and utilising our natural resources are all key elements of the design.

By using urban land efficiently and increasing the density homes are made *affordable*. The combination of smaller plots of land and reduced energy costs reduce home ownership costs.

6 DESIGN STRATEGY

6.1 Design Process

Urban planning – master planning and initial design stage

The area of Arch Hill is dominated by large scale buildings built to serve the automobile. These buildings have little regard for the community. The design needed to look at ways of creating a building form that re-prioritises the community.

Connections through the site for pedestrian movement played a key role in the early stages of master planning. Initial planning started by exploring density options on the site, featuring a variety of housing typologies, site coverage and open space. Time and effort was focused on producing design ideas that combined the ideas of community, sustainability, and social interaction. Through planning and analysis, preliminary design ideas began to emerge flowing from investigations into the surrounding area and its influences. Each of these moves had particular advantages and disadvantages, and it was felt that a successful scheme would integrate the benefits of each concept into a holistic design.

Initial concept designs explored the possibilities of reusing or relocating existing structures. The possibility to reuse some of the existing buildings on site was an important design consideration from the outset of this project, and has been carried through into the resolved design in the form of two villas, as discussed in the previous section and also under the Building Programme section. The majority of existing buildings fall into 'shed-like' typologies that are below market value for this area. It was decided that the investment into the buildings needed to lift their capital values was outweighed by the option of re-building elsewhere on cheaper land. Due to the light weight construction evident in the majority it is economically viable to rebuild rather than retrofit an obsolete structure.

An exemplar building or section was chosen at this stage, to be designed in some detail as an example for others to follow. It was important that the part chosen would be able to represent my design aims and philosophy.

Design decisions progressed through a process of analysing, redesigning and discarding plans in an attempt to formulate new designs that were more successful in achieving community and social interactions than the last. This process was ongoing throughout the design development utilizing planning, sectional and 3D drawing methods. The scheme needed to identify sustainable forms.

It was suggested that variety and diversity may be realised through less conventional means of design. Through an abstract process of modelling with Lego Blocks a proposal began to emerge which demonstrated a complexity of form that also combined public and private space. This process was able to produce an architectural typology which 2D drawing was unable to illustrate. Knowledge of international examples worked well to inspire ideas for this type of urban design, as many countries overseas are much more experienced in this type of urban planning, for example, Odhams Walk, London.

Designing in section became a way of integrating variety through: Reference to context at all design stages; the development of height changes amongst building density and type; investigation of level changes across the site that established spatial connections between public spaces.

Figure 66: Preliminary Lego Model

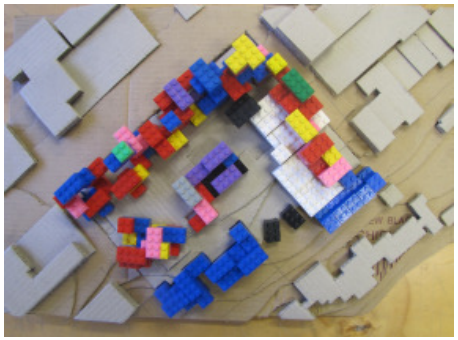


Figure 67: Resolved Lego Model

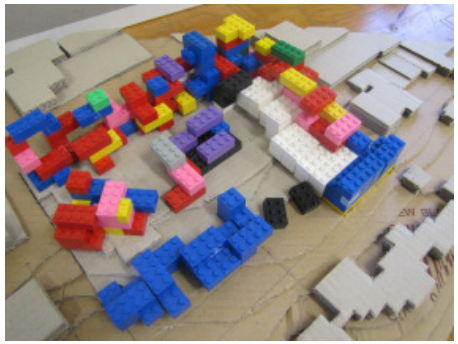


Figure 68: Resolved Lego Model

Integration into existing community

In order to achieve a successful integration into the existing community the functions of buildings became just as important as form, materiality and size. It was essential to recognise which businesses within the immediate context would have an impact of the design of this scheme. Vehicle movement, parking, operation hours and noise control all needed to be investigated and considered during the site analysis process. The types of commercial/retail activity that would be suited to this development were identified. It was initially considered that existing automobile functions were to be relocated on the site, as to reduce their dominance. After some discussion it was decided that it was justifiable to remove these functions from the site completely, as they did not contribute to the project aims. It was suggested during the midyear design critiques that this project and its suggested population warrants the inclusion of local shops into the masterplan.

The decision to retain the existing villas was made at the outset of the project upon finalising the choice of site. It was not intended that these villas be returned to a residential function but that they would form the central element of a new scheme, giving them a new life. Throughout the year these two villas and the decision made to keep them have been critically discussed and questioned: ‘are they worth keeping?’

Auckland’s developers have a reputation for removing historic buildings. Beaumont Quarter proves that it is possible to incorporate existing structures successfully into a new scheme. A detailed study into ways of incorporating the Villas into this scheme provided opportunities to test various options allowing an informed decision to emerge.

The close proximity of Newton Central Primary School was one of the driving factors in the selection of this site. In traditional settings school buildings or churches were seen as the central element when building a community. It became an important part throughout the design process to pull the school into the development. A decision was made to build over the eastern section of Monmouth Street in an attempt to integrate the school into the new pathways planned within

the site, with communal gardens providing a link between the villas and the school. It is expected that the school will use a section of these gardens to educate students; as such one villa is designated as a classroom facility to be used as an extension of the school. Bringing the activity of school into the scheme is one way to achieve integration between the two.

(Refer to Appendix D for floor plans of exisitng villas)

Figure 69: Relocated Villa layout

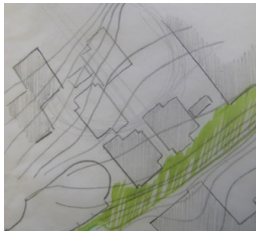


Figure 70: Villa Study

Figure 71: Villa Study

Figure 72: Villa Study

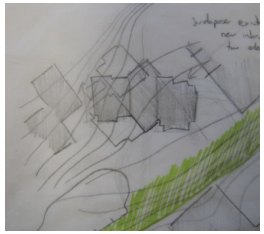


Figure 73: Villa Study

Figure 74: Villa Study

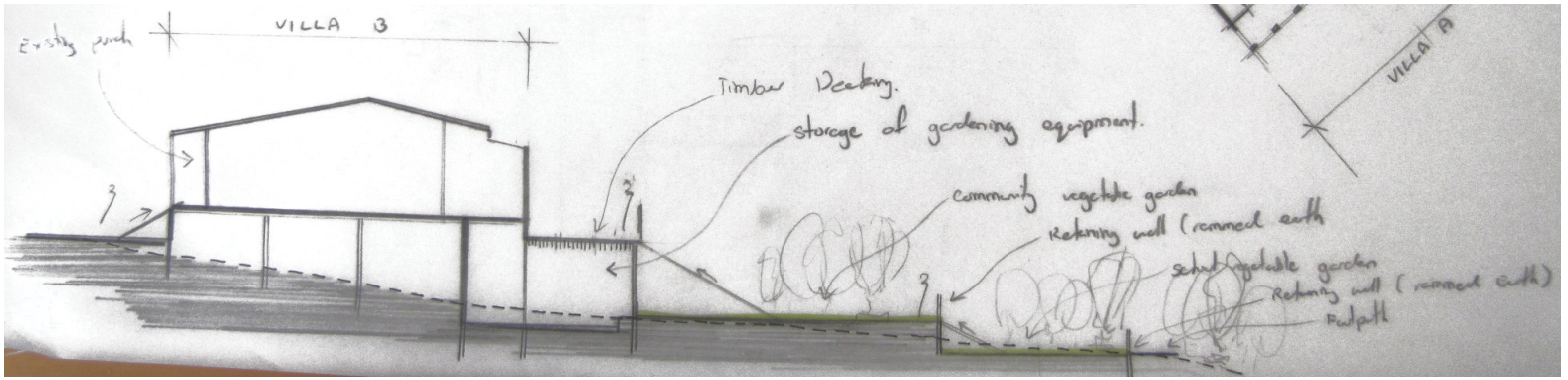


Figure 75: Section through Villa B

Pedestrian access and way finding

It was decided at an early stage that the interior of the site was to be dominated by pedestrian movement. This decision resulted in a network of potential routes through the site that are easily accessible, clear and safe. It was observed through analysis of case studies, Odhams Walk and Earthsong, that a pedestrian dominated ground plane provides a safe and open environment for the enjoyment of residents.

Before this project matured it was evident that a major entrance to the site was required, and as such would become the generator of links through the site. The corner of Burns Street and Great North Road was chosen to be this entrance point as it is the first point of the site when approaching along Great North Road from Auckland City. A link through the site connecting this corner to the entrance point of Newton Central Primary School serves as the main access route and implies a division line between the larger warehouse elements and the terraced housing elements. From here secondary routes were generated allowing connections from Waima Street, and from the western end of Great South Road. These routes through the site are intended to act as areas of interaction, where public facilities and shared communal spaces, are arranged. This notion resulted in the creation of five open spaces, one large central open space forming the focus of the scheme, and four subsidiary spaces which define differing areas within the site.

"Public space is seen as the common ground where people carry out the functional and ritual activities that bind a community"[112]

The idea to create a variety of spaces is one that stuck throughout the master planning design stages of this project, as it was a clear reflection of the intent and direction of the scheme. The large central space was designed as the 'hub' of the scheme as it is the main centre around which all activity for the residents are based.

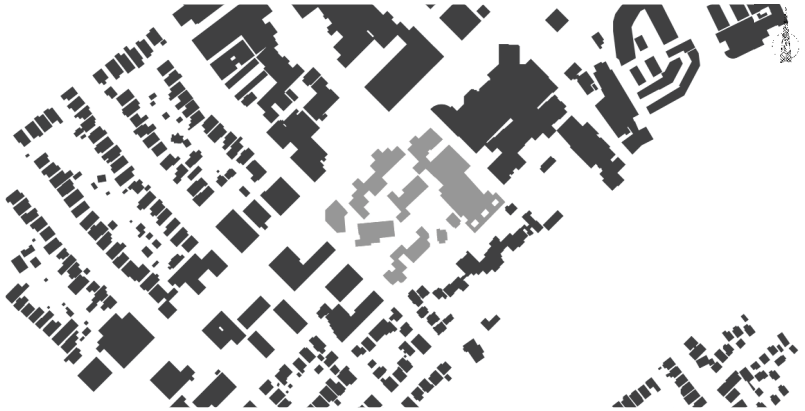


Figure 76: Figure ground image showing scheme in context

[112] Cuthbert, Alexander, ed. Designing Cities, critical readings in Urban Design, Oxford: Blackwell Publishing, 2003, pg 145

