Seafront Architecture: A New Wave of Resilient Design

How can architecture evolve to thrive alongside the realities of coastal erosion

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How can architecture evolve to thrive alongside the realities of coastal erosion?

Elena Polovnikoff

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ABSTRACT

New Zealand's coastline has long connected communities, evolving over centuries. Today, coastal areas are home to those seeking either affluence or a slower pace of life. However, these regions face significant challenges from rising sea levels and coastal erosion, worsened by climate change and human activity. This thesis explores design interventions for public coastal spaces to address these risks and support habitation while also making nature more of a priority over human-centric design. Focusing on a specific site, the research employs mapping, design practice, and model-making to develop strategies for mitigating erosion and enhancing community resilience. The findings contribute to the growing body of knowledge about future coastal design practices, and how ecology can play a significant role, offering foundational steps rather than definitive solutions.

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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.

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Thank you to everyone who has been a part of this journey.


OPUA RESIDENTS ASSOC

INTRODUCTION

Coastal living has historically been a cherished way of life, but recent times have made it increasingly unstable due to coastal erosion. This natural process, influenced by wind, water, and human-induced climate change, is accelerating and complicating efforts to slow its impact. Despite its challenges, the allure of waterfront living remains strong, driven by its benefits to both physical and psychological health.

Coastlines are integral to New Zealand's identity, but without improved design strategies, more homes and communities will be affected by erosion. Effective solutions are needed to help communities adapt and thrive despite these risks.

My personal connection to coastal living in the Bay of Islands, where I've witnessed significant environmental changes and natural disasters, drives my concern and research. By applying my architectural expertise and experience, I aim to explore resilient design strategies to address coastal erosion and promote sustainable coexistence with our changing coastal environments.

Fig. 1. Collage of trestle implementation

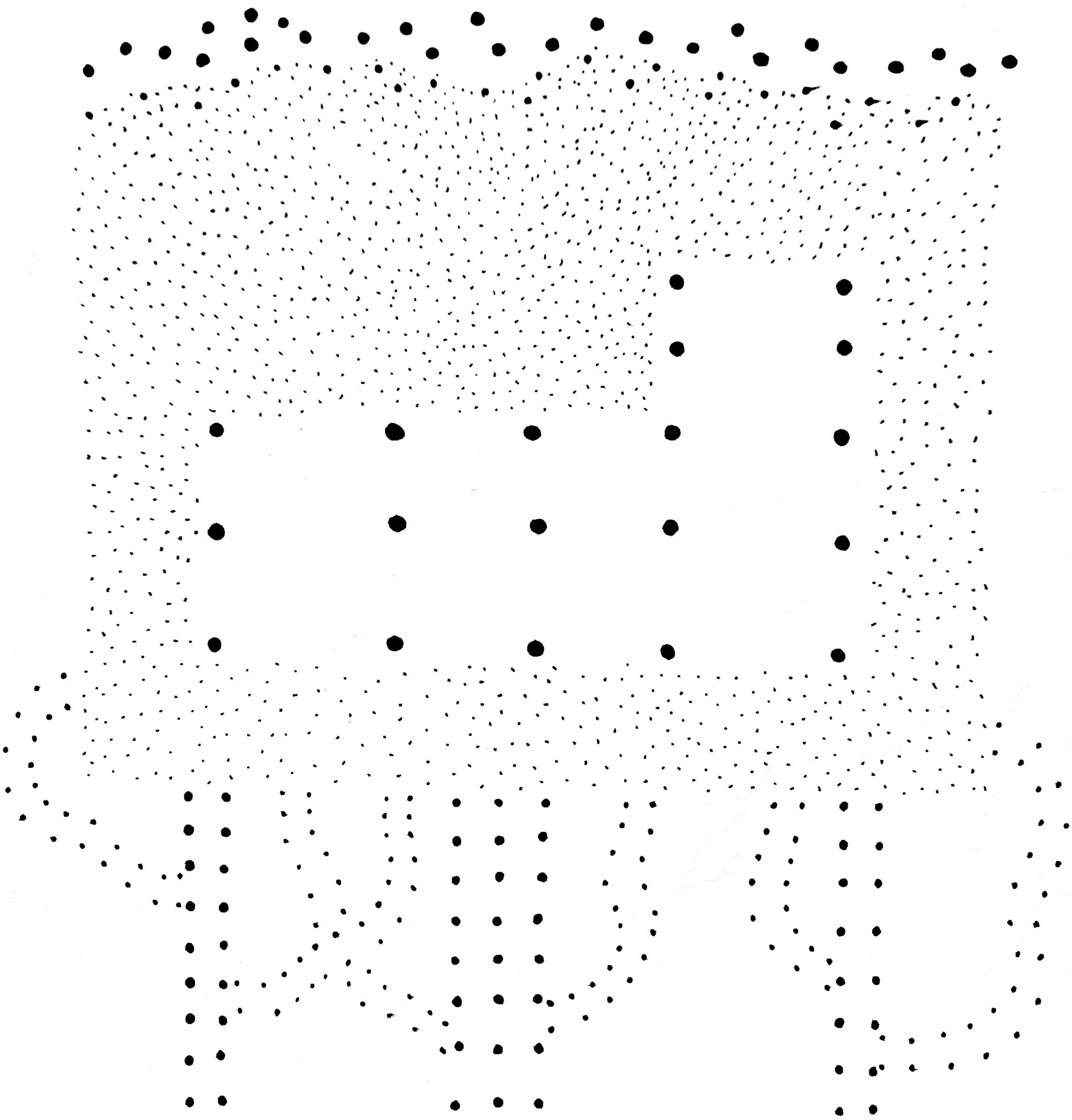


Fig. 2. Collage of trestle implementation

CHAPTER ONE

LITERATURE REVIEW

THE PROBLEM OF COASTAL EROSION

Coastal erosion results from both human activities and natural environmental changes, leading to imbalances in coastal dynamics (wave, current, wind) and resulting in the long-term loss of sediments, coastline retreat, and beach erosion (Ye, 2017). While changes in the dynamics of people, buildings, and land are often part of a natural cycle, the impacts of climate change (Lindsey & Dahlman, 2024) can exacerbate minor implications into significant realities. This raises concerns about the resilience of structures against current and future environmental threats. As the modern world evolves, challenges such as climate change and rising sea levels necessitate a critical examination of how coastal development must adapt to these changing environmental conditions.

This review examines recent literature on coastal erosion and various mitigation theories, shifting the focus from scientific methods to community-based strategies that address existing challenges. This chapter also delves into the history of Opua and draws on precedent studies and research papers that support a design-led approach to this complex issue, as articulated by Dunne and Raby (2013), reflected in the examined case studies.

MODEL OF COASTAL EROSION MITIGATION

This section discusses approaches taken to address coastal erosion, identifying three strategies used in attempts to mitigate this phenomenon. Across years of coastal data and research, there are still gaps regarding effective strategies to manage its effects (Eurosion project, 2004). Strategic approaches to respond to coastal erosion have been identified in these groupings: Defend, Retreat, and Co-exist (Sinay & Carter, 2020). These have been identified as the most widely used approaches but are dependent on where they are being used and for what coastal situation.

Fig. 3. Rock armour along Paihia, the neighboring town 7km from Opua

DEFEND

Defensive measures designed to address coastal erosion often merely postpone risks for residents, particularly in coastal areas where barriers are constructed for immediate issues (Nordstrom, 2014). These strategies can lead to breaches in defence systems (Sinay & Carter, 2020) and require significant financial investment in construction and materials (Jonkman et al., 2013). Communities like Saibai Island have independently initiated protective measures using local resources, such as sandbags, though these solutions can be vulnerable to seawater breaches (Sinay & Carter, 2020; Nunn et al., 2021). Over time, coastal defence strategies have evolved in response to changing environmental conditions (Pranzini, 2018; Sauve et al.,2023).

The UK government plans to invest two billion dollars (approximately four point one billion dollars New Zealand) in one thousand five hundred projects to combat coastal erosion (Kantamaneni et al., 2022), highlighting a significant commitment to coastal defence despite the potential for ineffectiveness (Williams & Dale, 2023). Current discussions have shifted from merely expanding defence infrastructure to critiquing the inadequacies of existing systems in adapting to future challenges (Kantamaneni et al., 2022).

Coastal defence strategies aim to protect regions from inundation and erosion caused by wave action and rising water levels (Weir, 2020). Historically, methods such as earth dykes in ancient Rome and seawalls in the 18th century have evolved alongside land reclamation and polderization efforts (Pranzini, 2018; Pranzini et al., 2015). Coastal defences typically include hard engineering (permanent structures like seawalls) and soft engineering (sustainable, natural solutions)(Cypress, 2023; Chen & Mehrabani, 2019). While hard engineering is often perceived as effective, evidence suggests that seawalls can create a false sense of security, merely redirecting water rather than eliminating its effects Nateghi et al., 2016; USGS, 2018).

Although structures like bulkheads and groynes are vital for coastal defence, they may detract from sustainable solutions (Cypress, 2023) and are often criticised for their environmental impacts (Western Bay of plenty District council, n.d.). Natural defence systems can effectively mitigate erosion and support community resilience (Narayan et al., 2016; The Flood Hub, 2021).

Additionally, marine infrastructure such as marinas and wharves can disrupt natural ocean currents (The Ocean Economy in 2030, 2016; Beachapedia, 2022) and often overlook the impacts on wave patterns (Black & Mead, n.d.). The adverse effects of artificial structures on local ecosystems are significant, as hard engineering approaches may damage marine environments and undermine the resilience of coastal infrastructure (Biodiversity Series, 2009; Cooper et al., 2020; Ministry for the Environment, 2021).

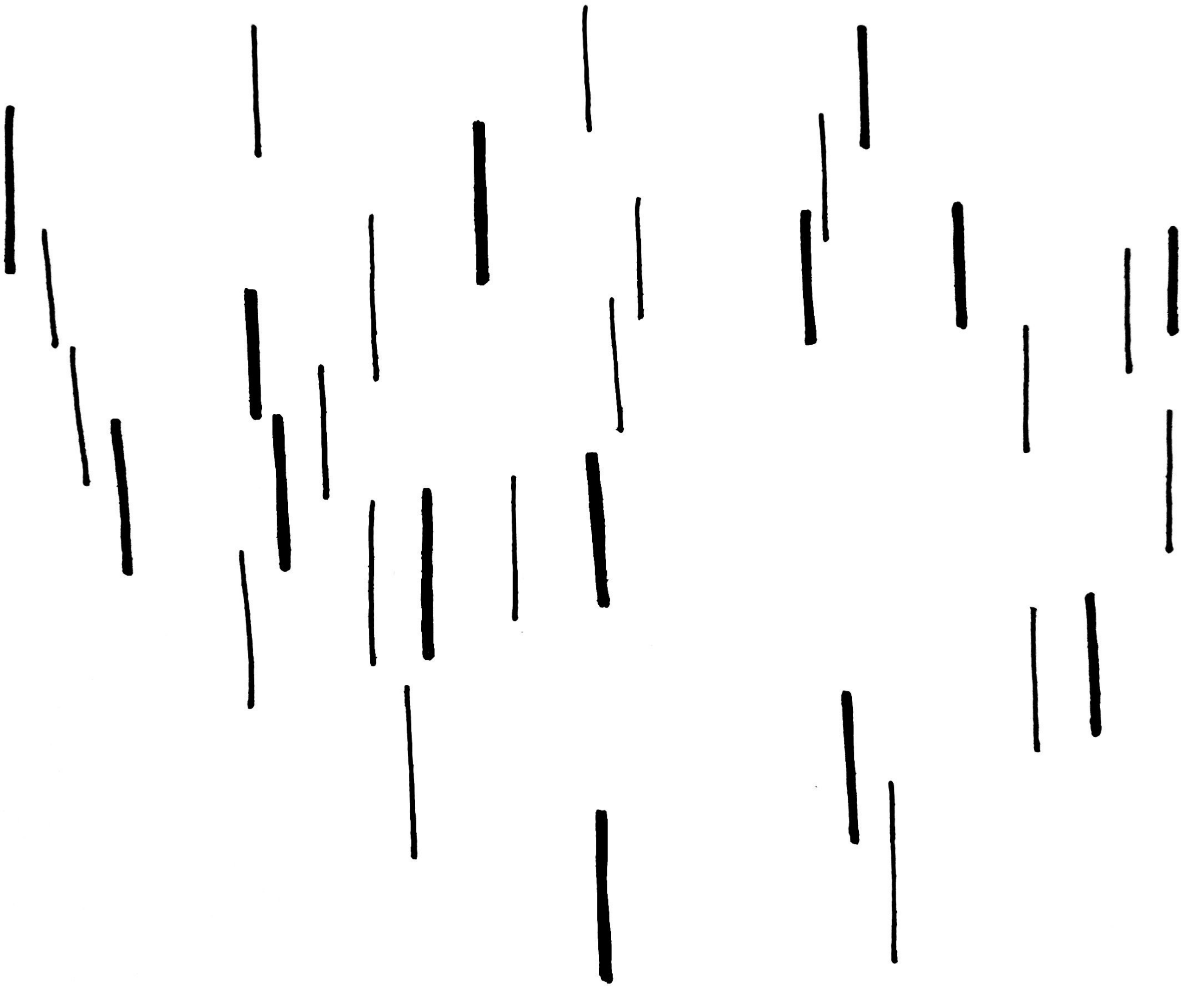


Fig. 4. Sign near site advising people to not entry

Fig. 5. Beginning of shapes on top of piles

RETREAT

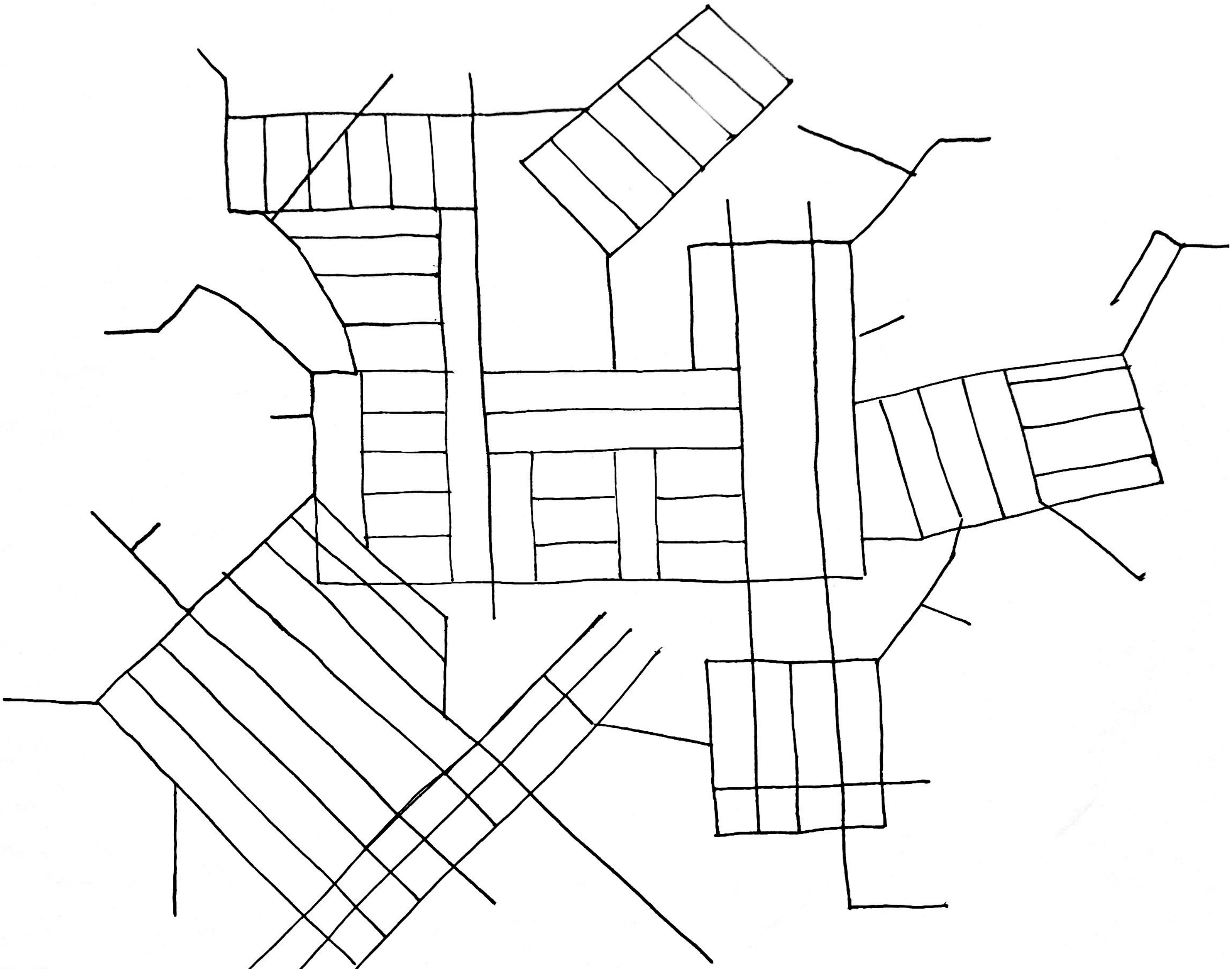
In community planning, "managed retreat" is defined by the Ministry for the Environment as the strategic relocation of residences, commercial properties, and culturally significant sites to safer locations (Ministry for the Environment, 2024). Migration due to relocation can exacerbate overcrowding, negatively impacting public health (Diaz, 2024; Western Bay of Plenty District Council, n.d.). Additionally, the displacement of properties and community networks raises significant health and well-being concerns.

Rising sea levels and coastal erosion are compelling small island nations like Fiji and Kiribati to consider relocation due to their low-lying topography (Merkens et al., 2016). Kiribati, expected to be one of the first submerged, faces unique challenges as a developing nation, making relocation a pressing necessity (Iberdrola, n.d; Raffaeli, 2021). Vunidogoloa in Fiji exemplifies this, having relocated after environmental pressures led to its abandonment (Lyons, 2022).

The Pacific coast of Colombia has also experienced large-scale relocations due to natural disasters and soil depletion from coastal erosion (Correa & Luis Gonzalez, 2000). Communities must decide whether to move agricultural activities to higher elevations or relocate inland, risking the loss of ancestral ties. Permanent relocation can adversely affect individuals' sense of belonging (Roberts & Andrei, 2015).
A recent account from Tuvalu highlights this issue, where a resident expressed discomfort about leaving her home despite its environmental challenges (Roy, 2019), underscoring the deep connections individuals have to their homes.

Recent research indicates that managed retreat can inflict trauma on individuals, with predominantly negative psychological effects tied to the loss of homes and community connections (Abu et al., 2024). While planned relocation may appear rational in response to environmental threats, the complexities involved raise concerns that extend beyond initial perceptions.

Fig. 6. Slip tumbling into the water



CO-EXIST

Coexistence is defined as a dynamic, sustainable condition where humans and wildlife thrive together in shared environments (Mekonen, 2020). This section examines the benefits of natural infrastructure for ecosystems and communities dependent on aquatic environments.

Trees play a crucial role in mitigating climate change impacts and enhancing ecological systems, benefiting both occupants and surrounding communities through vegetation integration (Teemusk & Mander, 2007; Susca et al., 2023; Dreyer et al., 2018). Their regenerative properties support restoration and biodiversity, while also preventing soil slips, reducing erosion, stabilising soil, shielding against wind and coastal damage, and filtering water (Forbes et al., 2023; Stokes et al., 2009; Goodenough & Waite, 2020; Hancock et al., 2020; Wetlands International and the Nature Conservancy, 2014; Jerbi et al., 2015). A study in Hawkes Bay demonstrated that areas with tree cover exhibited greater stability and reduced landslide risk compared to treeless areas (Mcivor et al., 2015). Trees also function as effective windbreaks during storms and mitigate flooding as natural infrastructure (Gardiner et al., 2000; Kozlowski & Pallardy, 1997; Canadell et al., 2020; Scialabba, 2021). Silvopastoral systems exemplify land-use strategies where trees, forage, and livestock coexist, fulfilling distinct roles (Cubbage et al., 2012).

A notable example of aquatic communities is the Bajau people, known as sea nomads, who have lived in the coastal waters of Malaysia, Indonesia, and the Philippines for centuries (Nimmo, 1968). Primarily reliant on fish and marine resources, they utilise low-tech fishing methods and gather materials from mangroves for shelter (Clifton & Majors, 2012). Historically residing in houseboats, they have transitioned to stilted homes, relying on maritime activities for livelihood, including trade and fishing (Kyoungho Jeon, 2019).

The Bajau illustrate how individuals adapted from land to a maritime lifestyle, coexisting with their environment in alignment with natural systems (Nimmo, 1968). Their elevated homes enhance resilience against natural disasters, providing protection during storm surges while fostering community connectivity through water travel. This living arrangement also promotes environmental adaptation and critical awareness of local conditions, encouraging residents to engage strategically with their dynamic marine ecosystem.

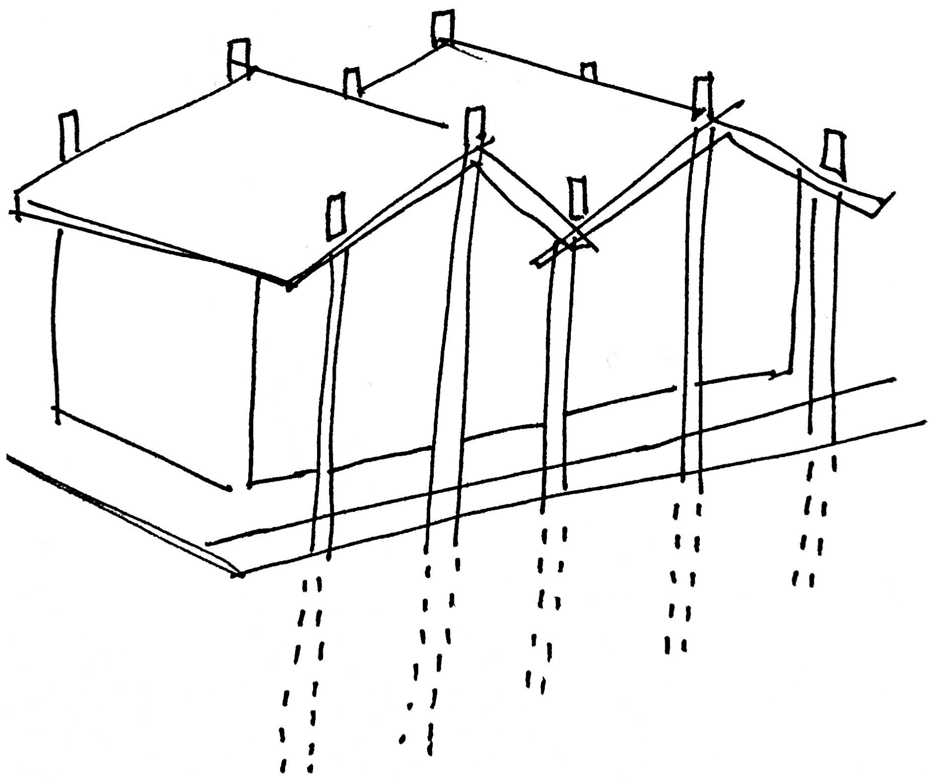
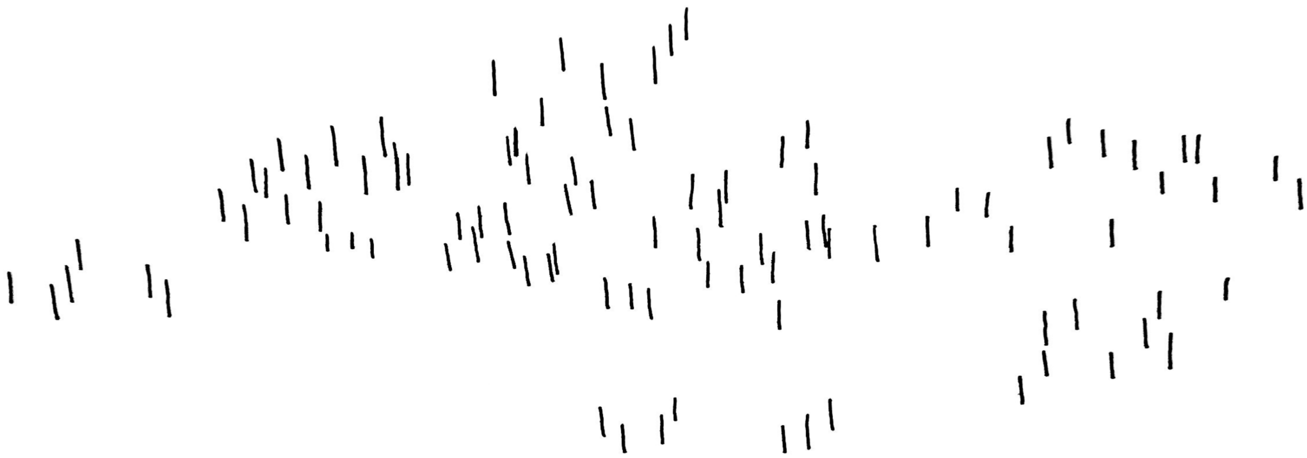


Fig. 7. Cliff slip highlighting the potential of tree root systems



Structured Analysis of Coastal Erosion Methods: A Review of Method Approaches in the Literature

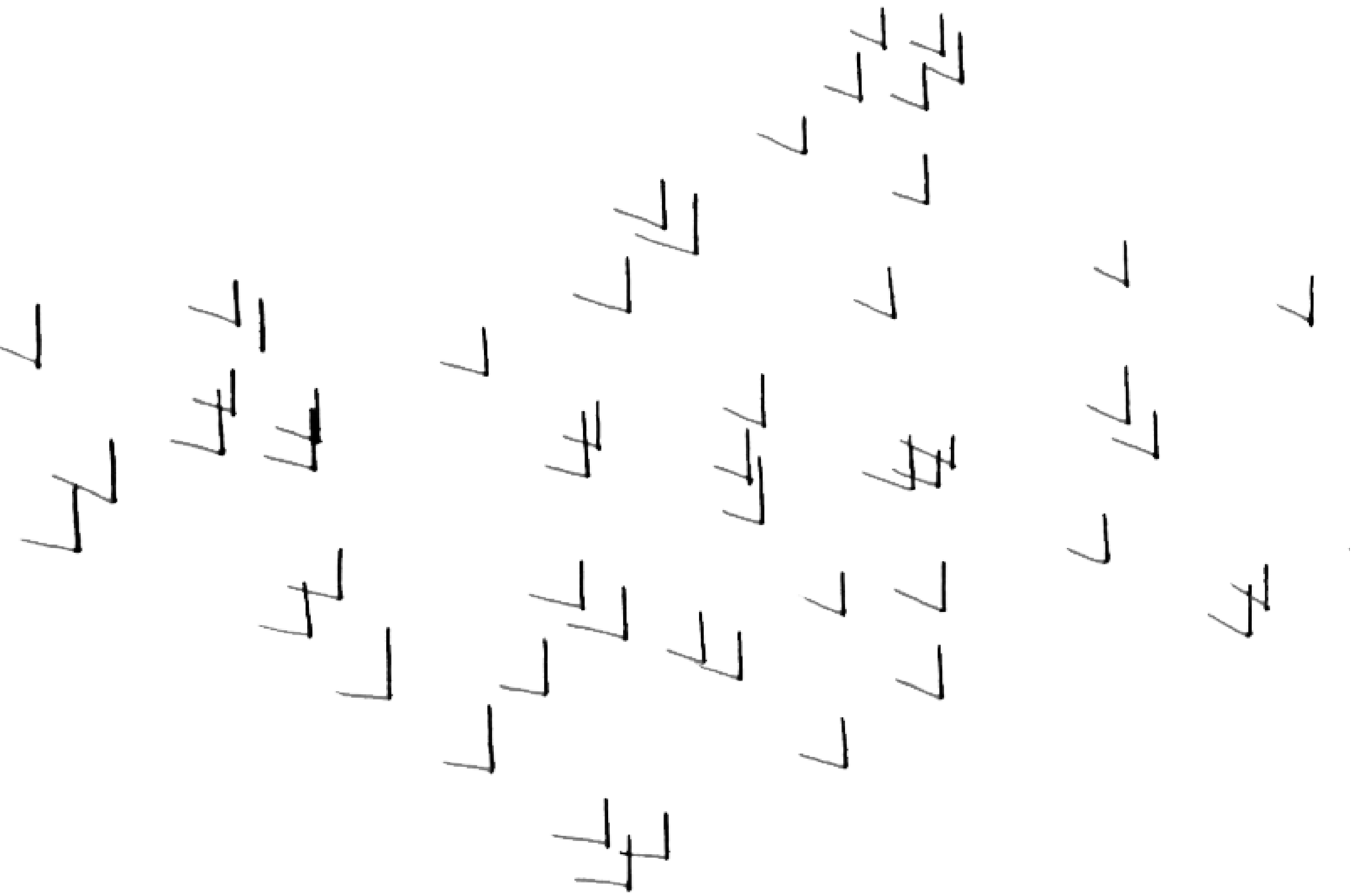
	DEFEND	RETREAT	CO-EXIST
01 Method summary	Defence refers to a mechanism or structure designed to prevent the entry or impact of external elements.	Retreat occurs when a community either gradually relocates inland in incremental steps or undertakes a complete relocation of the entire community	Coexistence refers to the practice of humans adapting to a changing environment by working in harmony with it, rather than opposing it, and making necessary adjustments to align with environmental conditions.
02 Pros & Cons	• Pro: In certain cases, defence may be effective for a limited duration. • Pro: Defensive measures can enhance the perceived safety of communities • Pro: Defence can prevent the occurrence of flooding breaches. • Con: Defense measures prevent an occurrence in a specific location thereby shifting the impact to another area. • Con: May incur significant costs • Con: Defensive measures may create a misleading sense of security	• Pro: Retreat can enhance safety • Pro: Retreat can provide individuals with the opportunity to explore new methods of living and initiate a fresh beginning • Con: Relocating a community from their familiar land can have repercussions on both their cultural heritage and mental health. • Con: Deciding whether to retreat can create divisions within a community, as individuals may be reluctant to leave the area where they have lived for generations. • Con: Retreating can entail significant costs, depending on the resources transported by the community and the extent of infrastructure that requires reconstruction.	• Pro: Coexistence does not adversely impact the environment. • Pro: The concept of co-existence presents an opportunity for humanity to transform its current mode of living. • Pro: To co-exist involves utilizing natural infrastructure. • Pro: Coexistence fosters an improved quality of life by reducing the need for continuous financial expenditure on defensive measures. • Pro: Natural infrastructure, including trees such as pōhutukawa and mangroves, possesses the inherent ability to sustain and care for itself. • Con: Not all individuals are likely to endorse this approach • Con: Coexistence is not a short-term solution and requires a significant investment of time. However, it is likely to yield benefits in the long term.
03 Example of the method	• Seawalls • Groynes • Rock armour • Beach nourishment • Artificial defence	• Gradual inland relocation • Relocating entirely • Managed retreat	• Employing natural infrastructure for defensive purposes. • Allowing nature to stabilise the land (Pohutukawa, Mangroves). • Not impeding the natural order of processes.
04 Environmental Impacts	• Hard defence measures can have adverse environmental effects, including the emission of harmful gases. • Defensive measures can disrupt natural processes	• Retreating can result in the loss of agricultural land either by relocating away from fertile soil or moving to less suitable land. • Retreating may influence and disrupt established species of flora and fauna in the new environment.	• Employing natural infrastructure for defensive purposes • Allowing nature to stabilise the land • Not impeding the natural order of processes • Allowing biodiversity to flourish • Co-exist can create ecosystems and stabalise existing ones

Fig. 8. Table summary of Defend, Retreat and Co-exist

There is a limited body of literature on coexistence, prompting me to broaden its definition. This gap suggests that further research is necessary in this area. These strategies are relevant to this research as they offer insights into various approaches for addressing coastal erosion. They emphasise flexibility, highlighting the need for adaptive solutions rather than a singular focus on unchangeable outcomes. Examining these strategies allows for the identification of successful global implementations, forming a foundation for design thinking. This approach encourages reinterpreting existing knowledge to develop innovative designs or modifications that facilitate coexistence with coastal erosion.

Fig. 9. A damaged pile among others

Fig. 10. A damaged pile among others in a row



OPUA: A SETTLEMENT WITH A PAST AND A FUTURE

Historically, communities have constructed buildings on and over water, as previously discussed by the Co-exist strategy. Similarly, Opua has a documented history of establishing structures on the water.

HISTORY OF OPUA

Opua is a small settlement of approximately 1,290 residents located in Northland's Bay of Islands. Historically significant as New Zealand's main port since 1870, it facilitates both recreational and commercial maritime activities. Opua serves as one of two key access points to Russell, New Zealand's first capital, via a ferry.

The community boasts a vibrant boating and sailing scene, supported by a strong marine industry, including a marina with over 400 berths for local and international vessels. The wharf is a hub for local fishing, charter boats, and visiting ships, while in the mid-19th century, it also accommodated occasional cruise ships. Opua is connected to the principal railway line from Auckland to Whangarei, completed in 1925, with an earlier line linking Kawakawa since 1884 for transporting goods and coal (Aspden, 2019). Following the railway's closure for repairs, the area has been repurposed for walking and cycling routes, accommodating daily commutes for some residents.

