LANDSCAPE REVIEW

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LANDSCAPE REVIEW
An Oceania Journal of Landscape Architecture

CONTRIBUTIONS

The editor welcomes contributions, and an author's template can be found under the Submissions link on the website.

The aim of *Landscape Review* is to showcase the relationship between research and professional practice in the field of landscape architecture. It offers a forum for scholarly writing and critique on a wide range of topics that particularly impact Oceania and, more broadly, the rest of the world.

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Production *Tanya Tremewan, Christchurch* and *Jenny Heine, Wellington*

Cover image *Gill Lawson, Christchurch (Ōpāwaho Heathcote River, Cashmere)*

LANDSCAPE REVIEW

Foreword

GILL LAWSON

This issue of *Landscape Review* continues to traverse the discursive space between practice and research in Oceania by foregrounding contemporary knowledge systems in three contexts. The first paper is a critical provocation about what non-Indigenous designers could or should develop as decolonising know-how for our discipline and profession. The other two papers provide valuable examples of new knowledge and ideas gained from a 'design thinking' methodology around peri-urban land-use possibilities and from complex knowledge and proposed actions around flood mitigation strategies based on predicted climate change scenarios.

Deb Robbins from Taylor Cullity Lethlean in Brisbane is a non-Indigenous designer who challenges us to reimagine our world through Indigenous eyes. She proffers a process of Indigenising our know-how that comes about by moving beyond universalising frameworks to integrate Indigenous perspectives, voices and stories in the most consultative and authentic ways possible. This concise paper clearly encourages action by non-Indigenous designers in support of First Nations peoples.

Dr Shannon Davis, Associate Professor Stuart Charters, Guanyu (Hanley) Chen and Professor Pablo Gregorini, all from the Centre of Excellence: Designing Future Productive Landscapes at Te Whare Wānaka o Aoraki | Lincoln University, reflect on a 'design-thinking' workshop with the Canterbury Mayoral Forum, in which participants explored alternative land-use scenarios and drew spatial plans for peri-urban areas in the Waitaha | Canterbury region of Aotearoa New Zealand. These authors suggest that conventional ways of problem-solving following an empirically driven approach can be supplemented with alternative 'design thinking' approaches to land-use planning that allow for the co-existence of food production and housing while preserving highly productive land. A fascinating process to inspire and provoke!

Dr Suphicha Muangsri from Silpakorn University, Dr Wendy McWilliam and myself from Te Whare Wānaka o Aoraki | Lincoln University explain how substantial flooding is projected to occur over the next 5 to 80 years in many low-lying coastal cities of Aotearoa New Zealand. We suggest that runoff accommodation strategies using green stormwater infrastructure on large privately owned industrial properties are far less risky and could be considered more cost-effective than large, publicly funded engineering structures. Know-how based on retrofit, redesign and relocation approaches could substantially improve our preparedness for flooding with future climate change. A call to action for coastal city governments!

Professor Jacky Bowring presents an intriguing review of *Campus: Building Modern Australian Universities*, edited by Andrew Saniga and Robert Freestone. She offers campuses. She contextualises relevant landscape delightful insights into the ways this book frames knowledge of political agendas, concerns with environmental change, and cultural issues within the fabric of the Australian and planning history, for which Saniga and Freestone are well known, from a non-Australian perspective. Her review will spur academics, built environment professionals and designers to explore this impressive work.

My thanks again to our authors, who have been responsive to our call for papers, and to our international panel of reviewers. We hope that these papers, like those in previous issues, will provoke other authors to have their say.

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KEY WORDS

landscape architecture publication; landscape architecture discourse; landscape architecture divide; landscape architecture knowledge

Turrbal Jagera Country Bur'uda/Hanlon Park (by BCC) adjacent to Burnett Swamp Bushcare Group Bush Tucker garden (image by author, 2023).

LANDSCAPE REVIEW

Keep going … How non-Indigenous designers can advance First Nations in Australia's post-referendum projects

DEB ROBBINS

As a built environment professional and in particular as a landscape architect, I am encouraged to see First Nations issues and culture are finally being given a prominent place in Australia's national conversation. Of course, for a landscape architect, extra joy arises from the concept of Caring for Country and the opportunity to enrich and mature Australian cultural life by reimagining, restoring and conserving our shared environment. Caring for Country – an interconnected concept concerning cultural, spiritual and practical ways of caring for the land – could be the cultural or, more controversially, the spiritual connection to accompany the modern practice of landscape architecture in Australia. The issue is: how is this expressed in a way that is as consultative and authentic as possible? And can non-Indigenous designers work in this space? If so, how? It is obvious that we must first engage with First Nations people, but some established and emerging ideas and protocols can help non-Indigenous designers achieve meaningful and authentic results for built projects.

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Introduction

Why do we care about maturing the Australian cultural life? I am rewriting this paper after the majority of Australian citizens voted down the referendum to recognise Indigenous Australians in the Constitution, inclusive of a Voice to Parliament. A positive outcome would have given Indigenous Australians a say in their daily lives, but now, faced with this refusal, Indigenous Australians will continue to 'receive' piecemeal measures that may not align with actual needs. It is clear that there is more work to be done to raise awareness of the widening gap between Indigenous and non-Indigenous Australians in terms of health care, education and opportunities available.

The referendum had three threads, each differing in its scale of ambition. The first addressed the practical and urgent need to close the gap and the second the symbolic recognition of Indigenous Australians in the Constitution, while the third made the more esoteric but equally important call to 'come to a new understanding of who we are' (Pearson, 2023, cited in Langton, 2023). It is this last thread that provides the challenge for landscape architects – as I see this as a 'call to arms' to explore the cultural shift needed to influence citizens, governments, institutions and corporations to close the gap and provide opportunities for First Nations people, which in turn will open up the opportunity to care for and heal Country.

Shifting the cultural dial is a huge ambition; it takes a coordinated and concerted effort, made in unison. Landscape architects can play our part by doing what we do best – creating design narratives that incorporates Indigenous culture, working for Country (climate-positive design), designing for the long term and working at all scales. What I have described sits within standard western design methodology and methods of production. The intention is that this is an interconnected approach that seeks to align to First Nations views of the world. However, I also acknowledge the emerging ideas concerned with decolonising methodologies by Indigenous scholars and designers, who will no doubt lead the way in this space (Smith, 2022). The idea here is to reimagine a world through Indigenous eyes, a process of Indigenising that comes about by moving beyond universalising frameworks and acknowledging the diversity of Indigenous cultures and histories (Moreton-Robinson, 2020). This reimagining is where we could witness the cultural shift occurring as we integrate Indigenous perspectives, voices and stories into a new version of how Australians see themselves.

KEY WORDS
caring for Country; design process; maturing Australian culture; Indigenous and non-Indigenous designers

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As a non-Indigenous designer, I recognise that there is a lot to learn, and what we bring to the table are our collaborative skills, knowledge of production and ability to interpret ideas to realise built work of cultural and environmental integrity.

The design process of landscape architects is well suited to designing on Country: we design for place using site analysis, we evoke sense of place using narratives, we understand the effects of time and we work at many different scales and for many different clients. What can be added to this process is First Nations Knowledge of Country ranging from Indigenous land management, cultural landscapes, ways of being, and stories, through to social and spiritual connections with the land (Gammage, 2012). By including this, we gain an opportunity to embed a cultural narrative into the way Australians think about Country. And in place of the previous 200 years of comparing our shared land to and imitating other places, Australians can begin to see First Nations culture reflected in and reinforced through our landscapes.

This possibility then begs the question, how do we as landscape architects help to shape this cultural narrative well? And can non-Indigenous designers participate to include, with permission, First Nations Knowledge and culture in projects? We understand that Australia has a relatively small number of Indigenous designers, let alone landscape architects (Bleby, 2023). Further, we understand the cultural responsibility and colonial burden placed on all First Nations people. To be faced with a series of losses every day, including cultural appropriation, displacement, systemic racism, language loss, health issues, stereotyping, marginalisation, and environmental and cultural erosion, is a heavy load to bear alone. Therefore, it is not a question of 'can' non-Indigenous designers participate but 'how' do non-Indigenous designers participate to share the load and, equally importantly, how do we participate as respectfully and authentically as possible?

Thankfully in 2024 we are seeing the formations of accepted pathways towards strengthening First Nations visibility in the built environment. With many taking cues from decades of work by Indigenous built environment professionals such as Kevin O'Brien, Dillon Kombumerri, Michael Mossman, Jeffa Greenaway, Craig Kerslake and Indigenous academics such as Carol Go-Sam and Daniele Hromek, the following three key areas of investigation could provide non-Indigenous designers with a baseline of knowledge for working in this space.

First, non-Indigenous designers (and their clients) could think about undergoing cultural competency training. This will bring a minimum required understanding of Indigenous issues to any engagement with Traditional Custodians, Elders or Indigenous community members. Also, if possible, encourage clients to engage Indigenous design consultants; where this is not possible, it is suggested that the best way to work with Traditional Owners rests with the client when procuring and delivering projects (figure 1). The point of this approach is to:

1. ensure Traditional Owners get paid for their knowledge (Indigenous cultural and intellectual property (ICIP) processes)
2. make Traditional Owners part of the design process from brief writing through to post occupancy evaluation of the project and beyond
3. create a level playing field when it comes to accessing Traditional Owners' knowledge or stories through the brief process.

Note that the ideal engagement process with Traditional Owners is co-design using decolonised design methodologies. But this would be the topic of another paper co-written through a combined Indigenous and non-Indigenous lens, which might be a better way of exploring how to develop a shared design language for our shared Country.

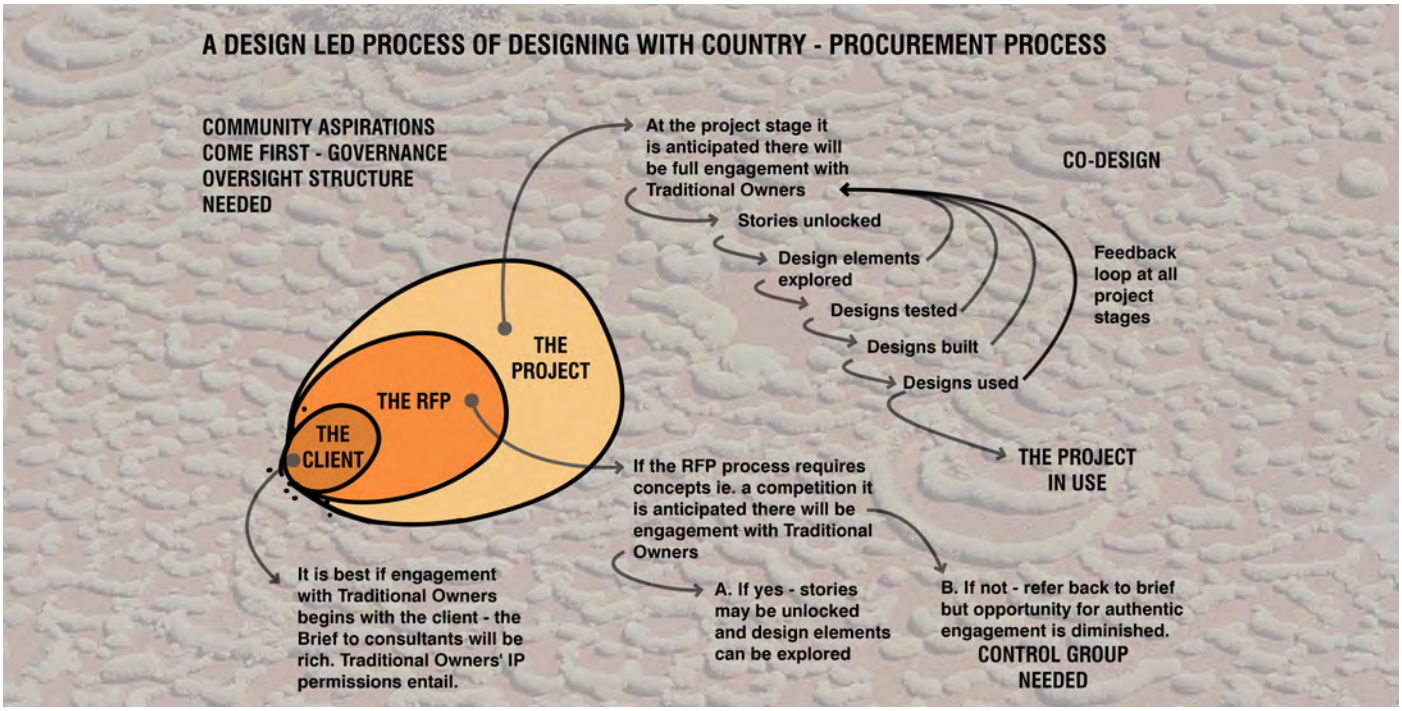

Figure 1. Designing with Country and a competitive Request for Proposal procurement process (image by author, 2022).

Second, look to the Indigenous designers, thinkers, artists and academics who are working and writing in this space, some of whom have created frameworks for others to follow. Two excellent guides in Southeast Queensland are Queensland University of Technology's (2020) Campus to Country: Positioning Strategy and the University of Queensland's Campuses on Countries: Aboriginal and Torres State Islander Design Framework (Go-Sam et al, 2021). Both invite non-Indigenous designers to follow their guidance. Another seminal work is Connecting with Country from the New South Wales Government Architect (2023), which is important because of its detailed description of a process of engagement, Australian ICIP and other protocols. Of note is that this work was centred around the Sydney Basin and that community's way of working, which may be different in other Countries around the nation.

Finally, look to professional and governing bodies. In particular, the Australian Institute of Landscape Architects offers excellent guidance material, governance policies and frameworks. Other relevant bodies are the emerging Indigenous Architecture and Design Australia group and the Australian Institute of Architects. All of these professional bodies uphold commitments to pursuing First Nations issues through their advocacy and values with working groups that support members' enquiries.

As this paper has shown, accepted pathways are available for non-Indigenous designers to self-educate, follow established processes and obtain guidance. What comes next? What is the opportunity? What will strengthen and pave the way for a cultural shift that reveres First Nations culture in contemporary society? I believe these questions may only be discovered through the daily practice of landscape architecture. If reports on these built works, along with discussion of the process and reflections, are then continually published and circulated, it can build up a body of work that is accessible to and features in public discourse. From there, we will begin to see what is working to deliver the best outcomes for First Nations people while making this work more visible and widely accepted. A range of projects could be relevant: just a few examples are community self-determination on Country handed back in far north Queensland; inner-city creek re-wilding projects; and new hospitals on the urban fringe creating culturally safe places for Indigenous patients and visitors. All of these projects will have a story of Indigenous inclusion to tell and celebrate. The more we see, the more all Australians will begin to gain 'a new understanding of who we are'.

Conclusion

A more mature Australian culture would recognise and celebrate 60,000 years of continuous culture, see it as the nation's superpower and want to infuse it into all aspects of cultural life in this country. As we have seen with the referendum, the opportunity to grow the national narrative to include all Australians was eroded by the denial of a bipartisan approach. The challenge for landscape architects moving forward will be to continue the good work, keep the momentum going and look for the opportunities to incorporate Indigenous culture where we can.

About the author

Deb Robbins AILA RLA has over 25 years' experience working as a landscape architect and urban designer, growing teams and collaborating with clients to create beautiful places. Over her career she has worked across many landscape typologies, such as infrastructure, education, health and wellbeing, commercial and residential towers, public realm, master planning, parklands, recreation and wetlands, retail, community consultation, streetscapes, villages and – last but not least – play.

Deb's legacy of projects includes the Cross River Rail Bid, where she led the urban design and landscape team across four inner city precincts. It was on this bid in 2018 that Deb worked with Kevin O'Brien and his framework on designing with Country. This was a formative experience that left a strong impression on the team for its original way of expressing a layered place-based and Indigenous design language that was contemporary and, at that time, largely unexplored in major infrastructure projects.

Deb's design process leans towards the poetic by creating foundations that resonate with people and place. She is a designer whose creative and collaborative approach to landscape design is a constant throughout the design process, from the generation of design concepts, through to the evolution of living landscapes.

Her purpose is to design collaboratively with others to create places of meaning and delight.

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A new greenfield residential subdivision, flanked by lifestyle blocks pushing into the productive hinterland. Lincoln, Waikiriri Selwyn District, Aotearoa New Zealand (with permission from Don Royds, 2023)

LANDSCAPE REVIEW

Exploring the design thinking methodology to stimulate alternative approaches in peri-urban landscape planning

SHANNON DAVIS, STUART CHARTERS, GUANYU CHEN AND PABLO GREGORINI

Peri-urban areas are vital to the function and value of our communities, environment and economy. Many epitomise the relationship between a community and the landscape, providing essential ecosystem services to a settlement. With the expansion of cities and the resulting urban sprawl, the ability of peri-urban zones to sustain food provision is threatened in Aotearoa New Zealand. This paper reports and reflects on a workshop facilitated by the Centre of Excellence: Designing Future Productive Landscapes, Te Whare Wānaka o Aoraki | Lincoln University, with the Canterbury Mayoral Forum, to explore alternative land use topologies for peri-urban areas in Waitaha | Canterbury. Its focus is on applying a 'design thinking methodology' to explore this issue and the opportunities for engagement and solution ideation that it promotes. Workshop participants engaged in activities designed to provoke alternative and innovative thinking about the spatial relationship between urban growth (housing) and agricultural land (production). Key findings illustrate the strengths of the methodology to elicit alternative responses to land use planning within the peri-urban zone, and indicate a desire to rethink how we plan and design city edges to better protect and enhance their ability to produce food and support other essential ecosystem services alongside urban expansion.

