The Architecture of Leaving: Reconstructing Communities on the Move

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Figure 1. Essence image, by author.

Abstract

The global climate continues to change, creating worsening living conditions across diverse regions vulnerable to its impacts. With this comes a rise in climate-related disasters such as flooding, coastal inundation, droughts, wildfires, etc. The need for climate adaptation and mitigation is urgent, especially for those who are particularly vulnerable. This thesis examines how managed retreat strategies can better support communities facing displacement. The research combines a review of past literature, key precedent analysis, in-depth site-based design research and material strategy analysis to inform three speculative architectural proposals. Previous research lacked in-depth exploration into the housing solutions needed to make managed retreat a socially viable adaptation strategy. Additionally, there has been no previous connection between managed retreat strategies and the implementation of circular economy principles. These gaps in the research offer a unique opportunity to engage with a managed retreat strategy in ways never before seen; exploring these new possibilities could be the key to improving an otherwise controversial adaptation strategy. By combining managed retreat with circular economy strategies, specifically deconstruction and material reuse, to produce three speculative architectural proposals, the thesis explores a housing design framework that enables communities to relocate with reduced financial and social burdens. Additionally, the design explorations seek to reduce material waste, contributing to both sustainable design and climate adaptation discourses.

Positionality Statement

This positionality statement reflects on how my upbringing, values, relationships and family heritage influence the way I approach research-led design. Understanding my position is essential to keep me conscious of how I engage with the people, places and systems within my project and remain accountable.
My education in architecture at AUT has furthered my understanding and conscious concern for the environment and the challenges it faces as climate change worsens. My education has also taught me the role which architecture can play in addressing climate change and providing climate adaptation solutions. I have a personal connection to deconstruction strategies, as my grandfather was a prominent figure in the New Zealand demolition industry and an early advocate for the salvage of materials from demolition sites. Additionally, I have family ties to a demolition salvage yard where I have worked part-time for the past 7 years, engaging in different stages of the deconstruction process. This insight motivates my research; however, I also recognise that I am an outsider to other aspects of this project, such as the site and managed retreat strategies. I approach this project with a commitment to learning and understanding of my own knowledge limitations.

My design work is grounded in values of circular economies, social equity, and regenerative solutions. I believe that architecture can be a strong catalyst for a shift towards more regenerative thinking and stronger climate resilience. Through the design process, I've become more aware of my assumptions about living dynamics and family structures and how they can shape interactions with space. This has shifted my approach and led me to a better understanding of alternative family structures and the representation of unique living systems in architecture.

Positioning my relationship to the Sandringham area, I acknowledge that I'm not a local to the suburb. While I view myself as an outsider to the community, I have lived adjacent to the area my whole life, have had plenty of experiences, and know many locals. Despite my outsider status, I can contribute valuable research and add to the discourse through architectural exploration. My motivation to explore Sandringham stemmed from my growing concern for climate-vulnerable areas in Aotearoa New Zealand; the selection was based on an evaluation of multiple sites in Auckland. I have lived in Auckland my whole life and witnessed the Auckland anniversary floods in 2023, during which numerous friends and family members were affected. This is a key factor behind my decision to focus on sites in Auckland.

Acknowledgements

I want to express my gratitude to everyone who has aided me in any way in completing this thesis.

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To my family and close friends, thank you for all your support throughout this process, from my mum helping me transport materials for presentations, to my dad recommending sources and discussing relevant topics with me, and to friends helping me with software I was unfamiliar with. I am very thankful to all of you for what you have done for me.

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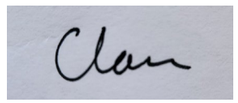
Attestation of Authorship

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



Chapter 1: Introduction

Introduction

Managed retreat, often viewed as a policy and logistical problem, also poses a significant architectural question: what can be done with the buildings and materials that are left behind? The current practice of retreat is dominated by demolition as a means of removal; this can adversely impact the displaced community, as it undermines their place identity and attachment, jeopardising social cohesion through the strategy (Willcocks-Musselman et al., 2025). However, these buildings offer an opportunity to become resources for regeneration. Deconstruction shifts the managed retreat narrative from one of loss to one of renewal, allowing the remains of a community to rebuild a new one. Managed retreat often affects marginalised communities the most (Siders, 2019a); however, through the potential for deconstruction in these strategies, it creates new architectural access and agency. Groups previously unable to access architectural services would have the opportunity to shape their built environment, extending the possibilities for non-traditional western housing approaches such as incremental housing, cohousing, and intergenerational housing.

This thesis explores the integration of deconstruction practices and material reuse within architectural design, culminating in a series of speculative design experiments that reimagine living solutions and material life cycles within the context of managed retreat. By exploring how buildings at risk of climate hazards can be carefully dismantled, with their components and materials reconstructed into housing solutions for the displaced residents, this research aims to demonstrate how architecture can exist within managed retreat systems as a regenerative force that retains connections between people, place and materials.

There are two primary motivations for this research. Firstly, it addresses the global waste crisis and the role architecture plays in rethinking construction and demolition (C&D) waste systems. C&D is one of the most significant contributors to global waste production, accounting for 25-30% of all waste (Sakthibala, 2025). This is primarily due to current linear building practices that extracts, constructs, uses and then demolishes. Demolition processes treat architecture as disposable, erasing not just the building but also the embodied energy and cultural narratives embedded in the materials. Deconstruction, however, allows buildings to be carefully dismantled, retaining the cultural and environmental value of the materials while enabling them to be repurposed and integrated into new contexts. The extension of material lifespans and reduction of waste align with the principles of the circular economy, shifting architecture toward a more future-thinking practice. Secondly, this research is driven by the spatial, social and environmental implications of managed retreat, which is becoming a growing reality in Aotearoa New Zealand and globally. As the effects of climate change worsen, so too do the living conditions of those in vulnerable regions, and the rise in climate-related disasters such as flooding, coastal inundation, droughts, and wildfires is inevitable (Thomas & Lopez, 2015). Adaptation strategies that previously protected communities from climate hazards are becoming less viable options for communities at risk; the only sure way of safe adaptation is now becoming retreat. Architecture is core to managed retreat strategies; architects act as intermediaries between humans and the built environment. Managed retreat involves the displacement of both.

Aotearoa New Zealand's unique climatic and geographic conditions have made it an extremely vulnerable target for climate hazards, particularly sea level rise and flooding, which have been significant concerns across the country, prompting discourse around potential relocation. In recent memory, the Auckland anniversary floods in 2023 caused over 2,000 slips and flooded nearly 10,000 properties in Aotearoa's largest city (1News, 2025). A week later, Cyclone Gabrielle struck Aotearoa, displacing more than 10,500 people and is likely to be the most devastating weather-related event ever to hit the country (Wilson et al., 2024).

Research Question(s)

Navigating this interconnected and overlapping space is complex. Design thinking can play a role in engagement with these themes but requires targeted framing that at once captures the broader issues and context but also allows deeper, focussed investigation. The main research question for this thesis is:

How can deconstruction play a role in reimaging managed retreat as a process of renewal rather than loss?

This is further framed by the sub-research questions:
How can deconstruction-based material reuse reduce waste and create regenerative architecture within managed retreat strategies?

How can managed retreat strategies that implement deconstruction produce living solutions that better reflect current social and cultural ways of living?

Thesis Structure

Chapter One:
Introduces the research context, aims, structure and methodology.

Chapter Two:
Explores managed retreat and its architectural implications through a review of literature, case study analysis and policy frameworks.

Chapter Three:
Explores deconstruction and material reuse through a review of literature, case study analysis and relevance to architecture.

Chapter Four:
Investigates potential sites, then examines the chosen sites' characteristics, opportunities and constraints.

Chapter Five:
Explores three design scenarios that exist within the context of deconstruction implementation in a managed retreat strategy, treating each scenario as a design sprint experiment, providing reflections on each.

Chapter Six:
Concludes the thesis through reflections and discussions on the findings, the research's strengths and limitations, and future research suggestions.

Limitations of the Study

Quantitative Research
The research relies on speculative design to inform the main findings, access and production of any quantitative data is limited, what is produced is very much indicative and is not verified. The data produced for material audits seen in chapter 5 is based on rough estimates and the quantitative survey of the selected site shown in chapter 4 is based on observations; both may not be entirely accurate but provide useful understandings for the speculative design. Further, the research lacks quantitative outcomes on costs, timeframes, and carbon-reduction estimates.

Community Engagement
The managed retreat strategies, three speculative scenarios and their architectural outputs were not developed through codesign processes with the local community. This limits the research's understanding of the community's priorities, which may affect the socio-cultural relevance of the design outcomes.

Site Focus
The design scenarios and analysis are heavily based on the selected site of Sandringham, Auckland, the local contextual analysis was key in shaping the design outcomes and strategies. This has limited the transferability of certain aspects of the research to other contexts, such as sites with different building densities or climate hazards.

Urban Planning
Due to time constraints and scope, urban planning and policy framework development were limited; broader urban system considerations were not included.

Design
The design scenarios were explored through short design sprints, limiting the depth of exploration for each in favour of broader design research potential. Alternative and hybrid design approaches were not fully explored. Furthermore, the thesis only addresses the retreat and deconstruction of residential low-density housing typologies, limiting research into infrastructure, non-residential and differing density building typologies.

By integrating deconstruction into managed retreat strategies, this thesis seeks to contribute to the expanding discourse on climate adaptation, particularly by offering architectural design experiments that can be refined and built on in the future. The thesis seeks to shift the thinking of managed retreat strategies from policy and urban planning responses to become a material and spatial design opportunity. The thesis argues for an approach to climate adaptation that is not only reactive to the issue but also responsive to the underlying issue of climate change, through the implementation of regenerative solutions. Within the context of managed retreat, the reuse of materials and deconstruction allow architecture to reframe loss as transformation, enabling the pieces of the past to sow the seeds of a greater future.

Methodology

Research Approach

Two separate targeted literature reviews both explored existing research topics: one examined deconstruction and related circular economy strategies, whilst the other examined managed retreat and related climate adaptation research. The literature reviews highlighted key themes within each research topic while identifying research gaps in both. Sources include government reports, academic journals, podcasts, and videos.

Methods

Literature Review
Two separate targeted literature reviews both explored existing research topics, one explored deconstruction and related circular economy strategies whilst the other explored managed retreat and related climate adaptation research. The literature reviews highlighted key themes within each research topic while identifying research gaps in both. Sources include government reports, academic journals, podcasts, and videos

Case Study Analysis
Case studies were selected for examination and analysis to identify learnings that can inform the speculative design process. Case studies were selected for each main topic; Superuse Studio (Netherlands) is an example of deconstruction strategies in practical application, while Matatā (Aotearoa New Zealand) and Kiruna city (Sweden) are examples of managed retreat strategies. A global and a local case study were chosen for the topic of managed retreat to understand how managed retreat can be situated within Aotearoa's cultural, environmental and regulatory context, whilst also providing alternative strategies and ways of thinking that challenge local understanding. Only one case study was selected for the topic of deconstruction due to limited examples; however, the selected case study explores multiple precedent projects that highlight different considerations and approaches to deconstruction.

Site Contextual Analysis

Four main sites were selected and considered for the final site; a site analysis of each was undertaken to ensure the most effective and informative outcome. These sites included Kumeu, Kawakawa Bay, Sandringham, and Waimauku. These sites were judged on population, diversity, building typologies, historical and cultural significance, current infrastructure and climate risks. From the initial site analysis, a final site was chosen and further analysed, exploring it in greater depth and in a more specific context for the research. The site analysis was integral to creating the design scenarios and informing speculative design decisions

Scenario Methodology

The scenario methodology enables the exploration of multiple possible futures by identifying and testing what-if scenarios. Rather than producing a single potential outcome, it allows researchers to imagine multiple plausible futures within the same context, changing only certain conditions to do so. This methodology is advantageous in architectural research as it allows for the testing of a design strategy's adaptability to varying social, material or environmental challenges. This methodology is implemented during the design phase of this project to explore speculative scenarios within the broader context of the managed retreat strategy.

Speculative Design

Design-based research was a methodology implemented to explore and test how reclaimed materials could be deployed in a deconstruction-based retreat-based strategy to create architectural housing solutions. Drawings, physical and digital models, and diagrams were produced to visualise and test interventions. The speculative design methodology was combined with the scenario methodology to produce three potential situations that would enable more exploratory experimentation with different aspects of the design strategy.

Ethical Considerations

None of the research required the use of methodologies involving human or non-human participants; all data and research were obtained from publicly available sources. No ethics approval was required for the completion of the thesis.

Methodology Diagram

The diagram seen in Figure 2.1 is a chronological representation of the research methodology, highlighting how each research step informs the next. It begins with the overall research topic and research questions that frame the thesis. Splitting into the two subtopics, managed retreat and deconstruction, respectively, literature reviews and case study analysis are the key research methodologies used in these sections. Insights from these research sections then inform key research areas explored in the site contextual analysis, mapping is a key technique used to communicate this research. The research exploration of the site and two sub-research topics converge into the development of three speculative design scenarios. These scenarios are iteratively developed, and a key research methodology is utilised to explore and act as experiments through speculative design, testing the overall research topic. From these speculative design scenarios, the findings and conclusions are drawn.

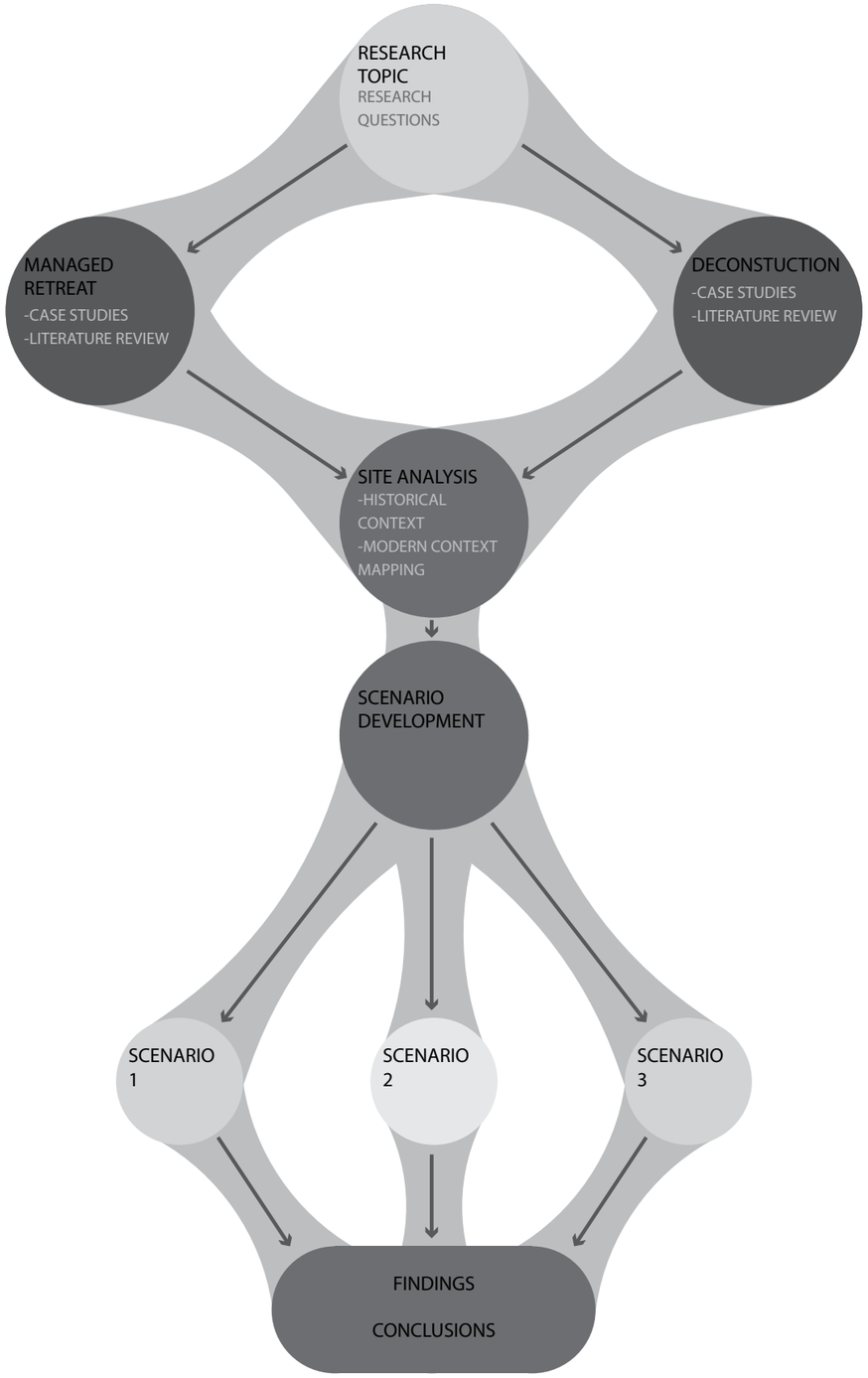


Figure 1.1. Methodologies diagram, by author

Chapter 2: Managed Retreat

Introduction

This chapter covers the key research topic of managed retreat, exploring its global and local significance, the chapter later informs the design context of this thesis. Managed retreat is the planned relocation or movement of people, infrastructure and other existing human inhabitations away from climate hazard risk areas. The concept of managed retreat is referred to by many terms that describe different forms of movement in response to climate hazards. There is currently no definitive term (Willocks-Musselman et al., 2025); as such, managed retreat is used as it is widely accepted within academia and by policymakers. Globally, as climate change worsens and climate hazards such as coastal erosion, flooding, wildfires, and landslides become more frequent and destructive, there is an increasing need for climate adaptation measures. Managed retreat is one of the three main climate adaptation categories alongside 'protect' and 'accommodate' strategies, although managed retreat is the most effective at removing risk, socio-economic factors have led to concerns about its implementation. While often associated with urban planning and policy decisions, managed retreat poses interesting questions for architecture, offering a unique context for design. This chapter explores managed retreat through past literature review, case study analysis, local contextual analysis, and policy frameworks/legislation.

Local Risk/Context

Aotearoa's unique climate and environment have made the effects of climate change more prevalent. Recent climate events, such as the Auckland anniversary floods and Cyclone Gabrielle, have made climate adaptation a more relevant topic. Aotearoa is famed for its extensive coastal areas; as an island nation, most of its largest cities are situated along the coast. Kiwis have a special connection to the coast, with 75% of the population living within ten kilometres of the coast (LEARNZ, 2019). However, as sea levels rise, these beloved coastal areas and their residents are under constant threat. Additionally, Aotearoa's position on the Indo-Australian and Pacific tectonic plates has led to the country's immense volcanic activity, which has shaped the steep and varied terrain that exists today. The rugged mountains, narrow valleys and coastal flats have made Aotearoa's cities and towns extremely susceptible to flooding, in Auckland, "around 20% of buildings in the region are exposed to some kind of flood risk" (Junn, 2025). Managed retreat has been a growing topic across the country as a potential resilience strategy. However, the response to the idea of managed retreat has been quite mixed; many think retreat "feels like we're losing a battle" (Tovey, 2023). Recently, a proposed managed retreat strategy in Kumeu to combat a historic pattern of flooding was scrapped due to pushback from residents, despite a council report finding no feasible engineering solutions (Mansell, 2025). As climate disasters become more commonplace in Aotearoa, adaptation strategies like managed retreat will become commonplace.

Literature review

This literature review aims to explore existing research and leading perspectives on one of the key themes of this thesis, 'managed retreat'. Managed retreat is an increasingly relevant yet highly divisive climate adaptation strategy that refers to the planned strategic movement of people and the built environments they inhabit away from areas at risk of climate-related hazards. As managed retreat continues to gain relevance, research and literature are also growing. Common areas of enquiry include the explorations into socio-economic impacts of retreat strategies (Agyeman et al., 2009; Dalton, 2021; Dannenberg et al., 2019; Hanna et al., 2020; Hoang & Noy, 2020; Keeler et al., 2022; Kraan et al., 2021; Koslov, 2016; Lawrence et al., 2020; Peart, 2023; Rahman et al., 2024; Siders, 2019a; Siders, 2019b; Tubridy et al., 2022), the role that place attachment makes in retreat planning (Adie, 2020; Devine & Quinn, 2020; Hanna et al., 2019; Jayakody et al., 2024; Qing et al., 2022; Willocks-Musselman et al., 2025; Wozniak-Brown, 2022), and the effectiveness of managed retreat compared to other climate adaptation strategies (Bragg et al., 2021; Dalton, 2021; Hanna et al., 2019; Koslov, 2016; O'Donnell, 2022; Siders, 2019a; White, 1945).

Socio-economic Impacts

One of the most examined areas of managed retreat research is the socio-economic impacts; considerable attention has been paid to the post-retreat outcomes that are often inequitable. Particularly, communities in need of climate adaptation are often among the most marginalised. This raises questions about managed retreat exacerbating pre-existing inequalities rather than alleviating them. Siders (2019a) highlighted the existing social injustice that can be seen in the populations most desperate for climate adaptation measures: "the US coast is... home to some of the most disadvantaged and historically marginalised people in the nation". Similarly, Tubridy et al. (2022) found that the imbalance in the effects climate change has on marginalised groups is the result of a lack of voice across the board, from the scientific community down to local decision-making at public meetings. This lack of a voice leads to feelings of disempowerment, which ultimately undermines future community cohesion (Tubridy, 2022). Similarly, Hanna et al. (2020) highlighted that communities involved in retreat strategies have often already experienced a climate disaster, meaning they are already in a vulnerable state. The current methodology of managed retreat implementation does little to aid these issues and instead exacerbates them (Hanna et al., 2020). Dannenberg et al. (2019) found that the fragmentation of communities that undergo managed retreat can "trigger mental health problems, including anxiety, depression, substance abuse". Hoang and Noy (2020), Tubridy (2022) and Agyeman et al. (2009) also found that retreat can have significant psychological impacts on the communities involved, ultimately undermining social capital. Furthermore, Kraan et al. (2021), Koslov (2016), Peart (2023), and Siders (2019a) highlight that managed retreat scenarios are typically funded through taxes, and the removal of properties through the retreat process reduces local government property tax revenue, creating financial strain on municipality budgets. Local authorities are not the only ones that bear the brunt of financial strain, though, as Kraan et al. (2021) highlight that the complexity of retreat strategies can create unfair and mismatched compensation for residents; equitable outcomes are often limited by cost-benefit analysis (CBA).

Justifications of managed retreat and potential remedies to these inequitable socio-economic outcomes have been explored. Freudenberg et al. (2016) and Keeler et al. (2022) proposed a buyout with rentbacks policy that could "reduce the magnitude of and scope of these negative outcomes" (Keeler et al., 2022). Similarly, Kraan et al. (2021) and Siders (2019b) explored remedies to the economic impacts of managed retreat, evaluating factors that create negative impacts and highlighting that "consequences of relying on CBA may be to create or perpetuate social inequity" (Siders, 2019b). Additionally, Rahman et al. (2024), Siders (2019b) and Tubridy et al. (2022) agree that re-evaluating reliance on 'cost-benefit analysis' in the decision-making process of managed retreat strategies would result in more equitable outcomes. Cost-benefit analysis disadvantages low-income and vulnerable communities, as their property values are often lower than those of wealthier communities (Siders, 2019b and Tubridy et al., 2022). This ignores cultural, psychological, and social costs that cannot be reduced to a dollar amount, thereby hiding subjective judgment and biases in an 'objective' decision-making process (Siders, 2019b; Tubridy et al., 2022). Similarly, Rahman et al. (2024) expressed that the "implementation of equitable retreat policies will require a paradigm shift, away from cost-benefit and efficiency metrics". Furthermore, researchers have argued that while these adverse outcomes are persistent in retreat strategies, failure to retreat can lead to even worse outcomes (Dalton, 2021; Siders, 2019a; Lawrence et al., 2020). Siders (2019a) also points out that inaction and resistance to implementing managed retreat can lead to worse socio-economic outcomes. For example, "growing demand for housing in safe locations may drive up prices and... contribute to gentrification" (Siders, 2019a). Additionally, Dalton (2021) and Lawrence et al. (2020) agree that as climate hazards continue to increase in frequency and intensity, insurance companies are raising rates in vulnerable areas and, in some cases, not providing coverage at all, which could lead to greater socio-economic strain following a disaster.

Place Attachment

Another common and significant theme in managed retreat research is the role of place attachment; considerable attention has been given to the duality of place attachment as it can play both positive and negative roles (Willcocks-Musselman et al., 2025). In particular, a strong sense of place affects the popularity of proposed retreats and adds to the controversial nature (Wozniak-Brown, 2022). Significant research has identified that strong place attachment is a major obstacle to the community acceptance of managed retreat strategies, hindering their implementation. Place attachment leads to the perception of retreat and relocation as threats to identity and belonging. Studies have highlighted a negative relationship between place attachment and managed retreat strategies (Jayakody et al., 2024; Qing et al., 2022). Adie (2020) and Wozniak-Brown (2022) found that, in coastal hazard scenarios, retreat is the least-preferred adaptation strategy, with

strong place attachment rooted in connections to communities, property, and cultural heritage being a key reason for resistance. Similarly, Willcocks-Musselman et al. (2025) argue that disruptions to place attachment in managed retreat scenarios can threaten mental health and well-being. Furthermore, Jayakody et al. (2024) found that failure to accommodate place attachment in climate adaptation strategies "can lead to reduced support for adaptation or even to maladaptation". Similarly, Wozniak-Brown (2022) noted that failing to account for the emotional costs of displacement stemming from strong place attachment can create mistrust and undermine retreat strategies.