The boating industry operates year-round, involving construction and maintenance activities. The marina attracts a diverse array of boating families, some of whom stay for months and enrol their children in the local Opua School, while others visit briefly for essential services. The ferry service to Russell is crucial for community connectivity, with seasonal fluctuations in traffic peaking during summer.

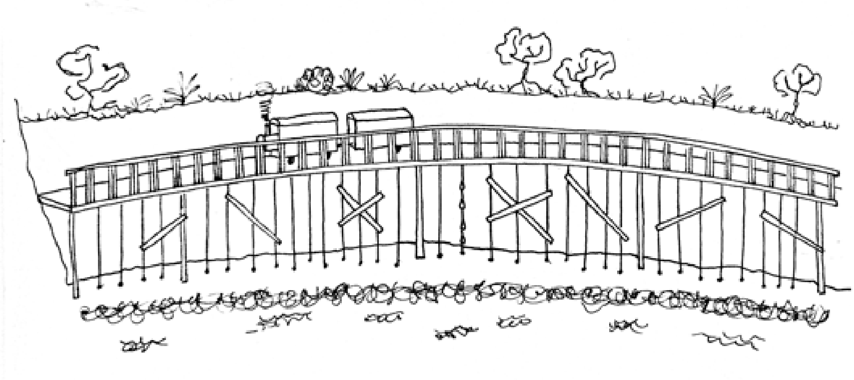


Fig. 11. The Opua railway track currently used as a bike and walking track

OPUA INFRASTRUCTURES

Opua is accessed primarily via a single main road, supplemented by additional access routes for residents. There are two primary access roads: one connects directly to residents' homes and the main road, while the other connects residents' homes to the main road. A disruption on the main road would significantly impact residents' ability to enter or exit Opua, affecting employment, truck deliveries, emergency services, and would necessitate a lengthy detour for residents traveling to Russell.

The workforce in Opua primarily consists of individuals employed locally or in nearby areas such as Paihia, Kawakawa, or other locations around Northland. While local parents are working, Opua is home to a school catering to students from Year 1 through Year 8 and also accommodates international yacht visitors.

Opua features a range of marine-related infrastructure and facilities, including establishments for marine retail such as boating supplies and repair services, metalworking, and marine engineering. The area also includes an active wharf and marina, which has been expanded due to increased demand and now accommodates vessels of various sizes, from small dinghies to superyachts. Essential services in Opua include a ferry service to Russell, which facilitates the transportation of goods such as supplies for Russell's stores, a local school, and a food store

Fig. 12. The Opua marina boat yard

THE OPUA STORE (OLD GENERAL STORE)

The historic general store, located on its original foundation with an ocean view, served the community for 110 years before being repurposed into three distinct functions. Meticulously preserved, it retains its original shape, form, and structural integrity, contributing to its enduring character.

Fig. 13. The old general store situated over the water on its original piles

OPUA WHARF MARITIME BUILDING (NEW GENERAL STORE)

Established in 2007, the Wharf Maritime Building in Opua is the primary provider of food and goods in the area. Originally designed for retail, it was repurposed in 2017 as the current general store, serving as a central hub where residents organise their schedules around it. As the only retail facility in the region, it is essential for the local community and also supports visiting boaters with supplies and postal services.

Fig. 14. The new general store located just before the Opua wharf

COMMUNITY HALL

The 89-year-old Community Hall reflects Opua's character, offering waterfront views and a welcoming atmosphere. It hosts activities like yoga, dance, and exercise, as well as private events, and hosts local markets to support the community by providing pre-owned goods, produce, and food. The hall remains a vital gathering place, surrounded by tranquil natural settings.

Fig. 15. The Community hall

THE BOAT HOUSE

Constructed in the 1900s as a warehouse for the general store, the boat house has been converted into a two-story holiday home used year-round. Its distinctive boat-like shape inspired the name "boat house", which is elevated on piles above the water and features a fishing deck that enhances its marine coastal ambiance.

Fig. 16. The Boat house

OPUA WHARF

Originally built in the 1880s, the wharf was expanded in 2010 to include the Opua Wharf Maritime Building. In the 1950s, it accommodated cruise ships and large international vessels but today, it is a venue for recreational fishing, charter boats, and larger vessels, including a tugboat for navigation assistance. Notably, the R Tucker Thompson, a vessel from 1970, is moored at the end of the wharf.

Fig. 17. The Opua Wharf

BOATS

The variety of vessels in Opua is diverse, encompassing commercial fishing boats for local produce, charter vessels, and privately owned yachts. Residents utilise their boats for fishing at nearby islands or for international voyages, returning at various times throughout the year. Yacht racing is a prominent activity in Opua, featuring weekly races and an annual sailing event that attracts boating communities from afar, fostering a strong sense of collective engagement.

Fig. 18. Anchored boats on the beach of Opua

MARINA

The marina, established in 2000 and expanded in 2017 to accommodate over 400 berths, is lively during the day and tranquil at night. Some boats docked here serve as residences for owners who may work locally, stay temporarily, or embark on global journeys, returning at various times throughout the year.

Fig. 19. The Opua marina

OPUA ECOLOGY

The local ecology in Opua is primarily coastal, supporting a diverse environment. Mussels and oysters thrive on the piles of the wharf and marina, serving as a food source for residents. Fishing from the wharf and harvesting shellfish from local structures are common practices among families.

Coastal reinforcement in Opua relies heavily on concrete and impermeable surfaces, with a significant retaining wall along the main road adjacent to the beach. This wall transitions to natural infrastructure, where Pohutukawa trees help stabilise the shore. Coastal vegetation, including these trees, mitigates erosion and protects homes from severe weather, while mangroves attenuate wave action in some areas. Although mangroves are scarce in high-activity boating zones, their establishment along the beach could enhance shoreline protection and foster biodiversity. Additionally, introducing mangroves beneath the wharf could offer further protection against water action and promote a supportive ecological environment. Utilising natural infrastructure may be more beneficial than non-permeable materials, which contribute to pollution and environmental degradation.

Fig. 20. The piles underneath the wharf revealing the mussels attached

Fig. 21. Slip on the coast of Opua

PRECEDENT EXAMPLES

This section analyses three projects that align with the theoretical frameworks explored in this thesis. Although situated in different locations, these projects share related typologies and characteristics. Each case study includes a summary of key attributes and relevant insights, which may be integrated into the final design, reflecting the study's underlying philosophies.

Focusing on distinctive public spaces, this analysis emphasises the importance of understanding behaviours and mobility patterns in areas without fixed functions. Traditional buildings often have rigid purposes that limit their adaptability to future needs, making it essential to avoid such constraints in contemporary design. The aim is to derive insights for developing strategies to address coastal erosion and to create innovative design approaches that support resilient communities in the face of natural disasters.

The section is structured as follows: an analysis of the 'Bamboo Pavilion,' followed by the 'Kait Workshop,' and concluding with 'Nest We Follow.' The discussion will explore how the architectural languages, theories, and philosophies of these projects can inform the final design. This is crucial as this section underscores the need for design practices that embrace adaptability and responsiveness to ensure that built environments remain relevant and functional in a rapidly changing world.

Fig. 22. Night collage of trestles in the water

BAMBOO PAVILION

Rising Canes, 2015 by Sun Dayong and Chris Precht, Penda, for Beijing Design Week Beijing, China Beijing,

Penda's Bamboo Pavilion, known as "Rising Canes," is located in Beijing, China, and features a modular structure made of bamboo, incorporating a network of triangular cabins that can expand both vertically and horizontally. Constructed in just two days using rope instead of conventional fasteners, this pavilion serves as a pilot installation for meetings and exhibitions, demonstrating the potential for modular structures to be repurposed as emergency housing.

The design includes X-shaped joints that facilitate easy disassembly and relocation, promoting a non-intrusive construction that accommodates ecological growth without harming the environment or the bamboo itself. Bamboo was chosen for its traditional use in China and its underestimated strength and flexibility, making it a viable, locally sourced material.

This pavilion exemplifies innovative design principles, highlighting adaptability and efficiency in assembly and disassembly. Its rapid construction capabilities make it suitable for emergency accommodation during natural disasters, fostering community resilience. The design allows for multiple configurations to address diverse needs, challenging traditional ideas of permanent structures by showcasing the viability of temporary, versatile builds. This approach is particularly crucial for responding to coastal and inland emergencies, enabling quick and secure construction.

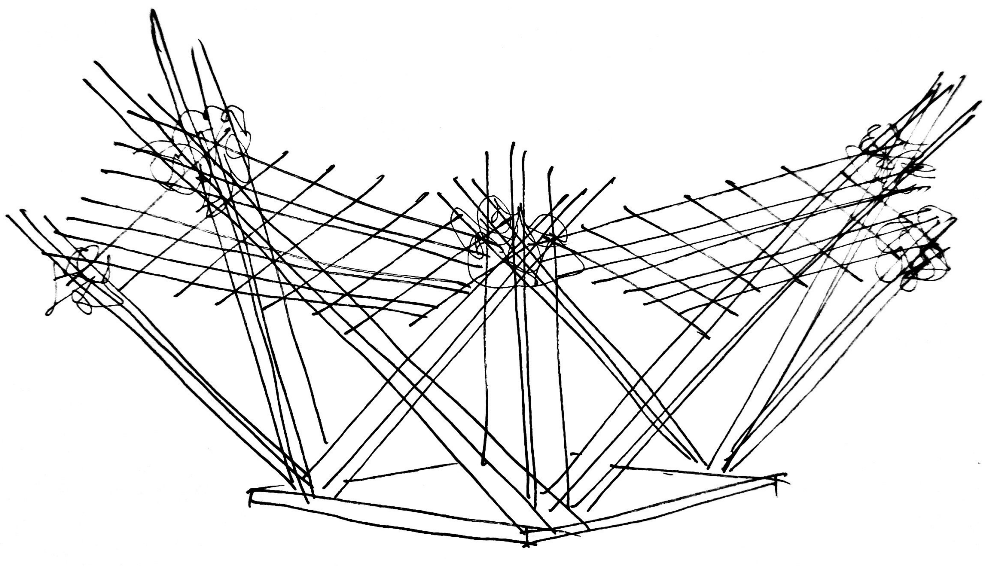


Fig. 23. Bamboo Pavilion by Penda, 2014 (Zhi, 2015)

KAIT WORKSHOP

The Kanagawa Institute of Technology (K.A.I.T), 2008 by Junya Ishigami, Junya Ishigami and Associates, Tokyo Japan.

The project's primary aim is to introduce architectural ambiguity. Designed for both students and the public, the studio space features floor-to-ceiling windows that integrate the outdoors, creating a floating effect. Its open-plan layout enhances transparency, while 305 strategically placed columns—though seemingly random—define distinct zones and support the roof (Thesispaper, 2024). Inspired by tree trunks, these columns evoke a forest-like ambiance and guide exploration within the space, shifting focus from the structure to the views.

The building challenges conventional design by offering adaptable spaces that reject fixed purposes, allowing occupants to customise their environment. This flexibility encourages mindful navigation and personalisation, contrasting with traditional office layouts. The unique tectonic language is characterised by columns arranged in an unconventional pattern, emphasising density in some areas while reducing it in others. This thoughtful design impacts public perception and functionality, and vertical expansion could preserve the architectural philosophy.

Ultimately, the building empowers occupants through its meticulous design, harmonising with the environment and featuring flexible interiors. This approach highlights how minor elements can significantly influence user experience in the final project design.

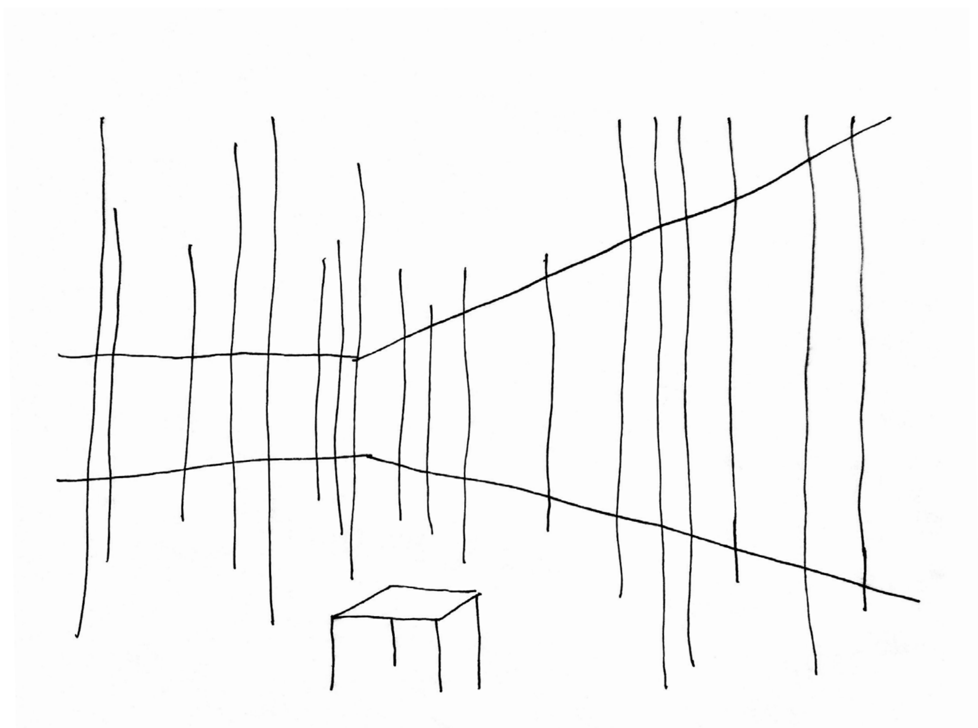


Fig. 24. Kait Workshop by Junya Ishigami and Associates , 2008 (Baan 2010)

NEST WE GROW

Nest We Grow, 2014 by Kengo Kuma, Kengo Kuma & Associates, Hokkaido, Japan

The primary aim of this architecturally dynamic building is to enhance community engagement through the storage, preparation, and enjoyment of local foods within a Japanese context. The design redefines connections with tranquil landscapes, utilising a timber grid structure that prioritises renewable materials (Archdaily, 2015). Its seasonal programming aligns with the life cycle of locally grown foods, allowing all community members to contribute and benefit from shared activities.

The building's assembly is a distinctive feature, blending American and Japanese construction techniques to create a space that invites exploration and curiosity. This community-centric design fosters flexible areas for tea, dining, and social interactions, enhancing its appeal.

Key attributes of this building, which benefit diverse users, will inform my own design, aiming to create inviting spaces that promote exploration and personal use. I will also focus on material reuse and assembly, particularly in coastal erosion contexts, ensuring a balance between internal functionality and external environmental impact.

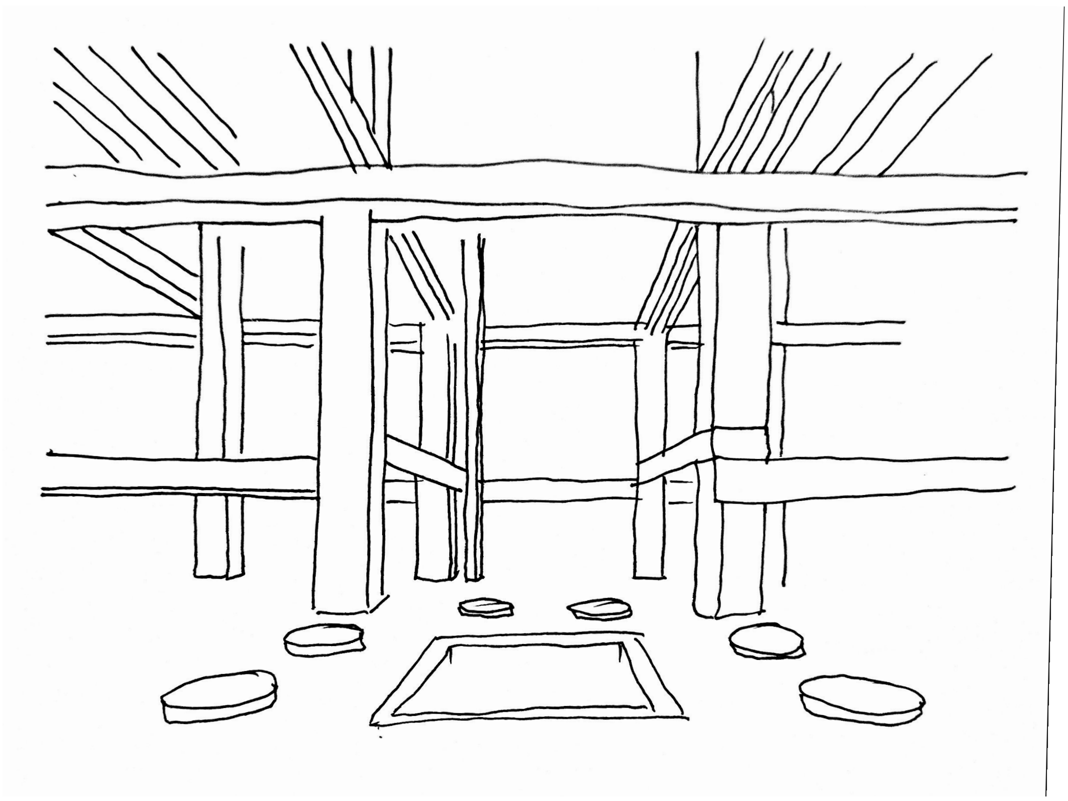


Fig. 25. Nest we grow by Kengo Kuma & Associates, 2014 (Sha, 2014)

The exploration of strategies such as defence, retreat, and coexistence underscore various approaches to mitigating coastal erosion while also initiating a consideration of Opua's context, history, and identity. Furthermore, analysing precedent examples facilitates the early stages of design thinking, enhances contextual awareness, and aids in building technical knowledge. The approaches articulated by Micivor, as well as those proposed by Sinay and Carter, have been instrumental in shaping the research design of the methodology for this thesis outlined in the subsequent chapter.

Fig. 26. Test of the density of Piles

CHAPTER TWO

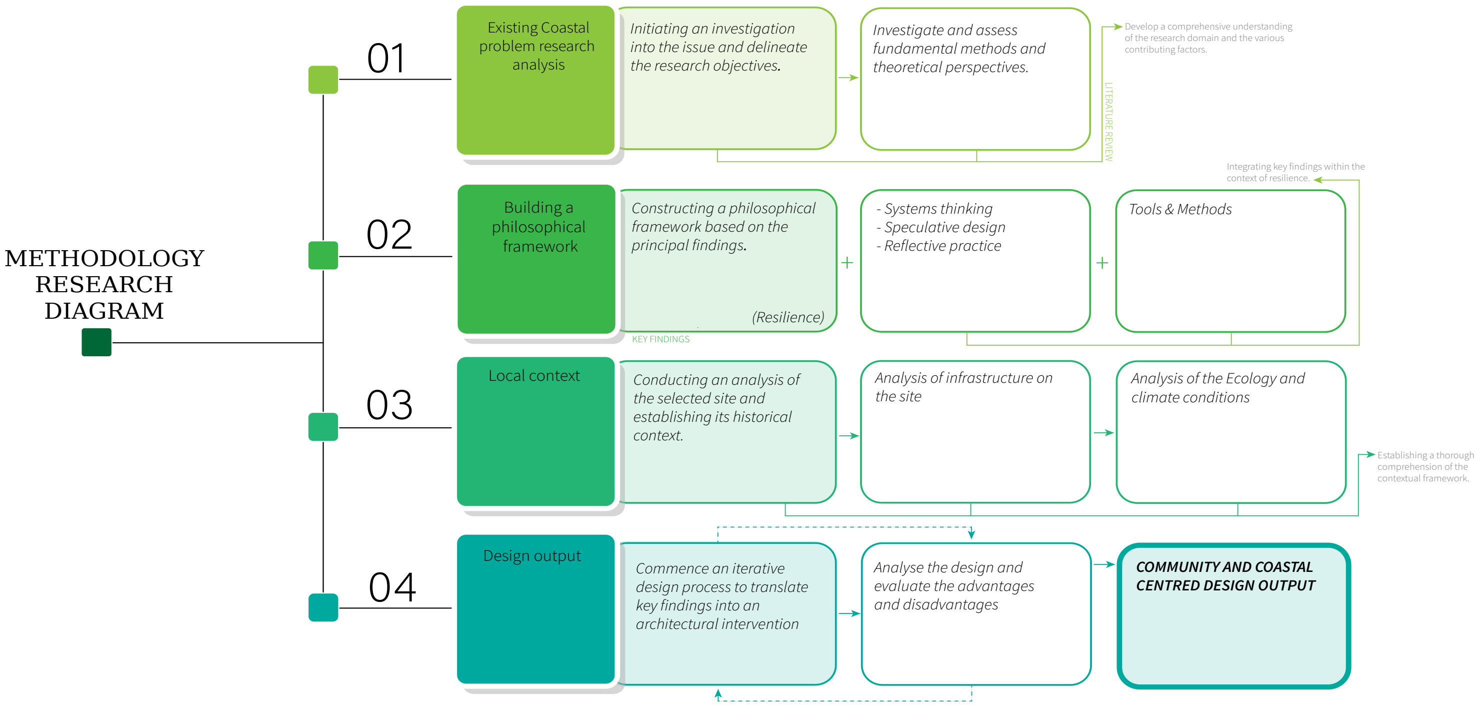
METHODOLOGY

Coastal erosion occurs when the interaction between human activities and natural environmental changes disrupts the balance of coastal dynamics (Ye, 2017). This phenomenon leads to landslides, increased water levels, and land loss, all linked to erosion. In architecture, addressing these challenges is crucial for effective design. A suitable theoretical framework is resilience, which provides a foundation for coastal structure design and highlights the necessity of incorporating resilience in both human and architectural systems (Laboy & Fannon, 2016; Aven & Thekdii, 2018)

This research project utilises theoretical discourse, literature review, and practice-based inquiry. The methodology chapter begins with a diagram outlining the philosophical foundations of the thesis and discusses the importance of the resilience framework, as well as the relevance of systems thinking principles. A second diagram presents the research design, detailing the phases and methods of the research process. It emphasises design research frameworks—speculative design and reflective practice—that inform the practical design-led approach. Additionally, various methods, including tools and processes used in site analysis, are explored in detail.

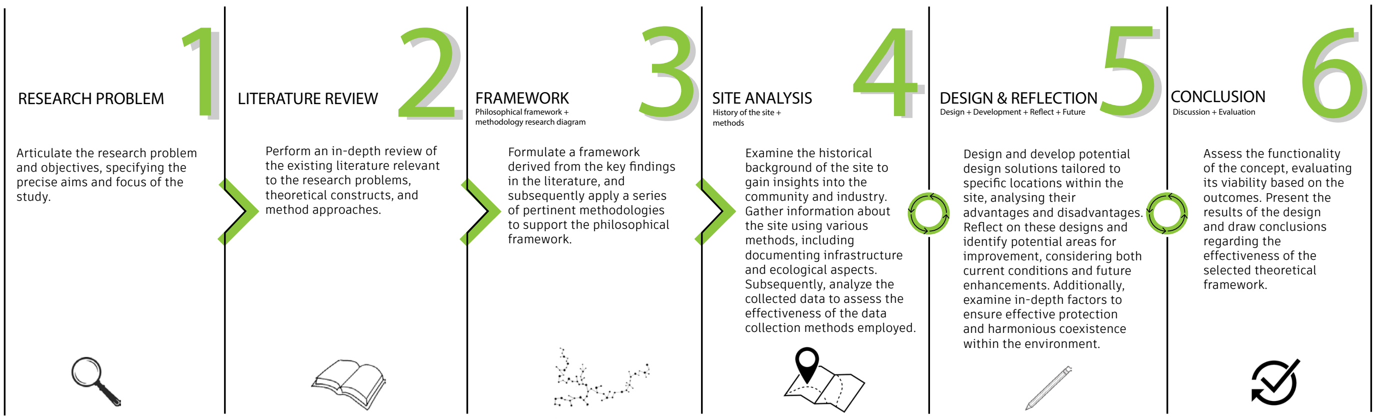
Fig. 27. Conceptual collage

RESEARCH DIAGRAM



The key frameworks illustrated in the diagram are significant as they offer guidance and structure, facilitating a systematic approach to organising thoughts and processes in the research. They promote consistency in method application, thereby simplifying the replication and validation of findings and anchoring the research in established theories, enhancing both its credibility and depth. Lastly, they encourage interdisciplinary connections across various fields, contributing to a more comprehensive understanding of the research context. Overall, these key frameworks enhance the rigor and impact of this research, making it more meaningful and applicable.

RESEARCH PHASE DIAGRAM



The research phase diagram functions as a roadmap for navigating this thesis, facilitating an understanding of the research progression. It enhances the clarity, organisation, and comprehensibility of the work, thereby supporting effective communication of the research approach and findings. Clearly defined methods within the diagram bolster the validity and reliability of the findings, fostering trust in the results and the conclusions drawn. Additionally, the site analysis, along with data collection and analysis, determines how data is gathered and examined, significantly influencing the depth and quality of insights derived from previous research phases. A well-constructed diagram underscores the systematic nature of the research, reinforcing the rigor and reliability of the thesis.

RESILIENCE

Resilience can lead to significant shifts (Britt et al., 2012), and originates from the field of ecology, where it denotes a system's ability to endure disturbances while maintaining its functions and identity (Minnery, 2015; Lui et al., 2010.). Various disciplines define resilience differently (Anderson, 2015), but fundamentally, it represents constructive adaptation, particularly the ability to sustain or restore mental well-being in adversity (Herrman et al., 2011). In architecture, resilience entails flexibility and the capacity to learn from previous designs to improve future construction (Minnery, 2015; Britt et al., 2012). Overall, it emphasizes a system's ability to adapt and bounce back from environmental changes (Aven & Thekdii, 2018).

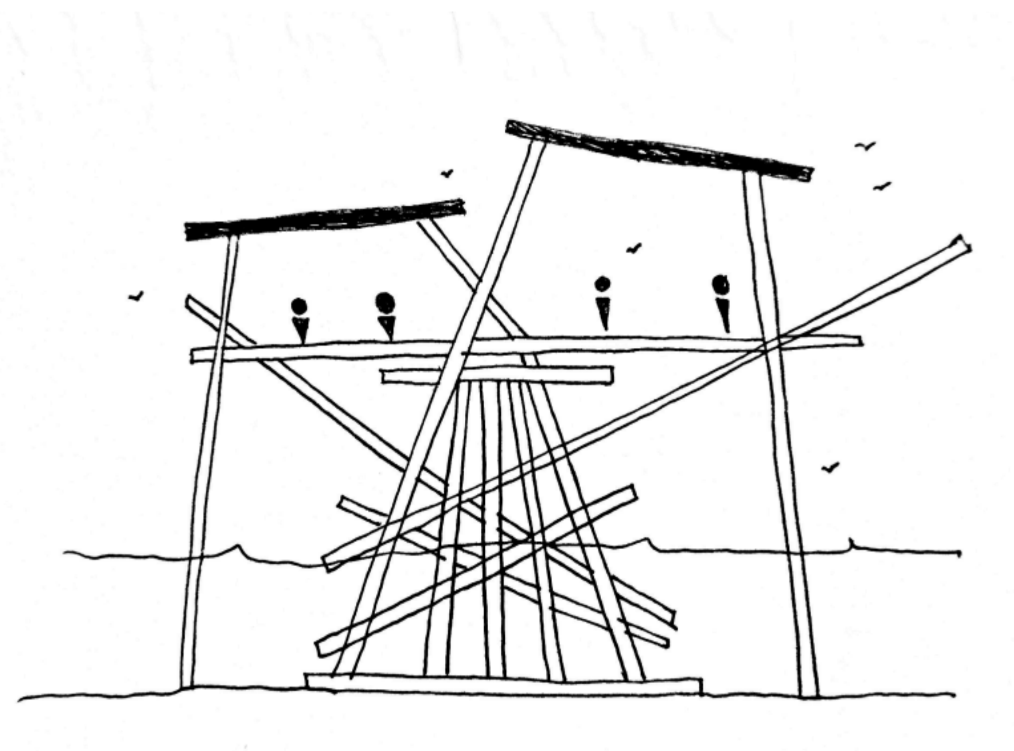
It is accentuated that the growing significance of resilience within architecture and across infrastructure is increasingly pronounced as climate change and its impacts, such as coastal erosion, are anticipated to intensify (De Burca, 2023). This aligns with the resilience framework by focusing on adaptation rather than drastic landscape alteration. It emphasises delicately enhancing the area to boost resilience, enabling both the environment and its inhabitants to adapt and evolve effectively. The study of methods to cultivate overall resilience is an increasingly vital and developing research field (Carpenter et al., 2012). Current focus is shifting towards approaches aimed at enhancing resilience, rather than solely reducing risks (Cerè et al., 2019), further substantiating the importance of comprehending resilience as a valuable framework. Although there have been improvements in crisis management for future events (Labaka et al., 2016), resilience is increasingly recognised across interdisciplinary domains, originally focusing on socio-organisational concerns but now expanding to encompass structural and infrastructural domains in recent years (Cerè et al., 2019).

Predicting the onset of a crisis and determining necessary preventive actions remains challenging (Labaka et al., 2016), underscoring the importance of resilience in the design of both simple and intricate structures. Developing resilience is essential not only for individuals but also for buildings, as significant uncertainty complicates the ability to respond logically, increasing the likelihood of adopting irrational approaches (Carpenter et al., 2012), which may inadvertently bind communities to disadvantageous outcomes.

Resilience is a problem-solving framework that emphasises the analysis of issues by examining the interrelationships among various components, concentrating on how these elements interact to create a cohesive system (Davies, 2024). This integration is vital for tackling challenges in an increasingly dynamic environment, such as natural disasters and disruptions, as well as for sustaining functionality when access to essential resources is restricted.

In reaction to the increase in natural disasters (Coronese et al., 2019), the thesis also shows an expansion of tree growth both on land and on water. This strategy was used to establish a resilient living system that would enhance stability and provide protection for the land as it is difficult to predict landslides or erosion events (Guzzetti et al., 2020; Jemec Auflič et al., 2023).

Resilience in a changing world is crucial for any project. In the context of coastal erosion, enhancing community resilience proves to be more advantageous than the ongoing effort to mitigate risks. It is essential to promote awareness of resilience through various approaches. Similarly, building resilience should extend not only to individuals but also to infrastructure. This focus on resilience will facilitate long-term planning and increase the lifespan of structures, yielding numerous benefits. Moreover, rational decision-making can prevent buildings from becoming vulnerable due to poor choices, thereby safeguarding against potential future challenges.



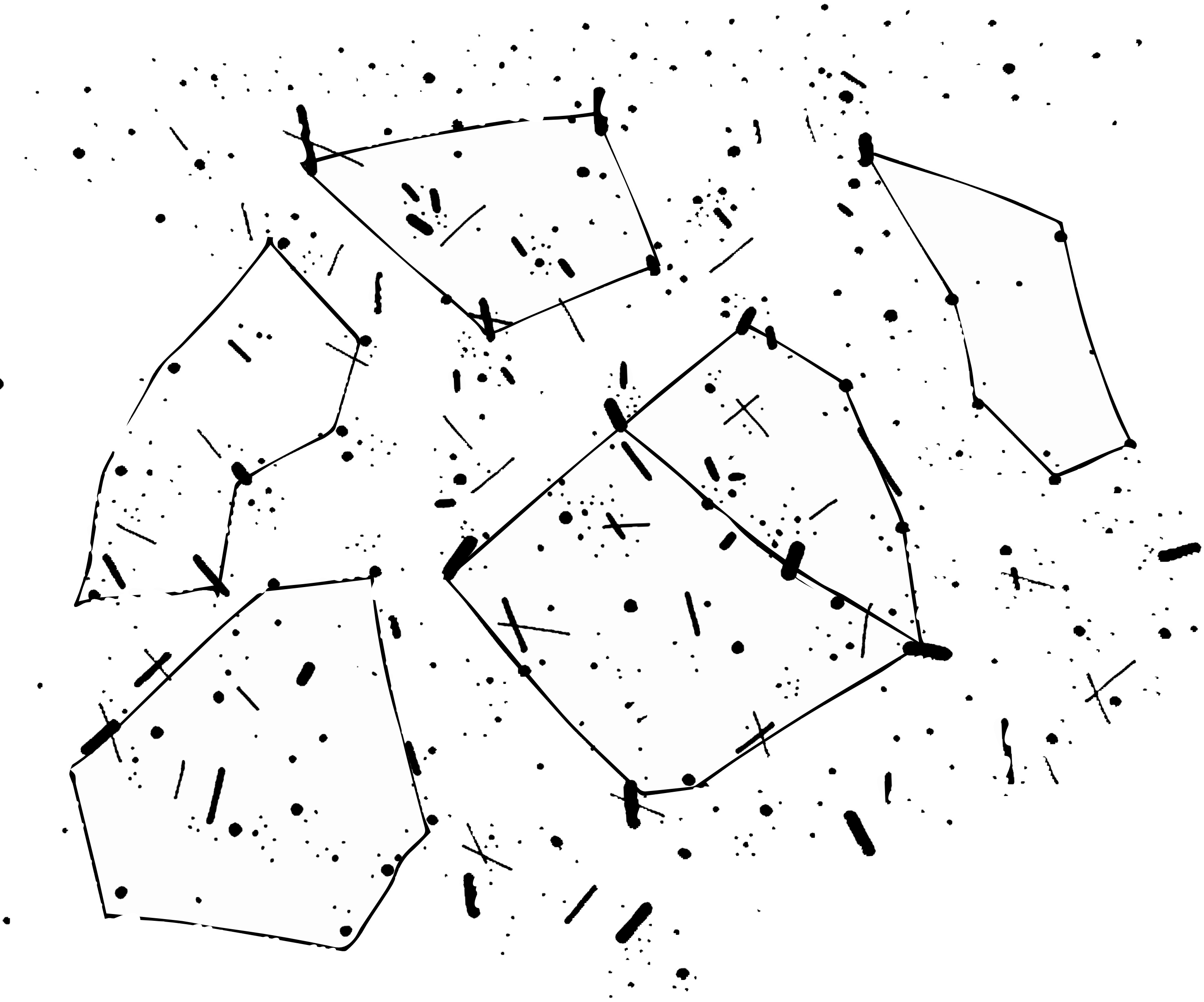


Fig. 28. A test of drawing shapes to match the Piles

SYSTEMS THINKING

Systems thinking is often ambiguous and complex, resisting a singular definition due to its interdisciplinary nature (Cabrera et al., 2008; Arnold & Wade, 2015). In contemporary Western paradigms, we are increasingly limited by unsustainable conditions that we can no longer afford to create.