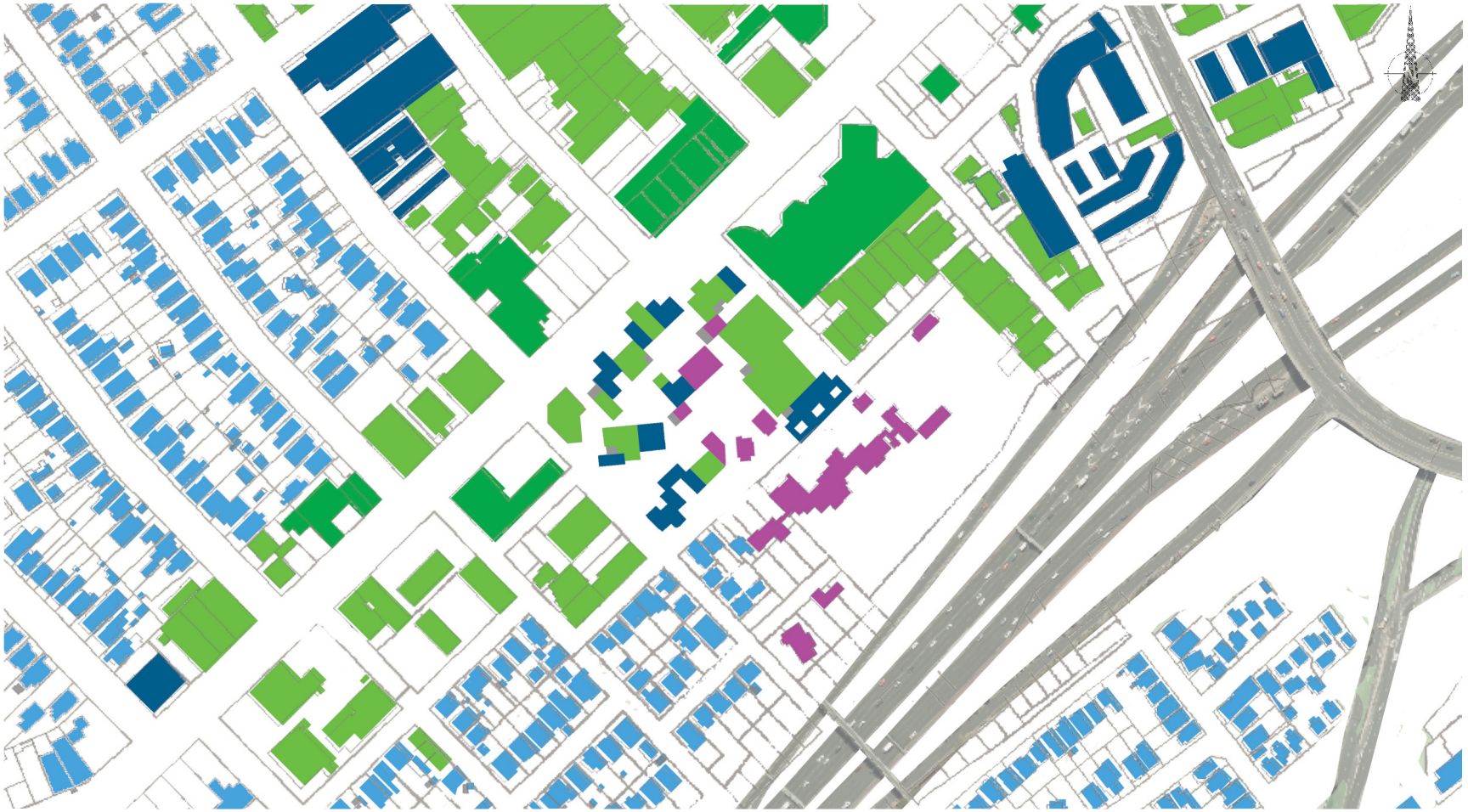


Figure 77: Building uses in surrounding area

Figure 78: Pedestrian Links

Vehicle access and Parking

From the genesis of this project the motor vehicle was to be de-prioritised in an attempt to create a community that does not depend on private car ownership. It was however important to ensure that adequate parking facilities are provided for residents. It was decided that there would be no surface car parking within the site area, and as such underground car parking became the solution required. A variety of underground car parking options were explored. The notable features of a successful parking system would have convenient access to residential and office spaces, be well ventilated, and have road access. The final car parking solution was to create three separate parking spaces that would serve distinct areas of the site. Splitting the car parking into smaller elements resulted in increased security and convenient access to a larger area of the site. In order to minimise the amount of earthworks needed to construct these parking facilities, an analysis into the contours of the site was undertaken to determine suitable positions. Car parking has deliberately been supplied at a significantly lower level than normally required in an attempt to reduce the dependency on the automobile. This is justifiable when acknowledging the public transport options that this site in particular has available to it, i.e. busses and trains, as well as walking and cycling routes available.

The location of the school played an important part in the placement of the car parking on the site, as it was undesirable and unsafe to have vehicular access on the street frontage facing the school. It was decided that Waima and Burns Streets would be suitable locations to provide vehicular access to the car parking, leaving Monmouth Street free of any additional vehicle movement.

Parking has been provided in small numbers on the ground plane at three points around the site. These parks are intended for visitors to the site as vehicle safety was an issue if non occupants were given entry to the secure underground car parking facilities. The surface parking closest to the school is specifically intended for the picking up and dropping off of school children.

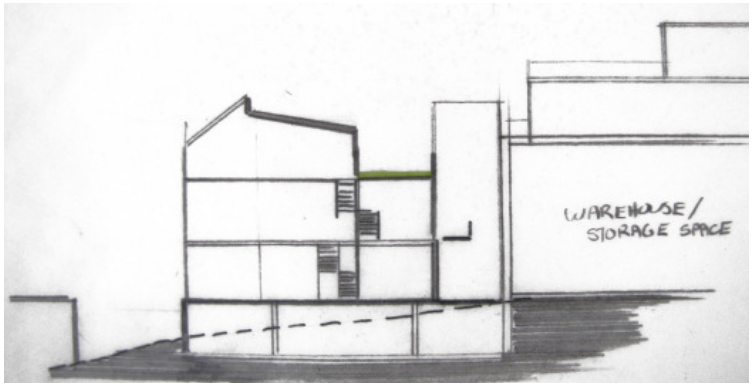


Figure 79: Carpark underneath Courtyard house types

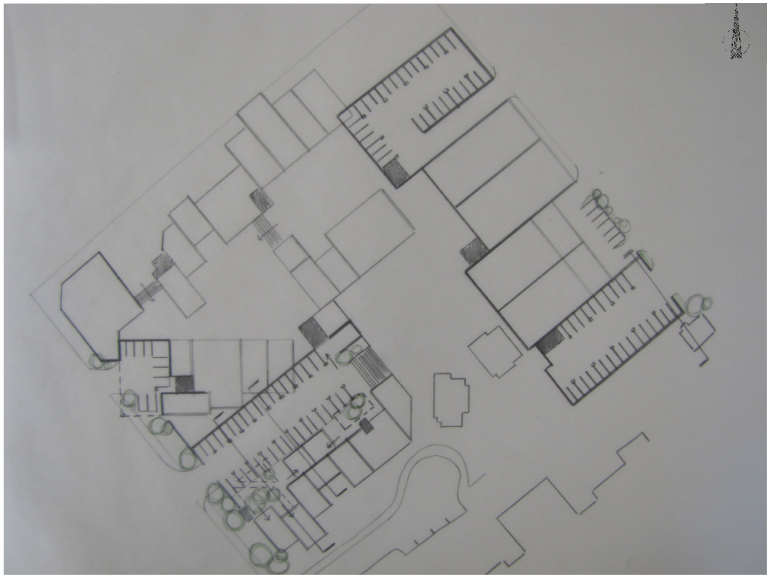


Figure 80: Carpark Plan

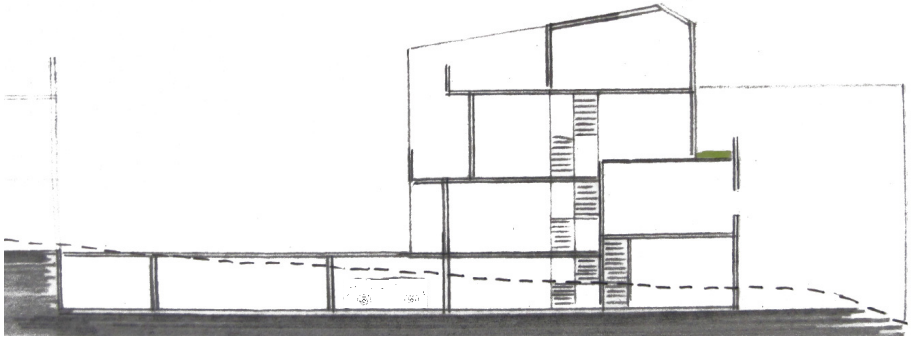


Figure 81: Section 1 through carpark with decking overtop

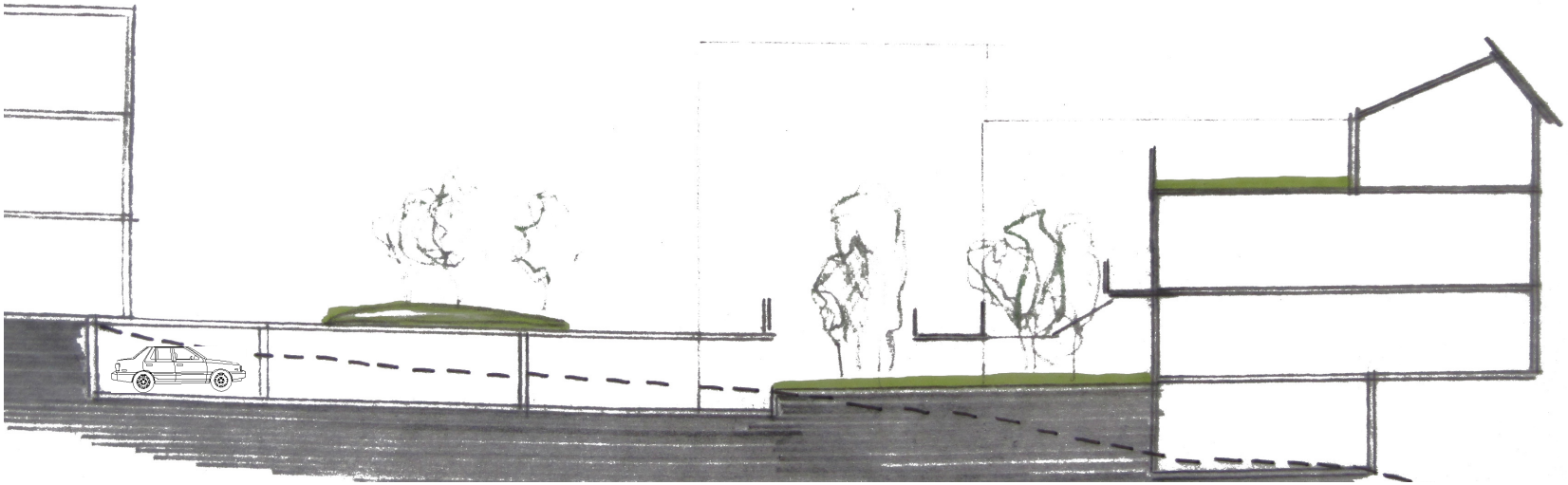


Figure 82: Section 2 through carpark with decking overtop, raised courtyard shown

As discussed earlier, initial design options failed to produce solutions that dealt with the issues of identity, variety, and diversity; instead those early explorations showed regularity and were considered 'safe'. Aesthetic questions surrounded this project from the start. What do I want these buildings to look like? How is this scheme going to look alongside its context? The contrast between existing and new needed to be articulated. From an early stage it was noted that the building form generated by this design process needed to respect its context, but have a strong sense of individuality. The Lego Block modelling process generated an architectural form which stands out from the context. The terraced roof forms provide space for green roofs and decks that would otherwise be difficult to achieve with a more conventional building form. Because of the relative abstract nature of this housing form, it became important to respect the heights of surrounding buildings. It was established early on in the massing stages of the project that a maximum height of 3-4 storeys should be adhered to across the site. Exceptions to this became acceptable where surrounding building form would dominate, i.e. Burns Street.

It has been argued that on initial viewing, the aesthetic impact, above all else, needed to be appealing in order for this scheme to be seen as successful design. This was in part answered by finding a material – rammed earth – that was very different to what was already being used within the general area. This new material highlights the new building forms in a modern, yet affordable and sustainable way. A sense of identity resulted, as the scheme had an architectural form unique to the area, expressed at a micro level through the use of rammed earth. Variety and diversity emerged through the development of a number of housing typologies that this architectural form made available.

Figure 83: Resolved plan of southern block

6.2 Design Features

Mixed use community

Through early design critiques it became clear that for this scheme to achieve the objectives of creating a social interactive community a mixed use scheme was required, at least at ground level. Creating a mixture of functions across the site achieved two things. Firstly it meant creating a secure environment as it enables spaces to be used throughout the day when commonly housing is left vacant. Secondly creating a mixed use community meant exactly that, the creation of a community.

"The purpose of mixing uses, allowing different activities to rub cheek, is to foster more complex and intertwined human relations and thus more interesting places. The purpose is to create human connections"[113]

By providing living and working opportunities within the same vicinity and by offering a variety of household type's mixed-use developments offer more for a community than if each function was to stand on its own.

"Interaction of various activities and functions in, and around public spaces allows the people involved to function together and to stimulate and inspire one another"[114]

In this development, a mixture of uses does not occur solely in a horizontal plane, but is also expressed through the vertical. This encourages the chance encounter, or the 'water cooler effect'. Where in a traditional office the water cooler is the place where people meet accidently.[115] A variety of housing forms are provided to cater for a diverse range of household structures. A series of live/work units, with light commercial studio space allowed for, have been incorporated into this high density housing community.

Non-residential uses to be coupled with housing needed to be selective with restrictions on noise and pollution. Through discussions during design critiques it was decided that commercial spaces provided would be occupied by Accountants, Architects, and Dentists, etc. Retail spaces provided were determined by things that you will need or want to have, that don't already exist in the area, i.e. café, dairy, or Laundromat.

[113] David Sucher, *City Comforts, how to build an urban village*,(Seatle: City Comforts Inc, 2003), pg 21.

[114] Jan Gehl, *Life Between Buildings, using public space*, (Copenhagen: The Danish Architectural Press, 2001), pg 103.
[115] Sucher, *City Comforts, how to build an urban village*, pg 30.

Structure and materiality

It became clear that the detailing and selection of materials to work alongside the existing context was going to be key in the design development of this scheme. Retaining existing structure on the site adds interest and variety to the design, creating layers of old and new elements that provide opportunities for contrasting aesthetics.

Rammed Earth became the material of choice – acting both aesthetically and structurally, with the aid of steel reinforcing. Although this material has similar qualities to that of precast concrete, it was felt that after research and case study analysis that Rammed Earth was better suited to the housing typology. Rammed Earth can be easily worked on site, has high fire ratings, and is affordable. This material also reduces the use of construction materials with a high embodied energy, reduces construction waste, conserves energy in the operation of the built structure, and offers significant longevity to the building form. [116]

Timber and low energy glazing became secondary material choices for use as aesthetic and functional elements, for instance, louvre systems for solar control and privacy, as well as minimal resource depletion.

Figure 84: Persepective sketch of refined design

[116] David Easton, "Rammed Earth", in *Alternative Construction: Contemporary natural building methods*, edited by Lynne Elizabeth and Cassandra Adams, 151-175, (New Jersey: John Wiley & Sons Inc, 2005), pg 158.