However, emerging research suggests that place attachment can serve as a facilitator of adaptation in managed retreat strategies. Wozniak-Brown (2022) and Willcocks-Musselman et al. (2025) found that properly incorporating place attachment into retreat planning can strengthen community engagement and ownership of the strategy while maintaining identity. Wozniak-Brown (2022) and Willcocks-Musselman et al. (2025) found that deep connection to place promotes a level of stewardship over the environment that encourages a willingness to retreat to protect said environment. Similarly, Hanna et al. (2019) argue that communities are more likely to engage with managed retreat if they have strong place attachment and understand that the place is under threat. Devine and Quinn (2020) highlighted that, in the case of the Great Barrier Reef, place attachment was so strong that it inspired global stewardship, leading to climate adaptation measures.

Effectiveness

Another key area of managed retreat research compares it to more traditional adaptation strategies, which are categorised as protect, accommodate and retreat (O'Donnell, 2022). Protective strategies focus on engineering measures to prevent damage from disasters, such as dune renourishment and seawalls (O'Donnell, 2022). However, these strategies are not perfect and require continued maintenance. In contrast, managed retreat is increasingly recognised for its ability to "minimise long-term maintenance and emergency management costs" (Hanna et al., 2019). Similarly, Siders (2019a) notes that protective measures such as levees and seawalls can fail or be breached, whereas managed retreat eliminates the risks. Moreover, the implementation of protective and accommodative strategies results in a continued cycle of rebuilding, reinforcing reluctance to retreat (Bragg et al., 2021; Dalton, 2021; Koslov, 2016; and Siders, 2019a). This phenomenon is known as the "levee effect " (White, 1945), in which a false sense of security is created and drives further development, thereby increasing the at-risk population (Bragg et al., 2021; Siders, 2019a). Managed retreat, however, offers an effective alternative that permanently reduces hazard exposure and long-term costs (Hanna et al., 2019 and Siders, 2019a).

Existing research on managed retreat extensively explores socio-economic implications, the role of place attachment and managed retreat's effectiveness compared to other climate adaptation strategies. This literature review identifies key concerns and barriers to managed retreat and provides relevant ideas for overcoming them. However, significant research gaps still remain. Much of the discourse and research on managed retreat has focused on the socio-economic impacts, while research on the environmental impacts remains limited. Further research should focus on the waste generated through current retreat practices and the carbon impacts of building new housing to accommodate displaced residents. As managed retreat becomes a more common adaptation strategy, they will need to consider how they are mitigating the climate conditions that are causing the need for climate adaptation. Another key gap in the research is the implementation of deconstruction strategies into managed retreat scenarios. Deconstruction is an underutilised tool in building removal that can deliver economic benefits by enabling the sale or reuse of salvaged materials. Future research should explore the feasibility of deconstruction and investigate how architectural interventions through deconstruction can positively influence place attachment. Additionally, there is limited research that explores the architectural outcomes of managed retreat. There is a need for housing solutions for displaced communities, presenting a valuable opportunity for architecture to be accessible to marginalised groups and to offer new architectural approaches to housing beyond traditional Western systems.

Case Studies

Matata Managed Retreat Strategy

The Matatā retreat strategy is a significant example of managed retreat, especially in Aotearoa, as unlike a lot of other global and local examples, the Matatā example highlights a strategy based on a preemptive response to future disasters. Matatā is a rural coastal town in the Bay of Plenty that experienced a planned voluntary buyout and home removal strategy following a landslip in May 2005, triggered by a torrential downpour that carried large amounts of debris into the township and caused flooding. The landslip resulted in the destruction of "27 homes and damaged a further 87 properties" on the western edge of the town (Whakatāne District Council, n.d). Six of the houses located on the debris fan were rebuilt soon after, and another ten that had sustained significant damage were repaired (Donaldson, 2021). The voluntary buyout and retreat strategy set a precedent for climate adaptation and hazard planning in Aotearoa.

Post-disaster, the Whakatāne District Council (WDC) enlisted the help of the Institute of Geological and Nuclear Sciences (GNS) to analyse the causes and provide a report on potential mitigation strategies (McSaveney et al., 2005). Their report found that the volcanic soils along the banks of the Awatarariki and Waitepuru streams, and the steep terrain of the hills south of Matatā, had left the area vulnerable to further disasters under future extreme rainfall events. Furthermore, the report indicated that "further debris flows are possible and likely" (McSaveney et al., 2005) and that although some areas may mitigate their risk to accepted levels through engineered solutions, there are many "areas where such mitigation probably is not feasible" (McSaveney et al., 2005).

Fourteen years after the disaster, in 2019, the WDC, in partnership with the Bay of Plenty Regional Council (BOPRC) and the central government, finalised and approved a voluntary buyout strategy to relocate residents from hazardous areas in Matatā. This signified a turning point for climate-hazard adaptation planning in Aotearoa, as they chose to pursue a managed retreat approach rather than engineered solutions, despite no further debris flows since 2005. The voluntary buyout strategy involved the purchase of thirty-four properties in the high-risk zone. The media coverage of the planning stage was scrutinous of the WDC and the idea of a managed retreat, with SunLive (2017) describing the proposed strategy as residents being "forced to abandon their homes and land". The execution of the strategy was similarly met with more criticism from both the community and media, with strong feelings from the community about a lack of transparency, lack of self-agency, and unfair financial compensation.

Figure 2.1. Matata following the debris flow on may 18th 2005 (McSaveney et al., 2005).

The retreat strategy officially ended nearly seventeen years following the disaster, with the final resident moving out in March 2022. The houses involved in the retreat were, for the most part, relocated either in whole or in part, although many were demolished (Donaldson, 2021). Despite public reaction and the media's critical perspective on the Matatā managed retreat strategy, it was an important step in the right direction for climate adaptation and hazard planning in Aotearoa, as it broke new ground as the first preemptive strategy. The struggles associated with the strategy often stemmed from the lack of previous examples to draw on for guidance. WDC strategic projects manager Jeff Farrell told RNZ they "had nothing to work off: no rules, no funding framework and, until 2017, no formal risk management policy" (Brettkelly, 2022). WDC, BOPRC, and the central government, however, laid substantial legal groundwork and set precedents for future retreat approaches. The legal planning undertaken by these government bodies highlighted a complete lack of legislation on climate adaptation, particularly regarding managed retreat. The Matatā retreat strategy would go on to inform much of future legislation, including the National Adaptation Plan.

Lessons and Reflections:

1. Pre-emptive actions

The pre-emptive managed retreat actions taken in Matatā are an important precedent for climate adaptation but highlight the need to be decisive and swift in early decision-making to provide affected residents with a clear understanding of future planning.

2. Policy and Legislative

The lack of precedent highlights the need for national frameworks, legislative innovation, and further research into retreat strategies in an Aotearoa context, providing local authorities with greater knowledge to lean on.

3. Importance of communication

Matatā highlights that transparency, continued communication, community engagement, and fair compensation are valuable for maintaining trust and reducing stress caused by displacement, as even voluntary buyout strategies may feel coercive if their implementation is not managed correctly.

Kiruna Managed Retreat Strategy

Kiruna is a Swedish mining town that offers a unique and complex case of managed retreat driven by a man-made environmental hazard. The towns retreat project began over 20 years ago and is still ongoing, It is an excellent example of a retreat strategy that has carefully balanced the impact of retreat on local indigenous and cultural heritage while preserving the town's identity and architectural heritage (Vallis et al., 2025). This case study analysis explores Kiruna's managed retreat strategy through an architectural lens, learning lessons from the community engagement, heritage preservation and use of architectural design solutions.

Figure 2.2. Kiruna retreat masterplan developed by White Arkitekter and Ghilardi + Hellsten Arkitekter (White Arkitekter, 2022).

Kiruna is Sweden's northernmost town, situated within the Arctic Circle. It is also home to the world's largest underground iron mine, owned and operated by LKAB (LKAB, 2025). Originally, the land of Sami people (the indigenous people of Sweden), the town was founded over 100 years ago alongside the mine, making mining a strong aspect of Kiruna's economic and social identity (Overud, 2019). However, a century of mining has caused "significant ground subsidence, progressively affecting significant parts of the town, including the town centre, several residential areas, and essential infrastructure" (Sjöholm, 2025). In partnership with the Swedish and local governments, LKAB began planning a managed retreat strategy in 2004, which is still ongoing. As of August 19th, 2025, approximately 3,000 homes and 6,000 people still need to be relocated (Little, 2025). The initial planning that began in 2004 and the master planning that began in 2012 culminated in the implementation of the retreat in 2014, with the first residents relocating and buildings finishing construction (White Arkitekter, 2022). The retreat phase is expected to finish in 2035 according to White Arkitekter (2022).

One of the key challenges the Kiruna strategy has had to contend with is how to preserve key cultural landmarks, heritage, and identity during the retreat. This architectural challenge was undertaken by White Arkitekter and Ghilardi+Hellsten in 2013 when their proposal won the international competition (White Arkitekter, 2022). The plan for the new town involved relocating 50 of the oldest buildings from their previous site, whilst the rest were demolished, and a new town was built from scratch (Vallis et al., 2025). One of the most ambitious moves was the Kiruna church, as seen in Figure 2.? , a 600-tonne, 113-year-old church that's been voted the most beautiful in Sweden in the past (Little, 2025).

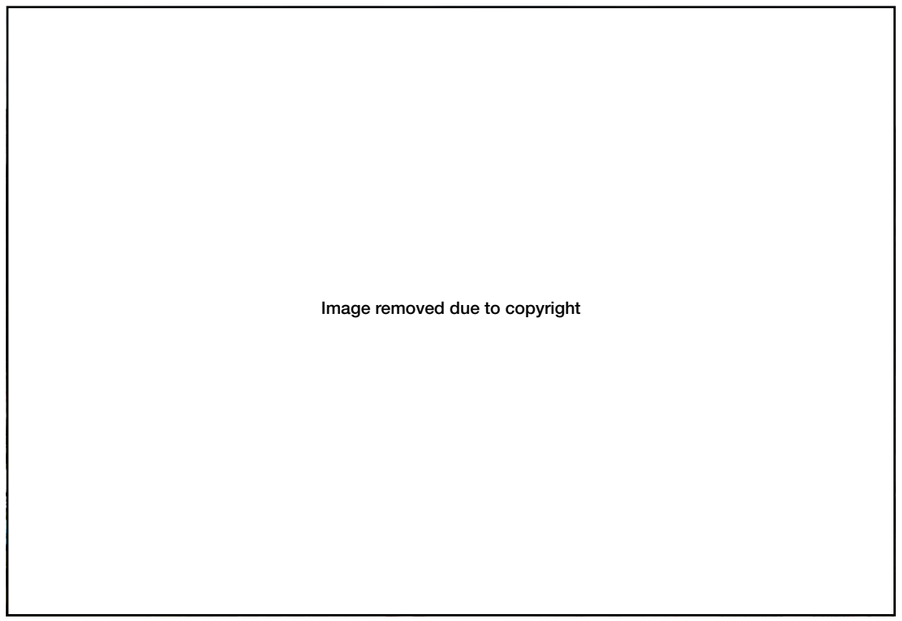


Figure 2.3. The moving of the 113-year-old Kiruna church to its new site (LKAB, 2025).

Kiruna highlights that managed retreat is more than just an architectural or urban planning project, but also heavily rooted in social understanding. Community engagement was important in Kiruna's strategy to strengthen social resilience during the displacement. Prior to the adoption of the development plan in 2014, the local municipality "conducted participatory activities such as workshops and surveys" (Sjöholm, 2025). Social engagement is a valuable tool used in the retreat process to foster a sense of ownership among locals over their new homes before they have even been relocated. However, as with many retreat strategies, many residents remain unsatisfied and feel the new town has removed them from their historical home. Shapiro (2020) proposes that the architecture and urban infrastructure of the new town must alleviate these concerns by creating opportunities for new memories while still reflecting the old ones.

Lessons and Reflections:

1. Architectures Role in Managed Retreat

Kiruna highlights the important role architecture should play in managed retreat, not merely as a tool for rehousing residents. Rather, something that can shape the retreat's vision from the beginning, enhancing the overall success of the strategy.

2. Importance of Participatory Design

Kiruna's retreat strategy had a strong connection and communication with the community, encouraging participatory design that produced a design language inclusive of the community, aiding in their resilience

3. Preservation of Heritage and Traditional Practices

The Kiruna retreat strategy explores the balance between preserving cultural heritage through the relocation of landmarks and urban renewal/modern design systems. Architecture must allow for the familiarity of the past while providing opportunities to make new memories, also noting shifts for historic, traditional patterns of land-use e.g., Sami reindeer herding traditions in this case and the environmental impacts these changes may bring.

4. Prolonged managed retreat

The Kiruna retreat strategy, like other successful strategies, implemented the retreat phase over many years; it is still ongoing and not expected to finish until 2035 (White Arkitekter, 2022). Longer retreat strategies tend to perform better than shorter ones, as they give residents more time to prepare for relocation and, by extension, reduce the burden on the funding entity, since buyouts can take place over a longer period.

Policy Frameworks/Planning Strategies

Environmental Defence Society (EDS) - Aotearoa

The EDS report 'Options and Models for Managed Relocation Policy' explores managed retreat in an Aotearoa context providing 2 models for managed retreat policy.

Model 1: Comprehensive nationally driven approach

Model one is an ambitious nationally centred approach to managed retreat planning that involves the establishment of a 'National Adaptation Agency' whose role is to "support risk assessment and adaptation planning, and to oversee the nuts and bolts of property acquisition and the relocation of people" (Peart et al., 2023). The agency would be an extension of the Earthquake Commission or Environmental Protection Authority, rather than a separate new entity.

Figure 2.4. EDS managed retreat framework 1 Comprehensive nationally driven approach (Peart et al., 2023).

Model 2: Decentralised community-led approach

Model two focuses on community-based decision-making processes that see the central government playing a supportive, passive role in the process. The model is based on the idea that communities know best and would see the adaptation process led by the local councils.

Figure 2.5. EDS managed retreat framework 2 Decentralised community-led approach (Peart et al., 2023).

Climate-ADAPT - European Union

The Climate-ADAPT special report 'Managed Retreat: Preparing Coastal Cities for Sea Level Rise' looks at managed retreat as an adaptation strategy for sea level rise, providing a framework for retreat.

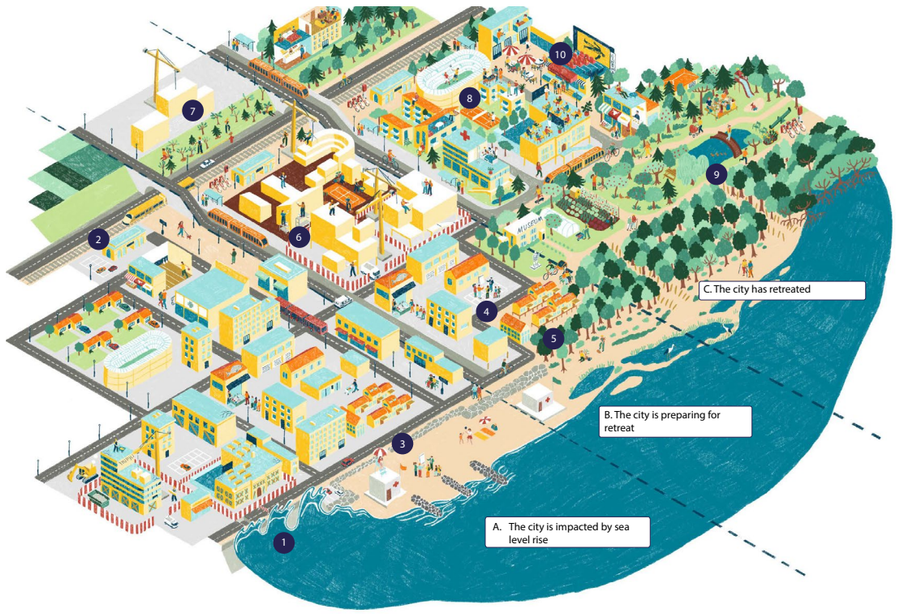


Figure 2.6. Climate-Adapt retreat framework diagram, (Ocean & Climate Platform, 2025).

A. Sea Level Rise impacts the City
1. Risk and vulnerability assessment identifies that sea level rise will render parts of the coastline uninhabitable for humans.
2. Local government begins to define inland systems' connections to the coastline, preparing for retreat
3. Social engagement is key; communities are informed and encouraged to participate to improve the overall acceptability of the managed retreat. Local government, in collaboration with key stakeholders, develops managed retreat and relocation plans.
B. The City is Dynamically Preparing for Managed Retreat
4. A steering committee is created to oversee the implementation of managed retreat whilst continuing communication and transparency with the community.
5. Local government begins retreat with the relocation of assets and facilities under its ownership; measures are also taken to prepare for a larger retreat, such as defining non-buildable zones and acquiring land for relocation
6. Inland areas begin development to accommodate the retreat, increasing density, and improving infrastructure and facilities. Policies are also implemented to make the inland lifestyle more appealing.
7. Residents are consulted on the design of future housing and urban planning of new neighbourhoods.

C. The City Has Retreated and is Resilient
8. Large-scale retreat begins: housing, neighbourhoods and industries. Removal of the properties is an emotional process for the residents, and the local government should support them through memorial initiatives and recycling of materials from the old building
9. Natural ecosystems are restored to serve as buffer zones to the natural hazards and slow down erosion; they are also converted to public recreational areas.
10. In their new neighbourhoods, residents enjoy economic, cultural, and social opportunities. Civic participation has become a key part of the community, with engagement in public projects, strengthening their resilience and sense of place.

The Role of Architecture in Managed Retreat

Architecture plays an important role in developing effective climate adaptation strategies. Managed retreat strategies, in particular, can be improved through clever design that reimagines the built environment and reconnects the community post-displacement. Architecture is key to human adaptation to climate change, utilising the built environment to facilitate adaptation services (Poulsen et al., 2020). Although retreat has the potential to amplify injustice, architecture's unique position across various disciplines positions its practitioners well to leverage "collective disciplines to envision equitable climate-changed futures" (Yarina et al., 2020). Architectural creativity, through its connection to futurity, has the potential to "reduce political polarisation, involve marginalised groups, and address historic wrongs" in managed retreat scenarios (Mach & Siders, 2021). Architecture is important for transforming the built environment into a regenerative habitat. Managed retreat offers the opportunity not only to protect communities from climate hazards but also to improve future communities' resilience through regenerative and climate-conscious design (Poulsen et al., 2020).

Waste in Managed Retreat

Demolition waste produced in managed retreat scenarios is often an overlooked factor. C&D waste already accounts for 25-30% of global waste (Sakthibala, 2025). As managed retreat strategies become more common, the amount of C&D waste produced will only increase. Some past examples of managed retreat have relocated houses; however, the most common practice is demolition. This practice is nonsensical as it ignores the unsustainable practices that have led to the need for retreat in the first place and continues the wasteful linear material cycle. Integrating the reuse of materials through deconstruction has the potential to reduce waste and support a more sustainable approach to helping vulnerable communities transition to low-impact living solutions.

Conclusion

Managed retreat is one of the most complicated yet important and necessary climate adaptation strategies. This chapter explored the global and local contexts, challenges and opportunities that influence its implementation and effectiveness. The review of past literature identified significant gaps in managed retreat research, including the feasibility and potential of integrating deconstruction strategies and the role that sustainable and regenerative systems and design play in the production of climate-mitigating retreat. However, as shown throughout the chapter, retreat isn't simply a technical or logistical issue but rather is deeply relevant to social, cultural and economic issues as well. The case study analysis of Matatā and Kiruna revealed the importance of early decision-making, equitable compensation, significant community engagement and transparent ongoing communication. Furthermore, they identify the important role architecture plays in transforming retreat into a tool for shaping adaptive, resilient, regenerative and equitable futures. Despite limited examples of policy and frameworks, the EDS and Climate-ADAPT models highlight the importance of structured, legislatively mandated processes; however, further innovations are still required. Ultimately, managed retreat requires a shift in how we think about our relationships with land and place and the role they play in our identities.

Chapter 3: Deconstruction and Circular Systems

Introduction

This chapter covers the key research topic of Deconstruction and the reuse of salvaged materials, exploring its global and local significance, the chapter adds a key layer to the design strategy. Deconstruction is the careful dismantling of a building to extract materials and components for reuse or recycling. As we enter the regenerative architectural age, we must evaluate the current systems we rely on and transition towards alternative solutions that better reflect a regenerative future. Deconstruction has immense potential to transform our built environment, challenging demolition and the current wasteful nature of the C&D industry. Despite the positive regenerative outcomes, barriers still prevent widespread use of deconstruction. Material reuse through deconstruction practices is a valuable tool for architects aiming for regenerative design outcomes, creating interesting design challenges and opportunities to be explored. This chapter explores deconstruction through past literature review, case study analysis, and historical and architectural relevance.

Literature Review

This literature review aims to explore existing research and leading perspectives on one of the key themes of this thesis, 'deconstruction and material reuse'. As the world continues to search for sustainable and regenerative practices, deconstruction offers a shift from the linear economy, which depletes the world, to a circular economy that will rejuvenate it. Deconstruction is the practice of carefully disassembling a building that has reached the end of its useful life for one reason or another, then reusing or recycling the salvaged materials for future construction or other purposes. Demolition is the process of tearing down a building, crushing its materials, and sending them to the landfill. Common areas of enquiry include environmental and socio-economic impacts (Bertino et al., 2021; Costa et al., 2025; Dean, 2024; Ellen MacArthur Foundation, 2013; Ng & Chau, 2015; Rakhshan et al., 2020; Rios et al., 2015), significant barriers facing deconstruction (Chini & Bruening, 2003; Costas et al., 2025; Ellen MacArthur Foundation, 2013; Gordon et al., 2023; Rakhshan et al., 2020; Rios et al., 2015; Ross, 2020) and the cultural and heritage value of salvaged materials (Bertino et al., 2021; Costa et al., 2025; Chini & Bruening, 2003; Rios et al., 2015; Ross, 2020; San Antonio Reuse, 2022).

Socio-economic and environmental impacts

One of the most common areas of enquiry in deconstruction research is its environmental and socio-economic impacts., considerable attention has been paid to the benefits of carbon sequestration, employment opportunities and material reuse. In particular, emphasis has been placed on reducing carbon emissions and pollution in the building industry. Dean (2024) found that compared to demolition, "deconstruction and reuse create considerably more economic, environmental and social value". Similarly, Costa et al. (2025) found that building and material reuse is the most efficient way to reduce carbon emissions in the building sector. Rios et al. (2015) argue that deconstruction is essential to closing material loops, additionally highlighting the benefits of closed loops; extending the life of raw material, reducing material costs and reducing carbon emissions, noting that "Deconstruction would be a feasible alternative to demolition given the right regulations and markets to be in place first". Bertino et al. (2021), Ng & Chau (2015) and Rakhshan et al. (2020) provide quantitative data to support the environmental benefits of deconstruction and material reuse. Bertino et al. (2021) found in a study of the complete deconstruction of a house that the "recovered materials could potentially save around 502.158 MJ of incorporated energy and prevent carbon emissions of around 27.029 t CO_2e". Similarly, Rakhshan et al. (2020) highlight that direct reuse of materials in the construction industry is ideal, as the reuse of reclaimed structural steel or timber can reduce "environmental impacts by 96% 83% respectively"; meanwhile, the environmental impact of recycled steel sections is 25 times higher. The life cycle energy analysis (LCEA) study by Ng & Chau (2015) found that, in every scenario, reuse, recycling, and energy recovery were more effective at reducing embodied carbon than traditional waste approaches. Furthermore, past research has identified the potential of deconstruction to create economic opportunities at both the local and wider scales (Dean, 2024; Ellen MacArthur Foundation, 2013). Dean (2024) found that if 50-75% of demolitions in NY were converted to deconstructions, it would "create between 8,130 and 12,630 jobs; and reclaim 270,000 to 420,000 tons of materials". Rios et al. (2015) and the Ellen MacArthur Foundation (2013) agree that labour-focused practices associated with deconstruction create significant employment opportunities for unskilled workers.

Barriers

Despite these benefits, the literature also identifies significant barriers to deconstruction. Rios et al. (2015) found that reused materials are perceived negatively; they are viewed as inferior for aesthetic and safety reasons. Similarly, Rakhshan et al. (2020) found a negative perception of material reuse, additionally finding a negative perception of the deconstruction process, stating, "occupational health concerns, liability and fear, lack of trust in the supplier of the reused components and unsatisfactory working environment". In the context of Aotearoa, one of the largest barriers to deconstruction and material reuse is the New Zealand Building Code (NZBC) (Ministry of Business, Innovation and Employment, n.d.). Strict certifications for materials and a lack of viable pathways to recertify materials mean that many salvaged materials cannot be used in construction. For example, salvaged structural timber would need to meet NZS 3603, demonstrating compliance with the structural performance standards (Standards New Zealand, 1993). Without a proper pathway or any grandfathering considerations, the time and effort required on top of the deconstruction process to recertify the timber make its reuse economically infeasible. Time constraint is another key challenge for deconstruction: "disassembly may [take] between three to eight times that of mechanical demolition" (Rios et al., 2015). Rakhshan et al. (2020) note that the "time required to deconstruct a 90 to 180 m2 building is three to five times higher" than the demolition of the same building. Additionally, there are no accurate methodologies to measure the benefits of deconstruction or the recy-

clability of salvaged materials, potentially leading to complications (Rios et al., 2015). However, Costas et al. (2025) and Gordon et al. (2023) explore the use of material passports and highlight that their implementation can overcome challenges, such as reducing deconstruction timeframes and costs whilst increasing the potential for salvaged materials. Furthermore, Rios et al. (2015) found that higher deconstruction labour costs are offset by lower equipment costs and the potential resale value of materials. Chini & Bruening (2003) also note that challenges facing deconstruction and material reuse can be overcome through the systematic change in policy and design thinking. Meanwhile, Ellen MacArthur Foundation (2013) and Ross (2020) highlight that design considerations can overcome negative aesthetic perceptions, but safety concerns remain.