Discussions on systems thinking underscore its importance for professionals in relevant fields (Arnold & Wade, 2015).). For this thesis, the most appropriate definition is, "Systems thinking is a way to approach issues by looking at them as systems. Rather than considering only how to solve an immediate problem, you consider how all of the pieces connect to make the whole."(Davies, 2024, What is systems thinking, para. 2). This definition emphasises the importance of understanding relationships rather than categorising elements and avoids bias by adopting a comprehensive, holistic perspective on the entire circular system.

"Taking a systems-thinking approach to architecture and the built environment could well bring a resolution" (Middleton, 2020, p. 74). Incorporating holistic approaches into the design process can lead to genuinely sustainable and transformational architecture (Middleton, 2020). Strict adherence to traditional design methods is insufficient; addressing complex architectural challenges requires a comprehensive approach like systems thinking.

"Changing the way we think does not automatically solve the various problems, issues, or crises we face. However, it does reframe how we think about what we view as a problem in the first place, and what solutions might look like." (Cabrera et al., 2008, p. 300). Returning to the topic of coastal erosion, this highlights the significance of systems thinking, which necessitates an analysis of the issue and an understanding of how feedback mechanisms relate to each contributing element, reconceptualising the issue and approaching it afresh, free from prior biases or preconceptions.

Given that this thesis focuses on coastal erosion and communities, it is essential to highlight the significance of systems thinking, which involves examining the problem and understanding how feedback mechanisms interconnect within a community. Regenerative design exemplifies this approach, encouraging consideration of how each component impacts the entire system and yielding benefits across environmental, societal, and cultural dimensions (Fallowfield, 2022). Key concepts related to this thesis that align with the framework of systems thinking include murmuration, flexibility, and adaptability.

Murmuration, Adaptability and Flexibility

Murmuration refers to the behaviour of starlings in flight, where they move cohesively as a group without a single leader. Each bird follows a set of simple rules (Chandally, 2021), resulting in synchronised movement that emerges from individual behaviours without enforcing a rigid structure.

An individual starling responds to the movements of its seven nearest neighbours, with their actions mutually influencing one another (Grounds, 2022). This dynamic promotes flexibility and adaptability, reflecting systems thinking principles, and allows for creative design variations without rigid constraints. This example demonstrates the principles of systems thinking, which involves holistic analysis of systems by focusing on relationships and interactions among components rather than isolating problems. It emphasises understanding the connections and interdependencies within a broader system.

Embracing systems thinking promotes a transformative shift toward adaptability and future-oriented change, which is vital in coastal architecture. This approach facilitates the development of safe spaces that can effectively respond to disasters. Such structures are designed to adapt and evolve in relation to the specific challenges presented by these events and their aftermath. Murmuration is advantageous in coastal design, where adherence to a set of established guidelines is necessary while also considering the project as an interconnected system. In this context, even minor adjustments or interactions can significantly impact outcomes, either positively or negatively.

This practice-based approach emphasises a speculative perspective, focusing on future possibilities while remaining grounded in architectural design. While rooted in practical application, my research expands into speculative territory, considering broader implications and possibilities beyond conventional architectural practices. While practice-based frameworks are commonly associated with professional contexts, my project derives its research through the design practice itself, and reflection on this practice and its outcomes. This thesis utilises practice-based research, but it diverges from traditional or normative projects by engaging with more complex issues. This has necessitated the incorporation of a more speculative approach, as a way of imagining how things could be and envisaging possible futures.

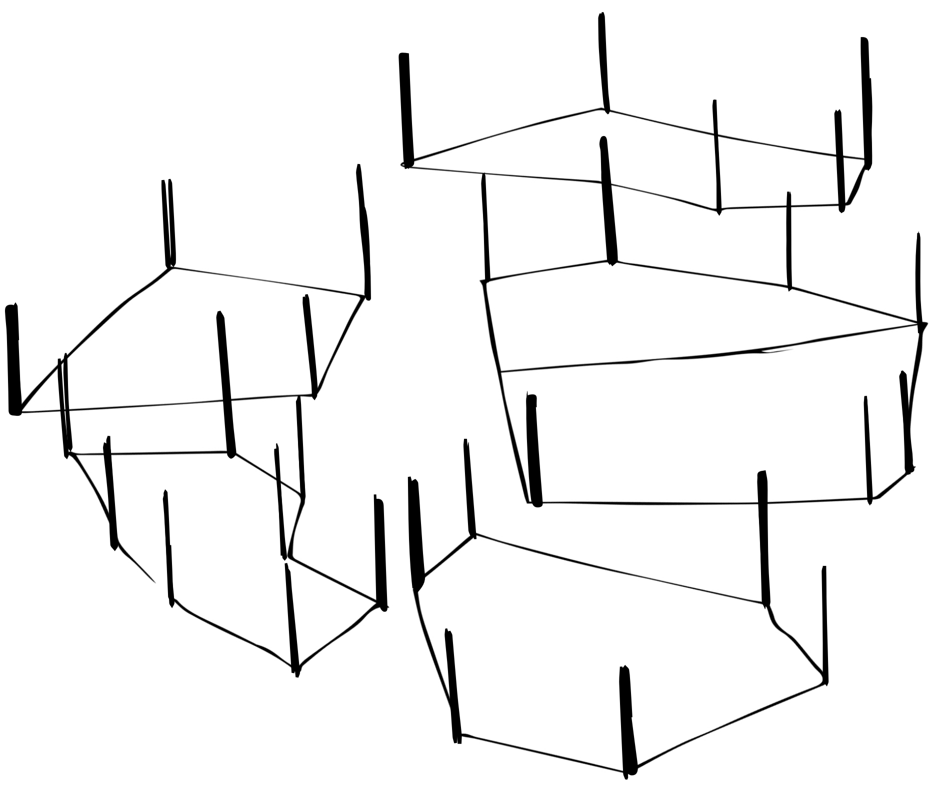


Fig. 29. Visualising Piles at each point of the shapes

SPECULATIVE DESIGN

Speculative design emphasises forward-looking imagination and the exploration of potential implications, focusing on envisioning plausible futures to foster discussions that shape desired outcomes (Dunne & Raby, 2013). It allows for flexibility and the freedom to explore, discover, and create without being constrained by specific criteria or a singular outcome.

Speculative design generates future scenarios for a specific location, prompting reflection on our visions of the future. Raby and Dunne state, "use design as a means of speculating how things could be – speculative design" (Dunne & Raby, 2013, p. 2), which aligns with the objective of this thesis. It challenges conventional reality by crafting narratives that extend beyond existing boundaries to forecast future designs, thereby stimulating further discussion (Neeley, 2024). Rather than focusing on predicting outcomes, speculative design seeks to envision possibilities (Sereno, n.d.), enabling the designs in this thesis to evolve and mutually influence one another, creating a cumulative effect.

Speculative design entails generating and exploring potential future scenarios to stimulate discussion and deliberation (Neeley, 2024). Raby and Dunne highlight that design's structure relies on imagination to foster new perspectives and alternative ways of living (Dunne & Raby, n.d.), underscoring the thesis's aim to move beyond Western cultural norms that limit possibilities, encouraging imaginative thinking to shape desired futures. This approach is relevant for adapting architecture to support coastal communities over time as speculative design allows for flexibility (Iaconesi, 2019) and creative exploration, facilitating the examination of diverse possibilities.

Speculative design is favourable for coastal design because it encourages exploration beyond conventional boundaries, fostering innovative possibilities. This creative exploration can be tempered with considerations of feasibility and practicality, leading to effective designs that might not have emerged without initial speculation and imagination. Considering the potential of a coastal community is essential for developing designs that encompass flexibility, adaptability, protection, safety, and functionality.

Fig. 30. Another test of drawing shapes to match the Piles

DESIGN PROCESS & REFLECTIVE PRACTICE

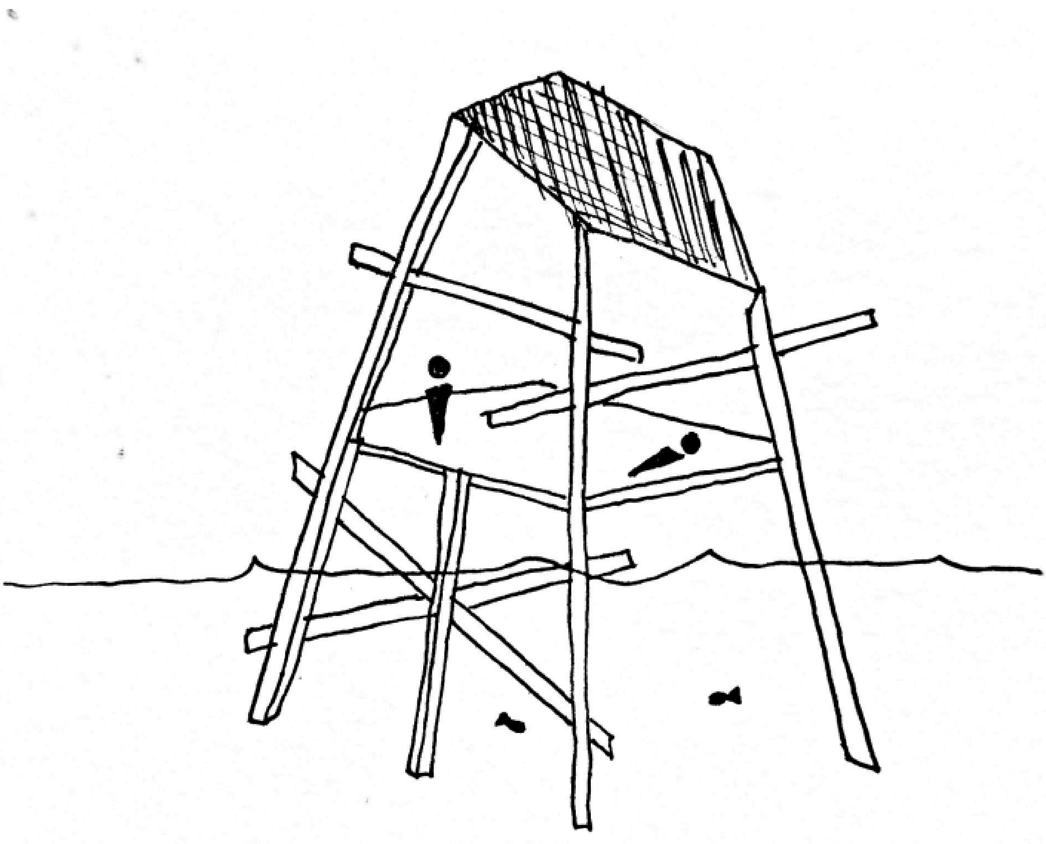
The designs in this thesis were created through drawing and model-making, supplemented by an iterative process of reflection in action and reflection on action, addressing both practical and analytical aspects. This framework facilitated the exploration of complex problems, enabling the evolution of ideas, designs, and outcomes.

Donald Schön asserts that individuals possess tacit knowledge within their actions, often knowing more than they can articulate, particularly in uncertain or complex situations (Schön, 1984). Coastal erosion draws on my tacit design knowledge, where insights from the design process are integral to the outcomes, allowing the work to convey meaning independently. During this project, I often faced uncertainty about the creation's purpose or usefulness, gaining clarity only upon completion and reflection. The outcome might have been discarded or led to unexpected insights, emphasising the importance of engaging with the work to test new understandings. This reflective process is vital for learning from design, a key aspect of artistry (Schön, 1984).

The answers to various challenges were initially unclear, and I was uncertain about the questions to ask. However, initiating any action triggered a chain reaction of reflection and subsequent action, leading to the creation of something new, regardless of its quality. This process resembled a two-steps-forward, one-step-back dynamic; through drawing, the work engaged in a dialogue, prompting a reflective conversation to unfold.

Schön highlights the issue of unintended consequences in design, where outcomes—whether positive or negative—often extend beyond initial intentions (Schön, 1994). While this challenge is common, reflection-in-action enables designers to make informed decisions by considering various factors and potential consequences in real-time, resulting in more suitable outcomes and reduced errors. This practice also enhances self-awareness, encouraging reflection on the process and underlying mindset, including biases and areas for improvement. Ultimately, it fosters personal growth and ongoing reflection in practice. Laura Malinin elaborates on Schön's epistemology, noting that it pertains to "how people recognise what they know in the consequences of their moves" (Malinin, 2018, p. 2.1.1.).

This methodology is essential for coastal architectural design, allowing for extensive speculation while ensuring a consistent process of design, reflection, and refinement. It fosters creativity and facilitates inquiry through iterative processes and enhanced reflection on actions. Throughout this thesis, the unique challenges of designing for coastal erosion highlighted the benefits of reflective practice, leading to more thoughtful and carefully considered outcomes.



SITE ANALYSIS

Site analysis is a critical process in ensuring reliable architectural design, as it guides the direction of design application (Park et al., 2023). Utilisation of various tools also enables architects to assess the site with a diverse array of techniques (Farrelly, 2012).

Site analysis is crucial as it facilitates the identification of both opportunities and constraints, and architects must engage with the site to develop a comprehensive understanding through multiple forms of analysis (Welsh Govt, 2016; Farrelly, 2012). This underscores the necessity of knowing the site intimately in order to achieve harmony with the surrounding environment and to optimise design outcomes.

Site-responsive design is essential to this thesis, as it focuses on understanding the existing context of the area, allowing for a design or modification to be integrated smoothly and sensitively. This approach can create a ripple effect, which is a critical aspect of this design exploration. Furthermore, a thorough site analysis enhances the user experience by ensuring that the needs and experiences of occupants are addressed, ultimately informing well-considered design solutions (Epperson, 2024).

Behind the outcomes of the site work within this thesis, not all material created by each technique was used. This did allow for the development and exploration of other site work to continue as when I was stuck on one thing I could move on to something else. Furthermore, even though some of the site work was not up to standard, it allowed the real explorations outcomes to come forward and be discovered, and these would not have been possible if there weren't multiple tools and techniques going on at once.

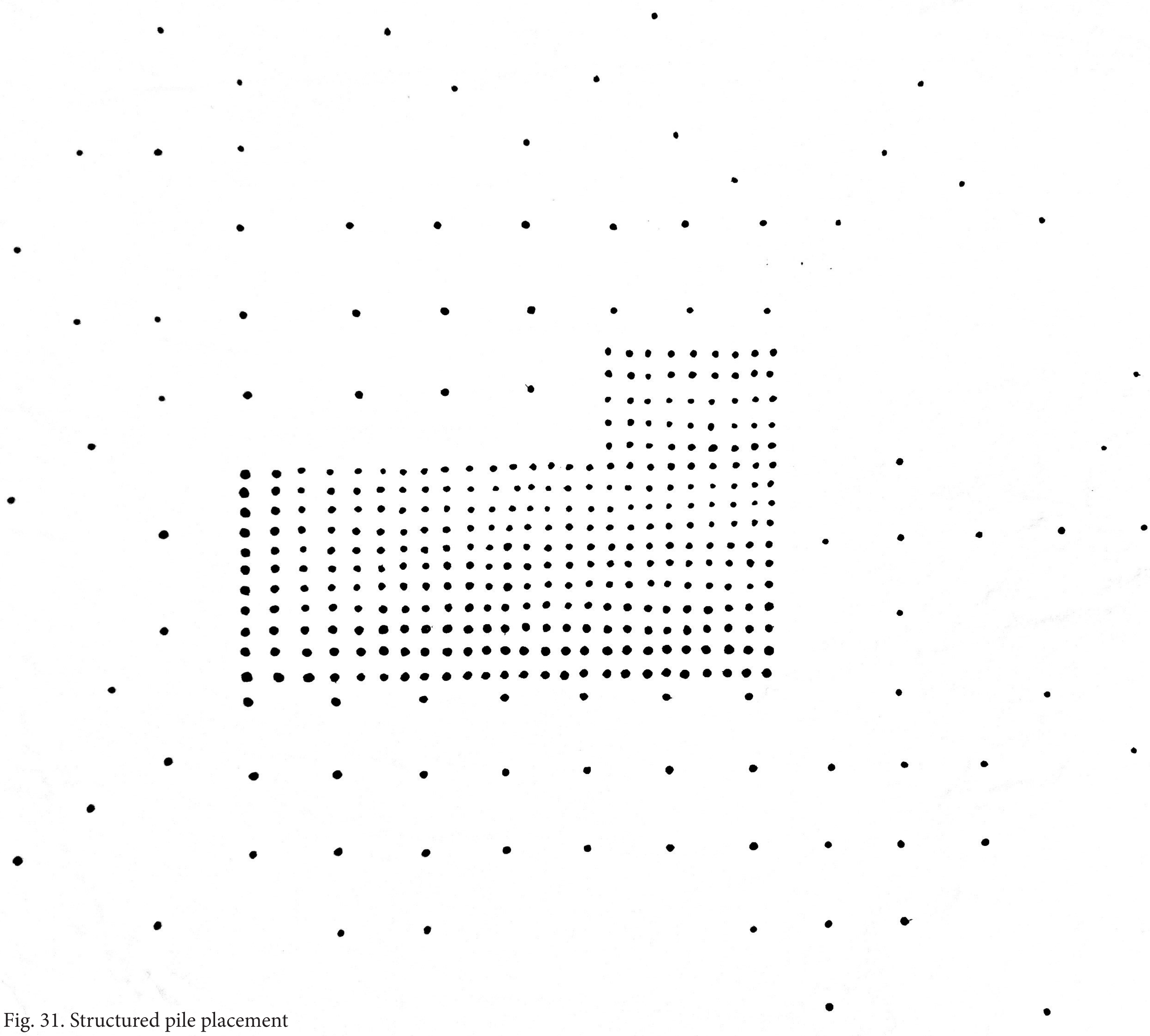


Fig. 31. Structured pile placement

TOOLS & METHODS USED IN SITE ANALYSIS

In this thesis, drawing serves as a primary method, reflecting the speculative nature of the design inquiry. It is important to recognize that "drawing" is a broad term, utilised in various contexts throughout the thesis, including documentation, experimentation, mapping, and design development.

The use of design tools such as concept maps and sketches facilitates the analysis and visualisation of concepts from diverse perspectives revealing significant yet often implicit aspects of methodologies (Kim & Jung, 2023; Craft & Cairns, n.d.; Hagen, 2009). Employing multiple approaches throughout a project fosters ongoing engagement and enables individuals to shift between tasks when faced with challenges, thereby ensuring the continuity of productive work.

Practitioners have the opportunity to reflect on their methods and assess how their existing tools may need to be expanded or enhanced as they explore new domains (Hagen, 2009). This relates to the notion that tools and methods can generate unforeseen relationships, which can only be uncovered through continual practice and making. The development of design methods that encourage innovation and the broad application of design thinking across diverse domains is essential (Marcus, 2015). This underscores the importance of tools and methods across various fields, suggesting that both designers and non-designers can utilise design thinking, though they may approach and process it in different ways.

The primary aim of design methods and tools is to cultivate a profound and pragmatic comprehension of the design process. This involves exploring ways to adapt, enhance transparency, and effectively manage the process to attain sustainable design outcomes. (Green & Bonollo, 2004). Utilising diverse drawing techniques and mapping facilitated the exploration and ongoing evolution of ideas, enabling continual discovery of new possibilities to achieve outcomes throughout this thesis.

These methodologies are crucial to this speculative thesis, which extensively engages with future-oriented concepts and events. Resilience and systems thinking are vital for practice-based approaches; however, speculative design becomes necessary when considering broader futuristic frameworks. Methodologies such as Schön's reflective practice are particularly significant, as ongoing reflection on potential outcomes can greatly influence their success. Site analysis, along with the tools and methods employed in this analysis, is fundamental to architectural practice. This will be elaborated in the next chapter, which focuses on site mapping and the methodologies underpinning the practical work.

CHAPTER THREE

SITE ANALYSIS

2. Image of the fallen Pohutukawa tree

In architecture, conducting a comprehensive site analysis is important for developing designs that effectively engage with their contextual environment, as highlighted in the previous chapter. This chapter focuses on the proposed project site located in Opua, within the Bay of Islands, and examines its unique characteristics, including location, identity, and environmental factors.

By analysing various elements such as topography, ecology, and surrounding infrastructure, this analysis aims to identify the challenges and opportunities inherent to the site. Utilising methodologies such as site walks, drawing, mapping, and photographic documentation, this chapter systematically investigates the spatial dynamics of the site and its environment, which subsequently informs the design strategies presented in the following chapter. Each method employed will be discussed in detail, accompanied by brief reflections, culminating in an overall assessment of the site analysis.

Fig. 33. Conceptual collage of a wharf

SITE ANALYSIS OF OPUA

This section presents the methodology and findings of the site investigation conducted in Opua. It identifies potential areas for further inquiry that, while seemingly minor, could have substantial impacts.

The goal was to provide a thorough site analysis of northern Opua, a coastal community in Northland, Te Tai Tokerau, with over 1,000 residents and the primary port of the Bay of Islands, where commercial fishing boats, charter vessels, and overseas and privately owned yachts, excluding cargo ships, must report to customs upon entering New Zealand. Having grown up in Opua, my familiarity with the area necessitated developing a fresh perspective during the site walkthrough, emphasising the importance of documentation, including mapping, historical research, and photography.

The investigation utilised observational and documentation methods to analyse a range of factors and events including both human and non-human movement on the site. Existing features, such as buildings and trees, were systematically recorded and explored through sketching, facilitating accurate data collection and valuable insights that led to significant design discoveries. This analysis is particularly relevant due to the site's unique characteristics, which have not been extensively studied, warranting careful examination given its small scale and distinct architectural sensibility.

Fig. 34. An Image of Opua taken from the Opua Wharf

CONTEXT OF OPUA

In the initial phases of site selection, I investigated the life and environment of Opua, as detailed in the literature review. This information underscores Opua's identity, deeply connected to its marine surroundings and its diverse community. The community has evolved over time due to the movement of various groups, including boaters, retirees, families, and tourists.

Located on the eastern side of Northland, Opua serves as the first port for international vessels entering New Zealand, highlighting its significance. This investigation provided deeper insights into the people and spaces that are vital to both the community and local ecology, revealing dimensions of Opua previously underestimated. It encouraged a closer examination of often-overlooked details, emphasising the interconnectedness within the coastal environment, where every element, from large structures to small shellfish, plays a crucial role in sustaining the ecosystem. These observations were further enriched during site walks.

Fig. 35. Map displaying the route of the photo documentation walk undertaken

Fig. 36. Conceptual collage of trestles lined together

SITE WALKS AND PHOTO DOCUMENTATION

I conducted site walks multiple times a week at varying times of day to enhance documentation efforts. During these walks, I alternated between capturing photographs and focusing solely on observation, engaging all my senses to gain insights into the auditory, olfactory, and tactile experiences that shape my perception of the space. This intentional engagement fostered a renewed awareness of my surroundings.

Walking the site allowed me to observe how individuals interacted with the environment, informing design decisions aimed at improving usability and user experience. Being physically present cultivated a deeper understanding of the site and enriched my perspective on these encounters.

Throughout my explorations, I traversed the length of Opua, capturing a total of 231 photographs. Beginning at one end, I documented images every ten steps to identify gaps and opportunities for further investigation, seeking hidden potential within the environment. This method heightened my awareness of each photograph's context, revealing the relationship between the site and its surroundings, including adjacent buildings, landscapes, flora, and infrastructure (For examples of these photographs and evident contextual relationships please refer to figures, 67, 83, 108, 113 for buildings; to figures, 5, 142, 123, 224 for infrastructure; and to figures, 1, 33, 23, 217, 161 in Appendix A).

The photographs documented patterns of movement, light, and shadow throughout the day, with some taken on different days to reflect varying weather conditions. This variability was essential for addressing aspects of the research question, providing insights into the site's responsiveness to atmospheric events. Additionally, the images showcased the unique characteristics of Opua's identity (see figures 183, 167, 190, 196 in Appendix A), highlighting traditional materials, modest structures, and the surrounding landscapes (see figures, 187, 185, 127 in Appendix A). Engaging in this process deepened my understanding of Opua's character and sparked speculative ideas regarding its potential future development.

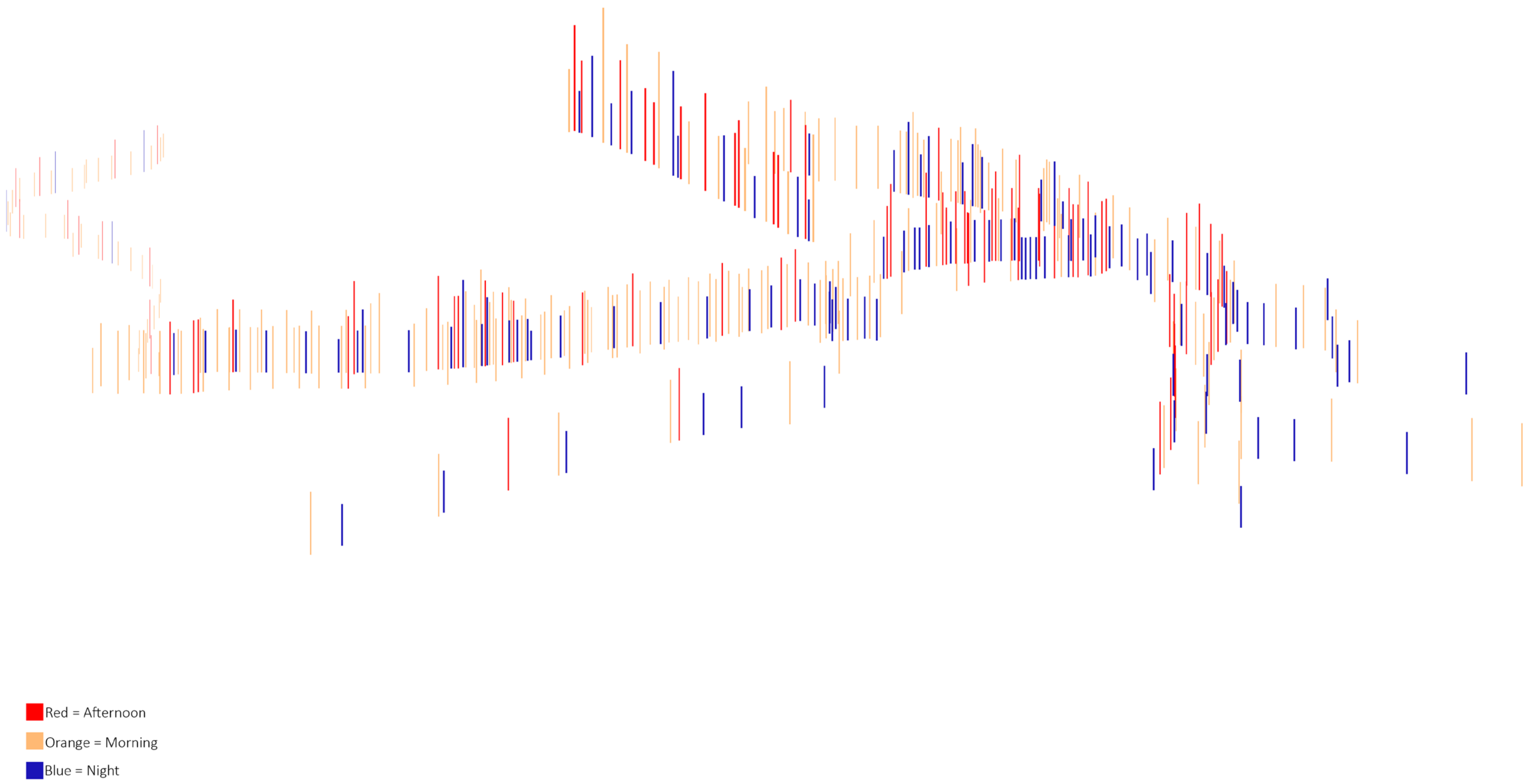


Fig. 37. Data collected from the site walk indicating movement patterns

Fig. 38. Young boys adventuring into the water to harvest the mussels

Fig. 39. A boy sitting on the edge of the Opua Wharf


Fig. 40. The active Wharf of Opua

Fig. 41. Showing her granddaughter the mussels underneath the Wharf

Fig. 42. An example of the oysters on the rock armour within Opua

MAPPING

Through walking, I visually mapped my sensory experiences, considering factors such as density, social flows, infrastructure placement, and the reasons behind spatial arrangements. This mapping provided essential information on the site's topography, vegetation, and existing structures, informing design choices in my proposal.

A thorough understanding of the site's ecology, including its flora and fauna, guided the assessment of environmental impacts related to the coastal lifestyle and highlighted strategies for ecological sustainability. Additionally, mapping facilitated the design of efficient pathways for residents and visitors, enhancing resilience against natural disasters. It also helped identify potential hazards, such as slipping and erosion, leading to the development of risk mitigation strategies.
Furthermore, mapping enabled the thoughtful integration of various building options within the landscape, fostering a harmonious environment. This meticulous approach allowed for the creation of designs that are both functional and aesthetically pleasing while being responsive to the needs of the environment and the community.

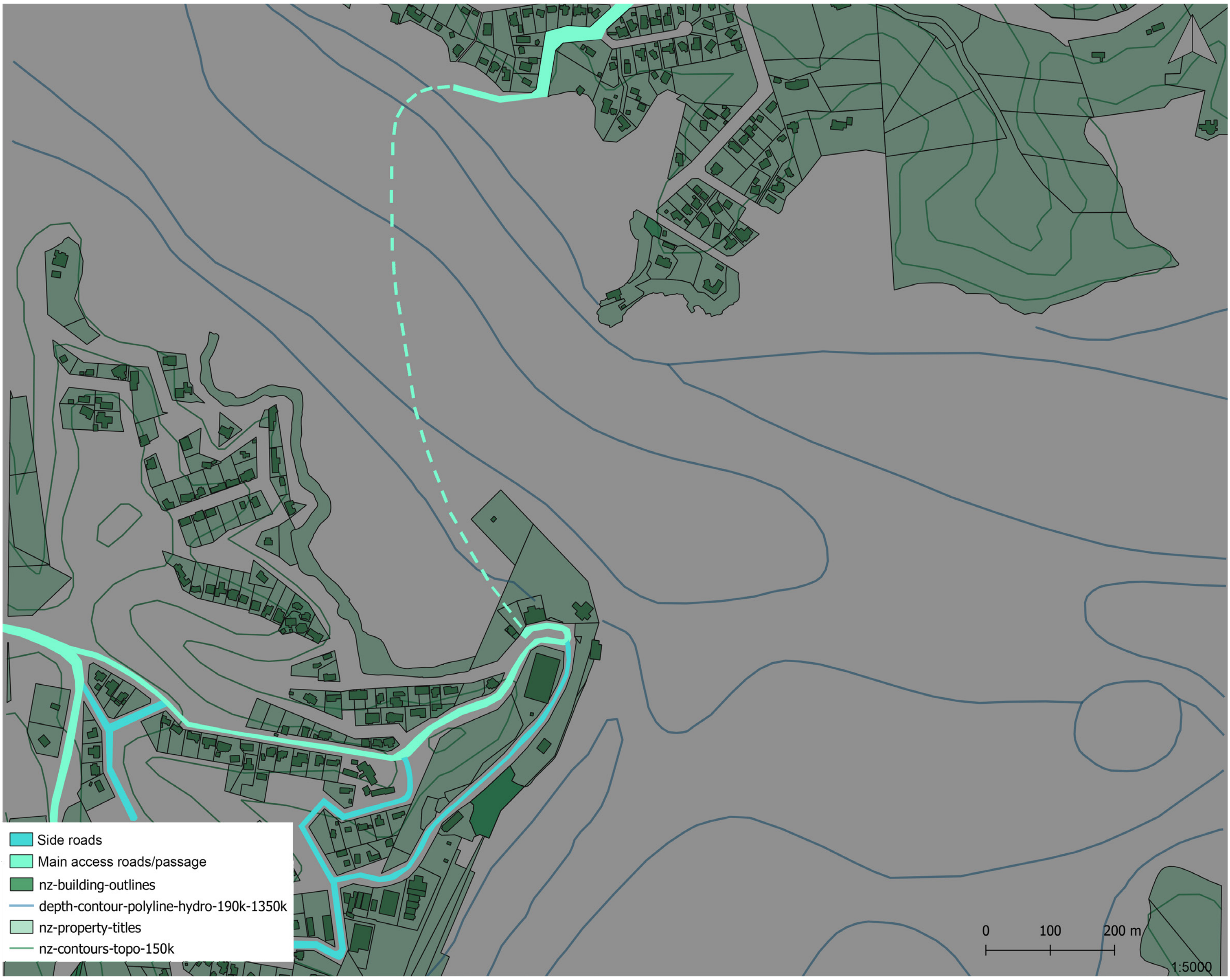


Fig. 43. Mapping the Main access roads, passages and side roads around Opua

Opua serves as the primary access point for crossing the Veronica Channel to reach Russell, making it a crucial route for connectivity. Consequently, access to Opua via its sole essential road is vital for the settlement's functionality and overall success. This thesis explores the significance of this settlement and emphasises the need for resilience in order to maintain its operational capacity and ensure that other areas connected to Opua remain functional as well.