Sustainability

Now that simple massing and room arrangement was designed, function, energy conservation, and sustainability could be combined into a cohesive design. A sustainable plan was applied integrating solar energy, water management and harvesting, and use of new materials.

Passive Design – research into passive design techniques allows for a fixed design, which can be applied without a specific site, location or building function as the principles are independent of these issues. It is therefore possible for high density housing to be strategically formulated to passive design principles, which can then be replicated throughout the country. Passive design for this project was a testing process due to an orientation to the west of north and a slope towards the south. Thermal mass was introduced as the dividing wall between residences, with Rammed Earth used as a thermal insulator. Double glazed low energy windows, and deep roof overhangs were additionally integrated into the design which help to create a healthy and comfortable indoor environment all year round.

Solar Hot Water - it became apparent through research that the incorporation of a solar hot water heating system into this project was practical and needed, due to the energy used to heat hot water in New Zealand homes. A closed loop solar hot water heating system was selected on the basis that the solar collector is separate from the storage cylinder. This has aesthetic benefits as the cylinder can be hidden inside the unit, and means that water only needs to be pumped a short distance to the bathrooms and kitchen. It is recognised that this option is less efficient than an open loop system, but when incorporated into each dwelling the occupants can receive significant energy savings.

"In a closed loop (indirect) system, the solar collector is separate from the storage cylinder. A heat transfer fluid such as glycol (which does not freeze) circulates through the collector panel (closed loop) to the cylinder using either thermo-siphon or a pump. The fluid absorbs heat in the solar panels, which is then transferred to the water in the cylinder through a heat exchanger. The heat transfer fluid does not come into direct contact with the water being heated."[117]

Future Use - It was recognised through research into sustainable housing developments that future use, and the provision for possible change needed to be addressed within the scheme for a sustainable solution to be reached. Research into housing occupancy trends within New Zealand played an important role in the design of individual living units. With occupancy rates predicted to continue their decline housing units had to be designed with this in mind. It was decided that a diverse range of housing options would be made available so that if an occupants living style changed, due to children arriving or leaving, they would be able to find suitable accommodation within the immediate region. The concept of flexibility in design is linked to this idea of future use as it allows building occupants to control their internal living environment to their desires. For this reason each dwelling type is provided with a room that can be used as a bedroom or a home office. In addition to this it was noted through research that internationally houses are being designed with only the kitchen and bathroom fixed in location, allowing flexibility in the plan.

[117] BRANZ, *Level; Heat Transfer Systems*, http://www.level.org.nz/energy/water-heating/solar-water-heating/heat-transfer-systems/. (accessed August 12 ,2012)

7 CRITICAL APPRASIAL OF THE FINISHED WORK AND ITS THEORETICAL FRAMEWORK

7.1 Analysis of Theoretical Process as Supporting Tool for Design

Theoretical research was an essential aspect of this project supporting the design process. Throughout the project this process of theoretical research was used to conduct an in depth investigation, which was focused on identifying common criteria for high-density housing. This process then allowed case studies to be selected and evaluated. These criteria sourced both nationally and internationally serve as a useful tool in determining an optimal site on which a high-density scheme could be designed.

Throughout the course of the year the theoretical direction of this project was relatively constant, yet also expanded into other areas. Through research into the ideals of community and social interaction and through the analysis of precedent studies it became apparent that sustainability, both social and environmental, were to be key aspects of this design. The project then explored how issues of environmental sustainability could be integrated with the concepts of community and social interaction. The issues of social sustainability have direct correlation to this project, as places are sustained when the people living in them appreciate the environment and have a sense of pride and belonging to that place. It was through the investigation of this idea that issues of community and social interaction began to unwrap.

At the start of this project, the intent was to undertake a development of a new, high density housing scheme to be located within Auckland. Arch Hill emerged as the region in which the site is located. As design work progressed it became clear that this was a substantial undertaking for a yearlong project. It was decided at this point that only part of the site would be planned in detail and that it would serve as a benchmark which will be applied as a standard to the remainder of the site to be developed. These criteria will determine density, material selections, built form, and the definition of public and private space. A holistic masterplan was produced to illustrate an urban design proposal for the entire site. A decision to retain and re-use existing buildings on the site enabled the project to develop further, without being affected by issues associated with re-use.

7.2 The Questions Answered

The process of applying research to design had its challenges. From the beginning there was a clear understanding of criteria and features that were to be integrated in the design. The success of this project was not confined to the implementation of research, but to going beyond these limits and creating an outcome that exceeds general expectations.

Due to the current poor reputation of high-density housing within New Zealand and Australia and public ignorance, a shift in attitude was aspired to for this project. The architectural design aims at making higher density living an acceptable option for more New Zealanders. The end product has resulted in a scheme with a clear direction, generated through the integration of findings from research into design which aimed at answering the initial question:

'How can the high density typology be used in the development of 21st Century New Zealand cities to build socially interactive communities?'

This question was answered through the architecture. A major factor for the architectural solution to consider was **community**, which, as stated previously, includes issues of **sustainability**.

The design needed to investigate ideas of **social and environmental sustainability**, as well as fit into a set of design criteria outlined through research. With each new question that emerged from the research a rational application was required for the design process. Through an investigation of case studies here in Auckland it appeared that the aims of, **community and sustainability** have rarely been implemented successfully into a housing scheme. It was here that international precedent examples became crucial, as New Zealand is behind the rest of the world when it comes to higher density development.

The overall design attempted to include features that would produce a successful community based housing scheme. Waste management and energy efficient solutions have been integrated into the design of this scheme through material selection, use of renewable energy, rainwater collection, with a focus on lower embodied energy during construction through careful material selection.

While environmental sustainability played a part in lowering the costs to run and live in the dwellings, it was perhaps more crucial to achieve social sustainability due to its impact on community. This was accomplished in the design by introducing

features of **identity, variety, choice and amenities**. Throughout the project it became apparent that **mixed-use** alternatives needed to be applied within the design. The provision of easy access to community amenities, public transport and workplaces is essential to the creation of a neighbourhood. It was important to provide housing choice for a **mix of tenure**. Single class developments often turn into slums. Residents usually want to be proud of their neighbourhood; it was an aim of this project to remove class segregation. Combining these qualities together ensures a community, and one that will be sustained.

The design developed through a mixture of designing in section, perspective and in plan. Throughout the design process many planning alternatives developed, from architectural plans and sections which progressed continuously. Perspective sketches provided opportunities for the building form to inform the plan, rather than be dependent on it; a process that played a crucial role in the development of public spaces. Design went through a process of continuous trial and error. This exercise took many attempts to find an architectural solution which could be deemed successful in its objectives. Through a **research by design** process, this project was able to answer the main question asked within this document:

'How can the high density typology be used in the development of 21st Century New Zealand cities to build socially interactive communities?'

7.3 Project Outcomes

The design objectives have been presented as a mixed-use high-density housing development, in which the issues of community have been resolved through the integration of environmentally and socially sustainable features. The design has firstly been presented as an urban design proposition, then with architectural concept designs for a selection of high-density dwellings with an inner-city 21st century context.

7.3.1 *To implement planning policies and strategies, set out by both the Auckland City Council and the New Zealand Ministry for Environment, to a site in real world context.*

Policies and strategies produced by the Auckland City Council and other New Zealand authorities/contributors have had significant input in the defining this project and its outcomes. *The Auckland City Council Draft City Centre Master Plan, the Auckland Regional Growth Strategy 2050, the Auckland Sustainability Framework, New Zealand Urban Design Protocol, and the New Zealand Energy Efficiency and Conservation Strategy* have all been important documents during the research component of this study. The inclusion of concepts summarised by these documents contributed towards the clarity of these conclusions.

7.3.2 *Formulate an innovative solution to the issues of density through high quality design of urban housing typologies; the result creating an aspiration of all future development projects.*

A priority in the project was to find an architectural solution to the issues of high density living and how social interaction can be brought back into a housing scheme. The end result is a precedent for future development. As suggested through the research explored for this project, a dense urban lifestyle is set to become common place in the future development of our cities. In order for this to happen, the negative attitude held towards this typology by the public needs to change. This project looked at creating an architectural solution that moves away from the negative stereotype and provides residents with choice, amenities, privacy, sociability, and a community.

7.3.3 *To develop an innovative high quality urban form that creates a variety of public spaces for a variety of interactions*

A high quality urban environment has been achieved through a rigorous architectural design process. This saw the spaces created between buildings taking precedence over the buildings themselves for a large portion of the master planning process. In urban design, we should provide for *spontaneous self-diversification among urban populations.*[118] A variety of public spaces with individual character have been generated allowing for a variety of interaction between occupants. The outcome aims to produce a scheme which investigates ways in which we can address the architectural issues relating to social integration. A high quality built environment is achieved when there is evidence of the following characteristics: design, variety, material selection, identity. Housing becomes successful when amenities and public spaces are easily accessible to residents.

7.3.4 *To create a multi function development that retains and continues to build on the existing character of the region, whilst rebuilding a community through the incorporation of modern ideals.*

The architectural suggestion of a mixed-use, high-density housing development meets the project's objective by exploring ideals of community and social interactions. The process of architectural design has been informed by council design criteria, precedent studies, and through the investigation of issues/ solutions pertaining to social and environmental sustainability. The creation of a successful built environment within a 21st century city is reliant on a variety of functions clashing/ integrating with one another. Such an issue has been dealt with in the project exploring relationships between, live and work, housing and services and housing and transport. It is through these modern ideals of lifestyle that a community can be rebuilt.

[118] Alexander Cuthbert, ed. *Designing Cities, critical readings in Urban Design*, (Oxford: Blackwell Publishing, 2003), pg 103.

7.4 Wider Scope of the Project and Research

The concepts of community, social interaction, and sustainability used within housing explored in this project can be adapted and applied to other sites within the context of a 21st century city. A starting point for future development generated by the architectural design process and research explored in this document has been generated. However, the specific analysis of each individual site is compulsory to reveal the advantages and disadvantages. Despite analysis required for the application to different sites, it is expected that the basic principles outlined here – exploring ways in which community and social interaction can be integrated into high density housing – can be applied anywhere.

Further Research

This project explored how community, social interaction, and sustainability impact the architectural design of mixed-use high-density housing development. It is acknowledged that further research into social patterns would have impacted the design of the scheme primarily through the master planning process, as spaces could be designed to reflect and respond to human behaviour in a real world context.

This project looked into ways community and social interactions can be fostered and encouraged within a high-density development, through the careful planning of public open spaces. Housing units repeat standard designs throughout the scheme. It has been recognised that individual planning would profit from detailed knowledge of the ways in which different groups of people use their homes. By providing a range of housing typologies a greater sense of community has been generated, benefiting a range of people.

It must be noted that economic factors were not considered or explored during this project's development. When these factors are taken into consideration financial aspects could begin to influence the design.

8 CONCLUSION

The architectural element of this project explores how community and social interactions can be integrated with sustainability within a high-density, mixed-use housing development. The project did not aim to solve issues of affordability or supply, but merely address social issues relating to housing.

Arch Hill was chosen as the site due to the key features it possesses making it possible to create a sustainable neighbourhood. These features are: close proximity to public transport (both current and proposed), work places, and local amenities. The quality of the community created is an essential element when creating a zone of increased density. This design promotes social interaction, sustainability and a sense of community.

The incorporation of environmentally sustainable features into the design was important throughout the design process to ensure lower running costs of our homes. These features, namely solar hot water systems, rainwater collection, energy efficient materials, often result in an increase in the capital cost, but as this project was not concerned with financial issues the long term benefits took precedence.

Four objectives set the direction of the project, all of which have been realised. First, planning policies and strategies set out by the *Auckland City Council and the New Zealand Government* have been implemented to a site in real world context. Second, an innovative solution to the issues of density has been formulated, resulting in an architectural form which sets a benchmark for future developments. Third, a variety of public spaces have been created providing a high quality urban environment for the development of a community. Fourth, a mixed-use development has been created that builds upon the foundations of the existing community.

The contents of this document were focused towards theoretical and methodological issues of the design project. **Research for Design** played a significant role throughout the design process as shown in this document. However, it was important to balance this with **Research by Design**. It is not enough to state that community and social interactions can be fostered in a high density development, for this to have any value it needed to be supported by design.