Cultural heritage preservation

Finally, the cultural and heritage value of salvageable materials is another valuable and common consideration in deconstruction literature. Costa et al. (2025) highlight the importance of the cultural values of materials in the reuse process, even when their economic value may not be much. Bertino et al. (2021) similarly highlighted that deconstruction also provides the opportunity for the "preservation of the historical building heritage". Meanwhile, Ross (2020) argues that many elements of the built environment contain cultural, associative and historical value that can be retained through deconstruction. Similarly, Chini & Bruening (2003) highlight that deconstruction has significant cultural value as it can preserve culturally significant components of heritage buildings and infrastructure. Additionally, they add an extra layer by highlighting the economic value of historically significant items, which can include building components. Meanwhile, San Antonio Reuse (2021) argue that the reuse of building materials through deconstruction can preserve the fabric and continuity of a community's built environment. Rios et al. (2015) add that the role of designers is critical to ensure the materials that are reused are valued and integrated appropriately, "the Design professionals have the most important role to revert this situation".

Overall, the literature demonstrates that deconstruction and material reuse can yield significant economic, environmental, and cultural benefits over traditional demolition. The existing research consistently highlights the potential for deconstruction and material reuse to reduce carbon emissions, create employment, conserve materials, and preserve heritage. At the same time, the literature identifies significant barriers that limit widespread adoption, such as high upfront labour costs, safety concerns and prolonged timeframes. The findings collectively suggest that deconstruction is not merely a technical or environmental practice but also a socio-cultural strategy that can influence identity, heritage conservation, and community engagement. Future research should explore these socio-cultural aspects in instances that involve both waste generation and complex socio-cultural elements, such as managed retreat, as the current research involving both topics is almost nonexistent. Although this literature review highlights the lack of current connection and the need for future research on the integration of managed retreat and deconstruction, current research into the cultural, heritage, and associative value of building components directly intersects with place attachment research in the managed retreat literature. This should be explored further in future research on managed retreat and deconstruction.

Case Study

Superuse Studio

Established in 1997 by Césare Peeren and Jan Jongert, the Dutch architectural practice Superuse Studio was founded on the desire to reduce the reliance on the constant extraction and use of new raw materials and instead shift towards the reuse of existing ones (Baldwin, 2021). The name (Superuse Studio) came from the firm's concept of 'superuse', in which materials are reused in their current form with little to no intervention. This process would reduce the energy required for transportation, breaking down, refining and reforming materials that might have been recycled or undergone more complex reuse processes (Spatial Agency, n.d.). The concept of superuse is integral to the firm's ethos of creating more sustainable, circular designs that still deliver "ingenious, beautiful and functional architectural and social design solutions" (Architecture Now, 2016). Superuse Studio undertakes a wide range of project typologies and scales, from small placemaking interventions to architectural and urban systems design. This is a valuable precedent for this thesis, as the innovation and ingenuity in the reuse of materials align perfectly with the aims of deconstruction and material reuse.

Villa Welpeloo

Located in the Roombeek district of Enschede, Villa Welpeloo, as shown in Figure 3.1, is a residential house designed for a couple who wanted to display various art pieces in their new home (Superuse Studio, n.d.). The project is one of Superuse's more ambitious material reuse projects, with the building becoming the first to achieve a "circular house with a 90% CO_2reduction in execution of structure and facade" (Superuse Studio, n.d.).

Figure 3.1. Image of Villa Welpeloo, (Van der Hoek, n.d.).

Villa Welpeloo highlights Superuse's unique approach to material reuse within the design and construction of their projects, exploring and experimenting with the reuse of non-building materials in the built environment. Light fittings are made from the ribs of used umbrellas, the structural elements are made of steel girders from a single decommissioned textile paternoster, and the wooden facade is made from old cable reels from a local factory (Superuse Studio, n.d.).

Country estate Brienenoord

Located on the island of Brienenoord on the Nieuwe Maas river in Rotterdam, the Country estate Brienenoord or Buitenplaats Brienenoord, as seen in figure 3.2, is a community centre in the heart of Rotterdam that aims to serve as a "rehearsal space for future ways of living" (Van Putten, 2025). This project serves as an excellent example of deconstruction and the direct reuse of deconstructed materials from the previous building, and of how their incorporation into the new design can alleviate budgetary and construction logistical stress.

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Figure 3.2. Image of Buitenplaats Brienenoord, (Hanswijk, n.d.).

The project was for a local charity foundation; as such, the budget was slim due to minimal fundraising. Additionally, the only access to the island is an old bridge that has a maximum weight limit of 15 tons, which added to the design challenge, as traditional lumber trucks were too heavy. 90% of the previous building was reused in the new building; the only new elements were fasteners, five wooden trusses, column shoes, and the glass on the south façade (Superuse Studio, n.d.). This project highlights the beneficial aspects of deconstruction and material reuse within architecture and construction, as the reuse of existing materials significantly reduced costs while not causing stress to the bridge.

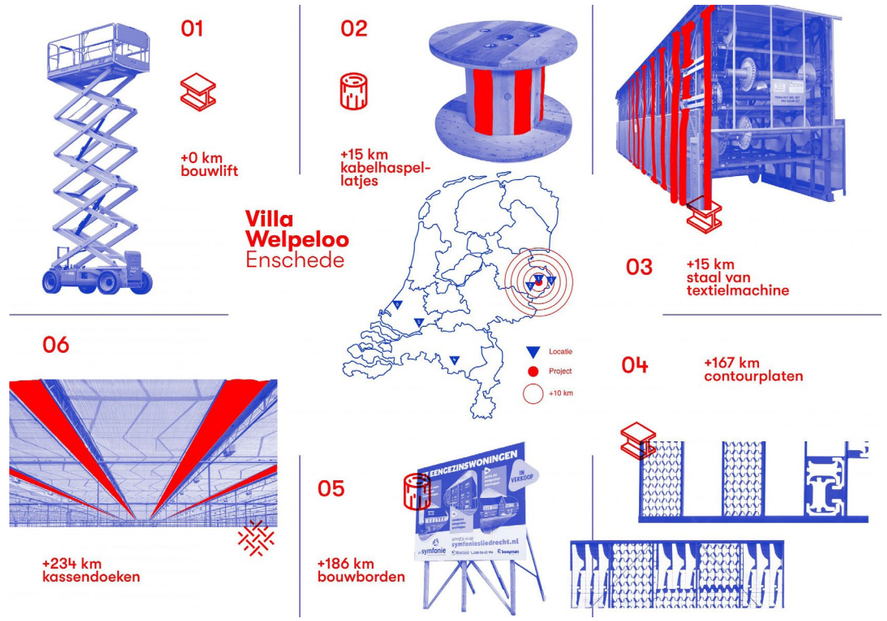


Figure 3.3. Material harvest map for the Villa Welpeloo project, (Superuse Studio, n.d.).

Superuse studios and their projects are leading examples of the integration of deconstruction and material reuse practices within the architecture and construction industry. Their innovative approach to circular and sustainable design is a key precedent for my own utilisation of deconstruction and material reuse, as their projects celebrate the reuse of materials whilst proving the feasibility. This precedent also provides an excellent example of the communication of these strategies, with their distinct and clear design communication language as seen in Figure 3.3. This is something I will utilise in the design stage through my own design communication lens.

History of Deconstruction

Deconstruction and material reuse have been popular methodologies long before it was associated with modern sustainability practices. Many indigenous and nomadic practices reflect deconstruction strategies through knowledge and respect for natural cycles, as well as the reuse of materials. Various nomadic tribes are known for disassembling their living structures when they move from one place to another, reusing and recycling the materials for the reconstruction of their living structures or as tools. One such example is the nomadic herders of Mongolia who live in yurts, round homes that can be disassembled, seen in Figure 3.4. The yurts are typically disassembled twice a year to move between pastures for their cattle and the steppes where their village camps are located (Griffiths, 2007). Other examples of nomadic tribes that would deconstruct and reuse the materials for future settlements include the Yakut/Nenet people (Siberia), the Sami people (Sweden) and the Tuareg people (Sahara). These nomadic movement practices are often triggered by climatic conditions, aligning with the

overall topic of deconstruction in managed retreat practices that are also shaped by climate.

Figure 3.4. Image of traditional Mongolian nomadic yurt, (Arneill, n.d.).

Furthermore, in the context of Aotearoa, te ao Māori concepts such as kaitiakitanga (guardianship over the natural world) and mauri (life force) express a considerate understanding of ecology (Ministry of Business Innovation and Employment, n.d.). These values are closely related to circular economy principles, highlighting the cultural depth and use of sustainability practices well before formal Western articulation.

Circular Design in Architecture

The idea of a circular economy or closed-loop economy has been developed and refined over time by many people and cultures. The circular economy, as the name suggests, subverts the current, traditional western linear economy, or take-make-waste, and instead involves the continuous reuse of materials, eliminating all waste, as seen in Figure 3.5. The circular economy is based on three key ideas: the elimination of waste and pollution, the recirculation of materials, and the regeneration of nature (Ellen MacArthur Foundation, n.d.). Design is a key aspect of realising a future circular economy, through material selection and design for disassembly, a designer can extend the life of materials far beyond their use in a single product or building. In the context of architecture, design for disassembly is becoming an increasingly popular design strategy; however, it ignores the countless buildings already built, most of which, under current practices, will be demolished and end up as waste. Deconstruction offers an opportunity to extend the life cycle of the materials stored in these buildings; furthermore, reusing these materials in new buildings, rather than using virgin materials, significantly reduces embodied carbon. As the world continues to seek regenerative solutions, deconstruction and material reuse will be indispensable tools for architects.

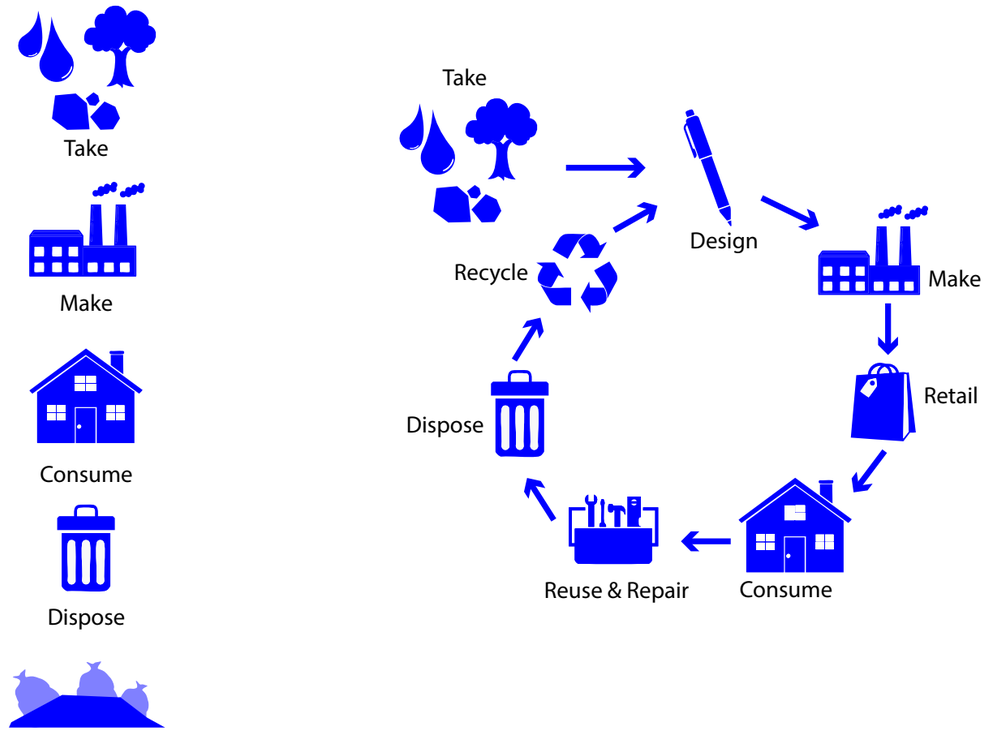


Figure 3.5. Circular economy vs linear economy, by author.

Comparison of Building Removal Methodologies

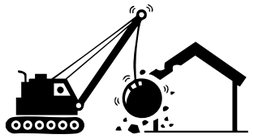
	Deconstruction	Demolition	Relocation
			
Environmental	- Reduces wastes - Reduces embodied carbon	- Adds considerable waste to landfill - Potential air and dust pollution	- Significantly reduces waste - Reduces embodied carbon - Transportation related emissions
Economic	- Long process - Costly - Supports local salvage and recycling industries	- Fastest process - Cheapest option - Landfill charges	- Long process - Costly - Logistics may not be viable
Design	- Allows for creativity - Potential to design more appropriate living solutions - Unique atheistic qualities - Potential safety concerns - Potential need for materials to meet regulations	- NA	- Very little design opportunities - May require alterations for new site conditions i.e. seismic
Socio-Cultural	- Preserves cultural and architecturally significant heritage elements - Increase in local employment opportunities	- Quick removal of unsafe or hazardous structures - Severs cultural heritage ties - Noise dust and air pollution	- Preserves cultural and architecturally significant heritage - Potentially disruptive to community during moving process

Table 3.1. Comparison of Deconstruction, Demolition and Relocation as building removal metods, by author.

Deconstruction in Managed Retreat Framework

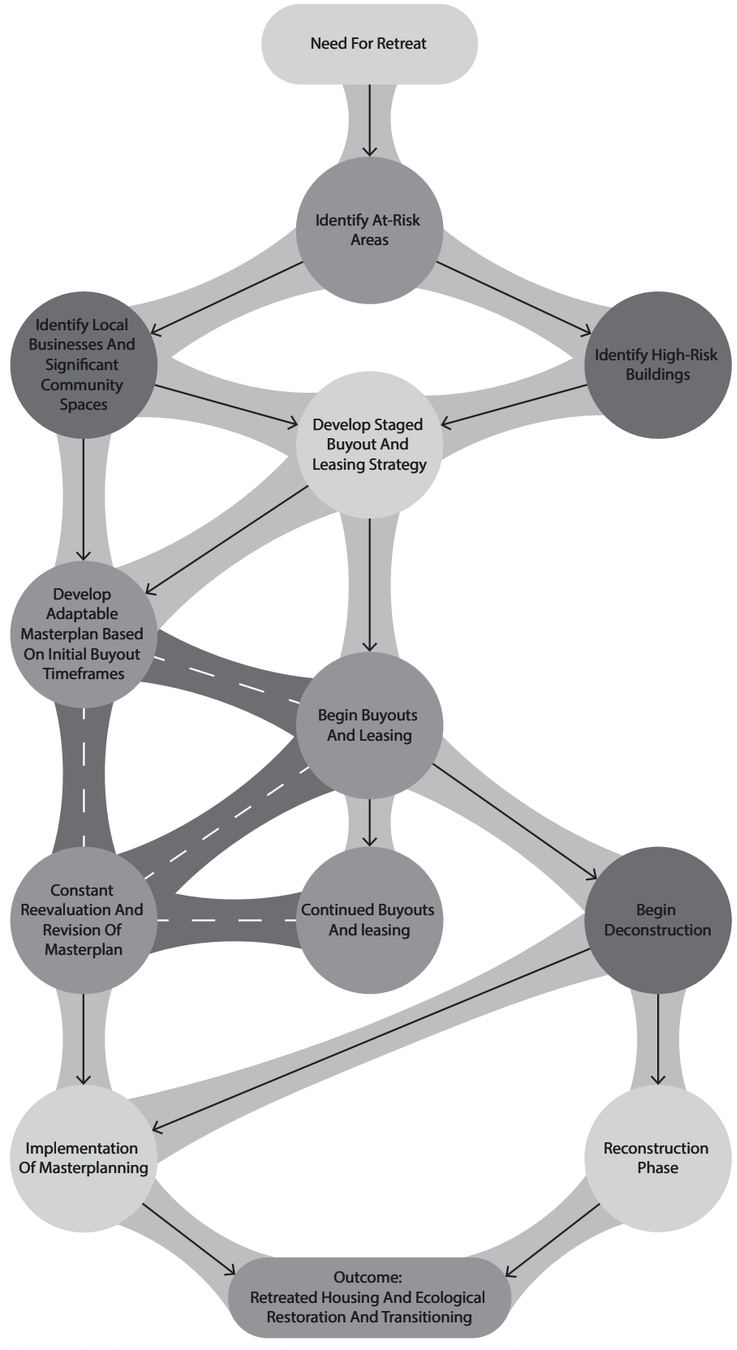


Figure 3.6. Speculative framework diagram of a managed retreat strategy that integrates deconstruction, by author.

Conclusion

This chapter has examined the key research topic of deconstruction and material reuse in architecture, highlighting their role as essential strategies for achieving sustainable and regenerative futures. Past literature distinguished deconstruction from demolition, highlighting the environmental, economic and socio-cultural benefits of deconstruction, such as job creation, carbon reduction and cultural heritage preservation. The chapter situates deconstruction within historical indigenous contexts and the wider regenerative system of circular economies to better understand its role in future adaptation systems. However, significant cost and time barriers were identified, requiring holistic design and planning systems to overcome these challenges, promoting outcomes such as the stimulation of salvage and recycling industries. The case study analysis illustrated the innovative design thinking that can successfully integrate deconstruction into architecture to overcome these barriers. As the built environment faces increasing threats from climate change and our resources are continually depleted through overextraction, there must be a shift in our architectural responses. Deconstruction can play a vital role in the future of a regenerative architecture that embraces climate adaptation challenges and actively works to improve the environmental, social, cultural and economic implications of adaptation strategies. The chapter informs the design strategies used in the exploratory design section, integrating deconstruction into a managed retreat scenario, aiming not only to reduce waste but also to strengthen community resilience and cultural continuity.

Chapter 4: Site Analysis

Introduction

The following chapter explores the research thinking and decision-making process to produce an appropriate site that effectively explores the research themes and questions. Four sites were identified as potential sites for exploration, these include Kawakawa Bay, Kumeu, Sandringham and Waimauku. The four sites are all in the greater Auckland area, an intentional decision to ensure accessibility and reflect motivations related to the Auckland anniversary floods. Each site was evaluated through different relevant factors to identify the ideal site for the design exploration. The selected site is further examined through demographic, historical, and contextual analysis, additionally supported by mappings. This chapter is highly significant to the design chapter, as the site selection and analysis inform the speculative managed retreat scenario within which the design exploration takes place. Insights into the community profile, building typologies and construction inform the creation of the three design scenarios, which serve as experiments to test the design hypothesis.

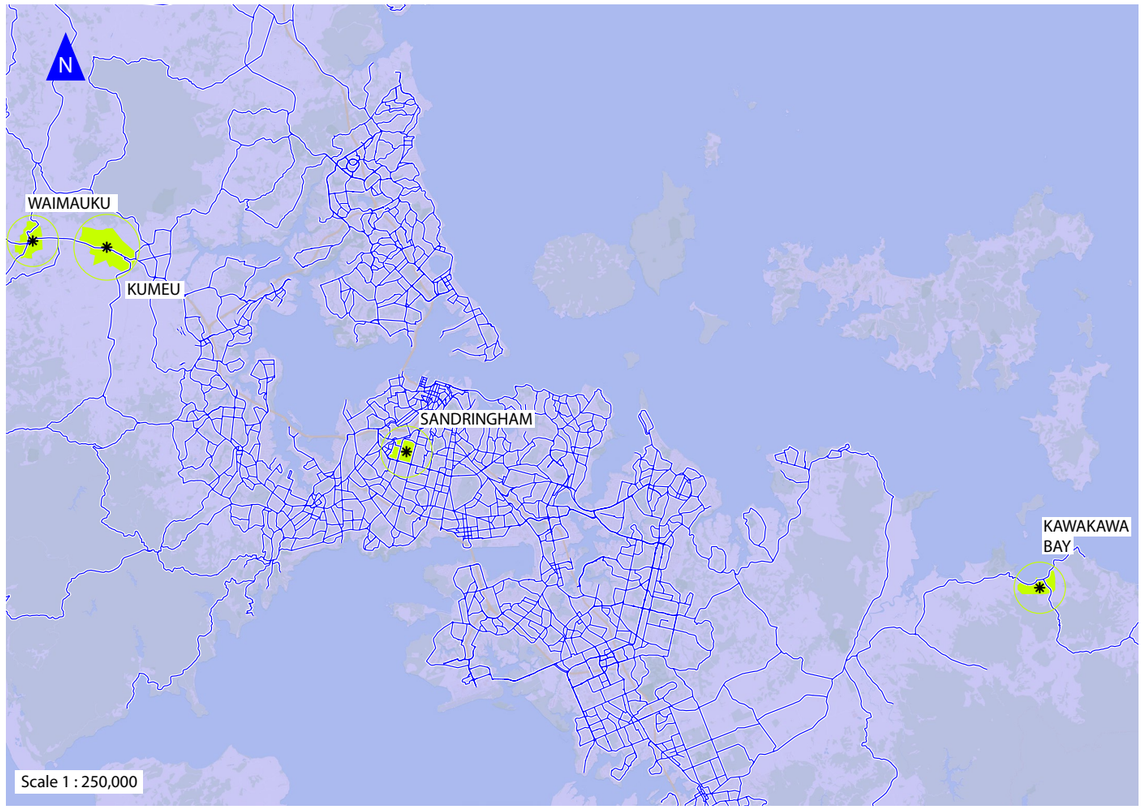


Figure 4.1. Map of initial sites across auckland, by author.

SITE SELECTION

Initially, four sites were selected across Auckland, all of which have previously experienced flooding and remain at risk of future flooding. The sites selected, as seen in Figure 4.1, were Kawakawa Bay, Kumeu, Sandringham and Waimauku. All four sites have a history of flooding and were heavily affected by the Auckland anniversary flood, which was caused by a one-in-100-year rainfall event, as shown in Figures 4.2, 4.3, 4.4, and 4.5. Research was conducted for each, exploring site elements and factors to select a final site that could best explore the research topic, this inital research is shown through mapping in figures 4.5, 4.6, 4.7 and 4.8. Additionally, Figures 4.9, 4.10 and 4.11 show a speculative planning approach for a buyout, lease, and deconstruction managed retreat strategy, high risk buildings are identified and incorporated into the strategy first.

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Figure 4.2. Image of residents tackling flooding in Waimauku, (Walton, 2024)

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Figure 4.3. Aerial image of Kumeu flooded in 2021, (NZ Herald, 2021)

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Figure 4.4. Image of police car washed away by flash floods in Kawakawa Bay, (Hurley, 2017)

Image removed due to copyright

Figure 4.5. Image of Gribblehirst Park still flooded the day after the rain event, (RNZ, 2023)

Sandringham

Key

Flood Plains

Flood Prone Areas

Buildings

At Risk Buildings

Overland Flow Paths

Figure 4.6. Map of climate hazards in Sandringham, by author.

Scale - 1:10,000

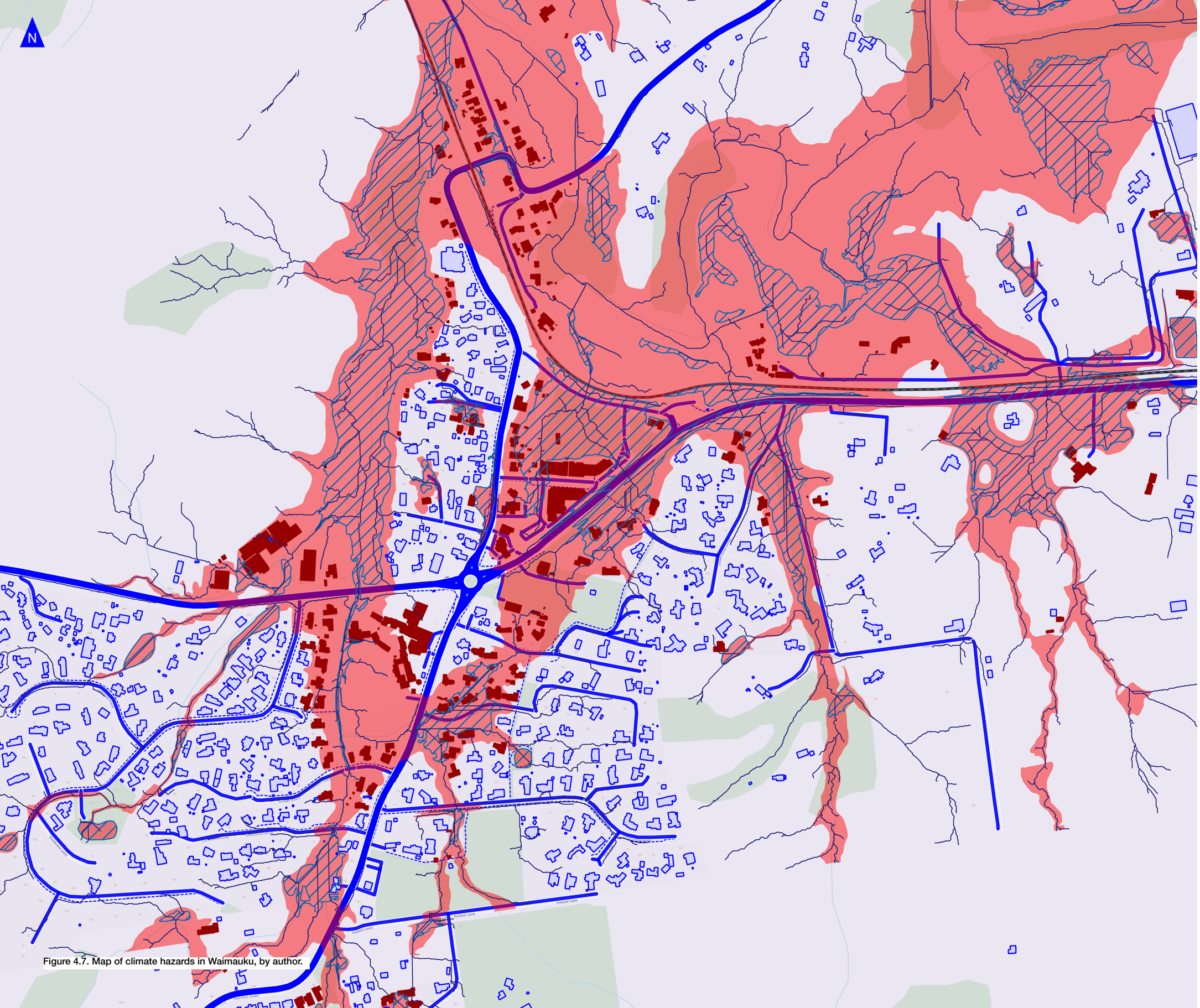


Figure 4.7. Map of climate hazards in Waimauku, by author.