Introduction

Governments, local authorities, planners and landscape architects have long recognised the need to limit city expansion, predominately from an 'urban' perspective that sees successful cities as having high levels of accessibility, connectivity, density and diversity, achieved primarily through a compact urban form (Bibri, Krogstie and Kärrholm, 2020; Haarstad et al, 2023). Looking at the issues associated with urban sprawl from a 'rural' perspective, we see a different range of priorities, including the need to protect versatile and highly productive soils, retain land for agricultural uses, defence of rural culture and to maintain access to local food production (Morgan, 2014; Morgan and Sonnino, 2010; Opitz et al, 2016; Pothukuchi and Kaufman, 1999; Steel, 2008, 2020; Viljoen, 2005; Viljoen and Bohn, 2005; Viljoen et al, 2015), alongside other important ecosystem services such as stormwater management and climate regulation, flood mitigation, water purification, and pollination. A broad consensus among designers and policy makers is that peri-urban agricultural land is an essential component of urban planning (Sarker, Bornman and Marinova, 2019). It follows that future thinking around peri-urban land use planning is critical to the long-term success of settlements and cities. With the global urban population growing exponentially, highly productive arable landscapes, as finite and scarce resources, are being irreversibly lost to make way for urban expansion to accommodate the growing population.

Although our understanding of land use conflicts in the peri-urban zone is articulated in a range of literature, research into spatial land use possibilities is an identified research gap in Aotearoa New Zealand. Notably too, the recently gazetted National Policy Statement on Highly Productive Land indicates a contest between national policy settings and practical application.

The conventional 'empirically driven' mindset of problem-solving has practical limitations due to interlocking political and practical constraints, as well as the strategic

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KEY WORDS

design thinking; structured provocations; land use planning; peri-urban; urban expansion; highly productive land

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uncertainty and unpredictability resulting from the systematic complexity of land use conflict. Within conventional ways of problem-solving, problems are expected to be addressed by following a rigorous and empirically driven approach, in which decisions are informed by knowledge generated through the rational process of data gathering, modelling and forecasting (Considine, 2012; Howlett, 2014; Parsons, 2002; Wagle, 2000). This perspective on problem-solving and decision-making is rooted in the belief that system challenges can be simplified to technical problems that are amenable to scientific solutions (Head, 2008).

However, this conventional approach may lead to stagnation in the endless analytical process when confronting a complex issue with many interlocking constraints and a high level of uncertainty and unpredictability (Davis and Stroink, 2016; Lewis, McGann and Blomkamp, 2020). One such issue is the conundrum over whether to use land for food or housing, a decision that Aotearoa New Zealand peri-urban areas are now facing as a consequence of pressure from urban population growth and the need for more housing. Further, as the irreversible loss of highly productive soil[1] is happening rapidly nationwide due to urban expansion, it has become an urgent task to find an alternative solution that allows the co-existence of food production landscapes and housing, and to preserve highly productive land. Exploring alternative approaches to inform decision-making is considered fundamental to enabling adaptive change. In this context, we adopted the design thinking methodology as an alternative approach aimed at facilitating the generation of innovative ideas with its focus on using 'design' as a method of creative problem-solving.

This case study research, documenting a local government exemplar, illustrates a way of using the design thinking methodology to identify land use issues within the peri-urban zone. By employing structured provocations in accordance with the design thinking methodology, we aimed to catalyse innovative thinking about the wicked problem: how can landscapes for both people and production prosper within peri-urban Aotearoa New Zealand, reconnecting people with land and food? This paper also showcases the processes we took to facilitate a design thinking workshop and discusses how design thinking can be applied to help with complex planning and decision-making issues where a conventional mindset or approach may fall short.

Design thinking as a tool for facilitating innovation

The concept of 'design thinking' was developed by David Kelly as an approach to provoke innovative ways of thinking in support of meeting customers' needs (Brown, 2008; Camacho, 2016). The design thinking approach was later found to be effective in facilitating innovation and addressing difficult or unusual challenges (Buchanan, 2019). As the process has undergone adaption, iteration, improvement and expansion, design thinking has been developed into new disciplines, and the process of 'design' refers ever more often to understanding real-world issues, identifying issues and needs, integrating knowledge, gaining insights from different disciplines and eventually contributing to the development of innovative solutions (Arifin and Mahmud, 2021; Léger, Laroche and Pruneau, 2020).

In contrast, the conventional mindset of problem-solving is considered to fall short in its capacity to help comprehend intricate challenges involving multi-spheres, which normally include environmental, social and economic considerations (Davis and Stroink, 2016). The field of facilitating innovation has seen a growing emphasis on design thinking as a fundamental tool crucial for fostering innovation and alternative solutions when dealing with complex, multidimensional problems (Dodgson, Gann and Salter, 2005; Groeger et al, 2019). A growing number of organisations are striving to incorporate a design thinking approach in tackling complex problems, and many of them have achieved favourable outcomes as a result (Bevan et al, 2007; Body, 2008; Leavy, 2012; Liedtka, 2011; Meyer, 2011).

The design thinking methodology has been widely adopted in a range of fields, including education (Balakrishnan, 2022; Panke, 2019; Rao, Puranam and Singh, 2022), product and service design (Parizi et al, 2022; Wang, 2022) and management (Knight,

Daymond and Paroutis, 2020; You, 2022). Yet it has seldomly been employed in engaging with politicians and decision-makers in order to catalyse insights into planning issues of public concern. Lewis, McGann and Blomkamp (2020) and McGann and colleagues (2018) investigated the experimental adoption of design thinking in the public sector for policy-making purposes. Based on their findings, they suggested that while design thinking is seen as a potential contributor to the problem-solving process, more research is needed to evaluate its actual impact on practices.

Participatory planning strategies have long been promoted in spatial design disciplines such as landscape architecture and urban design. Benefits of adopting such approaches have been explored in the areas of forming vision and goals, including community issues and concerns, and generating a feeling of public ownership and a consensus on priorities (Kumar et al, 2016). However, while there has been general agreement on the importance of participatory planning within the spatial design disciplines, design-focused outputs using participatory methods have been less studied. For landscape planning, as a profession involved in managing future landscape change, the systematised approach of design thinking, with its focus on rapid design ideation, offers an important tool. The design thinking workshop presented in this paper, held with local authority representatives, provided an opportunity to understand how design thinking can be used as a 'design tool' in supporting planning issues that are of public concern.[2]

Mayoral forum workshop using design thinking methodology

A representative group of mayors of Waitaha | Canterbury (all of them members of the Canterbury Mayoral Forum), elected councillors and employed professional planners attended a half-day workshop hosted by Te Whare Wānaka o Aoraki | Lincoln University, Centre of Excellence: Designing Future Productive Landscapes. The aim of the workshop was to rethink the conventional approach to land use planning and explore spatial land use alternatives for the peri-urban zones of Aotearoa New Zealand.

The design thinking methodology framed the workshop approach. Participants were introduced to the methodology and the individual steps were described. The workshop focused on the first three steps: 1. Empathise, 2. Define and 3. Ideate (figure 1). Each step was facilitated by one activity, as explained in the following three sections.

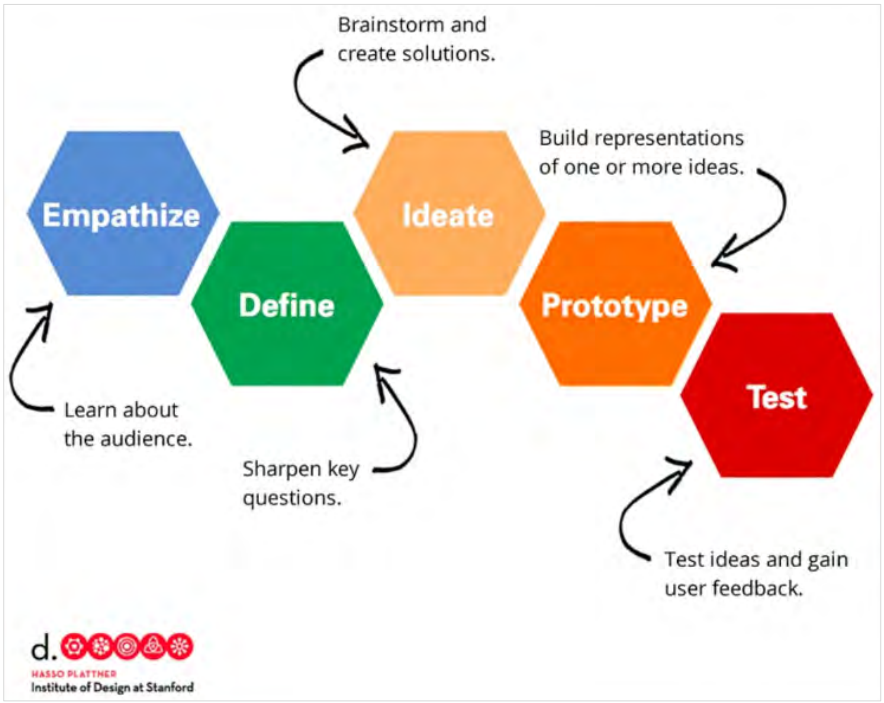


Figure 1. Design thinking process (Institute of Design at Stanford, used under Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Licence).

Activity one: Empathise – identifying current land use issues, conflicts and threats in peri-urban areas (group activity)

The first activity consisted of four tasks. The participants were grouped into teams of three or four to complete them, as follows.

1. On Post-it notes, write down the range of issues you are aware of in the Waitaha | Canterbury peri-urban zones, relating to:
    - residents
    - growers and farmers
    - land use planning
    - economic activity
    - community and recreation.
2. On poster paper, identify the one most important issue identified, and discuss it with your group.
3. Unpack your 'top issue': what is behind it?
    - Expectations vs reality?
    - Does it relate to pre-existing or new activity?
    - What initial ideas do you have that could help address the issue?
4. Report back.
    - What was your top issue?
    - Why is it your top issue?
    - What ideas do you have that could address the issue?

Activity one generated the identification of a range of issues and discussion around them, as shown in the word cloud (figure 2). The most commonly mentioned issues related to reverse sensitivity,[3] loss of land, housing, demands on the land/development, productive land and people.

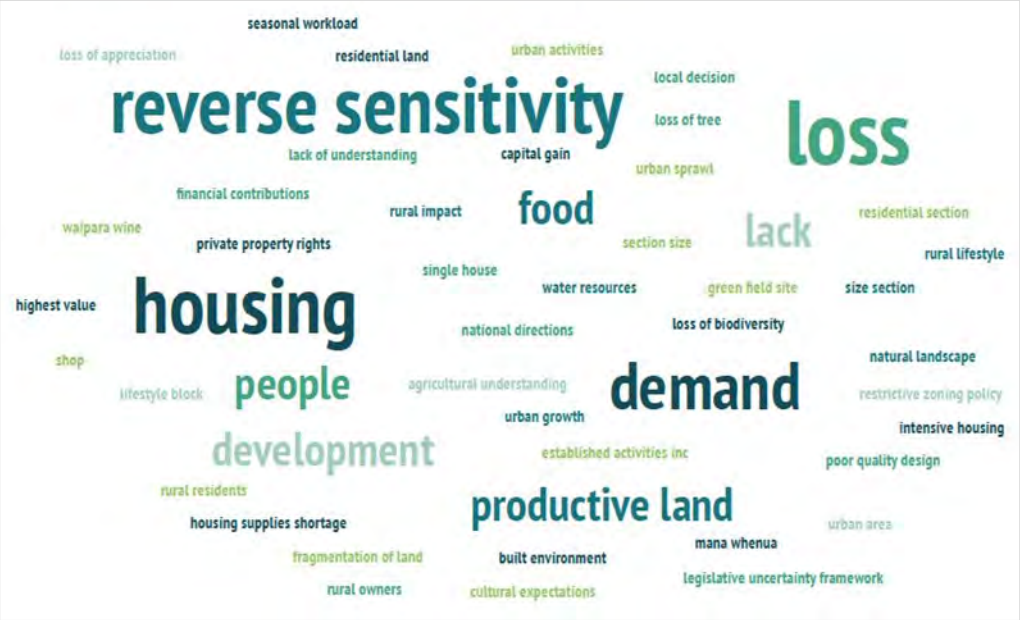


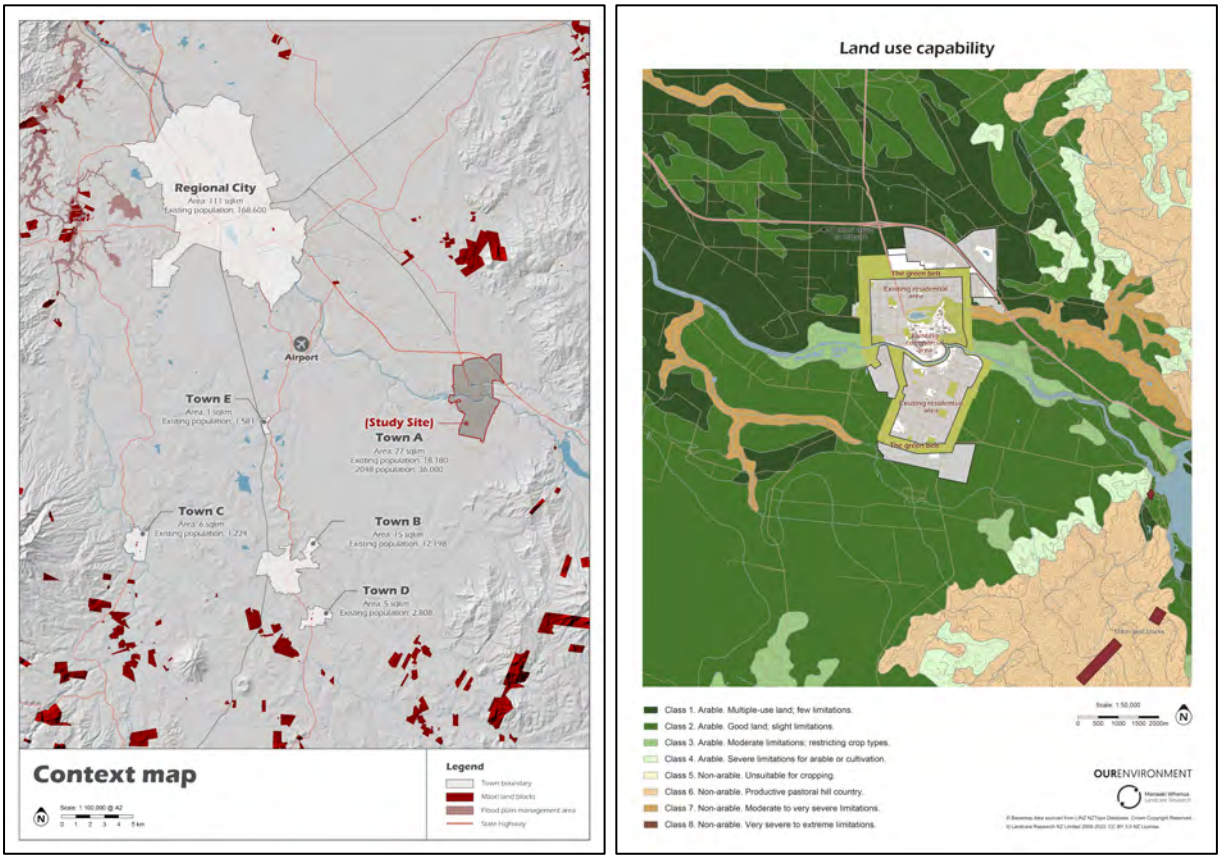
Figure 2. Word cloud generated from the issues identified in activity one (image by Guanyu Chen, 2022).

Activity two: Define – examining prepared land use scenarios (group activity)

Next, participants were introduced to five hypothetical urban planning scenarios developed to respond to the rapid population growth of an anonymous town in Aotearoa New Zealand. They were asked to move around the room and conduct a SWOT (strengths, weaknesses, opportunities, threats) analysis of the five scenarios, where differing spatial models were used to plan land for food production and land for housing. Participants were not introduced to the scenarios prior to arriving at each one to prevent them from developing preconceptions and to limit premature comparison. They were given the following instructions.

1. Examine the proposed scenario. Think about and record the strengths, weaknesses, opportunities and threats of this scenario in relation to land and land use relationships for housing and food production.
2. Move to the next tables and repeat for the other four scenarios.
3. Report back.
    - What scenario do you think will work best when planning for the future of the peri-urban areas within your constituency?
    - What are the top opportunities this scenario provides your district?

A case study, presented through maps and text (figure 3), was provided for activity two to allow participants to consider an overall hypothetical scenario for a town facing similar issues to that of the towns within Waitaha | Canterbury. A town outside the region was chosen to allow 'free' thinking for all workshop participants, without the burden of demands from a 'real-life' district and constituents.



(a) **(b)**

Figure 3. Hypothetical case study materials: **(a)** context map and **(b)** land use capability site map (images by Guanyu Chen, 2022; maps adapted from Manaaki Whenua Landcare Research, used under Creative Commons Attribution-ShareAlike 3.0 New Zealand Licence).