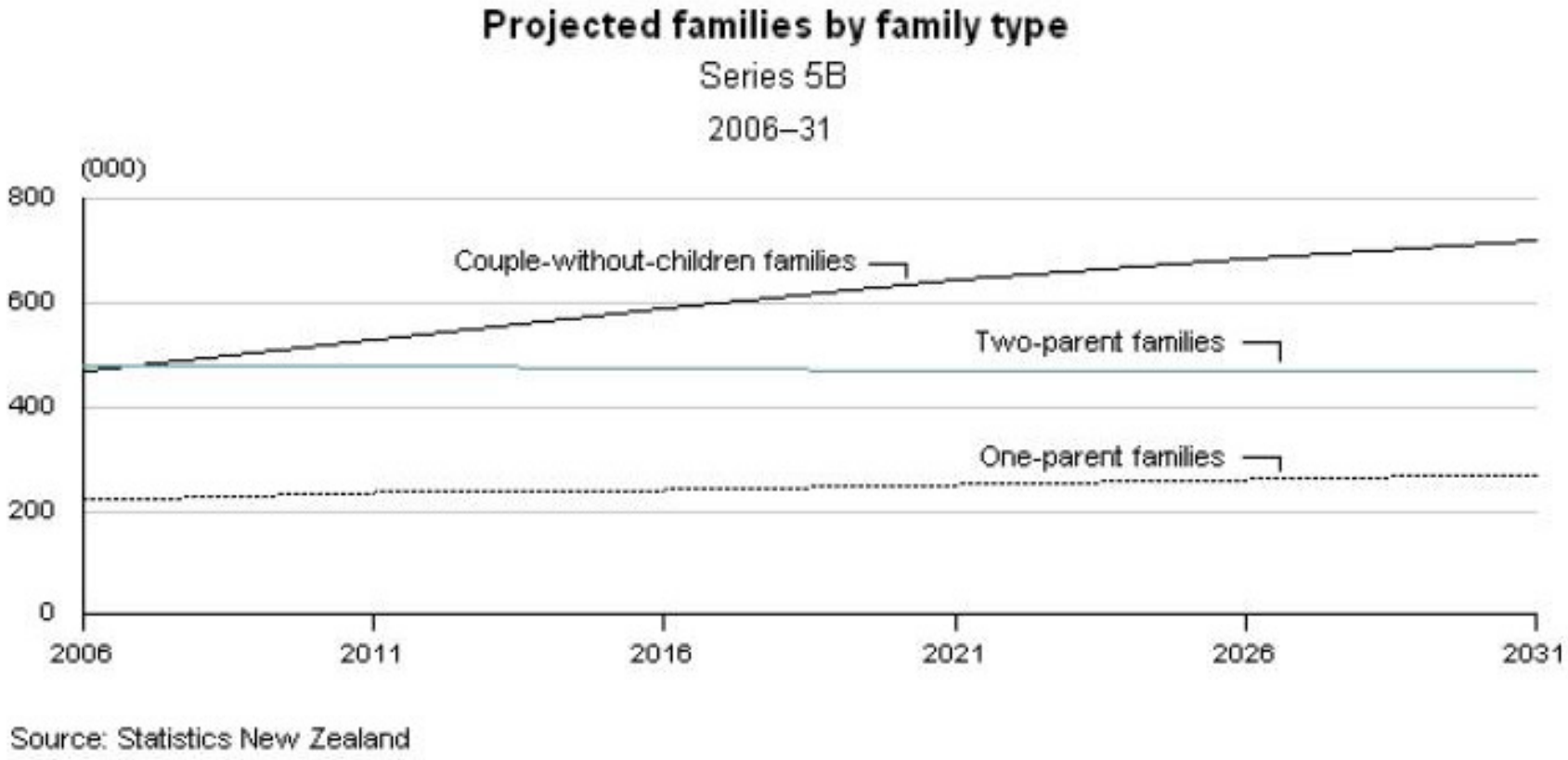
It is the hope of this project that it will be used as a benchmark for future investigations into communities at high-density. The need for intensification in Auckland is of growing importance, and is essential that the current public perception changes.

"It is not the strongest of the species that survives, nor the most intelligent – it is the one that is most adaptable to change"[119]

[119] Charles Darwin, quoted in Bjarke Ingels Group (BIG). *Yes is More: An Archicomic on Architectural Evolution*, (Copenhagen: Evergreen, 2009), pg 20.

9 APPENDICES

Appendix A - Projected family types graph - Source Statistics New Zealand[120]



[120] Statistics New Zealand, *National Family and Household Projections: 2006-2031 update*, July 2010, pg 5.

AppendixB - Criteria Required in the design of High-Density Housing

Urban and neighbourhood Design

Urban design of residential areas to achieve more density, diversity and affordability, while achieving high levels of residential amenity[121]

Integrate traditional models of urban settlement i.e., Leon Krier's ideal of high density, low rise, mixed use development

Return to mix-use developments, with a combination of living and working environments.

Existing sub-standard housing is replaced or upgraded to acceptable standards.[122]

The layout of buildings on an estate should be designed to avoid outlooks onto blank walls, or areas devoid of vegetation and activity[123]

[121] Judd, *Designed for Urban Living*, (Canberra: The Royal Australian Institute of Architects, 1993). - All text highlighted in blue is taken from this source.
[122] Regional Growth Forum, *Auckland Regional Affordable Housing Strategy*. - All text highlighted in green is taken form this source.
[123] Ministry of housing and Local Government. *Families living at high density, a study of estates in Leeds, Liverpool and London, (*London: Her Majesty's Stationary office, 1970). - All text highlighed in red is taken from this source.

Environmental fit/Community

Establishing a network of public streets which provide safe access through site[124]

Avoiding gated developments which prevent useful links being established between different parts of the neighbourhood

Providing continuity of character between new development and the existing urban fabric, designing to provide this continuity involves the combination of characteristics and relationships with materials, colours, textures, scales, shapes and fenestration patterns of the existing urban fabric

Higher-density housing needs to provide easy access to local amenities such as shops, public transport, parks, schools, and community facilities.[125]

Easy access to local amenities such as public transport, work places, shops, community facilities and other services.

[124] North Shore City Council, *Good Solutions Guide for Medium Density Housing*, (Auckland: North Shore City Council, 2007). - All text highlighted in black is taken from this source.
[125] Housing New Zealand Corporation. *Design Guide: Housing at higher densities*, (Housing New Zealand Corporation, 2005). - All text highlighted in organge is taken from this source.

Environmental sustainable

Retaining natural features such as bush, trees, landforms and waterways

Introduce diverse native trees and plants

Introducing designs which minimise runoff

Encourage people to walk by creating environments which are safe, interesting and easy to walk around

Adopting passive solar design principles

Attaching houses in a terraced, semi-detached or apartment style to conserve heat

Site planning should consider solar access and wind control; appropriate zoning and ventilation of spaces within the dwelling; careful selection of window location, size, type and shading systems; choice of construction materials and systems according to their embodied energy use, renewability, thermal mass, heat storage and insulation properties; and energy conscious selections of heating and cooling systems.

Future Use

Arranging and designing houses which front public streets to enable them to be used for different things over time

Mixed use units for living and working along busy streets

Avoid mixing living requirements with incompatible commercial activities which are noisy, produce odours or require late night hours of operation.

Economically sustainable/marketability

Building marketable housing in high quality, attractive environments

Understanding and addressing the needs and expectations of the marketplace is central to successful housing design.

Addressing both emotional and rational needs of housing consumers

Good teamwork will ensure the very best translation from market research to design brief and finally to a good product which is both marketable and profitable.

Social sustainability

For a development to be socially sustainable, it must meet the ongoing needs of the occupants for flexibility of use, privacy, cost-effective environmental controls, and minimisation of the cost of ownership.

Safety/Security

Designing houses to overlook the street

Building houses and parking in areas which are highly visible to neighbouring properties to deter buglurary and car theft

Increased housing densities can be both a positive and negative for security.

Easier for intruders to go unnoticed.

Increased surveillance.

Security lighting at entry points, access routes and common parking areas.

Windows near places where people spend more than a minute or two, all look out on areas of life[126]

[126] Christopher Alexander, Sara Ishikawa and Murray Silverstein, *A pattern language which generates multi-service centres,* (California: Centre for Environmental Structure, 1968). - All text highlighted in grey is taken from this source.

Waste management

Each dwelling should have enough space for the storage of refuse and recycling bags or bins

Refuse enclosures should provide for the separation of recycled waste products and have a hose tap and drainages sump installed for washing down.

Refuse collection points need adequate ventilation, security, and protection from vermin while retaining easy access for the occupants.

Materials and performance

Common walls need to be designed to maintain aural privacy and to minimise noise travel between dwelling units. In general, a sound transmission co-efficient (STC) rating of 55 or greater is required.

The choice of materials and finishes should permit easy and inexpensive maintenance.

Privacy

Providing sunny private outdoor space

Having good access between indoor and outdoor living space

Ensure maximum sunlight with at least 2 hours in winter for private outdoor spaces

Increased residential density raises concerns about privacy, resulting from reduced distances between dwellings, smaller private open space.

Privacy has more to do with control over information and social interaction according to behaviour-environment studies, and can be achieved through both physical and non physical means

The concept of privacy as control, rather than isolation, implies a more flexible set of design responses

Provide a clearly defined hierarchy of 'public', 'semi-private' and 'private' outdoor spaces

Juxtaposition of windows, opaque glass, or strategic position of planter boxes can solve 'overlooking' issues

Private space needs to be clearly separated from other outdoor areas by planting, fences, or other built elements. Upper floor balconies need to be useable, taking care to minimise overlook to private space below.

Occupant control of access

Aural and visual privacy between dwellings[127]

Building elements

Building forms should respond to their neighbourhood. The scale of the building should generally be in keeping with the territorial local authority's policy for the precinct or zone.

External building elements should be designed to assist understanding of the building as a whole

– There should be carefully designed transitions managing the relationships between public and communal, public and private, and communal and private spaces.

– The front door should be clearly visible from the point of site access.

[127] Anthony Radford and Thea Sarris, *Trends and Strategies in the Design of Medium Density Housing* (Adelaide: The University of Adelaide, 2005). - All text highlighted in purple is taken from this source.

Dwelling layout/design

The size, number and layout of rooms in high density group housing is subject to more demanding constraints than the detached house.

Multi storey dwelling types have the additional constraints of stair location and configuration and distribution of space onto several levels

General principles of good dwelling layout include clarity and definition of entry; simplicity; appropriate and convenient functional relationships; circulation efficiency; flexibility of room use and furnishing; clustering of ventilation and horizontal services; appropriate solar orientation of key rooms and their relationship to outdoor spaces and zoning of living areas and bedrooms.

The number and location of bathrooms and toilets is also an important consideration

Second/third bedrooms should be thought of as multi-purpose spaces which may be used for other purposes

The provision of adequate internal storage space is essential for a high density housing form

Interior layouts should include :

– simple plan layouts for clarity and economy

– minimum circulation space

– maximum usable area

– access to WC/bathroom screened from living areas where possible

– light and air to all prime rooms (ie. internal sleeping spaces will not be accepted)

– storage space

– direct access to private outside space

– easy access to carparking.

– A prime room (kitchen, dining, living) should overlook the street.

Use of open plan design to achieve a feeling of spaciousness;

Caters to specific needs of occupiers, which may be related to age, health, family size/structure, cultural needs or special needs.

Well designed dwellings with emphasis placed on energy efficiency, health and safely, privacy (acoustic/visual) and integration into the neighbourhood.

•One large space: Living/eating/cooking/working

•View is desirable but not critical

•'Heat and eat' kitchen

•Two good bedrooms preferred

•Two good bathrooms preferred

•Flexible 'other' space

•Two or 1-plus covered car spaces preferred

Living rooms should face south or west (North or west respectively for NZ) and kitchens should not face north (South respectively for NZ)

Occupants should be able to look out onto a common pedestrian street or space, especially form kitchen windows

Dinning-kitchens in family dwellings should be at least 100sq feet (30.48sq meters)

Identity, variety, diversity

Increases in housing density are usually associated with a decrease in expression of individuality identity

Incorporation of essential amenities and design elements of the detached or semi-detached house into the design of a higher density scheme can create greater residential satisfaction

Expression of identity can be provided through greater variety in design, or providing opportunities for personalisation

Creating variety in urban housing form is essential to achieving individual identity.

Provide stimulating, interesting building composition both at a distance and at close range. Housing units should be identifiable within a development as well as working well with the surrounding urban landscape and buildings.

Introduce a range of housing types within a single development. This introduces a better balance to the development than having every unit exactly the same.

Pedestrian access

Clear and convenient pedestrian access for both residents and visitors becomes increaslingly important as housing projects increase in size

Avoid ambiguity for visitors by providing a clearly marked entrance. i.e. a sheltered mail box, this strong entrance marks the boundary between public and private helping with security acting as a 'symbolic barrier'

Visibility of pedestrian Short cuts through the development should be avoided as it is likely to encourage intrusion by unwanted outsiders

Pedestrian network is visible and easily accessible from any on-site visitor parking

Building form should clearly articulate individual dwellings from each other and provide some individuality in the design of the entrance.

Adequate lighting, signage, logical numbering

A more vibrant and sustainable form results from blurring distinctions and making access to the local centre as convenient as possible

People will follow the easiest direct path between two points. Therefore paths that go the long way will not get used and a shortcut will be formed

•Design for visitabilityby people with physical disabilities

•Design for adaptability for occupation by people with physical disabilities

Layouts should deter pedestrians from taking shortcuts across open areas close to windows

There is a ramp and/or elevator connecting every change of level between public areas

Vehicular access and parking

Design for appropriate, efficient, conveniently located and aesthetically pleasing car access and storage with high levels of safety and security is a great challenge, but is a necessity for high density housing communities.

The ground plane should not be dominated by parking structures. Integrated or complimentary structures can add complexity, diversity and interest to an otherwise simple and repetitive form.