N

Kawakawa Bay

Key

Flood Plains

Flood Prone Areas

Buildings

At Risk Buildings

Overland Flow Paths

Sea Level Rise 5yr

Sea Level Rise 50yr

Sea Level Rise 100yr

Figure 4.8. Map of climate hazards in Kawakawa Bay, by author.

Scale - 1:10,000

Kumeu

Key

Flood Plains

Flood Prone Areas

Buildings

At Risk Buildings

Overland Flow Paths

Figure 4.9. Map of climate hazards in Kumeu, by author.

Scale - 1:10,000

Kumeu Stage 1

Key

- Flood Plains
- Flood Prone Areas
- Buildings
- At Risk Buildings
- Overland Flow Paths
- Buyout/Lease
- Deconstruction
- Completed Retreat

Figure 4.10. Map of speculative retreat scenario using a buyout leaseback and deconstruct strategy Kumeu, Phase 1, by author.

Scale - 1:10,000

Kumeu Stage 2

Key

Flood Plains

Flood Prone Areas

Buildings

At Risk Buildings

Overland Flow Paths

Buyout/Lease

Deconstruction

Completed Retreat

Figure 4.11. Map of speculative retreat scenario using a buyout leaseback and deconstruct strategy Kumeu, Phase 2, by author.

Scale - 1:10,000

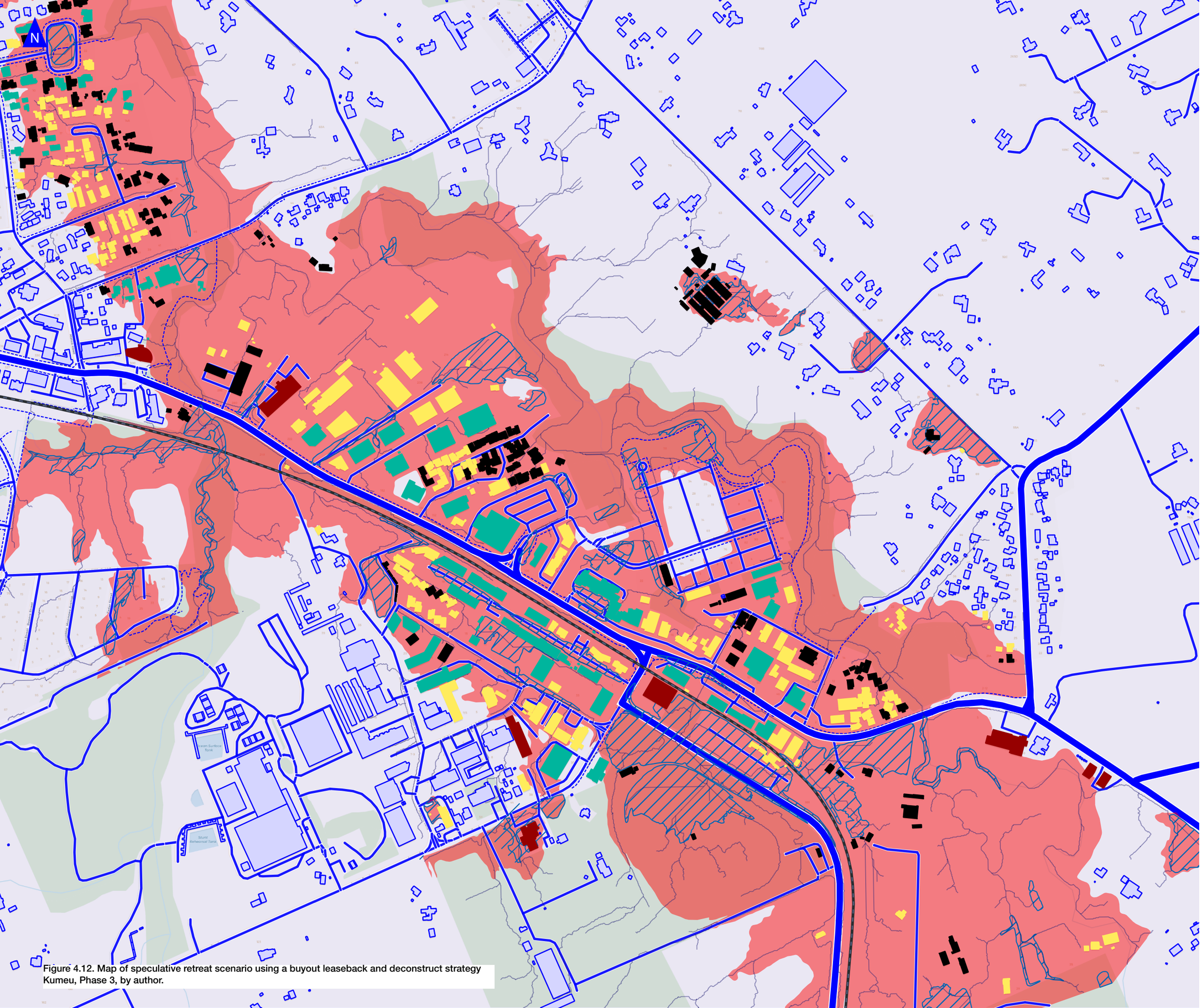


Figure 4.12. Map of speculative retreat scenario using a buyout leaseback and deconstruct strategy Kumeu, Phase 3, by author.

Selected Site - Sandringham

Historical Context

Aotearoa lies along the boundary of the Indo-Australian and Pacific tectonic plates. This has resulted in immense volcanic activity that has shaped the country's rugged terrain. In the Auckland volcanic field, there are over 53 recognised volcanic centres alone (GeoNet, n.d.). The eruptions and lava flow of these volcanoes have had a significant impact on the current terrain of Auckland; notably, lava caves can be found under the suburbs in central Auckland. In particular, an underground river created by the lava flows of Owairaka and Maungawhau runs underneath Sandringham, as shown in Figure 4.15. Known by the local iwi as Nga ana wai or 'the watery caverns', the underground river created a swampland and small lake known in colonial times as cabbage tree swamp, in what is now the surroundings of Gribblehirst Park (Auckland City Council, 2011), as shown in Figures 4.13 and 4.14.

Figure 4.13. Image of the view from cabbage tree swamp facing Mt Eden, (Richardson, 1909a)

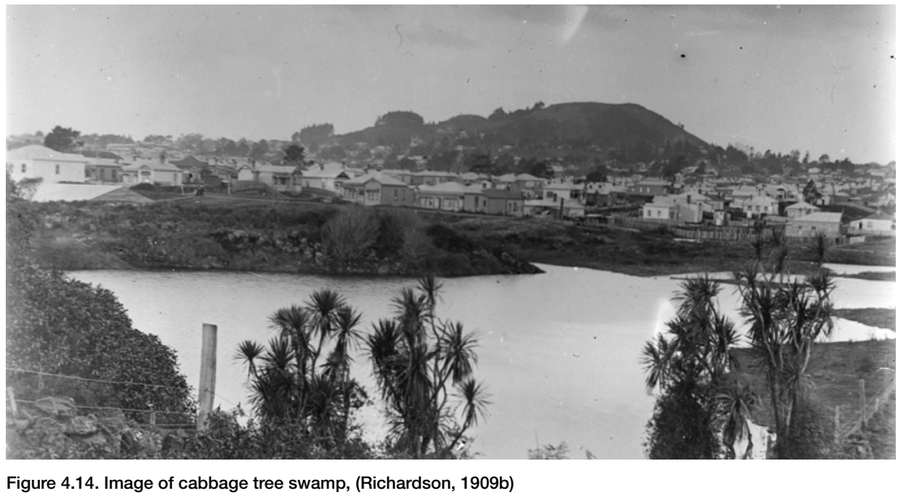


Figure 4.14. Image of cabbage tree swamp, (Richardson, 1909b)

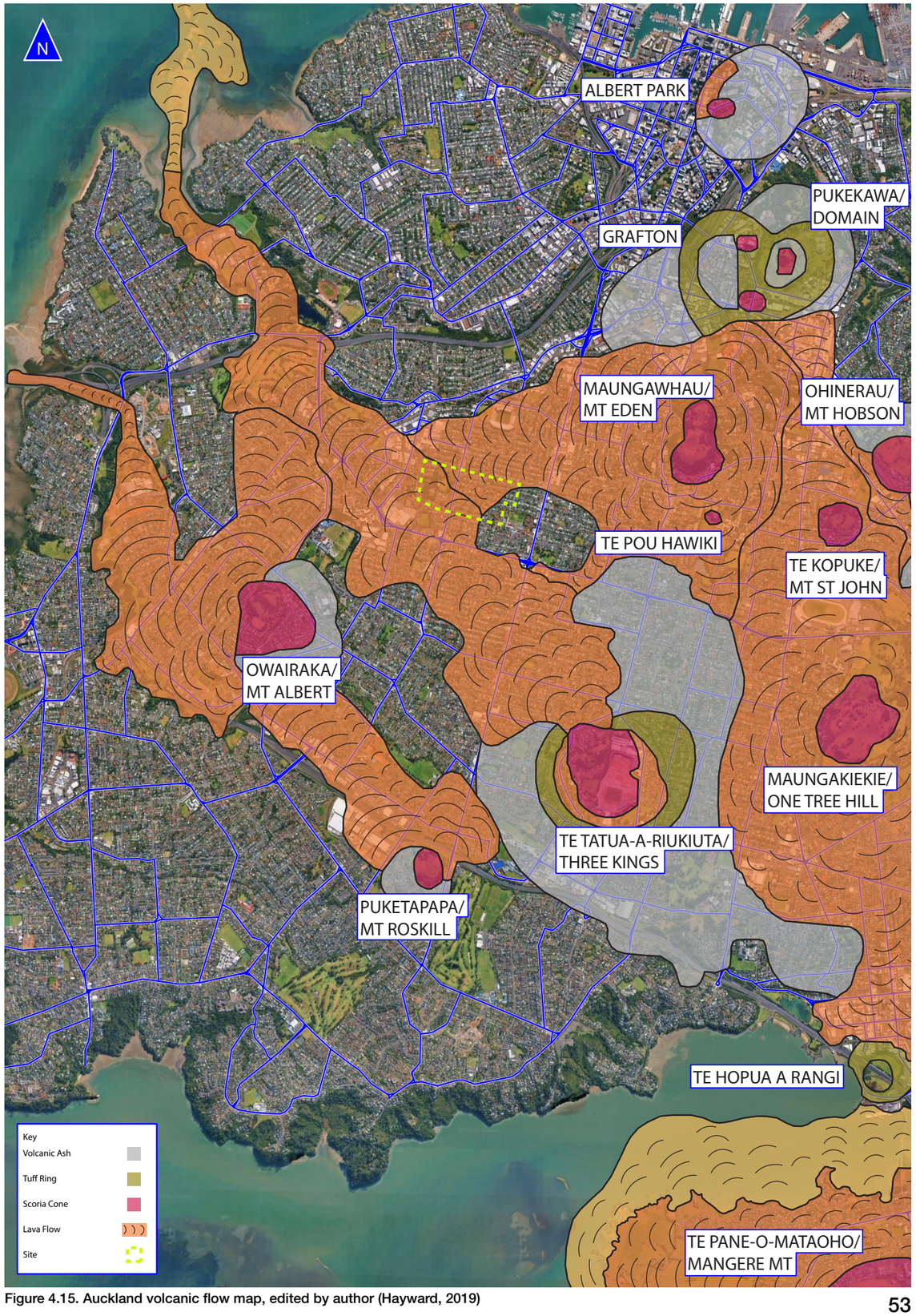


Figure 4.15. Auckland volcanic flow map, edited by author (Hayward, 2019)

The swamp was eventually drained and much of the vegetation was removed, although cabbage trees can still be seen in the area today. What was once a swamp has been transformed into the residential suburb it is today; however, the environmental conditions that made it a swamp remain prevalent. In 2023, during the Auckland anniversary floods, Sandringham was one of the areas in central Auckland hit hardest; no doubt its historical environment played a part. Figures 4.5 and 4.16 show the amount of water left over after.

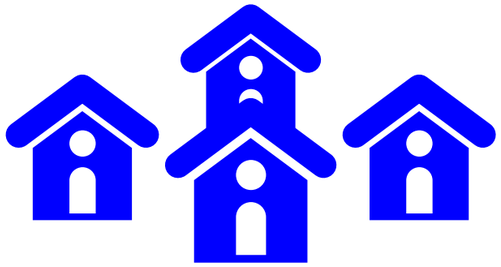
Figure 4.16. The Auckland Beekeepers Club headquarters and hives located in Gribblehirst Park still flooded following the rain event (Leslie, 2023)

Demographics and Community Profile

POPULATION- 12,500

NUMBER OF FAMILIES - 2,892

MEDIAN AGE - 34.9

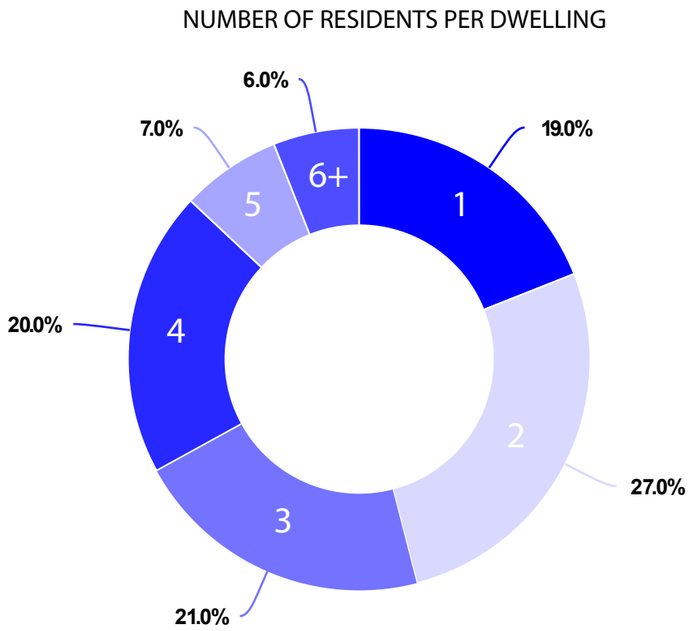


PRIVATE DWELLINGS - 4,362

HOME OWNERSHIP - 50.9%

MEDIAN WEEKLY RENT - $520

Figure 4.17. Community profile/demographics diagram 1, by author.



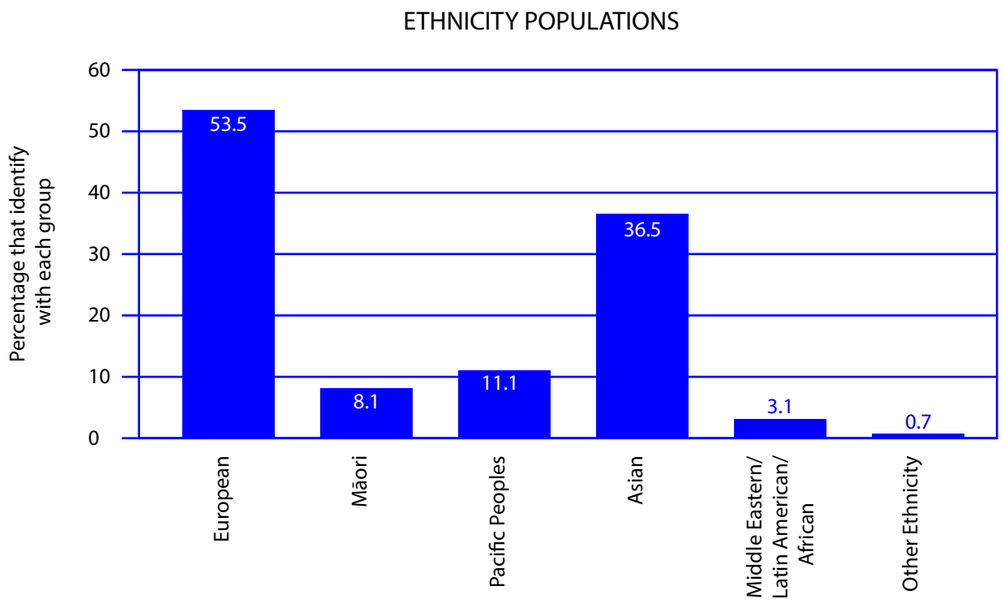


Figure 4.18. Community profile/demographics diagram 2, by author.

Building Analysis

Based on the historical context of the swampland surrounding Gribblehirst Park, the scope of the site was centred around that area, shown in Figure 4.19. Figures 4.20 and 4.21 present quantitative data on building typologies and construction within the site through mapping. The data was collected through online mapping services, including Auckland Council GeoMaps and Google Maps ; a site visit to collect the same information was also conducted to verify the data. The maps indicate a strong residential typology and clear trends toward timber- and brick-based facades. The housing is typically either early 1900s timber bungalows or former state housing built in the 1950s and 60s. Both housing typologies primarily accommodate the nuclear family model of living. Most of the identified housing utilises materials and construction practices that aid in the deconstruction, as well as including materials with high reuse value such as native timber flooring and cladding, masonry and corrugated roofing.

Key

Existing Buildings

Flood Prone

Flood Plains

High Risk

Medium Risk

Scale 1 : 5,000

Figure 4.19. Flood risk buildings map of Sandringham, by author

Key

Existing Buildings

Flood Prone

Flood Plains

Building Typologies

Residential

Commercial

Education

Community Facility

Recreation

Scale 1 : 5,000

Figure 4.20 Building typologies map of Sandringham, by author

Key

Existing Buildings

Flood Prone Areas

Flood Plains

Construction Material

Timber

Brick

Concrete/Cinder Block

Rendered

Mixed Cladding

Brick and Block

Stone Block

No Data

N

Scale 1 : 5,000

Figure 4.21 Construction typologies map of Sandringham, by author

Conclusion

Through the site analysis of various climate-vulnerable areas, Sandringham was chosen as the selected site as it offered valuable potential to explore an urban residential strategy as opposed to the other sites that were more rural. Through further analysis of the site, a rich history was uncovered, revealing the historic environmental conditions that have led to Sandringham's climate vulnerability. The scope of the site was properly adjusted to reflect a more realistic approach that would provide excellent potential post-retreat climate mitigation strategies, such as reintroducing the historic swampland as an urban sponge (although this research does not explore this). The site also revealed a diverse and family-oriented community, along with an analysis of the building typologies and construction; these site conditions were key influences in the development of the three speculative design scenarios.

Chapter 5: Design

Introduction

This design chapter sits within a speculative context of a managed retreat strategy in Sandringham. The retreat strategy incorporates deconstruction and material reuse, as identified in the retreat framework shown in Figure 3.7. The design chapter aims to create the groundwork for future research into the implementation of deconstruction and material reuse in a managed retreat strategy.

The scenario methodology is a design research approach that enables the exploration of multiple possible futures by identifying and testing what-if scenarios. The scenarios were treated as experimental design sprints and were each explored over the course of a week. All scenarios share the same overall objective: to produce regenerative architecture through material reuse in design. Each scenario has its own unique living system that it is attempting to foster through design. These include intergenerational housing, cohousing, and incremental housing, identified to address the current housing typology in Sandringham, which consists entirely of traditional nuclear-family housing. The chapter outlines the overall context of managed retreat and deconstruction for the design experiments. The chapter then consists of 3 scenario design sprints, each of which identifies the scenario's context and frames it alongside real houses, providing relevant architectural visuals and documentation. Each scenario offers specific reflections, which are then collated into a final design evaluation and reflection.

Design Context

Figure 5.1 details the material reuse flows for different construction materials, highlighting recycling and reuse options for reconstruction and alternative uses such as transportation infrastructure and furnishings. Figure 5.2 shows the retreat context for the design chapter, identifying the risk areas to be relocated as part of the strategy. Additionally, the map identifies the real houses that are used within the speculative design scenarios as well as the potential relocation sites. In Figure 5.2, the potential relocation sites are identified by the numbers 1, 2, and 3, corresponding to the scenarios they belong to. The potential sites were chosen due to the close proximity to the affected area to keep the residents local whilst remaining largely outside of the flood plains and flood prone areas, with the site for scenario 2 being the exception. In the design scenario, the proposed retreat zone would be returned to a swampland to act as a nature-based solution to prevent flooding in the surrounding areas during heavy rainfall events. This would limit the extent of the flood plains and prone areas making the potential site for scenario 2 a viable option (the swampland transformation was not explored in depth due to the scope of this thesis).

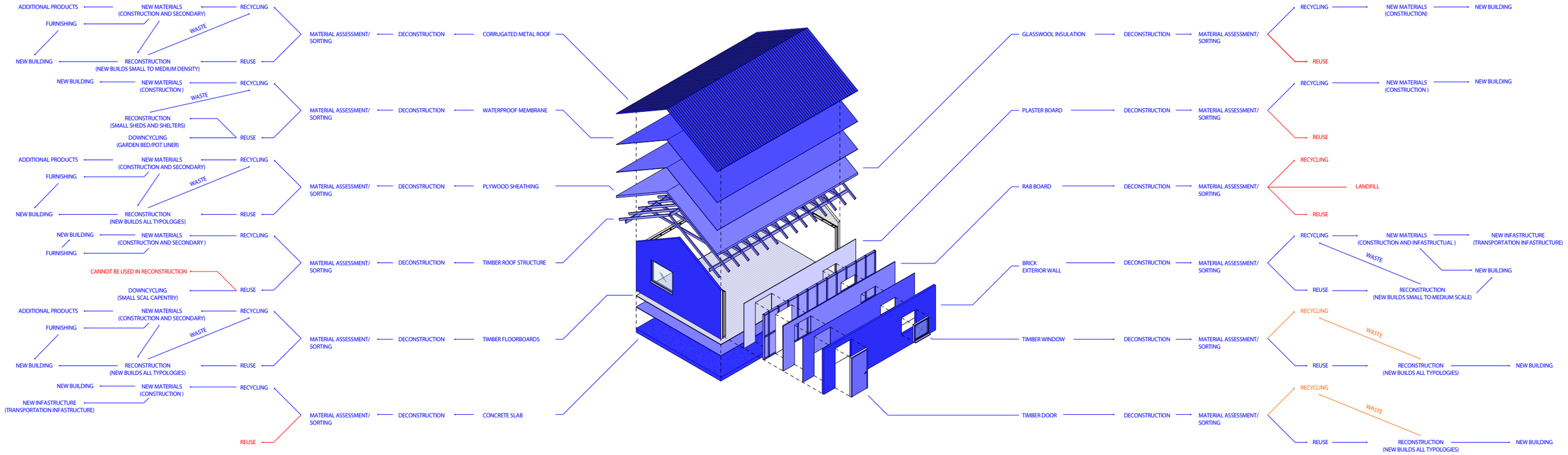


Figure 5.1 Deconstruction material reuse and recyling flow diagram, by author.

Figure 5.2. Retreat area map in speculative design scenarios, by author.

Scenario One

Scenario one is exploring the managed retreat of two homes within the retreat zone (Figure 5.2), utilising the deconstruction and reuse of materials to create a new living solution that is better suited to our current cultural and social make-up, through intergenerational design principles. The design aims to accommodate two related families, including a set of grandparents on either side; the family dynamic is shown in Figure 5.3. Inter or multigenerational housing has been around for almost all of human history across most cultures; it seeks to provide living arrangements that accommodate residents of all ages. This approach leads to social connections across generations, especially between the elderly and youth. Additionally, the approach can provide an extra layer of support for all residents, including childcare and meal-preparation assistance.