The hypothetical case study selected was a township that had a size, scale, and distance to a regional city similar to those within Waitaha | Canterbury. It had a predicted population growth of approximately 100 per cent over the next 25 years (figure 3(a)). The case study site was also surrounded by highly productive soil[1] (Land Use Capability classes 1–3) (figure 3(b)), consistent with the context of many towns in Waitaha | Canterbury. How to find the information associated with each scenario was explained to participants, which included the scenario 'approach' (for example, soil-oriented), residential area (in hectares) and urban density levels (including average density, and households per hectare (hh/ha) relating to each density present) (figure 4).

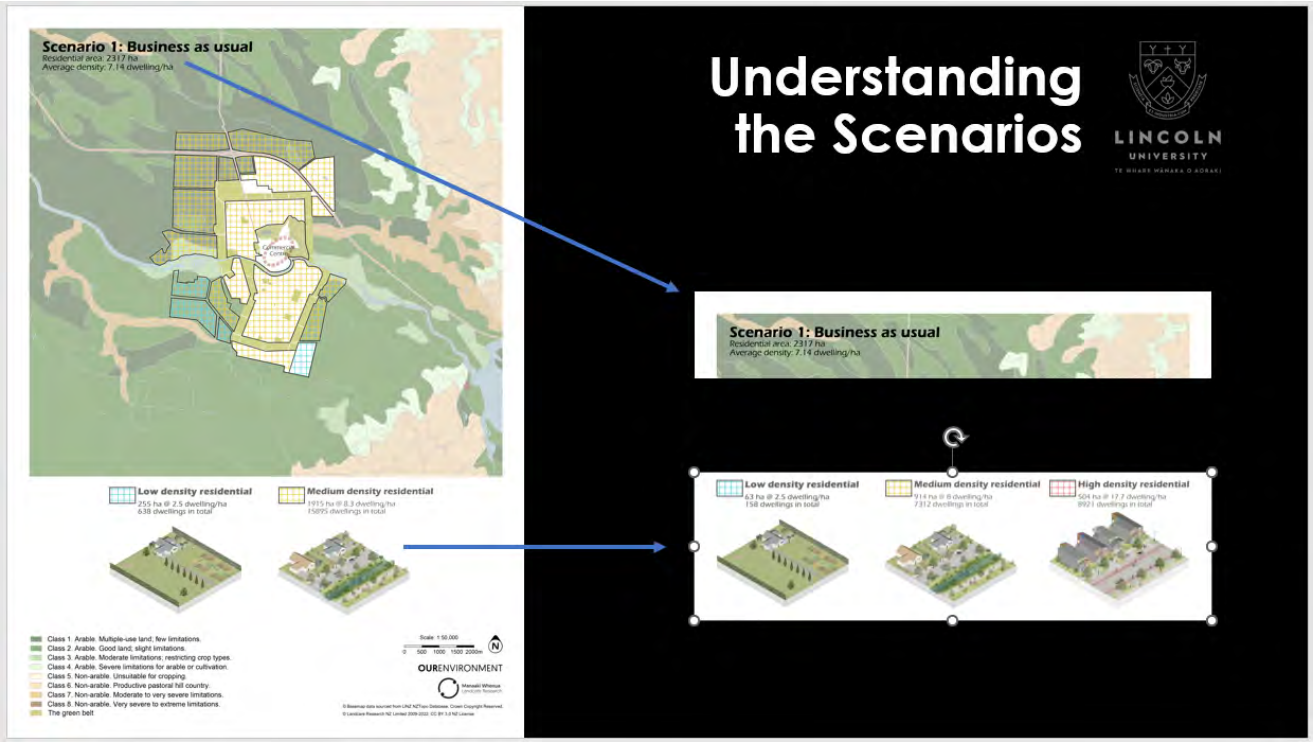


Figure 4. Information provided to help participants understand the scenarios (images by Guanyu Chen, 2022; map adapted from Manaaki Whenua Landcare Research, used under Creative Commons Attribution-ShareAlike 3.0 New Zealand Licence).

The five scenarios were:

- scenario 1: Business as usual (figure 5)
- scenario 2: Soil-oriented planning (figure 6)
- scenario 3: Transport-oriented planning (figure 7)
- scenario 4: Dense island/urban farm (figure 8)
- scenario 5: Hard boundary (figure 9).

The teams were left to circulate around the scenarios and conduct a SWOT analysis for each one.

Scenario 1 (figure 5) depicts residential housing of low (2.5 hh/ha) and medium (8.3 hh/ha) density. All existing housing densities are retained, and all urban extension areas are at a similar density. Urban expansion follows a 'sprawling' pattern (indicated on the map by additional hatched areas) predominately to the west, towards the regional city.

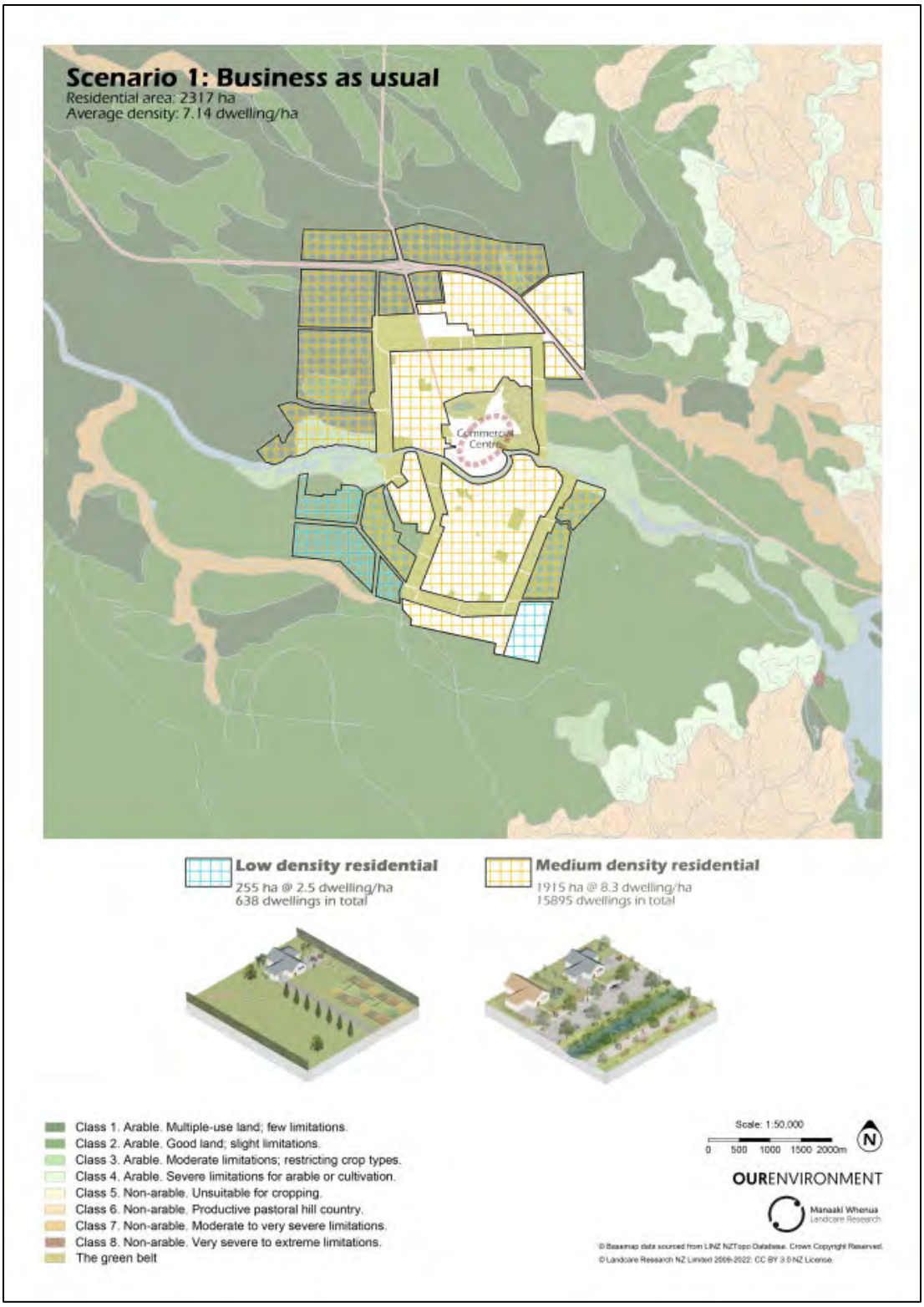


Figure 5. Scenario 1: Business as usual (image by Guanyu Chen, 2022; map adapted from Manaaki Whenua Landcare Research, used under Creative Commons Attribution-ShareAlike 3.0 New Zealand Licence).

Scenario 2 (figure 6) depicts residential housing of medium (8 hh/ha) and high (17.1 hh/ha) density. No urban expansion occurs on soil classes 1–3 (categorised in Aotearoa New Zealand as highly productive[1]). Instead, it occurs only on the two areas of class 4 soil (high-density housing), while the existing urban areas receive the remaining population by way of urban in-fill.

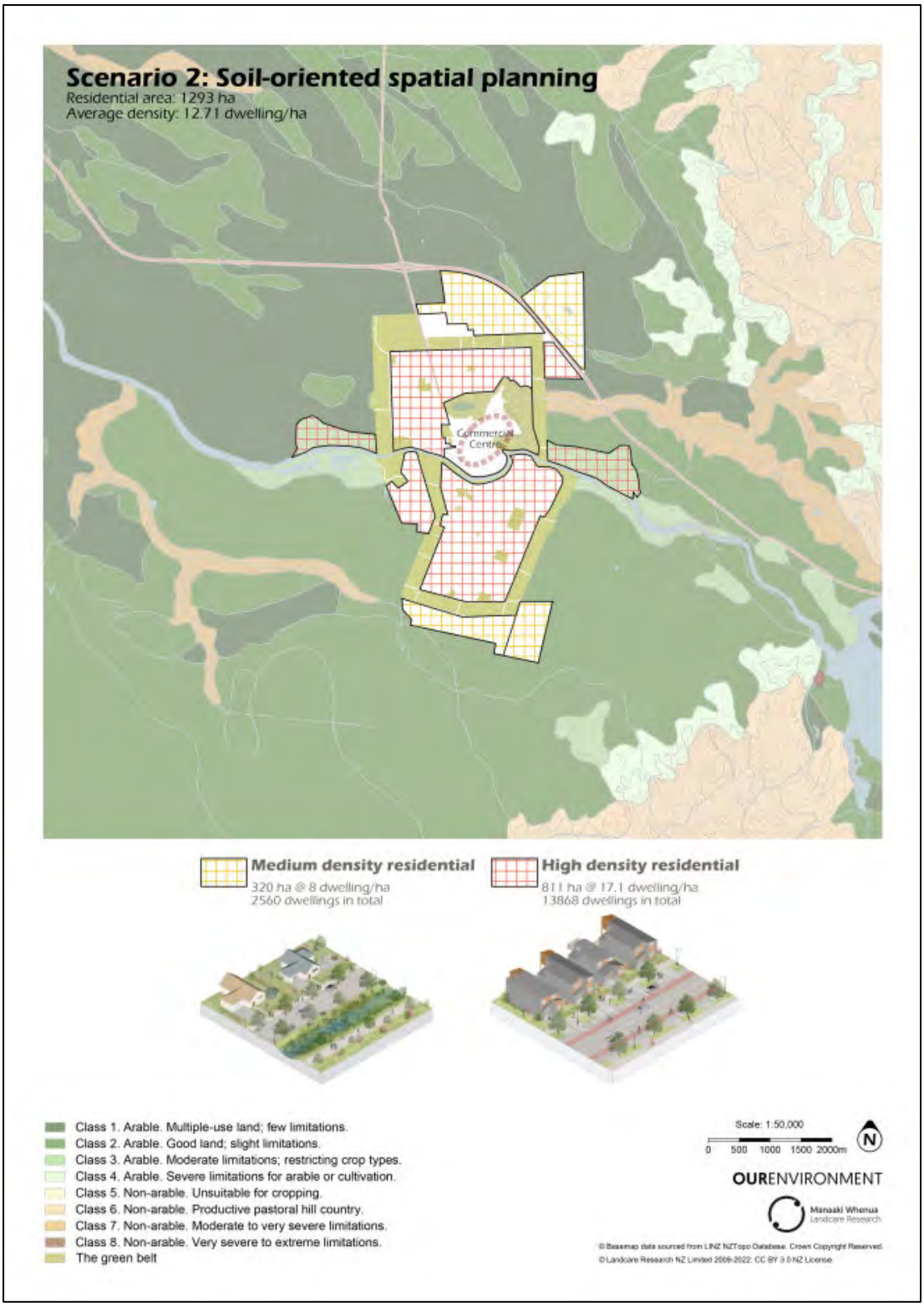


Figure 6. Scenario 2: Soil-oriented planning (image by Guanyu Chen, 2022; map adapted from Manaaki Whenua Landcare Research, used under Creative Commons Attribution-ShareAlike 3.0 New Zealand Licence).

Scenario 3 (figure 7) depicts residential development of low (2.5 hh/ha) and medium (8 hh/ha) density. Population increase is fulfilled by expanding the urban areas at a medium density along the existing highway linking the town to the regional city. All new development is at medium density.

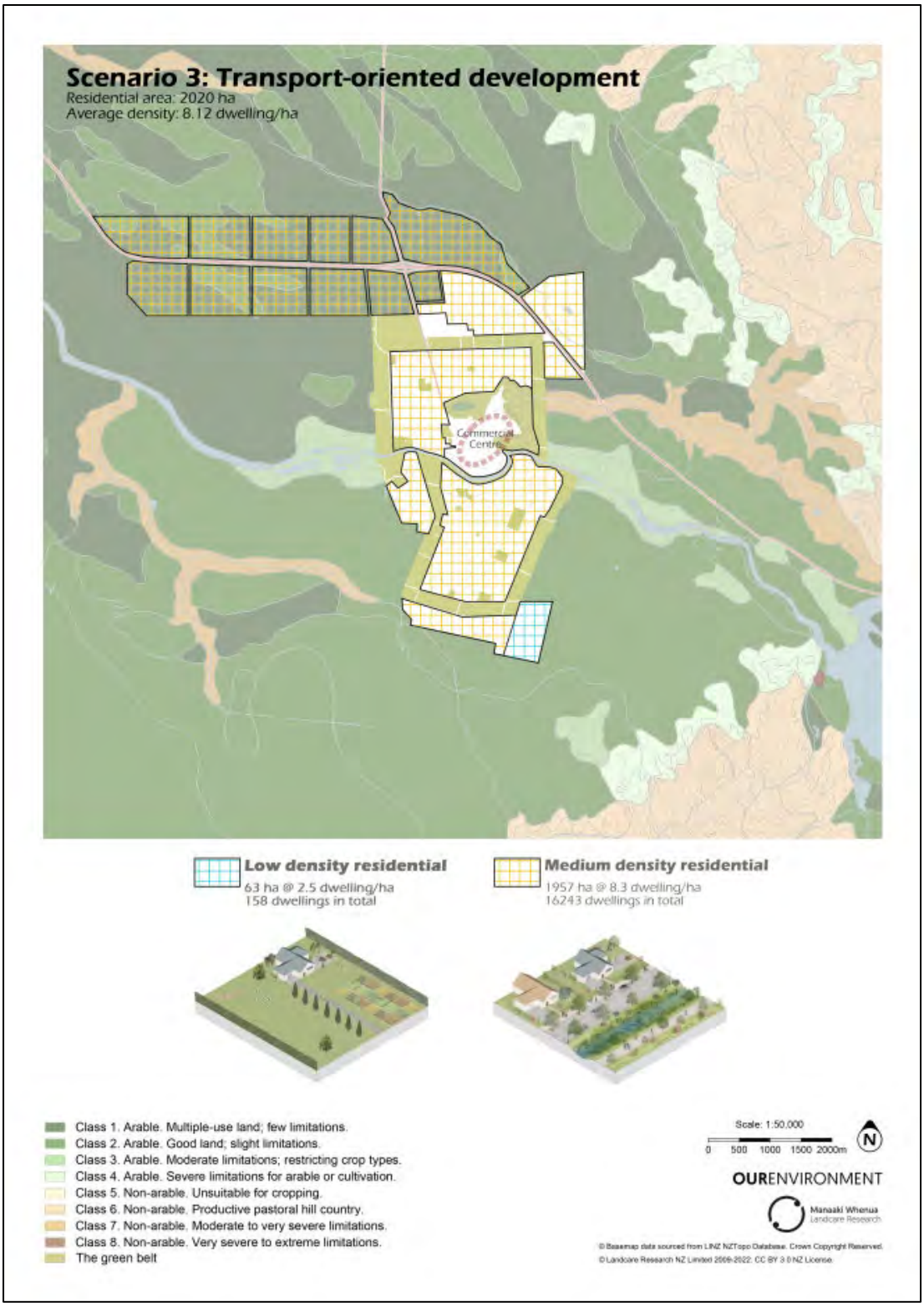


Figure 7. Scenario 3: Transport-oriented development (image by Guanyu Chen, 2022; map adapted from Manaaki Whenua Landcare Research, used under Creative Commons Attribution-ShareAlike 3.0 New Zealand Licence).

Scenario 4 (figure 8) depicts residential development at low (2.5 hh/ha), medium (8 hh/ha) and high (17.1 hh/ha) density. All existing densities remain the same, while the proposed additional population is received within the urban edge and accommodated in high-density housing located around 'urban farms'. The 'urban farm' zone is created around the immediate edge of the existing urban area. These 'urban farms' are approximately 100 ha, and spatially link to the existing greenbelt and open spaces.