Consider the number of car parking spaces allocated to each dwelling carefully as, over-provision can add unnecessary development costs, while under provision can have impacts on the environmental quality of a development or adjacent streets

Designs for vehicles need to consider:

lighting (and limiting overspill)

proximity to entrance(s)

noise

access to and from the street

safety for pedestrians, especially children

territorial local authorities, requirements, particularly for ambulance and fire services.

Landscaping/ openspace

With larger shared space there is greater emphasis on the quality of landscaping. Both hard and soft landscaping need to be integrated into the overall design. Good designs will include:

– clear uses for distinct areas of shared space

– plants that are large enough to resist damage

– low maintenance

– consideration of the landscape through all seasons

Communal spaces should have clear reasons for their existence and create specific activities.

Minimal private open space, more of an open room than a garden. It should be small but useable, such as a deep balcony or room-sized courtyard

Low maintenance private open space -lawn mowing is unfashionable

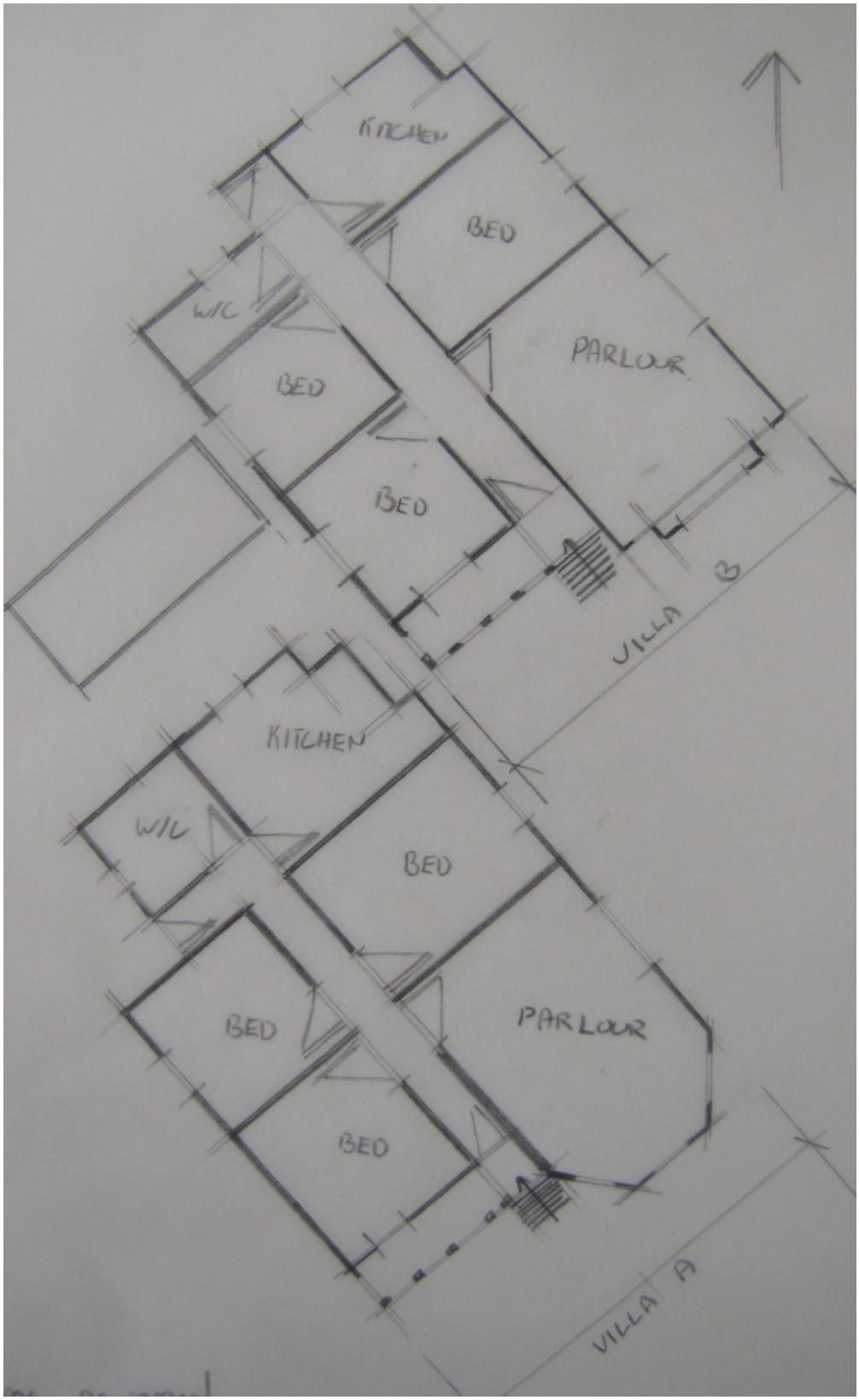
No expectation of maintenance of communal outside space

Outdoor benches are arranged overlooking activity, in the sun, and protected from the wind; and especially suited for elderly

Appendix C - Desired regional outcomes from the Regional Growth Strategy[128]

Outcome	Outcome definition
Water quality	water quality in streams and coastal marine area is maintained where it is good and improved where it is now degraded
Access and transport efficiency	more transport choices and high levels of access for all sections of the community, a closer relationship between home and work, activities, shopping, open space etc., managing traffic congestion and a better passenger transport system
Coastal environment	natural character of coastal environment including landscapes, ecosystems, native bush and water quality preserved and enhanced and access to clean and beautiful beaches maintained
Air quality	air quality is maintained where it is good and improved in areas where it is now degraded
Sustainable use of resources	more efficiency in use of natural and physical resources, including urban land, rural land, infrastructure and energy resources
Employment choice	more employment choices everywhere, better match of employment to population in different parts of region
Business opportunity	improved opportunities for businesses (business growth, development opportunities, affordable and suitable land and infrastructure)
Urban amenity	higher quality urban amenity particularly business, residential, shopping and public space areas (more trees, better streetscape, better urban design etc.)
Safe, healthy communities	safer, healthier communities with high-quality readily accessible community facilities and services publicly and privately provided (e.g. libraries, sporting facilities, schools, stadia, theatres, cafes, gyms etc.)
Housing choice/ affordability	improved housing choice and affordability throughout the region
Cultural heritage	protection and enhancement of cultural heritage
Habitat	expansion and protection of high-quality indigenous habitat
Open space	a greater range and diversity of protected open space
Rural amenity	better non-urban and rural amenity including landscape protection, and more trees and vegetation
Physical and social infrastructure	physical and social infrastructure provided, maintained, enhanced and optimised - existing infrastructure maintained and utilised where it has sufficient capacity for growth, and upgraded where it has not
Cultural identity	cultural identity, including maintaining cultural diversity

[128] Regional Growth Strategy, *Auckland Regional Growth Strategy: 2050* (Auckland: Auckland Regional Council, 1999), pg 20.


KITCHEN
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Appendix E - Acheiving sustainability in this project

1. Conserving Energy

Conserving the amount of energy that we use in our homes is one way we can make long term savings associated with running costs. Our energy demand increases each year as our population and economy grow - we are using about 2% more energy each year. Making the most of our energy efficiency opportunities means we can reduce this growth in energy demand.[129] *"Energy efficiency is not about going without – it is about getting more for your money and stopping waste."* [130] Energy efficient designs aspire to achieve one of the following goals:

Getting more output from the same energy
Getting the same output from less energy
Getting more output from less energy

The New Zealand Energy Efficiency and Conservation Strategy, a government response to meeting energy, climate change, and sustainability goals, aims at improving the overall standard of our homes. Actions outlined by the strategy include: improving the performance of existing homes; using better products such as energy efficient appliances and lighting; use of renewable energy, with a push toward solar water heating; and lifting current building code standards to improve the performance of new homes.[131] In 2007, the government announced a $66 million Energywise homes package to be delivered over four years and to provide funding for: interest-free loans for energy efficiency installations or upgrades; Energywise home grants; clean heat upgrades; the voluntary Home Energy Rating Scheme (HERS); informing households on energy efficiency, what is available and how to get it; research into new technologies; implementing the new Building Code; and the development of new financial incentives.[132]

"Sustainable energy use means designing homes to conserve energy, obtaining energy from sources that do the least possible long-term environmental harm and, where energy is used, to use it efficiently."[133]

[129] EECA; Energy Efficiency and Conservation Authority, *Efficient and renewable energy,* http://www.eeca.govt.nz/efficient-and-renewable-energy/energy-efficiency-and-conservation (accessed August 6 ,2012).
[130] EECA; Energy Efficiency and Conservation Authority, *Ecca Energywise; Why Be Energy Efficient*, http://www.energywise.govt.nz/. (accessed August 6 ,2012).
[131] Energy Efficiency and Conservation Strategy, *New Zealand Energy Efficiency and Conservation Strategy; Making It Happen* (Wellington: New Zealand Government, 2007). pg 18-19.
[132] Ibid., pg 21.
[133] BRANZ, *Level; Energy*, http://www.level.org.nz/energy/. (accessed August 7 ,2012).

2. Energy from renewable sources

Renewable energy - *is just as it sounds energy that is self-restoring. Examples include wind, solar energy, hydro energy and bioenergy from biomass (biological materials that store energy from the sun).*[134]

Non-renewable energy - *comes from fossil fuels like oil and gas. Once it's used - it's gone.*[135]

Space and water heating are the two biggest consumers of energy within New Zealand homes. It is affected by occupant behaviours, building design and the appliances used. The optimization of our renewable energy sources can successfully achieve energy savings in these areas, and ultimately contribute to healthier and more comfortable homes.

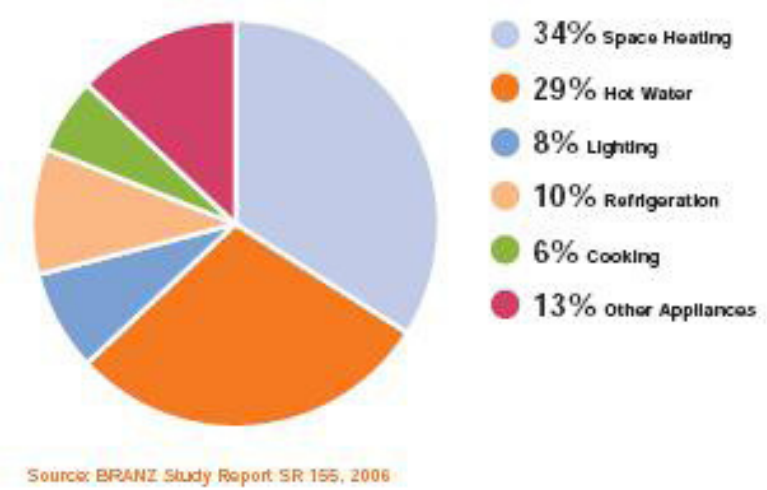


Figure 85: Heating requirements for a New Zealand home

[134] http://www.eeca.govt.nz/efficient-and-renewable-energy/renewable-energy
[135] Ibid

"Passive solar construction is a very attractive design philosophy as not only does it save energy, but it also reduces dampness and condensation, improves sound insulation, increases the durability of building materials and makes the home healthier".[136]

Passive solar utilizes the renewable energy sources of the sun and wind to control ventilation and the temperature of our homes. Using the sun's energy as free, renewable heat source in combination with quality insulation, adequate window orientation and size, and use of materials to provide thermal mass, passive design principles can allow significant savings on our energy bills and reduce our greenhouse gas emissions. Passive solar designed buildings can be low tech and need not cost any more than standard construction...once the correct principles are embodied in a house, little ongoing effort is required to achieve thermal comfort all year round.[137]

Houses should be designed with a Northern orientation to get the maximum benefits from the sun's free energy. A well orientated home combined with high levels of insulation and well designed glazing will ensure that a comfortable internal environment is provided all year round. During the summer it is important to provide shading to the northern aspect to avoid the problem of excess heating within the internal environment. Shading can be provided by using deep eaves, planting and louver systems. Eaves should be designed to allow the maximum amount of winter sun to enter the building whilst block out the high angle summer sun. Low angle sunlight during the summer from easterly and westerly orientations is best blocked by vertical louvers, avoiding uncomfortable living environments due to overheating, but also minimising glare all year round.

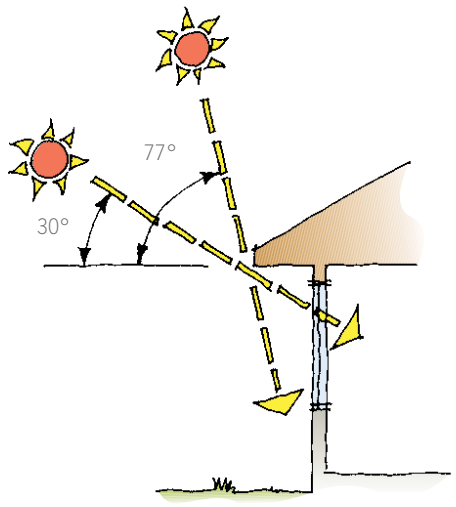


Figure 86: Design for shading

[136] ECCA; Energy Efficiency and Conservation Strategy, *Energy-Wise Renewables: Passive Solar Design for New Zealand Homes* (Auckland: ECCA; Energy Efficiency and Conservation Strategy, © ECCA 2000), pg 1.
[137] Ibid., pg 2.