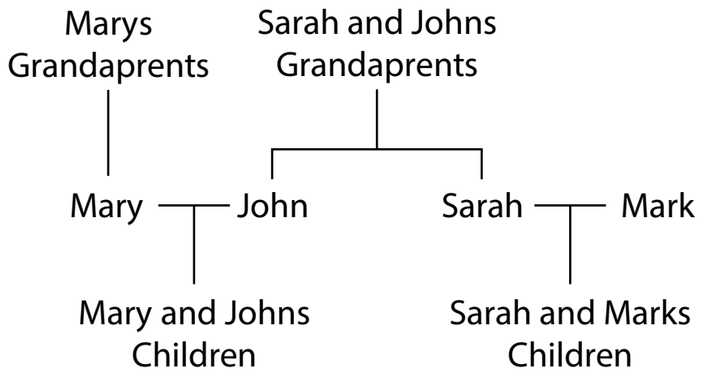


Figure 5.3. Scenario 1 family dynamic diagram, by author.

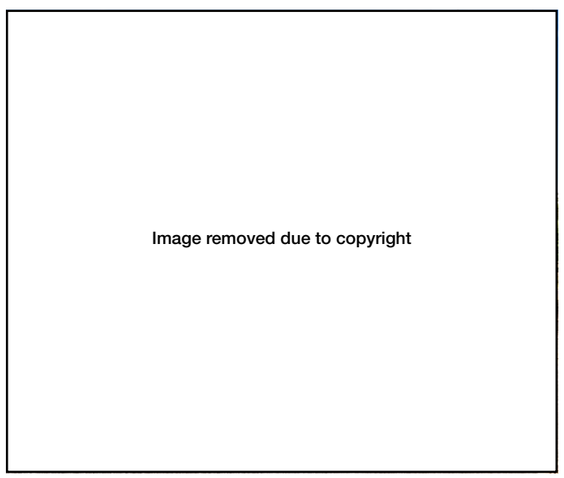


Figure 5.4. Image of 254 Sandringham Rd, (Barfoot & Thompson, n.d.).

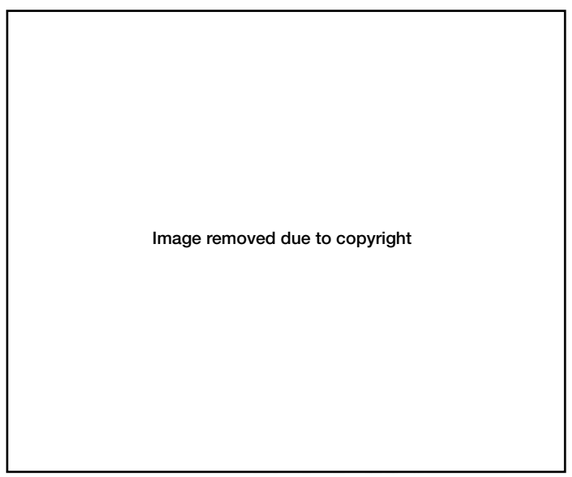


Figure 5.5. Floorplan for 254 Sandringham Rd, (Barfoot & Thompson, n.d.).

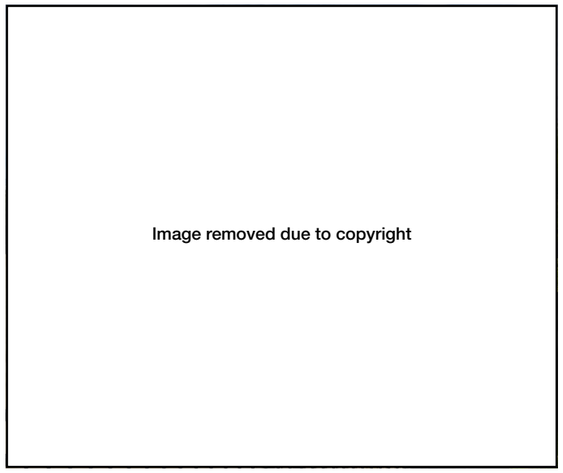


Figure 5.6. Image of 5 Parrish Rd, (Ray White, n.d.).

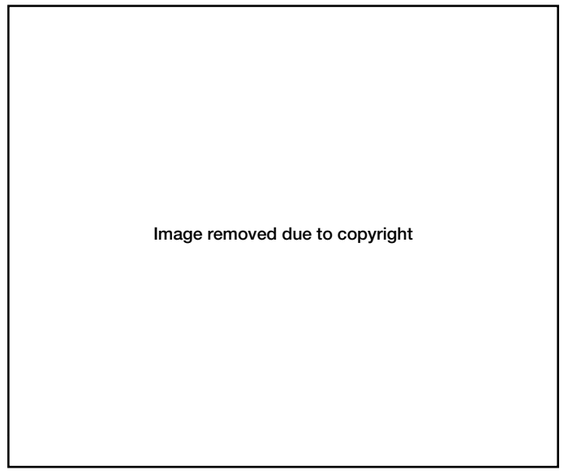


Figure 5.7. Floorplan for 5 Parrish Rd, (Ray White, n.d.).

Material Audit

Note that the data produced for the material audits are base on rough estimated amounts and is used as guide for the design (additional information on the data collection can be found in Appendix A).

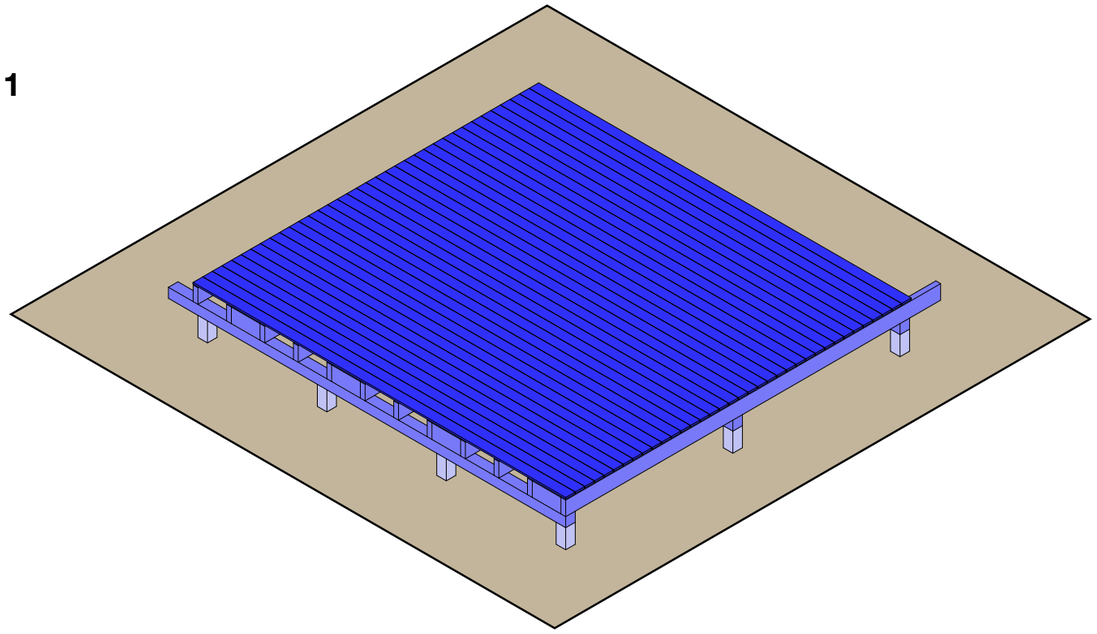
Material	254 Sandringham Rd	5 Parrish Rd	Waste Total	Total
Brick	3,383 Bricks	NA	98 bricks	3285 bricks
Weatherboard	NA	1347m	26.94m	1320m
Timber Flooring	1,080m	1186.3m	45.32m	2220.9m
Metal Roofing	NA	164.4m2	8.22m2	156.18m2
Concrete Block	NA	NA	NA	NA
Roofing Tile	268 tiles	NA	13 tiles	255 tiles
Polystyrene Insulation	NA	NA	NA	NA
Glass Wool Insulation	NA	68m3	3.4m3	64.6m3
Plasterboard	NA	299m2	15m2	284m2
Structual Timber	2.9 m3	4.1m3	0.35m3	6.7m3
Concrete Piles	NA	3.1m3	0.1m3	3m3
Concrete Slab	16m3	NA	1.5m3	14.5m3
Concrete (driveway, etc.)	26.2m3	19.3m3	2.2m3	43.3m3
Copper Piping	NA	30kg	2kg	28kg
PVC Piping	NA	55m	12m	43m
Timber Windows	12	NA	NA	12
Aluminium Windows	3	17	1	19
Interior Doors	NA	8		8
Exterior Doors	3	3		6

Table 5.1. Material audit for 5 Parrish Rd and 254 Sandringham Rd, by author.

Floor and Foundation Deconstruction

Floor and foundation deconstruction is one of the last steps in the deconstruction process, but also one of the easiest. The deconstruction of 5 Parrish Rd involves removing the timber flooring, floor bearers, floor joists and then unearthing the pile foundations. Figures 5.9, 5.10 and 5.11 highlight the steps taken in the deconstruction process of a timber floor and pile foundations. Timber flooring is extremely common in Aotearoa and can be found in many homes, especially native timbers such as Rimu, Matai and Kauri, which can be very valuable on the salvage market.

1



Once most other construction elements have been removed floor and foundations can be deconstructed. Begin by using a long pry-bar or similar tool to seperate floorboards from the flooring joists. once they have been removed they can be denailed.

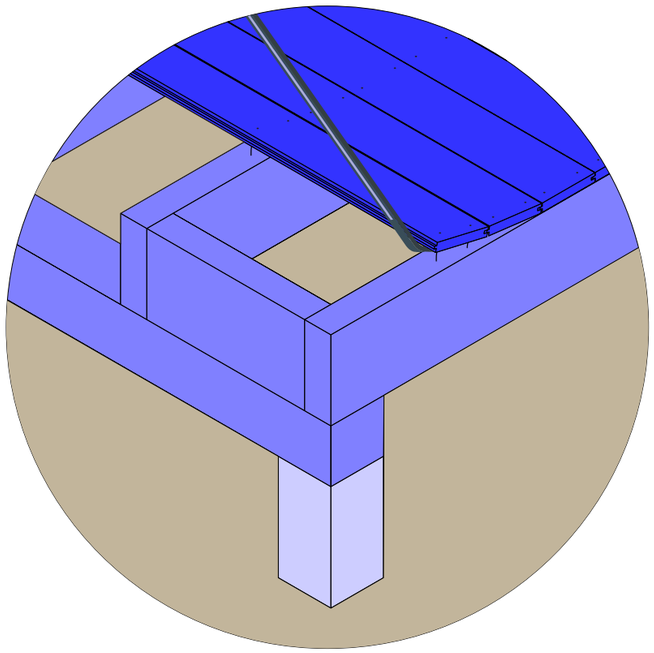
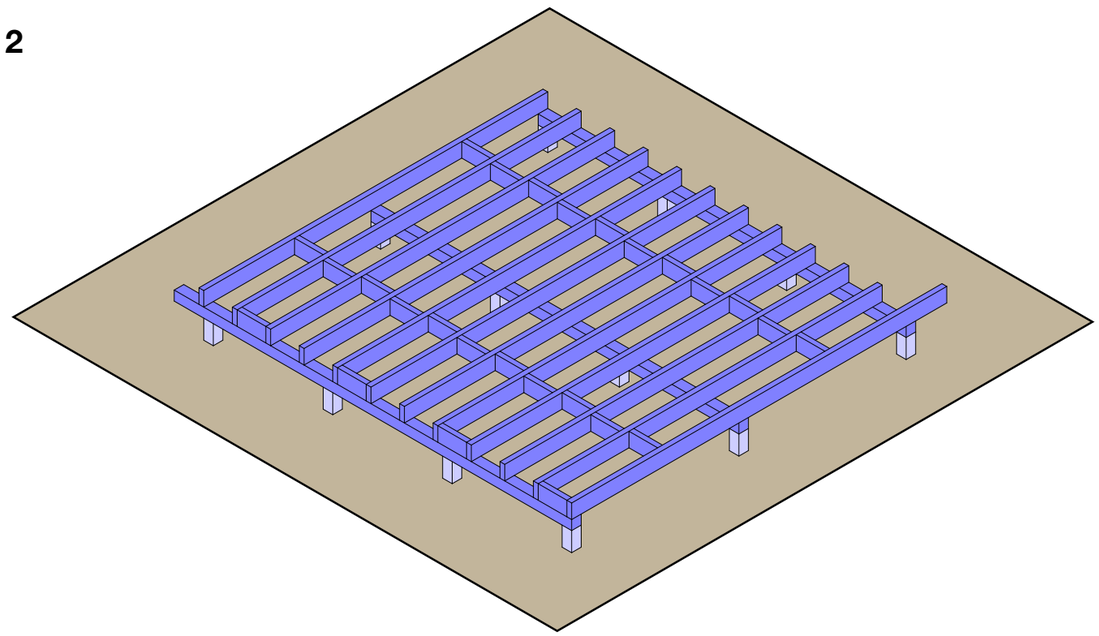


Figure 5.8. Deconstruction process diagram for timber subfloor and pile foundation, stage 1 removal of floorboards, by author.

2



Following the removal of the floorboards the floor joists and bearers are next. Remove the fixings using the appropriate tools, often joists will be held together with nails in these cases use a hammer to dislodge them and they can be denailed later.

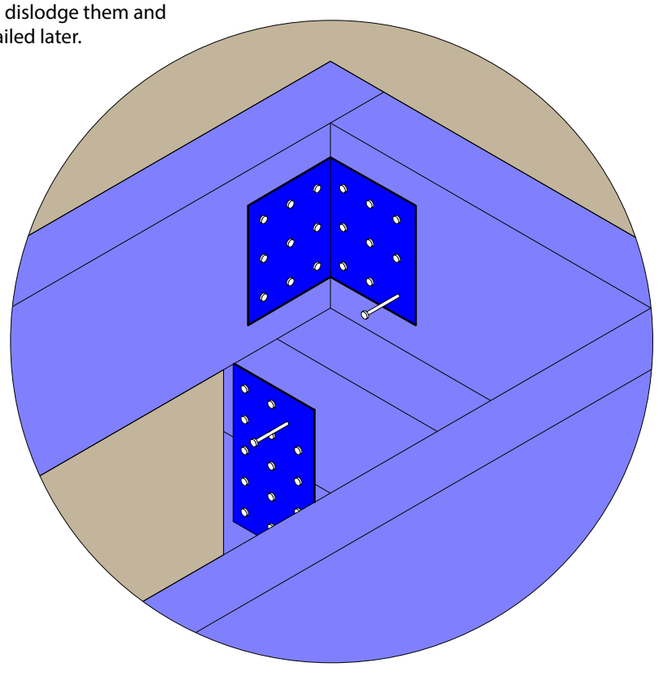
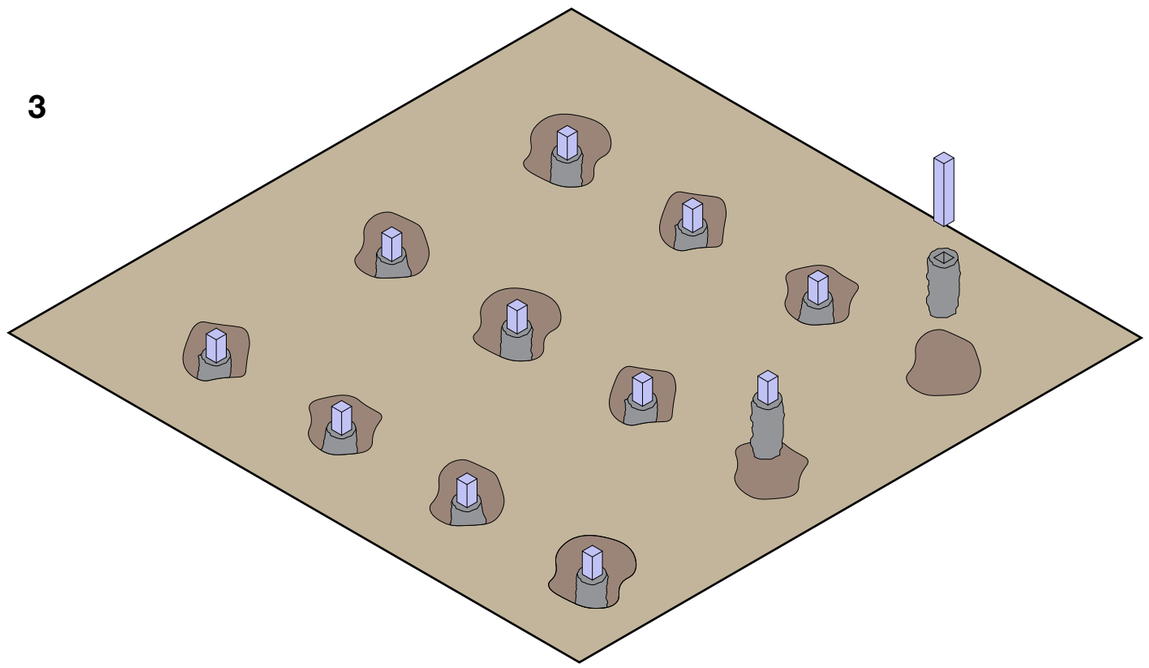


Figure 5.9. Deconstruction process diagram for timber subfloor and pile foundation, stage 2 removal of bearers and joists, by author.

3

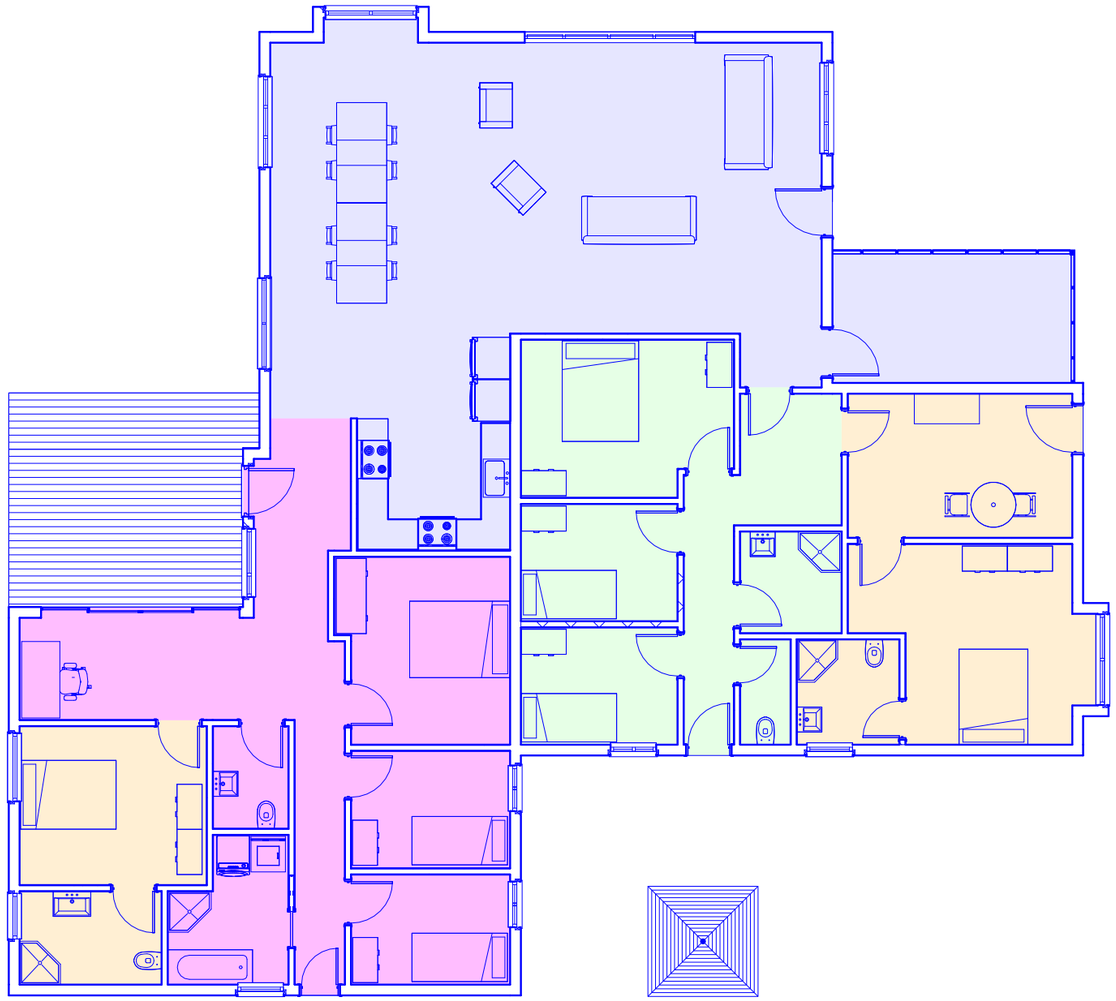


Finally, now that the joists and bearers have been removed the pile foundations can be dug up and the concrete can be removed from the piles to later become crush rock.

Figure 5.10. Deconstruction process diagram for timber subfloor and pile foundation, stage 3 removal of piles, by author.

N

Scenario 1 Floorplan



Shared Living and Dining Area

Private Grandparents Area

Living Area 1

Living Area 2

SCALE 1 : 100

Figure 5.11. Scenario one floorplan highlighting different generational spaces, by author.

Figure 5.12. Scenario one persective 1, interior view looking out of sunroom, by author.

Figure 5.13. Scenario one persective 2, exterior areial view, by author.

Figure 5.14. Scenario one persective 3, exterior view highlighting the integration of materials, by author.

Scenario Reflection

This scenario explored how intergenerational housing could emerge as a socially resilient outcome of managed retreat when guided by a deconstruction-and-material-reuse strategy. The reuse of materials in an intergenerational housing solution raised a compelling insight: for elderly residents, the integration of familiar materials such as salvaged doors, windows and façade materials from their previous homes can provide a sense of continuity, supporting their wellbeing. The combination of 2 houses, without going vertical, demonstrated an efficient use of land and highlighted the potential of intergenerational housing in managed retreat; similarly, other construction types, such as duplex housing, may be another design strategy to explore. The increased social connection created by intergenerational housing can be a valuable asset for mitigating feelings of displacement and loss of community caused by managed retreat. Furthermore, the built-in support networks intergenerational housing provides can ease stress, offering emotional, social and practical stability during a complex process. One limitation identified in the design process is the lack of adaptability and flexibility; there is no consideration for the potential growth of the occupants and how that may affect future connections. Although the design is spatially efficient, the use of materials is not; the taller-than-average ceiling is used to make rooms feel larger, counteracting feelings of crampedness, but it also requires more material. This, coupled with the need for a concrete slab foundation, can compromise the regenerative aspects of the design. Future designs should explore more efficient material use while maintaining a sense of spaciousness, perhaps by using vaulted ceilings. Another consideration is to explore an adaptable approach, potentially combining incremental and intergenerational housing.

Scenario Two

Scenario two is exploring the managed retreat of three homes within the retreat zone (Figure 5.2), utilising the deconstruction and reuse of materials to create a new living solution that contributes to social cohesion during a time of community fragmentation, through cohousing principles. The design aims to accommodate three families facing displacement, providing a communal living arrangement. Cohousing is a communal based housing model that shares facilities and the costs of the property, a much more affordable alternative to traditional housing systems, as such it has grown popular in recent years a notable example from Auckland is Cohaus (Cohaus, n.d.). This approach leads to stronger social connections on a daily basis strengthening the community, during times of retreat when communities are most vulnerable strategies that mitigate the negative social impacts are valuable.

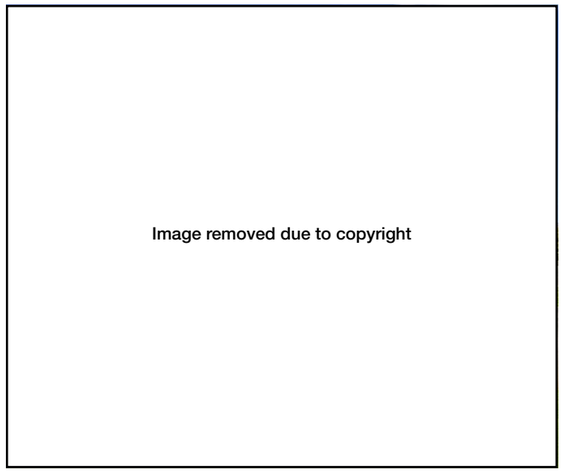


Figure 5.15. Image of 33 Parrish Rd, (Barfoot & Thompson, n.d.).

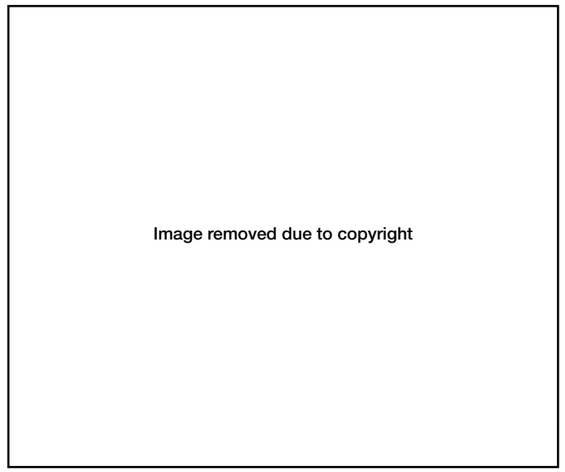


Figure 5.16. Floorplan for 33 Parrish Rd, (Barfoot & Thompson, n.d.).