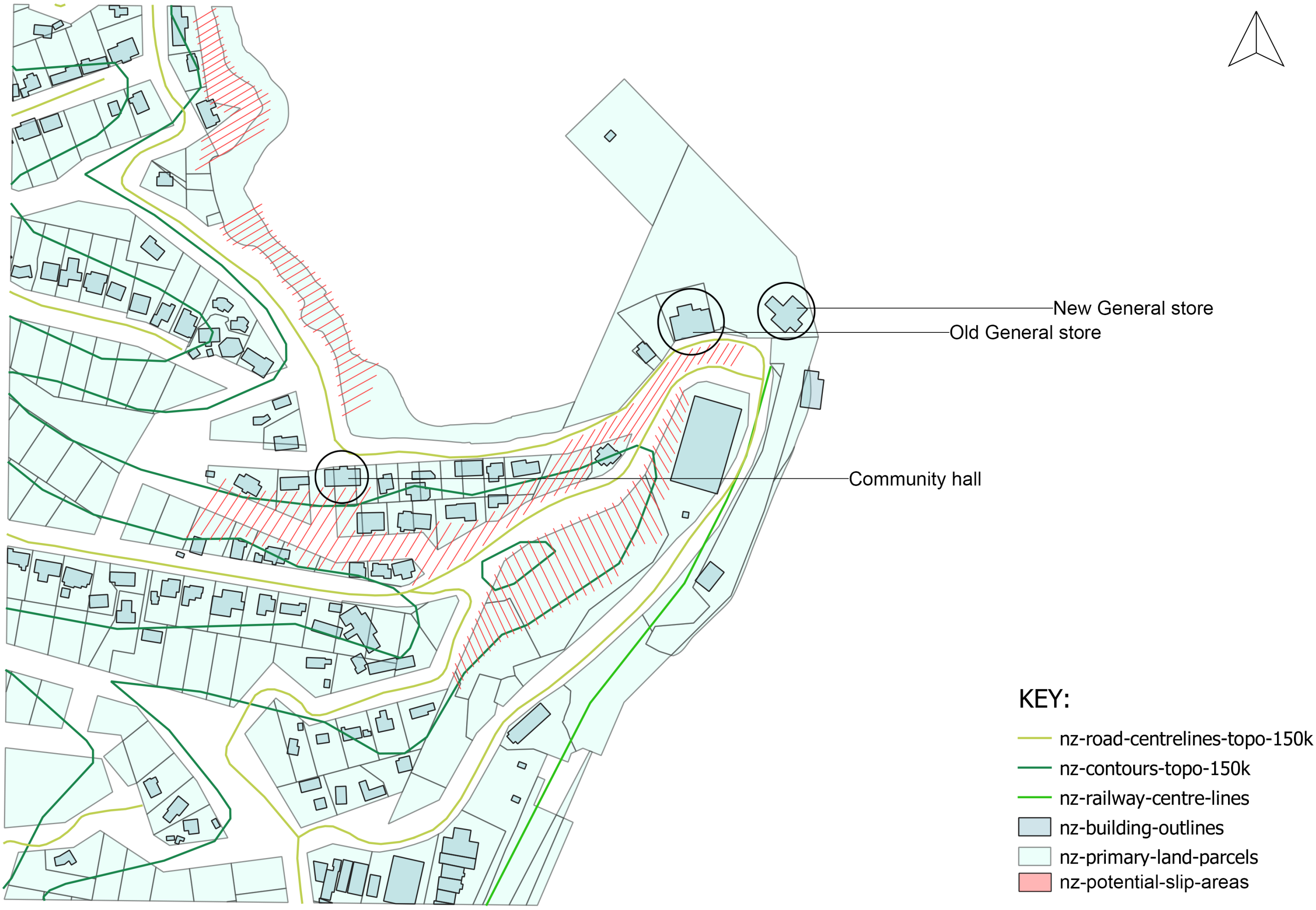


Fig. 44. Map indicated the hazardous areas around Opua

The site in Opua identified for the resilience transformation is a section of the beach. The terrain leading to this area is characterised by steep gradients, which poses a significant risk in the event of a landslide, potentially impacting residents, businesses, roads, and transport vehicles. This beach site is strategically located opposite the Russell ferry point, facilitating access for boaters from both Opua and Russell. Enhancing resilience within Opua should begin with prioritising the relocation of critical buildings that could become inaccessible during a natural disaster. Many current structures are either at risk or disrupt the natural landscape, hindering the land's ecological vitality.

Comprehensive mapping has revealed areas susceptible to slips and patterns of movement within the site. To realise the settlement's vision, it is essential to increase resilience while ensuring that the community is not locked into unsustainable development. The designated areas for the relocation of buildings are illustrated in the accompanying map (Fig. 29.). These locations will be further explored in the subsequent chapter. This site presents a valuable opportunity to enhance resilience while prioritising ecological integrity over purely human-centric development.

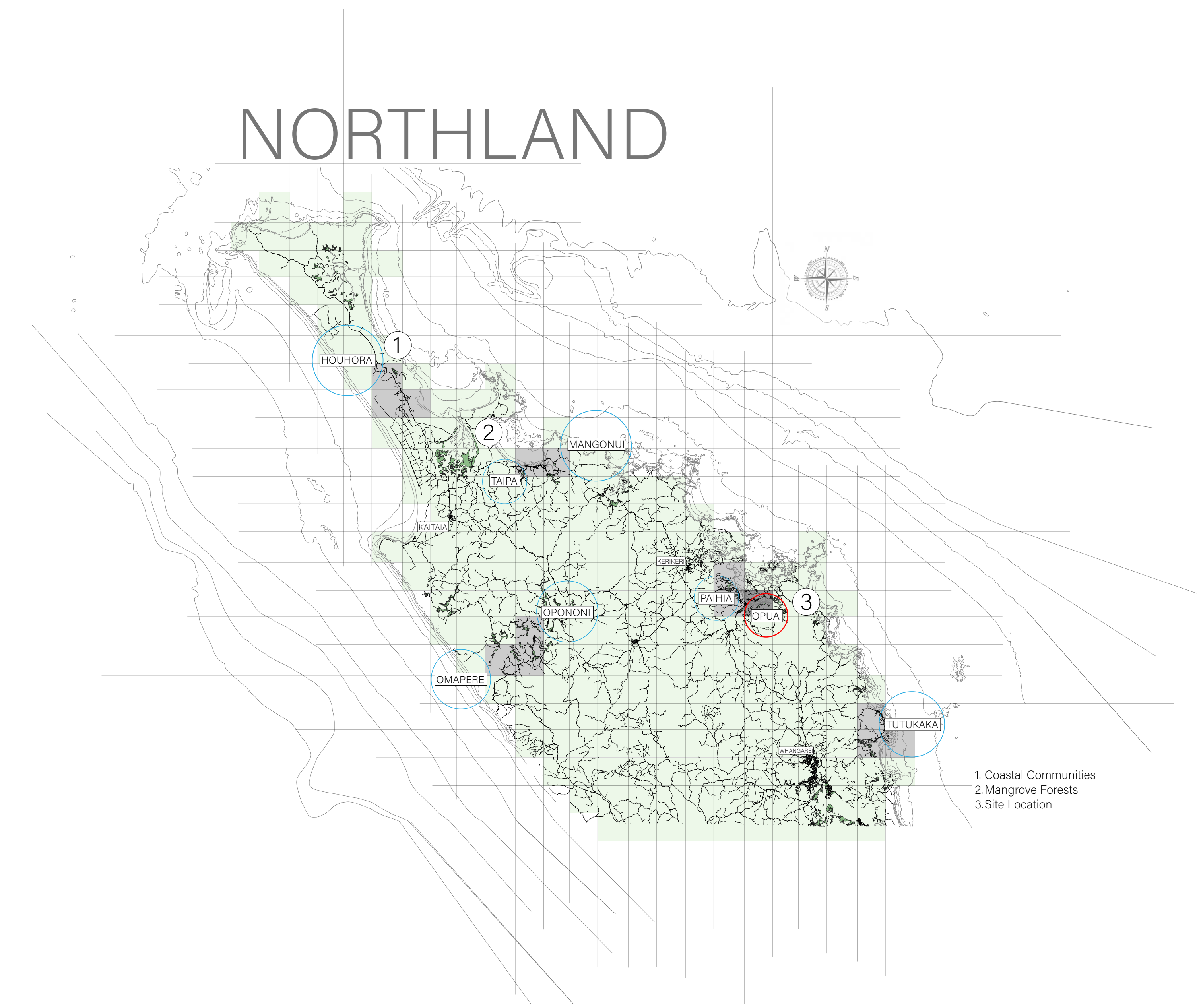


Fig. 45. Mapping of Northland and its Coastal communities

Fig. 46. Site map of Opua

Discovery & Method/s

1	Trees	Substantial trees are situated along the steep hillside opposite the site.	Site walks
2	Mangroves Trees	Mangroves that hug the edge of the cliffs of Opua	Site walks & Photo documentation
3	Pohutukawa Trees	Pohutukawa Protecting the buildings situated along the shore from the elements	Site walks & Photo documentation
4	Opua Wharf	People fishing and jumping off the wharf using it as a fun infrastructure and food source	Site walks, Photo documentation & Drawing
5	Hazards	Potential landside hazards located near the chosen site location	Site walks & Drawing
6	Piles	Greater usage of piles to be used for wave dissipation and local harvesting of shellfish	Site walks, Observation & Drawing
7	Nature	Perceiving what nature is doing for Opua, such as the trees and shellfish	Site walks, Observation & Drawing
8	Social flows	Greater understanding of where poeple walk, also during different times of day	Site walks & Mapping
9	Roads	Insight into the roads in and out of Opua	Mapping
10	Buildings	Locating critical buildings obstructing land or in potential danger	Mapping & Site walks

Fig. 47. Site analysis table visualising the methods used in the exploration

This table summarises the findings of the site analysis derived from various methods. The insights gained from this analysis significantly influenced the design development, emphasising the ecological significance of the Opua area and the ways in which people navigate and interact with the space for their own benefit. The incorporation of elements such as piles, the wharf, walking paths, and natural features revealed that users engage with these infrastructures in ways that diverge from traditional human-centred design intentions.

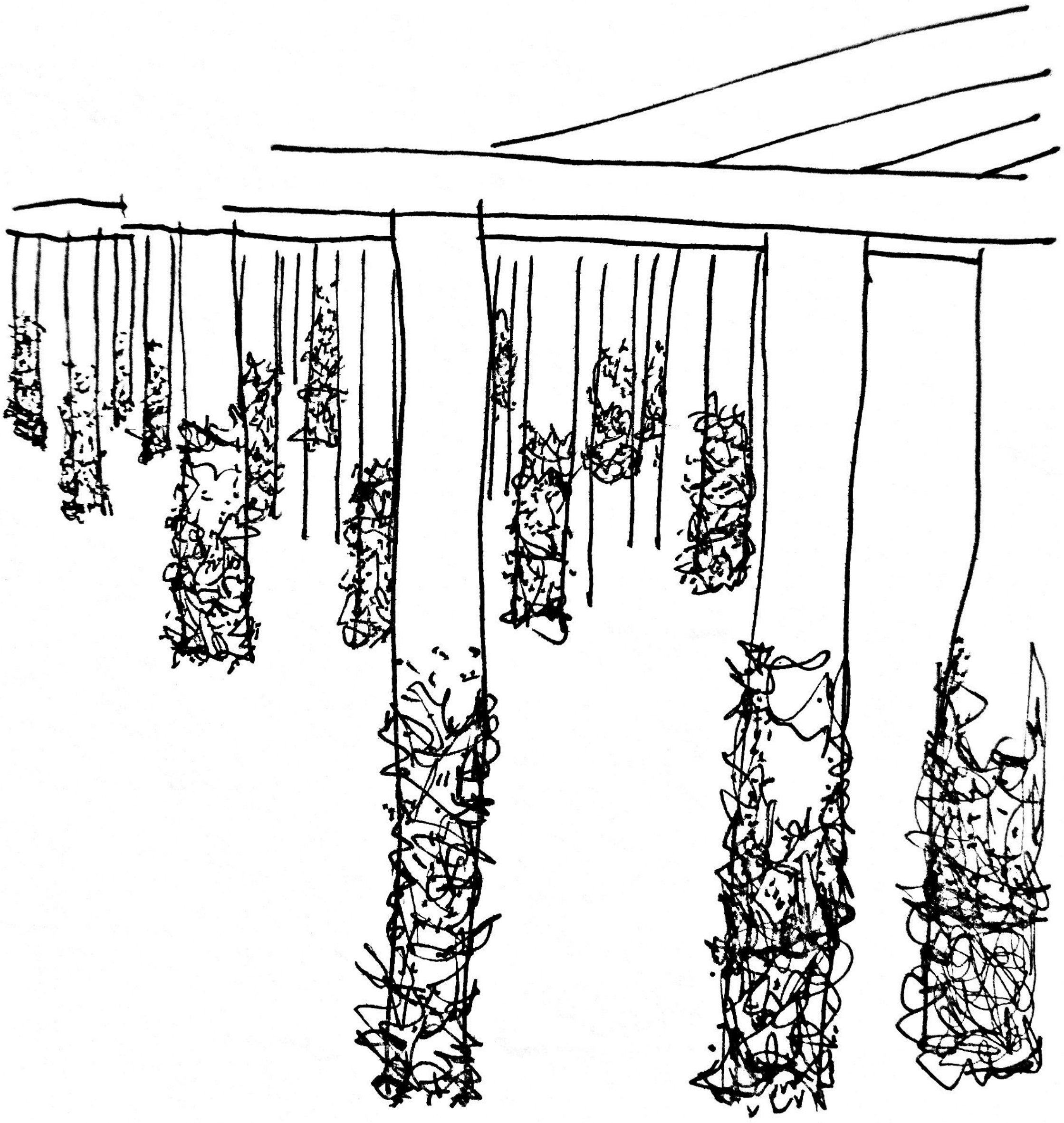


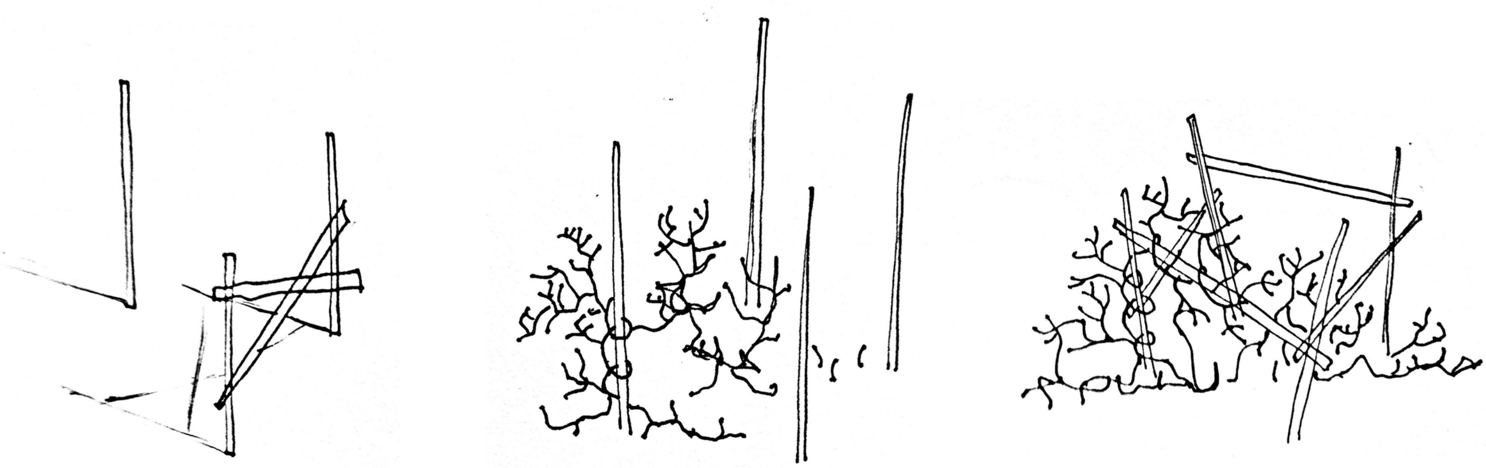
Fig. 48. Sketch of the mussels on the piles under Opua Wharf

Fig. 49. Collage showing how nature can mitigate landslides

The site analysis highlighted the different infrastructure and ecological importance of the Opua area (see fig. 30.), particularly its surrounding mangroves, which could expand along the proposed site's beach. While local piles offer potential harvesting resources, their placement may hinder public access beneath any constructed buildings. Enhancing accessibility around these piles could support community infrastructure and shellfish availability.

Opua's layout, characterised by a main road and side streets (see fig. 32.), encourages walking among residents, suggesting an active community. This insight underscores the need for additional pathways that emphasise scenic views, health benefits, and ecological stability, advocating for nature-focused design over traditional human-centred approaches.

The analysis revealed Opua's ecological contributions, enhancing my appreciation for its natural resources and reinforcing the importance of prioritising ecological resilience in future planning. This chapter identifies a site in Opua as an opportunity to foster resilience by reimagining public experiences that emphasise nature in response to sea level rise and erosion, marking a shift from conventional design practices.



CHAPTER FOUR

DESIGN

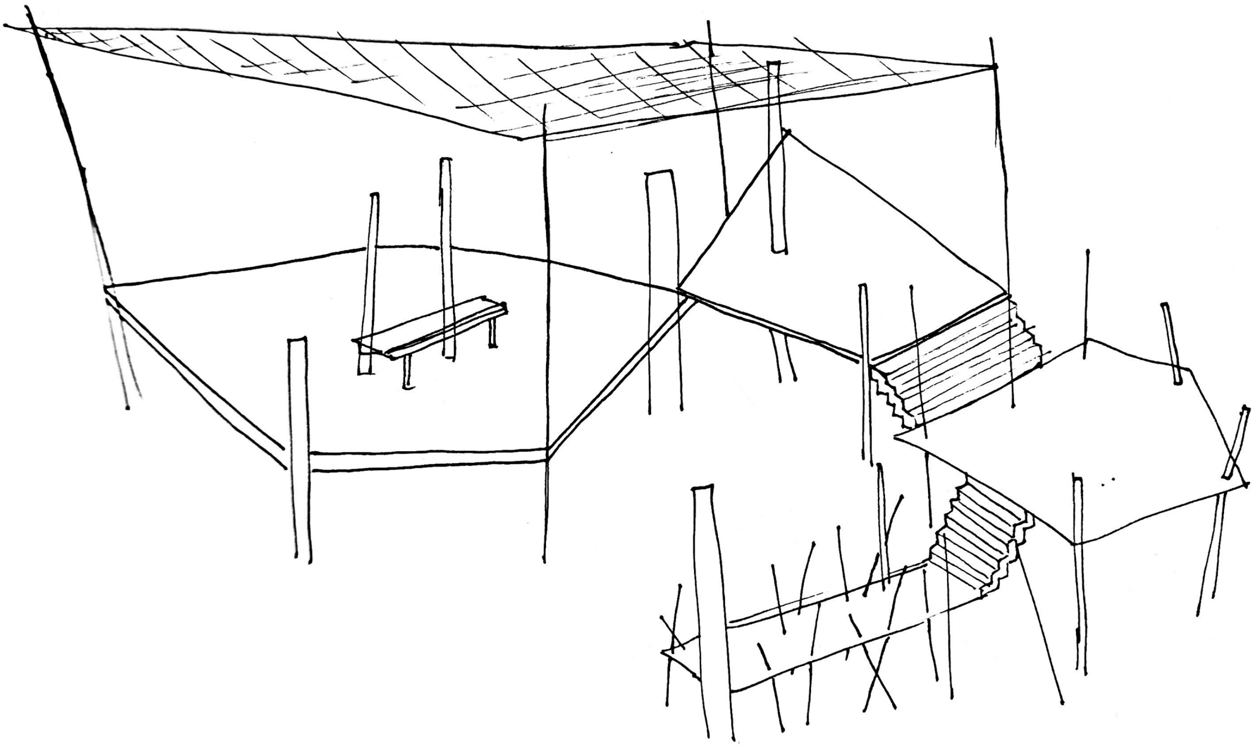


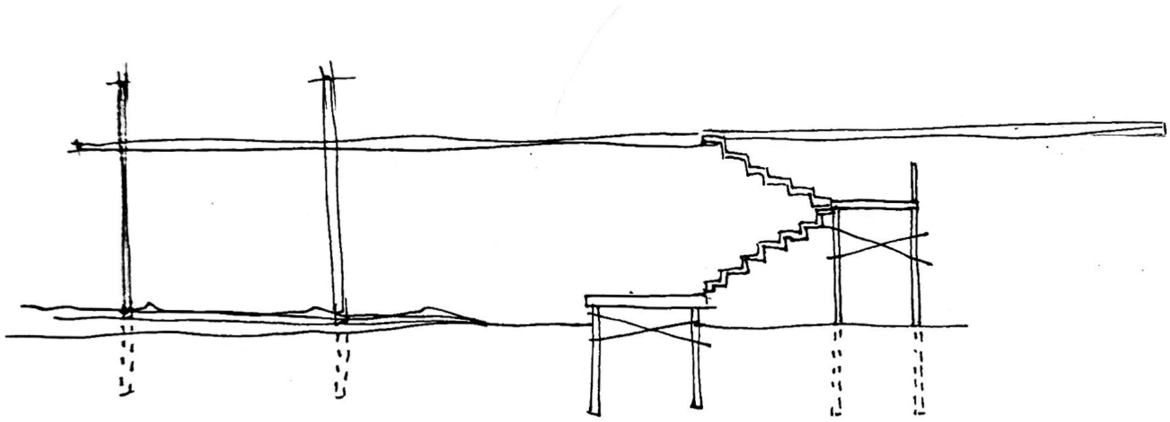
Fig. 50. Conceptual sketch

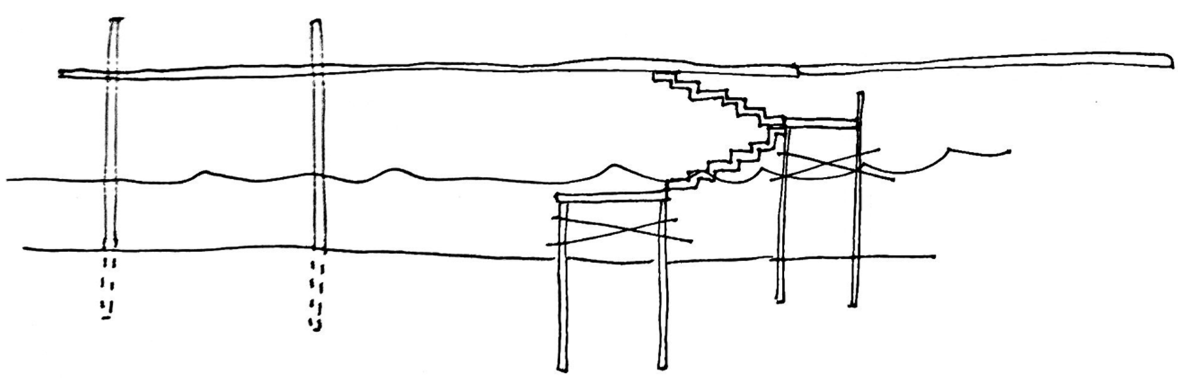
This chapter builds on the literature analysis of coastal erosion and the models of defend, retreat, and coexist presented in Chapter Two, integrating insights from the site analysis to explore the practical implementation of the thesis objectives. It emphasises environmental considerations over human-centric approaches, focusing on enhancing ecological resilience while re-evaluating human interactions.

A central aspect of my theoretical framework involves mapping influences to guide the design process, particularly regarding resilience. This framework addresses coastal erosion and natural disasters while seeking innovation in architectural practices, acknowledging that traditional responses often lack adaptability and flexibility.

The chapter also investigates the potential for architecture to harmonise with nature, questioning whether it can surpass human-focused design. By applying systems thinking, the methodology ensures that designs remain adaptable to uncertain environmental changes.

Through structured analysis, the chapter articulates how the design can create flexible spaces that empower the ecology of Opua, helping to re-stabilise the land and utilise natural infrastructure to mitigate coastal erosion. It presents proposals for three selected buildings, suggesting their relocation onto the water to enhance stability and initiate landscape regeneration. This approach addresses the current threats these structures pose to the landscape, facilitating less human-centric designs and encouraging architecture that collaborates with the environment rather than resisting it.





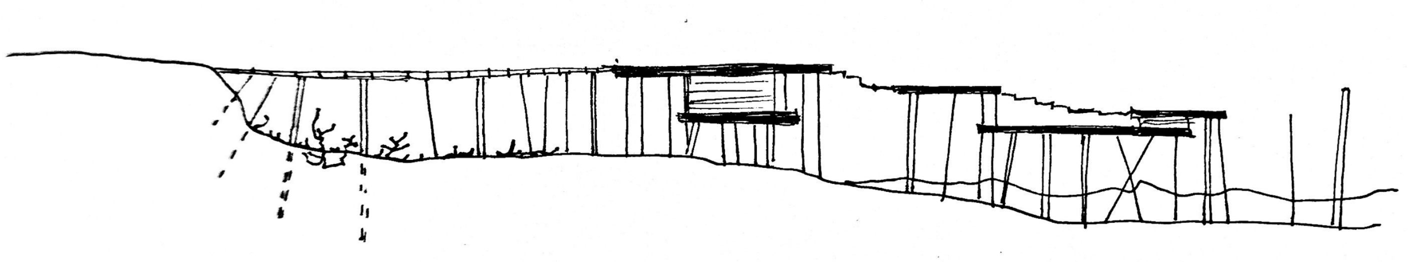
Based on the site analysis, three buildings have been identified as candidates for enhancing both resilience and identity in the face of coastal erosion (see fig. 33.). The proposed designs prioritise ecological and environmental considerations over purely human-centric needs, aiming to reduce damage from natural disasters. The buildings chosen are to act as three case studies that test out how architecture can co-exist with coastal erosion while also making nature a priority. The buildings are only a part of the overall idea of how architecture can begin to co-exist, as the other parts would make this a much larger thesis, and due to the amount of time there was for this thesis that was not possible.

The design philosophy advocates for a re-evaluation of human impacts on architecture, promoting a harmonious relationship between land and ecology. By embracing adaptability and flexibility, the designs facilitate natural systems' flourishing and allow for the dynamic utilisation of spaces.

Adopting a systems thinking approach, the design encourages multiple future possibilities, recognising the inevitability of erosion and advocating for designs that work with natural processes. Current coastal practices often prioritise human interests, leading to conflicts with nature; this design exploration argues for a shift in perspective that values all ecosystem elements equally.

Rather than seeking immediate solutions, which can entrap communities in rigid futures, the systems thinking approach fosters adaptability and creative navigation of challenges. The strategy engages with the complex interplay between the sea, ecology, vegetation, erosion, and community architecture, focusing on the selected buildings and their context.

While I have a personal connection to the community, I aim to promote greater community involvement in the planning process, particularly in light of the potential volatility of weather events. Emphasising resilience is crucial, as landslides can severely impact infrastructure and community well-being.
The proposed design aims to create a sustainable framework for the Opua community, fostering a balanced relationship between human habitation and the natural environment amidst ongoing ecological challenges.



PILES

The building designs are significantly shaped by the strategic placement of piles, which are central to the architectural concept. Additional piles are incorporated around each structure to allow for future extensions while keeping both the buildings and boardwalks unobstructed.

Various pile sizes serve distinct functions: larger piles provide structural stability and support shellfish growth, which aids in water quality improvement. These piles are positioned to allow for the passage of people, dinghies, and kayaks, with additional piles positioned in front of each building to dissipate wave action, mitigating coastal erosion.

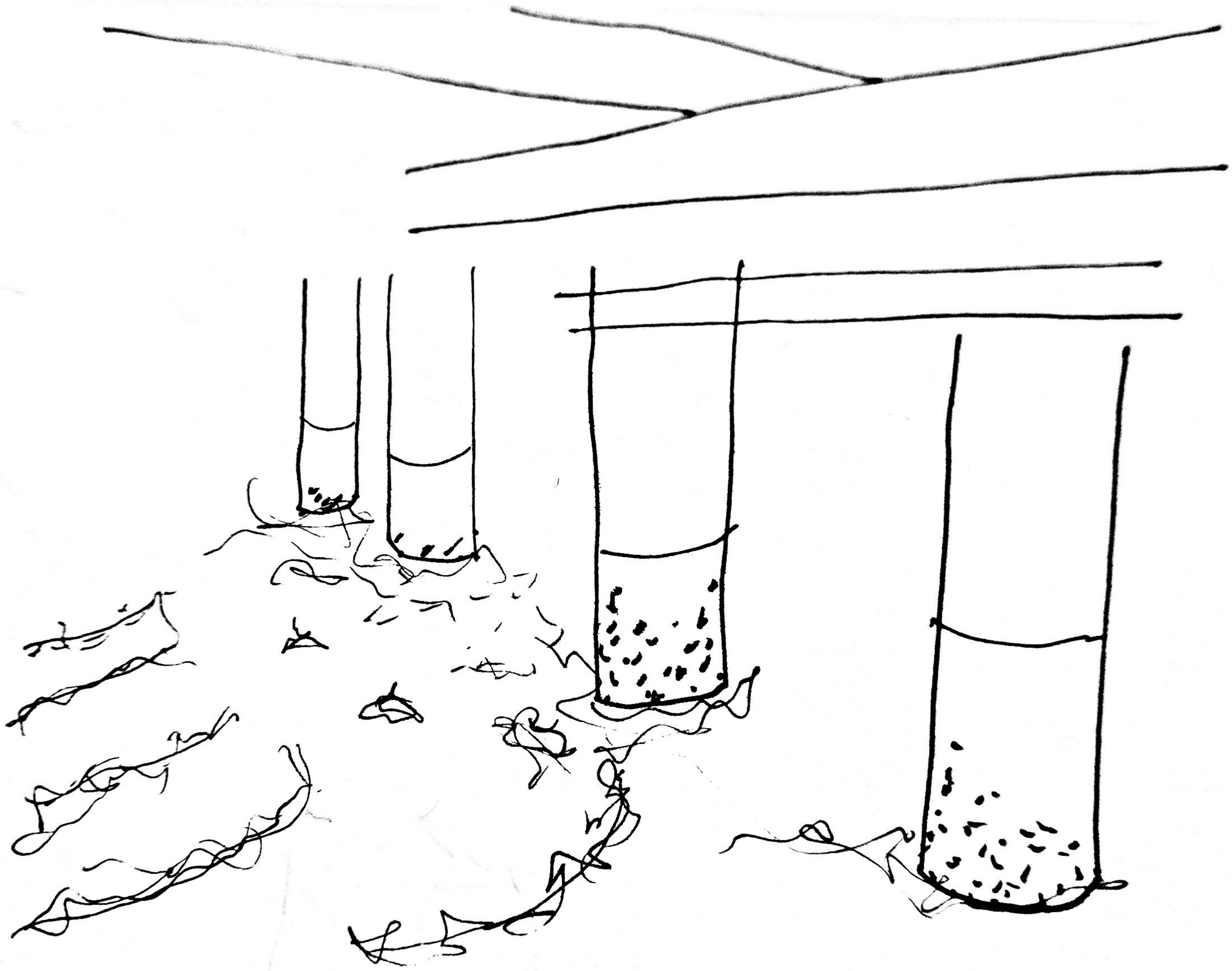
In the front of each building, these piles taper under the boardwalks to support mangrove growth. The arrangement is intentionally structured, with varying densities designed to be visually unobtrusive. Some piles cluster for structural integrity, while others stand independently, allowing for future expansion and maintenance without compromising stability. This design facilitates the replacement of untreated piles without compromising the stability of surrounding structures, ensuring that the removal of one pile does not impact the load-bearing capacity of others.

The primary goal of the pile placement is to prioritise erosion control and promote mangrove growth, fostering adaptation and coexistence with the natural environment. The design philosophy envisions architecture as a self-adapting feedback mechanism, integrating systems thinking to provide multiple pathways and redundancies for flexible future use.

Careful consideration of seabed conditions is essential for integrating buildings into the marine environment, with pile placement crucial for creating suitable habitats for mangroves and other ecosystems. While a grid layout (see fig. 44 & 64.) could enhance access for harvesting mussels, it requires precise measurements to accommodate boats and kayaks.