Consideration of the placement of windows in the designis important to ensure that maximum solar gain is achieved and that heat loss is prevented by reducing window mass on the southern facade of the building. As the biggest source of heat loss from a building is through windows; the use of double glazing along with correct positioning will reduce heat loss. Double glazing controls the levels of noise, glare, moisture, and heat transfer through the building element. Essentially, double glazed windows create an insulation layer of air or similar gas (Argon, Krypton, and Xenon, for increased performance). Not only is natural light allowed to penetrate into the building through the use of windows and similar glazing, but also enables natural ventilation.

Dense materials such as concrete, terra cotta or ceramic tiles and brick have excellent heat storage capacity compared to timber or metals. Thermal mass materials have the ability to absorb the sun's solar energy and radiate it back into the building as the interior spaces cool. Essentially they act like a rechargeable battery for storing heat.[138] This is particularly beneficial during the cooler months of the year and works best when exposed to north sunlight.

[138] ECCA; Energy Efficiency and Conservation Strategy, *Energy-Wise Renewables: Passive Solar Design for New Zealand Homes* (Auckland: ECCA; Energy Efficiency and Conservation Strategy, © ECCA 2000), pg 3.

"...high thermal mass materials exposed to sunlight may reduce total heating and cooling energy requirements by up to 25%."[139]

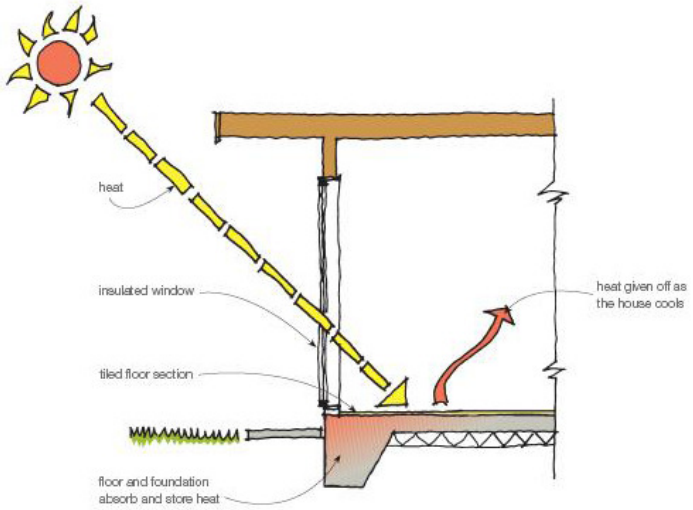


Figure 87: Thermal massing

Exposed concrete floors are the most commonly used thermal mass in New Zealand homes. To maximise the benefits of thermal mass, concrete floors should be insulated underneath, and not have coverings such as carpet, that will hinder the performance of the floor. External windows should be double or triple glazed down to floor level to provide maximum exposure.

[139] Branz, Level; *Thermal Mass*, http://www.level.org.nz/passive-design/controlling-temperature/thermal-mass/ . (Accessed August 8 2012).

Insulating the walls, under floor, and ceiling to a high level diminishes the heat transferred across the building element during summer and winter. Insulation should be above the current building codes specification as only a minimum level of insulation is specified and this may be less than the optimum for heat conservation.[140]

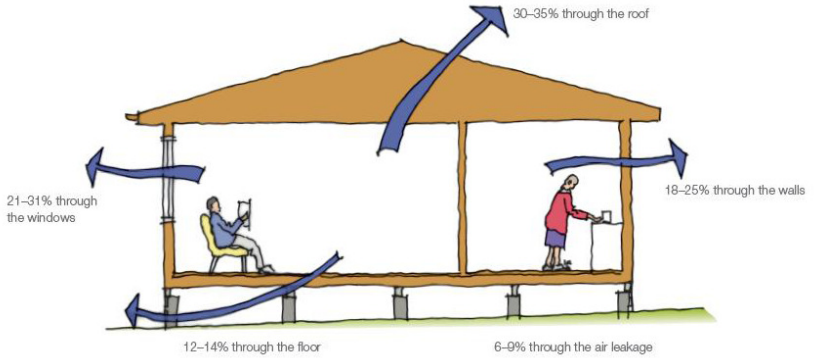


Figure 88: Heat loss from an uninsulated home

As stated above, successful passive solar design techniques incorporate natural air movement as a means of cooling the interior spaces. Passive cooling is a means of providing a comfortable indoor temperature throughout summer, without the use of an air conditioner or similar mechanical device. Passive ventilation is natural wind movement through the building, operated by manipulation of the building facade, windows/doors, by the building occupant. An air conditioning unit provides the same service but requires significant amounts of electricity, and requires the home to be sealed off from outdoor environments to work efficiently.

Solar and wind energy can be passively incorporated into a design to reduce energy requirements, but it can also be harnessed to generate energy directly providing an increased level of sustainability. It is an aim of this project to utilize features of both techniques. Photovoltaic systems absorb energy from the sun's rays and convert it into electricity and are made up of cells that contain semi-conductor material, usually silicon, sandwiched between glass and another robust material. Solar radiation striking the cells cause electrons to move between the semi-conductor layers, creating an electric current. Cells are connected to produce a voltage output from the panel.[141]

[140] ECCA; Energy Efficiency and Conservation Strategy, *Energy-Wise Renewables: Passive Solar Design for New Zealand Homes* (Auckland: ECCA; Energy Efficiency and Conservation Strategy, © ECCA 2000), pg 3.

[141] Branz, *Level; Photovoltaic Systems*, http://www.level.org.nz/energy/renewable-electricity-generation/photovoltaic-systems/ (accessed on August 9, 2012).

Advantages of photovoltaic systems

>Quiet

>Non-polluting

>Low operating costs

>Low maintenance costs

>Contribute to reduction of greenhouse gas emissions[142]

Disadvantages of photovoltaic systems

>High initial capital costs

>Require batteries if an off-grid installation

>May not meet all the household electricity needs.[143]

Photovoltaic solar panels can either be fixed to the roof or wall of the building, or can be fully integrated into the building as part of the structure or cladding.

A building integrated photovoltaic (BIPV) panel is integrated into or fully replaces a building element, such as roofs, walls, skylights or awnings.[144] Examples of fully integrated PV panels are not common in New Zealand due to their high cost compared to standard roof and wall claddings for domestic use, and that their system output is limited by the orientation of the building. Internationally these systems are being frequently used as external cladding elements, giving a new dynamic to the facades. BedZED is a good example where PV panels have been successfully integrated into the building. An option for integrating PV panels into the roof is solar tiles. Containing an integrated solar panel these tiles can replace conventional roof tiles, while allowing some dappled light through their semi-transparent surface.

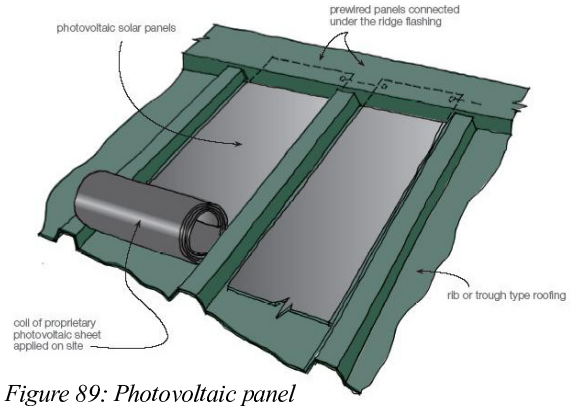


Figure 89: Photovoltaic panel

[142] Branz, *Level; Photovoltaic Systems*, http://www.level.org.nz/energy/renewable-electricity-generation/photovoltaic-systems/ (accessed on August 9, 2012).
[143] Ibid., (accessed on August 9, 2012).

[144] Branz, *Level; Photovoltaic System Location*, http://www.level.org.nz/energy/renewable-electricity-generation/photovoltaic-systems/photovoltaic-system-location/ (accessed on August 9, 2012).

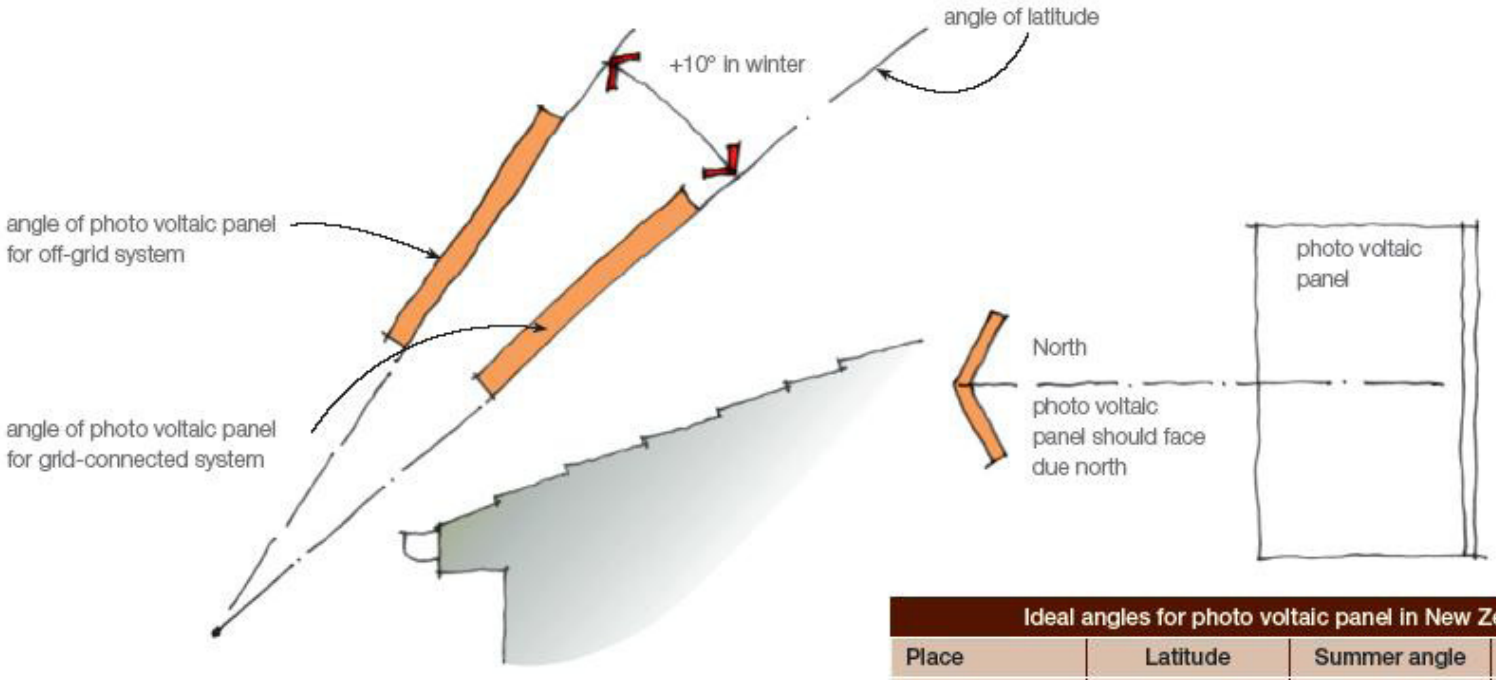


Figure 90: Photovoltaic panel tilt

Ideal angles for photo voltaic panel in New Zealand			
Place	Latitude	Summer angle	Winter angle
Whangarei	35° 45'	26°	51°
Auckland	36° 50'	27°	52°
Wellington	41° 15'	31°	56°
Christchurch	42° 30'	32°	57°
Dunedin	45° 50'	36°	61°
Invercargill	46° 30'	36°	61°

The average New Zealand household uses about 10,000kWh of electricity a year which equals just under 27.5kWh per day. Approximately 8m² of PV panels can produce a maximum of about 1kW of power under standard conditions.[145] The energy capacity of a photovoltaic system is directly proportional to the amount of sunlight absorbed. To achieve maximum sunlight absorption the panels should be orientated towards north for New Zealand conditions. It is recognised that due to shading, lack of space, poor building orientation and aesthetic reasons it may be necessary to change the panel's orientation. As general guidance, it is not recommended that the panel be orientated more than 20 degrees from true north.[146]

The tilt angle of the panels is the angle of the solar panels to the ground. It is generally accepted that the optimum tilt of the panel is the local latitude. To maximise energy output in winter when power need is greatest the tilt angle should be the local latitude plus 10°.[147] A system that allows adjustment of the tilt angle will maximise efficiency. Photovoltaic Panels pay off their embodied CO2 within three to three and a half years, and have an expected life of 25-50 years with a 5-8% reduction in electrical output towards the end of their useful life.[148]

In addition to photovoltaic panels the installation of a well designed solar hot water system can heat 50-75% of a household's hot water needs per annum[149] and will ensure significant power bill savings for residents.

Figure 91: Roof mounted solar hotwater unit

[145] Smarter Homes, *Photovoltaic cells*, http://www.smarterhomes.org.nz/energy/generating-your-own-electricity/photovoltaic-cells/ (accessed on August 12, 2012).
[146] Branz, *Level; Photovoltaic Systems*, (accessed on August 9, 2012).
[147] Ibid., (accessed on August 9, 2012).