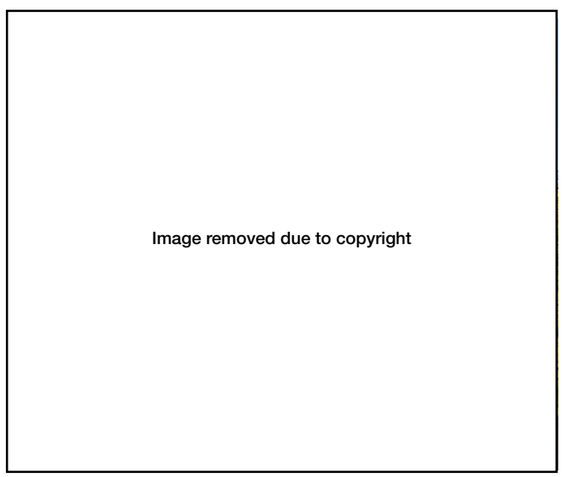


Figure 5.17. Image of 53 Gribblehirst Rd, (Ray White, n.d.).

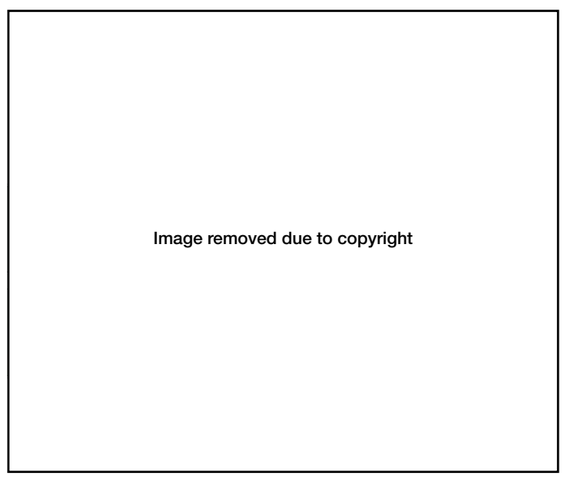


Figure 5.18. Floorplan for 53 Gribblehirst Rd, (Ray White, n.d.).

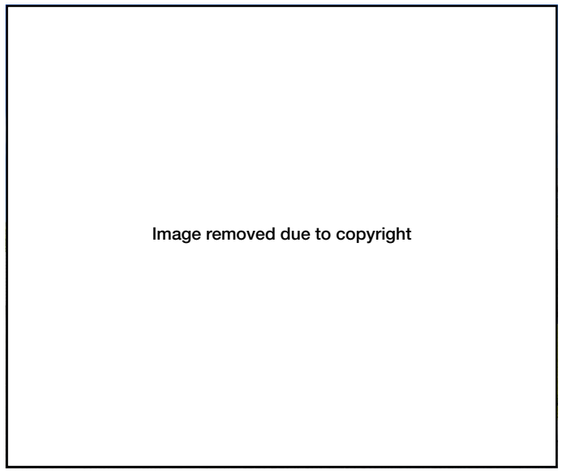


Figure 5.19. Image of 73 Gribblehirst Rd, (OneRoof, 2025).

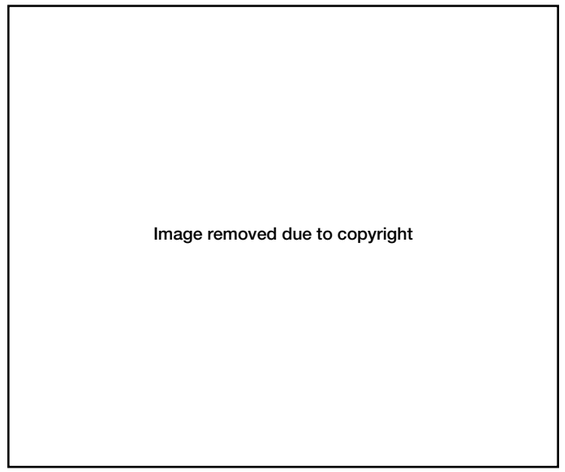


Figure 5.20. Floorplan for 73 Gribblehirst Rd, (OneRoof, 2025.).

Material Audit

Note that the data produced for the material audits are base on rough estimated amounts and is used as guide for the design (additional information on the data collection can be found in Appendix A).

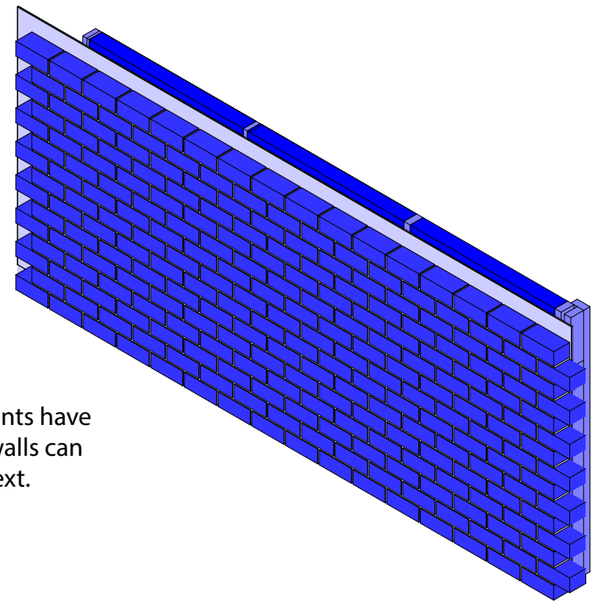
Material	53 Gribblehirst Rd	73 Gribblehirst Rd	33 Parrish Rd	Waste Total	Total
Brick	NA	NA	1841 bricks	92 bricks	1749 bricks
Weatherboard	718m	1573m	223.2m	52.8m	2461.4m
Timber Flooring	1210m	3610m	1140m	141.8m	5818.2
Metal Roofing	169m2	364m2	NA	26.65m2	506.35m2
Concrete Block	NA	160 blocks	NA	8 blocks	152 blocks
Roofing Tile	NA	NA	371 tiles	29 tiles	342 tiles
Glass Wool Insulation	21.4m3	70.2m3	35.4m3	6.35m3	120.6m3
Plasterboard	305.76m2	540.3m2	324.98m2	58.5m2	948.1m2
Structual Timber	18.15m3	45.7m3	13.3m3	3.87m3	73.29m3
Concrete Piles	NA	NA	NA	NA	NA
Concrete Slab	17.5m3	36.1m3	19.8m3	3.67m3	69.73m3
Concrete (driveway, etc.)	12.9m3	7.3m3	NA	1.01 m3	19.19m3
Copper Piping	30kg	10	30kg	3.5kg	66.5kg
PVC Piping	42m	NA	35m	7.7m	69.3m
Timber Windows	10	NA	15	NA	25
Aluminium Windows	NA	24	NA	2	22
Interior Doors	6	15	10	NA	31
Exterior Doors	3	3	4	NA	10

Table 5.2. Material audit for 33 Parrish Rd, 53 and 73 Gribblehirst Rd, by author.

Floor and Foundation Deconstruction

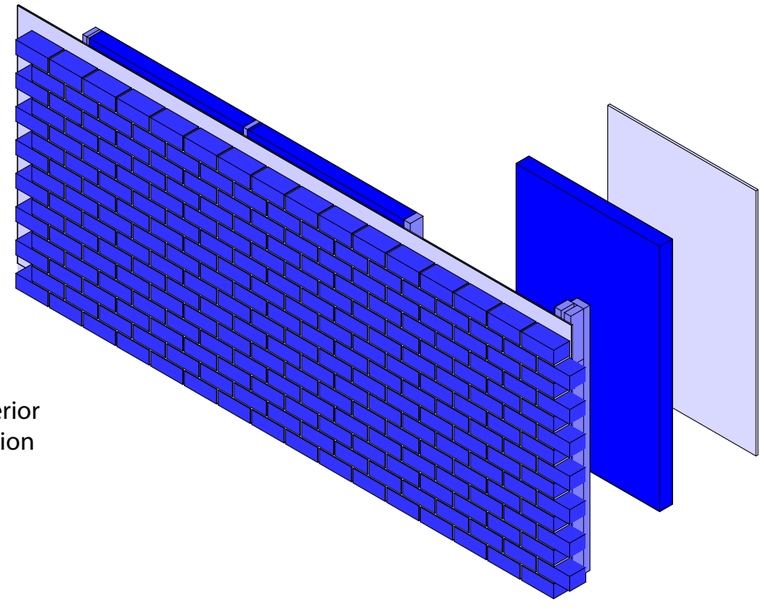
The deconstruction process of exterior walls varies heavily from building to building, as there are many different and unique wall constructions. 33 Parrish Rd has brick exterior walls, which require the removal of surrounding elements first to properly access the bricks during the deconstruction process. The bricks then require a post-deconstruction process before they can be suitable for reuse. Figures 5.22, 5.23 and 5.24 highlight the steps taken in the deconstruction process of a brick wall.

1



Once the roof elements have been removed the walls can be deconstructed next.

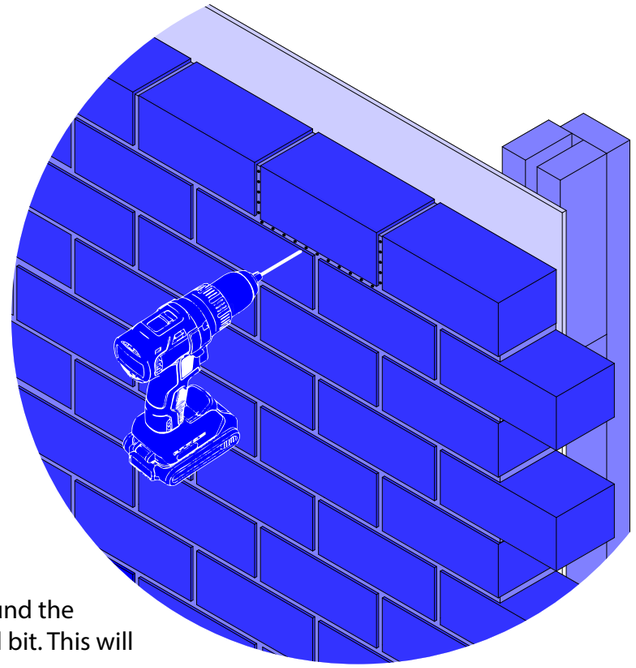
2



First remove the interior cladding and insulation batts.

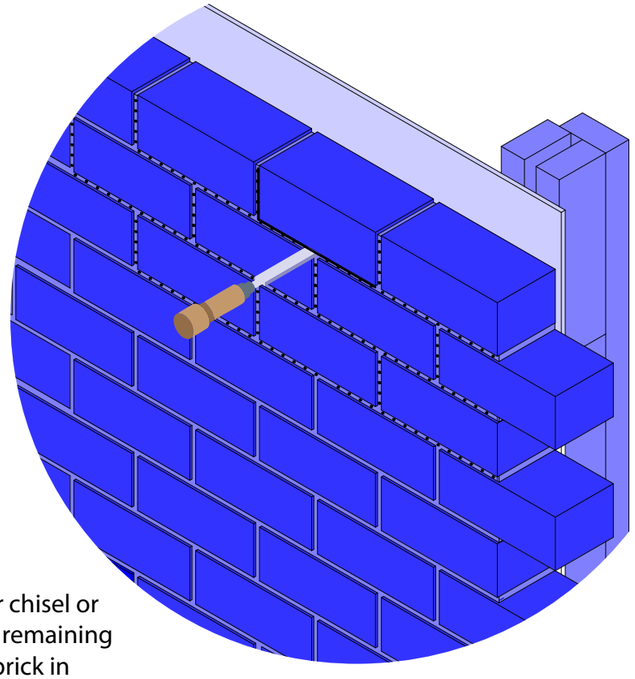
Figure 5.21. Brick wall deconstruction diagram stages 1 and 2, by author.

3



Begin by drilling holes around the bricks using a masonry drill bit. This will weaken the mortar.

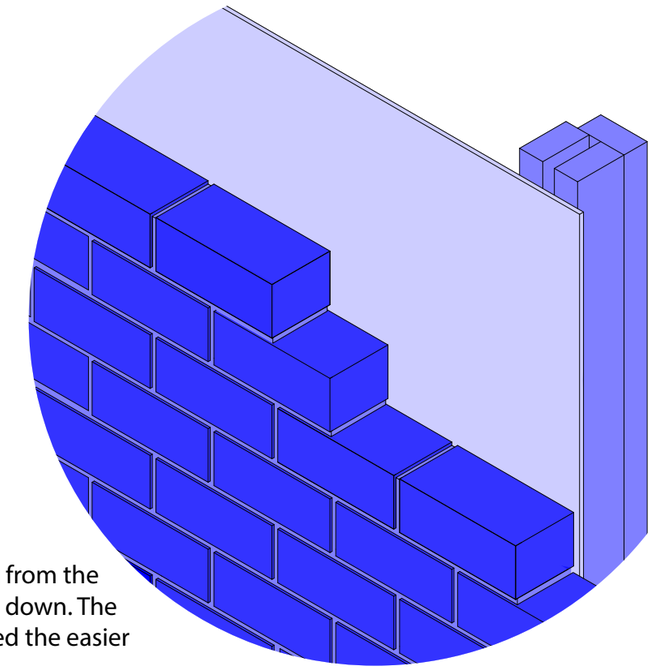
4



Next using a either a power chisel or hand held one remove any remaining mortar that is holding the brick in place, to free the brick

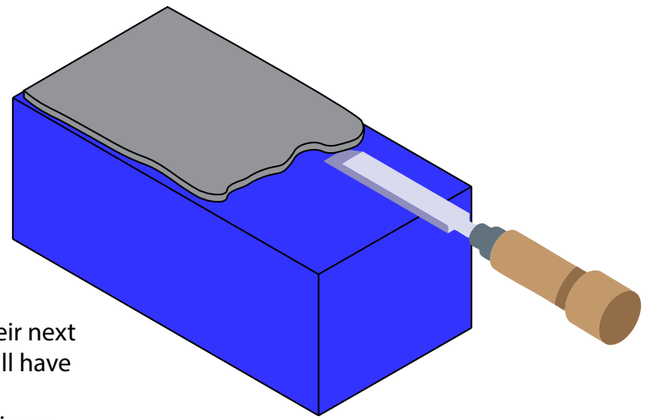
Figure 5.22. Brick wall deconstruction diagram stages 3 and 4, by author.

5



Repeat this process starting from the top of the wall and working down. The more bricks that are removed the easier the process becomes.

6

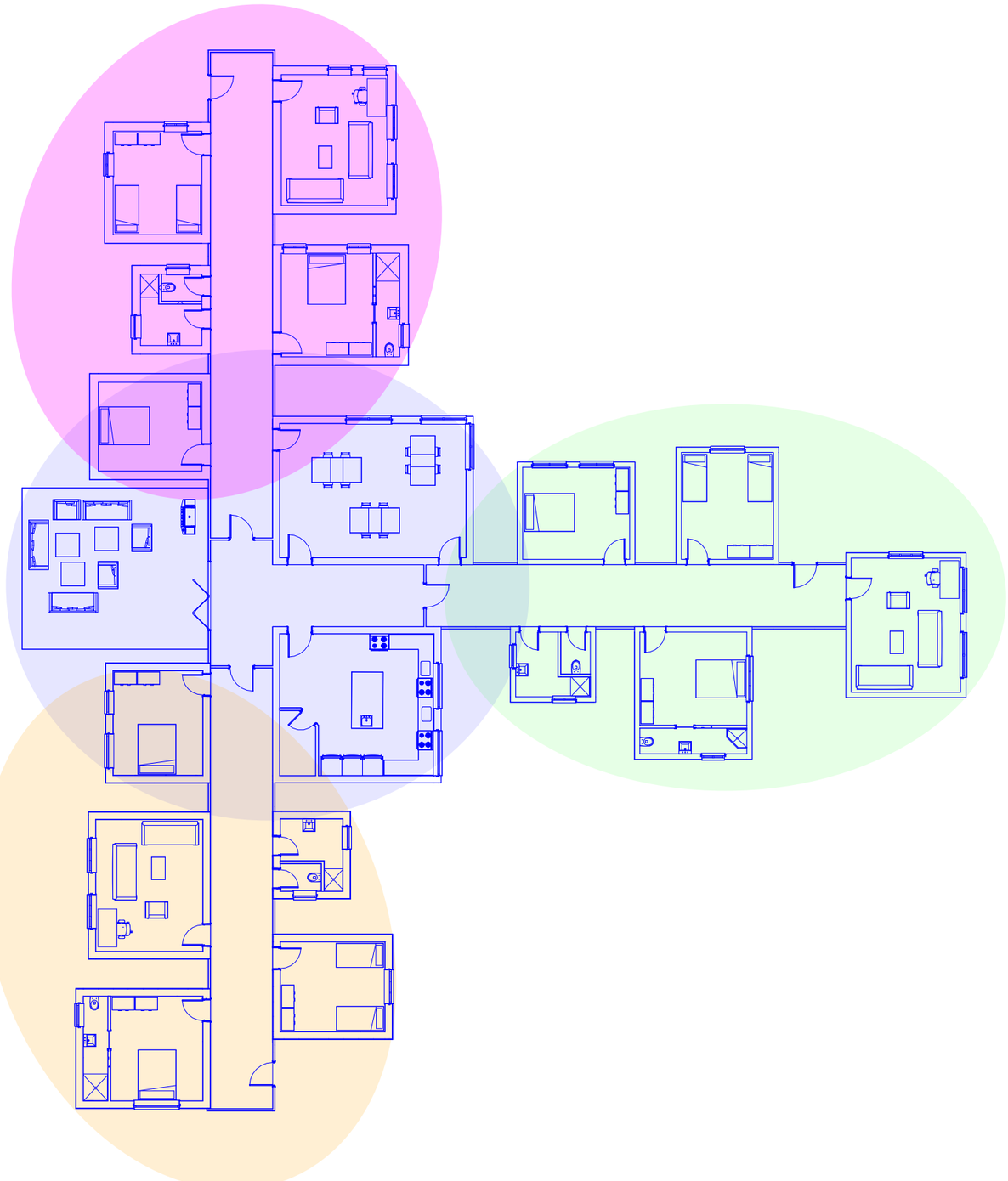


Once the bricks have been deconstructed they can start their next phase of life. Often bricks will still have excess mortar on them post deconstruction, clean this off using a chisel once again this will improve the ease of reuse.

Figure 5.23. Brick wall deconstruction diagram stages 5 and 6, by author.

N

Scenario 1 Floorplan



Communal Spaces

Family 1

Family 2

Family 3

SCALE 1 : 200

Figure 5.24. Scenario two floorplan highlighting the communal and private living spaces , by author.

Figure 5.25. Scenario two persective 1, exterior view of communal outdoor space, by author.

Figure 5.26. Scenario two persective 2, exterior view of residents having shared bbq, by author.

Figure 5.27. Scenario two persective 3, exterior areial view, by author.

Scenario Reflection

This scenario explored the potential of a cohousing living system developed through the implementation of deconstruction and material reuse in a managed retreat strategy. The communal nature of cohousing aligns with the social implications of managed retreat; the loss of community and feelings of displacement can be mitigated by fostering community in cohousing. The cohousing approach successfully created a regenerative outcome; the design of smaller, separated, shed-like rooms with interconnecting walkways significantly reduces the need for new materials, particularly structural elements. Additionally, the light framing approach allows the design to be less environmentally impactful through a sustainable foundation system such as screw piles rather than a concrete slab. However, a key limitation identified during the design process is the significant amount of land required. In a managed retreat context, land availability is often a key challenge; the spatial demands of this design would not work well within these constraints. Potential further development of this scenario might explore a multistorey cohousing system, though this may compromise some regenerative aspects and limit accessibility.

Scenario Three

Scenario three is exploring the managed retreat of two homes within the retreat zone (Figure 5.2), utilising the deconstruction and reuse of materials to create a new living solution that actively fights climate change through regenerative design contributions. The design scenario includes a thrid home outside of the retreat zone from which 2 incremental housing units will be built vertically on top of. Incremental housing involves the deliberate design of unused or partially used spaces in housing that can later accommodate expansion of the rest of the house. This opportunity affords deconstruction-based retreat strategies an incremental approach as well allowing for partial deconstruction and reconstruction.

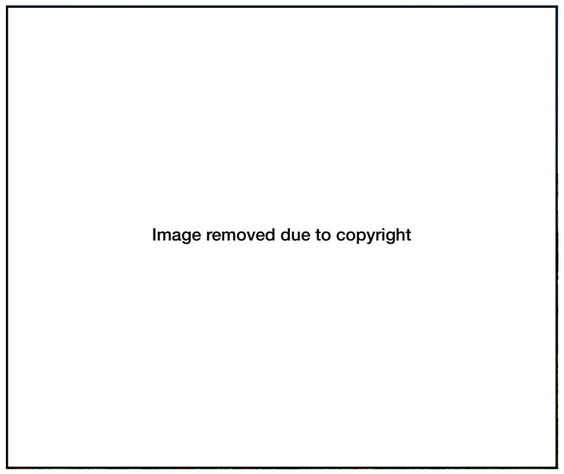


Figure 5.28. Image of 257 Sandringham Rd, (Ray White, n.d.).

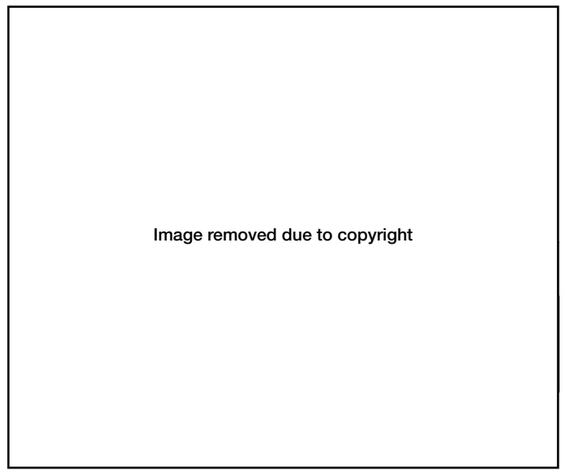


Figure 5.29. Floorplan for 257 Sandringham Rd, (Ray White, n.d.).

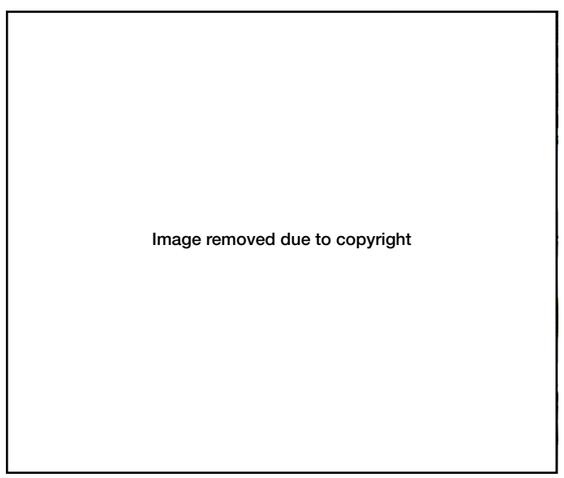


Figure 5.30. Image of 66 Paice Ave, (Oneroof, n.d.).

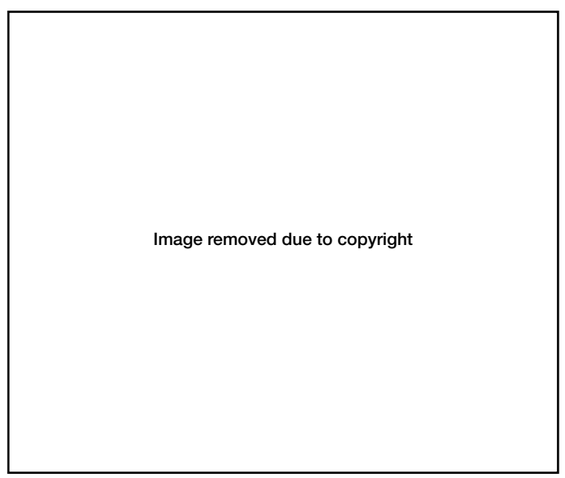


Figure 5.31. Floorplan for 66 Paice Ave, (Oneroof, n.d.).

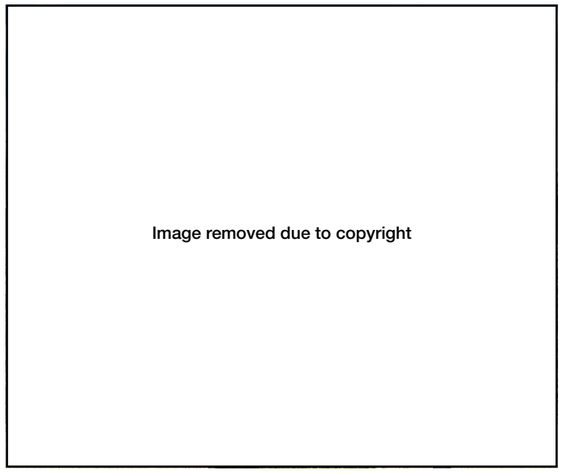


Figure 5.32. Image of 32 Cambourne Rd, (Harcourts 2025).

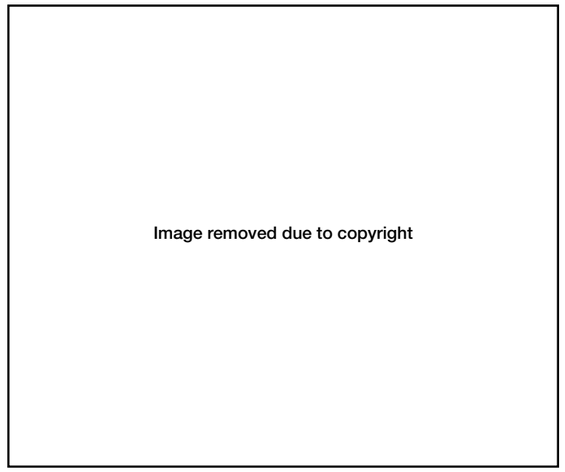


Figure 5.33. Floorplan for 32 Cambourne Rd, (Harcourts 2025).