Further exploration of the layout reveals trade-offs between access and wave mitigation. For example, one configuration may facilitate boat access (Figure) and harvesting of mussels from piles but inadequately mitigate wave wakes, while another may optimise wave dispersion while promoting organic development of mangroves at the expense of navigation (see Fig. 2, 22, 34, 43)

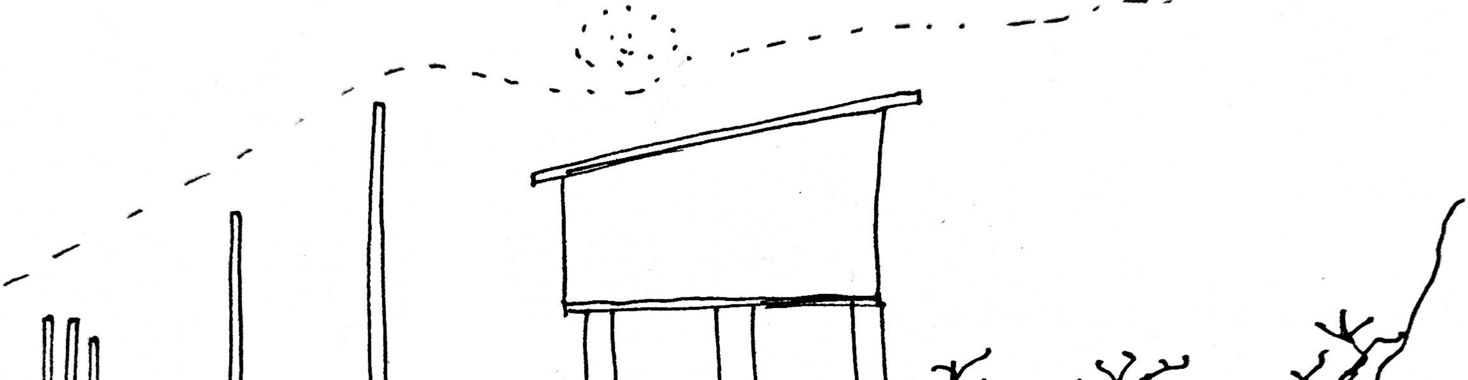
These designs harmonise ecological considerations with architectural innovation, emphasising adaptability and a cohesive relationship with the marine environment.



MANGROVES

Mangroves will be strategically established along the beach and integrated throughout the piles under the boardwalk, serving as a protective barrier for the shoreline by dispersing incoming water and wave action. This initiative will enhance the site's ecosystems, providing habitat and safety for fish and other marine organisms while shielding them from predators. Additionally, the mangroves will function as a natural filtration system, effectively removing pollutants from the water that may originate from drains or boats.

This approach exemplifies systems thinking, as it recognises the organic interactions within the ecosystem. Mangroves act as if there are no rules or leadership guiding their movements; instead, they emerge and grow naturally. By implementing these small interventions, a ripple effect that positively influences the entire system can be created.

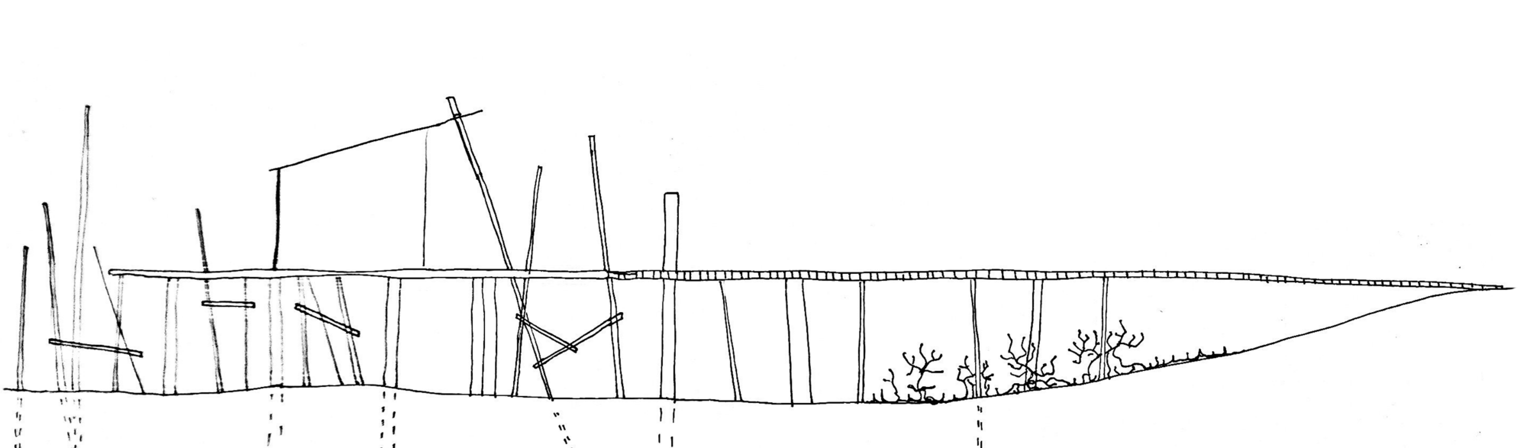


BOARDWALK

The design of the boardwalk is intended to mimic the shape of the mangroves situated beneath it, encouraging users to consider their approach to and departure from the three buildings, each of which offers multiple pathways for movement between them (see fig. 58 & 64) . The curves of the boardwalk provide a contrast to the more rigid lines of the buildings, symbolising the historical dominance of human design. This contrast illustrates the gradual transition toward a co-existence model, where design prioritises environmental and ecological considerations, thereby encouraging humans to adapt to their surroundings.

This approach explores the concepts of flexibility and adaptability in architectural design, questioning what it means to create spaces that can evolve over time. By identifying these buildings within Opua, the design opens up opportunities for new connections and reconnections, recognising that rigid pathways are no longer suitable for contemporary challenges. This architecture embodies a new way of thinking, emphasising adaptability.

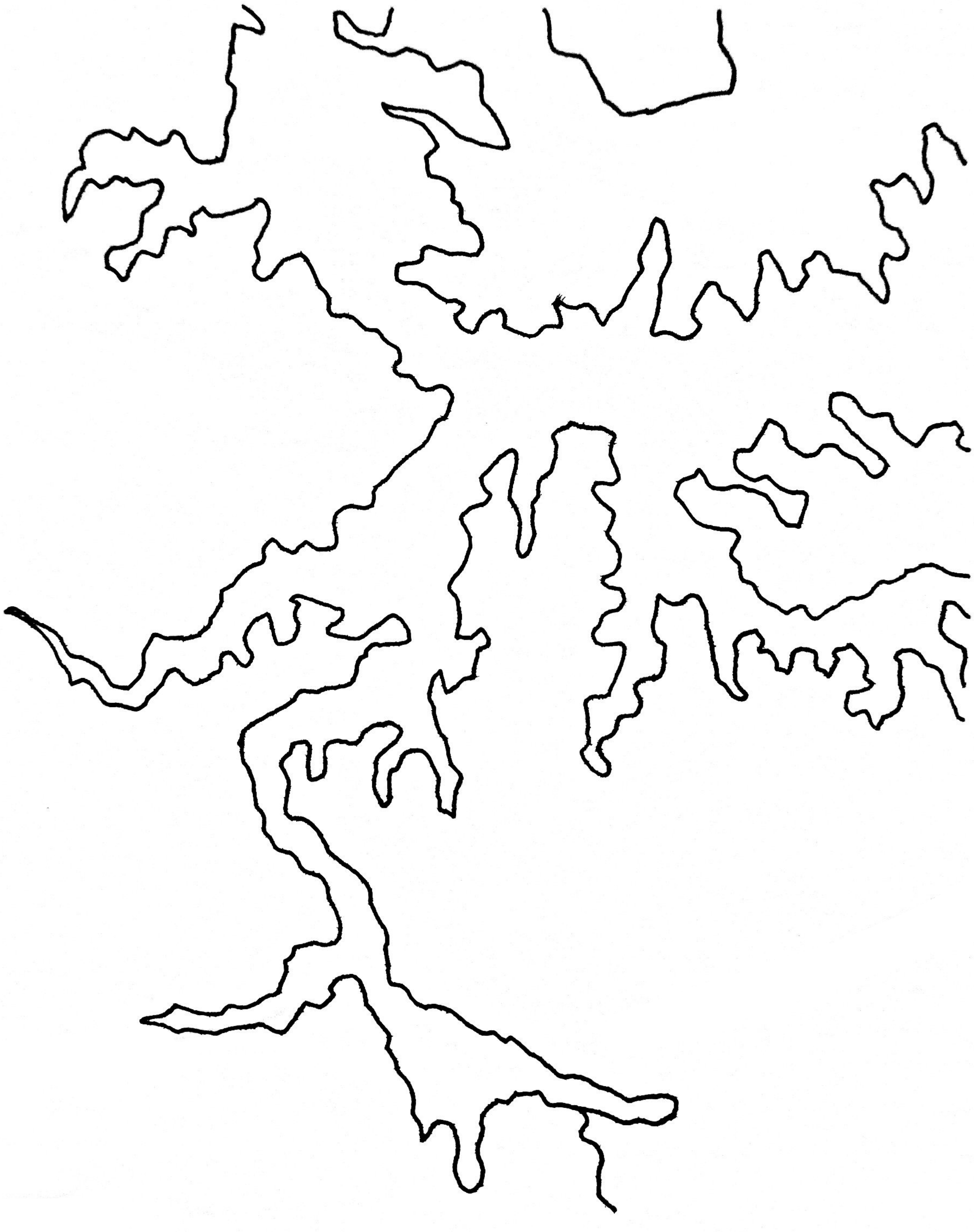
The design language employed creates spaces that accommodate diverse forms of life, including providing hiding places for fish, thereby showcasing the limitless potential of each design element and its capacity to enhance the ecosystem.



ROOF

The roofs of the buildings have been reconfigured from their original designs to enhance functionality. They are now angled to optimise solar gain while accommodating vegetation, which provides protection against harsh winds. This sloped design allows the roofs to align with the prevailing wind direction, facilitating airflow rather than resisting it.

The vegetation on the roofs will consist of small species of coastal flax and grasses, which visually and ecologically extend the landscape. This design choice emphasises the idea that the coastline does not simply terminate at the water's edge but continues beyond traditional boundaries, reinforcing the connection between the built environment and the natural landscape.



ECOLOGY

By relocating buildings onto the water, a process where additional structures follow suit over time can be initiated. This transition allows the land to begin regenerating and stabilising naturally, enhancing its resilience without reliance on man-made interventions. As a result, biodiversity is likely to flourish, with increased populations of flora and fauna, including birds and insects.

One of the significant benefits of this approach is its profound influence on the ecology of the site; it fundamentally alters the shoreline, creating a stronger connection to the coastline. This raises intriguing questions about the nature of water and land—can they truly be distinguished when one can stand in shallow water?

This philosophical and poetic exploration in design encourages us to reconsider the dichotomy of water and land. Instead of viewing them as separate entities, we should recognise them as interconnected systems with which we coexist. By embracing these rhythms and systems, we can create designs that align with natural processes rather than oppose them.

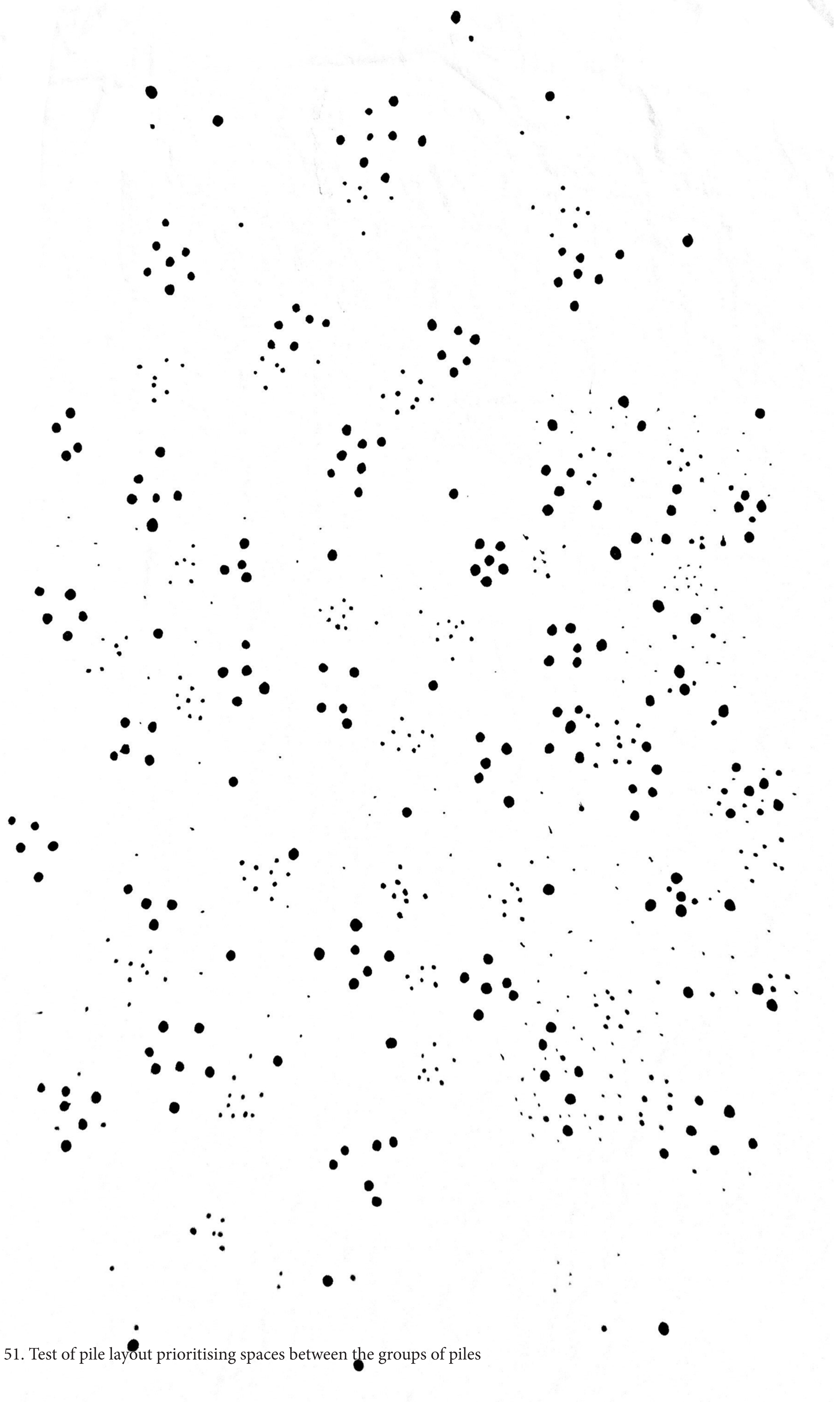


Fig. 51. Test of pile layout prioritising spaces between the groups of piles

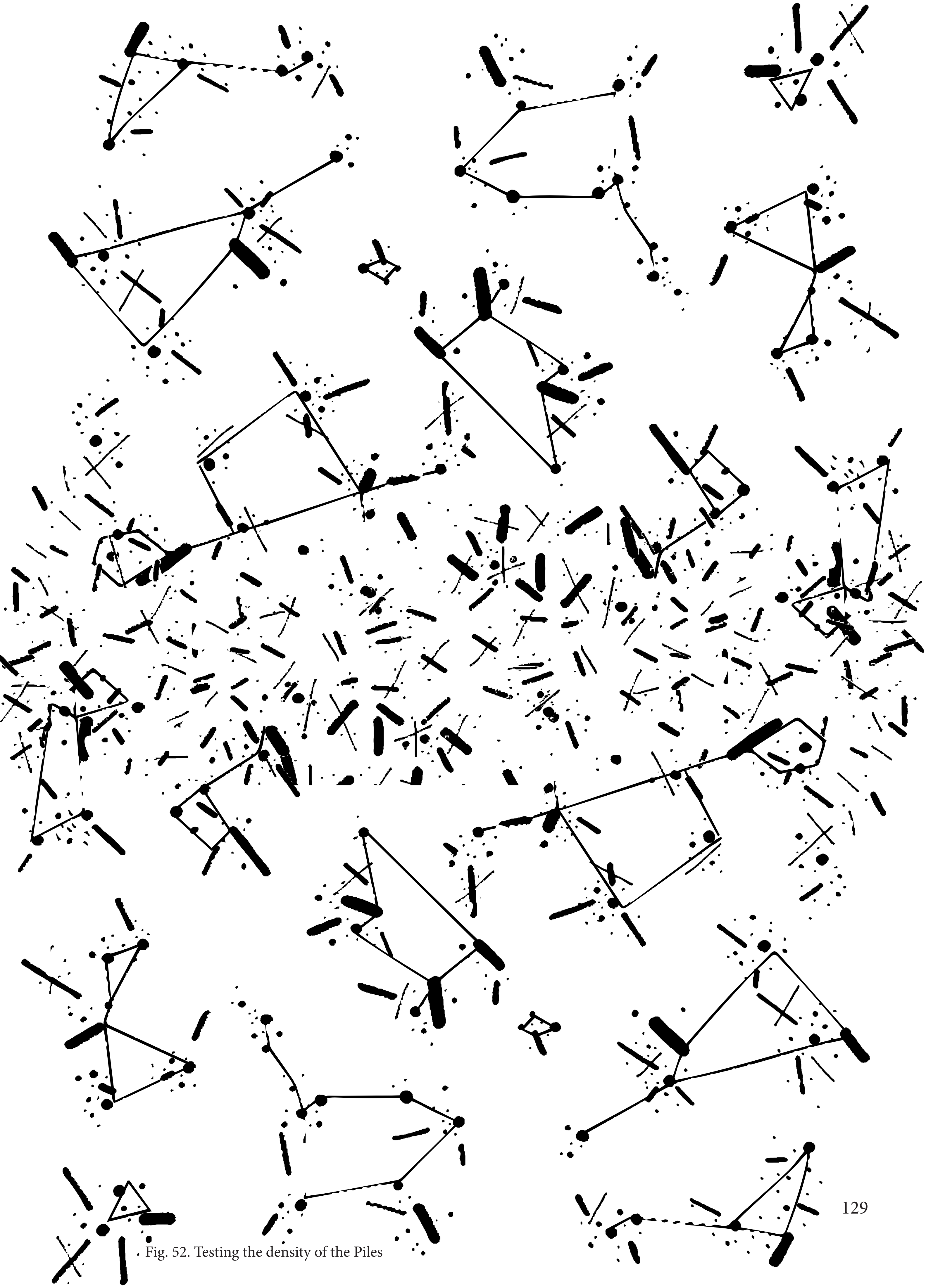


Fig. 52. Testing the density of the Piles

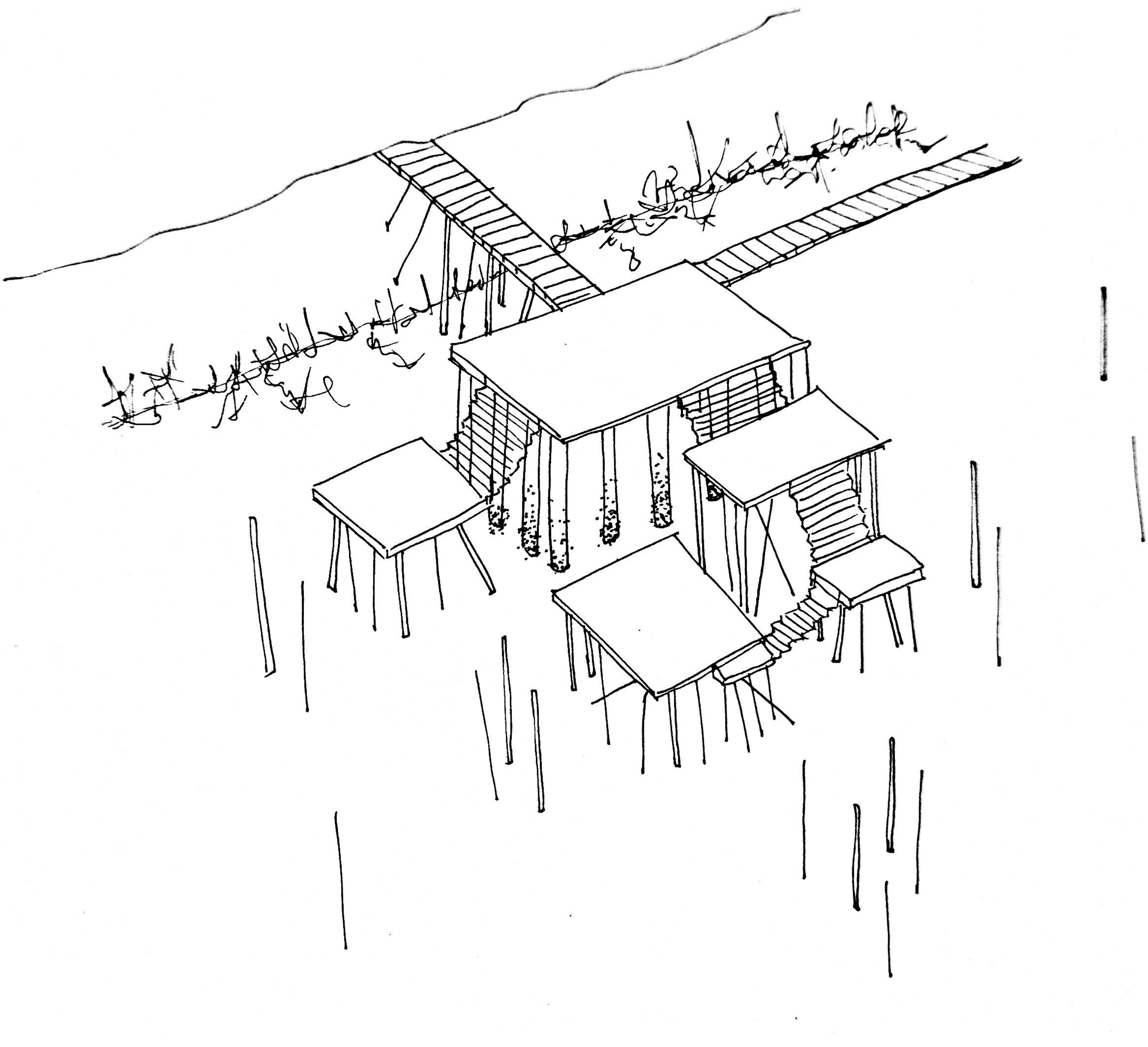


Fig. 53. Conceptual sketch bring people level with the sea

THE COMMUNITY HALL

Fig. 54. The Opua Community hall today

In the heart of the Opua community stands a beloved community hall, a cherished Opua heritage building that has been a focal point for 89 years. Each week, its doors have welcomed residents, creating a tapestry of memories that will undoubtedly continue for generations to come. However, the hall's location—nestled near the beach with a steep cliff looming behind—poses a growing threat. The risk of a slip looms large, threatening to cause significant damage to this storied structure.

Recognising the need for action, the community has decided that relocation is the only viable path forward. Plans are set in motion to move the hall to a new site closer to the water's edge, where it can continue to thrive. In preparation for this move, sturdy piles are installed to support the structure, allowing it to settle naturally into its new foundation.

As the day of relocation approaches, the reality becomes clear: the hall, after nearly a century of use, has begun to show signs of instability. This presents an unexpected opportunity—not just for preservation, but for renewal. With the hall needing to be rebuilt, the community envisions a future where its walls can be slightly altered to better fit the contours of the new foundation. Additional piles are being strategically installed to accommodate the anticipated future shift of buildings from land to water. This creative adaptation promises to breathe new life into the building, opening the door to fresh stories and possibilities that will enrich the lives of all who gather within its walls.

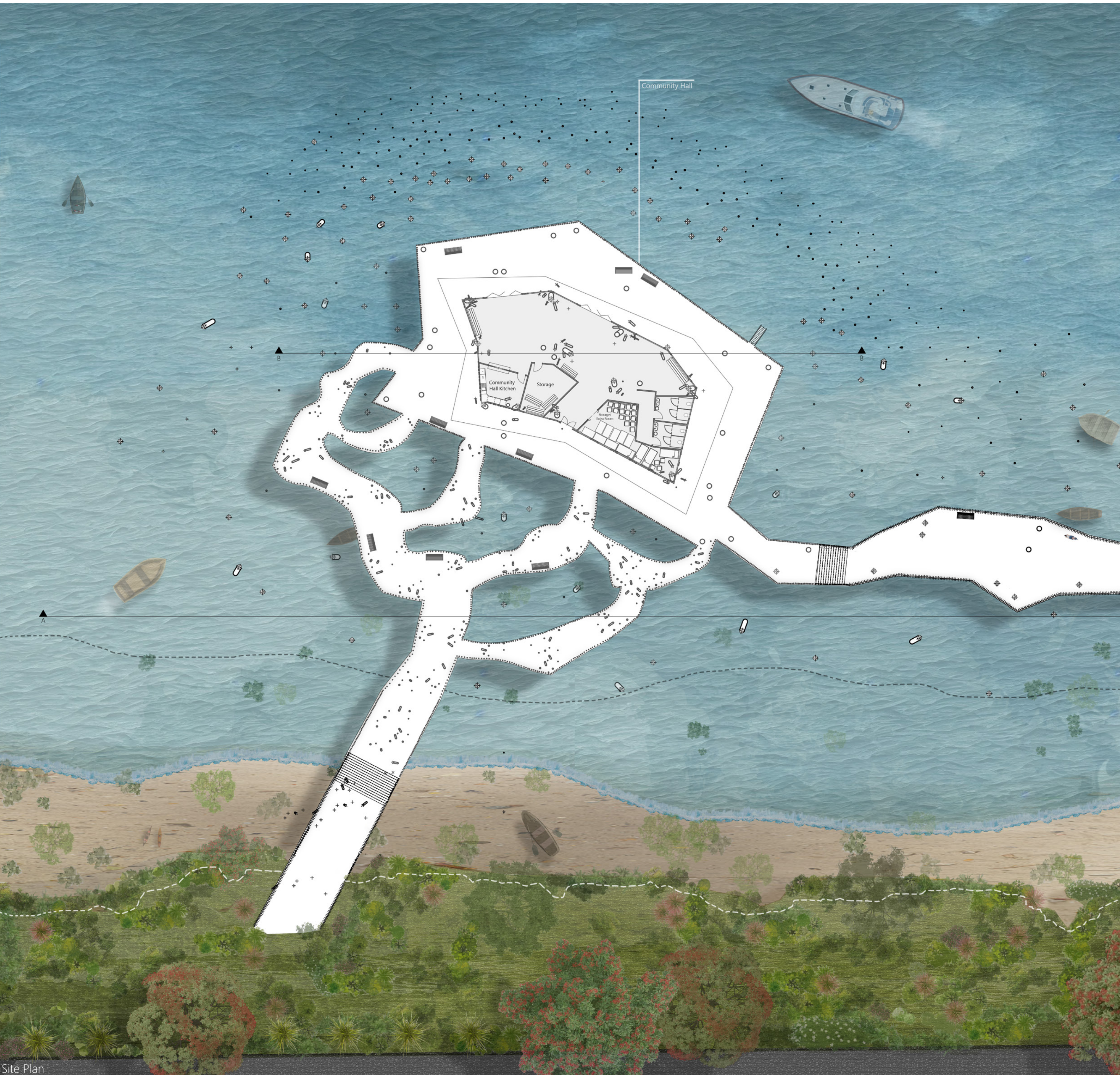
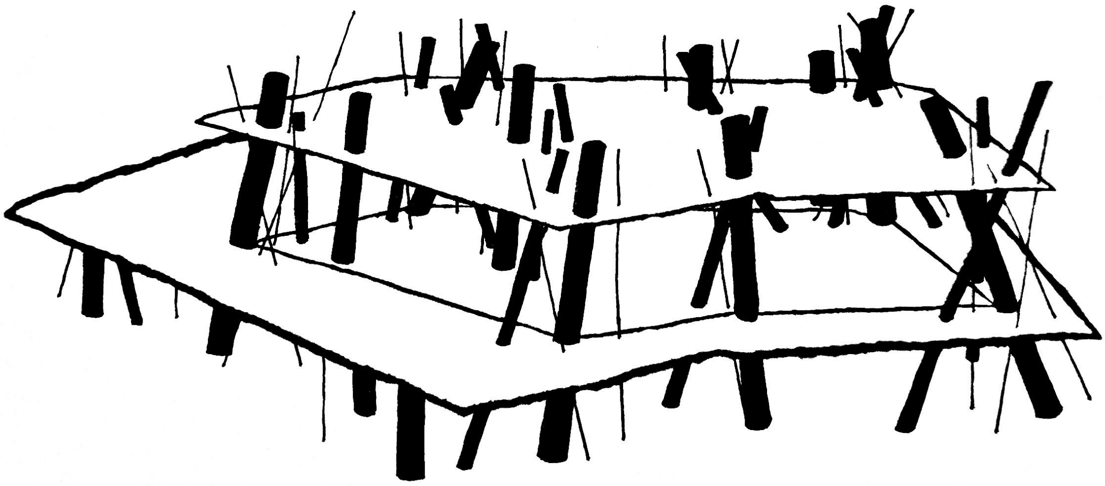