[148] Bill Dunster, Craig Simmons and Bobby Gilbert, *The ZEDbook: solutions for a shrinking world*,(Abingdon: Taylor and Francis, 2008), pg 41.
[149] Ministry for the Environment, *Smarter Homes; Is Solar Water Heating for Me?*, http://www.smarterhomes.org.nz/energy/solar-water-heating/is-solar-water-heating-for-me/. (accessed August 9 ,2012).

The process in which water is heated is relatively straight forward. Solar panels, typically mounted on the roof, capture the sun's energy and heat water which is then stored in an insulated cylinder to be used when required. During the summer this process will supply a household with the majority of its hot water needs, whilst in winter, a gas or electricity system is required as a back-up system. Savings of up to $500 per annum can be made, depending on the cost of the electricity or gas supply.[150] Ultimately correctly configured solar hot water systems reduce New Zealand's dependence on non-renewable energy sources and save us money.

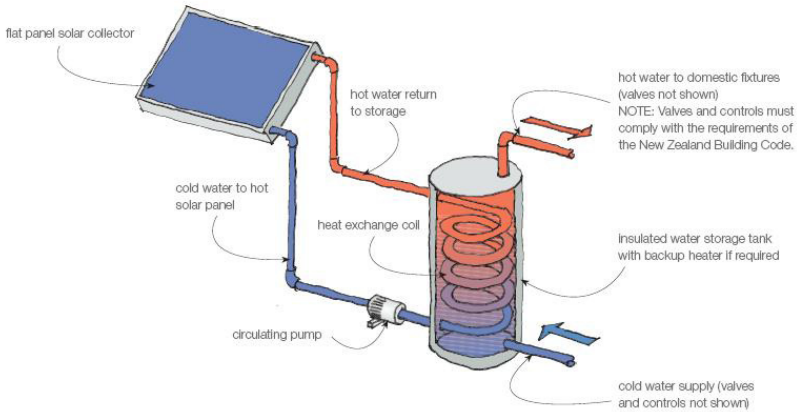


Figure 92: Closed loop solar hot water heating

[150] Ministry for the Environment, *Smarter Homes; Is Solar Water Heating for Me?*, http://www.smarterhomes.org.nz/energy/solar-water-heating/is-solar-water-heating-for-me/. (accessed August 9 ,2012).

"New Zealand has excellent wind resources and increasing numbers of wind farms are being proposed and built. Small-scale and micro wind turbines are also available; for homes, farms and businesses that want to generate their own wind power."[151]

Wind turbines generally rely on a relatively constant wind of reasonable speed to generate electricity. Horizontal-axis turbines are the ones most commonly installed in domestic situations and are modelled from the larger exemplars seen on wind farms. Small wind turbines used for domestic purposes require an average speed of 4.5ms^{-1} (16km/h) to operate effectively[152], and utilize a tail fin to ensure the blades are facing the wind. A less common variation of the wind turbine is a vertical-axis turbine. Vertical-axis wind turbines have the advantage of being more tolerant for changing and inconsistent wind directions, making them ideal for utilization in an urban context.[153] Due to the centre of mass, vertical-axis wind turbines are able to generate electricity at much lower wind velocities of 1ms^{-1}.[154]

[151] EECA, *Small Wind Turbines,* http://www.energywise.govt.nz/how-to-be-energy-efficient/generating-renewable-energy-at-home/small-wind-turbines (Accessed on August 12, 2012)
[152] Ibid., (Accessed on August 12, 2012).
[153] Dunster, *The ZEDbook: solutions for a shrinking world,* pg 116.
[154] Bill Dunster, *From A to ZED: Realising zero (fossil) energy developments*, (Bill Dunster architects ZEDfactory Ltd, 2003), pg 126.

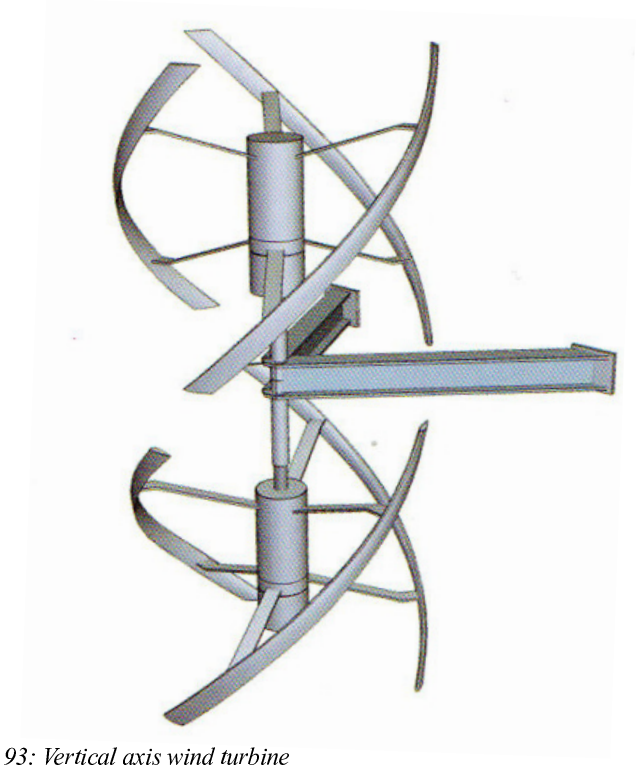


Figure 93: Vertical axis wind turbine

"Wind turbines are on average three times more cost effective than photovoltaic panels."[155]

[155] Dunster, *From A to ZED: Realising zero (fossil) energy developments*, pg 126.

3. Water Management

"In New Zealand, we're surrounded by water. It's easy to think of it as a free resource - one that will never run out. But that isn't entirely the case. Increasingly, towns and cities are facing water shortages."[156]

By making a few simple changes we achieve significant reductions in our water use. Currently about half of a households water comes from the bathroom, with both the toilet and shower using 25%, the laundry and garden use 20%, while the kitchen uses 10%.[157] The amount of water used in our homes can be reduced in a number of ways. By installing a pressure limiting valve on the mains supply the amount of water used within the house can be controlled. The use of efficient hot water systems, such as solar hot water described above, with storage cylinder located as close to the kitchen or bathrooms to minimise pipe work reduces the pressure put on mains supply.

[156] Smarter Homes, *Water*, http://www.smarterhomes.org.nz/water/ (accessed on August 12, 2012).
[157] Ministry for the Environment, *Sustainability.Govt.Nz; Typical Household Water Use*, http://www.sustainability.govt.nz/water/typical-household-water-use. (accessed August 10 ,2012).

Other features that can contribute significant water savings to a household are the control of water for flushing toilets by using dual cisterns or treated grey water, purchasing water-efficient appliances with a star rating indicating their water efficiency.[158]

The installation of a rainwater storage tank will drastically reduce the dependence on the council grid for water and is relatively simple and inexpensive. From a sustainability point of view storage tanks allow for minimal run-off from the expansive roof surface of a building which would otherwise be wasted as storm water. The collected rainwater can be used for the irrigation of gardens and flushing toilets.

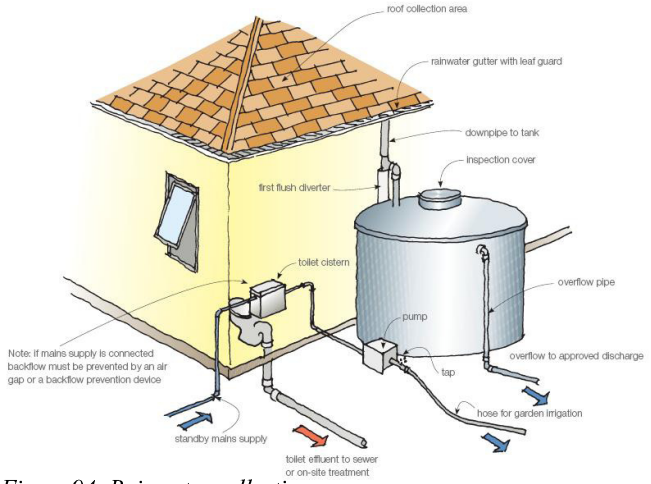


Figure 94: Rainwater collection

[158] Branz, *Level; Minimising water use*, http://www.level.org.nz/water/minimising-water-use/, (accessed August 8, 2012).

Rainwater tanks are commonly seen in rural environments where there is no access to mains supply. However there has been a move towards conserving water and as a result rainwater collection is gaining popularity in urban centres, as seen at Earthsong.

The process of grey water recycling uses water from kitchen sinks, dishwashers laundry taps, washing machines, baths, basins and showers to flush toilets and irrigate gardens. By reusing grey water instead of wasting it we can make savings on water use while reducing wastewater charges, and lessening the demand on mains supply. Health risk concerns arise with grey water recycling in domestic situations as possible contamination of drinking water may occur if systems are installed incorrectly and not maintained.