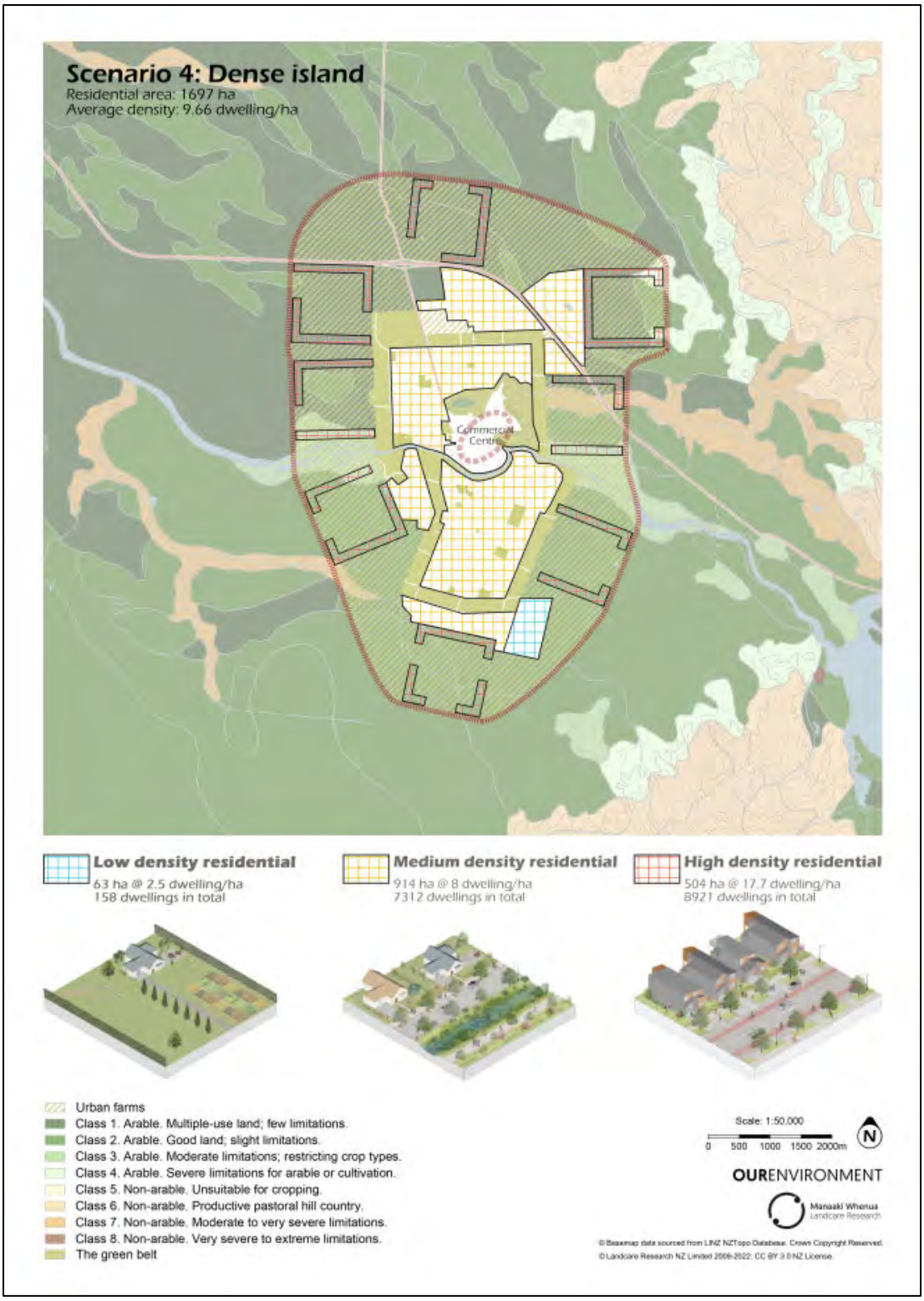


Figure 8. Scenario 4: Dense island/urban farm (image by Guanyu Chen, 2022; map adapted from Manaaki Whenua Landcare Research, used under Creative Commons Attribution-ShareAlike 3.0 New Zealand Licence).

Scenario 5 (figure 9) depicts residential development of high (16.8 hh/ha) density. All additional houses in this scenario are accommodated within the existing boundary of the settlement.

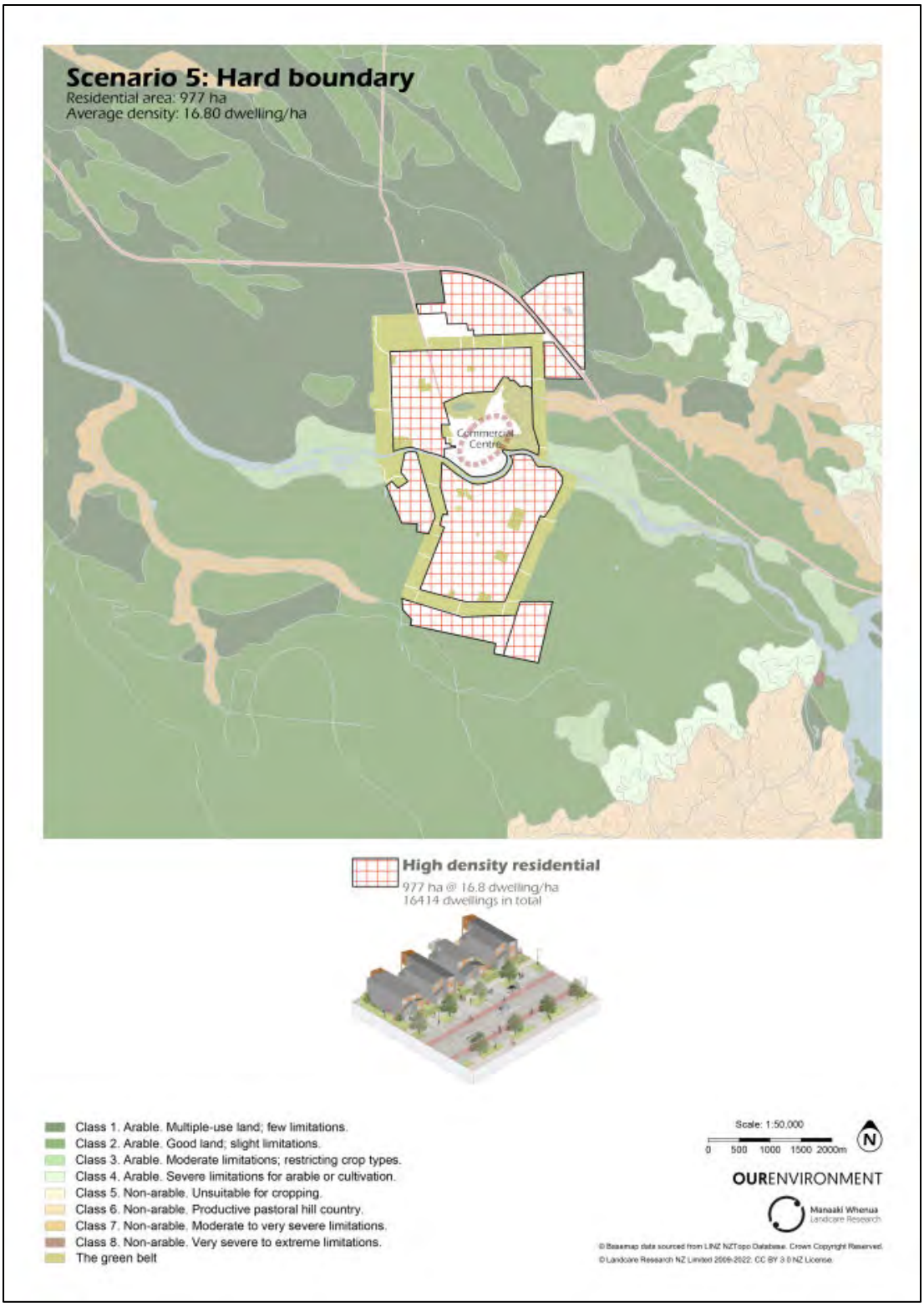


Figure 9. Scenario 5: Hard boundary (image by Guanyu Chen, 2022; map adapted from Manaaki Whenua Landcare Research, used under Creative Commons Attribution-ShareAlike 3.0 New Zealand Licence).

The outputs from the SWOT analyses were coded thematically and are presented in figure 10. The identified weaknesses and threats, and strengths and opportunities were colour-coded, showing similar or relevant topics in the same colour.

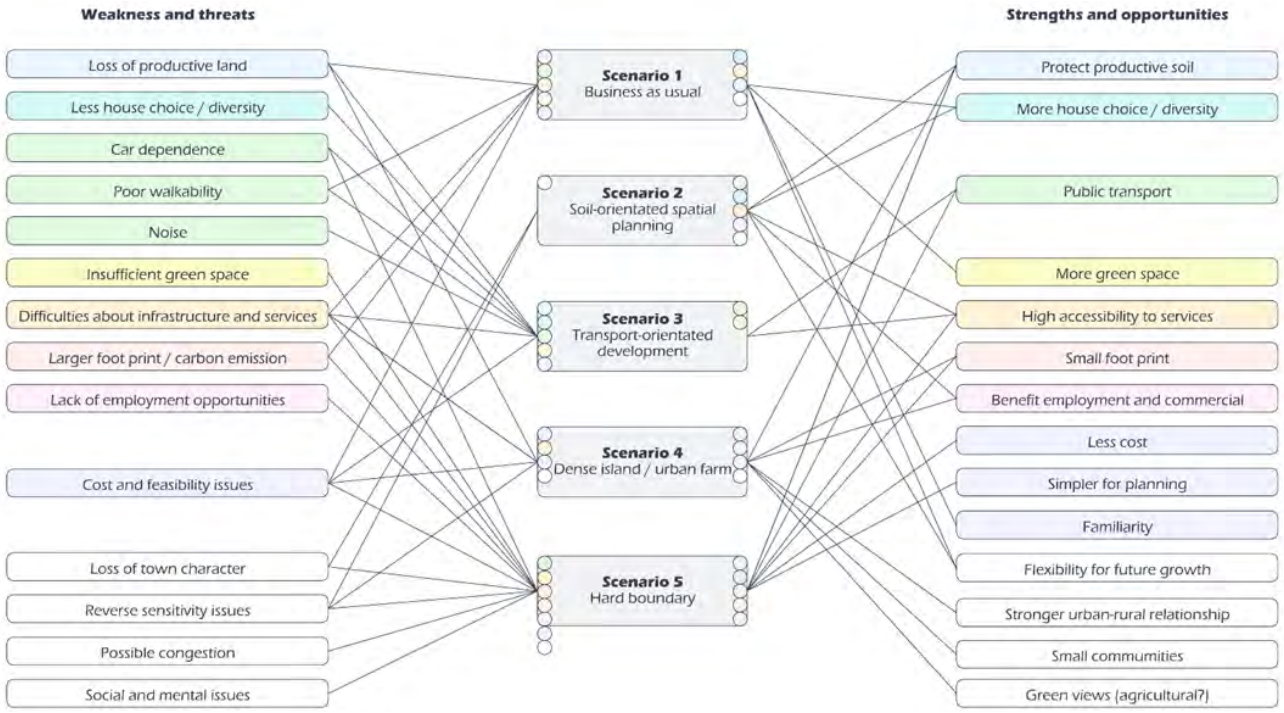


Figure 10. Thematic analysis of the SWOT analysis carried out by participants (image by Guanyu Chen, 2022).

Scenario 2: Soil-oriented development attracted the fewest weaknesses and threats (one) and the top equal number of strengths and opportunities (five), making it the most desirable scenario for participants according to this activity. This result highlights the perceived importance of protecting the highly productive land surrounding the town from urban development. Participants' evaluation of scenario 5: Hard boundary revealed the greatest number of weaknesses and threats (seven), as well as the most (equal to scenario 2) strengths and opportunities (five). Participants attributed to scenario 4: Dense island/urban farm an equal number of strengths and weaknesses (four of each), while scenario 3: Transport-oriented development accrued five weaknesses and threats, and two strengths and opportunities. Scenario 1: Business as usual elicited five weaknesses and threats, and four strengths and opportunities.

Of the strengths and opportunities participants identified, protecting productive land and high accessibility of services were the top occurring issues. For weaknesses and threats, the highest number of participants identified difficulties relating to infrastructure and services, alongside the issue of cost and feasibility. Loss of productive land and reverse sensitivity were both also identified in this activity as issues of concern.

Activity three: Ideate – design imagination (individual activity)

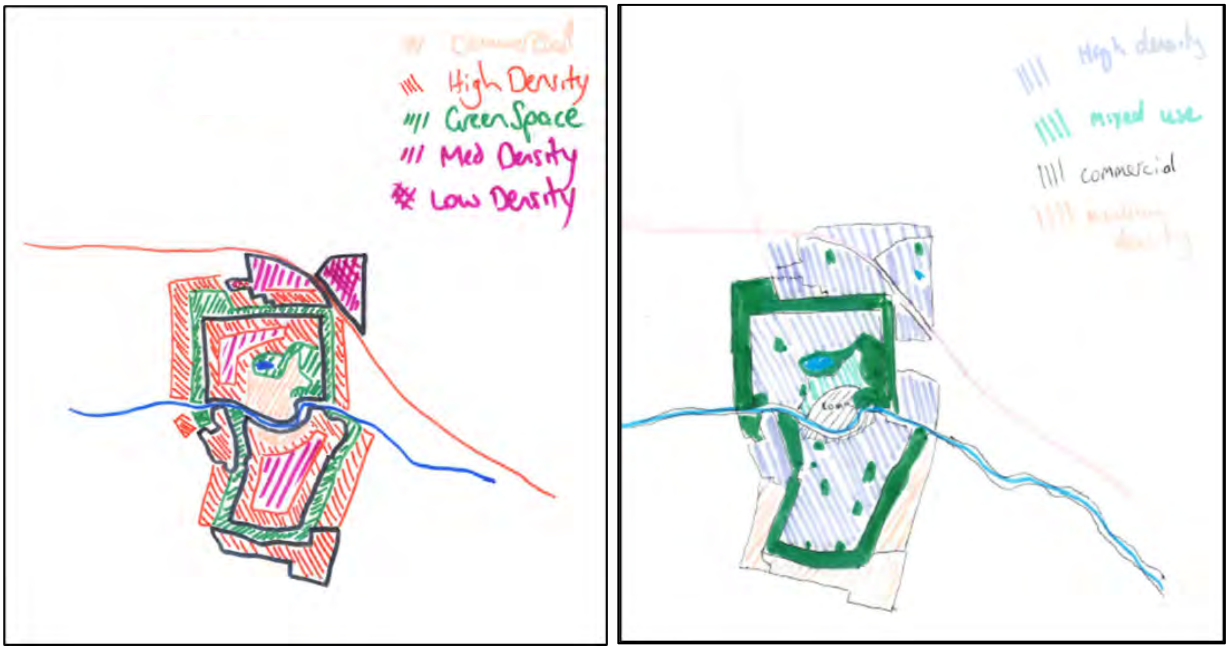
Building on the prior two steps, activity three asked the participants to review their SWOT analysis and then translate their thoughts into spatial design. The instructions provided for the participants were as follows.

1. Review the SWOT analysis from activity two.
2. Using the anonymous town base map as a landscape guide, draw your preferred peri-urban scenario.
3. Discuss with your table your spatial planning approach, highlighting why you have chosen to design the land use zones how you have.

Key themes identified through the analysis of participants' individual designs were: 'higher density housing', 'protection of productive soils and existing agricultural land', 'rural–urban transitions', 'accessibility' and 'integrated spatial design'. This section discusses each of these themes as well as presenting samples of participants' drawings related to them.

Higher-density housing

Figure 11(a) proposes increased density for both existing residential areas (by way of in-fill) and new housing areas located around the periphery of the existing town. Figure 11(b) also indicates an in-fill strategy for all existing developed areas, except for the existing urban extension sitting outside the existing greenbelt to the south. This area, along with two additional proposed medium-density extensions, is located around the edge of the existing green belt, benefitting from its amenity value.



(a) **(b)**

Figure 11. Self-drawn plans emphasising an increase in higher-density housing (with permission of participants, 2022). Both plans also illustrate the retention of existing 'commercial' and 'greenspace'. Example (a) shows both urban intensification of some existing urban areas, and new higher-density housing areas; however, it retains some existing urban areas as medium and low density. Example (b) illustrates a desired transition to all higher-density urban areas, apart from the southern 'edge', which is either retained or proposed as medium density.

Protection of productive soils and existing agricultural land

Figure 12 portrays a hard-boundary approach, with an in-fill housing strategy for all existing developed areas, as well as on the two lower-class soil (LUC 4) ']wings'.

Rural–urban transition

Figure 13(a) proposes 'high-density' urban growth within the lower-class soil 'wings', and the retention of medium- and low-density housing within the existing urban extensions. Figure 13(b) proposes two new extensions to the existing spatial form for medium- and low-density housing. Figure 13(c) proposes an in-fill strategy for all existing built-up areas, and then new growth zones for medium-density, very low-density (lifestyle) and industrial areas encompassed by a new green belt.

Accessibility (transport corridors, neighbourhood centres, public parks)

Figure 14 indicates urban expansion on the 'wings' that have lower-class soil, with an eventual extension on high-class soil along the main transportation highway to the east. Undeveloped areas to the north are also 'in-filled' to make the best use of space to the north, close to the existing highway.