Fig. 55. Plan showing the different access paths to and from the building



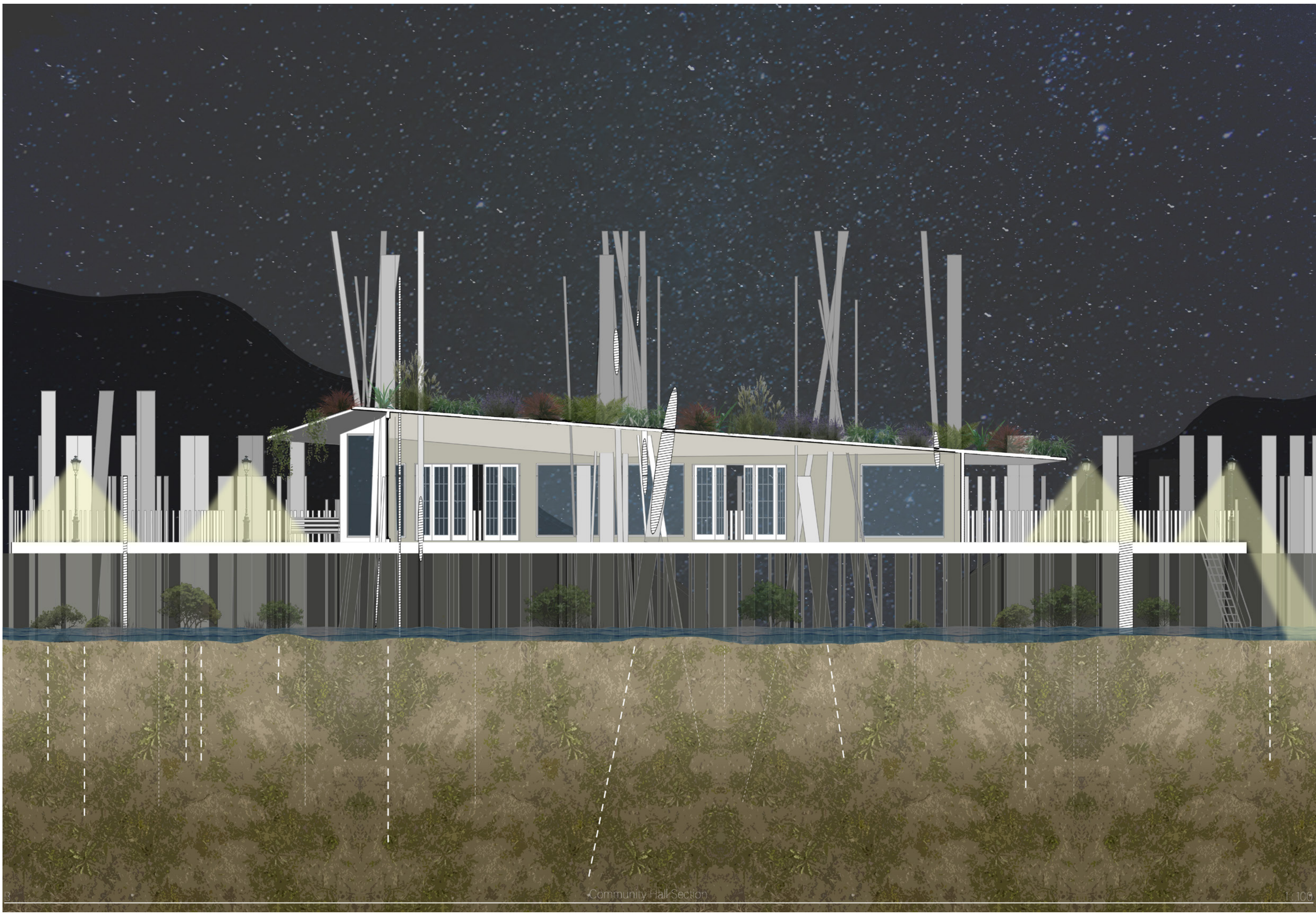


Fig. 56. Section A. The Piles supporting the building and environment

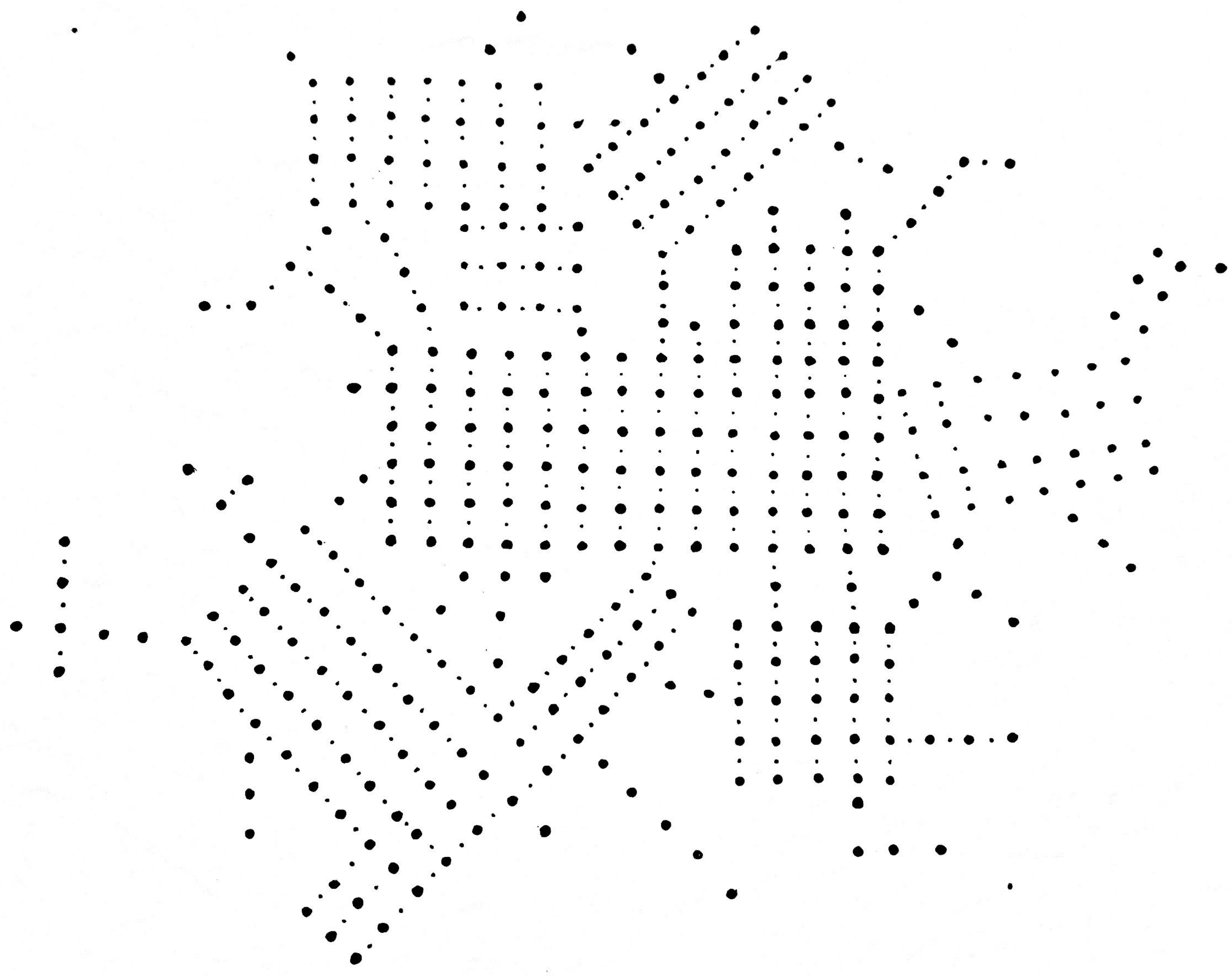


Fig. 57. A test of a more structured grid of piles

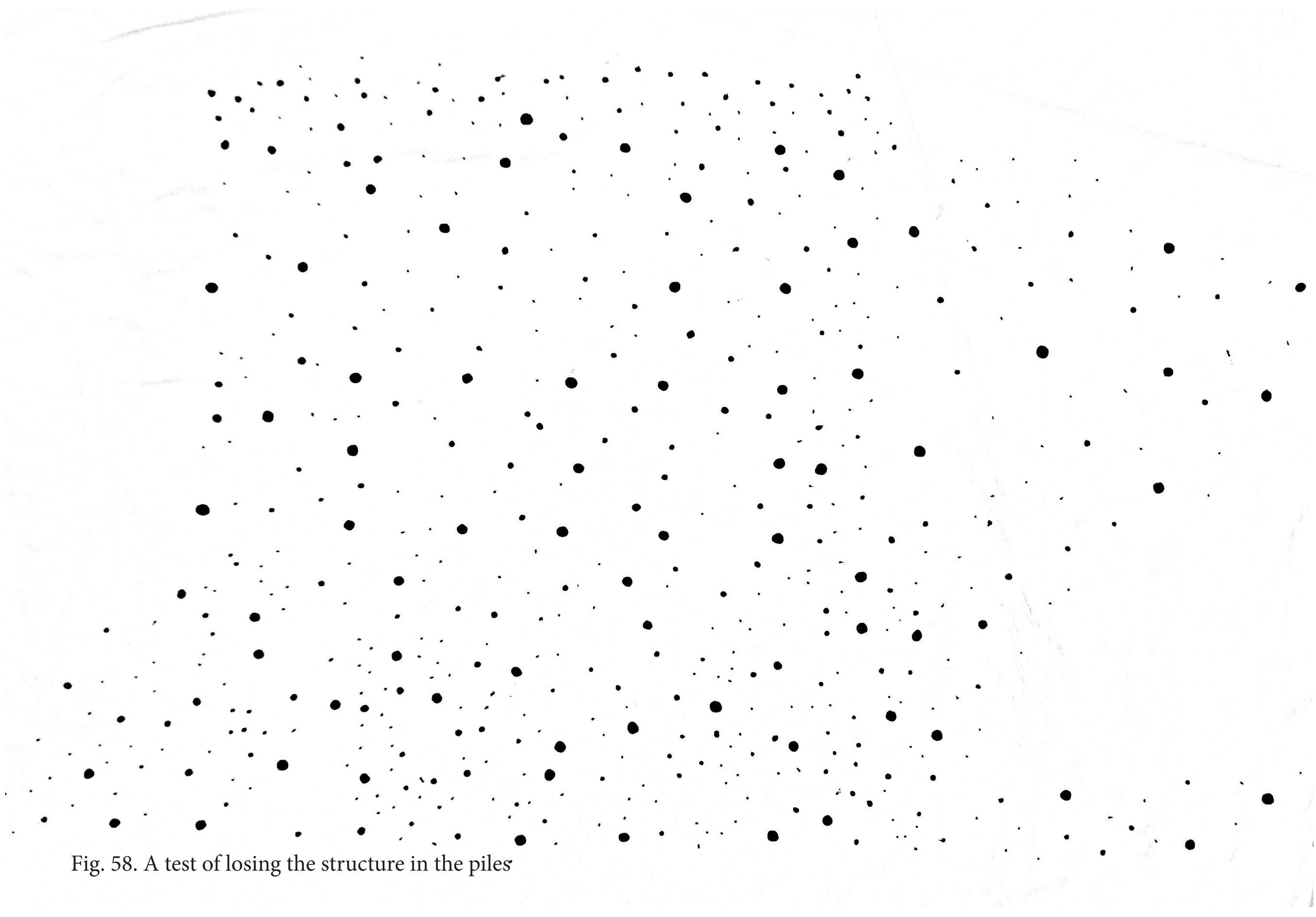


Fig. 58. A test of losing the structure in the piles

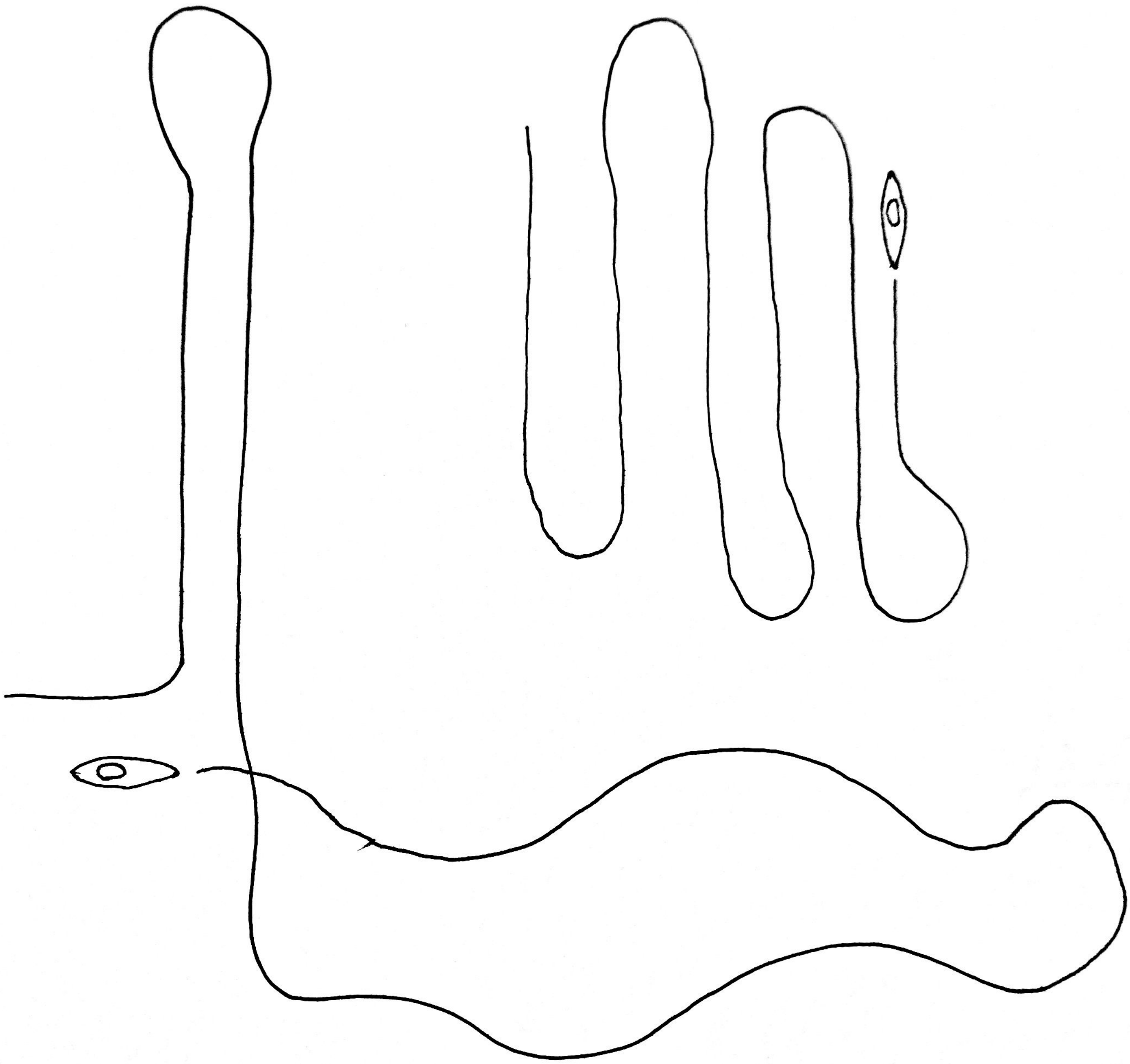


Fig. 59. A sketch path of a 3.9m kayak

Fig. 60. A moment inside the Community hall builidng

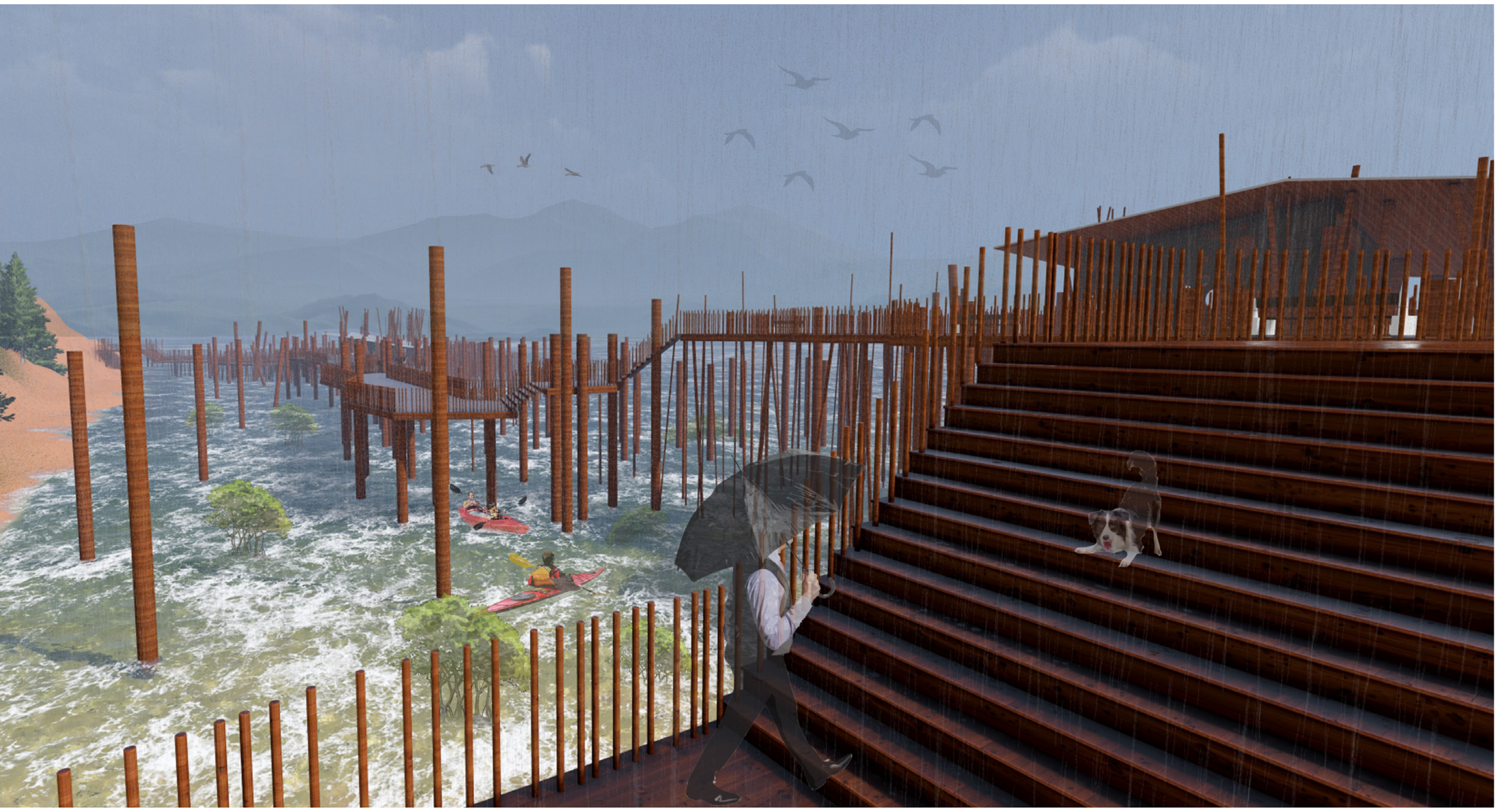


Fig. 61. Outside looking at the piles both under and infront of the building

THE OLD OPUA STORE

Fig. 62. The Old Opua store today

Nestled within the Opua community, stands the Old Store, a beloved landmark that has supported generations of residents. Over the years, it has adapted to various retail roles, evolving alongside the needs of the community. As a well-maintained heritage building, it holds a special place in the hearts of those who call Opua home.

Today, the Opua Store thrives as a hub for three distinct programs: Total Marine Engineering, a popular fish and chips shop, and the local Coastguard. Each day, the building buzzes with activity, connecting people and fostering a sense of belonging. Though the Opua Store has always been supported by piles over the water, this foundation has come to restrict the natural movements of the land around it. Recognising the need for a solution, the community envisions a new beginning for the building. Plans are set in motion to install new piles along the beach, mirroring the approach taken for the nearby community hall.

In anticipation of this change, the community works together to establish the new foundation, allowing it to settle and adapt to the rhythm of the water with additional piles being integrated into the structure to prepare for the eventual transition of buildings from land to water. As the Opua Store prepares for its transformation, it looks forward to a future where it can embrace new possibilities, all while remaining a cherished part of Opua's vibrant story.

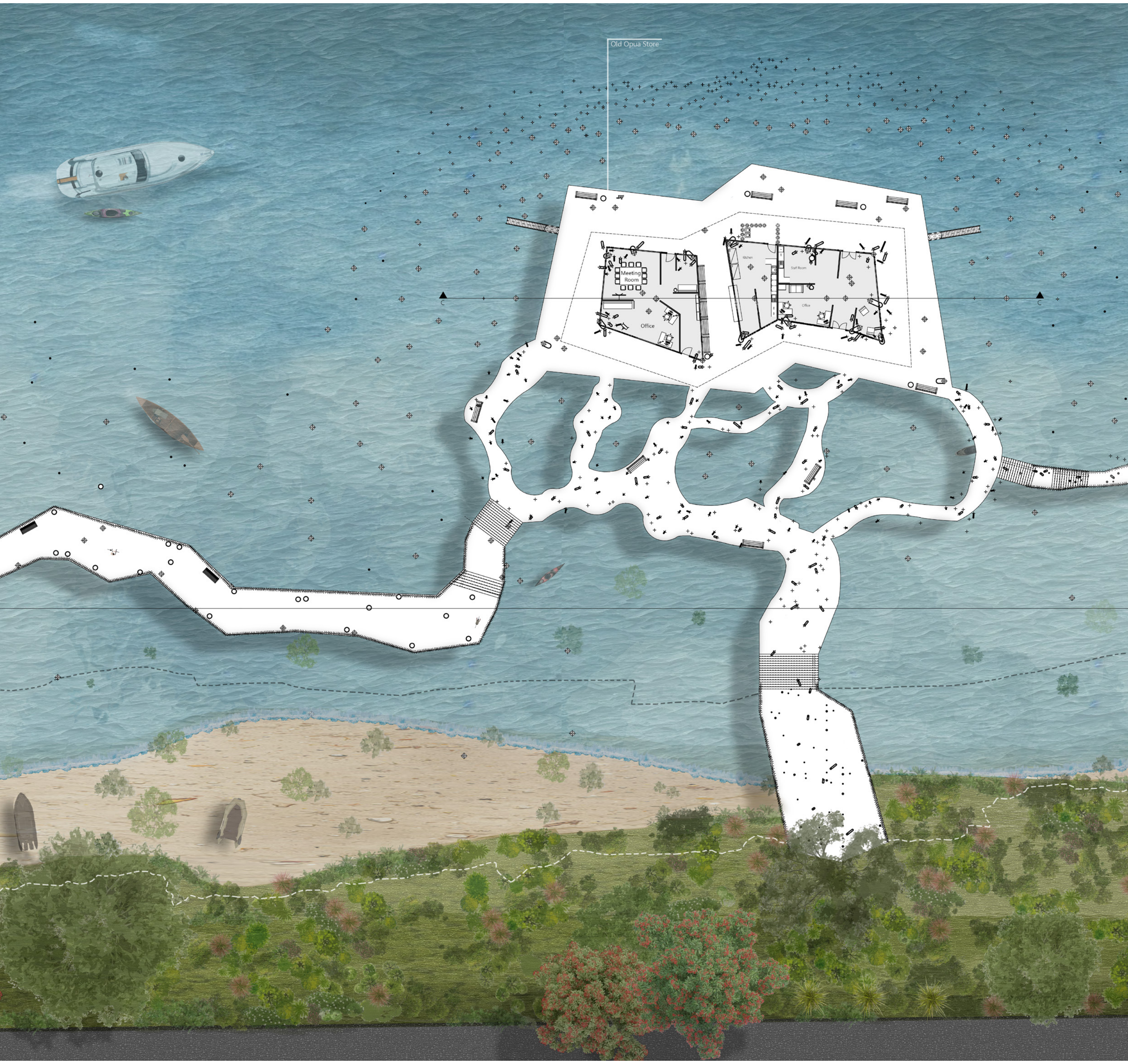


Fig. 63. A Plan showing the additional piles for future extensions

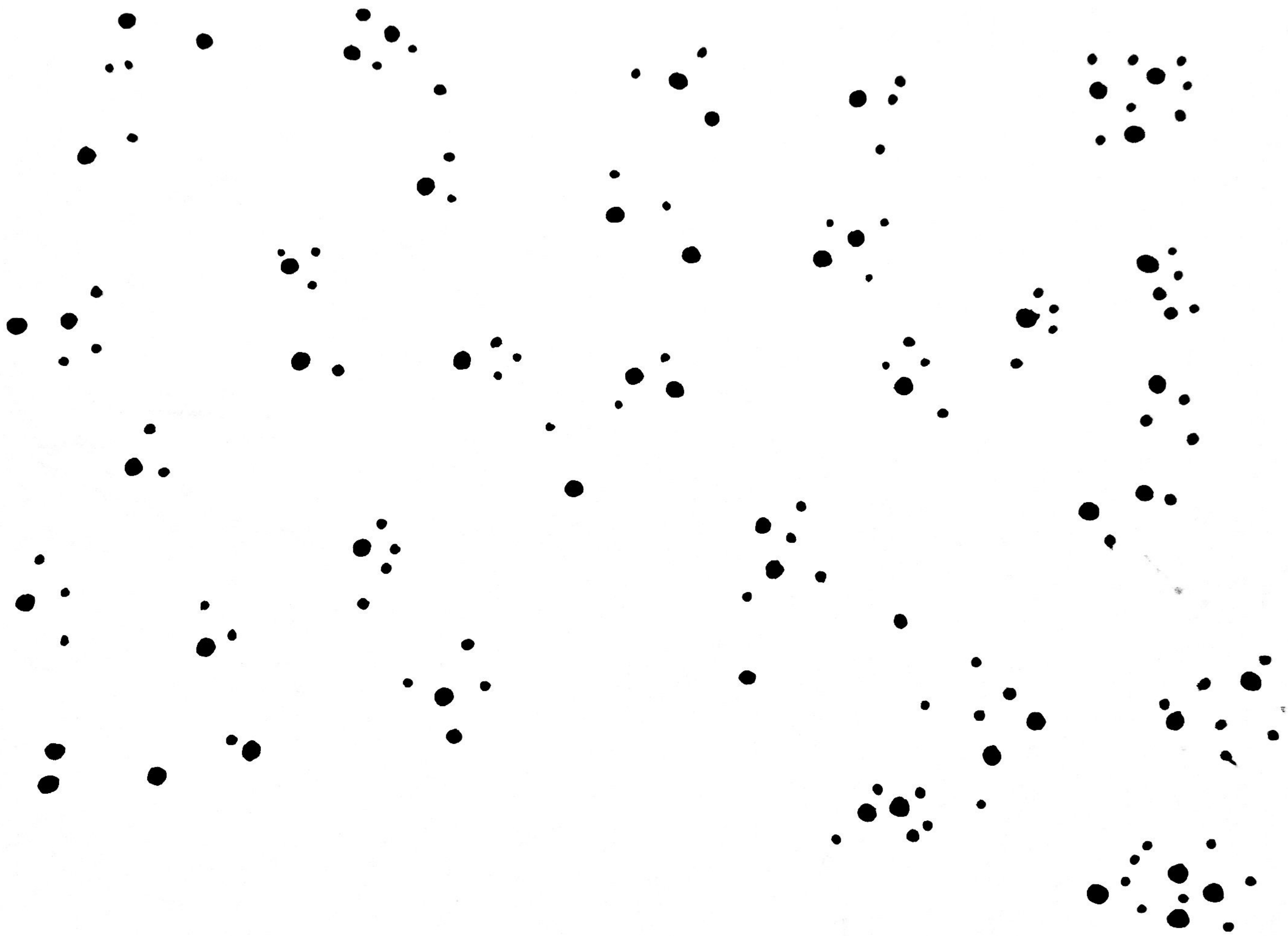


Fig. 64. Another test of pile placement

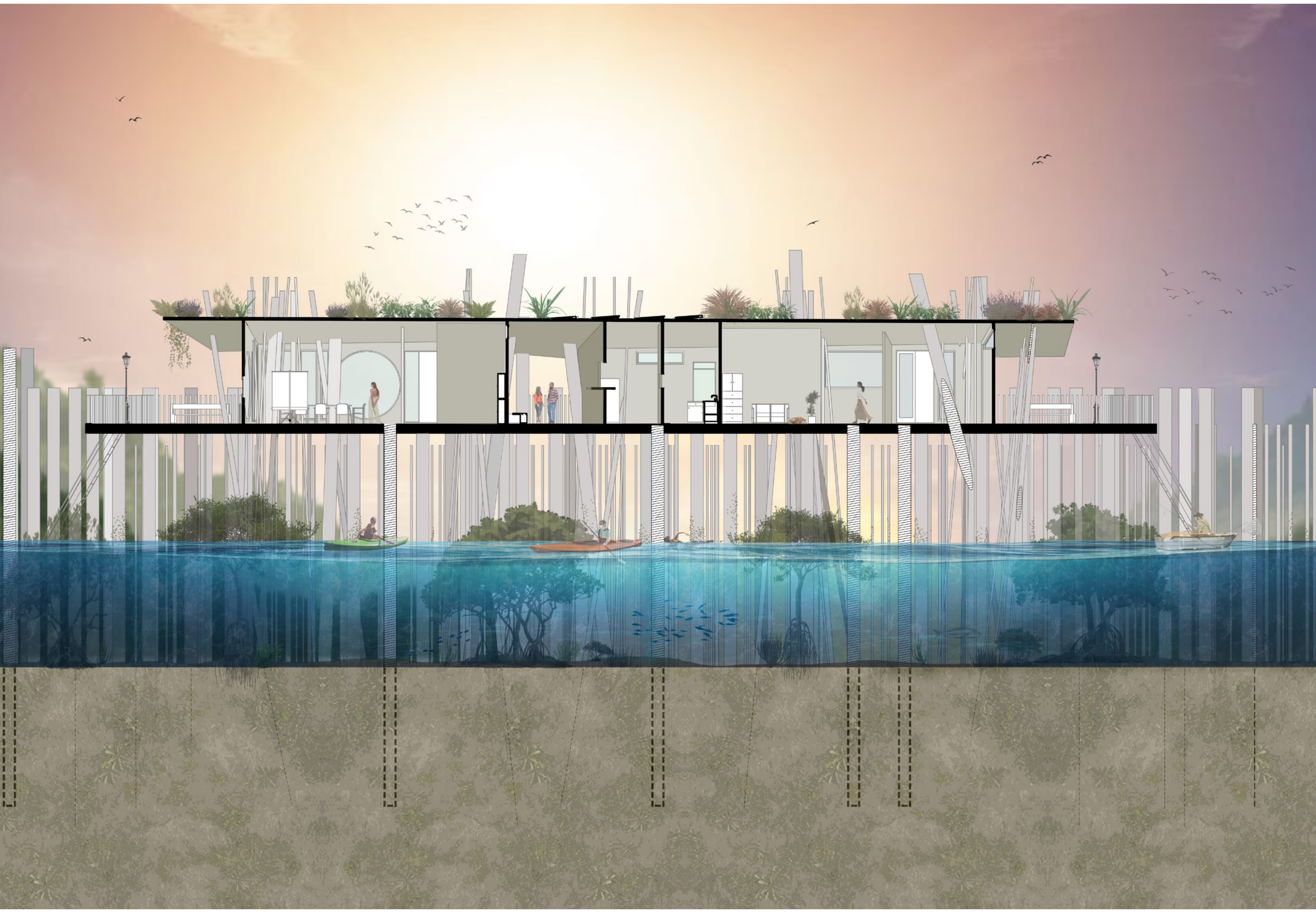
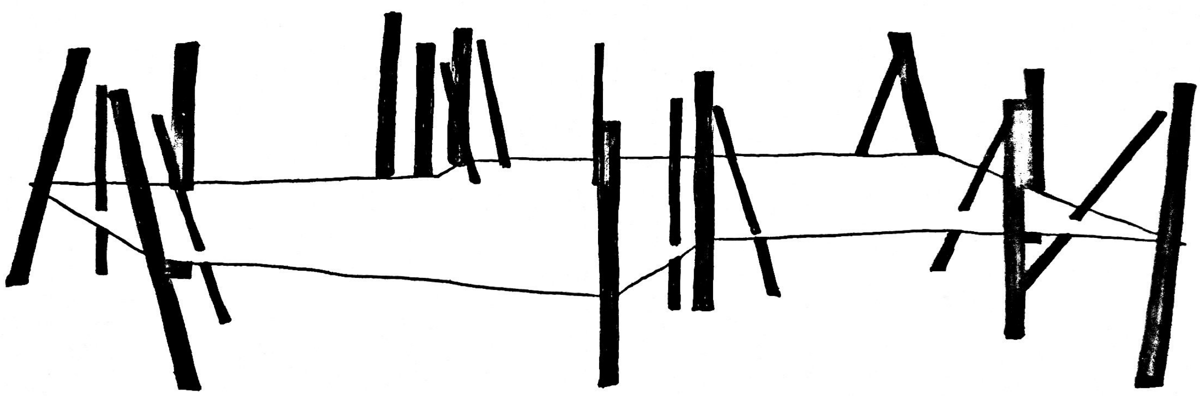


Fig. 65. Section A. Showing the spatial arrangements influenced by the piles.

Note: This is a black and white version of the drawing which will be substituted by the colour version that is to be presented in the examination. The image is still in progress at the time of submitting the exegesis and this image will be replaces by the final coloured version that includes people and foliage.



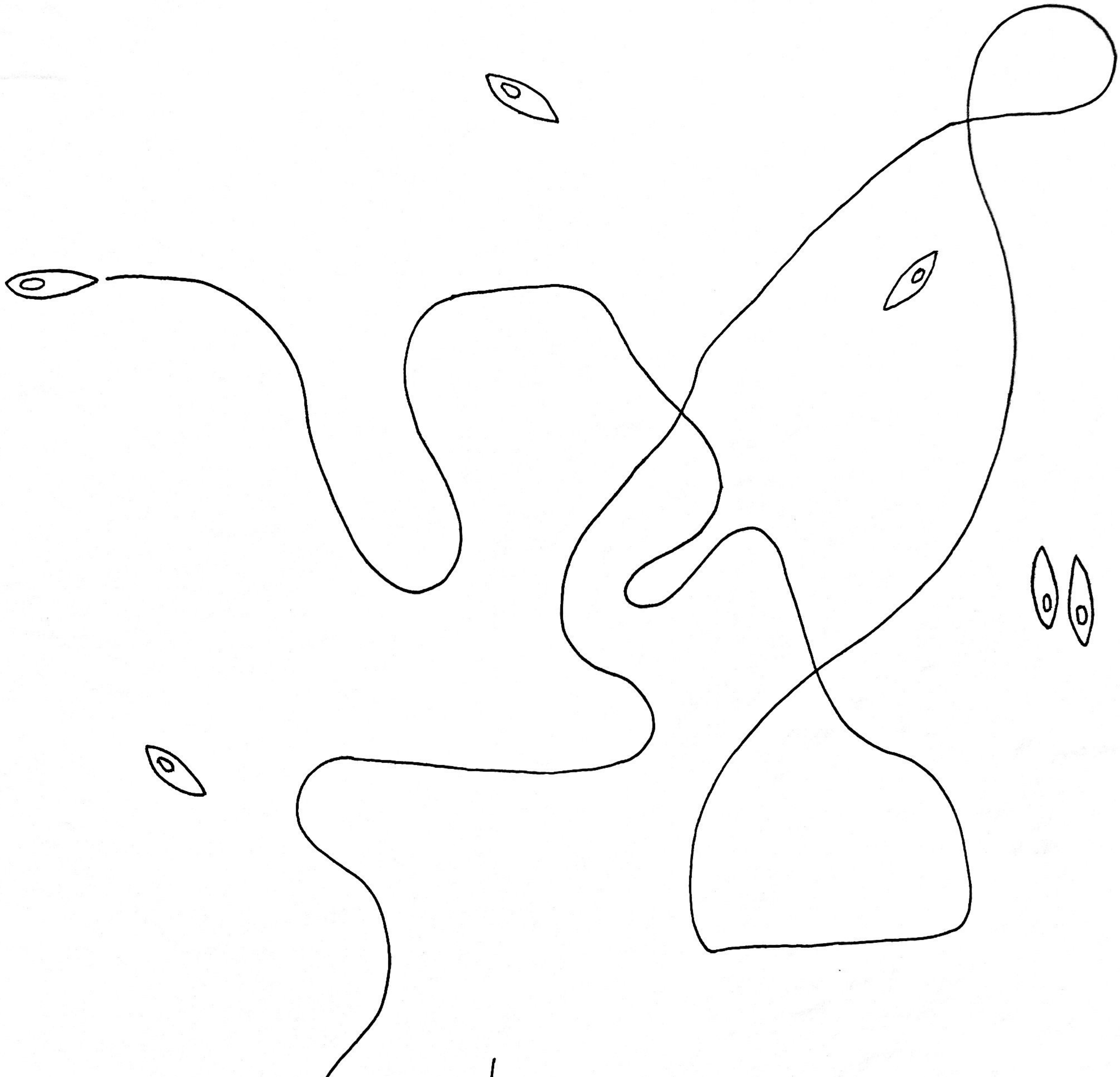


Fig. 66. Exploring the movement of a kayak

Fig. 67. A moment inside the Opua old store in the customs building.