Figure 95: Rainwater collection tank at Earthsong

Appendix F - Presentation Documentation

Figure 96: Location Plan

Figure 97.: Site Plan

Figure 98: Courtyard House Plans

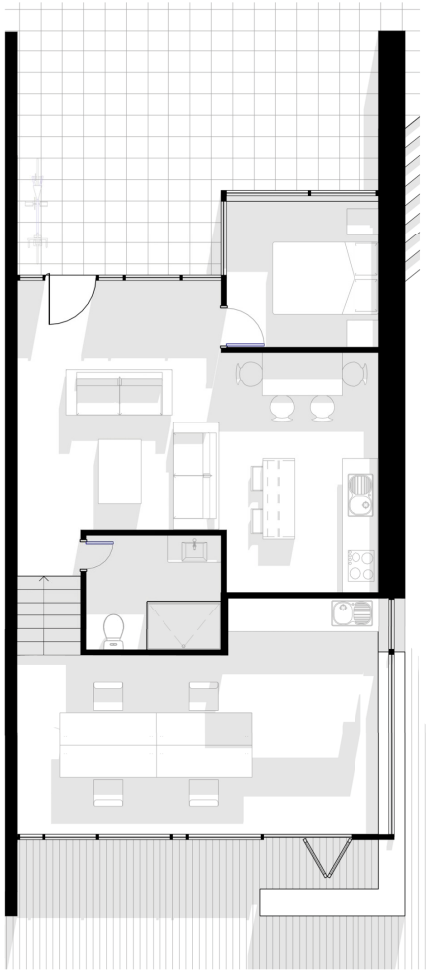


Figure 99: Live / Work House Plan

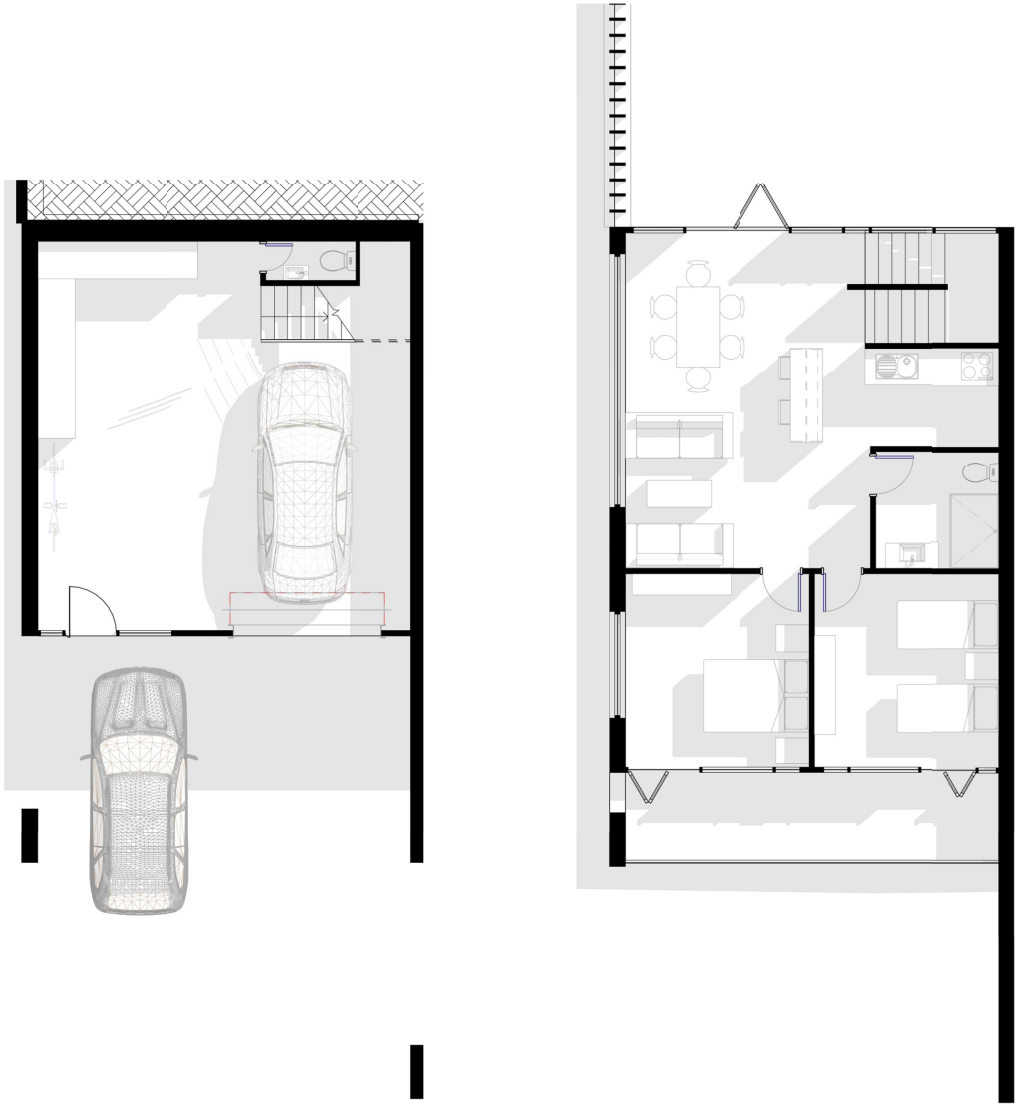


Figure 100: 2 Bedroom / Three person Dwelling Plans

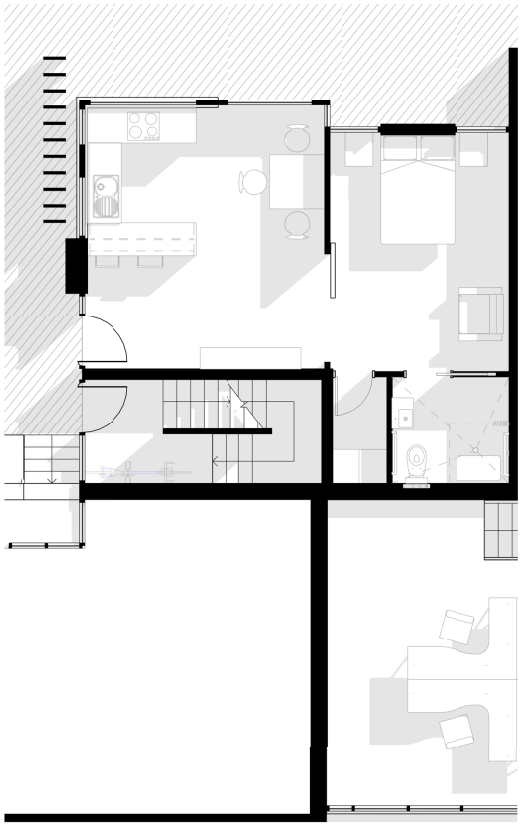


Figure 101: Elderly Housing Plan

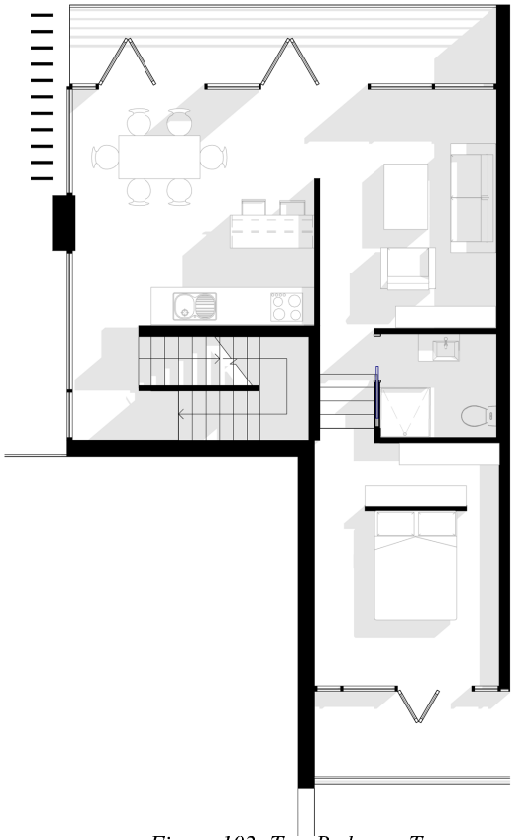
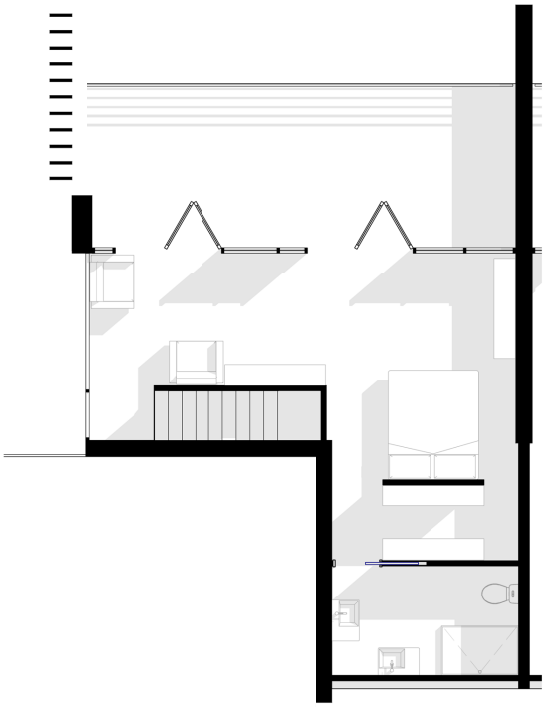


Figure 102: Two Bedroom Two person Dwelling



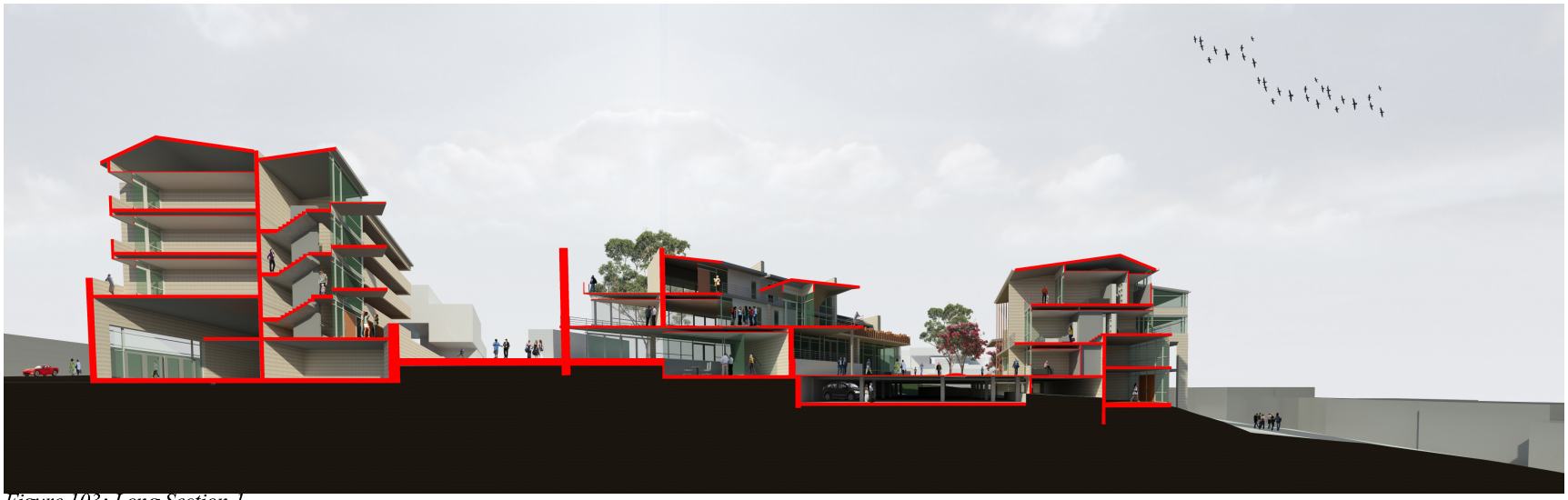


Figure 103: Long Section 1

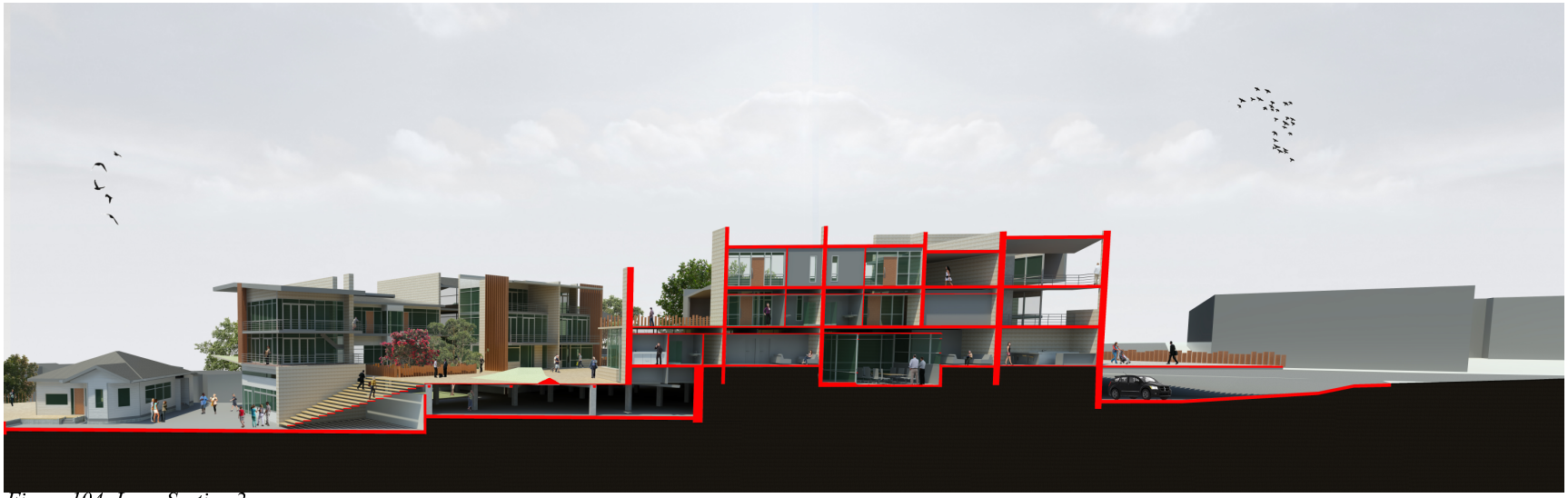


Figure 104: Long Section 2

Figure 105: Perspective 1 - Southern Corner

Figure 106: Perspective 2 - Interior Courtyard

Figure 107: Cross Section 1

Figure 108: Perspective 3 - Interior Courtyard

Figure 109: Perspective 4 - Community Gardens

Figure 110: Presentation

Figure 111: Location Model 1:1000

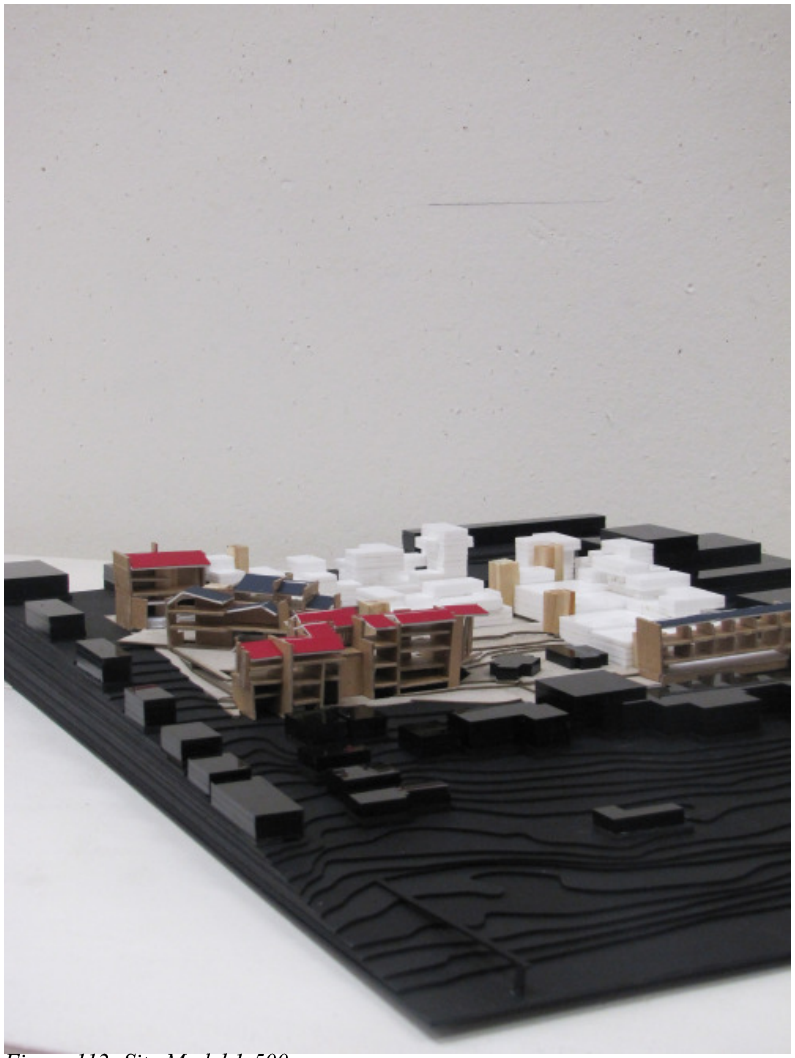


Figure 112: Site Model 1:500

10 FIGURES AND TABLES REFRENCES

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