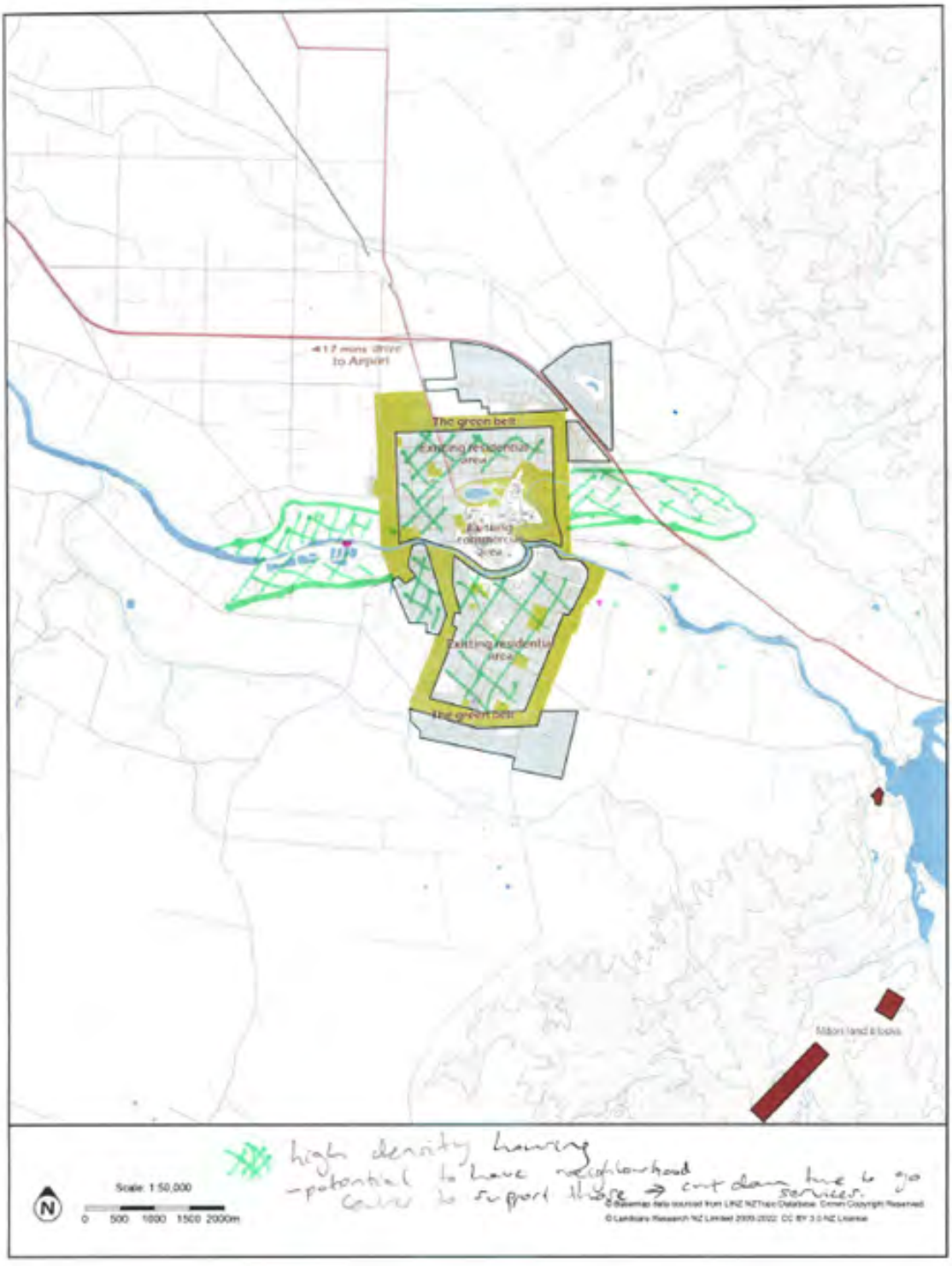
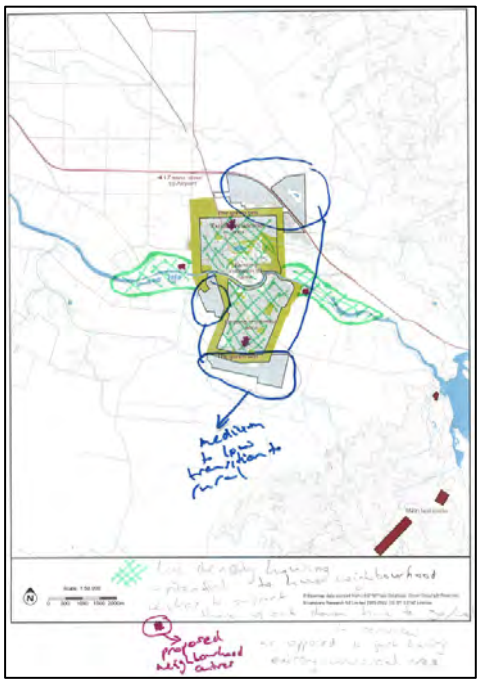
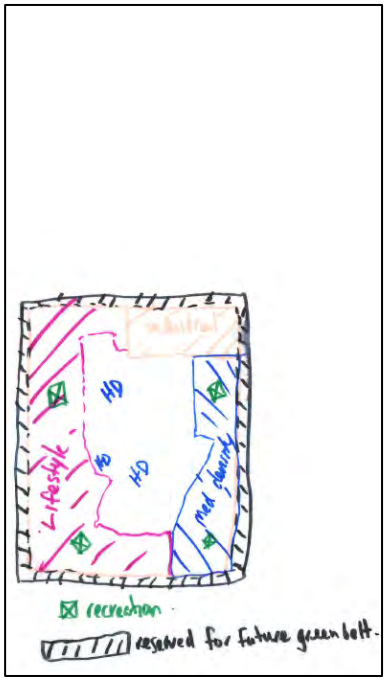


Figure 12. Self-drawn plan prioritising the protection of 'high-class' soil from residential sprawl (with permission of participant, 2022).



(a)

(b)



(c)

Figure 13. Self-drawn plans responding to the issue of 'density transition' from urban to rural areas (with permission of participants, 2022). Example (a) illustrates transition along the continuum from urban to rural through housing density moving from high density within the greenbelt, to medium and lower density closer to the urban edges. Similarly, example (b) illustrates urban–rural transition through the spatial transition of housing density. Example (c) illustrates a proposal of urban densification within the existing urban area, with a new medium and low (lifestyle blocks) density extending beyond the existing urban footprint, with a new greenbelt proposed at the periphery.

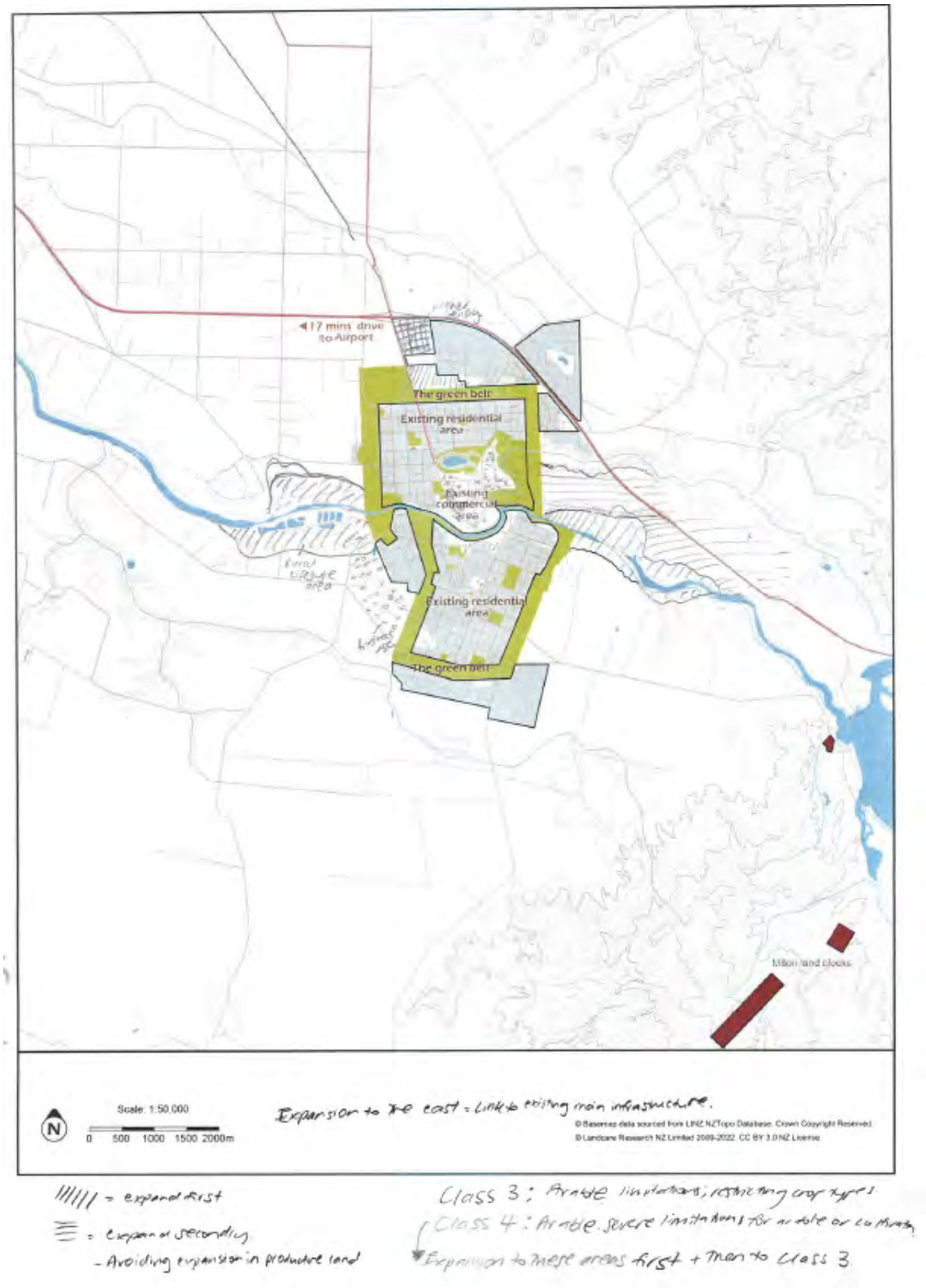


Figure 14. Self-drawn plan prioritising soil-oriented development with 'accessibility' (with permission of participant, 2022).

Integrated spatial design

The plan presented in figure 15 includes increasing housing density, providing active transport links and taking urban growth and accessibility into consideration to support the existing town centre. Further, in-fill of existing fragmented urban extensions improves accessibility to the existing highway, and a diversification of land use activities provides additional services south of the river.

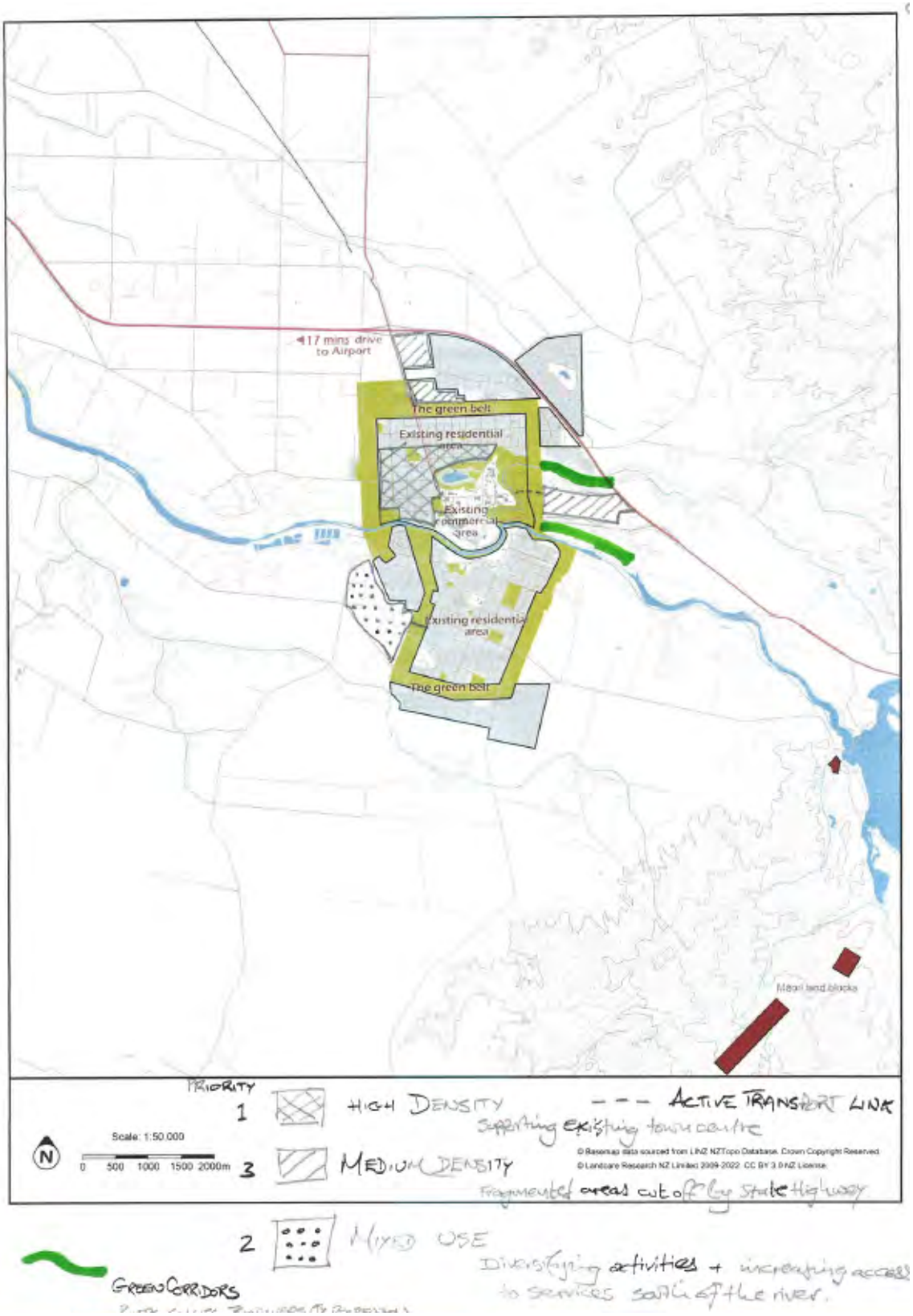


Figure 15. This self-drawn plan is an example of the most integrated spatial design proposed by participants (with permission of participant, 2022).

Discussion

By designing the workshop using an approach driven by design thinking, we were able to observe the strengths and weaknesses of the methodology within this setting. A range of themes emerged from the process that highlighted the opportunity a design thinking

process provides for spatial exploration and innovation when thinking about land use change. Clear themes were identified across the three activities, indicating the consistency of concern around issues such as loss of productive land, housing density and difficulties in accessing infrastructure and services, and reverse sensitivity.

The predominant theme to emerge from the workshop was that of protecting highly productive soils and existing agricultural land use. After being identified as an issue during activity one and then explored through a SWOT analysis during activity two, the protection of these soils and landscapes was an evident goal across most of the drawn plans produced in activity three. Related to protecting productive soils in this setting of population growth was the increase in housing density, which all participants also explored during the workshop.

Among the other key themes was the spatial transition between urban and rural land use, which saw participants exploring different spatial forms and approaches. Some participants in activity three, for example, adopted a hard boundary approach, while others preferred a continuum. Such differences underline the complexity of the issue and indicate the range of approaches under consideration to address it. Accessibility of people to transport, services and infrastructure was another theme highlighted across activities. Workshop participants, as representatives of their constituents and local landscapes, were cognisant of issues and concerns about adequate and efficient services and infrastructure. Many identified creating an accessible environment for people as an issue and explored it further. Aligned to this was the final key theme of land use and infrastructural integration, which was highlighted in activity three when participants considered multifunctional land use as part of their exploration of future planning.

As well as empowering participants to develop their thinking around the issues and future opportunities for peri-urban land use planning, the workshop drew out a number of challenges. One of these was the externality and impact on the participants' thinking due to their awareness of constituents' NIMBY (not in my back yard) attitudes. In practice, decision-makers often grapple with conundrums, such as residents desiring more roads but fewer vehicles on them, or the general desire to protect highly productive soil while individual landowners want to reap the economic benefits associated with urban development if land use change is permitted. Similarly, residents tend to understand the social benefits of higher-density living, but often contest initiatives promoting it when district plans change. This highlights the need for greater public awareness of the overall 'real' cost associated with each type of benefit and for early consultation with constituents where complex systems, such as peri-urban land use, are under consideration.

Our utilisation of the design thinking approach yielded many useful insights and useable points to consider, including the challenges noted above, in future peri-urban land use planning and policy. This underscores the methodological advantages of the 'quick and dirty' design thinking approach in a context that has a high level of complexity and uncertainty and that requires swift alternative solutions (McGann et al, 2018). This rapid ideation style may be able to deliver novel approaches and highlight previously unconsidered opportunities for implementable solutions to intricately structured problems that require interconnected responses. This aligns with Liedtka's (2011) argument that the most valuable insights in an uncertain environment often arise from rapid prototyping and real-world trials, as opposed to relying solely on extrapolation of history.