Material Audit

Note that the data produced for the material audits are base on rough estimated amounts and is used as guide for the design (additional information on the data collection can be found in Appendix A).

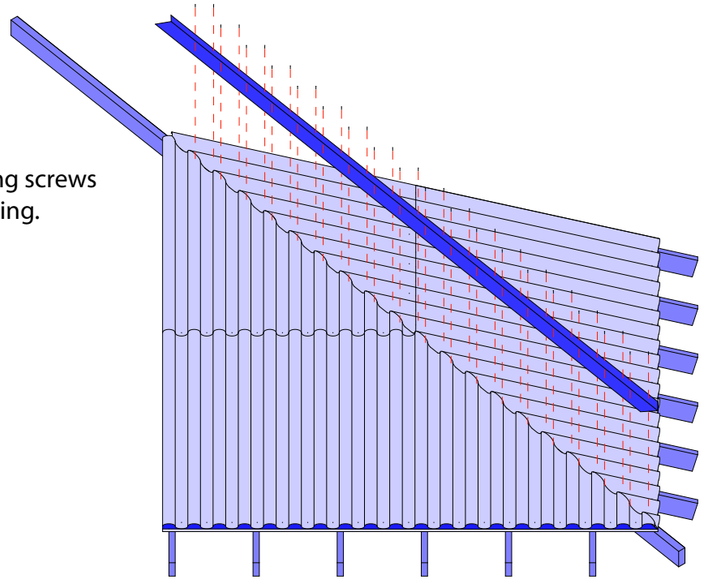
Material	66 Paice Ave	257 Sandringham Rd	Waste Total	Total
Brick	NA	NA	NA	NA
Weatherboard	956.7m	694.39m	82.55m	1568.5m
Timber Flooring	1487m	770m	112.85m	2144.15m
Metal Roofing	257m2	NA	12.85m	244.15m
Concrete Block	NA	270 blocks	14	256
Roofing Tile	NA	231 tiles	11	220
Glass Wool Insulation	65.1m3	16.3m3	5.02m3	95.475m3
Plasterboard	395m2	152m2	37.9m2	721.9m2
Structual Timber	6.4m3	11.55m3	0.4m3	9.25m3
Concrete Piles	3.82m3	2.9m3	0.19m3	3.6m3
Concrete Slab	NA	NA	NA	NA
Concrete (driveway, etc.)	NA	16.43m3	0.82	15.6m3
Copper Piping	30kg	20kg	4.5kg	45.5kg
PVC Piping	55m	35m	12m	78m
Timber Windows	NA	NA	NA	NA
Aluminium Windows	20	10	3	27
Interior Doors	14	6	NA	20
Exterior Doors	3	2	NA	5

Table 5.3. Material audit for 257 Sandringham Rd and 66 Paice Ave, by author.

Roof Deconstruction

Roof deconstruction is one of the first steps in the deconstruction process and can be very difficult as roofs have varying shapes, construction and materiality. 66 Paice Ave has a corrugated steel roof, which requires the removal of various flashings, fasteners, roof layers, and framing elements. Figures 5.35, 5.36 and 5.37 highlight the steps taken in the deconstruction process of a corrugated steel roof.

1



2

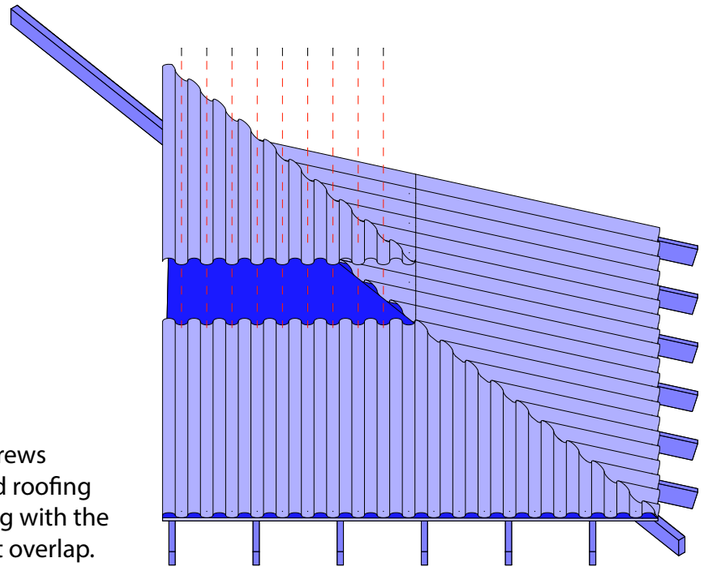
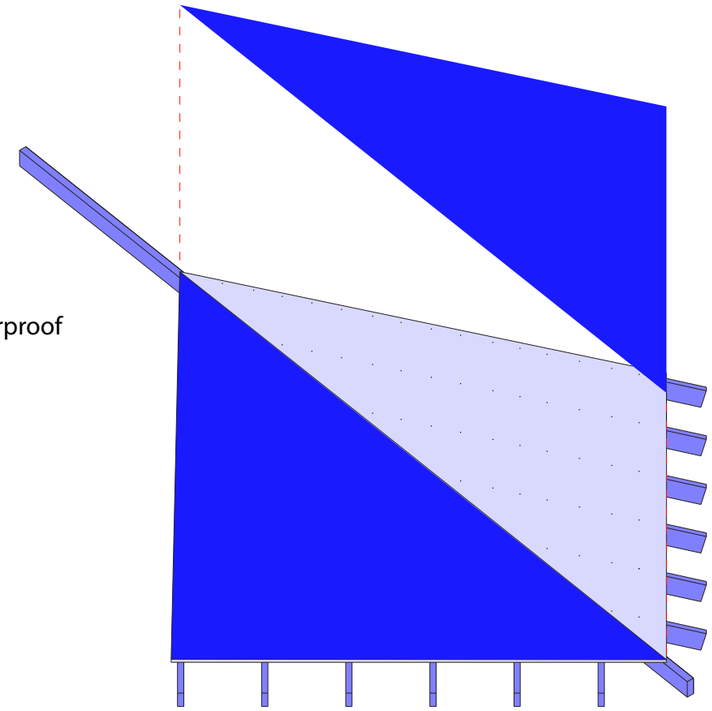


Figure 5.34. Corrugated steel roof deconstruction diagram stages 1 and 2, by author.

3

Remove waterproof membrane.



4

Remove plywood sheeting by removing screrws or using crowbar to lift out nails (depending on construction).

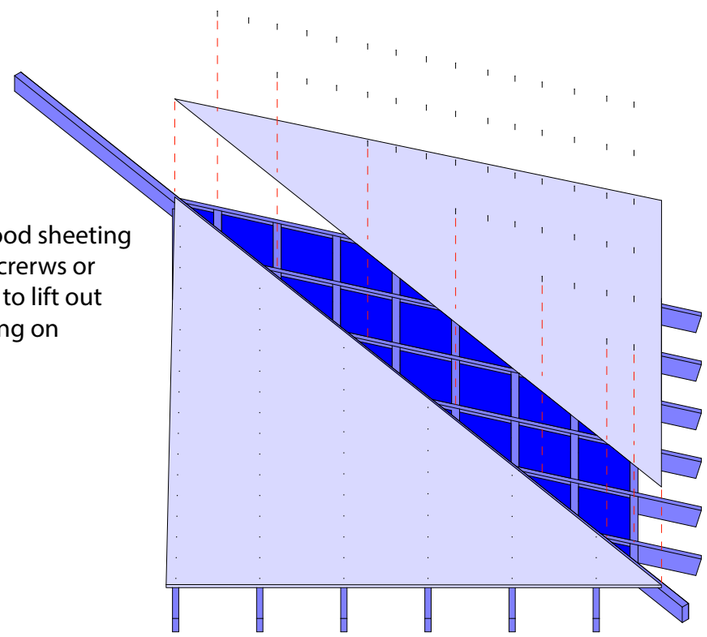
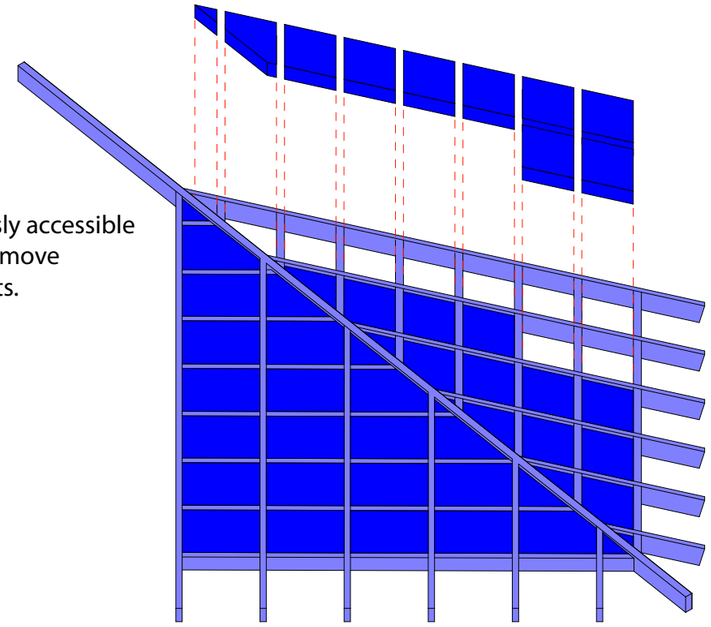


Figure 5.35. Corrugated steel roof deconstruction diagram stages 3 and 4, by author.

5

If not previously accessible via the attic remove insulation batts.



6

Dismantle timber frame.

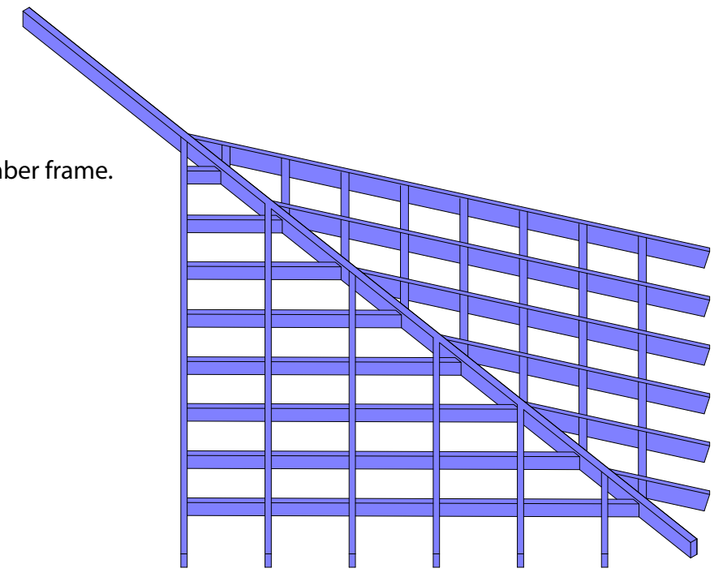
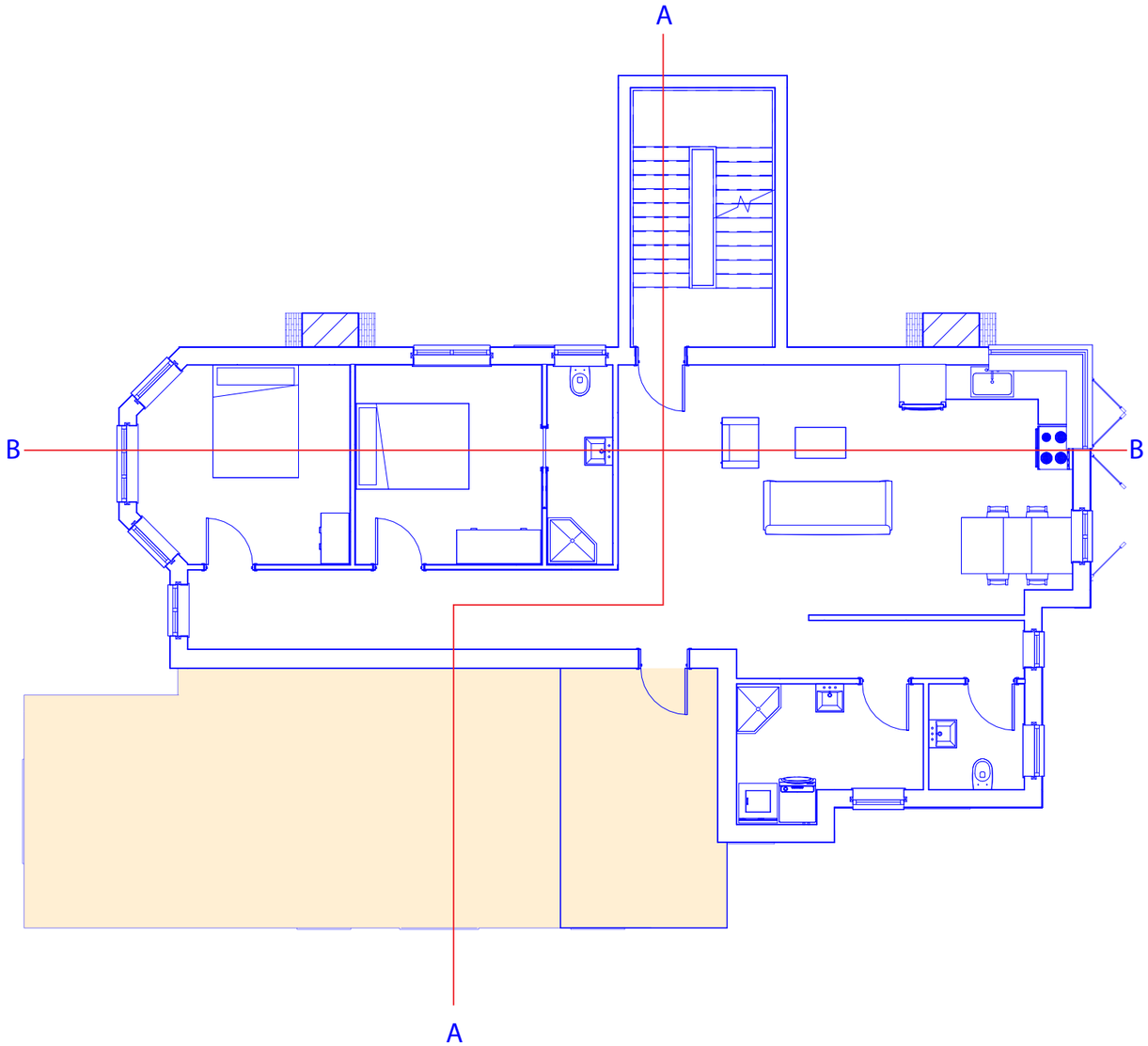


Figure 5.36. Corrugated steel roof deconstruction diagram stages 5 and 6, by author.

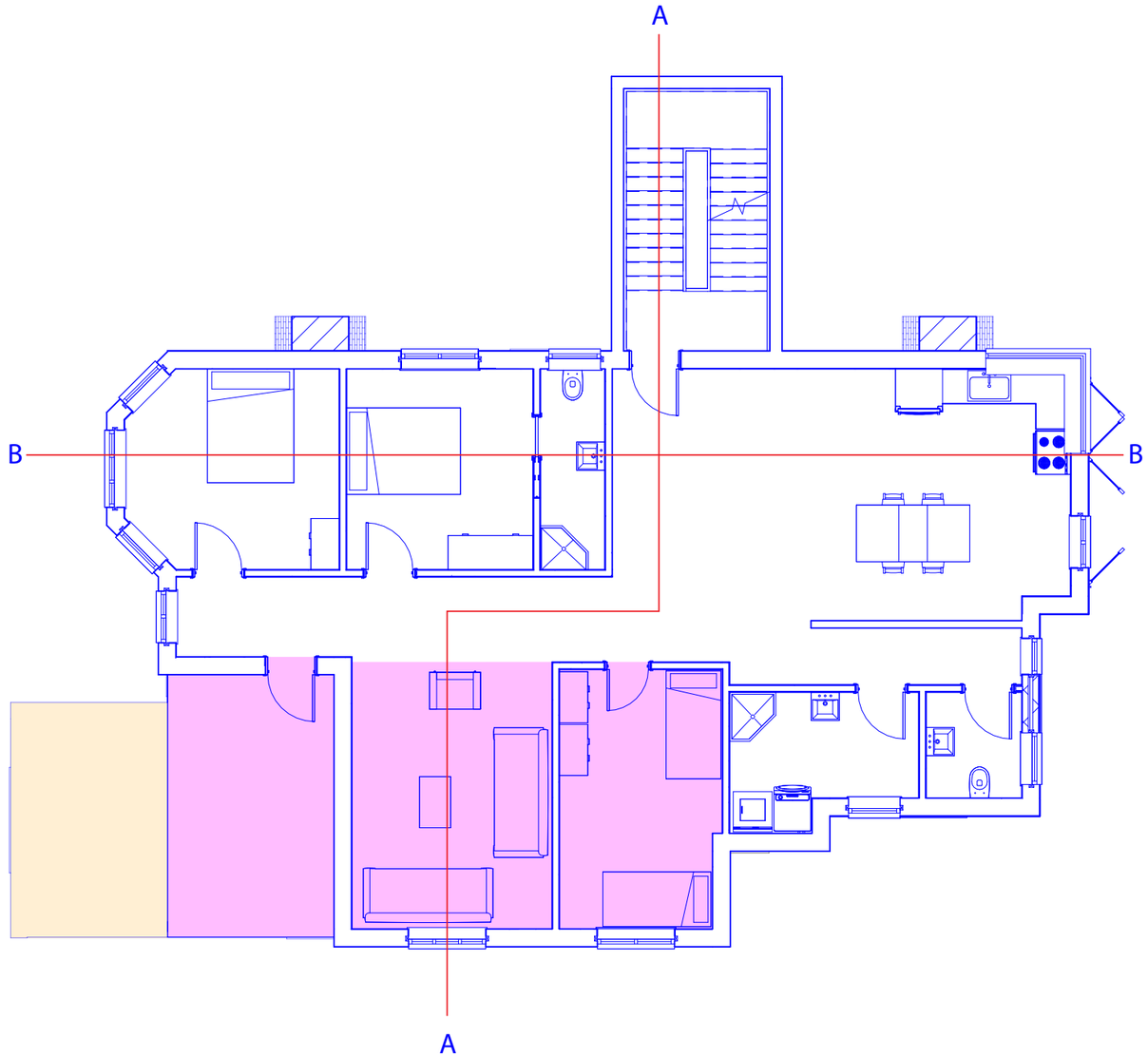
N

Floor One Starting Floorplan



SCALE 1 : 100

Floor One Starting Floorplan



Future Expansion Space

Expansions

Figure 5.37. Scenario three floorplan of the 1st floor highlighting the incremental expansion potential, by author.

N

Floor Two Starting Floorplan

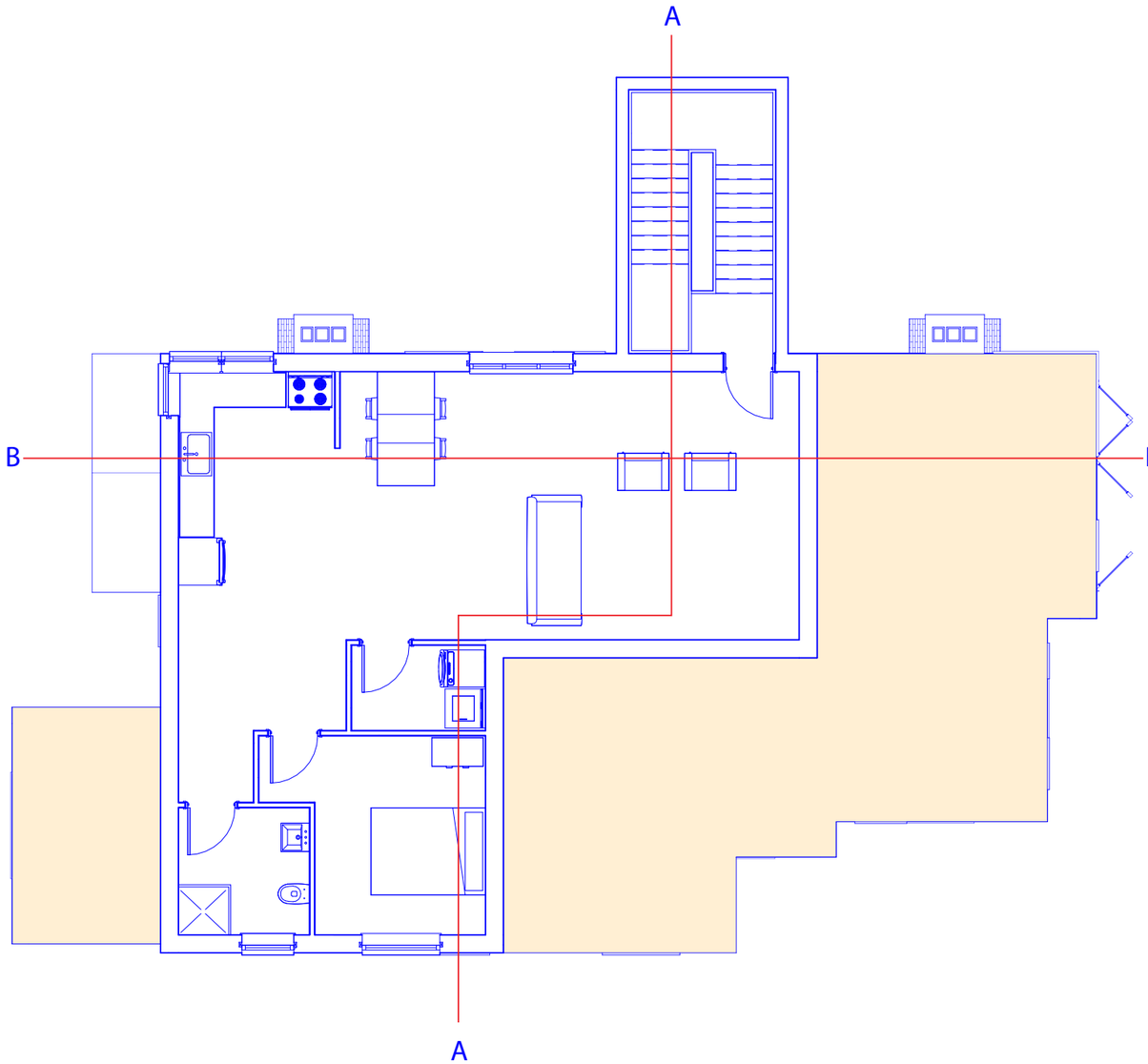


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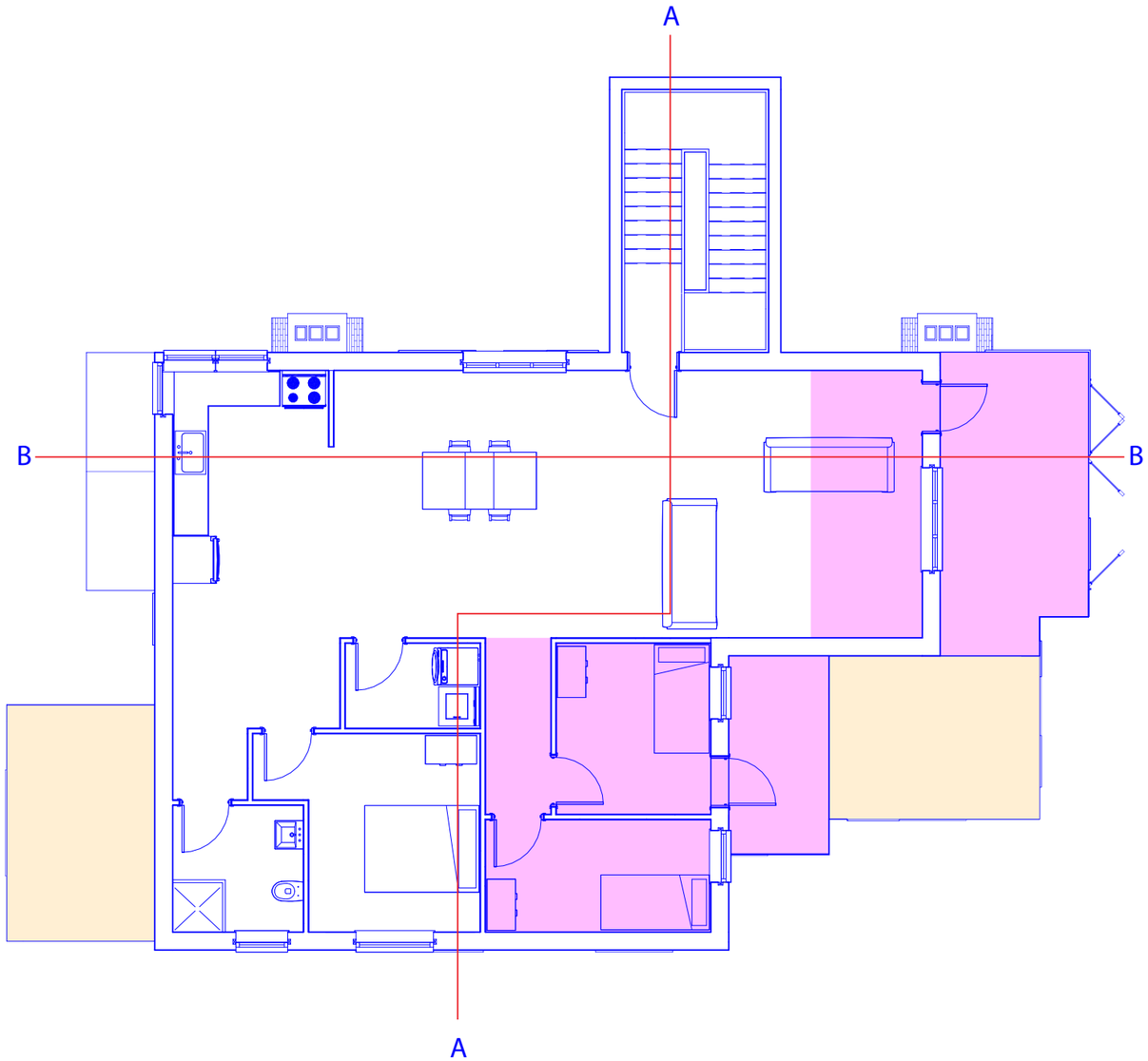
Figure 5.38. Scenario three floorplan of the 2nd floor highlighting the incremental expansion potential, by author.