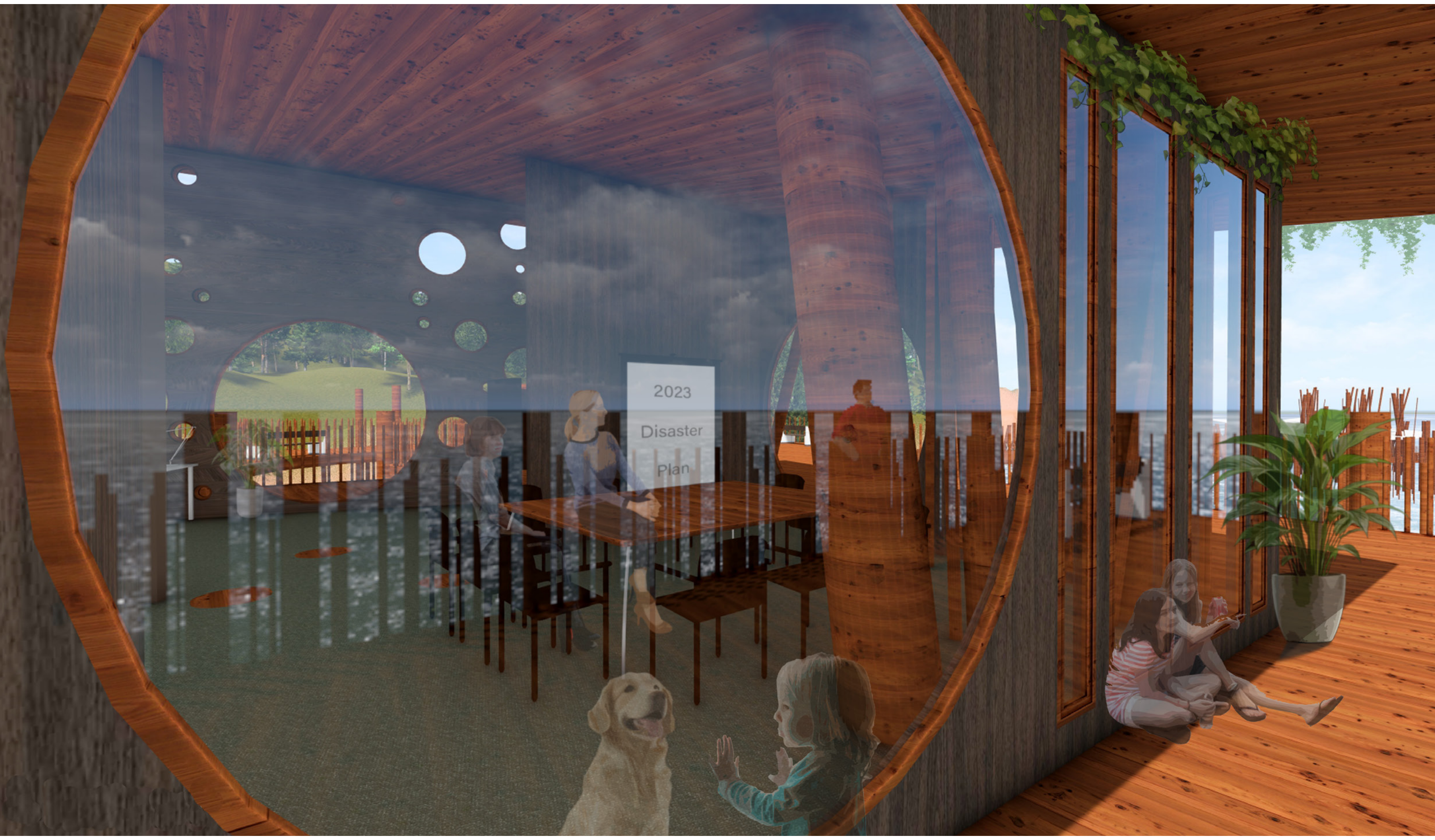


Fig. 68. A young girl looking into the customs building watching

THE GENERAL STORE

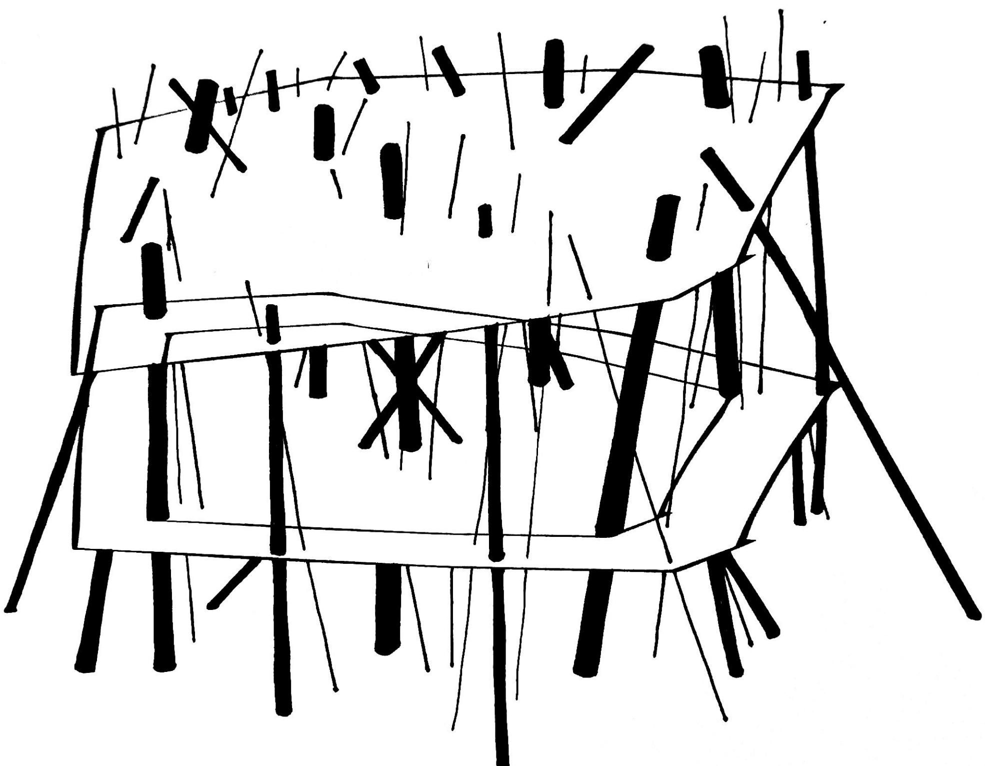
Fig. 69. Image of the General store today

In Opua, the General Store stands as a beacon of community spirit, a relatively new addition designed to meet the needs of a growing population and the steady stream of travellers en route to Russell and beyond. This vibrant building serves as a crucial hub, offering a range of services that include a food store, fishing equipment, postal services, a café, and even a pizza takeaway and ice cream shop. Its modern design and well-maintained facade make it a welcoming spot for locals and visitors alike.

As time goes on, the community envisions expanding the General Store to accommodate even more activities, including a marketplace where residents can gather to buy and sell fresh produce, reminiscent of a farmers' market. However, the store's current location—perched on piles above the water—limits the natural movement of the land beneath it.

Recognising the need for change, plans are set in motion to relocate the General Store to join its older neighbours by the beach. Before the move, new piles will be installed to ensure a stable foundation, with additional supports added for the new expansion. As the community comes together to prepare for this transformation, more piles are being incorporated to prepare for the future migration of buildings from the land to the water. The General Store looks forward to a bright future, ready to embrace its new role in enhancing the seafront and fostering resilience in the face of change.

Fig. 70. Plan showing the additional extension requested by the community.



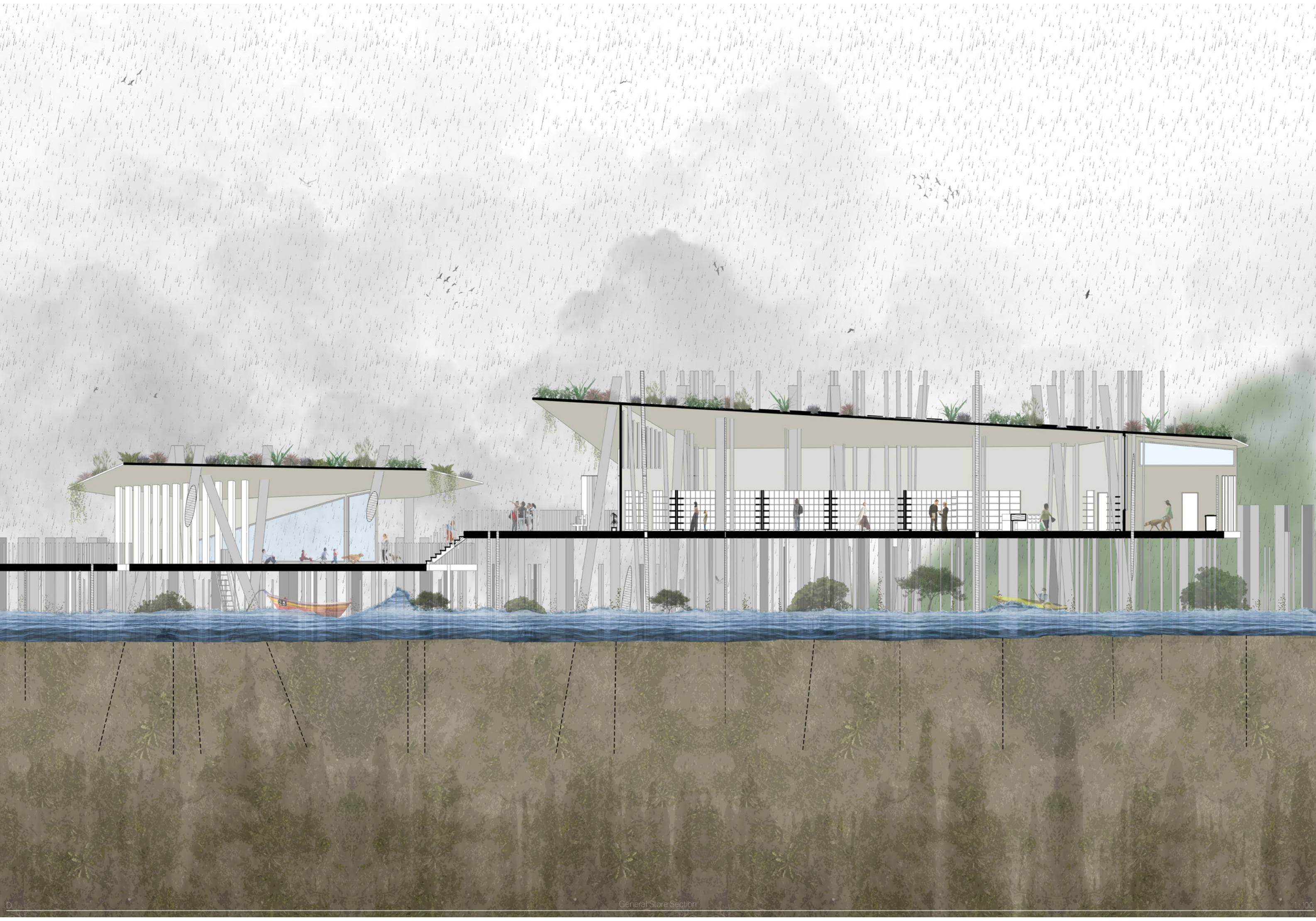


Fig. 71. Section A of the Opua store shows the interior spaces within the piles

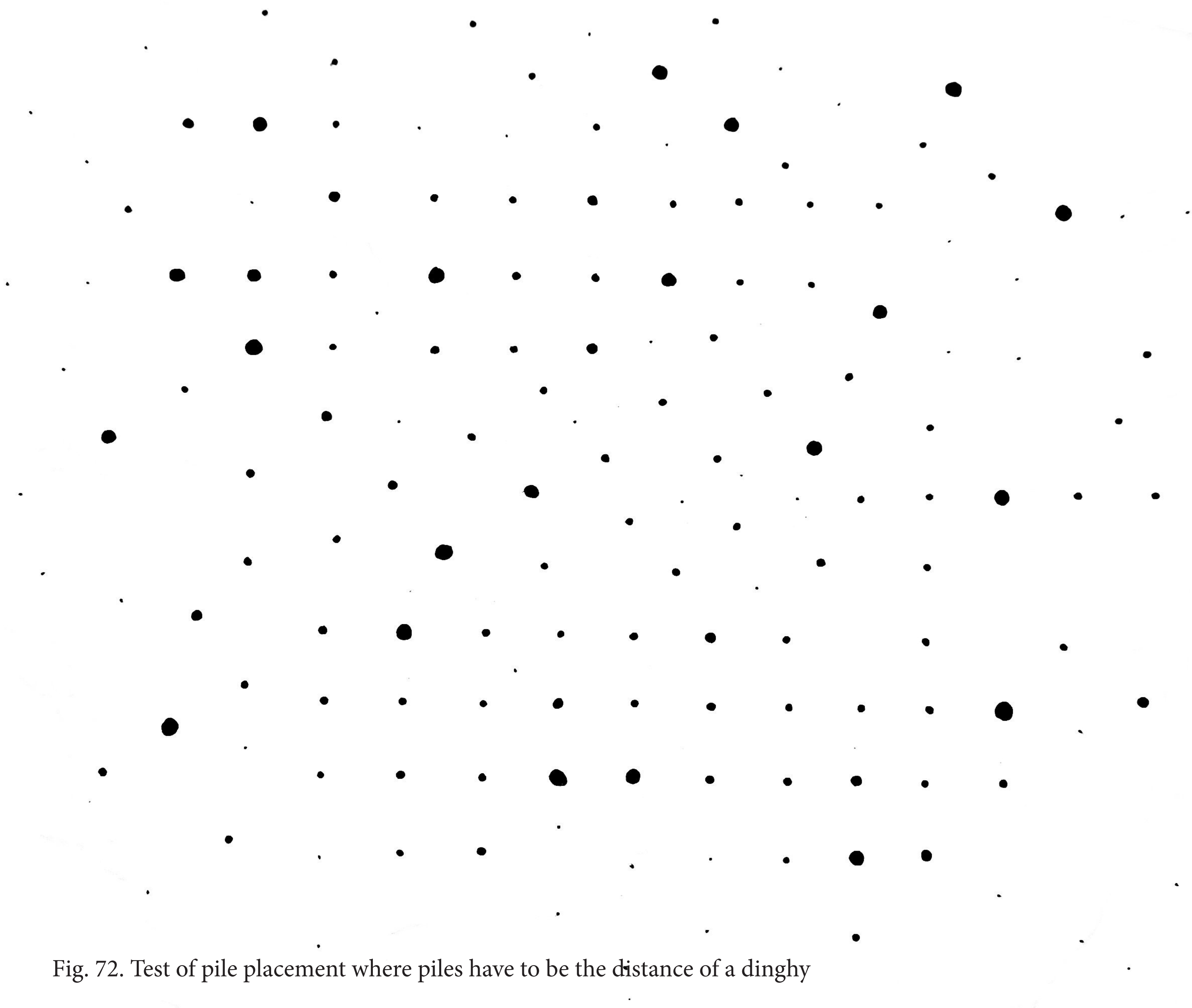


Fig. 72. Test of pile placement where piles have to be the distance of a dinghy

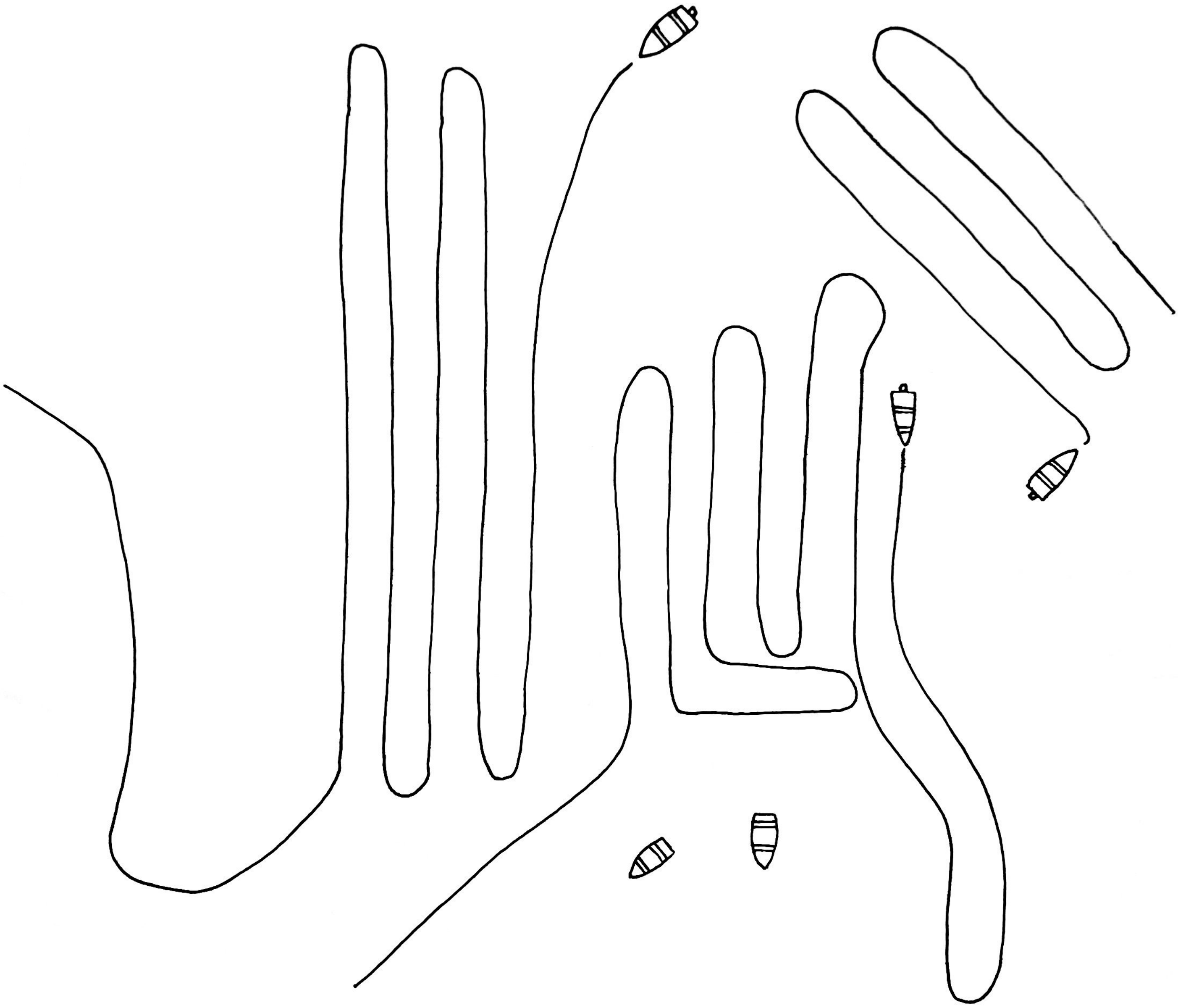


Fig. 73. Drawing the path of a kayak in a structured setting

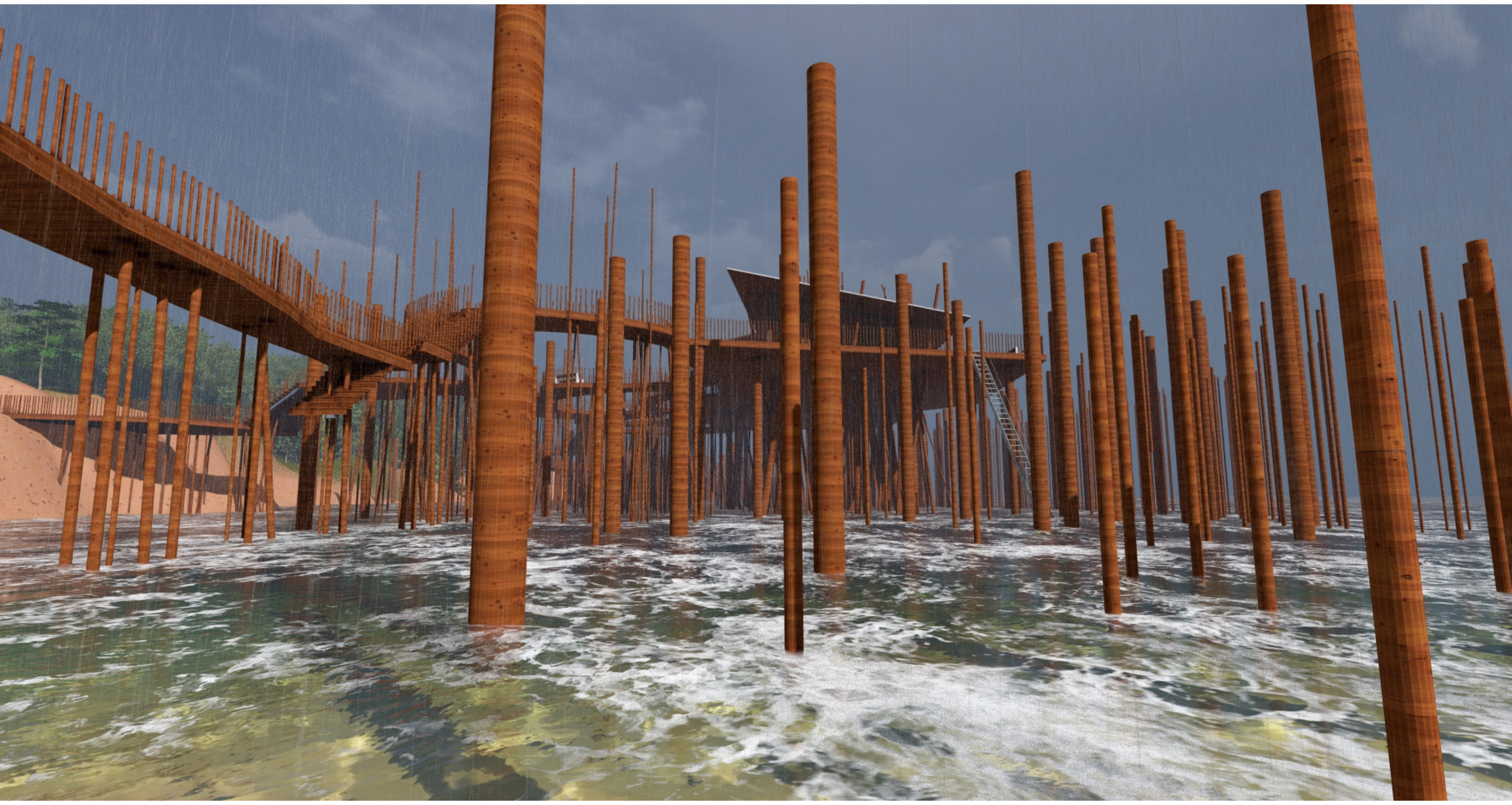


Fig. 74. The density of piles outside the General store

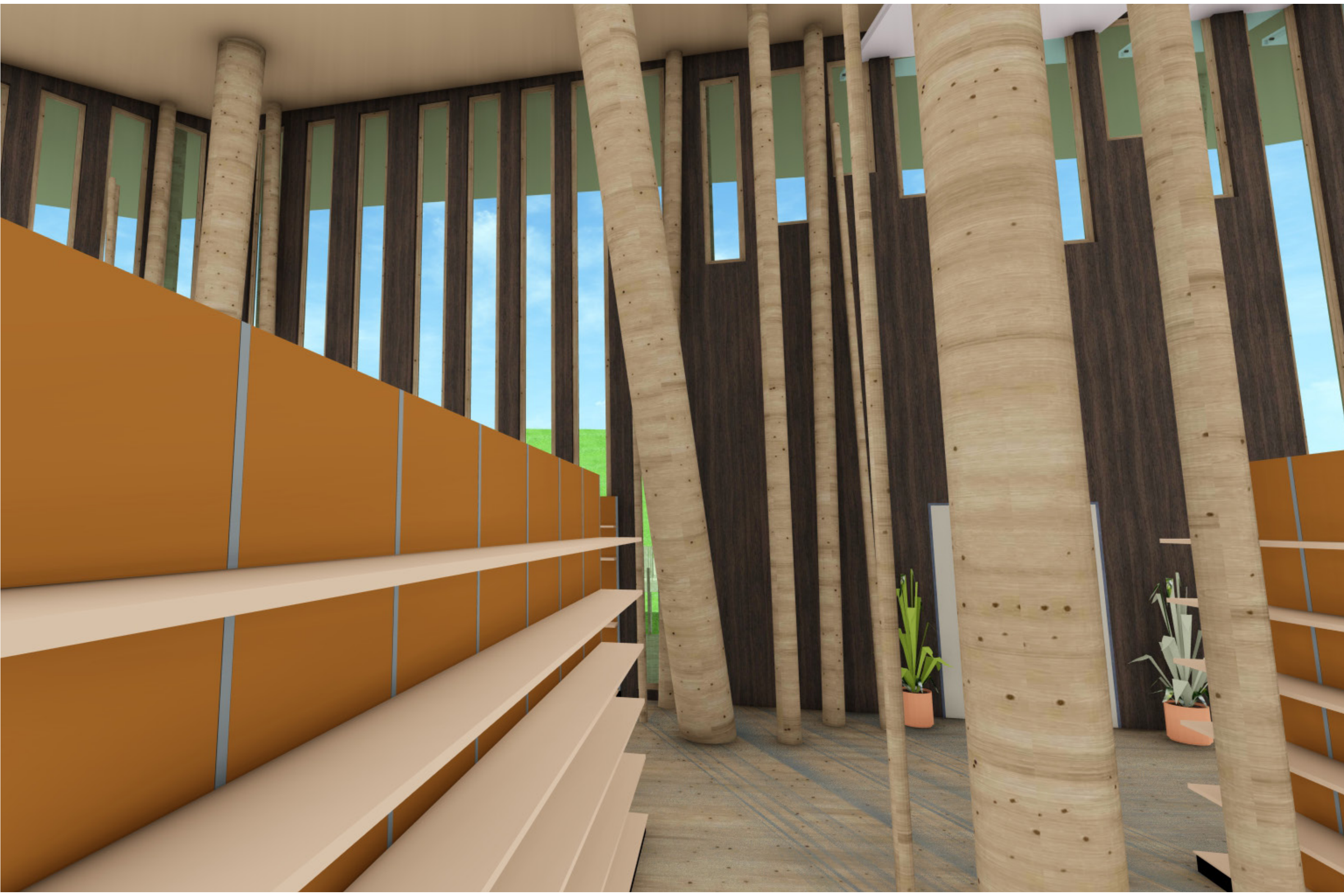


Fig. 75. Inside looking at the Piles correlating with the windows

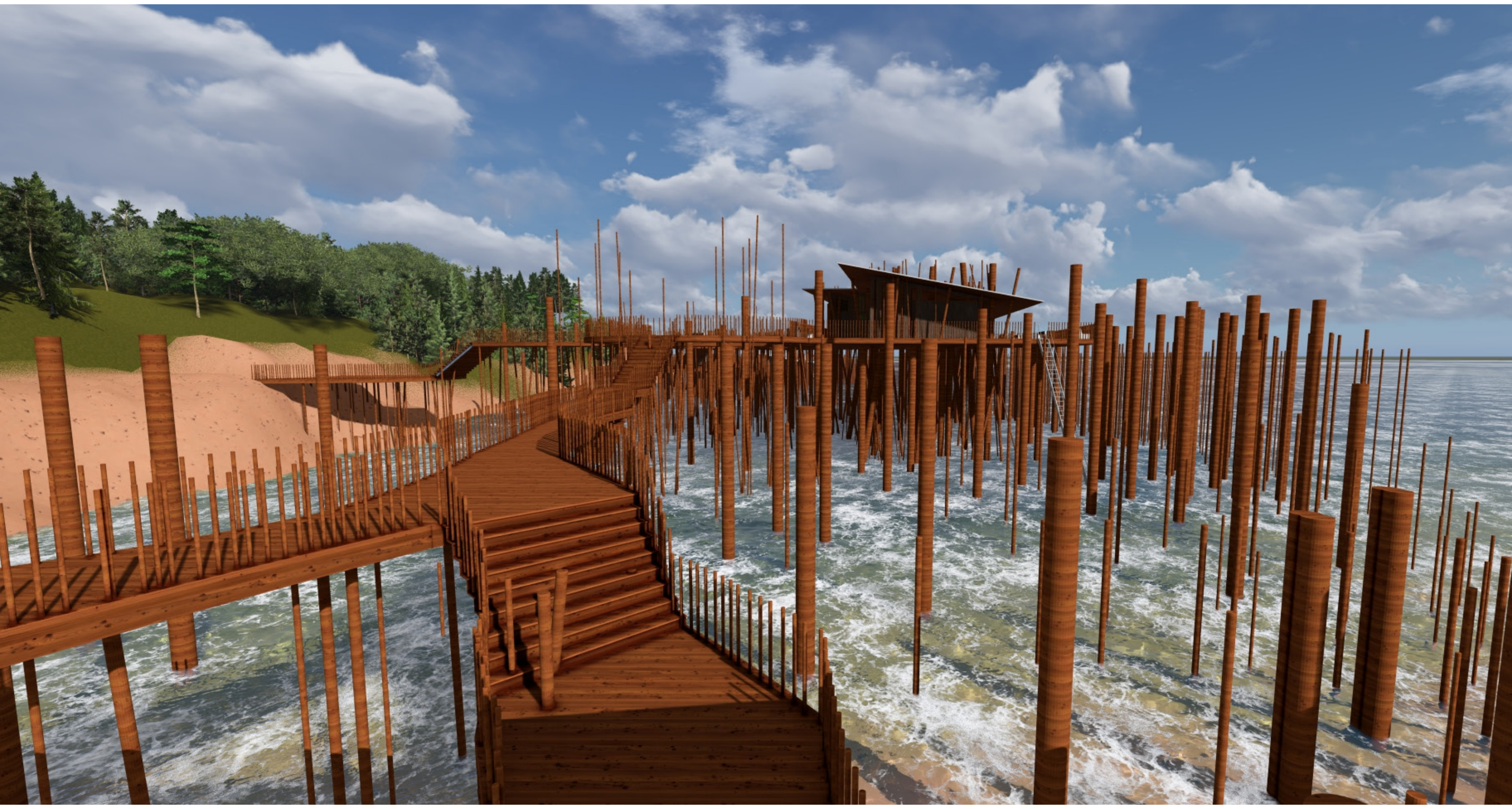


Fig. 76. A moment showing the extent of the piles supporting the buildings

BUILDINGS TOGETHER

The buildings are interconnected to enhance the sense of community that characterises Opua. They no longer obstruct the coastlines, instead facing the shore to honour their connection to the land. This relationship is maintained not only through their structural piles but also via boardwalks that link the buildings back to the shore. These boardwalks can be extended further due to additional piles being included during the relocation of each building, (See fig. 69.), which depicts the arrangement of piles around the structures.

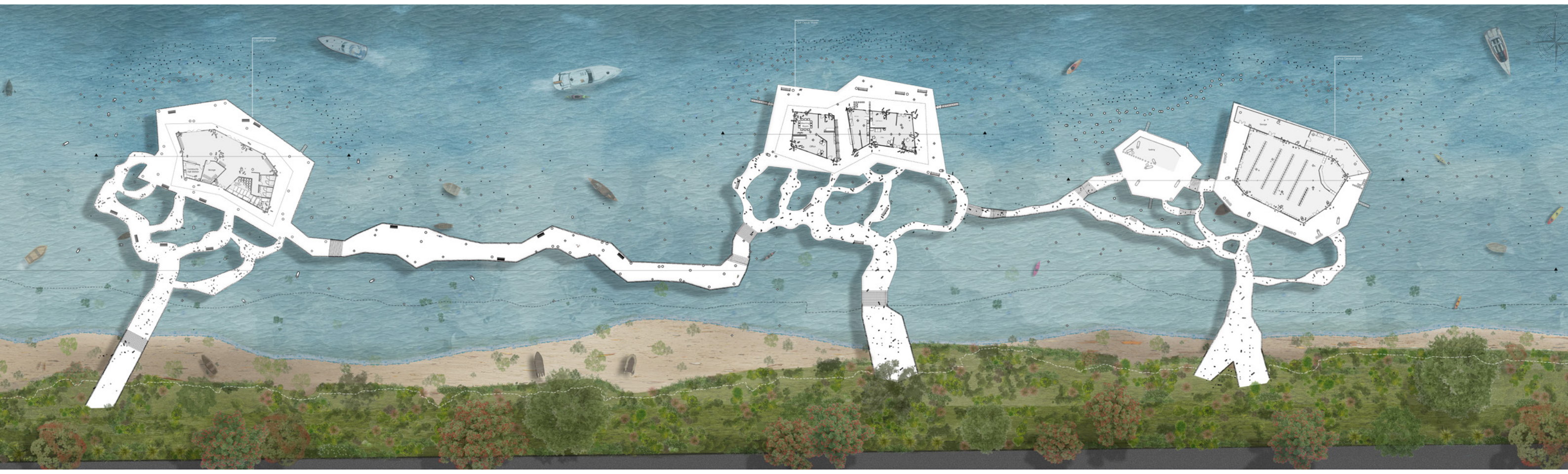


Fig. 77. The unique shapes of the structures influenced by the environment

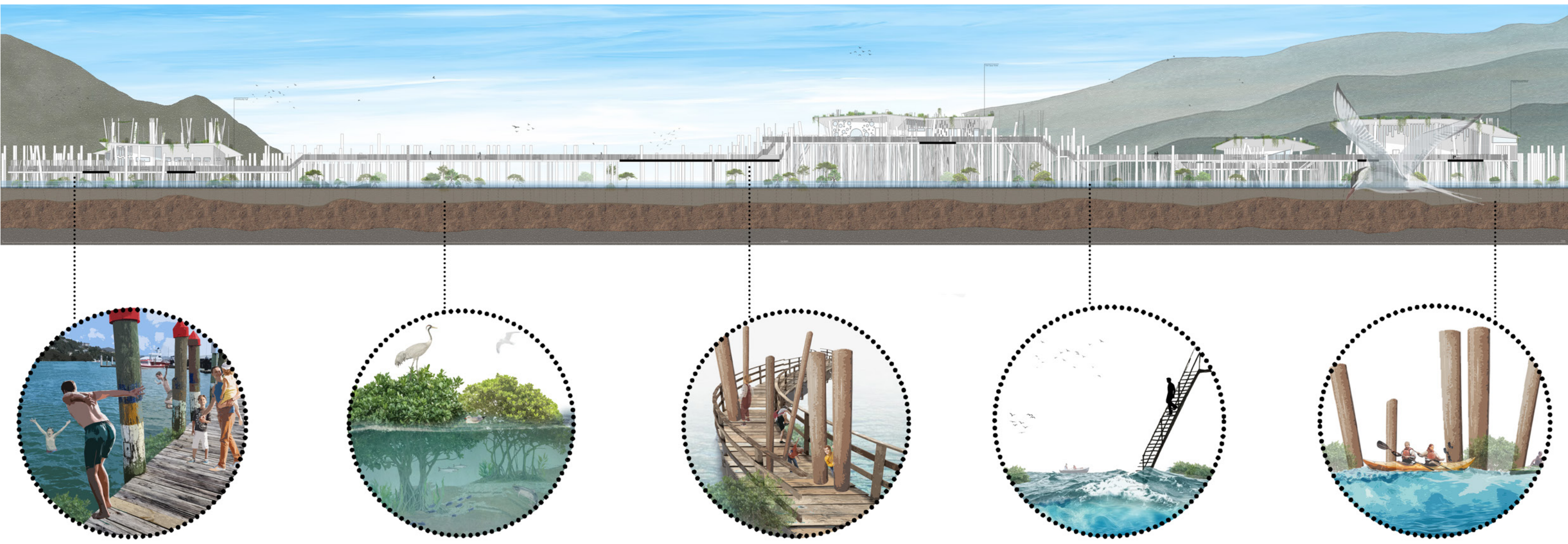


Fig. 78. Looking out to sea identifying the connections between the buildings

HYPOTHESIS DIAGRAM

This diagram illustrates the foundational hypothesis that informed the development of the overall design. It outlines the various phases required to achieve the objectives through the selected Co-exist method for this thesis.