At the initial stage of the design thinking process, the facilitator plays a pivotal role in nurturing fragile 'new' ideas. Many of these ideas may initially appear 'radical or unworkable', but may turn out to be valuable later on (Body, 2008). Several strategies can be employed to foster this incubation process and minimise bias. For instance, we deliberately structured workshop tasks to minimise contextual familiarity. The scenarios presented in activities two and three were situated in spatial contexts distinct from the participants' real-life work environments, although they were issue-aligned when considering pressure for land use change. This deliberate choice freed participants from the constraints of their everyday 'place' and community-based concerns and encouraged creative thinking by compelling them to embrace the issues rather than the place. Another

action we took to facilitate the process was to keep the participant groups small (in this case, groups of four). Echoing Body (2008), small groups are good for controlling conversations about why something won't work under the existing system and making the participants feel more comfortable about challenging the existing systems and assumptions, which in turn fosters a safer space for innovative thinking.

Recognising and overcoming bias throughout the design thinking approach – from planning to facilitation, to participation and the analysis and interpretation of outcomes – is critical to the integrity of the design thinking approach. The best way to support creativity and innovation is to identify possible bias and actively challenge it. To this end, as well as adopting a hypothetical landscape setting so that participants were removed from their specific constituent responsibilities and local landscape nuances, the workshop gave participants the scope to openly explore and identify issues free of limitations in activity one, explore and analyse five land use scenarios in activity two, and design 'freely', within the scope of the workshop topic, in activity three.

Related to this issue of scope is the consideration of methodological and procedural limitations. For example, the workshop focused on peri-urban landscape planning, specifically on the topics of highly productive land and housing, and did not explicitly consider other essential urban design considerations, such as flooding potential, erosion and topography, landscape identity or housing affordability. Another limitation was that participants were constrained in the time they had to engage in the workshop as busy, professional people with multiple commitments and responsibilities. Like bias, limitations are an inherent part of the design thinking approach; however, by actively questioning and engaging with the process, we can enrich outcomes from the design thinking approach.

What next?

The full potential of the design thinking approach is not harnessed through adopting it for one-off events such as this mayoral forum workshop. Rather, its true strength becomes apparent when it is employed iteratively. The mayoral forum workshop has formed the first step in a multi-step study looking at solution-based, peri-urban land use design. In subsequent research, we have surveyed and engaged with peri-urban residents and food producers, which allowed us to substantiate the views of the mayoral forum members and their understanding of the core issues facing peri-urban Aotearoa New Zealand (Davis, Chen and Darvill, 2023). This continuation of the design thinking methodology, in which we engage with different stakeholder groups, will deepen our understanding of the issues. We expect to further harvest these insights through ongoing engagement with iwi, diverse communities, and stakeholders.

In the context of the ongoing discourse surrounding peri-urban land use and food security, the design thinking approach serves as a useful design-focused toolkit to stimulate innovative and novel solutions, foster effective communication among stakeholders, and promote mutual understanding of issues such as highly productive and versatile soil. At the same time, it incorporates essential community knowledge and values, and ultimately drives a shift towards alternative approaches to peri-urban land planning. Design thinkers are well positioned to lead the way in facilitating interactions and building empathy among decision-makers, creating safe and supportive environments to incubate innovation and contributing to the iteration of the design thinking processes for diverse and novel outcomes.

Conclusion

The design thinking steps of 'empathise', 'define' and 'ideate' allowed the research team to better understand the existing landscape values and land use aspirations in a critical point in Aotearoa New Zealand's history.

This research has provided a case study and methodology for facilitating conversations between government authorities and environmental design professionals such as landscape architects. Activities based on design thinking, such as those in our study, demonstrate the possibility the design thinking methodology holds as a catalyst for

active engagement and solution ideation when considering complex land use issues. As presented in this paper, the design thinking methodology has potential to support design professionals in better understanding the range of pressures, expectations and aspirations of stakeholder groups, as well as finding diverse, community-led and novel solutions to complex issues.

The methodology supported both participants and researchers to deepen their understanding of how issues and policies could be translated to spatial land use design. Critical to the receiving environment and community, the peri-urban zone provides vital ecosystem services, and sophisticated and thoughtful future planning for these areas is essential to the protection of the landscape and the success of the communities it supports. Novel ideation is critical to tackling wicked problems facing twenty-first century cities globally. The design thinking methodology is a powerful enabler for unlocking solution-based futures both here in Aotearoa New Zealand and internationally as the world population grows and urbanises at an unprecedented rate.

About the authors

Shannon Davis is a Senior Lecturer in Landscape Planning in the School of Landscape Architecture, Lincoln University. She is also a research leader within the Centre of Excellence: Designing Future Productive Landscapes, leading the research theme 'Future Foodscapes for Health'. Her research specialises in the areas of urban agriculture and peri-urban land use.

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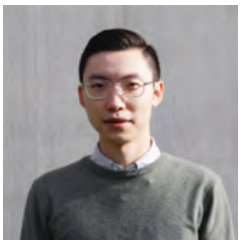

Guanyu Chen is a PhD candidate at Lincoln University. His current research focuses on landscape performance evaluation, its relevant evaluation methods, strategies, frameworks, supporting mechanisms, and theories, as well as environmental valuation, agricultural landscape, and peri-urban planning.

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NOTES

[1] The Land Use Capability (LUC) classification system categorises land into eight classes according to the physical qualities of the land, soil and environment (Manaaki Whenua Landcare Research, 2021). LUC Classes 1–3 are considered 'highly productive'.

LUC Class 1 is categorised as arable and is the most versatile multiple-use land, with minimal limitations, highly suitable for cropping, viticulture, berry fruit, pastoralism, tree crops and forestry. LUC Class 2 is categorised as arable with very good multiple-use land, slight limitations, suitable for cropping, viticulture, berry fruit, pastoralism, tree crops and forestry. LUC Class 3 is considered arable with moderate limitations, restricting crop types and intensity of cultivation, suitable for cropping, viticulture, berry fruit, pastoralism, tree crops and forestry. LUC Class 4 is considered arable but with significant limitations for arable use or cultivation, very limited crop types, suitable for occasional cropping, pastoralism, tree crops and forestry. Some Class 4 land is also suitable for viticulture and berry fruit. LUC Class 5 is considered non-arable but is highly productive pastoral land, not suitable for crops but only slight limitations to pastoral, viticulture, tree crops and forestry. LUC Class 6 is considered non-arable, with slight to moderate limitations to pastoral use, suitable for pasture, tree crops, forestry and, in some cases, vineyards. LUC Class 7 is described as non-arable with moderate to very severe limitations to pastoral use, and a high risk of land requiring active management to achieve sustainable production. This classification can be suited to grazing with intensive soil conservation measures but is more suited to forestry. Finally, LUC Class 8 is non-arable land with very severe to extreme limitations to all productive land uses (Manaaki Whenua Landcare Research, 2024).

[2] Human ethics approval for this study was granted by the Lincoln University Human Ethics Committee: HEC2002-13.

[3] Reverse sensitivity is the legal vulnerability of an established activity to complaints from a new land use. It arises when an established use is adversely impacting on nearby land and a new activity is proposed for the land.

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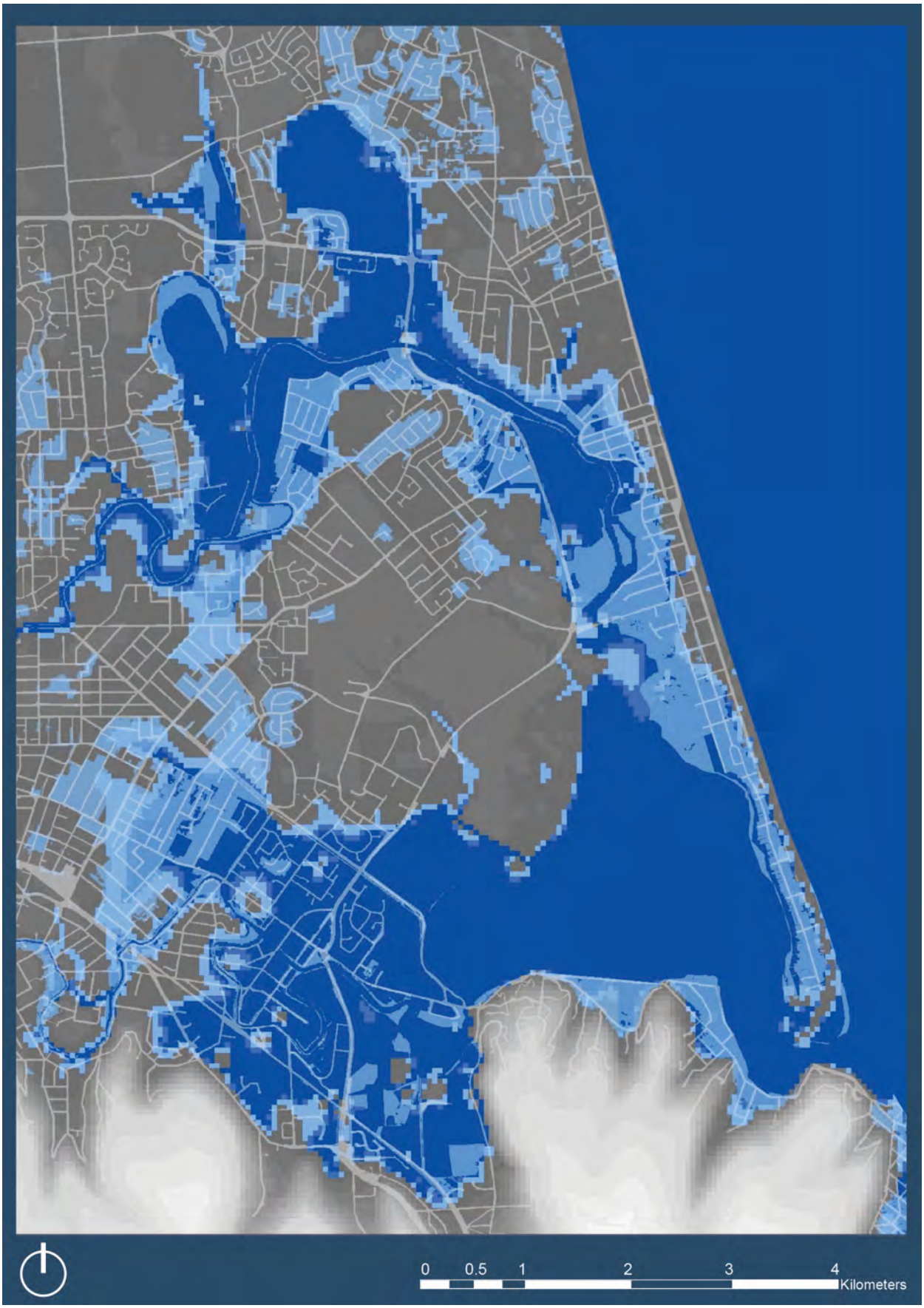

Image created based on rising sea levels, high tides and Christchurch flood level map associated with a 50-year storm (image by Suphicha Muangsri, 2023, retrieving data and images from Tonkin & Taylor Ltd (2017) and Christchurch City Council (2022)).

LANDSCAPE REVIEW

Adaptive flood mitigation planning: harnessing the maximum capability of strategic green stormwater infrastructure

SUPHICHA MUANGSRI, WENDY MCWILLIAM AND GILLIAN LAWSON

Flooding in low-lying coastal cities is expected to worsen with climate change, and planning for long-term flood mitigation is challenging due to high uncertainty in projections. Risks are associated with under- or over-investment in expensive grey infrastructure. Implementing green stormwater infrastructure (GSI) on strategically large private properties may be a lower-risk alternative. In our previous studies published in 2022 and 2024, we found that the capability of industrial properties to supplement city flood mitigation was substantial. They could offset climate change impacts in the long term, even under a major climate change scenario, and reduce flood probabilities. In this paper, we restate their potential as a case study of large private properties to draw more attention from practitioners and transfer scientific knowledge into practice. The maximum flood mitigation capabilities of large private properties can be met through networks of GSI facilities and a long-term adaptation plan that considers all possible approaches to implementing GSI over time. However, government regulations and policies are needed to support their implementation to the maximum capabilities.

Challenges in flood mitigation planning in low-lying coastal cities

Low-lying coastal cities have been confronting challenges in flood management, which will be exacerbated by climate change in the future (Dedekorkut-Howes, Torabi and Howes, 2020; Terry, Winspear and Goff, 2021). The challenges involve three main problems: increases in surface runoff, decreases in stormwater holding capacity and increases in the level of exposure (figure 1). Surface runoff into rivers has increased because impermeable surfaces in cities have expanded and intensified (Adnan et al, 2020) while storm events have increased in intensity and frequency with climate change (Martel et al, 2021). At the same time, climate change is causing more seawater to enter rivers due to higher sea levels, which will reduce the capacity of rivers to carry water and consequently will increase flooding (Moftakhari et al, 2017). Groundwater levels will increase with these rising sea levels (Vitousek et al, 2017), and thus reduce the storage capacity for holding stormwater in-ground (Davtalab et al, 2020). Moreover, some coastal cities, like Christchurch, are confronting high land subsidence rates that further increase their flood risk (Bagheri-Gavkosh et al, 2021).

Determining long-term solutions for protecting cities from this flooding is challenging for planners. Building higher and stronger defensive structures (for example, levees and sea walls) to prevent water from entering urban areas comes with the risks associated with under- or over-investment (Radhakrishnan et al, 2018) as we do not know how long their capacities are going to last. In addition, the longer the projection period, the greater the variations between different scenarios, making it challenging to determine the most suitable scenario to prepare for (Yousefpour and Hanewinkel, 2016) (figure 2). While retreat strategies are considered a cost-effective option to sustainably reduce flood risk in the long term (Diaz, 2016; Haasnoot, Lawrence and Magnan, 2021; Temmerman et al, 2013), they are very difficult to implement in communities (Lawrence et al, 2020) as many land owners do not want to leave their land. However, in the far future, under a major climate change scenario, retreat strategies might be the only option available to avoid the impacts of flooding. While accommodation strategies are preferable to handle near- to mid-term flood

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KEY WORDS

green stormwater infrastructure; flood mitigation; low-lying coastal city; adaptive planning; climate change

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impacts, the large facilities needed to hold large amounts of water, like underground storage tanks, will be very expensive to build and maintain (Chen and Mehrabani, 2019; Saraswat, Kumar and Mishra, 2016; Tsuchiya, Tortajada and Ratra, 2018).

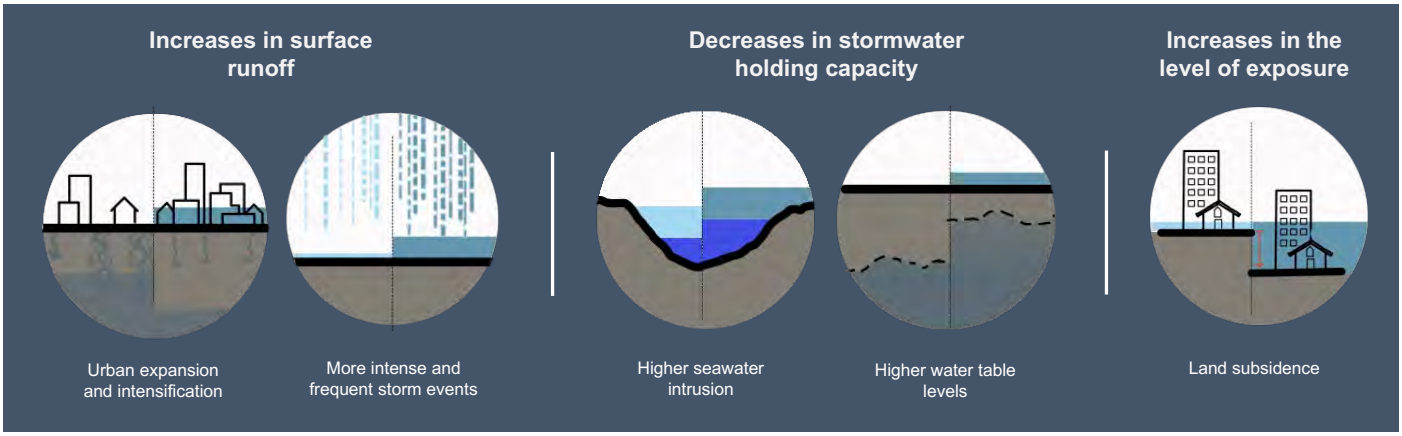

Figure 1. The problems causing challenges in coastal city flood management (image by Suphicha Muangsri, 2023).

Figure 2. Substantial flooding is projected to occur in many low-lying coastal cities of Aotearoa New Zealand. In Christchurch by 2050, runoff volumes corresponding to different rainfall events were projected to increase by between 6 per cent under the minor scenario (+1 degree Celsius by 2100) and 8 per cent under the major scenario (+4 degrees Celsius by 2100). While the impact associated with the minor scenario would remain steady after the middle of this century, increases in runoff volumes would reach about 10 per cent under the moderate scenario (+2 degrees Celsius by 2100) and 25 per cent under the major scenario by the end of this century (image by Suphicha Muangsri, 2023).