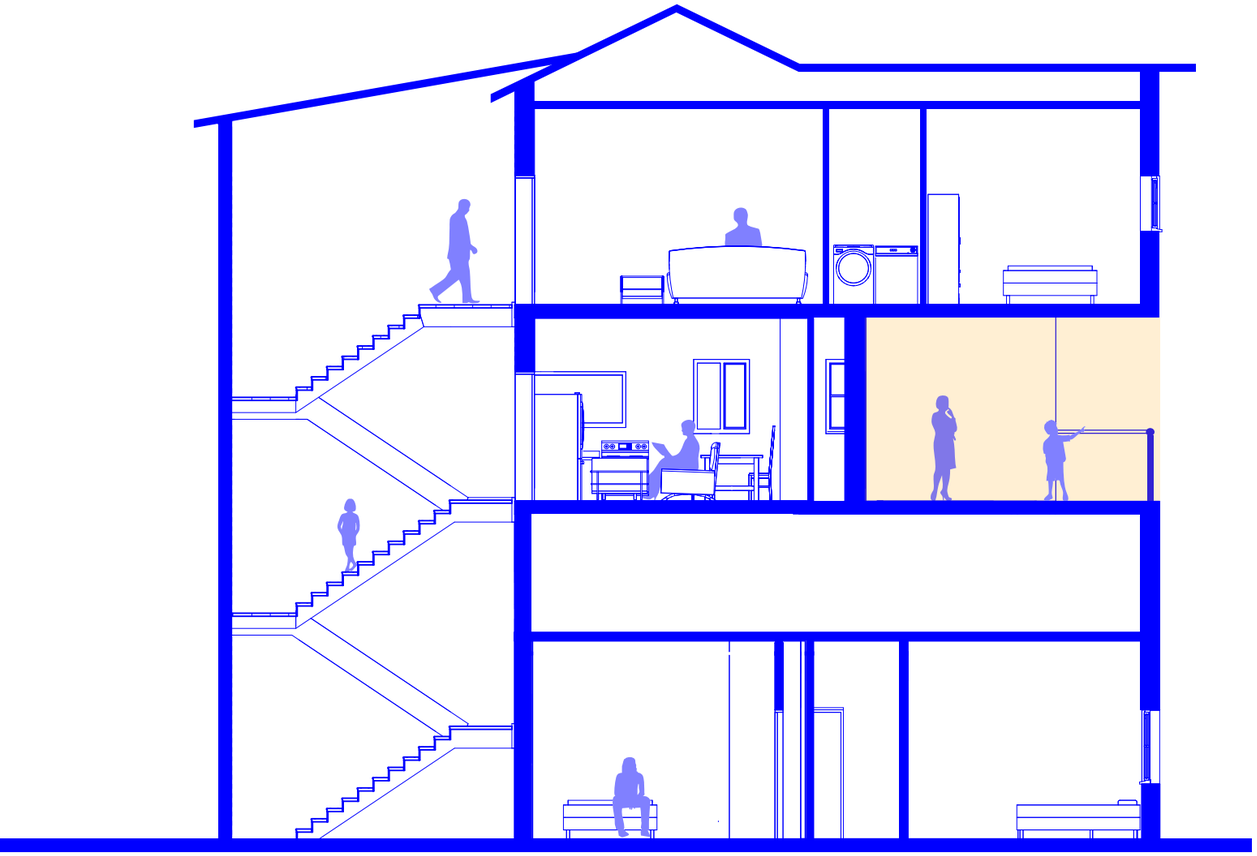
Floor Two Starting Floorplan



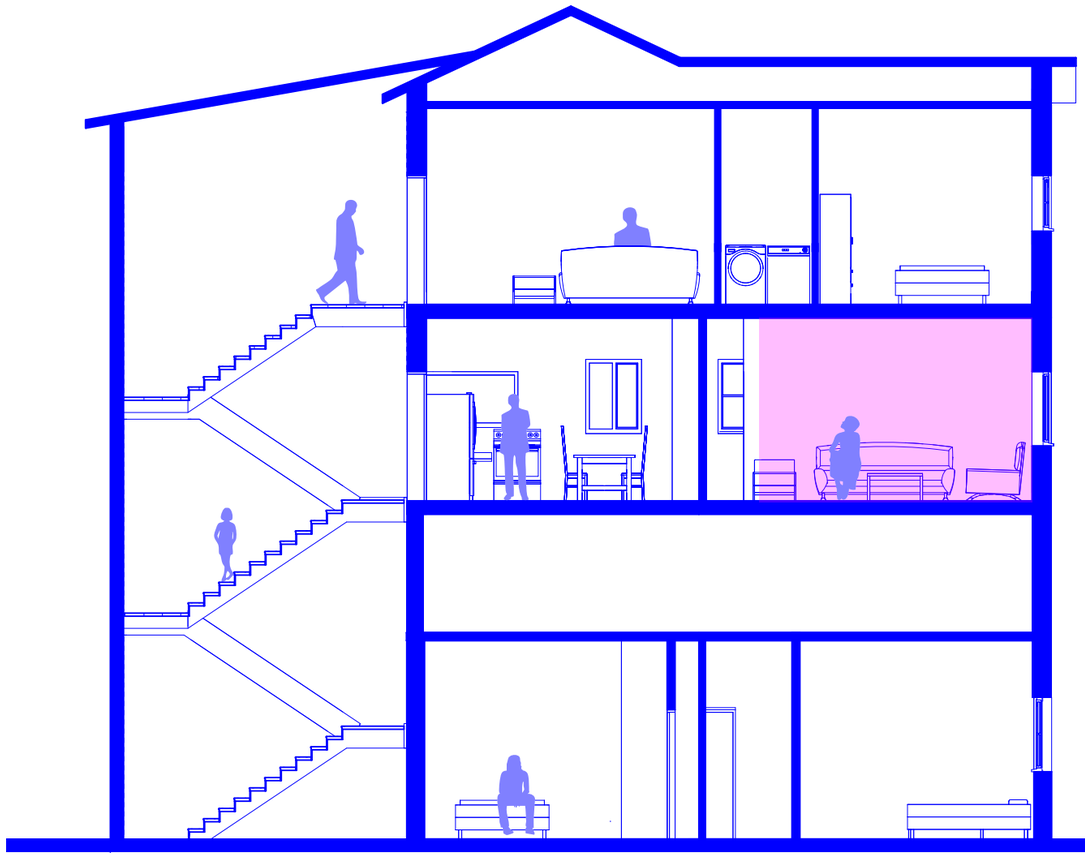
Future Expansion Space

Expansions

Section AA Starting



Section AA Expanded



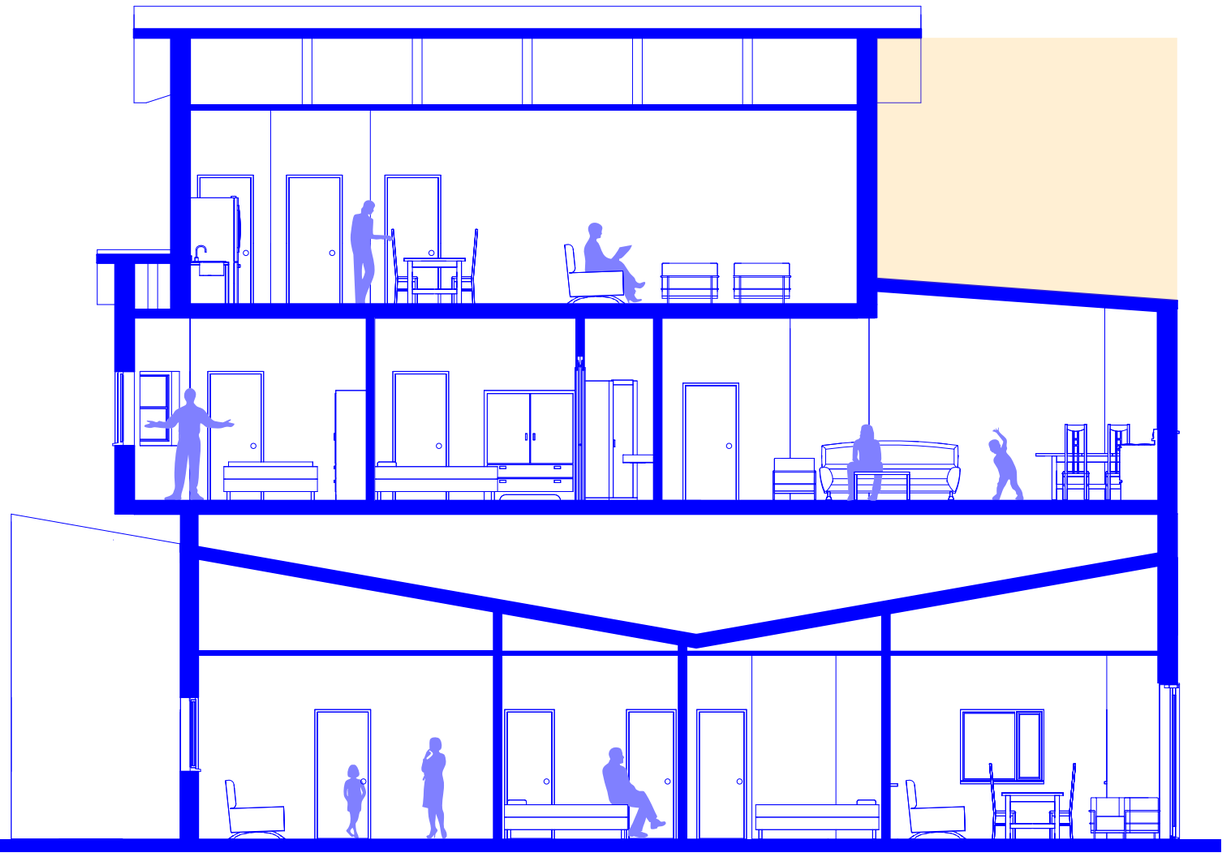
SCALE 1 : 100

Future Expansion Space

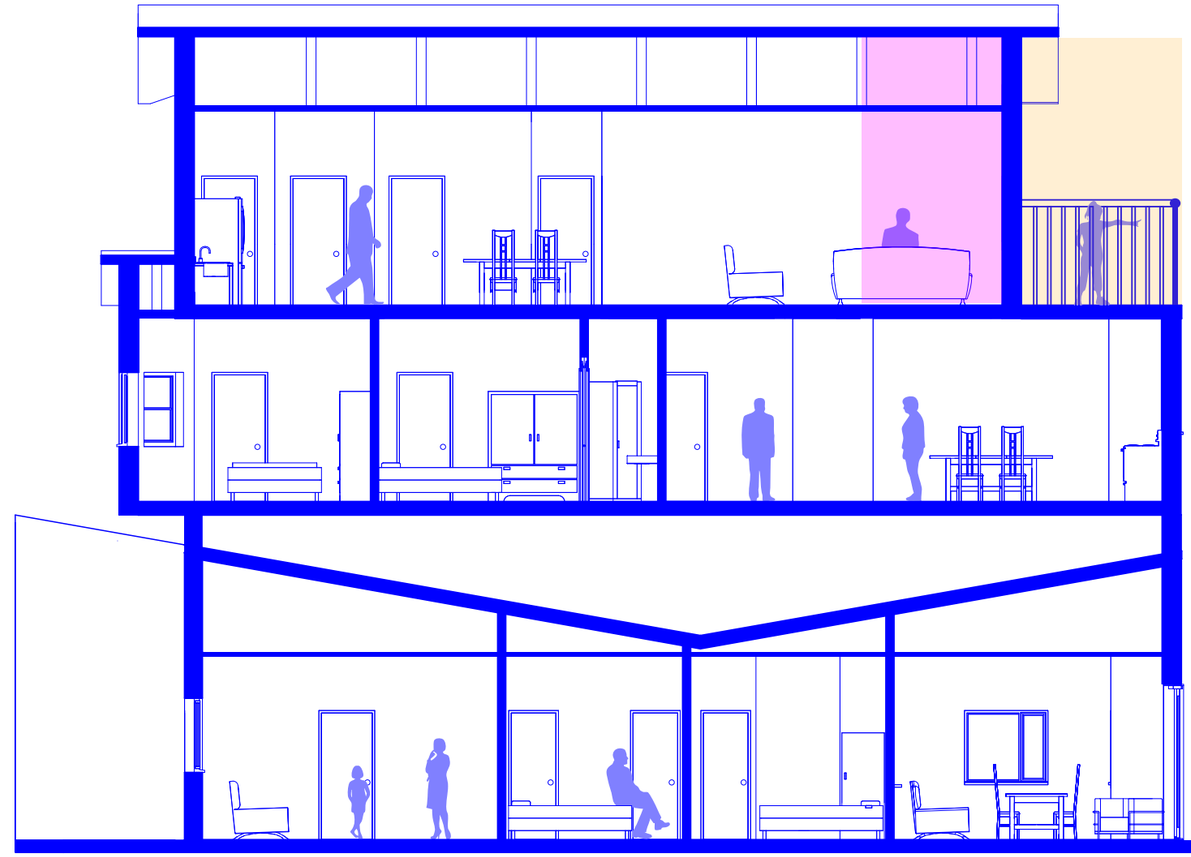
Expansions

Figure 5.39. Scenario three section AA highlighting the incremental expansion potential on the 1st floor dwelling, by author.

Section BB Starting



Section BB Expanded



SCALE 1 : 100

Future Expansion Space

Expansions

Figure 5.40. Scenario three section BB highlighting the incremental expansion potential on the 2nd floor dwelling, by author.

Figure 5.41. Scenario three persective 1, exterior view from backgarden, by author.

Figure 5.42. Scenario three persective 2, exterior view from front garden by author.

Figure 5.43. Scenario three persective 3, exterior aerial view, by author.

Scenario Reflection

This scenario explored the potential for medium-density incremental housing development in a managed retreat through a deconstruction and material reuse strategy. The incremental approach works well because it allows for gradual retreat and deconstruction, initially requiring only the deconstruction of half or less of a building, significantly reducing the timing and financial stresses of deconstruction and managed retreat. The adaptable nature of incremental housing also allows for easy, creative reuse of salvaged materials, aligning with Aotearoa's culture of DIY construction. However, a limitation identified during the design process is the need for a new heavy-load structure due to the vertical nature of the design. Regenerative options such as CLT (cross-laminated timber) beams have been used in this scenario, but this can affect the adaptability of the designs, undermining the incremental potential. A lighter scaffold-like steel structure would be more adaptable and better suited to the design, but it is a less regenerative option. Additionally, although the three-storey approach works within current unitary planning and does not require an elevator the design restricts accessibility and fails to follow universal design systems. Future design explorations for this scenario should focus on potential design strategies that make medium-density housing more regenerative without compromising social impacts.

Design Reflection

Across the three scenarios, the design chapter demonstrates how managed retreat, when paired with deconstruction and material reuse, has the opportunity to generate diverse housing strategies that are responsive to environmental, social and spatial challenges. Scenario 1 highlighted the potential for strong social outcomes from intergenerational housing, revealing how the reuse of materials can support continuity and well-being, particularly for elderly residents, while underscoring the need for further exploration of adaptable intergenerational models. Scenario 2 expanded on social resilience through a cohousing model, demonstrating how communal living and material-efficient structures can produce regenerative environmental and social solutions. However, its large building footprint limits its feasibility within a managed retreat context where land is constrained. Scenario 3 explored incremental housing as a phased and adaptable housing model for retreat, aligning well with the creative reuse of materials but introducing structural and accessibility challenges associated with medium-density housing.

Collectively, the design scenarios demonstrate that there is no single approach that offers complete outcome solutions; instead, each design provides distinct strengths. Ranging from social cohesion and adaptability to material efficiency and regenerative outcomes, these collectively frame a wider design strategy that can be used in managed retreat. The scenarios underscore the tension between regenerative architecture and practical implementations, in particular, structural and foundation systems and land availability. Overall, the chapter highlights the potential of a hybrid design approach that integrates the social benefits of intergenerational and cohousing with the adaptability and material-reuse systems of incremental housing, ensuring social and accessible goals are met without compromising regenerative outcomes.

Chapter 6: Conclusion

Conclusion

This thesis set out to explore how deconstruction and material reuse can be used as tools to transform managed retreat from a narrative into one of community resilience and regenerative architectural innovation. Through climate adaptation and deconstruction research, site-based contextual analysis and speculative design explorations, the research investigated how buildings vulnerable to climate hazards can be carefully deconstructed and their materials reused for regenerative housing solutions that preserve social cohesion and enable equitable living.

Summary of Main Findings

The managed retreat chapter's literature review and case study analysis highlighted significant research gaps, especially concerning regenerative and architectural implications. Existing discourse surrounding managed retreat has failed to thoroughly examine the waste produced through current retreat strategies or the potential architectural design interventions that can address post-retreat housing, beyond traditional Western models. Furthermore, the deconstruction and material reuse chapter's literature review and case study analysis identified significant social, environmental and economic benefits, including job creation, reduced carbon emissions, and cultural heritage preservation. However, the research also identified substantial barriers related to cost, time and negative public perceptions. Importantly, no prior literature or research was found linking managed retreat and deconstruction, despite their potential to complement one another seamlessly.

The site analysis of Sandringham produced helpful contextual understanding of an Auckland suburb facing flood vulnerability. The analysis revealed that the area's historical conversion from a swampland to residential housing has created the ongoing flood vulnerability, highlighted most recently by the 2023 Auckland Anniversary floods. The mapping and building analysis demonstrated the feasibility of deconstruction within the suburb and identified Western housing trends that are no longer representative of current lifestyles.

The design chapter, through the three scenario-based design experiments, explored and tested how deconstruction and material reuse could generate alternative housing solutions that work to mitigate the social impacts of displacement. Scenario one highlighted the potential of intergenerational housing to strengthen social connections, supporting resilience and well-being. Scenario two demonstrated how cohousing's communal living can encourage social cohesion, additionally, the construction methodologies highlighted regenerative opportunities in situations where land constraints may not exist. Scenario three highlighted an incremental housing approach's capability of easing retreat timelines and giving agency to the residents through DIY expansion opportunities. Though scenario three also identified regenerative challenges with the medium-density aspect of the approach that was used. Overall, these design scenarios

offered potential opportunities for hybrid designs that take the strengths of each scenario and combine them to create outcomes that match regenerative and social outcomes.

Critical Reflection

The research explores an original exploration of managed retreat, integrating deconstruction and material reuse to reimagine what retreat can be, this is a largely untouched area lacking development in both academic and industry practice. Contributions to architectural discourse are made from findings exploring alternative housing typologies, regenerative design thinking and the role of architects in managed retreat.

The architectural research findings ask questions of architecture and its relationship with the built environment beyond just the design phase. Although this research explores a very specific design context, the principles of deconstruction, material reuse, regenerative design, and alternative housing solutions should extend beyond this scenario and become standard practice in architecture. Regenerative architecture is on the rise and the approaches identified in this research will be extremely valuable for architects in the future. Increased frequency and severity of climate disasters will lead to either retreat or rebuilding projects, material scarcity will encourage circular-economy design, and housing crises will promote the adoption of alternative living systems. Architecture will be at the forefront of all of this.

The use of deconstruction and material reuse to produce regenerative architecture and/or alternative housing solutions can be applied outside of retreat contexts; however, shifts in industry will be needed. Deconstruction has been highlighted in this research as significantly more beneficial than demolition, the social, economic and environmental outcomes of deconstruction should be key considerations for the C&D industry to shift away from demolition. In the context of Aotearoa, our cities have long been dominated by suburbia, but as housing becomes an increasingly important issue, we have seen and will continue to see density intensification. As old houses are removed to make way for medium-density apartments, deconstruction and material reuse can play vital roles in this transformation of our cities, not just through the regenerative environmental and social impacts, but also through the preservation of our cultural architectural heritage, as embodied in the history of suburbia in Aotearoa.

Future Pathways

Community Engagement

A limitation of this research was the inability to engage with the community; future research should involve communities in codesign processes. This would ensure that retreat planning and architectural outcomes better reflect residents' priorities and socio-cultural practices. Additionally, greater insights into preferred housing typologies can be attained.

Empirical and Practical Deconstruction and Material Reuse

Deconstruction and material reuse quantitative studies in Aotearoa are needed to better understand local costs, timeframes, reuse and recyclability and carbon reduction potentials. Future practical projects are also required in this area to provide case studies and precedents for future research and policy developments. In particular, studies and projects that highlight the recertification process of reused materials.

Urban Planning

Due to scale and timeframe constraints, this research was unable to properly develop the detailed urban planning and policy framework aspects of a managed retreat strategy that implements deconstruction and material reuse. Future research could include urban master planning, buyout with rentback strategies that integrate a deconstruction phase, use of material passports, urban rewilding and renewal, material storage strategies and nature-based solutions.

Cross disciplinary

Integration of architectural research with psychology and sociology research can deepen understandings of place attachment and social effects found in managed retreat. Studying the psychological and sociological influence that material reuse can have on communities and individuals experiencing climate displacement could yield interesting outcomes. Further, integration with economic research could explore financial feasibility and reveal financial comparisons of demolition-based retreats and deconstruction-based retreats.

Expansion of design research

The three different design scenarios were carried out through design sprints, which meant that each scenario had a limited scope. Future research could explore each scenario in more detail, potentially revealing further research findings that are not shown in this thesis. An expansion of the design research could also investigate the potential for hybrid versions of the housing typologies, incorporating aspects of each scenario that complement one another.

Replication

This research could be used as a research methodology precedent to explore the possibility of deconstruction-based managed retreat on different sites, either in Aotearoa or globally. Future research could test the transferability of this research's findings and highlight how site-specific conditions and climate hazards may impact potential retreat strategies or how different cultures may prefer differing living systems.

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Appendices

Appendix A: Material Calculations

Brick and Concrete block estimates were calculated using an online brick calculator from Aubricks (n.d.).

Weatherboard total length estimates were calculated by counting the number of weatherboards spanning a wall and multiplying that by the length or height (depending on whether it was vertical or horizontal cladding) of the wall. To determine the total length, this was done for each exterior wall and summed; walls not visible in the photographs were estimated to have the same number of weatherboards as the walls they shared corners with. The lengths of the walls were found using the floor plans and geo data from Auckland council GeoMaps (Auckland Council, n.d.).

Timber flooring total length estimates were calculated using the total floor area divided by the width of the floorboards. 150mm was the width used for the floorboards for each house, and the area was found using the floor plans and geo data from Auckland council GeoMaps (Auckland Council, n.d.).

Roofing area estimates were calculated by splitting the roof elements into individual flat shapes (in plan view) and further simplifying them; e.g., trapezoids were split into 2 triangles and a rectangle. An average roof cavity height value of 1.2m was used unless the height was obviously and significantly different. The roof cavity height was used in Pythagoras' theorem (A^2 + B^2 = C^2) to find the real length of the diagonal sides. These dimensions were used to find the area for each shape adding them together gives the total area. Additionally, roofing tile totals can be found by dividing the total roof area by the area of a single roofing tile, in this case 0.11m2 was used as an average value.

Structural timber volume estimates are based on an average structural timber per m2 of 0.09 m3. This is based on Branz data from Jung and Page (2011).

Plasterboard area estimates were based on the total area of interior walls and ceilings, calculated using the total length of the interior walls multiplied by an average height value of 2.7m. This was added with the ceiling area (estimated to be the same as the floor area) to create the total area.

Insulation volume estimates were calculated using the area of the exterior walls and ceilings multiplied by an average insulation thickness value of 90mm.

Concrete pile volume estimates were calculated by first estimating the number of piles used for the particular house. This was done by using the area of the building footprint and an estimate of 1.5m in between each pile. The volume of concrete used in each pile was estimated to be 0.09 m3. This, multiplied by the estimated number of piles, gives the total volume of concrete.

Concrete volume estimates for both driveways and foundation slabs were calculated using the area of the building footprint/driveway multiplied by an estimated slab thickness of 125mm for both.

Timber/aluminium window and exterior/interior door totals were determined by counting each type using photographs and floor plans.

Appendix B: Final Presentation Images

Figure A1. Image of final presentation 1, by author.

Figure A2. Image of final presentation 2, by author.

Figure A3. Image of final presentation 3, by author.