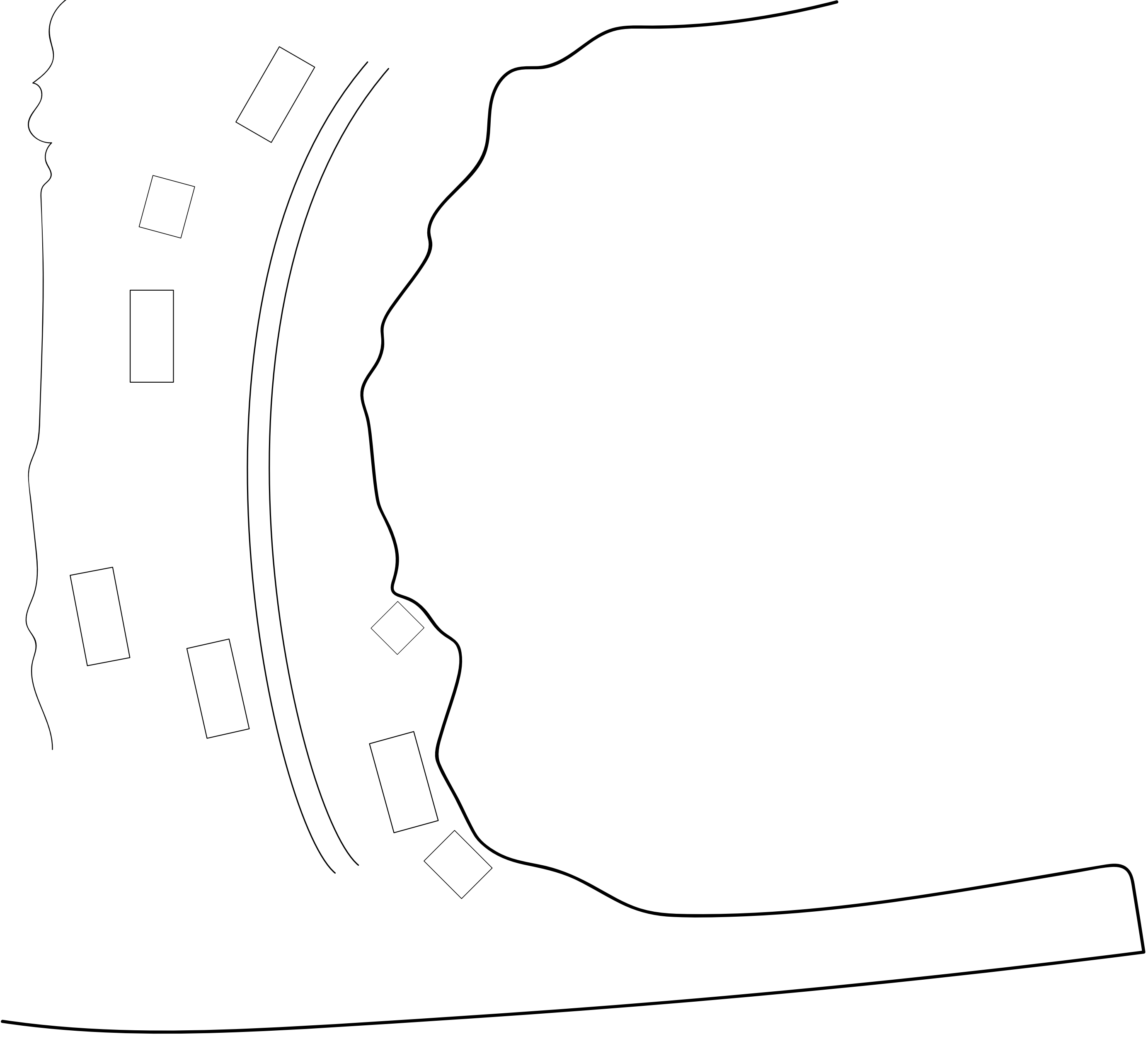


Fig. 79. The original layout of the site

Fig. 80. Phase one adding Piles and mangroves to serve coastal erosion

Fig. 81. Phase two of moving two critical buildings onto the water

Fig. 82. Phase three is when connecting boardwalks are established

Fig. 83. Phase four showing recovery of the land due to natural infrastructure

This Diagram show the evolution of moving the buildings onto the water and what it does for the land and surrounding ecology. Showing the future plan and indicating how the piles can be utilised for more buildings or walkways.

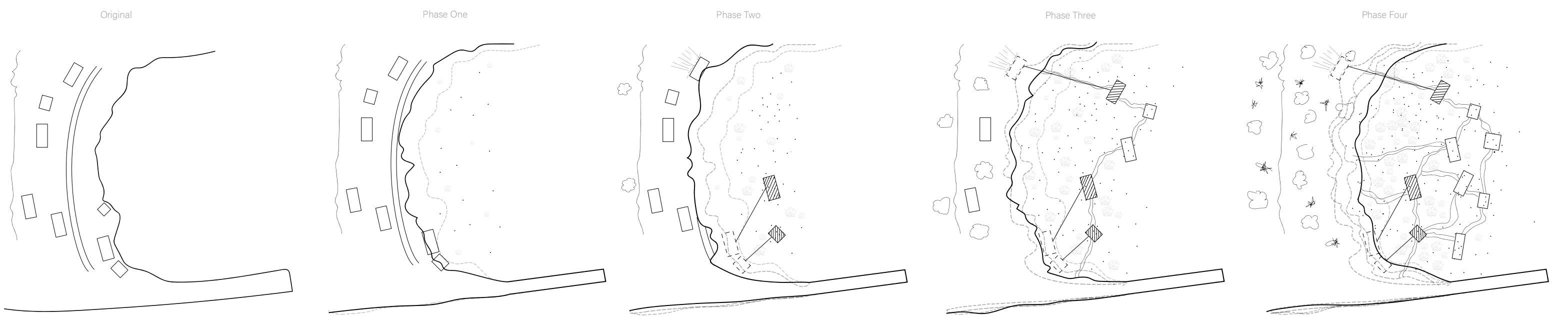


Fig. 84. The combine diagram of the underlying hypothesis for the design

Fig. 85. Intimate image of a person harvesting the mussels on the piles


Fig. 86. Image showing the life within Opua

Fig. 87. People within the water swimming or kayaking admiring the mussels

REFLECTION

This design proposal for Opua emphasises ecological rejuvenation, highlighting the significant impact of even the smallest organisms, such as trees and shellfish. Recognising that the ecology of Opua existed prior to human intervention is essential for understanding our role within this ecosystem. The design embodies this philosophy, showcasing the necessity of ecology independent of human needs.

The boardwalk structures reflect the complex interplay between nature's resilience and human influence, with organic shapes transitioning into the more rigid forms of the buildings. This design symbolises the merging of human activity with ecological values, advocating a return to principles that support ecosystem flourishing.

The proposal highlights architectural flexibility through adjustable elements like piles, which allow for reconfiguration of layouts and future extensions. This innovation redefines "space," creating unique experiential moments and enabling users to navigate around buildings via interconnected boardwalks.

This approach could serve as a model for enhancing small towns across New Zealand, underscoring the importance of ecological integrity in urban analysis. The concept of murmuration, discussed in Chapter Two, provides an architectural framework tailored to the needs of smaller communities. Furthermore, integrating systems thinking into architecture addresses contemporary challenges by fostering speculative design thinking, opening avenues for architectural evolution.

Throughout the design process, I aimed to preserve the essence of Opua while also adding a layer to its history. Achieving this required a nuanced approach to design, necessitating careful and delicate consideration of what elements to modify or retain. This delicate balance was crucial in ensuring that I did not overextend the alterations, thereby risking the loss of Opua's inherent character.

Ultimately, the design preserves the true essence of Opua through its ecological considerations and the ways individuals interact with the buildings, maximising the potential for utilisation and adaptation within the community.

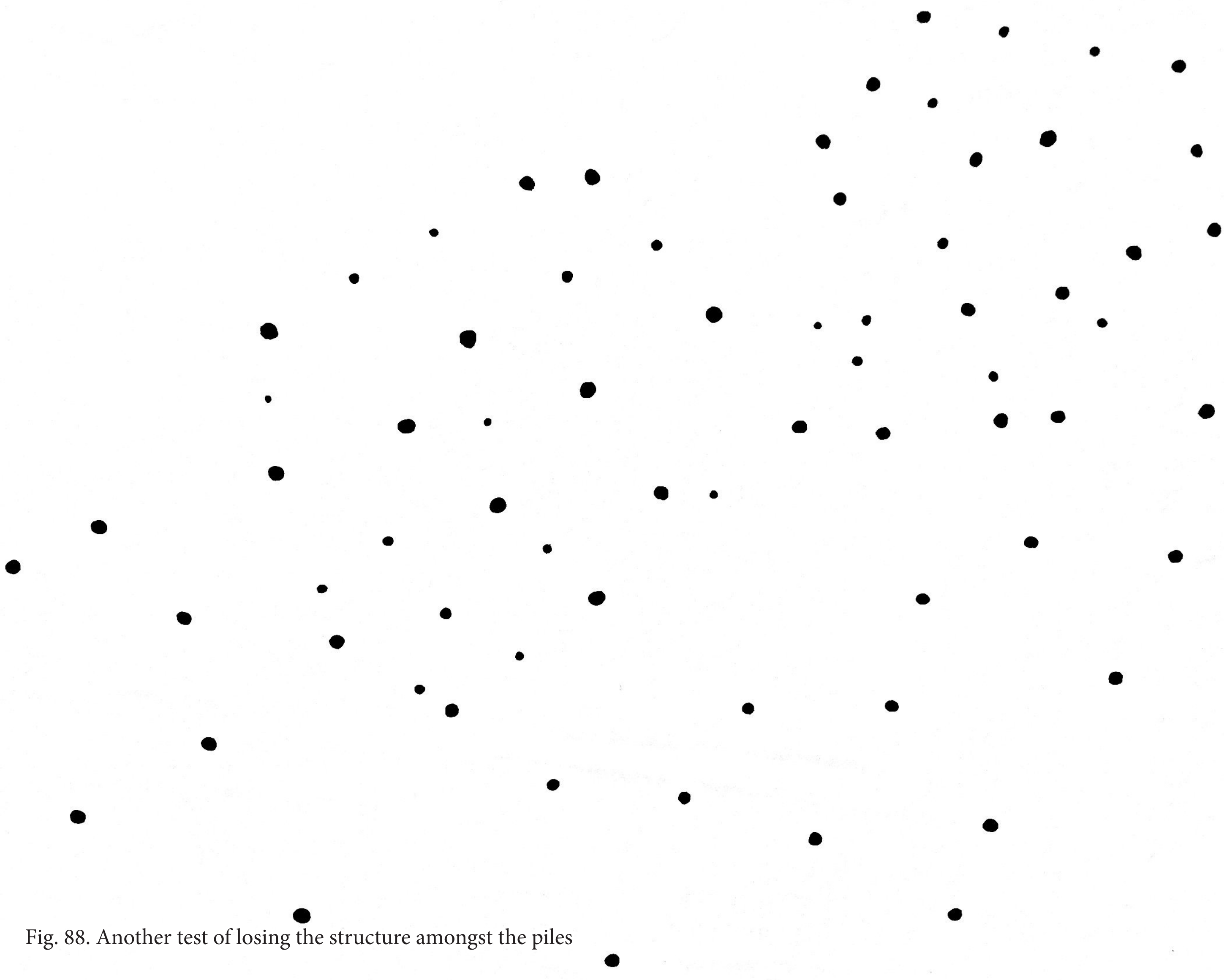


Fig. 88. Another test of losing the structure amongst the piles

CHAPTER FIVE

DISCUSSION

This chapter presents the research findings, design proposal, and limitations that contribute to the thesis conclusion. The project employed various design methodologies to address the research question. This exploration involved critical mapping, photography, and drawing, culminating in a speculative design proposal.

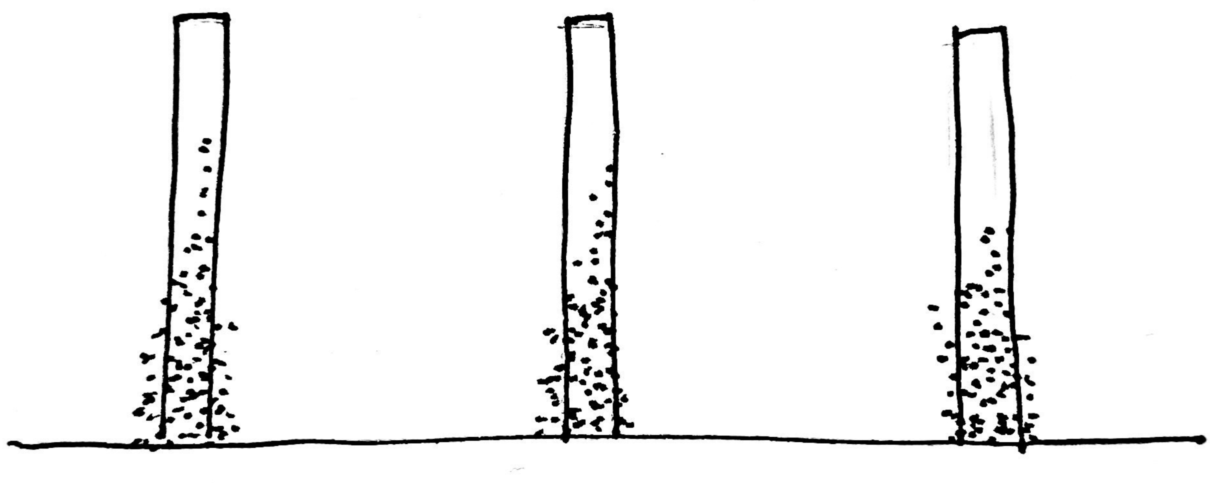
The findings, detailed in the previous chapter, illustrate a deepening understanding of architecture's adaptability to coastal erosion, resulting in a proposed design for Opua that reflects a stronger marine identity. The project aimed to cultivate a reflexive and speculative approach to architecture, emphasising reflection over traditional linear practices, particularly in areas prone to natural disasters where immediate solutions are essential alongside future possibilities.

Identifying methods such as reflective practice, proved vital in shaping the project. Upon reevaluating the thesis, I recognised that, although I initially employed the term "coexist", I had unconsciously integrated elements from the other theoretical frameworks defence and retreat, which ultimately operate synergistically. My approach involved 'defending' the coast with natural infrastructure and utilising piles for wave dissipation. Additionally, I adopted a strategy of retreat by relocating buildings and communities away from the shoreline. Notably, rather than moving structures away from the water, I ironically positioned them closer, aiming to demonstrate that water should not be feared but embraced. Ultimately, coexistence remains the central concept of this thesis and the foundation for the project.

Throughout the design phase, I recognised the interconnectedness of various design elements, leading to a stronger focus on the overall design program. This thesis demonstrates that transcending conventional architectural norms while achieving effective outcomes is possible, fostering critical thinking essential for addressing complex challenges.

The methodologies discussed in Chapter Two were effective in enhancing the resilience of coastal communities like Opua. The methodological framework was aligned with the research question and theoretical discussions, continuously reflecting and refining the thesis's rigor while maintaining alignment with initial objectives. Contextual research and site analysis informed the design process, yielding new insights that significantly impacted various design aspects.

This chapter encapsulates the design proposal and findings on how architecture can coexist with coastal erosion. By employing a diverse methodological approach, the project highlights architecture's potential to adapt and embrace its marine context. It emphasises the importance of a reflective and holistic approach, revealing coexistence as a synergistic interplay of strategies. Ultimately, the insights advocate for innovative architectural practices that enhance resilience and prioritise environmental harmony and community connection.



CONCLUSION

This thesis investigated the question of how architecture can evolve to thrive alongside the realities of coastal erosion through innovative design strategies. The findings indicate that integrating natural infrastructure and adaptive design significantly enhances resilience while fostering a deeper connection to the marine landscape.

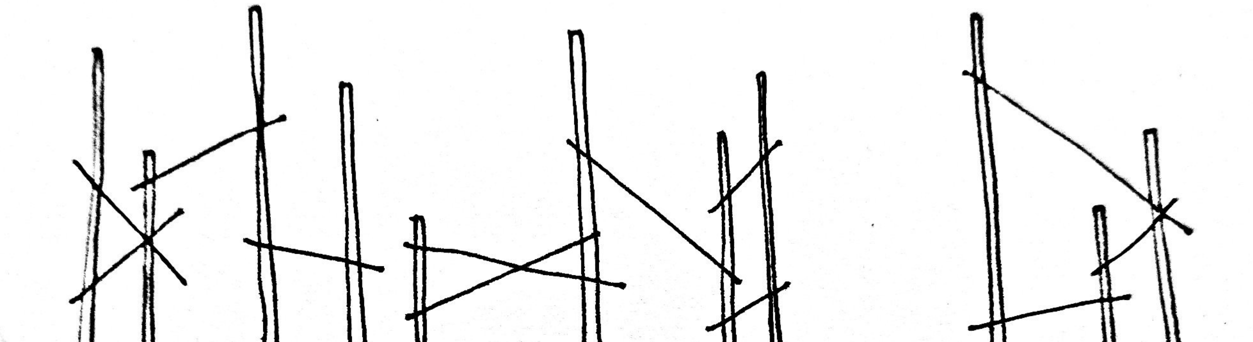
By exploring various theoretical frameworks, this research has conducted a comprehensive investigation into the potential for architectural coexistence. I assert that with the appropriate design thinking, such an approach is not only feasible but promising. This insight holds substantial value, as it opens new avenues in the design realm that could start to address a variety of complex challenges beyond coastal erosion, including societal and economic issues.

Key revelations from this project emphasise the critical importance of ecological considerations and the necessity for flexibility in design. Adopting a systems-thinking perspective, which views elements as interconnected rather than isolated, is essential in evolving architectural practice. This approach can enhance resilience within both coastal and broader communities, promoting a mindset focused on adaptation and spatial flexibility.

The objectives of this thesis were addressed through methodologies such as critical mapping and speculative design, which adeptly navigated the complexities of creating spaces that respond effectively to environmental challenges. The design proposed illustrates how architecture can coexist with coastal erosion, employing a speculative design approach and systems thinking to generate open-ended ideas and opportunities.

This work underscores the potential for architectural practices to transcend traditional boundaries, advocating for a holistic approach that prioritises sustainability and ecological well-being. Future research should further examine the interplay between urban development and natural ecosystems, particularly in vulnerable coastal regions, and explore how other areas in Northland can benefit from this mindset, extending its implications into societal and economic sectors.

Ultimately, this thesis affirms that architecture possesses the capability not only to withstand the forces of nature but also to harmonise with them, paving the way for resilient and vibrant communities.



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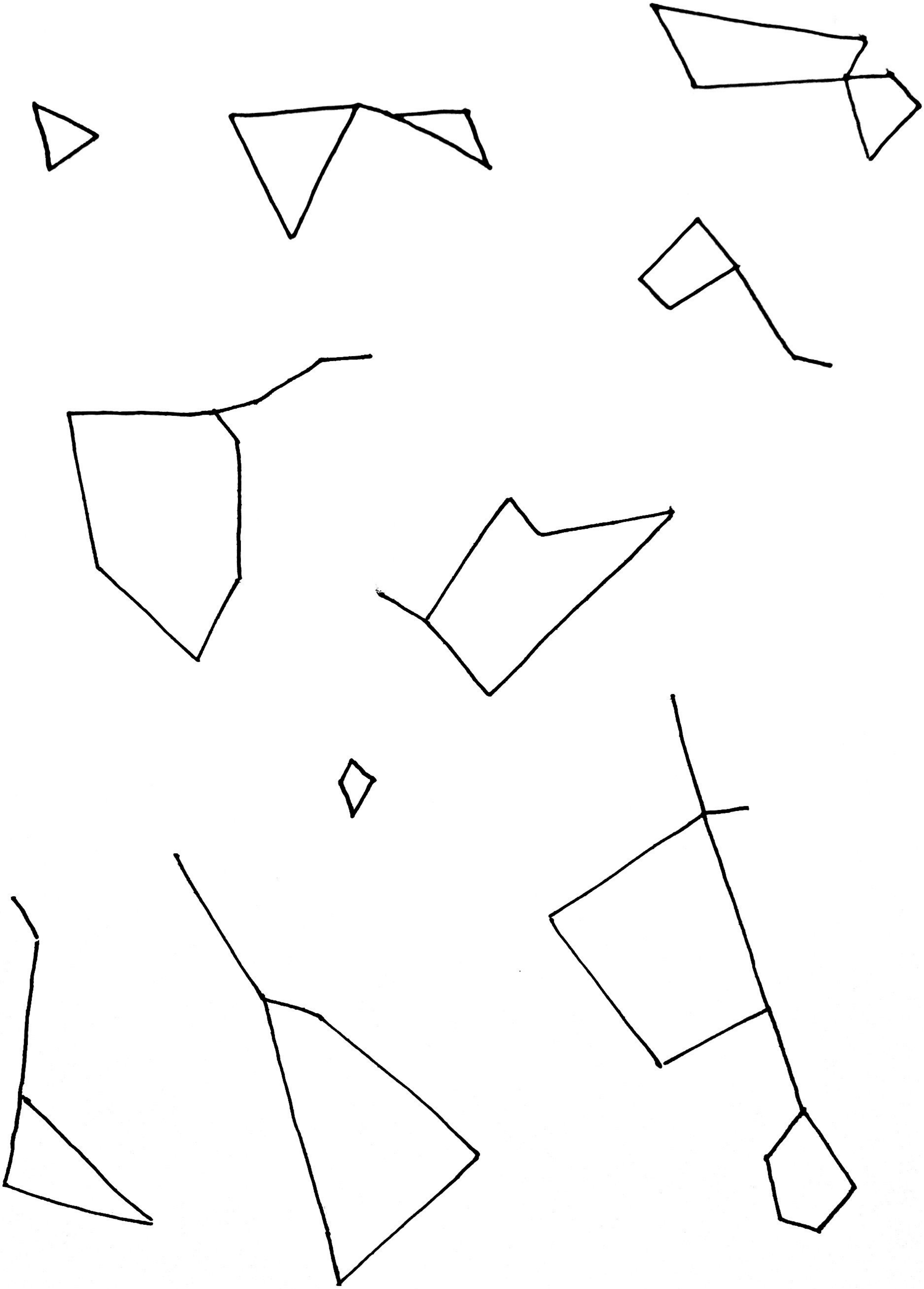

APPENDIX

APPENDIX A.


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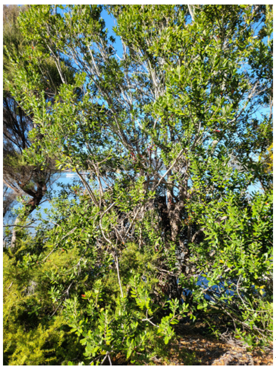
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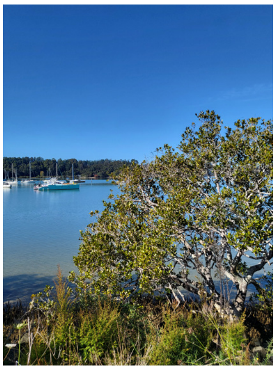
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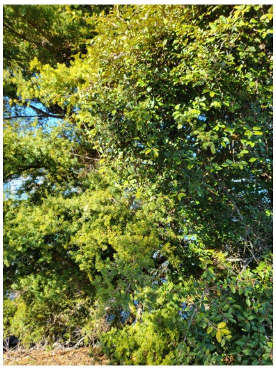
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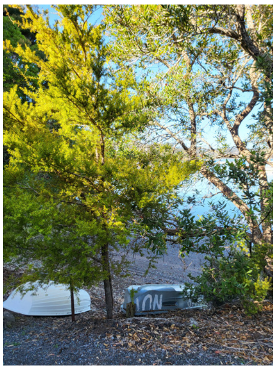
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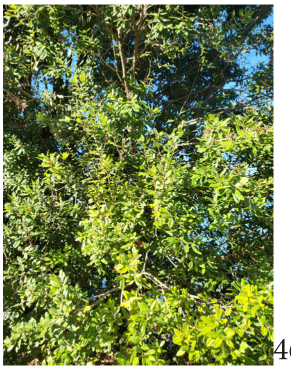
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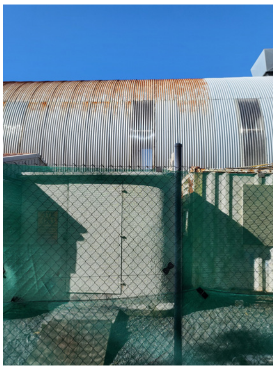
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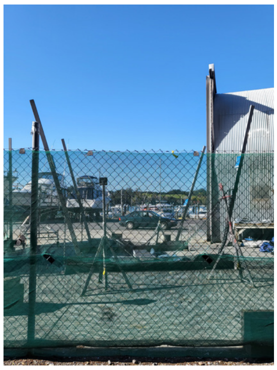
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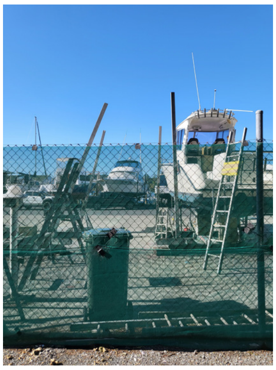
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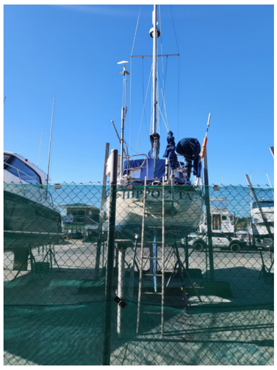
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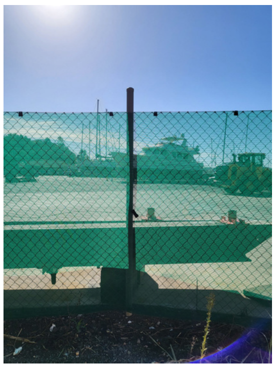
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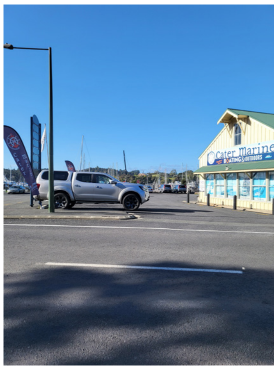

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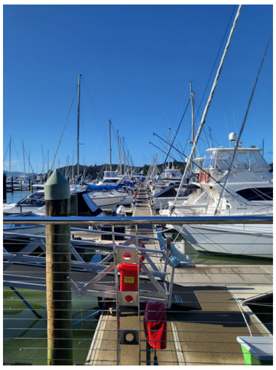
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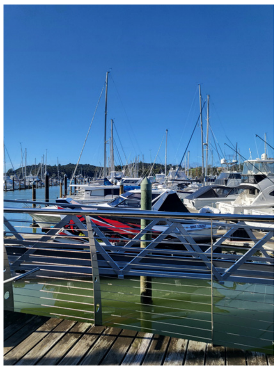
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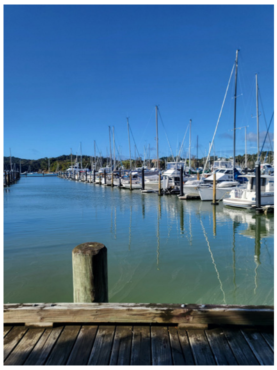
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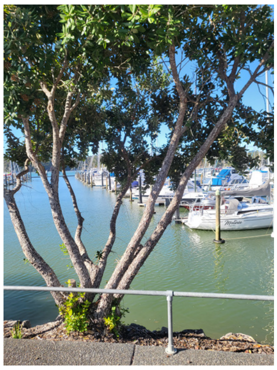
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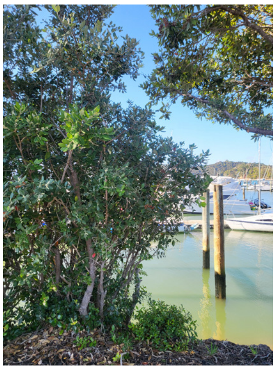
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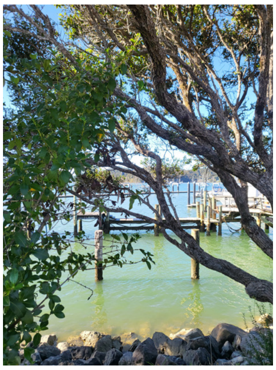
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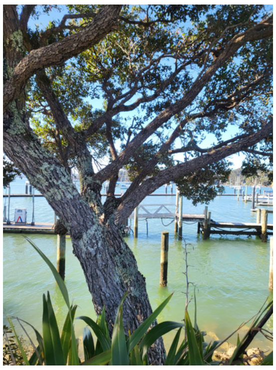
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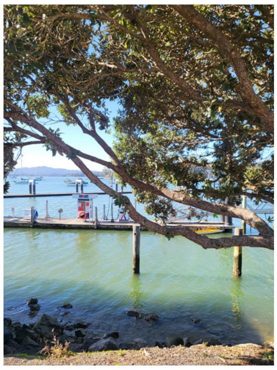
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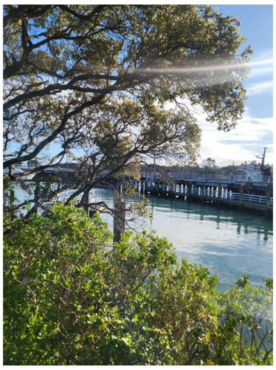
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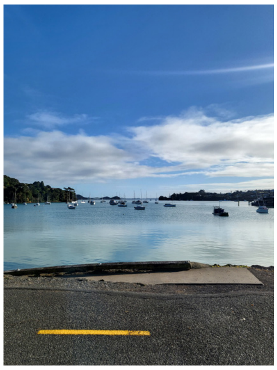
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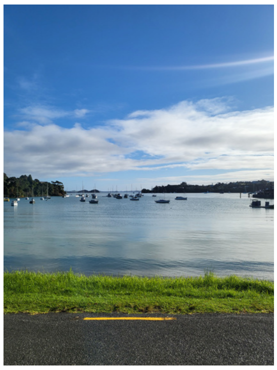
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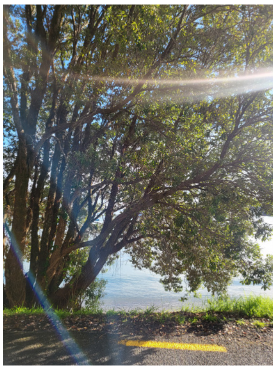
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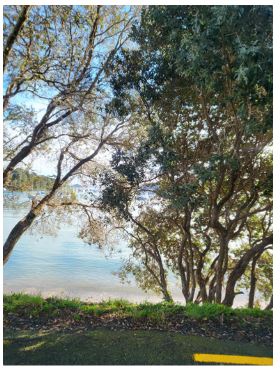
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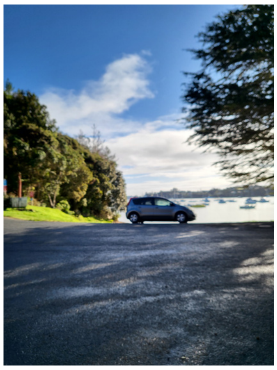
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