Implementing accommodation strategies through green stormwater infrastructure (GSI) is less risky and is considered more cost-effective than one-time and expensive flood mitigation investments (Haasnoot et al, 2013; Lawrence et al, 2021). GSI can be adaptively implemented to provide supplemental flood mitigation alongside the current system as climate change evolves (Haasnoot et al, 2012; Kirshen et al, 2015; Xu et al, 2019). Implementing GSI can enable planners to delay decision-making on investments in large engineering structures until the cost-effectiveness of those structures becomes better informed (Aerts et al, 2014). However, the extent to which GSI can effectively mitigate flooding depends on its ability to collect runoff from a wide area (Schubert et al, 2017).

The greater the area that GSI facilities control, the more they can reduce catchment runoff volume.

Due to limited space in already developed cities, only small-scale GSI facilities (for example, green roofs, permeable surfaces, and rain gardens) are likely to be implemented on limited public land, particularly along streets, or on small plots of private properties as an alternative. However, their effectiveness is limited under extreme storm events, particularly those induced by climate change (Joyce et al, 2017; Pappalardo et al, 2017; Tao et al, 2017; Zahmatkesh et al, 2015). As these facilities have limited storage capacity, they can only control runoff from small drainage areas. This means most private properties are required to retain their on-site runoff in these GSI facilities in addition to public land in order to substantially intercept a large amount of catchment runoff (Schubert et al, 2017). However, there are several barriers to implementing GSI on private land in general. Notably, many land owners do not want GSI facilities located on their land (Dai, Wörner and van Rijswick, 2017; Perry and Nawaz, 2008). Government management of GSI facilities to ensure they continue to function is also difficult given private property rights (Dai et al, 2017; Dhakal and Chevalier, 2017). The size and shape of available space in small lots may not be able to accommodate GSI facility installation (Aparicio Uribe, Bonilla Breenes and Hack, 2022; D'Ambrosio et al, 2022). Furthermore, it is very difficult and time-consuming for governments to work with too many private land owners (Backhaus and Fryd, 2012).

Targeting strategic private properties capable of implementing large-scale GSI facilities (for example, detention or retention basins, wetlands and stormwater storage) may be a viable alternative. Given large-scale facilities are more effective per unit area (Damodaram et al, 2010), they can be strategically allocated on large lots with sizable areas that have potential for installing GSI. This means fewer land owners would be required to achieve a flood protection objective, and planners could target land owners who are highly capable of providing flood mitigation and the most likely to benefit from implementing GSI facilities.

Potential of large private properties to supplement city flood mitigation

The landscape characteristics of large private properties, such as industrial, commercial and institutional land, could facilitate the installation of large-scale GSI facilities, resulting in a greater reduction in stormwater discharge (Aparicio Uribe et al, 2022; D'Ambrosio et al, 2022; Smith et al, 2015). For example, the results of our previous study highlighted the potential of implementing GSI on existing industrial land in Christchurch, as a case study of large private properties, to provide supplemental city flood mitigation under different climate change scenarios up to the end of this century (Muangsri, McWilliam and Davies, 2023). The existing industrial land in four out of six catchments ranged in size from 3.3 per cent to 28 per cent of the catchment area. This land could offset climate change–induced flooding up to the middle of this century under a minor climate change scenario (+1 degree Celsius by 2100). Two catchments could mitigate the impacts of a major climate change scenario (+4 degrees Celsius by 2100) up to the end of this century. Moreover, they could reduce the runoff volume of more infrequent (80-, 100- and 200-year) storms to below the volume of a storm for which current drainage and flood protection systems are designed (namely, a 50-year storm), although not under all climate scenarios (figure 3).

The findings of our study also indicated that GSI on large private properties could collect not only on-site runoff volume but also off-site runoff from upstream. However, these properties must have large upstream contributing areas, large potential GSI areas and significant depths to the high water table (Muangsri et al, 2023). For example, our study found that collecting runoff from 7.5 per cent (as the area of the industrial land) of the Heathcote River catchment could offset climate change–induced flooding under a moderate climate change scenario (+2 degrees Celsius by 2100) up to the end of this century. GSI on this industrial land could reduce the impacts of a major climate change scenario if it collected the runoff from an additional 23 per cent of the catchment that was upstream of the industrial land (figure 3).

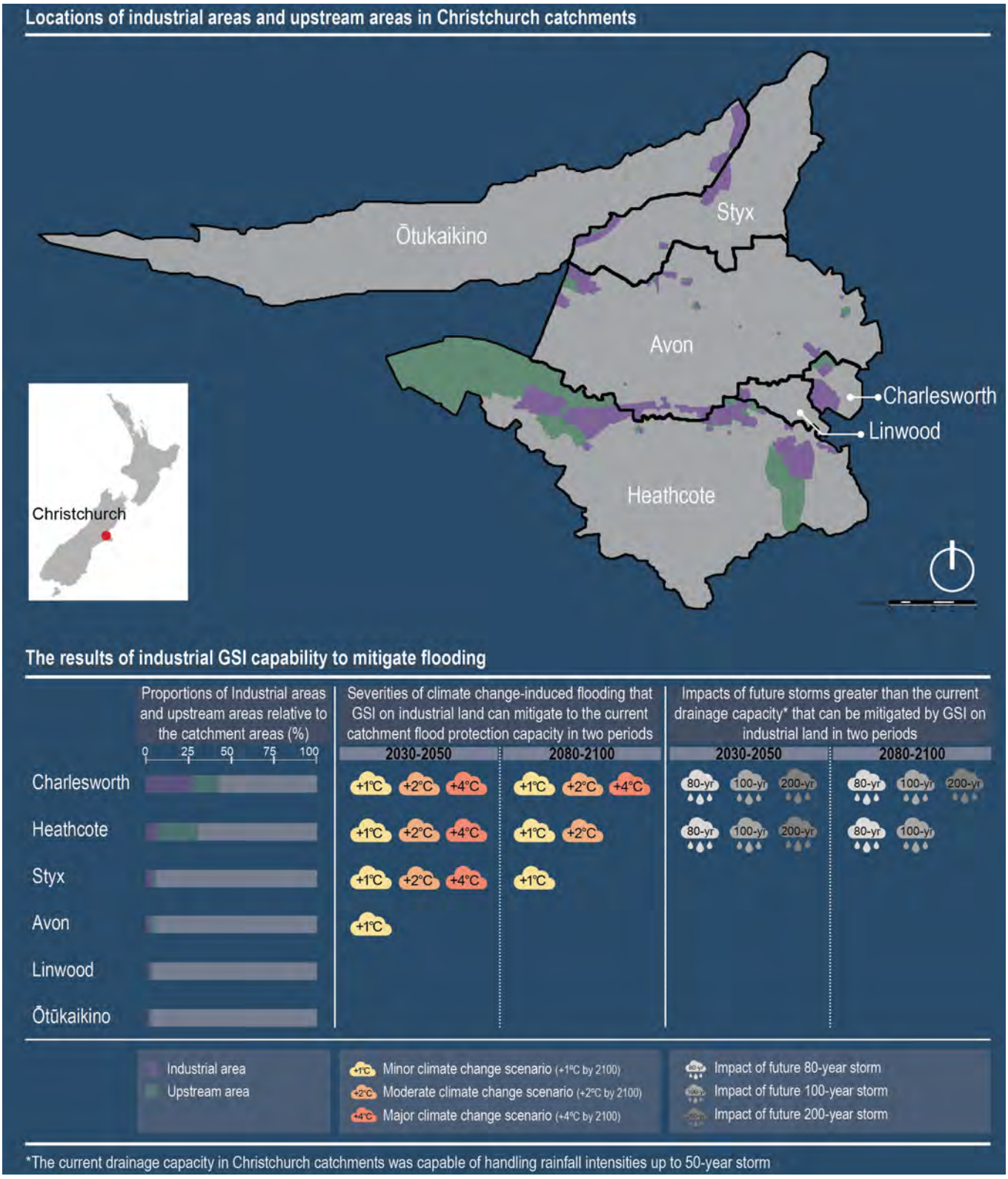

Figure 3. The capabilities of existing industrial land in Christchurch catchments to offset climate change–induced flooding and to reduce runoff volumes of storms larger than the design storm of current drainage capacity (the 50-year storm) vary with the percentage of the catchment occupied by industrial properties and whether they also capture runoff from upstream (image by author, 2023). The findings in Muangsri and colleagues (2024) refer to the data presented here.

The need for a green stormwater infrastructure network

A network of GSI is needed to take full advantage of the land capability to mitigate flooding. Storing off-site runoff from upstream would only be possible with a network to convey runoff from upstream to large properties downstream. Runoff volume exceeding GSI facilities may be transferred from one drainage area to others that have excess storage capacity, and where geography is capable of diverting water from one waterway to another.

For example, industrial zone 2B in the Heathcote River catchment had a large upstream area from which it could collect runoff (Muangsri et al, 2022a). However, the amount of water was larger than its potential in-ground storage capacity; therefore, it could only mitigate increased catchment runoff volume under the moderate climate change scenario up to the end of this century. The catchment flood mitigation capability could be enhanced if its excess runoff volume could be transferred to zones 2A and 2C, which were geographically connected with zone 2B. The capabilities of these zones combined could mitigate flooding just under that associated with the major climate change scenario (figure 4). In addition, a GSI network could allow the properties, having excess storage capacity beyond what is required, to trade their capability with the land owners who find it challenging to accommodate GSI facilities with their existing land uses (Fu et al, 2019). This could help municipalities achieve their flood protection objective while minimising the number of land owners involved.

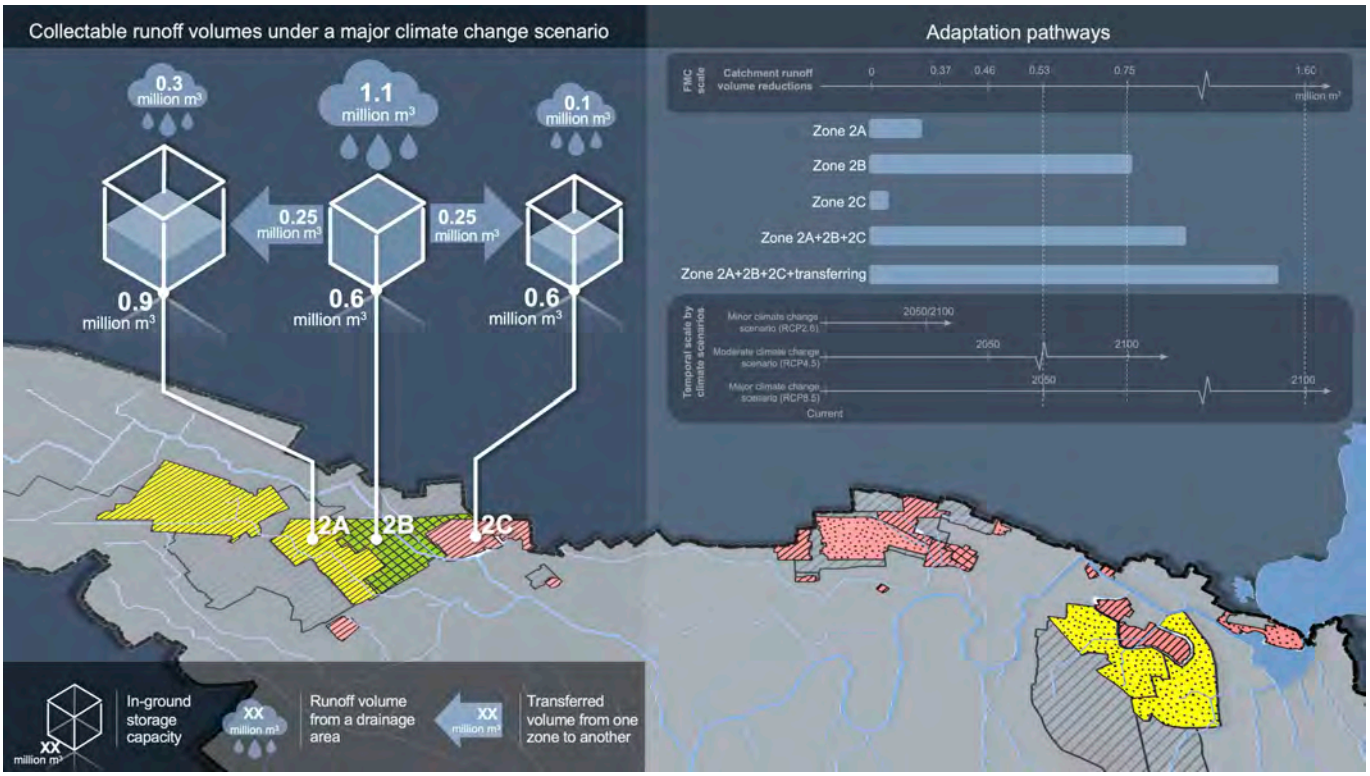

Figure 4. The summary of results from Muangsri and colleagues (2022a) demonstrates that a GSI network consisting of industrial zones 2A, 2B and 2C in the Heathcote River catchment, Christchurch, was almost able to mitigate climate change–induced flooding corresponding to a major scenario, when the capabilities of those zones were optimally utilised (image by author, 2023).

Long-term adaptive planning with climate change

GSI can be implemented through three possible approaches: retrofit, redesign and relocation. Each approach is appropriate for different circumstances and times.

A *retrofit approach*, where GSI facilities can be installed in existing available space to collect stormwater near the source, is the preferred approach as it allows for the immediate rollout of GSI while causing less disruption to current land uses (Shafique and Kim, 2017).

However, planners can only implement GSI facilities in areas that are currently considered the most suitable, which may not achieve maximum capability in cases where all potential GSI areas are needed. Conversely, in cases where only a small proportion of potential GSI area is needed to achieve the maximum flood mitigation capability, retrofitting would be the most appropriate.

A *redesign approach* involves altering the current site plan to better accommodate GSI facilities. This approach may result in having more areas that are suitable for GSI, where they may have been considered unsuitable before the redesign, and in turn maximising flood mitigation (Rogers et al, 2020). As it requires significant changes, it would not be a preferable option for near-term flood mitigation when the increased impacts of climate change can be managed through a retrofit approach (Rosly and Rashid, 2013). However, this approach would become attractive as climate change impacts continue to increase and existing land uses need to be changed to better serve future functions (Jaroszewska, 2019).

A *relocation approach* would be more applicable in areas with high flood risk when climate change impacts on coastal and groundwater floods cannot be mitigated in the far future under more severe climate change scenarios (May, 2020; Rey-Valette, Robert and Rulleau, 2019; Rogers et al, 2020). These flood-prone areas are likely to be located near rivers and coastlines and have a shallow water table (Doberstein, Fitzgibbons and Mitchell, 2018). In the long term, planners may need to relocate development in these areas and replace them with wetlands.

GSI networks can be implemented incrementally as climate change impacts increase to provide long-term supplemental flood mitigation. Therefore, implementation does not need to be limited to a retrofit approach. For instance, for near- to mid-term protection, GSI could be implemented in properties where retrofitting involves limited land-use disruptions. Where possible, these facilities could be expanded as needed to provide further protection. Then properties that are more capable but require redesign and relocation to achieve their substantial flood mitigation capability could be targeted for GSI implementation to provide mid- to long-term protection as needed (figure 5).

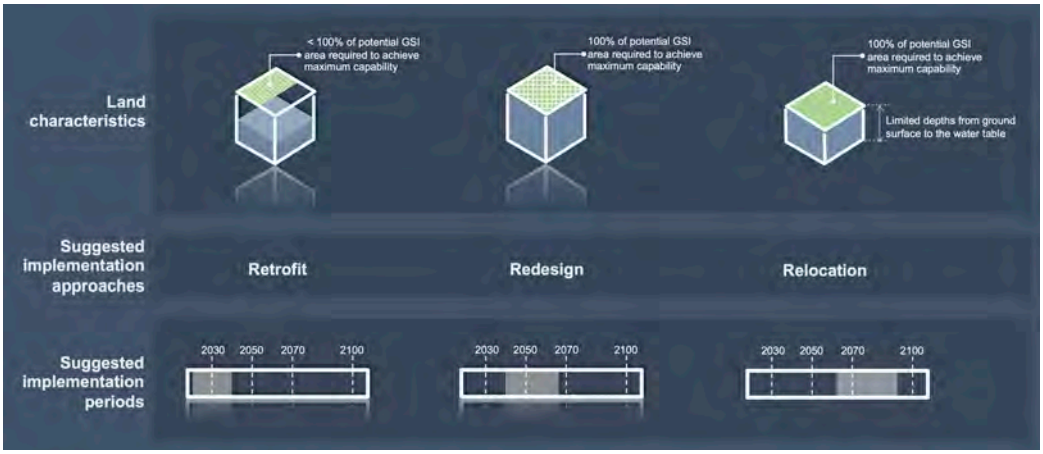

Figure 5. Muangsri and colleagues (2022b) classified large private properties into three groups based on the proportion of potential GSI area required to achieve maximum flood mitigation capability and the water table level. This classification can assist planners in determining an appropriate approach and period for implementing GSI (image by author, 2023).

A call to action!

Coastal city governments need to undertake the following three key actions to realise the potential of large GSI facilities on private property to protect our cities from flooding under climate change.

Enhance the value of GSI implementation

To leverage the value of implementing GSI, regulation and policy changes are needed to encourage land owners to implement GSI facilities. As a first step, policy-makers should ensure that every private land owner has a share in the responsibility for controlling surface runoff quantity and quality (Cote and Wolfe, 2014; Johns, 2019; van der Sterren et al, 2009). For instance, Melbourne Water requires all developable properties to pay a drainage contribution on the basis of the size and type of a development when it occurs (Melbourne Water, 2020).

Another change to consider is whether to remove regulations that prevent off-site stormwater management (Dhakal and Chevalier, 2017). For example, in cities where water is often abundantly available (like Christchurch), providing free access to, or low-priced, municipal water does not give land owners any incentive to store stormwater for reuse (Labadie, 2011).

In addition, financial incentives are needed to encourage owners of highly capable properties to collect off-site runoff where this is possible (Dhakal and Chevalier, 2017). Municipalities might provide financial incentives by:

1. offering an incentive to implement GSI through programmes that share costs and management (Parikh et al, 2011) or through reduced taxes (Dudula and Randhir, 2016)
2. establishing markets for allowance trading of runoff discharge at the catchment scale, which could enable off-site runoff collection (Fu et al, 2019). The trading market would not only motivate those who have a high potential for flood mitigation to store more runoff but also allow those with limited capability to meet minimum regulatory requirements
3. subsidising the cost of applying sustainable land development certificates (Cease et al, 2019) such as LEED and BREEAM (Saiu, Blečić and Meloni, 2022) when GSI facilities are implemented. Alternatively, cities could develop their own certification programmes requiring GSI for flood mitigation.

Designate stormwater management zones in city plans

Defining large private properties with high capability as a special zone for stormwater water management (SWM) would enable planners to make specific regulations for individual zones to maximise the effectiveness of GSI implementation (Christchurch City Council, 2016; de Moel, van Vliet and Aerts, 2014; Doberstein et al, 2018). Policies specific to individual SWM zones will inform land owners of the long-term flood management plans so that they do not inadvertently develop their lands in ways that may impede GSI redesign and land use relocation in the future (Hetz and Bruns, 2014; Mathews, Surminski and Roezer, 2021). In Australia, for example, the Queensland Reconstruction Authority (2019) proposed a non-statutory guide for delivering a coordinated approach to managing flood risk across the Brisbane River floodplain. It set out a range of strategies and actions, including land use planning, for state and local governments to consider in order to strengthen the flood resilience of the region. Moreover, a city plan must designate SWM zones so that planners can play a key role in GSI monitoring and management, as zone policies can specify the scope of a municipal authority to access private properties. This action could help to overcome government concerns that land owners do not manage GSI facilities (Dai et al, 2017; Johns, 2019; Mukhtarov et al, 2019).

Designating SWM zones can also provide land owners with financial support through schemes such as transfer of development rights (TDR) programmes. A TDR programme allows a municipality to restrict development density in an SWM zone below that permitted in the building code. In return, land owners are compensated for losing the right to develop their land at its maximum density (McGuire and Goodman, 2020).

Establish new governing bodies

Governing bodies are needed to ensure that properties in an SWM zone can work together, as well as cooperate with upstream communities and other SWM zones, to maximise flood mitigation capability.

First, a governing body at the SWM zone level is a necessity to implement a GSI network across properties within the zone. While land owners of selected properties should be key members of these bodies, city officials should also be included so that GSI networks are effectively integrated with the public stormwater management system and follow flood management plans (van Buuren et al, 2018). For example, Melbourne Water has some regional powers across catchments to designate areas where development is not permitted. Local drainage schemes in a specific catchment area guide the standards that developers need to meet for flood protection, water quality and waterway health. (Melbourne Water, 2020).

In addition, a governing body at the catchment level is needed to orchestrate the development of GSI networks in different zones to meet the goals of the catchment flood mitigation plan over time. This governing body should consist of the representatives of each strategic SWM zone, local agencies related to city flood management and community stakeholders. Given the uncertainty surrounding climate change, this governing body should have the autonomy to make decisions on implementing and managing GSI networks; however, regional and/or central government must oversee it and provide direction and support (van Buuren et al, 2018).

For governing bodies at both levels, disciplinary experts, such as hydrologists, engineers, planners and/or landscape architects, may also be valuable to provide guidelines for developing the GSI networks in support of multiple ecosystem services and in the most efficient way (van Buuren et al, 2018).

Conclusions

This paper demonstrates that strategically implementing GSI on large private properties can provide essential cost-effective supplementary flood mitigation to protect low-lying coastal cities from flooding with climate change. Because the degree and timing of impact cannot be predicted with certainty, long-term adaptive planning is essential to implement GSI networks incrementally using a range of approaches. However, regulation and policy changes will be needed to facilitate their implementation among land owners.

About the Authors and Collaborators

Suphicha Muangsri is a Lecturer in the Division of Landscape Architecture, Silpakorn University, Bangkok, Thailand. She works in GSI planning to transform stormwater management systems so that they can tackle the impacts of climate change, particularly in low-lying coastal cities. Additionally, she is interested in adaptive landscape solutions, exploring innovative approaches to adapt to climate change.

Wendy McWilliam is an Associate Professor in the School of Landscape Architecture, Lincoln University who specialises in urban and rural green infrastructure. Green infrastructure consists of natural and engineered landscape components and networks, such as waterways, shelterbelts and forested remnants, that support critical ecosystem services that aim to benefit human health and wellbeing. In her interdisciplinary research, she collaborates with natural scientists, planners and designers internationally, particularly in the United States, Canada, Japan and Europe.

Gillian Lawson is an Associate Professor in the School of Landscape Architecture, Lincoln University. Her interests are in landscape pedagogy, landscape visualisation and landscape sociology in Australia, Aotearoa New Zealand and other Asia-Pacific countries, and on water and food as catalysts for improving the adaptation of our cities to climate change. Her work has focused on the sociology of education, social practices in public and private open spaces, green infrastructure and waterfront communities in landscape planning and design.

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Data availability statement: The data about the assessment of industrial land in the Heathcote River catchment are openly available in Data@Lincoln at:

- 10.25400/lincolnuninz.21300507 for the characteristics of industrial SWM zones
- 10.25400/lincolnuninz.21358338 for runoff volume calculation
- 10.25400/lincolnuninz.21300522 for the estimation of in-ground storage capacity
- 10.25400/lincolnuninz.21358455 for flood mitigation capability assessment and classification.

Conflicts of interest: Gillian Lawson, a co-author of this paper, is a member of the *Landscape Review* editorial team. To ensure anonymity and the independence and integrity of the peer-review process, all her editorial responsibilities for this paper (including initial assessment, peer-review and the final decision-making process) were delegated to another member of the journal's editorial team.

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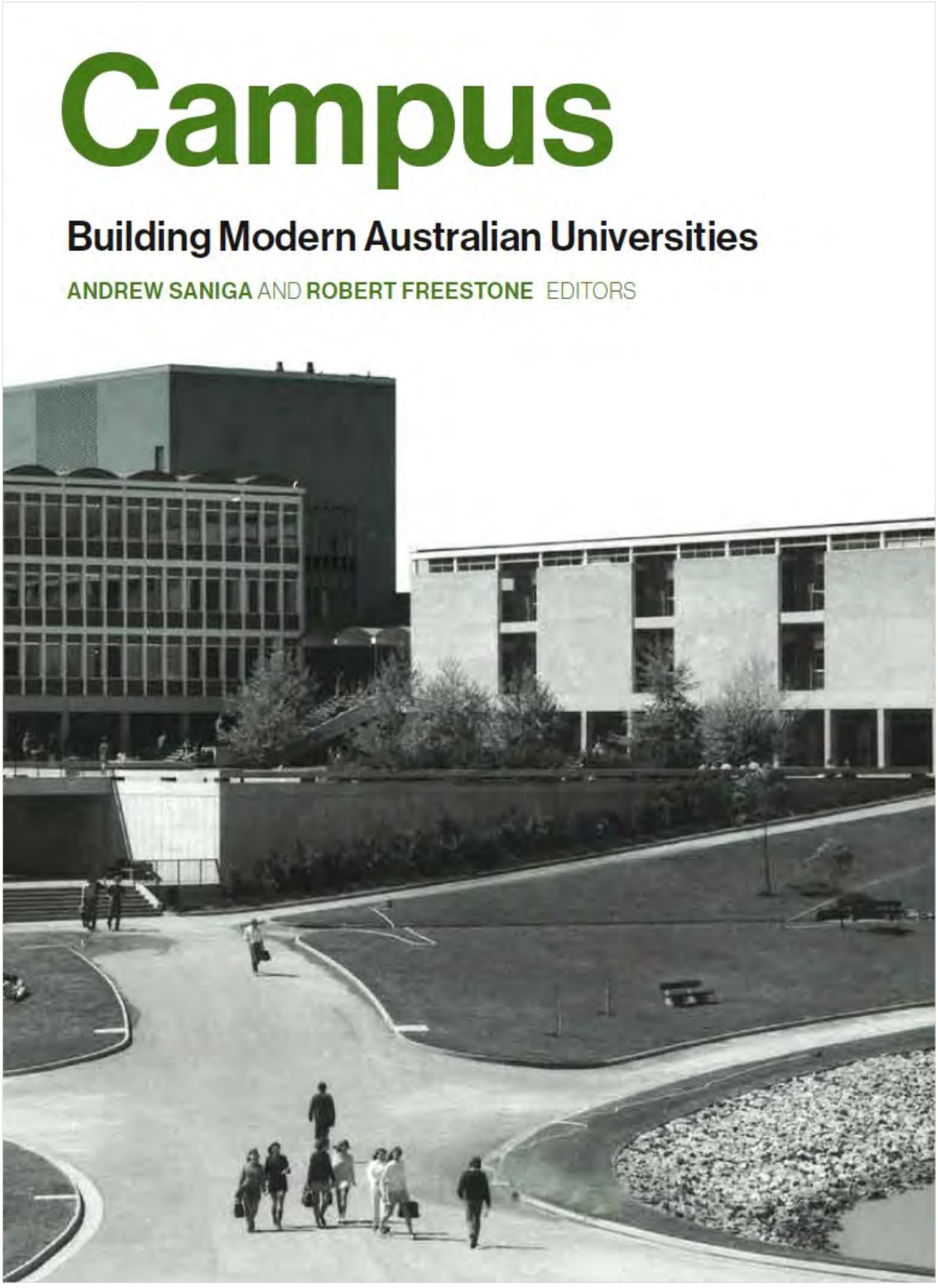

Front cover of *Campus: Building Modern Australian Universities*, featuring an image from Flinders University Archives (with permission from Andrew Saniga, 2024).

LANDSCAPE REVIEW

Worlds within worlds: explorations of Australian universities

JACKY BOWRING

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Campuses are fascinating landscape types. On the one hand, a university is in many ways a microcosm of the wider built environment, reflecting broader political agendas, concerns with environmental change, and cultural issues. This sense of the university as a microcosm is expressed spatially in campus design, holding a mirror up to the various forces and values that characterise culture at large, such as concerns for sustainability, heritage preservation and national identity. On the other hand, campuses can be conceptualised as what Michel Foucault (1986) termed 'heterotopias', literally 'other places'. While a heterotopia – like a cemetery or prison – can be seen as a microcosm or world within a world, it is also a juxtaposition with the world beyond.

Andrew Saniga and Robert Freestone's *Campus: Building Modern Australian Universities* traces the many dimensions of campuses as part of the built environment. Together with their co-authors, Saniga and Freestone explore the microcosmic aspects of campuses: how they are miniature cities or towns that echo the world beyond, including in their responses to the inevitable shifts in education policy and the wider political climate. The chapters reveal how universities are heterotopic too, as unique built environments where theories about education find their form. Campuses are also marketing tools, or what could be called logo landscapes, producing tangible expressions of an institution's values as a means of attracting funding and students. These landscapes of learning can be 'read' in terms of their manifestation of values and priorities. As Logan and colleagues (2023) note in the concluding chapter, the 'recent boom in university development and the wider context of estate management are impossible to understand if this cultural and communicative function of the campus is overlooked' (p 341).

Saniga and Freestone are well-known researchers in the areas of landscape and planning history, and their vision for this substantial tome on campuses extends their previous work, such as Saniga's (2012) *Making Landscape Architecture in Australia* and Freestone's (2010) *Urban Nation: Australia's Planning Heritage*. Weighing in at 430 pages, *Campus: Building Modern Australian Universities* contains 11 chapters around themes ranging from residential design for students to radicalism as a shaping force. It is well illustrated with maps, diagrams and photographs, and its format is inviting to read. Because of the scale and scope of the work, a more comprehensive index would be welcome. The existing index is mainly a list of names of people and locations, only including aspects such as 'radicalism' under a location. The odd subject like the Radburn Plan can be picked up in the index, but further threads and themes – such as indigeneity and COVID-19 – would be valuable additions.

From a non-Australian perspective, the detailed accounts of the universities in terms of their various sitings, histories and morphing that have shaped the different institutions can feel somewhat distant. However, the comprehensive coverage of the range of institutions encourages readers to reflect on campuses with which they are familiar. In my case, I found myself noting parallels and contrasts in relation to Lincoln University, Aotearoa New Zealand, where I teach. Our campus has an art collection that is sizeable – particularly for a small institution – and the discussion on Australian universities' collections revealed many points of comparison. For example, in discussing problems of

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maintenance and siting of one particular work, Hannah Lewi and Christien Garnaut commented that it was 'testament to the ongoing need for commitment to and understanding of the unique problems of outdoor collections on campuses' (p 294). More generally, as someone who is interested in design critique, and has been aware of campus design in Aotearoa New Zealand (including co-supervising a PhD student who studied the restorative benefits of campus design), I found myself often stopping to make notes. This is a book that will provide a valuable resource for wider thinking and teaching in landscape architecture, beyond the specificity of campus design and the Australian context.

The tracing of campus design in relation to wider models, such as Beaux Art and City Beautiful, offers valuable insights into the history of the built environment. In chapter 3, Freestone and co-author Nicola Pullan also investigate how the later twentieth century brought recognition of the need to draw in other influences. They note that in the 1960s, ideas about campus development in Australia were:

> shaped by international sociological research promoting the 'continuous teaching environment', designing for growth and change while still preserving contact between all parts of an institution, and the use of 'socio-diagrams' to depict relationships between people and functions. (p 90)

This observation illustrates how university campuses are symbolic expressions of prevailing concepts about education, as much as ideas about urban design such as the model of the New Town of this era (p 91).

Andrew Saniga and Susan Holden's exploration of campus design in the 1990s reveals the moves towards respecting the Indigenous culture and vegetation of a site, as at the University of Newcastle, and reclaiming Indigenous values on a site where they no longer existed, as at the University of Wollongong (p 159). With passive design and integrated water management, these campuses were part of the emerging zeitgeist characterised by agendas of sustainability, regionalism and indigeneity. Terms like 'Bush Campus' and 'Bush Court' speak a strongly Australian vernacular in relation to the design of universities. This growing emphasis on the local is also considered by Lewi and Garnaut (2023) in their chapter on campus art collections. They note that:

> many of these public works are motivated by the desire for universities to become places for promoting shared thinking and learning with Indigenous cultures. Their realisation marks a departure from traditional twentieth-century subjects of campus art that often drew on western conceptions of academic knowledge, classicism, and abstraction. (p 304)

The readership for this book is potentially diverse, ranging from academics in the realm of design history, through to built environment professionals involved in planning and designing campuses. A number of themes are valuable prompts for designers to consider. The typologies identified, as in the forms of residential halls characterised as the quadrangle, the slab, the L-shape, the tower and the village, are very effective forms of critique. Typologies create useful libraries of ideas and concepts, and their characterisation through clear naming generates a usable language for the analysis of campus design. Similarly, Hannah Lewi and Andrew Saniga's evocatively titled short case studies on radicalism and social spaces are nimbly handled, and create a memorable set of scenarios – unrest, dissatisfaction, under siege and occupied (pp 255–267). The book also reinforces how a campus as a mirror of the world beyond highlights the ways in which considerations of culture, gender and religion are important in design. A further important thread is the influence of transport on campus design.

Hanging over the book are questions about the disruptive impacts of the COVID-19 pandemic on the concept of the university campus. The timeline of the research for the book began with its funding from May 2016. As a consequence, by the time the implications of COVID-19 were becoming realised, the research had been underway for four years. The book makes passing references to the pandemic's consequences throughout, but there

remains considerable potential to explore these in future research. Universities have traditionally been so much about propinquity, nearness, interaction, a physical expression of the concept of a 'community of scholars'. But the pandemic changed all of that. Our work and teaching practices during the pandemic rapidly elevated the digital version of the campus. This warp-speed technological transformation of teaching has had massive impacts on the idea of what a campus is, and the implications are still being explored. Wider technological change, including augmented reality and artificial intelligence, also has the potential to dramatically shift future conceptions of campus design.

The concluding chapter, 'Transformation: conservation, sustainability, and new design', highlights some of the diversity of challenges in considering the campus into the future. Logan and colleagues (2023) point out that while digital disruption questions the very idea of a campus, 'At the same time, universities have invested enormous sums of money in new buildings and campus facilities' (p 339). Arguably the physical campus remains an opportunity to highlight a point of difference, a unique selling proposition, that transcends the homogeneity of the digital world. The endurance of campus landscapes and buildings amidst the increasing digital realm presents continued opportunities for designers to be involved in shaping space in meaningful ways, including by making places that support wellbeing and enhance sustainability. *Campus: Building Modern Australian Universities* provides plenty of food for thought in reflecting on the past and contemplating the future, and is a reminder to all universities about how, as Christine Garnaut and Susan Holden (2023) put it in chapter 2:

> the campus environment is a tangible place through which individual universities can express their engagement with society, by highlighting their historical foundations and institutional identity, and communicating the values and aspirations underpinning their contemporary role and purpose. (p 73)

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